

# **EDGECLIFF HALL RENOVATIONS**

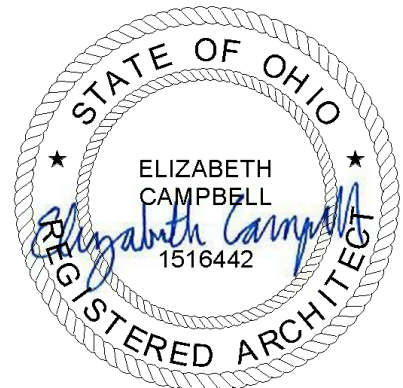
**March 23rd, 2018**

**Issue For Bid & Permit**

Project Address:  
Xavier University  
Edgecliff Hall  
1512 Herald Ave  
Cincinnati, Oh 45207

Owner, Architectural Design & Construction  
**Xavier Physical Plant**

Mechanical, Electrical & Plumbing  
**Motz Engineering**



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ELIZABETH CAMPBELL  
LICENSE #1516442 - EXPIRATION DATE 12/31/2019

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SECTION 01 23 00  
ALTERNATES

PART 1 - GENERAL

1.1 SUMMARY

- A. This section includes administrative and procedural requirements governing Alternates.

1.2 DEFINITIONS

- A. Definition: An alternate is an amount proposed by bidders for certain work defined in the Bidding Requirements that may be added to or deducted from the Base Bid amount if the Owner decides to accept a corresponding change in either the amount of construction to be completed, or in the products, materials, equipment, systems, or installation methods described in the Contract Documents.
  - 1. The cost or credit for each alternate is the net addition to or deduction from the Contract Sum to incorporate the Alternate into the Work. No other adjustments are made to the Contract Sum.

1.3 RELATED REQUIREMENTS

- A. Owner-Contractor Agreement: Alternates accepted by Owner for incorporation into the Work.
- B. Sections of Specifications identified in each Alternate.

1.4 PROCEDURES

- A. Coordination: Modify or adjust affected adjacent Work as necessary to completely and fully integrate that Work into the Project.
  - 1. Include as part of each alternate, miscellaneous devices, accessory objects, and similar items incidental to or required for a complete installation whether or not mentioned as part of the Alternate.
- B. Notification: Immediately following the award of the Contract, notify each party involved, in writing, of the status of each alternate. Indicate whether alternates have been accepted, rejected, or deferred for later consideration. Include a complete description of negotiated modifications to alternates.
- C. Execute accepted alternates under the same conditions as other Work of this Contract.
- D. Schedule: A "Schedule of Alternates" is included at the end of this section. Specification sections referenced in the Schedule contain requirements for materials necessary to achieve the Work described under each alternate.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 SCHEDULE OF ALTERNATES

- A. Alternate No. 1: Band Room 205 Changes
1. Base Bid:
    - a. Existing ceiling to remain
    - b. Replace stained ceiling tile
    - c. Replace existing light fixtures, see mep drawings
    - d. Install new powered mecho shades at windows
    - e. Modify existing plam cabinets and install new plam cabinets
  2. Alternate:
    - a. Demo existing act ceiling, lights, and devices, see mep drawings
    - b. Demo surface mounted acoustic tiles on existing plaster ceiling. Patch and repair plaster.
    - c. Paint exposed plaster ceiling, conduit and ductwork.
    - d. Install new biradial ceiling clouds 8'x8' suspended
    - e. Install new sprinklers, ductwork, and lighting per mep drawings
    - f. Install new wall mounted rpg diffractal wall panels
    - g. Install new suspened variable curtains near window
    - h. Install new powered mecho shades at windows
    - i. Modify existing plam cabinets and install new plam cabinets
  3. The Work of this Alternate is indicated on Drawings and has an impact on the scope of associated Specifications Sections:
    - a. 09 8300 ACOUSTIC DIFFRACTAL WALL PANELS
    - b. 098480 ACOUSTIC CEILING BIRADIAL ARRAY SUSPENDED
    - c. 11 06 23 VARIABLE ACOUSTIC BANNERS

END OF SECTION 01 23 00

SECTION 01 35 46 – ENVIRONMENTAL REQUIREMENTS FOR INDOOR AIR QUALITY CONTROL

PART 1- GENERAL

1.1 SUMMARY

A. This Section includes, but is not limited to, requirements for the following procedures:

1. Selection of products.

1.2 INTENT

A. It is the intent of the Owner to maintain a healthful environment for the present and future occupants of the building. Therefore, the Contractor shall conduct the Work in such a way as to avoid creating indoor air quality problems. Required procedures include:

1. Limiting use of products that may contribute to poor indoor air quality.

PART 2- PRODUCTS

2.1 PRODUCTS

A. Throughout the Work, use products, materials that contribute the minimum practicable dust, odors and contaminants to the indoor environment.

B. Products containing Volatile Organic Compounds (VOC's):

1. Comply with the following criteria for VOC limits for the following field-applied products.

a. Adhesives: Refer to Technical Sections that include adhesives, including but not limited to those in Divisions 6 and 9, for specific requirements.

- 1) Wood Glues: 30 *giL*.
- 2) Metal to Metal Adhesives: 30 *giL*.
- 3) Adhesives for Porous Materials (Except Wood): 50 *giL*.
- 4) Subfloor Adhesives: 50 *giL*.
- 5) Plastic Foam Adhesives: 50 *giL*.
- 6) Contact Adhesive: 250 *giL*.
- 7) Plastic Cement Welding Compounds: 350 *giL*.
- 8) ABS Welding Compounds: 400 *giL*.
- 9) CPVC Welding Compounds: 490 *giL*.
- 10) PVC Welding Compounds: 510 *giL*.
- 11) Adhesive Primer for Plastic: 50 *giL*.
- 12) Gypsum Board and Panel Adhesives: 50 *giL*.
- 13) Ceramic Tile Adhesives: 65 *giL*.



- 14) VCT and Asphalt Tile Adhesives: 50 *giL*.
- 15) Cove Base Adhesives: 50 *giL*.
- 16) Rubber tile and other sheet flooring Flooring Adhesives: 60 giL.
- 17) Carpet Adhesives: 50 *giL*.
- 18) Carpet Pad Adhesives: 50 *giL*.
- 19) Multipurpose Construction Adhesives: 70 giL.
- 20) Fiberglass Adhesives: 80 *giL*.
- 21) Structural Glazing Adhesives: 100 *giL*.

b. Sealants: Refer to Division 7 Section "Joint Sealants", and other Technical Sections requiring sealants, for specific requirements.

- 1) Sealants: 250 giL.
- 2) Sealant Primers for Nonporous Substrates: 250 *giL*.
- 3) Sealant Primers for Porous Substrates: 775 *giL*.

END OF SECTION 01 35 46

SECTION 01 73 29  
CUTTING AND PATCHING

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. This section includes administrative and procedural requirements for cutting and patching of existing surfaces and previously installed new surfaces, exclusive of what is specified in related sections below.
- B. Related Work
  - 1. Division 9 Section "Painting and Coating": Painting or touch-up painting of surfaces after cutting and patching work is performed.
  - 2. Division 22 - Plumbing: Cutting and patching of plumbing systems (but does not include walls, floors, ceilings, and structures).
  - 3. Division 23 - Heating, Ventilating and Air Conditioning: Cutting and patching of HVAC systems (but does not include walls, floors, ceilings, and structures).
- C. Refer to other Sections for specific requirements and limitations applicable to cutting and patching individual parts of the Work.
  - 1. Requirements of this Section apply to mechanical and electrical installations. Refer to Division 21 through 27 Sections for other requirements and limitations applicable to cutting and patching mechanical and electrical installations.

1.2 WARRANTY

- A. Existing Warranties: Replace, patch, and repair material and surfaces cut or damaged by methods and with materials in such a manner as not to void any warranties required or existing.

PART 2 – PRODUCTS

2.1 MATERIALS

- A. Use materials identical to existing materials. For exposed surfaces, use materials that visually match existing adjacent surfaces to the fullest extent possible if identical materials are unavailable or cannot be used. Use materials whose installed performance will equal or surpass that of existing materials.

## PART 3 – EXECUTION

### 3.1 INSPECTION

- A. Examine surfaces to be cut and patched and conditions under which cutting and patching is to be performed before cutting. If unsafe or unsatisfactory conditions are encountered, take corrective action before proceeding.
  - 1. Before proceeding, meet at the Project Site with parties involved in cutting and patching, including mechanical and electrical trades. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.

### 3.2 PERFORMANCE

- A. Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time and complete without delay.
  - 1. Cut existing construction to provide for installation of other components or performance of other construction activities and the subsequent fitting and patching required to restore surfaces to their original condition.
- B. Cutting: Cut existing construction using methods least likely to damage elements retained or adjoining construction. Where possible, review proposed procedures with the original Installer; comply with the original Installer's recommendations.
  - 2. In general, where cutting, use hand or small power tools designed for sawing or grinding, not hammering and chopping. Cut holes and slots as small as possible, neatly to size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
  - 3. To avoid marring existing finished surfaces, cut or drill from the exposed or finished side into concealed surfaces.
  - 4. Cut through concrete and masonry using a cutting machine, such as a Carborundum saw or a diamond-core drill.
  - 5. Where services are required to be removed, relocated, or abandoned, bypass utility services, such as pipe or conduit, before cutting. Cut-off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal the remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after by-passing and cutting.
- C. Patching: Patch with durable seams that are as invisible as possible. Comply with specified tolerances.
  - 6. Where feasible, inspect and test patched areas to demonstrate integrity of the installation.
  - 7. Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.

8. Where removing walls or partitions extends one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform color and appearance. Remove existing floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.
    - a. Where patching occurs in a smooth painted surface, extend final paint coat over entire unbroken surface containing the patch after the area has received primer and second coat.
  9. Patch, repair, or rehang existing ceilings as necessary to provide an even plane surface of uniform appearance.
  10. Trim and refinish existing wood doors as necessary to clear new floors.
- D. Damaged Surfaces: Patch or replace any portion of an existing finished surface which is found to be damaged, lifted, discolored, or shows other imperfections, with matching material.
1. Provide adequate support of substrate prior to patching the finish.
  2. Refinish patched portions of painted or coated surfaces in a manner to produce uniform color and texture over entire surface.
  3. When existing surface finish cannot be matched, refinish entire surface to nearest intersections.

### 3.3 CLEANING

A. Clean areas and spaces where cutting and patching are performed. Completely remove paint, mortar, oils, putty, and similar items. Thoroughly clean piping, conduit, and similar features before applying paint or other finishing materials. Restore damaged pipe covering to its original condition.

END OF SECTION 01 73 29

## SECTION 055213 - PIPE AND TUBE RAILINGS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Steel **pipe and tube** railings.
- B. Related Requirements:

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For the following:
  - 1. Manufacturer's product lines of mechanically connected railings.
  - 2. Railing brackets.
  - 3. Grout, anchoring cement, and paint products.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
- C. Samples: none
- D. Delegated-Design Submittal: For railings, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

#### 1.3 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: For pipe and tube railings, for tests performed by a qualified testing agency, according to ASTM E 894 and ASTM E 935.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Steel Pipe and Tube Railings:
  - 1. Basis-of-Design Product: Subject to compliance with requirements, provide [**product** or comparable product by one of the following:
    - a. Wagner, R & B, Inc.

## 2.2 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design railings, including attachment to building construction.
- B. Structural Performance: Railings, including attachment to building construction, shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
  - 1. Handrails and Top Rails of Guards:
    - a. Uniform load of **50 lbf/ ft. (0.73 kN/m)** applied in any direction.
    - b. Concentrated load of **200 lbf (0.89 kN)** applied in any direction.
    - c. Uniform and concentrated loads need not be assumed to act concurrently.

## 2.3 METALS, GENERAL

- A. Brackets, Flanges, and Anchors: Cast or formed metal of same type of material and finish as supported rails unless otherwise indicated.
  - 1. Provide type of bracket with predrilled hole for exposed bolt anchorage and that provides **1-1/2-inch (38-mm)** clearance from inside face of handrail to finished wall surface.

## 2.4 STEEL AND IRON

- A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.
- B. Tubing: **[ASTM A 500 (cold formed)] [or] [ASTM A 513]**.
- C. Pipe: ASTM A 53/A 53M, Type F or Type S, Grade A, Standard Weight (Schedule 40), unless another grade and weight are required by structural loads.
  - 1. Provide galvanized finish for exterior installations and where indicated.
- D. Plates, Shapes, and Bars: ASTM A 36/A 36M.
- E. Cast Iron: Either gray iron, ASTM A 48/A 48M, or malleable iron, ASTM A 47/A 47M, unless otherwise indicated.
- F. General: Provide the following:
  - 1. Ungalvanized-Steel Railings: Plated steel fasteners complying with ASTM B 633 or **ASTM F 1941 (ASTM F 1941M)**, Class Fe/Zn 5 for zinc coating.

## 2.5 MISCELLANEOUS MATERIALS

- A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.
- B. Low-Emitting Materials: Paints and coatings shall comply with the testing and product requirements of the California Department of Public Health's (formerly, the California Department of Health Services') "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- C. Etching Cleaner for Galvanized Metal: Complying with MPI#25.
- D. Shop Primers: Provide primers that comply with Section 099600 High-Performance Coatings.
- E. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.
- F. Epoxy Zinc-Rich Primer: Complying with MPI#20 and compatible with topcoat.
- G. Epoxy Intermediate Coat: Complying with MPI #77 and compatible with primer and topcoat.
- H. Polyurethane Topcoat: Complying with MPI #72 and compatible with undercoat.
- I. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.
- J. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107/C 1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.

## 2.6 FABRICATION

- A. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm) unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- B. Form work true to line and level with accurate angles and surfaces.
- C. Welded Connections: Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.
  - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  - 2. Obtain fusion without undercut or overlap.
  - 3. Remove flux immediately.
  - 4. At exposed connections, finish exposed surfaces smooth and blended so no roughness shows after finishing and welded surface matches contours of adjoining surfaces.

- D. Welded Connections for Aluminum Pipe: Fabricate railings to interconnect members with concealed internal welds that eliminate surface grinding, using manufacturer's standard system of sleeve and socket fittings.
- E. Nonwelded Connections: Connect members with concealed mechanical fasteners and fittings. Fabricate members and fittings to produce flush, smooth, rigid, hairline joints.
- F. Form changes in direction by inserting prefabricated elbow fittings
- G. For changes in direction made by bending, use jigs to produce uniform curvature for each repetitive configuration required. Maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.
- H. Close exposed ends of railing members with prefabricated end fittings.
- I. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated.
- J. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect railing members to other work unless otherwise indicated.
  - 1. At brackets and fittings fastened to plaster or gypsum board partitions, provide crush-resistant fillers or other means to transfer loads through wall finishes to structural supports and prevent bracket or fitting rotation and crushing of substrate.
- K. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
- L. Primer Application: Apply shop primer to prepared surfaces of railings unless otherwise indicated. Comply with requirements in SSPC-PA 1, "Shop, Field, and Maintenance Painting of Steel," for shop painting. Primer need not be applied to surfaces to be embedded in concrete or masonry.
  - 1. Do not apply primer to galvanized surfaces.
- M. High-Performance Coating: Apply epoxy intermediate and polyurethane topcoats to prime-coated surfaces. Comply with coating manufacturer's written instructions and with requirements in SSPC-PA 1, "Shop, Field, and Maintenance Painting of Steel," for shop painting. Apply at spreading rates recommended by coating manufacturer.
  - 1. Color: see finish schedule on drawings

## PART 3 - EXECUTION

### 3.1 INSTALLATION, GENERAL

- A. Set railings accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.



1. Do not weld, cut, or abrade surfaces of railing components that are coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
  2. Set posts plumb within a tolerance of 1/16 inch in 3 feet (2 mm in 1 m).
  3. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet (6 mm in 3.5 m).
- B. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.
1. Coat, with a heavy coat of bituminous paint, concealed surfaces of aluminum that are in contact with grout, concrete, masonry, wood, or dissimilar metals.

### 3.2 ATTACHING RAILINGS

- A. Attach railings to wall with wall brackets. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.
- B. Secure wall brackets and railing end flanges to building construction as follows:
1. For concrete and solid masonry anchorage, use drilled-in expansion shields and hanger or lag bolts.
  2. For hollow masonry anchorage, use toggle bolts.
  3. For wood stud partitions, use hanger or lag bolts set into studs or wood backing between studs. Coordinate with carpentry work to locate backing members.
  4. For steel-framed partitions, use hanger or lag bolts set into fire-retardant-treated wood backing between studs. Coordinate with stud installation to locate backing members.
  5. For steel-framed partitions, use self-tapping screws fastened to steel framing or to concealed steel reinforcements.
  6. For steel-framed partitions, use toggle bolts installed through flanges of steel framing or through concealed steel reinforcements.

### 3.3 ADJUSTING AND CLEANING

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

END OF SECTION 055213

SECTION 06 10 00 – MISCELLANEOUS ROUGH CARPENTRY

PART 1 - GENERAL

1.1 SUMMARY

- A. This section includes the following:
1. Wood nailers and blocking. (interior)
  2. Wood framed platform for file cabinets.

PART 2 - PRODUCTS

2.1 LUMBER, GENERAL

A. Lumber Standards: Comply with DOC PS 20, "American Softwood Lumber Standard," and with applicable grading rules of inspection agencies certified by ALSC's Board of Review.

B. Inspection Agencies: Inspection agencies, and the abbreviations used to reference them, include the following:

1. NELMA - Northeastern Lumber Manufacturers Association.
2. NLGA - National Lumber Grades Authority (Canadian).
3. SPIB - Southern Pine Inspection Bureau.
4. WCLIB - West Coast Lumber Inspection Bureau.
5. WWPA - Western Wood Products Association.

C. Grade Stamps: Provide lumber with each piece factory marked with grade stamp of inspection agency evidencing compliance with grading rule requirements and identifying grading agency, grade, species, moisture content at time of surfacing, and mill.

D. Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry lumber.

1. Provide dressed lumber, S4S.
2. Provide dry lumber with 19 percent maximum moisture content at time of dressing for 2 inch nominal (38 mm actual) thickness or less.

2.2 PRESERVATIVE-TREATED WOOD

A. Where lumber or plywood is indicated as preservative treated or is specified to be treated, comply with applicable requirements of AWPA C2 (lumber) and AWPA C9 (plywood). Mark each treated item with the Quality Mark Requirements of an inspection agency approved by ALSC's Board of Review.

1. Do not use chemicals containing chromium or arsenic.

B. Pressure treat above ground items with waterborne preservatives to a minimum retention of 0.25 lb/cu. ft. (4.0 kg/cu. m). After treatment, dry lumber and plywood to a maximum moisture content of 19 and 15 percent, respectively. Treat indicated items and the following:

1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping,

and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.

2. Wood sills, sleepers, blocking, furring, stripping, and similar concealed members in contact with masonry or concrete.

C. Pressure treat wood members in contact with ground or freshwater with waterborne preservatives to a minimum retention of 0.40 lb/cu. ft. (6.4 kg/cu. m).

D. Complete fabrication of treated items before treatment, where possible. If cut after treatment, apply field treatment complying with AWPA M4 to cut surfaces. Inspect each piece of lumber or plywood after drying and discard damaged or defective pieces.

E. 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 members less than 18 inches (460 mm) above grade.
4. Wood floor plates that are installed over concrete slabs directly in contact with earth.

### 2.3 FIRE-RETARDANT-TREATED WOOD

A. Where fire-retardant-treated wood is indicated, comply with applicable requirements of AWPA C20 (lumber) and AWPA C27 (plywood). Identify fire-retardant-treated wood with appropriate classification marking of UL; U.S. Testing; Timber Products Inspection, Inc.; or another testing and inspecting agency acceptable to authorities having jurisdiction.

1. Research or Evaluation Reports: Provide fire-retardant-treated wood acceptable to authorities having jurisdiction and for which a current model code research or evaluation report exists that evidences compliance of fire-retardant-treated wood for application indicated.
2. Use treatment for which chemical manufacturer publishes physical properties of treated wood after exposure to elevated temperatures, when tested by a qualified independent testing agency according to ASTM D 5664, for lumber and ASTM D 5516, for plywood.
3. Use treatment that does not promote corrosion of metal fasteners.

B. Exterior Type Fire-Retardant Treatment: Use Exterior type for exterior locations and where indicated.

1. Acceptable Products:
  - a. Arch Wood Protection, "FRX Fire Retardant Treatment".
  - b. Hoover Treated Wood Products, Inc., "Exterior Fire-X"

- C. Interior Type A High Temperature (HT) Fire Retardant Treatment: For interior locations, use chemical formulation that produces treated lumber and plywood with the following properties under conditions present after installation:
1. Bending strength, stiffness, and fastener-holding capacities are not reduced below values published by manufacturer of chemical formulation under elevated temperature and humidity conditions simulating installed conditions when tested by a qualified independent testing agency.
  2. No form of degradation occurs due to acid hydrolysis or other causes related to treatment.
  3. Contact with treated wood does not promote corrosion of metal fasteners.
  4. Dry lumber and plywood after treatment to a maximum moisture content of 15 percent for plywood and 19 percent for lumber. Inspect each piece of lumber and plywood after drying; do not use twisted, warped, bowed or otherwise damaged or defective wood.
  5. Use Interior Type A High Temperature (HT), unless otherwise indicated.
  6. Acceptable Products:
    - a. Arch Wood Protection, "Dricon Fire Retardant Treatment".
    - b. Hoover Treated Wood Products, Inc., "Pyro-Guard"

## 2.3 FASTENERS

- A. Provide fasteners of size and type indicated that comply with requirements specified in this Article for material and manufacture. All connections shall be in accordance with OBC Table 2304.9.1.
- B. All connection hardware specified as manufactured by the Simpson Strong-tie Company shall be fastened as specified by the Simpson Product and Instruction Manual.
- C. Nails, Wire, Brads, and Staples: ASTM F 1667.
- D. Power-Driven Fasteners: CABO NER-272.
- E. Wood Screws: ASME B18.6.1.
- F. Lag Bolts: ASME B18.2.1. (ASME B18.2.3.8M)
- G. Bolts: Steel bolts complying with ASTM A307, Grade A (ASTM F568, Property Class 4.6); with ASTM A563 (ASTM A563M) hex nuts and, where indicated, flatwashers.

## PART 3 – EXECUTION

### 3.1 INSTALLATION

- A. Discard units of material with defects that impair quality of rough carpentry and that are too small to use with minimum number of joints or optimum joint arrangement.
- B. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted.
- C. Fit rough carpentry to other construction; scribe and cope as required for accurate fit. Correlate location of blocking to allow attachment of other construction.
- D. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:
  - 1. CABO NER-272 for power-driven staples, P-nails, and allied fasteners.
  - 2. Published requirements of metal framing anchor manufacturer.
- E. 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; predrill as required.

### 3.2 WOOD BLOCKING

- A. Install wood blocking where shown and where required for attaching other work. Form to shapes shown and cut as required for true line and level of attached work. Coordinate locations with other work involved.
- B. Attach to substrates to support applied loading. Recess bolts and nuts flush with surfaces, unless otherwise indicated.
- C. Provide blocking as recommended by manufacturers. Where manufacturer's recommendations are not available, submit a list of Contractor's proposal for those areas.
- D. Provide concealed wood blocking in partitions for mounting surface mounted equipment, and hardware, regardless of whether the surface mounted equipment or hardware is part of this Contract or is furnished by Owner.

END OF SECTION 06 10 00

SECTION 06 40 00  
ARCHITECTURAL WOODWORK

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Wardrobes.
2. Lavatory base cabinets.
3. Laminate-clad base cabinets & wall mounted exhaust hood cabinet.
4. Solid surface countertops.
5. Integral solid surface bowl for vanity top
6. Wood furring, blocking, shims, and hanging strips for installing architectural wood cabinets unless concealed within other construction before cabinet installation.
7. Finishing of architectural wood cabinets.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product, including panel products, plastic laminate grade(s), cabinet hardware and accessories, and finishing materials and processes.

B. Submit shop drawings showing location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.

1. Show details full size.
2. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcing specified in other Sections.
3. Show locations and sizes of cutouts and holes for plumbing fixtures, faucets, and other items installed in architectural woodwork.
4. Show veneer leaves with dimensions, grain direction, exposed face, and an identification number indicated for each leaf. Identification number shall indicate the flitch and the sequence within the flitch for each leaf.

C. Samples for verification of the following:

1. Laminate samples

1.3 INFORMATIONAL SUBMITTALS

A. Woodwork Quality Standard Compliance Certificates: AWI Quality Certification Program certificates.

1.4 QUALITY ASSURANCE

A. Fabricator Qualifications: Firm experienced in producing architectural woodwork similar to that indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units without delaying the Work.

B. Single-Source Responsibility for Fabrication and Installation: Engage a qualified woodworking firm to assume undivided responsibility for fabricating, finishing, and installing woodwork specified in this Section.

- C. Quality Standard: Except as otherwise indicated, comply with the following standard:
  - 1. AWI Quality Standard: Comply with current edition of "Architectural Woodwork Institute Quality Standards" of the Architectural Woodwork Institute for specified grades of woodwork, construction, finishes, and other requirements.
  
- D. Mockup: Prior to fabricating or installing interior architectural woodwork, construct partial mockup to verify selections made under sample submittals and to demonstrate aesthetic effects as well as qualities of materials and execution. Build mock-up using materials indicated for final unit of work, and complying with the following requirements.
  - 1. Locate mockup on site in the location indicated by Owner Project Manager.
  - 2. Notify Owner one week in advance of the date and time when fabrication of mockup will begin.
  - 3. Notify Owner one week in advance of the date and time when mockup will be installed.
  - 4. Demonstrate the proposed range of aesthetic effects and workmanship.
  - 5. Obtain Owner's acceptance of mockup before start of final unit of Work.
  - 6. Retain and maintain mockup during construction in an undisturbed condition as a standard for judging the completed Work.
    - a. Accepted mock-up in an undisturbed condition at the time of Substantial Completion may become part of the completed Work.
  
- E. Pre-installation Conference: Conduct conference at Project site.
  - 1. Meet at project site prior to delivery of woodwork and review coordination and environmental controls required for proper installation and ambient conditioning in areas to receive work. Include in meeting the Contractor, Architect and other Owner Representatives (if any); Installers of woodwork, wet work such as plastering, other finishes, painting, mechanical work and electrical work; and firms or persons responsible for continued operation (whether temporary or permanent) of HVAC system as required to maintain temperature and humidity conditions. Proceed with woodwork installation only when everyone concerned agrees that required ambient conditions can be maintained.

## 1.5 DELIVERY, STORAGE AND HANDLING

- A. Protect woodwork during transit, delivery, storage, and handling to prevent damage, soilage, and deterioration.
  
- B. Do not deliver woodwork until painting and similar operations that could damage, soil, or deteriorate woodwork have been completed in installation areas. If woodwork must be stored in other than installation areas, store only in areas whose environmental conditions meet requirements specified in "Project Conditions."

## 1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install woodwork until building is enclosed, wet-work is completed, and HVAC system is operating and will maintain

temperature and relative humidity at occupancy levels during the remainder of the construction period.

B. Field Measurements: Where woodwork is indicated to be fitted to other construction, check actual dimensions of other construction by accurate field measurements before fabrication, and show recorded measurements on final shop drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1. Verify locations of concealed framing, blocking, reinforcements, and furring that support woodwork by accurate field measurements before being enclosed. Record measurements on final shop drawings.

## 1.7 COORDINATION

A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that architectural woodwork can be supported and installed as indicated.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

A. General: Provide materials that comply with requirements of the AWI quality standard for each type of woodwork and quality grade indicated and, where the specified products are part of woodwork, with requirements of the referenced product standards that apply to product characteristics indicated:

1. Recycled Content of Medium-Density Fiberboard: Provide products with an average recycled content so postconsumer recycled content plus one-half of pre-consumer recycled content is not less than 50 percent.

B. Lumber:

1. Grade Stamps: Provide lumber with each piece factory marked with grade stamp of inspection agency evidencing compliance with grading rule requirements and identifying grading agency, grade, species, moisture content at time of surfacing, and mill.

a. For exposed lumber, furnish pieces with grade stamps applied to ends or back of each piece, or omit grade stamps entirely and provide certificates of grade compliance issued by inspection agency.

C. Softwood Plywood: Comply with DOC PS 1, "U.S. Product Standard for Construction and Industrial Plywood"; manufactured with no added urea formaldehyde resins.

D. Hardwood Plywood and Face Veneers: Comply with HPVA HP-1, "Interim Voluntary Standard for Hardwood and Decorative Plywood"; manufactured with no added urea formaldehyde resins.

E. Hardboard: ANSI/AHA A135.4; manufactured with no added urea formaldehyde resins.



F. Medium-Density Fiberboard: Composite board manufactured with 100 percent recycled wood fiber in a phenol-formaldehyde resin matrix containing no urea formaldehyde resins.

1. Performance Classification: ANSI A208.2, Product Class MD.
2. Product: Subject to compliance with requirements, provide one of the following:
  - a. CMI, "Extira Treated Exterior Composite"
  - b. Flakeboard, "Vesta MDF"
  - c. Panel Source International, "PureKor MDF Plus".
  - d. Sierra Pine, Ltd., "Medite II" or "arreis".

G. High Pressure Decorative Plastic Laminate (HPDL): NEMA LD 3, grades as indicated.

1. Colors and Patterns: Plastic laminate colors and patterns shall be as selected by the Architect:
2. Manufacturers: Subject to compliance with requirements, provide products manufactured by the following:
  - a. Panolam Industries, Nevamar Decorative Surfaces
  - b. Pionite Decorative Surfaces.
  - c. Wilsonart International.
3. Adhesive for Bonding Plastic Laminate: Contact cement or aliphatic resin, as recommended by manufacturer. Use resorcinol where needed for fire resistance
4. Products:
  - a. See Room Finish Drawings for basis of design & color.

I. Thermoset Decorative Overlay: Decorative surface of thermally fused polyester or melamine-impregnated web, bonded to specified substrate and complying with ALA 1992.

1. Substrate: Medium-density fiberboard.

J. Solid-Surfacing Material:

1. Manufacturers: Subject to compliance with requirements, provide product one of the following:
  - a. Avonite, Inc.
  - b. E. I. du Pont de Nemours and Company.
  - c. Formica Corporation.
  - d. Wilsonart International.
2. See Room Finish Drawings for basis of design & color.

## 2.2 FIRE-RETARDANT-TREATED MATERIALS (at Laundry exhaust enclosure)

A. Where indicated, use materials impregnated with fire-retardant chemical formulations indicated by a pressure process or other means acceptable to authorities having jurisdiction to produce products with fire-test-response characteristics specified.

B. Fire-Retardant Chemicals: Use chemical formulations that do not bleed through or otherwise adversely affect finishes. Do not use colorants in solution to distinguish treated material from untreated material.

C. Fire-Retardant-Treated Lumber: Comply with the following:

1. Organic-Resin-Based Formulation: Exterior type per AWPA C20, consisting of organic-resin solution, relatively insoluble in water, thermally set in wood by kiln drying.
2. Low-Hygroscopic Formulation: Interior Type A per AWPA C20.
3. Nonpressure-Treatment Formulation: Nontoxic, water-soluble product applied by dip, spray, roller, curtain coating, vacuum chamber, or soaking.
4. Mill lumber after treatment, within limits set for wood removal that does not affect listed fire-test-response characteristics, using a woodworking plant certified by testing and inspecting agency.
5. Mill lumber before treatment and implement special procedures during treatment and drying processes that prevent lumber from warping and developing discolorations from drying sticks or other causes, marring, and other defects affecting appearance of treated woodwork.
6. Kiln-dry material before and after treatment to levels required for untreated material.
7. Discard treated material that does not comply with requirements of referenced woodworking standard. Do not use twisted, warped, bowed, discolored, or otherwise damaged or defective material.
8. Products: Subject to compliance with requirements, provide one of the following:
  - a. Organic-Resin-Based Formulation (Exterior Type):
    - 1) Exterior Fire-X; American Wood Treaters, Inc.
    - 2) Exterior Fire-X; Hoover Treated Wood Products, Inc. b.
  - Low-Hygroscopic Formulation (Type A):
    - 1) D-Blaze; J. H. Baxter Co.
    - 2) D-Blaze; Chemical Specialties, Inc.
    - 3) Pyro-guard; Continental Wood Preservers, Inc.
    - 4) Dricon; Hickson Corp.
    - 5) Pyro-guard; Hoover Treated Wood Products, Inc.
9. Product: Dricon by Hickson Corporation (no substitutions).

## 2.4 FABRICATION GENERAL

A. Interior Woodwork Grade: Provide woodwork complying with the referenced quality standard and of the following grade:

1. Grade: Premium.

B. Wood Moisture Content: Comply with requirements of referenced quality standard for wood moisture content in relation to relative humidity conditions existing during time of fabrication and in installation areas.

D. Fabricate woodwork to dimensions, profiles, and details indicated. Ease edges to radius indicated for the following:

1. Corners of cabinets and edges of solid-wood (lumber) members 3/4 inch (19 mm) thick or less: **1/16** inch (1.5 mm).
2. Edges of rails and similar members more than 3/4 inch (19 mm) thick: **1/8** inch (3 mm).
3. Corners of cabinets and edges of solid-wood (lumber) members and rails: **1/16** inch (1.5 mm).

E. Complete fabrication, including assembly, finishing, and hardware application, before shipment to Project site to maximum extent possible. Disassemble components only as

necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.

1. Trial fit assemblies at the fabrication shop that cannot be shipped completely assembled. Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial fitting. Verify that various parts fit as intended and check measurements of assemblies against field measurements indicated on approved shop drawings before disassembling for shipment.

F. Shop-cut openings, to maximum extent possible, to receive hardware, appliances, plumbing fixtures, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Smooth edges of cutouts and, where located in countertops and similar exposures, seal edges with a water-resistant coating.

## 2.5 LAMINATE-CLAD CABINETS (PLASTIC-COVERED CASEWORK)

A. Quality Standard: Comply with AWI Section 400 requirements for laminate-clad cabinets.

1. Grade: Premium.

B. AWI Type of Cabinet Construction: Flush overlay with reveal.

C. Laminate Cladding for Exposed Surfaces: High-pressure decorative laminate complying with the following requirements:

1. Horizontal Surfaces Other than Tops: HGS (0.048 inch).
2. Vertical Surfaces: HGS (0.048 inch).
3. Edges: HGS (0.048 inch).

D. Materials for Semiexposed Surfaces: Provide surface materials indicated below:

1. Surfaces Other than Drawer Bodies: VGP (0.028 inch)
2. Cabinet & Drawer Sides, tops and Backs: VGP (0.028 inch)
3. Cabinet & Drawer Bottoms: HGP (0.039 inch)

E. At all laminate clad door and drawer edges, apply edge laminates prior to application of door and drawer face laminates.

F. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:

1. Provide Architect's selections from laminate manufacturer's full range of colors and finishes in the following categories:
  - a. Solid colors.
  - b. Patterns.

G. Provide dust panels of 1/4 inch (6.4 mm) plywood or tempered hardboard above compartments and drawers except where located directly under tops.

H. Substrate: Medium density fiberboard, conforming to ANSI A208.2.

1. Provide 5 mm "Systems" screws for attachment of hardware to case body and nylon inserts for attachment of hardware to doors.

## 2.6 COUNTERTOPS

- A. Quality Standard: Comply with AWI Section 400 requirements for countertops.
  - 1. Grade: Premium.

## 2.7 CABINET HARDWARE AND ACCESSORIES

- A. General: Provide cabinet hardware and accessory materials associated with architectural cabinets except for items specified in Section 087111 "Door Hardware (Descriptive Specification)."
- B. Heavy Duty Continuous Piano Hinges
- D. Wire Pulls: see finish schedule on A-900
- E. Drawer Slides: BHMA A156.9.
  - 1. Grade 1 and Grade 2: Side mounted and extending under bottom edge of drawer; full-extension type; epoxy-coated steel with polymer rollers.
  - 2. Grade 1HD-100 and Grade 1HD-200: Side mounted; full-extension type; zinc-plated-steel ball-bearing slides.
  - 3. For drawers more than 3 inches high but not more than 6 inches high and not more than 24 inches wide, provide Grade 1HD-100.
  - 4. For drawers more than 6 inches high or more than 24 inches wide, provide Grade 1HD-200.
- F. Door and Drawer Silencers: BHMA A156.16, L03011.
- G. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with BHMA A156.18 for BHMA finish number indicated.
  - 1. Satin Chromium Plated: BHMA 626 for brass or bronze base; BHMA 652 for steel base.
- H. Clothes Hook: see drawings

## 2.8 MISCELLANEOUS MATERIALS

- A. Furring, Blocking, Shims, and Hanging Strips: Softwood or hardwood lumber dried to less than 15 percent moisture content.
- B. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide metal expansion sleeves or expansion bolts for post-installed anchors. Use nonferrous-metal or hot-dip galvanized anchors and inserts at inside face of exterior walls and at floors.
- C. Adhesives: Do not use adhesives that contain urea formaldehyde.
- D. Adhesives: Use adhesives that meet 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."

## 2.9 FABRICATION

- A. Complete fabrication, including assembly, finishing, and hardware application, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.
- B. Shop-cut openings to maximum extent possible to receive hardware, appliances, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.

## 2.10 SHOP FINISHING OF ARCHITECTURAL WOODWORK

- A. Quality Standard: Comply with AWI Section 1500, unless otherwise indicated.
  - 1. Grade: Provide finishes of same grades as items to be finished.
- B. General: The entire finish of interior architectural woodwork is specified in this Section, regardless of whether shop applied or applied after installation.
  - 1. Shop Finishing: To the greatest extent possible, finish architectural woodwork at the fabrication shop. Defer only final touch up, cleaning, and polishing until after installation.
- C. Preparations for Finishing: Comply with referenced quality standard for sanding, filling countersunk fasteners, sealing concealed surfaces, and similar preparations for finishing architectural woodwork, as applicable to each unit of work.
  - 1. Backpriming: Apply one coat of sealer or primer compatible with finish coats to concealed surfaces of woodwork, including backs of cabinets and the underside of countertops. Concealed surfaces of plastic laminate-clad woodwork do not require backpriming when surfaced with plastic laminate or thermoset decorative overlay.
- D. Washcoat for Stained Finish: Apply a vinyl washcoat to woodwork made from closed-grain wood before staining and finishing.
- E. Filled Finish for Open-Grain Woods: After staining (if any), apply paste wood filler to open-grain woods and wipe off excess. Tint filler to match stained wood.
  - 1. Apply vinyl washcoat sealer after staining and before filling.
- F. Transparent Finish: Comply with requirements indicated below for grade, finish system, staining, and sheen, with sheen measured on 60-degree gloss meter per ASTM D523.
  - 1. Grade: Premium.
  - 2. AWI Finish System: Conversion varnish.
  - 3. Staining: Match Architect's sample.
  - 4. Sheen: Satin 30-50 gloss units.
  - 5. Sheen: Semigloss 55-75 gloss units.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Before installation, condition cabinets to average prevailing humidity conditions in installation areas.

### 3.2 INSTALLATION

- A. Grade: Install cabinets to comply with same grade as item to be installed.
- B. Install wardrobes and cabinets level, plumb, true, and straight. Shim as required with concealed shims. Install level and plumb to a tolerance of 1/8 inch in 96 inches (3 mm in 2400 mm).
- C. Scribe and cut cabinets to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.
- D. Anchor wardrobes and cabinets to anchors or blocking built in or directly attached to substrates. Secure with countersunk, concealed fasteners and blind nailing. Use fine finishing nails for exposed fastening, countersunk and filled flush with woodwork and matching final finish where transparent finish is indicated.
- E. Cabinets: Install without distortion so that doors and drawers fit openings properly and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete the installation of hardware and accessory items as indicated.
  - 1. Install cabinets with no more than 1/8 inch in 96 inch (3 mm in 2400 mm) sag, bow, or other variation from a straight line.
  - 2. Maintain veneer sequence matching of cabinets with transparent finish.
- F. Tops: Anchor securely to base units and other support systems as indicated. Caulk space between backsplash and wall with mildew-resistant silicone sealant. Field assembled counters shall have a bead of mildew-resistant silicone sealant installed between the backsplash and the countertop.
  - 1. Install countertops with no more than 1/8 inch in 96 inch (3 mm in 2400 mm) sag, bow, or other variation from a straight line.
  - 2. Align adjacent solid-surfacing-material countertops and form seams to comply with manufacturer's written recommendations using adhesive in color to match countertop. Carefully dress joints smooth, remove surface scratches, and clean entire surface.
  - 3. Secure backsplashes to tops with concealed metal brackets at 16 inches (400 mm) o.c.
  - 4. Caulk space between backsplash and wall with sealant specified in Division 07 Section "Joint Sealants."

### 3.4 PROTECTION

- A. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and installer, which will ensure that woodwork will be without damage or deterioration at time of Substantial Completion.

END OF SECTION 06 40 00

SECTION 07 54 23 THERMOPLASTIC POLYOLEFIN  
(TPO) ROOFING

PART 1 - GENERAL

1.1 SUMMARY

- A. This section includes the following:
  - 1. Fully adhered thermoplastic polyolefin (TPO) sheet membrane roofing over mechanically attached insulation and cover board.
  - 2. Mechanical hoisting equipment, operating personnel and required rigging to perform the work of this section.
  
- B. Related Work:
  - 1. Division 6 Section "Rough Carpentry": Wood blocking and nailers.
  - 2. Division 7 Section "Self-Adhering Sheet Waterproofing".
  - 3. Division 7 Section "Joint Sealants": Sealants not in conjunction with roofing.

1.2 DEFINITIONS

- A. TPO: Thermoplastic polyolefin.
  
- B. Roofing Terminology: See ASTM D 1079 and glossary in NRCA's "The NRCA Roofing and Waterproofing Manual" for definitions of terms related to roofing work in this Section.

1.3 PERFORMANCE REQUIREMENTS

- A. Install sheet membrane roofing and base flashing that are watertight; will not permit the passage of liquid water; and will withstand wind loads, thermally induced movement, and exposure to weather without failure.
  
- B. Material Compatibility: Provide roofing materials that are compatible with one another under conditions of service and application required, as demonstrated by roofing system manufacturer based on testing and field experience.
  
- C. FM Listing: Provide sheet membrane, base flashings, and component materials that meet requirements of FM 4450 and FM 4470 as part of a roofing system and that are listed in FM's "Approval Guide" for Class 1 or noncombustible construction, as applicable. Identify materials with FM markings.
  - 1. Roofing system shall comply with the following:
    - a. Fire/Windstorm Classification: Class 1A-90.

- D. Energy Performance: Provide roofing system with initial Solar Reflectance Index not less than 78 when calculated according to ASTM E 1980, based on testing identical products by a qualified testing agency.

#### 1.4 SUBMITTALS

- A. Submit in accordance with Division 1 Section "Submittal Procedures", product data, installation instructions, and general recommendations from manufacturer of single-ply membrane system for types of roofing required. Include data substantiating that materials comply with requirements.
- B. Submit shop drawings:
  - 1. Shop drawings shall indicate fabricated flashings, flashings for pipe vents, roof drains, fascia/gravel stops, and other work, thickness of metals, dimensions, fastening methods, expansion joints and other provisions necessary for thermal expansion and contraction.
  - 2. Shop drawings for sheet membrane roofing shall include the following:
    - a. Outline of the roof and roof size.
    - b. Location and type of penetrations.
    - c. Perimeter and penetration details.
    - d. Special details.
    - e. Bill of Materials.
  - 3. Indicate layout of tapered insulation materials.
- C. Samples: Submit samples of finished roofing sheets, including T-shaped side/end-lap seam. Also include the following:
  - 1. Insulation board.
  - 2. Cover board.
  - 3. Vapor barrier.
- D. Submit pre-roofing conference records.
- E. Submit test data for pullout resistance of fastening systems.
- F. Submit a certificate, signed by the roofing membrane manufacturer and by the roofing subcontractor, stating that the roofing, flashing and roof insulation proposed to be used comply with these specifications, and that the installation complies with the manufacturer's printed instructions and are proper and adequate for the proposed installation and use.
  - 1. Certificate shall state that a warranty shall be issued as specified, upon completion of the roofing installation.
- G. LEED Submittals:
  - 1. Product Data for Credit SS 7.2: For roof materials, indicating that roof materials comply with Solar Reflectance Index requirement.
  - 2. Product Data for Credit EQ 4.1: For adhesives and sealants, including printed



statement of VOC content.

- H. Submit a copy of the warranty to be issued, for review.
- I. Inspection Report: Copy of roofing system manufacturer's inspection report of completed roofing installation.

## 1.5 QUALITY ASSURANCE

- A. Manufacturer: Obtain primary single-ply membrane roofing from a single manufacturer. Provide secondary materials as recommended by manufacturer of primary materials.
- B. Installer: Engage an experienced Installer that has specialized in installing roofing systems similar to those required for this Project. Installer must be acceptable to or licensed by manufacturer of primary roofing material.
  - 1. Work associated with single-ply membrane roofing, including (but not limited to) insulation, flashing, and membrane sheet joint sealers, is to be performed by Installer of this Work.
- C. Preinstallation Conference: Before installing roofing system, conduct conference at Project site to comply with requirements of Division 1 Section "Project Meetings". Notify participants at least 5 working days before conference.
  - 1. Meet with Owner; Architect; Owner's insurer, if applicable; testing and inspecting agency representative; roofing Installer; roofing system manufacturer's representative; deck Installer; and installers whose work interfaces with or affects roofing, including installers of roof accessories and roof-mounted equipment.
  - 2. Review methods and procedures related to roofing installation, including manufacturer's written instructions.
  - 3. Examine deck substrate conditions and finishes for compliance with requirements, including flatness and fastening.
  - 4. Review loading limitations of deck during and after roofing.
  - 5. Review flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that will affect roofing.
  - 6. Review governing regulations and requirements for insurance, certificates, and inspection and testing, if applicable.
  - 7. Review temporary protection requirements for roofing system during and after installation.
  - 8. Review roof observation and repair procedures after roofing installation.
  - 9. Document proceedings, including corrective measures or actions required, and furnish copy of record to each participant.
- D. UL Listing: Provide labeled materials that have been tested and listed by UL in "Building Materials Directory" or by other nationally recognized testing laboratory for Class A rated materials/system.

## 1.6 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials to the site in the manufacturer's original labeled containers, packages and rolls.
- B. Store roofing materials and insulation on raised platforms and protect from moisture. Provide fire preventive measures for storage areas.
  - 1. Store adhesives at temperatures above 40 degrees F.
  - 2. Limit storage loading on roof decks during installation period to 30 pounds per square foot of uniformly distributed load.
- C. Provide other protection as required by the roofing materials manufacturer.
  - 1. Replace materials damaged during handling or storage.
  - 2. Remove damaged materials from the premises immediately.

#### 1.7 PROJECT CONDITIONS

- A. Weather: Proceed with roofing work when existing and forecasted weather conditions permit work to be performed in accordance with manufacturers' recommendations and warranty requirements.
- B. Substrate Conditions: Do not begin roofing installation until substrates have been inspected and are determined to be in satisfactory condition.

#### 1.8 WARRANTY

- A. Roofing Subcontractor's Warranty: The roofing subcontractor shall submit to the Owner a two-year workmanship warranty signed and countersigned by Installer (Roofer) and Contractor. In the event that any roofing work including roofing membrane, composition flashing, roof insulation, and roof accessories, is found to be defective or otherwise not in accordance with the Contract Documents within two years of substantial completion, the roofing subcontractor shall remove and replace such defective work at no additional cost to the Owner. The roofing subcontractor's warranty obligation shall be directly to the Owner, and a copy shall be sent to the roofing membrane manufacturer.
- B. Manufacturer's Warranty: Submit executed copy of membrane manufacturer's "Total Roofing System Warranty" agreement covering materials and workmanship for the entire roofing system including all materials supplied or specifically approved by the membrane manufacturer. Provide warranty signed by an authorized representative of roofing membrane manufacturer. Provide form that was published with product literature as of date of Contract Documents.
  - 1. Warranty period shall be 20 years subsequent to the date of Substantial Completion of the Project.
- C. The warranty shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and will be in addition to and run concurrent with other warranties made by the Contractor under requirements of the Contract

Documents.

- D. Signed warranties as specified, must be submitted to the Architect before final payment for the membrane roofing work will be made.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Subject to compliance with requirements, provide membrane roofing system from one of the following manufacturers (no substitutions):
  - 1. Carlisle Syntec Systems.
  - 2. GenFlex Roofing Systems, GenCorp Polymer Products.
  - 3. Versico Inc.
  - 4. Firestone
- B. Basis of Design: Drawings and specifications are based on the following membrane roofing systems and products. Subject to strict compliance, roofing systems from acceptable manufacturers will be approved
  - 1. Fabric-Reinforced Thermoplastic Polyolefin Sheet:
    - a. Carlisle Syntec Systems. "Sure-Weld Membrane Roofing System".
  - 2. Fabric-Backed, Fabric-Reinforced Thermoplastic Polyolefin Sheet:
    - a. Carlisle Syntec Systems. "Sure-Weld FleeceBACK SWFB 115".

### 2.2 ROOF MEMBRANE

- A. Fabric-Reinforced Thermoplastic Polyolefin Sheet: Uniform, flexible sheet formed from a thermoplastic polyolefin, polypropylene resin, internally fabric or scrim reinforced for use, and as follows:
  - 1. Thickness: 60 mils (1.5 mm), nominal.
  - 2. Exposed Face Color: Light tan or gray color that meets energy performance requirements.
  - 3. Physical Properties:
    - a. Breaking Strength: 225 lbf (1 kN); ASTM D 751, grab method.
    - b. Elongation at Break: 15 percent; ASTM D 751.
    - c. Tearing Strength: 55 lbf (245 N) minimum; ASTM D 751, Procedure B.
    - d. Brittleness Point: Minus 22 deg F (30 deg C).
    - e. Ozone Resistance: No cracks after sample, wrapped around a 3-inch- (75-mm-) diameter mandrel, is exposed for 166 hours to a temperature of 104 deg F (40 deg C) and an ozone level of 100 pphm (100 mPa); ASTM D 1149.
    - f. Resistance to Heat Aging: 90 percent minimum retention of breaking strength, elongation at break, and tearing strength after 166 hours at 240 deg F (116 deg C); ASTM D 573.
    - g. Water Absorption: Less than 4 percent mass change after 166 hours'

immersion at 158 deg F (70 deg C); ASTM D 471.

- h. Linear Dimension Change: Plus or minus 2 percent; ASTM D 1204.
- B. Fabric-Backed, Fabric-Reinforced Thermoplastic Polyolefin Sheet: Uniform, flexible sheet formed from a thermoplastic polyolefin, polypropylene resin, internally fabric or scrim reinforced, and as follows:
1. Thickness: 60 mils (1.5 mm), nominal.
  2. Exposed Face Color: Light tan or gray color that meets energy performance requirements.
  3. Physical Properties:
    - a. Breaking Strength: 225 lbf (1 kN); ASTM D 751, grab method.
    - b. Elongation at Break: 15 percent; ASTM D 751.
    - c. Tearing Strength: 55 lbf (245 N) minimum; ASTM D 751, Procedure B.
    - d. Puncture Resistance: 450 lbf (2.0 kN); FTM Method 2031.
    - e. Brittleness Point: Minus 22 deg F (30 deg C).
    - f. Ozone Resistance: No cracks after sample, wrapped around a 3-inch- (75-mm-) diameter mandrel, is exposed for 166 hours to a temperature of 104 deg F (40 deg C) and an ozone level of 100 pphm (100 mPa); ASTM D 1149.
    - g. Resistance to Heat Aging: 90 percent minimum retention of breaking strength, elongation at break, and tearing strength after 166 hours at 240 deg F (116 deg C); ASTM D 573.
    - h. Water Absorption: Less than 4 percent mass change after 166 hours' immersion at 158 deg F (70 deg C); ASTM D 471.
    - i. Linear Dimension Change: Plus or minus 2 percent; ASTM D 1204.

### 2.3 AUXILLARY MATERIALS

- A. Reinforced-Polyethylene Vapor Retarder: 2 outer layers of polyethylene film laminated to an inner reinforcing layer consisting of either nylon cord or polyester scrim and weighing not less than 25 lb/1000 sq. ft., with maximum permeance rating of 0.0403 perm.
1. Surface-Burning Characteristics: Maximum flame-spread and smoke-developed indices of 25 and 50, respectively.
- B. Thermal Barrier: Glass-mat, water-resistant gypsum board, ASTM C1177, of type and thickness indicated below:
1. Type and Thickness: Type X, 5/8 inch (16 mm).
  2. Product: Subject to compliance with requirements, provide "Dens-Deck" manufactured by Georgia-Pacific Corp.
- C. Cover Board: Glass-mat, water-resistant gypsum board, ASTM C1177, of type and thickness indicated below:
1. Type and Thickness: Regular, 1/2 inch (12.7 mm).
  2. Product: Subject to compliance with requirements, provide "Dens-Deck" manufactured by Georgia-Pacific Corp.

- D. Cant Strips, Tapered Edge Strips, and Flashing Accessories: Types recommended by membrane manufacturer, including adhesive tapes, flashing cements, and sealants.
- E. Flashing Material: Manufacturer's standard system compatible with single-ply membrane.
- F. Fasteners: Factory-coated steel fasteners and metal or plastic plates meeting corrosion-resistance provisions of FM 4470, designed for fastening sheet to substrate, and acceptable to roofing system manufacturer.
- G. Membrane Adhesive: As recommended by membrane manufacturer for particular substrate and project conditions, formulated to withstand minimum 90-psf uplift force.

#### 2.4 INSULATING MATERIALS

- A. Extruded-Polystyrene Board Insulation: Rigid, cellular, thermal insulation with closed cells and integral high-density skin, complying with ASTM C578 for Type indicated; with 5-year aged r-values of 5.4 and 5.0 at 40 degrees and 75 degrees F (4.4 degrees and 23.9 degrees C), respectively, and as follows:
  - 1. Type IV, 1.6-pcf minimum density.
    - a. Surface Burning Characteristics: Maximum flame-spread and smoke-developed values of 5 and 165, respectively.
  - 2. Provide tapered boards sloped to drain. Fabricate with taper of 1/4 inch per foot.
  - 3. Manufacturers:
    - a. DiversiFoam Products.
    - b. Dow Chemical Company.
    - c. Owens Corning.
- B. Fasteners: Factory-coated steel fasteners and metal or plastic plates meeting corrosion-resistance provisions of FM 4470, designed for fastening roof insulation to substrate, and acceptable to roofing system manufacturer.

#### 2.5 WALKWAYS

- A. Walkway Pads: Factory-formed, nonporous, heavy-duty, solid-rubber, slip-resisting, surface-textured walkway pads, approximately 3/16 inch (5 mm) thick, and acceptable to roofing system manufacturer.

### PART 3 - EXECUTION

#### 3.1 INSPECTION AND PREPARATION

- A. Comply with manufacturers' instructions to prepare substrate to receive single-ply membrane system.
  - 1. Verify that penetrations, expansion joints, and blocking are in place and secured and that roof drains are properly clamped into position.

2. Examine roof deck surfaces for defects that will adversely affect roofing installation such as excessive surface roughness, contaminated surfaces, and structurally unsound substrates.
- B. Clean substrate of dust, debris, and other substances detrimental to roofing system work. Remove sharp projections.
- C. Install cant strips, flashings, and accessory items as shown and as recommended by manufacturer.
- D. Prevent compounds from entering and clogging drains and conductors and from spilling or migrating onto surfaces of other work.

### 3.2 INSTALLATION

- A. Start installation only in presence of manufacturer's technical representative.
- B. Comply with UL requirements for fire rated roof constructions and comply with FM requirements for "Class 1" metal deck construction and 1-90 roof construction.
  1. For membrane roofing on concrete roof decks, comply with UL Design No. D907 and additional requirements indicated.
  2. For membrane roofing on steel roof decks, comply with UL Design No. P717 and additional requirements indicated.
- C. Install vapor retarder over all roof decks, in accordance with the manufacturer's recommended application method. Install vapor retarder over a clean and dry deck. Lap all edges 2 inches and seal with adhesive or tape. Install no more vapor retarder in one day than can be properly covered and capped that day.
- D. Over steel decks, install thermal barrier perpendicular to steel roof deck with end joints staggered a minimum of 1 foot and occurring over crests of steel roof deck.

### 3.3 INSTALLING INSULATION

- A. Extend insulation full thickness in two layers, or in multiple layers over entire surface to be insulated, cutting and fitting tightly around obstructions. Form crickets, saddles, and tapered areas with additional material as shown and as required for proper drainage of membrane.
  1. Stagger joints in one direction for each course. For multiple layers, stagger joints in both directions between courses with no gaps to form a complete thermal envelope.
  2. Provide tapered units to suit drainage pattern indicated.
  3. Install cover board in single layer over insulation.
- B. Do not install more insulation each day than can be covered with membrane before end of day and before start of inclement weather.

- C. Install insulation to required thickness in 2 or more layers with joints of each succeeding layer staggered from joints of previous layer a minimum of 6 inches (150 mm) in each direction.
- D. Secure cover board and roof insulation to roof deck with mechanical anchors of type and spacing indicated; but in no case provide less than one anchor per 4 square feet of surface area or less anchorage than required by FM "Loss Prevention Data Sheet 1-28."

### 3.4 INSTALLING MEMBRANE

- A. Start installation only in presence of manufacturer's technical representative.
  - 1. Cut out and repair membrane defects at the end of each day's work.
- B. Fully Adhered Membrane: Install membrane by unrolling over prepared substrate, lapping adjoining sheets as recommended by manufacturer. Apply adhesive to surfaces to be bonded and roll into place when adhesive has properly cured. Heat weld seams and apply sealant to exposed sheet edges, tapering application as recommended by manufacturer. Install mechanical fasteners, flashings and counterflashings, and accessories at locations and as recommended by manufacturer.

### 3.5 WALKWAY INSTALLATION

- A. Walkways: Install walkway products in locations indicated. Adhere walkway products to substrate with compatible adhesive according to roofing system manufacturer's written instructions.

### 3.6 FIELD QUALITY CONTROL

- A. Verify field strength of seams a minimum of twice daily, according to manufacturer's written instructions, and repair seam sample areas.
- B. Final Roof Inspection: Arrange for roofing system manufacturer's technical personnel to inspect roofing installation on completion and submit report to Architect.
  - 1. Notify Architect or Owner 48 hours in advance of the date and time of inspection.

### 3.7 PROTECTING ROOFING

- A. After completing roofing (including associated work), institute appropriate procedures for surveillance and protection of roofing during remainder of construction period. At the end of the construction period, or at a time when remaining construction will in no way affect or endanger roofing, make a final inspection of roofing and prepare a written

report to Owner, describing nature and extent of deterioration or damage found.

- B. Repair or replace deteriorated or defective work found at the time of final inspection to a condition free of damage and deterioration at the time of Substantial Completion and according to the requirements of the specified warranty.

END OF SECTION 07 54 23



## SECTION 07 62 00

### SHEET METAL FLASHING AND TRIM

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. Manufactured Products:
    - a. Manufactured reglets.
    - b. Manufactured copings and roof edge fascias.
  - 2. Formed Products:
    - a. Formed roof drainage sheet metal fabrications.
    - b. Formed low-slope roof sheet metal fabrications.
    - c. Formed equipment support flashing.
    - d. Formed overhead-piping safety pans.
- B. Products furnished but not installed under this section:
  - 1. Division 4 Section "Unit Masonry": Metal counter flashings and wall flashings built into unit masonry.
  - 2. Division 7 Section "Thermoplastic Polyolefin (TPO) Membrane Roofing":
    - a. Metal gravel stops and fascia in conjunction with membrane roofing.
- C. Related Sections:
  - 1. Division 6 Section "Rough Carpentry" for wood nailers, curbs, and blocking.
  - 2. Division 7 Section "Foamed-In-Place Insulation" for membrane inner piece of through-wall flashing
  - 3. Division 7 Section "Thermoplastic Polyolefin (TPO) Roofing" for installing sheet metal flashing and trim integral with membrane roofing.

##### 1.2 PERFORMANCE REQUIREMENTS

- A. General: Sheet metal flashing and trim assemblies as indicated shall withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Completed sheet metal flashing and trim shall not rattle, leak, or loosen, and shall remain watertight.

- B. Fabricate and install roof edge flashing and copings capable of resisting the following forces according to recommendations in FMG Loss Prevention Data Sheet 1-49:
  - 1. Wind Exposure B: 90 miles per hour, 3 second gust.
- C. Thermal Movements: Provide sheet metal flashing and trim that allows for thermal movements from ambient and surface temperature changes.
  - 1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

### 1.3 SUBMITTALS

- A. Shop Drawings: Show fabrication and installation layouts of sheet metal flashing and trim, including plans, elevations, expansion-joint locations, and keyed details. Distinguish between shop- and field-assembled work. Include the following:
  - 1. Identification of material, thickness, weight, and finish for each item and location in Project.
  - 2. Details for forming sheet metal flashing and trim, including profiles, shapes, seams, and dimensions.
  - 3. Details for joining, supporting, and securing sheet metal flashing and trim, including layout of fasteners, cleats, clips, and other attachments. Include pattern of seams.
  - 4. Details of termination points and assemblies, including fixed points.
  - 5. Details of expansion joints and expansion-joint covers, including showing direction of expansion and contraction.
  - 6. Details of edge conditions, including eaves, ridges, valleys, rakes, crickets, and counterflashings as applicable.
  - 7. Details of special conditions.
  - 8. Details of connections to adjoining work.
  - 9. Detail formed flashing and trim at a scale of not less than 1-1/2 inches per 12 inches (1:10).
- B. Samples for Initial Selection: For each type of sheet metal flashing, trim, and accessory indicated with factory-applied color finishes involving color selection.
- C. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below:
  - 1. Sheet Metal Flashing: 12 inches (300 mm) long by actual width of unit, including finished seam and in required profile. Include fasteners, cleats, clips, closures, and other attachments.
  - 2. Trim, Metal Closures, Expansion Joints, Joint Intersections, and Miscellaneous Fabrications: 12 inches (300 mm) long and in required profile. Include fasteners and other exposed accessories.

3. Accessories and Miscellaneous Materials: Full-size Sample.
  4. Anodized Aluminum Samples: Samples to show full range to be expected for each color required.
- D. Qualification Data: For qualified fabricator.
- E. Maintenance Data: For sheet metal flashing, trim, and accessories to include in maintenance manuals.
- F. Warranty: Sample of special warranty.

#### 1.4 QUALITY ASSURANCE

- A. Fabricator Qualifications: Shop that employs skilled workers who custom fabricate sheet metal flashing and trim similar to that required for this Project and whose products have a record of successful in-service performance.
- B. Sheet Metal Flashing and Trim Standard: Comply with SMACNA's "Architectural Sheet Metal Manual" unless more stringent requirements are specified or shown on Drawings.
- C. Copper Sheet Metal Standard: Comply with CDA's "Copper in Architecture Handbook." Conform to dimensions and profiles shown unless more stringent requirements are indicated.
- D. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.
1. Build mockup of typical roof eave, including fascia and fascia trim, approximately 10 feet (3.0 m) long, including supporting construction cleats, seams, attachments, underlayment, and accessories.
  2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
- E. Preinstallation Conference: Conduct conference at Project site.
1. Meet with Owner, Architect, Owner's insurer if applicable, Installer, and installers whose work interfaces with or affects sheet metal flashing and trim including installers of roofing materials, roof accessories, unit skylights, and roof-mounted equipment.
  2. Review methods and procedures related to sheet metal flashing and trim.
  3. Examine substrate conditions for compliance with requirements, including flatness and attachment to structural members.
  4. Review special roof details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that will affect sheet metal flashing.
  5. Document proceedings, including corrective measures and actions required,

and furnish copy of record to each participant.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Do not store sheet metal flashing and trim materials in contact with other materials that might cause staining, denting, or other surface damage. Store sheet metal flashing and trim materials away from uncured concrete and masonry.
- B. Protect strippable protective covering on sheet metal flashing and trim from exposure to sunlight and high humidity, except to the extent necessary for the period of sheet metal flashing and trim installation.

#### 1.6 WARRANTY

- A. Special Warranty on Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace sheet metal flashing and trim that shows evidence of deterioration of factory-applied finishes within specified warranty period.
  - 1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:
    - a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
    - b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
    - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
  - 2. Finish Warranty Period: 20 years from date of Substantial Completion.

### PART 2 - PRODUCTS

#### 2.1 SHEET METALS

- A. General: Protect mechanical and other finishes on exposed surfaces from damage by applying a strippable, temporary protective film before shipping.
- B. Aluminum Sheet: ASTM B 209 (ASTM B 209M), alloy as standard with manufacturer for finish required, with temper as required to suit forming operations and performance required.
  - 1. Surface: Smooth, flat.
  - 2. Exposed Coil-Coated Finishes:
    - a. Two-Coat Fluoropolymer: AAMA 620. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

3. Color: Custom color as selected by Architect from manufacturer's full range to match approved color of aluminum curtain wall framing.
  4. Concealed Finish: Pretreat with manufacturer's standard white or light- colored acrylic or polyester backer finish, consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil (0.013 mm).
- C. Stainless-Steel Sheet: ASTM A 240/A 240M or ASTM A 666, Type 304, dead soft, fully annealed.
1. Finish: 2D (dull, cold rolled).
  2. Surface: Smooth, flat.

## 2.2 UNDERLAYMENT MATERIALS

- A. Polyethylene Sheet: 6-mil- (0.15-mm-) thick polyethylene sheet complying with ASTM D 4397.
- B. Felt: ASTM D 226, Type II (No. 30), asphalt-saturated organic felt, nonperforated.
- C. Self-Adhering, High-Temperature Sheet: Minimum 30 to 40 mils (0.76 to 1.0 mm) thick, consisting of slip-resisting polyethylene-film top surface laminated to layer of butyl or SBS-modified asphalt adhesive, with release-paper backing; cold applied. Provide primer when recommended by underlayment manufacturer.
1. Thermal Stability: ASTM D 1970; stable after testing at 240 deg F (116 deg C).
  2. Low-Temperature Flexibility: ASTM D 1970; passes after testing at minus 20 deg F (29 deg C).
  3. Products: Subject to compliance with requirements, provide one of the following:
    - a. Carlisle Coatings & Waterproofing Inc.; CCW WIP 300HT.
    - b. Grace Construction Products, a unit of W. R. Grace & Co.; Ultra.
    - c. Henry Company; Blueskin PE200 HT.
    - d. Metal-Fab Manufacturing, LLC; MetShield.
    - e. Owens Corning; WeatherLock Metal High Temperature Underlayment.
- D. Slip Sheet: Building paper, 3-lb/100 sq. ft. (0.16-kg/sq. m) minimum, rosin sized.

## 2.3 MISCELLANEOUS MATERIALS

- A. General: Provide materials and types of fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation and recommended

by manufacturer of primary sheet metal or manufactured item unless otherwise indicated.

- B. Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads and recommended by manufacturer of primary sheet metal or manufactured item.
  - 1. General: Blind fasteners or self-drilling screws, gasketed, with hex-washer head.
    - a. Exposed Fasteners: Heads matching color of sheet metal using plastic caps or factory-applied coating.
    - b. Blind Fasteners: High-strength aluminum or stainless-steel rivets suitable for metal being fastened.
    - c. Spikes and Ferrules: Same material as gutter; with spike with ferrule matching internal gutter width.
  - 2. Fasteners for Aluminum Sheet: Aluminum or Series 300 stainless steel.
  - 3. Fasteners for Stainless-Steel Sheet: Series 300 stainless steel.
  - 4. Fasteners for Zinc-Coated (Galvanized) Steel Sheet: Hot-dip galvanized steel according to ASTM A 153/A 153M or ASTM F 2329 or Series 300 stainless steel.
- C. Solder:
  - 1. For Stainless Steel: ASTM B 32, Grade Sn60, with an acid flux of type recommended by stainless-steel sheet manufacturer.
  - 2. For Zinc-Coated (Galvanized) Steel: ASTM B 32, Grade Sn50, 50 percent tin and 50 percent lead or Grade Sn60, 60 percent tin and 40 percent lead.
- D. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch (13 mm) wide and 1/8 inch (3 mm) thick.
- E. Elastomeric Sealant: ASTM C 920, elastomeric silicone polymer sealant; low modulus; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.
- F. Butyl Sealant: ASTM C 1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for hooked-type expansion joints with limited movement.
- G. Epoxy Seam Sealer: Two-part, noncorrosive, aluminum seam-cementing compound, recommended by aluminum manufacturer for exterior nonmoving joints, including riveted joints.
- H. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D 1187.
- I. Asphalt Roofing Cement: ASTM D 4586, asbestos free, of consistency required for application.

## 2.4 MANUFACTURED SHEET METAL FLASHING AND TRIM

- A. Reglets: Units of type, material, and profile indicated, formed to provide secure interlocking of separate reglet and counterflashing pieces, and compatible with flashing indicated with factory-mitered and -welded corners and junctions.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Cheney Flashing Company.
    - b. Fry Reglet Corporation.
    - c. Heckmann Building Products Inc.
    - d. Hickman, W. P. Company.
    - e. Hohmann & Barnard, Inc.; STF Sawtooth Flashing.
    - f. Keystone Flashing Company, Inc.
    - g. National Sheet Metal Systems, Inc.
    - h. Sandell Manufacturing Company, Inc.
  2. Material: Stainless steel, 0.019 inch (0.48 mm) thick.
  3. Surface-Mounted Type: Provide with slotted holes for fastening to substrate, with neoprene or other suitable weatherproofing washers, and with channel for sealant at top edge.
  4. Concrete Type: Provide temporary closure tape to keep reglet free of concrete materials, special fasteners for attaching reglet to concrete forms, and guides to ensure alignment of reglet section ends.
  5. Masonry Type: Provide with offset top flange for embedment in masonry mortar joint.
  6. Accessories:
    - a. Flexible-Flashing Retainer: Provide resilient plastic or rubber accessory to secure flexible flashing in reglet where clearance does not permit use of standard metal counterflashing or where Drawings show reglet without metal counterflashing.
    - b. Counterflashing Wind-Restraint Clips: Provide clips to be installed before counterflashing to prevent wind uplift of counterflashing lower edge.

## 2.5 FABRICATION, GENERAL

- A. General: Custom fabricate sheet metal flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, geometry, metal thickness, and other characteristics of item indicated. Fabricate items at the shop to greatest extent possible.
1. Fabricate sheet metal flashing and trim in thickness or weight needed to comply with performance requirements, but not less than that specified for each application and metal.
  2. Obtain field measurements for accurate fit before shop fabrication.
  3. Form sheet metal flashing and trim without excessive oil canning, buckling,

and tool marks and true to line and levels indicated, with exposed edges folded back to form hems.

4. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces exposed to view.
  
- B. Fabrication Tolerances: Fabricate sheet metal flashing and trim that is capable of installation to a tolerance of 1/4 inch in 20 feet (6 mm in 6 m) on slope and location lines as indicated and within 1/8-inch (3-mm) offset of adjoining faces and of alignment of matching profiles.
  
- C. Fabrication Tolerances: Fabricate sheet metal flashing and trim that is capable of installation to tolerances specified in MCA's "Guide Specification for Residential Metal Roofing."
  
- D. Sealed Joints: Form nonexpansion but movable joints in metal to accommodate elastomeric sealant.
  
- E. Expansion Provisions: Where lapped expansion provisions cannot be used, form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with butyl sealant concealed within joints.
  
- F. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.
  
- G. Fabricate cleats and attachment devices of sizes as recommended by SMACNA's "Architectural Sheet Metal Manual" and by FMG Loss Prevention Data Sheet 1-49 for application, but not less than thickness of metal being secured.
  
- H. Seams: Fabricate nonmoving seams with flat-lock seams. Tin edges to be seamed, form seams, and solder.
  
- I. Seams: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with elastomeric sealant unless otherwise recommended by sealant manufacturer for intended use. Rivet joints where necessary for strength.
  
- J. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints where necessary for strength.
  
- K. Do not use graphite pencils to mark metal surfaces.

## 2.6 ROOF DRAINAGE SHEET METAL FABRICATIONS

- A. Hanging Gutters: Fabricate to cross section indicated, complete with end pieces, outlet tubes, and other accessories as required. Fabricate in minimum 96-inch-(2400-mm-) long sections. Furnish flat-stock gutter spacers and gutter brackets fabricated from same metal as gutters, of size recommended by SMACNA but not less than twice the gutter thickness. Fabricate expansion joints, expansion-joint covers, gutter bead reinforcing bars, and gutter accessories from same metal as



gutters.

1. Gutter Style: SMACNA designation F.
  2. Expansion Joints: Lap type.
  3. Accessories: Continuous removable leaf screen with sheet metal frame and hardware cloth screen.
  4. Gutters with Girth up to 15 Inches (380 mm): Fabricate from the following materials:
    - a. Aluminum: 0.032 inch (0.81 mm) thick.
  5. Gutters with Girth 16 to 20 Inches (410 to 510 mm): Fabricate from the following materials:
    - a. Aluminum: 0.040 inch (1.02 mm) thick.
  6. Gutters with Girth 21 to 25 Inches (530 to 640 mm): Fabricate from the following materials:
    - a. Aluminum: 0.050 inch (1.27 mm) thick.
  7. Gutters with Girth 26 to 30 Inches (660 to 760 mm): Fabricate from the following materials:
    - a. Aluminum: 0.063 inch (1.60 mm) thick.
- B. Downspouts: Fabricate round downspouts complete with mitered elbows. Furnish with metal hangers, from same material as downspouts, and anchors.
1. Hanger Style: As indicated on Drawings.
  2. Fabricate from the following materials:
    - a. Aluminum: 0.024 inch (0.61 mm) thick.
- C. Conductor Heads: Fabricate conductor heads with flanged back and stiffened top edge and of dimensions and shape indicated complete with outlet tubes, exterior flange trim, and built-in overflows. Fabricate from the following materials:
1. Aluminum: 0.032 inch (0.81 mm) thick.
- D. Splash Pans: Fabricate from the following materials:
1. Aluminum: 0.040 inch (1.02 mm) thick.

## 2.7 LOW-SLOPE ROOF SHEET METAL FABRICATIONS

- A. Roof-Edge Flashing (Gravel Stop): Fabricate in minimum 96-inch- (2400-mm-) long, but not exceeding 10-foot- (3-m-) long, sections. Furnish with 6-inch- (150-mm-) wide, joint cover plates.
1. Joint Style: Butt, with 12-inch- (300-mm-) wide, concealed backup plate.
  2. Fabricate from the following materials:
    - a. Aluminum: 0.050 inch (1.27 mm) thick.
- B. Copings: Fabricate in minimum 96-inch- (2400-mm-) long, but not exceeding 10-foot- (3-m-) long, sections. Fabricate joint plates of same thickness as copings. Furnish with continuous cleats to support edge of external leg and drill elongated holes for fasteners on interior leg. Miter corners, seal, and solder or weld watertight.
1. Coping Profile: As indicated on Drawings.
  2. Joint Style: Butt, with 12-inch- (300-mm-) wide, concealed backup plate.

3. Fabricate from the following materials:
    - a. Aluminum: 0.050 inch (1.27 mm) thick.
  4. Product: Petersen Aluminum Corporation, "PAC-Continuous Cleat Coping" with "PAC-CLAD Kynar 500 Finish".
- C. Base Flashing: Fabricate from the following materials:
1. Stainless Steel: 0.019 inch (0.48 mm) thick.
- D. Counterflashing: Fabricate from the following materials:
1. Stainless Steel: 0.019 inch (0.48 mm) thick.
- E. Flashing Receivers: Fabricate from the following materials:
1. Stainless Steel: 0.016 inch (0.40 mm) thick.
- F. Roof-Drain Flashing: Fabricate from the following materials:
1. Stainless Steel: 0.016 inch (0.40 mm) thick.

## 2.8 WALL SHEET METAL FABRICATIONS

- A. Through-Wall Flashing, General: Two-piece flashing system comprising inner piece and outer piece for installation as shown on Drawings.
- B. Through-Wall Flashing, Outer Piece: Fabricate continuous flashings in minimum 96-inch- (2400-mm-) long, but not exceeding 12-foot- (3.6-m-) long, sections, under copings, at shelf angles, and where indicated. Fabricate discontinuous lintel, sill, and similar flashings to extend 6 inches (150 mm) beyond each side of wall openings. Form with 2-inch- (50-mm-) high, end dams where flashing is discontinuous. Fabricate from the following materials:
1. Stainless Steel: 0.016 inch (0.40 mm) thick.
- C. Through-Wall Flashing, Inner Piece: Refer to Division 7 Section "Foamed-In-Place Insulation" for membrane inner piece of through-wall flashing.

## 2.9 MISCELLANEOUS SHEET METAL FABRICATIONS

- A. Equipment Support Flashing: Fabricate from the following materials:
1. Stainless Steel: 0.019 inch (0.48 mm) thick.
- B. Overhead-Piping Safety Pans: Fabricate from the following materials:
1. Stainless Steel: 0.025 inch (0.64 mm) thick.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions and other conditions affecting performance of the Work.
  - 1. Verify compliance with requirements for installation tolerances of substrates.
  - 2. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.
- B. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 UNDERLAYMENT INSTALLATION

- A. General: Install underlayment as indicated on Drawings.
- B. Polyethylene Sheet: Install polyethylene sheet with adhesive for anchorage to minimize use of mechanical fasteners under sheet metal flashing and trim. Apply in shingle fashion to shed water, with lapped and taped joints of not less than 2 inches (50 mm).
- C. Felt Underlayment: Install felt underlayment with adhesive for temporary anchorage to minimize use of mechanical fasteners under sheet metal flashing and trim. Apply in shingle fashion to shed water, with lapped joints of not less than 2 inches (50 mm).
- D. Self-Adhering Sheet Underlayment: Install self-adhering sheet underlayment, wrinkle free. Apply primer if required by underlayment manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation; use primer rather than nails for installing underlayment at low temperatures. Apply in shingle fashion to shed water, with end laps of not less than 6 inches (150 mm) staggered 24 inches (600 mm) between courses. Overlap side edges not less than 3-1/2 inches (90 mm). Roll laps with roller. Cover underlayment within 14 days.

### 3.3 INSTALLATION, GENERAL

- A. General: Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement. Use fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.
  - 1. Install sheet metal flashing and trim true to line and levels indicated. Provide uniform, neat seams with minimum exposure of solder, welds, and sealant.
  - 2. Install sheet metal flashing and trim to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be

- covered before fabricating sheet metal.
  3. Space cleats not more than 12 inches (300 mm) apart. Anchor each cleat with two fasteners. Bend tabs over fasteners.
  4. Install exposed sheet metal flashing and trim without excessive oil canning, buckling, and tool marks.
  5. Install sealant tape where indicated.
  6. Torch cutting of sheet metal flashing and trim is not permitted.
  7. Do not use graphite pencils to mark metal surfaces.
- B. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating or by other permanent separation as recommended by SMACNA.
1. Coat back side of uncoated aluminum and stainless-steel sheet metal flashing and trim with bituminous coating where flashing and trim will contact wood, ferrous metal, or cementitious construction.
  2. Underlayment: Where installing metal flashing directly on cementitious or wood substrates, install a course of felt underlayment and cover with a slip sheet or install a course of polyethylene sheet.
- C. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet (3 m) with no joints allowed within 24 inches (600 mm) of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently watertight, form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with sealant concealed within joints.
- D. Fastener Sizes: Use fasteners of sizes that will penetrate
1. Wood Sheathing: Not less than 1-1/4 inches (32 mm) for nails and not less than 3/4 inch (19 mm) for wood screws
  2. Metal Decking: Not less than recommended by fastener manufacturer to achieve maximum pull-out resistance.
- E. Seal joints as shown and as required for watertight construction.
1. Where sealant-filled joints are used, embed hooked flanges of joint members not less than 1 inch (25 mm) into sealant. Form joints to completely conceal sealant. When ambient temperature at time of installation is moderate, between 40 and 70 deg F (4 and 21 deg C), set joint members for 50 percent movement each way. Adjust setting proportionately for installation at higher ambient temperatures. Do not install sealant-type joints at temperatures below 40 deg F (4 deg C).
  2. Prepare joints and apply sealants to comply with requirements in Division 7 Section "Joint Sealants."
- F. Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter. Pre-tin edges of sheets to be soldered to a width of 1-1/2 inches (38 mm), except reduce pre-tinning where pre-tinned surface would show in completed Work.

1. Location of Soldered Joints: Non-moving joints including joints between thimbles and flashing.
  2. Do not solder metallic-coated steel and aluminum sheet.
  3. Do not use torches for soldering. Heat surfaces to receive solder and flow solder into joint. Fill joint completely. Completely remove flux and spatter from exposed surfaces.
  4. Stainless-Steel Soldering: Tin edges of uncoated sheets using solder recommended for stainless steel and acid flux. Promptly remove acid flux residue from metal after tinning and soldering. Comply with solder manufacturer's recommended methods for cleaning and neutralization.
- G. Rivets: Rivet joints in uncoated aluminum where indicated and where necessary for strength.

### 3.4 ROOF DRAINAGE SYSTEM INSTALLATION

- A. General: Install sheet metal roof drainage items to produce complete roof drainage system according to SMACNA recommendations and as indicated. Coordinate installation of roof perimeter flashing with installation of roof drainage system.
- B. Hanging Gutters: Join sections with riveted and soldered joints or with lapped joints sealed with sealant. Provide for thermal expansion. Attach gutters at eave or fascia to firmly anchored gutter brackets or twisted straps spaced not more than 36 inches (900 mm) apart. Provide end closures and seal watertight with sealant. Slope to downspouts.
1. Fasten gutter spacers to front and back of gutter.
  2. Loosely lock straps to front gutter bead and anchor to roof deck.
  3. Anchor and loosely lock back edge of gutter to continuous cleat.
  4. Anchor back of gutter that extends onto roof deck with cleats spaced not more than 24 inches (600 mm) apart.
  5. Anchor gutter with spikes and ferrules spaced not more than 24 inches (600 mm) apart.
  6. Install gutter with expansion joints at locations indicated, but not exceeding, 50 feet (15.24 m) apart. Install expansion-joint caps.
  7. Install continuous gutter screens on gutters with noncorrosive fasteners, hinged to swing open for cleaning gutters.
- C. Downspouts: Join sections with 1-1/2-inch (38-mm) telescoping joints.
1. Provide hangers with fasteners designed to hold downspouts securely to walls. Locate hangers at top and bottom and at approximately 60 inches (1500 mm) o.c. in between.
  2. Provide elbows at base of downspout to direct water away from building.
  3. Connect downspouts to underground drainage system indicated.
- D. Splash Pans: Install where downspouts discharge on low-slope roofs. Set in elastomeric sealant compatible with roofing membrane.

- E. Parapet Scuppers: Install scuppers where indicated through parapet. Continuously support scupper, set to correct elevation, and seal flanges to interior wall face, over cants or tapered edge strips, and under roofing membrane.
  - 1. Anchor scupper closure trim flange to exterior wall and solder or seal with elastomeric sealant to scupper.
  - 2. Loosely lock front edge of scupper with conductor head.
  - 3. Solder or seal with elastomeric sealant exterior wall scupper flanges into back of conductor head.
- F. Conductor Heads: Anchor securely to wall with elevation of conductor head rim 1 inch (25 mm) below gutter discharge.
- G. Expansion-Joint Covers: Install expansion-joint covers at locations and of configuration indicated. Lap joints a minimum of 4 inches (100 mm) in direction of water flow.

### 3.5 ROOF FLASHING INSTALLATION

- A. General: Install sheet metal flashing and trim to comply with performance requirements, sheet metal manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, set units true to line, and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.
- B. Roof Edge Flashing: Anchor to resist uplift and outward forces according to recommendations in SMACNA's "Architectural Sheet Metal Manual" and as indicated. Interlock bottom edge of roof edge flashing with continuous cleat anchored to substrate at staggered 3-inch (75-mm) centers.
- C. Copings: Anchor to resist uplift and outward forces according to recommendations in SMACNA's "Architectural Sheet Metal Manual" and as indicated.
  - 1. Interlock exterior bottom edge of coping with continuous cleat anchored to substrate at 16-inch (400-mm) centers.
  - 2. Anchor interior leg of coping with washers and screw fasteners through slotted holes at 24-inch (600-mm) centers.
- D. Counterflashing: Coordinate installation of counterflashing with installation of base flashing. Insert counterflashing in reglets or receivers and fit tightly to base flashing. Extend counterflashing 4 inches (100 mm) over base flashing. Lap counterflashing joints a minimum of 4 inches (100 mm) and bed with sealant. Secure in a waterproof manner by means of interlocking folded seam or blind rivets and sealant.

### 3.6 WALL FLASHING INSTALLATION

- A. General: Install sheet metal wall flashing to intercept and exclude penetrating moisture according to SMACNA recommendations and as indicated. Coordinate installation of wall flashing with installation of wall-opening components such as windows, doors, and louvers.
- B. Through-Wall Flashing: Installation of through-wall flashing is specified in Division 4 Section "Unit Masonry Assemblies."
- C. Reglets: Installation of reglets is specified in Division 4 Section "Unit Masonry Assemblies."
- D. Opening Flashings in Frame Construction: Install continuous head, sill, jamb, and similar flashings to extend 4 inches (100 mm) beyond wall openings, unless otherwise indicated on Drawings.

### 3.7 MISCELLANEOUS FLASHING INSTALLATION

- A. Overhead-Piping Safety Pans: Suspend pans independent from structure above as indicated on Drawings. Pipe and install drain line to plumbing waste or drainage system.
- B. Equipment Support Flashing: Coordinate installation of equipment support flashing with installation of roofing and equipment. Weld or seal flashing with elastomeric sealant to equipment support member.

### 3.8 ERECTION TOLERANCES

- A. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerance of 1/4 inch in 20 feet (6 mm in 6 m) on slope and location lines as indicated and within 1/8-inch (3-mm) offset of adjoining faces and of alignment of matching profiles.

### 3.9 CLEANING AND PROTECTION

- A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.
- B. Clean and neutralize flux materials. Clean off excess solder.
- C. Clean off excess sealants.
- D. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed unless otherwise indicated in manufacturer's written installation instructions. On completion of installation, remove unused materials and clean finished surfaces. Maintain in a clean condition during construction.

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- E. Replace sheet metal flashing and trim that have been damaged or that have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 07 62 00



## SECTION 07 84 00 FIRESTOPPING

### PART 1- GENERAL

#### 1.1 SUMMARY

- A. This section includes the following work:
  - 1. Through-penetration firestop systems for penetrations through the following fire-resistance-rated assemblies, including both empty openings and openings containing penetrating items:
    - a. Floors.
    - b. Roofs.
    - c. Walls and partitions.
    - d. Smoke barriers.
  - 2. Fire-resistive joint systems where Fire-resistance-rated assemblies meet along a horizontal or vertical joint.

#### 1.2 REFERENCES

- A. American Society for Testing and Materials (ASTM)
  - 1. C612: Specification for Mineral Fiber Block and Board Thermal Insulation.
  - 2. E84: Test Method for Surface Burning Characteristics of Building Materials.
  - 3. E136: Test Method for Behavior of Materials in a Vertical Tube Furnace at 750 degs. F.
  - 4. E814: Fire Tests of Through-Penetration Fire Stops.
- B. Factory Mutual (FM) Research:
  - 1. FM Approval Standard of Firestop Contractors- Class 4991.
- C. Firestop Contractors International Association (F.I.C.A.)
  - 1. M.O.P. Manual of Practice
- D. International Firestop Council (IFC)
  - 1. Reference 1: Recommended IFC Guidelines for Evaluating Firestop Systems Engineering Judgments (April 2001)
  - 2. Reference 2: Inspectors Field Pocket Guide
- E. National Fire Protection Association (NFPA)
- F. Underwriters Laboratories (UL), Inc.

#### 1.3 PERFORMANCE REQUIREMENTS

A. General: For the following constructions, provide through-penetration firestop systems that are produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of assembly penetrated.

1. Fire-resistance-rated load-bearing walls, including partitions, with fire-protection-rated openings.
2. Fire-resistance-rated non-load-bearing walls, including partitions, with fire-protection-rated openings.
3. Fire-resistance-rated floor assemblies.
4. Fire-resistance-rated roof assemblies.
5. Fire-resistance rated smoke barriers with fire protection-rated openings.

B. F-Rated Systems: Provide through-penetration firestop systems with F-ratings indicated, as determined per ASTM E814, but not less than that equaling or exceeding fire-resistance rating of constructions penetrated.

C. T-Rated Systems: For the following conditions, provide through-penetration firestop systems with T-ratings indicated, as well as F-ratings, as determined per ASTM E814, where systems protect penetrating items exposed to potential contact with adjacent materials in occupiable floor areas:

1. Penetrations located outside wall cavities.
2. Penetrations located outside fire-resistive shaft enclosures.
3. Penetrations located in construction containing fire-protection-rated openings.
4. Penetrating items larger than 4 inch diameter nominal pipe or 16 sq. in. in overall cross-sectional area.

D. For through-penetration firestop systems exposed to view, traffic, moisture, and physical damage, provide products that after curing do not deteriorate when exposed to these conditions both during and after construction.

1. For piping penetrations for plumbing and wet-pipe sprinkler systems, provide moisture-resistant through-penetration firestop systems.
2. For floor penetrations with annular spaces exceeding 4 inches (100 mm) in width and exposed to possible loading and traffic, provide firestop systems capable of supporting floor loads involved either by installing floor plates or by other means.
3. For penetrations involving insulated piping, provide through-penetration firestop systems not requiring removal of insulation.

E. For through-penetration firestop systems exposed to view, provide products with flame-spread ratings of less than 25 and smoke-developed ratings of less than 450, as determined per ASTM E84.

#### 1.4 SUBMITTALS

A. Submit shop drawings detailing materials, installation methods, and relationships to adjoining construction for each through-penetration firestop system, and each kind of construction condition penetrated and kind of penetrating item. Include firestop design designation of qualified testing and inspecting agency evidencing compliance with requirements for each condition indicated.

1. Submit documentation, including illustrations, from a qualified testing and inspecting agency that is applicable to each through-penetration firestop configuration for construction and penetrating items.

A. Qualification Data: Submit qualification data for firms and persons specified in "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.

B. Product Certificates: Submit product certificates signed by manufacturers of through-penetration firestop system products certifying that products furnished comply with requirements.

C. Product Test Reports: Submit product test reports from a qualified testing agency indicating through-penetration firestop system complies with requirements, based on comprehensive testing of current products.

D. For those firestop applications that exist for which no tested system is available through a manufacturer, a manufacturer's engineering judgment derived from similar tested systems designs or other tests shall be submitted to local authorities having jurisdiction for their review and approval prior to installation. Manufacturer's engineering judgment must follow the requirements set forth by the International Firestop Council (09/07/94).

## 1.5 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who is qualified by having the necessary experience, staff, and training to install manufacturer's products per specified requirements. A manufacturer's willingness to sell its through-penetration firestop system products to Contractor or to an installer engaged by Contractor does not in itself confer qualification on buyer.

B. Contractor Qualifications: Acceptable installers shall either be:

1. FM Research approved in accordance with FM Standard 4991 – Approval of Firestop Contractors, or meet any 2 of the following requirements:
  - a. Licensed by State or local authority where applicable.
  - b. Approved by the firestop manufacturer with a minimum of 3 years experience on comparable projects.
  - c. Shown to have successfully completed not less than 5 comparable scale projects using this system.

- C. Source Limitations: Obtain through-penetration firestop systems, for each kind of penetration and construction condition indicated, from a single manufacturer.
- D. Fire-Test-Response Characteristics: Provide firestop systems that comply with the following requirements and those specified in "Performance Requirements" Article:
  - 1. Firestopping tests are performed by a qualified testing and inspecting agency. A qualified testing and inspecting agency is UL, or another agency performing testing and follow-up inspection services for firestop systems acceptable to authorities having jurisdiction.
  - 2. Through-penetration firestop systems are identical to those tested per ASTM E 814. Provide rated systems complying with the following requirements:
    - a. Through-penetration firestop system products bear classification marking of qualified testing and inspecting agency.
    - b. Through-penetration firestop systems correspond to those indicated by reference to through-penetration firestop system designations listed by the following:
    - c. UL in "Fire Resistance Directory."
- E. Preinstallation Conference: Conduct conference at Project site.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver through-penetration firestop system products to Project site in original, unopened containers or packages with intact and legible manufacturers' labels identifying product and manufacturer; date of manufacture; lot number; shelf life, if applicable; qualified testing and inspecting agency's classification marking applicable to Project; curing time; and mixing instructions for multicomponent materials.
- B. Store and handle materials for through-penetration firestop systems to prevent their deterioration or damage due to moisture, temperature changes, contaminants, or other causes.

#### 1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install through-penetration firestop systems when ambient or substrate temperatures are outside limits permitted by through-penetration firestop system manufacturers or when substrates are wet due to rain, frost, condensation, or other causes.
- B. Ventilate through-penetration firestop systems per manufacturer's written instructions by natural means or, where this is inadequate, forced-air circulation.

#### 1.8 COORDINATION

- A. Coordinate construction of openings and penetrating items to ensure that through-penetration firestop systems are installed according to specified requirements.
- B. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate through-penetration firestop systems.
- C. Notify Owner's inspecting agency at least seven days in advance of through-penetration firestop system installations; confirm dates and times on days preceding each series of installations.
- D. Do not cover up through-penetration firestop system installations that will become concealed behind other construction until Owner's inspecting agency and building inspector, if required by authorities having jurisdiction, have examined each installation.

## PART 2- PRODUCTS

### 2.1 MANUFACTURERS

- A. Provide firestopping products as manufactured by one of the following:
  - 1. Hilti, Inc.
  - 2. Grace Construction Products.
  - 3. RectorSeal Corporation (The).
  - 4. Specified Technologies, Inc.
  - 5. 3M Fire Protection Products; Minnesota Mining and Manufacturing.

### 2.2 FIRESTOP SYSTEMS AND FIRE-RESISTIVE JOINT SYSTEMS

- A. Compatibility: Provide through-penetration firestop systems that are compatible with one another, with the substrates forming openings, and with the items, if any, penetrating through-penetration firestop systems, under conditions of service and application, as demonstrated by through-penetration firestop system manufacturer based on testing and field experience.
- B. Accessories: Provide components for each through-penetration firestop system and fire-resistive joint system that are needed to install fill materials and to comply with "Performance Requirements" Article. Use only components specified by through-penetration firestop system manufacturer and approved by the qualified testing and inspecting agency for firestop systems and fire-resistive joint systems indicated. Accessories include, but are not limited to, the following items:
  - 1. Permanent forming/damming/backing materials, including the following:
    - a. Slag-/rock-wool-fiber insulation.
    - b. Sealants used in combination with other forming/damming/backing materials to prevent leakage of fill materials in liquid state.
    - c. Fire-rated form board.
    - d. Fillers for sealants.

2. Temporary forming materials.
3. Substrate primers.
4. Collars.
5. Steel sleeves.

### 2.3 FILL MATERIALS

A. General: Provide through-penetration firestop systems and fire-resistive joint system containing the types of fill materials indicated in the Through-Penetration Firestop System Schedule at the end of Part 3 by referencing the types of materials described in this Article. Fill materials are those referred to in directories of referenced testing and inspecting agencies as "fill," "void," or "cavity" materials.

B. Cast-in-Place Firestop Devices: Factory-assembled devices for use in cast-in-place concrete floors and consisting of an outer metallic sleeve lined with an intumescent strip, a radial extended flange attached to one end of the sleeve for fastening to concrete formwork, and a neoprene gasket.

C. Latex Sealants: Single-component latex formulations that after cure do not re-emulsify during exposure to moisture.

D. Firestop Devices: Factory-assembled collars formed from galvanized steel and lined with intumescent material sized to fit specific diameter of penetrant.

E. Intumescent Composite Sheets: Rigid panels consisting of aluminum-foil-faced elastomeric sheet bonded to galvanized steel sheet.

F. Intumescent Putties: Nonhardening dielectric, water-resistant putties containing no solvents, inorganic fibers, or silicone compounds.

G. Intumescent Wrap Strips: Single-component intumescent elastomeric sheets with aluminum foil on one side.

H. Mortars: Prepackaged dry mixes consisting of a blend of inorganic binders, hydraulic cement, fillers, and lightweight aggregate formulated for mixing with water at Project site to form a nonshrinking, homogeneous mortar.

I. Pillows/Bags: Reusable heat-expanding pillows/bags consisting of glass-fiber cloth cases filled with a combination of mineral-fiber, water-insoluble expansion agents, and fire-retardant additives.

J. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

K. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below:

1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces, and nonsag formulation for openings in vertical and other surfaces requiring a nonslumping, gunnable sealant, unless indicated firestop system limits use to nonsag grade for both opening conditions.
2. Grade for Horizontal Surfaces: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces.
3. Grade for Vertical Surfaces: Nonsag formulation for openings in vertical and other surfaces.

## PART 3- EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Surface Cleaning: Clean out openings immediately before installing through-penetration firestop systems to comply with written recommendations of firestop system manufacturer and the following requirements:
  1. Remove from surfaces of opening substrates and from penetrating items foreign materials that could interfere with adhesion of through-penetration firestop systems.
  2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with through-penetration firestop systems. Remove loose particles remaining from cleaning operation.
  3. Remove laitance and form-release agents from concrete.

Priming: Prime substrates where recommended in writing by through-penetration firestop system manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

Masking Tape: Use masking tape to prevent through-penetration firestop systems from contacting adjoining surfaces that will remain exposed on completion of Work and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove smears from firestop system materials. Remove tape as soon as possible without disturbing firestop system's seal with substrates.

### 3.3 THROUGH-PENETRATION FIRESTOP SYSTEM INSTALLATION

- A. General: Install through-penetration firestop systems to comply with "Performance Requirements" Article and firestop system manufacturer's written installation instructions and published drawings for products and applications indicated.

B. Install forming/damming/backing materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.

1. After installing fill materials, remove combustible forming materials and other accessories not indicated as permanent components of firestop systems.

C. Install fill materials for firestop systems by proven techniques to produce the following results:

1. Fill voids and cavities formed by openings, forming materials, accessories, and penetrating items as required to achieve fire-resistance ratings indicated.

2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.

3. For fill materials that will remain exposed after completing Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

### 3.5 FIELD QUALITY CONTROL

A. Inspecting Agency: Owner will engage a qualified independent inspecting agency to inspect through-penetration firestop systems and to prepare test reports.

1. Inspecting agency will state in each report whether inspected through-penetration firestop systems comply with or deviate from requirements.

B. Proceed with enclosing through-penetration firestop systems with other construction only after inspection reports are issued.

C. Where deficiencies are found, repair or replace through-penetration firestop systems so they comply with requirements.

### 3.6 IDENTIFICATION

A. Identify through-penetration firestop systems with pressure-sensitive, self-adhesive, preprinted vinyl labels. Attach labels permanently to surfaces of penetrated construction on both sides of each firestop system installation where labels will be visible to anyone seeking to remove penetrating items or firestop systems. Include the following information on labels:

1. The words: "Warning--Through-Penetration Firestop System--Do Not Disturb. Notify Building Management of Any Damage."

2. Contractor's name, address, and phone number.

3. Through-penetration firestop system designation of applicable testing and inspecting agency.

4. Date of installation.

5. Through-penetration firestop system manufacturer's name.



6. Installer's name.

3.7 CLEANING AND PROTECTION

A. Clean off excess fill materials adjacent to openings as Work progresses by methods and with cleaning materials that are approved in writing by through penetration firestop system manufacturers and that do not damage materials in which openings occur.

B. Provide final protection and maintain conditions during and after installation that ensure through-penetration firestop systems are without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated through-penetration firestop systems immediately and install new materials to produce through-penetration firestop systems complying with specified requirements.

END OF SECTION 07 84 00

## SECTION 07 92 00 - JOINT SEALANTS

### PART 1 - GENERAL

#### 1.1 SUMMARY

##### A. Section Includes:

1. Exterior joints in the following vertical surfaces:
  - a. Perimeter joints between materials and frames of doors and windows.
2. Interior joints in the following vertical surfaces and horizontal nontraffic surfaces:
  - a. Perimeter joints between interior wall surfaces and frames of interior doors and windows.
  - b. Joints between plumbing fixtures and adjoining walls, floors, and counters.
  - c. Other joints as indicated.
3. Interior joints in the following horizontal traffic surfaces:
  - a. Movement joints in tile flooring.

#### 1.2 PERFORMANCE REQUIREMENTS

- A. Provide elastomeric joint sealants that establish and maintain watertight and airtight continuous joint seals without staining or deteriorating joint substrates.
- B. Provide joint sealants for interior applications that establish and maintain airtight and water-resistant continuous joint seals without staining or deteriorating joint substrates.

#### 1.3 SUBMITTALS

- A. Submit in accordance with Division 1 Section "Submittal Procedures", product data for each joint-sealant product indicated.
- B. Submit Samples for Initial Selection: Manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.
- C. Submit Samples for Verification: For each type and color of joint sealant required. Install joint sealants in 1/2 inch (13 mm) wide joints formed between two 6 inch (150 mm) long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.

- D. Submit Product Certificates: Signed by manufacturers of joint sealants certifying that products furnished comply with requirements and are suitable for the use indicated.
- E. Submit Qualification Data: for firms and persons specified in "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.
- F. Submit Preconstruction field Test Reports: Indicate which sealants and joint preparation methods resulted in optimum adhesion to joint substrates based on preconstruction testing specified in "Quality Assurance" Article.
- G. Submit Field Test Report Log: for each elastomeric sealant application. Include information specified in "field Quality Control" Article.
- H. Submit Compatibility and Adhesion Test Reports: From sealant manufacturer indicating the following:
  - 1. Materials forming joint substrates and joint-sealant backings have been tested for compatibility and adhesion with joint sealants.
  - 2. Interpretation of test results and written recommendations for primers and substrate preparation needed for adhesion.
- I. Submit Product Test Reports: from a qualified testing agency indicating sealants comply with requirements, based on comprehensive testing of current product formulations.
- J. Submit Warranties: Special warranties specified in this Section.

## 1.2 ACTION SUBMITTALS

- A. Submit product data for each joint-sealant product indicated.
- B. Submit Samples for Initial Selection: Manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.
- C. Submit Samples for Verification: For each type and color of joint sealant required. Install joint sealants in 1/2 inch (13 mm) wide joints formed between two 6 inch (150 mm) long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.
- D. Submit Product Certificates: Signed by manufacturers of joint sealants certifying that products furnished comply with requirements and are suitable for the use indicated.
- E. Product Data: For each joint-sealant product indicated. Include maximum VOC contents specified below.
- F. Joint-Sealant Schedule: Include the following information:

1. Joint-sealant application, joint location, and designation.
2. Joint-sealant manufacturer and product name.
3. Joint-sealant formulation.
4. Joint-sealant color.

### 1.3 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Qualified according to ASTM C 1021 to conduct the testing indicated.
- B. Preinstallation Conference: Conduct conference at Project site.

### 1.4 WARRANTY

- A. Special Installer's Warranty: Manufacturer's standard form in which Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
  1. Warranty Period: Two years from date of Substantial Completion.
- B. Special Manufacturer's Warranty: Manufacturer's standard form in which joint-sealant manufacturer agrees to furnish joint sealants to repair or replace those that do not comply with performance and other requirements specified in this Section within specified warranty period.
  1. Warranty Period: Twenty years from date of Substantial Completion, for exterior sealants at windows.

## PART 2 - PRODUCTS

### 2.1 MATERIALS, GENERAL

- A. VOC Content of Interior Sealants: Sealants and sealant primers used inside the weatherproofing system shall comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
  1. Architectural Sealants: 250 g/L.
  2. Sealant Primers for Nonporous Substrates: 250 g/L.
  3. Sealant Primers for Porous Substrates: 775 g/L.

### 2.2 JOINT SEALANT BACKING

- A. Provide sealant backings of material and type that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.

- B. Cylindrical Sealant Backings: ASTM C1330, of Type recommended by the sealant manufacturer for the particular application, and type of sealant used.
- C. Cylindrical Sealant Backings: ASTM C1330, of type indicated below and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance:
  - 1. Type C: Closed-cell material with a surface skin.
- D. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint where such adhesion would result in sealant failure. Provide self-adhesive tape where applicable.

### 2.3 MISCELLANEOUS MATERIALS

- A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.
- B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials.
- C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions.
  - 1. Remove laitance and form-release agents from concrete.
  - 2. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants.
- B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.
- C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

### 3.2 INSTALLATION

- A. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- B. Install sealant backings of kind indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
  - 1. Do not leave gaps between ends of sealant backings.
  - 2. Do not stretch, twist, puncture, or tear sealant backings.
  - 3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.
- C. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.
- D. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
  - 1. Place sealants so they directly contact and fully wet joint substrates.
  - 2. Completely fill recesses in each joint configuration.
  - 3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
- E. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified in subparagraphs below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.
  - 1. Remove excess sealant from surfaces adjacent to joints.
  - 2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
  - 3. Provide concave joint profile per Figure 8A in ASTM C 1193, unless otherwise indicated.
- F. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

### 3.3 PROTECTION

- A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from the original work.

### 3.4 ELASTOMERIC JOINT-SEALANT SCHEDULE

- A. Low-Modulus Nonacid-Curing Silicone Sealant: Where joint sealants of this type are indicated, provide products complying with ASTM C920 and the following:
1. Products: Provide one of the following or equal:
    - a. 791 plus primer; Dow Corning.
    - b. Silpruf LM SCS2700; GE Silicones.
    - c. 890; Pecora Corporation.
    - d. SikaSil-C 990; Sika Corporation.
    - e. Spectrem 1; Tremco.
  2. Type and Grade: S (single component) and NS (nonsag).
  3. Class: 50/50.
  4. Additional Movement Capability: 50 percent movement in extension and 50 percent movement in compression.
  5. Use Related to Exposure: NT (nontraffic).
  6. Uses Related to Joint Substrates: M, G, A, and, as applicable to joint substrates indicated, O.
    - a. Use O Joint Substrates: Coated glass, color anodic aluminum, aluminum coated with a high-performance coating, galvanized steel, brick, granite, limestone, marble, ceramic tile, and wood.
  7. Stain-Test-Response Characteristics: Nonstaining to porous substrates per ASTM C1248.
  8. Applications: Exterior and interior joints in vertical surfaces of concrete and masonry; between concrete masonry and stone; between metal and concrete, mortar, or stone; interior and exterior perimeter joints of metal frames in exterior walls; exterior overhead joints; and where indicated.
- B. Mildew-Resistant Silicone Sealant: Where joint sealants of this type are indicated, provide products formulated with fungicide that are intended for sealing interior ceramic tile joints and other nonporous substrates that are subject to in-service exposures of high humidity and temperature extremes, and that comply with ASTM C920 and the following:
1. Products: Provide one of the following or equal:
    - a. 786 Mildew Resistant; Dow Corning.
    - b. Sanitary SCS1700; GE Silicones.
    - c. 898 Silicone Sanitary Sealant; Pecora Corporation.
    - d. PST-611; Polymeric Systems, Inc.
    - e. Tremsil 600; Tremco.
  2. Type and Grade: S (single component) and NS (nonsag).

3. Class: 25.
4. Use Related to Exposure: NT (nontraffic).
5. Uses Related to Joint Substrates: G, A, and, as applicable to joint substrates indicated, O.

### 3.5 NON-ELASTOMERIC JOINT-SEALANT SCHEDULE

A. Latex Sealant: Where joint sealants of this type are indicated, provide products complying with the following:

1. Products: Provide one of the following or equal:

- a. Chem-Calk 600; Bostik Inc.
- b. AC-20; Pecora Corporation.
- c. PSI-701; Polymeric Systems, Inc.
- d. Tremflex 834; Tremco.

2. Applications: Interior exposed joints in field painted vertical and overhead surfaces; at perimeter of hollow metal door frames; in gypsum drywall, plaster, and concrete masonry; and where indicated.

END OF SECTION 07 92 00



## SECTION 08 14 16 - FLUSH WOOD DOORS

### PART 1 - GENERAL

#### 1.1 SUMMARY

##### A. Section Includes:

1. Solid-core doors with wood-veneer faces.
2. Factory finishing flush wood doors.

#### 1.2 ACTION SUBMITTALS

- A. Product data for each type of wood door, including details of core and edge construction, trim for openings.
1. Include factory-finishing specifications.
  2. Low-Emitting Materials: Fabricate doors with adhesives and composite wood products that do not contain urea formaldehyde.
- B. Shop Drawings: Submit shop drawings that indicate location, size, and hand of each door; elevation of each kind of door; construction details not covered in product data; location and extent of hardware blocking; and other pertinent data.
1. Indicate dimensions and locations of mortises and holes for hardware.
  2. Indicate dimensions and locations of cutouts.
  3. Indicate doors to be factory finished and finish requirements.
  4. Indicate fire ratings for fire doors.
- C. Samples for Verification: Submit samples as follows:
1. Corner sections of doors approximately 8 by 10 inches with door faces representing the typical range of color and grain for each species of veneer. Finish sample with same materials proposed for factory-finished doors.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. See drawings

#### 2.2 DOOR CONSTRUCTION, GENERAL

- A. Doors for Transparent Finish: Comply with the following requirements:
1. Grade: Premium, with Grade AA face. No sapwood allowed.

### 2.3 SOLID-CORE DOORS

- A. Particleboard Cores: Comply with the following requirements:
  - 1. Particleboard: ANSI A208.1, Grade LD-2.
  - 2. Blocking: Provide wood blocking at particleboard-core doors as follows:
    - a. 5 inch (125 mm) top-rail blocking, at doors indicated to have closers.
    - b. 5 inch (125 mm) bottom-rail blocking, at exterior doors and doors indicated to have kick, mop, or armor plates.
    - c. 5 inch (125 mm) midrail blocking, at doors indicated to have exit devices.
- B. Interior Veneer-Faced Doors: Comply with the following requirements:
  - 1. Core: Particleboard core.
  - 2. Construction: Five plies with stiles and rails bonded to core, then entire unit abrasive planed before veneering.
- C. Fire-Rated Doors: Comply with the following requirements:
  - 1. Construction: Construction and core specified above for type of face
    - a. indicated or manufacturer's standard mineral-core construction as required
    - b. to provide fire rating indicated.
  - 2. Blocking: For mineral-core doors, provide composite blocking with
    - a. improved screw-holding capability approved for use in doors of fire ratings
    - b. indicated and as follows:
      - i. 5 inch (125 mm) top-rail blocking.
      - ii. 5 inch (125 mm) bottom-rail blocking, at doors indicated to have kick, mop, or armor plates.
      - iii. 4-1/2 by 10 inch (114 by 250 mm) lock blocks.
      - iv. 5 inch (125 mm) midrail blocking, at doors indicated to have exit devices.
  - 3. Edge Construction: At hinge stiles, provide manufacturer's standard laminated-edge construction with improved screw-holding capability and split resistance and with outer stile matching face veneer.

### 2.4 FLUSH WOOD DOORS

- A. Flush Faced Wood Doors (Non-Fire-Rated): 1-3/4 inches thick, solid particleboard core, flush wood doors conforming to AWI Quality Standards, Premium Grade, Type PC-5.
  - 1. Stiles: Laminated-edge construction for improved screw-holding
    - a. capability, laminated to core with Type II water-resistant glue; outer stile species to match face veneer.
  - 2. Rails: Mill-option hardwoods; 5 inch wide top rail (after trimming),
    - a. suitable for attaching surface applied closer with steel screws.
  - 3. Lock Blocks: 4-1/2 inch by 10 inch lock blocks. Provide lock blocks at each stile for doors scheduled to have exit devices.
  - 4. Cross Bands: Oven-dried hardwoods (natural or engineered fiber), 1/16
    - a. inch minimum thickness, extending full width of door and laid with grain at right angles to face veneers.

5. Face Veneers: HPMA/AWI Grade A, no sapwood allowed, not less than 1/50 inch thick.
6. Bond cross bands and face veneers to core with Type I exterior resin glue.

B. Flush Faced Wood Doors (Fire-Rated): 1-3/4 inches thick, solid mineral core, flush wood doors conforming to AWI Quality Standards, Premium Grade, Type FD, 5-ply construction. Provide fire rated doors bearing appropriate UL Label.

1. Stiles: 9/16 inch thick untreated, multi-ply maple. Provide veneer banding on stiles to match face veneers. On pairs of doors with both leaves active, provide matching veneer covered metal edge guards on meeting edges (so overlapping astragals or coordinators are not required) or provide manufacturer's concealed system approved for fire rated doors.
2. Top Rails: 5 inch wide fire retardant treated plywood, suitable for attaching surface applied closer with steel screws.
3. Lock Blocks: 4-1/2 inch by 10 inch minimum, fire retardant treated plywood. Provide lock blocks at each stile for doors scheduled to have exit devices. Provide reinforcement blocking at bottom corner at strike edge for attachment of vertical rod guide for doors scheduled to have surface mounted vertical rod exit devices.
4. Face Veneers: Book-match, balanced, plain sliced HPMA/AWI Grade A **Grade AA**, no sapwood allowed, not less than 1/50 inch thick.
5. Bond hardwood cross bands and face veneers to core with Type I exterior resin glue.

## 2.5 FABRICATTON

A. Factory fit doors to suit frame-opening sizes indicated, with the following uniform clearances and bevels, unless otherwise indicated:

1. Clearances: Provide 1/8 inch (3.2 mm) at heads, jambs, and between pairs of doors. Provide 1/8 inch (3.2 mm) from bottom of door to top of decorative floor finish or covering. Where threshold is shown or scheduled, provide 1/4 inch (6.4 mm) from bottom of door to top of threshold.

B. Factory machine doors for hardware that is not surface applied. Locate hardware to comply with DHI-WDHS-3. Comply with final hardware schedules, door frame Shop Drawings, DHI A115-W series standards, and hardware templates.

1. Coordinate measurements of hardware mortises in metal frames to verify dimensions and alignment before factory machining.

## 2.6 FACTORY FINISHING

- A. Comply with referenced AWI quality standard including Section 1500 "Factory Finishing."
- B. Finish wood doors at factory that are indicated to receive transparent finish.

### 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.
  - 2. Reject doors with defects.
  - 3. Reject doors with excessive variation in veneer pattern & color.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Hardware: For installation, see Division 08 Section, "Door Hardware."
- B. Manufacturer's Written Instructions: Install wood doors to comply with manufacturer's written instructions, referenced quality standard, and as indicated.
  - 1. Install fire-rated doors in corresponding fire-rated frames according to NFPA 80.
- C. Job-Fit Doors: Align and fit doors in frames with uniform clearances and bevels as indicated below; do not trim stiles and rails in excess of limits set by manufacturer or permitted with fire-rated doors. Machine doors for hardware. Seal cut surfaces after fitting and machining.
  - 1. Clearances: Provide 1/8 inch (3.2 mm) at heads, jambs, and between pairs of doors. Provide 1/8 inch (3.2 mm) from bottom of door to top of decorative floor finish or covering. Where threshold is shown or scheduled, provide 1/4 inch (6.4 mm) from bottom of door to top of threshold.
  - 2. Bevel non-fire-rated doors 1/8 inch in 2 inches (3-1/2 degrees) at lock and hinge edges.
- C. Factory-Fitted Doors: Align in frames for uniform clearance at each edge.
- D. Factory-Finished Doors: Restore finish before installation, if fitting or machining is required at Project site.

### 3.3 ADJUSTING AND PROTECTING

- A. Operation: Rehang or replace doors that do not swing or operate freely.
- B. Finished Doors: Refinish or 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 14 16

SECTION 08 3473  
STC 51 WOOD VENEER SOUND CONTROL DOORS

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. Furnish and install Sound Control Doors specified herein and per the locations and orientations shown on the Contract Documents. Verify all dimensions and requirements and coordinate with other trades as necessary
  - 1. Swing Sound Control Doors, Frame and Seals
  - 2. Glazing of Sound Control Doors (Where Applicable)
  - 3. Supply and Installation of hardware for Sound Control Doors.

1.3 RELATED SECTIONS:

- A. Specified elsewhere:
  - 1. Section \_\_\_\_:Administrative Provisions
  - 2. Section \_\_\_\_:Furnishing of Hardware
  - 3. Section \_\_\_\_:Finish painting of doors

1.4 SUBMITTALS:

- A. Submit shop drawings, manufacture's data, and product performance certification in accordance with General Conditions.
- B. Shop drawings:
  - a. Provide full size details of frames and sound gasket components.
  - b. Provide installation details applicable to the construction in which the Sound Control Doors and frames will be installed.
  - c. Indicate construction, sizes, thicknesses, reinforcing, anchoring, and finishes of all materials.
  - d. Where applicable, doors requiring veneering or special finishes should note type, species, and finish on the drawings.
- C. Manufacturer's data:

- a. Provide illustrations and descriptions of all seals and hardware items which will be exposed on doors and frames for design review by Architect and project Acoustics Consultant.
- b. Provide complete installation and adjustment information

D. Certification:

- a. Provide certified laboratory test reports from an independent NVLAP certified acoustics laboratory showing that a fully operating installation of the specific Sound Control Door/Frame assembly proposed for installation has been measured in accordance with ASTM E 90-09 and has met or exceeded the scheduled STC ratings. The test results shall be representative of the performance of the proposed Sound Control Door/Frame assembly.
- b. Provide written evidence of at least two acoustic field tests showing that comparable installations have been measured in excess of a Noise Isolation Class (NIC) which is not more than six (6) points below the specified STC rating following the procedures set forth in ASTM E 336-90.

1.4 QUALITY ASSURANCE:

A. Regulatory Requirements:

1. Acoustical performance: STC (Sound Transmission Class) of 51.
2. Reference Standards:
  - a. ASTM E90-99 or ASTM E90-09 and E413-87 Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions.
3. All laboratory testing shall be performed within the last five (5) years to assure product integrity.

1.5 DELIVERY, STORAGE AND HANDLING:

- A. Upon award of contract and before commencement of building construction, submit to the Architect any special requirements (scheduling, flatness of floor, etc.) which are necessary to assure successful installation.
- B. Protect door systems during transit, handling and storage to prevent damage, soiling, and deterioration.
- C. Deliver frames to General Contractor with complete installation drawings and instructions for installation by the General Contractor.
- D. Deliver doors to project site only after the building has been closed in. Store doors in the building in a dry location and stack in accordance with manufacturer's instructions.
- E. Protect door assemblies, especially sound gaskets, from damage before, during and after their installation.

- F. Note any special conditions for unloading the doors.
- G. Swing doors shall be stored off the ground in an upright position and shall be protected from weather and damage.
- H. Wood veneered doors need to be stored in a clean, dry area that is temperature (60 to 90 degrees F) and humidity (50% maximum) controlled. If doors are purchased unsealed they must be sealed as soon as possible after receipt on the jobsite but no more than 4 days. Only the use of water based-based stains and finishes are acceptable. They will not degrade the adhesive used to bond the veneer to the metal door face. Note: Failure to follow these storage and finishing procedures will void the warranty.

1.6 WARRANTY:

- A. Provide a sound control door manufacturer's warranty covering failures of materials (excluding wear and tear on sound seals) and workmanship for a period of five (5) years from installation.
- B. Finish warranty: Furnish sound control door manufacturer's written warranty covering failure of the factory-applied finish on metal panels within the warranty period. This warranty shall be in addition to and not a limitation of other rights the Owner may have against the Contractor under the Contract Documents.

Warranty Period: 5 years on door/frame assembly  
2 years on hardware  
1 year on wood veneer

1.7 ACOUSTICAL PERFORMANCE:

- A. All tests for validation of swing door performance for compliance with these specifications shall be conducted by an independent NVLAP certified testing laboratory, National Institute of Standards (NIST) accredited to the most current standard of testing. At a minimum the testing results must conform and be tested to ASTM E90-09 and ASTM E413-87.

Sound Transmission Loss, db

Octave Band Center Frequency, Hz

Door Type	125	250	500	1K	2K	4K	STC
QS-51	40	44	48	52	52	55	51

- B. The complete door/frame assembly, if tested in the field, shall meet the FSTC ASTM E336-97 within 6 dB of the specified STC rating.

1.8 EXPERIENCE:

- A. Swinging Sound Control Door supplier must provide a list of ten (10) similar successful installations supplied within the last five years.

- B. Materials requiring testing shall be manufactured in the same location, with the same equipment for at least five (5) years and have 3<sup>rd</sup> party, independent testing results no more than five (5) years old.

## PART 2 - PRODUCTS

### 2.1 MATERIALS:

- A. The Sound Control door/frame assemblies shall be a 2 ½” thick, “QuietSwing” Model QS-51 doors as manufactured by Noise Barriers, LLC., Libertyville, IL.

Manufacturer:  
Noise Barriers, LLC  
2001 Kelley Ct.  
Libertyville, IL 60048

Phone: (847) 843-0500

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

Contact:  
John Finnegan  
Email: [info@noisebarriers.com](mailto:info@noisebarriers.com)

Phone: (315) 682-3821

- B. Source Limitations: Obtain pre-hung, pre-swung steel sound control door assemblies, including doors, frames, sound control seals, hinges, thresholds, and other items essential for sound control, from single source from single manufacturer.

### 2.2 MATERIALS of CONSTRUCTION

- C. Door leaf shall be fabricated from one skin a minimum of 12 gauge steel. Door shall be filled with sound-absorbing and dampening elements.
- D. Door frame shall be fabricated from minimum 14 gauge steel. Provide frames with anchors and attachments as necessary to transfer loads to surrounding wall construction. “Split” door frames are designed to be installed after the walls are constructed.
- E. Acoustic seals: Side and head of door and frame shall be provided with two (2) sets of factory installed self-aligning magnetic-compression seals to hold door in closed position by the magnetic force of perimeter seals. Corners must be mitered and sealed.
- F. Door Bottom: Bottom of door shall be provided with a factory installed continuous, adjustable, Teflon coated, neoprene compression seal mortised into the door bottom and designed to compress against floor as door is closed. Automatic door bottom seals will not be accepted.
- G. Vision Lights: Factory installed double-glazed windows in dimensions per the door schedule. All glazing shall be installed by skilled workmen at the manufacturer’s facility.



1. Where noted on drawings provide a 12" x 12", 4" x 30", 24" x 36 " or 22" x 60" double glazed window with glazing thicknesses required to maintain the specified acoustical performance of the doors. Glazing is factory installed.

H. Hardware:

1. Provide minimum two (2) factory installed cam-lift type hinges for each door. Finish of hinges shall be US26D.
2. Locks, pull handles, push plates, and other door hardware as specified in the hardware schedule will be furnished and factory installed by the sound door supplier. Door leaf and frame for each unit shall be prepared to receive security locks as specified in the hardware schedule.
3. Other Hardware: Comply with requirements in [Section 087100 "Door Hardware."] [Section 087111 "Door Hardware (Descriptive Specification)."]

2.3 FABRICATION:

- A. Assemble doors using all welded construction conforming to pertinent requirements of AWS D1-1. Assembly and adjustment of door, frame, acoustic seals and hinges shall be performed at the factory. Each entire unit shall be shipped to the job site ready for installation and subsequent operation. No field assembly of doors or frames shall be permitted.
- B. Reinforce as required to withstand operating loads.
- C. Using templates furnished by finish hardware.
- D. Painting and cleaning:
  1. On surfaces which are inaccessible after assembly, apply protective coating of the manufacture's standard rust-inhibitive primer.
  2. After assembly, and prior to inspection, thoroughly clean all surfaces.
  3. After inspection, and completion of repairs and revisions required by the inspection, apply a shop coat of rust inhibitive primer to exposed surfaces.

PART 3 - EXECUTION

3.1 INSPECTION:

- A. Assure that all door openings conform to all dimensions and tolerances shown on architectural plans and sound control door manufacturer's approved shop drawings. Check that surfaces in contact with sliding doors are free of debris and that wall openings and adjoining air and vapor seal materials are ready to receive work of this section. All work must be plumb, flat, and square to accept the door system.
  - a. Installation shall not proceed until unsatisfactory conditions are corrected.

- b. Beginning of installation means acceptance of existing conditions.

### 3.2 INSTALLATION

- A. Installation of door frames, doors perimeter seals, and final adjustments for door operation and for the design attenuation shall be performed by factory trained personnel under the supervision of the manufacturer.
- B. Comply with manufacturer's instructions and approved shop drawings.
- C. Install items plumb (or as indicated on the contract documents), straight, square, level, and in their proper elevation, plane and location.
- D. At fire-rated openings, install frames according to NFPA 80.
- E. At openings requiring smoke and draft control, install frames according to NFPA 105.
- F. Adjust bottom seal per manufacturer's instructions.
- G. After installation, adjust doors and hardware for smooth and easy operation.
- H. Once the facility is deemed complete all work shall be completed in every detail including the final adjustment of the bottom seal and the finished work shall be clean for Architect prior to final acceptance.

### 3.3 ADJUST AND CLEAN

- A. Check and readjust operation finish hardware in work just prior to final inspection. Leave work in complete and proper operating condition. Remove and replace defective work.
- B. Immediately after erection, sand smooth all rusted or damaged areas of prime coat and apply touch-up of compatible air-drying primer.

### 3.4 NOTIFICATION OF WORK COMPLETION:

- A. After installation and prior to acceptance testing, provide a letter to the Architect and the project Acoustics Consultant, co-signed by the General Contractor's project representative, indicating that all Sound Control Doors assemblies have been installed and gaskets have been adjusted to form an airtight seal around the full perimeter of each door panel.

### 3.5 ACCEPTANCE TESTING

- A. At the discretion of the Owner, Architect, or project Acoustical Consultant acoustic performance testing of the installation may be performed. The cost of such testing is not the responsibility of the door manufacturer.

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- B. The installation shall be deemed acceptable if the Sound Control Door assemblies meet or exceed a Noise Isolation Class (NIC) which is not more than six (6) points below the specified STC rating.

END OF SECTION

SECTION 083810  
SOUND CONTROL WINDOWS

1.0 GENERAL

1.1 DESCRIPTION OF WORK

- A. Furnish and install FACTORY PREGLAZED Sound Control Windows specified herein and per the locations and orientations shown on the Contract Documents-site installation of glazing into frames is not acceptable. Verify all dimensions and requirements and coordinate with other trades as necessary
  - 1. Sound Control Windows, Frames, Stops, Glazing, Sound Absorbing Material and Concealed Fasteners
  - 2. Installation of Sound Control Windows.

1.2 RELATED SECTIONS:

- A. Specified elsewhere:

1.3 QUALITY ASSURANCE

- A. Acoustic Performance:
  - 1. The manufacturer shall submit certified laboratory test results indicating a Sound Transmission Class (STC) rating of at least 53 when tested in accordance with ASTM E 90-90 and E413-87.
- B. Warranty:
  - 1. The window systems shall be guaranteed against defective materials and/or workmanship for a period of one (1) year from date of acceptance of the installations.

1.4 SUBMITTALS

- A. Submit shop drawings, manufacture's data, and product performance certification in accordance with General Conditions.
- B. Shop drawings:
  - 1. Provide full size details of frames and sound gasket components.
  - 2. Provide installation details applicable to the construction in which the Sound Control Windows will be installed.
  - 3. Indicate construction, sizes, thicknesses, reinforcing, anchoring, and finishes of all materials.

- C. Manufacturer's data:
  - 1. Provide illustrations and descriptions of all frame details that will be exposed on window units for design review by Architect and project Acoustics Consultant.
  - 2. Provide complete installation and adjustment information.
- D. Certification:
  - 1. Provide certified laboratory test reports from a Navlap certified acoustics laboratory showing that a fully operating installation of the specific Sound Control Window assembly proposed for installation has been measured in accordance with ASTM E 90-90 and has met or exceeded the scheduled STC ratings. The test results shall be representative of the performance of the proposed Sound Control Window assembly.
- E. Notification of work completion:
  - 1. After installation and prior to acceptance testing, provide a letter to the Architect and the project Acoustics Consultant, co-signed by the General Contractor's project representative, indicating that all Sound Control Window Units have been installed and gaskets have been adjusted to form an airtight seal around the full perimeter of each window unit panel.

## 1.5 SEQUENCING AND DELIVERY

- A. Upon award of contract and before commencement of building construction, submit to the Architect any special requirements (scheduling, opening conditions, etc.) that are necessary to assure successful installation.
- B. Protect pre-glazed window units during transit, handling and storage to prevent damage, soiling, and deterioration.
- C. Deliver preglazed window units to General Contractor with complete installation drawings and instructions for installation by the General Contractor.
- D. Deliver pre-glazed window units to project site only after the building has been closed in. Store window units in the building in a dry location and stack in accordance with manufacture's instructions.
- E. Protect pre-glazed window unit assemblies, especially sound gaskets, from damage before, during and after their installation.

## 2.0 PRODUCTS

### 2.1 APPROVED MANUFACTURER'S:

- A. The acoustical window units shall be QuietLite Sound Control Windows manufactured by Noise Barriers, LLC, Libertyville, IL.

Manufacturer:  
Noise Barriers, LLC  
2001 Kelley Ct  
Libertyville, IL. 60048

Phone: (847) 843-0500  
Fax: (847) 843-0501  
[www.noisebarriers.com](http://www.noisebarriers.com)

Contact:  
John Finnegan

Phone: (315) 682-3821  
Fax: (315) 682-3868  
[info@noisebarriers.com](mailto:info@noisebarriers.com)

## 2.2 MATERIALS

- A. Window frames shall be 1 ¼ in. thick fabricated from not less than 12 gauge steel, reinforced and filled with sound-absorbing acoustic fill, Inside and outside corners shall be mitered and interlocked to hairline measurements, made square, continuously welded, and ground smooth, flush, and invisible.
- B. Stops shall be up to 1 inch thick and readily removable, fabricated from not less than 16 gauge rolled steel sections predrilled and aligned with frame to form tight square acoustical joint. Stop fasteners shall be concealed.
- C. Acoustic seals for glazing shall be vibration-isolating resilient closed-cell polyethylene foam glazing tape. Glazing tape must be designed to withstand environmental breakdown and maintain an effective seal. Self-contained, sound-absorptive interior perimeter of not less than 22 gauge steel shall be perforated and prefinished black. Desiccant material shall be incorporated into multiple glazed units.
- D. Assembly of acoustic window units including frames, stop, glazing, acoustic seals, sound-absorbing material, and concealed fasteners shall take place at the factory to insure required noise reduction is achieved. Glazing shall not need to be removed to facilitate fastening or anchoring at the job site.
- E. Finish – Unless otherwise specified, steel window frame assemblies shall receive one shop coat of gray primer. Stainless steel shall not be painted.
- F. Lights for single-and double-glazed units shall be minimum ¼ in. laminated safety glass consisting of multi-layer clear float with clear plastic interlayer. Bullet-resistant glazing (if required) shall be certified to meet UL 752 specifications. Note: *This project requires one (1) layer of 3/8" thick laminated safety glass and one (1) layer of 1/2" laminated safety glass in a window unit 6" thick. (adjust as necessary)*

## 2.3 ACOUSTICAL PERFORMANCE CHARACTERISTICS

- A. At least 10 days prior to bidding, manufacturer shall submit laboratory test data certifying Sound Transmission Loss and Sound Transmission Class (STC) when tested in accordance with ASTM E 90-90 of not less than the following:

Window Type	<u>Sound Transmission Loss, db</u>						
	125	250	500	1K	2K	4K	STC
Double glazed	38	43	49	56	59	62	53

## 2.4 FABRICATION

- A. Assemble windows using all welded construction conforming to pertinent requirements of AWS D1-1. Assembly and adjustment of window units, frames, stop, glazing, acoustic seals, sound-absorbing material and concealed fasteners shall be performed at the factory. Each entire unit shall be shipped to the job site ready for installation and subsequent operation.
- B. Reinforce as required to withstand operating loads.
- C. Painting and cleaning:
1. On surfaces that are inaccessible after assembly, apply protective coating of the manufacturer's standard rust-inhibitive primer.
  2. After assembly, and prior to inspection, thoroughly clean all surfaces.
  3. After inspection, and completion of repairs and revisions required by the inspection, apply a shop coat of rust inhibitive primer to exposed surfaces.

## 3.0 EXECUTION

### 3.1 EXAMINATION

Before commencing installation, examine the substrate and surrounding conditions to verify that there is nothing to prevent proper and timely execution of the installation. Start of work shall indicate acceptance of the substrate and surrounding conditions.

### 3.2 INSTALLATION

- A. Installation of window units, seals, and final adjustments for window operation and for the design attenuation shall be performed by factory trained personnel or under the supervision of the manufacturer.
- B. Install items plumb (or as indicated on the contract documents), straight, square, level, and in their proper elevation, plane and location.

- C. Adjust all gaskets to achieve an airtight seal around the entire perimeter of each window unit.
- D. Apply resilient caulking at any locations designated by the installation drawings and the entire perimeter of the window frame.
- E. After installation, adjust windows for smooth and easy operation.
- F. All work shall be complete in every detail and the finished work shall be clean for Architect prior to final acceptance.

### 3.3 ADJUST AND CLEAN

- A. Check and readjust operation finish hardware in work just prior to final inspection. Leave work in complete and proper operating condition. Remove and replace defective work.
- B. Immediately after erection, sand smooth all rusted or damaged areas of prime coat and apply touch-up of compatible air-drying primer.

### 3.4 ACCEPTANCE TESTING

- A. Before acceptance of the installed Sound Control Window Units, and at any time within the project guaranteed period, the Owner, Architect, or project Acoustics Consultant may request that acoustic performance testing of the installations be performed. Ideally, this testing shall be performed by an independent acoustics consultant at the expense of the Installing Contractor under the supervision of the project Acoustics Consultant, and expenses for the project Acoustics Consultant to supervise the testing shall be paid by the Installing Contractor. Alternatively, the project Acoustics Consulting may be independently retained by the Installing Contractor to perform this testing.
- B. The installations shall be deemed acceptable if the Sound Control Window Units meet or exceed a Noise Isolation Class (NIC) that is not more than six (6) points below the specified STC rating.

END OF SECTION



SECTION 08 71 00  
DOOR HARDWARE

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:

1. Mechanical door hardware for the following:
  - a. Swinging doors.
2. Online Electronic Lock and Reader for single door.

1.2 ACTION SUBMITTALS

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

B. Other Action Submittals:

1. Door Hardware Schedule: Prepared by or under the supervision of Installer, detailing fabrication and assembly of door hardware, as well as installation procedures and diagrams. Coordinate final door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.
  - a. Format: Use same scheduling sequence and format and use same door numbers as in the Contract Documents.
  - b. Content: Include the following information:
    - 1) Identification number, location, hand, fire rating, size, and material of each door and frame.
    - 2) Locations of each door hardware set, cross-referenced to Drawings on floor plans and to door and frame schedule.
    - 3) Complete designations, including name and manufacturer, type, style, function, size, quantity, function, and finish of each door hardware product.
    - 4) Description of electrified door hardware sequences of operation and interfaces with other building control systems.
2. Keying Schedule: Prepared by or under the supervision of Installer, detailing Owner's final keying instructions for locks.  
(Prepared by Xavier University and sent directly to KABA)

1.3 QUALITY ASSURANCE

- A. Installer Qualifications: Supplier of products and an employer of workers trained and approved by product manufacturers and an Architectural Hardware Consultant who is available during the course of the Work to consult with Contractor, Architect, and Owner about door hardware and keying.

- B. Access Control System Integrator Qualifications: An experienced access control systems integrator who has completed projects similar in material, design, and extent to that indicated for this Project, whose work has resulted in a record of successful in-service performance, and recognized as an authorized Supplier/Dealer in good standing by the manufacturer of primary materials. Qualifications include, but are not necessarily limited, to the following:
1. Systems Integrator: Firms to have a dedicated access control systems integration department with full time, access control professional(s) on staff who are experienced in providing on site consulting services for both electrified door hardware and integrated access control systems installations.
  2. Factory Training: Installation and service technicians are to be competent factory trained and certified personnel capable of maintaining the system.
- C. Door Hardware Supplier Qualifications: An experienced door hardware supplier with warehousing facility in Project's vicinity and who has on staff a certified Architectural Hardware Consultant (AHC) available during the course of the Work to consult with Contractor, Architect, and Owner concerning both standard and electromechanical door hardware and keying. Supplier recognized as an authorized distributor in good standing by the manufacturers of the primary materials.
1. Scheduling Responsibility: Review of door hardware schedule.
- D. Source Limitations: Provide electrified door hardware from same manufacturer as mechanical door hardware, unless otherwise indicated. Manufacturers that perform electrical modifications and that are listed by a testing and inspecting agency acceptable to authorities having jurisdiction are acceptable.
- E. Fire-Rated Door Assemblies: Where fire-rated door assemblies are indicated, provide door hardware rated for use in 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 or UL 10C, unless otherwise indicated. Provide door hardware that meet requirements of assemblies tested according to UL 1784 and installed in compliance with NFPA 105.
1. Air Leakage Rate: Maximum air leakage of 0.3 cfm/sq. ft. (3 cu. m per minute/sq. m) at the tested pressure differential of 0.3-inch wg (75 Pa) of water.
- F. Electrified Door Hardware: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction.
- G. Means of Egress Doors: Latches do not require more than 15 lbf (67 N) to release the latch. Locks do not require use of a key, tool, or special knowledge for operation.
- H. Accessibility Requirements: For door hardware on doors in an accessible route, comply with the U.S. Architectural & Transportation Barriers Compliance Board's ADA Accessibility Guidelines and ICC/ANSI A117.1.

1. Provide operating devices that do not require tight grasping, pinching, or twisting of the wrist and that operate with a force of not more than 5 lbf (22.2 N).
2. Comply with the following maximum opening-force requirements:
  - a. Interior, Non-Fire-Rated Hinged Doors: 5 lbf (22.2 N) applied perpendicular to door.
  - b. Fire Doors: Minimum opening force allowable by authorities having jurisdiction.
3. Bevel raised thresholds with a slope of not more than 1:2. Provide thresholds not more than 1/2 inch (13 mm) high.
4. Adjust door closer sweep periods so that, from an open position of 70 degrees, the door will take at least 3 seconds to move to a point 3 inches (75 mm) from the latch, measured to the leading edge of the door.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Inventory door hardware on receipt and note any discrepancies to the Construction Manager. Store the delivered hardware in designated secure location provided by the Construction Manager.
  1. Access control hardware: Where approved and directed, inventory upon receipt and store electronic access control equipment in a secure, temperature and humidity controlled environment in original manufacturer's sealed containers.
- B. Tag each item or package separately with identification related to the final Door Hardware Schedule, and include basic installation instructions with each item or package.
- C. Deliver permanent keys, cores, access control credentials, software and related accessories directly to Owner.

#### 1.6 COORDINATION

- A. Coordinate quantity and arrangement of assemblies with ceiling space configuration and with components occupying ceiling space, including structural members, pipes, air-distribution components, raceways, cable trays, recessed lighting fixtures, and other items.
- B. Access Control System Roughing-In: Coordinate the layout and installation of scheduled electrified door hardware and access control equipment with required connections to source power junction boxes, power supplies, detection and monitoring hardware and fire alarm system.
  1. Door Hardware Interface: The card key access control system to interface and be connected to electronic door control hardware (electromechanical locks, electric strikes, magnetic locks, door position switches, other monitoring contacts, and related auxiliary control devices) as described in this section. Coordinate the installation and configuration of specified door hardware being monitored or controlled with the controls, software and access control hardware specified in this Section.

- C. Templates: Obtain and distribute to the parties involved templates for doors, frames, and other work specified to be factory prepared for installing standard, electrified and access control system hardware. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing hardware to comply with indicated requirements.
- D. Door and Frame Preparation: Related Division 08 (Steel, Aluminum and Wood) doors and corresponding frames are to be prepared, reinforced and wired to receive the installation of the specified electrified, monitoring, signaling and access control system hardware without additional in-field modifications.
- E. Access Control System Coordination Meeting: Coordinate the layout and installation of scheduled electrified door hardware and access control equipment with required connections to source power junction boxes, power supplies, detection and monitoring hardware and fire alarm system. Meeting attendees should include electrician, fire alarm & data contractor, door, frame and hardware installing contractor, Owner representative, and any others that may be involved with the access control system.
  - 1. Review the wiring diagrams provided by the hardware supplier
  - 2. Outline the scope of work and timeline required by all contractors involved. Coordinate the layout and installation of scheduled electrified door hardware and access control equipment with required connections to source power junction boxes, power supplies, detection and monitoring hardware and fire alarm system.
  - 3. Coordinate the installation and configuration of specified door hardware being monitored or controlled with the controls, software and access control hardware specified in this Section.
  - 4. Owner and Architect to approve the location of each access control component.
  - 5. Owner to approve the operational description of each access controlled opening.

## 1.6 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period: One year from date of Substantial Completion, unless otherwise indicated.
- B. Special Warranty Period (Access Control System): The entire installed access control system, covering all related parts and labor, to be warranted for 12 months after Opening Commissioning.
  - 1. A published copy of this agreement to be included with the submittal package.
  - 2. Support for the installed access control system components is provided through the vendor under a 24 hour technical assistance program.
  - 3. Access control and management system components are to be available on a one-day turn around time frame from the manufacturer.

4. Primary systems manufacturer to offer and provide remote modem or internet access for direct factory support to the vendor. The factory level support to include diagnostics and troubleshooting support on systems related issues at no additional cost to the owner.

## 1.7 MAINTENANCE SERVICE

- A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools, equipment, and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of door and access control system hardware.
- B. Maintenance Service: Beginning at Substantial Completion, provide continuous 12 months full maintenance by skilled employees of door hardware and integrated access control systems suppliers and installers. Include preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper door opening operation. Provide equipment, parts and supplies as used in the manufacture and installation of original products.

## PART 2 - PRODUCTS

### 2.1 SCHEDULED DOOR HARDWARE

- A. Provide door hardware for each door as scheduled in Part 3 below and on Drawings to comply with requirements in this Section.
  1. Door Hardware: Provide quantity, item, size, finish or color indicated, and products equivalent in function and comparable in quality to named products.
  2. Sequence of Operation: Provide electrified door hardware function, sequence of operation, and interface with other building control systems indicated.
- B. Designations: Requirements for design, grade, function, finish, size, and other distinctive qualities of each type of door hardware are indicated in Part 3 "Door Hardware Schedule" Article. Products are identified by using door hardware designations, as follows:
  1. Named Manufacturers' Products: Manufacturer and product designation are listed for each door hardware type required for the purpose of establishing minimum requirements. Manufacturers' names are abbreviated in Part 3 "Door Hardware Schedule" Article.

### 2.2 HINGES

- A. Hinges: BHMA A156.1. Provide template-produced hinges for hinges installed on hollow-metal doors and hollow-metal frames.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Butt Hinges:
    - 1) Hager Companies (HA)
    - 2) McKinney Products (MCK)

## 2.3 MECHANICAL LOCKS AND LATCHES

- A. Strikes: Provide manufacturer's standard strike for each lock bolt or latchbolt complying with requirements indicated for applicable lock or latch and with strike box and curved lip extended to protect frame; finished to match lock or latch.
  1. Flat-Lip Strikes: For locks with three-piece antifriction latchbolts, as recommended by manufacturer.
  2. Lock Throw: Comply with testing requirements for length of bolts to comply with labeled fire door requirements, and as follows:
    - a. Mortise Locks: Minimum 3/4-inch latchbolt throw.
    - b. Bored Locks: Minimum 1/2-inch latchbolt throw.
- B. Mortise Locks: BHMA A156.13; Grade 1; stamped steel case with steel or brass parts; Series 1000.
  1. Basis-of-Design Product: Subject to compliance with requirements, **provide product indicated in Part 3** or comparable product by one of the following:
    - a. SARGENT Manufacturing Company; an ASSA ABLOY Group company.
    - b. Schlage Commercial Lock Division; an Ingersoll-Rand company.
    - c. Schlage Commercial Lock Division; an Ingersoll-Rand company.
    - d. Yale Security Inc.; an ASSA ABLOY Group company.

## 2.5 LOCK CYLINDERS

- A. CYLINDERS AND KEYING
  1. Provide patented and restricted, security cylinders utilizing a unique factory code pattern that is both geographically and time zoned protected. Manufacturers of cylinders to allow for the ability of the patented and restricted security keys to operate both security and conventional cylinders that are used together under the same facility master or grandmaster key system. End User is required to have the ability for on-site cylinder pinning and original key cutting. A letter of authorization by the End User is required to accompany purchases of any products which involve patented and restricted cylinders, keys and accessories.
  2. Cylinders:
    - a. KABA (NO Substitution)

3. Standards: BHMA certified products complying with the following:

- a. Cylinders: BHMA A 156.5, Grade 1.

## 2.6 KEYING

- A. Keying System: Factory registered, complying with guidelines in BHMA A156.28, Appendix A. Incorporate decisions made in keying conference. Provide for a keying system that matches the existing system.

## 2.7 SURFACE CLOSERS

- A. Surface Closers: BHMA A156.4; rack-and-pinion hydraulic type with adjustable sweep and latch speeds controlled by key-operated valves and forged-steel main arm. Comply with manufacturer's written recommendations for size of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Provide factory-sized closers, adjustable to meet field conditions and requirements for opening force.

1. Basis-of-Design Product: Subject to compliance with requirements, **provide product indicated in Part 3** or comparable product by one of the following:

- a. Corbin Russwin Architectural Hardware; an ASSA ABLOY Group company.
- b. DORMA Architectural Hardware; Member of The DORMA Group North America.
- c. LCN Closers; an Ingersoll-Rand company.
- d. Norton Door Controls; an ASSA ABLOY Group company.
- e. SARGENT Manufacturing Company; an ASSA ABLOY Group company.

## 2.8 MECHANICAL STOPS AND HOLDERS

- A. Wall- and Floor-Mounted Stops: BHMA A156.16; aluminum base metal.

1. Basis-of-Design Product: Subject to compliance with requirements, **provide product indicated in Part 3** or comparable product by one of the following:

- a. Burns Manufacturing Incorporated.
- b. Glynn-Johnson
- c. IVES Hardware; an Ingersoll-Rand company.
- d. Rockwood Manufacturing Company.
- e. SARGENT Manufacturing Company; an ASSA ABLOY Group company.
- f. Stanley Commercial Hardware; Div. of The Stanley Works.

## 2.9 DOOR GASKETING

- A. Door Gasketing: BHMA A156.22; air leakage not to exceed 0.50 cfm per foot (0.000774 cu. m/s per m) of crack length for gasketing other than for smoke control, as tested according to ASTM E 283; with resilient or flexible seal strips that are easily replaceable and readily available from stocks maintained by manufacturer.

1. **Basis-of-Design Product:** Subject to compliance with requirements, **provide product indicated in Part 3** or comparable product by one of the following:
  - a. Hager Companies.
  - b. M-D Building Products, Inc.
  - c. National Guard Products.
  - d. Pemko Manufacturing Co.; an ASSA ABLOY Group company.
  - e. Reese Enterprises, Inc.
  - f. Sealeze; a unit of Jason Incorporated.
  - g. Zero International.

## 2.10 THRESHOLDS

- A. Thresholds: BHMA A156.21; fabricated to full width of opening indicated.

1. **Basis-of-Design Product:** Subject to compliance with requirements, **provide product indicated in Part 3** or comparable product by one of the following:
  - a. Hager Companies.
  - b. National Guard Products.
  - c. Pemko Manufacturing Co.; an ASSA ABLOY Group company.
  - d. Rixson Specialty Door Controls; an ASSA ABLOY Group company.
  - e. Zero International.

## 2.11 FABRICATION

- A. Fasteners: Provide door hardware manufactured to comply with published templates generally prepared for machine, wood, and sheet metal screws. Provide screws according to manufacturers recognized installation standards for application intended.

1. Fire-Rated Applications:
  - a. Wood or Machine Screws: For the following:
    - 1) Hinges mortised to doors or frames
    - 2) Strike plates to frames.
    - 3) Closers to doors and frames.

## 2.12 FINISHES

- A. Provide finishes complying with BHMA A156.18 as indicated in door hardware schedule.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Steel Doors and Frames: For surface applied door hardware, drill and tap doors and frames according to ANSI/SDI A250.6.



- B. Wood Doors: Comply with DHI WDHS.5 "Recommended Hardware Reinforcement Locations for Mineral Core Wood Flush Doors."
- C. Mounting Heights: Mount door hardware units at heights THAT COORDINATE W/ EXISTING DOOR FRAME STRIKES unless otherwise indicated or required to comply with governing regulations.
  - 1. Standard Steel Doors and Frames: ANSI/SDI A250.8.
  - 2. Custom Steel Doors and Frames: HMMA 831.
  - 3. Wood Doors: DHI WDHS.3, "Recommended Locations for Architectural Hardware for Wood Flush Doors."
- D. Install each door hardware item to comply with manufacturer's written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work. Do not install surface-mounted items until finishes have been completed on substrates involved.
  - 1. Set units level, plumb, and true to line and location. Adjust and reinforce attachment substrates as necessary for proper installation and operation.
  - 2. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.
- E. Hinges: Install types and in quantities indicated in door hardware schedule but not fewer than the number recommended by manufacturer for application indicated or one hinge for every 30 inches (750 mm) of door height, whichever is more stringent, unless other equivalent means of support for door, such as spring hinges or pivots, are provided.
- F. Lock Cylinders:
  - 1. Furnish permanent cores to Owner for installation.
- G. Thresholds: Set thresholds for exterior doors and other doors indicated in full bed of sealant complying with requirements specified in Section 079200 "Joint Sealants."
- H. Stops: Provide floor stops for doors unless wall or other type stops are indicated in door hardware schedule. Do not mount floor stops where they will impede traffic.
- I. Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.
- J. DO NOT USE THROUGH-FASTENERS FOR ATTACHMENT OF CLOSERS ON NEW DOORS. New wood doors and new hollow metal doors to be reinforced as specified.

3.3 HARDWARE SCHEDULE (see door schedule on drawings for assignments)

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 Cincinnati Ohio

AX -- Altronix  
 MCK – McKinney  
 PE – Pemko  
 RO – Rockwood  
 SA – Sargent  
 SC - Schlage  
 SU - Securitron

**Hardware Schedule**

**SET 01**

EACH TO HAVE:

1 set	BULB SEAL	5050C (JAMBS & HEAD)	CHARCOAL	NGP
1	AUTO DOOR BOTTOM NPG	220S W/END CAPS		DKB

**SET 02**

EACH TO HAVE:

1 set	BULB SEAL	5050C (JAMBS & HEAD)	CHARCOAL	NGP
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**SET 03**

EACH TO HAVE:

6	HINGES MK	TA2714 4.5x4.5		26D
1	RIM EXIT	12-LC-8808-ETJ- RHR (confirm lever)	32D	SA
1	TRIM COVER PLATE	688	32D	SA
1	RIM EXIT	12-8810-LHR	32D	SA
1	I/C RIM SHELL KSP	308		26D
1	I/C MORTISE SHELL	407-(cam)	26D	KSP
2	I/C CYLINDER KABA	8850-25-1207		26D
1	REMOVABLE MULLION	LC-L980S	PRIMED	SA
2	MULLION STABILIZER KIT	651		SA
2	CLOSER W/STOP	351-CPS	ED	SA
2	CLOSER PLATES	351L	ED	SA
1 set	BULB SEAL	5050C (JAMBS & HEAD)	CHARCOAL	NGP
2	FACE MULLION SEALS NPG	2525C	CHARCOAL	
1	AUTO DOOR BOTTOM NPG	220S W/END CAPS		DKB
1 set	LEADING EDGE SEAL NPG	5075B		BN

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SET 04

EACH TO HAVE:

2	CLOSER W/STOP	351-CPS	ED	SA
2	CLOSER PLATES	351L	ED	SA
1 set	BULB SEAL	5050C (JAMBS & HEAD)	CHARCOAL	NGP

SET 05

*ALL DOOR HARDWARE TO BE PROVIDED BY AND FACTORY INSTALLED SOUND DOOR MANUFACTURER. HARDWARE SHOULD BE PREPED TO RECEIVE KABA CYLINDER.*

EACH TO HAVE:

PROVIDE MINIMUM TWO (2) FACTORY INSTALLED CAM-LIFT TYPE HINGES FOR EACH DOOR. FINISH OF HINGES SHALL BE US26D.

1 OFFICE 70 8205 LNL 10B SA

1 IC CORE 8850-25-1207 10B KABA

1 WALL STOP 409 10B RO

GASKETS INTEGRAL TO DOOR

BALANCE OF DOOR HARDWARE TO REMAIN

END OF SECTION 08 71 00

SECTION 08 80 00 GLAZING

PART 1- GENERAL

1.1 SUMMARY

A. This section includes glazing for the following products and applications, including those specified in other sections where glazing requirements are specified by reference to this section:

1. Doors.
2. Interior borrowed lites.

PART 1- GENERAL

1.1 PERFORMANCE REQUIREMENTS

- A. Safety Glazing Labeling: Where safety glazing labeling is indicated, permanently mark glazing with certification label of the manufacturer. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.
- B. Fire-Protection-Rated Glazing Labeling: Permanently mark fire-protection-rated glazing with certification label of a testing agency acceptable to authorities having jurisdiction. Label shall indicate manufacturer's name, test standard, whether glazing is for use in fire doors or other openings, whether or not glazing passes hose-stream test, whether or not glazing has a temperature rise rating of 450 deg F, and the fire-resistance rating in minutes.
- 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.

1.2 SUBMITTALS

- A. Submit Glazing Schedule: Use same designations indicated on Drawings for glazed openings in preparing a schedule listing glass types and thicknesses for each size opening and location.
- B. Submit Product Certificates: Signed by manufacturers of glass and glazing products certifying that products furnished comply with requirements.
- C. Sample of fire-rated impact resistant glass.

1.3 QUALITY ASSURANCE

- A. **Installer Qualifications:** An experienced installer who has completed glazing similar in material, design, and extent to that indicated for Project and whose work has resulted in construction with a record of successful in-service performance.
- B. **Fire-Rated Door Assemblies:** Assemblies 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 NFPA252.
- C. **Fire-Rated Window Assemblies:** Assemblies 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 257.
- D. **Safety Glass:** Category II materials complying with testing requirements in 16 CFR 1201 and ANSI Z97.1.
1. Subject to compliance with requirements, permanently mark safety glass with certification label of Safety Glazing Certification Council or another certification agency acceptable to authorities having jurisdiction.
- E. **Glazing Publications:** Comply with published recommendations of glass product manufacturers and organizations below, unless more stringent requirements are indicated. Refer to these publications for glazing terms not otherwise defined in this Section or in referenced standards.
1. **GANAS Publications:** GANA'S "Glazing Manual" and "Laminated Glass Design Guide."
  2. **SIGMA Publications:** SIGMA TM-3000, "Vertical Glazing Guidelines".
- F. **Installer's Warranty:** All glass installed under the work of this section shall be guaranteed by the glazing subcontractor against leakage or water penetration, caused by poor workmanship, caulking or sealant failure, for a period of two years subsequent to final acceptance by the Owner.

## PART 2- PRODUCTS

### 2.1 FIRE-RATED GLAZING PRODUCTS

- A. **Laminated Ceramic Glazing:** Laminated glass made from 2 plies of clear, ceramic flat glass; 5/16-inch (8-mm) total nominal thickness; complying with testing requirements in 16 CFR 1201 for Category II materials.
1. **Fire-Protection Rating:** As indicated for the assembly in which the glazing material is installed, and permanently labeled by a testing and inspecting agency acceptable to authorities having jurisdiction.
  2. Polished on both surfaces, transparent.
  3. **Products:** Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

- a. Nippon Electric Glass Co., Ltd. (distributed by Technical Glass Products); FireLite Plus.
- b. Schott North America, Inc.; Laminated Pyran Platinum L.
- c. Vetrotech Saint-Gobain; SGG Keralite FR-L.

## 2.2 GLAZING COMPOUND FOR FIRE-RATED GLAZING MATERIALS

- A. Glazing Tape: Closed cell polyvinyl chloride (PVC) foam, coiled on release paper over adhesive on two sides, maximum water absorption by volume of 2 percent.
- B. Glazing Compound: DAP 33 putty.
- C. Silicone Sealant: One-part neutral curing silicone, medium modulus sealant, Type S; Grade NS; Class 25 with additional movement capability of 50 percent in both extension and compression (total 100 percent); Use (Exposure) NT; Uses (Substrates) G, A, and O as applicable. Available Products:
  1. Dow Corning 795 - Dow Corning Corp.
  2. Silglaze-II 2800 - General Electric Co.
  3. Spectrem 2 - Tremco Inc.
- D. Setting Blocks: Neoprene, EPDM, or silicone; tested for compatibility with glazing compound; of 70 to 90 Shore A hardness.
- E. Cleaners, Primers, and Sealers: Type recommended by manufacturer of glass and gaskets.

## PART 3- EXECUTION

### 3.1 INSTALLATION (GLAZING)

- A. Comply with referenced FGMA standards and instructions of manufacturers of glass, glazing sealants, and glazing compounds.
- B. Protect glass from edge damage during handling and installation. Inspect glass during installation and discard pieces with edge damage that could affect glass performance.
- C. Set units of glass in each series with uniformity of pattern, draw, bow, and similar characteristics.
- D. Cut glazing tape to length and set against permanent stops, flush with sight lines to fit openings exactly, with stretch allowance during installation.
- E. Place setting blocks located at quarter points of glass with edge block no more than 6 inches from corners.
- F. Glaze vertically into labeled fire-rated metal frames or partition walls with same fire rating as glass and push against tape for full contact at perimeter of pane or unit.
- G. Place glazing tape on free perimeter of glazing in same manner described above.

- H. Install removable stop and secure without displacement of tape.
- I. Glazing Sealants for Fire-Rated Glazing Products: Products that are approved by testing agencies that listed and labeled fire-resistant glazing products with which they are used for applications and fire-protection ratings indicated.
- J. Use specified glazing compound, without adulteration; bed glazing material in glazing compound; entirely fill all recess and spaces. Provide visible glazing compound with smooth and straight edges.
- K. Install in vision panels in fire-rated doors to requirements of NFPA 80.
- L. Install so that appropriate UL markings remain permanently visible.

END OF SECTION 08 80 00

SECTION 09 21 16  
GYPSUM BOARD ASSEMBLIES

PART 1 - GENERAL

1.1 SUMMARY

- A. This section includes the following:
  - 1. Interior gypsum wallboard.
  - 2. Exterior finish for gypsum board panels at ceilings and soffits.
  - 3. Cementitious (tile) backing units.
  - 4. Non-load-bearing steel framing.
  
- B. Related Work
  - 1. Division 5 Section Cold-Formed Metal Framing: For steel-stud curtainwall framing members.
  - 2. Division 6 Section Rough Carpentry: For wood nailers, blocking, and wood framing and furring.
  - 3. Division 6 Section Gypsum Sheathing: For gypsum board panels for exterior ceilings and soffits.
  - 4. Division 7 Section Thermal Insulation: For insulation and vapor retarders installed in gypsum board assemblies.
  - 5. Division 7 Section Applied Fireproofing: Fireproofing structural steel members concealed behind gypsum board assemblies.
  - 6. Division 7 Section Firestopping: Firestopping systems and fire-resistance- rated joint sealants.
  - 7. Division 7 Section Joint Sealants: Building sealants except as specified in this section.
  - 8. Division 9 Section Gypsum Board Shaft-Wall Assemblies: For framing, gypsum panels, and other components of shaft wall assemblies.

1.2 DEFINITIONS

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

1.3 SUBMITTALS

- A. Submit in accordance with Division 1 Section Submittal Procedures, product data for each type of product indicated.
  - 1. Submit manufacturer's limiting heights tables for non-load bearing studs indicating height limitations for all interior studs.
  
- B. Samples: For the following products:
  - 1. Trim Accessories: Full-size sample in 12 inch (300 mm) long length for each trim accessory indicated.
  - 2. Finish for Exterior Ceilings and Soffits: Manufacturer's standard size for each textured finish indicated and on same backing indicated for Work.



#### 1.4 QUALITY ASSURANCE

- A. Fire-Test-Response Characteristics: For gypsum board assemblies with fire- resistance ratings, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing and inspecting agency acceptable to authorities having jurisdiction.
  - 1. Fire-Resistance-Rated Assemblies: Indicated by design designations from UL's "Fire Resistance Directory."
  
- B. Sound Transmission Characteristics: For gypsum board assemblies with STC ratings, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by a qualified independent testing agency.
  - 1. STC-Rated Assemblies: Indicated by design designations from GA-600, "Fire Resistance Design Manual."
  
- C. Gypsum Board Finish Mockups: Before finishing gypsum board assemblies, install mockups of at least 100 sq. ft. (9 sq. m) in surface area to demonstrate aesthetic effects and qualities of materials and execution.
  - 1. Install mockups for the following applications:
    - a. Each level of gypsum board finish indicated for use in exposed locations indicated to receive nontextured paint finishes.
    - b. Each texture finish indicated.
  - 2. Simulate finished lighting conditions for review of mockups.
  - 3. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

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

#### 1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Comply with ASTM C 840 requirements or gypsum board manufacturer's written recommendations, whichever are more stringent.
  
- B. Room Temperatures: Maintain not less than 40 degrees F (4 degrees C). Do not exceed 95 degrees F (35 degrees 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. Acceptable Manufacturers: Subject to compliance with requirements, provide products of the following:
1. Steel Framing and Furring:
    - a. Clark Steel Framing Systems.
    - b. Dale Industries, Inc.; Dale/Incor.
    - c. Dietrich Industries, Inc.
    - d. MarinoWare; Division of Ware Ind.
    - e. National Gypsum Company.
    - f. Unimast, Inc.
  2. Gypsum Board and Related Products:
    - a. American Gypsum Co.
    - b. CertainTeed Corporation.
    - c. G-P Gypsum Corp.
    - d. National Gypsum Company.
    - e. United States Gypsum Co.
  3. Exterior Finish System for Ceilings and Soffits
    - a. BASF Wall Systems, Senergy Brand.
    - b. Parex Incorporated
    - c. Sto Corporation.

## 2.2 STEEL SUSPENDED CEILING AND SOFFIT FRAMING

- A. Components: Comply with ASTM C 754 for conditions indicated.
- B. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.0625 inch (1.59 mm) diameter wire, or double strand of 0.0475 inch (1.21 mm) diameter wire.
- C. Hanger Attachments to Concrete: As follows:
1. Anchors: Fabricated from corrosion-resistant materials with holes or loops for attaching hanger wires and capable of sustaining, without failure, a load equal to 5 times that imposed by construction as determined by testing according to ASTM E 488 by a qualified independent testing agency.
  2. Powder-Actuated Fasteners: Suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other devices for attaching hangers of type indicated, and capable of sustaining, without failure, a load equal to 10 times that imposed by construction as determined by testing according to ASTM E 1190 by a qualified independent testing agency.
- D. Hangers: As follows:
1. Wire Hangers: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.162 inch (4.12 mm) diameter.
  2. Angle Hangers: ASTM A 653/A 653M, G60 (Z180) hot-dip galvanized commercial-steel sheet.
    - a. Minimum Base Metal Thickness: 0.0312 inch (0.79 mm).
    - b. Size: 2 by 2 inches (50.8 by 50.8 mm).
- E. Carrying Channels: Cold-rolled, commercial-steel sheet with a base metal thickness of

0.0538 inch (1.37 mm), a minimum 1/2 inch (12.7 mm) wide flange, with ASTM A 653/A 653M, G60 (Z180), hot-dip galvanized zinc coating.

1. Depth: 2-1/2 inches (63.5 mm).
- F. Furring Channels (Furring Members): Commercial-steel sheet with ASTM A 653/A 653M, G60 (Z180), hot-dip galvanized zinc coating.
1. Cold Rolled Channels: 0.0538 inch (1.37 mm) bare steel thickness, with minimum 1/2 inch (12.7 mm) wide flange, 3/4 inch (19.1 mm) deep.
  2. Steel Studs: ASTM C 645.
    - a. Minimum Base Metal Thickness: 0.0312 inch (0.79 mm).
    - b. Depth: As indicated.
  3. Hat-Shaped, Rigid Furring Channels: ASTM C 645, 7/8 inch (22.2 mm) deep.
    - a. Minimum Base Metal Thickness: 0.0312 inch (0.79 mm).
  4. Resilient Furring Channels: 1/2 inch (12.7 mm) deep members designed to reduce sound transmission.
    - a. Configuration: Asymmetrical or hat shaped, with face attached to single flange by a slotted leg (web) or attached to two flanges by slotted or expanded metal legs.
- G. Grid Suspension System for Interior Ceilings: ASTM C 645, direct-hung system composed of main beams and cross-furring members that interlock.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Armstrong World Industries, Inc.; Furring Systems/Drywall.
    - b. Chicago Metallic Corporation; Fire Front 630, Drywall Furring 640, Fire Front 650 or Fire Front 670 System.
    - c. USG Interiors, Inc.; Drywall Suspension System.

### 2.3 STEEL PARTITION AND SOFFIT FRAMING

- A. Components: As follows:
1. Comply with ASTM C 754 for conditions indicated.
  2. Steel Sheet Components: Complying with ASTM C 645 requirements for metal and with manufacturer's standard corrosion-resistant zinc coating.
  3. Steel Sheet Components for Wet or Corrosive Environments: Complying with ASTM C 645 requirements for metal and with ASTM A 653/A 653M, G40 (Z120), hot-dip galvanized zinc coating.
- B. Steel Studs and Runners: ASTM C 645.
1. Minimum Base Metal Thickness: 0.0312 inch (0.79 mm) (20 gauge).
  2. Depth: As indicated, and as required to achieve partition deflection no greater than L/360 for given span.
- C. Deep-Leg Deflection Track: ASTM C 645 top runner with 2 inch (50.8 mm) deep flanges.
- D. Proprietary Firestop Track: Top runner manufactured to allow partition heads to expand and contract with movement of the structure while maintaining continuity of fire-resistance-rated assembly indicated; in thickness not less than indicated for studs and

in width to accommodate depth of studs.

1. Product: Subject to compliance with requirements, provide one of the following:
  - a. Fire Trak Corp.; Fire Trak attached to studs with Fire Trak Slip Clip.
  - b. Metal-Lite, Inc.; The System.
  
- E. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.
  1. Minimum Base Metal Thickness: 0.0312 inch (0.79 mm).
  
- F. Cold-Rolled Channel Bridging: 0.0538 inch (1.37 mm) bare steel thickness, with minimum 1/2 inch (12.7 mm) wide flange.
  1. Depth: 1-1/2 inches (38.1 mm).
  2. Clip Angle: 1-1/2 by 1-1/2 inch (38.1 by 38.1 mm), 0.068 inch (1.73 mm) thick, galvanized steel.
  
- G. Hat-Shaped, Rigid Furring Channels: ASTM C 645.
  1. Minimum Base Metal Thickness: 0.0179 inch (0.45 mm).
  2. Depth: 7/8 inch (22.2 mm).
  
- H. Resilient Furring Channels: 1/2 inch (12.7 mm) deep, steel sheet members designed to reduce sound transmission.
  1. Configuration: Asymmetrical or hat shaped, with face attached to single flange by a slotted leg (web) or attached to two flanges by slotted or expanded metal legs.
  
- I. Cold-Rolled Furring Channels: 0.0538 inch (1.37 mm) bare steel thickness, with minimum 1/2 inch (12.7 mm) wide flange.
  1. Depth: 3/4 inch (19.1 mm).
  2. Furring Brackets: Adjustable, corrugated-edge type of steel sheet with minimum bare steel thickness of 0.0312 inch (0.79 mm).
  3. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.0625 inch (1.59 mm) diameter wire, or double strand of 0.0475 inch (1.21 mm) diameter wire.
  
- J. Z-Shaped Furring: With slotted or nonslotted web, face flange of 1-1/4 inches (31.8 mm), wall attachment flange of 7/8 inch (22.2 mm), minimum bare metal thickness of 0.0179 inch (0.45 mm), and depth required to fit insulation thickness indicated.
  
- K. Fasteners for Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.

## 2.4 INTERIOR GYPSUM WALLBOARD

- A. Panel Size: Provide in maximum lengths and widths available that will minimize joints in each area and correspond with support system indicated.
  
- B. Gypsum Wallboard: ASTM C 36.
  1. Regular Type:
    - a. Thickness: 5/8 inch thick, unless noted otherwise.

- b. Long Edges: Tapered and featured (rounded or beveled) for prefilling.
      - c. Location: As indicated.
    - 2. Type X:
      - a. Thickness: 5/8 inch thick, unless noted otherwise.
      - b. Long Edges: Tapered and featured (rounded or beveled) for prefilling.
      - c. Location: Where required for fire-resistance-rated assembly. May also be used at all locations if approved manufacturer does not offer regular type in 5/8-inch thickness.
  - C. Flexible Gypsum Wallboard: ASTM C 36, manufactured to bend to fit tight radii and to be more flexible than standard regular-type panels of the same thickness.
    - 1. Thickness: 1/4 inch (6.4 mm).
    - 2. Long Edges: Tapered.
    - 3. Location: Apply in double layer at curved assemblies.
  - D. Sag-Resistant Gypsum Wallboard: ASTM C 36, manufactured to have more sag resistance than regular-type gypsum board.
    - 1. Thickness: 1/2 inch (12.7 mm).
    - 2. Long Edges: Tapered.
    - 3. Location: Ceiling surfaces.
  - E. Proprietary, Special Fire-Resistive Type: ASTM C 36, having improved fire resistance over standard Type X.
    - 1. Products: Subject to compliance with requirements, provide one of the following:
      - a. American Gypsum Co.; FireBloc Type C.
      - b. G-P Gypsum Corp.; Firestop Type C.
      - c. National Gypsum Company; Gold Bond Fire-Shield G.
      - d. United States Gypsum Co.; SHEETROCK Brand Gypsum Panels, FIRECODE C Core or ULTRACODE Core.
    - 2. Thickness: As indicated.
    - 3. Long Edges: Tapered and featured (rounded or beveled) for prefilling.
    - 4. Location: Where required for specific fire-resistance-rated assembly indicated.
  - F. Water-Resistant Gypsum Backing Board: ASTM C 630/C 630M.
    - 1. Core: As indicated.
- 2.5 EXTERIOR FINISH SYSTEM FOR CEILINGS AND SOFFITS
- A. Exterior Gypsum Soffit Board: Refer to Division 06 Section "Gypsum Sheathing" issued with Bid Package B.
  - B. Finish System for Exterior Gypsum Ceilings and Soffits: System manufacturer's standard system comprising the following components
    - 1. Base-Coat Materials: Factory-blended dry formulation of portland cement, natural sand aggregate, alkaline-resistant chopped glass fibers, and dry polymer

admixture to which only water is added at Project site:

2. Finish-Coat Materials: Factory-mixed formulation of polymer-emulsion binder, colorfast mineral pigments, sound stone particles, and fillers. Color and texture as selected by Architect from manufacturer's full range.
3. Reinforcing Mesh: Balanced, alkali-resistant, open-weave glass-fiber mesh, complying with ASTM D578; treated for compatibility with other system materials; not less than 4.2 oz./sq. yd. (142 g/sq. m).
4. Water for Mixing with Base Coat and Finish Coat Materials: Potable.
5. Basis of Design: Drawings and specifications are based on the following product. Subject to project requirements and specifications, equivalent finish systems from acceptable manufacturers will be accepted. :
  - a. Parex Incorporated, "Parex ACR Soffit" with "Parex 121 Optimum Base Coat" and "Parex DPR Optimum Finish Coat"

## 2.6 CEMENTITIOUS BACKING UNITS

- A. Panel Size: Provide in maximum lengths and widths available that will minimize joints in each area and correspond with support system indicated.
- B. Cementitious Backer Units: ANSI A118.9.
  1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Custom Building Products; Wonderboard.
    - b. FinPan, Inc.; Util-A-Crete Concrete Backer Board.
    - c. United States Gypsum Co.; DUROCK Cement Board.
  2. Thickness: 1/2 inch (12.7 mm).

## 2.7 TRIM ACCESSORIES

- A. Interior Trim: ASTM C 1047.
  1. Material: Galvanized or aluminum-coated steel sheet, rolled zinc, plastic, or paper-faced galvanized steel sheet.
  2. Shapes:
    - a. Cornerbead: Use at outside corners.
    - b. LC-Bead (J-Bead): Use at exposed panel edges.
    - c. L-Bead: Use where indicated.
    - d. U-Bead: Use where indicated.
    - e. Expansion (Control) Joint: Use where indicated or recommended by gypsum board manufacturer..
    - f. Curved-Edge Cornerbead: With notched or flexible flanges; use at curved openings.
- B. Exterior Trim: ASTM C 1047.
  1. Material: Hot-dip galvanized steel sheet or rolled zinc.
  2. Shapes:
    - a. Cornerbead: Use at outside corners.
    - b. LC-Bead (J-Bead): Use at exposed panel edges.
    - c. Expansion (Control) Joint: One-piece, rolled zinc with V-shaped slot and removable strip covering slot opening. Use where indicated or

recommended by gypsum board manufacturer.

- C. Aluminum Trim: Extruded accessories of profiles and dimensions indicated.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
    - a. Fry Reglet Corp.
    - b. Gordon, Inc.
    - c. MM Systems Corporation.
    - d. Pittcon Industries.
  - 2. Aluminum: Alloy and temper with not less than the strength and durability properties of ASTM B 221 (ASTM B 221M), alloy 6063-T5.
  - 3. Finish: Corrosion-resistant primer compatible with joint compound and finish materials specified.

## 2.8 JOINT TREATMENT MATERIALS

- A. Comply with ASTM C 475.
- B. Joint Tape:
  - 1. Interior Gypsum Wallboard: Paper.
  - 2. Exterior Gypsum Soffit Board: Paper.
  - 3. Glass-Mat Gypsum Sheathing Board: 10 by 10 glass mesh.
  - 4. Tile Backing Panels: As recommended by panel manufacturer.
- C. Joint Compound for Interior Gypsum Wallboard: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.
  - 1. Prefilling: At open joints, rounded or beveled panel edges, and damaged surface areas, use setting-type taping compound.
  - 2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use setting-type taping compound.
  - 3. Fill Coat: For second coat, use setting-type, sandable topping compound.
  - 4. Finish Coat: For third coat, use drying-type, all-purpose compound.
  - 5. Skim Coat: For final coat of Level 5 finish, use drying-type, all-purpose compound.
- D. Joint Compound for Exterior Applications:
  - 1. Exterior Gypsum Soffit Board: Use setting-type taping and setting-type, sandable topping compounds for tape and skim coat.
    - a. Product: Georgia Pacific, "Toughrock Setting Compound".
- E. Joint Compound for Cementitious Backer Units :
  - 1. Cementitious Backer Units: As recommended by manufacturer.

## 2.9 ACOUSTICAL SEALANT

- A. Products: Subject to compliance with requirements, provide one of the following:
  - 1. Acoustical Sealant for Exposed and Concealed Joints:
    - a. Pecora Corp.; AC-20 FTR Acoustical and Insulation Sealant.
    - b. United States Gypsum Co.; SHEETROCK Acoustical Sealant.

2. Acoustical Sealant for Concealed Joints:
    - a. Ohio Sealants, Inc.; Pro-Series SC-170 Rubber Base Sound Sealant.
    - b. Pecora Corp.; BA-98.
    - c. Tremco, Inc.; Tremco Acoustical Sealant.
  
  - B. Acoustical Sealant for Exposed and Concealed Joints: Nonsag, paintable, nonstaining, latex sealant complying with ASTM C 834 that effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.
  
  - C. Acoustical Sealant for Concealed Joints: Nondrying, nonhardening, nonskinning, nonstaining, gunnable, synthetic-rubber sealant recommended for sealing interior concealed joints to reduce airborne sound transmission.
- 2.10 AUXILIARY MATERIALS
- A. Provide auxiliary materials that comply with referenced installation standards and manufacturer's written recommendations.
  
  - B. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.
  
  - C. Steel Drill Screws: ASTM C 1002, unless otherwise indicated.
    1. Use screws complying with ASTM C 954 for fastening panels to steel members from 0.033 to 0.112 inch (0.84 to 2.84 mm) thick.
    2. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.
  
  - D. Isolation Strip at Exterior Walls:
    1. Asphalt-Saturated Organic Felt: ASTM D 226, Type I (No. 15 asphalt felt), nonperforated.
    2. Foam Gasket: Adhesive-backed, closed-cell vinyl foam strips that allow fastener penetration without foam displacement, 1/8 inch (3.2 mm) thick, in width to suit steel stud size.
  
  - E. Sound Attenuation Blankets: ASTM C 665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.



1. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames, cast-in anchors, and structural framing, for compliance with requirements and other conditions affecting performance. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 PREPARATION

- A. Suspended Ceilings: Coordinate installation of ceiling suspension systems with installation of overhead structure to ensure that inserts and other provisions for anchorages to building structure have been installed to receive ceiling hangers at spacing required to support ceilings and that hangers will develop their full strength.
  1. Furnish concrete inserts and other devices indicated to other trades for installation in advance of time needed for coordination and construction.
- B. Coordination with Sprayed Fire-Resistive Materials:
  1. Before sprayed fire-resistive materials are applied, attach offset anchor plates or ceiling runners (tracks) to surfaces indicated to receive sprayed-on fire-resistive materials. Where offset anchor plates are required, provide continuous plates fastened to building structure not more than 24 inches (600 mm) o.c.
  2. After sprayed fire-resistive materials are applied, remove them only to extent necessary for installation of gypsum board assemblies and without reducing the fire-resistive material thickness below that which is required to obtain fire-resistance rating indicated. Protect remaining fire-resistive materials from damage.

#### 3.3 INSTALLING STEEL FRAMING, GENERAL

- A. Installation Standards: ASTM C 754, and ASTM C 840 requirements that apply to framing installation.
- B. Install supplementary framing, 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 gypsum board manufacturer's written recommendations or, if none available, with United States Gypsum's "Gypsum Construction Handbook."
- C. Isolate steel framing from building structure at locations indicated to prevent transfer of loading imposed by structural movement.
  1. Isolate ceiling assemblies where they abut or are penetrated by building structure.
  2. Isolate partition framing and wall furring where it abuts structure, except at floor. Install slip-type joints at head of assemblies that avoid axial loading of assembly and

laterally support assembly.

- a. Use deep-leg deflection track where indicated.
- b. Use proprietary firestop track where indicated.

- D. Do not bridge building control and expansion joints with steel framing or furring members. Frame both sides of joints independently.

### 3.4 INSTALLING STEEL SUSPENDED CEILING AND SOFFIT FRAMING

- A. Suspend ceiling hangers from building structure as follows:
  1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or ceiling suspension system. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
  2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with the location of hangers required to support standard suspension system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards.
  3. Secure wire hangers by looping and wire-tying, either directly to structures or to inserts, eyescrews, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause them to deteriorate or otherwise fail.
  4. Secure angle hangers to structure, including intermediate framing members, by attaching to inserts, eyescrews, or other devices and fasteners that are secure and appropriate for structure and hanger, and in a manner that will not cause hangers to deteriorate or otherwise fail.
  5. Do not connect or suspend steel framing from ducts, pipes, or conduit.
- B. Installation Tolerances: Install steel framing components for suspended ceilings so members for panel attachment are level to within 1/8 inch in 12 feet (3 mm in 3.6 m) measured lengthwise on each member and transversely between parallel members.
- C. Wire-tie or clip furring channels to supports, as required to comply with requirements for assemblies indicated.
- D. Install suspended steel framing components in sizes and spacings indicated, but not less than that required by the referenced steel framing and installation standards.
  1. Hangers: Maximum 48 inches (1219 mm) o.c.
  2. Carrying Channels (Main Runners): maximum 48 inches (1219 mm) o.c.
  3. Furring Channels (Furring Members): maximum 16 inches (406 mm) o.c.
- E. Grid Suspension System: Attach perimeter wall track or angle where grid suspension system meets vertical surfaces. Mechanically join main beam and cross-furring members to each other and butt-cut to fit into wall track.
  1. Provide grid suspension system only at corridor locations.

### 3.5 INSTALLING STEEL PARTITION AND SOFFIT FRAMING

- A. Install tracks (runners) at floors, ceilings, and structural walls and columns where gypsum board assemblies abut other construction.
  - 1. Where studs are installed directly against exterior walls, install asphalt-felt or foam-gasket isolation strip between studs and wall.
  - 2. Where top track (runner) is parallel to metal deck flutes and is not completely covered by bottom flute, provide continuous 20 gage steel plate to span between flutes above track. Fasten plate to underside of metal deck.
  - 3. Where top runner (track) is indicated to be fastened to underside of a structural steel member, attach 20 gage steel Z-clips at 24 inches on center to bottom flange of structural steel member. If partition is offset from structural steel member, provide a continuous 14 gage steel plate attached at 24 inches on center, to bottom flange of structural steel member. Install clips and plates prior to application of sprayed-on fireproofing.
  
- B. Installation Tolerance: Install each steel framing and furring member so fastening surfaces meet the following criteria:
  - 1. Variation of fastening surface shall be not more than 1/8 inch (3 mm) from the plane formed by the faces of adjacent framing.
  - 2. Fastening surface shall be plumb.
  - 3. Intersections between fastening surfaces shall meet within 1 degree of 90- degree angle if not otherwise specifically shown, or within 1 degree of other angle indicated on Drawings.
  
- C. Extend partition framing full height to structural supports or substrates above suspended ceilings, except where partitions are indicated to terminate at suspended ceilings. Continue framing over frames for doors and openings and frame around ducts penetrating partitions above ceiling to provide support for gypsum board.
  - 1. Cut studs 1/2 inch (13 mm) short of full height to provide perimeter relief.
  - 2. For fire-resistance-rated and STC-rated partitions that extend to the underside of floor/roof slabs and decks or other continuous solid-structure surfaces to obtain ratings, install framing around structural and other members extending below floor/roof slabs and decks, as needed to support gypsum board closures and to make partitions continuous from floor to underside of solid structure.
  
- D. Install steel studs and furring at the following spacings:
  - 1. Single-Layer Construction: maximum 16 inches (406 mm) o.c., unless otherwise indicated.
  - 2. Multilayer Construction: maximum 16 inches (406 mm) o.c., unless otherwise indicated.
  - 3. Cementitious Backer Units: maximum 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 panel can be attached to open (unsupported) edges of stud flanges first.
  
- F. Curved Partitions:
  - 1. Cut top and bottom track (runners) through leg and web at 2 inch (50 mm) intervals

- for arc length. In cutting lengths of track, allow for uncut straight lengths of not less than 12 inches (300 mm) at ends of arcs.
2. Bend track to uniform curve and locate straight lengths so they are tangent to arcs.
  3. Support outside (cut) leg of track by clinching steel sheet strip, 1 inch (25 mm) high by thickness of track metal, to inside of cut legs using metal lock fasteners.
  4. Begin and end each arc with a stud, and space intermediate studs equally along arcs at stud spacing recommended in writing by gypsum board manufacturer for radii indicated. On straight lengths of not less than 2 studs at ends of arcs, place studs 6 inches (150 mm) o.c.
- G. Frame door openings to comply with GA-600 and with gypsum board manufacturer's applicable written recommendations, unless otherwise indicated. Screw vertical studs at jambs to jamb anchor clips on door frames; install runner track section (for cripple studs) at head and secure to jamb studs.
1. Install two studs at each jamb.
  2. Install cripple studs at head adjacent to each jamb stud, with a minimum 1/2 inch (13 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.
  4. Over frames and through stud knock-outs, and within 12" above openings, install 1-1/2" cold rolled channel horizontal stiffener which extends at least one full 16" stud space beyond each jamb stud. Lock in place by rolling channel in knock-outs, then secure in place with tie wire.
- H. Frame openings other than door openings the same as required for door openings, unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.
- I. Z-Furring Members:
1. Erect insulation vertically and hold in place with Z-furring members spaced maximum 24 inches (610 mm) o.c.
  2. Except at exterior corners, securely attach narrow flanges of furring members to wall with concrete stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches (600 mm) o.c.
  3. At exterior corners, attach wide flange of furring members to wall with short flange extending beyond corner; on adjacent wall surface, screw-attach short flange of furring channel to web of attached channel. At interior corners, space second member no more than 12 inches (300 mm) from corner and cut insulation to fit.
  4. Until gypsum board is installed, hold insulation in place with 10 inch (250 mm) staples fabricated from 0.0625 inch (1.59 mm) diameter, tie wire and inserted through slot in web of member.

### 3.6 APPLYING AND FINISHING PANELS, GENERAL

- A. Gypsum Board Application and Finishing Standards: ASTM C 840 and GA-216.
- B. Install sound attenuation blankets before installing gypsum panels, unless blankets are readily installed after panels have been installed on one side.

- C. Install ceiling board panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in the central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.
- D. Install gypsum panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch (1.5 mm) of open space between panels. Do not force into place.
- E. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.
- F. Attach gypsum panels to steel studs so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.
- G. Attach gypsum panels to framing provided at openings and cutouts.
- H. Spot grout hollow metal door frames for solid-core wood doors, hollow metal doors, and doors over 32 inches wide. Apply spot grout at each jamb anchor clip and immediately insert gypsum panels into frames.
- I. Form control and expansion joints with space between edges of adjoining gypsum panels.
- J. Cover both faces of steel stud partition framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.
  - 1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. (0.7 sq. m) in area.
  - 2. Fit gypsum panels around ducts, pipes, and conduits.
  - 3. Where partitions intersect open concrete coffers, concrete joists, and other structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by coffers, joists, and other structural members; allow 1/4 to 3/8 inch (6.4 to 9.5 mm) wide joints to install sealant.
- K. Isolate perimeter of non-load-bearing gypsum board partitions at structural abutments, except floors. 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. .
- L. STC-Rated Assemblies: Seal construction at perimeters, behind control and expansion joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C 919 and manufacturer's written recommendations for locating edge trim and closing off sound-flanking paths around or through gypsum board assemblies, including sealing partitions above acoustical ceilings.

- M. Space fasteners in gypsum panels according to referenced gypsum board application and finishing standard and manufacturer's written recommendations.
  - 1. Space screws a maximum of 12 inches (304.8 mm) o.c. for vertical applications.
- N. Space fasteners in panels that are tile substrates a maximum of 8 inches (203.2 mm) o.c.

### 3.7 PANEL APPLICATION METHODS

- A. Single-Layer Application:
  - 1. On ceilings, apply gypsum panels before wall/partition board application to the greatest extent possible and at right angles to framing, unless otherwise indicated.
  - 2. On partitions/walls, apply gypsum panels vertically (parallel to framing), unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints.
    - a. Stagger abutting end joints not less than one framing member in alternate courses of board.
    - b. At stairwells and other high walls, install panels horizontally, unless otherwise indicated or required by fire-resistance-rated assembly.
  - 3. On Z-furring members, apply gypsum panels vertically (parallel to framing) with no end joints. Locate edge joints over furring members.
- B. Multilayer Application on Ceilings: Apply gypsum board indicated for base layers before applying base layers on walls/partitions; apply face layers in same sequence. Apply base layers at right angles to framing members and offset face-layer joints 1 framing member, 16 inches (400 mm) minimum, from parallel base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly.
- C. Multilayer Application on Partitions/Walls: Apply gypsum board indicated for base layers and face layers vertically (parallel to framing) with joints of base layers located over stud or furring member and face-layer joints offset at least one stud or furring member with base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly. Stagger joints on opposite sides of partitions.
  - 1. Z-Furring Members: Apply base layer vertically (parallel to framing) and face layer either vertically (parallel to framing) or horizontally (perpendicular to framing) with vertical joints offset at least one furring member. Locate edge joints of base layer over furring members.
- D. Single-Layer Fastening Methods: Apply gypsum panels to supports with steel drill screws.
- E. Multilayer Fastening Methods: Fasten base layers and face layers separately to supports with screws.
- F. Laminating 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 written recommendations and temporarily brace or fasten gypsum panels until fastening adhesive has set.

G. Curved Partitions:

1. Install panels horizontally and unbroken, to the extent possible, across curved surface plus 12 inch (300 mm) long straight sections at ends of curves and tangent to them.
2. Wet gypsum panels on surfaces that will become compressed where curve radius prevents using dry panels. Comply with gypsum board manufacturer's written recommendations for curve radii, wetting methods, stacking panels after wetting, and other preparations that precede installing wetted gypsum panels.
3. On convex sides of partitions, begin installation at one end of curved surface and fasten gypsum panels to studs as they are wrapped around curve. On concave side, start fastening panels to stud at center of curve and work outward to panel ends. Fasten panels to framing with screws spaced 12 inches (300 mm) o.c.
4. For double-layer construction, fasten base layer to studs with screws 16 inches (400 mm) o.c. Center gypsum board face layer over joints in base layer, and fasten to studs with screws spaced 12 inches (300 mm) o.c.
5. Allow wetted gypsum panels to dry before applying joint treatment.

H. Cementitious Backer Units:

1. Cementitious Backer Units: ANSI A108.11. Provide metal stud back-up at all horizontal and vertical joints in cementitious backer board units.
  - a. Change to water-resistant gypsum backing board beyond the "area subject to wetting" at an inside or outside corner only.

- I. Substrates for Epoxy Paint: For substrates indicated to receive epoxy paint finish, install water-resistant gypsum backing board panels with tapered edges taped and finished to produce a flat surface.

### 3.8 INSTALLING TRIM ACCESSORIES

- A. For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.
- B. Control Joints: Install control joints according to ASTM C 840 and in specific locations approved by Architect for visual effect.
1. In addition to the control joints required above, provide an additional 10 percent control joints for layout reasons, locations to be determined by the Architect.

### 3.9 FINISHING GYPSUM BOARD ASSEMBLIES

- A. Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.
- B. Prefill open joints, rounded or beveled edges, and damaged surface areas.

- C. Apply joint tape over gypsum board joints, except those with trim having flanges not intended for tape.
  
- D. Gypsum Board Finish Levels: Finish panels to levels indicated below, according to ASTM C 840, for locations indicated:
  - 1. Level 1: Embed tape at joints in 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: Embed tape and apply separate first coat of joint compound to tape, fasteners, and trim flanges where panels are substrate for tile.
  - 3. Level 4: Embed tape and apply separate first, fill, and finish coats of joint compound to tape, fasteners, and trim flanges at panel surfaces that will be exposed to view, unless otherwise indicated.
  - 4. Level 5: Embed tape and apply separate first, fill, and finish coats of joint compound to tape, fasteners, and trim flanges, and apply skim coat of joint compound over entire surface. Provide Level 5 finish at the following areas:
    - a. Walls that are perpendicular to an exterior wall that have a window coming right up to the intersection of the interior and exterior walls.
  
- E. Cementitious Backer Units: Finish according to manufacturer's written instructions.
  
- F. Exterior Finish System for Ceilings and Soffits: Finish according to manufacturer's written instructions.
  - 1. Trim: Apply trim accessories at perimeter of exterior soffits and ceilings, at expansion joints, and elsewhere as indicated, according to finish system manufacturer's written instructions. Coordinate with installation of insulation
  - 2. Expansion Joints: Install at locations indicated, where required by finish system manufacturer
  - 3. Base Coat: Apply to exposed surfaces of insulation in minimum thickness recommended in writing by finish system manufacturer, but not less than 1/16-inch (1.6-mm) dry-coat thickness.
  - 4. Reinforcing Mesh: Embed type indicated below in wet base coat to produce wrinkle-free installation with mesh continuous at corners and overlapped not less than 2-1/2 inches (64 mm) or otherwise treated at joints to comply with ASTM C 1397 and finish system manufacturer's written instructions. Do not lap reinforcing mesh within 8 inches (204 mm) of corners. Completely embed mesh, applying additional base-coat material if necessary, so reinforcing-mesh color and pattern are not visible.
    - a. Standard-impact reinforcing mesh.
  - 5. Primer: Apply over dry base coat according to finish system manufacturer's written instructions.
  - 6. Finish Coat: Apply over dry primed base coat, maintaining a wet edge at all times for uniform appearance, in thickness required by finish system manufacturer to produce a uniform finish of color and texture matching approved sample and free of cold joints, shadow lines, and texture variations.
    - a. Texture: As selected by Architect from manufacturer's full range.



### 3.10 FIELD QUALITY CONTROL

- A. Above-Ceiling Observation: Before Contractor installs gypsum board ceilings, Architect will conduct an above-ceiling observation and report 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 seven days in advance of date and time when Project, or part of Project, will be ready for above-ceiling observation.
  2. Before notifying Architect, complete the following in areas to receive gypsum board ceilings:
    - a. Installation of 80 percent of lighting fixtures, powered for operation.
    - b. Installation, insulation, and leak and pressure testing of water piping systems.
    - c. Installation of air-duct systems.
    - d. Installation of air devices.
    - e. Installation of mechanical system control-air tubing.
    - f. Installation of ceiling support framing.

END OF SECTION 09 21 16

SECTION 09 51 00  
ACOUSTICAL CEILINGS

PART 1 – GENERAL

1.1 SUMMARY

- A. This section includes the following:
1. Acoustical lay-in panel ceilings
  2. Exposed suspension systems.
  3. Salvaged grid.
  4. Salvaged ceiling panels.

1.2 SUBMITTALS

- A. Submit product data for each type of product specified.

1.3 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 percent of amount installed.
  2. Exposed Suspension System Components: Furnish quantity of each exposed component equal to 2 percent of amount installed.

PART 2 - PRODUCTS

2.1 ACOUSTICAL PANELS

- A. See finish schedule on A900

2.2 METAL SUSPENSION SYSTEMS

- A. Manufacturers: Subject to compliance with requirements, provide Basis of Design Product (or substitution FIELD VERIFY COMPATIBILITY FOR PATCHING DURING BIDDING):
- i. Armstrong Suprafine 9/16" T bar grid .
- B. Standard for Metal Suspension Systems: Provide metal suspension systems of
- a. type, structural classification and finish indicated which comply with applicable
  - b. ASTM C635 requirements.
- C. Finish: Baked polyester paint.
- D. Color: White
- E. Attachment Devices: Size for 5 times design load indicated in ASTM C635, Table 1, Direct Hung.
1. Concrete Inserts: Inserts formed from hot-dipped galvanized sheet steel and designed for attachment to concrete forms and for embedment in concrete, with holes or loops for attachment at hanger wires.

F. Hanger Wire: Galvanized carbon steel wire, ASTM A641, soft temper, prestretched, Class 1 coating, sized so that stress at 3 times hanger design load (ASTM C635, Table 1, Direct Hung), will be less than yield stress of wire, but provide not less than 12 gage.

1. Provide stainless steel hanger wire when aluminum suspension systems are indicated.

G. Edge Moldings and Trim: Metal or extruded plastic of types and profiles indicated or, if not indicated, provide manufacturer's standard molding for edges and penetrations of ceiling which fits with type of edge detail and suspension system indicated.

H. Accessories: Armstrong Adaptor Clip (GC3W)

## PART 3 – EXECUTION

### 3.1 INSTALLATION

- A. Install acoustical tile ceilings to comply with ASTM C 636/C 636M and seismic design requirements indicated, according to manufacturer's written instructions and CISCA's "Ceiling Systems Handbook."
- B. Install edge moldings of type indicated at perimeter of acoustical ceiling area and at locations where necessary to conceal edges of acoustical units.
  1. Apply acoustical sealant in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.
  2. Screw attach moldings to substrate at intervals not 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.
  3. Do not use exposed fasteners, including pop rivets, on moldings and trim.
- C. For reveal-edged panels, rabbet all field-cut edges of panels to form reveal-edge of same depth and width as factory formed edges. Match profiles of factory-formed panel edges. Use only special cutting tool such as the "Reveal Border Saw" by Interior Systems for field cutting reveal-edge panels.
  1. 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.

END OF SECTION 09 51 00

SECTION 096466  
WOOD ATHLETIC FLOORING REFINISHING

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes wood athletic flooring refinishing.

1.2 ACTION SUBMITTALS

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

1.3 CLOSEOUT SUBMITTALS

- A. Maintenance data.

PART 2 - PRODUCTS

2.1 MATERIALS:

- A. Manufacturer: Bona Sport Poly 350 System

2.2 ACCESSORIES

- A. Resilient Wall Base: Reuse existing vented cove base. Remove, clean, and reinstall.

- B. Thresholds: See finish schedule

PART 3 - EXECUTION

3.1 FINISHING

A. Sanding

1. Sand per manufacturer's recommendations.
2. After sanding, buff entire floor using 100 grit screen or equal grit sandpaper, with a heavy-duty buffing machine.
3. Inspect entire area of floor to insure the floor presents a smooth surface without drum stop marks, gouges, streaks or shiners.
4. Vacuum and/or tack floor before first coat of seal.
5. Floor should be clean and completely free of dirt and sanding dust.

B. Finishing

1. SANDING AND FINISHING NEW FLOORS:
  - a. Sand and prepare floor using MFMA-accepted methods.
  - b. Make your final cut with 100-120-grit paper. Screen with 100-120-grit screen.
  - c. Vacuum thoroughly. 4. Tack with mineral spirits. 5. Apply sealer and finish system (see finish directions).
2. THE BONA SPORT POLY 350 SYSTEM: Bona Sport Poly 350 is a 3-coat system, 1 coat of a Bona oil-modified sport sealer, CourtLines paint (if desired) and 2 coats of Bona Sport Poly 350.
3. RECOMMENDED APPLICATORS: Heavy weight T-bar, Lambs wool applicator.  
NOTE: Use a clean applicator for sealer and a separate clean applicator for finish.
4. MIXING INSTRUCTIONS: Remove lid and stir thoroughly before using. DO NOT THIN.

5. FINISHING:
  - a. Apply Bona Sport Poly 350 with a heavy weight T-bar applicator. Go with the grain of the wood applying a thin, uniform coat.
  - b. BE SURE YOU ARE USING THE RECOMMENDED COVERAGE OF 600 SQ FT PER GALLON.
  - c. Avoid leaving puddles of excessive amounts of finish on the floor.
  - d. Allow first coat to dry thoroughly (approximately 18-24 hours). High humidity and/or low temperature conditions will extend dry time while increased ventilation and airflow will reduce dry time (recommended conditions of 65-80°F (18°-27° C)/40-60% relative humidity).
  - e. For proper adhesion, abrade between coats of finish. Allow final coat to dry a minimum of 72 hours before use.
  
6. INTERCOAT ABRASION FOR FLOORS WITHOUT GAME LINES: Abrade between all sealer and finish coats using Bona Conditioning Pads or 120 to 150 grit screens to ensure adhesion. Always vacuum and tack thoroughly after abrading.
  
7. RECOATING: Be sure floor is free from wax, polish and oily residues. Follow the Bona Prep® system, applying 1-2 coats of Bona Sport Poly 350. Delamination can occur if the Bona Prep process is not followed; always test for compatibility. Protect wood athletic flooring during remainder of construction period to allow finish to cure and to ensure that flooring and finish are without damage or deterioration at time of Substantial Completion.
  
8. CURING: The curing process takes approximately 14 days. The floor may be walked on after 24 hours, but the floor is susceptible to scuffing or marring prior to completion of the curing time. Do not replace athletic or walk-off mats until finish is fully cured. Do not clean with water or detergent during the curing process.

END OF SECTION 096466

SECTION 09 65 19 - RESILIENT BASE

PART 1- GENERAL

1.1 SUMMARY

- A. This section includes the following:
1. Resilient wall base and accessories.

1.2 SUBMITTALS

- A. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units showing the full range of colors and patterns available for each type of product indicated.
- B. Samples for Verification: Submit full-size tiles of each different color and pattern of resilient floor tile specified, showing the full range of variations expected in these characteristics.
1. For resilient accessories, manufacturer's standard-size samples, but not less than 12 inches (300 mm) long, of each resilient accessory color and pattern specified. Provide mock-up of each transition strip in conjunction with adjacent floor materials for owner's review.
- C. Product Certificates:
1. Submit certification by tile manufacturer that products supplied for tile installation comply with local regulations controlling use of volatile organic compounds (VOC's).
- D. Maintenance Data: Submit maintenance data for resilient base.

1.3 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an experienced installer to perform work of this section who has specialized in installing resilient products similar to those required for this Project and with a record of successful in-service performance.
- B. Source Limitations: Obtain each type, color, and pattern of product specified from one source with resources to provide products of consistent quality in appearance and physical properties without delaying the Work.
- C. Fire-Test-Response Characteristics: Provide products with the following fire-test-response characteristics as determined by testing identical products per test method indicated below by a testing and inspecting agency acceptable to authorities having jurisdiction.
1. Critical Radiant Flux: 0.45 W/sq. cm or greater when tested per ASTM E648.
  2. Smoke Density: Maximum specific optical density of 450 or less when tested per ASTM E662.

#### 1.4 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to Project site in manufacturer's original, 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 and 90 degrees F (10 and 32 degrees C).
- C. Move products into spaces where they will be installed at least 48 hours before installation, unless longer conditioning period is recommended in writing by manufacturer.

#### 1.5 PROJECT CONDITIONS

- A. Maintain a temperature of not less than 70 degrees F (21 degrees C) or more than 95 degrees F (35 degrees C) in spaces to receive products for at least 48 hours before installation, during installation, and for at least 48 hours after installation, unless manufacturer's written recommendations specify longer time periods. After post-installation period, maintain a temperature of not less than 55 degrees F (13 degrees C) or more than 95 degrees F (35 degrees C).
- B. Do not install products until they are at the same temperature as the space where they are to be installed.
- C. Close spaces to traffic during flooring installation and for time period after installation recommended in writing by manufacturer.
- D. Install accessories after other finishing operations, including painting, have been completed.
- E. Do not install flooring over concrete slabs until slabs have cured and are sufficiently dry to bond with adhesive, as determined by and moisture test.

#### 1.6 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed, are packaged with protective covering for storage, and are identified with labels describing contents.
  - 1. Furnish not less than 10 linear feet (3 linear m) for each 500 linear feet (150 linear m) or fraction thereof, of each type, color, pattern, and size of resilient accessory installed.
  - 2. Deliver extra materials to owner.

### PART 2- PRODUCTS

#### 2.1 MANUFACTURERS

- B. Rubber and vinyl base and flooring accessories:  
Acceptable Manufacturer:
  - 1. Roppe
  - 2. Armstrong Floor Division, Armstrong World Industries.
  - 3. BurkeMercer Flooring Products.
  - 4. Johnsonite.
  - 5. Basis of Design Product:
    - a. See Room Finish schedule drawing for basis of design & color.

## 2.2 INSTALLATION ACCESSORIES

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland-cement-based formulation provided or approved by flooring manufacturer for applications indicated.
- B. Adhesives: Type recommended by manufacturer to suit resilient products and substrate conditions indicated. See section 013546 - ENVIRONMENTAL REQUIREMENTS FOR INDOOR AIR QUALITY CONTROL for requirements.

## PART 3- EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions where installation of resilient products will occur, with Installer present, for compliance with manufacturer's requirements. Verify that substrates and conditions are satisfactory for resilient product installation and comply with requirements specified.

### 3.2 PREPARATION

- A. Comply with resilient product manufacturer's written installation instructions for preparing substrates indicated to receive resilient products.
- B. Remove coatings, including curing compounds, and other substances that are incompatible with flooring adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
- C. Broom and vacuum clean substrates to be covered immediately before product installation. After cleaning, examine substrates for moisture, alkaline salts, carbonation, or dust. Do not proceed with installation until unsatisfactory conditions have been corrected.



### 3.4 RESILIENT ACCESSORY INSTALLATION

- A. Install resilient accessories according to manufacturer's written installation instructions.
- B. Apply resilient wall base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.
  - 1. INSTALL WALL BASE IN LENGTHS AS LONG AS POSSIBLE WITHOUT GAPS AT SEAMS AND WITH TOPS OF ADJACENT PIECES ALIGNED.
  - 2. Tightly adhere wall base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.
  - 3. Do not stretch base during installation.
  - 4. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient wall base with manufacturer's recommended adhesive filler material.
  - 5. Form outside corners on job from straight pieces of maximum lengths possible, without whitening at bends. Shave back of base at points where bends occur and remove strips perpendicular to length of base that are only deep enough to produce a snug fit without removing more than half the wall base thickness.
  - 6. 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 a snug fit to substrate.
- C. Place resilient accessories so they are butted to adjacent materials and bond to substrates with adhesive. Install reducer strips at edges of flooring that would otherwise be exposed.
- D. Apply resilient products to stairs as indicated and according to manufacturer's written installation instructions.

### 3.5 CLEANING AND PROTECTING

- A. Perform the following operations immediately after installing resilient products:
  - 1. Remove adhesive and other surface blemishes using cleaner recommended by resilient product manufacturers.

END OF SECTION 09 65 19

SECTION 09 68 13  
TILE CARPETING

PART I- GENERAL

1.1 SUMMARY

- A. This Section includes carpet tile products, accessories and installation.

1.2 SUBMITTALS

- A. Submit product data for each type of product indicated. Include manufacturer's written data on physical characteristics, durability, and fade resistance. Include installation methods.
- B. Shop Drawings: Show the following:
1. Columns, doorways, enclosing walls or partitions, built-in cabinets, and locations where cutouts are required in carpet tiles.
  2. Existing flooring materials to be removed.
  3. Existing flooring materials to remain.
  4. Carpet tile type, color, and dye lot.
  5. Type of subfloor.
  6. Type of installation.
  7. Pattern of installation.
  8. Pattern type, location, and direction.
  9. Type, color, and location of edge, transition, and other accessory strips.
  10. Transition details to other flooring materials.
- C. Samples: Submit samples for each of the following products and for each color and texture required. Label each Sample with manufacturer's name, material description, color, pattern, and designation indicated on Drawings and in schedules.
1. Carpet Tile: Full-size sample.
  2. Exposed Edge Stripping and Accessory: 12 inch (300 mm) long samples.
- D. Product Schedule: Submit schedule of carpet tile using same room and product designations indicated on Drawings and in schedules.
- E. Maintenance Data: Submit maintenance data for carpet tile. Include the following:
1. Methods for maintaining carpet tile, including cleaning and stain-removal products and procedures and manufacturer's recommended maintenance schedule.
  2. Precautions for cleaning materials and methods that could be detrimental to carpet tile.
- F. Concrete Moisture Vapor Transmission Reduction System: Submit the following:
1. Plans showing the proposed moisture test and bond test locations, approved by the flooring manufacturer. Identify each location by a unique designation.
  2. Test results for all moisture and bond tests.

G. Certification that all concrete substrate surfaces have been inspected and are free of coatings, curing agents, alkali, have the required texture and are in conformance with ASTM F710 and the flooring and underlayment manufacturers' requirements.

### 1.3 QUALITY ASSURANCE

1. Installer Qualifications: An experienced installer who is certified by the Floor Covering Installation Board or who can demonstrate compliance with its certification program requirements.

A. Fire-Test-Response Ratings: Where indicated, provide carpet tile identical to those of assemblies tested for fire response according to NFPA 253 by a qualified testing agency.

B. Product Options: Products and manufacturers named in Part 2 establish requirements for product quality in terms of appearance, construction, and performance. Other manufacturers' products comparable in quality to named products and complying with requirements may be considered. Refer to Division 01, Section "Substitution Procedures".

C. Single-Source Responsibility: Obtain each type of carpet from one source and by a single manufacturer.

1. Dye Lot: Provide each carpet type beginning from the start of a full dye lot.

D. Mockups: Before installing carpet tile, install mockups for each type of carpet tile installation required to demonstrate aesthetic effects and qualities of materials and execution. Install mockups to comply with the following requirements, using materials indicated for the completed Work:

1. Install mockups in the location and of the size indicated or, if not indicated, as directed by Architect.
2. Notify Architect seven days in advance of dates and times when mockups will be installed.
3. Demonstrate the proposed range of aesthetic effects and workmanship.
4. Obtain Owner and Architect's approval of mockups before starting work.
5. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
6. Approved mockups may become part of the completed Work if undamaged at time of Substantial Completion.

### 1.4 DELIVERY, STORAGE, AND HANDLING

A. Comply with CRT 104, Section 5, "Storage and Handling".

B. Remove wrapping from carpet 24 hours prior to installation to allow "off-gassing" of carpet.

### 1.5 PROJECT CONDITIONS

A. Comply with CRT 104, Section 6.1, "Site Conditions; Temperature and Humidity".

B. Environmental Limitations: Do not install carpet tile until wet work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

C. Do not install carpet tile over concrete slabs until slabs have cured and are sufficiently dry to bond with adhesive and concrete slabs have pH range recommended by carpet tile manufacturer.

D. Where items are indicated for installation on top of carpet tile, install carpet tile before installing these items.

#### 1.6 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. Carpet Tile: Full-size units equal to 5 percent of amount installed for each type indicated, but not less than 10 sq. yd. (8.3 sq. m).

### PART 2- PRODUCTS

#### 2.1 CARPET CPT-1,

- A. See Room Finish Schedule drawing for basis of design.

#### 2.2 INSTALLATION ACCESSORIES

A. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided by or recommended by carpet tile manufacturer.

B. Adhesives: Water-resistant, mildew-resistant, nonstaining type to suit products and subfloor conditions indicated, that complies with flammability requirements for installed carpet tile and that is recommended by carpet tile manufacturer.

### PART 3- EXECUTION

#### 3.1 EXAMINATION

A. Examine substrates, areas, and conditions for compliance with requirements for maximum moisture content, alkalinity range, installation tolerances, and other conditions affecting carpet tile performance. Verify that substrates and conditions are satisfactory for carpet tile installation and comply with requirements specified.

B. Concrete Subfloors: Verify that concrete slabs comply with ASTM F710 and the following:

1. Slab substrates are dry and free of curing compounds, sealers, hardeners, and other materials that may interfere with adhesive bond. Determine adhesion and

dryness characteristics by performing bond and moisture tests. a. Test concrete in accordance with ASTM Standard F-2170-02.

Perform three (3) tests for each area under 2000 sq. ft., with one additional test for every additional 1000 sq. ft. Test locations shall be selected less than 5 feet from building perimeter, near window and door openings wherever possible. Pass threshold: Less than 85 percent ERH (Equilibrium Relative Humidity).

2. Subfloors are free of cracks, ridges, depressions, scale, and foreign deposits.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

A. Comply with CRT 104, Section 6.2, "Site Conditions; Floor Preparation," and carpet tile manufacturer's written installation instructions for preparing substrates indicated to receive carpet tile installation.

B. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, and depressions in substrates.

C. Remove coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, without using solvents. Use mechanical methods recommended in writing by carpet tile manufacturer.

D. Concrete-Subfloor Preparation: Apply concrete-slab primer, according to manufacturer's directions, where recommended by the carpet manufacturer.

1. Test concrete in accordance with ASTM Standard F-2170-02. Perform three (3) tests for each area under 2000 sq. ft., with one additional test for every additional 1000 sq. ft. Test locations shall be selected less than 5 feet from building perimeter, near window and door openings wherever possible. Pass threshold: less than 85% ERH (Equilibrium Relative Humidity).

E. Broom and vacuum clean substrates to be covered immediately before installing carpet tile. After cleaning, examine substrates for moisture, alkaline salts, carbonation, or dust. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.3 INSTALLATION

A. Comply with CRT 104, Section 13, "Carpet Modules (Tiles)".

B. Installation Method: Glue-down; install every tile with releasable adhesive.

C. Cut and fit carpet tile to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Bind or seal cut edges as recommended by carpet tile manufacturer.

D. Extend carpet tile into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.

E. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on finish flooring as marked on subfloor. Use nonpermanent, nonstaining marking device.

F. Install pattern parallel to walls and borders.

#### 3.4 CLEANING AND PROTECTION

- A. Perform the following operations immediately after installing carpet tile:
1. Remove excess adhesive, seam sealer, and other surface blemishes using cleaner recommended by carpet tile manufacturer.
  2. Remove yarns that protrude from carpet tile surface.
  3. Vacuum carpet tile using commercial machine with face-beater element.
- B. Protect installed carpet tile to comply with CRT104, Section 15, "Protection of Indoor Installations".
- C. Protect carpet tile against damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by carpet tile manufacturer.

END OF SECTION 09 68 13

SECTION 098300

ACOUSTIC DIFFRACTAL WALL PANELS

**PART 1 GENERAL**

1.01 SECTION INCLUDES

- A. 1-Dimensional Nested Sound Diffuser: DiffRACTAL<sup>®</sup>, Model 72MH
- B. Coordination with all trades having elements that attach to, penetrate through or are concealed behind/above the wood panels of this section.

1.02 PRODUCTS INSTALLED BUT NOT SUPPLIED UNDER THIS SECTION

- A. Wood mounting battens.

1.03 RELATED SECTIONS

- A. Section 06420 – Wood Paneling
- B. Section 09120 – Suspension Framing/Furring for Plaster/Gypsum Board Assemblies
- C. Section 09250 – Gypsum Board
- D. Division 15 Sections – Mechanical Work
- E. Division 16 Sections – Electrical Work
- F. Division 17 Sections – Audio, Data, Telecommunication Work

1.04 DEFINITIONS

- A. 1-Dimensional Nested Sound Diffusers can be either independent, stand alone units or specially fabricated so that standard size units join together to form a continuous, larger unit.
- B. Well Terminations
  - 1. End (E): Last partial width end well terminates with solid, side board, which is usually exposed visually.
  - 2. Half (H): Last well is half width without a side board and meant to abut against adjacent wall at inside corners where open side is concealed visually.
  - 3. Joining (J): Last well is half width without well board or side board (top & bottom only). Full width joining well board is inserted into top and bottom between two adjoining units to form one continuous Diffuser.
- C. Unit Types
  - 1. End/End (E/E): Unit has two end wells and side boards to make standalone unit.
  - 2. End/Half (E/H): Unit has one end well and one half well to abut against inside corner.
  - 3. End/Joining (E/J): Unit has one end well and one joining well to adjoin with adjacent unit.
  - 4. Half/Half (H/H): Unit has two half wells to fit into opening where sides are not visible.
  - 5. Half/Joining (H/J): Unit has one half well to abut against inside corner and one joining well to adjoin with adjacent unit.
  - 6. Joining/Joining (J/J): Unit has two joining wells to adjoin to adjacent units on both sides.

7. Note: Well termination type and unit type do not affect cost significantly and usually are not detailed until the shop drawings are prepared.

#### 1.05 ALTERNATES

- A. Prior Approval: Proposed substitutions for products in this section may be submitted to the architect and acoustical consultant no later than ten (10) working days prior to the bid due date. Substitutions shall only be considered if submitted with complete information including acoustic data and a sample not smaller than 59 cm x 59 cm (23" x 23") showing product design, composition and finish. Acceptance of substituted products is contingent on the architect's and acoustical consultant's approval and the substitution's compliance with all specified criteria. The architect shall approve substitution request via addendum.
- B. Unapproved Substitutions. Substitutions not approved via addendum shall not be submitted to the architect or acoustical consultant.

#### 1.06 REFERENCES

- A. Local Building Code – Current Edition
- B. International Organization for Standardization
  1. ISO 354 Measurement of Sound Absorption in a Reverberation Room
  2. ISO 10534 - Determination of sound absorption coefficient and impedance in impedance tubes - Part 1: Method using standing wave ratio.
  3. ISO 17497-1 Sound-scattering properties of surfaces- Part 1: Measurement of the random-incidence scattering coefficient in a reverberation room.
- C. AES-4id-2001: AES Information Document for Room Acoustics & Sound Reinforcement Systems – Characterization & Measurement of Surface Scattering Uniformity.
- D. American Society for Testing & Materials (ASTM)
  1. ASTM E 1050-98 - Standard Test Method for Impedance and Absorption of Acoustical Materials Using a Tube, Two Microphones, and a Digital Frequency Analysis System
  2. ASTM C 423 - Sound Absorption & Sound Absorption Coefficients by the Reverberation Room Method
  3. ASTM E 84: Standard Test Method for Surface Burning Characteristics of Building Materials
- E. Published technical papers
  1. T.J. Cox, B-I.Dalenback, P. D'Antonio, J.J. Embrechts, J.Y. Jeon, E. Mommertz and M. Vorlaender, "A tutorial on scattering and diffusion coefficients for room acoustic surfaces", Acta Acustica uW Acustica, 92, 1-15 (2006)
  2. AES-4id-2001, "AES Information document for room acoustics and sound reinforcement systems- Characterization and measurement of surface scattering uniformity", J. Audio Engineering Soc., 49(3), 149-165 (2001)
  3. E. Mommertz, Appl. Acoust., 60(2), 201-204 (2000)

#### 1.07 SUBMITTALS

- A. Product Data: Submit manufacturers' technical data including basic system description, options and component sizes. Identify all applicable features and options. Cross out any inapplicable features or options.
- B. Shop Drawings: The contractor shall produce and submit shop drawings of products and suspension or mounting systems overlaid on base drawings (interior elevations or reflected ceiling plans) supplied electronically by the architect. Show overall layout with dimensions



and references to details as necessary for penetrations, joints, ends and intersections with other materials or building components. Submit schedule of all quantities, sizes, hole patterns, edge banding, borders, veneers and finishes. Field verify site conditions with dimensions shown on shop drawings.

- C. Samples: Minimum 29.2 cm (11-1/2") x 22.9 cm (9") sample of specified wood and finish.
- D. Certifications: Manufacturers' certifications that products comply with specified requirements, including laboratory reports showing compliance with specified tests and standards.

#### 1.08 QUALITY ASSURANCE

- A. Qualifications: Manufacturer and installation contractor shall have a minimum of three years experience with similar systems.
- B. Single Source: All products under this section shall be supplied by a single manufacturer to ensure consistency in product size and finish.
- C. Woodworking Standards: Manufacturer to comply with specified provisions of Architectural Woodworking Institute quality standards.
- D. Flame Spread / Smoke Developed Characteristics: Product components tested by independent, accredited NVLAP facility according to ASTM E 84 and NFPA 255.
  - 1. Composite Flame Spread Rating: 25 (maximum)
  - 2. Smoke Developed: 450 (maximum)
- E. Pre-Installation Meeting: Installing contractor shall organize and conduct pre-installation meetings with all other trades to coordinate substrate conditions, conditioning of the space (temperature & humidity), and elements attaching to, penetrating through or concealed above/behind work in this section.

#### 1.09 DELIVERY STORAGE AND HANDLING

- A. Shipping, Handling and Unloading: Deliver wood panels to the project site in the manufacturer's original, unopened packaging. Do not unpack or handle finished products until the project environmental requirements have been met and the products are ready to be installed.
- B. Storage and Protection: Store all wood panels and associated wood trim pieces in a clean, dry, fully-enclosed storage facility. Protect products from damage that may be caused by exposure to water, chemicals, direct sunlight or infestation.
- C. Acceptance at Site: Ensure that all project environmental requirements have been met prior to unpacking or installing wood panels and all associated wood trim products. Full or partial installation constitutes complete product acceptance.
- D. Waste Management and Disposal: Dispose of all packaging materials and debris in a safe and environmentally responsible manner according to the instructions set forth by the General Contractor, local ordinances or codes and the Environmental Protection Agency.

#### 1.10 PROJECT CONDITIONS

- A. Project Environmental Requirements: Prior to unpacking or installing wood products, ensure that the installation area is fully enclosed and protected from moisture and direct sunlight. Ensure that the building's mechanical systems are fully operational and will not be turned off again even for testing and balancing of the mechanical systems. Coordinate with other trades to ensure that all work above or behind wood surfaces is complete and that all wet and dusty trades have completed work.

- B. Product Acclimation: For a minimum period of seventy-two (72) hours and prior to unpacking or installing any wood products, allow both the installation area and the wood products to stabilize in temperature and humidity levels that are representative of the final temperature and humidity levels expected after building completion and occupation. Do not install products if the humidity exceeds 65%.
- C. Product Handling: Handle wood panels carefully so as to avoid chipping, scratching, scuffing or denting the wood finish or edges.

#### 1.11 WARRANTY

- A. Submit to Owner or Owner's Representative a written and dated warranty issued by the wood ceiling/wall manufacturer warranting the wood panels and associated trim pieces against defects in materials or manufacturing for a period of one (1) year from the date of delivery.
- B. Components used in the system but not provided by the manufacturer are excluded from the manufacturer's warranty. Damage caused by exposure to moisture or rapid or extreme changes to temperature or humidity are excluded from the manufacturer's warranty. Damage caused by improper storage, handling, acclimatization, or installation is excluded from the warranty. Appearances and colorings of wood products, stains and finishes can vary over time and as site conditions change and are therefore excluded from the warranty.

#### 1.12 OWNER'S INSTRUCTIONS

- A. Installing contractor shall provide to the building owner or to the owner's representative a copy of the manufacturer's maintenance manual supplied with the panels.

#### 1.13 MAINTENANCE

- A. Extra Materials: If provided per the project requirements, extra materials shall remain in the manufacturer's original, unopened packaging and shall be given to the building owner or owner's representative upon substantial completion of work.

### **PART 2 PRODUCTS**

#### 2.01 MANUFACTURER

- A. RPG Diffusor Systems, Inc., 651-C Commerce Drive, Upper Marlboro, MD 20774 301-249-0044 (telephone), 301-249-3912 (facsimile), <http://www.rpginc.com>.

#### 2.02 MATERIALS

- A. Class-A Duraflake core (1/2") with rotary cut, uniform, birch veneer (or different wood species as selected by architect).

#### 2.03 MANUFACTURED UNITS

- A. Unit Dimensions
  1. Standard 2 x 2 Units: Height 23-5/8", Width 23-5/8", Depth 9-1/8"
  2. Standard 4 x 2 Units: Height 47-1/4", Width 23-5/8", Depth 9-1/8"
  3. Custom Units: Height 96" maximum, Depth 4" minimum)

- B. Weight
  - 1. Standard 2 x 2 Units: 36 pounds (maximum)
  - 2. Standard 4 x 2 Units: 68 pounds (maximum)
  - 3. Custom: approximately 8.5 pounds per square foot (assuming 9-1/8" depth)

#### 2.04 ACCESSORIES

- A. Wall Cleats: Units are supplied with top and bottom wood wall cleats that are screwed to substrate prior to diffuser installation.

#### 2.05 FINISHES

- A. Shop Finishing: Units shall be shop-finished with paint per architect selection, clear lacquered without stain, or stained and lacquered per architect selection prior to arrival at site.

### **PART 3 EXECUTION**

#### 3.01 INSTALLERS

- A. Installing contractor shall have a minimum of five (5) years successful experience installing wood ceiling and wall systems in similar applications using similar mounting techniques or suspension systems.

#### 3.02 EXAMINATION

- A. Site Verification of Conditions: Examine installation area for compliance with all manufacturers' project environmental requirements and ensure uninstalled products have been stored, handled and acclimatized properly prior to commencing installation. Inspect all substrates for completion and quality of work to ensure that surfaces are level, plumb, clean, dry and completely cured from water or solvent evaporation. Do not commence installation if the structural capacity of the substrate is questionable or inadequate.
- B. Coordination with Other Trades: Coordinate with all other trades to ensure that wet work including concrete, terrazzo, plastering, painting, etc. in the installation area is complete, cured and dry prior to installation. Coordinate with all other trades to verify that components associated with mechanical, electrical, lighting, data, telecommunication, audio, video, fire suppression and other building systems are installed behind or above designated installation areas prior to commencing installation. Coordinate the exact size, location and sequencing of building system components that penetrate the wood ceiling/wall panels.

#### 3.03 PREPARATION

- A. Protection: Protect all floor, wall and ceiling finishes against possible damage prior to commencing installation and during installation.
- B. Surface Preparation: When necessary, field measure substrates to acquire accurate dimensions of wood panels and submit final dimensions to manufacturer.
- C. Dry Fit (Joining Units Only): Prior to commencing installation of joining units, unpack all diffuser pieces and set pieces on clean, soft, dry surface. Ensure that all pieces are present and dry fit all pieces together.

- D. Field Measure: Prior to commencing installation, measure diffusers (standard units or dry-fit joining units) and ensure that dimensions correspond to field measured dimensions of installation area.

#### 3.04 INSTALLATION

- A. Install wood panels as shown and detailed in the architectural drawings and according to manufacture's guidelines and industry standards.
- B. Install wood wall cleats provided with diffusers.
- C. Install diffusers by placing units over cleats and screwing through tops and bottoms of diffusers into wall cleats.
- D. Install units so that finished side with wells faces into occupied space.

#### 3.05 CONSTRUCTION

- A. Interface with Other Work: Support all light fixtures, HVAC air inlet/outlet devices, speakers, signage, sprinkler heads/piping, etc. independently from wood panels. Contractor shall not use wood panels to support the weight of any other building element or component.

#### 3.06 ADJUSTING

- A. Following initial installation, adjust mounting hardware or suspension system so that removable panels can be removed easily, yet stay safely secured upon replacement. Adjust panels so that surfaces are aligned, flush and level or plumb and gaps in between units are of a consistent width and straight.
- B. Check that manufacturer's joining requirements were maintained during installation.
- C. Remove and replace at no extra charge any damaged panels that cannot be repaired to the Owner's and Architect's satisfaction.

#### 3.07 CLEANING

- A. Remove dust from surfaces and penetrations by vacuuming using only a soft brush. Do not scratch wood surfaces with sharp metal or plastic vacuum cleaner extensions. Remove pencil marks with soft erasure. Remove general surface dirt with a clean, soft cloth dampened with a diluted, mild, cleaning agent and warm water. Wipe again with clean, soft cloth dampened only with warm water. Finally, dry surface completely with clean, dry cloth. Do not use abrasive cleaners with grit or cloths that could scratch the wood finish.
- B. Remove and replace at no additional charge any materials that cannot be cleaned to the Owner's satisfaction.

#### 3.08 DEMONSTRATION

- A. Demonstrate to the building owner or to the owner's representative the safe and proper method for removing and replacing all types of accessible panels.
- B. Supply the building owner or the owner's representative with any special tools provided by the manufacturer required to unlatch safety hardware on accessible panels.

#### 3.09 PROTECTION

Edgecliff Hall Renovation  
Xavier University  
Cincinnati Ohio

- A. Upon completion of work, protect installed wood surfaces from damage or soiling until project substantial completion and owner occupancy.

END OF SECTION

**SECTION 09840**  
**ACOUSTICAL WALL TREATMENT**

**PART 1 GENERAL**

1.01 SUMMARY

- A. Section Includes: Custom fabricated acoustical wall panels.

1.02 REFERENCES

- A. ASTM International:
  - 1. ASTM C423 Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.
  - 2. ASTM E84 Standard Test Method for Surface Burning Characteristics of Building Materials.
  - 3. ASTM E795 Standard Practices for Mounting Test Specimens During Sound Absorption Tests.

1.03 SYSTEM DESCRIPTION

- A. Performance Requirements:
  - 1. Surface Burning Characteristics (ASTM E84):
    - a. Flamespread: 25 maximum.
    - b. Smoke Developed: 450 maximum.
    - c. Fire ratings for all fabric covered panels is based on testing of the panel wrapped with the standard in stock fabric, Guilford of Maine, Model FR 701.
    - d. This rating applies to all acoustical wall treatment unless specifically excluded in the product specification section 2.02.

1.04 SUBMITTALS

- A. General: Submit listed submittals in accordance with Conditions of the Contract and Division 1 Submittal Procedures Section.
- B. Product Data: Submit product data sheet, for specified products.
- C. Shop Drawings: Submit shop drawings showing layout, edge profiles and panel components, including anchorage, accessories, finish colors and textures.
- D. Samples: Submit selection and verification samples of finishes, colors and textures.
- E. Test Reports: Certified test reports showing compliance with specified performance requirements.
  - 1. Standard Systems: Submit certified copies of previous test reports substantiating performance of system in lieu of retesting.

1.05 DELIVERY, STORAGE & HANDLING

- A. General: Comply with Division 1 Product Requirements Section.
- B. Delivery: Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.
- C. Storage and Protection: Store materials protected from exposure to harmful environmental conditions and at temperature and humidity conditions recommended by the manufacturer.

#### 1.06 PROJECT CONDITIONS

- A. Environmental Requirements: Do not install panels until wet work, such as concrete and plastering, is complete; the building is enclosed; and the temperature and relative humidity are stabilized at 60 - 80 degrees F (16 - 27 degrees C) and 35% MINIMUM RH and 55% MAXIMUM RH, respectively. All products constructed with wood or wood fiber content must be stored for at least 72 hours in the controlled environment specified herein prior to installation to allow the materials to stabilize.

### **PART 2 PRODUCTS**

#### 2.01 ACOUSTICAL WALL PANELS

- A. Manufacturer: Kinetics Noise Control.
  - 1. Contact: PO Box 655, 6300 Irelan Place, Dublin, OH 43017; Telephone: (614) 889-0480; Fax: (614) 889-0075; E-mail: [intsales@kineticsnoise.com](mailto:intsales@kineticsnoise.com); Web site: [www.kineticsnoise.com](http://www.kineticsnoise.com).
- B. Substitutions: No substitutions permitted.

#### 2.02 MANUFACTURED UNITS

- A. Tuned Absorber Diffuser, Model TAD Panels:
  - 1. Thickness: 2"
  - 2. Sizes:
    - a. 24 inches (588 mm) x 48 inches (1176 mm),
    - b. 36 inches (914 mm) x 48 inches (1176 mm),
    - c. 48 inches (1176 mm) x 48 inches (1176 mm)
  - 3. Core: 2 inch (49 mm) thick cores for greater low frequency absorption.
  - 4. Edge Detail: Square hardened with non-resin, Class A hardening solution
  - 5. Impact resistant, 1/8 inch (6 mm) thick hardboard facing laminated to the core. Randomized 1/2 inch (12 mm) diameter hole pattern designed to tune the panel for greater absorption in the 250 to 1000 Hz frequency range while providing increased diffusion of reflected sound relative to a flat surface.
  - 6. Fabric Facing: [100% polyester fabric, FR 701 Style 2100 by Guilford of Maine] [Factory approved customer selected fabric]. Designer selected fabrics must be approved by the panel manufacturer as acceptable quality for wrapping and covering core materials. Some fabrics are unstable, too stiff, or lack the weight and thread density for producing an acceptable finish product.

- a. Color: [As selected from panel manufacturer's stocked range of colors] [As selected from fabric manufacturer's full range of colors].
7. Sound Absorption (ASTM C423): Noise Reduction Coefficient of 0.70. Absorption coefficients in the 2500 Hz to 5000 Hz frequency range shall not exceed 0.55 at any single 1/3 octave band.

Specifier note: NRC, sound absorption data is based on testing with Guilford FR701 fabric. To maintain specified sound absorption, fabrics should be selected that allow air to pass easily through the material into the acoustical core.

8. Scattering Coefficients per ISO 17497-1, Acoustic Sound Scattering Properties of Surfaces, must average 0.12 or greater for 1/3 octave bands from 800 Hz to 10,000 Hz (1-1/8 inch panel thickness).
9. Mounting Accessories: Z-brackets
10. Surface Burning Characteristics: The fiberglass core and Guilford FR701 fabric have been tested and achieved a Class A rating per ASTM E84. The 1/8 inch thick laminate is not included in the fire test results and may change the composite panel's fire rating.

### **PART 3 EXECUTION**

#### **3.01 MANUFACTURER'S INSTRUCTIONS**

- A. Compliance: Comply with manufacturer's product data, including product technical bulletins, product catalog installation instructions and product carton instructions for installation.

#### **3.02 EXAMINATION**

- A. Site Verification of Conditions: Verify that substrate conditions, which have been previously installed under other sections, are acceptable for product installation in accordance with manufacturer's instructions.
  1. Verify that stud spacing is 16 inches (406 mm) oc, maximum, for panels installed over open studs.
  2. Do not install panels until unsatisfactory conditions are corrected.

#### **3.03 CLEANING**

- A. Follow manufacturer's instructions for cleaning panels soiled during installation. Replace panels that cannot be cleaned to as new condition.
- B. Keep site free from accumulation of waste and debris.

**END OF SECTION**



SECTION 09848

2-DIMENSIONAL SOUND DIFFUSING CEILING CLOUD  
(WAVEFORM™ BIRADIAL-G)

**PART 1 GENERAL**

1.01 SECTION INCLUDES

- A. 2-Dimensional Sound Diffusing Ceiling Cloud: Waveform™ Biradial-G.
- B. Suspension hardware and anchors.

1.02 PRODUCTS RECOMMENDED BUT NOT SUPPLIED UNDER THIS SECTION

- A. \_\_\_ (yes) \_\_\_ (no) Fiberglass Batts, low density (1-3 pcf) on topsides of Diffusers.
- B. Metal cable seismic suspension hardware and building anchors.

1.03 RELATED SECTIONS

- A. Section 09510 – Acoustical Ceilings
- B. Division 13 Sections – Fire Suppression
- C. Division 15 Sections – Mechanical Work
- D. Division 16 Sections – Electrical Work
- E. Division 17 Sections – Audio, Data, Telecommunication Work

1.04 ALTERNATES

- A. Prior Approval: Proposed substitutions for products in this section may be submitted to the architect and acoustical consultant no later than ten (10) working days prior to the bid due date. Substitutions shall only be considered if submitted with complete information including acoustic data and a full size sample showing product design, composition, size and finish. Acceptance of substituted products is contingent on the architect's and acoustical consultant's approval and the substitution's compliance with all specified criteria. The architect shall approve substitution requests via an addendum.
- B. Unapproved Substitutions. Substitutions not approved via addendum shall not be submitted to the architect or acoustical consultant.

1.05 REFERENCES

- A. Local Building Code – Current Edition
- B. International Organization for Standardization
  - 1. ISO 354 Measurement of Sound Absorption in a Reverberation Room
  - 2. ISO 10534 - Determination of sound absorption coefficient and impedance in impedance tubes - Part 1: Method using standing wave ratio.
  - 3. ISO 17497-1 Sound-scattering properties of surfaces- Part 1: Measurement of the random-incidence scattering coefficient in a reverberation room.
- C. AES-4id-2001: AES Information Document for Room Acoustics & Sound Reinforcement Systems – Characterization & Measurement of Surface Scattering Uniformity.
- D. American Society for Testing & Materials (ASTM)

1. ASTM E 1050-98 - Standard Test Method for Impedance and Absorption of Acoustical Materials Using a Tube, Two Microphones, and a Digital Frequency Analysis System
  2. ASTM C 423 - Sound Absorption & Sound Absorption Coefficients by the Reverberation Room Method
  3. ASTM E 84: Standard Test Method for Surface Burning Characteristics of Building Materials
- E. Published technical papers
1. T.J. Cox, B-I.Dalenback, P. D'Antonio, J.J. Embrechts, J.Y. Jeon, E. Mommertz and M. Vorlaender, "A tutorial on scattering and diffusion coefficients for room acoustic surfaces", Acta Acustica uW Acustica, 92, 1-15 (2006)
  2. AES-4id-2001, "AES Information document for room acoustics and sound reinforcement systems- Characterization and measurement of surface scattering uniformity", J. Audio Engineering Soc., 49(3), 149-165 (2001)
  3. E. Mommertz, Appl. Acoust., 60(2), 201-204 (2000)

#### 1.06 SUBMITTALS

- A. Product Data: Submit manufacturers' technical data including basic system description, options and component sizes. Identify all applicable features and options. Cross out any inapplicable features or options.
- B. Shop Drawings: The contractor shall produce and submit shop drawings of products and suspension or mounting systems overlaid on base drawings (interior elevations or reflected ceiling plans) supplied electronically by the architect. Show overall layout with dimensions and references to details as necessary for penetrations, joints, ends and intersections with other materials or building components. Submit schedule of all quantities and finishes. Field-verify site conditions with dimensions shown on shop drawings.
- C. Samples: 10" (25.4cm) x 10" (25.4cm) size sample of specified panel and finish.
- D. Certifications: Manufacturers' certifications that products comply with specified requirements, including laboratory reports showing compliance with specified tests and standards.

#### 1.07 QUALITY ASSURANCE

- A. Flame Spread / Smoke Developed Characteristics: Tested by independent, accredited NVLAP facility according to ASTM E 84 and NFPA 255.
  1. Composite Flame Spread Rating: 25 (maximum)
  2. Smoke Developed: 450 (maximum)

#### 1.08 DELIVERY STORAGE AND HANDLING

- A. Packing, Shipping, Handling and Unloading: Deliver Diffusers to the project site in the manufacturer's original, unopened packaging. Diffusers are fragile and must be removed from packaging and handled with care. Diffusers should be handled by no less than four people, one in each corner. Raise and lower diffusers uniformly when moving. Raising units by one end or corner may result in bending or twisting and breakage.
- B. Acceptance at Site: Installation constitutes complete acceptance.
- C. Storage and Protection: Protect stored units from water and extreme moisture. Store units flat on clean, level, dry surface.

- D. Waste Management and Disposal: Dispose of all packaging materials and debris in a safe and environmentally responsible manner according to the instructions set forth by the General Contractor, local ordinances or codes and the Environmental Protection Agency.

#### 1.09 PROJECT CONDITIONS

- A. Project Environmental Requirements: Installation area shall be enclosed, protected from weather and be temperature and humidity controlled prior to unpacking and installing Diffusers.

#### 1.10 WARRANTY

- A. Submit to Owner or Owner's Representative a written and dated warranty issued by the Diffuser manufacturer warranting the Diffusers against defects in materials or manufacturing for a period of one (1) year from the date of delivery.
- B. Components used in the system but not provided by the manufacturer are excluded from the manufacturer's warranty. Damage caused by exposure to moisture or rapid or extreme changes to temperature or humidity are excluded from the manufacturer's warranty. Damage caused by improper storage, handling, acclimatization, or installation is excluded from the warranty.

### **PART 2 PRODUCTS**

#### 2.01 MANUFACTURERS

- A. RPG Diffuser Systems, Inc., 651-C Commerce Drive, Upper Marlboro, MD 20774 301-249-0044 (telephone), 301-249-3912 (facsimile), <http://www.rpginc.com>.

#### 2.02 MATERIALS

- A. The 2-Dimensional Sound Diffusing Ceiling Cloud shall be fabricated from 1/8" thick, non-combustible glass reinforced gypsum.

#### 2.03 MANUFACTURED UNITS

- A. Unit Dimensions: 48" (121.9cm) x 48" (121.9cm). Assembly Dimensions (2x2 unit configuration): 96" (243.8cm) x 96" (243.8cm). 1/8" nominal material thickness. Assembly depth 14.3" (36.3cm).
- B. Surface Weight 3 psf (maximum), Unit Weight: 50 lbs (maximum); Assembly Weight 256 lbs.
- C. Suspension Points: Units shall have embedded metal loops to which supporting hardware can be attached.

#### 2.04 FINISHES

- A. Factory applied stained finish

### **PART 3 EXECUTION**

#### 3.01 INSTALLERS

- A. Installing contractor shall have a minimum of five (5) years successful experience installing ceiling systems in similar applications using similar mounting techniques or suspension systems.

### 3.02 EXAMINATION

- A. Site Verification of Conditions: Examine installation area for compliance with all manufacturers' project environmental requirements and ensure uninstalled products have been stored, handled and acclimatized properly prior to commencing installation. Inspect all substrates for completion and quality of work to ensure that surfaces are level, plumb, clean, dry and completely cured from water or solvent evaporation. Do not commence installation if the structural capacity of the substrate is questionable or inadequate.
- B. Coordination with Other Trades: Coordinate with all other trades to ensure that wet work including concrete, terrazzo, plastering, painting, etc. in the installation area is complete, cured and dry prior to installation. Coordinate with all other trades to verify that components associated with mechanical, electrical, lighting, data, telecommunication, audio, video, fire suppression and other building systems are installed behind or above designated installation areas prior to commencing installation. Coordinate the exact size, location and sequencing of building system components that penetrate the ceiling/wall panels.

### 3.03 PREPARATION

- A. Protection: Protect all floor, wall and ceiling finishes against possible damage prior to commencing installation and during installation.
- B. Surface Preparation: When necessary, field measure substrates to acquire accurate dimensions of panels and submit final dimensions to manufacturer.

### 3.04 INSTALLATION

- A. Install panels as shown and detailed in the architectural drawings and according to manufacturer's guidelines and industry standards. For ceiling application only.

### 3.05 CONSTRUCTION

- A. Interface with Other Work: Support all light fixtures, HVAC air inlet/outlet devices, speakers, signage, sprinkler heads/piping, etc. independently from panels. Contractor shall not use panels to support the weight of any other building element or component.

### 3.06 ADJUSTING

- A. Following initial installation, adjust mounting hardware or suspension system so that removable panels can be removed easily, yet stay safely secured upon replacement. Adjust panels so that surfaces are aligned, flush and level or plumb and gaps in between units are of a consistent width and straight.
- B. Remove and replace at no extra charge any damaged panels that cannot be repaired to the Owner's and Architect's satisfaction.

### 3.07 CLEANING

- A. Remove dust from surfaces and penetrations by vacuuming using only a soft brush. Do not scratch surfaces with sharp metal or plastic vacuum cleaner extensions. Remove pencil marks with soft erasure. Remove general surface dirt with a clean, soft cloth dampened with a diluted, mild, cleaning agent and warm water. Wipe again with clean, soft cloth dampened only with warm water. Finally, dry surface completely with clean, dry cloth. Do not use abrasive cleaners with grit or cloths that could scratch the finish.
- B. Remove and replace at no additional charge any materials that cannot be cleaned to the Owner's satisfaction.

### 3.08 DEMONSTRATION

- A. Demonstrate to the building owner or to the owner's representative the safe and proper method for removing and replacing all types of accessible panels.
- B. Supply the building owner or the owner's representative with any special tools provided by the manufacturer required to unlatch safety hardware on accessible panels.

### 3.09 PROTECTION

- A. Upon completion of work, protect installed surfaces from damage or soiling until project substantial completion and owner occupancy.

END OF SECTION

SECTION 09 91 23  
PAINTING AND COATING

PART 1 - GENERAL

1.1 SUMMARY

A. This section includes surface preparation and field painting of the following:

1. Exposed interior items and surfaces.
2. Surface preparation, priming, and finish coats specified in this section are in addition to shop priming and surface treatment specified in other sections.

B. Paint exposed surfaces 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 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.

1.2 SUBMITTALS

A. Submit samples of manufacturers' latest color chips for selection by the Architect. Colors shall be selected by Architect prior to commencement of the painting work.

B. Samples for Verification Purposes: Provide samples of each color and material to be applied, with texture to simulate actual conditions, on representative samples of the actual substrate. Define each separate coat, including block fillers and primers. Use representative colors when preparing samples for review. Resubmit until required sheen, color, and texture are achieved.

1. Provide a list of material and application for each coat of each sample. Label each sample as to location and application.
2. Submit samples for the Architect's review of color.

1.3 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 other undercoat paint produced by same manufacturer as finish coats. Use thinners approved by paint manufacturer, and use within recommended limits.

C. Coordination of Work: Review other sections in which primers are provided to ensure compatibility of the total systems for various substrates. On request, furnish information on characteristics of finish materials to ensure use of compatible primers.

1. Notify the Architect of problems anticipated using the materials specified.

D. 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.

E. Provide products which comply with all state and local regulations controlling use of volatile organic compounds (VOCs).

#### 1.4 MOCK-UPS

A. Before proceeding with the work, a representative room with permanent lighting shall be designated for the mockup and the walls finish painted in a white color. Samples of the various wall color schemes shall be prepared on 4 foot by 8 by 1/4" foot sheets of gypsum board (one color to each sheet) and exhibited in the mock-up room for Architect's approval.

1. If requested by Architect, prepare a new mock-up for each color as many as two more times, with minor tint adjustments, for final color approval.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

A. Architectural Coating Products: Basis of design products are listed in the schedule. Substitutions will be considered if adequate documentation is provided during bidding.

#### 2.2 MATERIALS

A. Provide paint products listed in schedules at end of this section for the various paint systems and substrates indicated.

B. Sealers and primers: As recommended by the finish paint manufacturer.

C. Spackle: An approved plaster filler.

D. Gypsum board joint compound finish system shall be as approved by gypsum board manufacturer.

E. Tinting material shall be of the best quality, universal colorants ground in propylene glycol, alkali proof, non-fading, lead-free colorants.

1. Tint all primers and undercoats to the approximate shade (lighter or darker, depending on color selected) of the finish coat. Where the color schedule calls for the use of "deeptones" it is the responsibility of the painting subcontractor to utilize the appropriate deep base primers for use on the surfaces for which they are intended.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

A. Examine substrates and conditions under which painting will be performed for compliance with requirements for application of paint. Do not begin paint application until unsatisfactory conditions have been corrected.

1. Start of painting will be construed as the Applicator's acceptance of surfaces and conditions within a particular area.

#### 3.2 PREPARATION

A. General Procedures: Remove hardware and hardware accessories, plates, machined surfaces, lighting fixtures, and similar items in place that are not to be painted, or provide surface-applied protection prior to surface preparation and painting. Remove these items if necessary for complete painting of 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.

1. Clean surfaces before applying paint or surface treatments. Remove oil and grease prior to cleaning. Schedule cleaning and painting so that dust and other contaminants from the cleaning process will not fall on wet, newly painted surfaces.

B. Surface Preparation: Clean and prepare surfaces to be painted in accordance with the manufacturer's instructions for each particular substrate condition and as specified.

1. Provide barrier coats over incompatible primers or remove and re-prime. Notify Architect in writing of problems anticipated with using the specified finish coat material with substrates primed by others.
2. Cementitious Materials: Prepare concrete masonry block 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 blistering and burning of finish paint, correct this condition before application. Do not paint surfaces where moisture content exceeds that permitted in manufacturer's printed directions.
3. Ferrous Metals: Clean non-galvanized 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 Steel Structures Painting Council.
  - a. Blast steel surfaces clean as recommended by the paint system manufacturer and in accordance with requirements of SSPC specification SSPS-SP 10.
  - b. Treat bare and sandblasted or pickled clean metal with a metal treatment wash coat before priming.
  - c. Materials Preparation: Carefully mix and prepare paint materials in accordance with manufacturer's directions.
    1. Maintain containers used in mixing and application of 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 thinners approved by the paint manufacturer, and within recommended limits.

### 3.3 APPLICATION

A. Apply paint in accordance with manufacturer's directions. Use applicators and techniques best suited for substrate and type of material being applied.

- a. SPRAY APPLY PAINT for SHELVES to be painted.

B. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions detrimental to formation of a durable paint film.

C. Paint colors, surface treatments, and finishes are indicated in "schedules."

D. Provide finish coats that are compatible with primers used.

E. The number of coats and film thickness required is 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 an even smooth surface in accordance with the manufacturer's directions.

F. Apply additional coats when undercoats, stains, or other conditions show through final coat of paint until paint film is of uniform finish, color, and appearance. 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.



G. The term "exposed surfaces" includes areas visible when permanent or built-in fixtures, convector 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.

H. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Paint surfaces behind permanently fixed equipment or furniture with prime coat only before final installation of equipment.

I. Paint interior surfaces or cuts, where visible through registers or grilles, with a flat, non-specular black paint.

J. Omit primer on metal surfaces that have been shop-primed and touch up painted.

K. 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, and does not deform or feel sticky under moderate thumb pressure and where application of another coat of paint does not cause lifting or loss of adhesion of the undercoat.

L. Minimum Coating Thickness: Apply materials at not less than the manufacturer's recommend spreading rate. Provide a total dry film thickness of the entire system as recommended by the manufacturer.

M. Block Fillers: Apply block fillers to concrete masonry block at a rate to ensure complete coverage with pores filled.

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

O. Pigmented (Opaque) Finishes: Completely cover to provide an opaque, smooth 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.

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

### 3.5 CLEANING AND PROTECTION

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

B. Protect work of other trades, whether to be painted or not, against damage by painting.

Correct damage by cleaning, repairing or replacing, and repainting, as acceptable to Architect.

C. Provide "Wet Paint" signs to protect newly painted finishes. Remove temporary protective wrappings provided by others for protection of their work after completion of painting operations.

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

### 3.7 PAINTING SCHEDULE

A. Existing Stair wood railings, balusters, and posts

1. Two Coats (semi-gloss):

a. PPG Paints 6-1510 Speedhide Alkyd WB Gloss Enamel

B. New Drywall, PRIMER

1. First Coat (primer):

a. PPG Series 6-2 /Quick Drying Interior Latex Primer

- C. New Ferrous Metal PRIMER
  - 1. First Coat (primer):
    - a. PPG 6-208 Red / SPEEDHIDE Interior/Exterior Rust Inhibitive Steel Primer
  
- D. Ferrous Metal (new HM door frames, metal railings)
  - 1. First Coat (primer):
    - a. PPG Series 90-709/712 Pitt-Tech High Performance Primer/Finish
  
- E. Previously Painted or newly primed Concrete Masonry Units, Gypsum Board
  - 1. Two Coats:
    - a. PPG 16-310/ PITT-GLAZE® WB1 Interior Eggshell Pre-Catalyzed Water-Borne Acrylic Epoxy
  
- F. Previously Painted or newly primed Drywall bulkheads & soffits, exposed concrete slab in basement.
  - 1. Two Coats:
    - a. PPG Series 6-70 / Speedhide Interior Flat Wall Paint
  
- G. Previously Painted or newly primed Metal
  - 1. Two Coats (semi-gloss finish):
    - a. PPG 6-1510 / SPEEDHIDE Interior / Exterior WB Alkyd Semi-Gloss
  
- H. Grilles, Uncovered Runout, Housings and Accessories of Mechanical Equipment and Apparatus
  - 1. First Coat (primer):
    - a. Moore Acrylic Metal Primer M04.
    - b. PPG Pitt-Tech High Performance Primer/Finish, Series 90-709/712.
    - c. S-W PrepRite Classic Interior Latex Primer, B28W101.
  - 2. Second and Third Coats (semi-gloss finish):
    - a. Moore DTM Acrylic Semi-Gloss M29.
    - b. PPG Pitt-Tech Satin DTM Enamel, Series 90-474.
    - c. S-W DTM Acrylic Semi-Gloss Coating, B66-200 Series.
  
- I. Existing concrete and steel stairs
  - 1. First Coat (at exposed metal tread)
    - a. PPG Alkyd metal primer 6-208
  - 2. Two Coats:
    - a. PPG Paints Amerlock 2 VOC Semi-Gloss Epoxy
    - b. Alternate if current stair paint is acrylic (field test prior to painting):  
PPG Paints 3-510 Satin Floor Enamel
  
- J. Wood Transparent Finish (for wood trim)
  - 1. First Coat: OLYMPIC Premium Wood Conditioner
  - 2. Second Coat: Olympic 44500 low VOC oil stain.
  - 3. Third, Fourth, and Fifth Coats (transparent satin finish):  
Olympic 42786 Polyurethane WB Varnish

### 3.8 SAFETY COLOR CODE

- A. Markings shall be as designated by the University Standards.
  - 1. All exposed pipe lines, ducts, plenums, conduits, and hangers shall be stenciled and marked with flow arrows at entrance and exit of all pipes within such areas, and at not more than 20 foot intervals between.

2. All concealed pipe lines which are accessible by access doors and ceiling removal, shall be banded at each point of entry, junction, or exit to the concealed space and banding shall be repeated at distances not to exceed 20 feet between identifying bands, and shall be repeated at each valve. Exception to the preceding: all condenser water (tower) lines shall receive two coats of primer their entire length.

END OF SECTION 09 90 00

SECTION 10 14 00  
SIGNAGE

PART 1 - GENERAL

1.1 SUMMARY

A. This section includes the following types of signs:

1. Panel signs.

1.2 SUBMITTALS

A. Submit in accordance with Division 01 Section "Submittal Procedures", product data for each type of sign specified, including details of construction relative to materials, dimensions of individual components, profiles, and finishes.

1. Provide message list for each sign required, including large-scale details of wording and lettering layout.
2. For signs supported by or anchored to permanent construction, provide setting drawings, templates, and directions for installation of anchor bolts and other anchors to be installed as a unit of Work in other Sections.

B. Samples: Provide the following samples of each sign component for initial selection of color, pattern and surface texture as required and for verification of compliance with requirements indicated.

1.3 PROJECT CONDITIONS

A. Field Measurements: Take field measurements prior to preparation of shop drawings and fabrication to ensure proper fitting. Show recorded measurements on final shop drawings. Coordinate fabrication schedule with construction progress to avoid delay.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. Manufacturers of Panel Signs:
  - a. ASI Sign Systems, Inc.
  - b. Best Manufacturing Co.
  - c. Mohawk Sign Systems.

2.2 MATERIALS

A. Cast Acrylic Sheet: Provide cast (not extruded or continuous cast) methyl methacrylate monomer plastic sheet, in sizes and thicknesses indicated, with a minimum flexural strength of 16,000 psi when tested according to ASTM D 790, with a minimum allowable continuous service temperature of 176 deg F (80deg C), and of the following general types:

1. Opaque Sheet: Where sheet material is indicated as "opaque," provide colored opaque acrylic sheet in colors and finishes as selected by Architect from the manufacturer's standards.

B. Colored Coatings for Acrylic Plastic Sheet: Use colored coatings, including inks and paints for copy and background colors, that are recommended by acrylic manufacturers for optimum adherence to acrylic surface and are nonfading for the application intended.

## 2.3 PANEL SIGNS

A. Locations: Provide one room identification sign for each permanent room and as scheduled.

B. Panel Signs: Comply with requirements indicated for materials, thicknesses, finishes, colors, designs, shapes, sizes, and details of construction.

1. Produce smooth, even, level sign panel surfaces, constructed to remain flat under installed conditions within a tolerance of plus or minus 1/16 inch measured diagonally.

C. Unframed Panel Signs: Fabricate signs with edges mechanically and smoothly finished to conform with the following requirements:

1. Room Identification Sign Dimensions: SEE DRAWINGS.
  - a. Match Kuhlman Standard.

D. Graphic Content and Style: Provide sign copy that complies with the requirements indicated for size, style, spacing, content, position, material, finishes, and colors of letters, numbers, and other graphic devices.

E. Raised Copy: Machine-cut copy characters from matte-finished opaque acrylic sheet and chemically weld onto the acrylic sheet forming sign panel face. Produce precisely formed characters with square cut edges free from burrs and cut marks.

1. Panel Material: Matte-finished opaque acrylic sheet.
2. Raised Copy Thickness: Not less than 1/32 inch.

## 2.4 FINISHES

A. Colors and Surface Textures: For exposed sign material that requires selection of materials with integral or applied colors, surface textures or other characteristics related to appearance, provide color matches indicated, or if not indicated, as selected by the Architect from the manufacturer's standards.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

A. Locate sign units and accessories where indicated, using mounting methods of the type described and in compliance with the manufacturer's instructions.

1. Install signs level, plumb, and at the height indicated, with sign surfaces free from distortion or other defects in appearance.

B. Wall-Mounted Panel Signs: Attach panel signs to wall surfaces using the methods indicated below:

1. Silicone-Adhesive Mounting: Use liquid silicone adhesive recommended by the sign manufacturer to attach sign units surfaces.
2. Two-Face Tape: Clean bond-breaking materials from substrate surface and remove loose debris. Apply tape strips symmetrically to back of sign and of suitable quantity to support weight of sign without slippage. Keep strips away from edges to prevent visibility at sign edges. Place sign in position, and push to engage tape adhesive.

Edgecliff Hall Renovation  
Xavier University  
Cincinnati Ohio

3.2 INTERIOR SIGN SCHEDULE / See drawings.

END OF SECTION 10 14 00

**SECTION 10 26 23**  
**WALL PROTECTION**

Part 1 - General

1.01 Summary

- A. This section includes the following types of wall protection systems:
  - 1. Wall Panels
- B. Related sections: The following sections contain requirements related to this section:
  - 1. Handrails, Bumper Guards, Crash Rails, Corner Guards, Accent Rails, Wall Covering, Door Protection; refer to section 10 26 00 "Wall and Door Protection"

1.02 References

- A. National codes (IBC, UBC, SBCCI, BOCA and Life Safety)
- B. American Society for Testing and Materials (ASTM)
- C. Underwriters Laboratories (UL)
- D. California 01350 specification

1.03 Submittals

- A. General: Submit the following in accordance with conditions of contract and Division 1 specification section 01 33 00 "Submittal Procedures".
- B. Product data and detailed specifications for each system component and installation accessory required, including installation methods for each type of substrate.
- C. Shop drawings showing locations, extent and installation details of wall panel products.
- D. Samples for verification purposes: Submit the following samples, as proposed for this work, for verification of color, texture, pattern and thickness:
  - 1. Sample of each product specified.
- E. Product test reports from a qualified independent testing laboratory showing compliance of each component with requirements indicated.
- F. Maintenance data for wall protection system components for inclusion in the operating and maintenance manuals specified in Division 1.

1.04 Quality Assurance

- A. Installer qualifications: Engage an installer who has no less than 3 years experience in installation of wall panels similar in complexity to those required for this project.
- B. Manufacturer's qualifications: Not less than 5 years experience in the production of specified products and a record of successful performance.
- C. Code compliance: Assemblies should conform to all applicable codes including IBC, UBC, SBCCI, BOCA, Life Safety and CA 01350.
- D. Fire performance characteristics: Provide engineered PETG wall panels with a UL label indicating that they are identical to those tested in accordance with ASTM E84 for Class B characteristics listed below:
  - 1. Flame spread 75 or less
  - 2. Smoke developed: 350 or less
- E. Impact Strength: Provide assembled wall protection units that have been tested in accordance with the applicable provisions of ASTM F 476.
- F. Chemical and stain resistance: Provide wall panels with chemical and stain resistance in accordance with ASTM D543.
- G. Color Match: Provide wall panels that are color matched in accordance with the following:
  - 1. Delta Ecmc of no greater than 1.0 using CIELab color space. Components of the wall protection system manufactured by the same company to ensure compatibility of color, texture and physical properties.

- H. Single source responsibility: Provide all components of the wall protection system manufactured by the same company to ensure compatibility of color, texture and physical properties.
- 1.05 Delivery, Storage and Handling
  - A. Deliver materials to the project site in unopened packaging clearly labeled to show manufacturer.
  - B. Store materials in original, undamaged packaging in a clean, dry place out of direct sunlight and exposure to the elements. A room temperature of 40-100°F (4-38°C) should be maintained.
  - C. Materials must be stored flat.
- 1.06 Project Conditions
  - A. Materials must be acclimated in an environment of 65-75°F (18-24°C) for at least 24 hours prior to beginning the installation.
  - B. Installation areas must be enclosed and weatherproofed before installation commences.

## Part 2 - Products

- 2.01 Manufacturers
  - A. Interior surface protection products specified herein and installed on the submittal drawings shall be manufactured by Construction Specialties, Inc.
- 2.02 Materials
  - A. Engineered PETG Wall Panels to be Acrovyn 4000 by Construction Specialties Inc: Wall panels to be manufactured of .040" (1.02mm) thick Acrovyn 4000 sheet, Suede texture, factory-bonded to the face side and edges of a 3/8" (9.53mm) thick particle board core. The backside of the panel and return edges to be laminated with a moisture resistant barrier.
    - 1. See finish schedule
- 2.03 Wall Panel Mounting
  - A. Construction grade adhesive to be supplied by manufacturer.
- 2.04 Reveals
  - A. Reveal: Reveal spacing
    - 1. ¼" of visible Painted wall.
- 2.05 Fabrication
  - A. General: Fabricate wall panels to comply with requirements indicated for design, dimensions, detail, finish and sizes.
- 2.06 Accessories
  - A. Acrovyn Wall Panels shall be furnished as a complete packaged system.

## Part 3 - Execution

- 3.01 Examination
  - A. Verification of conditions: Examine areas and conditions under which work is to be performed and identify conditions detrimental to proper or timely completion.
    - 1. Do not proceed until unsatisfactory conditions have been corrected.
- 3.02 Preparation
  - A. Surface preparation: Prior to installation, clean substrate to remove dirt, debris and loose particles. Perform additional preparation procedures as required by manufacturer's instructions.
  - B. Protection: Take all necessary steps to prevent damage to material during installation as required in manufacturer's installation instructions.



3.03 Installation

- A. Install the work of this section in strict accordance with the manufacturer's recommendations and the required field verified dimensions.
- B. Temperature at the time of installation must be between 65-75°F (18-24°C) and be maintained for at least 48 hours after the installation to allow for proper adhesive set up.
- C. Relative humidity shall not exceed 80%.
- D. Do not expose wall panels to direct sunlight during or after installation. This will cause the surface temperature to rise, which in turn will cause bubbles and delamination.

3.04 Cleaning

- A. General: Immediately upon completion of installation, clean wall panels and accessories in accordance with manufacturer's recommended cleaning method.
- B. Remove surplus materials, rubbish and debris resulting from installation as work progresses and upon completion of work.

3.05 Protection

- A. Protect installed materials to prevent damage by other trades. Use materials that may be easily removed without leaving residue or permanent stains.

END OF SECTION

**SECTION 11 06 23**  
**VARIABLE ACOUSTIC BANNERS – 12’ ROLL TYPE**

**PART 1: GENERAL**

1.01 SUMMARY

- A. Section Includes:
  - 1. Variable Acoustic Banners – Motorized Roll Type Operation
  - 2. Variable Acoustic Banner Controls
- B. Provision of banner assemblies, equipment and services as specified herein:
  - 1. Verification of site dimensions and conditions
  - 2. Submittals as described herein and in the contract documents
  - 3. Provision and installation of banner assemblies as described herein
  - 4. Provision of control system for installation by Electrical Contractor as described herein
  - 5. Scheduling, sequencing and coordination with other trades
  - 6. Testing and demonstration of banner system and controls
  - 7. Record drawings and Operation and Maintenance manual
  - 8. Instruction to Owner’s representatives

1.02 RELATED WORK BY OTHERS

- A. Section 05 50 00 – Metal Fabrication
  - 1. All supplemental steel required to support the acoustic banners.
- B. Division 26 – Electrical
  - 1. All conduit, wiring, and terminations for power and control wiring
  - 2. All devices not listed herein, including external disconnects, as required by AHJ and prevailing code.
- C. All modifications to surfaces and provision of access hatches required to provide future access to the banner components.

1.03 REFERENCES

- A. NFPA 70, National Electrical Code
- B. NFPA 79, Electrical Standard for Industrial Machinery
- C. NFPA 701, Standard Methods of Fire Tests for Flame Propagation of Textiles and Films
- D. ASTM C423-08a Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Room Reverberation Method
- E. UL 325, Standard for Door, Drapery, Gate, Louver; Window Operators and Systems
- F. UL 508A, Standard for the Construction of Industrial Control Panels

1.04 QUALITY ASSURANCE

- A. Acoustic Testing: The acoustic properties shall be tested and certified by an accredited independent laboratory to insure that the banner fabric and configuration are certified in accordance with ASTM C423-08a Sound Absorption Coefficient by Reverberation Room Method. Systems offered without this certification will not be approved. **Documentation of this must be submitted with the bid.**

- B. Fire Resistance Rating: Certifications shall be provided evidencing that the fabric has been treated so as to comply with NFPA-701 small scale.
- C. Cycle Testing: Banner product shall have been cycle tested for no less than 5000 cycles.
- D. Documentation of this must be submitted with the bid.
- E. Manufacturer Qualifications: A company regularly engaged in the manufacture of variable acoustic banner systems with minimum five (5) years experience with systems similar to those specified.

#### 1.05 SUBMITTALS

- A. Prepare and Submit in accordance with Section 01 33 00 – Submittal procedures:
  - 1. General Arrangements drawings shall show banners integrated into the facility with specific attention to required clearances. Banners shall be coordinated with other trades and field verified.
  - 2. Shop Drawings detail all materials, fastening and finishes, and indicate all dimensions.
  - 3. Electrical drawings shall indicate controls and required electrical service(s), and all required electrical field interconnections between devices.
  - 4. Submit manufacturer's swatch card for color selection.
  - 5. Custom color wool shall be available at no additional cost. Lab dip samples will be submitted in the fabric to be used to fabricate the banners for approval.
- B. No material shall be purchased or fabricated, shipped or installed without prior approval of submitted drawings.

#### 1.06 DELIVERY, STORAGE AND HANDLING

- A. Carefully wrap and package banners and controls for shipment to site.
- B. Do not deliver materials to site until building is weather tight. Do not subject banners to significant temperature change.
- C. Store materials inside under cover and keep them dry and protected against damage from direct sunlight, surface contamination, corrosion, construction traffic and other damage.

### **PART 2: PRODUCTS**

#### 2.01 MANUFACTURERS

- A. Subject to compliance with requirement herein, provide one of the following products:

- 1. acouRoLL® RW12 by acouStaCorp, LLC Bronx, NY (718) 402-2677

#### 2.02 VARIABLE ACOUSTIC BANNERS

- A. Type: Electrically operated Variable Acoustic Banner capable of being wall or ceiling mounted, consisting of frame, fabric, motor with electric brake and mechanical limits, positioning sensor, roller tube, tension and diverter tubes.
- B. Mounting Positions: Ceiling mount Banners must be rigidly attached to structure. Supply cross bracing if necessary.
- C. Frame: A heavy duty frame in powder coated aluminum, constructed to mount either from the top or rear, shall support and house the motor assembly and banner. Units shall be powder coated in standard color selected by the architect.
  - 1. There shall be an integral mounting system built into the frame for mounting to the building structure.

- D. Infill Panels: The frame shall have infill panels made of low VO Sintra, removable for maintenance. Color Selection: White, Black, Grey, Silver, Beige, Blue and Red to be determined by the Architect.
- E. Motor: The motor shall be UL approved, single phase 120 VAC, 60Hz, 4 wire, instantly reversing, permanent split capacitor motor. Motor shall be lifetime lubricated, and equipped with an internal thermal overload protector, and electric fail-safe brake, and pre-set limit switches.
1. The system shall be capable of nominal lifting speed of 27 - 30/fpm. The motor and drive system shall be sized to accommodate the size and weight of the specified banner.
  2. The motor shall be fitted with a plug/cord connection to allow for installation of banners after electrical work has been completed. Connector shall be a Mini 4 pin connector ("7/8" trade size) extended ground pin.
  3. Starter and encoder for each machine shall be supplied by this contractor.
- F. Limit Switches: The motor shall incorporate two internal, mechanical-type limit switches.
1. The switches shall directly remove power from the motor circuit when they are tripped.
  2. They shall be adjustable at any time without the need for laptops or other accessory equipment. Limits may be engaged or disengaged with the simple push of a button on the motor to allow for fabric maintenance or adjustment.
    - a. Limit adjustment that requires the use of a laptop or other equipment that is not part of the installed system in unacceptable.
  3. Limits that are electronic in nature, or rely solely on positioning information are not acceptable
    - a. Example of unacceptable motor: SOMFY ILT2.
- G. Positioning Sensor: The banner assembly shall incorporate a separate solid state encoder as a positioning sensor to provide feedback information to the controls.
1. The positioning sensor shall be fitted within the frame to read the position of the main roller tube. This position information is sent to the control system to provide real time position of the banner to the operator. This information updates even when the banner is moving.
  2. The sensor shall be fitted with a plug/cord connection to allow for installation of banners after electrical work has been completed. Connector shall be a M12 4 pin connector.
  3. Encoders that are incorporated within the motor and are not replaceable are not acceptable.
    - a. Example of unacceptable motor: SOMFY ILT2.
- H. Receptacles: A pair of mating receptacles shall be supplied with each banner motor. Mating receptacles shall be provided loose for installation in standard electric junction box knock outs (1/2" ko), to be mounted in separate junction boxes to maintain separation. Receptacles provided with 12" leads.
- I. Controls: Banners shall be controlled by the Variable Acoustic Controls.

## 2.03 ACOUSTIC BANNER FABRIC PANELS

- A. Fabric: 29oz per linear yard, 100% Wool, Durably Flame Retardant.
1. The fabric panel is one continuous fabric loop which is seamless and flat.
  2. Colors may be manufacturer's standard colors.
  3. Fabric shall meet NFPA 701 testing standards.

- A. Fabric Panel: The banner shall have an inner chamber of 3” depth formed by the bottom tube weight and two idler rollers within the frame. The two planes of fabric shall be parallel and separate at a constant distance of 3” over the full height and width of the banner.
- B. The banner fabric shall be kept taut by means of an internal bottom tube weight.
- C. Banners shall travel vertically and plumb. There shall be no folding of the banner fabric; it shall be fully enclosed in the frame described above and as shown on the drawings.
- D. RW12 exposed fabric shall be seamless, height as specified on drawings; maximum 12’ tall.
- E. Fabric edges shall be cut straight, plumb and true. Selvage shall not be incorporated in the width of the banner.
- F. Provide (4) RW12-MB2’s – 2 installed at One Large Window (17’-4” wide x 9’-4” high); 1 each installed at the two smaller windows (10’-0” wide x 9’-4” high). Each RW12-MB2 shall accept 2 fabric panels width fabric with up to 4’-11” wide. Panels shall have a maximum 3” gap between them when installed on the same roller.

#### 2.04 VARIABLE ACOUSTIC CONTROLS

- A. Control Source: Subject to compliance with requirement herein, provide products of one of the following:
  - 1. acouTroL® Symphony by acouStaCorp, LL
  - 2. Alternate: ETC rigging control with ETC FSMS or MCI (See Rigging Control Specification).
    - a. Optional third party interface CRESTRON (see G below).
- B. The Control System: Shall be specifically designed for the control of motorized equipment for environments such as theatrical, corporate, arenas, convention centers, etc. It shall provide a high level of reliability, accuracy, and stability appropriate for systems operating equipment in places of public assembly or work environments.
  - 1. The control system shall be capable of controlling over 50 axis and maintaining sixteen (16) presets for each axis. An additional eight (8) global presets shall be provided.
  - 2. Grouping functions shall also be included to allow for up to sixteen (16) groups.
  - 3. To provide additional security, system shall allow for individual user logins.
- C. User Interface: A controller shall be provided that includes a touch screen and discrete pushbuttons, switches and indicators to allow for easy and simple control of the banner system.
  - 1. Controller shall be: Wall mount Touchscreen Control with associated wall plate.
    - a. System has the ability to operate from the front panel. Pendant is only required where line of sight to equipment is obstructed at controller.
  - 2. Controller faceplate marking shall be engraved and filled, or polycarbonate type with printing on the reverse. Silkscreen text is susceptible to wear and is not acceptable.
  - 3. Touch screen display shall be of rugged industrial design, rated IP65 and 6” class minimum.
  - 4. Button/switches shall be 22mm industrial type.
    - 1. An Emergency Stop Button shall be part of the Emergency Stop Circuit and shall conform to NFPA 79 requirements. Resetting of this circuit shall not initiate motion.
    - 2. A key switch shall prevent unauthorized usage and provide system security. It shall control power to the control system, starters, and drives. Turning the system off shall remove all power from the motors, starters, and drives. The control system shall retain all position data, presets, and soft limits when the system is turned off.
    - 3. Illuminated Operation buttons shall be included on the face of the controller, and shall illuminate only when the associated function is available
    - 4. Operators that control motion shall be configured to require constant pressure- Hold to Run.
    - 5. Indicators LED shall be multicolor and 8mm in size.

- D. Motor Controllers: Shall be furnished to accommodate all banners in the system. Provide [#] of group Motor Control Panels (MCPs) as indicated on the drawings. Controllers shall include all short-circuit and over current protection required for system operation.
1. For fire and electrical safety, MCPs shall conform to the NEC (NFPA 70), be built in accordance with UL Standard 508A.
  2. MCPs shall also meet “touch safe” requirements per IEC 204-1 “Protection against direct contact” rules.
  3. Each MCP shall be equipped with disconnecting means, accessible from the front face of the enclosure.
  4. MCP enclosures shall be NEMA 12 rated to protect components.
  5. Each controller shall be sized to match the motor horsepower. Overload and over current protection shall conform to UL and NEC requirements.
  6. Field terminals shall be provided for each banner connected. All terminals shall be labeled.
  7. All internal wiring shall be numbered and labeled matching the schematics to aid service and maintenance.
- E. Operation: Primary user control of the system shall be through the touch screen display. This shall be used in conjunction with the physical operator buttons, which initiate motion.
1. System shall provide for sixteen (16) Flex presets for each banner.
  2. System shall provide for eight (8) Global presets for the system as a whole.
  3. System shall provide for sixteen (16) Groups for easy selection and control of banners in the system. Individual banners may be members of multiple groups.
  4. System shall provide user adjustable labels for each of the Flex Presets, Global Presets, and Groups.
  5. System shall be provided with multiple levels of password.
    - a. User Level – allowing recall of presets, and adjusting banners limited Jog functionality.
    - b. Advanced Level – allowing for the functions of User Level, and adding the ability to record presets, adjust labels and various banner parameter adjustments.
    - c. Administrator Level – allows for the creation, adjustment, and deletion of individual user logins.
    - d. Factory Level – used to configure banners and hardware settings for the system.
  6. System shall indicate on the touch screen when and which E-stop in the system has been triggered.
  7. Soft limits may be set or adjusted inside of the banners physical limits.
  8. A graphical “map” shall be incorporated in all screens of the complete system to help the user easily identify each banner.
  9. System shall indicate graphically the position in real time of all the banners in the system.
  10. System shall indicate graphically with color, the status of each banner in the system. An online key shall be included to assist with determining the status based on color.
  11. System shall provide means to backup all user adjustable info onto USB or SD card.
- F. Service Indicator: An indicator will illuminate and a notice on the touchscreen shall be provided to alert the user when regular system service and inspections are required.

## **PART 3: EXECUTION**

### **3.01 EXAMINATION**

- A. Installing contractor is responsible for examination of structure to which banners shall be attached for compliance with requirements for installation tolerances and other conditions affecting performance with the banners.
- B. Installing contractor is responsible for field verification of all banner dimensions prior to release for fabrication.
- C. Do not proceed with installation until unsatisfactory conditions have been corrected.

### 3.02 INSTALLATION OF MOTORIZED BANNERS

- A. Install Variable Acoustic Banners in the locations as indicated on the drawings.
- B. Banner mounting to be coordinated with Manufacturer.
- C. Installing contractor is responsible for thoroughly reviewing technical product information.
- D. Installing contractor to coordinate installation with other trades.
- E. All installation shall be level and plumb.
- F. All hardware shall have minimum rating of Grade 5; all bolted fastenings shall use locking nuts and washers.

### 3.03 TRAINING AND DOCUMENTATION

- A. After completion of electrical power and control system installation, by others, train the client in the proper operation and maintenance of the banners.
- B. Provide digital files of As-built Drawings and Operations and Maintenance Manual.
- C. Provide a minimum one year warranty upon acceptance by owner.

**END OF SECTION**

SECTION 122100

WINDOW CURTAINS

2.1 MANUFACTURERS AND CONTRACTORS

- A. Track and Drapery systems shall be installed by one of the following Stage Rigging Contractors:
  - 1. Beck Studios, Milford, OH (513) 831-6650
- B. Curtain tracks, machines and related components shall manufactured by:
  - 1. Automatic Devices Company, Allentown, PA
- C. Fabrics shall be manufactured/supplied by:
  - 1. DeBall of America, New York, NY
  - 2. KM Mills, Greenville, SC
  - 3. Rosebrand, New York, NY
- D. Draperies shall be fabricated by:
  - 1. Stage Decorations, Greensboro, NC
  - 2. Rosebrand, New York, NY

2.2 MATERIALS and COMPONENTS

- A. Curtain Face Fabric - IFR Synthetic Velour:
  - 1. Minimum 25 ounce, 100% Polyester Inherently Flame Resistant synthetic "velour". Fabric shall be as supplied by JL de Ball or KM Mills.
  - 2. Standard Color to be determined by the Architect
- B. Curtain Lining:
  - 1. PD Cloth, 100% Polyester Trevira CS, 72" wide as supplied by Janis. Color: Black.
- C. Grommets:
  - 1. Grommets shall be #4 brass type, maximum 12" on center.
- D. Jute Webbing:
  - 1. Webbing is to be 12 lb., 3-1/2" wide jute type.

2.3 ASSEMBLIES

- A. Curtain Tracks: Curtain tracks (Model 2200) shall be of 16 gauge extruded aluminum construction, anodized finish, entirely enclosed except for slot in the bottom, and in one continuous piece except where splicing clamps are required. Each curtain carrier (Model 1701) shall be placed on 6" centers and shall be of plated steel construction with two polyethylene wheels held to block by plated steel rivet, such wheels rolling on two separate parallel treads. Master carriers (Model 2200) shall be plated steel construction with two polyethylene wheels held to block by plated steel rivet and shall allow curtain overlap by passing each other in a common track channel. Track design shall provide a 12" center overlap.



1. Provide Model 22 Trak-Eze Walk Along Operation as manufactured by Automatic Devices Company or equal.
- B. Curtain Panels: The curtains shall be fabricated in two panels in sizes indicated by the drawings. Panels shall be fabricated in 75% fullness. Panels shall be lined. Lining shall be provided in 75% fullness. Fabric shall be provided as KM's IFR (or equal) color to be determined by architect. Lining shall be white. Curtain shall be box pleated with all seams vertical and hidden in pleats. Fabric nap shall be run "down". The top of each panel shall be finished with jute webbing, sewn over the pleats with stitching top and bottom. Provide grommets at 12" o.c. for the length of the webbing with spring clips for connection to track carrier chains. Grommets shall not break stitching. Provide two grommets at the on stage end of each panel spaced 3 ½" apart for connection to a master carrier. Provide one additional grommet at the end of each panel. Provide a minimum 4" bottom hem with a separate canvas pocket filled with continuous #8 plated and vinyl-coated (to prevent any contact of metal with water) jack chain sewn in. Lining shall have a 4" bottom hem and stop 2" above bottom of the house curtain panel.

## SECTION 122124

### MOTORIZED ROLLER SHADE SYSTEM

#### PART 1 – GENERAL

##### 1.1 SECTION INCLUDES

- A. Provide manually operated, sunscreen and blackout roller shades as applicable.
- B. Provide electrically operated, sunscreen and blackout roller shades as applicable. Work includes local, group and master control systems for shade operation with addressable, encoded, electronic drive units (EDU).
- C. Related Sections:
  - 1. Division 09 - Gypsum Board Assemblies: Coordination with gypsum board assemblies for blocking, installation of shade pockets, closures and related accessories.
  - 2. Division 09 - Acoustical Ceilings: Coordination with acoustical ceiling systems for blocking, installation of shade pockets, closures and related accessories.
  - 3. Division 26 - Electrical: Electric service for EDU's, and EDU controls, internal communication, low voltage wiring and data transfer.

##### 1.2 SUBMITTALS

- A. Bid Submittal, Information Required with Submittal of Bid: In order to evaluate proposals for motorized window shade systems, the Architect requires the following information be submitted prior to the award of the system.
  - 1. Bid proposal shall be accompanied with a document that notes all deviations from these specifications on a line-by-line basis.
  - 2. Bid shall confirm that roller shade EDU's and all related controls shall be integrated into a compatible control system as specified herein.
- B. Product Data: Manufacturer's data sheets on each product to be used, including:
  - 1. Preparation instructions and recommendations.
  - 2. Styles, material descriptions, dimensions of individual components, profiles, features, finishes and operating instructions.
  - 3. Storage and handling requirements and recommendations.
  - 4. Mounting details and installation methods.
  - 5. Typical wiring diagrams including integration of EDU controllers.
- C. Shop Drawings: Plans, elevations, sections, product details, installation details, operational clearances, power and control wiring diagrams, and relationship to adjacent work.
  - 1. Prepare shop drawings on AutoCAD or Microstation format using base sheets provided electronically by the Architect.
  - 2. Prepare control, wiring diagrams based on, switching and operational requirements provided by the Architect in electronic format.
  - 3. Include one-line diagrams, wire counts, coverage patterns, and physical dimensions of each item.

- D. Window Treatment Schedule: For all roller shades. Use same room designations as indicated on the Drawings and include opening sizes and key to typical mounting details.
- E. Verification Samples: For each finish product specified, one complete set of shade components, unassembled, demonstrating compliance with specified requirements. Shade cloth samples and aluminum finish sample as selected. Mark face of material to indicate interior faces.
- F. Maintenance Data: Methods for maintaining roller shades, precautions regarding cleaning materials and methods, instructions for operating hardware and controls.

### 1.3 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Obtain roller shades system through one source from a single manufacturer with a minimum of twenty years experience and minimum of five projects of similar scope and size in manufacturing products comparable to those specified in this section. This includes but is not limited to all required extrusions, accessories, controls and fabricated roller shades or else all stated and published warranties may be void.
- B. Installer Qualifications: Engage an installer, which shall assume responsibility for installation of all system components, with the following qualifications.
  - 1. Installer for roller shade system shall be trained and certified by the manufacturer with a minimum of ten years experience in installing products comparable to those specified in this section.
    - a. Installer's to include roller shade manufacturer's training certification.
- C. Fire-Test-Response Characteristics: Passes NFPA 701-99 small and large-scale vertical burn. Materials tested shall be identical to products proposed for use.
- D. Electrical Components: NFPA Article 100 listed and labeled by either UL or ETL or other testing agency acceptable to authorities having jurisdiction, marked for intended use, and tested as a system. Individual testing of components will not be acceptable in lieu of system testing. Where applicable, system components shall be FCC compliant.
- E. Shadecloth Anti-Microbial Characteristics: 'No Growth' per ASTM G 21 results for fungi ATCC9642, ATCC 9644, and ATCC9645.
- F. PVC-Free Shadecloth: Comply with the following.
  - 1. Environmental Certification: Submit written certification from the manufacturer, including third party evaluation, recycling characteristics, and perpetual use certification as specified below. Initial submittals, which do not include the Environmental Certification, below will be rejected. Materials that are simply 'PVC free' without identifying their inputs shall not qualify as meeting the intent of this specification and shall be rejected.
  - 2. Third Party Evaluation: Provide documentation stating the shade cloth has undergone third party evaluation for all chemical inputs, down to a scale of 100 parts per million, that have been evaluated for human and environmental safety. Identify any and all inputs, which are known to be carcinogenic, mutagenic, teratogenic, reproductively toxic, or endocrine disrupting. Also identify items that are toxic to aquatic systems, contain heavy metals, or organohalogen. The material shall contain no inputs that are

known problems to human or environmental health per the above major criteria, except for an input that is required to meet local fire codes.

3. Recycling Characteristics: Provide documentation that the shade cloth can, and is part of a closed loop of perpetual use and not be required to be down cycled, incinerated or otherwise thrown away. Scrap material can be sent back to the mill for reprocessing and recycling into the same quality yarn and woven into new material, without down cycling. Certify that this process is currently underway and will be utilized for this project.
  4. Perpetual Use Certification: Certify that at the end of the useful life of the shade cloth, that the material can be sent back to the manufacturer for recapture as part of a closed loop of perpetual use and that the material can and will be reconstituted into new yarn, for weaving into new shade cloth. Provide information on each shade band indicating that the shade band can be sent back to the manufacturer for this purpose.
- G. Requirements for Electronic Hardware, Controls, and Switches:
1. Roller shade hardware, shade fabric, EDU, and all related controls shall be furnished and installed as a complete two-way communicating system and assembly.
- H. Mock-Up: Provide a mock-up, if Architect requires, of one roller shade assembly for evaluation of mounting, appearance and accessories.
1. Locate mock-up in window designated by Architect.
  2. Do not proceed with remaining work until, mock-up is accepted by Architect.

#### 1.4 DELIVERY, STORAGE, AND HANDLING

- A. Deliver components in factory-labeled packages, marked with manufacturer and product name, fire-test-response characteristics, and location of installation using same room designations indicated on Drawings and in the Window Treatment Schedule.

#### 1.5 PROJECT CONDITIONS

- A. Environmental Limitations: Install roller shades after finish work including painting is complete and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
- B. Power and control wiring shall be complete and certified, fully operational with uninterrupted communication on the lines and minimal noise certified by a commissioning agent (engaged by others).
1. 485, ICON, Lonmark and Dry Contract Network: Noise on the line not to exceed shade manufacturer's limits.

#### 1.6 WARRANTY

- A. Warranty: Provide manufacturer's standard warranties, including the following:
1. Roller Shade Hardware, and Shadecloth: Manufacturer's standard non-depreciating twenty-five year limited warranty.
    - a. EcoVeil standard non-depreciating 10-year limited warranty.
  2. Electronic Roller Shade EDU's and EDU Control Systems: Manufacturer's standard non-depreciating five-year warranty.
  3. Roller Shade Installation: One year from date of Substantial Completion, not including scaffolding, lifts or other means to access to the work above 12' Feet AFF,

which are the responsibility of others.

## PART 2 – PRODUCTS

### 2.1 MANUFACTURER

- A. Basis of Design Manufacturer for Window Shade System: Products by MechoSystems; 42-03 35<sup>th</sup> Street, Long Island City, NY 11101. Tel: (718) 729-2020: KMA & Associates Jeannine Land, [jland@kma.bz](mailto:jland@kma.bz) 317-502-3597.
- B. Substitutions not permitted.
- C. Alternates: The following products and manufacturers may be bid as an alternate product in accordance with Section 01030. Any pricing for alternate product shall be listed separately from the base bid specified product. Any alternate pricing must include line-by-line compliance or non-compliance with the specifications. If the alternate product is acceptable to the architect, the specified manufacturer will be given the opportunity to provide an equivalent proposal.

### 2.2 INTELLIGENT ENCODED ELECTRONIC DRIVE SYSTEM

- A. Electronic Drive Unit (EDU):
  - 1. Intelligent Encoded EDU, and Control System: Tubular, asynchronous (non-synchronous) EDU's, with built-in reversible capacitor operating at 120VAC/60Hz, (230VAC/50Hz) single phase, temperature Class B, thermally protected, totally enclosed, maintenance free with line voltage power supply equipped with locking disconnect plug assembly furnished with each EDU.
  - 2. Quiet [42 – 46 db] (within 3 feet open air).
  - 3. Maximum current draw for each 506 EDU of 0.9Amps at 120VAC.
  - 4. Use EDU's rated at the same nominal speed for all shades in the same room.
  - 5. Use EDU's with minimum of 34RPM, that shall not vary due to load / lift capacity.
  - 6. Total hanging weight of shade band shall not exceed 80 percent of the rated lifting capacity of the shade EDU and tube assembly.
- B. EDU System: (software, two-way communication): Specifications and design are based on the Intelligent EDU Control System, WhisperShade®IQ® System) as manufactured by MechoSystems. Other systems may be acceptable providing all of the following performance capabilities are provided. EDU and control systems not in complete compliance with these performance criteria shall not be accepted as equal systems.
  - 1. EDU shall support two methods of control.
    - a. Local Dry Contact Control Inputs:
      - 1) EDU shall be equipped with dry contact inputs to support moving the EDU/shade to the upper and lower limits.
      - 2) EDU shall be equipped with dry contact inputs to support moving the EDU/shade to local switch preset positions.
    - b. Network Control:
      - 1) Serial Communication. EDU shall be equipped with a bi-directional network communication capability in order to support commanding the operation of large groups of shades over a common backbone. The network communication card shall be embedded into the tubular EDU assembly.

2. Upper and lower stopping points (operating limits) of shade bands shall be programmed into EDU's using either a hand held removable program module / configurator or a local switch.
3. Alignment Positions: Each EDU shall support a minimum of 133 repeatable and precisely aligned shade positions (including limits and presets).
  - a. All shades on the same switch circuit or with the same network group address with the same opening height shall align at each limit or preset (intermediate stopping position) when traveling from any position, up or down.
  - b. Shades of differing heights shall have capability for custom, aligned intermediate stop positions when traveling from any position, up or down.
  - c. Alignment of shades mechanically aligned on the same EDU shall not exceed +/- 0.125 inches (3.175mm) when commanded to the same alignment position.
  - d. Alignment of shades on adjacent EDU's shall not exceed +/- 0.25" inches (6.35mm) when commanded to the same alignment position.
  - e. Local Switch Presets: A minimum of 3 customizable preset positions shall be accessible over the local dry contact control inputs and over the network connection.
    - 1) Upon setting the limits for the shade EDU these preset positions shall automatically default to 25%, 50% and 57% of the shade travel.
    - 2) These positions shall be capable of being customized to any position between and including the upper and lower limits of the shade. A removable program module / configurator or local switch shall be capable of customizing the position of these presets.
  - f. Network Presets: A minimum of 29 customizable preset positions (including the 3 local switch presets) shall be accessible via network commands.
    - 1) Upon setting the limits for the shade EDU these preset positions shall automatically default to the lower limit unless customized elsewhere.
    - 2) These positions shall be capable of being customized to any position between and including the upper and lower limits of the shade. A removable program module / configurator shall be capable of customizing the position of these presets.
4. Network Control:
  - a. The system shall have the capability of two-way digital communication with the EDU's over a common backbone.
  - b. Each EDU shall possess 8 addresses capable of being employed for various levels of group control. These addresses shall be configurable via a handheld configurator and/or a PC controller. A 9<sup>th</sup> unique address shall enable the EDU(s) to be independently controlled and configured over the network via a handheld configurator and/or a PC controller.
  - c. Low Voltage Communication Network Implementation.
    - 1) The low voltage network shall employ a bus topology with daisy chained network connections between nodes over a CAT5 cable (4 UTP) or over a 2 UTP cable employing at least 1 pair at 16 AWG for power and 1 pair at 22 AWG for data.
    - 2) The low voltage network (+/- 13VDC) shall be powered by the nodes attached to it. These nodes could be line voltage powered EDU's attached to 120 VAC or 230 VAC. Alternatively, low voltage nodes shall be powered typically by a centralized low voltage power supply. If a CAT5 network cable is employed and the node draws less than 1W then the node may be powered by DC power supplied by an associated line voltage EDU.
    - 3) Network Capacity: 4000 ft max, 250 nodes max

- (a) The number and size of a centralized DC supply shall vary depending upon the network requirements.
- 5. Operating Modes:
  - a. Uniform or Normal Modes of Operation:
    - 1) Uniform mode shall allow for shades to only move to defined intermediate stop positions to maintain maximum uniformity and organization.
    - 2) Normal Mode shall allow for shades to move to both intermediate stop positions, plus any position desired between the upper and lower limits as set by the installer.
- 6. Wall Switches:
  - a. Shades shall be operated by, 5, 7, or 10-button low voltage standard switches. Standard switch shall be wired to a network splitter.
  - b. An address that is transmitted by either a switch or central controller shall be responded to by those EDU's with the same address in their control table.
  - c. Standard switch may control an individual, sub-group or group of EDU's in accordance with the address in each EDU.

### 2.3 SHADE BANDS

- A. Shade Bands: Construction of shade band includes the fabric, the enclosed hem weight, shade roller tube, and the attachment of the shade band to the roller tube. Sewn hems and open hem pockets are not acceptable.
  - 1. Concealed Hembar: Shall be continuous extruded aluminum for entire width of shade band and with the following characteristics:
    - a. Hembar shall be heat sealed on all sides.
    - b. Open ends shall not be accepted.
  - 2. Shade Band and Shade Roller Attachment:
    - a. Use extruded aluminum shade roller tube of a diameter and wall thickness required to support shade fabric without excessive deflection.
    - b. Provide for positive mechanical attachment of shade band to roller tube; shade band shall be made removable / replaceable with a "snap-on" snap-off" spline mounting, without having to remove shade roller from shade brackets.
    - c. Mounting Spline shall not require use of adhesives, adhesive tapes, staples, and/or rivets.
    - d. Any method of attaching shade band to roller tube that requires the use of: adhesive, adhesive tapes, staples, and/or rivets, does not meet the performance requirements of this specification and shall not be accepted.

### 2.4 ROLLER SHADE FABRICATION

- A. Fabricate shade cloth to hang flat without buckling or distortion. Fabricate with heat-sealed trimmed edges to hang straight without curling or raveling. Fabricate unguided shade cloth to roll true and straight without shifting sideways more than 1/8 inch (3.18 mm) in either direction per 8 feet (2438 mm) of shade height due to warp distortion or weave design.
- B. Provide custom batten locations in standard shades and railroaded shades as required to assure proper tracking and uniform rolling of the shade bands. Contractor shall be responsible for assuring the width-to-height (W:H) ratios shall not exceed manufacturer's standards or, in absence of such standards, shall be responsible for establishing appropriate standards to assure proper tracking and rolling of the shade cloth within specified standards. Battens shall be roll-formed stainless steel or tempered steel, as required.

1. Custom batten locations to be specified by design team.
- C. Blackout shade bands, when used in side channels, shall have horizontally mounted, roll-formed stainless steel or tempered-steel battens not more than 3 feet (115 mm) on center extending fully into the side channels. Battens shall be concealed in an integrally colored fabric to match the inside and outside colors of the shade band, in accordance with manufacturer's published standards for spacing and requirements.
1. Battens shall be roll formed of stainless steel or tempered steel and concave to match the contour of the roller tube.

## 2.5 ROLLER SHADE COMPONENTS

- A. Access and Material Requirements:
1. Provide shade hardware allowing for the removal of shade roller tube from brackets without removing hardware from opening and without requiring end or center supports to be removed.
  2. Provide shade hardware that allows for removal and re-mounting of the shade bands without having to remove the shade tube, drive or operating support brackets.
  3. Use only Delran engineered plastics by DuPont for all plastic components of shade hardware. Styrene based plastics, and /or polyester, or reinforced polyester shall not be accepted.
- B. Motorized Shade Hardware and Shade Brackets:
1. Provide shade hardware constructed of minimum 1/8-inch (3.18 mm) thick plated steel, or heavier, thicker, as required to support 150 percent of the full weight of each shade. Plastic components without use of steel angle construction do not meet the intent of this specification and shall not be accepted.
  2. Provide shade hardware system that allows for field adjustment of EDU or replacement of any operable hardware component without requiring removal of brackets, regardless of mounting position (inside, or outside mount).
  3. Provide shade hardware system that allows for operation of multiple shade bands offset by a maximum of 8-45 degrees from the EDU axis between shade bands (4-22.5 degrees) on each side of the radial line, by a single shade EDU (multi-banded shade, subject to manufacturer's design criteria).
  4. All bands within a single EDU group shall be aligned within 1/4 inch (6 mm).
- C. Manual Operated Chain Drive Hardware and Brackets:
1. Provide for universal, regular and offset drive capacity, allowing drive chain to fall at front, rear or non-offset for all shade drive end brackets. Universal offset shall be adjustable for future change.
  2. Provide hardware capable for installation of a removable fascia, for both regular and/or reverse roll, which shall be installed without exposed fastening devices of any kind.
  3. Provide shade hardware system that allows for removable regular and/or reverse roll fascias to be mounted continuously across two or more shade bands without requiring exposed fasteners of any kind.
  4. Provide shade hardware system that allows for operation of multiple shade bands (multi-banded shades) by a single chain operator, subject to manufacturer's design criteria. Connectors shall be offset to assure alignment from the first to the last shade band.



5. Provide shade hardware system that allows multi-banded manually operated shades to be capable of smooth operation when the axis is offset a maximum of 6 degrees on each side of the plane perpendicular to the radial line of the curve, for a 12 degrees total offset.
6. Provide positive mechanical engagement of drive mechanism to shade roller tube. Friction fit connectors for drive mechanism connection to shade roller tube are not acceptable.
7. Provide shade hardware constructed of minimum 1/8-inch (3.18 mm) thick plated steel or heavier as required to support 150 percent of the full weight of each shade.

## 2.6 ROLLER SHADE SCHEDULE

- A. Roller Shade Schedule: Refer to the Drawings for locations.
  - a. See sheet A900 for schedule

## 2.7 SHADECLOTH

1. Shadecloth Types: Refer to drawings for locations.
  - a. See sheet A900 for schedule

## 2.8 ROLLER SHADE ACCESSORIES

- A. Shade Pocket: For recessed mounting in acoustical tile or drywall ceilings as indicated on the drawings.
  1. Either extruded aluminum and or formed steel shade pocket, sized to accommodate roller shades, with exposed extruded aluminum closure mount, tile support and removable closure panel to provide access to shades.
  2. Provide "Vented Pocket" such that there will be a minimum of four 1 inch (25.4 mm) diameter holes per foot allowing the solar gain to flow above the ceiling line.
- B. Fascia:
  1. Continuous removable extruded aluminum fascia that attaches to shade mounting brackets without the use of adhesives, magnetic strips, or exposed fasteners.
  2. Fascia shall be able to be installed across two or more shade bands in one piece.
  3. Fascia shall fully conceal brackets, shade roller and fabric on the tube.
  4. Provide bracket / fascia end caps where mounting conditions expose outside of roller shade brackets.
  5. Color: Select from manufacturer's standard colors.
- C. Room Darkening Side and Sill Channels:
  1. Extruded aluminum with polybond edge seals and SnapLoc-mounting brackets and with concealed fastening. Exposed fastening is not acceptable. Channels shall accept one-piece exposed blackout hembar with vinyl seal to assure side light control and sill light control.
    - a. MechoSystems side channels, 1-15/16 inches (49.2 mm) wide by 1-3/16 inches (30.1 mm) deep, two-band center channels, 2-5/8 inches (66.6 mm) wide by 1-3/16 inches (30.1 mm) deep. The 2-5/8-inch (66.6 mm) double-center channels may be installed at center-support positions of multi-band-shade ElectroShades.

- MechoSystems side channels 2-5/8 inch (66.6 mm) may be used as center supports for ElectroShades; shade bands up to 8 high. For shade bands over 8 feet (2438 mm), provide ElectroShade side channels.
- b. ElectroShade side channels, 2-1/2 inches (63.5 mm) wide by 1-3/16 inches (30.1 mm) deep; two-band center channels 5 inches (127 mm) wide by 1-3/16 inches (30.1 mm) deep. The 2-5/8-inch (66.6 mm) double-center channels may be installed at center-support positions of multi-band-shade ElectroShades. MechoSystems side channels 2-5/8 inches (66.6 mm) may be used as center supports for ElectroShades. Also provide for use with manually operated room darkening MechoSystems's over 8 feet (2438 mm) in height.
  - c. Color: Selected from manufacturer's standard colors or custom color as selected by Architect.

### PART 3 – EXECUTION

#### 3.1 EXAMINATION

- A. Do not begin installation until substrates have been properly prepared. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

#### 3.2 PREPARATION

- A. Clean surfaces thoroughly prior to installation. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

#### 3.3 INSTALLATION OF ROLLER SHADES

- A. Contractor Furnish and Install Responsibilities:
  - 1. Window Covering Contractor (WC) shall be present for all related jobsite scheduling meetings.
  - 2. WC shall supervise the roller shade installation, and setting of intermediate stops of all shades to assure the alignment of the shade bands within a single EDU group, which shall not exceed +/- 0.125 inches (3.175mm), and to assure the alignment between EDU groups, which shall not exceed +/- 0.25 inches (6.35mm).
  - 3. WC shall be responsible for field inspection on an area-by- area and floor-by-floor basis during construction to confirm proper mounting conditions per approved shop drawings.
  - 4. Verification of Conditions: examine the areas to receive the work and the conditions under which the work would be performed and notify General Contractor and Owner of conditions detrimental to the proper and timely completion of the work. Do not proceed until unsatisfactory conditions have been corrected. Commencement of installation shall constitute acceptance of substrate conditions by the installer.
  - 5. WC Installer shall install roller shades level, plumb, square, and true according to manufacturer's written instructions, and as specified here in. Blocking for roller shades installed under the contract of the interior General Contractor shall be installed plumb, level, and fitted to window mullion as per interior architect's design documents and in accordance with industry standard tolerances. The horizontal

surface of the shade pocket shall not be out-of-level more than 0.625 inch (15.875mm) over 20 linear feet (6.096 meters)

6. Shades shall be located so the shade band is not closer than 2 inches (50 mm) to the interior face of the glass. Allow proper clearances for window operation hardware.
7. Adjust, align and balance roller shades to operate smoothly, easily, safely, and free from binding or malfunction throughout entire operational range.
8. Installer shall set Upper, Lower and up to 3 intermediate stop positions of all motorized shade bands, and assure alignment in accordance with the above requirements.
9. WC shall certify the operation of all motorized shades and turn over each floor for preliminary acceptance.
10. The WC shall participate and cooperate with the electrical contractor, the window shade manufacturer and the Commissioning agent to verify and certify the installation is in full conformance with the specifications and is fully operational. This work to occur during the commissioning stage and is in addition to preliminary acceptance required for each floor.

#### 3.4 PROTECTION

- A. Protect installed products until completion of project.
- B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION

SECTION 12 35 83  
SPECIALTY CASEWORK

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Music instrument storage casework.
- B. Acoustically enhanced music instrument storage casework.
- C. Robe and uniform storage casework.
- D. Sheet music storage casework.
- E. Theater make-up casework.
- F. Portable theater make-up stations.

1.2 RELATED SECTIONS

- A. Section 01 35 00 - Special Procedures.
- B. Section 44 01 50 - Operation and Maintenance of Solid Waste Control and Reuse.
- C. Section 01 60 00 - Product Requirements.
- D. Section 09 21 16.23 - Gypsum Board Shaft Wall Assemblies.
- E. Section 09 65 13 - Resilient Base and Accessories.
- F. Section 12 32 16 - Manufactured Plastic-Laminate-Clad Casework.

1.3 REFERENCES

- A. American National Standards Institute (ANSI):
  - 1. ANSI A208.1 - Particleboard.
- B. American Society of Civil Engineers (ASCE):
  - 1. ASCE 7 - Minimum Design Loads for Buildings and Other Structures.
- C. ASTM International (ASTM):
  - 1. ASTM C 423 - Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.
  - 2. ASTM C 1503 - Specification for Silvered Flat Glass Mirror.
  - 3. ASTM E 488 - Standard Test Methods for Strength of Anchors in Concrete and Masonry Elements.
  - 4. ASTM E 795 - Standard Practices for Mounting Test Specimens During Sound Absorption Tests.
- D. Audio Engineering Society (AES):

1. AES-4id - AES information document for room acoustics and sound reinforcement systems -- Characterization and measurement of surface scattering uniformity.
- E. Builders Hardware Manufacturers Association (BHMA):
  1. ANSI/BHMA A156.9 - Cabinet Hardware.
- F. GREENGUARD Environmental Institute (GEI):
  1. GREENGUARD certified low emitting products.
- G. International Electrotechnical Commission (IEC)
  1. Requirements for listing and labeling of products.
- H. National Electrical Manufacturers Association (NEMA):
  1. NEMA LD 3 - High Pressure Decorative Laminates.
- I. National Fire Protection Association (NFPA):
  1. NFPA 70 - National Electrical Code (NEC).
- J. Underwriters' Laboratories, Inc. (UL) and Underwriters' Laboratories of Canada (ULC):
  1. Requirements for listing and labeling of products.
- K. US Green Building Council (USGBC):
  1. Leadership in Energy and Environmental Design (LEED) Green Building Rating System.
- L. U.S. Department of Commerce, National Institute of Standards and Technology (NIST):
  1. DOC PS 1 - U.S. Product Standard for Construction and Industrial Plywood.
- M. California Air Resources Board (CARB).
- N. California 93120 - Formaldehyde Emissions Phase I.

#### 1.4 SUBMITTALS

- A. Product Data: Manufacturer's data sheets, installation instructions, and maintenance recommendations.
- B. LEED Submittals:
  1. Credit EQ 4.4: Manufacturer's certificate indicating that composite wood products and adhesives used in casework with no urea formaldehyde added.
- C. Shop Drawings: Prepared by manufacturer. Include elevations showing casework components, details of each condition of installation, and types and locations of hardware and fasteners. Show fabrication and installation details. Include plans, elevations, sections, details, and attachments to other Work.
  1. Indicate seismic bracing and fastening requirements.
- D. Samples: For each color and finish for each exposed casework component.
- E. Operation and Maintenance Data.

- F. Warranty: Submit sample meeting warranty requirements of this Section.

## 1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Approved manufacturer listed in this section, with minimum 5 years experience in manufacture of similar products in use in similar environments.
- B. Obtain music education casework through one source from a single approved manufacturer.
- C. Electrical Components: Listed and labeled per NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction.

## 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle casework in accordance with manufacturer's recommendations. Ship to jobsite only after roughing-in, painting work, and other related finish work has been completed and installation areas are ready to accept casework and recommended temperature and humidity levels will be maintained during the remainder of construction.

## 1.7 COORDINATION

- A. Coordinate installation of blocking and supports in frame wall assemblies under work of other sections where required for anchoring casework.

## 1.8 WARRANTY

- A. Special Warranty: Manufacturer's written warranty indicating manufacturer's intent to repair or replace components of music education storage casework that fail in materials or workmanship within 10 years from date of Substantial Completion. Failures are defined to include, but are not limited to, the following:
  1. Fracturing or breaking of casework components including doors, panels, shelves, or hardware resulting from normal wear and tear and normal use other than vandalism.
  2. Delamination or other failures of glue bond of components.
  3. Warping of casework components not resulting from leaks, flooding, or other uncontrolled moisture or humidity.
  4. Failure of operating hardware.

## PART 2 PRODUCTS

### 2.1 MANUFACTURERS

- A. Acceptable Manufacturer: Wenger Corporation / JR Clancy, which is located at: 555 Park Dr.; Owatonna, MN 55060; Toll Free Tel: 800-4WENGER (493-6437); Tel: 507-455-4100; Fax: 507-455-4258; Email: [request info \(info@wengercorp.com\)](mailto:info@wengercorp.com); Web: [www.wengercorp.com](http://www.wengercorp.com) | [www.JRClancy.com](http://www.JRClancy.com)
- B. Substitutions: Not permitted.
- C. Requests for substitutions will be considered in accordance with provisions of Section

01 60 00 - Product Requirements.

1. Approval of Comparable Products: Submit the following in accordance with project substitution requirements, within time period allowed for substitution review:
  - a. Product data, including certified independent test data indicating compliance with requirements for acoustical performance.
  - b. Samples of each type of product specified, including but not limited to the following:
    - 1) Door and casework panels.
    - 2) Grille doors.
    - 3) Hinges with through-bolting hardware.
    - 4) Latches with through-bolting hardware.
  - c. Project references: minimum of 5 installations not less than 5 years old, with owner contact information.
  - d. List of successful installations of similar products available for evaluation by Architect.
  - e. Sample warranty.
2. Approved manufacturers shall meet separate requirements of Submittals.

2.2 MATERIALS

- A. Materials Meeting Sustainable Design Requirements:
  1. No Added Urea Formaldehyde Products: Provide music education storage casework made with composite products and adhesives with no urea formaldehyde added.
  2. FSC Certified Wood Products: Provide music education storage casework made with wood from certified sources. Also available in Moisture Resistant, Class 1 Fire rated and Plywood cores.
- B. Particleboard: ANSI A208.1, minimum 43 lb/cu. ft. (689 kg/cu. m) density, composite products and adhesives, with no urea formaldehyde added.
- C. Fire Rated Particle Board: ANSI A208.1, minimum 45 lb/cu. ft. (720 kg/cu. m) density ASTM E-84 class 1.
- D. Plywood: APA standards PS1-98 section 5.7.4 or 5.7.1 or ANSI /HPVA HP-1-2004 Panel provide with HDF skins to prevent grain telegraphing.
- E. Particleboard Thermoset Panels: Particleboard finished with thermally-fused polyester surfacing on both sides meeting performance properties of NEMA LD 3 for VGS grade, edge-banded, including the following:
  1. Surface Abrasion Resistance: Taber Wheel, 400 cycles, for solid colors.
- F. Particleboard Thermoset Panels: Particleboard panel with no formaldehyde added 3/4 inch (19 mm) thick finished with thermally-fused polyester surfacing on both sides meeting performance requirements of NEMA LD 3 for VGS grade, edge-banded, including the following:
  1. Surface Abrasion Resistance: Taber Wheel, 400 cycles, for solid colors.
- G. Polyethylene Shelves: High-density, one-piece, blow-molded or polyethylene, with radiused front edge, for abuse-resistant shelves. Same color throughout will not show

scratches.

- H. PVC Edge Banding: Radiused PVC extrusions, 1/8 inch (3 mm) thick.

2.3 STORAGE CASEWORK

- A. Modular instrument storage casework with integral bases, adjustable levelers, and through-bolted fastening, enabling owner reconfiguration of unit layout.
  1. Acoustically enhanced instrument storage casework finished with interior lining of sound-absorbent material providing sound absorption and noise reduction properties.
  2. Sound Absorption Average: Minimum SAA of 0.80, based upon sound absorption coefficient for twelve one-third octave bands from 200 to 2500 Hz, inclusive, with a minimum Noise Reduction Coefficient (NRC) of 0.75, per ASTM C 423 and ASTM E 795.
  3. Acoustical Performance, One-third Octave Band Center Frequency, Hz, for four: 27 by 84 by 29 inches deep (606 by 2134 by 737 mm deep) units:

	125	250	500	1000	2000	4000
Sound Absorption Coefficient						
Mounting Type F65	1.08	0.71	0.86	0.77	0.75	0.68
Sound Absorption, sabins/unit						
Mounting Type F65	68.72	45.25	55.00	48.83	47.85	43.45
Scattering Coefficient	0.10	0.13	0.40	0.62	0.80	1.44

4. Wave grille doors in 5/16 inch (24 mm) and 1/4 inch (6.4 mm) diameter designed to reduce vibration.
- B. Seismic Performance: Comply with ASCE 7, "Minimum Design Loads for Buildings and Other Structures": Section 9, "Earthquake Loads" based upon seismic design criteria indicated.
  - C. Storage Casework Component Load Capacities:
    1. Storage Casework Wire-Grille Door Hinge: Each weld capable of resisting 400 lbf (1779 N) pull test without visible damage or permanent deformation.
    2. Storage Casework Full Grille Door Hinge= Full length door capable of supporting 315 lbs (143 kg). Through open and close cycle without permanent damage.
    3. Robe and Uniform Storage Casework Garment Hanger Rods: Capable of supporting vertical load applied uniformly along width of unit of 200 lbf (890 N).
  - D. Robe and uniform storage casework with integral bases, adjustable levelers, and through-bolted fastening, enabling owner reconfiguration of unit layout.
  - E. General: Provide through-ventilating instrument storage casework meeting requirements in System Description and Performance Requirements Articles.
  - F. General: Provide through-ventilating robe and uniform storage casework meeting requirements in System Description and Performance Requirements Articles.



- G. Side Panels and Divider Panels: Particleboard thermoset panel with no urea formaldehyde added, 3/4 inch (19 mm) thick. Side panels machined to accept unit-to-unit through-bolting.
- H. Panel Doors: Particleboard thermoset panel with no urea formaldehyde added, 3/4 inch (19 mm) thick.
  - 1. Color: Cherry.
  - 2. Provide for robe and uniform storage casework.
  - 3. Provide for casework indicated.
- I. Panel Edge Banding: 3 mm thick, heat-bonded, with radiused and profiled edges and corners.
- J. Shelving: Sized with adequate gap between shelving and casework side panels to allow air movement inside casework.
  - 1. Up to 27 inches (686 mm) wide: Removable molded polyethylene shelf, with impact-resistant, radiused front edge, mounted to cabinet wall with self-locking clip.
  - 2. Over 27 inches (686 mm) wide: For large instrument casework: Removable formed polyethylene shelf, ribbed, with high-impact-resistant, radiused front edge, supported by steel tube frame.
  - 3. Tubular steel supports are included for shelves over 19 inches (483 mm) wide.
  - 4. Corner cabinet revolving shelving: 0.053 inch (1.3 mm) min. thickness steel sheet bolted to revolving steel center post, with radiused hardboard deflector panel.
- K. Casework Panel Color: As selected by Architect from manufacturer's standard colors.
- L. Filler Panels and Closure: 3/4 inch (19 mm) thick particleboard thermoset panels with no urea formaldehyde in Oyster color. Provide the following, cut to fit field conditions, where indicated:
  - 1. Wall filler between cabinet side and wall.
  - 2. Top filler between cabinet top and wall.
  - 3. Top of cabinet closure panel between cabinet and finished ceiling or soffits.
  - 4. Finished back panel for exposed cabinet backs.
- M. Butt Hinges: 2-3/4 inches (70 mm), 5-knuckle steel hinges made from 0.090 inch (2.29 mm) thick metal, ANSI/BHMA A156.9, Grade 1, with powder-coated finish, through-bolted to door and side panels and welded to grille door frames. Provide 2 hinges on compartment doors, and 4 hinges on full-height doors.
- N. Slide Latch: 0.105 inch (2.67 mm) min. thickness steel, with padlock eye, powder-coat finish, through-bolted to panel door and side panel and welded to grille door frames. Latches securely without padlock. Provide with clear plastic label holder for use with standard size labels; number system available for user to print. Padlocks furnished by Owner.
- O. Panel Connectors: 1/4- 20 by 1.77 inch (45 mm) panel connectors, with steel thread inserts, powder coated to match panels.
- P. Cabinet Levelers: Leveling glides with 3/8 inch (9.5 mm) diameter threaded steel rod

in steel corner brackets, minimum two each per cabinet side, accessible from within unit, and concealed in completed installation.

- Q. Carcass joinery includes lag screws powder coated to match substrate.
- R. Back panel 7/32 inch (5.6 mm) reinforced with 3/4 inch (19 mm) stretchers panels held in a dado groove and lag screwed in place.
- S. Fasteners: Manufacturer-recommended fasteners as required for casework substrate and project performance requirements, consisting of one or more of the following:
  - 1. Sheet Metal Screws: SAE J78, corrosion-resistant-coated, self-drilling, self-tapping steel drill screws.
  - 2. Wood Screws: ASME B18.6.1.
  - 3. Expansion Anchors in Concrete and Concrete Masonry Units: Carbon-steel, zinc plated.
  - 4. Hardware supplied to anchor the cabinets to the wall and to adjacent casework
- T. Finish: Steel Sheet, Steel Wire, and Exposed Fasteners. Urethane-based electrostatic powder coating, color as indicated. Refer to Drawings.

### PART 3 EXECUTION

#### 3.1 EXAMINATION

- A. Examine casework installation areas for compliance with requirements for installation tolerances, location of blocking and other anchoring reinforcements, and other existing conditions affecting installation and performance of casework. Proceed with casework installation upon correction of unsatisfactory conditions.

#### 3.2 CASEWORK INSTALLATION

- A. Install plumb, level, and true; using integral levelers. Install in accordance with manufacturer's recommendations and approved submittals.
  - 1. Install seismic bracing and fastening in accordance with approved shop drawings.
- B. Install hardware uniformly and precisely. Set hinges snug and flat. Adjust and align hardware so moving parts operate freely and contact points meet accurately. Allow for final adjustment after installation.
- C. Adjust casework and hardware so doors and drawers operate smoothly without warp or bind and close with uniform reveals.

#### 3.3 CLEANING AND PROTECTING

- A. Repair or replace defective work as directed by Architect upon inspection.
- B. Clean casework surfaces. Touch up, refinish, or replace damaged components in a manner acceptable to Architect.
- C. Turn over operation and maintenance instructions to Owner.

END OF SECTION

**PROJECT MANUAL  
FOR  
MINOR RENOVATIONS  
AT  
EDGECLIFF HALL  
FOR**



**MARCH 2018**



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MEP Design

Security

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Commissioning

Design / Build

**PROJECT MANUAL**  
**FOR**  
**MINOR RENOVATIONS**  
**AT**  
**EDGECLIFF HALL**  
**FOR**  
**XAVIER UNIVERSITY**

**PREPARED BY**

**MOTZ ENGINEERING**  
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**MARCH 2018**

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## SECTION 210000 – FIRE SUPPRESSION WORK

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. This Section includes a summary of all Fire Suppression related work.
- B. Related Sections:
  - 1. 210500 – Common Work Results for Fire Suppression
  - 2. 210523 – General-Duty Valves for Fire Suppression Systems
  - 3. 210529 – Hangers And Supports for Fire Suppression Systems
  - 4. 210553 – Identification for Fire Suppression Systems
  - 5. 211313 – Wet-Pipe Sprinkler Systems
- C. Work by Others:
  - 1. The following work will be done by other contractors, as specified under respective headings, which this contractor shall read to ascertain what is called for therein:
    - a. General Construction
    - b. HVAC
    - c. Integrated Automation
    - d. Electric

#### 1.3 PROJECT CONDITIONS

- A. Alterations of and Additions to Fire Suppression Systems
  - 1. The contract shall include new work as shown, specified, or required, and shall include, but not limited to, the following principal components:
    - a. Provide wet pipe sprinkler system in renovated portions of existing building, as designated on the drawings. All sprinkler heads shall be normal coverage type.
    - b. Provide requisite drain piping.
    - c. Perform start-up for all fire suppression systems and commission same in accordance with the commissioning requirement.
    - d. Provide and/or participate in training of Owner's personnel on the use of all new fire suppression systems.
  - 2. All work shall be performed in strict accordance with the City and State of Ohio rules, regulations, and drawings.



3. The contractor shall exercise adequate protective and safety measures for all persons and property and shall be responsible for any damages or injuries arising from the execution of this work.
  4. Alterations of and additions to existing systems shall include the requisite rigging, wrecking, hauling, protection of permanent equipment and the building structures, and cleaning up. Care shall be exercised to keep dust and dirt to a minimum. All debris shall be promptly removed.
  5. The existing facility will be occupied and will remain in operation throughout the period that this work is being performed, and certain new work will be performed during this period. Unscheduled interruptions of the facility will not be tolerated. The contractor shall exercise extreme caution, shall thoroughly inform his workmen and subcontractors of the critical nature of this work, and shall continually review the work procedure being followed in order to prevent accidental interruption of service. Before performing any act which could result in interruption of service, the contractor shall notify the Owner and Engineer of the hazards involved and the contractor shall proceed in a manner and at a time specifically approved by the Owner and Engineer.
  6. All work necessitating the temporary turning off or shutting down the operation of existing mechanical and/or electrical facilities shall be done at times specifically approved by the Owner and Engineer in advance of any disruption of existing facilities.
- B. Installation of Pipe:
1. Codes:
    - a. All work, including joints, fittings, hangers, slope of piping, drains, etc. shall be installed in strict accordance with applicable City, County, and State laws and codes, and NFPA bulletins including latest revisions. All material and equipment shall bear U. L. label or similar acceptable identification.
- C. Drains:
1. Provide 1" test valves and/or drain valves where required by code or at all low points in piping in all systems and extend drain piping to exterior of building, nearest floor drain, or janitor's receptor as approved by Engineer.
- D. Design of Systems:
1. Sprinkler Contractor shall lay out sprinkler heads and design piping distribution systems using the hydraulic calculation method based on NFPA Bulletin 13, unless specified otherwise. Refer to Section 21 13 13 for Hazard Classifications.
  2. For compiling their bids, contractors shall layout and design a system using the hydraulic calculation method based on the sprinkler head location for the above coverage requirements and F.M. requirements. The successful low bidder shall submit his plans and calculations for approval to the Engineer and then to appropriate agencies and authorities for approval and permits.
- E. Flow Test:
1. All calculations shall include flow test results. Flow tests shall be performed by the successful Fire Protection Contractor and verified by the local fire department, and/or Engineer. Prior flow tests on file with jurisdictional agencies may be used in lieu of new flow tests only when previous test has been made within 3 months of project start date.

2. Contractor shall use 90% of flow test pressure data as the base in performance of the small calculations and the system shall be calculated from the flow test evaluation to the highest sprinkler head.
- F. Shop Drawings:
1. As soon as possible after award of the contract, and prior to fabrication, the contractor shall prepare complete shop drawings of the sprinkler systems, which shall in general conform to the bidding documents; any deviations deemed necessary by the contractor shall be noted and agreed upon prior to starting the work.
  2. In preparing his working drawings, the contractor shall coordinate the location of sprinkler heads and piping with the other contractors and with existing conditions. Drawings shall show ceiling grids, lights, registers, grilles, heat detection devices, access panel, skylights, audio/visual devices and equipment, etc. Any changes in fabricated sprinkler piping occasioned by lack of coordination shall be made by the contractor at no change in the contract price.
  3. All drawings and calculations shall be reviewed and accepted by the Engineer before submitting them to the local fire department, building department, state, fire marshal, and the insurance carrier or insurance reviewing authority. Indication of review and/or acceptance by the agencies shall be certified by name of the reviewer, agency, and date affixed to the plans or reproducibles submitted.
- G. Fees
1. Contractors shall pay all charges and fees pertaining to plan reviews, permits, inspections, etc.
- H. Performance:
1. Fire protection work shall be performed by a Sprinkler Contractor certified for sprinkler work by State Fire Marshal.
  2. Wiring for tamper switches, alarms, etc. shall be furnished and installed by Electric Contractor.
- I. Excavation And Backfilling And Restoration Of Surfaces
1. Refer to Division 01.
- J. Guarantee
1. This contractor shall guarantee all workmanship, materials, and equipment entering into this contract for a period of one year; all from date of substantial completion or from the "recognized" start-up date, whichever is later. Should the Owner elect to accept a portion of work prior to the date of substantial completion, the guarantee period for the accepted portion of the work shall commence on the date of acceptance or on the "recognized" start-up date for that portion of the work, whichever is later. If the specifications dictate a different period of guarantee for a given component or piece of equipment, the more stringent requirements shall govern.
  2. The "recognized" start-up date shall be defined as that date on which the contractor has successfully completed all work, including the following:
    - a. Submitted and received approval of four (4) copies of the Instruction Booklets.
    - b. Submitted complete "As-Built" drawings.

- c. Completed all testing, cleaning, adjusting, and trial run.
  3. In the case where the Engineer is accepting a portion of the work, the contractor shall have completed all phases of that portion of the work to be accepted, including Items above, for that accepted portion of the work.
  4. Any workmanship, materials, or equipment proving to be defective during this guarantee period shall be made good by this contractor without additional cost to the Owner.
  5. Refer to Division 00.
- K. Equipment
  1. Any and all costs associated with piping, electric, wiring, conduit, supports, pads, or other modifications to accommodate installation for manufacturer's equipment that differs from equipment layout on drawings shall be included on contractor's bid. The contractor is responsible to insure that the equipment will fit within space allocated with appropriate clearances for maintenance, operation, servicing, and code.
- L. Schedule
  1. The contractor shall be responsible to meet the project schedule as stated by the Owner. The contractor shall include in his bid the cost associated with all requisite coordination.
  2. In addition, the contractor must prepare a schedule for his work that integrates with the Owner's schedule. The contractor shall update progress and revise schedule at least twice monthly.
  3. This contractor shall be responsible to expedite any materials and work any overtime in order to meet the schedule. The cost for any expediting of overtime work shall be included in his bid.

PART 2 – PRODUCTS (NOT APPLICABLE)

PART 3 – EXECUTION (NOT APPLICABLE)

END OF SECTION 210000

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## SECTION 210500 – COMMON WORK RESULTS FOR FIRE SUPPRESSION

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. This Section includes the following:
  - 1. Piping materials and installation instructions common to most piping systems.
  - 2. Mechanical sleeve seals.
  - 3. Sleeves.
  - 4. Escutcheons.
  - 5. Grout.
  - 6. Fire-suppression equipment.
  - 7. Equipment installation requirements common to equipment sections.
  - 8. Painting and finishing.
  - 9. Supports and anchorages.

#### 1.3 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in chases.
- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.
- F. The following are industry abbreviations for rubber materials:
  - 1. EPDM: Ethylene-propylene-diene terpolymer rubber.
  - 2. NBR: Acrylonitrile-butadiene rubber.

#### 1.4 SUBMITTALS

- A. Product Data: For the following:
  - 1. Mechanical sleeve seals.
  - 2. Escutcheons.

## 1.5 QUALITY ASSURANCE

- A. Electrical Characteristics for Fire-Suppression Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

## 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.
- B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

## 1.7 COORDINATION

- A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for fire-suppression installations.
- B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.
- C. Coordinate requirements for access panels and doors for fire-suppression items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Frames."

## PART 2 – PRODUCTS

### 2.1 MANUFACTURERS

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

### 2.2 PIPE, TUBE, AND FITTINGS

- A. Refer to individual Division 21 piping Sections for pipe, tube, and fitting materials and joining methods.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

### 2.3 JOINING MATERIALS

- A. Refer to individual Division 21 piping Sections for special joining materials not listed below.
- B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.

1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
  - a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
2. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.

C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

## 2.4 MECHANICAL SLEEVE SEALS

- A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
1. Manufacturers:
    - a. Advance Products & Systems, Inc.
    - b. Calpico, Inc.
    - c. Metraflex Co.
    - d. Pipeline Seal and Insulator, Inc.
  2. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
  3. Pressure Plates: Carbon steel. Include two for each sealing element.
  4. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

## 2.5 SLEEVES

A. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.

## 2.6 ESCUTCHEONS

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

## 2.7 GROUT

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

## PART 3 – EXECUTION

### 3.1 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. Install piping according to the following requirements and Division 21 Sections specifying piping systems.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping to permit valve servicing.
- G. Install piping at indicated slopes.
- H. Install piping free of sags and bends.
- I. Install fittings for changes in direction and branch connections.
- J. Install piping to allow application of insulation.
- K. Select system components with pressure rating equal to or greater than system operating pressure.
- L. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:
  - 1. New Piping:
    - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
    - b. Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish.
    - c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
    - d. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
    - e. Bare Piping in Unfinished Service Spaces: One-piece, stamped-steel type with concealed hinge and set screw.
    - f. Bare Piping in Equipment Rooms: One-piece, stamped-steel type with set screw.
    - g. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.



- M. Sleeves are not required for core-drilled holes.
  - N. Permanent sleeves are not required for holes formed by removable PE sleeves.
  - O. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
    - 1. Cut sleeves to length for mounting flush with both surfaces.
      - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
    - 2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
      - a. Steel Pipe Sleeves: For pipes smaller than NPS 6.
      - b. Steel Sheet Sleeves: For pipes NPS 6 and larger, penetrating gypsum-board partitions.
      - c. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Refer to Division 07 Section "Sheet Metal Flashing and Trim" for flashing.
        - 1) Seal space outside of sleeve fittings with grout.
        - 2) Except for underground wall penetrations, seal annular space between sleeve and pipe, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.
  - P. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07 Section "Penetration Firestopping" for materials.
  - Q. Verify final equipment locations for roughing-in.
  - R. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.
- 3.2 PIPING JOINT CONSTRUCTION
- A. Join pipe and fittings according to the following requirements and Division 21 Sections specifying piping systems.
  - B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
  - C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
  - D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
  - E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.

- F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
  - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
  - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- G. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

### 3.3 PAINTING

- A. Painting, if any, of fire-suppression systems, equipment, and components is specified in Division 09 Sections "Interior Painting" and "Exterior Painting."
- B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

### 3.4 ERECTION OF METAL SUPPORTS AND ANCHORAGES

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

### 3.5 GROUTING

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

END OF SECTION 210500

## SECTION 210523 – GENERAL-DUTY VALVES FOR FIRE SUPPRESSION SYSTEMS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Underwater laboratory approved valves.
  - 2. Water service valves.

#### 1.3 DEFINITIONS

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

#### 1.4 SUBMITTALS

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

#### 1.5 QUALITY ASSURANCE

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

## 1.6 DELIVERY, STORAGE, AND HANDLING

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

## PART 2 – PRODUCTS

### 2.1 GENERAL REQUIREMENTS FOR VALVES

- A. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- B. Valve Sizes: Same as upstream piping unless otherwise indicated.
- C. Valve-End Connections:
  - 1. Flanged: With flanges according to ASME B16.1 for iron valves.
  - 2. Grooved: With grooves according to AWWA C606.
  - 3. Solder Joint: With sockets according to ASME B16.18.
  - 4. Threaded: With threads according to ASME B1.20.1.
- D. Valve Bypass and Drain Connections: MSS SP-45.
- E. Furnish and install all valves where shown or required for the proper operation of the system.
- F. Valves shall always be placed in accessible positions for operation and repairs.
- G. Provide chain operators on all valves 3" and larger installed more than 7'-0" above mechanical equipment and floors.

### 2.2 UNDERWRITER LABORATORY APPROVED VALVES

- A. Butterfly Valves 2-1/2" and larger shall be Grinnell Series 8000 FP, Central, Mueller, Stockham, or equal, UL approved lug type butterfly valves with handwheel and factory pre-adjusted internal monitor switch (GS-1).

- B. Butterfly Valves 2" and smaller shall be Milwaukee Valve Co. Model BB501, Central, or Nibco, 175 lb. with built-in tamper switch with S.P.D.T. micro switch.
- C. Gate Valves OS & Y 2-1/2" and larger shall be Mueller Fig. A-2078-6, Central, Stockham, or Nibco, outside screw and yoke type, cast iron, epoxy coated body, resilient wedge, UL approved for 200 psi working pressure (400 psi test).
- D. Gate Valves 2" and smaller shall be Grinnell Fig. 2920, Central, Stockham, or approved equal, UL approved all bronze, 175 lb. working pressure (300 lb. test).
- E. Globe Valves shall be Grinnell Fig. 97-SD, Central, Stockham, or approved equal, UL approved all bronze 175 lb. W.O.G. (300 lb. test).
- F. Check Valves 4" and larger shall be Grinnell-Kennedy Fig. 126, Central, Stockham, or approved equal, UL approved swing check, bronze and steel, 175 lb. working pressure (300 lb. test).
- G. Check Valves 3" and smaller shall be Grinnell-Kennedy Fig. 2950, Central, Stockham, or approved equal, UL approved swing check, all bronze, 175 lb. W.O.G. (300 lb. test).
- H. Angle Valves shall be Grinnell Fig. 2930, FP, Central, Stockham, or approved equal, UL approved all bronze, 175 W.O.G. (300 lb. test).
- I. Detector Check Valve shall be ITT Grinnell-Hersey, EDC IV, Ames, or approved equal, UL approved, with flanged ends and 1" metered bypass.

### PART 3 – EXECUTION

#### 3.1 EXAMINATION

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

#### 3.2 VALVE INSTALLATION

- A. Locate valves for easy access and provide separate support where necessary.
- B. Install valves in horizontal piping with stem at or above center of pipe.

- C. Install valves in position to allow full stem movement.

### 3.3 ADJUSTING

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

END OF SECTION 210523

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## SECTION 210529 – HANGERS AND SUPPORTS FOR FIRE SUPPRESSION SYSTEMS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section includes:
  - 1. Metal pipe hangers and supports.
  - 2. Trapeze pipe hangers.
  - 3. Metal framing systems.
  - 4. Fastener systems.
  - 5. Pipe stands.
  - 6. Pipe positioning systems.
- B. Related Sections:
  - 1. Division 05 Section "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.

#### 1.3 DEFINITIONS

- A. MSS: Manufacturers Standardization Society for The Valve and Fittings Industry Inc.

#### 1.4 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Hangers and supports for fire suppression piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI7.
  - 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.
  - 3. Design seismic-restraint hangers and supports for piping and equipment and obtain approval from authorities having jurisdiction.

#### 1.5 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Show fabrication and installation details and include calculations for the following:
  - 1. Trapeze pipe hangers.
  - 2. Metal framing systems.
  - 3. Fiberglass strut systems.

4. Pipe stands.

PART 2 - PRODUCTS

2.1 HANGERS AND SUPPORTS

- A. Horizontal piping 4" and smaller shall be supported by steel clevis or split ring malleable iron hangers with adjustable rods.
- B. For all other piping: hangers for pipe sizes 4" and smaller pipe shall be spaced not more than 10'-0" apart; provide one additional hanger at each location where pipe changes direction.
- C. Hangers for fire protection piping shall be steel hangers complying with the requirements of NFPA bulletins.
- D. Hangers for suspended piping shall be Grinnell, Fee and Mason or Gateway hangers each to the following Grinnell Figure Numbers. Hangers shall be Grinnell Fig. 108 split malleable iron pipe ring and Fig. 114 turnbuckle, for pipes 2" and smaller; and Grinnell Fig. 260, steel clevis for 2-1/2" to 4" pipe. Adjustment shall be 2" for securing proper grade and alignment.
- E. Pipe supported on floor shall be supported on Grinnell Fig. 259, Fee and Mason, or Gateway pipe consisting of cast iron yoke and nuts. Install on 3" Schedule 40 pipe with steel base plate.
- F. Pipe supported on steel support racks shall be supported on Grinnell Fig. 271, Fee and Mason, or Gateway pipe roll stands consisting of cast iron pipe roll, steel rod and cast iron stand.
- G. Supports for hangers shall be solid rods of ASTM A-107 steel with running threads on both end rods or shall be all-thread rods. Rods shall be sized according to the requirements of NFPA bulletins and shall be not less than the following:

	SINGLE ROD	TWO RODS
3/4" to 2" Pipe	3/8" Dia.	
2-1/2" to 3" Pipe	2" Dia.	
4" Pipe	5/8" Dia.	1/2" Dia.

- H. All rods shall be adjustable and shall be accurately plumbed and double nutted.
- I. Piping shall not be supported from ceiling grid, ductwork, electric conduit, heating or fire suppression lines, or any other utility lines, and vice versa. Each utility and the ceiling grid system shall be a separate installation and each shall be independently supported from the building structure. Where interferences occur, in order to support ductwork, piping, conduit, ceiling grid systems, etc., trapeze type hangers or supports



shall be employed and shall not be located where they interfere with access to mixing boxes, fire dampers, valves, etc.

- J. Hangers under new concrete construction shall be supported by concrete inserts, Grinnell Fig. 282, Fee and Mason or Gateway, malleable iron body and nut. Where additional supports are required, install, per manufacturer's installation instructions and load ratings (with 5:1 safety factor) Rawl or Hilti expansion bolts.
- K. Adjacent to concrete and block construction, hangers shall be supported by Rawl or Hilti expansion bolts installed per manufacturer's installation instructions and load ratings (with 5:1 safety factor).
- L. Under steel beam construction, hangers shall be supported by beam clamps, Grinnell Fig. 218, Fee and Mason, or Gateway malleable iron jaws with steel rod and nut. Where intermediate support between beams is required, contractor shall weld angle iron supports between beam or joists, top of angles being level with top of building steel.
- M. Under bar joist construction, hangers shall be supported by beam clamps, Grinnell Fig. 218, Fee and Mason, or Gateway malleable iron jaws with steel rod and nut. Where intermediate support between beams is required, contractor shall weld angle iron supports between beam or bar joists, top of angles being level with top of building steel.
- N. Any cutting and patching required to install hangers, supports, rods, or inserts shall be performed by this contractor.

## 2.2 SUPPORTS – VERTICAL PIPING

- A. Supports - vertical piping shall be supported at intermediate floors with Grinnell Fig. 261, Fee and Mason, or Gateway steel riser clamps placed under hub, fitting, or coupling, and with approved solid bearing on floor construction.

## 2.3 ANCHORS AND GUIDES

- A. Anchors and guides shall be heavy substantial steel anchors of type suitable for the conditions at each location, and place on the pipe lines where shown or necessary to force the expansion in the proper direction. Horizontal anchors shall be constructed of structural angles or shapes properly fabricated and securely bolted to the construction and fitted with clamps and welds to secure the piping. Guides, independent of the expansion joints, shall be installed on pipe lines on each side of joint completely in accordance with manufacturer's recommendations but not less than one guide at 4 pipe diameters and another guide at 14 pipe diameters from each joint to prevent buckling of piping. Certain guides for piping 4" through 6" size, where indicated, shall be Grinnell No. 255.

## 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 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 above for individual pipe hangers.
  - 2. Field fabricate from ASTM A 36/A 36M, steel shapes selected for loads being supported. Weld steel according to AWS D1.1.
- C. 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. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- G. 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.
- H. Install lateral bracing with pipe hangers and supports to prevent swaying.
- I. 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.
- J. Load Distribution: Install hangers and supports so piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

- K. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.9 (for building services piping) are not exceeded.
- L. Insulated Piping: Comply with the following:
  - 1. Attach clamps and spacers to piping.
    - a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
    - b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
    - c. Do not exceed pipe stress limits according to ASME B31.9 for building services piping.
  - 2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
  - 3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.

### 3.2 METAL FABRICATIONS

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

### 3.3 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.

### 3.4 PAINTING

- A. Touch Up: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
  - 1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.

### 3.5 PIPE HOLES

- A. Where new piping is to be installed through existing concrete floors or roof, and where holes do not exist, this contractor shall bore new holes and shall protect the building from moisture and/or dust at these locations. Space between bare pipe or insulation and hole shall be caulked so as to make airtight, waterproof, and with fire resistive rating equal to or greater than the construction penetrated.
- B. In fire rated walls, space between bare pipe or insulation and hole shall be filled with the following applicable 3M Brand fire barrier products: Model CP25N/S no-sag caulk, moldable putty, Model FS-195 wrap/strip or Model CS-195 composite sheet.
- C. Contractor shall cut and patch all openings in concrete or masonry walls, furnish and set sleeves hereinafter specified, and patch around same.
- D. The contractor will close all openings resulting from the removal of piping. Patching work shall match and be integral with existing surrounding surfaces.

### 3.6 PIPE SLEEVES

- A. Where new pipe passes through concrete or masonry walls, inside partitions, or furrings, pipe sleeves ½" larger in diameter than the outside of pipe or pipe covering for which they are intended shall be provided and set in place by this contractor. Contractor shall do all cutting and patching of construction required for the proper installation of the sleeves.
- B. No sleeves shall be installed through structural beams or concrete joists unless specifically shown and/or approved.
- C. Sleeves through exterior walls below grade shall be Schedule 40 cast iron pipe; all other sleeves shall be Schedule 40 steel pipe. All sleeves shall be machine cut. Space between bare pipe or insulation and sleeves shall be caulked so as to make airtight and waterproof and with fire resistive rating equal to or greater than the construction penetrated. In outside walls, space between sleeve and pipe shall be filled with resilient compressible packing with outside face of joint sealed with permanently flexible caulking material.
- D. Wall sleeves shall finish flush with wall lines, and where lateral movement of pipe must be provided for, the sleeves shall be oval in section. Floor sleeves shall be set with bottom flush with finished construction below and top extending 1" above finished floor in wet areas and 1/4" above finished floor in all other areas.
- E. For pipe penetrations in exterior building wall, provide mechanical sleeve seals of modular design, with interlocking rubber links shaped to continuously fill annular space between pipe and sleeve. Include connecting bolts and pressure plates. Seal penetrations using sleeves and mechanical sleeve seals. Size sleeve for 1" (25 mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals. Install steel pipe for sleeves smaller than 6" (150 mm) in diameter. Install cast-iron "wall pipes" for sleeves 6" (150 mm) in diameter and larger. Assemble and install mechanical sleeve seals according to manufacturer's written instructions. Tighten bolts that cause rubber sealing elements to expand and make watertight seal. Mechanical

sleeve seals shall be manufactured by Calpico, Inc., Metraflex Co., or  
Thunderline/Link-Seal.

END OF SECTION 210529

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## SECTION 210553 – IDENTIFICATION FOR FIRE SUPPRESSION SYSTEMS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Pipe labels.
  - 2. Stencils.
  - 3. Valve tags.

#### 1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples: For color, letter style, and graphic representation required for each identification material and device.
- C. Valve numbering scheme.
- D. Valve Schedules: For each piping system to include in maintenance manuals.

#### 1.4 COORDINATION

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Coordinate installation of identifying devices with locations of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.

### PART 2 – PRODUCTS

#### 2.1 TAGGING

- A. All new valves shall be identified with numbered 2" diameter brass tags attached to valve wheels or stems with heavy brass chains. Tags shall have stamped letters, to designate piping system, and numbers, i.e., - ST-1-1, etc.
- B. The contractor shall prepare a printed chart, designating the location and briefly stating the function of each valve so marked, properly classified and placed in numerical order. Copy of chart shall be submitted to the Engineer for proofreading and approval. Approved copy of chart and instructions to be mounted and set in frame under glass

and hung in fire pump room. Bind a copy with each set of instructions to be furnished under the General Conditions.

## 2.2 IDENTIFICATION

- A. The contractors shall include identification of all piping installed under their respective contracts. Such identification shall be in the form of stenciling.
- B. Contents of piping shall be identified within 3 feet of each valve, or near each branch. All other piping shall be identified along pipe runs at not more than 25 foot intervals where piping is concealed and 50 foot intervals where piping is exposed.
- C. Identification of all pipe shall be made in the form of stenciling by applying one heavy coat of enamel and shall consist of identifying name in lettering at least 1" high, 8" long directional arrow below name, and a 2-1/4" wide band consisting of three 3/4" wide bands of different painted colors encircling pipe on each side of name and arrow. In addition, for insulated piping, identifying name shall also identify insulation type. Name, arrow, and bands for the same piping system contents shall be of same colors; colors to be used for various systems shall be as directed by the Engineer.
- D. Piping contents shall be labeled as follows:
  - 1. Wet Sprinkler – Fire Protection - - - - SPRINKLERS

## PART 3 – EXECUTION

### 3.1 PREPARATION

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

### 3.2 EQUIPMENT LABEL INSTALLATION

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

END OF SECTION 210553

## SECTION 211313 – WET-PIPE SPRINKLER SYSTEMS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 DESCRIPTION OF WORK

- A. Furnish and install automatic wet pipe sprinkler systems for the building addition.
- B. Furnish and install the following:
  - 1. Sprinkler zone main shut-off valves.
  - 2. Zone flow alarms and test valves.
  - 3. Sprinkler heads.
  - 4. Mains, branches, drains, and related piping.

#### 1.3 SUMMARY

- A. Section Includes:
  - 1. Pipes, fittings, and specialties.
  - 2. Fire-protection valves.
  - 3. Fire-department connections.
  - 4. Sprinklers.
  - 5. Alarm devices.
  - 6. Pressure gages.
- B. Related Sections:
  - 1. Division 21 Section "Fire-Suppression Standpipes" for standpipe piping.
  - 2. Division 21 Section "Dry-Pipe Sprinkler Systems" for dry-pipe sprinkler piping.
  - 3. Division 21 Section "Electric-Drive, Centrifugal Fire Pumps" for fire pumps, pressure-maintenance pumps, and fire-pump controllers.

#### 1.4 DEFINITIONS

- A. Standard-Pressure Sprinkler Piping: Wet-pipe sprinkler system piping designed to operate at working pressure of 175 psig maximum.

#### 1.5 SYSTEM DESCRIPTIONS

- A. Wet-Pipe Sprinkler System: Automatic sprinklers are attached to piping containing water and that is connected to water supply through alarm valve. Water discharges immediately from sprinklers when they are opened. Sprinklers open when heat melts fusible link or destroys frangible device. Hose connections are included if indicated.



## 1.6 PERFORMANCE REQUIREMENTS

- A. Standard-Pressure Piping System Component: Listed for 175-psig minimum working pressure.
- B. Sprinkler system design shall be approved by authorities having jurisdiction.
  - 1. Margin of Safety for Available Water Flow and Pressure: percent, including losses through water-service piping, valves, and backflow preventers.
  - 2. Sprinkler Occupancy Hazard Classifications:
    - a. Building Service Areas: Ordinary Hazard, Group 1.
    - b. Classrooms: Light Hazard.
    - c. Electrical Equipment Rooms: Ordinary Hazard, Group 1.
    - d. General Storage Areas: Ordinary Hazard, Group 1.
    - e. Libraries except Stack Areas: Light Hazard.
    - f. Library Stack Areas: Ordinary Hazard, Group 2.
    - g. Mechanical Equipment Rooms: Ordinary Hazard, Group 1.
    - h. Office and Public Areas: Light Hazard.
  - 3. Minimum Density for Automatic-Sprinkler Piping Design:
    - a. Light-Hazard Occupancy: 0.10 gpm over 1500-sq. ft. area.
    - b. Ordinary-Hazard, Group 1 Occupancy: 0.15 gpm over 1500-sq. ft. area.
    - c. Ordinary-Hazard, Group 2 Occupancy: 0.20 gpm over 1500-sq. ft. area.
  - 4. Maximum Protection Area per Sprinkler: Per UL listing.
  - 5. Maximum Protection Area per Sprinkler:
    - a. Office Spaces: 225 sq. ft. (20.9 sq. m).
    - b. Storage Areas: 130 sq. ft.
    - c. Mechanical Equipment Rooms: 130 sq. ft.
    - d. Electrical Equipment Rooms: 130 sq. ft.
    - e. Other Areas: According to NFPA 13 recommendations unless otherwise indicated.
  - 6. Total Combined Hose-Stream Demand Requirement: According to NFPA 13 unless otherwise indicated:
    - a. Light-Hazard Occupancies: 100 gpm for 30 minutes.
    - b. Ordinary-Hazard Occupancies: 250 gpm for 60 to 90 minutes.
- C. Seismic Performance: Sprinkler piping shall withstand the effects of earthquake motions determined according to NFPA 13 and ASCE/SEI 7.

## 1.7 SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings: For wet-pipe sprinkler systems. Include plans, elevations, sections, details, and attachments to other work.
  - 1. Wiring Diagrams: For power, signal, and control wiring.
- C. Coordination Drawings: Sprinkler systems, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
  - 1. Domestic water piping.
  - 2. HVAC hydronic piping and ductwork.

3. Items penetrating finished ceiling include the following:
  - a. Lighting fixtures.
  - b. Air outlets and inlets.
  - c. Fire alarm devices.
  - d. Technology Equipment (i.e. projectors-ceiling mounted; screens, etc).

D. Qualification Data: For qualified Installer.

E. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, that have been approved by authorities having jurisdiction, including hydraulic calculations if applicable.

F. Fire-hydrant flow test report.

G. Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13. Include "Contractor's Material and Test Certificate for Aboveground Piping."

H. Field quality-control reports.

I. Operation and Maintenance Data: For sprinkler specialties to include in emergency, operation, and maintenance manuals.

## 1.8 QUALITY ASSURANCE

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

B. NFPA Standards: Sprinkler system equipment, specialties, accessories, installation, and testing shall comply with the following:

1. NFPA 13, "Installation of Sprinkler Systems."
2. NFPA 13R, "Installation of Sprinkler Systems in Residential Occupancies up to and Including Four Stories in Height."
3. NFPA 24, "Installation of Private Fire Service Mains and Their Appurtenances."

## 1.9 COORDINATION

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

## 1.10 EXTRA MATERIALS

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

1. Sprinkler Cabinets: Finished, wall-mounted, steel cabinet with hinged cover, and with space for minimum of three spare sprinklers of each type plus sprinkler wrench. Include number of sprinklers required by NFPA 13 and sprinkler wrench. Include separate cabinet with sprinklers and wrench for each type of sprinkler used on Project.

## PART 2 – PRODUCTS

### 2.1 PIPING MATERIALS

- A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, and fitting materials, and for joining methods for specific services, service locations, and pipe sizes. Also, refer to Section 211000 for specific piping information.

### 2.2 STEEL PIPE AND FITTINGS

- A. Pipe 2" and Smaller:
1. Pipe: Schedule 40 black steel, threaded.
  2. Fitting: 125# cast iron or 150# malleable iron, screwed.
- B. Pipe 2-1/2" and Larger:
1. Pipe: Schedule 40 black steel, grooved except at flanged valves, equipment, etc.
  2. Fittings: Grooved, mechanical, bolted, malleable iron, (Victaulic) except at flanged valves, fittings, and equipment where fittings shall be 125# flanged galvanized cast iron.

### 2.3 LISTED FIRE-PROTECTION VALVES

- A. Refer to Section 21 05 23.

### 2.4 SPRINKLERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Globe Fire Sprinkler Corporation.
  2. Reliable Automatic Sprinkler Co., Inc.
  3. Tyco Fire & Building Products LP.
  4. Victaulic Company.
- B. General Requirements:
1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
  2. Pressure Rating for Automatic Sprinklers: 175 psig minimum.
- C. Sprinkler Heads – All sprinkler heads shall be extended coverage type:
1. Type "C" – Concealed, Ceiling: Type "C" heads shall be Reliable Model "G1", concealed pendent, sprinkler, 165° with 1/2" orifice, 1" filed adjustment and white cover plate assembly. Sprinkler heads must be centered in ceiling tiles.
  2. Type "D" – Exposed, Upright: Type "D" heads shall be Reliable Model "GFR", Upright, 165° with plain finish and 1/2" orifice.
  3. Type "E" – Exposed, Pendent: Type "E" heads same as Type "D" heads except heads shall be pendent.
  4. Heads must be centered in ceiling tiles, unless shown otherwise on the drawing.
  5. Provide three (3) extra sprinkler heads of each type and wrenches in a steel cabinet to be located where directed by Owner or Engineer. Stock of extra heads to include all ratings and types installed.

## 2.5 DRAIN AND TEST CONNECTIONS

- A. Drain and test connections for all systems shall each consist of 1” gate valve and 1” hose connection with cap. Install test connections where required by code and drain connections at all low points in system. Contractor may substitute SURE-TEST inspectors test and drain valves for the above valves. Extend valve discharges to outside of building, or over a floor drain or janitor’s closet if approved by the Engineer and Owner.

## 2.6 ALARM DEVICES

- A. Refer to Section 21 05 00.

## 2.7 PRESSURE GAGES

- A. Refer to Section 21 05 00.

## 2.8 ESCUTCHEONS

- A. Refer to Section 21 05 00.

## 2.9 SLEEVES

- A. Refer to Section 21 05 00.

## 2.10 SLEEVE SEALS

- A. Refer to Section 21 05 00.

## 2.11 GROUT

- A. Refer to Section 21 05 00.

## PART 3 – EXECUTION

### 3.1 PREPARATION

- A. Perform fire-hydrant flow test according to NFPA 13 and NFPA 291. Use results for system design calculations required in "Quality Assurance" Article.
- B. Report test results promptly and in writing.

### 3.2 SERVICE PIPING

- A. Connect sprinkler piping to existing water-service piping at various locations throughout the building.

### 3.3 PIPING INSTALLATION

- A. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated, as far as practical.
  - 1. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with Engineer before deviating from approved working plans.
- B. Piping Standard: Comply with requirements for installation of sprinkler piping in NFPA 13.
- C. Install seismic restraints on piping. Comply with requirements for seismic-restraint device materials and installation in NFPA 13.
- D. Use listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.
- E. Install unions adjacent to each valve in pipes NPS 2 and smaller.
- F. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.
- G. Install "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve, and sized and located according to NFPA 13.
- H. Install sprinkler piping with drains for complete system drainage.
- I. Install sprinkler control valves, test assemblies, and drain risers adjacent to standpipes when sprinkler piping is connected to standpipes.
- J. Install alarm devices in piping systems.
- K. Install hangers and supports for sprinkler system piping according to NFPA 13. Comply with requirements for hanger materials in NFPA 13.
- L. Install pressure gages on riser or feed main, at each sprinkler test connection, and at top of each standpipe. Include pressure gages with connection not less than NPS 1/2 and with soft metal seated globe valve, arranged for draining pipe between gage and valve. Install gages to permit removal, and install where they will not be subject to freezing.
- M. Fill sprinkler system piping with water.
- N. Install electric heating cables and pipe insulation on sprinkler piping in areas subject to freezing. Comply with requirements for heating cables in Division 21 "Heat Tracing for Fire-Suppression Piping" and for piping insulation in Division 21 Section "Fire-Suppression Systems Insulation."

### 3.4 JOINT CONSTRUCTION

- A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure ratings same as or higher than system's pressure rating for aboveground applications unless otherwise indicated.
- B. Install unions adjacent to each valve in pipes NPS 2 and smaller.
- C. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.
- D. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- E. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
- F. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with gasket and bolts according to ASME B31.9.
- G. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
  - 1. Apply appropriate tape or thread compound to external pipe threads.
  - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
- H. Steel-Piping, Roll-Grooved Joints: Roll rounded-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe grooved joints.

### 3.5 VALVE AND SPECIALTIES INSTALLATION

- A. Install listed fire-protection valves, trim and drain valves, specialty valves and trim, controls, and specialties according to NFPA 13 and authorities having jurisdiction.
- B. Install listed fire-protection shutoff valves supervised open, located to control sources of water supply except from fire-department connections. Install permanent identification signs indicating portion of system controlled by each valve.
- C. Specialty Valves:
  - 1. General Requirements: Install in vertical position for proper direction of flow, in main supply to system.
  - 2. Alarm Valves: Include bypass check valve and retarding chamber drain-line connection.

### 3.6 SPRINKLER INSTALLATION

- A. Install sprinklers in suspended ceilings in center of narrow dimension of acoustical ceiling panels. Center sprinkler heads in ceiling tiles.

- B. Install dry-type sprinklers with water supply from heated space. Do not install pendent or sidewall, wet-type sprinklers in areas subject to freezing.
- C. Install sprinklers into flexible, sprinkler hose fittings and install hose into bracket on ceiling grid.

### 3.7 ESCUTCHEON INSTALLATION

- A. Refer to Section 21 05 00.

### 3.8 SLEEVE INSTALLATION

- A. Refer to Section 21 05 00.

### 3.9 SLEEVE SEAL INSTALLATION

- A. Refer to Section 21 05 00.

### 3.10 IDENTIFICATION

- A. Refer to Section 21 05 53.

### 3.11 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
  1. Leak Test: After installation, charge systems and test for leaks. Repair leaks and retest until no leaks exist.
  2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
  3. Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter.
  4. Energize circuits to electrical equipment and devices.
  5. Start and run excess-pressure pumps.
  6. Coordinate with fire-alarm tests. Operate as required.
  7. Coordinate with fire-pump tests. Operate as required.
  8. Verify that equipment hose threads are same as local fire-department equipment.
- C. Sprinkler piping system will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

### 3.12 CLEANING

- A. Clean dirt and debris from sprinklers.
- B. Remove and replace sprinklers with paint other than factory finish.

3.13 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain specialty valves.

3.14 PIPING SCHEDULE

- A. Refer to Part 2.

3.15 SPRINKLER SCHEDULE

- A. Refer to Part 2.

END OF SECTION 211313

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## SECTION 230000 – HEATING, VENTILATING, AND AIR CONDITIONING WORK

### 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 a summary of all Heating, Ventilating, and Air Conditioning related work.
- B. Related Sections:
  - 1. 230000 – Heating, Ventilating, and Air Conditioning Work
  - 2. 230400 – General Heating, Ventilating, and Air Conditioning (HVAC) Requirements
  - 3. 230500 – Common Work Results for HVAC
  - 4. 230513 – Common Motor Requirements for HVAC Systems
  - 5. 230515 – General Piping Requirements
  - 6. 230517 – Sleeves and Sleeve Seals for HVAC Piping
  - 7. 230518 – Escutcheons for HVAC Piping
  - 8. 230519 – Meters and Gages for HVAC Piping
  - 9. 230523 – General Duty Valves for HVAC Piping
  - 10. 230529 – Hangers and Supports for HVAC Equipment
  - 11. 230553 – Identification for HVAC Piping and Equipment
  - 12. 230593 – Testing Adjusting and Balancing for HVAC
  - 13. 230700 – Pipe Insulation
  - 14. 230701 – Equipment Insulation
  - 15. 230702 – Duct Insulation
  - 16. 230800 – Commissioning of HVAC
  - 17. 232111 – Piping Materials
  - 18. 232113 – Hydronic Piping
  - 19. 232114 – Hot Water Heating System
  - 20. 232115 – Chilled Water System
  - 21. 232116 – Dual Temperature Water System
  - 22. 232500 – HVAC Water Treatment
  - 23. 233113 – Metal Ducts
  - 24. 233600 – Air Terminal Units
  - 25. 233713 – Diffusers, Registers, and Grilles

#### 1.3 DESCRIPTION

- A. The General Conditions, Special Conditions and Division 1 through Division 32, as set forth in these specifications, are hereby incorporated into and shall become a part of the specifications for work under this title, insofar as they apply hereto.
- B. Furnish material, labor, tools, accessories and equipment to complete and leave ready for operation all HVAC systems for this project as described in these specifications and as shown on the drawings, or as required.

#### 1.4 SCOPE OF WORK

- A. Work includes, but is not limited to:
1. Furnish and install all new valves and accessories associated with existing dual temperature water pumps.
  2. Install chilled water, hot water and dual temperature water piping as indicated.
  3. Provide requisite drain and flushing connections for testing and chemical treatment.
  4. Furnish and install all terminal units.
  5. Clean existing ductwork.
  6. Furnish and install all required condensate, equipment and drain piping.
  7. Furnish and install pipe, equipment and duct insulation.
  8. Furnish and install new instruments as shown.
  9. Furnish and install new ductwork and all associated grilles, diffusers, registers, etc.
  10. Perform air and water balancing.
  11. Perform final setting and leveling of all new equipment.
  12. Perform start-up for all HVAC systems and commission same in accordance with the commissioning requirement.
  13. Provide and/or participate in training of Owner's personnel on the use of all new HVAC systems.
  14. Furnish and install requisite drain and finishing connections for testing and chemical treatment.
  15. Refer to drawings for Schedules of HVAC Equipment.
  16. The contractor shall exercise adequate protective and safety measures for all persons and property and shall be responsible for any damages or injuries arising from the execution of this work.
  17. Alterations and additions to existing work shall include the requisite dismantling of the old equipment, rigging, wrecking, hauling, protections of permanent equipment and the building structures, and cleaning up. Care shall be exercised to keep dust and dirt to a minimum and to confine it to the area where the removal work is being performed. All debris shall be promptly removed.
  18. If asbestos insulation is encountered on any existing piping which is to be removed or remodeled, contractor shall immediately notify Owner of the existence of asbestos and Owner will arrange proper removal of same without cost to contractor.
  19. Unless otherwise noted, remove all other existing equipment and piping, valves, fittings, etc. which will not be reused in the final arrangement. Unless otherwise noted, all items which will be removed by this this contractor and not reused shall become the property of the contractor and shall be promptly removed from the site by him.
  20. The existing facility will be occupied and will remain in operation throughout the period that this work is being performed, and certain new work will be performed during this period. Unscheduled interruptions of the facility will not be tolerated. The contractor shall exercise extreme caution, shall thoroughly inform his workmen and subcontractors of the critical nature of this work, and shall continually review the work procedure being followed in order to prevent accidental interruption of service. Before performing any act which could result in interruption of service, the contractor shall notify the Owner and Engineer of the hazards involved and the contractor shall proceed in a manner and at a time specifically approved by the Owner and Engineer.

21. All work necessitating the temporary turning off or shutting down the operation of existing mechanical and/or electrical facilities shall be done at times specifically approved by the Owner and Engineer in advance of any disruption of existing facilities. Also, refer to Section 230400 – General Heating, Ventilating, and Air Conditioning (HVAC) Requirements.

B. Demolition Work

1. Coordinate all Demolition with the Owner so that shutdowns occur at times agreeable to the Owner.
2. The HVAC Contractor shall remove certain existing air handling systems. The existing plans are available for review at the Engineer's Office and the Owner will provide access to contractors desiring to verify existing conditions. The contractor shall be responsible to verify the extent of demolition work and shall include in their bid all demolition work affecting their trade.

1.5 EXCAVATION AND BACKFILLING AND RESTORATION OF SURFACES

- A. Refer to Division 1 and Section 23 04 00.

1.6 EQUIPMENT

- A. Any and all costs associated with piping, electric, wiring, conduit, supports, pads, or other modifications to accommodate installation for manufacturer's equipment that differs from equipment layout on drawings shall be included on contractor's bid. The contractor is responsible to insure that the equipment will fit within space allocated with appropriate clearances for maintenance, operation, servicing, and code.

1.7 DUKE ENERGY INCENTIVE PROGRAM

- A. Comply with all requirements of the Duke Energy Incentive Program in order that the Owner will be able to obtain incentive monies from Duke Energy for this project. If Duke Energy requirements are more restrictive than the specifications, the Duke Energy requirements shall govern. A copy of the Duke Energy Incentive information for equipment is available on their web site. The contractor shall complete these forms, provide all requisite documentation, and present this information to the Owner for submission to Duke Energy. The incentive monies shall be solely available to the Owner.

1.8 QUALIFICATIONS

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

1.9 LICENSES

- A. The installation of this HVAC work shall be made by Contractors and craftsmen licensed by the Governing Authorities.
- B. Obtain all permits and licenses required by code authorities having jurisdiction.

#### 1.10 FEES

- A. The Contractor shall obtain all inspections or permits required by all laws, ordinances, rules, regulations or public authority having jurisdiction and obtain certificates of such inspections and permits and submit same to the Architect. The Contractor shall pay all fees, charges and other expenses in connection therein for HVAC work including inspection fees, etc. associated with the building permit.

#### 1.11 CODES, REGULATIONS AND STANDARDS

- A. Unless otherwise noted, the following latest enforced Edition shall apply to this work:

- Ohio Building Code
- Life Safety Code
- National Fire Protection Association
- Ohio Fire Code
- OSHA Requirements
- EPA Requirements

#### 1.12 QUALITY ASSURANCE

- A. The HVAC Contractor shall be responsible for all costs associated with changes to wire size, conduit size, fuse size, starter size, pipe size, duct size, monitoring, supports, etc. caused by the change of equipment from the basis of design specified to other named manufacturers. The Contractor is responsible to insure that the other manufacturer named supplied equipment will fit within space allocated, with appropriate clearances for maintenance, operation, service, code requirements, etc. Any contractor utilizing a manufacturer other than basis of design shall be responsible for any additional requirements for electrical service, concrete pad size, physical space limitations, and capacities at no additional cost to the building Owner. If manufacturers are listed, no other manufactures except those listed within the Sections of this Division, that are able to comply with the contract document requirements and minimum standards of these specifications, will be acceptable.
- B. Work provided or performed by the Contractor shall be guaranteed to be replaced and made good at his own expense any defects which may develop, within one (1) year after final payment and acceptance by the building Owner, due to faulty workmanship or material, upon receipt of written notification of the defect from the building Owner.

#### PART 2 – PRODUCTS (NOT APPLICABLE)

#### PART 3 – EXECUTION

##### 3.1 EXISTING WORK

- A. Each Contractor shall locate existing site utilities, installed in previous phase, prior to beginning work. Provide adequate means of protection during work operations. Repair existing utilities damaged during work operations to the satisfaction of the utility owner and at Contractor's expense.
- B. Should uncharted or incorrectly charted piping or other utilities be encountered during

work operations, notify the Engineer immediately for procedure directions. Cooperate with utility companies in maintaining active services and facilities in operation.

### 3.2 OPENING LOCATIONS AND CUTTING

- A. Each Contractor shall be responsible for their required openings.
- B. All cutting through poured concrete slabs and walls shall be done with core drills. No jack hammers will be allowed. All cutting and patching shall be by this Contractor.

### 3.3 CLEANING AND PAINTING

- A. All equipment shall be kept dry and clean during the construction period.
- B. Prime and paint by this Contractor.
- C. When all work is completed and all work has been satisfactorily tested and accepted by the Architect, mechanical equipment and other exposed surfaces shall be thoroughly cleaned.
- D. Repair marred and damaged factory painted finish with materials and procedures to match original factory finish.

### 3.4 CONCRETE WORK

- A. Each Contractor shall provide concrete pads required for equipment they have supplied. See Division 3 - Cast-in-Place Concrete.

### 3.5 PROTECTION AND DAMAGE

- A. In addition to the provisions and stipulation of the General Conditions, each contractor and subcontractor shall provide various types of protection as follows:
  - 1. Protect finished floors from chips and cutting oil by the use of metal drip receiving pan and oil proof floor cover.
  - 2. Protect equipment and finished surfaces from welding and cutting splatters with baffles and splatter blankets.
  - 3. Protect equipment and finished surfaces from paint droppings, insulation adhesive and sizing droppings, etc. by use of drop cloths.
- B. All equipment shall be stored at the site with openings, bearings, etc., covered to exclude dust and moisture. All stock piled pipe shall be placed on dunnage and protected from weather and from entry of foreign material.
- C. Piping and construction openings and excavations required for Mechanical work shall be covered when work is not in progress as follows:
  - 1. Cap pipe openings with fittings or plugs.
  - 2. Cover wall and ceiling openings with plywood, or canvas covered framing.
  - 3. Cover floor openings and excavations with structural material of adequate strength to support traffic.
- D. The Owner's property and the property of other Contractors shall be scrupulously

respected at all times (including damage from leaks). Provide drop cloths and visqueen or similar barriers where dust and debris is generated, to protect adjacent area.

- E. Contractor shall be held responsible for damage caused by his work or through neglect of his workmen. Repairing of damaged work shall be done by Contractor as directed by the Architect. Cost of repairs shall be paid by Contractor.
- F. The Owner reserves the right to make emergency repairs as required to keep equipment in operation without voiding the Contractor's guarantee bond not relieving the contractor of his responsibilities during the bonding period.

END OF SECTION 230000

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## SECTION 230400 - GENERAL HEATING, VENTILATING, AND AIR CONDITIONING (HVAC) REQUIREMENTS

### PART 1 - GENERAL

#### 1.1 HVAC WORK

- A. The following paragraphs are applicable to Division 23 and are complementary to other sections of specifications. Where items described in other sections of the specifications are repeated herein, it is done to call special attention to or to qualify them, but it is not intended that any part of the documents shall be assumed to be omitted if not repeated herein.
- B. Where contradictions occur between this section and Division 1, the more stringent of the two shall apply. Architect/Engineer shall decide which is most stringent.

#### 1.2 DRAWINGS AND SPECIFICATIONS

- A. HVAC drawings are diagrammatic and indicate general arrangement of systems and work included in the contract and shall be adhered to insofar as possible. The drawings and specifications are complementary and are intended, without giving every minute detail, to cover a workable installation complete in every respect including, whether mentioned or not, all material and equipment usually furnished with such systems and/or needed to make a complete operational installation omitting only such parts as are specifically excepted.
- B. Consult drawings and details for exact location of fixtures and equipment, and where not definitely indicated, request this information in writing.
- C. The specification for each division of the work is written in sectional form for brevity and convenience in reference, without repeating in each section all applicable general clauses and/or pertinent data covered elsewhere in the specification, but it is not intended that any of the documents shall be assumed to be omitted if not repeated in each division.
- D. Where specifications are written for brevity, with incomplete sentences, the omission of words or phrases, such as "the contractor shall", "shall be", "provide", "furnish", "all", etc. are intentional and such omitted words or phrases shall be supplied by inference; unless otherwise mentioned, such clauses, lists, and/or directives indicate work to be done by the contractor for that specific division of work.

#### 1.3 VERIFYING CONDITIONS

- A. The work under this contract occurs on the site of and within the existing facility. The work under this contract shall be scheduled and performed so as to provide a minimum of interference with the normal operation of the existing facilities.
- B. Before submitting a proposal, contractors shall visit the site, and shall also carefully examine all bidding documents including those for other branches of the work, to satisfy themselves as to the nature and scope of all work to be done. Prints showing the original building architectural, structural, mechanical, and electrical work are available at the Engineer's office for contractors' review.

- C. The submission of a proposal shall be taken as evidence that such an examination has been made and difficulties, if any, noted. Later claims for labor, work, material, and equipment required for any difficulties encountered which could have been foreseen, shall not be recognized, and all such difficulties shall be properly taken care of by the contractor at no additional expense to the Owner.

#### 1.4 EXISTING WORK AND/OR CONDITIONS

- A. The accompanying drawings and specifications illustrate and describe the existing conditions, mechanical utilities, sewers, water mains, pipes, ducts, conduits, etc. that are particularly relevant to the new work insofar as these mains are shown on existing records or evident by field inspections and tests; however, it is not the intent that these documents shall be construed to guarantee to the contractor the exact location of these items. Each contractor shall verify and determine the exact location of these items in the field, and all work under this contract shall be executed to avoid conflict with or damage to existing work. The work shall be planned and executed to avoid interference, as much as possible, with traffic and with the normal use of the existing facility.
- B. All work involving hazards to persons shall be suitably barricaded and provided with warning lights or signs, as required.
- C. Where necessary for the performance of the contract, existing work shall be cut, altered, removed, or temporarily removed and replaced. Work that is altered or replaced shall match similar existing work and said work shall be performed by trade applicable to the work; if said work is NOT shown or noted the Drawings relating to applicable trade, cost shall be paid by contractor requiring said work. However, unless otherwise provided by the drawings or specifications, no structural members shall be cut or altered without authorization of the Architect and Engineer. Work remaining in place, which is damaged or defaced by reason of work done under this contract, shall be restored in kind equal to its condition at the time of award of the contract by applicable trade as hereinbefore specified.
- D. Existing work shall not be disturbed further than necessary for proper installation of new work. New work to be connected or made integral with existing work shall be properly erected to secure solidity and be continuous in finish. Such new work in extension of existing work shall correspond in all respects with that to which it connects, or similar existing sound work, unless otherwise specified.

#### 1.5 EXISTING MECHANICAL FACILITIES

- A. Where existing mechanical facilities and/or service lines occur in the area of the work and such facilities or lines are to be abandoned or changed, the contractor for the branch of work or trade involved shall cut off and properly cap the old lines, so as not to interfere with the new construction work. If any portions of such lines are required for the operation of an existing building the lines shall be altered and relocated to clear new construction and shall also be restored into service to provide continued operation of the existing building.

#### 1.6 INTERRUPTION OF SERVICES

- A. Work which requires the temporary turning off or shutting down the operation of existing mechanical and/or electrical facilities shall be done at times specifically



approved by the Owner or utility company and the work shall be pre-scheduled and executed so there is a minimum outage of such services and/or delay in the new construction work.

- B. Unscheduled interruptions of the facility will not be tolerated. The contractor shall exercise extreme caution, shall thoroughly inform his workmen and subcontractors of the critical nature of this work, and shall continually review the work procedure being followed in order to prevent accidental interruption of service. Before performing any act which could result in interruption of service, the contractor shall notify the Owner and Engineer of the hazards involved and the contractor shall proceed in a manner and at a time specifically approved by the Owner and Engineer.
- C. All work necessitating the temporary turning off or shutting down the operation of existing mechanical and/or electrical facilities shall be done at times specifically approved by the Owner and Engineer in advance of any disruption of existing facilities.

#### 1.7 MATERIALS AND EQUIPMENT

- A. All materials and equipment entering into the work shall be approved by the Engineer, and must be new, without defects, and of the sizes and capacities shown on the drawings or hereinafter specified. All manufactured materials or equipment shall bear the identification mark of the manufacturer or, if required by the Engineer, shall be certified by an approved testing laboratory. All equipment shall operate within the manufacturer's range of speeds, guaranteed capacities, performance, etc. as indicated by the manufacturer's latest catalog and/or engineering data, shall be of proper size and dimension for the allocated space, and shall be placed in the space allocated in the proper construction sequence. Special consideration will be given to equipment which has been in successful field use or similar applications for at least three (3) years (exclusive of field tests), and to equipment which has an extended guarantee period in lieu of long use period. The contractor shall submit with his bid complete data on equipment he proposes to use; failure to so submit, or to meet these requirements fully and those of the specifications, shall be grounds for rejecting the items.
- B. All electrical materials, apparatus, and equipment shall be new, of the make and characteristics specified, shall conform to NEMA standards, and shall be designed to comply with and be installed in accordance with the latest rules and regulations of the National Electrical Code, and all of the legally constituted public authorities having local jurisdiction. Verify the exact voltage and current characteristics at the building before ordering motors or similar equipment.
- C. All motors shall be NEMA frame sizes, heavy duty, 40 degree C. ambient motors with ball or roller bearings and with maximum full load temperature rise not exceeding NEMA limits of temperature rise. All motors shall have adequate starting and protective equipment as specified or required, and shall have a conduit terminal box of size adequate to accommodate conduits and wires as sized on electrical drawings or as specified. The capacity of each motor shall be sufficient to operate associated driven devices under all conditions of operation and load without overloading or overheating and each motor shall be of not less than the

horsepower indicated or specified.

- D. Conduct such tests and adjustment of equipment as specified or necessary to verify performance requirements. Submit data taken during such tests.

#### 1.8 QUIET OPERATION

- A. The work shall be installed in such a manner that under all conditions of load it shall operate without sound or vibration which is objectionable in the occupied spaces, in the opinion of the Engineer.
- B. In case of moving machinery, sound or vibration noticeable outside of the room in which it is installed or annoyingly noticeable inside its own room will be considered objectionable. Sound or vibration considered objectionable shall be corrected by the contractor.

#### 1.9 PROTECTION

- A. In performing this contract, safeguard workmen and the public and protect the work and equipment until final completion and acceptance. After delivery and before and after installation, protect work against theft, injury, or damage. Carefully store material and equipment received on site which are not immediately installed. Close open ends of work with temporary covers or plugs during construction to prevent entry of obstructing materials. Protect related or adjacent work and the material of the other trades or the Owner from damage that might be caused by this work and make good any damage thus caused. Provide all safeguards, scaffolding, drop cloths, etc. as required.
- B. No welding or soldering shall be done near combustible materials of any kind; all adjoining work, finished surfaces, glass, etc. shall be protected from flames, sparks, hot metal, etc. by metal guards or approved noncombustible drop cloths or barriers.
- C. Each contractor shall replace any items or portions thereof wherever removed or damaged, in a manner equal to the original construction and finish, or where directed by the Engineer, he shall pay other trades to perform this work.
- D. All mechanical equipment with a factory finish shall be protected during construction and must be free of dust, dirt, cement splatters, etc. when the building is turned over to the Owner. Dents and marred finishes shall be repaired to the satisfaction of the Engineer, or a replacement furnished where necessary.
- E. Provide belt drives and rotating machinery with readily removable guards complying with OSHA requirements to enclose the drive completely and consisting of heavy angle iron frames, hinged and latched, with heavy galvanized iron wire crimped mesh or sheet steel securely fastened to frames.

#### 1.10 EXECUTION OF WORK

- A. The HVAC Work shall be performed and coordinated with the program of the General Contractor and the other subcontractors. Promptly upon award of the contracts, the subcontractors shall confer with the General Contractor and the

Engineer and other subcontractors to prepare a time schedule for the completion of the various divisions and details of the work. Each subcontractor shall proceed diligently with the work and shall cooperate with the General Contractor and the other contractors to maintain the approved time schedule to the best of his ability and as conditions permit.

#### 1.11 GENERAL SUPERVISION AND INSTALLATION OF WORK

- A. Each contractor shall at all times give the work his best skill and attention, including adequate construction supervision over his work, employees, and subcontractors, and he shall fully cooperate with and confer with the Engineer and other contractors so that the best possible installation shall be obtained. Exact locations and relations are to be determined in the field, subject to the approval of the Engineer, and with preference to the dimensioned and architectural and structural drawings and approved shop and setting drawings.
- B. Unless otherwise shown, pipes, ducts, etc. in rooms with finished ceilings, shall be concealed in furred ceilings, shafts, walls, and floors, and all work must be exactly and accurately located to conform with the spaces provided therefor. In general, all other new piping, ducts, etc. in mechanical equipment rooms, telephone rooms, etc. shall be exposed.
- C. Install pipes, ducts, etc. in a neat and workmanlike manner, close to walls, generally as high as possible, true and square to the building, utilizing standard practices, and properly graded for correct functioning of the system involved; multiple lines in close proximity shall be coordinated and neatly grouped. Install work in proper construction sequence and arranged so as to be readily accessible for operation, maintenance, and repair; minor deviations from drawings may be made to accomplish this, but changes of magnitude or which involve extra cost shall not be made without approval. All fixtures, outlets, etc. shall truly center with the adjacent architectural finish. All work, both exposed and concealed, shall meet the approval of the Engineer regarding neatness of appearance, location, and practicability of installation. The Engineer reserves the right to direct the removal and replacement of any item which, in his opinion, does not present an orderly and reasonably neat and workmanlike appearance.
- D. Each contractor shall familiarize himself with the work of the other contractors, shall perform and coordinate his work with the other contractors, shall lay out his work to meet conditions at the building, shall give freedom to and prevent conflict with the work of other contractors, and shall make reasonable modification in locations or arrangement from those indicated on the drawings if required to avoid conflicts or to conform to tile, wood, marble, or other architectural finish. From time to time as the work progresses, the contractor shall examine the work installed by others, insofar as it may affect his work, and he shall, before proceeding with the work, notify the Engineer in writing, if any condition exists which prevents the successful installation of his own work.
- E. If the contractor places any work in violation of any of the above mentioned requirements, and conflicting or unworkmanlike conditions result, he shall, without additional charge, remove and reinstall or satisfactorily readjust such portions of his work as may be necessary and as the Engineer may direct. The Engineer's

decision regarding such conditions shall be final.

#### 1.12 ENGINEER'S OBSERVATION

- A. A periodic inspection of the work by the Engineer, commonly referred to as supervision, is only for the express purpose of verifying compliance by the contractor with the contract documents. Such engineering inspections and services rendered by the Engineer or his representatives shall not be construed as the supervising of construction; nor the assuming by the Engineer of the duties and responsibility of the contractors nor making the Engineer responsible for providing a safe place or procedure for the performance of the work or for the contractor's employees or for subcontractors.

#### 1.13 EXCAVATION AND BACKFILLING OF TRENCHES, ETC.

- A. Unless otherwise specified, the HVAC Contractor shall do all excavation of trenches for piping, etc. in connection with his work, and after his work is in place and inspected by the Engineer and Civil Authorities, he shall backfill in layers of not to exceed six inches (6") in depth, thoroughly moistened, thoroughly rammed, tamped, and compacted to a density at least equal to the surrounding earth to minimize after settlement. If, in the opinion of the Engineer, the excavated material is unsuitable for backfilling, the contractor shall backfill with bank run gravel well compacted. The bottom of each sewer trench shall be filled with sand to an elevation of 6" above the top of the sewer. Top of backfill or trench surface shall be level with adjoining ground or surface; furnish additional material if required to fill trenches. All surplus earth shall be moved by this contractor and disposed of as directed by the Engineer. Compact backfill in trenches within building lines the same as specified in architectural branches.
- B. Any sheet piling or shoring or pumping necessary shall be done by this contractor at his own expense and all trenches shall be dug in a careful manner, with bottoms properly pitched to insure perfect drainage and to provide uniform bearing and support for each section of pipe on undisturbed soil along its entire length, except where it is necessary to excavate for bell holes and for the proper sealing of pipe joints. The bottoms of all sewer trenches shall be excavated 6" below the bottom elevation of the sewer and backfilled with sand so at least one-third of the circumference of the pipe will rest firmly on tamped sand. These trenches shall be not less than 12" wider, nor more than 16" wider, than the outside diameter of the pipe to be laid therein; this requirement applies to the width at and below the level of the top of the pipe; the width above that level may be wider for proper sheeting and bracing and the proper installation of the work. Shoring, bracing, barricades, etc. shall be provided to protect the workmen and/or public amply; refer to the Ohio Bulletin No. 201 "Specific Safety Requirements Relating to Building and Construction Work".
- C. Unless otherwise approved, the following minimum cover shall be provided above the top of underground pipes outside the buildings: Water lines, refer to elevations on plans.
- D. Whenever wet or otherwise unstable soil, that is incapable of properly supporting the pipe as determined by the Engineer, is encountered in the trench bottom, such

soil shall be removed to a depth required and for the length designated by the Engineer, and the trench backfilled to trench bottom grade with coarse sand, fine gravel, or other suitable materials, properly compacted.

- E. Excavation near or under building footings shall be backfilled with concrete installed under the direction of the Engineer.
- F. Where contractor elects to have any excavation work performed by a subcontractor, subcontractor must be approved by the Owner prior to commencing any work.
- G. Construction Fence
  - 1. Refer to Division 01.

#### 1.14 RESTORATION OF SURFACES AND CONCRETE WORK

- A. Unless otherwise specified, all new concrete work for parking lots, driveways, pads, etc. shall be provided by this contractor. Unless otherwise specified, all new concrete work for pads, and all surfaces such as concrete floors, walls, paving, sidewalks, roof deck, or other surfaces disturbed in the execution of work, and which remain in use, shall be restored in kind by this contractor, or he shall pay the cost of such work.
- B. Where this contractor has performed excavation work, this contractor shall backfill as hereinbefore specified in Paragraph 1.16.
- C. Concrete Work, shall be performed by a qualified, competent, Concrete Contractor, and work shall comply with the following:
  - 1. Sidewalks shall be concrete, Class C, unreinforced, complying with ODOT 608. Width and finish shall match existing adjacent sidewalks. Sidewalks shall be the same depth as the existing adjacent sidewalks or 7" deep whichever is greater.
  - 2. All other concrete for parking lots, driveways, and pads shall be 4000 PSI compressive strength concrete with reinforcing steel. Thickness of concrete for parking lots and driveways shall be not less than 7" thick. Reinforcing steel shall be 6" x 6" 58 pound welded wire fabric (WWF) top and bottom. All welded wire fabric shall be in flat sheets, not rolls.

#### 1.15 SLEEVES, CUTTING, PATCHING, CLEANING, WATERPROOFING, ETC.

- A. Provide and accurately set frames and Schedule 40 steel pipe sleeves for required openings in new work to minimize cutting. Perform all cutting, patching, etc. required to install the work. Use approved power operated boring machine for small holes wherever practical. Remove all rubbish incidental to the work. Where any work pierces waterproofing, provide all necessary sleeves, caulking, and flashing required to make openings absolutely watertight.
- B. Refer to the ACI Code 381.71, Section 6.3 for limitations and requirements for penetrations and openings.

#### 1.16 PATENTS

- A. The contractor shall defend and guarantee the Owner against any expense, claims, litigation, etc. occasioned by the use in this work of any materials, devices, etc. covered by patents not owned by the contractor, or of which he is not a licensed user.

#### 1.17 CONTEMPLATED WORK

- A. The work contemplated occurs on the site of and within the existing building.
- B. The drawings and specifications for the mechanical and electrical portion of this project have been prepared by Motz Consulting Engineers, Inc., doing business as Motz Engineering.
- C. The various items of work necessary for completion of this work are hereinafter specified under the respective section headings or shown on accompanying drawings, and shall be included in any contract or contracts made for completion of respective divisions of the work. Such contracts shall also include necessary details reasonably incidental to the proper execution and completion of such work.

#### 1.18 MOVING MATERIALS

- A. If it becomes necessary at any time during the progress of this work to move materials which have been temporarily located and which are to enter into the final construction, the contractor furnishing said materials shall, when so directed by the Engineer, move them or cause them to be moved. Cost of such moving shall be included in the contract price.

#### 1.19 ACCIDENT PREVENTION

- A. Precaution shall be exercised at all times for the protection of persons and property. The safety provisions of applicable law, building, and construction codes shall be observed. Machinery, equipment, and other hazards shall be guarded in accordance with safety provisions of the "Manual of Accident Prevention in Construction" published by Associated General Contractors of America to the extent that such provisions are not inconsistent with applicable law or regulations.

#### 1.20 PROPERTY PROTECTION

- A. All hoisting shall be done with proper tag lines and buffers to prevent damage to the sides of the building. Where it is necessary to hoist materials to the roof, the parapets at top of the building and the roof where materials are landed from hoists shall be protected with heavy wood covers. Parapet protection shall be placed on both sides and top, and shall extend far enough on either side of landing point to insure adequate cover. The roof, from the landing point at parapet to final location of material, shall be adequately protected by planks laid side by side on roofing and spiked together on outside edges with planks running at right angles to main planking. The roof shall be adequately protected against leaks at all times.
- B. Where hoists are erected on the roof for hoisting material up the side of the building, the roof shall be adequately protected against abrasion or other damage. Materials

stored on the roof shall be placed on planks or other protection approved by the Engineer and shall be placed only at locations approved by the Engineer.

- C. If hoisted materials are taken through windows, the jams, head, and sill shall be adequately protected with wood planking or proper buffers.
- D. Any work, equipment, or property damaged during construction of this project and due to operations under this contract shall be repaired or replaced by this contractor, without additional cost to the Owner. Upon completion of the work, the contractor shall remove all protections herein specified.

#### 1.21 REMOVAL OF RUBBISH

- A. It shall be each contractor's duty to keep the building and surrounding premises clean, free from rubbish of every description. No rubbish, crating materials, packing, or dirt shall be allowed to accumulate at any time, but shall be removed at once and hauled away.
- B. Each trade shall be responsible for its own tools and materials during the periods of rubbish removal but contractors shall use reasonable care in removal of rubbish to protect the tools and materials of others against loss or damage. The Owner reserves the right, in the event that removal of rubbish is not promptly and properly carried out by the Contractors to have rubbish removed and to charge the cost of its removal to the contractor.
- C. Also, refer to Division 1.

#### 1.22 MATERIAL SAFETY DATA SHEETS (MSDS)

- A. The contractor shall obtain and maintain on-site during the course of the project the Material Safety Data Sheets (MSDS's) for all chemicals or products containing chemicals that may be considered toxic or hazardous. The MSDS's are to be forwarded to the Office of Environmental Health and Safety upon completion of the project.

#### 1.23 INSTRUCTION OF PERSONNEL

- A. The HVAC Subcontractor shall provide free on site instruction in the proper use of installed equipment to designated representatives of the Owner, sufficient to ensure safe, secure, efficient, non-failing utilization, and operation of systems. This instruction shall include the following:
  - 1. One Site Training: Provide a minimum of 24 hours of training for owner's staff. Submit a syllabus to the Engineer prior to the first session.
  - 2. Support: Provide a minimum of 16 hours of support either on site or by telephone to answer operations questions.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION 230400

## SECTION 230500 - COMMON WORK RESULTS FOR HVAC

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. This Section includes the following:
1. Piping materials and installation instructions common to most piping systems.
  2. Transition fittings.
  3. Dielectric fittings.
  4. Mechanical demolition.
  5. Equipment installation requirements common to equipment sections.
  6. Painting and finishing.
  7. Concrete bases.
  8. Supports and anchorages.
  9. Fire stopping.

#### 1.2 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspace, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in duct shafts.
- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.
- F. The following are industry abbreviations for plastic materials:
1. ABS: Acrylonitrile-butadiene-styrene plastic.
  2. CPVC: Chlorinated polyvinyl chloride plastic.
  3. PE: Polyethylene plastic.
- G. The following are industry abbreviations for rubber materials:
1. EPDM: Ethylene-propylene-diene terpolymer rubber.
  2. NBR: Acrylonitrile-butadiene rubber.

#### 1.3 SUBMITTALS

- A. Product Data: For the following:
1. Transition fittings.
  2. Dielectric fittings.
  3. Roof Curbs



- B. Welding certificates.

#### 1.4 QUALITY ASSURANCE

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

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.
- B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

#### 1.6 COORDINATION

- A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for mechanical installations.
- B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.
- C. Coordinate requirements for access panels and doors for mechanical items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 8 Section "Access Doors and Frames."
- D. Provide coordination drawings as specified in section 230000.

### PART 2 - PRODUCTS

#### 2.1 ROOF CURBS, PIPE CURBS AND ROOF PIPE SUPPORTS

- A. Not Applicable.

## 2.2 PIPE, TUBE, AND FITTINGS

- A. Refer to individual Division 23 piping Sections for pipe, tube, and fitting materials and joining methods.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

## 2.3 JOINING MATERIALS

- A. Refer to individual Division 23 piping Sections for special joining materials not listed below.
- B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
  - 1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
    - a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
    - b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
  - 2. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.
- C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
- D. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.
- E. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- F. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.
- G. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- H. Grooved Joints: Use lubricant supplied by the coupling manufacturer and suitable for the elastomer and fluid media.

## 2.4 TRANSITION FITTINGS

- A. AWWA Transition Couplings: Same size as, and with pressure rating at least equal to and with ends compatible with, piping to be joined.
- B. Manufacturers:
  - 1. Cascade Waterworks Mfg. Co.
  - 2. Dresser Industries, Inc.; DMD Div.
  - 3. Ford Meter Box Company, Incorporated (The); Pipe Products Div.
  - 4. JCM Industries.
  - 5. Smith-Blair, Inc.
  - 6. Viking Johnson.

7. Victaulic Co. of America

- C. Aboveground Pressure Piping: Pipe fitting.
- D. Plastic-to-Metal Transition Fittings: CPVC and PVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions; one (1) end with threaded brass insert, and one solvent-cement-joint end.
- E. Plastic-to-Metal Transition Adaptors: One-piece fitting with manufacturer's SDR 11 equivalent dimensions; one (1) end with threaded brass insert, and one (1) solvent-cement-joint end.
- F. Plastic-to-Metal Transition Unions: MSS SP-107, CPVC and PVC four (4) part union. Include brass end, solvent-cement-joint end, rubber O-ring, and union nut.
- G. Flexible Transition Couplings for Underground Nonpressure Drainage Piping: ASTM C 1173 with elastomeric sleeve, ends same size as piping to be joined, and corrosion-resistant metal band on each end.

2.5 DIELECTRIC FITTINGS

- A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.
- B. Insulating Material: Suitable for system fluid, pressure, and temperature.
- C. Dielectric Unions: Factory-fabricated, union assembly, for 250 psig minimum working pressure at 200 deg F.
  - 1. Manufacturers:
    - a. Capitol Manufacturing Co.
    - b. Central Plastics Company.
    - c. Epco Sales, Inc.
    - d. Hart Industries, International, Inc.
    - e. Watts Industries, Inc.; Water Products Div.
    - f. Zurn Industries, Inc.; Wilkins Div.
- D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150 psig minimum working pressure as required to suit system pressures.
  - 1. Manufacturers:
    - a. Capitol Manufacturing Co.
    - b. Central Plastics Company.
    - c. Epco Sales, Inc.
    - d. Watts Industries, Inc.; Water Products Div.
- E. Dielectric-Flange Kits: Companion-flange assembly for field assembly. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.
  - 1. Manufacturers:
    - a. Advance Products & Systems, Inc.
    - b. Calpico, Inc.
    - c. Central Plastics Company.

d. Pipeline Seal and Insulator, Inc.

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

## 2.6 FIRE STOPPING

- A. Description: UL-classified Systems; C-AJ or W-L-7001-7999. Type of fill materials; one or both of the following: Latex sealant or mortar.

## PART 3 - EXECUTION

### 3.1 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. Install piping according to the following requirements and Division 23 Sections specifying piping systems.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping to permit valve servicing.
- G. Install piping at indicated slopes.
- H. Install piping free of sags and bends.

- I. Install fittings for changes in direction and branch connections.
- J. Install piping to allow application of insulation.
- K. Select system components with pressure rating equal to or greater than system operating pressure.
- L. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:

New Piping:

- 1. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
  - 2. Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish.
  - 3. Insulated Piping: One-piece, stamped-steel type with spring clips.
  - 4. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
  - 5. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type.
  - 6. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-casting, cast-brass type with polished chrome-plated finish.
  - 7. Bare Piping in Unfinished Service Spaces: One-piece, stamped-steel type with concealed hinge and spring clips.
  - 8. Bare Piping in Equipment Rooms: One-piece, cast-brass type.
  - 9. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.
- M. Sleeves are not required for core-drilled holes.
  - N. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
    - 1. Cut sleeves to length for mounting flush with both surfaces.
      - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
    - 2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
    - 3. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 7 Section "Joint Sealants" for materials and installation.
  - O. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
    - 1. Install steel pipe for sleeves smaller than 6 inches in diameter.
    - 2. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.
    - 3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

- P. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 7 Section "Through-Penetration Firestop Systems" for materials.
- Q. Verify final equipment locations for roughing-in.
- R. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

### 3.2 PIPING JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 23 Sections specifying piping systems.
- B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32, wiped smooth.
- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.
- F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
  - 1. Apply appropriate Teflon tape or Permatex pipe thread compound to external pipe threads unless dry seal threading is specified.
  - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.
- H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

### 3.3 PIPING CONNECTIONS

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

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

### 3.4 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

- A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.
- B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- C. Install mechanical equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
- D. Install equipment to allow right of way for piping installed at required slope.

### 3.5 PAINTING

- A. All general painting of piping, insulation, and equipment, if any, will be performed by the Contractor. Unless otherwise noted, where this contractor has cut finished building surfaces, this contractor shall patch and paint these surfaces.

### 3.6 ERECTION OF METAL SUPPORTS AND ANCHORAGES

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

### 3.7 ERECTION OF WOOD SUPPORTS AND ANCHORAGES

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

### 3.8 FIRE STOPPING

- A. Provide fire stopping for all mechanical penetrations of all fire rated construction such as walls and floors.

3.9 DRAIN PIPING

- A. Extend drain piping from all drains and cooling coil discharge all at new air conditioning units, etc. to spill over the nearest floor drain or janitor's receptor.
- B. Provide valved blowoff on all strainers and pipe to floor drain; where no sizes are shown, blowoff shall be full size of strainer connection.

END OF SECTION 230500

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## SECTION 230513 - COMMON MOTOR REQUIREMENTS FOR HVAC SYSTEMS

### PART 1 – GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. This Section includes basic requirements for factory-installed and field-installed motors.

#### 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.

#### 1.4 DEFINITIONS

- A. Factory-Installed Motor: A motor installed by motorized-equipment manufacturer as a component of equipment.
- B. Field-Installed Motor: A motor installed at Project site and not factory installed as an integral component of motorized equipment.

#### 1.5 SUBMITTALS

- A. Product Data for Field-Installed Motors: For each type and size of motor, provide nameplate data and ratings; shipping, installed, and operating weights; mounting arrangements; size, type, and location of winding terminations; conduit entry and ground lug locations; and information on coatings or finishes.
- B. Shop Drawings for Field-Installed Motors: Dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Include the following:
  1. Each installed unit's type and details.
  2. Nameplate legends.
  3. Diagrams of power and control wiring. Provide schematic wiring diagram for each type of motor and for each control scheme.
- C. Qualification Data: For testing agency.
- D. Test Reports: Written reports specified in Parts 2 and 3.
- E. Operation and Maintenance Data: For field-installed motors to include in emergency, operation, and maintenance manuals.

## 1.6 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent testing agency, acceptable to authorities having jurisdiction, with the experience and capability to conduct the testing indicated, as documented according to ASTM E 548.
- B. Source Limitations: Obtain field-installed motors of a single type through one source from a single manufacturer.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- D. Comply with NFPA 70.

## 1.7 COORDINATION

- A. Coordinate features of motors, installed units, and accessory devices. Provide motors that are:
  - 1. Compatible with the following:
    - a. Magnetic controllers.
    - b. Multi-speed controllers.
  - 2. Designed and labeled for use with variable frequency controllers, and suitable for use throughout speed range without overheating.
  - 3. Matched to torque and horsepower requirements of the load.
  - 4. Matched to ratings and characteristics of supply circuit and required control sequence.
- B. Coordinate motor support with requirements for driven load; access for maintenance and motor replacement; installation of accessories, belts, belt guards; and adjustment of sliding rails for belt tensioning.

## PART 2 - PRODUCTS

### 2.1 MOTOR REQUIREMENTS

- A. Motor requirements apply to factory-installed and field-installed motors except as follows:
  - 1. Different ratings, performance, or characteristics for a motor are specified in another Section.
  - 2. Manufacturer for a factory-installed motor requires ratings, performance, or characteristics, other than those specified in this Section, to meet performance specified.
- B. Comply with Energy Independence and Security Act of 2007.
- C. Comply with NEMA MG 1 table 12-11 unless otherwise noted.
- D. Comply with IEEE 847 for Severe-Duty motors.

### 2.2 MOTOR CHARACTERISTICS

- A. Motor Phase: As indicated on drawings.
- B. Frequency Rating: 60 Hz.
- C. Voltage Rating: NEMA standard voltage selected to operate on nominal circuit voltage to which motor is connected.
- D. Service Factor: 1.15.
- E. Duty: Continuous duty at ambient temperature of 105 deg F and at an altitude of 3300 feet above sea level.
- F. 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.
- G. Enclosure: Open drip proof for interior mounted motors. Totally enclosed fan cooled for exterior mounted motors.

### 2.3 POLYPHASE MOTORS

- A. Description: NEMA MG 1, Design B, medium induction motor.
- B. Efficiency: Premium efficiency.
- C. Stator: Copper windings, unless otherwise indicated.
  - 1. Multi-speed motors shall have separate winding for each speed.
- D. Rotor: Squirrel cage, unless otherwise indicated.
- E. Bearings: Double-shielded, pre-lubricated ball bearings suitable for radial and thrust loading.
- F. Temperature Rise: Match insulation rating, unless otherwise indicated.
- G. Insulation: Class F, unless otherwise indicated.
- H. Motors Used with Variable Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.
  - 1. Designed with critical vibration frequencies outside operating range of controller output.
  - 2. Temperature Rise: Matched to rating for Class B insulation.
  - 3. Insulation: Class H.
  - 4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.
  - 5. Motor shall be design for vector or inverter-duty service with design resistant to transient spikes, high frequencies and short time rise pulse produced by inverters.
  - 6. Motor manufacture shall ensure specified motor operational and performance characteristics are suitable for inverter drive operation.

7. Motor shall be provided with minimum of one shaft mounted grounding protection ring to discharge pulse width modulation induced shaft voltages and bearing currents in reducing the effects of bearing pitting and scoring.
  8. Motor shall include factory wired internal automatic reset high temperature thermal protector switch wired to over sized motor terminal box.
- I. Rugged-Duty Motors: Totally enclosed, with 1.15 minimum service factor, greased bearings, integral condensate drains, and capped relief vents. Windings insulated with nonhygroscopic material.
    1. Finish: Chemical-resistant paint over corrosion-resistant primer.

## 2.4 SINGLE-PHASE MOTORS

- A. Type: One of the following, to suit starting torque and requirements of specific motor application:
  1. Permanent-split capacitor.
  2. Split-phase start, capacitor run.
  3. Capacitor start, capacitor run.
- B. Shaded-Pole Motors: For motors 1/20 hp and smaller only.
- C. 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.
- D. Bearings: Ball type for belt-connected motors and other motors with high radial forces on motor shaft; sealed, pre-lubricated-sleeve type for other single-phase motors.
- E. Source Quality Control: Perform the following tests on each motor according to NEMA MG 1:
  1. Measure winding resistance.
  2. Read no-load current and speed at rated voltage and frequency.
  3. Measure locked rotor current at rated frequency.
  4. Perform high-potential test.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine areas to receive field-installed motors for compliance with requirements, installation tolerances, and other conditions affecting performance.
- B. Examine roughing-in of conduit systems to verify actual locations of conduit connections before motor installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 MOTOR INSTALLATION

- A. Anchor each motor assembly to base, adjustable rails, or other support, arranged and

sized according to manufacturer's written instructions. Attach by bolting. Level and align with load transfer link.

- B. Wiring of motor to controller and auxiliary controls and/or safeties shall be in accordance with motor controller manufacture instructions, NFPA 70 and local code requirements.
- C. Properly ground all equipment according to controller manufacturer's requirements regarding noise attenuation and electromagnetic interference. Where not specifically specified by motor controller manufacture, ground equipment according to NFPA 70.
- D. Requirements of motor T-lead conductors shall comply with Division 26 Specification 260519 "Wires and Cable".

### 3.3 FIELD QUALITY CONTROL

- A. Prepare for acceptance tests as follows:
  - 1. Run each motor with its controller. Demonstrate correct rotation, alignment, and speed at motor design load.
  - 2. Test interlocks and control features for proper operation.
  - 3. Verify that current in each phase is within nameplate rating.
- B. Testing: Perform the following field quality-control testing:
  - 1. Perform each electrical test and visual and mechanical inspection stated in NEMA ATS, Section 7.15.1. 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.

### 3.4 ADJUSTING

- A. Align motors, bases, shafts, pulleys and belts. Tension belts according to manufacturer's written instructions.

### 3.5 CLEANING

- A. After completing equipment installation, inspect unit components. Remove paint splatters and other spots, dirt, and debris. Repair damaged finish to match original finish.
- B. Clean motors, on completion of installation, according to manufacturer's written instructions.

END OF SECTION 230513

## SECTION 230515 - GENERAL PIPING REQUIREMENTS

### PART 1 - GENERAL

#### 1.1 PIPING SYSTEMS - GENERAL

- A. The following instructions apply to all piping systems, except where otherwise noted.
  - 1. Provide unions or flanges at each final connection and at each piece of equipment.
  - 2. Make connections to equipment as detailed on the Drawings or per manufacturer's installation instructions.
  - 3. Where connection size is smaller than piping, make reduction at final connection only (Do not reduce size of pipe drop).
  - 4. Provide valves and specialties as required, to complete installation of each piece of equipment, for proper operation.
- B. Clean out and flush water piping systems.
- C. If other means of draining are not provided, install drain valves at all low points to permit complete draining of each water system.
- D. Certified Pipe Welding Bureau. Welds to be stamped at each joint or fitting.
- E. Install dielectric unions at all connections of dissimilar metals.

### PART 2 - PRODUCTS

#### 2.1 COPPER PIPE

- A. Copper pipe to be of type and thickness as specified in Section 232113. Fittings shall be wrought copper fittings with soldered ends designed for 150 psi (steam) and 300 psi (water) pressure. All joints and fittings shall comply with the latest edition of ASME code for pressure piping. 2-1/2 inches and larger equipment and valved connections shall be flanged.
- B. In domestic water piping, all soldered joints shall be made with lead-free nickel silver solder for 150 psi, 250 deg F.

#### 2.2 BLACK STEEL PIPE

- A. Steel pipe to be of type specified in Section 232113. For welded piping 1-1/2 inches and smaller, pipe shall be butt welded steel. Larger pipe shall be seamless steel or electric resistance welded. Pipe thickness shall be as scheduled in the specifications. All joints and fittings shall comply with the latest edition of ASME code for pressure piping.
- B. Threaded pipe shall be accurately cut NPT tapered right hand threads. Screwed fittings shall be of the same make and thickness for weight as the pipe used.
- C. Butt weld pipe joints shall be butt type, single vee made by fusion welding oxy-acetylene, electric welding using high test welding rod or semi-automatic metal arc welding machines using micro-wire. Branches in straight pipe are to be made with

welding tees of same make and thickness of weight as the pipe used. Branches 1/4 the size of the main or less may be made with weld neck flanges, weld-o-let=s or thread-o-let fittings. Elbows shall be long radius.

- D. Socket weld pipe joints shall be made using 2000 lb. socket weld steel fittings. All other items shall be per part 2.2, paragraph C this section of specifications.
- E. Flanged pipe: Connections to valves, equipment, etc. shall be made with 125 - 150 lb. standard flanges, except for 250 - 300 lb. extra heavy flanges or fitting on valves, equipment, etc. furnished with extra heavy flanges. Flanged joints are to be faced square and true.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION

- A. Each union or flange be installed to permit east removal of parts and equipment, and in a position permitting the device or equipment to be removed without disconnecting piping. Connections to equipment shall be arranged to facilitate ease of removal and service without dismantling of the run-outs of main piping, and shall be installed by the use of multiple elbows or other similar methods to minimize strain on the equipment connections.
- B. Make reductions in piping lines with reducing coupling or weld fitting reducer.
- C. Install piping to provide clearance for personnel passage, headroom, operation of doors or windows, equipment, lighting outlets, or with Owner's apparatus and equipment.
- D. In pipe spaces to be entered for servicing, piping shall be offset so that all lateral runs are located either near floor or 6'-0" above floor and all vertical piping is held close to the wall through that height. Keep all piping to side of chase wherever possible.
- E. Piping containing liquids shall not be installed over electrical equipment.
- F. Install pipes, valves, fittings, etc. to be insulated with a minimum of 1/2-inch clearance between the finished covering and other work and between the finished covering of parallel, adjacent pipes.
- G. Make changes in pipe line direction with fittings only.
- H. Offset lines around columns, beams and other obstructions as required. Where special conditions are encountered in field, arrangement and alignment of piping shall be decided by the Owner's Representative.
- I. At time of erection, piping components shall be cleaned of loose material. After erection, and prior to putting in service, lines shall be blown or flushed free of loose

materials. Clean strainer screens and sediment pockets prior to putting lines in service.

- J. Install valves at service connections to equipment and branch lines from main lines. All valves and unions to be installed so as to be accessible through ceiling or wall access panel.
- K. Contractor is responsible for conformance with all applicable requirements for welding and burning. Contractor shall obtain all necessary permits.
- L. SECURELY SUPPORT all piping from structure with approved hangers, rods, brackets and accessories.
- M. Where piping is installed in new masonry block walls, coordinate with General Contractor so piping extends out through a masonry joint where possible.
- N. Bullhead fittings are not allowed.
- O. Where exposed pipes pass through walls, floors or ceilings of finished rooms, provide chrome-plated escutcheons. Prime-coated black iron escutcheons may be used in unfinished rooms. Protect escutcheons from tool marks.
- P. Keep pipe level except where a slope is required. Use eccentric reducers to keep top of pipe level.
- Q. Avoid trapping of piping.
- R. Use transition fittings as recommended by manufacturers to change from one pipe material or type to another.
- S. All new piping during the installation period shall have openings protected with temporary caps or protective covers as required to keep the inside of the piping system clean from all dirt, debris and foreign material.
- T. At completion of project, thoroughly flush each of the various HVAC hydronic circulating systems with a cleaning solution as recommended by the chemical supplier and the various material manufacturers, so as to remove any oil, rust, dirt, scale or grease that may be present.
- U. Do not obstruct passageways, headroom, door and window operation, and similar areas with the installation of piping.

### 3.2 PIPING PROHIBITIONS

- A. Contractor shall not run piping over electrical panels, across windows, door openings, access panels, lighting fixture or within 36 inches in front of electrical panels. Obtain instructions from the Architect if a conflict occurs.
- B. On any given system, the Contractor will not be permitted to mix and joint different types of pipe material. For example, if a hot water heating system uses copper and steel, the Contractor may change from one to the other only once, the line may not be changed back to the first material further downstream.



- C. Drain lines shall be continuously sloped; trapping is expressly prohibited.

END OF SECTION 230515

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## SECTION 230517 - SLEEVES AND SLEEVE SEALS FOR HVAC PIPING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Sleeves.
  - 2. Stack-sleeve fittings.
  - 3. Sleeve-seal systems.
  - 4. Sleeve-seal fittings.
  - 5. Grout.

#### 1.3 SUBMITTALS

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

### PART 2 - PRODUCTS

#### 2.1 SLEEVES

- A. Cast-Iron Wall Pipes: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.
- B. Galvanized-Steel Wall Pipes: ASTM A 53/A 53M, Schedule 40, with plain ends and welded steel collar; zinc coated.
- C. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, with plain ends.
- D. Galvanized-Steel-Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

#### 2.2 STACK-SLEEVE 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. Smith, Jay R. Mfg. Co.
  - 2. Zurn Specification Drainage Operation; Zurn Plumbing Products Group.
- B. Description: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring, bolts, and nuts for membrane flashing.
  - 1. Underdeck Clamp: Clamping ring with setscrews.

## 2.3 SLEEVE-SEAL SYSTEMS

- 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. Advance Products & Systems, Inc.
  2. CALPICO, Inc.
  3. Metraflex Company (The).
  4. Pipeline Seal and Insulator, Inc.
  5. Proco Products, Inc.
- B. Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.
1. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
  2. Pressure Plates: Carbon steel.
  3. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating of length required to secure pressure plates to sealing elements.

## 2.4 SLEEVE-SEAL 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:
- B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
1. Presealed Systems.
- C. Description: Manufactured plastic, sleeve-type, waterstop assembly made for imbedding in concrete slab or wall. Unit has plastic or rubber waterstop collar with center opening to match piping OD.

## 2.5 GROUT

- A. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- B. Characteristics: Nonshrink; recommended for interior and exterior applications.
- C. Design Mix: 5000-psi , 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

## PART 3 - EXECUTION

### 3.1 SLEEVE INSTALLATION

- A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.

- B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch annular clear space between piping and concrete slabs and walls.
  - 1. Sleeves are not required for core-drilled holes.
- C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.
- D. Cut sleeves to length for mounting flush with both surfaces.
  - 1. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level.
  - 2. Using grout, seal the space outside of sleeves in slabs and walls without sleeve-seal system.
- E. Install sleeves for pipes passing through interior partitions.
  - 1. Cut sleeves to length for mounting flush with both surfaces.
  - 2. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
  - 3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint. Comply with requirements for sealants specified in Division 07 Section "Joint Sealants."
- F. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in Division 07 Section "Penetration Firestopping."

### 3.2 STACK-SLEEVE-FITTING INSTALLATION

- A. Install stack-sleeve fittings in new slabs as slabs are constructed.
  - 1. Install fittings that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
- B. Fire-Barrier Penetrations: Maintain indicated fire rating of floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in Division 07 Section "Penetration Firestopping."

### 3.3 SLEEVE-SEAL-SYSTEM INSTALLATION

- A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building.
- B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

### 3.4 SLEEVE-SEAL-FITTING INSTALLATION

- A. Install sleeve-seal fittings in new walls and slabs as they are constructed.

- B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.
- C. Secure nailing flanges to concrete forms.
- D. Using grout, seal the space around outside of sleeve-seal fittings.

### 3.5 SLEEVE AND SLEEVE-SEAL SCHEDULE

- A. Use sleeves and sleeve seals for the following piping-penetration applications:
  - 1. Exterior Concrete Walls above Grade:
    - a. Piping Smaller Than NPS 6: Cast-iron wall sleeves, Galvanized-steel wall sleeves, or Galvanized-steel-pipe sleeves.
    - b. Piping NPS 6 and Larger: Cast-iron wall sleeves, Galvanized-steel wall sleeves, or Galvanized-steel-pipe sleeves.
  - 2. Exterior Concrete Walls below Grade:
    - a. Piping Smaller Than NPS 6: Cast-iron wall sleeves with sleeve-seal system, Galvanized-steel wall sleeves with sleeve-seal system, or Galvanized-steel-pipe sleeves with sleeve-seal system.
      - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
    - b. Piping NPS 6 and Larger: Cast-iron wall sleeves with sleeve-seal system, Galvanized-steel wall sleeves with sleeve-seal system, or Galvanized-steel-pipe sleeves with sleeve-seal system.
      - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
  - 3. Concrete Slabs above Grade:
    - a. Piping Smaller Than NPS 6 Galvanized-steel-pipe sleeves, Stack-sleeve fittings, Sleeve-seal fittings
    - b. Piping NPS 6 and Larger: Galvanized-steel-pipe sleeves, Stack-sleeve fittings.
  - 4. Interior Partitions:
    - a. Piping Smaller Than NPS 6 Galvanized-steel-pipe sleeves,
    - b. Piping NPS 6 and Larger: Galvanized-steel-sheet sleeves.

END OF SECTION 230517

## SECTION 230518 - ESCUTCHEONS FOR HVAC PIPING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Escutcheons.
  - 2. Floor plates.

#### 1.3 SUBMITTALS

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

### PART 2 - PRODUCTS

#### 2.1 ESCUTCHEONS

- A. One-Piece, Cast-Brass Type: With rough brass finish and setscrew fastener.
- B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with chrome-plated finish and spring-clip fasteners.
- C. One-Piece, Stamped-Steel Type: With chrome-plated finish and spring-clip fasteners.
- D. Split-Casting Brass Type: With rough-brass finish and with concealed hinge and setscrew.
- E. Split-Plate, Stamped-Steel Type: With chrome-plated finish, concealed hinge, and spring-clip fasteners.

#### 2.2 FLOOR PLATES

- A. One-Piece Floor Plates: Cast-iron flange.
- B. Split-Casting Floor Plates: Cast brass with concealed hinge.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION

- A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.
- B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
  - 1. Escutcheons for New Piping:

- a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
  - b. Insulated Piping: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge.
  - c. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, cast-brass or split-casting brass type with rough brass finish.
  - d. Bare Piping in Unfinished Service Spaces: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge.
  - e. Bare Piping in Equipment Rooms: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge.
2. Escutcheons for Existing Piping:
- a. Insulated Piping: Split-plate, stamped-steel type with concealed hinge.
  - b. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-casting brass type with rough brass finish.
  - c. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-casting brass type with rough brass finish.
  - d. Bare Piping in Unfinished Service Spaces: Split-plate, stamped-steel type with concealed hinge.
  - e. Bare Piping in Equipment Rooms: Split-plate, stamped-steel type with concealed hinge.
- C. Install floor plates for piping penetrations of equipment-room floors.
- D. Install floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
- 1. New Piping: One-piece, floor-plate type.
  - 2. Existing Piping: Split-casting, floor-plate type.
- 3.2 FIELD QUALITY CONTROL
- A. Replace broken and damaged escutcheons and floor plates using new materials.

END OF SECTION 230518

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## SECTION 230519 - METERS AND GAGES FOR HVAC PIPING

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. This Section includes the following meters and gages for mechanical systems:
  - 1. Thermometers.
  - 2. Gages.
  - 3. Test plugs.

#### 1.2 DEFINITIONS

- A. CR: Chlorosulfonated polyethylene synthetic rubber.
- B. EPDM: Ethylene-propylene-diene terpolymer rubber.

#### 1.3 SUBMITTALS

- A. Product Data: For each type of product indicated; include performance curves.
- B. Shop Drawings: Schedule for thermometers and gages indicating manufacturer's number, scale range, and location for each.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

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

#### 2.2 METAL-CASE, LIQUID-IN-GLASS THERMOMETERS

- A. Manufacturers:
  - 1. Palmer - Wahl Instruments Inc.
  - 2. Terice, H. O. Co.
  - 3. Weiss Instruments, Inc.
  - 4. Weksler Instruments Operating Unit; Dresser Industries; Instrument Div.
- B. Type: Liquid-in-glass type, 9 inch long of chrome plated brass construction or self-powered digital type with glass passivated thermistor and internal potentiometer.
- C. Tube: Red reading, liquid filled, with magnifying lens. The use of mercury shall be prohibited.
- D. Tube Background: Satin-faced, non-reflective aluminum with permanently etched scale markings.
- E. Window: Clear acrylic held in place with removable stainless steel cap.
- F. Connector: Adjustable type, 180 degrees in vertical plane, 360 degrees in horizontal



plane, with locking device.

- G. Stem: Brass for thermowell installation and of length to suit installation.
- H. Accuracy: Plus or minus 1 scale division to maximum of 1.5 percent of range.

### 2.3 THERMOWELLS

- A. Manufacturers: Same as manufacturer of thermometer being used.
- B. Description: Pressure-tight, socket-type brass or stainless steel fitting made for insertion into piping and of type, diameter, and length required to hold thermometer. Thermowell to have a two inch extension with threaded cap nut and cap for all insulated piping.

### 2.4 PRESSURE GAGES

- A. Manufacturers:
  - 1. Palmer - Wahl Instruments Inc.
  - 2. Terrice, H. O. Co.
  - 3. Weiss Instruments, Inc.
  - 4. Weksler Instruments Operating Unit; Dresser Industries; Instrument Div.
- B. Direct-Mounting, Dial-Type Pressure Gages: Indicating-dial type complying with ASME B40.100.
  - 1. Case: Dry or Glycerine filled type, 4-1/2 inch diameter.
  - 2. Pressure-Element Assembly: Stainless Steel, Bourdon tube.
  - 3. Pressure Connection: Brass, NPS 1/4, bottom-outlet type.
  - 4. Movement: Mechanical, with link to pressure element and connection to pointer.
  - 5. Dial: Satin-faced, nonreflective aluminum with permanently etched scale markings.
  - 6. Pointer: Black metal.
  - 7. Window: Glass.
  - 8. Ring: Stainless Steel.
  - 9. Accuracy: Grade 2A, plus or minus 0.5 percent of scale range.
  - 10. Range for Fluids under Pressure: Two (2) times operating pressure.
  - 11. Provide gauges without back mounting plate.
  - 12. Vacuum Range: 30 inches HG of vacuum to 15 PSIG of pressure.

### 2.5 TEST PLUGS

- A. Manufacturers:
  - 1. Peterson Equipment Co., Inc.
  - 2. Sisco Manufacturing Co.
  - 3. Terrice, H. O. Co.
  - 4. Watts Industries, Inc.; Water Products Div.
- B. Description: 1/2 inch NPT, Corrosion-resistant brass body with core inserts and gasketed and threaded cap, with extended stem for units to be installed in insulated piping.
- C. Minimum Pressure and Temperature Rating: 1000 psi at 350 deg F.

- D. Core Inserts: Two (2) self-sealing rubber valves.
  - 1. Insert material for air, water, oil, or gas service at 20 to 350 deg F shall be Nordel.
  
- E. Test Kit: Furnish one (1) test kit containing one (1) pressure gage and adaptor, two (2) thermometers, and carrying case. Pressure gage, adapter probes, and thermometer sensing elements shall be of diameter to fit test plugs and of length to project into piping.
  - 1. Pressure Gage: Small bourdon-tube insertion type with 2- to 3- inch diameter dial and probe. Dial range shall be 0 to 200 psig.
  - 2. Low Range Thermometer: Small bimetallic insertion type with 2 inch diameter dial and tapered-end sensing element. Dial ranges shall be 0 to 220 deg F.
  - 3. Carrying case shall have formed instrument padding.

### PART 3 - EXECUTION

#### 3.1 THERMOMETER APPLICATIONS

- A. Install liquid-in-glass thermometers in the following locations:
  - 1. Where indicated on the design drawing piping diagrams.
  - 2. Inlet and outlet of each hydronic boiler and chiller.
  - 3. Inlet and outlet of air handling unit heating & cooling coils.
  
- B. Provide the following temperature ranges for thermometers:
  - 1. Heating Hot Water: 30 to 200 deg F, with 2-degree scale divisions.
  - 2. Chilled Water: 0 to 100 deg F, with 2-degree scale divisions.

#### 3.2 GAGE APPLICATIONS

- A. Install dry-case-type pressure gages for discharge of each pressure-reducing valve.
  
- B. Install liquid-filled-case-type pressure gages at chilled water inlet and outlet of chiller and boiler.
  
- C. Install liquid-filled-case-type pressure gages at suction and discharge of each pump.

#### 3.3 TEST PLUG APPLICATIONS

- A. Inlet and outlet of each heating and cooling coil.
  
- B. Inlet and outlet of each strainer on coils.
  
- C. Inlet and outlet of each temperature regulating valve.
  
- D. Inlet and outlet of each pressure reducing valve.
  
- E. Both inlets to differential pressure transmitters.

#### 3.4 INSTALLATIONS

- A. Install direct-mounting thermometers and adjust vertical and tilted positions.

- B. Install thermowells with socket extending to center of pipe and in vertical position in piping tees where thermometers are indicated.
- C. Install direct-mounting pressure gages in piping tees with pressure gage located on pipe at most readable position.
- D. Install needle-valve and snubber fitting in piping for each pressure gage for fluids.
- E. Install test plugs in tees in piping. Install test plugs with sufficient clearance to permit installation of test gauges and thermometers.

### 3.5 CONNECTIONS

- A. Install meters and gages adjacent to machines and equipment to allow service and maintenance for meters, gages, machines and equipment.

### 3.6 ADJUSTING

- A. Adjust faces of meters and gages to proper angle for best visibility.

END OF SECTION 230519

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## SECTION 230523 – GENERAL DUTY VALVES FOR HVAC PIPING

### PART 1 - GENERAL

#### 1.1 DESCRIPTION

- A. Provide valves to facilitate maintenance and isolation of piping systems.

#### 1.2 QUALITY ASSURANCE

##### A. STANDARDS

1. American National Standards Institute (ANSI), American Society of Mechanical Engineers (ASME), American Society for Testing and Materials (ASTM) and the Manufacturers' Standardization Society of the Valve and Fittings Industry (MSS).
2. ANSI B16.10, MSS SP0-67-90 Butterfly Valves.
3. MSS SP-70-90 Cast Iron Gate Valves, Flanged or Threaded Ends.
4. MSS SP-78-92 Cast Iron Plug Valves Flanged and Threaded.
5. MSS SP-80-87 Bronze Gate, Globe, and Check Valves.
6. MSS SP-85-85 Cast Iron Globe and Angle Valves, Flanged and Threaded Ends.
7. MSS SP-110-92 Ball Valves Threaded, Socket-Welded, Solder Joint, Grooved and Flared Ends.

- B. To assure uniformity and compatibility of piping components in grooved end piping systems, all grooved products utilized shall be supplied by the same manufacturer.

#### 1.3 DEFINITIONS

##### A. The following are standard abbreviations for valves:

1. CWP: Cold working pressure.
2. EPDM: Ethylene-propylene-diene terpolymer rubber.
3. NBR: Acrylonitrile-butadiene rubber.
4. PTFE: Polytetrafluoroethylene plastic.
5. OS & Y: Outside screw and yoke.
6. RS: Rising stem.
7. SWP: Steam working pressure.
8. TFE: Tetrafluoroethylene plastic.

#### 1.4 SUBMITTALS

- A. Product Data: For each type of valve indicated. Include body, seating, and trim materials; valve design; pressure and temperature classifications; end connections; arrangement; dimensions; and required clearances. Include list indicating valve and its application. Include rated capacities; shipping, installed, and operating weights; furnished specialties; and accessories.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

##### A. Prepare valves for shipping as follows:

1. Protect internal parts against rust and corrosion.
2. Protect threads, flange faces, grooves, and weld ends.
3. Set angle, gate, and globe valves closed to prevent rattling.
4. Set ball and plug valves open to minimize exposure of functional surfaces.
5. Set butterfly valves closed or slightly open.

6. Block check valves in either closed or open position.
- B. Use the following precautions during storage:
  1. Maintain valve end protection.
  2. Store valves indoors and maintain at higher than ambient dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.
- C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use hand wheels or stems as lifting or rigging points.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. All similar valves used on the project shall be by the same manufacturer.
- B. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
  1. Manufacturers: Subject to compliance with requirements, provide products by one (1) of the manufacturers specified.

### 2.2 VALVES, GENERAL

- A. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- B. Valve Sizes: Same as upstream pipe, unless otherwise indicated.
- C. Valve Actuators:
  1. Chainwheel: For attachment to valves, of size and mounting height, as indicated in the "Valve Installation" Article in Part 3.
  2. Gear Drive: For quarter-turn valves NPS 6 and larger and on discharge of all pumps without VFD's.
  3. Handwheel: For valves other than quarter-turn types.
  4. Lever Handle: For quarter-turn valves NPS 5 and smaller, except plug valves.
  5. Wrench: For plug valves with square heads. Furnish Owner with one (1) wrench for every ten (10) plug valves, for each size square plug head.
- D. Extended Valve Stems: On insulated valves.
- E. Valve Flanges: ASME B16.1 for cast-iron valves, ASME B16.5 for steel valves and ASME B16.24 for bronze valves.
- F. Valve Grooved Ends: AWWA C606.
- G. Solder Joint: With sockets according to ASME B16.18. Caution: Use solder with melting point below 840 deg F for angle, check, gate, and globe valves; below 421 deg F for ball valves.
- H. Threaded Joint: With threads according to ASME B1.20.1.
- G. Valve Bypass and Drain Connections: MSS SP-45.

### 2.3 GATE VALVES (USED ONLY WHERE INDICATED)

- A. Four inches and larger gate valves in steel pipe shall be iron body, bronze mounted, outside screw and yoke, flanged bonnet, rising stem, solid wedge. Rated at 200 psi WOG; 125 psi steam: Powell Fig 1793.
- B. Manufacturers:
  - 1. Powell (Basis of Design)
  - 2. Milwaukee
  - 3. Lunkenheimer
  - 4. Nibco
  - 5. Hammond

### 2.4 BALL VALVES (2-1/2 INCHES AND SMALLER)

- A. 400 psi WOG, 150 psi steam, bubble-tight against 100 psi, cast bronze body, self-aligning free floating stainless steel ball and stem with full flow port, non-rising stem, Teflon seat and body seal, quarter turn operation, solder joint or screwed ends. Valves to include memory stop and stem extensions for insulated piping.
  - 1. Drain valves with hose fitting, dust cover and chain attachment: Apollo No. 78-144
  - 2. All other valves: Apollo No. 77-140/240
  - 3. Manufacturers:
    - a. Apollo (Basis of Design)
    - b. Hammond
    - c. Milwaukee
    - d. Nibco
    - e. Watts
    - f. Victaulic Co. of America
- B. Two-Piece Standard Port Ductile Iron Ball Valve, (Sizes 2 inch to 2-1/2 inch):
  - 1. Manufacturer:
    - a. Victaulic Company Series 726
  - 2. Description:
    - a. Standard: MSS SP-72.
    - b. CWP Rating: 800 psig
    - c. Body Material: ASTM A 536 Ductile Iron
    - d. Ends: Grooved.
    - e. Seats: TFE.
    - f. Stem: Stainless steel.
    - g. Ball: Stainless Steel.
    - h. Port: Full port to match pipe size.

### 2.5 BUTTERFLY VALVES (IN TUNNEL AND MECHANICAL ROOM)

- A. Chilled water butterfly valves shall be Keystone K-Lok Figure 362, DeZurick, Norris, Demco, Crane, Watts, Ginnell, or approved equal high performance butterfly valves suitable for 200° F at a system shutoff pressure of 740 PSI.
  - 1. Valves shall have carbon steel body with full lug type body with holes drilled and tapped for 150 PSI flanges, stainless steel shaft and disc, stainless steel/nitride bearings, and with EPDM seat.
  - 2. Valves 6" and larger at valves at pump discharge shall be equipped with enclosed gear operators; smaller valves shall be equipped with notched plate and rotary

handle.

2.6 BUTTERFLY VALVES (3 INCHES AND LARGER)

- A. 225 psi line pressure, bubble-tight bi-directionally against 225 psi differential pressure, 250 psi dead end pressure, cast iron lugged type body, double-seated, stainless steel disc, with EPDM seat, stainless steel shaft, bronze bushings, 200° F maximum water temperature.
  - 1. 12 inches and smaller: Keystone Fig. 22
  - 2. 14 inches and larger : Keystone Fig. AR2
  
- B. Manufacturers:
  - 1. DeZurik
  - 2. Keystone (Basis of Design)
  - 3. Milwaukee
  - 4. Nibco
  - 5. Norris
  - 6. Watts

2.7 CHECK VALVES

- A. Pump discharge and vertical piping
  - 1. Semi-steel body, bronze mounted, anti-water hammer type
    - a. 2-1/2 inches and smaller: Williams No. 329
    - b. 3 inches and larger: Williams No. 636
    - c. Manufacturers:
      - 1) McAlear
      - 2) Mission
      - 3) Mueller
      - 4) Williams (Basis of Design)
      - 5) Victaulic Co. of America
  
- B. 2 inches and smaller: 200 psi WOG, bronze swing check, solder joint tubing ends or threaded ends with replaceable composition disc and integral seat.
  - 1. 2 inches and smaller in copper pipe: Powell Fig. 1825
  - 2. 2 inches and smaller in steel pipe: Powell Fig. 560
  
- C. 2-1/2 inches and larger: 200 psi WOG, iron body bronze trim, renewable disc; Powell Fig. 559.
  
- D. Manufacturers:
  - 1. Hammond
  - 2. Lunkenheimer
  - 3. Powell (Basis of Design)
  - 4. Victaulic Co. of America

## 2.9 CALIBRATED BALANCING VALVES

- A. Bell & Gossett Circuit Setter Plus or equal by Armstrong, Taco, Tour & Andersson, Flowset with positive shut-off, memory stop screw or 4-turn digital readout handwheel, drain connection, read-out valves with EPT insert and check valve, insulated cover, bronze or Ametal brass body, brass ball or globe type, carbon filled TFE or Ametal seats, calibrated name plate. Balancing valves to be 30 PSIT/250 Deg, F rated for 1/2" to 3" NPT connections, 200 PSIG/250 Deg, F rated for 1/2" to 3/4" sweat or grooved connections and 125 PSIG/250 Deg, F rated for 4" flanged or grooved connections.
- B. Furnish a portable flow measuring instrument for verifying and determining flow. Furnish carrying case, gage, valve block and color coded hoses for low and high pressure connections, and connectors for connection to read-out valves.

## 2.10 CHAINWHEEL ACTUATORS

- A. Description: Valve actuation assembly with sprocket rim, brackets, and chain.
  - 1. Sprocket Rim with Chain Guides: Cast iron, of type and size required for valve.
  - 2. Brackets: Type, number, size, and fasteners required to mount actuator on valve.
  - 3. Chain: Hot-dip, galvanized steel, of size required to fit sprocket rim.

## 2.11 AUTOMATIC BALACING VALVE

- A. Valve with cartridges that automatically control flow rates with plus or minimum 5% accuracy over an operating pressure differential range of at least 14 times the minimum required for control. Valve internal control mechanism shall consist of a stainless steel one-piece cartridge with segmented port design and full travel linear coil spring or equivalent. Body design shall allow inspection or removal of cartridge or strainer without disturbing piping connections. Provide isolation valves on both inlet and outlet side of the balancing valves that permit removal of balancing valve without drain down of piping. Valves 2-1/2 inch and smaller shall be solder or screwed ends, valves 3 inch and larger shall be flanged. Extra cartridges shall be provided as required for a 2 year to adjust system flows to meet demand.
- B. Automatic balancing valves shall not be used where modulating temperature control valves are installed.
- C. Manufacturers:
  - 1. Griswald
  - 2. Automatic Flow Control
  - 3. Armstrong

## PART 3 – EXECUTION

### 3.1 EXAMINATION

- A. Examine piping system for compliance with requirements for installation tolerances and other conditions affecting performance.
  - 1. Proceed with installation only after unsatisfactory conditions have been corrected.



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

### 3.2 VALVE APPLICATIONS

- A. Refer to piping Sections for specific valve applications. If valve applications are not indicated, use the following:
  - 1. Shutoff Service: Ball valves for size 2-1/2" and less; butterfly valves for sizes 3" and larger.
  - 2. Throttling Service: Ball valves for size 2-1/2" and less; butterfly valves for sizes 3" and larger.
- B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP class or CWP ratings may be substituted.

### 3.3 VALVE INSTALLATION

- A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install valves with unions, grooved couplings or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- C. Locate valves for easy access and provide separate support where necessary.
- D. Install valves in horizontal piping with stem at or above center of pipe.
- E. Install valves in position to allow full stem movement.
- F. Install chain wheel operators on valves NPS 3 and larger and more than 96 inches above floor. Extend chains to 78 inches above finished floor elevation.
- G. Install check valves for proper direction of flow and as follows:
  - 1. Swing Check Valves: In horizontal position with hinge pin level.
  - 2. Dual-Plate Check Valves: In horizontal or vertical position, between flanges.

3. Lift Check Valves: With stem upright and plumb.

H. Provide sufficient space to allow adjustment of balancing values.

I. Install drain valves in piping at low points and trapped areas to provide complete drainage of all systems.

#### 3.4 JOINT CONSTRUCTION

A. Grooved Joints: Assemble joints with keyed coupling housing, gasket, lubricant, and bolts according to coupling and fitting manufacturer's written instructions.

B. Soldered Joints: Use ASTM B 813, water-flushable, lead-free flux; ASTM B 32, lead-free-alloy solder; and ASTM B 828 procedure, unless otherwise indicated. Open valves before soldering.

#### 3.5 ADJUSTING

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

END OF SECTION 230523

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## SECTION 230529 - HANGERS AND SUPPORTS FOR HVAC EQUIPMENT

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. This Section includes hangers and supports for mechanical system equipment.

#### 1.2 DEFINITIONS

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

#### 1.3 PERFORMANCE REQUIREMENTS

- A. Design channel support systems for piping to support multiple pipes capable of supporting combined weight of supported systems, system contents, and test water.

#### 1.4 SUBMITTALS

- A. Product Data: For each type of pipe hanger, channel support system component, and thermal-hanger shield insert indicated.
- B. Shop Drawings: Signed and sealed by a qualified professional engineer for multiple piping supports and trapeze hangers. Include design calculations and indicate size and characteristics of components and fabrication details.
- C. Welding Certificates: Copies of certificates for welding procedures and operators.

#### 1.5 QUALITY ASSURANCE

- A. Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one (1) of the manufacturers specified:
  - 1. Channel Support Systems:
    - a. Grinnell Corp.; Power-Strut Unit.
    - b. Michigan Hanger Co., Inc.; O-Strut Div.
    - c. National Pipe Hanger Corp.
    - d. Thomas & Betts Corp.
    - e. Unistrut Corp.
  - 2. Thermal-Hanger Shield Inserts:
    - a. Michigan Hanger Co., Inc
    - b. Pipe Shields, Inc.
    - c. Rilco Manufacturing Co., Inc.

- d. Value Engineered Products, Inc.
3. Powder-Actuated Fastener Systems:
  - a. Gunnebo Fastening Corp.
  - b. Hilti, Inc.
  - c. ITW Ramset/Red Head.
  - d. Masterset Fastening Systems, Inc.

## 2.2 MANUFACTURED UNITS

- A. Pipe Hangers, Supports, and Components: MSS SP-58, factory-fabricated components. Refer to "Hanger and Support Applications" Article in Part 3 for where to use specific hanger and support types.
  1. Galvanized, Metallic Coatings: For piping and equipment that will not have field-applied finish.
  2. Nonmetallic Coatings: On attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- B. Channel Support Systems: MFMA-2, factory-fabricated components for field assembly.
  1. Coatings: Manufacturer's standard finish, unless bare metal surfaces are indicated.
  2. Nonmetallic Coatings: On attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- C. Thermal-Hanger Shield Inserts: 100 psi minimum compressive-strength insulation, encased in sheet metal shield.
  1. Material for Cold Piping: ASTM C 552, Type I cellular glass with vapor barrier.
  2. Material for Hot Piping: ASTM C 552, Type I cellular glass.
  3. For Trapeze or Clamped System: Insert and shield cover entire circumference of pipe.
  4. For Clevis or Band Hanger: Insert and shield cover lower 180 degrees of pipe.
  5. Insert Length: Extend 2" beyond sheet metal shield for piping operating below ambient air temperature.

## 2.3 MISCELLANEOUS MATERIALS

- A. Powder-Actuated Drive-Pin Fasteners: Powder-actuated-type, drive-pin attachments with pull-out and shear capacities appropriate for supported loads and building materials where used.
- B. Mechanical-Anchor Fasteners: Insert-type attachments with pull-out and shear capacities appropriate for supported loads and building materials where used.
- C. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars, black and galvanized.
- D. Grout: ASTM C 1107, Grade B, factory-mixed and -packaged, nonshrink and nonmetallic, dry, hydraulic-cement grout.
  1. Characteristics: Post hardening and volume adjusting; recommended for both interior and exterior applications.
  2. Properties: Nonstaining, noncorrosive, and nongaseous.
  3. Design Mix: 5000-psi 28-day compressive strength.

## PART 3 - EXECUTION

### 3.1 HANGER AND SUPPORT APPLICATIONS

- A. Specific hanger requirements are specified in Sections specifying equipment and systems.
- B. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping system Specification Sections.

### 3.2 EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure above or to support equipment above floor.
- B. Grouting: Place grout under supports for equipment and make smooth bearing surface.

### 3.3 METAL FABRICATION

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

### 3.5 ADJUSTING

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

### 3.6 PAINTING

- A. Touching Up: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 9.
- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A780.

END OF SECTION 230529

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## SECTION 230553 - IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

### PART 1 - GENERAL

#### 1.1 DESCRIPTION

##### A. IDENTIFY BY LABELS AND TAGS THE FOLLOWING ITEMS

1. Equipment such as exhaust fans, air handling units, control cabinets, VAV boxes, etc.
2. Piping, valves and ductwork exposed in equipment rooms and accessible service areas.
3. Piping, valves and ductwork running above accessible ceiling construction and near access panels in non-accessible construction areas.
4. All temperature control valves and automatic control dampers.

- B. Install laminated plastic markers and metal stamped nameplates for equipment. Provide color banding, flow arrows and contents identification for piping and ductwork.

#### 1.2 SUMMARY

- A. This Section includes the following mechanical identification materials and their installation:

1. Equipment nameplates.
2. Equipment markers.
3. Pipe markers.
4. Duct markers.
5. Stencils.
6. Valve tags.
7. Valve Schedules.
8. Warning tags.

#### 1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples: For color, letter style, and graphic representation required for each identification material and device.
- C. Valve numbering scheme.
- D. Valve Schedules: For each piping system. Furnish three extra copies (in addition to mounted copies) to include in maintenance manuals.

#### 1.4 QUALITY ASSURANCE

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

## 1.5 COORDINATION

- A. Coordination installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Coordinate installation of identifying devices with location of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.
- D. All trades shall use the same type, style and appearance of identification.

## PART 2 - PRODUCTS

### 2.1 EQUIPMENT IDENTIFICATION DEVICES

- A. Equipment Nameplates: Metal, with data engraved or stamped, for permanent attachment on equipment.
  - 1. Data:
    - a. Manufacturer, product name, model number, and serial number.
    - b. Capacity, operating and power characteristics, and essential data.
    - c. Labels of tested compliances.
  - 2. Location: Accessible and visible.
  - 3. Fasteners: As required to mount on equipment.
- B. Equipment Markers: Engraved, laminated plastic, white lettering on black background. Markers shall be screw on, except where screws might damage equipment, use a contact-type permanent adhesive.
  - 1. Terminology: Match schedules as closely as possible.
  - 2. Size: Sized for 3/4-inch lettering.

### 2.2 PIPING IDENTIFICATION DEVICES

- A. Manufactured Pipe Markers, General: Preprinted, color-coded, with lettering indicating service, and showing direction of flow.
  - 1. Colors: As indicated in specification schedule.
  - 2. Lettering: Use piping system terms indicated and abbreviate only as necessary for each application length.
  - 3. Pipes with OD, including insulation, less than 6 inches: Full-band pipe markers extending 360 degrees around pipe at each location.
  - 4. Pipes with OD, including insulation, 6 inches and larger: Either full-band or strip-type pipe markers at least three (3) times letter height and of length required for label.
  - 5. Arrows: A separate unit on each pipe marker to indicate direction of flow. 2.3

### 2.3 DUCT IDENTIFICATION DEVICES

- A. Stencils: Prepared with minimum letter height of 1-1/4 inches for ducts.
  - 1. Stencil Paint: Exterior, gloss, alkyd enamel black, unless otherwise indicated. Paint may be in pressurized spray-can form.
  - 2. Identification Paint: Exterior alkyd enamel in colors as indicated in specification schedule.



- B. Manual dampers: Wrap duct with red plastic ribbon with 12" long tail at each manual damper.

#### 2.4 VALVE TAGS

- A. Valve Tags: 2" diameter tag stamped or engraved with ¼-inch letters for piping system abbreviation and ½-inch numbers, with numbering scheme, approved by Engineer. Provide 5/32-inch hole for fastener.  
Material: 16 gauge brass.
  - 1. Valve-Tag Fasteners: Brass beaded chain.

#### 2.5 VALVE SCHEDULES

- A. Valve Schedules: For each piping system, on standard-size bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulation), and variations for identification. Mark valves for emergency shutoff and similar special uses.
  - 1. Valve-Schedule Frames: Glazed display frame for removable mounting on masonry walls for each page of valve schedule. Include mounting screws.
  - 2. Frame: Extruded aluminum.
  - 3. Glazing: ASTM C 1036, Type I, Class 1, Glazing Quality B, 2.5-mm, single-thickness glass.

#### 2.6 WARNING TAGS

- A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags; of plasticized card stock with matte finish suitable for writing.
  - 1. Size: Approximately 4 by 7 inches.
  - 2. Fasteners: Brass grommet and wire.
  - 3. Nomenclature: Large-size primary caption such as DANGER, CAUTION, or DO NOT OPERATE.
  - 4. Color: Yellow background with black lettering.

### PART 3 - EXECUTION

#### 3.1 APPLICATIONS, GENERAL

- A. Products specified are for applications referenced in other Division 15 Sections. If more than single-type material, device, or label is specified for listed applications, selection is Installer's option.
- B. Installing Contractor is responsible for valve tagging, equipment markers and pipe identification of all valves, equipment and piping on packaged pumping skids.

#### 3.2 EQUIPMENT IDENTIFICATION

- A. Install equipment markers with screws, or, if screws might damage equipment, use permanent adhesive on or near each major item of mechanical equipment.
  - 1. Locate markers where accessible and visible. Include markers for the following

general categories of equipment:

- a. Main control and operating valves, including safety devices.
- b. Terminal VAV units.
- c. Boilers
- d. Pumps, chillers and similar motor-driven units.
- e. Coils, heat recovery units and similar equipment.
- f. Fans, blowers, primary balancing dampers, and mixing boxes.
- g. Packaged HVAC central-station and air handling units.
- h. Tanks and pressure vessels.
- i. Water-treatment systems and similar equipment.

### 3.3 PIPING IDENTIFICATION

- A. Install manufactured pipe markers indicating service of each piping system. Install with flow indication arrows showing direction of flow.
- B. All underground pipe shall be marked with a continuous, underground-type plastic line marker. Confirm location of markers with the Engineer.
- C. Locate pipe markers and color bands where piping is exposed in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior non-concealed locations as follows:
  1. Near each valve and control device.
  2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
  3. Near penetrations through walls, floors, ceilings, and non-accessible enclosures.
  4. At access doors, manholes, and similar access points that permit view of concealed piping.
  5. Near major equipment items and other points of origination and termination.
  6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
  7. On piping above removable acoustical ceilings.

D. Pipe Identification:

<u>TYPE OF SERVICE</u>	1" BAND	½" BAND	<u>DESIGNATION</u>
	<u>COLOR</u>	<u>COLOR</u>	
Chilled Water Supply	Blue	Black	CHWS
Chilled Water Return	Blue	Black	CHWR
Heating Water Supply	Lime Green	Lime Green	HWS
Heating Water Return	Lime Green	Lime Green	HWR
Dual Temp. Supply	Blue	Lime Green	DTS
Dual Temp. Return	Blue	Lime Green	DTR
Mechanical City Water	Blue	Blue	MCW

### 3.4 DUCT IDENTIFICATION

- A. Stenciled Duct Markers: Stenciled markers, showing service and direction of flow. Stencil only after ductwork is painted.
- B. Locate markers near points where ducts enter into concealed spaces and at maximum intervals of 50 feet in each space where ducts are exposed or concealed by removable

ceiling system and at access doors in concealed spaces.

C. Duct Identification:

<u>TYPE OF SERVICE</u>	<u>1" BAND COLOR</u>	<u>DESIGNATION</u>
Supply Air	Green	SUPPLY
Return Air	Blue	RETURN
Exhaust Air	Blue	EXH
Outdoor Air	Blue	OA

3.5 VALVE-TAG INSTALLATION

A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; plumbing fixture supply stops; shutoff valves; faucets; convenience and lawn-watering hose connections; and HVAC terminal devices and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.

B. Valve-Tag Application Schedule: Tag valves with captions as indicated in the following:

<u>TYPE OF SERVICE</u>	<u>VALVE TAG DESIGNATION</u>
Heating Water Supply	HWS
Heating Water Return	HWR
Chilled Water Supply	CHWS
Chilled Water Return	CHWR
Dual Temperature Supply	DTS
Dual Temperature Return	DTR
Mechanical City Water	MCW

3.6 VALVE-SCHEDULE INSTALLATION

A. Mount valve schedule on wall in accessible location where directed by Owner. Provide aluminum frame with plexiglass cover for valve chart.

3.7 WARNING-TAG INSTALLATION

A. Write required message on, and attach warning tags to equipment and other items where required.

3.8 ADJUSTING

A. Relocate mechanical identification materials and devices that have become visually blocked by other work. Stencils, name tags, etc. must be readable from a standing position.

A. When arrows and letters cannot be stenciled on pipe, stencil identification on 16 gauge aluminum metal panels in correct color and hang panel on piping with key chains.

### 3.9 CLEANING

- A. Clean faces of mechanical identification devices and glass and frames of valve schedules.

### 3.10 UNDERGROUND UTILITIES

- A. The following underground utility shall have a 3M ball marker or full-range marker, each having a distinct color and frequency, for locating underground utilities. The marker shall be used only when the utility will be 8 feet or less below the future finished grade. The marker shall be placed in the trench, on top of the utility. A marker shall be placed every 25 feet. A marker shall be placed at every direction change. There shall be a minimum of two markers for each utility trench. Each marker shall be as follows:
  - 1. The 1253 full-range green marker for chilled water and hot water piping.
- B. Note, all underground utilities and proposed areas of excavation shall be marked in strict accordance with Ohio's Universal Marketing Standards.

END OF SECTION 230553

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## SECTION 230593 - TESTING ADJUSTING AND BALANCING FOR HVAC

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. The testing, adjusting and balancing work as specified in this section is to be performed by a certified balancing contractor that is hired by the HVAC Contractor. All final tab work will be completed at the end of the final phase of work. The HVAC Contractor is to provide all necessary assistance and coordination with the testing, adjusting and balancing, (TAB) contractor as required to complete the balancing work and generate the balancing report as specified in this section. The HVAC Contractor is to provide all system start-up procedures and commissioning tasks that are required prior to balancing work as specified in the other sections of this specification.
- B. This Section includes testing, adjusting and balancing to produce design objectives for the following:
  - 1. Air Systems:
    - a. Constant-volume air systems.
    - b. Variable-air-volume systems.
  - 2. Hydronic Piping Systems:
    - a. Chilled water systems.
    - b. Hot water heating systems.
    - c. Dual temperature water systems.
  - 3. HVAC equipment quantitative-performance settings.
  - 4. Verifying that automatic control devices are functioning properly.
  - 5. Reporting results of activities and procedures specified in this Section.
  - 6. In general, the Balancing Work will occur at the end of the last phase of this project.

#### 1.2 DEFINITIONS

- A. Adjust: To regulate fluid flow rate and air patterns at the terminal equipment, such as to reduce fan speed or adjust a damper.
- B. Balance: To proportion flows within the distribution system, including sub-mains, branches, and terminals, according to indicated quantities.
- C. Barrier or Boundary: Construction, either vertical or horizontal, such as walls, floors, and ceilings that are designed and constructed to restrict the movement of airflow, smoke, odors, and other pollutants.
- D. Draft: A current of air, when referring to localized effect caused by one or more factors of high air velocity, low ambient temperature, or direction of airflow, whereby more heat is withdrawn from a person's skin than is normally dissipated.
- E. NC: Noise criteria.
- F. Procedure: An approach to and execution of a sequence of work operations to yield repeatable results.
- G. RC: Room criteria.
- H. Report Forms: Test data sheets for recording test data in logical order.

- I. Static Head: The pressure due to the weight of the fluid above the point of measurement. In a closed system, static head is equal on both sides of the pump.
- J. Suction Head: The height of fluid surface above the centerline of the pump on the suction side.
- K. System Effect: A phenomenon that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
- L. System Effect Factors: Allowances used to calculate a reduction of the performance ratings of a fan when installed under conditions different from those presented when the fan was performance tested.
- M. TAB: Testing, adjusting, and balancing.
- N. Terminal: A point where the controlled medium, such as fluid or energy, enters or leaves the distribution system.
- O. Test: A procedure to determine quantitative performance of systems or equipment.
- P. Testing, Adjusting, and Balancing (TAB) Firm: The entity responsible for performing and reporting TAB procedures.

### 1.3 SUBMITTALS

- A. Qualification Data: Within 30 days from Contractor's Notice to Proceed, submit two (2) copies of evidence that TAB firm and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.
- B. Contract Documents Examination Report: Within 30 days from Contractor's Notice to Proceed, submit two (2) copies of the Contract Documents review report as specified in Part 3.
- C. Strategies and Procedures Plan: Within 90 days from Contractor's Notice to Proceed, submit two (2) copies of TAB strategies and step-by-step procedures as specified in Part 3 "Preparation" Article. Include a complete set of report forms intended for use on this Project.
- D. Certified TAB Reports: Submit two (2) copies of reports prepared, as specified in this Section, on approved forms certified by TAB firm.
- E. Sample Report Forms: Submit two (2) sets of sample TAB report forms.
- F. Warranties specified in this Section.

### 1.4 QUALITY ASSURANCE

- A. TAB Firm Qualifications: Engage a TAB firm certified by either AABC or NEBB.
- B. TAB Conference: Meet with Owner's and Architect's representatives on approval of TAB strategies and procedures plan to develop a mutual understanding of the details. Ensure the participation of TAB team members, equipment manufacturers' authorized service representatives, HVAC controls installers, and other support personnel. Provide seven (7) days' advance notice of scheduled meeting time and location.

1. Agenda Items: Include at least the following:
    - a. Submittal distribution requirements.
    - b. The Contract Documents examination report.
    - c. TAB plan.
    - d. Work schedule and Project-site access requirements.
    - e. Coordination and cooperation of trades and subcontractors.
    - f. Coordination of documentation and communication flow.
  - C. Certification of TAB Reports: Certify TAB field data reports. This certification includes the following:
    1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
    2. Certify that TAB team complied with approved TAB plan and the procedures specified and referenced in this Specification.
  - D. TAB Report Forms: Use standard forms from AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems", NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems", SMACNA's "HVAC Systems - Testing, Adjusting, and Balancing", or TAB firm's forms approved by Engineer.
  - E. Instrumentation Type, Quantity, and Accuracy: As described in AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems," Section II, "Required Instrumentation for NEBB Certification."
  - F. Instrumentation Calibration: Calibrate instruments at least every six (6) months or more frequently if required by instrument manufacturer.
    1. Keep an updated record of instrument calibration that indicates date of calibration and the name of party performing instrument calibration.
- 1.5 PROJECT CONDITIONS
- A. Partial Owner Occupancy: Owner may occupy completed areas of building before Substantial Completion. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.
- 1.6 COORDINATION
- A. Coordinate the efforts of factory-authorized service representatives for systems and equipment, HVAC controls installers, and other mechanics to operate HVAC systems and equipment to support and assist TAB activities.
  - B. Notice: Provide seven (7) days' advance notice for each test. Include scheduled test dates and times.
  - C. Perform TAB after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

## 1.7 WARRANTY

- A. National Project Performance Guarantee: Provide a guarantee on AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems" forms stating that AABC will assist in completing requirements of the Contract Documents if TAB firm fails to comply with the Contract Documents or provide a guarantee on NEBB forms stating that NEBB will assist in completing requirements of the Contract Documents if TAB firm fails to comply with the Contract Documents. Guarantee shall include the following provisions:
  - 1. The certified TAB firm has tested and balanced systems according to the Contract Documents.
  - 2. Systems are balanced to optimum performance capabilities within design and installation limits.

## PART 2 - PRODUCTS – (NOT APPLICABLE)

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine 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.
  - 1. Verify that balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are required by the Contract Documents. Verify that quantities and locations of these balancing devices are accessible and appropriate for effective balancing and for efficient system and equipment operation.
- B. Examine approved submittal data of HVAC systems and equipment.
- C. Examine Project Record Documents described in Division 1 Section "Project Record Documents."
- D. Examine design data, including HVAC system descriptions, statements of design assumptions for environmental conditions and systems' output, and statements of philosophies and assumptions about HVAC system and equipment controls.
- E. Examine equipment performance data including fan and pump curves. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system. Calculate system effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from those presented when the equipment was performance tested at the factory. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," Sections 7 through 10; or in SMACNA's "HVAC Systems--Duct Design," Sections 5 and 6. Compare this data with the design data and installed conditions.
- F. Examine system and equipment installations to verify that they are complete and that testing, cleaning, adjusting, and commissioning specified in individual Sections have been performed.
- G. Examine system and equipment test reports.



- H. Examine systems for functional deficiencies that cannot be corrected by adjusting and balancing.
- I. Examine HVAC equipment to ensure that clean filters have been installed, bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.
- J. Examine terminal units, such as variable-air-volume boxes, to verify that they are accessible and their controls are connected and functioning.
- K. Examine plenum ceilings used for supply air to verify that they are airtight. Verify that pipe penetrations and other holes are sealed.
- L. Examine strainers for clean screens and proper perforations.
- M. Examine heat-transfer coils for correct piping connections and for clean and straight fins.
- N. Examine system pumps to ensure absence of entrained air in the suction piping.
- O. Examine equipment for installation and for properly operating safety interlocks and controls.
- P. Examine automatic temperature system components to verify the following:
  - 1. Dampers, valves, and other controlled devices are operated by the intended controller.
  - 2. Dampers and valves are in the position indicated by the controller.
  - 3. Integrity of valves and dampers for free and full operation and for tightness of fully closed and fully open positions. This includes dampers in variable-air-volume terminals.
  - 4. Automatic modulating and shutoff valves, including two-way valves, are properly connected.
  - 5. Thermostats and humidistats are located to avoid adverse effects of sunlight, drafts, and cold walls.
  - 6. Sensors are located to sense only the intended conditions.
  - 7. Sequence of operation for control modes is according to the Contract Documents.
  - 8. Controller set points are set at indicated values.
  - 9. Interlocked systems are operating.
  - 10. Changeover from heating to cooling mode occurs according to indicated values.
- Q. 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 strategies and step-by-step procedures.
- B. Complete system readiness checks and prepare system readiness reports. Verify the following:
  - 1. Permanent electrical power wiring is complete.
  - 2. Hydronic systems are filled, clean, and free of air.
  - 3. Automatic temperature control systems are operational.

4. Equipment and duct access doors are securely closed.
5. Balance and fire dampers are open.
6. Isolating and balancing valves are open and control valves are operational.
7. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
8. Windows and doors can be closed so indicated conditions for system operations can be met.

### 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 Testing and Balancing Heating, Ventilating, and Air Conditioning Systems" or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" and this Section.
- B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary to allow adequate performance of procedures. After testing and balancing, close probe holes and patch insulation with new materials identical to those removed. Restore vapor barrier and finish according to insulation Specifications for this Project.
- C. Mark equipment and balancing device settings with paint or other suitable, permanent identification material, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, 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. For variable-air-volume systems, develop a plan to simulate diversity.
- D. Determine the best locations in main and branch ducts for accurate duct airflow measurements.
- E. Check airflow patterns from the outside-air louvers and dampers and the return- and exhaust-air dampers, through the supply-fan discharge and mixing dampers.
- F. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
- G. Verify that motor starters are equipped with properly sized thermal protection.
- H. Check dampers for proper position to achieve desired airflow path.
- I. Check for airflow blockages.
- J. Check condensate drains for proper connections and functioning.

- K. Check for proper sealing of air-handling unit components.
- L. Check for proper sealing of air duct system.

### 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 fan static pressures to determine actual static pressure as follows:
    - a. Measure outlet static pressure as far downstream from the fan as practicable and upstream from restrictions in ducts such as elbows and transitions.
    - b. Measure static pressure directly at the fan outlet or through the flexible connection.
    - c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from flexible connection and downstream from duct restrictions.
    - d. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.
  - 2. Measure static pressure across each component that makes up a rooftop unit.
    - a. Simulate dirty filter operation and record the point at which maintenance personnel must change filters.
  - 3. Measure static pressures entering and leaving other devices such as sound traps and heat recovery equipment, under final balanced conditions.
  - 4. Compare design data with installed conditions to determine variations in design static pressures versus actual static pressures. Compare actual system effect factors with calculated system effect factors to identify where variations occur. Recommend corrective action to align design and actual conditions.
  - 5. Obtain approval from Engineer for adjustment of fan speed higher or lower than indicated speed. Make required adjustments to pulley sizes, belt, sheaves, motor sizes, and electrical connections to accommodate fan-speed changes including changing of belts, pulleys and sheaves.
  - 6. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in; full cooling, full heating, economizer, and any other operating modes to determine the maximum required brake horsepower.
- B. Adjust volume dampers for main duct, sub-main ducts, and major branch ducts to indicated airflows within specified tolerances.
  - 1. Measure static pressure at a point downstream from the balancing damper and adjust volume dampers until the proper static pressure is achieved.
    - a. Where sufficient space in sub-main and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.
  - 2. Re-measure each sub-main and branch duct after all have been adjusted. Continue to adjust sub-main and branch ducts to indicated airflows within specified tolerances.
- C. Measure terminal outlets and inlets without making adjustments.
  - 1. Measure terminal outlets using a direct-reading hood or outlet manufacturer's written instructions and calculating factors.
- D. Adjust terminal outlets and inlets for each space to indicated airflows within specified

tolerances of indicated values. Make adjustments using volume dampers rather than extractors and the dampers at air terminals.

1. Adjust each outlet in same room or space to within specified tolerances of indicated quantities without generating noise levels above the limitations prescribed by the Contract Documents.
2. Adjust patterns of adjustable outlets for proper distribution without drafts.

### 3.6 GENERAL PROCEDURES FOR HYDRONIC SYSTEMS

- A. Prepare test reports with pertinent design data and number in sequence starting at pump to end of system. Check the sum of branch-circuit flows against approved pump flow rate.
- B. Prepare schematic diagrams of systems' "as-built" piping layouts.
- C. Prepare hydronic systems for testing and balancing according to the following, in addition to the general preparation procedures specified above:
  1. Open all manual valves for maximum flow.
  2. Check expansion tank liquid level.
  3. Check makeup-water station pressure gage for adequate pressure for highest vent.
  4. Check flow-control valves for specified sequence of operation and set at indicated flow.
  5. Set differential-pressure control valves at the specified differential pressure.
  6. Set system controls so automatic valves are wide open to heat exchangers.
  7. Check pump-motor load. If motor is overloaded, throttle main flow-balancing device so motor nameplate rating is not exceeded.
  8. Check air vents for a forceful liquid flow exiting from vents when manually operated.
  9. Check ethylene glycol percent by volume in chilled water system.

### 3.7 PROCEDURES FOR HYDRONIC SYSTEMS

- A. Measure water flow at pumps. Use the following procedures, except for positive-displacement pumps:
  1. Verify impeller size by operating the pump with the discharge valve closed. Read pressure differential across the pump. Convert pressure to head and correct for differences in gage heights. Note the point on manufacturer's pump curve at zero flow and verify that the pump has the intended impeller size.
  2. Check system resistance. With all valves open, read pressure differential across the pump and mark pump manufacturer's head-capacity curve. Adjust pump discharge valve until indicated water flow is achieved.
  3. Verify pump-motor brake horsepower. Calculate the intended brake horsepower for the system based on pump manufacturer's performance data. Compare calculated brake horsepower with nameplate data on the pump motor. Report conditions where actual amperage exceeds motor nameplate amperage.
  4. Report flow rates that are not within plus or minus 5% of design.
- B. Verify flow rate through automatic flow control valves
- C. Measure flow at all stations and adjust, where necessary, to obtain first balance.
- D. Measure pump flow rate and make final measurements of pump amperage, voltage,

rpm, pump heads, and systems' pressures and temperatures including outdoor-air temperature.

- E. Measuring the differential-pressure control valve settings existing at the conclusions of balancing.

### 3.8 PROCEDURES FOR MOTORS

- A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:
  1. Manufacturer, model, and serial numbers.
  2. Motor horsepower rating.
  3. Motor rpm.
  4. Efficiency rating.
  5. Nameplate measured voltage and amperage for each phase.
  6. Starter thermal-protection-element rating.
- B. Motors Driven by Variable-Frequency Controllers: Test for proper operation at speeds varying from minimum to maximum. Record observations, including: controller manufacturer, model and serial numbers, and nameplate data.

### 3.9 PROCEDURES FOR HEAT TRANSFER COILS

- A. Water Coils: Measure the following data for each coil:
  1. Entering and leaving water temperature.
  2. Water flow rate.
  3. Water pressure drop
  4. Dry-bulb temperature of entering and leaving air.
  5. Wet-bulb temperature of entering and leaving air for cooling coils.
  6. Airflow.
  7. Air pressure drop.

### 3.10 PROCEDURES FOR TEMPERATURE MEASUREMENTS

- A. During TAB, report the need for adjustment in temperature regulation within the automatic temperature-control system.
- B. Measure indoor wet and dry bulb temperatures every other hour for a period of two (2) successive eight-hour days, in each separately controlled zone, to prove correctness of final temperature settings. Measure when the building or zone is occupied.
- C. Measure outside air, wet and dry-bulb temperatures.

### 3.11 TEMPERATURE-CONTROL VERIFICATION

- A. Verify that controllers are calibrated and commissioned.
- B. Check transmitter and controller locations and note conditions that would adversely affect control functions.
- C. Record controller settings and note variances between set points and actual measurements.
- D. Check the operation of limiting controllers (i.e., high and low temperature controllers).

- E. Check free travel and proper operation of control devices such as damper and valve operators.
- F. Check the sequence of operation of control devices. Note air pressures and device positions and correlate with airflow and water flow measurements. Note the speed of response to input changes.
- G. Check the interaction of electrically operated switch transducers.
- H. Check the interaction of interlock and lockout systems.
- I. Record voltages of power supply and controller output. Determine whether the system operates on a grounded or non-grounded power supply.
- J. Note operation of electric actuators using spring return for proper fail-safe operations.

### 3.12 TOLERANCES

- A. Set HVAC system airflow and water flow rates within the following tolerances:
  - 1. Supply, Return, and exhaust Fans and Equipment with Fans: Plus 5% to plus 10%.
  - 2. Air Outlets and Inlets: 0 to minus 10%.
  - 3. Heating-Water Flow Rate: 0 to minus 10%.
  - 4. Cooling-Water Flow Rate: 0 to minus 5%.

### 3.13 REPORTING

- A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for systems' balancing devices. Recommend changes and additions to systems' balancing devices to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.
- B. Status Reports: As Work progresses, prepare reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system.

### 3.14 FINAL REPORT

- A. General: Typewritten, or computer printout in letter-quality font, on standard bond paper, in three-ring binder, tabulated and divided into sections by tested and balanced systems.
- B. Include a certification sheet in front of binder signed and sealed by the certified testing and balancing engineer.
  - 1. Include a list of instruments used for procedures, along with proof of calibration.
- C. Final Report Contents: In addition to certified field report data, include the following:
  - 1. Pump curves.
  - 2. Fan curves.

3. Manufacturers' test data.
  4. Field test reports prepared by system and equipment installers.
  5. Other information relative to equipment performance, but do not include Shop Drawings and Product Data.
- D. General Report Data: In addition to form titles and entries, include the following data in the final report, as applicable:
1. Title page.
  2. Name and address of TAB firm.
  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 firm 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. Data for terminal units, including manufacturer, type size, and fittings.
  14. Notes to explain why certain final data in the body of reports varies from indicated values.
  15. Test conditions for fans and pump performance forms including the following:
    - a. Settings for outside, return, and exhaust air dampers.
    - b. Conditions of filters.
    - c. Cooling coil, wet and dry bulb conditions.
    - d. Face and bypass damper settings at coils.
    - e. Fan drive settings including settings and percentage of maximum pitch diameter.
    - f. Settings for supply air, static pressure controller.
    - g. Other system operating conditions that affect performance.
- E. Air-Handling Unit Test Reports: For air-handling units with coils, include the following:
1. Unit Data: Include the following:
    - a. Unit identification.
    - b. Location.
    - c. Make and type.
    - d. Model number and unit size.
    - e. Manufacturer's serial number.
    - f. Unit arrangement and class.
    - g. Discharge arrangement.
    - h. Sheave make, size in inches, and bore.
    - i. Sheave dimensions, center-to-center, and amount of adjustments in inches.
    - j. Number of belts, make, and size.
    - k. Number of filters, type, and size.

2. Motor Data:
    - a. Make and frame type and size.
    - b. Horsepower and rpm.
    - c. Volts, phase, and hertz.
    - d. Full-load amperage and service factor.
    - e. Sheave make, size in inches, and bore.
    - f. Sheave dimensions, center-to-center, and amount of adjustments in inches.
  3. Test Data (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. Outside airflow in cfm.
    - j. Return airflow in cfm.
    - k. Outside air damper position.
    - l. Return air damper position.
- F. Apparatus-Coil Test Reports:
1. Coil Data:
    - a. System identification.
    - b. Location.
    - c. Coil type.
    - d. Number of rows.
    - e. Fin spacing in fins per inch o.c.
    - f. Make and model number.
    - g. Face area in sq. ft.
    - h. Tube size in NPS.
    - i. Tube and fin materials.
    - j. Circuiting arrangement.
  2. Test Data (Indicated and Actual Values):
    - a. Airflow rate in cfm.
    - b. Average face velocity in fpm.
    - c. Air pressure drop in inches wg.
    - d. Outside air, wet and dry bulb temperatures in deg F.
    - e. Return air, wet and dry bulb temperatures in deg F.
    - f. Entering air, wet and dry bulb temperatures in deg F.
    - g. Leaving air, wet and dry bulb temperatures in deg F.
    - h. Water flow rate in gpm.
    - i. Water pressure differential in feet of head or psig.
    - j. Entering water temperature in deg F.
    - k. Leaving water temperature in deg F.
- G. Fan Test Reports: For supply 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. Sheave dimensions, center-to-center, and amount of adjustments in inches.
    2. Motor Data:
      - a. Make and frame type and size.
      - b. Horsepower and rpm.
      - c. Volts, phase, and hertz.
      - d. Full load amperage and service factor.
      - e. Sheave make, size in inches, and bore.
      - f. Sheave dimensions, center-to-center, and amount of adjustments in inches.
      - g. Number of belts, make, and size.
    3. Test Data (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.
- H. Round 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. Duct static pressure in inches wg.
    - d. Duct size in inches.
    - e. Duct area in sq. ft.
    - f. Indicated airflow rate in cfm.
    - g. Indicated velocity in fpm.
    - h. Actual airflow rate in cfm.
    - i. Actual average velocity in fpm.
- I. Air-Terminal-Device Reports:
  1. Unit Data:
    - a. System and air-handling unit identification.
    - b. Location and zone.
    - c. Test apparatus used.
    - d. Area served.
  2. Test Data (Indicated and Actual Values):
    - a. Airflow rate in cfm.
    - b. Air velocity in fpm.
    - c. Preliminary airflow rate as needed in cfm.
    - d. Preliminary velocity as needed in fpm.
    - e. Final airflow rate in cfm.
    - f. Final velocity in fpm.
    - g. Space temperature in deg F.
- J. System-Coil Reports: For reheat coils and water coils of terminal units, include the following:
  1. Unit Data:
    - a. System and air handling unit identification.
    - b. Location and zone.
    - c. Room or riser served.
    - d. Coil make and size.
    - e. Flowmeter type.

2. Test Data (Indicated and Actual Values):
  - a. Airflow rate in cfm.
  - b. Entering water temperature in deg F.
  - c. Leaving water temperature in deg. F.
  - d. Water pressure drop in feet of head or psig.
  - e. Entering air temperature in deg F.
  - f. Leaving air temperature in deg F.

K. Pump Test Reports:

1. Unit Data:
  - a. Unit identification
  - b. Location.
  - c. Service.
  - d. Make and size.
  - e. Model and serial numbers.
  - f. Water flow rate in gpm.
  - g. Water pressure differential in feet of head or psig.
  - h. Required net positive suction head in feet of head or psig.
  - i. Pump rpm.
  - j. Impeller diameter in inches.
  - k. Motor make and frame size.
  - l. Motor horsepower and rpm.
  - m. Voltage at each connection.
  - n. Amperage for each phase.
  - o. Full load amperage and service factor.
  - p. Seal type.
2. Test Data (Indicated and Actual Values):
  - a. Static head in feet of head or psig.
  - b. Pump shutoff pressure in feet of head or psig.
  - c. Actual impeller size in inches.
  - d. Full open flow rate in gpm.
  - e. Full open pressure in feet of head or psig.
  - f. Final discharge pressure in feet of head or psig.
  - g. Final suction pressure in feet of head or psig.
  - h. Final total pressure in feet of head or psig.
  - i. Final water flow rate in gpm.
  - j. Voltage at each connection.
  - k. Amperage for each phase.

L. Instrument Calibration Reports:

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

### 3.15 INSPECTIONS

A. Initial Inspection:

1. After testing and balancing are complete, operate each system and randomly check measurements to verify that the system is operating according to the final test and balance readings documented in the Final Report.

2. Randomly check the following for each system:
  - a. Measure airflow of at least 10% of air outlets.
  - b. Measure water flow of at least 5% of terminals.
  - c. Measure room temperature at each thermostat/temperature sensor.  
Compare the reading to the set point.
  - d. Verify that balancing devices are marked with final balance position.
  - e. Note deviations to the Contract Documents in the Final Report.
  
- B. Final Inspection:
  1. After initial inspection is complete and evidence by random checks verifies that testing and balancing are complete and accurately documented in the final report, request that a final inspection be made by Architect.
  2. TAB firm test and balance engineer shall conduct the inspection in the presence of Architect.
  3. Architect shall randomly select measurements documented in the final report to be rechecked. The rechecking shall be limited to either 10% of the total measurements recorded, or the extent of measurements that can be accomplished in a normal 8 hour business day.
  4. If the rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."
  5. If the number of "FAILED" measurements is greater than 10% of the total measurements checked during the final inspection, the testing and balancing shall be considered incomplete and shall be rejected.
  6. TAB firm shall recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes and resubmit the final report.
  7. Request a second final inspection. If the second final inspection also fails, Owner shall contract the services of another TAB firm to complete the testing and balancing in accordance with the Contract Documents and deduct the cost of the services from the final payment.

### 3.16 ADDITIONAL TESTS

- A. Within 90 days of completing TAB, perform additional testing and balancing 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 testing, inspecting, and adjusting during near-peak summer and winter conditions.

END OF SECTION 230593

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## SECTION 230700 - PIPE INSULATION

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. This Section includes preformed, rigid and flexible pipe insulation; insulating cements; field-applied jackets; accessories and attachments; and sealing compounds.

#### 1.2 SUBMITTALS

- A. Product Data: Identify thermal conductivity, thickness, and jackets (both factory and field applied, if any), for each type of product indicated.
- B. Shop Drawings: Show fabrication and installation details for the following:
  - 1. Application of protective shields, saddles, and inserts at pipe hangers for each type of insulation and hanger.
  - 2. Insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
  - 3. Removable insulation at piping specialties and equipment connections.
  - 4. Application of field-applied jackets.

#### 1.3 QUALITY ASSURANCE

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the U.S. Department of Labor, Bureau of Apprenticeship and Training.
- B. Fire-Test-Response Characteristics: As determined by testing materials identical to those specified in this Section according to ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and sealer and cement material containers with appropriate markings of applicable testing and inspecting agency.
  - 1. Insulation Installed Indoors: Flame-spread rating of 25 or less, and smoke-developed rating of 50 or less.
- C. ASHRAE Standards: Comply with performance efficiencies prescribed for ASHRAE 90.1, "Energy Efficient Design for New Buildings, Except Low Rise Residential Buildings" for pipe insulation.
- D. No damaged or water soaked insulation shall be used.

#### 1.4 DELIVERY, STORAGE, AND HANDLING

- A. Packaging: Ship insulation materials in containers marked by manufacturer with appropriate ASTM specification designation, type and grade, and maximum use temperature.

## 1.5 COORDINATION

- A. Coordinate size and location of supports, hangers, and insulation shields.
- B. Coordinate clearance requirements with piping installer for insulation application.

## 1.6 SCHEDULING

- A. Schedule insulation application after testing piping systems. Insulation application may begin on segments of piping that have satisfactory test results.

## PART 2 – PRODUCTS

### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one (1) of the manufacturers specified.
  - 1. Mineral-Fiber Insulation:
    - a. CertainTeed Manson.
    - b. Knauf FiberGlass GmbH.
    - c. Owens-Corning Fiberglas Corp.
    - d. Schuller International, Inc.
    - e. Armacell

### 2.2 INSULATION MATERIALS

- A. Mineral-Fiber Insulation: Glass fibers bonded with a thermosetting resin complying with the following:
  - 1. Preformed Pipe Insulation: Comply with ASTM C 547, Type 1, with factory-applied, all-purpose, vapor-retarder jacket.
  - 2. Fire-Resistant Adhesive: Comply with MIL-A-3316C in the following classes and grades:
    - a. Class 1, Grade A for bonding glass cloth and tape to unfaced glass-fiber insulation, for sealing edges of glass-fiber insulation, and for bonding lagging cloth to unfaced glass-fiber insulation.
    - b. Class 2, Grade A for bonding glass-fiber insulation to metal surfaces.
  - 3. Vapor-Retarder Mastics: Fire- and water-resistant, vapor-retarder mastic for indoor applications. Comply with MIL-C-19565C, Type II.
  - 4. Mineral-Fiber Insulating Cements: Comply with ASTM C 195.
  - 5. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449.
- B. Cellular-Glass Insulation: Foamed glass, annealed, rigid, hermetically sealed cells, incombustible. Preformed Pipe Insulation, with Jacket: Comply with ASTM C 552, Type II, Class 2.
- C. Flexible Elastomeric Thermal Insulation: Closed-cell, sponge- or expanded-ruber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.
  - 1. Adhesive: As recommended by insulation material manufacturer.
- D. Prefabricated Thermal Insulating Fitting Covers: Comply with ASTM C 450 for dimensions used in preforming insulation to cover valves.

- E. Insulation Of Dual Temperature, Chilled Water, and Hot Water Piping
  - 1. Foamed Plastic Insulation:
    - a. Pipe: Insulation shall be 1” thick Armstrong “FR-Armaflex”, Rubatex, or IMCOA Polyolefin flexible foamed plastic, fire-retardant, closed cell, ozone resistant pipe insulation. At hangers, insulation shall be installed as detailed on drawing, shall be properly coordinated with paragraph heading “Pipe Hangers and Supports”, and shall be continuous through hanger rings and supports. Adjoining sections and any longitudinal joints shall be butted firmly together and cemented with Armstrong No. 520 adhesive.
    - b. Fittings: All fittings shall be insulated with fabricated mitered segments of the same foamed plastic pipe insulation with joints butted firmly together and cemented with Armstrong No. 520 adhesive.
    - c. Jackets: Refer to Paragraph 2.3.

### 2.3 FIELD APPLIED JACKETS

- A. General: ASTM C 921, Type 1, unless otherwise indicated.
- B. Standard PVC Fitting Covers: Factory-fabricated fitting covers manufactured from 20-mil thick, high-impact, ultraviolet-resistant PVC.
  - 1. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, reducers, end caps, soil-pipe hubs, traps and mechanical joints.
  - 2. Adhesive: As recommended by insulation material manufacturer.
- C. PVC Jacket: High-impact-resistant, UV resistant PVC complying with ASTM D1784, Class 16354-C; 30 mils thick; roll stock ready for shop or field cutting and forming. Finish color to be white.
- D. Aluminum Jacket: Aluminum roll stock, ready for shop or field cutting and forming to indicated sizes. Comply with ASTM B 209, 3003 alloy, H-14 temper
  - 1. Finish and Thickness: Stucco-embossed finish, 0.020-inch thick.
  - 2. Moisture Barrier: 1-mil thick, heat-bonded polyethylene and kraft paper.
  - 3. Elbows: Preformed, 45- and 90-degree, short- and long-radius elbows; same material, finish, and thickness as jacket.
- E. Glass Cloth Covering: Self-adhesive, mastic impregnated, rewettable cloth.
  - 1. Thickness: 0.028 inches
  - 2. Maximum Service Temperature: 450 degrees F.
  - 3. Density: 14.3 oz/sq yd
  - 4. Surface Burning Characteristic: 25/50 per ASTM E84

### 2.4 ACCESSORIES AND ATTACHMENTS

- A. Bands: 3/4 inch wide, in one of the following materials compatible with jacket:
  - 1. Aluminum: 0.007 inch thick.
- B. Wire: 0.080 inch, nickel-copper alloy; 0.062 inch, soft-annealed, stainless steel; or 0.062 inch soft-annealed, galvanized steel.
- C. Glass Cloth and Tape: Comply with MIL-C-20079H, Type I for cloth and Type II for tape. Woven glass-fiber fabrics, plain weave presized a minimum of 14.3 oz./sq. yd.
  - 1. Tape Width: 4 inches.

## 2.5 VAPOR RETARDERS

- A. Mastics: Materials recommended by insulation material manufacturer that are compatible with insulation materials, jackets, and substrates.

## PART 3 – EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

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

### 3.3 GENERAL APPLICATION REQUIREMENTS

- A. Apply insulation materials, accessories, and finishes according to the manufacturer's written instructions; with smooth, straight, and even surfaces; free of voids throughout the length of piping, including fittings, valves, and specialties.
- B. Refer to schedules at the end of this Section for materials, forms, jackets, and thicknesses required for each piping system.
- C. Use accessories compatible with insulation materials and suitable for the service. Use accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Apply insulation with longitudinal seams at top and bottom of horizontal pipe runs.
- E. Apply multiple layers of insulation with longitudinal and end seams staggered.
- F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- G. Seal joints and seams with vapor-retarder mastic on insulation indicated to receive a vapor retarder.
- H. Keep insulation materials dry during application and finishing.
- I. Apply insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by the insulation material manufacturer.
- J. Apply insulation with the least number of joints practical.
- K. Apply insulation over fittings, valves, and specialties, with continuous thermal and vapor-retarder integrity, unless otherwise indicated. Refer to special instructions for applying insulation over fittings, valves, and specialties.

- L. Hangers and Anchors:
  - 1. Apply insulation continuously through hangers and around anchor attachments.
  - 2. For insulation application where vapor retarders are indicated, extend insulation on anchor legs at least 12 inches from point of attachment to pipe and taper insulation ends. Seal tapered ends with a compound recommended by the insulation material manufacturer to maintain vapor retarder.
  - 3. Install insert materials and apply insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by the insulation material manufacturer.
  - 4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect the jacket from tear or puncture by the hanger, support, and shield.
  
- M. Insulation Terminations: For insulation application where vapor retarders are indicated, taper insulation ends. Seal tapered ends with a compound recommended by the insulation material manufacturer to maintain vapor retarder.
  
- N. Apply adhesives and mastics at the manufacturer's recommended coverage rate.
  
- O. Apply insulation with integral jackets as follows:
  - 1. Pull jacket tight and smooth.
  - 2. Circumferential Joints: Cover with 3-inch wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip and spaced 4 inches o.c.
  - 3. Longitudinal Seams: Overlap jacket seams at least 1-1/2 inches. Apply insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 4 inches o.c.
    - a. Exception: Do not staple longitudinal laps on insulation having a vapor retarder.
  - 4. Vapor-Retarder Mastics: Where vapor retarders are indicated, apply mastic on seams and joints and at ends adjacent to flanges, unions, valves, and fittings.
  - 5. At penetrations in jackets for thermometers and pressure gages, fill and seal voids with vapor-retarder mastic.
  
- P. Exterior Wall Penetrations: For penetrations of below-grade exterior walls, terminate insulation flush with mechanical sleeve seal. Seal terminations with vapor-retarder mastic.
  
- Q. Interior Wall and Partition Penetrations: Apply insulation continuously through walls and floors.
  
- R. Fire-Rated Wall and Partition Penetrations: Apply insulation continuously through penetrations of fire-rated walls and partitions.
  - 1. Firestopping and fire-resistive joint sealers are specified in Division 7 Section "Firestopping."
  
- S. Floor Penetrations: Apply insulation continuously through floor assembly.
  - 1. For insulation with vapor retarders, seal insulation with vapor-retarder mastic where floor supports penetrate vapor retarder.



### 3.4 MINERAL-FIBER INSULATION APPLICATION

- A. Apply insulation to straight pipes and tubes as follows:
1. Secure each layer of preformed pipe insulation to pipe with wire, tape, or bands without deforming insulation materials.
  2. Where vapor retarders are indicated, seal longitudinal seams and end joints with vapor-retarder mastic. Apply vapor retarder to ends of insulation at intervals of 15 to 20 feet to form a vapor retarder between pipe insulation segments.
  3. For insulation with factory-applied jackets, secure laps with outward clinched staples at 6 inches on center.
  4. For insulation with factory-applied jackets with vapor retarders, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by the insulation material manufacturer and seal with vapor-retarder mastic.
  5. All exposed ends for mineral fiber insulation shall be neatly trimmed and beveled. All exposed insulation material shall be covered with mastic.
- B. Apply insulation to flanges as follows:
1. Apply preformed pipe insulation to outer diameter of pipe flange.
  2. Make width of insulation segment the same as overall width of the flange and bolts, plus twice the thickness of the pipe insulation.
  3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
  4. Apply canvas jacket material with manufacturer's recommended adhesive, overlapping seams at least 1 inch, and seal joints with vapor-retarder mastic.
- C. Apply insulation to fittings and elbows as follows:
1. Apply premolded insulation sections of the same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions and cover with insulating cement trowelled smooth.
  2. When premolded insulation elbows and fittings are not available, apply mitered sections of pipe insulation, or glass-fiber blanket insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with tape and cover with insulating cement trowelled smooth.
  3. Cover fittings with standard PVC fitting covers.
- D. Apply insulation to valves and specialties as follows:
1. Apply premolded insulation sections of the same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
  2. When premolded insulation sections are not available, apply glass-fiber blanket insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation. For check valves, arrange insulation for access to strainer basket without disturbing insulation.

### 3.5 CELLULAR GLASS INSULATION APPLICATION

- A. Apply insulation to straight pipes and tubes as follows:
1. Secure each layer of insulation to pipe with wire, tape, or bands without deforming insulation materials.
  2. Where vapor retarders are indicated, seal longitudinal seams and end joints with vapor-retarder mastic.
  3. For insulation with factory-applied jackets, secure laps with outward clinched

- staples at 6 inches o.c.
4. For insulation with factory-applied jackets with vapor retarders, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by the insulation material manufacturer and seal with vapor-retarder mastic.
  5. All exposed ends for mineral fiber insulation shall be neatly trimmed and beveled. All exposed insulation material shall be covered with mastic.

### 3.6 FIELD APPLIED JACKET APPLICATION

- A. Apply aluminum metal jacket for all exterior above ground chilled water piping, with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal joints with weatherproof sealant recommended by insulation cover manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.
- B. Apply glass cloth or PVC jacket, for piping that is exposed in all areas including mechanical rooms, directly over insulation with factory-applied jackets.
  1. Apply jacket smooth and tight to surface with 1-inch overlap at seams and joints.
  2. Embed glass cloth between two (2) 0.062-inch thick coats of jacket manufacturer's recommended adhesive.
  3. Completely encapsulate insulation with jacket, leaving no exposed raw insulation.
- C. Provide PVC fitting covers for all exposed piping that is to be insulated. For Victaulic piping, provide PVC fitting covers for all fittings and couplings.

### 3.7 PIPING SYSTEM APPLICATIONS

- A. Materials and thicknesses for systems listed below are specified in schedules within this section.
- B. Insulate the following piping systems:
  1. Insulate heating hot water supply and return piping with glass fiber insulation
  2. Insulate indoor chilled water supply and return piping with glass fiber insulation.
  3. Insulate outdoor chilled water supply and return piping with closed cell elastomeric insulation.
  4. Make up mechanical city water piping with glass fiber insulation.
- C. Items Not Insulated: Unless otherwise indicated, do not apply insulation to the following systems, materials, and equipment:
  1. Flexible connectors.
  2. Vibration-control devices.
  3. Fire-suppression piping.
  4. Below-grade piping, unless otherwise indicated.
  5. Chrome-plated pipes and fittings, unless potential for personnel injury.
  6. Hot water air chambers, unions, strainers, check valves, plug valves, and flow regulators.

D. MINIMUM INSULATION THICKNESS FOR PIPE SIZES

Hot water, chilled water and dual temperature water piping insulation shall be 1-1/2" thick.

PIPING SYSTEM TYPES	FLUID TEMPERATURE RANGES (DEG. F)	LESS THAN 1" (INCHES)	1" TO 1-1/4" (INCHES)	1-1/2" TO 3" (INCHES)	4" AND LARGER (INCHES)
Make-up Water	40°-55°F	0.5	0.5	1.0	1.0

NOTE: The minimum listed thickness is based on a minimum R value of 4.6. Thickness to vary if the insulation R value is different than 4.6. In addition, the minimum thickness is to be increased as required to meet ASHRAE 90.1.

- E. Insulation at fire walls: All insulated piping penetrating walls with a fire resistive rating shall be insulated with molded foam glass;  $\Delta$ ASJ-SSL<sup>®</sup> covering with a dual purpose fireproof, kraft aluminum foil, laminated white jacket. Insulation to be of same thickness as adjoining insulation.

F. SUCTION REFRIGERANT AND CONDENSATE DRAIN PIPING

1. Pipe Insulation: 3/4 inch thick, fire retardant, flexible elastomeric thermal insulation.
2. Exposed Exterior Insulation: Cover with two coats of the insulation manufacturer's coating that is recommended for UV protection.

G. PIPE INSULATING SUPPORT

1. On insulated piping with pipe supports around outside of covering provide galvanized steel formed bearing plates. Plates to be lined with length of foam glass insulation.
  - a. 8" and smaller pipe: 12" long, 12 gauge plate
  - b. 10" and larger pipe: 24" long, 10 gauge plate

3.8 FIELD QUALITY CONTROL

- A. Insulation applications will be considered defective if sample inspection reveals noncompliance with requirements. Remove defective Work and replace with new materials according to these Specifications.

END OF SECTION 230700

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## SECTION 230701 - EQUIPMENT INSULATION

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. This Section includes blanket insulation; insulating cements; field-applied jackets; accessories and attachments; and sealing compounds.

#### 1.2 SUBMITTALS

- A. Product Data: Identify thermal conductivity, thickness, and jackets (both factory and field applied, if any), for each type of product indicated.
- B. Shop Drawings: Show fabrication and installation details for the following:
  - 1. Field application for each equipment type.
  - 2. Removable insulation sections at access panels.
  - 3. Application of field-applied jackets.
  - 4. Special shapes for cellular-glass insulation.

#### 1.3 QUALITY ASSURANCE

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the U.S. Department of Labor, Bureau of Apprenticeship and Training.
- B. Fire-Test-Response Characteristics: As determined by testing materials identical to those specified in this Section according to ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and sealer and cement material containers with appropriate markings of applicable testing and inspecting agency.
  - 1. Insulation Installed Indoors: Flame-spread rating of 25 or less, and smoke-developed rating of 50 or less.

#### 1.4 DELIVERY, STORAGE AND HANDLING

- A. Packaging: Ship insulation materials in containers marked by manufacturer with appropriate ASTM specification designation, type and grade, and maximum use temperature.

#### 1.5 COORDINATION

- A. Coordinate clearance requirements with equipment installer for insulation.

## PART 2 - PRODUCTS

### 2.1 INSULATION MATERIALS

- A. Flexible Elastomeric Thermal Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type II for sheet materials.
  - 1. Adhesive: As recommended by insulation material manufacturer.

### 2.2 FIELD APPLIED JACKETS

- A. General: ASTM C 921, Type 1, unless otherwise indicated.
- B. Glass Cloth Covering: Self-adhesive, mastic impregnated, rewettable cloth.
  - 1. Thickness: 0.028 inches
  - 2. Maximum Service Temperature: 450 degrees F.
  - 3. Density: 14.3 oz/sq yd
  - 4. Surface Burning Characteristic: 25/50 per ASTM E84

### 2.3 ACCESSORIES AND ATTACHMENTS

- A. Bands: 3/4 inch wide, in one of the following materials compatible with jacket:
  - 1. Aluminum: 0.007 inch thick.
- B. Glass Cloth and Tape: Comply with MIL-C-20079H, Type I for Cloth and Type II for Tape. Woven glass-fiber fabrics, plain weave presized a minimum of 14.3 oz/sq. yd.
  - 1. Tape width: 4 inches

## PART 3 – EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

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

### 3.3 GENERAL APPLICATION REQUIREMENTS

- A. Apply insulation materials, accessories, and finishes according to the manufacturer's written instructions; with smooth, straight, and even surfaces; and free of voids throughout the length of equipment.
- B. Refer to schedules at the end of this Section for materials, forms, jackets, and thicknesses required for each equipment system.
- C. Use accessories compatible with insulation materials and suitable for the service. Use

accessories that do not corrode, soften, or otherwise attack insulation or jacket in either the wet or dry state.

- D. Apply multiple layers of insulation with longitudinal and end seams staggered.
- E. Keep insulation materials dry during application and finishing.
- F. Apply insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by the insulation material manufacturer.
- G. Apply insulation with the least number of joints practical.
- H. Apply insulation over fittings and specialties, with continuous thermal and vapor-retarder integrity, unless otherwise indicated.
- I. Cut insulation according to manufacturer's written instructions to prevent compressing insulation to less than 75 percent of its nominal thickness.

### 3.4 EQUIPMENT APPLICATIONS

- A. Materials and thicknesses for equipment listed below are specified in this Section.
- B. Insulate the following indoor equipment:
  - 1. Dual Temperature water pump housings.
  - 2. Strainers.
- C. Omit insulation from the following hot water system and provide removable insulation segments for chilled water system:
  - 1. Vibration-control devices.
  - 2. Testing agency labels and stamps.
  - 3. Nameplates and data plates.
- D. Equipment Insulation Type:
  - 1. Operating Temperature: 20 to 70 deg. F.
  - 2. Insulation Material: Flexible Elastomeric.
  - 3. Insulation Thickness: 1 inch.

### 3.5 FIELD QUALITY CONTROL

- A. Insulation applications will be considered defective if sample inspection reveals noncompliance with requirements. Remove defective Work and replace with new materials according to these Specifications.

END OF SECTION 230701

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## SECTION 230702 - DUCT INSULATION

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. This Section includes semi-rigid and flexible duct and plenum insulation; insulating cements; field-applied jackets; accessories and attachments; and sealing compounds.

#### 1.2 SUBMITTALS

- A. Product Data: Identify thermal conductivity, thickness and jackets (both factory and field applied, if any), for each type of product indicated.
- B. Shop Drawings: Show fabrication and installation details for the following:
  - 1. Removable insulation sections at access panels.
  - 2. Application of field-applied jackets.
  - 3. Applications at linkages for control devices.

#### 1.3 QUALITY ASSURANCE

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the U.S. Department of Labor, Bureau of Apprenticeship and Training.
- B. Fire-Test-Response Characteristics: As determined by testing materials identical to those specified in this Section according to ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and sealer and cement material containers with appropriate markings of applicable testing and inspecting agency.
  - 1. Insulation Installed Indoors: Flame-spread rating of 25 or less and smoke-developed rating of 50 or less.
- C. ASHRAE Standards: Comply with performance efficiencies prescribed for ASHRAE 90.1, "Energy Efficient Design for New Buildings, Except Low Rise Residential Buildings" for duct insulation.
- D. No damaged or water soaked insulation shall be used.

#### 1.4 DELIVERY, STORAGE, AND HANDLING

- A. Packaging: Ship insulation materials in containers marked by manufacturer with appropriate ASTM specification designation, type and grade and maximum use temperature.

#### 1.5 COORDINATION

- A. Coordinate clearance requirements with duct Installer for insulation application.

## 1.6 SCHEDULING

- A. Schedule insulation application after testing duct systems. Insulation application may begin on segments of ducts that have satisfactory test results.

## PART 2 – PRODUCTS

### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one (1) of the manufacturers specified:
  - 1. Mineral-Fiber Insulation:
    - a. CertainTeed Manson.
    - b. Knauf FiberGlass GmbH.
    - c. Owens-Corning Fiberglas Corp.
    - d. Schuller International, Inc.
    - a. Aeroflex USA Inc.; Aerocel.
    - b. Armacell LLC; AP Armaflex.
    - c. RBX Corporation; Insul-Sheet 1800 and Insul-Tube 180.

### 2.2 INSULATION MATERIALS

- A. Mineral-Fiber Board Thermal Insulation: Glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IB, without facing and with all-service jacket manufactured from aluminum foil, skim kraft, vapor seal.
- B. Mineral-Fiber Blanket Thermal Insulation: Glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II, without facing and with all-service jacket manufactured from aluminum foil, skim kraft, vapor seal.
- C. Glass Fiber Duct Liner
  - 1. Insulation ASTM C553; flexible noncombustible with erosion resistant and mold resistant coating.
    - a. 'K' value: ASTM C518 and C177, 024 at 75 degrees F.
    - b. Maximum Service Temperature: 250 degrees F.
    - c. Maximum Moisture Absorption: 0.5 percent per volume.
    - d. Density: 3.0 1l/cu ft.
- D. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.
- E. Noise Barrier Sound Insulation
  - 1. Where shown, as hereinbefore specified, and as detailed on the drawings, ducts shall be insulated on outside with 2" thick, 2lb. density flexible mass loaded vinyl laminated to a quilted fiberglass decoupler on exterior of duct. Provide VinaFlex VP2-200 Noise Barrier Sheet with Fiberglass Absorber/Decoupler (VP) or approved equal. Comply with ASTM E-84, Class A rating.
    - a. Acoustical Properties (noise transmission Loss (dB)/Frequency (Hz):
      - 1) 125 Hz – 21 dB
      - 2) 250 Hz – 24 dB
      - 3) 500 Hz – 29 dB
      - 4) 1000 Hz – 41 dB



- 5) 2000 Hz – 54 dB
  - 6) 4000 Hz – 68 dB
  - 7) STC – 34 dB
2. The sections shall be butted tightly together to provide effective insulation and to prevent condensation. Should condensation appear on ductwork with internal lining, the contractor shall repair or replace insulation.
  3. Contractor to provide insulation from diffuser connection to point of penetrating acoustic wall on inside of room. For lined ducts, dimensions of duct shown on drawing is dimension inside sound lining.

### 2.3 FIELD-APPLIED JACKETS

- A. General: ASTM C 921, Type 1, unless otherwise indicated.
- B. Foil and Paper Jacket: Laminated, glass-fiber-reinforced, flame-retardant kraft paper and aluminum foil.
- C. Glass Cloth Covering: Self-adhesive, mastic impregnated, rewettable cloth.
  1. Thickness: 0.028 inches
  2. Maximum Service Temperature: 450 degrees F.
  3. Density: 14.3 pz/sq yd
  4. Surface Burning Characteristic: 25/50 per ASTM E84
- D. Aluminum Jacket: Comply with ASTM B 209, Alloy 3003, 3005, 3105 or 5005, Temper H-14.
  4. Sheet and roll stock ready for shop or field sizing.
  5. Finish and thickness are indicated in field-applied jacket schedules.
  6. Factory-Fabricated Fitting Covers:
    - a. Same material, finish, and thickness as jacket.
    - b. Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
    - c. Tee covers.
    - d. Flange and union covers.
    - e. End caps.
    - f. Beveled collars.
    - g. Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

### 2.4 ACCESSORIES AND ATTACHMENTS

- A. Wire: 0.062-inch, soft-annealed, galvanized steel.
- B. Adhesive-Attached Anchor Pins and Speed Washers: Galvanized steel plate, pin and washer manufactured for attachment to duct and plenum with adhesive. Pin length sufficient for insulation thickness indicated.
  1. Adhesive: Recommended by the anchor pin manufacturer as appropriate for surface temperatures of ducts and plenums; and to achieve a holding capacity of 100 lb for direct pull perpendicular to the adhered surface.
- C. Self-Adhesive Anchor Pins and Speed Washers: Galvanized steel plate, pin, and washer manufactured for attachment to duct and plenum with adhesive. Pin length sufficient for insulation thickness indicated.

- D. Glass Cloth and Tape: Comply with MIL-C-20079H, Type I for cloth and Type II for tape. Woven glass-fiber fabrics, plain weave, presized a minimum of 14.3 oz./sq. yd.
  - 1. Tape Width: 4 inches
- E. Aluminum Jacket strapping and seals: All jacketing shall be secured on not greater than 18 inch centers with aluminum straps not less than 0.20 inch thickness. All jacketing shall have 0.75 inch wide aluminum wing seals not less than 0.32 inch thickness.

## 2.5 VAPOR RETARDERS

- A. Mastics: Materials recommended by insulation material manufacturer that are compatible with insulation materials, jackets and substrates.

## PART 3 – EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

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

### 3.3 GENERAL APPLICATION REQUIREMENTS

- A. Apply insulation materials, accessories, and finishes according to the manufacturer's written instructions; with smooth, straight, and even surfaces; and free of voids throughout the length of ducts and fittings.
- B. Refer to schedules at the end of this Section for materials, forms, jackets and thicknesses required for each duct system.
- C. Use accessories compatible with insulation materials and suitable for the service. Use accessories that do not corrode, soften or otherwise attack insulation or jacket in either wet or dry state.
- D. Apply multiple layers of insulation with longitudinal and end seams staggered.
- E. Keep insulation materials dry during application and finishing.
- F. Apply insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by the insulation material manufacturer.
- G. Apply insulation with the least number of joints practical.
- H. Apply insulation over fittings and specialties with continuous thermal and vapor-retarder integrity, unless otherwise indicated.

- I. Apply insulation with integral jackets as follows:
  - 1. Pull jacket tight and smooth.
  - 2. Joints and Seams: Cover with tape and vapor retarder as recommended by insulation material manufacturer to maintain vapor seal.
- J. Cut insulation according to manufacturer's written instructions to prevent compressing insulation to less than 75 percent of its nominal thickness.
- K. Interior Wall and Partition Penetrations: Apply insulation continuously through walls and partitions, except fire-rated walls and partitions.
- L. Fire-Rated Wall and Partition Penetrations: Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations.
- M. Provide weld pins located a maximum of 18 inches on center for all insulation serving ductwork that has a width or height dimension that exceeds 20 inches.
- N. Floor Penetrations: Terminate insulation at underside of floor assembly and at floor support at top of floor.
  - 1. For insulation indicated to have vapor retarders, taper termination and seal insulation ends with vapor-retarder mastic.

### 3.4 MINERAL FIBER INSULATION APPLICATION

- A. Blanket or Board Applications for Ducts and Plenums: Secure blanket insulation with adhesive, anchor pins and speed washers.
  - 1. Apply adhesives according to manufacturer's recommended coverage rates per square foot for 100 percent coverage of duct and plenum surfaces.
  - 2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
  - 3. Install anchor pins and speed washers on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
    - a. On duct sides with dimensions 18 inches and smaller, along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints and locate 16 inches on center.
    - b. On duct sides with dimensions larger than 18 inches. Space 16 inches on center each way and 3 inches maximum from insulation joints. Apply additional pins and clips to hold insulation tightly against surface at cross bracing.
    - c. Anchor pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
    - d. Do not over-compress insulation during installation.
  - 4. Impale insulation over anchors and attach speed washers.
  - 5. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
  - 6. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from one edge and one end of insulation segment. Secure laps to adjacent insulation segment with 1/2-inch staples, 1 inch on center and cover with pressure-sensitive tape having same facing as insulation.
  - 7. Apply insulation on rectangular duct elbows and transitions with a full insulation

segment for each surface. Groove and score insulation to fit as closely as possible to outside and inside radius of elbows. Apply insulation on round duct elbows with individually mitered gores cut to fit the elbow.

8. Insulate duct stiffeners, hangers and flanges that protrude beyond the insulation surface with 6-inch wide strips of the same material used to insulate duct. Secure on alternating sides of stiffener, hanger and flange with anchor pins spaced 6 inches on center.

### 3.5 FIELD APPLIED JACKET APPLICATION

- A. Apply glass cloth jacket directly over insulation with factory applied jackets for all exposed insulation for all exposed insulation in finished, occupied rooms, including Lobby 100B, Reading Room Circulation 131, Student Dining 167 and Scene Shop 149.
  1. Apply jacket smooth and tight to surface with 2-inch overlap at seams and joints.
  2. Embed glass cloth between two (2) 0.062-inch thick coats of jacket manufacturer=s recommended adhesive.
  3. Completely encapsulate insulation with jacket, leaving no exposed raw insulation.
- B. Apply aluminum jacket directly over flexible elastomeric insulation located exterior to the building.
  1. Apply aluminum jacket as recommended by the manufacture.
  2. Completely encapsulate insulation with jacket leaving no exposed raw insulation.
  3. Seal watertight.

### 3.6 DUCT SYSTEM APPLICATIONS

- A. Materials and thicknesses for systems listed below are specified in schedules at the end of this Section.
- B. Insulate the following plenums and duct systems:
  1. Indoor concealed supply, return and outside air ductwork.
  2. Indoor exposed supply, return and outside air ductwork.
  3. Indoor outside air plenums connected to louvers.
  4. Indoor exhaust air ductwork and plenums from exhaust louver or discharge hood to the discharge of the exhaust fan or air handling unit.
  5. Indoor exhaust air ductwork located within 10 feet of roof mounted exhaust fan with backdraft damper.
  6. Where indicated, provide noise barrier sound insulation. Refer to drawings for specific locations.
- C. Items Not Insulated: Unless otherwise indicated, do not apply insulation to the following systems, materials and equipment:
  1. Metal ducts with duct liner.
  2. Manufactured double wall, insulated duct systems.
  3. Factory-insulated flexible ducts.
  4. Factory-insulated plenums, casings, terminal boxes, filter boxes and sections.
  5. Flexible connectors.
  6. Vibration-control devices.
  7. Testing agency labels and stamps.
  8. Nameplates and data plates.
  9. Access panels and doors in air-distribution systems.

### 3.7 INDOOR DUCT AND PLENUM APPLICATION SCHEDULE

- A. Service: Round supply, return, exhaust and outdoor air ducts; concealed.
  - 1. Material: Mineral-fiber blanket.
  - 2. Thickness: 1-1/2 inches.
  - 3. Minimum R value: 3.5.
  - 4. Number of Layers: One.
  
- B. Service: Rectangular supply, return, exhaust and outdoor air ducts; concealed.
  - 1. Material: Mineral-fiber blanket.
  - 2. Thickness: 1-1/2 inches.
  - 3. Minimum R value: 3.5.
  - 4. Number of Layers: One.
  
- C. Service: Round supply, return, exhaust and outdoor air ducts; exposed.
  - 1. Material: Mineral-fiber board.
  - 2. Thickness: 1-1/2 inches.
  - 3. Minimum R Value: 3.5.
  - 4. Number of Layers: One.
  
- D. Service: Rectangular supply, return, exhaust and outdoor air ducts; exposed.
  - 1. Material: Mineral-fiber board.
  - 2. Thickness: 1-1/2 inches.
  - 3. Minimum R Value: 3.5.
  - 4. Number of Layers: One.
  
- E. Service: Rectangular transfer air ducts.
  - 1. Material: Fiberglass Duct Liner
  - 2. Thickness: 1 inch
  
- F. Service: Rectangular and round supply and return air ducts in spaces not tempered.
  - 1. Insulation Material: Mineral fiber blanket.
  - 2. Thickness: 2 inches.
  - 3. Minimum R Value: 8

END OF SECTION 230702

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## SECTION 230800 – COMMISSIONING OF HVAC

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.
- B. Refer to Section 019113 “Commissioning” for all specific requirements required associated with the commissioning process that will be required as part of this work. As part of this project, participation in the commissioning process as described in Section 01 91 13 shall be required.

#### 1.2 SUMMARY

- A. Section includes commissioning process requirements for HVAC systems, assemblies, and equipment.
- B. Related Sections:
  - 1. Division 01 Section "General Commissioning Requirements" for general commissioning process requirements.

#### 1.3 DEFINITIONS

- A. Commissioning Plan: A document that outlines the organization, schedule, allocation of resources, and documentation requirements of the commissioning process.
- B. CxA: Commissioning Authority.
- C. HVAC&R: Heating, Ventilating, Air Conditioning, and Refrigeration.
- D. DDC: Direct Digital Controls.
- E. Systems, Subsystems, Equipment, and Components: Where these terms are used together or separately, they shall mean "as-built" systems, subsystems, equipment, and components.

#### 1.4 ALLOWANCES

- A. Labor, instrumentation, tools, and equipment costs for technicians for the performance of commissioning testing are covered by the "Schedule of Allowances" Article in Division 01 Section "Allowances."

#### 1.5 UNIT PRICES

- A. Commissioning testing allowance may be adjusted up or down by the "List of Unit Prices" Article in Division 01 Section "Unit Prices" when actual man-hours are computed at the end of commissioning testing.

## 1.6 CONTRACTOR'S RESPONSIBILITIES

- A. Perform commissioning tests at the direction of the CxA.
- B. Attend construction phase HVAC and Integrated Automation coordination meetings.
- C. Attend testing, adjusting, and balancing review and coordination meetings.
- D. Participate in HVAC systems, assemblies, equipment, and component maintenance orientation and inspection as directed by the CxA.
- E. Provide information requested by the CxA for final commissioning documentation.
- F. Provide measuring instruments and logging devices to record test data, and provide data acquisition equipment to record data for the complete range of testing for the required test period.

## 1.7 CxA'S RESPONSIBILITIES

- A. Provide Project-specific construction checklists and commissioning process test procedures for actual HVAC systems, assemblies, equipment, and components to be furnished and installed as part of the construction contract.
- B. Direct commissioning testing.
- C. Verify testing, adjusting, and balancing of Work are complete.
- D. Provide test data, inspection reports, and certificates in Systems Manual.

## 1.8 COMMISSIONING DOCUMENTATION

- A. Provide the following information to the CxA for inclusion in the commissioning plan:
  - 1. Plan for delivery and review of submittals, systems manuals, and other documents and reports.
  - 2. Identification of installed systems, assemblies, equipment, and components including design changes that occurred during the construction phase.
  - 3. Process and schedule for completing construction checklists and manufacturer's prestart and startup checklists for HVAC systems, assemblies, equipment, and components to be verified and tested.
  - 4. Certificate of completion certifying that installation, prestart checks, and startup procedures have been completed.
  - 5. Certificate of readiness certifying that HVAC systems, subsystems, equipment, and associated controls are ready for testing.
  - 6. Test and inspection reports and certificates.
  - 7. Corrective action documents.
  - 8. Verification of testing, adjusting, and balancing reports.

## 1.9 SUBMITTALS

- A. Certificates of readiness.
- B. Certificates of completion of installation, prestart, and startup activities.

#### 1.10 COMMISSIONING AUTHORITY

- A. Motz Engineering acting in conjunction with the Owner's Maintenance Personnel will take the role of the Commissioning Authority for this project. The Commissioning Authority will respond to all issues directly to the Owner and shall have the authority to grant final acceptance of each system commissioned.

#### 1.11 COMMISSIONING PLAN

- A. This section and sections in other Divisions shall outline the work required for the project, consistent with the Commissioning Plan. Any discrepancies between the Commissioning Plan and the Project Manual sections shall be brought to the attention of the Commissioning Agent for clarification.

#### 1.12 COORDINATION

- A. The HVAC Contractor and appropriate Subcontractors shall be responsible for cooperating and coordinating their work during the installation and commissioning process. Refer to the specific requirements and other sections for required work associated with coordination of installation work and preparation of Coordination Construction Drawings by the contractors.
- B. The Commissioning Authority will participate in the coordination of installation work as necessary to insure the installation of system components meet the Owner's project requirements and will provide a facility that has appropriate access and means for future maintenance and service by Owner.

### PART 2 - PRODUCTS (NOT APPLICABLE)

### PART 3 - EXECUTION

#### 3.1 TESTING PREPARATION

- A. Certify that HVAC systems, subsystems, and equipment have been installed, calibrated, and started and are operating according to the Contract Documents.
- B. Certify that HVAC instrumentation and control systems have been completed and calibrated, that they are operating according to the Contract Documents, and that pretest set points have been recorded.
- C. Certify that testing, adjusting, and balancing procedures have been completed and that testing, adjusting, and balancing reports have been submitted, discrepancies corrected, and corrective work approved.
- D. Set systems, subsystems, and equipment into operating mode to be tested (e.g., normal shutdown, normal auto position, normal manual position, unoccupied cycle, emergency power, and alarm conditions).
- E. Inspect and verify the position of each device and interlock identified on checklists.



- F. Check safety cutouts, alarms, and interlocks with smoke control and life-safety systems during each mode of operation.
- G. Testing Instrumentation: Install measuring instruments and logging devices to record test data as directed by the CxA.

### 3.2 TESTING VERIFICATION

- A. Prior to performance of testing and balancing Work, provide copies of reports, sample forms, checklists, and certificates to the CxA.
- B. Notify the CxA at least 10 days in advance of testing and balancing Work, and provide access for the CxA to witness testing and balancing Work.
- C. Provide technicians, instrumentation, and tools to verify testing and balancing of HVAC systems at the direction of the CxA.
  - 1. The CxA will notify testing and balancing Subcontractor 10 days in advance of the date of field verification. Notice will not include data points to be verified.
  - 2. The testing and balancing Subcontractor shall use the same instruments (by model and serial number) that were used when original data were collected.
  - 3. Failure of an item includes, other than sound, a deviation of more than 10 percent. Failure of more than 10 percent of selected items shall result in rejection of final testing, adjusting, and balancing report. For sound pressure readings, a deviation of 3 dB shall result in rejection of final testing. Variations in background noise must be considered.
  - 4. Remedy the deficiency and notify the CxA so verification of failed portions can be performed.

### 3.3 GENERAL TESTING REQUIREMENTS

- A. Provide technicians, instrumentation, and tools to perform commissioning test at the direction of the CxA.
- B. Scope of HVAC testing shall include entire HVAC installation.
- C. Test all operating modes, interlocks, control responses, and responses to abnormal or emergency conditions, and verify proper response of building automation system controllers and sensors.
- D. Tests will be performed using design conditions whenever possible.
- E. Simulated conditions may need to be imposed using an artificial load when it is not practical to test under design conditions. Before simulating conditions, calibrate testing instruments. Provide equipment to simulate loads. Set simulated conditions as directed by the CxA and document simulated conditions and methods of simulation. After tests, return settings to normal operating conditions.
- F. The CxA may direct that set points be altered when simulating conditions is not practical.

- G. The CxA may direct that sensor values be altered with a signal generator when design or simulating conditions and altering set points are not practical.
- H. If tests cannot be completed because of a deficiency outside the scope of the HVAC system, document the deficiency and report it to the Owner. After deficiencies are resolved, reschedule tests.
- I. If the testing plan indicates specific seasonal testing, complete appropriate initial performance tests and documentation and schedule seasonal tests.

#### 3.4 HVAC SYSTEMS, SUBSYSTEMS, AND EQUIPMENT TESTING PROCEDURES

- A. The following systems shall be commissioned:
  - 1. HVAC systems including:
    - a. Direct digital automatic temperature control system.
    - b. Air distribution systems.
    - c. Exhaust systems.
    - d. Unitary equipment.

END OF SECTION 230800

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## SECTION 232111 - PIPING MATERIALS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes a summary of all Piping Materials related work:
- B. Related Sections:
  - 1. 232113 – Hydronic Piping

#### 1.3 HOT WATER PIPING

- A. 2 ½" and Larger.
  - 1. Pipe: Standard, A-53 black steel.
  - 2. Fittings: Standard, butt-weld.
- B. 2" and Smaller.
  - 1. Pipe: Type "L" copper tubing, hard temper.
  - 2. Fittings: Solder end, cast red brass or wrought copper.

#### 1.4 CHILLED WATER PIPING

- A. 2-1/2" and Larger.
  - 1. Pipe: Standard, A-53 black steel.
  - 2. Fittings: Standard, butt-weld.
- B. 2" and Smaller.
  - 1. Pipe: Type "L" copper tubing, hard temper.
  - 2. Fittings: Solder end, cast red brass or wrought copper.

#### 1.5 DUAL TEMPERATURE WATER PIPING

- A. 2-1/2" and Larger.
  - 1. Pipe: Standard, A-53 black steel.
  - 2. Fittings: Standard, butt-weld.
- B. 2" and Smaller.
  - 1. Pipe: Type "L" copper tubing, hard temper.
  - 2. Fittings: Solder end, cast red brass or wrought copper.

#### 1.6 MECHANICAL CITY WATER

- A. 3" and Smaller
  - 1. Pipe: Hard Temper, Type "L" copper, with solder joints.
  - 2. Fittings: Wrought copper with solder joints.

1.7 DRAIN PIPING

A. Copper Piping.

1. Pipe: Type "L" copper tubing, hard temper.
2. Fittings: Solder end, cast red brass or wrought copper.

B. Steel Piping.

1. Pipe: Standard, A-53 black steel.
2. Fittings: Threaded 150# black malleable iron or 125# black cast iron.

PART 2 – PRODUCTS – (NOT APPLICABLE)

PART 3 – EXECUTION – (NOT APPLICABLE)

END OF SECTION 232111

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## SECTION 232113 - HYDRONIC PIPING

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. This Section includes piping, special-duty valves, and hydronic specialties for air vent piping, blowdown drain lines and condensate drain piping.

#### 1.2 SUBMITTALS

- A. Shop Drawings: Detail fabrication of pipe anchors, hangers, special pipe support assemblies, alignment guides, expansion joints and loops, and their attachment to the building structure. Detail location of anchors, alignment guides, and expansion joints and loops.
  - 1. Grooved joint couplings and fittings shall be shown on drawings and product submittals and shall be specifically identified with the applicable manufacturer's style or series designation.
- B. Welding Certificates: Copies of certificates for welding procedures and personnel.
- C. Field Test Reports: Written reports of tests specified in Part 3 of this Section. Include the following:
  - 1. Test procedures used.
  - 2. Test results that comply with requirements.
  - 3. Failed test results and corrective action taken to achieve requirements.
- D. Maintenance Data: For hydronic specialties and special-duty valves to include in maintenance manuals specified in Division 1.
- E. Water Analysis: Submit a copy of the water analysis to illustrate water quality available at Project site.

#### 1.3 QUALITY ASSURANCE

- A. Welding: Qualify processes and operators according to the ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
- B. ASME Compliance: Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation. Safety valves and pressure vessels shall bear the appropriate ASME label. Fabricate and stamp air separators and expansion tanks to comply with the ASME Boiler and Pressure Vessel Code, Section VIII, Division 1.
- C. To assure uniformity and compatibility of piping products in grooved end piping systems, all groove products utilized shall be supplied by a single manufacturer. Grooving tools shall be supplied by the same manufacturer.
- D. The grooved coupling manufacturer's factory trained representative shall provide on-site training for contractor's field personnel in use of grooving tools, application of groove and installation of grooved joint products. The manufacturer's representative shall periodically visit the jobsite and review the installation. The Contractor shall remove and replace all joints deemed to be improperly installed.

#### 1.4 COORDINATION

- A. Coordinate layout and installation of hydronic piping and suspension system components with other construction, including light fixtures, HVAC equipment, fire-suppression-system components, and partition assemblies.
- B. Coordinate pipe sleeve installations for foundation wall penetrations.
- C. Coordinate pipe fitting pressure classes with products specified in related Sections.
- D. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into base. Concrete, reinforcement, and formwork requirements are specified in Division 3 Sections.
- E. Coordinate installation of pipe sleeves for penetrations through exterior walls and floor assemblies. Coordinate with requirements for firestopping for fire wall and floor assemblies.

#### 1.5 EXTRA MATERIALS

- A. Water Treatment Chemicals: Furnish sufficient chemicals for initial system startup and for preventive maintenance for one (1) year from date of Substantial Completion.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one (1) of the following:
  - 1. Pressure-Reducing Valves:
    - a. Amtrol, Inc.
    - b. Conbraco Industries, Inc.
    - c. ITT Bell & Gossett; ITT Fluid Technology Corp.
    - d. Spence Engineering Company, Inc.
    - e. Watts Industries, Inc.; Watts Regulators.

#### 2.2 PIPING MATERIALS

- A. General: Refer to Part 3 "Piping Applications" Article for applications of pipe and fitting materials.

#### 2.3 COPPER TUBE AND FITTINGS

- A. Drawn-Temper Copper Tubing: ASTM B 88, Type L.
- B. DWV Copper Tubing: ASTM B 306, Type DWV.
- C. Wrought-Copper Fittings: ASME B16.22. For hot and chilled water piping, Pro-Press fittings rated for 200 PSI operating pressure, 600 PSI test pressure and with 50 year warranty shall be permitted as an acceptable alternative for pipe sizes up to 4 inch system to be per ASTM B16. 18 or ASTM B16.22 with EPDM O-Rings.
- D. Wrought-Copper Unions: ASME B16.22.

- E. Solder Filler Metals: ASTM B 32, 95-5 tin antimony.
- F. Brazing Filler Metals: AWS A5.8, Classification BAg-1 (silver).

## 2.6 VALVES

- A. Gate, check, ball, and butterfly and calibrated balancing valves are specified in Division 23 Section 230523.

## PART 3 – EXECUTION

### 3.1 PIPING APPLICATIONS

- A. Condensate Drain Lines: Type L drawn-temper copper tubing with soldered joints.

### 3.2 VALVE APPLICATIONS

- A. General Duty Valve Applications: Unless otherwise indicated, use the following valve types:
  - 1. Shutoff Duty: Ball and butterfly valves, (as indicated on the drawings).
- B. Install shutoff duty valves at each branch connection to supply mains, at supply connection to each piece of equipment, unless only one piece of equipment is connected in the branch line. Install throttling duty valves at each branch connection to return mains, at return connections to each piece of equipment, and elsewhere as indicated.

### 3.4 PIPING INSTALLATIONS

- A. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.
- B. Install drains, consisting of a tee fitting, NPS 3/4 ball drain valve, at low points in piping system mains and elsewhere as required for system drainage.
- C. Install piping at a uniform grade of 0.2 percent upward in direction of flow.
- D. Reduce pipe sizes using eccentric reducer fitting installed with level side up.
- E. Unless otherwise indicated, install branch connections to mains using tee fittings in main pipe, with the takeoff coming out the bottom of the main pipe. For up-feed risers, install the takeoff coming out the top of the main pipe.
- F. Anchor piping for proper direction of expansion and contraction.

### 3.5 HANGERS AND SUPPORTS

- A. Hanger, support, and anchor devices are specified in Division 23 Section "Hangers and Supports." Comply with requirements below for maximum spacing of supports.
- B. Install the following pipe attachments:
  - 1 Adjustable steel clevis hangers for individual horizontal piping less than 20 feet

- long.
2. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet or longer, supported on a trapeze.
  3. Spring hangers to support vertical runs.
  4. On plastic pipe, install pads or cushions on bearing surfaces to prevent hanger from scratching pipe.
- C. Install hangers for drawn-temper 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 1-1/2” to 2”: | Maximum span, 8 feet; minimum rod size, 3/8 inch. |
| 4. NPS 2-1/2”:       | Maximum span, 9 feet; minimum rod size, 3/8 inch. |
- D. Support vertical runs at roof, at each floor, and at 10-foot intervals between floors

### 3.6 FIELD QUALITY CONTROL

- A. Prepare hydronic piping according to ASME B31.9 and as follows:
1. Leave joints, including welds, un-insulated and exposed for examination during test.
  2. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.
  3. Flush system with clean water. Clean strainers.
  4. Isolate equipment from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Install blinds in flanged joints to isolate equipment.
  5. Install safety valve, set at a pressure no more than one-third higher than test pressure, to protect against damage by expanding liquid or other source of overpressure during test.
- B. Perform the following tests on hydronic piping:
1. Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.
  2. While filling system, use vents installed at high points of system to release trapped air. Use drains installed at low points for complete draining of liquid.
  3. Check expansion tanks to determine that they are not air bound and that system is full of water.
  4. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the design pressure. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed either 90 percent of specified minimum yield strength or 1.7 times "SE" value in Appendix A of ASME B31.9, "Building Services Piping."
  5. After hydrostatic test pressure has been applied for at least 10 minutes, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks. Final test shall hold pressure for eight (8) hours.
  6. Prepare written report of testing.



### 3.7 CLEANING

- A. Flush hydronic piping systems with clean water. Remove and clean or replace strainer screens.  
After cleaning and flushing hydronic piping systems, but before balancing, remove disposable fine-mesh strainers in pump suction diffusers.

END OF SECTION 232113

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## SECTION 232114 - HOT WATER HEATING SYSTEM

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 DESCRIPTION OF SYSTEM

- A. The new closed loop hot water piping system to accommodate this project.

#### 1.3 VALVES AND SPECIALTIES

- A. Furnish and install the valves and specialties as indicated on the drawings.
- B. All control valves, etc. to be furnished by the Building Automation Contractor.
- C. In branch piping at high points of the system: 1/8" manual air vent cocks.
- D. In the mains at high point of system: Anderson, Crane, Fischer, 1/2" automatic air vent traps with cast iron body and bronze float and valve mechanism, and with discharge piped to floor drain.
- E. At all low points of piping: A drain valve with hose fitting capped.

#### 1.4 INSTRUMENTS

- A. Furnish and install the following instruments:
  - 1. In hot water supply and return piping: Wells furnished by the Building Automation Contractor.
  - 2. In the piping, 1/2" pressure-temperature test plugs at the following locations for use with gauges and thermometers specified in Section 230519:
    - a. At inlet and outlet of each pump.

PART 2 – PRODUCTS – (NOT APPLICABLE)

PART 3 – EXECUTION (NOT APPLICABLE)

END OF SECTION 232114

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## SECTION 232115 - CHILLED WATER SYSTEM

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 DESCRIPTION OF SYSTEM

- A. New chilled water piping to accommodate this project.

#### 1.3 CONNECTIONS

- A. Furnish and install the following valves and specialties:
  - 1. In branch piping, where shown, and at high points of the system: One 1/8" manual air vent cock.
  - 2. In the mains at high points of the system: One Anderson, Crane, Fischer, Hoffman, or equal, 1/2" automatic air vent trap with cast iron body and bronze float and valve mechanism, and with discharge piped to floor drain except at fan coil units air vent discharge shall be piped to fan coil unit drain.
  - 3. Where shown, and at all low points of piping: A 3/4" drain valve with hose fitting capped.

#### 1.4 VALVES AND SPECIALTIES

- A. Furnish and install valves and specialties as indicated on the drawings.
- B. In branch piping, where shown, and at high points of the system: One (1) 1/8" manual air vent cock.
- C. In the mains at high points of the system: One (1) 2" automatic air vent with discharge piped to floor drain. Refer to Section 23 05 19.
- D. Where shown, and at all low points of piping: A 3/4" drain valve with hose fitting capped.

PART 2 – PRODUCTS – (NOT APPLICABLE)

PART 3 – EXECUTION – (NOT APPLICABLE)

END OF SECTION 232115

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## SECTION 232116 – DUAL TEMPERATURE WATER SYSTEM

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 DESCRIPTION OF SYSTEM

- A. New dual temperature water piping to accommodate this project.

#### 1.3 DUAL TEMPERATURE WATER SYSTEM EQUIPMENT

- A. New Dual Temperature Water Pumps: Refer to Section 232123.
- B. New Expansion Tank: Refer to Section 230516.

#### 1.4 CONNECTIONS

- A. Furnish and install the following valves and specialties:
  - 1. In branch piping, where shown, and at high points of the system: One 1/8" manual air vent cock.
  - 2. In the mains at high points of the system: One Anderson, Crane, Fischer, Hoffman, or equal, 1/2" automatic air vent trap with cast iron body and bronze float and valve mechanism, and with discharge piped to floor drain except at fan coil units air vent discharge shall be piped to fan coil unit drain.
  - 3. Where shown, and at all low points of piping: A 3/4" drain valve with hose fitting capped.

#### 1.5 INSTRUMENTS

- A. Furnish and install the following instruments:
  - 1. In dual temperature water supply and return piping: Wells furnished by Building Automation Contractor.
  - 2. In dual temperature water supply and return piping: One (1) valve outlet for Building Automation Contractor's pressure sensors.
  - 3. In the piping, 1/2" pressure-temperature test plugs at the following locations as specified in Paragraph 230519:
    - a. At inlet and outlet of strainer at pumps.
    - b. At inlet and outlet of pumps.

#### 1.6 VALVES AND SPECIALTIES

- A. Furnish and install valves and specialties as indicated on the drawings.
- B. All dual temperature water control valves, etc. to be furnished by the Building Automation Contractor.

- C. In branch piping, where shown, and at high points of the system: One (1) 1/8" manual air vent cock.
- D. In the mains at high points of the system: One (1) 2" automatic air vent with discharge piped to floor drain. Refer to Section 230519.
- E. Where shown, and at all low points of piping: A 3/4" drain valve with hose fitting capped.

PART 2 – PRODUCTS – (NOT USED)

PART 3 – EXECUTION – (NOT USED)

END OF SECTION 232116

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## SECTION 232500 - HVAC WATER TREATMENT

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. This Section includes the following HVAC water-treatment systems:
  - 1. HVAC water-treatment chemicals.
  - 2. Cleaning and Testing Hydronic Piping System.

#### 1.3 DEFINITIONS

- A. EEPROM: Electrically erasable, programmable read-only memory.
- B. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling power-limited circuits.
- C. TDS: Total dissolved solids.
- D. UV: Ultraviolet.
- E. AABC: Associated Air Balance Council.
- F. NEBB: National Environmental Balancing Bureau.
- G. TAB: Testing, adjusting, and balancing.
- H. TABB: Testing, Adjusting, and Balancing Bureau.
- I. TAB Specialist: An entity engaged to perform TAB Work.

#### 1.4 COORDINATION

- A. Notice: Provide seven days' advance notice for each test. Include scheduled test dates and times.
- B. Perform pressure tests on water distribution systems have been satisfactorily completed.

#### 1.5 TESTING

- A. Provide equipment for testing, including necessary pumps, air compressors, hoses, gages, etc. Make necessary temporary connections to perform testing. Test piping systems before insulation and control devices are installed wherever feasible. Tests shall be performed before any work is concealed, covered, or painted.

- B. Preliminary testing using air may be performed by the contractor to void delays in filling and draining of system for repairs. However, final test shall be hydrostatic unless specified otherwise.
- C. A test fails if a leakage is observed or if the pressure drop exceeds 5% of test pressure over the duration of specified time.
- D. Repair pipe or fittings which fail required test, by disassembly and reinstallation, using new materials to extent required to overcome leakage. Do not use chemicals, stop-leak compounds, mastics, or other temporary repair methods.
- E. After successful, final test, which must be witnessed by the Owner, Owner's Representative or Engineer, drain all water from system.
- F. Hydrostatic tests shall be maintained for a minimum of eight (8) hours; air tests shall be maintained for a minimum of twenty-four (24) hours.
- G. Water Systems: All HVAC hydronic piping shall be tested and made tight initially under air pressure and then under hydrostatic pressure each equal to 1-1/2 times the working pressure but in not case less than 125 PSI.

#### 1.6 PERFORMANCE REQUIREMENTS

- A. Water quality for HVAC systems shall minimize corrosion, scale buildup, and biological growth for optimum efficiency of HVAC equipment without creating a hazard to operating personnel or the environment.
- B. Base HVAC water treatment on quality of water available at Project site, HVAC system equipment material characteristics and functional performance characteristics, operating personnel capabilities, and requirements and guidelines of authorities having jurisdiction.
- C. Closed hydronic systems, including hot-water heating and chilled water, shall have the following water qualities:
  - 1. pH: Maintain a value within 9.0 to 10.5.
  - 2. "P" Alkalinity: Maintain a value within 100 to 500 ppm.
  - 3. Boron: Maintain a value within 100 to 200 ppm.
  - 4. Chemical Oxygen Demand: Maintain a maximum value of 100 ppm.
  - 5. Soluble Copper: Maintain a maximum value of 0.20 ppm.
  - 6. TDS: Maintain a maximum value of 10 ppm.
  - 7. Ammonia: Maintain a maximum value of 20 ppm.
  - 8. Free Caustic Alkalinity: Maintain a maximum value of 20 ppm.
  - 9. Microbiological Limits:
    - a. Total Aerobic Plate Count: Maintain a maximum value of 1000 organisms/ml.
    - b. Total Anaerobic Plate Count: Maintain a maximum value of 100 organisms/ml.
    - c. Nitrate Reducers: Maintain a maximum value of 100 organisms/ml.
    - d. Sulfate Reducers: Maintain a maximum value of 0 organisms/ml.
    - e. Iron Bacteria: Maintain a maximum value of 0 organisms/ml.

## 1.7 SUBMITTALS

- A. Strategies and Procedures Plan: Within 60 days of Contractor's Notice to Proceed, submit cleaning and testing strategies and step-by-step procedures as specified in "Preparation" Article.
- B. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories for the following products:
  - 1. Bypass feeders.
  - 2. Water meters.
  - 3. Inhibitor injection timers.
  - 4. pH controllers.
  - 5. TDS controllers.
  - 6. Biocide feeder timers.
  - 7. Chemical solution tanks.
  - 8. Injection pumps.
  - 9. Chemical test equipment.
  - 10. Chemical material safety data sheets.
- C. Shop Drawings: Pretreatment and chemical, treatment equipment showing tanks, maintenance space required, and piping connections to HVAC systems. Include plans, elevations, sections, details, and attachments to other work.
- D. Field quality-control test reports.
- E. Other Informational Submittals:
  - 1. Water-Treatment Program: Written sequence of operation on an annual basis for the application equipment required to achieve water quality defined in the "Performance Requirements" Article above.
  - 2. Water Analysis: Illustrate water quality available at Project site.
  - 3. Passivation Confirmation Report: Verify passivation of galvanized-steel surfaces, and confirm this observation in a letter to Architect.

## 1.8 QUALITY ASSURANCE

- A. HVAC Water-Treatment Service Provider Qualifications: An experienced HVAC water-treatment service provider capable of analyzing water qualities, installing water-treatment equipment, and applying water treatment as specified in this Section.
- B. All cleaning and flushing of piping shall be scheduled in advance with the Owner and the Commissioning Agent in order that they can witness the process.

## 1.9 MAINTENANCE SERVICE

- A. Scope of Maintenance Service: Provide chemicals and service program to maintain water conditions required above to inhibit corrosion, scale formation, and biological growth for cooling, chilled-water piping, hot-water piping, and equipment. Services and chemicals shall be provided for a period of two years from date of Substantial Completion, and shall include the following:
  - 1. Initial water analysis and HVAC water-treatment recommendations.



2. Startup assistance for Contractor to flush the systems, clean with detergents, and initially fill systems with required chemical treatment prior to operation.
3. Periodic field service and consultation.
4. Customer report charts and log sheets.
5. Laboratory technical analysis.
6. Analyses and reports of all chemical items concerning safety and compliance with government regulations.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Aqua-Chem, Inc.; Cleaver-Brooks Div.
  2. GE Betz.
  3. HVC Chemical.
  4. Dow Chemical.
  5. Industrial Water Solutions.

### 2.2 CLEANING

- A. All piping systems must have been satisfactory tested before systems are cleaned. Also, before any system is placed in service and before start-up of any equipment, each contractor shall clean piping, fixtures, and equipment installed under their respective contracts, and shall remove other foreign matter detrimental to the operation of the system.
- B. All Water Systems shall be thoroughly washed out with treated water until the systems are clean and passivated and free of all scale, dirt, weld beads, solder, or other deleterious matter. The contractor shall provide the following chemicals or approved equals:
- C. Water Systems – H. D. Cleaner Model No. 203
- D. All strainers shall then be cleaned.
- E. Flush lines utilizing temporary water pumps as required. Contractor to finish an ultra fine strainer for pumps. Contractor shall also provide all temporary valved by-passes to be installed in the piping as required to circulate cleaners.

## 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 cleaning and testing of systems.
- B. Examine system installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.

- C. Report deficiencies discovered before and during performance of cleaning and painting procedures. Observe and record system reactions to changes in conditions.

### 3.2 WATER ANALYSIS

- A. Perform an analysis of supply water to determine quality of water available at Project site.

### 3.3 CONNECTIONS

- A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment to allow service and maintenance.
- C. Confirm applicable electrical requirements in Division 26 Sections for connecting electrical equipment.
- D. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- E. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

### 3.4 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections. Report results in writing.
- B. Perform tests and inspections and prepare test reports.
  - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- C. Tests and Inspections:
  - 1. Inspect field-assembled components and equipment installation, including piping and electrical connections.
  - 2. Inspect piping and equipment to determine that systems and equipment have been cleaned, flushed, and filled with water, and are fully operational before introducing chemicals for water-treatment system.
  - 3. Do not enclose, cover, or put piping into operation until it is tested and satisfactory test results are achieved.
  - 4. Test for leaks and defects. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
  - 5. Leave uncovered and unconcealed new, altered, extended, and replaced water piping until it has been tested and approved. Expose work that has been covered or concealed before it has been tested and approved.
  - 6. Cap and subject piping to static water pressure of 50 psig (345 kPa) above operating pressure, without exceeding pressure rating of piping system materials.

Isolate test source and allow test pressure to stand for four hours. Leaks and loss in test pressure constitute defects.

7. Repair leaks and defects with new materials and retest piping until no leaks exist.
- D. Remove and replace malfunctioning units and retest as specified above.
  - E. At six-week intervals following Substantial Completion, perform separate water analyses on hydronic systems to show that automatic chemical-feed systems are maintaining water quality within performance requirements specified in this Section. Submit written reports of water analysis advising Owner of changes necessary to adhere to Part 1 "Performance Requirements" Article.
  - F. Comply with ASTM D 3370 and with the following standards:
    1. Silica: ASTM D 859.
    2. Steam System: ASTM D 1066.
    3. Acidity and Alkalinity: ASTM D 1067.
    4. Iron: ASTM D 1068.
    5. Water Hardness: ASTM D 1126.

### 3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain HVAC water-treatment systems and equipment.
- B. Training: Provide a "how-to-use" self-contained breathing apparatus video that details exact operating procedures of equipment.

END OF SECTION 232500

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## SECTION 233113 - METAL DUCTS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. This Section includes metal ducts for supply, return, outside, and exhaust air-distribution systems in pressure classes from minus 2 to plus 4 inch w.g. Metal ducts are to include the following:
  - 1. Rectangular ducts and fittings.
  - 2. Single-wall, round spiral-seam ducts and formed fittings.
  - 3. Duct liner.

#### 1.2 SYSTEM DESCRIPTION

- A. Duct system design, as indicated, has been used to select size and type of air moving and distribution equipment and other air system components. Changes to layout or configuration of duct system must be specifically approved in writing by the Engineer. Accompany requests for layout modifications with calculations showing that proposed layout will provide original design results without increasing system total pressure.

#### 1.3 SUBMITTALS

- A. Shop Drawings: The Sheet Metal Contractor shall prepare ductwork drawings, at a minimum scale of 1/4" = 1'-0", in ACAD Release 2000 or newer edition. Submit an electronic copy of ductwork drawings for review and approval by the Architect/Engineer before coordination drawings are submitted for coordination. Drawings may be submitted to the Architect/Engineer in stages if required to expedite work. Do not proceed with fabrication of ductwork until submitted drawings are approved by the Architect/Engineer

#### 1.4 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code--Steel," for hangers and supports and AWS D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.
- B. NFPA Compliance:
  - 1. NFPA 90A, "Installation of Air Conditioning and Ventilating Systems."
  - 2. NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

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

#### 2.2 SHEET METAL MATERIALS

- A. Comply with the most current version of SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods, unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
- B. Galvanized Sheet Steel: Lock-forming quality; complying with ASTM A 653 and having G60 (Z180) coating designation; ducts shall have mill-phosphatized finish for surfaces exposed to view.
- C. Carbon-Steel Sheets: ASTM A 366 cold-rolled sheets; commercial quality; with oiled, matte finish for exposed ducts.
- D. Stainless Steel: ASTM A 480, Type 304, and having a No. 2D finish for concealed ducts and mill for exposed ducts.
- E. Aluminum Sheets: ASTM B 209, alloy 3003, tempered H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.
- F. Exposed ductwork shall be suitable for painting (paint grip) in field by General Contractor.
- G. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts.
- H. Tie Rods: Galvanized steel, 1/4 inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

## 2.3 SEALANT MATERIALS

- A. Joint and Seam Sealants, General: The term "sealant" is not limited to materials of adhesive or mastic nature but includes tapes and combinations of open-weave fabric strips and mastics.
- B. Joint and Seam Tape: 2 inches wide; glass-fiber-reinforced fabric.
- C. Tape Sealing System: Woven-fiber tape impregnated with gypsum mineral compound and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.
- D. Water-Based Joint and Seam Sealant: Flexible, adhesive sealant, resistant to UV light when cured, UL 723 listed, and complying with NFPA requirements for Class 1 ducts.
- E. Solvent-Based Joint and Seam Sealant: One-part, non-sag, solvent-release-curing, polymerized butyl sealant formulated with a minimum of 75 percent solids.
- F. Flanged Joint Mastic: One-part, acid-curing, silicone, elastomeric joint sealant complying with ASTM C 920, Type S, Grade NS, Class 25, Use O.
- G. Flange Gaskets: Butyl rubber or EPDM polymer with polyisobutylene plasticizer.

## 2.4 HANGERS AND SUPPORTS

- A. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
  - 1. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
  - 2. Exception: Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.
- B. Hanger Materials: Galvanized sheet steel or threaded steel rod.
  - 1. Strap and Rod Sizes: Comply with the most current version of SMACNA's "HVAC Duct Construction Standards-Metal and Flexible" for steel sheet width and thickness and for steel rod diameters.
  - 2. Galvanized-steel straps attached to aluminum ducts shall have contact surfaces painted with zinc-chromate primer.
- C. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- D. Trapeze and Riser Supports: Steel shapes complying with ASTM A 36.
  - 1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
  - 2. Supports for Stainless-Steel Ducts: Stainless-steel support materials.
  - 3. Supports for Aluminum Ducts: Aluminum support materials unless materials are electrolytically separated from ducts.

## 2.5 RECTANGULAR DUCT FABRICATION

- A. Fabricate ducts, elbows, transitions, offsets, branch connections, and other construction according to the most current version of SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" and complying with requirements for metal thickness, reinforcing types and intervals, tie-rod applications, and joint types and intervals.
  - 1. Lengths: Fabricate rectangular ducts in lengths appropriate to reinforcement and rigidity class required for pressure class.
  - 2. Deflection: Duct systems shall not exceed deflection limits according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."
- B. Transverse Joints: Prefabricated slide-on joints and components constructed using manufacturer's guidelines for material thickness, reinforcement size and spacing, and joint reinforcement.
  - 1. Manufacturers:
    - a. Ductmate Industries, Inc.
    - b. Nexus Inc.
    - c. Ward Industries, Inc.
- C. Formed-On Flanges: Construct according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," Figure 1-4, using corner, bolt, cleat, and gasket details.
  - 1. Duct Size: Maximum 30 inches wide and up to 2-inch wg pressure class.
  - 2. Longitudinal Seams: Pittsburgh lock sealed with non-curing polymer sealant.

- D. Cross Breaking or Cross Beading: Cross break or cross bead duct sides 19 inches and larger and 0.0359 inch thick or less, with more than 10 sq. ft. of non-braced panel area unless ducts are lined.

## 2.6 ROUND DUCT AND FITTING FABRICATION

- A. Round, Spiral Lock Seam Ducts: Fabricate supply ducts of galvanized steel according to the most current version of SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."
  - 1. Manufacturers:
    - a. Lindab
    - b. McGill AirFlow Corporation.
    - c. SEMCO Incorporated.
  - B. Duct Joints:
    - 1. Minus 2 inches wg to plus 2 inches wg pressure class
      - a. Ducts up to 20 inches in Diameter: Interior, center-beaded slip coupling, sealed before and after fastening, attached with sheet metal screws.
      - b. Ducts 21 to 72 Inches in Diameter: Three-piece, gasketed, flanged joint consisting of two (2) internal flanges with sealant and one (1) external closure band with gasket.
      - c. Joints shall be made with pop rivets or sheet metal screws and sealed.
    - 2. Less than minus 2 inches wg or more than plus 2 inches wg pressure class
      - a. All fitting ends shall come factory equipped with a double lipped, U-profile, EPDM rubber gasket. Gasket shall be manufactured to gauge and flexibility so as to insure that system will meet all of the performance criteria set forth in the manufacturer=s literature. Gasket shall be classified by Underwriter=s Laboratories to conform to ASTM E84-91a and NFPA 90A flame spread and smoke developed ratings of 25/50.
      - b. All fitting ends shall be calibrated to manufacturer=s published dimensional tolerance standard and associated spiral duct.
      - c. All fitting ends from 3" to 24" Dia. shall have rolled over edges for added strength and rigidity.
      - d. All elbows from 3" to 12" Dia. shall be 2-piece die stamped and continuously stitch welded. All elbows 14" Dia. and larger shall be standing seam gorelock construction and internally sealed.
      - e. The radius of all 90° and 45° elbows shall be 1.5 times the elbow diameter.
      - f. All fittings that are of either spot welded or button punched construction shall be internally sealed.
      - g. Fittings shall be connected with self tapping sheet metal screws or pressure proof pop rivets in quantity and procedure per manufacturer=s recommendations.
- C. 90-Degree Tees and Laterals and Conical Tees: Fabricate to comply with SMACNA's "1985 HVAC Duct Construction Standards--Metal and Flexible," with metal thicknesses specified for longitudinal-seam straight ducts.
- D. Diverging-Flow Fittings: Fabricate with reduced entrance to branch taps and with no excess material projecting from fitting onto branch tap entrance.

- E. Fabricate elbows using die-formed, gored, pleated, or mitered construction. Bend radius of die-formed, gored, and pleated elbows shall be 1-1/2 times duct diameter. Unless elbow construction type is indicated, fabricate elbows as follows:
  - 1. Mitered-Elbow Radius and Number of Pieces: Welded construction complying with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," unless otherwise indicated.
  - 2. Die-Formed Elbows for Sizes through 12 Inches in Diameter with 2-piece welded construction, 24 ga.
  - 3. Round Elbows Larger Than 14 Inches in Diameter: Fabricate gored elbows 22 ga. for 16 inches through 26 inches, 20 ga. for 28 inches and above.
- F. All tees and crosses shall be conical fittings.
- G. Round connections to rectangular ducts shall be made with bellmouth fittings.
- H. All connections to round ductwork shall be made with full body fittings. Side taps and saddles are not acceptable.

## 2.7 INSULATED CASING

- A. Construct casing for the air handling units exhaust and outdoor air plenums. Casing shall be built per field conditions and air handling unit connections. Casing shall be self-supporting, prefabricated steel panels, 2" thick, with 4-1/4 lb. density insulation, encased in inner face of minimum 20 gauge, and outer face of minimum 22 gauge galvanized steel sheets; connection between inner and outer skins shall be thermally broken. Stiffening elements shall be a minimum of 16 gauge and gasketed or cabled assembly to be airtight at 10" H<sub>2</sub>O pressure difference. Provide minimum 20 gauge, hinged access door, with pressure type door handles and hinges with provision to operate from either side of door.
- B. Interior skin to be stainless steel where indicated on drawings.

## 2.8 DUCT LINER

- A. Fibrous-Glass Liner: Comply with NFPA 90A or NFPA 90B and with NAIMA AH124.
  - 1. Manufacturers:
    - a. CertainTeed Corp.; Insulation Group.
    - b. Johns Manville International, Inc.
    - c. Knauf Fiber Glass GmbH.
    - d. Owens Corning.
  - 2. Materials: ASTM C 1071; surfaces exposed to airstream shall be coated to prevent erosion of glass fibers.
    - a. Thickness: 1 inch.
    - b. Thermal Conductivity (k-Value): 0.26 at 75 deg F mean temperature.
    - c. Fire-Hazard Classification: Maximum flame-spread index of 25 and smoke-developed index of 50 when tested according to ASTM E 84.
    - d. Liner Adhesive: Comply with NFPA 90A or NFPA 90B and with ASTM C 916.
    - e. Mechanical Fasteners: Galvanized steel suitable for adhesive attachment, mechanical attachment, or welding attachment to duct without damaging liner when applied as recommended by manufacturer and without causing leakage in duct.
      - 1) Tensile Strength: Indefinitely sustain a 50-lb tensile, dead-load test



- perpendicular to duct wall.
- 2) Fastener Pin Length: As required for thickness of insulation and without projecting more than 1/8 inch into airstream.
- 3) Adhesive for Attaching Mechanical Fasteners: Comply with fire-hazard classification of duct liner system.

## 2.9 APPLICATION OF LINER IN RECTANGULAR DUCTS

- A. 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.
- B. Apply adhesive to transverse edges of liner facing upstream that do not receive metal nosing.
- C. Butt transverse joints without gaps and coat joint with adhesive.
- D. Fold and compress liner in corners of rectangular ducts or cut and fit to ensure butted-edge overlapping.
- E. Do not apply liner in rectangular ducts with longitudinal joints, except at corners of ducts, unless duct size and standard liner product dimensions make longitudinal joints necessary.
- F. Apply adhesive coating on longitudinal seams in ducts with air velocity of 2500 fpm.
- G. 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.
- H. 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:
  - 1. Fan discharges.
  - 2. Intervals of lined duct preceding unlined duct.
  - 3. Upstream edges of transverse joints in ducts where air velocities are greater than 2500 fpm or where indicated.
- I. Terminate inner ducts with build-outs attached to fire-damper sleeves, dampers, turning vane assemblies, or other devices. Fabricated build-outs (metal hat sections) or other build-out means are optional; when used, secure build-outs to duct walls with bolts, screws, rivets, or welds.

## 2.10 STAINLESS STEEL DUCTS

- A. Where indicated on the drawings, within 18" of outdoor air louvers, ducts shall be constructed of 304-2B stainless steel with mill finish and shall conform to the following schedule:

<u>Width in Inches</u>	<u>U. S. Gauge</u>
Up to 30"	No. 26

- B. Joints: All joints and seams shall be continuously soldered with stainless steel solder and made watertight. Longitudinal seams shall be on top side of horizontal ducts.

### PART 3 – EXECUTION

#### 3.1 DUCT APPLICATIONS

- A. Static-Pressure Classes: Unless otherwise indicated, construct ducts according to the following:
  - 1. Supply Ducts (from air handling units to VAV terminal units), (Positive Pressure): 4 inch w.g. pressure class.
  - 2. Supply Ducts: (from terminal units to air devices), (Positive Pressure): 2-inch w.g. pressure class.
  - 3. Return Ducts: (from air devices to air handling units) (Negative Pressure): 2-inch w.g. pressure class.
  - 4. Exhaust Ducts, (Negative Pressure): 2-inch w.g. pressure class.
  - 6. Outside Air Ducts, (Positive and Negative Pressure): 2-inch pressure class.
  - 7. Combustion Air & Transfer Air (Positive Pressure): 2 inch pressure class.
- B. All ducts shall be of galvanized steel construction except for Type 2 exhaust hoods and clothes dryer exhaust ducts which shall be of aluminum construction and Type 1 exhaust hood ductwork which shall be welded 304 stainless steel. Type 1 and Type 2 exhaust hood exhaust ductwork shall comply with the requirements of the Ohio Mechanical Code.

#### 3.2 DUCT INSTALLATION

- A. Construct and install ducts according to the most current version of SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," unless otherwise indicated.
- B. Install round ducts in lengths not less than 10 feet unless interrupted by fittings.
- C. Install ducts with fewest possible joints.
- D. Install fabricated fittings for changes in directions, size, and shape and for connections. Fittings indicated on drawings are diagrammatic and are for information purposes only.
- E. Install couplings tight to duct wall surface with a minimum of projections into duct. Secure couplings with sheet metal screws. Install screws at intervals of 12 inches, with a minimum of three (3) screws in each coupling.
- F. Install ducts, unless otherwise indicated, vertically and horizontally and parallel and perpendicular to building lines; avoid diagonal runs.
- G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
- H. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.
- I. Conceal ducts from view in finished spaces. Do not encase horizontal runs in solid partitions unless specifically indicated.

- J. Coordinate layout with suspended ceiling, fire-dampers, lighting layouts, and similar finished work.
- K. Seal all joints and seams. Apply sealant to male end connectors before insertion, and afterward to cover entire joint and sheet metal screws. Longitudinal joints shall be on the top side of horizontal ducts.
- L. Electrical Equipment Spaces: Route ducts to avoid passing through electrical equipment spaces and enclosures.
- M. Non-Fire-Rated Partition Penetrations: Where ducts pass through interior partitions and exterior walls and are exposed to view, conceal spaces between construction openings and ducts or duct insulation with sheet metal flanges of same metal thickness as ducts. Overlap openings on 4 sides by at least 1-1/2 inches.
- N. Fire-Rated Partition Penetrations: Where ducts pass through interior partitions and exterior walls, install appropriately rated fire dampers, sleeves, and firestopping sealant.
- O. Protect duct interiors from the elements and foreign materials until building is enclosed. Follow SMACNA's "Duct Cleanliness for New Construction." All ductwork is to be maintained at the SMACNA Intermediate Cleanliness level.
- P. This Contractor shall paint interiors of metal ducts, that do not have duct liner, for 24 inches upstream and downstream of duct mounted registers and grilles. Apply one (1) coat of flat, black, latex finish coat over a compatible galvanized-steel primer.
- Q. Duct dimensions on drawings are inside clear dimensions.

### 3.3 SEAM AND JOINT SEALING

- A. Seal all duct seams and joints according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for duct pressure class indicated.
- B. Seal ducts before external insulation is applied.

### 3.4 HANGING AND SUPPORTING

- A. Support horizontal ducts within 24 inches of each elbow and within 48 inches of each branch intersection.
- B. Support vertical ducts at maximum intervals of 6 feet and at each floor.
- C. Install upper attachments to structures with an allowable load not exceeding one-fourth of failure (proof-test) load.
- D. Install concrete inserts before placing concrete.

- E. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
  - 1. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.

### 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.

### 3.7 DUCT CLEANING

lean 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. Comply with Division 23 Section "Air Duct Accessories" for access panels and doors.
  - 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.

### 3.6 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections according to SMACNA's "HVAC Air Duct Leakage Test Manual" and prepare test reports:
  1. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
  2. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If pressure classes are not indicated, test the entire system at the maximum system design pressure. Do not pressurize systems above maximum design operating pressure. Give seven (7) days' advance notice for testing.
  3. Maximum Allowable Leakage: Comply with requirements for Leakage Class 3 for round ducts, Leakage Class 12 for rectangular ducts in pressure classes lower than and equal to 2 inch w.g. (both positive and negative pressures) and leakage class 6 for pressure classes above 2 inch w.g.
  4. Remake leaking joints and retest until leakage is equal to or less than maximum allowable.

END OF SECTION 233113

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## SECTION 233600 – AIR TERMINAL UNITS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Pressure independent, variable volume air terminal units.

#### 1.3 SUBMITTALS

- A. Product Data: For each type of the following products, including rated capacities, furnished specialties, sound-power ratings, and accessories.
  - 1. Air terminal units.
  - 2. Liners and adhesives.
  - 3. Sealants and gaskets.
  - 4. Seismic-restraint devices.
- B. Shop Drawings: For air terminal units. Include plans, elevations, sections, details, and attachments to other work.
  - 1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  - 2. Wiring Diagrams: For power, signal, and control wiring.
  - 3. Hangers and supports, including methods for duct and building attachment, seismic restraints, and vibration isolation.
- C. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:
  - 1. Ceiling suspension assembly members.
  - 2. Size and location of initial access modules for acoustic tile.
  - 3. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
- D. Field quality-control reports.
- E. Operation and Maintenance Data: For air terminal units to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
  - 1. Instructions for resetting minimum and maximum air volumes.
  - 2. Instructions for adjusting software set points.

#### 1.4 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1-2004, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-Up."

#### PART 2 - PRODUCTS

##### 2.1 DAMPER MOTOR OPERATED VARIABLE VOLUME TERMINAL UNITS WITH HOT WATER REHEAT COILS

- A. Furnish and install, where shown, DDC operated, pressure independent, variable volume air control terminal units.
- B. Variable air volume supply air control terminals for connection to medium pressure duct, central air systems, with direct digital control, and unit mounted hot water coils.
- C. Identify each terminal unit with clearly marked identification label and airflow indicator. Label shall include unit nominal air flow, maximum factory set air flow, minimum factory set air flow, and coil type. Also provide, mounted on bottom of box to be clearly visible from below, laminated label indicating box number and AHU number which feeds box.
- D. Controls: Terminal unit manufacture shall include factory mounting, continuity check, calibrating, and testing of direct digital controls provided by Temperature Control Contractor under a separate bid package.
- E. Casings: Units shall be completely factory assembled, manufactured of corrosion protected welded steel, and fabricated with a minimum of 18-gauge metal on the inlet side of the VAV damper and 22-gauge metal on the outlet side and unit casing.
- F. Insulation: Foil Face - Interior surface of unit casing is acoustically and thermally lined with a minimum of 1 inch, R-Value 4.3, 1.9 lb./cu. ft. foil face insulation. All exposed edges are sealed to prevent fibers in the airstream. Meets NFPA-90A, UL 181 and bacteriological standard ASTM C 665.
- G. Assembly: Air volume damper, fans, and controls in single cabinet.
- H. Volume Damper: Locate air volume damper assembly inside unit casing. Construct from extruded aluminum or a minimum of 20 gauge galvanized steel components. Key damper blades into shaft with nylon fitted pivot points. Flow sensor must be provided regardless of control chosen. Flow sensor must be a ring or cross. Bar or single point sensing device is not acceptable. Air volume control damper shall be factory calibrated assembly consisting of air valve with integral actuator. Electric actuator shall position damper.
- I. Hot water heating coil: Heating coil capacities shall be as scheduled on the drawings. A quick opening access panel shall be provided to allow cleaning and inspection of the coil. The coils shall be constructed of 0.500" x 0.017" copper tube. Fins shall be

0.0045" thick aluminum sine wave configuration. The coil shall be contained in a 0.030" galvanized steel casing. The coils shall be pressure tested to 349 PSIG at 300 degree Fahrenheit tube surface temperature. Coil shall be tested and certified according to ARI Standard 410. Coil connections can be right hand or left hand as noted on the drawings. Control valves, air vents and drain vents shall be field installed by the HVAC contractor.

J. Tests:

1. Factory set and check all DDC controllers to within 5% of scheduled maximum and minimum settings. Base performance on tests conducted in accordance with ARI 880.
2. Maximum Casing Leakage: 1 percent of nominal air flow at 0.5 in wg inlet static pressure.
3. Maximum Damper Leakage: 1 percent of design air flow at 4 in wg inlet static pressure.

K. Each terminal unit shall operate as follows:

1. At all times (ddc control): Unit shall be capable of regulating supply air from minimum to maximum supply air quantities. Refer to schedule on drawings for minimum and maximum air quantities.
2. Each terminal unit shall include a laminated label showing terminal unit number and which ACU it is fed from.
3. Bids shall be based on, Titus, Price, Carrier, York, Trane, Tuttle & Bailey terminal units equipped with hot water reheat coil of various types and sizes as scheduled on the drawings.
4. Unit shall include inlet air temperature sensor to automatically change from the heat/cool mode to satisfy zone requirements.

## 2.2 SOURCE QUALITY CONTROL

A. Factory Tests: Test assembled air terminal units according to ARI 880.

1. Label each air terminal unit with plan number, nominal airflow, maximum and minimum factory-set airflows, coil type, and ARI certification seal.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install air terminal units according to NFPA 90A, "Standard for the Installation of Air Conditioning and Ventilating Systems."
- B. Install air terminal units level and plumb. Maintain sufficient clearance for normal service and maintenance.
- C. Install wall-mounted thermostats.

### 3.2 HANGER AND SUPPORT INSTALLATION

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "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 and for slabs more than 4 inches thick.
  - 4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes and for slabs less than 4 inches thick.
  - 5. Do not use powder-actuated concrete fasteners for seismic restraints.
- C. Hangers Exposed to View: Threaded rod and angle or channel supports.
- D. 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.

### 3.3 CONNECTIONS

- A. Install piping adjacent to air terminal unit to allow service and maintenance.
- B. Hot-Water Piping: In addition to requirements in Division 23 Section "Hydronic Piping," connect heating coils to supply with shutoff valve, strainer, control valve, and union or flange; and to return with balancing valve and union or flange.
- C. Connect ducts to air terminal units according to Division 23 Section "Metal Ducts."
- D. Make connections to air terminal units with flexible connectors complying with requirements in Division 23 Section "Air Duct Accessories."

### 3.4 IDENTIFICATION

- A. Label each air terminal unit with plan number, nominal airflow, and maximum and minimum factory-set airflows. Comply with requirements in Division 23 Section "Identification for HVAC Piping and Equipment" for equipment labels and warning signs and labels.

### 3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- C. Perform tests and inspections.
  - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- D. Tests and Inspections:

1. After installing air terminal units and after electrical circuitry has been energized, test for compliance with requirements.
2. Leak Test: After installation, fill water coils and test for leaks. Repair leaks and retest until no leaks exist.
3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

E. Air terminal unit will be considered defective if it does not pass tests and inspections.

F. Prepare test and inspection reports.

### 3.6 STARTUP SERVICE

A. Perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.
2. Verify that inlet duct connections are as recommended by air terminal unit manufacturer to achieve proper performance.
3. Verify that controls and control enclosure are accessible.
4. Verify that control connections are complete.
5. Verify that nameplate and identification tag are visible.
6. Verify that controls respond to inputs as specified.

### 3.7 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain air terminal units.

END OF SECTION 233600

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## SECTION 233713 - DIFFUSERS, REGISTERS AND GRILLES

### PART 1 - GENERAL

#### 1.1 REFERENCE

##### A. SCOPE OF WORK

1. Provide diffusers and appurtenances with size and capacities as shown on drawings.

#### 1.2 SUBMITTALS

##### A. Product Data: For each 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 Schedule: Indicate drawing designation, room location, quantity, model number, size and accessories furnished.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

##### A. Manufacturers: Subject to compliance with requirements, provide products by one (1) of the manufacturers specified:

1. Price (Basis of Design)
2. Krueger
3. Titus
4. Anemostat

#### 2.2 SQUARE PLAQUE FACED CEILING DIFFUSERS

- ##### A.
- Ceiling diffusers of sizes and mounting types designated by the plans and air device schedule. Diffusers shall consist of a precision formed back cone of one piece seamless construction which incorporates a round inlet collar of sufficient length for connecting rigid or flexible duct. An inner plaque assembly shall be incorporated that drops no more than 1/4" below the ceiling plane to assure proper air distribution performance. The inner plaque assembly shall be completely removable from the diffuser face to allow full access to any dampers or other ductwork components located near the diffuser neck. The diffuser is to include an integral opposed blade damper that is adjustable from the face of the air device. Finish shall be white powder coat.

#### 2.3 SUPPLY REGISTERS

- ##### A.
- Supply registers of the sizes and mounting types indicated on the plans and outlet schedule. Registers shall be double deflection type with two sets of fully adjustable deflection blades spaced 3/4" on center. The front set of blades shall run parallel to the short or long dimension of the register as indicated in the air device schedule. The integral volume control damper shall be of the opposed blade type and shall be constructed of cold rolled steel. The damper shall be operable from the register face. The damper shall be coated steel. Registers are to be suitable for surface mounting or duct mounting as indicated on the drawings. Registers mounted in walls shall have

steel plaster frames. Provide 1-1/4 " margin with countersunk screw mounting for drywall and masonry surfaces complete with mounting frame. Units in equipment rooms shall be a mill finish. All other registers shall have a white powder coat finish.

#### 2.4 HEAVY DUTY BAR TYPE RETURN REGISTER AND GRILLES

- A. Exhaust registers of the sizes and mounting types indicated on the plans and outlet schedule. Registers shall be 45 degree deflection fixed louver type with blades spaced 3/4" on center. The outlet shall have 14 gauge steel blades and heavy duty steel support bars and frame. Blades shall run parallel to the long dimension of the register. The integral volume control damper shall be of the opposed blade type and shall be constructed of cold rolled steel. The damper shall be operable from the register face. The damper shall be coated steel. Registers mounted in walls shall have steel plaster frames. Provide 1-1/4 " margin with countersunk screw mounting for drywall and masonry surfaces complete with mounting frame. All registers shall have a white powder coat finish.

#### 2.5 EGGCRATE GRILLES AND REGISTERS

- A. Exhaust registers and grilles of the sizes and mounting types indicated on the plans and air device schedule. Units shall be of aluminum construction, consisting of aluminum 1/2" x 1/2" x 1/2" eggcrate core and an extruded aluminum border. Units designated as registers shall be equipped with integral volume control damper of the opposed blade type and shall be constructed of heavy gauge cold rolled steel. The damper shall be operable from the register face. The damper shall be coated steel. Units in equipment rooms shall be a mill finish. All other units shall have white powder coat finish.

#### 2.6 SOURCE QUALITY CONTROL

- A. Verification of Performance: Rate diffusers, registers and grilles according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine areas where diffusers 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 and air devices 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 practicable. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of

final location.

- C. Install diffusers and air devices 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 and air devices to air patterns indicated, or as directed before starting air balancing.

END OF SECTION 233713

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## SECTION 250000 – INTEGRATED AUTOMATION

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. This Section includes a summary of all Integrated Automation which is principally Direct Digital Control (DDC System) related work.
- B. Related Sections:
  - 1. 250501 – Common Work Results for Integrated Automation
  - 2. 250990 – Sequence Of Operation
- C. Work by Others:
  - 1. The following work will be done by other contractors, as specified under respective headings, which this contractor shall read to ascertain what is called for therein:
    - a. HVAC
    - b. Electric
  - 2. The Integrated Automation Work shall be a subcontract to the HVAC Contractor.

#### 1.3 GENERAL

- A. This contract shall include the furnishing of all labor and materials required for the installation of new temperature regulating systems to monitor, control, and regulate automatically and completely the new and renovated systems, as shown on the accompanying drawings and hereinafter specified. The temperature control equipment shall be installed by trained mechanics and technicians employed by the manufacturer and working in conjunction with the other contractors.
- B. Bids for the temperature control work, hereinafter specified, shall be based upon a Siemens direct digital control system with electronic sensors for indication and control functions, electrically actuated devices including new valves, etc., and all connections to sensors and actuated devices. All bidders of controls shall comply with this specification and shall provide any additional labor, hardware, software, programming, network integrators, etc., to communicate with, control and display graphically the new systems.
- C. Provide a complete, neat and workmanlike installation. Use only manufacturer employees who are skilled, experienced, trained, and familiar with the specific equipment, software, standards and configurations to be provided for this project.
- D. The BMS as provided shall incorporate, at minimum, the following integrated features, functions and services:

1. Operator information, alarm management and control functions.
2. Enterprise-level information and control access.
3. Information management including monitoring, transmission, archiving, retrieval, and reporting functions.
4. Diagnostic monitoring and reporting of BMS functions.
5. Offsite monitoring and management access.
6. Energy management.
7. Standard applications for terminal HVAC systems.

E. Acceptable Manufacturers and Installers:

1. Siemens Controls.
2. ASA.

F. The BMS Contractor shall be a recognized national manufacturer, installer and service provider of BMS. The BMS Contractor shall have a branch facility within a 50-mile radius of the job site supplying complete maintenance and support services on a 24 hour, 7-day-a-week basis.

G. The Building Management System architecture shall consist of the products of a manufacturer regularly engaged in the production of Building Management Systems, and shall be the manufacturer's latest standard of design at the time of bid.

H. The new systems shall be complete with all piping connections, switches, relays, wiring, or other devices required to accomplish the required results. All control devices shall be of the manufacturer's best construction. Complete shop drawings of the control system shall be submitted for approval. Contractor shall become thoroughly familiar with interconnections, with equipment specified under other sections of this specification including electric work, and all work furnished by the Direct Digital Control Contractor shall be coordinated therewith.

#### 1.4 PROJECT CONDITIONS

A. Alterations and Additions to DDC Systems

1. The contract shall include new work as shown, specified, or required, and shall include, but not limited to, the following principle components:
  - a. Provide complete system for control of all equipment and systems as specified herein for Base Bid and Alternate Bids.
  - b. Furnish and install all requisite wells and devices for temperature, pressure, alarm, indication, etc.

B. Shop Drawings

1. As soon as possible after award of the contract, and prior to fabrication, the contractor shall prepare complete shop drawings of the DDC systems, which shall in general conform to the bidding documents; any deviations deemed necessary by the contractor shall be noted and agreed upon prior to starting the work.
2. In preparing his working drawings, the contractor shall coordinate the location of all equipment and devices with the other contractors. Drawings shall show ceiling grids, lights, registers, grilles, heat detection devices, access panel, skylights, etc. Any changes in fabricated DDC layout occasioned by lack of coordination shall be made by the contractor at no change in the contract price.

3. Drawing shall be on 11" x 17" or 18" x 24" sheets at the contractor's option.
  4. All submittals shall be in PDF format and routed through the Engineer.
  5. The submittals shall include control diagrams of all equipment that is to be controlled, monitored, etc. The submittal shall include all of the control information for terminal units, variable frequency drives, etc.
  6. The contractor shall implement all control sequences specified and indicated on the input/output schedules.
  7. Each input/output device shall have a unique identifier which shall be permanently labeled on or adjacent to the device. The unique identifier shall be labeled on the various submittals as well.
- C. Restoration Of Surfaces
1. Refer to Division 01.
- D. Guarantee
1. This contractor shall guarantee all workmanship, materials, and equipment entering into this contract for a period of two years; all from date of substantial completion or from the "recognized" start-up date, whichever is later. Should the Owner elect to accept a portion of work prior to the date of substantial completion, the guarantee period for the accepted portion of the work shall commence on the date of acceptance or on the "recognized" start-up date for that portion of the work, whichever is later. If the specifications dictate a different period of guarantee for a given component or piece of equipment, the more stringent requirements shall govern.
  2. The "recognized" start-up date shall be defined as that date on which the contractor has successfully completed all phases of his work, including the following:
    - a. Submitted and received approval of three (3) copies of the Instruction Booklets.
    - b. Submitted complete "As-Built" drawings.
    - c. Completed all testing, cleaning, adjusting, and trial run. This testing shall include the successful completion of all commissioning tasks.
  3. In the case where the Engineer is accepting a portion of the work, the contractor shall have completed all phases of that portion of the work to be accepted, including Items above, for that accepted portion of the work.
  4. Any workmanship, materials, or equipment proving to be defective during this guarantee period shall be made good by this contractor without additional cost to the Owner.
- E. Equipment
1. Any and all costs associated with piping, electric, wiring, conduit, supports, pads, or other modifications to accommodate installation for manufacturer's equipment that differs from equipment layout on drawings shall be included on contractor's bid. The contractor is responsible to insure that the equipment will fit within space allocated with appropriate clearances for maintenance, operation, servicing, and code.
- F. Schedule
1. The contractor shall be responsible to meet the project schedule as stated by the Owner. The contractor shall include in his bid the cost associated with all requisite coordination.



2. In addition, the contractor must prepare a schedule for his work that integrates with the Mechanical Contractor's schedule. The contractor shall update progress and revise schedule at least twice monthly.
3. This contractor shall be responsible to expedite any materials and work any overtime in order to meet the schedule. The cost for any expediting of overtime work shall be included in his bid.

#### 1.5 FUNCTIONAL PERFORMANCE TEST

- A. The Functional Performance test (FPT) shall be executed by the Contractor and approved by the Owner. If the project is phased, then a separate test plan shall be executed for each phase. Use FPT sample procedures, designated by the Commissioning Agent, as a guide to creating the test plan spreadsheets.
- B. Obtain written approval of the Functional Performance Test plan for each phase of testing before beginning that phase of testing. Give the Commissioning Agent written notification of planned testing at least 30 days prior to the test but not before completion of any test and balance (TAB) requirements have been completed. Notification shall be accompanied by the proposed test procedure, a verified Pre-performance Testing Checklist, and a written estimated time table required to perform the test. After the written notification is received, the Commissioning Agent shall convene a meeting with the Contractor and the Owner at least 14 days prior to testing. In no case will the Contractor be allowed to start testing without written Owner approval of the Functional Performance Test plan.
- C. Demonstrate compliance of the heating, ventilating, and air conditioning control system with the contract documents including proper labeling of controls and wiring. Furnish personnel, equipment, instrumentation, and supplies necessary to perform calibration and site testing. Ensure that test personnel are regularly employed in the testing and calibration of DDC systems.
- D. Functional Performance testing will include, but not be limited to, workstation operations, calibration results for input and output devices required by manufacturer, proper tuning of control loops, and ensuring proper execution of the sequence of operation. Use the BACnet protocol analyzer during the performance testing to demonstrate communications reliability.
- E. The Pre-performance Testing Checklist shall be used as the Contractor's guide to prepare for the FPT and to guide discussions at the pre-performance test meeting between the Contractor and the Owner. Every item on the check list shall be validated by the Contractor's QC representative prior to the test meeting.
- F. Verify all workstations, notebook computers, and maintenance personnel interface tools have been delivered, all system and database software installed, and graphic pages created for each workstation and notebook computers. Notify the Owner when phone lines or network connections are needed at least 30 days prior to installation of the workstation.
  1. Verify integrity/safety of all electrical connections.
  2. Verify proper communications over network segments and between controllers.
  3. Coordinate with TAB contractor to obtain control settings that are determined from balancing procedures.

4. Test, calibrate, and set all digital and analog sensing and actuating devices as required.
  5. Check and set zero and span adjustments for all actuating devices as required.
  6. Check each digital controller for stand-alone operation by temporarily removing from the network.
  7. Check proper sequences have been installed and tested.
  8. Check all control loops have been properly tuned.
  9. Check all alarms are programmed and routed to their proper destination.
  10. Check all trends are operating for each item marked for trending on the points list.
  11. Check all schedules are operating for each item marked for schedules on the points list.
  12. Complete all "as-built" record drawings and I/O points list.
- G. The test procedure reporting documents shall be developed by the Contractor and based specifically on the control system installed in a spread sheet format allowing sufficient space for individual testing of each area of the control system. List the test procedure and the expected response for each piece of equipment and system in each test area specified. Develop a separate row or column for each item that is required to be "demonstrated" within a test area. Allow ample space for comments, pass, fail, and retest lines. Each area of testing shall have four signature lines, one for the Contractor's QC representative, the Contractor's FPT administrator, the Commissioning Agent representative, and the Owner to acknowledge successful completion for each test area. Include references to the paragraph number or drawing number in the contract documents for each item or group of items to be tested. BACnet protocol analyzer test results shall be included with the test reporting. During and after completion of the Functional Performance Test, identify, determine causes, replace, repair or calibrate equipment that fails to meet the specification, and submit a written report to the Owner.
- H. Document all tests with detailed test results. Explain in detail the nature of each failure and corrective action taken. Provide a written report containing test documentation after the Functional Performance Test. Schedule a meeting with the Owner to present the results to the Owner after all failures have been corrected. Based on the report and test review meeting, the Owner will determine the successful completion of the testing. If retesting of any portion of the FPT is required, do not retest until after receipt of written notification by the Owner. At the conclusion of retest, assessment will be repeated. The Owner reserves the right to require retesting of 100 percent on every component in the system when results from sampled areas are found deficient. Final test results will be submitted in electronic format on CD media.
- I. Using the completed shop drawings and the FPT spreadsheet, conduct the performance verification test to demonstrate workstations and network communications are operating correctly, control system maintains set points, control loops are tuned, and controllers are programmed for the correct sequence of operation. The test report shall include the required four authorization signatures for successful completion of each test area. Test areas may have several sub-areas and each shall be fully satisfied to receive approval. Specifically the FPT consists of the individual test areas below and shall demonstrate the following:

- J. Controller Capability, Accessibility, and Labeling
  - 1. Memory: Demonstrate that programmed data, parameters, and trend/alarm history collected during normal operation is not lost due to power failures.
  - 2. Direct Connect Interface: Demonstrate the ability to connect directly to each type of digital controller with a notebook computer. Demonstrate that maintenance personnel interface tools perform as specified in the Manufacturer's technical literature.
  - 3. Wiring and AC Power: Demonstrate the ability to disconnect any controller safely from its power source using the AC Power Table.
  - 4. Demonstrate the ability to match wiring labels easily with the control drawings. Demonstrate the ability to locate a controller's location using the riser communications diagram in the control drawings.
  - 5. Nameplates and Tags: Demonstrate the nameplates and tags bearing device unique identifiers are accurate and permanently attached to HVAC the control panel doors and back plates. Demonstrate that plastic or metal tags have the correct equipment name and point identifier.
  
- K. Workstation and Software Operation
  - 1. For Owner's existing operators workstation (OWS) and notebook computer:
    - a. Verify that the correct software has been installed and licensed with the latest revisions available, delivery of all associated peripheral components are installed correctly, CD installation media including system restore disks are delivered, and the on-site warranty has been properly registered with the manufacturer. For each existing user workstation or notebook computer specified for upgrade, verify that all hardware and software upgrades have been installed and licensed correctly.
    - b. Demonstrate that point's lists are generated as specified and conform to the proper naming conventions.
    - c. Demonstrate that graphics are complete, resolution size fills the workstation or notebook computer screen areas without scrolling and the operator can navigate successfully to every mechanical system and zone.
    - d. Demonstrate the UPS backup maintains power for the specified time on the workstation during a power failure and can recover automatically after an extended power loss when the UPS battery has drained.
  - 2. BACnet Communications and Interoperability Areas
    - a. Demonstrate proper functioning of the five interoperability areas of data sharing, alarm and event management, trending, scheduling, and device and network management. Use the BACnet protocol analyzer to demonstrate that communications are free from errors and that devices from different manufacturers are interoperable. These requirements shall be met even if there is only one manufacturer's equipment installed.
  
- L. Alarm and Event Management
  - 1. Alarm Lists - Demonstrate that alarms are installed and configured to detect alarms and events for the points indicated in the system drawings and are prioritized according to the standardized list designated by the Owner. Demonstrate system alarms, such as offline controllers are generated. Demonstrate software logic has been set up to avoid nuisance alarms, e.g., no temperature or status alarms shall be generated when fan systems are not running, or during start-up and shut-down transitions. Demonstrate that delays between the occurrence of an alarm condition and its annunciation are

adjustable. Demonstrate alarms appear at any local workstation within 5 seconds over a web-based browser connection and 15 seconds on a dial-up modem connection. Demonstrate workstations display an alarm message window that appears on top of any other open windows and alarm message window has a distinctive color and appearance to attract the operator's attention. Demonstrate alarms that require operator acknowledgment and cause the alarm window to remain active until such an acknowledgment is received and when multiple alarms are received, unacknowledged alarms shall be displayed on a first-come first-served basis grouped by priority, with the highest priority alarms displayed first.

2. Alarm Parameter Adjustment - Demonstrate the ability for operators (with sufficient privilege) to change alarm parameters for all standard BACnet event types.
3. Alarm Routing Adjustment - Demonstrate the ability for operators (with sufficient privilege) to change alarm routing (BACnet notification classes) for each alarm including the destination for each type of alarm and alarm priority, the day of week and time of day, and the type of transition involved (TO-OFFNORMAL, TO-NORMAL, etc.).

M. Scheduling

1. Schedule Lists - Demonstrate that schedules are installed and configured start/stop, mode change, and night setback schedules as defined in the sequence of operations including holidays. Demonstrate the ability to program alterations to programmed operating schedules based on the priority of events, including the ability to temporarily override the programmed schedule of equipment. Demonstrate operational override of a programmed schedule shall be for a specific duration following which the schedule shall revert back to the preprogrammed schedule.
2. Display of Start/Stop Times and Actions - Demonstrate the ability to inspect the content of any schedule and determine the specific control actions that will occur at any time, on any date.
3. Modification of Schedules - Demonstrate that all calendar entries and schedules shall be modifiable from any local workstation by an operator with sufficient privilege.

N. Trending

1. Archival Storage of Data - Demonstrate that archival storage of data will be handled by the operator workstation/server. Demonstrate that local trend archiving and display can be accomplished through the use of BACnet Trend Log objects.
2. Modification of Trend Log Parameters - Demonstrate that an operator with sufficient privilege shall be able to change the data points to be logged, the sampling rate, and the duration of a trend log.

O. Device and Network Management

1. Display of Device Status Information - Operators shall be able to display at any time the operational status of any device on the network.
2. Display of BACnet Object Information - Operators shall be able to display at any time any property of any BACnet object. Operators shall be able to display property values of objects grouped by object type, object location, and building system.

3. Silencing Devices that are Transmitting Erroneous Data -Operators shall be able to direct a field device to stop transmitting event, alarm, or COV notifications until a subsequent command to resume transmissions is received.
  4. Time Synchronization - Operators shall be able to set the time and date in any device on the network that supports time-of-day functionality. The operator shall be able to select to set the time and date for an individual device or all devices on a single local network.
  5. Remote Device Re-initialization - Operators shall have the ability to issue re-initialization commands to any device that supports remote reinitialization.
  6. Backup and Restore - Operators shall have the ability to backup and restore all BACnet devices on the network that support this capability.
- P. Execution of Sequence of Operation - Demonstrate the HVAC system operates properly through the complete sequence of operation. Insert the complete sequence of operation into the PVT spreadsheet with spaces between each line to allow for observations and comments.
- Q. Control Loop Stability and Accuracy - Furnish the Owner graphed trends of control loops to demonstrate the control loop is stable and that setpoint is maintained. Control loop response shall respond to setpoint changes of 10 percent and stabilize in 3 minutes or less. Control loop trend data shall be in real time and the time between data points shall not be greater than one minute.
- R. Stand-alone Capability - Demonstrate stand-alone controller capability for each central mechanical system, each air handler, and each zone. Zones with identical controllers and identical sequences may be randomly tested one controller per zone. Controllers shall provide stable and reliable stand-alone operation using default values or other method for values normally read over the network. Verify that a system alarm is generated indicating the communications failure for each controller in a stand-alone state.
- S. Graphics Update – Update graphics for all work for Edgecliff Building(new and existing).

## 1.6 ELECTRONIC SENSORS

- A. Description: Vibration and corrosion resistant for wall, immersion or duct mounting, as required.
- B. Room Sensor Cover Construction: Manufacturer's standard locking covers.
  1. Set-Point Adjustment: Exposed.
  2. Set-Point Indication: Exposed.
- C. Room sensor accessories, include the following:
  1. Insulating Bases: For sensors located on exterior walls.
  2. Guards: Locking, solid metal, ventilated for public spaces.
  3. Adjusting Key: As required for calibration and cover screws.

## 1.7 GAS DETECTION EQUIPMENT

- A. Manufacturers:
  - 1. B. W. Technologies.
  - 2. Ebtron, Inc.
  - 3. INTEC Controls, Inc.
  - 4. I.T.M. Instruments Inc.
  - 5. TSI Incorporated.
  - 6. Vaisala.
  - 7. Vulcain Inc.
  
- B. Carbon Dioxide Sensor and Transmitter: Single detectors using solid-state infrared sensors; suitable over a temperature range of 23 to 130 deg F and calibrated for 0 to 2 percent, with continuous or averaged reading, 4- to 20-mA output;, for wall mounting.

## 1.8 ACTUATORS

- A. Electronic Actuators: Direct-coupled type designed for minimum 60,000 full-stroke cycles at rated torque.
  - 1. Manufacturers:
    - a. Belimo Aircontrols (USA), Inc. or equal.
  - 2. Valves: Size for torque required for valve close off at maximum pump differential pressure.
  - 3. Dampers: Size for running torque calculated as follows:
    - a. Parallel-Blade Damper with Edge Seals: 7 inch-lb/sq. ft. of damper.
    - b. Opposed-Blade Damper with Edge Seals: 5 inch-lb/sq. ft. of damper.
    - c. Parallel-Blade Damper without Edge Seals: 4 inch-lb/sq. ft. damper.
    - d. Opposed-Blade Damper without Edge Seals: 3 inch-lb/sq. ft. of damper.
    - b. Dampers with 2- to 3-Inch wg of Pressure Drop or Face Velocities of 1000 to 2500 fpm: Increase running torque by 1.5.
    - c. Dampers with 3- to 4-Inch wg of Pressure Drop or Face Velocities of 2500 to 3000 fpm: Increase running torque by 2.0.
  - 4. Coupling: V-bolt and V-shaped, toothed cradle.
  - 5. Overload Protection: Electronic overload or digital rotation-sensing circuitry.
  - 6. Fail-Safe Operation: Mechanical, spring-return mechanism. Provide external, manual gear release on nonspring-return actuators.
  - 7. Power Requirements (Two-Position Spring Return): 24 or 120-V ac.
  - 8. Power Requirements (Modulating): Maximum 10 VA at 24-V ac or 8 W at 24-V dc.
  - 9. Proportional Signal: 2- to 10-V dc or 4 to 20 mA, and 2- to 10-V dc position feedback signal.
  - 10. Temperature Rating: Minus 22 to plus 122 deg F.
  - 11. Temperature Rating (Smoke Dampers): Minus 22 to plus 250 deg F.
  - 12. Run Time: 12 seconds open, 5 seconds closed.

## 1.9 CONTROL VALVES

- A. Manufacturers:
  - 1. Siemens Building Technologies, Inc.
  
- B. Hot Water and Chilled Water Control Valves

1. Control valve shall be globe or ball style with equal percentage flow characteristics.
  2. Sizing:
    - a. The valve shall be sized to have control authority over the coil branch circuit. Valve authority shall be between 0.25 and 0.5 as defined by pressure drop at valve full open divided by pressure drop of full circuit with valve full open.
    - b. Select the control valve using the Cv of the control valve to be as close to or one size higher than the Cv of the rest of the circuit. The Cv of the rest of the circuit defined by the design flow of the coil (gpm) divided by the square root of the cumulative pressure drops in the circuit, such as coil, piping, fittings, isolation valves, balancing valves, triple duty valves, strainers, etc.
    - c. Four pipe fan coil valves shall be pressure independent control valves as described below in this section.
    - d. Air handler chilled water control valve shall be a three way modulating valve sized for the revised flow requirements as indicated on the plans.
- C. Hydronic system globe valves shall have the following characteristics:
1. NPS 2 and Smaller: Class 125 bronze body, bronze trim, rising stem, renewable composition disc and screwed ends with backseating capacity repackable under pressure.
  2. NPS 2-1/2 and Larger: Class 125 iron body, bronze trim, rising stem, plug-type disc, flanged ends and renewable seat and disc.
  3. Internal Construction: Replaceable plugs and stainless-steel or brass seats.
  4. Sizing: 3-psig maximum pressure drop at design flow rate or the following:
    - a. Two-Way Modulating: Either the value specified above or twice the load pressure drop, whichever is more.
    - b. Three-Way Modulating: Twice the load pressure drop, but not more than value specified above.
  5. Flow Characteristics: Two-way valves shall have equal percentage characteristics; three-way valves shall have linear characteristics.
  6. Close-Off (Differential) Pressure Rating: Combination of actuator and trim shall provide minimum close-off pressure rating of 150 percent of total system (pump) head for two-way valves and 100 percent of pressure differential across valve or 100 percent of total system (pump) head.
- D. Ball Valves
1. Ball valves shall meet "general" specifications above.
  2. Full port ball valves shall only be used for isolation or 2-position on-off control.
- E. Butterfly Valves: 200-psig, 150-psig maximum pressure differential, ASTM A 126 cast-iron or ASTM A 536 ductile-iron body and bonnet, extended neck, stainless-steel stem, field-replaceable EPDM or Buna N sleeve and stem seals.
1. Body Style: Lug.
  2. Disc Type: Aluminum bronze.
  3. Sizing: 1-psig maximum pressure drop at design flow rate.
- F. Terminal Unit Control Valves: Bronze body, stainless steel trim, two ports as indicated, ball valves replaceable plugs and seats, and union and threaded ends.
1. Rating: Class 125 for service at 125 psig and 250 deg F operating conditions.

2. Sizing: 3-psig maximum pressure drop at design flow rate, to close against pump shutoff head.
3. Flow Characteristics: Two-way valves shall have equal percentage characteristics; three-way valves shall have linear characteristics.

PART 2 – PRODUCTS (NOT APPLICABLE)

PART 3 – EXECUTION (NOT APPLICABLE)

END OF SECTION 250000

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## SECTION 250501 – COMMON WORK RESULTS FOR INTEGRATED AUTOMATION

### 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. Integrated Automation equipment coordination and installation.
  - 2. Sleeves for raceways and cables.
  - 3. Sleeve seals.
  - 4. Grout.
  - 5. Common Integrated Automation installation requirements.
- B. Related Sections:
  - 1. 250000 – Integrated Automation
  - 2. 250990 – Sequence Of Operation

#### 1.3 DEFINITIONS

- A. EPDM: Ethylene-propylene-diene terpolymer rubber.
- B. NBR: Acrylonitrile-butadiene rubber.

#### 1.4 SUBMITTALS

- A. Product Data: For sleeve seals.

#### 1.5 COORDINATION

- A. Coordinate arrangement, mounting, and support of Integrated Automation equipment:
  - 1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
  - 2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
  - 3. To allow right of way for piping and conduit installed at required slope.
  - 4. So connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.
- B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.
- C. Coordinate location of access panels and doors for Integrated Automation items that are behind finished surfaces or otherwise concealed. Access doors and panels are specified in Division 08 Section "Access Doors and Frames."

- D. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping".

## PART 2 - PRODUCTS

### 2.1 SLEEVES FOR RACEWAYS AND CABLES

- A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.
- B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- C. Sleeves for Rectangular Openings: Galvanized sheet steel.
  - 1. Minimum Metal Thickness:
    - a. For sleeve cross-section rectangle perimeter less than 50 inches and no side more than 16 inches, thickness shall be 0.052 inch.
    - b. For sleeve cross-section rectangle perimeter equal to, or more than, 50 inches and 1 or more sides equal to, or more than, 16 inches, thickness shall be 0.138 inch.

### 2.2 SLEEVE SEALS

- A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.
  - 1. Basis-of-Design Product: Subject to compliance with requirements, provide one of the following:
    - a. Advance Products & Systems, Inc.
    - b. Calpico, Inc.
    - c. Metraflex Co.
    - d. Pipeline Seal and Insulator, Inc.
  - 2. Sealing Elements: EPDM interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
  - 3. Pressure Plates: Carbon steel. Include two for each sealing element.
  - 4. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

### 2.3 GROUT

- A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

## PART 3 - EXECUTION

### 3.1 COMMON REQUIREMENTS FOR INTEGRATED AUTOMATION INSTALLATION

- A. Comply with NECA 1.

- B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.
- C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.
- D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both Integrated Automation equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.
- E. Right of Way: Give to piping systems installed at a required slope.

### 3.2 SLEEVE INSTALLATION FOR INTEGRATED AUTOMATION PENETRATIONS

- A. Integrated Automation penetrations occur when raceways, pathways, cables, wireways, or cable trays penetrate concrete slabs, concrete or masonry walls, or fire-rated floor and wall assemblies.
- B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.
- C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
- D. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.
- E. Cut sleeves to length for mounting flush with both surfaces of walls.
- F. Extend sleeves installed in floors 2 inches above finished floor level.
- G. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and raceway or cable, unless indicated otherwise.
- H. Seal space outside of sleeves with grout for penetrations of concrete and masonry
  1. Promptly pack grout solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect grout while curing.
- I. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Division 07 Section "Joint Sealants".
- J. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway and cable penetrations. Install sleeves and seal raceway and cable penetration sleeves with firestop materials. Comply with requirements in Division 07 Section "Penetration Firestopping."

- K. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.
- L. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- M. Underground, Exterior-Wall Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch annular clear space between raceway or cable and sleeve for installing mechanical sleeve seals.

### 3.3 SLEEVE-SEAL INSTALLATION

- A. Install to seal exterior wall penetrations.
- B. Use type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

### 3.4 FIRESTOPPING

- A. Apply firestopping to penetrations of fire-rated floor and wall assemblies for Integrated Automation installations to restore original fire-resistance rating of assembly.

END OF SECTION 250501

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## SECTION 250990 – SEQUENCE OF OPERATION

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. This Section includes a summary of all Integrated Automation which is principally Direct Digital Control (DDC System) related work.
- B. Related Sections:
  - 1. 250000 – Integrated Automation
  - 2. 250501 – Common Work Results for Integrated Automation

#### 1.3 SUMMARY OF WORK

- A. This contract shall include the furnishing of all labor and materials required for the installation of new temperature regulating systems to monitor, control, and regulate automatically and completely the new and renovated air conditioning, ventilating, hydronic and heating systems, as shown on the accompanying drawings and hereinafter specified. The temperature control equipment shall be installed by trained mechanics and technicians employed by the manufacturer and working in conjunction with the other contractors.
- B. The Integrated Automation Contractor shall extend all requisite power and control wiring in conduit to the devices, equipment, panels, workstation, servers, etc. that are provided under their contract.
- C. The Integrated Automation Contractor shall provide all interface equipment required for interconnectivity of their system to the equipment, panels, servers, workstation, meters, etc. that are part of the Owner's system.
- D. The Integrated Automation Contractor shall coordinate installation of all devices, meters, sensors, etc. with other contractors and their systems.

#### 1.4 CONTROLS FOR MODIFICATIONS TO EXISTING DUAL TEMPERATURE WATER SYSTEM

- A. Dual temperature water system with two sets of two (2) variable speed pumps (two (2) at Schmidt Hall and two (2) at Edgecliff Hall) and supply and return piping to circulate varying quantities of chilled water or hot water from campus loop to multiple fan coil units and air handling units throughout the building.
- B. Existing temperature sensors.

1. In the supply and return water piping to the building (Quantity: 4, 2 in two locations(two (2) at Schmidt Hall and two (2) at Edgecliff Hall)).
  - C. Existing differential pressure transmitter.
    1. In the building, between dual temperature supply and return water mains.
  - D. Changeover Valves
    1. New automatic electronic changeover valves (3” and 4”) shall be installed in chilled water supply and return and hot water supply and return piping for both Edgecliff Hall and Schmidt Hall (Total Qty.: 8 Valves).
  - E. Operation of Controls
    1. Existing dual temperature water pumps for Schmidt Hall and Edgecliff Hall will continue to operate as have been. No. 1 or No. 2 for each building shall operate at all times (other pump is standby and will be started by DDC controller if lead pump fails). In order to maintain equal runtime on each dual temperature water pump, DDC controller shall determine order in which pumps shall operate by performing an automatic lead change on a monthly basis.
    2. All season operation: When either dual temperature water pump is operating, DDC controller, receiving signal from differential pressure transmitter located in building supply and return mains piping, shall provide speed signal to pump speed controller. Speed controller shall in turn, vary pump speed in order to maintain constant differential pressure in dual temperature water mains.
    3. Summer operation: Chilled water will be available for cooling from the campus chilled water piping loop. DDC controller shall position four (4) 2-way dual temperature water valves for each building to the chilled water position for normal chilled water flow to the building. In addition, DDC controller shall position the mixing/emergency shutoff valve located in the return water piping from the building to the fully open position. However, DDC controller receiving signal from temperature sensor located in the campus chilled water return water piping from the building shall override controls to completely shut the chilled water return valve if the temperature of the water in the chilled water return piping exceeds 120°F (DDC adjustable).
    4. Winter operation: Hot water will be available for heating from the campus hot water piping loop. When the season changes over from summer to winter mode, DDC controller shall position four (4) 2-way dual temperature water valves for each building to the hot water position for normal hot water flow to the building.
- 1.5 CONTROLS FOR NEW AND EXISTING VAV TERMINAL UNITS (EXISTING CONTROLS ON EXISTING TERMINAL UNITS WILL BE CHANGED OUT TO DDC.)
- A. Zone Controls:
    1. Each room will have its own individual control.
    2. All existing room variable air volume (VAV) terminal units shall use electronic damper valve actuators. The damper/valve actuators shall move in a smooth, steady progression without overloading the actuator in any way. The Direct Digital Control Contractor shall be responsible for properly sizing actuators to the torque requirements of each terminal unit damper and reheat valve. The speed of the actuator shall be appropriate to the application so that the control loop may be easily tuned. This Contractor shall be responsible for properly securing the

- actuator to the terminal box damper shaft. Electronic actuated valves shall be capable of being manually opened or closed.
3. Provide terminal equipment controllers (TEC's) as required for all variable air volume terminal boxes. Each TEC shall be a microprocessor based direct digital control unit and shall be capable of operating either as a stand-alone controller or on a multi-drop communications network originating at a direct digital controller at associated air handling unit direct digital controller. Provide each TEC with sufficient memory to operate independently supporting its own inputs and outputs, operating system, database and programs necessary to perform specified control sequences.
  4. An airflow sensor with multi-point, center averaging velocity sensors will be provided with each terminal unit. The multi-point sensor shall provide a representative average of the box total air flow at the box discharge, regardless of air flow profiles, assuring an accurate signal to the controller. The controller shall modulate the terminal damper actuator from the minimum to maximum CFM set points specified for each VAV terminal box. Provide test port openings in flow sensor tubing for local manometer readings of differential pressure across the pitot tube. After the new TEC controller is installed, the Test and Balance (TAB) Contractor will measure the actual air volume through the terminals as part of the commissioning and acceptance process. The Direct Digital Control Contractor shall then adjust the volume indication at the controller to the actual volume found at both the minimum and maximum setpoint of the terminal box.
  5. Each terminal equipment controller controlling space temperature shall be provided with a matching room temperature sensor. The sensor shall be an RTD providing the following minimum performance requirements:
    - a. Accuracy: 0.5 Degrees F.
    - b. Operating range: 35 Degrees F. to 115 Degrees F.
    - c. Setpoint range: 55 Degrees F to 95 Degrees F.
    - d. Modes: Occupied, Unoccupied, Heating, and Cooling.
    - e. Calibration adjustments: None.
    - f. Installation: Up to 100 ft. from controller.
  6. Each room temperature sensor shall include a terminal jack integral to the sensor assembly. The terminal jack shall be used to connect a portable laptop or similar operator's terminal to control and monitor all hardware and software points associated with the controller.
  7. The room temperature sensor shall include the following auxiliary devices:
    - a. Setpoint adjustment buttons/dial.
    - b. LCD temperature indicator.
    - c. Occupied override pushbutton.
  8. The setpoint adjustment dial or button shall allow for modification of the temperature setpoint by the occupant. Setpoint adjustment may be locked out, overridden or limited as to temperature or time of day through software by an authorized operator at an existing operator's workstation.
  9. Each controller shall perform its primary control function independent of other digital controllers on the network, network communication, or if the network communication is interrupted.
  10. Each controller shall include algorithms incorporating proportional, integral and derivative (PID) gains for all applications. All PID gains and biases shall be field adjustable by the user via a portable computer. Controllers that incorporate proportional, and integral (PI) control algorithms only, shall not be acceptable.

11. All user defined database information required for each terminal controller must be stored in the controller in non-volatile EEPROM or FLASH ROM. Terminal controller point/controller database information must also be stored at the direct digital controller to which terminal controller local area network is connected. The terminal controllers shall be able to return to full normal operation without user intervention after a power failure of unlimited duration.
12. Terminal controller's occupied/unoccupied setpoint shall be controlled by a CO2 sensor. For rooms without CO2 sensors, room terminal controller shall be provided with a time of day schedule to allow for 365 day advanced scheduling of rooms HVAC operation, (e.g. for common class and office schedules). All room schedules shall be located in the direct digital controller also serving the rooms associated air handler.
13. Each terminal controller shall have connection provisions for a portable laptop computer similar to the connection provided at the room temperature sensor as previously specified. The terminal may be used for readout of system variables, override control, adjustment of control parameters, air balancing, servicing and troubleshooting. The Direct Digital Control Contractor shall provide three copies of the terminal control interface software required to communicate with the terminal controller.
14. All communications and displays via the portable computer shall be in full English with accompanying English and SI units.
15. Terminal controller hardware inputs/outputs required:
  - a. Analog inputs:
    - 1) Terminal box discharge air velocity sensor.
    - 2) Terminal box discharge air temperature sensor.
    - 3) Room temperature sensor.
    - 4) Room temperature setpoint dial.
    - 5) Room CO2 sensor (Where indicated on the plans)
  - b. Analog (or three-point floating) outputs:
    - 1) Damper actuators.
    - 2) Reheat valve actuator.

## 1.6 SYSTEM INPUT/OUTPUT SCHEDULES

- A. Refer to Input/Output Schedule.

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**CONTROL SYSTEM POINTS - INPUT/OUTPUT SUMMARY  
FOR EDGECLIFF HALL  
XAVIER UNIVERSITY**

DEVICE MARK	CONTROL POINTS	INPUTS/OUTPUTS				CONTROL	MONITOR	ALARM	DATA	COMMENTS
		AI	DI	DO	AO					
	POINT NAME DESCRIPTION									
<b>VAV UNIT WITH HOT WATER HEAT:EXISTING</b>										
FM-1	FLOW MEASURING SENSOR	X					X			EXISTING DEVICE: PROVIDE NEW SENSOR
AAD-1	DAMPER				X	X				EXISTING DAMPER: PROVIDE NEW ACTUATOR
TT-1	SUPPLY AIR TEMPERATURE TRANSMITTER	X				X				NEW
CO2	CO2 SENSOR (WHERE APPLICABLE)	X				X				NEW
T-1	ROOM TEMPERATURE SENSOR	X				X				NEW
TCV	TEMPERATURE CONTROL VALVE				X	X				EXISTING VALVE, PROVIDE NEW ACTUATOR
<b>VAV UNIT WITH HOT WATER HEAT:NEW (ALT. BID 1)</b>										
FM-1	FLOW MEASURING SENSOR	X					X			PROVIDED WITH VAV BOX
AAD-1	DAMPER				X	X				PROVIDED WITH VAV BOX
TT-1	SUPPLY AIR TEMPERATURE TRANSMITTER	X				X				
CO2	CO2 SENSOR (WHERE APPLICABLE)	X				X				
T-1	ROOM TEMPERATURE SENSOR	X				X				
TCV	TEMPERATURE CONTROL VALVE				X	X				PROVIDE NEW VALVE AND ACTUATOR

## SECTION 260000 – ELECTRICAL WORK

### 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 a summary of all Electrical related work.
- B. Related Sections:
  - 1. 260400 – General Electrical Requirements
  - 2. 260500 – General Electrical Provisions
  - 3. 260510 – Apparatus Coordination, Inspection, and Testing
  - 4. 260519 – Wires and Cables
  - 5. 260526 – Grounding and Bonding
  - 6. 260529 – Supporting Devices
  - 7. 260533 – Raceway and Boxes
  - 8. 260534 – Junction and Pull Boxes
  - 9. 260535 – Raceway Fittings
  - 10. 260536 – Manufactured Sound and Vibration Control Components
  - 11. 260553 – Electric Identification
  - 12. 260923 – Lighting Control Devices
  - 13. 262726 – Wiring Devices
  - 14. 262730 – Taps, Splices, and Terminations
  - 15. 262816 – Enclosed Switches and Circuit Breakers
  - 16. 265100 – Interior Lighting

#### 1.3 DESCRIPTION

- A. The General Conditions, Special Conditions and Division 1 through Division 32, as set forth in these specifications, are hereby incorporated into and shall become a part of the specifications for work under this title, insofar as they apply hereto.
- B. Furnish material, labor, tools, accessories and equipment to complete and leave ready for operation all Electrical systems for this project as described in these specifications and as shown on the drawings, or as required.

#### 1.4 SCOPE OF WORK

- A. Work includes, but is not limited to:
  - 1. Installation of feeders and branch wiring including overload and disconnecting means.
  - 2. Installation of new Terminal boxes as part of Alternate Bid 1.
  - 3. Removal and Installation of all light fixtures through the building.
  - 4. Re-installation of existing equipment.

5. Wiring devices, multi-gang back boxes plates and supporting hardware and/or equipment.
6. Wiring of equipment and final connections of equipment furnished by others.
7. Required material and labor necessary to complete project scope as indicated within complete specifications, drawings or schedules

#### 1.5 EQUIPMENT

- A. Any and all costs associated with piping, electric, wiring, conduit, supports, pads, or other modifications to accommodate installation for manufacturer's equipment that differs from equipment layout on drawings shall be included on contractor's bid. The contractor is responsible to insure that the equipment will fit within space allocated with appropriate clearances for maintenance, operation, servicing, and code.

#### 1.6 QUALIFICATIONS

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

#### 1.7 LICENSES

- A. The installation of this Electrical work shall be made by Contractors and craftsmen licensed by the Governing Authorities.
- B. Obtain all permits, plan revisions, inspections, and licenses required by code authorities having jurisdiction.

#### 1.8 FEES

- A. The Owner will obtain and pay for the building permit. The Contractor shall obtain all inspections or additional permits required by all laws, ordinances, rules, regulations or public authority having jurisdiction and obtain certificates of such inspections and permits and submit same to the Architect. The Contractor shall pay all fees, charges and other expenses in connection therein for Electric work including inspection fees, etc. associated with the building permit.

#### 1.9 CODES, REGULATIONS AND STANDARDS

- A. Unless otherwise noted, the following latest enforced Edition shall apply to this work:  
Ohio Building Code  
National Fire Protection Association  
National Electrical Code  
Ohio Fire Code  
OSHA Requirements  
EPA Requirements

#### 1.10 QUALITY ASSURANCE

- A. The Electrical Contractor shall be responsible for all costs caused by the change of equipment from the basis of design specified to other named manufacturers. The

Contractor is responsible to insure that the other manufacturer named supplied equipment will fit within space allocated, with appropriate clearances for maintenance, operation, service, code requirements, etc. Any contractor utilizing a manufacturer other than basis of design shall be responsible for any additional requirements for electrical service, concrete pad size, physical space limitations, and capacities at no additional cost to the building Owner. If manufacturers are listed, no other manufactures except those listed within the Sections of this Division, that are able to comply with the contract document requirements and minimum standards of these specifications, will be acceptable.

- B. Work provided or performed by the Contractor shall be guaranteed to be replaced and made good at his own expense any defects which may develop, within one (1) year after final payment and acceptance by the building Owner, due to faulty workmanship or material, upon receipt of written notification of the defect from the building Owner.

#### 1.11 COORDINATION DRAWINGS

##### A. General:

1. The HVAC Contractor shall be in charge of the coordination drawing process and shall be responsible to resolve all conflicts and settle any disputes resulting from the coordination drawing process.
2. Contract drawings are diagrammatic. Included in the base bid shall be all offsets, fittings, etc. for a completed project.
3. Field discrepancies shall be resolved by the field foreman. When discrepancies cannot be resolved, the signed-off coordination drawings shall be re-examined for rights.
4. Documented, coordinated, dimensioned work will have precedence. Owner will not pay for rework of a particular trade. Uncoordinated work will not be tolerated.
5. Each Contractor shall coordinate the exact location of their work with the work of other trades prior to fabrication or installation of same. Verify all dimensions and elevations. Provide additional offsets and sections of material as may be required to meet the applicable job condition requirements. Coordinate with and review all related Construction Drawings and Shop Drawings of all equipment suppliers prior to start of work.
6. It is the responsibility of the Electric Contractor to coordinate between his equipment suppliers and his temperature control subcontractor and other subcontractors as to which control devices are supplied with equipment, required wiring and voltages, and other related coordination times, so as to ensure a complete, proper, and operable installation.

##### B. Electrical Contractor:

1. Conduits less than 1" in size are not required to be indicated on coordination drawings; however, the Electrical Contractor is responsible for routing these conduits in a manner to not cause a conflict with other trades. Conduits not indicated on coordination drawings shall be field offset to avoid all conflicts.

##### C. General Contractor:

1. All furrings and holes shall be clearly noted.
2. All ceiling heights shall be clearly noted.

D. Service Areas:

1. Contractors shall indicate service areas for all equipment, terminal units, etc. by shaded areas on drawings.

PART 2 – PRODUCTS (NOT APPLICABLE)

PART 3 – EXECUTION

3.1 EXISTING WORK

- A. Each Contractor shall locate existing site utilities, installed in previous phase, prior to beginning work. Provide adequate means of protection during work operations. Repair existing utilities damaged during work operations to the satisfaction of the utility owner and at Contractor's expense.
- B. Should uncharted or incorrectly charted piping or other utilities be encountered during work operations, notify the Engineer immediately for procedure directions. Cooperate with utility companies in maintaining active services and facilities in operation.

3.2 OPENING LOCATIONS AND CUTTING

- A. Each Contractor shall give the General Contractor locations and sizes of all openings required for the installation of new mechanical work before new walls, etc. are started.
- B. All cutting through poured concrete slabs and walls shall be done with core drills. No jack hammers will be allowed. All cutting and patching by General Contractor that is coordinated by the Electric Contractor. All cutting and patching not coordinated by the Electric Contractor with the General Contractor shall be by the Electric Contractor.

3.3 CLEANING AND PAINTING

- A. All equipment shall be kept dry and clean during the construction period.
- B. Prime and paint by General Contractor, unless otherwise noted.
- C. When all work is completed and all work has been satisfactorily tested and accepted by the Architect, mechanical equipment and other exposed surfaces shall be thoroughly cleaned.
- D. Repair marred and damaged factory painted finish with materials and procedures to match original factory finish.

3.4 PROTECTION AND DAMAGE

- A. In addition to the provisions and stipulation of the General Conditions, each contractor and subcontractor shall provide various types of protection as follows:
  1. Protect finished floors from chips and cutting oil by the use of metal drip receiving pan and oil proof floor cover.
  2. Protect equipment and finished surfaces from welding and cutting splatters with

- baffles and splatter blankets.
3. Protect equipment and finished surfaces from paint droppings, insulation adhesive and sizing droppings, etc. by use of drop cloths.
- B. All equipment shall be stored at the site with openings, bearings, etc., covered to exclude dust and moisture. All stock piled pipe shall be placed on dunnage and protected from weather and from entry of foreign material.
- C. Conduit and construction openings and excavations required for Electrical work shall be covered when work is not in progress as follows:
1. Cap pipe openings with fittings or plugs.
  2. Cover wall and ceiling openings with plywood, or canvas covered framing.
  3. Cover floor openings and excavations with structural material of adequate strength to support traffic.
- D. The Owner's property and the property of other Contractors shall be scrupulously respected at all times (including damage from leaks). Provide drop cloths and visqueen or similar barriers where dust and debris is generated, to protect adjacent area.
- E. Contractor shall be held responsible for damage caused by his work or through neglect of his workmen. Repairing of damaged work shall be done by Contractor as directed by the Architect. Cost of repairs shall be paid by Contractor.
- F. The Owner reserves the right to make emergency repairs as required to keep equipment in operation without voiding the Contractor's guarantee bond not relieving the contractor of his responsibilities during the bonding period.

END OF SECTION 260000

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## SECTION 260400 – GENERAL ELECTRICAL REQUIREMENTS

### PART 1 - GENERAL

#### 1.1 GENERAL

- A. The following paragraphs are applicable to Division 26 and are complementary to other sections of specifications. Where items described in other sections of the specifications are repeated herein, it is done to call special attention to or to qualify them, but it is not intended that any part of the documents shall be assumed to be omitted if not repeated herein.
- B. Where contradictions occur between this section and Division 1, the most stringent of the two shall apply. Architect/Engineer shall decide which is most stringent.

#### 1.2 DRAWINGS AND SPECIFICATIONS

- A. Electrical drawings are diagrammatic and indicate general arrangement of systems and work included in the contract and shall be adhered to insofar as possible. The drawings and specifications are complementary and are intended, without giving every minute detail, to cover a workable installation complete in every respect including, whether mentioned or not, all material and equipment usually furnished with such systems and/or needed to make a complete operational installation omitting only such parts as are specifically excepted.
- B. Consult drawings and details for exact location of fixtures and equipment, and where not definitely indicated, request this information in writing.
- C. The specification for this division of the work is written in sectional form for brevity and convenience in reference, without repeating in each section all applicable general clauses and/or pertinent data covered elsewhere in the specification, but it is not intended that any of the documents shall be assumed to be omitted if not repeated in this division.
- D. Where specifications are written for brevity, with incomplete sentences, the omission of words or phrases, such as "this contractor shall", "shall be", "provide", "furnish", "all", etc. are intentional and such omitted words or phrases shall be supplied by inference; unless otherwise mentioned, such clauses, lists, and/or directives indicate work to be done by this contractor for that specific branch of work.

#### 1.3 EXISTING WORK AND/OR VERIFYING CONDITIONS

- A. The work under this contract occurs on the site of and within the existing facility. The Owner will continue to use the present building during the construction period. The work under this contract shall be scheduled and performed so as to provide a minimum of interference with the normal operation of the existing building.
- B. Before submitting a proposal, Electrical Contractors shall visit the site, and shall also carefully examine all bidding documents including those for other branches of the work, to satisfy themselves as to the nature and scope of all work to be done. Prints showing

the original building architectural, structural, mechanical, and electrical work are available at the Engineer's office for contractors' review

- C. The submission of a proposal shall be taken as evidence that such an examination has been made and difficulties, if any, noted. Later claims for labor, work, material, and equipment required for any difficulties encountered which could have been foreseen, shall not be recognized, and all such difficulties shall be properly taken care of by this contractor at no additional expense to the Owner.
- D. The accompanying drawings and specifications illustrate and describe the existing conditions, mechanical and electrical utilities, sewers, water mains, pipes, ducts, conduits, etc. that are particularly relevant to the new work insofar as these mains are shown on existing records or evident by field inspections and tests; however, it is not the intent that these documents shall be construed to guarantee to the contractor the exact location of these items. The contractor shall verify and determine the exact location of these items in the field, and all work under this contract shall be executed to avoid conflict with or damage to existing work. The work shall be planned and executed to avoid interference, as much as possible, with the normal use of the existing building.
- E. All work involving hazards to persons shall be suitably barricaded and provided with warning lights or signs, as required.
- F. Where necessary for the performance of the contract, existing work shall be cut, altered, removed, or temporarily removed and replaced. Work that is altered or replaced shall match similar existing work and said work shall be performed by trade applicable to the work; if said work is NOT shown or noted the Drawings relating to applicable trade, cost shall be paid by contractor requiring said work. However, unless otherwise provided by the drawings or specifications, no structural members shall be cut or altered without authorization of the Architect and Engineer. Work remaining in place, which is damaged or defaced by reason of work done under this contract, shall be restored in kind equal to its condition at the time of award of the contract by applicable trade as hereinbefore specified.
- G. Existing work shall not be disturbed further than necessary for proper installation of new work. New work to be connected or made integral with existing work shall be properly erected to secure solidity and be continuous in finish. Such new work in extension of existing work shall correspond in all respects with that to which it connects, or similar existing sound work, unless otherwise specified.

#### 1.4 ALTERATIONS TO EXISTING WORK

- A. Alterations and additions to existing work shall include the requisite dismantling of the old equipment, rigging, wrecking, hauling, protection of permanent equipment and the building structures, and cleaning up. Care shall be exercised to keep dust and dirt to a minimum and to confine it to the area where the removal work is being performed. All debris shall be promptly removed.
- B. If asbestos insulation is encountered on any existing wiring which is to be removed or remodeled, contractor shall immediately notify Owner of the existence of asbestos and Owner will arrange proper removal of same without cost to contractor.



- C. Unless otherwise noted, remove all other existing equipment and conduit, wires, boxes, etc. which will not be reused in the final arrangement. Unless otherwise noted, all items which will be removed by this contractor and not reused shall become the property of the contractor and shall be promptly removed from the site by him.

#### 1.5 EXISTING MECHANICAL AND/OR ELECTRICAL FACILITIES

- A. Where existing mechanical and electrical facilities and/or service lines occur in the area of the work and such facilities or lines are to be abandoned or changed, the contractor for the branch of work or trade involved shall cut off and properly cap the old lines, so as not to interfere with the new construction work. If any portions of such lines are required for the operation of the existing building the lines shall be altered and relocated to clear new construction and shall also be restored into service to provide continued operation of the existing building.

#### 1.6 INTERRUPTION OF SERVICES

- A. The existing facility will be occupied and will remain in operation throughout the period that this work is being performed, and certain new work will be performed during this period. Unscheduled interruptions of the facility will not be tolerated. The contractor shall exercise extreme caution, shall thoroughly inform his workmen and subcontractors of the critical nature of this work, and shall continually review the work procedure being followed in order to prevent accidental interruption of service. Before performing any act which could result in interruption of service, the contractor shall notify the Owner and Engineer of the hazards involved and the contractor shall proceed in a manner and at a time specifically approved by the Owner and Engineer.
- B. All work necessitating the temporary turning off or shutting down the operation of existing mechanical and/or electrical facilities shall be done at times specifically approved by the Owner in advance of any disruption of existing facilities.

#### 1.7 MATERIALS AND EQUIPMENT

- A. All materials and equipment entering into the work shall be approved by the Architect and Engineer, and must be new, without defects, and of the sizes and capacities shown on the drawings or hereinafter specified. All manufactured materials or equipment shall bear the identification mark of the manufacturer or, if required by the Architect and Engineer, shall be certified by an approved testing laboratory. All equipment shall operate within the manufacturer's range of speeds, guaranteed capacities, performance, etc. as indicated by the manufacturer's latest catalog and/or engineering data, shall be of proper size and dimension for the allocated space, and shall be placed in the space allocated in the proper construction sequence. Special consideration will be given to equipment which has been in successful field use or similar applications for at least three (3) years (exclusive of field tests), and to equipment which has an extended guarantee period in lieu of long use period. This contractor shall submit with his bid complete data on equipment he proposes to use; failure to so submit, or to meet these requirements fully and those of the specifications, shall be grounds for rejecting the items.
- B. All electrical materials, apparatus, and equipment shall be new, of the make and characteristics specified, shall conform to NEMA standards, and shall be designed to

comply with and be installed in accordance with the latest rules and regulations of the National Electrical Code, and all of the legally constituted public authorities having local jurisdiction. Upon completion of the work, furnish a certificate of approved inspection from an approved electrical insurance inspector. Verify the exact voltage and current characteristics at the building before ordering motors or similar equipment.

- C. Conduct such tests and adjustment of equipment as specified or necessary to verify performance requirements. Submit data taken during such tests.

#### 1.8 QUIET OPERATION

- A. The work shall be installed in such a manner that under all conditions of load it shall operate without sound or vibration which is objectionable in the occupied spaces, in the opinion of the Architect and Engineer.
- B. In case of moving machinery, sound or vibration noticeable outside of the room in which it is installed or annoyingly noticeable inside its own room will be considered objectionable. Sound or vibration considered objectionable shall be corrected by the contractor.

#### 1.9 PROTECTION

- A. In performing this contract, safeguard workmen and the public and protect the work and equipment until final completion and acceptance. After delivery and before and after installation, protect work against theft, injury, or damage. Carefully store material and equipment received on site which are not immediately installed. Close open ends of work with temporary covers or plugs during construction to prevent entry of obstructing materials. Protect related or adjacent work and the material of the other trades or the Owner from damage that might be caused by this work and make good any damage thus caused. Provide all safeguards, scaffolding, drop cloths, etc. as required.
- B. No welding or soldering shall be done near combustible materials of any kind; all adjoining work, finished surfaces, glass, etc. shall be protected from flames, sparks, hot metal, etc. by metal guards or approved noncombustible drop cloths or barriers.
- C. Each contractor shall replace any items or portions thereof wherever removed or damaged, in a manner equal to the original construction and finish, or where directed by the Architect and Engineer, contractor shall pay other trades to perform this work.
- D. All mechanical and electrical equipment with a factory finish shall be protected during construction and must be free of dust, dirt, cement splatters, etc. when building is turned over to the Owner. Dents and marred finishes are to be repaired to the satisfaction of the Architect and Engineer, or a replacement furnished where necessary.

#### 1.10 EXECUTION OF WORK

- A. Promptly upon award of contracts, the Electrical subcontractor shall confer with the General Contractor and Engineer and the other subcontractors to prepare a time schedule for completion of the work. The electrical work shall be performed and

coordinated with the program of the General Contractor and the other subcontractors. Each subcontractor shall proceed diligently with the work and shall cooperate with the General Contractor and the other subcontractors to maintain the approved project construction and progress schedule to the best of his ability and as conditions permit.

#### 1.11 GENERAL SUPERVISION AND INSTALLATION OF WORK

- A. Each contractor shall at all times give the work his best skill and attention, including adequate construction supervision over his work, employees, and sub-contractors, and he shall fully cooperate with and confer with the Architect and Engineer and other contractors so that the best possible installation shall be obtained. Exact locations and relations are to be determined in the field, subject to the approval of the Architect and Engineer, and with preference to the dimensioned drawings and approved shop and setting drawings.
- B. Unless otherwise shown, conduits, etc. shall be exposed.
- C. Install conduits, etc. in a neat and workmanlike manner, close to walls, generally as high as possible, true and square to the building, utilizing standard practices, and properly graded for correct functioning of the system involved; multiple lines in close proximity shall be coordinated and neatly grouped. Install work in proper construction sequence and arranged so as to be readily accessible for operation, maintenance, and repair; minor deviations from drawings may be made to accomplish this, but changes of magnitude or which involve extra cost shall not be made without approval. All fixtures, outlets, etc. shall truly center with the adjacent architectural finish. All work, both exposed and concealed, shall meet the approval of the Architect and Engineer regarding neatness of appearance, location, and practicability of installation. The Architect and Engineer reserve the right to direct the removal and replacement of any item which, in his opinion, does not present an orderly and reasonably neat and workmanlike appearance.
- D. Each contractor shall cooperate with the General Contractor in the preparation of the "Coordination Drawings". The contractor shall familiarize himself with the work of the other contractors, shall lay out his work to meet conditions at the building, shall give freedom to and prevent conflict with the work of other contractors, and shall make reasonable modification in locations or arrangement from those indicated on the drawings if required to avoid conflicts or to conform to tile, wood, marble, or other architectural finish. From time to time as the work progresses, each contractor shall examine the work installed by others, insofar as it may affect his work, and he shall, before proceeding with the work, notify the Architect and Engineer in writing, and shall not proceed until directed by the Architect and Engineer, if any condition exists which prevents the successful installation of his own work.
- E. If the contractor places any work in violation of any of the above mentioned requirements, and conflicting or unworkmanlike conditions result, he shall, without additional charge, remove and reinstall or satisfactorily readjust such portions of his work as may be necessary and as the Architect and Engineer may direct. The Architect's and Engineer's decision regarding such conditions shall be final.

#### 1.12 ENGINEER'S OBSERVATION

- A. Periodic observation of the work by the Engineer is only for the express purpose of verifying compliance by the contractor with the contract documents to the best of his knowledge. Such engineering observations and services rendered by the Engineer or his representatives shall not be construed as the supervising of construction; nor the assuming by the Engineer of the duties and responsibility of the contractors; nor making the Engineer responsible for providing a safe place or procedure for the performance of the work or for the contractors' employees or for sub-contractors.

#### 1.13 SLEEVES, CUTTING, PATCHING, CLEANING, WATERPROOFING, ETC.

- A. Provide and accurately set frames and Schedule 40 steel pipe sleeves for required openings in new work to minimize cutting. Perform all cutting, patching, etc. required to install the work. Use approved power operated boring machine for small holes wherever practical. Remove all rubbish incidental to the work. Where any work pierces waterproofing, provide all necessary sleeves, caulking, and flashing required to make openings absolutely watertight.
- B. Refer to the ACI Code 381.71, Section 6.3 for limitations and requirements for penetrations and openings.

#### 1.14 PATENTS

- A. The contractor shall defend and guarantee the Owner against any expense, claims, litigation, etc. occasioned by the use in this work of any materials, devices, etc. covered by patents not owned by this contractor, or of which he is not a licensed user.

#### 1.15 CONTEMPLATED WORK

- A. The drawings and specifications for the mechanical and electrical portion of this project have been prepared by Motz Consulting Engineers, Inc., doing business as Motz Engineering.
- B. The various items of work necessary for completion of this work are hereinafter specified under the respective section headings or shown on accompanying drawings, and shall be included in any contract or contracts made for completion of respective divisions of the work. Such contracts shall also include necessary details reasonably incidental to the proper execution and completion of such work.

#### 1.16 MOVING MATERIALS

- A. If it becomes necessary at any time during the progress of this work to move materials which have been temporarily located and which are to enter into the final construction, the contractor furnishing said materials shall, when so directed by the Engineer, move them or cause them to be moved. Cost of such moving shall be included in the contract price.

#### 1.17 ACCIDENT PREVENTION

- A. Precaution shall be exercised at all times for the protection of persons and property. The safety provisions of applicable law, building, and construction codes shall be observed. Machinery, equipment, and other hazards shall be guarded in accordance with safety provisions of the "Manual of Accident Prevention in Construction" published by Associated General Contractors of America to the extent that such provisions are not inconsistent with applicable law or regulations.

#### 1.18 TOOLS AND MATERIALS

- A. Tools and materials shall be stored on the premises at locations designated by the Owner.

#### 1.19 PROPERTY PROTECTION

- A. All hoisting shall be done with proper tag lines and buffers to prevent damage to the sides of the building. Where it is necessary to hoist materials to the roof, the parapets at top of the building and the roof where materials are landed from hoists shall be protected with heavy wood covers. Parapet protection shall be placed on both sides and top, and shall extend far enough on either side of landing point to insure adequate cover. The roof, from the landing point at parapet to final location of material, shall be adequately protected by planks laid side by side on roofing and spiked together on outside edges with planks running at right angles to main planking. The roof shall be adequately protected against leaks at all times.
- B. Where hoists are erected on the roof for hoisting material up the side of the building, the roof shall be adequately protected against abrasion or other damage. Materials stored on the roof shall be placed on planks or other protection approved by the Engineer and shall be placed only at locations approved by the Engineer.
- C. If hoisted materials are taken through windows, the jams, head, and sill shall be adequately protected with wood planking or proper buffers.
- D. Any work, equipment, or property damaged during construction of this project and due to operations under this contract shall be repaired or replaced by this contractor, without additional cost to the Owner. Upon completion of the work, the contractor shall remove all protections herein specified.

#### 1.20 REMOVAL OF RUBBISH

- A. It shall be each contractor's duty to keep the building and surrounding premises clean, free from rubbish of every description. No rubbish, crating materials, packing, or dirt shall be allowed to accumulate at any time, but shall be removed at once and hauled away.
- B. Each trade shall be responsible for its own tools and materials during the periods of rubbish removal but contractors shall use reasonable care in removal of rubbish to protect the tools and materials of others against loss or damage. The Owner reserves the right, in the event that removal of rubbish is not promptly and properly carried out

by the Contractors to have rubbish removed and to charge the cost of its removal to the contractor.

C. Also, refer to Division 1.

#### 1.21 MATERIAL SAFETY DATA SHEETS (MSDS)

A. The contractor shall obtain and maintain on-site during the course of the project the Material Safety Data Sheets (MSDS's) for all chemicals or products containing chemicals that may be considered toxic or hazardous. The MSDS's are to be forwarded to the Office of Environmental Health and Safety upon completion of the project.

#### 1.22 INSTRUCTION OF PERSONNEL

A. The Electrical Subcontractor shall provide free on site instruction in the proper use of installed equipment to designated representatives of the Owner, sufficient to ensure safe, secure, efficient, non-failing utilization, and operation of systems. This instruction shall include the following:

1. One Site Training: Provide a minimum of 4 hours of training for owner's staff. Submit a syllabus to the Engineer prior to the first session.
2. Support: Provide a minimum of 4 hours of support either on site or by telephone to answer operations questions.

PART 2 – PRODUCTS (NOT APPLICABLE)

PART 3 – EXECUTION (NOT APPLICABLE)

END OF SECTION 260400

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## SECTION 260500 – GENERAL ELECTRICAL PROVISIONS

### PART 1 – GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Special Conditions, General Requirements, Division 1 Specifications, apply to this Section.

#### 1.2 REFERENCE TO CONDITIONS OF THE CONTRACT

- A. The Conditions of the Contract General, Supplementary and other Conditions and Divisions 1 through 31 and General Requirements, apply to the work specified in Division “26” and “28”. Unless the specifications contain statements which are more definitive or more restrictive than those contained in the Conditions of the Contract, the specifications shall not be interpreted as waiving or overruling any requirements expressed in the Conditions of the Contract.
- B. No claim or additional compensation shall be entertained on behalf of or paid on account of failure to be informed of the above conditions and requirements.
- C. Should a bidder find discrepancies in or omissions from the drawings or specifications, or should he be in doubt as to their meaning, he should at once notify the Associate who shall send written instructions to bidders. If these are ignored by the Contractor, he shall be responsible for furnishing the proper or workable equipment as necessary.
- D. Before submitting a bid, bidders shall be held responsible to have visited the site of work, attend the Pre-Bid Meeting, and fully inform themselves as to existing conditions and limitations, including rules, rates and fringe benefits, travel pay, affiliation fees and transportation expense prevailing in the local labor market, and no allowance shall subsequently be made on behalf of the bidder by reason of any error on his part.
- E. Carefully examine the architectural, structural, heating, ventilating and air conditioning, plumbing and any other relevant contract documents. If any discrepancies occur within Contract documents, report such discrepancies to the Associate in writing and obtain written instructions as to the manner in which to proceed. No departures from the contract documents shall be made without prior written approval of the Associate.
- F. Obtain any additional reference documents and/or information required for installation prior to installing equipment. Coordinate work with other trades making minor adjustments as required. Wiring or conduit layouts are schematic based and exact locations shall be determined by structural or other restricting conditions.
- G. Minor details not usually shown or specified but necessary for proper installation and operation shall be provided in the Electrical Contractors estimate, the same as if herein specified or otherwise shown.
- H. Coordination with the Utility servicing this facility including following and policies of the utility company shall be included in this bid. Where material and installation is deemed the responsibility of the Electrical Contractor by the Utility Company, such work shall be included within his bid.
- I. Electrical Contractor bid submission shall give written notice to the Architect of record

any materials or apparatus believed inadequate, in violation of laws, ordinances, rules, standard installation practices and any necessary item required or work omitted. In the absence of such written notice, it is mutually agreed that the Electrical Contractor has included the cost associated of all required item in his proposal and that he will be responsible for the approved satisfactory functioning of the entire system without extra cost compensation.

### 1.3 WORK INCLUDED

- A. Provide and install a complete and operating electrical installation in accordance with these specifications and accompanying contract documents. This shall include required labor, material, apparatus and supervision.
- B. Without limiting or restricting the volume of work and solely for convenience, the work to be performed will, in general, comprise the following:
  - 1. Installation of feeders and branch wiring including overload and disconnecting means.
  - 2. Installation of new Terminal boxes as part of Alternate Bid 1.
  - 3. Removal and Installation of all light fixtures through the building.
  - 4. Re-installation of existing equipment.
  - 5. Wiring devices, multi-gang back boxes plates and supporting hardware and/or equipment.
  - 6. Wiring of equipment and final connections of equipment furnished by others.
  - 7. Required material and labor necessary to complete project scope as indicated within complete specifications, drawings or schedules
- C. Items of labor, material, and equipment not specified in detail or shown within Contract documents, but incidental to or necessary for the complete installation and proper operation of the several branches of work and described herein, or reasonably implied in connection herewith, shall be furnished as if called for in detail by the specifications or Contract documents. This includes electrical work associated with mechanical and plumbing work whether indicated on electrical drawings or not.
- D. This contractor is advised to carefully coordinate the delivery of large, awkward, heavy equipment, material or relevant items. Delivery limitations may require modifications, supporting means or structural modifications in order to set equipment or components. This contractor shall be responsible for all calculations, material, labor, equipment, machinery, deliveries, transportation or safety related equipment required for equipment such as but not limited to: transformers, switchgear, generator, site lighting, disconnects, staging materials, panelboards etc.
- E. Electrical Contractor shall provide raceways, fittings, supports, feeders, branch circuits, overload/short circuit protection, relays, starters, terminals and related accessories to complete his work including installation and termination of items, equipment or controls furnished by other contractors unless specifically stated otherwise.
- F. It is the responsibility of the Electrical Contractor to verify proper motor rotation and sizing of motor overload protection is in compliance with NEC and equipment manufacturer.

### 1.4 WORK NOT INCLUDED

- A. The following items of Electrical Construction are not included in this contract:



1. Low voltage wiring of certain systems or devices shall be done by the respective Contractor such as temperature control wiring, interlock wiring and related control devices for HVAC equipment unless noted or otherwise. Raceways shall be provided by the Electrical Contractor.
2. Certain motors and equipment shall be provided by others, complete with motor and built-in or separate controllers as covered by such contracts such as packaged HVAC or plumbing equipment. The Electrical contractor shall provide feeders, branch circuits and/or disconnecting means as called for within the Contract documents.

## 1.5 DEFINITIONS AND ABBREVIATIONS

### A. Definitions

1. "Furnish" shall mean supply and deliver to project site, ready for unloading, unpacking, assembly, installation, etc., as applicable in each instance.
2. "Install" shall be used to describe operations at project site including unloading, packing, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protection, cleaning, and similar operations, as applicable in each instance.
3. "Installer" shall mean a company or individual specializing in performing work meeting the requirements of their trade with minimum of three (3) years of experience.
4. "Provide" shall mean furnish and install, complete and ready for intended use, as applicable in each instance.
5. "Directed" shall mean as directed by Xavier University or its Representative prior to installation of equipment.
6. "Indicated" shall mean "indicated on Contract Documents".
7. "Shown" shall mean "shown on Contract Documents".
8. "Section" shall mean one of the Specification Sections.
9. "Division" shall mean one of the Specification Divisions.
10. "Article" shall mean one of the numbered paragraphs of the Specification Section.  
"Work" or "Electrical Work" herein includes products, labor, equipment, tools, appliances, transportation and related items, directly or indirectly required to complete the specified and/or indicated electrical installation.
11. "Code" shall mean any and all regulations and requirements of regulatory bodies, public or private, having jurisdiction over the work involved.
12. "Product" used in Division 26, 27 and 28 means material, equipment, machinery, and/or appliances directly or indirectly required to complete the specified and/or indicated Electrical Work.
13. "Standard Product" shall mean a manufactured product, illustrated and/or described in catalogs or brochures, which are in general distribution prior to the date of issue of construction documents for bidding. Products shall generally be identified by means of a specific catalog number and manufacturer's name.
14. "Wiring" shall mean fittings, conduits, wires, junction boxes, connections to equipment, splices, and other accessories required to complete the work.
15. Abbreviations and Symbols: See lists on drawings.
16. "This Contractor" shall mean the Contractor responsible for Divisions 26, 27 and 28 work.
17. Contract Documents: drawings, specifications, manufacturer's specification/data sheets, bid forms, addendum, and change orders.

18. Whenever the phrases "approved by the Associate or Owner's Representative," "approved equivalent," or "equivalent to" appear in these specifications, they shall be interpreted as meaning "as recommended by the Associate and approved by the Authority."

B. Reference to the latest editions of codes and standards shall mean:

<u>Reference</u>	<u>Definition</u>
NEC	National Electrical Code
ASTM	American Society for Testing Materials
NEMA	National Electrical Manufacturers Association
ANSI	American National Standards Institute
FS	Federal Specification, US Government
CS	Commercial Standards issued by US Department of Commerce
NESC	National Electrical Safety Code
NETA	National Electrical Testing Association
ADA	Americans with Disabilities Act
OBC	Ohio Building Code
NFPA	National Fire Protection Association
Owner	Owner / Owner's Representative

#### 1.6 REGULATIONS

- A. Electrical work, equipment, and materials furnished and installed under this contract shall conform to the requirements of the latest edition of the National Electrical Code, the National Fire Protection Association and any other governmental or local authorities having jurisdiction. Pay any fees required for the installation of this Division work. Certificates of approval shall be obtained in duplicate from any department or agency issuing same, and shall be turned over to OWNER or its representative at the completion of the work.
- B. Provide any labor, materials, services, apparatus, CAD drawings and documents required to comply with applicable laws, ordinances, rules and regulations, whether or not shown.
- C. Obtain certificates of inspection and approval from authorities having jurisdiction and deliver same to OWNER as a prerequisite for final acceptance of the work. Provide record copies of permit applications, permits and other items for which certification are indicated.

## 1.7 SPECIAL ENGINEERING SERVICES

- A. In the instance of complex or specialized electrical systems such as fire alarm, security, telecommunication or similar systems; the installation, final connections and testing of such systems shall be made under the direct supervision of qualified authorized service engineers who shall be in the employ of the respective equipment manufacturer. Provide OWNER with copies of instruction manuals and booklets for each system and piece of equipment installed. Provide any additional instructions over and above that listed above in the care, adjustment and operation of parts of the electrical systems.
- B. Pay any and all expenses incurred by these equipment manufacturers' representatives.

## 1.8 SUBMITTALS

- A. Shop drawings, product data, and samples shall be submitted to the Associate for approval. Submit a minimum of (6) sets (or equivalent documentation in PDF format) of shop drawings and related specifications to the Associate in a bound set included with letter of transmittal.
  - 1. Electrical Contractor must first review content for project specification compliance prior to submission. Drawings and specifications shall bear the Electrical Contractor's approval stamp indicating specification compliance. Sets received without Electrical Contractors approval stamp will not be reviewed.
  - 2. Shop drawings shall be new drawings, and not reproductions or tracings of the Contract Documents. In preparing shop drawings, establish lines and levels for the work specified, and check the drawings to avoid interference with structural features and other work. Immediately call to the attention of the Architect any interference for clarification in writing.
  - 3. Manufacturer's literature and data sheets shall be submitted indicating the necessary installation dimensions, weights, materials, and performance information. Each piece of literature shall be identified with the specific specification number, paragraph, and equipment schedule identification.
  - 4. Engineer's review of Manufacturer documents or specifications shall not relieve the contractor from responsibility of errors or omissions in such submittals, schedules, drawings or deviations from contract documents.
  - 5. Layout and detail drawings shall be submitted in the form of legible sepia reproducible and paper prints. Manufacturer's drawings shall be standard drawings. Equipment shop drawings shall show specific data and other special features required for review consideration.
  - 6. Equipment shop drawings (8-1/2 by 11 inch sheets) shall be bound together in sets, in loose leaf binders, and shall be indexed in accordance with Specification Section. Additional shop drawings may be submitted at a later date for insertion therein, and the original submittal shall note which shop drawings shall be submitted later. Marked-up catalogs are not acceptable, and shall be rejected.
  - 7. Materials and equipment shop drawings shall be submitted within 30 calendar days of Contract receipt.
  - 8. Manufacturers' instruction manuals shall be submitted together with shop drawings. Furnish instruction manuals and parts listed for each piece of electrical equipment, on 8-1/2 by 11 inch sheets, or catalogs, suitable for loose leaf side binding, packaged separately, and clearly identified. Instructions shall include information pertaining to installation, operation, and maintenance of equipment as applicable. Each piece of literature shall be clearly identified with the specific

job equipment identification. Literature shall be factory printed and not reproduced copies.

9. Any characteristic of any piece of equipment which deviates from the characteristics of the equipment specified shall be hi-lighted and circled in red.

- B. Submit manufacturers' data, and/or shop drawings of the following:
  1. Emergency and safety related equipment.
  2. Wiring devices.
  3. Disconnect switches, motor starters, and controls supplied by the Electrical Contractor.

## 1.9 OPERATING AND MAINTENANCE INSTRUCTIONS

- A. After final tests and adjustments have been completed, furnish the services of qualified personnel to fully instruct the OWNER Maintenance representative in the operation and maintenance procedures for equipment installed. Operation and maintenance instructions for major items of equipment shall be directly supervised by the equipment manufacturer's representative. Supply qualified personnel to operate equipment for sufficient length of time as required to meet governing authorities' operation and performance tests and as required to assure that OWNER representatives are properly qualified to take over operation and maintenance procedures.
  1. Notify the Associate, OWNER representatives and equipment manufacturers' representatives, by letter, as to the time and date of operating and maintenance instruction periods at least one week prior to conducting same.
  2. Forward to the Associate the signatures of all present for the instruction periods.
- B. Furnish three (3) copies of recommended equipment operation and maintenance procedures manuals as specified herein, assembled and bound together in 8-1/2 by 11 inch three-ring binders. The ring binders shall be submitted to the Associate in accordance with procedures established for shop drawing submittals.
  1. The operation and maintenance procedures manuals shall include the following:
    - a. Project Title
    - b. Associate's Name and Address
    - c. Date Submitted
    - d. Contractor's Name and Address
    - e. Index (in alphabetical order, with page numbers)
    - f. General Description of Each System
    - g. Parts List, identifying the various parts of equipment for repair and replacement purposes.
    - h. List of spares recommended for normal service requirements.
    - i. Operating instructions outlining step-by-step procedures required for system start-up and operation. The instructions shall include the manufacturer's name, model number, service manual, and brief description of each piece of equipment and its basic operating features.
    - j. Maintenance instructions describing routine maintenance and lubrication procedures and schedules, and simplified diagrams which illustrate the systems as installed.
    - k. Wiring and control diagrams for each piece of equipment, showing "as installed" conditions.

1.10 SINGULAR NUMBER

- A. References made to any item in the singular number shall apply equally to as many identical items that the work may require.

1.11 PROTECTION OF SERVICES

- A. Repair, replace and maintain in service any new or existing utilities, facilities or services (underground, overhead, interior or exterior) damaged, broken or otherwise rendered inoperative during the course of construction. The method used in repairing, replacing or maintaining the services shall be approved OWNER and Associate. OWNER reserves the right to make emergency repairs as required to keep equipment in operation without voiding the Contractor's guarantee bond not relieving the contractor of his responsibilities during bond period.
- B. OWNER's property and the property of other trades shall be scrupulously respected at all times include damage from leaks. This contractor shall provide drop cloths or similar barriers where dust or debris is generated protecting adjacent area.
- C. This contractor shall be held responsible for damages caused by his work or through neglect of his workman or subcontractors. Repairing of damages shall be done in accordance by OWNER or its representative. Costs associated with repairs shall be paid by this contractor.

1.12 PROTECTION OF FLOORS, EQUIPMENT AND PERSONNEL

- A. Protect flooring from damage during the construction period. Provide plywood or similar material under equipment or materials stored on floors, and in areas where construction may damage the floor surfaces. Replace floor surfaces (including sealer) damaged during the construction.
- B. In addition to the provisions and stipulation of the General Conditions, each contractor and subcontractor of shall provide various types of protection as follows:
  - 1. Protect finish floors from chips and cutting oil by the use of metal drip receiving pan and oil proof floor coverings.
  - 2. Protect equipment and finish surfaces from welding and cutting splatters with baffles and splatter blankets.
  - 3. Protect equipment and finished surfaces from paint droppings, insulation adhesives, grout, fire proofing and other related non-finished material.
- C. All equipment shall be stored at the site with openings, bearings, etc., covered to exclude dust, moisture or foreign debris from entering.
- D. Construction openings, trip hazards and unsafe conditions created by this contractor shall be scrupulously inspected for personnel safety and protection of property with strict compliance of OSHA work and construction practices.
- E. Conduit and excavations required for electric work shall be covered when work is not in progress such as capping conduit openings, cover wall or floor openings with material of adequate strength supporting construction traffic, safety warning tape, warning lights and signs.

### 1.13 SUBSTITUTIONS

- A. It is the intent of these specifications that wherever a manufacturer or product is specified, and the term "or approved equivalent" is used, the substituted item must conform in respects to the specified item. Consideration shall not be given to claims that the substituted item meets the performance requirements with lesser construction. Performance indicated in schedules, drawings and specifications shall be interpreted as minimum performance.
- B. Note that where specific manufacturers' products are indicated in the Contract Documents, the associated systems have been designed on the basis of that product's physical characteristics. Where specific manufacturers' products are indicated in the Contract Documents and other manufacturers' names are listed, the associated systems have been designed on the basis of the first-named manufacturer's product. When products other than those used as the basis of design are provided, additional costs related installation, usage or modifications to the systems and/or structure required by the use of that product shall be paid by this contractor.
- C. This Contractor shall be responsible for all costs associated with changes to sizes such as conduit, fuse, starter, wire, supports etc. caused by change of equipment from the basis of design including usage of other named manufactures. Space allocation due to usage of other manufacture shall be the responsible of the Contractor ensuring adequate clearances for maintenance, operation, service, code requirements are met.
- D. Equipment of one type shall be the products of one manufacturer; similar items of the same classification shall be identical, including equipment, assemblies, parts and components.
- E. Materials furnished shall be new, defect free, used in accordance to its listing and determined safe by a nationally recognized testing organization, such as Underwriters' Laboratories, Inc., or Factory Mutual Engineering Corporation, and materials shall be labeled, certified or listed by such organizations.
- F. Where a specific manufacturer is specified and other manufacturers' names are listed as equivalent, the bid shall be based upon the specified or equivalent manufacturers only. Any substitutions shall be submitted to the associate no later than ten (10) days prior to the bid opening. Refer to Article I and the General Conditions of this specification for more information.
- G. Final acceptance of substitutions shall be at the discretion of the associate.

### 1.14 PERFORMANCE OF EQUIPMENT

- A. Materials, equipment and appurtenances of any kind, shown on the drawings, hereinafter specified or required for the completion of the work in accordance with the intent of these specifications, shall be completely satisfactory and acceptable in operation, performance and capacity. No approval either written or verbal of any drawings, descriptive data or samples or such material, equipment and/or appurtenance shall relieve the Contractor of his responsibility to turn over the same to OWNER in perfect working order at the completion of the work.
- B. Any material, equipment or appurtenances, the operation, capacity or performance of which does not comply with the drawings and/or specification requirements or which is

damaged prior to acceptance by OWNER shall be held to be defective material and shall be removed and replaced with proper and acceptable materials, equipment and/or appurtenances or put in proper and acceptable working order, satisfactory to the university, without additional cost to the Owner.

#### 1.15 WEATHERPROOFING LOCATIONS (WP)

- A. Electrical apparatus, such as outlet boxes, switches, thermal switches, manual starters, disconnect switches, combination switches and starters, motor control centers, and motor starters shall be weatherproof gasket type, NEMA Types 4 in the following instances:
  - 1. On surface of exterior face of building, including areas where not under canopies, cast boxes with threaded hubs must be used and under canopies steel boxes with gasket connections to devices.
  - 2. In any areas where specifically noted "WP" or required by the NEC or Electrical Regulations mentioned herein.
  - 3. Within air conditioning enclosures.
  - 4. In underground splice boxes.
  - 5. On building roof.

#### 1.16 CLEANING, PROTECTING AND ADJUSTING

- A. Materials shall be stored in a manner that shall maintain an orderly, clean appearance. If stored on-site in open or unprotected areas, equipment and material shall be kept off the ground by means of pallets or racks, and covered with tarpaulins.
- B. Equipment and material, if left unprotected and damaged, shall be repainted or otherwise refurbished at the discretion of the Owner. Equipment and material is subject to rejection and replacement if, in the opinion of the Associate or the manufacturer's engineering department, the equipment has deteriorated or been damaged to the extent that its immediate use or performance is questionable, or that its normal life expectancy has been curtailed.
- C. During the construction period, protect ductwork, raceways, conduit and equipment from damage and dirt. Properly cap ductwork and conduit.
- D. Vacuum cabinets, switch boards, distribution panels, lighting and power panels, etc., after completion of work.
- E. Remove recorded construction measurements from equipment, panels, walls or other defaced surfaces.

#### 1.17 ACCESSIBILITY

- A. Coordinate to ensure the adequacy of the size of shafts and chases, and the adequacy of clearances in hung ceilings and other areas required for the proper installation of this work.
- B. Locate equipment which must be serviced, operated or maintained in fully accessible positions. Equipment requiring access shall include, but is not necessarily limited to, motors, junction boxes, fire alarm devices, controllers and switchgear.
- C. Provide, as required, the exact locations of access doors. Provide access doors in

finished construction for installation by others. Locations of access doors in finished construction shall be submitted in sufficient time to be installed in the normal course of the work. Keep conduit and other electrical devices clear of access door openings to allow adequate space to work in or enter the concealed space.

- D. Access panels shall not be smaller than 12 inches by 16 inches or as required by authority of jurisdiction and shall be all-steel construction with a No. 16 gauge wall or ceiling frame and a No. 14 gauge panel door with not less than 1/8 inch fireproofing secured to the inside of the door. Doors shall be provided with concealed hinges and be secured with suitable clips and countersunk screws. Outside of access panels shall finish flush with finished wall or ceiling surfaces. Covers shall be factory primed with two (2) coats of primer.
- E. Working clearances: Provide at least 3'-0" of clear space in front of all electrical panels and as wide as the equipment with a minimum of 2'-6" wide. Height and width of working spaces shall be in accordance to Article 110.26 of National Electric Code.

#### 1.18 GUARANTEE

- A. Guarantee material, equipment and workmanship for a period of one (1) year from date of final acceptance by Associate and Owner's Representative. Replace defective material and workmanship furnished and installed and other work and equipment damaged thereby.
- B. In addition to the one (1) year guarantee, furnish any warranties or guarantees that normally come with specific pieces of equipment that exceed the one (1) year guarantee. These additional warranties shall be given to OWNER for the time period specified.

#### 1.19 COORDINATION

- A. The General Contractor shall be in charge of the coordination drawing process and shall be responsible to resolve all conflicts and settle any disputes resulting from the coordination drawing process. Coordinate and furnish in writing to other Primes, including the Associate, any information necessary to permit the work of all contractors to satisfactorily complete installation of their work with the least possible interference or delay.
- B. Each Prime Contractor shall participate in the preparation of coordination drawings. No installation of permanent systems shall proceed until the coordination drawings are approved by the General Contractor. No extra charges shall be allowed for changes required to accommodate installation of system by other contractors.
- C. Coordination drawings shall be prepared in Revit 2015 format for each floor level and shall be of a scale not less than 1/4 inch - 1 foot. Coordination drawings shall include equipment, lighting, telecommunication, fire alarm, cable tray and raceway plans, with elevations with dimensions. Coordination drawings shall also include required access points through ceiling panels, access doors, cover plates, etc.
- D. Field discrepancies shall be resolved by the field foreman. When discrepancies cannot be resolved, the signed-off coordination drawings shall be re-examined for rights. Any and all discrepancies in construction, phasing, etc., due to the lack of coordination shall be at the sole expense of the associated contractors and in no way will be passed on



to OWNER.

- E. Devices and appurtenances which are to be installed in finished areas shall be coordinated with the General Contractor and OWNER for final approval as it relates to location, finish, materials, color, and texture.
- F. When work is installed without proper coordination, changes to this work deemed necessary by the Associate shall be made to correct conditions without any extra cost to OWNER.
- G. Disciplines shall include in coordination: Electric, Telecommunications, HVAC, Mechanical, Plumbing, Fire Protection and Fire Alarm System.
- H. Related coordination specification in Division 01.

#### 1.20 PRE-BID SITE VISIT

- A. Before submitting a bid, the Bidder is required to visit the site and fully inform themselves concerning all conditions affecting the scope of the work. Any discrepancies between the contract documents and the job site shall be brought to the Contract Officer's attention before bids are due. Failure to visit the site shall not relieve the Contractor from any responsibility in the performance of this Contract. No extra charges shall be allowed as a result of existing conditions.

#### 1.21 DRAWINGS

- A. The Electrical drawings are diagrammatic and indicate the general arrangement of fixtures, equipment, furniture and work included in this contract. Consult the project documents and details for locations and dimensions of such equipment. All dimensions shall be field verified prior to material ordering. Where such items are not dimensioned or properly detailed, contact the Architect for required information.
- B. The Electrical Contractor shall follow the drawings in laying out work while checking drawings of other trades prior to installation. Maintain NEC required work clearances including overhead electric space requirements. Contact the Architect where clearances are inadequate prior to equipment installation.
- C. Where directed by the Architect, the Electrical Contractor shall modify layouts as needed to prevent conflict of work with other trades. No additional charges shall be made for coordination. Failure to coordinate with other trades or within project documents shall not relieve the Electrical Contractor from his responsibility or necessity of furnishing material or performing his work as required by the contract documents.

### PART 2 - PRODUCTS

#### 2.1 MATERIALS AND WORKMANSHIP

- A. Equipment shall be so built and installed as to deliver its full rated capacity at the efficiency for which it was designed. Equipment shall meet the detailed requirements indicated, and shall be suitable for the installation shown.
- B. Surface mounted electrical equipment shall be installed on 3/4" thick, fire retardant mounting board. Mounting board shall bear UL classified mark indicating ASTM E 84 test compliancy. Backboard material shall have a final applied finish according to

manufacturer specifications prior to mounting of electrical equipment. Finishing material may include but not limited to fire retardant coatings. Backboard material shall minimally extend 6" in all directions beyond grouping of electrical equipment. The Electrical Contractor may use discretionary expertise to provide fire retardant backboard for individual equipment such as standalone disconnect switches, starters and the like. Where said devices are grouped (starters, disconnects, contactors etc.) installation shall include fire retardant backboard. Fire retardant mounting board installed on perimeter outside walls to be shimmed 1/2" from wall with washers to permit back ventilation.

1. Approved manufacturer: Hoover Treated Wood Products Inc. - Pyro-Guard
2. Approved equal.

- C. Where two or more units of the same class of equipment are furnished in same Section of Specifications, provide each from the same manufacturer. Furnish equipment and materials new and free from defects of size, make, type and quality herein specified, or as reviewed.
- D. Work shall be installed in a neat and workmanlike manner. Raceway installations shall parallel exterior and interior walls and be level. Vertical runs shall be plumb.
- E. Capacities, dimensions, or sizes specified or indicated are minimums, unless otherwise stated. Tolerances used in rating or testing standards specified shall not be allowed in determining capacities of equipment.
- F. Materials shall be listed by the Underwriters' Laboratories, Inc. where applicable and shall be manufactured in accordance with applicable standards established by ANSI, NEMA, ASTM, and IEEE.
- G. Any products judged not in accordance with the Specifications either before or after installation will be rejected. Costs associated with rejection shall be paid by this contractor.
- H. Where products are specified with no reference to a particular manufacturer's product, the product used shall meet or exceed industry construction and testing procedure standards applicable to the product, for life expectancy, performance and safety.
- I. Where electrical products are a fabricated assembly, the fabricator shall assume responsibility for correct operation of the entire assembly and of its individual components.
- J. Tools: Provide special tools for proper operation and maintenance of the equipment.
- K. It's the responsibility of the Electrical Contractor to provide clean electrical equipment which is free from dirt, paint, blemishes or markings. Scratches to equipment or enclosures shall be touched up with factory-color paint matching field color. Acceptance to restoration shall be to the satisfaction of the Architect.
- L. Required device or equipment adjustments shall be made by EC before and after equipment is in operation throughout the warranty period.
- M. Job site cleanliness and site safety of the removal of electrical generated trash or debris is the responsibility of this contractor. All job site safety rules, regulations and

requirements shall be followed and maintained.

## 2.2 IDENTIFICATION

- A. Switchgear, panels, relays, terminal control cabinets, junction boxes, contactors, circuit breakers, safety switches, motor starters, and similar items shall be identified with a single nameplate. Nameplates shall be laminated phenolic with white surface and black core (red surface for emergency and white core). Use 1/16" thick material for plates up to 2" x 4" and 1/8" thick for larger sizes. The lettering shall be condensed gothic with space between the lines equal to the width of the letters.
- B. Nameplate shall read as follows:
  - 1. First line shall be 1/2 inch letters stating panel/equipment name.
  - 2. Second line (if applicable) shall be 1/4 inch letters stating the existing panel name in parentheses ( ).
  - 3. Third line shall be 1/4 inch letters stating voltage/phase.
  - 4. Fourth line shall be 1/4 inch letters stating breaker number, panel number, and final room name/room number from which it is fed.
  - 5. Fifth line shall be 1/4 inch letters stating function and/or equipment which it controls.
- C. Names and numbers shall coincide with those listed within Contract documents unless altered by Owner descriptors.
- D. Nameplates shall be secured with screws, a minimum of one on each end.
- E. Label receptacle plates with identification showing panel and breaker number from which it is fed. Labels shall be made using the Dymo RinoPro or approved equal.
- F. Label junction boxes and pull boxes, showing circuit numbers contained in the enclosure. Use an approved marking device as noted.
- G. Label wire with an identification tag showing panel and breaker number from which it is fed at splices, junctions, and terminations as explained in this specification.
- H. Label fire alarm device bases with identification showing device address number assigned by fire alarm system manufacturer. Labels shall be made using the Dymo RinoPro or equivalent system.
- I. Branch breakers shall be labeled by Owner provided room numbers and descriptors.

## 2.3 ANCHOR BOLTS

- A. Provide and set in place, at the time of pouring of concrete foundations, necessary anchor bolts as required for the equipment called for under these specifications. Anchor bolts shall be of the hook type, of proper size and length to suit the equipment. Anchor bolts shall be set in pipe sleeves of approximately twice the bolt diameter and one half the embedded length of the bolt. Assume full responsibility for proper emplacement of the bolts.

## 2.4 INSERTS

- A. Provide inserts of an approved metallic type for hangers. Where two or more parallel conduits are installed, continuous inserts may be used. Where required to distribute the

load on the inserts, a piece of reinforcing steel of sufficient length shall be passed through the insert.

## 2.5 SLEEVES

- A. Provide sleeves in all roofs, floors, and any fire-rated walls. Each sleeve shall extend through its respective floor, wall or partition and shall be cut flush with each surface unless otherwise required.
- B. Sleeves in bearing and masonry walls, floors and partitions shall be standard weight steel pipe finished with smooth edges. For other than masonry partitions, through suspended ceilings, and for concealed vertical piping, sleeves shall be No. 22 USG galvanized iron.
- C. Sleeves shall be properly installed and securely cemented in place.
- D. Floor sleeves shall extend 1 inch above the finished floor, unless otherwise noted. Space between floor sleeves and passing conduit shall be caulked with graphite packing and waterproof caulking compound.
- E. Where conduits pass through waterproofed floor or walls, design of sleeves shall be such that waterproofing can be flashed into and around the sleeves.
- F. Where conduits pass through roofs, sleeves shall be installed and flashed and made watertight by the General Contractor unless otherwise specified or shown within Contract documents.
- G. Sleeves through exterior walls below grade shall have the space between conduit and sleeve caulked watertight using an approved method.

## 2.6 FIREPROOFING

- A. Where sleeves, ducts, cable trays, or other penetrations pierce floors or walls having specific fire ratings, the space between the sleeves and passing conduit shall be fireproofed with an approved UL listed fire proofing assembly. Installation method shall be per manufacturer's recommendations and approved by the Associate.
- B. Reference Division 7, section "Through-Penetration Firestop System".

## 2.7 WIRE GAUGE

- A. The sizes of conductors and thickness of metals called for herein or within other Contract documents shall be understood to be American Wire Gauge.

## 2.8 MISCELLANEOUS METAL AND STRUCTURAL STEEL

- A. Scope of Work: Furnish labor, materials, equipment and services necessary for the installation of miscellaneous metal and structural steel work required to complete this contract. Erect structural steel required for the proper support of equipment required under this contract.
- B. Supports, brackets, and clamps and other items specified herein shall be installed in strict accordance with the best practices and recognized code.

- C. Materials: Structural steel members required under this part shall conform to ASTM Standard Specification A-7. Other materials shall be as specified hereinafter.
- D. Priming: steel and iron work shall be primed with Rust-Oleum 769 or approved equivalent. Before priming, metal shall be thoroughly cleaned free from scale, rust and dirt.
- E. Anchors: Provide anchors, bolts, screws, dowels and connecting members, and do cutting and fitting necessary to secure the work to adjoining construction. Build in connecting members to masonry, concrete and structural steel as the work progresses.
- F. Supports and Brackets: shall be neatly constructed to structural shapes to adequately support the equipment intended. Supports must be approved prior to installation. Attention is directed to the proper rigid support required for conduit. Field conditions shall regulate the type of support required.
- G. Reference Division 7, Section “Spray fire-resistive Material” for coordination of hangers and applicable supports.

## 2.9 VIBRATION ISOLATION MOUNTS

- A. Provide vibration isolation mounts for all substations, power centers, transformers or equipment subject vibrations in accordance with this or other applicable sections.

## 2.10 MOTORS

- A. Motors shall be built in accordance with the latest standards of NEMA and as specified. Motors shall be tested in accordance with ASA C50 and conform thereto with respect to insulation resistance and dielectric strength.
- B. Each motor shall be provided with conduit terminal box and adequate starting and protective equipment as specified or required. The capacity shall be sufficient to operate associated driven devices under conditions of operation and load and without overload, and shall be at least the horsepower indicated or specified. Each motor type shall be premium energy efficient and of quiet operation.
- C. Motor starting equipment must be selected so that starting currents or transients do not have an adverse effect on lighting or other electrical equipment. This contractor shall provide devices or equipment required to snub or eliminate such electrical disturbances.
- D. Motors shall be verified for proper rotation prior to service of equipment.
- E. Motors connected to inverter controllers shall comply with the requirements of Division 23 Specification 230513 “Common Motor Requirements For HVAC Equipment” when included in Contract Documents.
- F. Motors shall comply with Energy Independence and Security Act of 2007.
  - 1. Motors shall comply with NEMA MG 1 table 12-11 and 12-12 unless noted otherwise.
- G. Motors connected to inverter controllers shall be inverter rated containing shaft mounted grounding protection ring such as AEGIS bearing protection ring.

## PART 3 - EXECUTION

### 3.1 GENERAL

- A. Provide information to the General Contractor for any chases or openings required under this Contract. No cutting shall be done which may affect the building structurally or architecturally without the prior approval of the Associate. Damaged construction shall be restored to its original conditions and finished to match the surrounding work. Refer to "Supplementary General Conditions" for the disposition of Cutting and Patching.
- B. Grades, elevations, and dimensions shown on the drawings are approximately correct; however, field check and otherwise verify such data at the site before proceeding with work.
- C. The Contractor shall be entirely responsible for apparatus, equipment, and appurtenances furnished by him or his subcontractors in connection with the work and special care shall be taken to protect parts thereof in such manner as may be necessary or as may be directed. Protection shall include covers, crating, sheds or other means to prevent dirt, grit, plaster or other foreign substances from entering the working parts of machinery or equipment. Special care shall be taken to keep open ends of pipes closed while in storage and during installation. Where equipment must be stored outside the building, it shall be totally covered and secured with heavy weatherproofing tarps and kept dry at all times. Where equipment has been subjected to moisture, it shall be removed from the site and replaced with new equipment. Protect open excavating until covered over.
- D. Due to the schematic nature and small scale of the electrical drawings, it is not possible to indicate exact locations, offsets, fittings, access panels, pull boxes, and miscellaneous parts which may be required to form a complete system. The drawings are generally indicative of the work to be installed. Arrange work accordingly furnishing necessary parts and equipment as may be required to meet the various conditions and to provide a complete circuit from end use device to circuit protective device in panel.
- E. Within thirty (30) days after acceptance of bids, submit to the Associate for approval, a complete list of equipment and materials to be furnished under this contract, giving names and addresses of manufacturers and material cut sheets they intend to furnish.

### 3.2 CLEARANCES

- A. Take caution when routing conduit and location of equipment. In many cases, ceiling (plenums) clearance is limited due to ductwork and other mechanical lines, systems and structural steel. The Contractor shall be responsible for routing around mechanical equipment and ducts in order that everything can remain concealed in finished areas.

### 3.3 CUTTING AND PATCHING

- A. Provide cutting and patching necessary to install the work specified herein. Patching shall match adjacent surfaces. Refer to Section 01731, Cutting and Patching, for specific direction.
- B. No structural members shall be cut without prior approval of the Associate, and such cutting shall be done in a manner directed by the Associate.

- C. Provide ceiling removal and replacement where work above finished ceilings is required. Replace ceiling components damaged in the process.
- D. Provide patching where electrical devices are removed from or through walls, ceilings or floors.

### 3.4 PAINTING

- A. Finished painting shall be performed by this Contractor except for standard factory finishes.
- B. Electrical motor's, pump casings, and other similar items shall be provided with three coats of machinery enamel at the factory, and shall be carefully cleaned, rubbed down, and oiled after installation.

### 3.5 LOCATIONS

- A. Apply for detailed and specific information regarding the location of equipment as the final location may differ from that indicated on the drawings. Outlets, equipment or wiring improperly placed because of failure to obtain this information shall be relocated and re-installed without additional cost to the Owner. Determine the actual direction of door swings, so that local switches and other controls shall be installed at the lockside of doors, unless otherwise noted. Improperly located switches shall be relocated without additional cost to the Owner.
- B. The design shall be subject to such revisions as may be necessary to overcome building obstructions. No changes shall be made in location of outlets or equipment without written consent of the associate.
- C. Unless otherwise mentioned or indicated, mounting heights of outlets are shown on the drawings or in the specification. Dimensions given shall be considered to be from center of outlet to finished floor.
- D. Coordinate the exact location and elevation of all electrical devices and fixtures with the architectural interior elevation plan and reflective ceiling plan prior to installation.
- E. Properly rough in for the electrical conduit and equipment under this contract and modify as required for coordination during the construction period.

### 3.6 RECORD DRAWINGS

- A. During the construction period, maintain in good order a complete set of as-built electrical contract drawings. Record the actual electrical installation as the work progresses. Include changes to the contract and to equipment sizes and types. Keep these drawings available at the site at all times for inspection.
- B. Take proper caution against the use of superseded drawings. Check such copies and mark "void." Where drawings have been corrected by memorandum, assume the responsibility for marking all drawings so affected with the changes; such marked drawings shall remain in use until revised drawings are issued.
- C. At the conclusion of the work, provide to the Associate a complete set of drawings which indicate precisely how the electrical system, single line, and riser diagram equipment has been installed. Return such reproducible drawings within 30 days to the

Associate.

### 3.7 EQUIPMENT, FOUNDATIONS, SUPPORTS, PIERS AND ATTACHMENTS

- A. Provide necessary foundations, supports, pads, bases and piers required for equipment specified in this division; submit drawings in accordance with Shop Drawing Submittal requirements prior to the purchase, fabrication or construction of same.
- B. Provide concrete pads for base-mounted transformers and Electric Contractor provided rotating equipment and for other floor mounted electrical equipment. Pads shall be extended 6 inches beyond matching base in all directions with top edge chamfered. Inset 6 inch steel dowel rods into floors to anchor pads.
- C. Construction of foundations, supports, pads, bases and piers, where mounted on the floor, shall be of the same materials and same quality of finish as the adjacent and surrounding floor material.
- D. Equipment shall be securely attached to the building structure in an approved manner. Attachments shall be of a strong and durable nature and any attachments that are, in the opinion of the Associate, not strong and durable shall be replaced as directed. Reference Division 3 “Concrete”.

### 3.8 SCAFFOLDING

- A. Furnish and erect scaffolding and ladders required in the installation of wiring, raceways, cable tray, equipment and lighting fixtures.

### 3.9 ENVIRONMENTAL AIR PLENUMS

- A. In spaces over suspended ceilings which are used for environmental air handling purposes as defined by Article 300.22C of the National Electric Code, power, data and communications cables must be in conduit or of the type cable rated for air plenum use. This Contractor shall be responsible to clearly define ceiling space used for environmental air purposes, provide material and installations meeting installation environment.

### 3.10 HAZARDOUS LOCATIONS

- A. In hazardous locations as defined by Article 500 of the National Electrical Code, electrical work installed in these areas shall be installed in accordance with the requirements of Article 500 whether specifically called for or not. Fixtures, fittings, and devices shall be installed according to, be rated for area of installation and meet requirements of binding code, including devices, seal offs, etc. Determine such areas as defined by the NEC and NFPA and conform to requirements of the enforcing agencies.

END OF SECTION 260500



## SECTION 260510 – APPARATUS COORDINATION, INSPECTION & TESTING

### PART 1 – GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Special Conditions, General Requirements, Division 1 Specifications, apply to this Section.

#### 1.2 DESCRIPTION

- A. The intent of the inspection, testing and check-out work specified herein, or required, is to ensure that electrical workmanship and equipment is installed and performs in accordance with the design specifications, drawings, manufacturer's instructions and applicable codes and requirements. Also, it is intended to provide, ensure, or determine the following.
  - 1. If the equipment or installation has been subjected to damage during shipment or installation.
  - 2. If the equipment is in accordance with the purchase orders and Contract Documents.
  - 3. Provide initial acceptance tests and recorded data that can be used as a bench mark for future routine maintenance and trouble shooting.
  - 4. Ensure a successful start-up with a minimum of last minute interruptions and problems.
  - 5. Determine the suitability of the equipment and systems for energization and placing into operating service.
  - 6. Provide assurance that each system component is not only installed satisfactorily but performs and shall continue to perform its function in the system with reasonable reliability throughout the life of the system.
- B. Provide necessary supervision, labor, materials, tools, test instruments or other equipment or services and expenses required to inspect, test, adjust, set, calibrate, functionally and operationally check work and components of the various electrical systems and circuitry throughout the installation. Include the furnishing of sufficient personnel to assist operating forces in any additional checks that may be required for acceptance, start-up, run-in and placing the equipment and systems into continuous service.
- C. As specified herein, electrical equipment and systems shall be tested and adjusted in accordance with current NETA testing specifications. It will be acceptable for the testing of low-voltage systems such as fire alarm systems, security and access control systems to be performed by the equipment manufacturer.
- D. Contractor provided inspections and tests of the facilities, in accordance with recognized standards, in no way relieves the Contractor of the responsibility for the performance of varied tests, check-outs, and inspections required during the various stages of construction. Nor does it relieve or shift responsibility for the guarantee outlined in this specification. The Contractor must allow for corrective action to resolve failing items while meeting project schedule.
- E. The listings and descriptions of the inspections, tests and checks described herein shall not be considered as complete and all-inclusive. Additional normal standard

construction (and sometimes repetitive) checks and tests shall be necessary throughout the job, prior to final acceptance by Owner.

## PART 2 - PRODUCTS (NOT APPLICABLE)

## PART 3 - EXECUTION

### 3.1 GENERAL REQUIREMENTS FOR INSPECTION, TESTING AND START-UP

- A. Obtain all inspections required by all laws, ordinances, rules, regulations or public authority having jurisdiction and obtain certificates of such inspections and submit same to Associate and Owner. Pay all fees, charges and other expenses in connection therein.
- B. When the Associate and Owners Representative makes final inspection of all electrical work, tests will be ordered as deemed necessary. This Contractor shall provide such assistance as required (including manpower and tools) to start and stop the various systems. This Contractor (not Owner or its representatives) is responsible to turn on the systems and demonstrate they are operating properly including any programming or final adjustments.
- C. Prepare proposed procedures and schedules for inspections, test, settings and calibrations specified or otherwise required prior to or during the checkout for start-up and acceptance of the electrical components, equipment and systems. This work shall be coordinated and shall be compatible with both the work of other crafts and the project schedule. The above must be organized and submitted with proposed testing and check out forms for the review and approval of the Owner's representative. The procedures must provide specific instructions for the checking and testing of each component in addition to the system functional checks. Tests and inspections shall also be scheduled as the job progresses and may require repetition in greater detail at a later stage of construction. Procedures submitted shall include job safety rules proposed.
- D. Equipment purchased by the Contractor or purchased by Owner for installation shall be inspected and tested to determine its condition. See other applicable sections of the specifications and contract documents for required checks and responsibilities.
- E. At any stage of construction and when observed, any electrical equipment or system determined to be damaged, faulty, or requiring repairs shall be reported. Corrective action may require prior approval.
- F. Electrical power distribution equipment and systems shall be tested in accordance with the current edition of NETA Standard's acceptance testing specification. The Contractor shall be responsible for all final settings and adjustments on protective devices and transformer tap changes.
- G. Check the continuity of all circuits to ground before they are energized. The phase wires and neutral wires shall be checked for continuity prior to the last connection made. Feeders shall be meggered for insulation abrasions in accordance to NETA testing specifications.

### 3.2 TESTS TO BE PERFORMED

- A. The following electrical equipment and systems shall be tested in accordance with the current edition of the NETA Acceptance Testing Specifications where installed within Project:
  - 1. Motors and related control systems.

### 3.3 DOCUMENTATION OF TEST RESULTS

- A. All personnel engaged in performing the above tests shall provide a signed legible letter verifying successful operation of the system(s). Attached to this letter shall be a copy of the document outlined in paragraph 3.1 with a check indicating tests performed by this individual.
- B. Any measured test data shall also be attached for future reference by the University.

END OF SECTION 260510

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## SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Building wires and cables rated 600 V and less.
  - 2. Connectors, splices, and terminations rated 600 V and less.
- B. Related Requirements:

#### 1.2 ACTION SUBMITTALS

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

#### 1.3 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

### PART 2 - PRODUCTS

#### 2.1 CONDUCTORS AND CABLES

- A. Copper Conductors: Comply with NEMA WC 70/ICEA S-95-658.
- B. Conductor Insulation: Comply with NEMA WC 70/ICEA S-95-658 for Type THW-2 Type THHN/THWN-2 Type XHHW-2.

#### 2.2 CONNECTORS AND SPLICES

- A. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

#### 2.3 SYSTEM DESCRIPTION

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

### PART 3 - EXECUTION

#### 3.1 CONDUCTOR MATERIAL APPLICATIONS

- A. Feeders: Copper stranded for No. 12 AWG and larger.
- B. Branch Circuits: Copper stranded for No. 12 AWG and larger, except VFC cable, which shall be extra flexible stranded.

### 3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

- A. Exposed Feeders: Type THHN/THWN-2, single conductors in raceway
- B. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspace: Type THHN/THWN-2, single conductors in raceway
- C. Exposed Branch Circuits, Including in Crawlspace: Type THHN/THWN-2, single conductors in raceway.
- D. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN/THWN-2, single conductors in raceway. Metal-clad cable, Type MC for lighting fixture drops no longer than 6'-0".
- E. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.

### 3.3 INSTALLATION OF CONDUCTORS AND CABLES

- A. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.
- B. Complete raceway installation between conductor and cable termination points according to Section 260533 "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables.
- C. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
- D. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
- E. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.
- F. Support cables according to Section 260529 "Hangers and Supports for Electrical Systems."

### 3.4 CONNECTIONS

- A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.
- B. Make splices, terminations, and taps that are compatible with conductor material[ and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors].
- C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches (150 mm) of slack.

### 3.5 IDENTIFICATION

- A. Identify and color-code conductors and cables according to Section 260553 "Identification for Electrical Systems."
- B. Identify each spare conductor at each end with identity number and location of other end of conductor, and identify as spare conductor.

### 3.6 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

### 3.7 FIRESTOPPING

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Section 078413 "Penetration Firestopping."

### 3.8 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
  - 1. After installing conductors and cables and before electrical circuitry has been energized, test feeder conductor for compliance with requirements.
  - 2. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
- B. Test and Inspection Reports: Prepare a written report to record the following:
- C. Cables will be considered defective if they do not pass tests and inspections.

END OF SECTION 260519

## SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes grounding and bonding systems and equipment.

#### 1.2 ACTION SUBMITTALS

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

### PART 2 - PRODUCTS

#### 2.1 SYSTEM DESCRIPTION

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with UL 467 for grounding and bonding materials and equipment.

#### 2.2 CONDUCTORS

- A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.

#### 2.3 CONNECTORS

- A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.
- B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy.
- C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.
- D. Bus-Bar Connectors: Mechanical type, cast silicon bronze, solderless mechanical-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.

#### 2.4 GROUNDING ELECTRODES

- A. Existing to remain

### PART 3 - EXECUTION

#### 3.1 APPLICATIONS

- A. Conductors: Install stranded conductors for No. 12 AWG and larger unless otherwise indicated.
- B. Conductor Terminations and Connections:

1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
3. Connections to Ground Rods at Test Wells: Bolted connectors.
4. Connections to Structural Steel: Welded connectors.

### 3.2 GROUNDING AT THE SERVICE

- A. Existing to remain

### 3.3 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS

- A. None.

### 3.4 EQUIPMENT GROUNDING

- A. Install insulated equipment grounding conductors with all feeders and branch circuits.
- B. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:
  1. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.

### 3.5 INSTALLATION

- A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage. Grounding conductors associated with feeders and branch circuits shall be run in the same conduit with the circuit conductors.
- B. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.
  1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
  2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.
  3. Use exothermic-welded connectors for outdoor locations; if a disconnect-type connection is required, use a bolted clamp.

### 3.6 FIELD QUALITY CONTROL

- A. Perform tests and inspections. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.

END OF SECTION 260526



## SECTION 260529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Hangers and supports for electrical equipment and systems.
- B. Related Requirements:

#### 1.2 ACTION SUBMITTALS

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

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

- A. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents as well as accidental load.
- B. Steel Slotted Support Systems: Comply with MFMA-4 factory-fabricated components for field assembly.
  - 1. Material: Pre-galvanized steel
  - 2. Channel Width: 1-1/4 inches.
  - 3. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
  - 4. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-.
  - 5. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
  - 6. Channel Dimensions: Selected for applicable load criteria.
- C. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- D. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be made of malleable iron.
- E. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M steel plates, shapes, and bars; black and galvanized.
- F. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
  - 1. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel, for use in hardened portland cement concrete, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.

2. Concrete Inserts: Steel or malleable-iron, slotted support system units are similar to MSS Type 18 units and comply with MFMA-4 or MSS SP-58.
3. Clamps for Attachment to Steel Structural Elements: MSS SP-58 units are suitable for attached structural element.
4. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
5. Toggle Bolts: All-steel springhead type.
6. Hanger Rods: Threaded steel.

## 2.2 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

- A. Description: Welded or bolted structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.

## PART 3 - EXECUTION

### 3.1 APPLICATION

- A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems unless requirements in this Section are stricter.
- B. Comply with requirements for raceways and boxes specified in Section 260533 "Raceways and Boxes for Electrical Systems."
- C. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMTs, IMCs, and RMCs as scheduled in NECA 1, where its Table 1 lists maximum spacing that are less than those stated in NFPA 70. Minimum rod size shall be 1/4 inch in diameter.
- D. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted or other support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.
  1. Secure raceways and cables to these supports with two-bolt conduit clamps

### 3.2 SUPPORT INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this article.
- B. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.
- C. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements.
- D. Drill holes for expansion anchors in concrete at locations and to depths that avoid the need for reinforcing bars.

### 3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

- A. Comply with installation requirements in Section 055000 "Metal Fabrications" for site-fabricated metal supports.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.
- C. Field Welding: Comply with AWS D1.1/D1.1M.

### 3.4 PAINTING

- A. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 260529

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## SECTION 260533 - RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
1. Metal conduits, tubing, and fittings.
  2. Metal wireways and auxiliary gutters.
  3. Surface raceways.
  4. Boxes, enclosures, and cabinets.

- B. Related Requirements:

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

#### 1.3 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Conduit routing plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of items involved:
1. Structural members in paths of conduit groups with common supports.
  2. HVAC and plumbing items and architectural features in paths of conduit groups with common supports.

### PART 2 - PRODUCTS

#### 2.1 METAL CONDUITS, TUBING, AND FITTINGS

- A. Listing and Labeling: Metal conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. GRC: Comply with ANSI C80.1 and UL 6.
- C. IMC: Comply with ANSI C80.6 and UL 1242.
- D. EMT: Comply with ANSI C80.3 and UL 797.
- E. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.
- F. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.
1. Conduit Fittings for Hazardous Locations: Comply with UL 886 and NFPA 70.
  2. Fittings for EMT:
    - a. Material: Steel
    - b. Type: Compression.

## 2.2 METAL WIREWAYS AND AUXILIARY GUTTERS

- A. Description: Sheet metal, complying with UL 870 and NEMA 250, Type 1 unless otherwise indicated, and sized according to NFPA 70.
  - 1. Metal wireways installed outdoors shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

## 2.3 SURFACE RACEWAYS

- A. Listing and Labeling: Surface raceways shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Surface Metal Raceways: Galvanized steel with screw-on covers complying with UL 5.

## 2.4 BOXES, ENCLOSURES, AND CABINETS

- A. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.
- B. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.
- C. Luminaire Outlet Boxes: Nonadjustable, designed for attachment of luminaire weighing 50 lb. Outlet boxes designed for attachment of luminaires weighing more than 50 lb shall be listed and marked for the maximum allowable weight.
- D. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- E. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, galvanized, cast iron with gasketed cover.
- F. Box extensions used to accommodate new building finishes shall be of same material as recessed box.
- G. Device Box Dimensions: 4 inches square by 2-1/8 inches deep.
- H. Gangable boxes are prohibited.
- I. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 1 with continuous-hinge cover with flush latch unless otherwise indicated.
  - 1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
  - 2. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.
- J. Cabinets:
  - 1. NEMA 250, Type 1 galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.

2. Hinged door in front cover with flush latch and concealed hinge.
3. Key latch to match panelboards.
4. Metal barriers to separate wiring of different systems and voltage.
5. Accessory feet where required for freestanding equipment.

## PART 3 - EXECUTION

### 3.1 RACEWAY APPLICATION

- A. Indoors: Apply raceway products as specified below unless otherwise indicated.
  1. Exposed, Not Subject to Physical Damage: EMT.
  2. Exposed, Not Subject to Severe Physical Damage: EMT Exposed and Subject to Severe
  3. Physical Damage: IMC. Raceway locations include the following:
    - a. Loading dock.
    - b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
    - c. Mechanical rooms.
  4. Concealed in Ceilings and Interior Walls and Partitions: EMT
  5. Connection to Vibrating Equipment Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment: FMC, except use LFMC in damp or wet locations.
  6. Damp or Wet Locations: IMC.
  7. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4 nonmetallic in institutional and commercial kitchens and damp or wet locations.
- B. Minimum Raceway Size: 3/4-inch trade size.
- C. Raceway Fittings: Compatible with raceways and suitable for use and location.
  1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
  2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with this type of conduit. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.
  3. EMT: Use setscrew steel fittings. Comply with NEMA FB 2.10.
  4. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.
- D. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.
- E. Install surface raceways only where indicated on Drawings.
- F. Do not install nonmetallic conduit.

### 3.2 INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for

aluminum conduits. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.

- B. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
- C. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for hangers and supports.
- D. Arrange stub-ups so curved portions of bends are not visible above finished slab.
- E. Install no more than the equivalent of three 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within 12 inches of changes in direction.
- F. Conceal conduit and EMT within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
- G. Support conduit within 12 inches of enclosures to which attached.
- H. Stub-ups to Above Recessed Ceilings:
  - 1. Use EMT, IMC, or RMC for raceways.
  - 2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.
- I. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.
- J. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than No. 4 AWG.
- K. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4-inch trade size and insulated throat metal bushings on 1-1/2-inch trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.
- 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. Cap underground raceways designated as spare above grade alongside raceways in use.
- M. Surface Raceways:
  - 1. Install surface raceway with a minimum 2-inch radius control at bend points.
  - 2. Secure surface raceway with screws or other anchor-type devices at intervals not exceeding 48 inches and with no less than two supports per straight raceway section. Support surface raceway according to manufacturer's written instructions. Tape and glue are not acceptable support methods.
- N. Install raceway sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed raceways, install each fitting in a

flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces.

- O. Install devices to seal raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all raceways at the following points:
  - 1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
  - 2. Where an underground service raceway enters a building or structure.
  - 3. Where otherwise required by NFPA 70.
  
- P. Expansion-Joint Fittings:
  - 1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed 30 deg F and that has straight-run length that exceeds 25 feet.
  - 2. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:
    - a. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F temperature change.
  - 3. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per degree F of temperature change for PVC conduits.
  - 4. Install expansion fittings at all locations where conduits cross building or structure expansion joints.
  - 5. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.
  
- Q. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 72 inches of flexible conduit for recessed and semi-recessed luminaires, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.
  - 1. Use LFMC in damp or wet locations subject to severe physical damage.
  - 2. Use LFMC or LFNC in damp or wet locations not subject to severe physical damage.
  
- R. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to of box unless otherwise indicated.
  
- S. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surfaces to provide a flat surface for a rain tight connection between the box and cover plate or the supported equipment and box.
  
- T. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.
  
- U. Locate boxes so that cover or plate will not span different building finishes.



- V. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.
- W. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.
- X. Set metal floor boxes level and flush with finished floor surface.

### 3.3 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

### 3.4 FIRESTOPPING

- A. Install firestop at penetrations of fire-rated floor and wall assemblies.

### 3.5 PROTECTION

- A. Protect coatings, finishes, and cabinets from damage and deterioration.
  1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
  2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION 260533

## SECTION 260534 – JUNCTION & PULL BOXES

### PART 1 – GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 DESCRIPTION

- A. Provide junction and pull boxes in accordance with Contract Documents. Wherever possible, use outlet boxes for junction and pull boxes. Fuses in equipment shall be furnished by the respective contractor supplying the device and installed under this Division.
- B. Provide cabinets in accordance with the Contract Documents. Cabinets for same type of use shall be the product of a single manufacturer. Do not install surface mounted cabinets in finished areas, unless indicated. Where conflicting data is indicated, verify mounting requirements prior to ordering cabinets.

### PART 2 – PRODUCTS

#### 2.1 MANUFACTURER

- A. Sheet Steel Junction and Pull Boxes: Hoffman, Hammond Mfg, Steel City or approved equal.
- B. Cast Iron Junction and Pull Boxes: O.Z. Electric Manufacturing Company, Crouse Hinds Company, or equal.
- C. Rigid Nonmetallic Junction and Pull Boxes: Carlon Electric Sciences, Inc. Hubbell, Cantex Industries or equal.
- D. Not used.
- E. Cabinets: Products of the following manufacturers are acceptable. Other products shall be approved as equal.
  - 1. Cabinets for General Use: Hoffman Engineering Company, Hammond Manufacturing, or equal.
  - 2. Cabinets for systems and/or products, use cabinets furnished by manufacturer with system or product. Where system or product cabinets do not comply with these specifications, submit cabinet shop drawings, indicating deviations, and obtain approval for their use.

#### 2.2 MATERIALS

- A. Fabricate sheet metal junction and pull boxes of galvanized, Code gauge, sheet steel. Include angle iron framing where required for rigidity. Boxes shall not deflect or deform when covers are removed after conduit and conductors are installed, and any deflection occurring shall not prevent the easy installation and removal of cover attachment screws.

- B. Size junction and pull boxes to not less than minimum National Electrical Code requirements. Increase size above Code requirements where necessary to provide space for pulling, racking, or splicing enclosed conductors, or where specified or indicated dimensions exceed Code requirements.
- C. Metal junction and pull boxes exposed to weather shall be listed for use such as (and not installed in or below grade) raintight, weatherproof or waterproof. Boxes shall contain gaskets with removable covers. Use boxes constructed to meet NEMA 3R requirements or otherwise noted or required by code. Equivalent gasket boxes or boxes of similar design permanently rendered weatherproof. Raintight or weatherproof boxes shall use threaded watertight hubs for top or side entry and may use knockout for bottom entry only. For exterior pull boxes, use a minimum of 14 gauge galvanized sheet steel. Apply galvanizing by the hot dip process after fabrication.
- D. Surface sheet metal junction and pull boxes with covers aligning with the sides of the box and equip flush boxes with covers extending 3/4 inch all around the perimeter of the back box. Provide sufficient cover attachment screws to ensure that box covers contact the surface of the box for the entire perimeter of the enclosure. Use brass or stainless steel screws to attach covers to boxes.
- E. Use brass screws only to attach junction and pull box covers to interior floor boxes or boxes located where moisture may be present.
- F. Do not use single covers for junction and pull boxes having cover length or width dimension exceeding 3 feet so specified, indicated, or approved. Sectionalize covers that exceed 3 feet in either dimension into two or more sections.
- G. Provide barrier between pull boxes for cables of different voltage and to separate cables connected to the emergency and normal power.
- H. Provide split or hinged covers on junction/pull boxes when the cover exceeds eight (8) square feet in area.
- I. This contractor shall paint all fire alarm system junction boxes, pull boxes and covers in red paint in accordance to Ohio Building Code.
- J. Indoor Cabinets:
  - 1. Construct of cold rolled quality steel, with metal gauges and construction methods conforming to National Electrical Code requirements, and Underwriters' Laboratory standards.
  - 2. Finish doors, trims, and back boxes for surface mounted cabinets in finished areas, by applying a rust resistant treatment, prime coat, and a final coat of manufacturer's standard enamel or lacquer finish. Galvanize all other sheet metal components of cabinets, excepting non ferrous metal parts, or steel parts provided with cadmium plating or equivalent protective plating.
  - 3. Equip doors with concealed or semi concealed hinges and with flush or semi flush spring catch type flush cylinder locks. Key cabinet doors of similar use alike, and provide two keys with each lock.
  - 4. Set cabinet doors flush into cabinet trim. Equip trim with adjustable clamps or other approved means to fasten trim to cabinets. Fastening method shall permit adjustment for aligning the trim of flush cabinets to a plumb position. Trim for

flush cabinets shall extend not less than 3/4 inch beyond the perimeter of the back box.

5. Do not use factory furnished knockouts with surface back boxes. Punch or drill required openings during installation. Equip flush back boxes with manufacturer's standard pattern of knockouts.

K. Not used.

## PART 3 – EXECUTION

### 3.1 INSTALLATION

- A. Locate interior junction and pull boxes in machine rooms, equipment rooms, storage rooms, electrical rooms, and similar utility spaces, unless otherwise indicated or approved. Fasten plates to boxes with countersunk flat head screws. Provide plates with 3/4 inch trim all around.
- B. Do not exceed the equivalent of three 90deg bends between general wiring pull and junction boxes, and reduce to not more than the equivalent of two 90deg bends where telephone or other multi conductor cable shall be installed.
- C. Install junction boxes and pull boxes in a manner to insure that equipment ground continuity is maintained.
- D. Junction and pull boxes shall be accessible.
- E. Boxes shall be installed every 100 feet in major feeders.
- F. Underground junction boxes shall be installed according to manufacturer's instructions.
- G. Support all junction/pull boxes with 1/2 inch all-thread rod from floor above or joists or structural members. If mounted tight to floor above, use approved anchors. Tie wire used to support, suspend, or secure junction/pull boxes is not acceptable.
- H. Cabinets:
  1. Set cabinets at heights indicated or specified. In the absence of such information, set cabinets at not to exceed 6 feet 6 inches from finished floor to top of cabinet.
  2. Level and align the tops of cabinets in sight of each other at a uniform height.
  3. Install cabinets (and other enclosure products) plumb with building construction. Install flush enclosures so that the trim shall rest against the surrounding surface metal around the entire perimeter of the enclosure.
  4. Fastenings shall be made by means of not smaller than 3/16 inch diameter bolts, expansion bolts, or toggle bolts; not smaller than No. 9 x 1 inch wood screws. Fastenings, where exposed to weather or moisture, shall be galvanized. Not less than four fastenings shall be used to secure each cabinet. Do not use nails, or wooden fiber inserts in masonry.
  5. On masonry or concrete walls, columns or flooring, fastenings shall be made by means of lead expansion shields not smaller than shield size 3/8 inch diameter by 5/8 inch long for use with No.10 24 round head machine screws. Machine screws shall be not less than 1-1/4 inches long for installation on ceiling and not less than 1 inch long elsewhere.

6. Holes for lead expansion shields shall be carefully and accurately drilled, using sharp drills to a depth which shall afford the maximum practical engagement of threads (depth equal to screw length not less than 1 1/4 inches past plaster into solid concrete). Installation shall develop full strength of screws.

END OF SECTION 260534

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## SECTION 260535 - RACEWAY & FITTINGS

### PART 1 – GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Special Conditions, General Requirements, Division 1 Specifications, apply to this Section.

#### 1.2 DESCRIPTION

- A. Provide all raceway fittings, supports and back boxes required to complete work indicated on the Contract Documents.

### PART 2 - PRODUCTS

#### 2.1 MATERIALS

- A. Subject to general requirements and use as specified in Section 260533 "Raceway and Boxes".
- B. For fittings of specialized type, use the products as scheduled for each type under "Manufacturers," or approved equal.

#### 2.2 MANUFACTURERS

- A. General Use Fittings: Steel City, Thomas & Betts, O.Z. Electric Manufacturing Co., Carlon, Sealing Fittings: Appleton Electric, Crouse-Hinds.
- B. Liquid-Tight Flexible Conduit Fittings: Thomas & Betts, Appleton Electric, Steel City.
- C. Expansion Fittings: O.Z. Type "DX" or approved equal of Appleton, Thomas & Betts, Crouse Hinds.
- D. Cast Metal Straight, Tee, Cross, and Fittings: Crouse-Hinds, Appleton Electric, Killark.
- E. Rigid Nonmetallic Conduit Fitting: Carlon Electrical Sciences, Inc. Cantex Industries, Hubbell.
- F. PVC coated fittings: Occidental Coating Company, Robroy Industries, Ocal (Thomas & Betts) or equal.

### PART 3 - EXECUTION

#### 3.1 USE

- A. Use threaded fittings for rigid and intermediate metal conduit.
- B. Compression or drive-on watertight fittings shall be used for metallic tubing. Fittings with set screws for trade size smaller than 2 inch is not approved for use.
- C. Fittings for flexible conduit as approved by the enforcing Code official.

- D. Use fittings made of the same material and corrosion resistance as the raceway except:
  - 1. Malleable iron and steel are interchangeable.
  - 2. Die cast fittings may be used for flexible steel conduit, and for factory manufactured offsets.
  - 3. Use insulated bushings for conduit trade sizes.
  - 4. Use steel insulated throat connectors for electrical metallic tubing.
  
- E. Use steel fittings that are galvanized, cadmium-plated, or have other approved protective coating.
  
- F. Use double locknuts for terminating rigid conduit at sheet metal enclosures and equipment conduit ends with bushings.
  
- G. Provide expansion fittings on every raceway larger than 1-1/2 inches, and use a 2 foot piece of seal tight on all conduit routings 1-1/2 inches and smaller where it crosses any building expansion joints. Expansion fittings shall be provided for conduit thermal expansion or contraction in accordance to tables specified in NEC. Verify exact location of building expansion joints prior to installation of raceway with project Architect.
  
- H. Where an expansion fitting is used, conduit bonding shall be continuous by means of a flexible braided copper bonding strap with ground clamps. Bonding strap and clamps shall be provided for grounding continuity as required by NEC. Strap shall be of sufficient length to allow full expansion. Manufacturer Crouse-Hinds XJ or XJG-EMT or approved equal.
  
- I. Use PVC coated fittings for rigid PVC coated steel conduit.
  
- J. Provide moisture barrier fittings for conduit routing entering conditioned spaces from non-conditioned spaces. This contractor shall fill fitting with an approved material preventing circulation and formations of moisture in the conduit system.
  
- K. Where conduit is subject to collection of condensation or moisture, provide a low point combination breather/drain such as Crouse-Hinds ECD or approved manufacturer equal.

END OF SECTION 260535

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## SECTION 260536 – MANUFACTURED SOUND AND VIBRATION CONTROL COMPONENTS

### 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 work of this section.

#### 1.2 RELATED WORK SPECIFIED ELSEWHERE

- A. Coordinate work of this section with work of other sections as required to properly execute the work and as necessary to maintain satisfactory progress of the work of other sections, including:
  - 1. Section 260500 Common Work Results for Electrical

#### 1.3 DESCRIPTION OF SYSTEM

- A. The work under this Section shall include furnishing all labor, materials, tools, appliances and equipment, and performing all operations necessary for the complete execution of the installation of the acoustical fire rated outlet backer pad as shown, detailed and/or scheduled on the drawings, and/or specified in this section of the specifications except as listed above. This work in general shall be included but not necessarily be limited to the following:
  - 1. Electrical outlets shall be wrapped with an outlet backer pad where indicated on drawings.

#### 1.4 REFERENCES

- A. Test Requirements:
  - 1. ASTM E-814-02, "Standard Method of Fire Tests of Through Penetration Fire Stops"
  - 2. ASTM E119 "Standard Test Methods for Fire Tests of Building Construction and Materials"
- B. Underwriters Laboratories (UL) of Northbrook, IL runs ASTM E-814 under their designation of UL 1479, ASTM E-119 under their designation of UL 263 and publishes the results in their "FIRE RESISTANCE DIRECTORY" that is updated annually.
  - 1. UL Fire Resistance Directory:
    - a. Wall Opening Protective Materials CLIV
- C. All major building codes: ICBO, SBCCI, BOCA, and OBC.
- D. NFPA 101 - Life Safety Code

#### 1.5 QUALITY ASSURANCE

- A. Acoustical Firestop System installation must meet requirements of ASTM E-814, UL 1479 and ASTM E-119, UL 263 tested assemblies that provide a fire rating equal to that of construction being penetrated.



- B. Proposed acoustical firestop materials and methods shall conform to applicable governing codes having local jurisdiction.

#### 1.6 SUBMITTALS

- A. Submit Product Data: Manufacturer's specifications and technical data for each material, documentation of UL listing or equivalent and manufacturer's installation instructions.
- B. Submit material safety data sheets provided with product delivered to job-site.

#### 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials undamaged in manufacturer's clearly labeled, unopened containers, identified with brand, type, and UL label.
- B. Coordinate delivery of materials with scheduled installation date to allow minimum storage time at job-site.
- C. Store materials under cover and protect from weather and damage in compliance with manufacturer's requirements, including temperature restrictions.
- D. Comply with recommended procedures, precautions or remedies described in material safety data sheets as applicable.
- E. Do not use damaged or expired materials.

#### 1.8 PROJECT CONDITIONS

- A. Do not use materials that contain flammable solvents.
- B. Schedule installation of backer pads after completion of penetrating item installation but prior to covering or concealing of openings.
- C. Verify existing conditions and substrates before starting work. Correct unsatisfactory conditions before proceeding.

### PART 2 – PRODUCTS

#### 2.1 ACCEPTABLE MANUFACTURERS

- A. Subject to compliance with Wall Opening Protective Materials (CLIV) listed in the UL Fire Resistance Directory, provide products of the following manufacturers as identified below:
  - 1. Kinetics Noise Control.
  - 2. Acoustical Solutions.
  - 3. ATS Acoustics.
  - 4. Approved equal.

#### 2.2 MATERIALS

- A. Use only backer pads that have been UL 1479 or ASTM E-814 tested for specific fire-rated construction conditions conforming to construction assembly type, penetrating item type, and fire-rating involved for each separate instance.

- B. Wall opening protective materials for use with U.L. listed metallic and specified nonmetallic outlet boxes, the following products are acceptable:
  - 1. Kinetics Noise Control Model IsoBacker: Acoustical Fire Rated Outlet Backer Pad or approved equal.

### PART 3 – EXECUTION

#### 3.1 PREPARATION

- A. Verification of Conditions: Examine areas and conditions under which work is to be performed and identify conditions detrimental to proper or timely completion.
  - 1. Verify penetrations are properly sized and in suitable condition for application of materials.
  - 2. Surfaces to which backer pads will be applied shall be free of dirt, grease, oil, rust, laitance, release agents, water repellents, and any other substances that may affect proper adhesion.
  - 3. Do not proceed until unsatisfactory conditions have been corrected.

#### 3.2 INSTALLATION

- A. Regulatory Requirements: Install backer pads in accordance with UL Fire Resistance Directory
- B. Manufacturer's Instructions: Comply with manufacturer's instructions for installation of backer pads.
  - 1. Peel off release paper from one side of backer pad
  - 2. Position backer pad on the back side of outlet after electrical wires have been installed
  - 3. Wrap backer pad around entire outlet
  - 4. Peel off release paper from second side
  - 5. If part of outlet still exposed use a second pad to wrap the rest of the outlet

#### 3.3 FIELD QUALITY CONTROL

- A. Examine sealed outlet to ensure proper installation before concealing or enclosing areas.

END OF SECTION 260536

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## SECTION 260553 - IDENTIFICATION FOR ELECTRICAL SYSTEM

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Identification for raceways.
  - 2. Identification of power and control cables.
  - 3. Identification for conductors.
  - 4. Warning labels and signs.
  - 5. Instruction signs.
  - 6. Equipment identification labels, including arc-flash warning labels.
  - 7. Miscellaneous identification products.

#### 1.2 ACTION SUBMITTALS

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

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

- A. Comply with ASME A13.1 and IEEE C2.
- B. Comply with NFPA 70.
- C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.
- D. Comply with ANSI Z535.4 for safety signs and labels.
- E. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

#### 2.2 COLOR AND LEGEND REQUIREMENTS

- A. Raceways and Cables Carrying Circuits at 600 V or Less:
  - 1. White letters on a black field.
  - 2. Legend: Indicate voltage and system or service type.
- B. Warning labels and signs shall include, but are not limited to, the following legends:
  - 1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
  - 2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES."

#### 2.3 LABELS

- A. Vinyl Labels for Raceways Carrying Circuits at 600 V or Less: Preprinted, flexible labels laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing label ends.

1. Preprinted, 3-mil-thick, vinyl flexible label with acrylic pressure-sensitive adhesive.
  - a. Nominal Size: 3.5-by-5-inch.

## 2.4 TAPES AND STENCILS:

- A. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.
- B. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; not less than 3 mils thick by 1 to 2 inches wide; compounded for outdoor use.

## 2.5 TAGS

- A. Nonmetallic Preprinted Tags: Polyethylene tags, 0.015 inch thick, color-coded for phase and voltage level, with factory screened permanent designations; punched for use with self-locking cable tie fastener.

## 2.6 SIGNS

- A. Laminated Acrylic or Melamine Plastic Signs:
  1. Engraved legend.
  2. Thickness:
    - a. For signs up to 20 sq. inches, minimum 1/16-inch thick.
    - b. For signs larger than 20 sq. inches, 1/8 inch thick.
    - c. Engraved legend with white letters on a dark grey background
    - d. Punched or drilled for mechanical fasteners.
    - e. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

## 2.7 CABLE TIES

- A. General-Purpose Cable Ties: Fungus inert, self-extinguishing, one piece, self-locking, Type 6/6 nylon.
  1. Minimum Width: 3/16 inch.
  2. Tensile Strength at 73 deg F according to ASTM D 638: 12,000 psi.
  3. Temperature Range: Minus 40 to plus 185 deg F.
  4. Color: Black, except where used for color-coding.
- B. Plenum-Rated Cable Ties: Self-extinguishing, UV stabilized, one piece, self-locking.
  1. Minimum Width: 3/16 inch.
  2. Tensile Strength at 73 deg F according to ASTM D 638: 7000 psi.
  3. UL 94 Flame Rating: 94V-0.
  4. Temperature Range: Minus 50 to plus 284 deg F.
  5. Color: Black.

## 2.8 MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.
- B. Apply identification devices to surfaces that require finish after completing finish work.
- C. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
- D. Attach plastic raceway and cable labels that are not self-adhesive type with clear vinyl tape, with adhesive appropriate to the location and substrate.
- E. Cable Ties: For attaching tags. Use general-purpose type, except as listed below:
  - 1. In Spaces Handling Environmental Air: Plenum rated.

### 3.2 IDENTIFICATION SCHEDULE

- A. Power-Circuit Conductor Identification, 600 V or Less: For conductors in, pull and junction boxes, use color-coding conductor tape to identify the phase.
  - 1. Color-Coding for Phase- and Voltage-Level Identification, 600 V or Less: Use industry standard colors for ungrounded feeder and branch-circuit conductors.
    - a. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.
- B. Control-Circuit Conductor Identification: For conductors and cables in pull and junction boxes, use self-adhesive vinyl labels with the conductor or cable designation, origin, and destination.
- C. Control-Circuit Conductor Termination Identification: For identification at terminations, provide with the conductor designation.
- D. Conductors to Be Extended in the Future: Attach write-on tags to conductors and list source.
- E. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.
  - 1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
  - 2. Use system of marker-tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.
  - 3. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and operation and maintenance manual.
- F. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical-fiber cable.

1. Limit use of underground-line warning tape to direct-buried cables.
  2. Install underground-line warning tape for direct-buried cables and cables in raceways.
- G. Workspace Indication: Install floor marking tape to show working clearances in the direction of access to live parts. Workspace shall comply with NFPA 70 and 29 CFR 1926.403 unless otherwise indicated. Do not install at flush-mounted panelboards and similar equipment in finished spaces.
- H. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Self-adhesive warning labels
1. Comply with 29 CFR 1910.145.
  2. Identify system voltage with black letters on an orange background.
  3. Apply to exterior of door, cover, or other access.
  4. For equipment with multiple power or control sources, apply to door or cover of equipment, including, but not limited to, the following:
    - a. Power-transfer switches.
    - b. Controls with external control power connections.
- I. Arc Flash Warning Labeling: Self-adhesive thermal transfer vinyl labels.
1. Comply with NFPA 70E and ANSI Z535.4.
- J. Operating Instruction Signs: Install instruction signs to facilitate proper operation and maintenance of electrical systems and items to which they connect. Install instruction signs with approved legend where instructions are needed for system or equipment operation.
- K. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and operation and maintenance manual.
1. Labeling Instructions:
    - a. Indoor Equipment: Engraved, laminated acrylic or melamine plastic label, punched or drilled for mechanical fasteners. Unless otherwise indicated, provide a single line of text with 1/2-inch-high letters on 1-1/2-inch-high label; where two lines of text are required, use labels 2 inches high.
    - b. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.
    - c. Unless labels are provided with self-adhesive means of attachment, fasten them with appropriate mechanical fasteners that do not change the NEMA or NRTL rating of the enclosure.

END OF SECTION 260553

## SECTION 260923 – LIGHTING CONTROL DEVICES

### PART 1 – GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Reference specification Division 26 Section 262726 “Wiring Devices”.

#### 1.2 SUMMARY

- A. This Section includes the following lighting control devices:
  - 1. Switches
  - 2. Key Switches
  - 3. Indoor occupancy sensors
  - 4. Wall mounted occupancy switch sensors and dimming switch sensors

#### 1.3 DEFINITIONS

- A. LED: Light-emitting diode.
- B. PIR: Passive infrared.
- C. US: Ultrasonic.
- D. DT: Dual technology PIR & US

#### 1.4 SUBMITTALS

- A. Product Data Sheet: Submit data sheet(s) for each type of lighting control, sensors, required relays and controllers.
- B. Shop Drawings: Provide installation plan drawing with layouts and details for each room or area having lighting controls. Each drawing shall include location of controls, light fixtures, sensors and other required equipment. Include bill of material identifying products used with cross-reference to product data sheets. Wiring schematics shall be included for each type of control scheme.
- C. Operation and Maintenance Data: Provide for each product used within project shall have 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, smoke detectors, fire-suppression system, and partition assemblies.

## PART 2 - PRODUCTS (SELECTED TYPES WHERE APPLICABLE)

### 2.1 INTERIOR DIMMING SWITCHES

- A. Reference specification Division 26 Section 262726 “Wiring Devices”.

### 2.2 OCCUPANCY/VACANCY SWITCHES AND SENSORS

- A. Wall mounted Occupancy/Vacancy Sensor Switch - It's the responsibility of the Electrical Contractor to ensure that sensors meet or exceed the specifications included herein. Sensors and their subcomponents shall operate as intended and under load conditions as shown within Contract documents.
  1. Building Codes: All units shall comply with applicable, local building codes.
  2. All sensors shall be FCC compliant where applicable.
  3. Manufacturer shall 100% test all equipment prior to shipment. Sample testing is not acceptable.
  4. UL listed having standard warranty of 5 years.
  5. This contractor shall provide low voltage communication cable (type per manufacturer specification) from low voltage sensor to remote power pack or fixture per installation details. Cable shall be rated for plenum use.
  6. Controls shall be recessed to limit tampering and provide user adjustable settings for time delay and sensitivity.
  7. Dimming requirements are 0-10v – dimming units to have built in photosensor for automatic daylight harvesting option.
  8. Dual technology style sensors to be used in office areas.
  9. Wall switch sensors shall recess into single-gang switch box and fit a standard GFI opening.
  10. Wall switch sensors shall have the optional features for photocell/daylight override, vandal resistant lens, and low/high temperature humidity operation.
  11. Wall switch sensors shall be available in four standard colors (Ivory, White, Light Almond, Gray).
  12. Automatically adapt to changing room conditions—with the ability to disable adaptive features.
  13. Shall save learned and adjusted settings in non-volatile memory that retains all settings during power outages.
  14. Maximum adapted time-out shall not exceed 30 minutes.
  15. Switch sensor shall utilize PIR, ultrasonic or by combining both sensing technologies pending application of switch.
  16. Dual operation: Automatic - on/off and manual on/off or automatic only operation
  17. Dual operation: Automatic - on/off and manual on/off or automatic only operation.
  18. Zero point switching.
  19. Shall have a 3-position service switch: off, auto, and on when configured for dual operation or no switch for automation only operation.
    - a. Single circuit



- 1) Shall recognize motion detected within 20 seconds of turning off lighting as a false off. In response to a false off, the microprocessor shall increase the time-off setting.
- B. Submittals:
1. Bill of Materials: Complete list of all parts needed to fully install selected occupancy sensors.
    - a. Product Data: Submit product data, including catalog cut sheets for specified products.
    - b. Shop and Wiring Drawings: Submit shop drawings detailing all mechanical and electrical equipment including one-line diagrams, wire counts, coverage patterns, and physical dimensions of each item.
  2. Documentation & Commissioning
    - a. Field terminations shall be identified indicating wire originations. Point-to-point wiring diagram shall be provided and shall include “As-Built” conditions. Submit in duplicates to Owner and Project Architect.
    - b. EC shall provide System Manufacturer on-site configuration and programming of lighting system. EC to provide training of Owners representative.
    - c. Fixture Compatibility: List of ballasts and lamp combinations compatible with occupancy sensors, by manufacturer and catalog number.
    - d. Control cabling specifications.
- C. Low Voltage Switch Requirements LV
1. The programming for the digital switch shall reside in the switch itself and shall communicate to system components via RS 485. Switches shall provide capabilities to be locally programmed. Each individual switch button being programmed for On only, Off only.
  2. Switches installed shall be rated for high abuse areas and shall be vandal resistant, contain no moving parts, and be touch sensitive and available with up to three buttons in a single gang.
- D. Switches must be capable of handling electrostatic discharges of at least 30,000 volts (1cmspark) without any interruption or failure in operation
1. The Electrical Contractor, as part of the work of this section, shall coordinate, receive, mount, connect, and place into operation all occupancy related equipment. The Electrical Contractor shall furnish all conduit, wire, connectors, hardware, and other incidental items necessary for properly functioning lighting control and occupancy sensors as described herein and shown within contract documents. The Electrical Contractor shall maintain performance criteria stated by manufacturer without defects, damage, or failure.
- E. Ceiling Occupancy/Vacancy Sensors
1. Shall use microprocessor for motion signal analysis and internal, adaptive self-adjustment. Shall automatically adapt to changing room conditions.
  2. Shall identify, record and learn a room’s normal occupancy cycles to automatically adjust the sensitivity threshold.
  3. Shall save learned and adjusted settings in non-volatile memory that retains all settings during power outages.
  4. Shall accept Class 2 wiring.
  5. Shall mount on the ceiling.

6. Shall provide a concealed bypass switch to force on lighting.
  7. Shall save learned and adjusted settings in non-volatile memory that retains all settings during power outages.
  8. Shall be equipped with tamper resistant cover.
  9. All controls shall be accessible from front of unit.
  10. Rugged, plastic housing shall be available in white.
  11. Shall incorporate a real-time motion indicator LED, which is visible from the front of unit.
  12. Provide white ceiling mount occupancy sensors with accessories and required components as specified within Contract documents by one manufacturer. All color choices shall be confirmed with Architect.
    - a. Dual Sensor
      - 1) Shall incorporate Doppler shift ultrasonic and passive infrared motion detection technologies.
      - 2) Shall be available in 360° coverage patterns. Infrared lenses shall have a 360° field of view.
      - 3) Sensor shall have two modes of operation:
        - a) Multi-technology mode: where the sensors send infrared signal to the microprocessor, which makes the decision to turn on lighting based on the level of the signal.
        - b) Single technology mode: where the user chooses technology that will turn on lighting.
      - 4) Shall have mask inserts for PIR rejection to prevent false tripping.
    - b. Single Sensor - Ultrasonic
      - 1) Shall utilize Doppler shift ultrasonic detection technology.
    - c. Single Sensor – PIR
      - 1) Shall utilize passive infrared motion detection.
      - 2) Shall automatically adapt to changing background PIR levels.
      - 3) Infrared lenses shall have 360° field of view.
      - 4) Shall have mask inserts for PIR rejection to prevent false tripping.
  13. Line-Low Voltage Power Pack
    - a. Shall be compatible with incandescent, magnetic or electronic low voltage, and magnetic or electronic fluorescent, as well as motor loads.
    - b. Relay function shall not require more than 5-ma control current to operate.
    - c. Shall be installed inside a standard 4" x 4" junction box.
    - d. Ratings:
      - 1) 20A incandescent, 20A fluorescent, 20A LED @ 120vAC, 20A fluorescent @ 277vAC
      - 2) HVAC Relay – SPDT 500ma@24VDC three-wire isolated. Ratings: 0.5A, 125VAC; 1A, 30VD
  14. The Electrical Contractor, as part of the work of this section, shall coordinate, receive, mount, connect, and place into operation all occupancy related equipment. The Electrical Contractor shall furnish all conduit, wire, connectors, hardware, and other incidental items necessary for properly functioning lighting control and occupancy sensors as described herein and shown within contract documents. The Electrical Contractor shall maintain performance criteria stated by manufacturer without defects, damage, or failure.
- F. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Hubbell Building Automation – Basis of Design

2. Watt Stopper
3. Sensor Switch
4. Cooper Controls

## PART 3 - EXECUTION

### 3.1 SENSOR INSTALLATION

- A. Install and aim sensors in locations to achieve not less than 95 percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions. Provide back boxes, mounting brackets, guards, trims plates or other required finishes to provide a complete and functional unit.

The locations and quantities of sensors indicated within Contract drawings are diagrammatic and indicate only the rooms which are to be provided with sensors. The contractor shall provide additional sensors if required to properly and completely cover the intended area while meeting 95 percent coverage. It is this contractor's responsibility to arrange a pre-purchase/installation meeting with the manufacturer's factory authorized representative, at the owner's facility, to verify placement of sensors and installation criteria.

### 3.2 CONTACTOR INSTALLATION

- A. Mount electrically held lighting contactors with elastomeric isolator pads, to eliminate structure-borne vibration, unless contactors are installed in an enclosure with factory-installed vibration isolators.

### 3.3 WIRING INSTALLATION

- A. Wiring Method: Comply with Division 26 Section "Wire & Cables." Minimum conduit size shall be 3/4 inch.
- B. Wiring within Enclosures: Comply with NECA 1. Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.
- C. Cable type, pair quantity or sizing of conductors according to lighting control 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. It is this contractor's responsibility to insure exposed cables are properly bundled, supported, protected and rated (plenum) for area of installation.

### 3.4 IDENTIFICATION

- A. Identify components and power and control wiring according to Division 26 Section "Identification for Electrical Systems."
  1. Identify controlled circuits in lighting contactors.
  2. Identify circuits or luminaries controlled by photoelectric and occupancy sensors at each sensor.

### 3.5 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 operation of each lighting control device, and adjust time delays.
- B. Lighting control devices which fail tests and inspections are considered defective work and shall be replaced at no cost to the project.

### 3.6 ADJUSTING

- A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting sensors to suit occupied conditions.

### 3.7 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain lighting control devices. Refer to Division 01 Section "Demonstration and Training." Provide no less than (3) three complete set of operation and maintenance manuals at time of training.

END OF SECTION 260923

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## SECTION 262726 – WIRING DEVICES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. This Section includes the following:
  1. Receptacles, receptacles with integral GFCI, and associated device plates.
  2. Receptacles with integral surge suppression units.
  3. Isolated-ground receptacles.

#### 1.3 DEFINITIONS

- A. EMI: Electromagnetic interference.
- B. GFCI: Ground-fault circuit interrupter.
- C. Pigtail: Short lead used to connect a device to a branch-circuit conductor.
- D. RFI: Radio-frequency interference.
- E. TVSS: Transient voltage surge suppressor.
- F. UTP: Unshielded twisted pair.

#### 1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: List of legends and description of materials and process used for premarking wall plates.
- C. Samples: One for each type of device and wall plate specified, in each color specified.
- D. Field quality-control test reports.
- E. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing label warnings and instruction manuals that include labeling conditions.

#### 1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain each type of wiring device and associated wall plate through one source from a single manufacturer. Insofar as they are available, obtain all wiring devices and associated wall plates from a single manufacturer and one source.

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.

## 1.7 EXTRA MATERIALS

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

1. Floor Service Outlet Assemblies: one for every 10 of each type installed.
2. Wiring Devices: Three for every 100 of each type installed.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

A. Manufacturers' Names: Shortened versions (shown in parentheses) of the following manufacturers' names are used in other Part 2 articles:

1. Cooper Wiring Devices; a division of Cooper Industries, Inc. (Cooper).
2. Hubbell Incorporated; Wiring Device-Kellems (Hubbell).
3. Pass & Seymour/Legrand; Wiring Devices & Accessories (Pass & Seymour).

### 2.2 WIRING DEVICES

A. Furnish and install the following wiring devices at the locations indicated on the drawings by the Standard Wiring Symbols. All wiring devices shall be Arrow-Hart, Bryant, Hubbell, Pass and Seymour/Legrand, or equal make, and equal in capacity, quality, and type of the following plate numbers:

1. Single pole switches, 20A, 120/277V: Hubbell No. 1221-I.
2. Single pole (locking type) switches, 20A, 120/277V: Hubbell No. 1221-L.
3. Two pole switches, 20A, 120/277V: Hubbell No. 1222-I.
4. Three-way switches, 20A, 120/277V: Hubbell No. 1223-I.
5. Momentary contact switches, SP/DT, 20A, 120/277V: Hubbell No. 1557-I.
6. Surge suppression receptacles with light and alarm, 20A, 125V, 2P, 3W, Grd.: Hubbell No. 8362 IS.
7. Emergency convenience outlets, 20A, 120V, 2P, 3W, Grd.: Hubbell No. 8300-ILR.
8. Ground fault interrupting receptacles, 20A, 125V, 2P, 3W, Grd.: Hubbell No. HGF8300-I.
9. NEMA 5-20R non-locking receptacles, 20A, 125V, 2P, 3W, Grd.: Hubbell No. 8300-I.
10. Other outlets: As indicated on drawings.

## 2.3 STRAIGHT BLADE RECEPTACLES

- A. Isolated-Ground, Duplex Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, and UL 498.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Hubbell; CR 5253IG.
    - b. Pass & Seymour; IG6300.
  2. Description: Straight blade; equipment grounding contacts shall be connected only to the green grounding screw terminal of the device and with inherent electrical isolation from mounting strap. Isolation shall be integral to receptacle construction and not dependent on removable parts.

## 2.4 GFCI RECEPTACLES

- A. General Description: Straight blade, feed-through type. Comply with NEMA WD 1, NEMA WD 6, UL 498, and UL 943, Class A, and include indicator light that is lighted when device is tripped.
- B. Hospital-Grade, Duplex GFCI Convenience Receptacles, 125 V, 20 A: Comply with UL 498 Supplement SD.
1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
  2. Products: Subject to compliance with requirements, provide one of the following:
    - a. Cooper; HGF20.
    - b. Hubbell; HGF8300.
    - c. Pass & Seymour; 2091-SHG.

## 2.5 FLUSH FLOOR BOX

- A. Furnish and install, where indicated, floor mounted outlets for power.

Power Flush Floor Box: Hubbell Flush Floor Boxes for Wooden Floors, consisting of Catalog No. B2481 single-gang rectangular stamped steel floor box featuring one 1" hub for power feed. Floor box shall be capable of accepting Hubbell rectangular flanged cover for wooden floor applications. Stamped steel floor box and flanged cover combination shall exceed UL514A requirements. Cover assembly shall be constructed of curable cast aluminum, with powder coat finishes in brass or aluminum colors (Architect to select finish). Provide Catalog No. DR15\*\*TR, 20A, 125V duplex receptacle. Note: \*\* Color to be selected by architect.

- B. Installation: Electric Contractor shall saw-cut channel in existing concrete floor, shall install floor box, shall extend power and low voltage conduit to nearest wall, shall pour concrete fill to match existing surfaces and shall install all fittings in accordance with standards and recommendations of manufacturer.

## 2.6 OCCUPANCY SENSORS

- A. Refer to Section 260923.

## 2.7 WALL PLATES

- A. Single and combination types to match corresponding wiring devices.
- B. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with type 3R weather-resistant die-cast aluminum with lockable cover.
- C. On exposed work, switch covers shall be Crouse-Hinds No. DS32G, or equal, rustproofed ferrous alloy, with handle guard; covers for convenience receptacles inside building shall be No. DS32 without spring door.
- D. Covers for convenience receptacles installed outside building where exposed to weather or in other wet locations shall be TayMacCorporation No. 20370 vertical mount standard depth cover with tumbler key lock. The safety outlet enclosure shall be UL Listed and clearly marked "Suitable For Wet Locations While In Use". There must be a gasket between the enclosure and the mounting surface and between the cover and base to assume a proper seal. Standard Battleship Grey finish shall be suitable for repainting by others after installation.
- E. All other plates for wall switches, convenience receptacles, etc. shall be Bryant, Hubbell, or approved equal, .040" thick stainless steel with flat surface with beveled edges and of finish approved by the Engineer. Note, cover plates for outlets in acoustical ceilings shall be white to match devices and ceiling material.
- F. Where two or more devices are in the same location, they shall be mounted in gang with a single wall plate.

## 2.8 FINISHES

- A. Color: To be determined by Architect and Owner.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Comply with NECA 1, including the mounting heights listed in that standard, unless otherwise noted.
- B. Coordination with Other Trades:
  - 1. Take steps to insure that devices and their boxes are protected. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of the boxes.
  - 2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
  - 3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
  - 4. Install wiring devices after all wall preparation, including painting, is complete.



C. Conductors:

1. Do not strip insulation from conductors until just before they are spliced or terminated on devices.
2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.
4. Existing Conductors:
  - a. Cut back and pigtail, or replace all damaged conductors.
  - b. Straighten conductors that remain and remove corrosion and foreign matter.
  - c. Pigtailing existing conductors is permitted provided the outlet box is large enough.

D. Device Installation:

1. Replace all devices that have been in temporary use during construction or that show signs that they were installed before building finishing operations were complete.
2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
4. Connect devices to branch circuits using pigtails that are not less than 6 inches in length.
5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, 2/3 to 3/4 of the way around terminal screw.
6. Use a torque screwdriver when a torque is recommended or required by the manufacturer.
7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
8. Tighten unused terminal screws on the device.
9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device mounting screws in yokes, allowing metal-to-metal contact.

E. Receptacle Orientation:

1. Install ground pin of vertically mounted receptacles down, and on horizontally mounted receptacles to the right.

F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

G. Dimmers:

1. Install dimmers within terms of their listing.
2. Verify that dimmers used for fan speed control are listed for that application.
3. Install unshared neutral conductors on line and load side of dimmers according to manufacturers' device listing conditions in the written instructions.

- H. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.
- I. 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 "Identification for Electrical Systems."
  - 1. Receptacles: Identify panelboard and circuit number from 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 FIELD QUALITY CONTROL

- A. Perform tests and inspections and prepare test reports.
  - 1. In healthcare facilities, prepare reports that comply with recommendations in NFPA 99.
  - 2. Test Instruments: Use instruments that comply with UL 1436.
  - 3. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated LED indicators of measurement.
- B. Tests for Convenience Receptacles:
  - 1. Line Voltage: Acceptable range is 105 to 132 V.
  - 2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is not acceptable.
  - 3. Ground Impedance: Values of up to 2 ohms are acceptable.
  - 4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
  - 5. Using the test plug, verify that the device and its outlet box are securely mounted.
  - 6. The tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.

END OF SECTION 262726

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## SECTION 262730 - TAPS, SPLICES & TERMINATIONS

### PART 1 – GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Special Conditions, General Requirements, Division 1 Specifications, apply to this Section.

#### 1.2 DESCRIPTION

- A. Provide taps, splices and termination devices approved and sized for copper cables at voltage and current rating matching characteristics of terminating conductor.

### PART 2 - PRODUCTS

#### 2.1 MATERIALS

- A. Conductors splices in No. 10 AWG and smaller wire to be made with Minnesota Mining Manufacturing Co. insulated "Scotch Locks", Ideal Co. "Wing Nut", T. & B "Piggy" connectors, or with mechanically crimped sleeves as manufactured by T & B or Ideal Company, which shall be insulated with pressure sensitive electrical tape equal to Scotch No. "33+" or No. 88. Splicing components shall be rated for copper and aluminum conductors.
- B. Conductors #8 AWG and larger shall be terminated, spliced, and tapped with Thomas & Betts color-keyed compression connector's series 54000 or equal. The manufacturers recommended tools and dies shall be used.
- C. Copper cable lug connections #8 and larger to copper bus bar mains and branches shall use copper solderless connectors having either 2-bolt cast copper clamps or compression connectors, Thomas & Betts Series 54000 with manufacturer's recommended hexagonal dies and hydraulic compression tools.
- D. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
- E. Connections to equipment shall be made with pressure type terminals. Stranded wire shall use spade type terminals or terminal approved for use. Connections shall contain one conductor unless otherwise rated for multiple conductors.

#### 2.2 MANUFACTURERS

- A. 3-M
- B. O.Z.
- C. Thomas & Betts
- D. Approved manufacturer equal

#### 2.3 WIRE LABELS

- A. Each cable or wire termination shall be identified as noted on drawings, schedules or where not indicated, label shall note applicable branch circuit, phase and/or connected

equipment. Labels shall be pressure sensitive or clip on PVC type. Approved Manufacturers: Brady, 3M or approved equal.

## 2.4 TERMINAL BLOCKS

- A. Where terminal blocks/strips are indicated or otherwise required, provide a complete assembly of blocks/strips having each terminal equipped with two clamp type pressure lugs or two washer bead binding screws. Use terminal strips with voltage and ampere rating sufficient to carry intended loads. Provide a white marking strip along the center line of each row of terminal for identification. Use strips having plastic barriers between adjacent terminals. Provide indicated terminal quantities or otherwise required. If quantity is not indicated, provide one terminal for each conductor entering enclosure plus 20 percent spare terminals. Type or otherwise mark the identification strip to identify each connected circuit. Relate identification to wiring diagrams, panel schedules and other terminals in a logical manner, where specific identification requirements are not indicated. Under no circumstances shall more than one wire be terminated under each terminal unless rated otherwise. Use only approved type jumper to mechanically connect terminals to each other.
1. Approved Manufacturer: Allen Bradley, IlSCO, Marathon or approved equal.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Make taps, splices, and terminations at junction boxes, pull boxes, switches, panel boards, and any other electrical equipment, etc. Wires shall be continuous between outlet to outlet, or from panel board to the first outlet, etc.
- B. Backboxes, device boxes, fittings or junction boxes shall be suitably sized permitting adequate conductor fill capacity per Article 314 of the National Electrical Code.
- C. All taps and splices shall be fully insulated meeting minimum insulating values of wire or conductors used.
- D. After splices are mechanically secure, provide listed electrical tape to insulate splice to equal the original insulation voltage rating of the wires, or utilize Thomas & Betts heat shrinkable insulators Series H.S. If the type of connector installed provides equivalent insulation, taping may be omitted.
- E. EC shall provide and install all feeders and branch circuit wiring to all disconnect switches, equipment, controllers, motors and wiring devices. Terminations shall be in full compliance with project documents and meet the installation requirements of the manufacturer.

END OF SECTION 262830

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## SECTION 262816 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Fusible switches.
  - 2. Nonfusible switches.
  - 3. Enclosures.

#### 1.3 DEFINITIONS

- A. NC: Normally closed.
- B. NO: Normally open.
- C. SPDT: Single pole, double throw.

#### 1.4 SUBMITTALS

- A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.
  - 1. Enclosure types and details for types other than NEMA 250, Type 1.
  - 2. Current and voltage ratings.
  - 3. Short-circuit current ratings (interrupting and withstand, as appropriate).
  - 4. Include evidence of NRTL listing for series rating of installed devices.
  - 5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.
  - 6. Include time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device.
- B. Shop Drawings: For enclosed switches and circuit breakers. Include plans, elevations, sections, details, and attachments to other work.
  - 1. Wiring Diagrams: For power, signal, and control wiring.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

1. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers; include selectable ranges for each type of overcurrent protective device.

#### 1.6 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Member company of NETA or an NRTL.
  1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.
- B. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single source from single manufacturer.
- C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.
- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- E. Comply with NFPA 70.

#### 1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:
  1. Ambient Temperature: Not less than minus 22 deg F and not exceeding 104 deg F.
  2. Altitude: Not exceeding 6600 feet.
- B. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:
  1. Notify Owner no fewer than seven days in advance of proposed interruption of electric service.
  2. Indicate method of providing temporary electric service.
  3. Do not proceed with interruption of electric service without Owner's written permission.
  4. Comply with NFPA 70E.

#### 1.8 COORDINATION

- A. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

## PART 2 - PRODUCTS

### 2.1 FUSIBLE SWITCHES

- A. Type HD, Heavy Duty, Single Throw, 600V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate indicated fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

### 2.2 NONFUSIBLE SWITCHES

- A. Type HD, Heavy Duty, Single Throw, 600V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

### 2.3 ENCLOSURES

- A. Enclosed Switches and Circuit Breakers: NEMA AB 1, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.
  - 1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.
  - 2. Outdoor Locations: NEMA 250, Type 3R.
  - 3. Other Wet or Damp, Indoor Locations: NEMA 250, Type 4.
  - 4. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.
- B. Comply with mounting and anchoring requirements specified in Section 260548.16 "Seismic Controls for Electrical Systems."
- C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.
- D. Install fuses in fusible devices.
- E. Comply with NECA 1.

### 3.3 IDENTIFICATION

- A. Comply with requirements in Section 260553 "Identification for Electrical Systems."
  - 1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
  - 2. Label each enclosure with engraved metal or laminated-plastic nameplate.

### 3.4 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
  - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- B. Acceptance Testing Preparation:
  - 1. Test insulation resistance for each enclosed switch and circuit breaker, component, connecting supply, feeder, and control circuit.
  - 2. Test continuity of each circuit.
- C. Tests and Inspections:
  - 1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
  - 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
  - 3. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports, including a certified report that identifies enclosed switches and circuit breakers and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

### 3.5 ADJUSTING

- A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.
- B. Set field-adjustable circuit-breaker trip ranges.

END OF SECTION 262816

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## SECTION 265100 – INTERIOR LIGHTING

### PART 1 - GENERAL

#### 1.1 SCOPE

- A. Contractor shall furnish and install interior lighting fixtures and lamps as indicated in Fixture Schedule shown within Contract documents, and specified herein.
- B. Lighting fixtures are indicated within Contract documents with an identifying letter and number. Refer to the fixture schedule which identifies the light fixtures.

#### 1.2 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.
- B. Shop Drawings: Show details of nonstandard or custom fixtures. Indicate dimensions, weights, method of field assembly, components, features and accessories.
- C. Wiring Diagrams: Power, signal and control wiring.
- D. Product Certificates: For each type of ballast for dimmer-controlled fixtures, signed by product manufacturer.
- E. Source quality-control test reports.
- F. Field quality-control test reports.
- G. Operation and Maintenance Data: For lighting equipment and fixtures to include in emergency, operation and maintenance manuals. In addition to items specified in Division 1 include the following:
  - 1. Catalog data for each fixture. Include the diffuser, driver, ballast and lamps installed in that fixture.
- H. Safety chain details.

#### 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.
- C. LED light sources shall have a label from a Nationally Recognized Testing Laboratory (NRTL) that is acceptable to the authority having jurisdiction (AHJ).

- D. Underwriters Laboratory
  - 1. Fluorescent, HID, Incandescent - UL 1598
  - 2. LED Equipment for use in Lighting products – UL 8750
  - 3. Low Voltage Lighting Systems – UL 1838
  - 4. Luminaries – UL 1598
  - 5. Track - UL 1574
  - 6. Emergency - UL 924

#### 1.4 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.
- B. Electrical contractor is responsible to determined ceiling areas used as plenums. Fixtures installed in these areas shall be rated and listed for use.

#### 1.5 WARRANTY

- A. Special Warranty for Fluorescent Ballasts: Manufacturer's standard form in which ballast manufacturer agrees to repair or replace ballasts that fail in materials or workmanship within specified warranty period.
  - 1. Warranty period for Electronic Ballasts: Five (5) years from date of substantial completion.

### PART 2 - PRODUCTS

#### 2.1 FIXTURES AND COMPONENTS, GENERAL

- A. Recessed Fixtures: Comply with NEMA LE 4 for ceiling compatibility for recessed fixtures.
- B. Metal Parts: Free of burrs and sharp corners and edges.
- C. Sheet Metal Components: Steel, unless otherwise indicated. Form and support to prevent warping and sagging.
- D. Doors, Frames and Other Internal Access: Smooth operating, free of light leakage under operating conditions and designed to permit relamping without use of tools. Designed to prevent doors, frames lenses, diffusers and other components from falling accidently during relamping and when secured in operating positions.
- E. Plastic Diffusers, Covers and Globes:
  - 1. Acrylic Lighting Diffusers: 100% 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" minimum unless different thickness is scheduled.
    - b. UV stabilized.
  - 2. Glass: Annealed crystal glass, unless otherwise indicated.

- F. Electromagnetic-Interference Filters: A component of fixture assembly. Suppress conducted electromagnetic-interference as required by MIL-STD-461D. Fabricate lighting fixtures with one filter on each ballast.
- G. Low voltage transformer: Where provided by the Electrical Contractor or furnished by lighting manufacturer, the low voltage transformer shall be protected by fuses sized according to transformer manufacturer. Provide fuses and spares per Specification 262813 "Fuses."
- H. Solid state transformers for low voltage lighting shall not be used for dimming applications unless the assembly (transformer and dimmer) are UL listed specifically indented for such application.

## 2.2 LIGHTING FIXTURES

- A. Fixtures type and features: See schedule for basis of design.
- B. Manufacturers: Submitted manufacturer must meet minimal features, options and specifications per base of design manufacturer as scheduled or noted.

## 2.3 LED LIGHTING FIXTURES

- A. Description: Include the following features, unless otherwise indicated:
  - 1. Fixture to be rated for LM-79, LM-80 and/or TM-21
  - 2. Life span of LED must be a minimum of 50,000hrs
  - 3. Minimum CRI of 80
  - 4. Interior fixtures to be 3500 degrees K
  - 5. LED drivers shall be electronics type, labeled as compliant with radio frequency and interferences (RFI) requirements of FCC Title 47 Part 15, and comply with NEMA SSL1 "Electronic Drivers for LED devices, Arrays, or systems". LED drivers shall have a sound rating of "A", have a minimum efficiency of 85%, and be rated for a THD of less than 20% at all input voltages.
  - 6. Dimmable LED drivers shall be 0-10V type. Dimmable drivers shall be capable of dimming without LED strobing or flicker across their full diming range

## 2.4 FIXTURE SUPPORT COMPONENTS

- A. Comply with Division 26 Section "Supporting Devices" for channel- and angle-iron supports and nonmetallic channel and angle supports.
- B. Single-Stem Hangers: 1/2" steel tubing with swivel ball fittings and ceiling canopy. Finish same as fixture.
- C. Twin-Stem Hangers: Two, 1/2" steel tubes with single canopy designed to mount a single fixture. Finish same as fixture.
- D. Wires: ASTM A 641, Class 3, soft temper, zinc-coated, 12 gage.
- E. Wires for Humid Spaces: ASTM A 580, Composition 302 or 304, annealed stainless steel, 12 gage.

- F. Rod Hangers: 3/16" minimum diameter, cadmium-plated, threaded steel rod.
- G. Hook Hangers: Integrated assembly matched to fixture and line voltage and equipped with threaded attachment, cord and locking-type plug.
- H. Aircraft Cable Support: Use cable, anchorages and intermediate supports recommended by fixture manufacture.

## 2.5 FINISHES

- A. Fixtures: Manufacturer's standard, unless otherwise indicated.
  - 1. Paint Finish: Applied over corrosion-resistant treatment or primer free of defects.
  - 2. Metallic Finish: Corrosion resistant.

## 2.6 SOURCE QUALITY CONTROL

- A. Factory test fixtures with ballasts and lamps; certify results for electrical ratings and photometric data.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Fixtures: Set level, plumb and square with ceilings and walls. Install lamps in each fixture.
- B. Support for fixtures in or on Grid-Type Suspended Ceilings: Use grid for support.
  - 1. Support Clips: Electrical Contractor shall secure fixtures to ceiling grid members at or near each fixture corner with manufacture clips which are UL listed for the application or by securely fasten to ceiling members via bolts, screws or rivets. Where fixtures weighing 56 pounds or more shall be connected via four wires, one at each corner terminating to above structure.
  - 2. Fixtures of Sizes Less Than Ceiling Grid: Install as indicated on reflected ceiling plans or center in acoustical panel, and support fixtures independently with at least two (2) 3/4" metal channels spanning and secured to ceiling tees.
  - 3. Recessed incandescent or compact fluorescent downlight fixtures in suspended ceilings weight 20 pounds or more shall be supported by connecting at least one fixture support wire to the fixture housing terminating to above structure.
  - 4. Wire hangers may be wrapped cable or closed link chain. In all cases, the hanger shall be of sufficient strength to support the weight of the unit with a factor of safety of four (4). Where "S" hooks are used and allowed per manufacture installation guidelines, both ends shall be completely closed after installation.
- C. Suspended Fixture Support: As follows:
  - 1. Pendants and Rods: Where longer than 48", 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.
  - 5. As recommended by fixture manufacturer.

- D. Adjust fixtures to provide required light intensities.

### 3.2 CONNECTIONS

- A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

### 3.3 FIELD QUALITY CONTROL

- A. Inspect each installed fixture for damage. Replace damaged fixtures and components.
- B. A few of the first recessed fixtures shall be checked as soon as they are suspended, to determine if any sagging or twisting of the ceiling system exists and if fixtures are firm and hang straight.
- C. Finally, after fixtures and lamps have been installed, the ceiling shall be rechecked for sagging, and any corrections shall be the responsibility of the Electrical contractor.
- D. Verify normal operation of each fixture after installation.
- E. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify normal transfer to battery power source and retransfer to normal.
- F. Prepare a written report of test, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standard.
- G. Corroded Fixtures: During warranty period, replace fixtures that show any signs of corrosion.

END OF SECTION 265100

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## SECTION 270000 – COMMUNICATIONS WORK

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. This Section includes a summary of all Communications related work.
- B. Related Sections:
  - 1. 270500 – COMMON WORK RESULTS FOR COMMUNICATIONS
  - 2. 271500 – COMMUNICATIONS HORIZONTAL CABLING

#### 1.3 PROJECT CONDITIONS

- A. Work to be included in Base Bid
  - 1. Alterations of and Additions to existing Communications Systems
    - a. The contract shall include new work as shown, specified, or required, and shall include, but not limited to, the following principal components:
      - 1) Furnish and install outlet boxes in walls and conduit drops from outlet box to above ceiling.
    - b. The contractor shall exercise adequate protective and safety measures for all persons and property and shall be responsible for any damages or injuries arising from the execution of this work.
    - c. Alterations and additions to existing work shall include the requisite dismantling of the old equipment, rigging, wrecking, hauling, protection of permanent equipment and the building structures, and cleaning up. Care shall be exercised to keep dust and dirt to a minimum and to confine it to the area where the removal work is being performed. All debris shall be promptly removed.
    - d. If asbestos insulation is encountered on any existing wiring which is to be removed or remodeled, contractor shall immediately notify Owner of the existence of asbestos and Owner will arrange proper removal of same without cost to contractor.
    - e. Disconnect and remove all unused telephone and data wire and all associated exposed empty conduits, outlet boxes, junction boxes, etc.; disconnect and remove all unused wire connected to communications items which are noted to be removed, and disconnect and remove all unused exposed empty conduits, outlet boxes, junction boxes from which this contractor removes all wiring; provide blank covers for unused recessed boxes which remain. Unless otherwise noted, all items which will be removed by this contractor and not reused shall become the property of the contractor and shall be promptly removed from the site by him.
    - f. The existing facility will be occupied and will remain in operation throughout the period that this work is being performed, and certain new work will be performed during this period. Unscheduled interruptions of the facility will not

- be tolerated. The contractor shall exercise extreme caution, shall thoroughly inform his workmen and subcontractors of the critical nature of this work, and shall continually review the work procedure being followed in order to prevent accidental interruption of service. Before performing any act which could result in interruption of service, the contractor shall notify the Owner and Engineer of the hazards involved and the contractor shall proceed in a manner and at a time specifically approved by the Owner and Engineer.
- g. All work necessitating the temporary turning off or shutting down the operation of existing mechanical and/or electrical and/or communications shall be done at times specifically approved by the Owner and Engineer in advance of any disruption of existing facilities.
2. Excavation, Backfilling, and Restoration of Surfaces
    - a. This paragraph is not applicable.
  3. Guarantee
    - a. This contractor shall guarantee all workmanship, materials, and equipment entering into this contract for a period of one year; all from date of substantial completion or from the "recognized" start-up date, whichever is later. Should the Owner elect to accept a portion of work prior to the date of substantial completion, the guarantee period for the accepted portion of the work shall commence on the date of acceptance or on the "recognized" start-up date for that portion of the work, whichever is later. If the specifications dictate a different period of guarantee for a given component or piece of equipment, the more stringent requirements shall govern.
    - b. The "recognized" start-up date shall be defined as that date on which the contractor has successfully completed all phases of his work, including the following:
      - 1) Submitted and received approval of four (4) copies of the Instruction Booklets.
      - 2) Submitted complete "As-Built" drawings.
      - 3) Completed all testing, cleaning, adjusting, and trial run.
    - c. In the case where the Engineer is accepting a portion of the work, the contractor shall have completed all phases of that portion of the work to be accepted, including Items above, for that accepted portion of the work.
    - d. Any workmanship, materials, or equipment proving to be defective during this guarantee period shall be made good by this contractor without additional cost to the Owner.
    - e. Refer to Divisions 00 for additional requirements.
  4. Equipment
    - a. Any and all costs associated with wiring, conduit, supports, or other modifications to accommodate installation for manufacturer's equipment that differs from equipment layout on drawings shall be included on contractor's bid. The contractor is responsible to insure that the equipment will fit within space allocated with appropriate clearances for maintenance, operation, servicing, and code.

#### 1.4 APPROVED CONTRACTORS

- A. The installing contractor(s) must be Panduit Certified for renovations that include the entire building. This is a mandatory requirement per the request of the University. NO exceptions will be permitted on this requirement.

- B. The Electrical Contractor shall obtain bids from multiple Communication Contractors, including approved Communication Contractors, for the Work described above.
- C. The Communication Contractor shall be a Subcontractor the Electrical Contractor.

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION (NOT APPLICABLE)

END OF SECTION 270000

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## SECTION 270500 – COMMON WORK RESULTS FOR COMMUNICATIONS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Electrical equipment coordination and installation.
  - 2. Sleeves for raceways and cables.
  - 3. Sleeve seals.
  - 4. Grout.
  - 5. Common electrical installation requirements.

#### 1.3 DEFINITIONS

- A. EPDM: Ethylene-propylene-diene terpolymer rubber.
- B. NBR: Acrylonitrile-butadiene rubber.

#### 1.4 REGULATORY REFERENCES

- A. All work and materials shall conform in every detail to the rules and requirements of the National Fire Protection Association, the local Electrical Code and present manufacturing standards.
- B. All materials shall be UL or ETL Listed and shall be marked as such. If UL/ETL has no published standards for a particular item, then other national independent testing standards shall apply and such items shall bear those labels. Where UL/ETL has an applicable system listing and label, the entire system shall be so labeled.
- C. The cabling system described in this is derived from the recommendations made in recognized telecommunications industry standards. The following documents are incorporated by reference:
  - 1. ANSI/TIA-568-C.0, Generic Communications Cabling for Customer Premises, February 2009
  - 2. ANSI/TIA-568-C.1, Commercial Building Communications Cabling Standard Part 1: General Requirements, February 2009
  - 3. ANSI/TIA-568-C.2, Balanced Twisted-Pair Communications Cabling and Components Standard, August 2009
  - 4. ANSI/TIA-568-C.3, Optical Fiber Cabling Components Standards, June 2008
  - 5. ANSI/TIA/EIA-569-A, Commercial Building Standard for Communications Pathways and Spaces, February, 1998
  - 6. ANSI/TIA/EIA-606-A, Administration Standard for Communications Infrastructure of Commercial Buildings, May, 2002
  - 7. ANSI/J-STD-607-A, Commercial Building Grounding and Bonding Requirements for Communications, October, 2002

8. TIA-758-A, Customer-Owned Outside Plant Communications Cabling Standard, August 2004
9. TIA-758-A, Customer-Owned Outside Plant Telecommunications Cabling Standard, August 2004.
10. BICSI - TDMM, Building Industries Consulting Services International, Communications Distribution Methods Manual (TDMM) – 12th Edition.
11. National Fire Protection Agency (NFPA – 70), National Electrical Code (NEC) – 2005
12. FCC 47 CFR 68
13. NEMA 250
14. NEC 2005
15. NEC Articles 770 and 800
16. ADA, Americans with Disabilities Act
17. UCIT STANDARDS DOCUMENT (June 2014)
18. UCIT & Division of Administration and Finance Planning+Design+Construction Project Procedures (Feb,2013)

- D. If this document and any of the documents listed above are in conflict, then the more stringent requirement shall apply. All documents listed are believed to be the most current releases of the documents. The Contractor has the responsibility to determine and adhere to the most recent release when developing the proposal for installation.
- E. This document does not replace any code, either partially or wholly. The contractor must be aware of local codes that may impact this project.

#### 1.5 SUBMITTALS

- A. Product Data: For sleeve seals.

#### 1.6 COORDINATION

- A. Coordinate arrangement, mounting, and support of electrical equipment:
1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
  2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
  3. To allow right of way for piping and conduit installed at required slope.
  4. So connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.
- B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.
- C. Coordinate location of access panels and doors for electrical items that are behind finished surfaces or otherwise concealed. Access doors and panels are specified in Division 08 Section "Access Doors and Frames."
- D. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."

## PART 2 - PRODUCTS

### 2.1 SLEEVES FOR RACEWAYS AND CABLES

- A. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- B. Sleeves for Rectangular Openings: Galvanized sheet steel.
  - 1. Minimum Metal Thickness:
    - a. For sleeve cross-section rectangle perimeter less than 50 inches and no side more than 16 inches, thickness shall be 0.052 inch.
    - b. For sleeve cross-section rectangle perimeter equal to, or more than, 50 inches and 1 or more sides equal to, or more than, 16 inches, thickness shall be 0.138 inch.

### 2.2 SLEEVE SEALS

- A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.
  - 1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
    - a. Advance Products & Systems, Inc.
    - b. Calpico, Inc.
    - c. Metraflex Co.
    - d. Pipeline Seal and Insulator, Inc.
  - 2. Sealing Elements: EPDM interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
  - 3. Pressure Plates: Stainless steel. Include two for each sealing element.
  - 4. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

### 2.3 GROUT

- A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

## PART 3 - EXECUTION

### 3.1 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION

- A. Comply with NECA 1.
- B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.
- C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.

- D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.
- E. Right of Way: Give to piping systems installed at a required slope.

### 3.2 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Electrical penetrations occur when raceways, cables, wireways, cable trays, or busways penetrate concrete slabs, concrete or masonry walls, or fire-rated floor and wall assemblies.
- B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.
- C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
- D. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.
- E. Cut sleeves to length for mounting flush with both surfaces of walls.
- F. Extend sleeves installed in floors 2 inches above finished floor level.
- G. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and raceway or cable, unless indicated otherwise.
- H. Seal space outside of sleeves with grout for penetrations of concrete and masonry
  1. Promptly pack grout solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect grout while curing.
- I. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Division 07 Section "Joint Sealants".
- J. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway and cable penetrations. Install sleeves and seal raceway and cable penetration sleeves with firestop materials. Comply with requirements in Division 07 Section "Penetration Firestopping."

### 3.3 FIRESTOPPING

- A. All firestop penetrations shall utilize STI EZ Path firestop. 22, 33 & 44 series where applicable for horizontal penetrations. Ganging should be utilized if multiple EZ paths are used. EZ path w/ floor kits to be utilized between floors.
- B. A firestop system is comprised of the item or items penetrating the fire rated structure, the opening in the structure and the materials and assembly of the materials used to

seal the penetrated structure. Firestop systems comprise an effective block for fire, smoke, heat, vapor and pressurized water stream.

- C. All penetrations through fire-rated building structures (walls and floors) shall be sealed with an STI EZ Path firestop system. This requirement applies to through penetrations (complete penetration) and membrane penetrations (through one side of a hollow fire rated structure). Any penetrating item i.e., riser slots and sleeves, cables, conduit, cable tray, and raceways, etc. shall be properly firestopped using STI's EZpath.
- D. Firestop systems shall be UL Classified to ASTM E814 (UL 1479) and shall be approved by a qualified Professional Engineer (PE), licensed (actual or reciprocal) in the state where the work is to be performed. A drawing showing the proposed firestop system, stamped/embossed by the PE shall be provided to the Owner's Technical Representative prior to installing the firestop system(s).

END OF SECTION 270500

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## SECTION 271500 - COMMUNICATIONS HORIZONTAL CABLING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Pathways.
  - 2. Horizontal cabling.
  - 3. Coaxial cable.
  - 4. Telecommunications outlet/connectors.
  - 5. Cabling system identification products.

#### 1.3 DEFINITIONS

- A. Basket Cable Tray: A fabricated structure consisting of wire mesh bottom and side rails.
- B. BICSI: Building Industry Consulting Service International.
- C. Channel Cable Tray: A fabricated structure consisting of a one-piece, ventilated-bottom or solid-bottom channel.
- D. Consolidation Point: A location for interconnection between horizontal cables extending from building pathways and horizontal cables extending into furniture pathways.
- E. Cross-Connect: A facility enabling the termination of cable elements and their interconnection or cross-connection.
- F. EMI: Electromagnetic interference.
- G. IDC: Insulation displacement connector.
- H. Ladder Cable Tray: A fabricated structure consisting of two longitudinal side rails connected by individual transverse members (rungs).
- I. LAN: Local area network.
- J. MUTOA: Multiuser telecommunications outlet assembly, a grouping in one location of several telecommunications outlet/connectors.
- K. Outlet/Connectors: A connecting device in the work area on which horizontal cable or outlet cable terminates.

- L. RCDD: Registered Communications Distribution Designer.
- M. Solid-Bottom or Nonventilated Cable Tray: A fabricated structure consisting of longitudinal side rails and a bottom without ventilation openings.
- N. Trough or Ventilated Cable Tray: A fabricated structure consisting of longitudinal side rails and a bottom having openings for the passage of air.
- O. UTP: Unshielded twisted pair.

#### 1.4 HORIZONTAL CABLING DESCRIPTION

- A. Horizontal cable and its connecting hardware provide the means of transporting signals between the telecommunications outlet/connector and the horizontal cross-connect located in the communications equipment room. This cabling and its connecting hardware are called "permanent link," a term that is used in the testing protocols.
  - 1. TIA/EIA-568-B.1 requires that a minimum of two telecommunications outlet/connectors be installed for each work area.
  - 2. Horizontal cabling shall contain no more than one transition point or consolidation point between the horizontal cross-connect and the telecommunications outlet/connector.
  - 3. Bridged taps and splices shall not be installed in the horizontal cabling.
- B. The maximum allowable horizontal cable length is 295 feet. The maximum allowable length does not include an allowance for the length of 16 feet in the horizontal cross-connect.

#### 1.5 PERFORMANCE REQUIREMENTS

- A. General Performance: Horizontal cabling system shall comply with transmission standards in TIA/EIA-568-B.1, when tested according to test procedures of this standard.

#### 1.6 SUBMITTALS

- A. Product Data: For each type of product indicated.
  - 1. For coaxial cable, include the following installation data for each type used:
    - a. Nominal OD.
    - b. Minimum bending radius.
    - c. Maximum pulling tension.
- B. Shop Drawings:
  - 1. System Labeling Schedules: Electronic copy of labeling schedules, in software and format selected by Owner.
  - 2. System Labeling Schedules: Electronic copy of labeling schedules that are part of the cabling and asset identification system of the software.
  - 3. Cabling administration drawings and printouts.
  - 4. Wiring diagrams to show typical wiring schematics, including the following:
    - a. Cross-connects.
    - b. Patch panels.
    - c. Patch cords.

5. Cross-connects and patch panels. Detail mounting assemblies, and show elevations and physical relationship between the installed components.
6. Cable tray layout, showing cable tray route to scale, with relationship between the tray and adjacent structural, electrical, and mechanical elements. Include the following:
  - a. Vertical and horizontal offsets and transitions.
  - b. Clearances for access above and to side of cable trays.
  - c. Vertical elevation of cable trays above the floor or bottom of ceiling structure.
  - d. Load calculations to show dead and live loads as not exceeding manufacturer's rating for tray and its support elements.
- C. Samples: For jacks, jack assemblies, in specified finish, one for each size and outlet configuration and faceplates for color selection and evaluation of technical features.
- D. Qualification Data: For Installer, qualified layout technician, installation supervisor, and field inspector.
- E. Source quality-control reports.
- F. Field quality-control reports.
- G. Maintenance Data: For splices and connectors to include in maintenance manuals.

#### 1.7 QUALITY ASSURANCE

- A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.
  1. Layout Responsibility: Preparation of Shop Drawings, Cabling Administration Drawings, and field testing program development by an RCDD.
  2. Installation Supervision: Installation shall be under the direct supervision of Registered Technician, who shall be present at all times when Work of this Section is performed at Project site.
  3. Testing Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.
- B. Testing Agency Qualifications: An NRTL.
  1. Testing Agency's Field Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.
- C. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
  1. Flame-Spread Index: 25 or less.
  2. Smoke-Developed Index: 50 or less.
- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- E. Telecommunications Pathways and Spaces: Comply with TIA/EIA-569-A.



- F. Grounding: Comply with ANSI-J-STD-607-A.

## 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Test cables upon receipt at Project site.
  - 1. Test each horizontal cable for open and short circuits.

## 1.9 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install cables and connecting materials until wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

## 1.10 COORDINATION

- A. Coordinate layout and installation of telecommunications pathways and cabling with Owner's telecommunications and LAN equipment and service suppliers.
- B. Coordinate telecommunications outlet/connector locations with location of power receptacles at each work area.

## 1.11 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Device Plates: One of each type.
  - 2. Telecommunications Outlet Assemblies: One of each type.

## PART 2 - PRODUCTS

### 2.1 PATHWAYS

- A. General Requirements: Comply with TIA/EIA-569-A.
- B. Cable Support: NRTL labeled for support of Category 6 cabling, designed to prevent degradation of cable performance and pinch points that could damage cable.
  - 1. Support brackets with cable tie slots for fastening cable ties to brackets.
  - 2. Lacing bars, spools, J-hooks, and D-rings.
  - 3. Straps and other devices.

### 2.2 GROUNDING

- A. Comply with requirements in Division 26 Section "Grounding and Bonding for Electrical Systems" for grounding conductors and connectors.
- B. Comply with ANSI-J-STD-607-A.

### 2.3 HORIZONTAL CABLING

- A. CABLE, HORIZONTAL, CAT. 6 UTP, PLENUM
  - 1. Panduit PUP6504IG-UY.

2. Blue.
3. Note: Standard data cabling.

B. CABLE, HORIZONTAL, CAT. 6 UPT, RISER (NON-PLENUM)

1. Panduit PUR6504IG-UY
2. Blue.
3. Note: Standard data cabling, use where applicable in building.

C. CABLE, HORIZONTAL, CAT. 6A 10GIG UTP, PLENUM

1. Panduit PUP6ASD04BU-UG.
2. Blue.
3. Note: Wireless data cabling.

D. CABLE, HORIZONTAL, CAT. 6A 10GIG, RISER (NON-PLENUM)

1. Panduit PUP6ASD04BU-CG.
2. Blue.
3. Note: Wireless data cabling, use where applicable in buildings.

## 2.4 CABLE TERMINATION AND MANAGEMENT

A. JACK, CAT. 6, 8-PIN MODULAR

1. Panduit CJ688TGEI, CJ688TGBL.
2. Mini-com TX6 Plus UTP jack modules – TG sytel.
3. Note: Coordinate jack/faceplate color with architect, use black in modular patch panels.
4. Note: Termination Pin-out T568B, for use with 10GB cabling.

B. JACK, CAT. 6A 10GIG, 8-PIN MODULAR

1. Panduit CJ6X88TGEI, CJ6X88TGBL.
2. Mini-com TX6 plus UTP jack modules – TG style.
3. Note: Coordinate jack/faceplate color with architect, use black in modular patch panels.
4. Note: Termination Pin-out T568B, for use with 10 GB cabling.

C. PATCH PANEL, RACK MOUNT, ANGLED, 48-POSITION, 8-PIN MODULAR, 2 RU

1. Panduit CPPA48FMWBLY.
2. Black.
3. Note: Termination Pin-out T568B.

D. PATCH PANEL, RACK MOUNT, ANGLED, 48-POSITION, 8-PIN MODULAR, 1 RU

1. Panduit CPPA48HDEWBL.
2. Black.
3. Note: Used in Smith Hall and Learning Commons.

E. PATCH PANEL, RACK MOUNT, FLAT, 48-POSITION, 8-PIN MODULAR, 2 RU

1. Panduit CPP48FMWBLY.
2. Black.
3. Note: Use only in racks with existing flat panels.

F. CABLE MANAGEMENT PANEL, RACK MOUNT, 2 RU

1. Panduit WMPHF2E.
2. Note: 1 per patch panel.

- G. 110-TYPE CABLE TERMINATION, 100-PAIR, WALL-MOUNTED.
  - 1. Panduit P110KB1004Y.
  - 2. Note: Use only in applicable situations, coordinate with Owner.

- H. 110-TYPE CABLE TERMINATION, 110-PAIR, RACK-MOUNTED
  - 1. Panduit P110B1004R2Y.

## 2.5 PATCH CORDS

- A. PATCH CORDS, CAT. 6, UTP, 4-PAIR, SIX-FOOT.
  - 1. Panduit UTPSP6BU.
  - 2. Note: Coordinate color(s) with Owner.
- B. PATCH CORDS, CATEGORY 6A (SD), 10GB/S UTP – TX6A 10GIG, 4-PAIR, SIX-FOOT
  - 1. Panduit UTP6ASD6BU.
  - 2. Note: Coordinate color(s) with Owner.

## 2.6 AUXILLARY HARDWARE

- A. FACEPLATE, SINGLE-GANG, 4-POSITION
  - 1. Panduit CFPE4EIY.
  - 2. Note: Coordinate color with Architect.
- B. FACEPLATE, WALL PHONE, RECESSED JACK
  - 1. Panduit CFPEIEIY.
  - 2. Metal.
- C. EQUIPMENT RACK
  - 1. Panduit CMR 19X84.
  - 2. Black.
- D. EQUIPMENT RACK VRETICAL WIRING GUTTER, 8”
  - 1. Panduit PRD8.
  - 2. Black.
- E. EQUIPMENT RACK VERTICAL WIRING GUTTER DOORS, 8”, DUAL HINGED
  - 1. Panduit PRD8.
  - 2. Black.
- F. EQUIPMENT RACK END PANEL CLOSURE
  - 1. Panduit PREP.
  - 2. Black.
- G. EQUIPMENT RACK CABLE ROUTING THROUGH, 4 RU
  - 1. Panduit CMT4.
  - 2. Black.
- H. EQUIPMENT RACK TOP CABLE THROUGH
  - 1. Panduit CRTW.
  - 2. Black.

## 2.7 TELECOMMUNICATIONS GROUNDING BUS BAR

- A. PANDUIT RKTGB.

## 2.8 COAXIAL CABLE

- A. Cable Characteristics: Broadband type, recommended by cable manufacturer specifically for broadband data transmission applications. Coaxial cable and accessories shall have 75-ohm nominal impedance with a return loss of 20 dB maximum from 7 to 806 MHz.
- B. RG-6/U: NFPA 70, Type CATV or CM.
  - 1. No. 16 AWG, solid, copper-covered steel conductor; gas-injected, foam-PE insulation.
  - 2. Double shielded with 100 percent aluminum-foil shield and 60 percent aluminum braid.
  - 3. Jacketed with black PVC or PE.
  - 4. Suitable for indoor installations.
- C. NFPA and UL compliance, listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 1655 and with NFPA 70 "Radio and Television Equipment" and "Community Antenna Television and Radio Distribution" Articles. Types are as follows:
  - 1. CATV Cable: Type CATV.
  - 2. CATV Plenum Rated: Type CATVP, complying with NFPA 262.
  - 3. CATV Riser Rated: Type CATVR, complying with UL 1666.
  - 4. CATV Limited Rating: Type CATVX.

## 2.9 COAXIAL CABLE HARDWARE

- A. Coaxial-Cable Connectors: Type BNC, 75 ohms.

## 2.10 IDENTIFICATION PRODUCTS

- A. Comply with TIA/EIA-606-A and UL 969 for labeling materials, including label stocks, laminating adhesives, and inks used by label printers.
- B. Comply with requirements in Division 26 Section "Identification for Electrical Systems."

## 2.11 SOURCE QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to evaluate cables.
- B. Factory test UTP/horizontal cables according to TIA/EIA-568-B.1.
- C. Factory test UTP/horizontal cables according to TIA/EIA-568-B.2.
- D. Factory-sweep test coaxial cables at frequencies from 5 MHz to 1 GHz. Sweep test shall test the frequency response, or attenuation over frequency, of a cable by generating a voltage whose frequency is varied through the specified frequency range and graphing the results.

- E. Cable will be considered defective if it does not pass tests and inspections.
- F. Prepare test and inspection reports.

### PART 3 - EXECUTION

#### 3.1 WIRING METHODS

- A. Wiring Method: Install cables in raceways and cable trays except within consoles, cabinets, desks, and counters. Conceal raceway and cables except in unfinished spaces.
  - 1. Install plenum cable in environmental air spaces, including plenum ceilings.
  - 2. Comply with requirements for raceways and boxes specified in Division 26 Section "Raceway and Boxes for Electrical Systems."
- B. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.
- C. Wiring within Enclosures: Bundle, lace, and train cables to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.

#### 3.2 INSTALLATION OF PATHWAYS

- A. Cable Trays: Comply with NEMA VE 2 and TIA/EIA-569-A-7.
- B. Comply with requirements for demarcation point, pathways, cabinets, and racks specified in Division 27 Section "Communications Equipment Room Fittings." Drawings indicate general arrangement of pathways and fittings.
- C. Comply with TIA/EIA-569-A for pull-box sizing and length of conduit and number of bends between pull points.
- D. Comply with requirements in Division 26 Section "Raceway and Boxes for Electrical Systems" for installation of conduits and wireways.
- E. Install manufactured conduit sweeps and long-radius elbows whenever possible.
- F. Pathway Installation in Communications Equipment Rooms:
  - 1. Position conduit ends adjacent to a corner on backboard where a single piece of plywood is installed, or in the corner of room where multiple sheets of plywood are installed around perimeter walls of room.
  - 2. Install cable trays to route cables if conduits cannot be located in these positions.
  - 3. Secure conduits to backboard when entering room from overhead.
  - 4. Extend conduits 3 inches above finished floor.
  - 5. Install metal conduits with grounding bushings and connect with grounding conductor to grounding system.

#### 3.3 INSTALLATION OF CABLES

- A. Comply with NECA 1.

- B. General Requirements for Cabling:
1. Comply with TIA/EIA-568-B.1.
  2. Comply with BICSI ITSIM, Ch. 6, "Cable Termination Practices."
  3. Install 110-style IDC termination hardware unless otherwise indicated.
  4. MUTOA shall not be used as a cross-connect point.
  5. Consolidation points may be used only for making a direct connection to telecommunications outlet/connectors:
    - a. Do not use consolidation point as a cross-connect point, as a patch connection, or for direct connection to workstation equipment.
    - b. Locate consolidation points for UTP at least 49 feet from communications equipment room.
  6. Terminate conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.
  7. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches and not more than 6 inches from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
  8. Install lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.
  9. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIM, "Cabling Termination Practices" Chapter. Install lacing bars and distribution spools.
  10. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
  11. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
  12. In the communications equipment room, install a 10-foot-long service loop on each end of cable.
  13. Pulling Cable: Comply with BICSI ITSIM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.
- C. Horizontal Cable Installation:
1. Comply with TIA/EIA-568-B.2.
  2. Do not untwist cables more than 1/2 inch from the point of termination to maintain cable geometry.
- D. Open-Cable Installation:
1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
  2. Suspend UTP cable not in a wireway or pathway a minimum of 8 inches above ceilings by cable supports not more than 60 inches apart.
  3. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.
- E. Group connecting hardware for cables into separate logical fields.
- F. Separation from EMI Sources:

1. Comply with BICSI TDMM and TIA/EIA-569-A for separating unshielded copper voice and data communication cable from potential EMI sources, including electrical power lines and equipment.
2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:
  - a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches.
  - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches.
  - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches.
3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:
  - a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches.
  - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches.
  - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches.
4. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:
  - a. Electrical Equipment Rating Less Than 2 kVA: No requirement.
  - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches.
  - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches.
5. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches.
6. Separation between Communications Cables and Fluorescent Fixtures: A minimum of 5 inches.

### 3.4 FIRESTOPPING

- A. Comply with requirements in Division 07 Section "Penetration Firestopping."
- B. Comply with TIA/EIA-569-A, Annex A, "Firestopping."
- C. Comply with BICSI TDMM, "Firestopping Systems" Article.

### 3.5 GROUNDING

- A. Install grounding according to BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.
- B. Comply with ANSI-J-STD-607-A.
- C. Locate grounding bus bar to minimize the length of bonding conductors. Fasten to wall allowing at least 2-inch clearance behind the grounding bus bar. Connect grounding bus bar with a minimum No. 4 AWG grounding electrode conductor from grounding bus bar to suitable electrical building ground.
- D. Bond metallic equipment to the grounding bus bar, using not smaller than No. 6 AWG equipment grounding conductor.

### 3.6 IDENTIFICATION

- A. Identify system components, wiring, and cabling complying with TIA/EIA-606-A. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."
  - 1. Administration Class: 1, 2, 3, 4.
  - 2. Color-code cross-connect fields. Apply colors to voice and data service backboards, connections, covers, and labels.
- B. Using cable management system software specified in Part 2, develop Cabling Administration Drawings for system identification, testing, and management. Use unique, alphanumeric designation for each cable and label cable, jacks, connectors, and terminals to which it connects with same designation. At completion, cable and asset management software shall reflect as-built conditions.
- C. Comply with requirements in Division 09 Section "Interior Painting" for painting backboards. For fire-resistant plywood, do not paint over manufacturer's label.
- D. Paint and label colors for equipment identification shall comply with TIA/EIA-606-A for Class 2, Class 3, Class 4, level of administration, including optional identification requirements of this standard.
- E. Cable Schedule: Post in prominent location in each equipment room and wiring closet. List incoming and outgoing cables and their designations, origins, and destinations. Protect with rigid frame and clear plastic cover. Furnish an electronic copy of final comprehensive schedules for Project.
- F. Cabling Administration Drawings: Show building floor plans with cabling administration-point labeling. Identify labeling convention and show labels for telecommunications closets, backbone pathways and cables, entrance pathways and cables, terminal hardware and positions, horizontal cables, work areas and workstation terminal positions, grounding buses and pathways, and equipment grounding conductors. Follow convention of TIA/EIA-606-A. Furnish electronic record of all drawings, in software and format selected by Owner.
- G. Cable and Wire Identification:
  - 1. Label each cable within 4 inches of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.
  - 2. Each wire connected to building-mounted devices is not required to be numbered at device if color of wire is consistent with associated wire connected and numbered within panel or cabinet.
  - 3. Exposed Cables and Cables in Cable Trays and Wire Troughs: Label each cable at intervals not exceeding 15 feet.
  - 4. Label each terminal strip and screw terminal in each cabinet, rack, or panel.
    - a. Individually number wiring conductors connected to terminal strips, and identify each cable or wiring group being extended from a panel or cabinet to a building-mounted device shall be identified with name and number of particular device as shown.
    - b. Label each unit and field within distribution racks and frames.
  - 5. Identification within Connector Fields in Equipment Rooms and Wiring Closets: Label each connector and each discrete unit of cable-terminating and connecting



- hardware. Where similar jacks and plugs are used for both voice and data communication cabling, use a different color for jacks and plugs of each service.
6. Uniquely identify and label work area cables extending from the MUTOA to the work area. These cables may not exceed the length stated on the MUTOA label.

- H. Labels shall be preprinted or computer-printed type with printing area and font color that contrasts with cable jacket color but still complies with requirements in TIA/EIA-606-A.
  1. Cables use flexible vinyl or polyester that flex as cables are bent.

### 3.7 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Perform tests and inspections.
- C. Tests and Inspections:
  1. Visually inspect UTP cable jacket materials for NRTL ETL or UL certification markings. Inspect cabling terminations in communications equipment rooms for compliance with color-coding for pin assignments, and inspect cabling connections for compliance with TIA/EIA-568-B.1.
  2. Visually confirm Category 6, marking of outlets, cover plates, outlet/connectors, and patch panels.
  3. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
  4. UTP Performance Tests:
    - a. Test for each outlet and MUTOA. Perform the following tests according to TIA/EIA-568-B.1 and TIA/EIA-568-B.2:
      - 1) Wire map.
      - 2) Length (physical vs. electrical, and length requirements).
      - 3) Insertion loss.
      - 4) Near-end crosstalk (NEXT) loss.
      - 5) Power sum near-end crosstalk (PSNEXT) loss.
      - 6) Equal-level far-end crosstalk (ELFEXT).
      - 7) Power sum equal-level far-end crosstalk (PSELFEXT).
      - 8) Return loss.
      - 9) Propagation delay.
      - 10) Delay skew.
  5. Coaxial Cable Tests: Conduct tests according to Division 27 Section "Master Antenna Television System."
  6. Final Verification Tests: Perform verification tests for UTP systems after the complete communications cabling and workstation outlet/connectors are installed.
    - a. Voice Tests: These tests assume that dial tone service has been installed. Connect to the network interface device at the demarcation point. Go off-hook and listen and receive a dial tone. If a test number is available, make and receive a local, long distance, and digital subscription line telephone call.
    - b. Data Tests: These tests assume the Information Technology Staff has a network installed and is available to assist with testing. Connect to the network interface device at the demarcation point. Log onto the network to ensure proper connection to the network.

- D. Document data for each measurement. Data for submittals shall be printed in a summary report that is formatted similar to Table 10.1 in BICSI TDMM, or transferred from the instrument to the computer, saved as text files, and printed and submitted.
- E. End-to-end cabling will be considered defective if it does not pass tests and inspections.
- F. Prepare test and inspection reports.

### 3.8 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel in cable-plant management operations, including changing signal pathways for different workstations, rerouting signals in failed cables, and keeping records of cabling assignments and revisions when extending wiring to establish new workstation outlets. Include training in cabling administration software.

END OF SECTION 271500

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