

- b. CWP Rating: 200 psig.
- c. Body Design: Horizontal flow.
- d. Body Material: ASTM B 62, bronze.
- e. Ends: Threaded or soldered. See valve schedule articles.
- f. Disc: Bronze.

B. Class 150, Bronze Swing Check Valves with Bronze Disc:

1. Description:

- a. Standard: MSS SP-80, Type 3.
- b. CWP Rating: 300 psig.
- c. Body Design: Horizontal flow.
- d. Body Material: ASTM B 62, bronze.
- e. Ends: Threaded or soldered. See valve schedule articles.
- f. Disc: Bronze.

2.11 IRON SWING CHECK VALVES

A. Class 125, Iron Swing Check Valves with Metal Seats:

1. Description:

- a. Standard: MSS SP-71, Type I.
- b. CWP Rating: 200 psig.
- c. Body Design: Clear or full waterway.
- d. Body Material: ASTM A 126, gray iron with bolted bonnet.
- e. Ends: Flanged or threaded. See valve schedule articles.
- f. Trim: Bronze.
- g. Gasket: Asbestos free.

2.12 IRON SWING CHECK VALVES WITH CLOSURE CONTROL

A. Class 125, Iron Swing Check Valves with Lever- and Spring-Closure Control:

1. Description:

- a. Standard: MSS SP-71, Type I.
- b. CWP Rating: 200 psig.
- c. Body Design: Clear or full waterway.
- d. Body Material: ASTM A 126, gray iron with bolted bonnet.
- e. Ends: Flanged or threaded. See valve schedule articles.
- f. Trim: Bronze.
- g. Gasket: Asbestos free.
- h. Closure Control: Factory-installed exterior lever and weight.

2.13 IRON, GROOVED-END SWING CHECK VALVES

A. 300 CWP, Iron, Grooved-End Swing Check Valves:

1. Description:

- a. CWP Rating: 300 psig.
- b. Body Material: ASTM A 536, ductile iron.
- c. Seal: EPDM.

- d. Disc: Spring operated, ductile iron or stainless steel.

2.14 IRON, CENTER-GUIDED, SPRING-LOADED CHECK VALVES

A. Class 125, Iron, Compact-Wafer, Center-Guided Check Valves with Metal Seat:

1. Description:

- a. Standard: MSS SP-125.
- b. CWP Rating: 200 psig.
- c. Body Material: ASTM A 126, gray iron.
- d. Style: Compact wafer, spring loaded.
- e. Seat: Bronze.

B. Class 125, Iron, Globe, Center-Guided Check Valves with Metal Seat:

1. Description:

- a. Standard: MSS SP-125.
- b. CWP Rating: 200 psig.
- c. Body Material: ASTM A 126, gray iron.
- d. Style: Globe, spring loaded.
- e. Ends: Flanged.
- f. Seat: Bronze.

C. Class 150, Iron, Compact-Wafer, Center-Guided Check Valves with Metal Seat:

1. Description:

- a. Standard: MSS SP-125.
- b. CWP Rating: 300 psig.
- c. Body Material: ASTM A 395/A 395M or ASTM A 536, ductile iron.
- d. Style: Compact wafer, spring loaded.
- e. Seat: Bronze.

D. Class 150, Iron, Globe, Center-Guided Check Valves with Metal Seat:

1. Description:

- a. Standard: MSS SP-125.
- b. CWP Rating: 300 psig.
- c. Body Material: ASTM A 395/A 395M or ASTM A 536, ductile iron.
- d. Style: Globe, spring loaded.
- e. Ends: Flanged.
- f. Seat: Bronze.

E. Class 125, Iron, Globe, Center-Guided Check Valves with Resilient Seat:

1. Description:

- a. Standard: MSS SP-125.
- b. CWP Rating: 200 psig.
- c. Body Material: ASTM A 126, gray iron.
- d. Style: Globe, spring loaded.
- e. Ends: Flanged.
- f. Seat: EPDM.

F. Class 150, Iron, Globe, Center-Guided Check Valves with Resilient Seat:

1. Description:
 - a. Standard: MSS SP-125.
 - b. CWP Rating: 300 psig.
 - c. Body Material: ASTM A 395/A 395M or ASTM A 536, ductile iron.
 - d. Style: Globe, spring loaded.
 - e. Ends: Flanged.
 - f. Seat: EPDM or NBR.

G. Class 250, Iron, Globe, Center-Guided Check Valves with Resilient Seat:

- a. Standard: MSS SP-125.
- b. CWP Rating: 400 psig.
- c. Body Material: ASTM A 126, gray iron.
- d. Style: Globe, spring loaded.
- e. Ends: Flanged.
- f. Seat: EPDM or NBR.

2.15 BRONZE GLOBE VALVES

A. Class 125, Bronze Globe Valves with Bronze Disc:

- a. Standard: MSS SP-80, Type 1.
- b. CWP Rating: 200 psig.
- c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
- d. Ends: Threaded or solder joint.
- e. Stem and Disc: Bronze.
- f. Packing: Asbestos free.
- g. Handwheel: Malleable iron.

2.16 IRON GLOBE VALVES

A. Class 125, Iron Globe Valves:

- a. Standard: MSS SP-85, Type I.
- b. CWP Rating: 200 psig.
- c. Body Material: ASTM A 126, gray iron with bolted bonnet.
- d. Ends: Flanged.
- e. Trim: Bronze.
- f. Packing and Gasket: Asbestos free.

B. Class 250, Iron Globe Valves:

- a. Standard: MSS SP-85, Type I.
- b. CWP Rating: 500 psig.
- c. Body Material: ASTM A 126, gray iron with bolted bonnet.
- d. Ends: Flanged.
- e. Trim: Bronze.
- f. Packing and Gasket: Asbestos free.

2.17 IRON, FLANGE BUTTERFLY VALVES

- A. 200 CWP, Iron, Flange Butterfly Valves with EPDM Seat and Stainless-Steel Disc:
- a. Standard: MSS SP-67, Type I.
 - b. CWP Rating: 200 psig.
 - c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
 - d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
 - e. Seat: EPDM.
 - f. Stem: One- or two-piece stainless steel.
 - g. Disc: Stainless steel.

2.18 IRON, GROOVED-END BUTTERFLY VALVES

- A. 175 CWP, Iron, Grooved-End Butterfly Valves:
- a. Standard: MSS SP-67, Type I.
 - b. CWP Rating: 175 psig.
 - c. Body Material: Coated, ductile iron.
 - d. Stem: Two-piece stainless steel.
 - e. Disc: Coated, ductile iron.
 - f. Seal: EPDM.

2.19 BRONZE ANGLE VALVES

- A. Class 125, Bronze Angle Valves with Bronze Disc:
- a. Standard: MSS SP-80, Type 1.
 - b. CWP Rating: 200 psig.
 - c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
 - d. Ends: Threaded.
 - e. Stem and Disc: Bronze.
 - f. Packing: Asbestos free.
 - g. Handwheel: Malleable iron.
- B. Class 150, Bronze Angle Valves with Bronze Disc:
- a. Standard: MSS SP-80, Type 1.
 - b. CWP Rating: 300 psig.
 - c. Body Material: ASTM B 62, bronze with integral seat and union-ring bonnet.
 - d. Ends: Threaded.
 - e. Stem and Disc: Bronze.
 - f. Packing: Asbestos free.
 - g. Handwheel: Malleable iron.

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. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- B. Locate valves for easy access and provide separate support where necessary.
- C. Install valves in horizontal piping with stem at or above center of pipe.
- D. Install valves in position to allow full stem movement.
- E. Install chainwheels on operators for gate valves 4-inch and larger and more than 96 inches above floor. Extend chains to 60 inches above finished floor
- F. Install check valves for proper direction of flow and as follows:
 - 1. Swing Check Valves: In horizontal position with hinge pin level.
 - 2. Center-Guided and Plate-Type Check Valves: In horizontal or vertical position, between flanges.
 - 3. Lift Check Valves: With stem upright and plumb.
- G. Install valve tags. Comply with requirements in Section 220553 "Identification for Plumbing Piping and Equipment" for valve tags and schedules.

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.

3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

- A. If valves with specified CWP ratings are unavailable, the same types of valves with higher CWP ratings may be substituted.

- B. If valve applications are not indicated, use the following:
 - 1. Shutoff Service: Gate valves.
 - 2. Butterfly Valve Dead-End Service: Single-flange (lug) type.
 - 3. Throttling Service: Globe or ball valves.
- C. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP classes or CWP ratings may be substituted.
- D. Select valves except wafer types with the following end connections:
 - 1. For Copper Tubing, 2-1/2-inch to 4-inch: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
 - 2. For Copper Tubing, 5-inch and Larger: Flanged ends.
 - 3. For Steel Piping, 2-inch and Smaller: Threaded ends.
 - 4. For Steel Piping, 2-1/2-inch to 4-inch: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
 - 5. For Steel Piping, 5-inch and Larger: Flanged ends.

3.5 DOMESTIC HOT- AND COLD-WATER VALVE SCHEDULE

- A. Pipe 2-inch and Smaller:
 - 1. Bronze Valves: May be provided with solder-joint ends instead of threaded ends.
 - 2. Two-piece, bronze ball valves with full port and stainless-steel trim.
 - 3. Three-piece, bronze ball valves with full port and stainless-steel trim.
- B. Pipe 2-1/2-inch and Larger:
 - 1. Steel and Iron Valves, 2-1/2-inch to 4-inch: May be provided with threaded ends instead of flanged ends.
 - 2. Two-piece, bronze ball valves with full port and stainless-steel trim.
 - 3. Three-piece, bronze ball valves with full port and stainless-steel trim.
 - 4. Class 150, steel ball valves with full port.
 - 5. Class 150, iron ball valves.

3.6 SANITARY-WASTE AND STORM-DRAINAGE VALVE SCHEDULE

- A. Pipe 2-inch and Smaller:
 - 1. Bronze Swing Check Valves: Class 150, bronze disc.
 - 2. Bronze Gate Valves: Class 150, NRS.
 - 3. Bronze Globe Valves: Class 150, bronze disc.
- B. Pipe 2-1/2-inch and Larger:
 - 1. Iron Valves, 2-1/2-inch to 4-inch: May be provided with threaded ends instead of flanged ends.
 - 2. Iron Swing Check Valves: Class 125, metal seats.
 - 3. Iron Swing Check Valves with Closure Control: Class 125, lever and spring.

END OF SECTION 220523

SECTION 220529 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Related Requirements:
 - 1. Section 055000 "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
- C. Related Sections:
 - 1. Section 220100 Plumbing General Requirements
 - 2. Section 220516 Expansion Fittings and Loops for Plumbing Piping
 - 3. Section 220523 General Duty Valves for Plumbing Piping
 - 4. Section 220548 Vibration and Seismic Controls for Plumbing Piping and Equipment
 - 5. Section 220719 Plumbing Piping Insulation
 - 6. Section 221116 Domestic Water Piping
 - 7. Section 221125 Natural Gas Piping
 - 8. Section 221316 Sanitary Waste and Vent Piping
 - 9. Section 221413 Storm Drainage Piping
 - 10. Section 221423 Storm Drainage Piping Specialties

1.2 SUMMARY

- A. Section Includes:
 - 1. Metal pipe hangers and supports.
 - 2. Trapeze pipe hangers.
 - 3. Fiberglass pipe hangers.
 - 4. Metal framing systems.
 - 5. Fiberglass strut systems.
 - 6. Thermal-hanger shield inserts.
 - 7. Fastener systems.
 - 8. Pipe stands.
 - 9. Pipe positioning systems.
 - 10. Equipment supports.

1.3 DEFINITIONS

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

1.4 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design trapeze pipe hangers and equipment supports, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Structural Performance: Hangers and supports for plumbing piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.
 - 1. Design supports for multiple pipes, 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 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Show fabrication and installation details and include calculations for the following; include Product Data for components:
 - 1. Trapeze pipe hangers.
 - 2. Metal framing systems.
 - 3. Fiberglass strut systems.
 - 4. Pipe stands.
 - 5. Equipment supports.
- C. Delegated-Design Submittal: For trapeze hangers indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
 - 1. Detail fabrication and assembly of trapeze hangers.
 - 2. Design Calculations: Calculate requirements for designing trapeze hangers.

1.6 INFORMATIONAL SUBMITTALS

- A. Welding certificates.

1.7 QUALITY ASSURANCE

- A. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

PART 2 - PRODUCTS

2.1 METAL PIPE HANGERS AND SUPPORTS

A. Carbon-Steel Pipe Hangers and Supports (Inside Building):

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Galvanized Metallic Coatings: Pregalvanized or hot dipped.
3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.

B. Copper Pipe Hangers:

1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.
2. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.

2.2 TRAPEZE PIPE HANGERS

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

2.3 METAL FRAMING SYSTEMS

A. MFMA Manufacturer Metal Framing Systems:

1. Description: Shop- or field-fabricated pipe-support assembly for supporting multiple parallel pipes.
2. Standard: MFMA-4.
3. Channels: Continuous slotted steel channel with inturned lips.
4. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
6. Metallic Coating: Hot-dipped galvanized.
7. Paint Coating: Epoxy.
8. Plastic Coating: Epoxy.

B. Non-MFMA Manufacturer Metal Framing Systems:

1. Description: Shop- or field-fabricated pipe-support assembly made of steel channels, accessories, fittings, and other components for supporting multiple parallel pipes.
2. Standard: Comply with MFMA-4.
3. Channels: Continuous slotted steel channel with inturned lips.
4. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
6. Coating: Zinc.

2.4 THERMAL-HANGER SHIELD INSERTS

- A. Insulation-Insert Material for Hot and Cold Piping: ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psi minimum compressive strength and vapor barrier.
- B. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
- C. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
- D. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.5 FASTENER SYSTEMS

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

2.6 PIPE STANDS

- A. General Requirements for Pipe Stands: Shop- or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.
- B. Compact Pipe Stand: One-piece plastic unit with integral-rod roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.
- C. Low-Type, Single-Pipe Stand: One-piece stainless-steel base unit with plastic roller, for roof installation without membrane penetration.
- D. High-Type, Single-Pipe Stand:
 - 1. Description: Assembly of base, vertical and horizontal members, and pipe support, for roof installation without membrane penetration.
 - 2. Base: Stainless steel.
 - 3. Vertical Members: Two or more cadmium-plated-steel or stainless-steel, continuous-thread rods.
 - 4. Horizontal Member: Cadmium-plated-steel or stainless-steel rod with plastic or stainless-steel, roller-type pipe support.
- E. High-Type, Multiple-Pipe Stand:
 - 1. Description: Assembly of bases, vertical and horizontal members, and pipe supports, for roof installation without membrane penetration.
 - 2. Bases: One or more; plastic.
 - 3. Vertical Members: Two or more protective-coated-steel channels.
 - 4. Horizontal Member: Protective-coated-steel channel.
 - 5. Pipe Supports: Galvanized-steel, clevis-type pipe hangers.
- F. Curb-Mounting-Type Pipe Stands: Shop- or field-fabricated pipe supports made from structural-steel shapes, continuous-thread rods, and rollers, for mounting on permanent stationary roof curb.

2.7 PIPE POSITIONING SYSTEMS

- A. Description: IAPMO PS 42, positioning system of metal brackets, clips, and straps for positioning piping in pipe spaces; for plumbing fixtures in commercial applications.

2.8 EQUIPMENT SUPPORTS

- A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

2.9 MISCELLANEOUS MATERIALS

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

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT INSTALLATION

- A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.
- B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.
 - 1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.
 - 2. Field fabricate from ASTM A 36/A 36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.
- C. 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. Pipe Stand Installation:

1. Pipe Stand Types except Curb-Mounted Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
 2. Curb-Mounted-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb. See Section 077200 "Roof Accessories" for curbs.
- G. Pipe Positioning-System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture.
- H. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- I. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- J. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- K. Install lateral bracing with pipe hangers and supports to prevent swaying.
- L. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, 2-1/2-inch and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.
- M. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- N. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.
- O. Insulated Piping:
1. Attach clamps and spacers to piping.
 - a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
 - b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
 - c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.
 2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
 - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe 4-inch and larger if pipe is installed on rollers.
 3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
 - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe 4-inch and larger if pipe is installed on rollers.
 4. Shield Dimensions for Pipe: Not less than the following:
 - a. 1/4-inch to 3-inch: 12 inches long and 0.048 inch thick.

- b. 4-inch: 12 inches long and 0.06 inch thick.
 - c. 5-inch and 6-inch: 18 inches long and 0.06 inch thick.
 - d. 8-inch to 14-inch: 24 inches long and 0.075 inch thick.
 - e. 16-inch to 24-inch: 24 inches long and 0.105 inch thick.
5. Pipes 8-inch and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.
 6. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.2 EQUIPMENT SUPPORTS

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

3.3 METAL FABRICATIONS

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

3.4 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.5 PAINTING

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

- B. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 9.
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

3.6 HANGER AND SUPPORT SCHEDULE

- A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.
- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Use carbon-steel pipe hangers and supports, metal trapeze pipe hangers and metal framing systems and attachments for general service applications.
- F. Use copper-plated pipe hangers and copper or stainless-steel attachments for copper piping and tubing.
- G. Use padded hangers for piping that is subject to scratching.
- H. Use thermal-hanger shield inserts for insulated piping and tubing.
- I. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes ½-inch to 12-inch.
 - 2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F, pipes 4-inch to 24-inch, requiring up to 4-inches of insulation.
 - 3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes ¾-inch to 12-inch, requiring clamp flexibility and up to 4-inches of insulation.
 - 4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes ½-inch to 12-inch if little or no insulation is required.
 - 5. Pipe Hangers (MSS Type 5): For suspension of pipes ½-inch to 4-inch, to allow off-center closure for hanger installation before pipe erection.
 - 6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes ¾-inch to 8-inch.
 - 7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes ½-inch to 8-inch.
 - 8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes ½-inch to 8-inch.
 - 9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes ½-inch to 8-inch.
 - 10. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes 3/8-inch to 8-inch.
 - 11. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes 3/8-inch to 3-inch.

12. U-Bolts (MSS Type 24): For support of heavy pipes ½-inch to 12-inch.
 13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
 14. Pipe Saddle Supports (MSS Type 36): For support of pipes 4-inch to 12-inch, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
 15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes 4-inch to 12-inch, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
 16. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes 2-1/2-inch to 12-inch if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.
 17. Single-Pipe Rolls (MSS Type 41): For suspension of pipes 1-inch to 12-inch, from two rods if longitudinal movement caused by expansion and contraction might occur.
 18. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes 2-1/2-inch to 12-inch, from single rod if horizontal movement caused by expansion and contraction might occur.
 19. Complete Pipe Rolls (MSS Type 44): For support of pipes 2-inch to 12-inch if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
 20. Pipe Roll and Plate Units (MSS Type 45): For support of pipes 2-inch to 12-inch if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.
 21. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes 2-inch to 12-inch if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.
- J. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers ¾-inch to 12-inch.
 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers ¾-inch to 12-inch if longer ends are required for riser clamps.
- K. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6-inches for heavy loads.
 2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
 3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
 4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
 5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.
- L. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
 2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape.
 3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
 4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
 5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
 6. C-Clamps (MSS Type 23): For structural shapes.

7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
 8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
 9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
 10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
 11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
 12. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:
 - a. Light (MSS Type 31): 750 lb.
 - b. Medium (MSS Type 32): 1500 lb.
 - c. Heavy (MSS Type 33): 3000 lb.
 13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
 14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
 15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.
- M. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
 2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
 3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.
- N. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
 2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
 3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41, roll hanger with springs.
 4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
 5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from hanger.
 6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from base support.
 7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from trapeze support.
 8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:
 - a. Horizontal (MSS Type 54): Mounted horizontally.
 - b. Vertical (MSS Type 55): Mounted vertically.
 - c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.
- O. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.

- P. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.
- Q. Use mechanical-expansion anchors instead of building attachments where required in concrete construction.
- R. Use pipe positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

END OF SECTION 220529

SECTION 220548 - VIBRATION AND SEISMIC CONTROLS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Related Sections:
 - 1. Section 220100 Plumbing General Requirements
 - 2. Section 220516 Expansion Fittings and Loops for Plumbing Piping
 - 3. Section 220517 Sleeves and Sleeve Seals for Plumbing Piping
 - 4. Section 220529 Hangers and Supports for Plumbing Piping and Equipment
 - 5. Section 221116 Domestic Water Piping
 - 6. Section 221125 Natural Gas Piping
 - 7. Section 221316 Sanitary Waste and Vent Piping
 - 8. Section 221413 Storm Drainage Piping

1.2 SUMMARY

- A. Section Includes:
 - 1. Elastomeric isolation pads.
 - 2. Elastomeric isolation mounts.
 - 3. Restrained elastomeric isolation mounts.
 - 4. Open-spring isolators.
 - 5. Housed-spring isolators.
 - 6. Restrained-spring isolators.
 - 7. Housed-restrained-spring isolators.
 - 8. Pipe-riser resilient supports.
 - 9. Resilient pipe guides.
 - 10. Elastomeric hangers.
 - 11. Spring hangers.
 - 12. Snubbers.
 - 13. Restraint channel bracings.
 - 14. Restraint cables.
 - 15. Seismic-restraint accessories.
 - 16. Mechanical anchor bolts.
 - 17. Adhesive anchor bolts.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
 - 2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of vibration isolation device and seismic-restraint component required.

- a. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by an agency acceptable to authorities having jurisdiction.
 - b. Annotate to indicate application of each product submitted and compliance with requirements.
3. Interlocking Snubbers: Include ratings for horizontal, vertical, and combined loads.
- B. Shop Drawings:
1. Detail fabrication and assembly of equipment bases. Detail fabrication including anchorages and attachments to structure and to supported equipment.
 2. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.
- C. Delegated-Design Submittal: For each vibration isolation and seismic-restraint device.
1. Include design calculations and details for selecting vibration isolators and seismic restraints complying with performance requirements, design criteria, and analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
 2. Design Calculations: Calculate static and dynamic loading due to equipment weight and operation, due to seismic forces required to select vibration isolators, and due to seismic restraints.
 3. Riser Supports: Include riser diagrams and calculations showing anticipated expansion and contraction at each support point, initial and final loads on building structure, spring deflection changes, and seismic loads. Include certification that riser system was examined for excessive stress and that none exists.
 4. Seismic-Restraint Details:
 - a. Design Analysis: To support selection and arrangement of seismic restraints. Include calculations of combined tensile and shear loads.
 - b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events. Indicate association with vibration isolation devices.
 - c. Coordinate seismic-restraint and vibration isolation details with wind-restraint details required for equipment mounted outdoors. Comply with requirements in other Sections for equipment mounted outdoors.
 - d. Preapproval and Evaluation Documentation: By an evaluation service member of ICC-ES, OSHPD or an agency acceptable to authorities having jurisdiction, showing maximum ratings of restraint items and the basis for approval (tests or calculations).
- 1.4 INFORMATIONAL SUBMITTALS
- A. Coordination Drawings: Show coordination of vibration isolation device installation and seismic bracing for plumbing piping and equipment with other systems and equipment in the vicinity, including other supports and restraints, if any.
 - B. Qualification Data: For professional engineer and testing agency.
 - C. Welding certificates.

- D. Field quality-control reports.

1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7 and that is acceptable to authorities having jurisdiction.
- B. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.
- C. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- D. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear anchorage preapproval OPA number from OSHPD, preapproval by ICC-ES, or preapproval by another agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are unavailable, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Seismic-Restraint Loading:
 - 1. Site Class as Defined in the IBC: [A] [B] [C] [D] [E] [F].
 - 2. Assigned Seismic Use Group or Building Category as Defined in the IBC: [I] [II] [III].
 - a. Component Importance Factor: 1.0.
 - b. Component Response Modification Factor: 1.5.
 - c. Component Amplification Factor: 1.0.
 - 3. Design Spectral Response Acceleration at Short Periods (0.2 Second).
 - 4. Design Spectral Response Acceleration at 1.0-Second Period.
 - 5. Rated strengths, features, and applications shall be as defined in reports by an agency acceptable to authorities having jurisdiction.
 - a. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they are subjected.

2.2 ELASTOMERIC ISOLATION PADS

- A. Elastomeric Isolation Pads.
 - 1. Fabrication: Single or multiple layers of sufficient durometer stiffness for uniform loading over pad area.
 - 2. Size: Factory or field cut to match requirements of supported equipment.

3. Pad Material: Oil and water resistant with elastomeric properties.
4. Surface Pattern: Smooth pattern.
5. Infused nonwoven cotton or synthetic fibers.
6. Load-bearing metal plates adhered to pads.
7. Sandwich-Core Material: Resilient and elastomeric.
 - a. Surface Pattern: Smooth pattern.
 - b. Infused nonwoven cotton or synthetic fibers.

2.3 ELASTOMERIC ISOLATION MOUNTS

A. Double-Deflection, Elastomeric Isolation Mounts.

1. Mounting Plates:
 - a. Top Plate: Encapsulated steel load transfer top plates, factory drilled and threaded with threaded studs or bolts.
 - b. Baseplate: Encapsulated steel bottom plates with holes provided for anchoring to support structure.
2. Elastomeric Material: Molded, oil-resistant rubber, neoprene, or other elastomeric material.

2.4 RESTRAINED ELASTOMERIC ISOLATION MOUNTS

A. Restrained Elastomeric Isolation Mounts.

1. Description: All-directional isolator with seismic restraints containing two separate and opposing elastomeric elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.
 - a. Housing: Cast-ductile iron or welded steel.
 - b. Elastomeric Material: Molded, oil-resistant rubber, neoprene, or other elastomeric material.

2.5 OPEN-SPRING ISOLATORS

A. Freestanding, Laterally Stable, Open-Spring Isolators.

1. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
2. Minimum Additional Travel: 50 percent of the required deflection at rated load.
3. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
4. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
5. Baseplates: Factory-drilled steel plate for bolting to structure with an elastomeric isolator pad attached to the underside. Baseplates shall limit floor load to 500 psig.
6. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.

2.6 HOUSED-SPRING ISOLATORS

A. Freestanding, Laterally Stable, Open-Spring Isolators in Two-Part Telescoping Housing.

1. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.

2. Minimum Additional Travel: 50 percent of the required deflection at rated load.
3. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
4. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
5. Two-Part Telescoping Housing: A steel top and bottom frame separated by an elastomeric material and enclosing the spring isolators.
 - a. Drilled base housing for bolting to structure with an elastomeric isolator pad attached to the underside. Bases shall limit floor load to 500 psig.
 - b. Top housing with elastomeric pad.

2.7 RESTRAINED-SPRING ISOLATORS

- A. Freestanding, Laterally Stable, Open-Spring Isolators with Vertical-Limit Stop Restraint.
 1. Housing: Steel housing with vertical-limit stops to prevent spring extension due to weight being removed.
 - a. Base with holes for bolting to structure with an elastomeric isolator pad attached to the underside. Bases shall limit floor load to 500 psig.
 - b. Top plate with elastomeric pad.
 - c. Internal leveling bolt that acts as blocking during installation.
 2. Restraint: Limit stop as required for equipment and authorities having jurisdiction.
 3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

2.8 HOUSED-RESTRAINED-SPRING ISOLATORS

- A. Freestanding, Steel, Open-Spring Isolators with Vertical-Limit Stop Restraint in Two-Part Telescoping Housing.
 1. Two-Part Telescoping Housing: A steel top and bottom frame separated by an elastomeric material and enclosing the spring isolators. Housings are equipped with adjustable snubbers to limit vertical movement.
 - a. Drilled base housing for bolting to structure with an elastomeric isolator pad attached to the underside. Bases shall limit floor load to 500 psig.
 - b. Threaded top housing with adjustment bolt and cap screw to fasten and level equipment.
 2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

2.9 PIPE-RISER RESILIENT SUPPORT

- A. Description: All-directional, acoustical pipe anchor consisting of two steel tubes separated by a minimum 1/2-inch thick neoprene.
1. Vertical-Limit Stops: Steel and neoprene vertical-limit stops arranged to prevent vertical travel in both directions.
 2. Maximum Load Per Support: 500 psig on isolation material providing equal isolation in all directions.

2.10 RESILIENT PIPE GUIDES

- A. Description: Telescopic arrangement of two steel tubes or post and sleeve arrangement separated by a minimum 1/2-inch thick neoprene.
1. Factory-Set Height Guide with Shear Pin: Shear pin shall be removable and reinsertable to allow for selection of pipe movement. Guides shall be capable of motion to meet location requirements.

2.11 ELASTOMERIC HANGERS

- A. Elastomeric Mount in a Steel Frame with Upper and Lower Steel Hanger Rods.
1. Frame: Steel, fabricated with a connection for an upper threaded hanger rod and an opening on the underside to allow for a maximum of 30 degrees of angular lower hanger-rod misalignment without binding or reducing isolation efficiency.
 2. Dampening Element: Molded, oil-resistant rubber, neoprene, or other elastomeric material with a projecting bushing for the underside opening preventing steel to steel contact.

2.12 SPRING HANGERS

- A. Combination Coil-Spring and Elastomeric-Insert Hanger with Spring and Insert in Compression.
1. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
 2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
 6. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.
 7. Adjustable Vertical Stop: Steel washer with neoprene washer "up-stop" on lower threaded rod.
 8. Self-centering hanger-rod cap to ensure concentricity between hanger rod and support spring coil.

2.13 SNUBBERS

- A. Description: Factory fabricated using welded structural-steel shapes and plates, anchor bolts, and replaceable resilient isolation washers and bushings.
1. Anchor bolts for attaching to concrete shall be seismic-rated, drill-in, and stud-wedge or female-wedge type.

2. Resilient Isolation Washers and Bushings: Oil- and water-resistant neoprene.
3. Maximum 1/4-inch air gap, and minimum 1/4-inch thick resilient cushion.

2.14 RESTRAINT CHANNEL BRACINGS

- A. Description: MFMA-4, shop- or field-fabricated bracing assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end and other matching components and with corrosion-resistant coating; rated in tension, compression, and torsion forces.

2.15 RESTRAINT CABLES

- A. Restraint Cables: ASTM A 603 galvanized-steel cables. End connections made of steel assemblies with thimbles, brackets, swivel, and bolts designed for restraining cable service; with a minimum of two clamping bolts for cable engagement.

2.16 SEISMIC-RESTRAINT ACCESSORIES

- A. Hanger-Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections to hanger rod.
- B. Hinged and Swivel Brace Attachments: Multifunctional steel connectors for attaching hangers to rigid channel bracings and restraint cables.
- C. Bushings for Floor-Mounted Equipment Anchor Bolts: Neoprene bushings designed for rigid equipment mountings, and matched to type and size of anchor bolts and studs.
- D. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings, and matched to type and size of attachment devices used.
- E. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.

2.17 MECHANICAL ANCHOR BOLTS

- A. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

2.18 ADHESIVE ANCHOR BOLTS

- A. Adhesive Anchor Bolts: Drilled-in and capsule anchor system containing PVC or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and equipment to receive vibration isolation and seismic-control devices for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

- A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application by an evaluation service member of ICC-ES, OSHPD or an agency acceptable to authorities having jurisdiction.
- B. Hanger-Rod Stiffeners: Install hanger-rod stiffeners where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods due to seismic forces.
- C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength is adequate to carry present and future static and seismic loads within specified loading limits.

3.3 VIBRATION CONTROL AND SEISMIC-RESTRAINT DEVICE INSTALLATION

- A. Coordinate the location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork specified in Division 3.
- B. Installation of vibration isolators must not cause any change of position of equipment or piping resulting in stresses or misalignment.
- C. Comply with requirements in Section 077200 "Roof Accessories" for installation of equipment supports and roof penetrations.
- D. Equipment Restraints:
 - 1. Install seismic snubbers on plumbing equipment mounted on vibration isolators. Locate snubbers as close as possible to vibration isolators and bolt to equipment base and supporting structure.
 - 2. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch.
 - 3. Install seismic-restraint devices using methods approved by an evaluation service member of ICC-ES, OSHPD or an agency acceptable to authorities having jurisdiction that provides required submittals for component.
- E. Piping Restraints:
 - 1. Comply with requirements in MSS SP-127.
 - 2. Space lateral supports a maximum of 40 feet o.c., and longitudinal supports a maximum of 80 feet o.c.
 - 3. Brace a change of direction longer than 12 feet.

- F. Install cables so they do not bend across edges of adjacent equipment or building structure.
- G. Install seismic-restraint devices using methods approved by an evaluation service member of ICC-ES, OSHPD or an agency acceptable to authorities having jurisdiction that provides required submittals for component.
- H. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.
- I. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.
- J. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.
- K. Drilled-in Anchors:
 - 1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
 - 2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
 - 3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
 - 4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
 - 5. Set anchors to manufacturer's recommended torque, using a torque wrench.
 - 6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.4 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

- A. Install flexible connections in piping where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where the connections terminate with connection to equipment that is anchored to a different structural element from the one supporting the connections as they approach equipment. Comply with requirements in Section 221116 "Domestic Water Piping" and Section 221125 "Natural Gas Pipe" for piping flexible connections.

3.5 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. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.

2. Schedule test with Owner, through Architect, before connecting anchorage device to restrained component (unless postconnection testing has been approved), and with at least seven days' advance notice.
3. Obtain Architect's approval before transmitting test loads to structure. Provide temporary load-spreading members.
4. Test at least four of each type and size of installed anchors and fasteners selected by Architect.
5. Test to 90 percent of rated proof load of device.
6. Measure isolator restraint clearance.
7. Measure isolator deflection.
8. Verify snubber minimum clearances.

D. Remove and replace malfunctioning units and retest as specified above.

E. Prepare test and inspection reports.

3.6 ADJUSTING

A. Adjust isolators after piping system is at operating weight.

B. Adjust limit stops on restrained-spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.

END OF SECTION 220548

SECTION 220553 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Related Sections:
 - 1. Section 220100 Plumbing General Requirements
 - 2. Section 220523 General Duty Valves for Plumbing Piping
 - 3. Section 221116 Domestic Water Piping
 - 4. Section 221125 Natural Gas Piping
 - 5. Section 221316 Sanitary Waste and Vent Piping
 - 6. Section 221413 Storm Drainage Piping

1.2 SUMMARY

- A. Section Includes:
 - 1. Equipment labels.
 - 2. Warning signs and labels.
 - 3. Pipe labels.
 - 4. Valve tags.
 - 5. Warning tags.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples: For color, letter style, and graphic representation required for each identification material and device.
- C. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.
- D. Valve numbering scheme.
- E. Valve Schedules: For each piping system to include in maintenance manuals.

1.4 COORDINATION

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Coordinate installation of identifying devices with locations of access panels and doors.

- C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Metal Labels for Equipment:

1. Material and Thickness: Brass, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Letter Color: Black.
3. Background Color: White.
4. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
5. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
6. Fasteners: Stainless-steel self-tapping screws.
7. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Plastic Labels for Equipment:

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8-inch-thick, and having predrilled holes for attachment hardware.
2. Letter Color: Black.
3. Background Color: White.
4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
7. Fasteners: Stainless-steel self-tapping screws.
8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

- C. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), and the Specification Section number and title where equipment is specified.

- D. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number, and identify Drawing numbers where equipment is indicated (plans, details, and schedules) and the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 WARNING SIGNS AND LABELS

- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8-inch-thick, and having predrilled holes for attachment hardware.
- B. Letter Color: Black.
- C. Background Color: White.

- D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
- E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
- F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
- G. Fasteners: Stainless-steel self-tapping screws.
- H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- I. Label Content: Include caution and warning information plus emergency notification instructions.

2.3 PIPE LABELS

- A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.
- B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.
- C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
- D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings; also include pipe size and an arrow indicating flow direction.
 - 1. Flow-Direction Arrows: Integral with piping-system service lettering to accommodate both directions or as separate unit on each pipe label to indicate flow direction.
 - 2. Lettering Size: Size letters according to ASME A13.1 for piping (minimum of 1/2-inch).

2.4 VALVE TAGS

- A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.
 - 1. Tag Material: Brass, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
 - 2. Fasteners: Brass wire-link chain or beaded chain.
- B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.
 - 1. Valve-tag schedule shall be included in operation and maintenance data.

2.5 WARNING TAGS

- A. Description: Preprinted or partially preprinted accident-prevention tags of plasticized card stock with matte finish suitable for writing.
 - 1. Size: Approximately 4 by 7 inches.
 - 2. Fasteners: Reinforced grommet and wire.
 - 3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
 - 4. Color: Safety yellow background with black lettering.

PART 3 - EXECUTION

3.1 PREPARATION

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

3.2 GENERAL INSTALLATION REQUIREMENTS

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

3.3 EQUIPMENT LABEL INSTALLATION

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

3.4 PIPE LABEL INSTALLATION

- A. Piping Color Coding: Painting of piping is specified in Division 9.
- B. Stenciled Pipe Label Option: Stenciled labels may be provided instead of manufactured pipe labels, at Installer's option. Install stenciled pipe labels, complying with ASME A13.1, with painted, color-coded bands or rectangles on each piping system.
 - 1. Identification Paint: Use for contrasting background.
- C. Pipe Label Locations: Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
 - 1. Near each valve and control device.

2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
 3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
 4. At access doors, manholes, and similar access points that permit view of concealed piping.
 5. Near major equipment items and other points of origination and termination.
 6. Spaced at maximum intervals of 25 feet along each run. Reduce intervals to 10 feet in areas of congested piping and equipment.
 7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.
- D. Directional Flow Arrows: Arrows shall be used to indicate direction of flow in pipes, including pipes where flow is allowed in both directions.
- E. Pipe Label Color Schedule:
1. Domestic Water Piping
 - a. Background: Safety green.
 - b. Letter Colors: White.
 2. Sanitary Waste and Storm Drainage Piping:
 - a. Background Color: Safety white.
 - b. Letter Color: Black.
 3. Natural Gas Piping:
 - a. Background Color: Yellow
 - b. Letter Color: Black

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, shutoff valves, faucets, convenience and lawn-watering hose connections, and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.
- B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:
1. Valve-Tag Size and Shape:
 - a. Hot and Cold Water: 1-1/2 inches, round.
 - b. Natural Gas: 1-1/2 inches, round.
 2. Valve-Tag Colors:
 - a. Cold Water: Natural.
 - b. Hot Water: Natural.
 3. Letter Colors:
 - a. Hot and Cold Water: Black.
 - b. Natural Gas: Black

3.6 WARNING-TAG INSTALLATION

- A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION 220553

SECTION 220719 - PLUMBING PIPING INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Related Sections:
 - 1. Section 220100 Plumbing General Requirements
 - 2. Section 220523 General Duty Valves for Plumbing Piping
 - 3. Section 220529 Hangers and Supports for Plumbing Piping and Equipment
 - 4. Section 220553 Identification for Plumbing Piping and Equipment
 - 5. Section 221116 Domestic Water Piping
 - 6. Section 221413 Storm Drainage Piping
 - 7. Section 221423 Storm Drainage Piping Specialties
 - 8. Section 224300 Plumbing Fixtures

1.2 SUMMARY

- A. Section includes insulating the following plumbing piping services:
 - 1. Domestic cold-water piping.
 - 2. Domestic hot-water piping.
 - 3. Domestic recirculating hot-water piping.
 - 4. Domestic chilled-water piping for drinking fountains.
 - 5. Sanitary waste piping exposed to freezing conditions.
 - 6. Storm-water piping exposed to freezing conditions.
 - 7. Roof drains and rainwater leaders.
 - 8. Supplies and drains for handicap-accessible lavatories and sinks.

1.3 REFERENCE STANDARDS

- A. ASTM International (ASTM).
- B. American Society of Heating, Refrigerating, and Air Conditioning Engineers, Inc. (ASHRAE).
- C. North American Insulation Manufacturers Association (NAIMA).
- D. NAIMA – "Guide to Insulating Chilled Water Piping Systems with Mineral Fiber Pipe Insulation."
- E. "National Commercial & Industrial Insulation Standards" – MICA Manual.
- F. National Fire Protection Association (NFPA).
- G. Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA).
- H. Underwriter's Laboratories (UL).

- I. Underwriter's Laboratories Environmental (UL Environment).

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory- and field-applied, if any).
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
 - 1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
 - 2. Detail attachment and covering of heat tracing inside insulation.
 - 3. Detail insulation application at pipe expansion joints for each type of insulation.
 - 4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
 - 5. Detail removable insulation at piping specialties, equipment connections, and access panels.
 - 6. Detail application of field-applied jackets.
 - 7. Detail application at linkages of control devices.
- C. Samples: For each type of insulation and jacket indicated. Identify each Sample, describing product and intended use. Sample sizes are as follows:
 - 1. Preformed Pipe Insulation Materials: 12 inches long by 2-inches.
 - 2. Jacket Materials for Pipe: 12 inches long by 2-inches.

1.5 INFORMATIONAL SUBMITTALS

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

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.
- B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84 by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.
 - 1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
 - 2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

- C. Mockups: Before installing insulation, build mockups for each type of insulation and finish listed below to demonstrate quality of insulation application and finishes. Build mockups in the location indicated or, if not indicated, as directed by Architect. Use materials indicated for the completed Work.
1. Piping Mockups:
 - a. One 10-foot section of 2-inch straight pipe.
 - b. One each of a 90-degree threaded, welded, and flanged elbow.
 - c. One each of a threaded, welded, and flanged tee fitting.
 - d. One 2-inch or smaller valve, and one 2-1/2-inch or larger valve.
 - e. Four support hangers including hanger shield and insert.
 - f. One threaded strainer and one flanged strainer with removable portion of insulation.
 - g. One threaded reducer and one welded reducer.
 - h. One pressure temperature tap.
 - i. One mechanical coupling.
 2. For each mockup, fabricate cutaway sections to allow observation of application details for insulation materials, adhesives, mastics, attachments, and jackets.
 3. Notify Architect seven days in advance of dates and times when mockups will be constructed.
 4. Obtain Architect's approval of mockups before starting insulation application.
 5. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 6. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
 7. Demolish and remove mockups when directed.
- D. Comply with the following applicable standards and other requirements specified for miscellaneous components:
1. Supply and Drain Protective Shielding Guards: ANSI A117.1.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.8 COORDINATION

- A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."
- B. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.
- C. Coordinate installation and testing of heat tracing with Electrical Contractor.

1.9 SCHEDULING

- A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

- B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

- A. Fiberglass: Inorganic, incombustible, molded of heavy density resin bonded inorganic glass fibers.
 - 1. Density: ASTM C 302.
 - 2. Operating Temp. Range: ASTM C 411.
 - 3. Jacket Temp Limitation: ASTM C 1136.
 - 4. Jacket Permeance: ASTM E 96.
- B. Mineral-Fiber, Preformed Pipe Insulation:
 - 1. Type I, 850 Deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ-SSL.
- C. Phenolic:
 - 1. Preformed pipe insulation of rigid, expanded, closed-cell structure. Comply with ASTM C 1126, Type III, Grade 1.
 - 2. Block insulation of rigid, expanded, closed-cell structure. Comply with ASTM C 1126, Type II, Grade 1.
 - 3. Factory fabricate shapes according to ASTM C 450 and ASTM C 585.
 - 4. Factory-Applied Jacket: Requirements are specified in "Factory-Applied Jackets" Article.
- D. Comply with requirements in "Piping Insulation Schedule, General," "Indoor Piping Insulation Schedule," "Outdoor, Aboveground Piping Insulation Schedule," and "Outdoor, Underground Piping Insulation Schedule" articles for where insulating materials shall be applied.
- E. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- F. Composite surface burning characteristic shall comply with ASTM E84.
- G. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

2.2 INSULATING CEMENTS

- A. Mineral-Fiber Insulating Cement: Comply with ASTM C 195.
- B. Expanded or Exfoliated Vermiculite Insulating Cement: Comply with ASTM C 196.
- C. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449.

2.3 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.
- B. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

1. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. PVC Jacket Adhesive: Compatible with PVC jacket.

1. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.4 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.

1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below-ambient services.

1. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm at 43-mil dry film thickness.
2. Service Temperature Range: Minus 20 to plus 180 deg F.
3. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
4. Color: White.

C. Vapor-Barrier Mastic: Solvent based; suitable for indoor use on below-ambient services.

1. Water-Vapor Permeance: ASTM F 1249, 0.05 perm at 35-mil dry film thickness.
2. Service Temperature Range: 0 to 180 deg F.
3. Solids Content: ASTM D 1644, 44 percent by volume and 62 percent by weight.
4. Color: White.

D. Breather Mastic: Water based; suitable for indoor and outdoor use on above-ambient services.

1. Water-Vapor Permeance: ASTM F 1249, 1.8 perms at 0.0625-inch (1.6-mm) dry film thickness.
2. Service Temperature Range: Minus 20 to plus 180 deg F.
3. Solids Content: 60 percent by volume and 66 percent by weight.
4. Color: White.

2.5 SEALANTS

A. Joint Sealants:

1. Materials shall be compatible with insulation materials, jackets, and substrates.
2. Permanently flexible, elastomeric sealant.
3. Service Temperature Range: Minus 100 to plus 300 deg F.
4. Color: White or gray.
5. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

6. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

B. PVC Jacket Flashing Sealants:

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

2.6 FACTORY-APPLIED JACKETS

- A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
 2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
 3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.

2.7 FIELD-APPLIED JACKETS

- A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
- B. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.
1. Adhesive: As recommended by jacket material manufacturer.
 2. Color: White.
 3. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.
 - a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.

2.8 TAPES

- A. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.
1. Width: 2 inches.
 2. Thickness: 6 mils.
 3. Adhesion: 64 ounces force/inch in width.
 4. Elongation: 500 percent.
 5. Tensile Strength: 18 lbf/inch in width.

2.9 SECUREMENTS

A. Bands:

1. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304; 0.015-inch-thick, 1/2-inch-wide with wing seal or closed seal.
2. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020-inch-thick, 1/2-inch-wide with wing seal or closed seal.

B. Staples: Outward-clinching insulation staples, nominal 3/4-inch-wide, stainless steel or Monel.

C. Wire: 0.062-inch soft-annealed, stainless steel.

2.10 PROTECTIVE SHIELDING GUARDS

A. Protective Shielding Pipe Covers:

1. Description: Manufactured plastic wraps for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with Americans with Disabilities Act (ADA) requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.

1. Verify that systems to be insulated have been tested and are free of defects.
2. Verify that surfaces to be insulated are clean and dry.

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

3.2 PREPARATION

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

B. Surface Preparation: Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:

1. Stainless Steel: Coat 300 series stainless steel with an epoxy primer 5 mils thick and an epoxy finish 5 mils thick if operating in a temperature range between 140 and 300 deg F. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
2. Carbon Steel: Coat carbon steel operating at a service temperature between 32 and 300 deg F with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.

C. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.

- D. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.3 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of pipe system as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- G. Keep insulation materials dry during application and finishing.
- H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- I. Install insulation with least number of joints practical.
- J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
 - 1. Install insulation continuously through hangers and around anchor attachments.
 - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
 - 3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
 - 4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- L. All indoor exposed plumbing piping that requires insulation shall be provided with a PVC jacket.
- M. Install insulation with factory-applied jackets as follows:
 - 1. Draw jacket tight and smooth.
 - 2. Cover circumferential joints with 3-inch-wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
 - 3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install 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 2 inches o.c.

- a. For below-ambient services, apply vapor-barrier mastic over staples.
- 4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
- 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.
- N. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- O. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- P. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.
- Q. For above-ambient services, do not install insulation to the following:
 - 1. Vibration-control devices.
 - 2. Testing agency labels and stamps.
 - 3. Nameplates and data plates.
 - 4. Cleanouts.

3.4 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
 - 1. Seal penetrations with flashing sealant.
 - 2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
- B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.
- C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
 - 1. Seal penetrations with flashing sealant.
 - 2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 - 3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
 - 4. Seal jacket to wall flashing with flashing sealant.
- D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.
 - 1. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping and fire-resistive joint sealers.

F. Insulation Installation at Floor Penetrations:

1. Pipe: Install insulation continuously through floor penetrations.
2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.5 GENERAL PIPE INSULATION INSTALLATION

A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.

B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:

1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.
6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
9. Stencil or label the outside insulation jacket of each union with the word "union." Match size and color of pipe labels.

C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

- D. Install removable insulation covers at locations indicated. Installation shall conform to the following:
1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
 2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
 3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.
 4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
 5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.6 INSTALLATION OF FIBERGLASS INSULATION

- A. General Installation Requirements:
1. Secure single-layer insulation with stainless-steel bands at 12-inch intervals and tighten bands without deforming insulation materials.
 2. Install 2-layer insulation with joints tightly butted and staggered at least 3 inches. Secure inner layer with 0.062-inch wire spaced at 12-inch intervals. Secure outer layer with stainless-steel bands at 12-inch intervals.
- B. Insulation Installation on Straight Pipes and Tubes:
1. Secure each layer of insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
 2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
 3. For insulation with factory-applied jackets on above-ambient services, secure laps with outward clinched staples at 6 inches o.c.
 4. For insulation with factory-applied jackets with vapor retarders on below-ambient services, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.
- C. Insulation Installation on Pipe Flanges:
1. Install preformed pipe insulation to outer diameter of pipe flange.
 2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
 3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of block insulation of same material and thickness as pipe insulation.
- D. Insulation Installation on Pipe Fittings and Elbows:
1. Install preformed insulation sections of same material as straight segments of pipe insulation. Secure according to manufacturer's written instructions.

E. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed insulation sections of same material as straight segments of pipe insulation. Secure according to manufacturer's written instructions.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.

3.7 INSTALLATION OF MINERAL-FIBER INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above-ambient surfaces, secure laps with outward clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets on below-ambient surfaces, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

3.8 FIELD-APPLIED JACKET INSTALLATION

- A. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints. Seal with manufacturer's recommended adhesive.
 - 1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.
- B. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

3.9 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Perform tests and inspections.
- C. Tests and Inspections:
 - 1. Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations of threaded strainers, two locations of welded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.
- D. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.10 PIPING INSULATION SCHEDULE, GENERAL

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

3.11 INDOOR PIPING INSULATION SCHEDULE

- A. Domestic Cold Water:
 - 1. 1-inch and Smaller: Insulation shall be one of the following:
 - a. Fiberglass: 1/2-inch thick.
 - b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1/2-inch thick.
 - 2. 1 1/4-inch and Larger: Insulation shall be one of the following:

- a. Fiberglass: 1-inch thick.
 - b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1-inch thick.
- B. Domestic Hot and Recirculated Hot Water:
1. 1 1/4-inch and Smaller: Insulation shall be one of the following:
 - a. Fiberglass: 1 inch thick.
 - b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1-inch thick.
 2. 1-1/2-inch and Larger: Insulation shall be one of the following:
 - a. Fiberglass: 1-1/2 inches thick.
 - b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1-1/2 inches thick.
- C. Storm-water and Overflow (Horizontal piping and first 3 feet of vertical drop):
1. All Pipe Sizes: Insulation shall be one of the following:
 - a. Fiberglass: 1-inch thick.
 - b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
 - c. Phenolic: 1 inch thick.
- D. Roof Drain and Overflow Drain Bodies:
1. All Pipe Sizes: Insulation shall be one of the following:
 - a. Fiberglass: 1-inch thick.
 - b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
 - c. Phenolic: 1 inch thick.
- E. Exposed Sanitary Drains, Domestic Water, Domestic Hot Water, and Stops for Plumbing Fixtures for People with Disabilities:
1. All Pipe Sizes: Insulation shall be PVC.
- F. Grease Waste Piping Where Heat Tracing Is Installed:
1. All Pipe Sizes: Insulation shall be one of the following:
 - a. Fiberglass: 1 1/2-inch thick.
 - b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1-1/2 inches thick.
- G. Floor Drains, Traps, and Sanitary Drain Piping within 10 Feet of Drain Receiving Condensate and Equipment Drain Water below 60 Deg F:
1. All Pipe Sizes: Insulation shall be one of the following:
 - a. Fiberglass: 1-inch thick.
 - b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch-thick.
- H. Hot Service Drains:
1. All Pipe Sizes: Insulation shall be one of the following:

- a. Fiberglass: 1-inches thick.
- b. Mineral-Fiber, Preformed Pipe, Type I or II: 1-inch thick.

3.12 INDOOR, FIELD-APPLIED JACKET SCHEDULE

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
- B. If more than one material is listed, selection from materials listed is Contractor's option.
- C. Piping, Exposed:
 1. PVC: 20 mils thick.

END OF SECTION 220719

SECTION 221116 - DOMESTIC WATER PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Related Sections:
 - 1. Section 220100 Plumbing General Requirements
 - 2. Section 220516 Expansion Fittings and Loops for Plumbing Piping
 - 3. Section 220517 Sleeves and Sleeve Seals for Plumbing Piping
 - 4. Section 220518 Escutcheons for Plumbing Piping
 - 5. Section 220519 Meters and Gauges for Plumbing Piping
 - 6. Section 220523 General Duty Valves for Plumbing Piping
 - 7. Section 220529 Hangers and Supports for Plumbing Piping and Equipment
 - 8. Section 220548 Vibration and Seismic Controls for Plumbing Piping and Equipment
 - 9. Section 220553 Identification for Plumbing Piping and Equipment
 - 10. Section 220719 Plumbing Piping Insulation
 - 11. Section 221119 Domestic Water Piping Specialties
 - 12. Section 224300 Plumbing Fixtures

1.2 SUMMARY

- A. Section Includes:
 - 1. Under-building-slab and aboveground domestic water pipes, tubes, and fittings inside buildings.
 - 2. Encasement for piping.

1.3 REFERENCES

- A. American Society of Mechanical Engineers:
 - 1. ASME B16.1 - Cast Iron Pipe Flanges and Flanged Fittings.
 - 2. ASME B16.3 - Malleable Iron Threaded Fittings.
 - 3. ASME B16.4 - Gray Iron Threaded Fittings.
 - 4. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings.
 - 5. ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
 - 6. ASME B16.26 - Cast Copper Alloy Fittings for Flared Copper Tubes.
 - 7. ASME B31.9 - Building Services Piping.
 - 8. ASME B36.10M - Welded and Seamless Wrought Steel Pipe.
- B. ASTM International:
 - 1. ASTM A47/A47M - Standard Specification for Ferritic Malleable Iron Castings.
 - 2. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
 - 3. ASTM A234/A234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.

4. ASTM A395/A395M - Standard Specification for Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures.
 5. ASTM A536 - Standard Specification for Ductile Iron Castings.
 6. ASTM B32 - Standard Specification for Solder Metal.
 7. ASTM B42 - Standard Specification for Seamless Copper Pipe, Standard Sizes.
 8. ASTM B43 - Standard Specification for Seamless Red Brass Pipe, Standard Sizes.
 9. ASTM B75 - Standard Specification for Seamless Copper Tube.
 10. ASTM B88 - Standard Specification for Seamless Copper Water Tube.
 11. ASTM B251 - Standard Specification for General Requirements for Wrought Seamless Copper and Copper-Alloy Tube.
 12. ASTM B302 - Standard Specification for Threadless Copper Pipe, Standard Sizes.
- C. American Welding Society:
1. AWS A5.8 - Specification for Filler Metals for Brazing and Braze Welding.
 2. AWS D1.1 - Structural Welding Code - Steel.
- D. American Water Works Association:
1. AWWA C104 - American National Standard for Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water.
 2. AWWA C105 - American National Standard for Polyethylene Encasement for Ductile-Iron Pipe Systems.
 3. AWWA C110 - American National Standard for Ductile-Iron and Grey-Iron Fittings, 3 in. through 48 in. (75 mm through 1200 mm), for Water and Other Liquids.
 4. AWWA C111 - American National Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
 5. AWWA C151 - American National Standard for Ductile-Iron Pipe, Centrifugally Cast, for Water.
- E. NSF International:
1. NSF 61 - Standard for Drinking Water System Components - Health Effects.
- F. Safe Drinking Water Act:
1. SDWA 1417 - Standard for Lead Free Drinking Water.
- 1.4 SUBMITTALS
- A. Product Data: For the following products:
1. Transition fittings.
 2. Dielectric fittings.
- B. System purging and disinfecting activities report.
- C. Field quality-control reports.
- 1.5 PERFORMANCE REQUIREMENTS
- A. Seismic Performance: Domestic water piping and support and installation shall withstand effects of earthquake motions determined according to ASCE/SEI 7.

1.6 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with NSF 61 for potable domestic water piping and components.
- C. All components of the potable domestic water system shall meet the requirements of SDWA-1417.

1.7 FIELD CONDITIONS

- A. Interruption of Existing Water Service: Do not interrupt water service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water service according to requirements indicated:
 - 1. Notify Architect, Construction Manager and Owner no fewer than two days in advance of proposed interruption of water service.
 - 2. Do not interrupt water service without Architect's, Construction Manager's and Owner's written permission.

1.8 COORDINATION

- A. Coordinate sizes and locations of concrete bases with actual equipment provided.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

- A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.2 COPPER TUBE AND FITTINGS

- A. Hard Copper Tube: ASTM B 88, Type L water tube, drawn temper.
- B. Soft Copper Tube: ASTM B 88, Type K or ASTM B 88, Type L water tube, annealed temper.
- C. Cast-Copper, Solder-Joint Fittings: ASME B16.18, pressure fittings.
- D. Wrought-Copper, Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.
- E. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.
- F. Joints: ASTM B32, Alloy Grade Sb5 tin-antimony, or Alloy Grade Sn95 tin-silver, lead free solder AWS A5.8 Classification BCuP-3 or BCuP-4 silver braze.
- G. Copper Unions:
 - 1. MSS SP-123.
 - 2. Cast-copper-alloy, hexagonal-stock body.

3. Ball-and-socket, metal-to-metal seating surfaces.
4. Solder-joint or threaded ends.

H. Copper-Tube, Extruded-Tee Connections:

1. Description: Tee formed in copper tube according to ASTM F 2014.

I. Appurtenances for Grooved-End Copper Tubing:

1. Bronze Fittings for Grooved-End, Copper Tubing: ASTM B 75 copper tube or ASTM B 584 bronze castings.
2. Mechanical Couplings for Grooved-End Copper Tubing:
 - a. Copper-tube dimensions and design similar to AWWA C606.
 - b. Ferrous housing sections.
 - c. EPDM-rubber gaskets suitable for hot and cold water.
 - d. Bolts and nuts.
 - e. Minimum Pressure Rating: 300 psig.

J. Press Fit Connections:

1. Press Fitting: Copper and copper alloy press fittings conforming to ASME B16.18 or ASME B16.22. Sealing elements for press fittings shall be EPDM and factory installed. Press ends shall have SC feature design (leakage path) to assure detection and easy identification of leakage of liquids from inside the system past the sealing element of an unpressed connection.

2.3 DUCTILE-IRON PIPE AND FITTINGS

A. Mechanical-Joint, Ductile-Iron Pipe:

1. AWWA C151/A21.51, with mechanical-joint bell and plain spigot end unless grooved or flanged ends are indicated.
2. Glands, Gaskets, and Bolts: AWWA C111/A21.11, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

2.4 PIPING JOINING MATERIALS

A. Pipe-Flange Gasket Materials:

1. AWWA C110/A21.10, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and asbestos free unless otherwise indicated.
2. Full-face or ring type unless otherwise indicated.

B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.

C. Solder Filler Metals: ASTM B 32, lead-free alloys.

D. Flux: ASTM B 813, water flushable.

E. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.

2.5 ENCASEMENT FOR PIPING

- A. Standard: ASTM A 674 or AWWA C105/A21.5.
- B. Form: Sheet or tube.
- C. Color: Black or natural.

2.6 TRANSITION FITTINGS

- A. General Requirements:
 - 1. Same size as pipes to be joined.
 - 2. Pressure rating at least equal to pipes to be joined.
 - 3. End connections compatible with pipes to be joined.
- B. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
- C. Sleeve-Type Transition Coupling: AWWA C219.

2.7 DIELECTRIC FITTINGS

- A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.
- B. Dielectric Unions:
 - 1. Standard: ASSE 1079.
 - 2. Pressure Rating: 125 psig minimum at 180 deg F 150 psig.
 - 3. End Connections: Solder-joint copper alloy and threaded ferrous.
- C. Dielectric Flanges:
 - 1. Standard: ASSE 1079.
 - 2. Factory-fabricated, bolted, companion-flange assembly.
 - 3. Pressure Rating: 125 psig minimum at 180 deg F 150 psig.
 - 4. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.
- D. Dielectric-Flange Insulating Kits:
 - 1. Nonconducting materials for field assembly of companion flanges.
 - 2. Pressure Rating: 150 psig.
 - 3. Gasket: Neoprene or phenolic.
 - 4. Bolt Sleeves: Phenolic or polyethylene.
 - 5. Washers: Phenolic with steel backing washers.
- E. Dielectric Nipples:
 - 1. Standard: IAPMO PS 66.
 - 2. Electroplated steel nipple complying with ASTM F 1545.
 - 3. Pressure Rating and Temperature: 300 psig at 225 deg F.
 - 4. End Connections: Male threaded or grooved.
 - 5. Lining: Inert and noncorrosive, propylene.

PART 3 - EXECUTION

3.1 EARTHWORK

- A. Comply with requirements in Section 312000 "Earth Moving" for excavating, trenching, and backfilling.

3.2 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.
- B. Install copper tubing under building slab according to CDA's "Copper Tube Handbook."
- C. Install ductile-iron piping under building slab with restrained joints according to AWWA C600 and AWWA M41.
- D. Install underground copper tube and ductile-iron pipe in PE encasement according to ASTM A 674 or AWWA C105/A21.5.
- E. Install shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve inside the building at each domestic water-service entrance. Comply with requirements for pressure gages in Section 220519 "Meters and Gages for Plumbing Piping" and with requirements for drain valves and strainers in Section 221119 "Domestic Water Piping Specialties."
- F. Install shutoff valve immediately upstream of each dielectric fitting.
- G. Install water-pressure-reducing valves downstream from shutoff valves. Comply with requirements for pressure-reducing valves in Section 221119 "Domestic Water Piping Specialties."
- H. Install domestic water piping level with 0.25 percent slope downward toward drain and plumb.
- I. Rough-in domestic water piping for water-meter installation according to utility company's requirements.
- J. Install seismic restraints on piping. Comply with requirements for seismic-restraint devices in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- K. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.
- L. 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.
- M. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.
- N. Install piping to permit valve servicing.
- O. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than the system pressure rating used in applications below unless otherwise indicated.

- P. Install piping free of sags and bends.
- Q. Install fittings for changes in direction and branch connections.
- R. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.
- S. Install pressure gages on suction and discharge piping for each plumbing pump and packaged booster pump. Comply with requirements for pressure gages in Section 220519 "Meters and Gages for Plumbing Piping."
- T. Install thermometers on inlet and outlet piping from each water heater. Comply with requirements for thermometers in Section 220519 "Meters and Gages for Plumbing Piping."
- U. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
- V. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
- W. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

3.3 JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
- C. 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.
- D. Brazed Joints for Copper Tubing: Comply with CDA's "Copper Tube Handbook," "Braze Joints" chapter.
- E. Soldered Joints for Copper Tubing: Apply ASTM B 813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B 828 or CDA's "Copper Tube Handbook."
- F. Extruded-Tee Connections: Form tee in copper tube according to ASTM F 1044. Use tool designed for copper tube; drill pilot hole, form collar for outlet, dimple tube to form seating stop, and braze branch tube into collar.
- G. Joint Construction for Grooved-End Copper Tubing: Make joints according to AWWA C606. Roll groove ends of tubes. Lubricate and install gasket over ends of tubes or tube and fitting. Install coupling housing sections over gasket with keys seated in tubing grooves. Install and tighten housing bolts.
- H. Joint Construction for Grooved-End, Ductile-Iron Piping: Make joints according to AWWA C606. Cut round-bottom grooves in ends of pipe at gasket-seat dimension required for specified (flexible or rigid) joint. Lubricate and install gasket over ends of pipes or pipe and fitting. Install coupling housing sections over gasket with keys seated in piping grooves. Install and tighten housing bolts.

- I. Joint Construction for Grooved-End Copper Piping: Make joints according to AWWA C606. Square cut Roll groove ends of pipe as specified. Lubricate and install gasket over ends of pipes or pipe and fitting. Install coupling housing sections over gasket with keys seated in piping grooves. Install and tighten housing bolts.
- J. Flanged Joints: Select appropriate asbestos-free, nonmetallic gasket material in size, type, and thickness suitable for domestic water service. Join flanges with gasket and bolts according to ASME B31.9.
- K. Joints for Dissimilar-Material Piping: Make joints using adapters compatible with materials of both piping systems.

3.4 TRANSITION FITTING INSTALLATION

- A. Install transition couplings at joints of dissimilar piping.
- B. Transition Fittings in Underground Domestic Water Piping:
 - 1. Fittings for 1-1/2-inch and Smaller: Fitting-type coupling.
 - 2. Fittings for 2-inch and Larger: Sleeve-type coupling.
- C. Transition Fittings in Aboveground Domestic Water Piping 2-inch and Smaller: Plastic-to-metal transition fittings or unions.

3.5 DIELECTRIC FITTING INSTALLATION

- A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
- B. Dielectric Fittings for 2-inch and Smaller: Use dielectric couplings couplings or nipples.
- C. Dielectric Fittings for 2-1/2-inch to 4-inch: Use dielectric flanges flange kits.
- D. Dielectric Fittings for 5-inch and Larger: Use dielectric flange kits.

3.6 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements for seismic-restraint devices in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- B. Comply with requirements for pipe hanger, support products, and installation in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."
 - 1. Vertical Piping: MSS Type 8 or 42, clamps.
 - 2. Individual, Straight, Horizontal Piping Runs:
 - a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
 - b. Longer than 100 Feet: MSS Type 43, adjustable roller hangers.
 - c. Longer than 100 Feet if Indicated: MSS Type 49, spring cushion rolls.
 - 3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
 - 4. Base of Vertical Piping: MSS Type 52, spring hangers.

- C. Support vertical piping and tubing at base and at each floor.
- D. Rod diameter may be reduced one size for double-rod hangers, to a minimum of 3/8 inch.
- E. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
 - 1. 3/4-inch and Smaller: 60 inches with 3/8-inch rod.
 - 2. 1-inch and 1-1/4-inch: 72 inches with 3/8-inch rod.
 - 3. 1-1/2-inch and 2-inch: 96 inches with 3/8-inch rod.
 - 4. 2-1/2-inch: 108 inches with 1/2-inch rod.
 - 5. 3-inch to 5-inch: 10 feet with 1/2-inch rod.
 - 6. 6-inch: 10 feet with 5/8-inch rod.
 - 7. 8-inch: 10 feet with 3/4-inch rod.
- F. Install supports for vertical copper tubing every 10 feet.
- G. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:
 - 1. 1-1/4-inch and Smaller: 84 inches with 3/8-inch rod.
 - 2. 1-1/2-inch: 108 inches with 3/8-inch rod.
 - 3. 2-inch: 10 feet with 3/8-inch rod.
 - 4. 2-1/2-inch: 11 feet with 1/2-inch rod.
 - 5. 3-inch: 12 feet with 1/2-inch rod.
 - 6. 4-inch and 5-inch: 12 feet with 5/8-inch rod.
 - 7. 6-inch: 12 feet with 3/4-inch rod.
 - 8. 8-inch to 12-inch: 12 feet with 7/8-inch rod.
- H. Install supports for vertical steel piping every 15 feet.
- I. Support piping and tubing not listed in this article according to MSS SP-69 and manufacturer's written instructions.

3.7 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. When installing piping adjacent to equipment and machines, allow space for service and maintenance.
- C. Connect domestic water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.
- D. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:
 - 1. Plumbing Fixtures: Cold- and hot-water-supply piping in sizes indicated, but not smaller than that required by plumbing code.
 - 2. Equipment: Cold- and hot-water-supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for 2-1/2-inch and larger.

3.8 IDENTIFICATION

- A. Identify system components. Comply with requirements for identification materials and installation in Section 220553 "Identification for Plumbing Piping and Equipment."
- B. Label pressure piping with system operating pressure.

3.9 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 - 1. Piping Inspections:
 - a. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
 - b. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:
 - 1) Roughing-in Inspection: Arrange for inspection of piping before concealing or closing in after roughing in and before setting fixtures.
 - 2) Final Inspection: Arrange for authorities having jurisdiction to observe tests specified in "Piping Tests" Subparagraph below and to ensure compliance with requirements.
 - c. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
 - d. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
 - 2. Piping Tests:
 - a. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
 - b. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.
 - c. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
 - d. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow it to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
 - e. Repair leaks and defects with new materials, and retest piping or portion thereof until satisfactory results are obtained.
 - f. Prepare reports for tests and for corrective action required.
- B. Domestic water piping will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

3.10 ADJUSTING

- A. Perform the following adjustments before operation:
1. Close drain valves, hydrants, and hose bibbs.
 2. Open shutoff valves to fully open position.
 3. Open throttling valves to proper setting.
 4. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.
 - a. Manually adjust ball-type balancing valves in hot-water-circulation return piping to provide hot-water flow in each branch.
 - b. Adjust calibrated balancing valves to flows indicated.
 5. Remove plugs used during testing of piping and for temporary sealing of piping during installation.
 6. Remove and clean strainer screens. Close drain valves and replace drain plugs.
 7. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.
 8. Check plumbing specialties and verify proper settings, adjustments, and operation.

3.11 CLEANING

- A. Clean and disinfect potable domestic water piping as follows:
1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
 2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:
 - a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
 - b. Fill and isolate system according to either of the following:
 - 1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.
 - 2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.
 - c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
 - d. Repeat procedures if biological examination shows contamination.
 - e. Submit water samples in sterile bottles to authorities having jurisdiction.
- B. Clean non-potable domestic water piping as follows:
1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
 2. Use purging procedures prescribed by authorities having jurisdiction or; if methods are not prescribed, follow procedures described below:
 - a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
 - b. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.

- C. Prepare and submit reports of purging and disinfecting activities. Include copies of water-sample approvals from authorities having jurisdiction.
- D. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

3.12 PIPING SCHEDULE

- A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.
- B. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.
- C. Fitting Option: Extruded-tee connections and brazed joints may be used on aboveground copper tubing.
- D. Under-building-slab, domestic water, building-service piping, 3-inch and smaller, shall be the following:
 - 1. Soft copper tube, ASTM B 88, Type K; wrought-copper, solder-joint fittings; and brazed joints.
- E. Under-building-slab, domestic water, building-service piping, 4-inch to 8-inch, shall be the following:
 - 1. Mechanical-joint, ductile-iron pipe; standard-pattern, mechanical-joint fittings; and mechanical joints.
- F. Under-building-slab, combined domestic water, building-service, and fire-service-main piping, 6-inch to 12-inch, shall be one of the following:
 - 1. Mechanical-joint, ductile-iron pipe; standard pattern, mechanical-joint fittings; and mechanical joints.
 - 2. Push-on-joint, ductile-iron pipe; standard pattern, push-on-joint fittings; and gasketed joints.
 - 3. Plain-end, ductile-iron pipe; grooved-joint, ductile-iron-pipe appurtenances; and grooved joints.
- G. Under-building-slab, domestic water piping, 2-inch and smaller, shall be the following:
 - 1. Soft Hard copper tube, ASTM B 88, Type K; wrought-copper, solder-joint fittings; and brazed joints.
- H. Aboveground domestic water piping, 2-inch and smaller, shall be one of the following:
 - 1. Hard copper tube, ASTM B 88, Type L; wrought-copper, solder-joint fittings; and soldered brazed joints.
 - 2. Hard copper tube, ASTM B 88, Type L; wrought-copper, press-fit fittings; and press-fit joints.
 - 3. Hard copper tube, ASTM B 88, Type L; wrought-copper, grooved end tubing and fittings; and mechanical couplings.
- I. Aboveground domestic water piping, 2-1/2-inch to 4-inch, shall be one of the following:
 - 1. Hard copper tube, ASTM B 88, Type L; wrought-copper, solder-joint fittings; and soldered brazed joints.
 - 2. Hard copper tube, ASTM B 88, Type L; wrought-copper, press-fit fittings; and press-fit joints.
 - 3. Hard copper tube, ASTM B 88, Type L; wrought-copper, grooved end tubing and fittings; and mechanical couplings.

3.13 VALVE SCHEDULE

- A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
 - 1. Shutoff Duty: Use ball valves for piping 2-inch and smaller. Use ball, or gate valves with flanged ends for piping 2-1/2-inch and larger.
 - 2. Throttling Duty: Use ball valves for piping 2-inch and smaller. Use ball valves with flanged ends for piping 2-1/2-inch and larger.
 - 3. Hot-Water Circulation Piping, Balancing Duty: Calibrated Memory-stop balancing valves.
 - 4. Drain Duty: Hose-end drain valves.
- B. Use check valves to maintain correct direction of domestic water flow to and from equipment.
- C. Iron grooved-end valves may be used with grooved-end piping.

END OF SECTION 221116

SECTION 221119 - DOMESTIC WATER PIPING SPECIALTIES

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. Related Sections:
 - 1. Section 220100 Plumbing General Requirements
 - 2. Section 220519 Meters and Gauges for Plumbing Piping
 - 3. Section 220523 General Duty Valves for Plumbing Piping
 - 4. Section 220529 Hangers and Supports for Plumbing Piping and Equipment
 - 5. Section 220553 Identification for Plumbing Piping and Equipment
 - 6. Section 221116 Domestic Water Piping
 - 7. Section 224300 Plumbing Fixtures

1.2 SUMMARY

- A. Section Includes:
 - 1. Vacuum breakers.
 - 2. Backflow preventers.
 - 3. Water pressure-reducing valves.
 - 4. Balancing valves.
 - 5. Temperature-actuated, water mixing valves.
 - 6. Strainers.
 - 7. Hose bibbs.
 - 8. Drain valves.
 - 9. Water-hammer arresters.
 - 10. Air vents.
 - 11. Trap-seal primer valves.
 - 12. Trap-seal primer systems.
 - 13. Trap guards.
 - 14. Specialty valves.
 - 15. Flexible connectors.

1.3 PERFORMANCE REQUIREMENTS

- A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig, unless otherwise indicated.

1.4 SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For domestic water piping specialties.

1. Include diagrams for power, signal, and control wiring.
- C. Field quality-control test reports.
- D. Operation and Maintenance Data: For domestic water piping specialties to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. NSF Compliance:
 1. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9."

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PIPING SPECIALTIES

- A. Potable-water piping and components shall comply with NSF 61 Annex G and NSF 14.

2.2 VACUUM BREAKERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Febco.
 2. Watts.
 3. Conbraco.
- B. Pipe-Applied, Atmospheric-Type Vacuum Breakers:
 1. Standard: ASSE 1001.
 2. Size: 1/4-inch to 3-inch, as required to match connected piping.
 3. Body: Bronze.
 4. Inlet and Outlet Connections: Threaded.
 5. Finish: Chrome plated.
- C. Hose-Connection Vacuum Breakers:
 1. Standard: ASSE 1011.
 2. Body: Bronze, nonremovable, with manual drain.
 3. Outlet Connection: Garden-hose threaded complying with ASME B1.20.7.
 4. Finish: Chrome.

2.3 BACKFLOW PREVENTERS

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

2. Watts.
 3. Conbraco.
- B. Intermediate Atmospheric-Vent Backflow Preventers:
1. Standard: ASSE 1012.
 2. Operation: Continuous-pressure applications.
 3. Size: Refer to Plumbing Drawings.
 4. Body: Bronze.
 5. End Connections: Solder joint.
 6. Finish: Rough bronze.
- C. Reduced-Pressure-Principle Backflow Preventers:
1. Standard: ASSE 1013.
 2. Operation: Continuous-pressure applications.
 3. Pressure Loss: 12 psig maximum, through middle third of flow range.
 4. Size: Refer to Plumbing Drawings.
 5. Body: Bronze for 2-inch and smaller; cast iron with interior lining that complies with AWWA C550 or that is FDA approved for 2-1/2-inch and larger.
 6. End Connections: Threaded for 2-inch and smaller; flanged or grooved for 2-1/2-inch and larger.
 7. Configuration: Designed for horizontal, straight-through flow.
 8. Accessories:
 - a. Valves 2-inch and Smaller: Ball type with threaded ends on inlet and outlet.
 - b. Valves 2-1/2-inch and Larger: Outside-screw and yoke-gate type with flanged ends on inlet and outlet.
 - c. Air-Gap Fitting: ASME A112.1.2, matching backflow-preventer connection.
- D. Double-Check, Backflow-Prevention Assemblies:
1. Standard: ASSE 1015.
 2. Operation: Continuous-pressure applications unless otherwise indicated.
 3. Pressure Loss: 5 psig maximum, through middle third of flow range.
 4. Size: Refer to Plumbing Drawings.
 5. Body: Bronze for 2-inch and smaller; cast iron with interior lining that complies with AWWA C550 or that is FDA approved for 2-1/2-inch and larger.
 6. End Connections: Threaded for 2-inch and smaller; flanged or Grooved for 2-1/2-inch and larger.
 7. Configuration: Designed for horizontal, straight-through flow.
 8. Accessories:
 - a. Valves 2-inch and Smaller: Ball type with threaded ends on inlet and outlet.
 - b. Valves 2-1/2-inch and Larger: Outside-screw and yoke-gate type with flanged ends on inlet and outlet.
- E. Beverage-Dispensing-Equipment Backflow Preventers:
1. Operation: Continuous-pressure applications.
 2. Size: 1/4-inch or 3/8-inch.
 3. Body: Stainless steel.
 4. End Connections: Threaded.
- F. Dual-Check-Valve Backflow Preventers:
1. Standard: ASSE 1024.
 2. Operation: Continuous-pressure applications.
 3. Size: Refer to Plumbing Drawings.
 4. Body: Bronze with union inlet.
- G. Carbonated-Beverage-Dispenser, Dual-Check-Valve Backflow Preventers:

1. Standard: ASSE 1032.
2. Operation: Continuous-pressure applications.
3. Size: 1/4-inch or NPS 3/8-inch.
4. Body: Stainless steel.
5. End Connections: Threaded.

H. Double-Check, Detector-Assembly Backflow Preventers:

1. Standard: ASSE 1048 and is FM Global approved or UL listed.
2. Operation: Continuous-pressure applications.
3. Pressure Loss: 5 psig maximum, through middle third of flow range.
4. Size: Refer to Plumbing Drawings.
5. Body: Cast iron with interior lining that complies with AWWA C550 or that is FDA approved.
6. End Connections: Flanged.
7. Configuration: Designed for horizontal, straight-through flow.
8. Accessories:
 - a. Valves: Outside-screw and yoke-gate type with flanged ends on inlet and outlet.
 - b. Bypass: With displacement-type water meter, shutoff valves, and reduced-pressure backflow preventer.

I. Hose-Connection Backflow Preventers:

1. Operation: Up to 10-foot head of water back pressure.
2. Inlet Size: 1/2-inch or 3/4-inch.
3. Outlet Size: Garden-hose thread complying with ASME B1.20.7.
4. Capacity: At least 3-gpm flow.

J. Backflow-Preventer Test Kits:

1. Description: Factory calibrated, with gages, fittings, hoses, and carrying case with test-procedure instructions.

2.4 WATER PRESSURE-REDUCING VALVES

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

1. Cash Acme.
2. Watts.
3. Conbraco.
4. CLA-VAL Automatic Control Valves.

B. Water Regulators:

1. Standard: ASSE 1003.
2. Pressure Rating: Initial working pressure of 150 psig □
3. Size: Refer to Plumbing Drawings.
4. Body: Bronze for 2-inch and smaller; cast iron for 2-1/2-inch and 3-inch.
5. Valves for Booster Heater Water Supply: Include integral bypass.
6. End Connections: Threaded for 2-inch and smaller; flanged for 2-1/2-inch and 3-inch.

C. Water-Control Valves:

1. Description: Pilot-operated, diaphragm-type, single-seated, main water-control valve.
2. Pressure Rating: Initial working pressure of 150 psig minimum with AWWA C550 or FDA-approved, interior epoxy coating. Include small pilot-control valve, restrictor device, specialty fittings, and sensor piping.
3. Main Valve Body: Cast- or ductile-iron body with AWWA C550 or FDA-approved, interior epoxy coating; or stainless-steel body.

- a. Size: Refer to Plumbing Drawings□
- b. Pattern: Globe Angle-valve design.
- c. Trim: Stainless steel.
4. .
5. End Connections: Threaded for 2-inch and smaller; flanged for 2-1/2-inch and larger.

2.5 BALANCING VALVES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Armstrong International, Inc.
 2. Watts.
 3. ITT Industries; Bell & Gossett Div.
 4. Taco Inc.
 5. Flo Fab Inc.
- B. Copper-Alloy Calibrated Balancing Valves:
 1. Type: Ball Y-pattern globe valve with two readout ports and memory-setting indicator.
 2. Body: Bronze.
 3. Size: Same as connected piping, but not larger than 2-inch.
 4. Accessories: Meter hoses, fittings, valves, differential pressure meter, and carrying case.
- C. Cast-Iron Calibrated Balancing Valves:
 1. Type: Adjustable with Y-pattern globe valve, two readout ports, and memory-setting indicator.
 2. Size: Same as connected piping, but not smaller than 2-1/2-inch.
- D. Accessories: Meter hoses, fittings, valves, differential pressure meter, and carrying case.
- E. Memory-Stop Balancing Valves:
 1. Standard: MSS SP-110 for two-piece, copper-alloy ball valves.
 2. Pressure Rating: 400-psig minimum CWP.
 3. Size: 2-inch or smaller.
 4. Body: Copper alloy.
 5. Port: Standard or full port.
 6. Ball: Chrome-plated brass.
 7. Seats and Seals: Replaceable.
 8. End Connections: Solder joint or threaded.
 9. Handle: Vinyl-covered steel with memory-setting device.

2.6 TEMPERATURE-ACTUATED, WATER MIXING VALVES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Armstrong International, Inc.
 2. Lawler.
 3. Leonard.
 4. Watts.
 5. Symmons.
 6. Powers.
- B. Water-Temperature Limiting Devices:
 1. Standard: ASSE 1017.
 2. Pressure Rating: 125 psig.
 3. Type: Thermostatically controlled, water mixing valve.
 4. Material: Bronze body with corrosion-resistant interior components.

5. Connections: Threaded or union inlets and outlet.
 6. Accessories: Check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.
 7. Tempered-Water Setting: 110 deg F.
 8. Valve Finish: Chrome plated.
- C. Primary, Thermostatic, Water Mixing Valves:
1. Standard: ASSE 1017.
 2. Pressure Rating: 125 psig minimum unless otherwise indicated.
 3. Type: Exposed-mounted, thermostatically controlled, water mixing valve.
 4. Material: Bronze body with corrosion-resistant interior components.
 5. Connections: Threaded or union inlets and outlet.
 6. Accessories: Manual temperature control, check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.
 7. Tempered-Water Setting: 110 deg F.
 8. Valve Finish: Chrome plated.
 9. Piping Finish: Copper.
 10. Cabinet: Factory fabricated, stainless steel, for recessed or surface mounting and with hinged, stainless-steel door.

2.7 STRAINERS FOR DOMESTIC WATER PIPING

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Cash Acme.
 2. Watts.
 3. Conbraco.
 4. CLA-VAL Automatic Control Valves.
- B. Y-Pattern Strainers:
1. Pressure Rating: 125 psig minimum unless otherwise indicated.
 2. Body: Bronze for 2-inch and smaller; cast iron with interior lining that complies with AWWA C550 or that is FDA approved, epoxy coated and for 2-1/2-inch and larger.
 3. End Connections: Threaded for 2-inch and smaller; flanged for 2-1/2-inch and larger.
 4. Screen: Stainless steel with round perforations unless otherwise indicated.
 5. Perforation Size:
 - a. Strainers 2-inch and Smaller: 0.020 inch.
 - b. Strainers 2-1/2-inch to 4-inch: 0.045 inch.
 - c. Strainers 5-inch and Larger: 0.10 inch.
 6. Drain: Factory-installed, hose-end drain valve or Pipe plug.

2.8 HOSE BIBBS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Josam Company.
 2. JR Smith.
 3. Watts.
 4. Woodford.

B. Hose Bibbs:

1. Standard: ASME A112.18.1 for sediment faucets.
2. Body Material: Bronze.
3. Seat: Bronze, replaceable.
4. Supply Connections: ½-inch or ¾-inch threaded or solder-joint inlet.
5. Outlet Connection: Garden-hose thread complying with ASME B1.20.7.
6. Pressure Rating: 125 psig.
7. Vacuum Breaker: Integral or field-installation, non-removable, drainable, hose-connection vacuum breaker complying with ASSE 1011.
8. Finish for Equipment Rooms: Rough bronze, or chrome or nickel plated.
9. Finish for Service Areas: Chrome or nickel plated.
10. Finish for Finished Rooms: Chrome or nickel plated.
11. Operation for Equipment Rooms: Wheel handle □
12. Operation for Service Areas: Wheel handle.
13. Include integral wall flange with each chrome- or nickel-plated hose bibb.
 - a. .

2.9 DRAIN VALVES

A. Ball-Valve-Type, Hose-End Drain Valves:

1. Standard: MSS SP-110 for standard-port, two-piece ball valves.
2. Pressure Rating: 400-psig minimum CWP.
3. Size: 3/4-inch.
4. Body: Copper alloy.
5. Ball: Chrome-plated brass.
6. Seats and Seals: Replaceable.
7. Handle: Vinyl-covered steel.
8. Inlet: Threaded or solder joint.
9. Outlet: Threaded, short nipple with garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

B. Gate-Valve-Type, Hose-End Drain Valves:

1. Standard: MSS SP-80 for gate valves.
2. Pressure Rating: Class 125.
3. Size: 3/4-inch.
4. Body: ASTM B 62 bronze.
5. Inlet: 3/4-inch threaded or solder joint.
6. Outlet: Garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

C. Stop-and-Waste Drain Valves:

1. Standard: MSS SP-110 for ball valves or MSS SP-80 for gate valves.
2. Pressure Rating: 200-psig minimum CWP or Class 125.
3. Size: 3/4-inch.
4. Body: Copper alloy or ASTM B 62 bronze.
5. Drain: 1/8-inch side outlet with cap.

2.10 WATER-HAMMER ARRESTERS

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

1. Josam Company.
2. PPP Inc.
3. Watts.
4. JR Smith.
5. Sioux Chief.

B. Water-Hammer Arresters:

1. Standard: ASSE 1010 or PDI-WH 201.
2. Type: Copper tube with piston.
3. Size: ASSE 1010, Sizes AA and A through F, or PDI-WH 201, Sizes A through F.

2.11 AIR VENTS

A. Bolted-Construction Automatic Air Vents:

1. Body: Bronze.
2. Pressure Rating and Temperature: 125-psig minimum pressure rating at 140 deg F.
3. Float: Replaceable, corrosion-resistant metal.
4. Mechanism and Seat: Stainless steel.
5. Size: 1/2-inch minimum inlet.
6. Inlet and Vent Outlet End Connections: Threaded.

B. Welded-Construction Automatic Air Vents:

1. Body: Stainless steel.
2. Pressure Rating: 150-psig minimum pressure rating.
3. Float: Replaceable, corrosion-resistant metal.
4. Mechanism and Seat: Stainless steel.
5. Size: 3/8-inch minimum inlet.
6. Inlet and Vent Outlet End Connections: Threaded.

2.12 TRAP-SEAL PRIMER DEVICE

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

1. JR Smith.
2. PPP Inc.
3. Watts.
4. Sioux Chief.

B. Supply-Type, Trap-Seal Primer Device:

1. Standard: ASSE 1018.
2. Pressure Rating: 125 psig minimum.
3. Body: Bronze.
4. Inlet and Outlet Connections: 1/2-inch threaded, union, or solder joint.
5. Gravity Drain Outlet Connection: 1/2-inch threaded or solder joint.
6. Finish: Chrome plated, or rough bronze for units used with pipe or tube that is not chrome finished.

- C. Drainage-Type, Trap-Seal Primer Device:
 - 1. Standard: ASSE 1044, lavatory P-trap with 3/8-inch minimum, trap makeup connection.
 - 2. Size: 1-1/4-inch minimum.
 - 3. Material: Chrome-plated, cast brass.

2.13 TRAP-SEAL PRIMER SYSTEMS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. JR Smith.
 - 2. PPP Inc.
 - 3. Watts.
 - 4. Sioux Chief.
- B. Trap-Seal Primer Systems:
 - 1. Standard: ASSE 1044.
 - 2. Piping: 3/4-inch, ASTM B 88, Type L; copper, water tubing.
 - 3. Cabinet: Surface or Recessed-mounted steel box with stainless-steel cover.
 - 4. Electric Controls: 24-hour timer, solenoid valve, and manual switch for 120-V ac power.
 - a. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 - 5. Vacuum Breaker: ASSE 1001.
 - 6. Number Outlets: Four.
 - 7. Size Outlets: 1/2-inch.

2.14 TRAP-GUARDS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Sure Seal.
 - 2. ProSet.
 - 3. JR Smith.
- B. Trap-Guard Device:
 - 1. Standard: ASSE 1072.
 - 2. Commercial grade UV and Ozone resistant ABS plastic housing with EPDM rubber diaphragm and soft rubber sealing gasket.
 - 3. Size: Refer to Plumbing Drawings.

2.15 SPECIALTY VALVES

- A. Comply with requirements for general-duty metal valves in Section 220523.12 "Ball Valves for Plumbing Piping," Section 220523.13 "Butterfly Valves for Plumbing Piping," Section 220523.14 "Check Valves for Plumbing Piping," and Section 220523.15 "Gate Valves for Plumbing Piping."

2.16 FLEXIBLE CONNECTORS

- A. Bronze-Hose Flexible Connectors: Corrugated-bronze tubing with bronze wire-braid covering and ends brazed to inner tubing.
 - 1. Working-Pressure Rating: Minimum 200 psig.
 - 2. End Connections 2-inch and Smaller: Threaded copper pipe or plain-end copper tube.
 - 3. End Connections 2-1/2-inch and Larger: Flanged copper alloy.

- B. Stainless-Steel-Hose Flexible Connectors: Corrugated-stainless-steel tubing with stainless-steel wire-braid covering and ends welded to inner tubing.
 - 1. Working-Pressure Rating: Minimum 200 psig.
 - 2. End Connections 2-inch and Smaller: Threaded steel-pipe nipple.
 - 3. End Connections 2-1/2-inch and Larger: Flanged steel nipple.

2.17 WATER METERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Neptune.
 - 2. Badger.
 - 3. Zenner.
 - 4. Dwyer.

- B. Displacement-Type Water Meters:
 - 1. Description:
 - a. Standard: AWWA C700.
 - b. Pressure Rating: 150-psig working pressure.
 - c. Body Design: Nutating disc; totalization meter.
 - d. Registration: In gallons or cubic feet as required by utility company.
 - e. Case: Bronze.
 - f. End Connections: Threaded.

- C. Turbine-Type Water Meters:
 - 1. Description:
 - a. Standard: AWWA C701.
 - b. Pressure Rating: 150-psig working pressure.
 - c. Body Design: Turbine; totalization meter.
 - d. Registration: In gallons or cubic feet as required by utility company.
 - e. Case: Bronze.
 - f. End Connections for Meters 2-inch and Smaller: Threaded.
 - g. End Connections for Meters 2-1/2-inch and Larger: Flanged.

- D. Compound-Type Water Meters:
 - 1. Description:
 - a. Standard: AWWA C702.
 - b. Pressure Rating: 150-psig working pressure.
 - c. Body Design: With integral mainline and bypass meters; totalization meter.
 - d. Registration: In gallons or cubic feet as required by utility company.

- e. Case: Bronze.
 - f. Pipe Connections: Flanged.
- E. Remote Registration System: Direct-reading type complying with AWWA C706; modified with signal-transmitting assembly, low-voltage connecting wiring, and remote register assembly as required by utility company.
- F. Remote Registration System: Encoder type complying with AWWA C707; modified with signal-transmitting assembly, low-voltage connecting wiring, and remote register assembly as required by utility company.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install backflow preventers in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction.
- 1. Locate backflow preventers in same room as connected equipment or system.
 - 2. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe-to-floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are unacceptable for this application.
 - 3. Do not install bypass piping around backflow preventers.
- B. Install water regulators with inlet and outlet shutoff valves and bypass with memory-stop balancing valve. Install pressure gages on inlet and outlet.
- C. Install water-control valves with inlet and outlet shutoff valves. Install pressure gages on inlet and outlet.
- D. Install balancing valves in locations where they can easily be adjusted.
- E. Install temperature-actuated, water mixing valves with check stops or shutoff valves on inlets and with shutoff valve on outlet.
- 1. Install cabinet-type units recessed in or surface mounted on wall as specified.
- F. Install Y-pattern strainers for water on supply side of each control valve, water pressure-reducing valve and solenoid valve.
- G. Install outlet boxes recessed in wall or surface mounted on wall. Install 2-by-4-inch fire-retardant-treated-wood blocking, wall reinforcement between studs. Comply with requirements for fire-retardant-treated-wood blocking in Section 061000 "Rough Carpentry."
- H. Install water-hammer arresters in water piping according to PDI-WH 201.
- I. Install air vents at high points of water piping.
- J. Install supply-type, trap-seal primer valves with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust valve for proper flow.

- K. Install drainage-type, trap-seal primer valves as lavatory trap with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting.
- L. Install trap-seal primer systems with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust system for proper flow.

3.2 CONNECTIONS

- A. Comply with requirements for ground equipment in Section 260526 "Grounding and Bonding for Electrical Systems."
- B. Fire-retardant-treated-wood blocking is specified in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" for electrical connections.

3.3 LABELING AND IDENTIFYING

- A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:
 - 1. Pressure vacuum breakers.
 - 2. Intermediate atmospheric-vent backflow preventers.
 - 3. Reduced-pressure-principle backflow preventers.
 - 4. Double-check, backflow-prevention assemblies.
 - 5. Carbonated-beverage-machine backflow preventers.
 - 6. Dual-check-valve backflow preventers.
 - 7. Reduced-pressure-detector, fire-protection, backflow-preventer assemblies.
 - 8. Double-check, detector-assembly backflow preventers.
 - 9. Water pressure-reducing valves.
 - 10. Calibrated balancing valves.
 - 11. Primary, thermostatic, water mixing valves.
 - 12. Primary water tempering valves.
 - 13. Supply-type, trap-seal primer valves.
 - 14. Trap-seal primer systems.
- B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.4 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 - 1. Test each pressure vacuum breaker, reduced-pressure-principle backflow preventer, double-check, backflow-prevention assembly and double-check according to authorities having jurisdiction and the device's reference standard.
- B. Domestic water piping specialties will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports.

3.5 ADJUSTING

- A. Set field-adjustable pressure set points of water pressure-reducing valves.
- B. Set field-adjustable flow set points of balancing valves.
- C. Set field-adjustable temperature set points of temperature-actuated, water mixing valves.

END OF SECTION 221119

SECTION 221316 - SANITARY WASTE AND VENT PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Related Sections:
 - 1. Section 220100 Plumbing General Requirements
 - 2. Section 220517 Sleeves and Sleeve Seals for Plumbing Piping
 - 3. Section 220518 Escutcheons for Plumbing Piping
 - 4. Section 220529 Hangers and Supports for Plumbing Piping and Equipment
 - 5. Section 220548 Vibration and Seismic Controls for Plumbing Piping and Equipment
 - 6. Section 220553 Identification for Plumbing Piping and Equipment
 - 7. Section 221313 Facility Sanitary Sewers
 - 8. Section 221319 Sanitary Waste Piping Specialties

1.2 SUMMARY

- A. Section Includes:
 - 1. Hub-and-spigot, cast-iron soil pipe and fittings.
 - 2. Hubless, cast-iron soil pipe and fittings.
 - 3. Copper tube and fittings.
 - 4. Specialty pipe fittings.

1.3 REFERENCES

- A. American Society of Mechanical Engineers:
 - 1. ASME B16.12 - Cast Iron Threaded Drainage Fittings.
 - 2. ASME B16.23 - Cast Copper Alloy Solder Joint Drainage Fitting DWV.
 - 3. ASME B16.26 - Cast Copper Alloy Fittings for Flared Copper Tubes.
 - 4. ASME B16.29 - Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fitting DWV.
- B. ASTM International:
 - 1. ASTM A74 - Standard Specification for Cast Iron Pipe.
 - 2. ASTM A888 - Standard Specification for Cast Iron Pipe.
 - 3. ASTM B32 - Standard Specification for Solder Metal.
 - 4. ASTM B42 - Standard Specification for Seamless Copper Pipe, Standard Sizes.
 - 5. ASTM B43 - Standard Specification for Seamless Red Brass Pipe, Standard Sizes.
 - 6. ASTM B75 - Standard Specification for Seamless Copper Tube.
 - 7. ASTM B88 - Standard Specification for Seamless Copper Water Tube.
 - 8. ASTM B251 - Standard Specification for General Requirements for Wrought Seamless Copper and Copper-Alloy Tube.
 - 9. ASTM B302 - Standard Specification for Threadless Copper Pipe, Standard Sizes.

- C. Cast Iron Soil Pipe Institute:
 - 1. CISPI 301 – Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste and Vent Piping Applications.
 - 2. CISPI 10 - Specification for Coupling for Use in Connection with Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste and Vent Piping Applications.


1.4 ACTION SUBMITTALS

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

1.5 INFORMATIONAL SUBMITTALS

- A. Seismic Qualification Certificates: For waste and vent piping, accessories, and components, from manufacturer.
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - 2. Detailed description of piping anchorage devices on which the certification is based and their installation requirements.
- B. Field quality-control reports.

1.6 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- B. All pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute  and listed by NSF[®] International.

1.7 FIELD CONDITIONS

- A. Interruption of Existing Sanitary Waste Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:
 - 1. Notify Owner Construction Manager no fewer than three days in advance of proposed interruption of sanitary waste service.
 - 2. Do not proceed with interruption of sanitary waste service without Owners written permission.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Components and installation shall be capable of withstanding the following minimum working pressure unless otherwise indicated:
 - 1. Soil, Waste, and Vent Piping: 10-foot head of water.

- B. Seismic Performance: Soil, waste, and vent piping and support and installation shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

2.2 PIPING MATERIALS

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.3 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings: ASTM A 74, Service and Extra Heavy class(es).
- B. Gaskets: ASTM C 564, rubber.
- C. Calking Materials: ASTM B 29, pure lead and oakum or hemp fiber.

2.4 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings: ASTM A 888 or CISPI 301.
- B. CISPI, Hubless-Piping Couplings:
 - 1. Standards: ASTM C 1277 and CISPI 310.
 - 2. Description: Stainless-steel corrugated shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.
- C. Heavy-Duty, Hubless-Piping Couplings:
 - 1. Standards: ASTM C 1277 and ASTM C 1540.
 - 2. Description: Stainless-steel shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

2.5 COPPER TUBE AND FITTINGS

- A. Copper Type DWV Tube: ASTM B 306, drainage tube, drawn temper.
- B. Copper Drainage Fittings: ASME B16.23, cast copper or ASME B16.29, wrought copper, solder-joint fittings.
- C. Hard Copper Tube: ASTM B 88, Type L and Type M, water tube, drawn temper.
- D. Soft Copper Tube: ASTM B 88, Type L, water tube, annealed temper.
- E. Copper Pressure Fittings:
 - 1. Copper Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.
 - 2. Copper Unions: MSS SP-123, copper-alloy, hexagonal-stock body with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.

- F. Copper Flanges: ASME B16.24, Class 150, cast copper with solder-joint end.
 - 1. Flange Gasket Materials: ASME B16.21, full-face, flat, nonmetallic, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
 - 2. Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
- G. Solder: ASTM B 32, lead free with ASTM B 813, water-flushable flux.

2.6 SPECIALTY PIPE FITTINGS

- A. Transition Couplings:
 - 1. General Requirements: Fitting or device for joining piping with small differences in OD's or of different materials. Include end connections same size as and compatible with pipes to be joined.
 - 2. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
 - 3. Unshielded, Nonpressure Transition Couplings:
 - a. Standard: ASTM C 1173.
 - b. Description: Elastomeric, sleeve-type, reducing or transition pattern. Include shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end.
 - c. End Connections: Same size as and compatible with pipes to be joined.
 - d. Sleeve Materials:
 - 1) For Cast-Iron Soil Pipes: ASTM C 564, rubber.
 - 4. Shielded, Nonpressure Transition Couplings:
 - a. Standard: ASTM C 1460.
 - b. Description: Elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.
 - c. End Connections: Same size as and compatible with pipes to be joined.
- B. Dielectric Fittings:
 - 1. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.
 - 2. Dielectric Unions:
 - a. Description:
 - 1) Standard: ASSE 1079.
 - 2) Pressure Rating: 125 psig minimum at 180 deg F.
 - 3) End Connections: Solder-joint copper alloy and threaded ferrous.
 - 3. Dielectric Flanges:
 - a. Description:
 - 1) Standard: ASSE 1079.
 - 2) Factory-fabricated, bolted, companion-flange assembly.
 - 3) Pressure Rating: 125 psig minimum at 180 deg F.
 - 4) End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

4. Dielectric-Flange Insulating Kits:
 - a. Description:
 - 1) Nonconducting materials for field assembly of companion flanges.
 - 2) Pressure Rating: 150 psig.
 - 3) Gasket: Neoprene or phenolic.
 - 4) Bolt Sleeves: Phenolic or polyethylene.
 - 5) Washers: Phenolic with steel backing washers.

5. Dielectric Nipples:
 - a. Description:
 - 1) Standard: IAPMO PS 66.
 - 2) Electroplated steel nipple.
 - 3) Pressure Rating: 300 psig at 225 deg F.
 - 4) End Connections: Male threaded or grooved.
 - 5) Lining: Inert and noncorrosive, propylene.

PART 3 - EXECUTION

3.1 EARTH MOVING

- A. Comply with requirements for excavating, trenching, and backfilling specified in Section 312000 "Earth Moving."

3.2 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems.
 1. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations.
 2. Install piping as indicated unless deviations to layout are approved on coordination drawings.
- B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- E. Install piping to permit valve servicing.
- F. Install piping at indicated slopes.
- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.

- I. Install piping to allow application of insulation.
- J. Install seismic restraints on piping. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- K. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends.
 - 1. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical.
 - 2. Use long-turn, double Y-branch and 1/8-bend fittings if two fixtures are installed back to back or side by side with common drain pipe.
 - a. Straight tees, elbows, and crosses may be used on vent lines.
 - 3. Do not change direction of flow more than 90 degrees.
 - 4. Use proper size of standard increasers and reducers if pipes of different sizes are connected.
 - a. Reducing size of waste piping in direction of flow is prohibited.
- L. Lay buried building waste piping beginning at low point of each system.
 - 1. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream.
 - 2. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements.
 - 3. Maintain swab in piping and pull past each joint as completed.
- M. Install soil and waste and vent piping at the following minimum slopes unless otherwise indicated:
 - 1. Building Sanitary Waste: 2 percent downward in direction of flow for piping 2 1/2-inch and smaller; 1 percent downward in direction of flow for piping 3-inch and larger.
 - 2. Horizontal Sanitary Waste Piping: 1 percent downward in direction of flow.
 - 3. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.
 - 4. Grease Waste Piping: 2 percent downward in direction of flow.
- N. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
 - 1. Install encasement on underground piping according to ASTM A 674 or AWWA C105/A 21.5.
- O. Install aboveground copper tubing according to CDA's "Copper Tube Handbook."
- P. Install engineered soil and waste and vent piping systems as follows:
 - 1. Combination Waste and Vent: Comply with standards of authorities having jurisdiction.
 - 2. Hubless, Single-Stack Drainage System: Comply with ASME B16.45 and hubless, single-stack aerator fitting manufacturer's written installation instructions.
 - 3. Reduced-Size Venting: Comply with standards of authorities having jurisdiction.
- Q. Plumbing Specialties:
 - 1. Install backwater valves in sanitary waster gravity-flow piping.

- a. Comply with requirements for backwater valves specified in Section 221319 "Sanitary Waste Piping Specialties."
2. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers in sanitary waste gravity-flow piping.
 - a. Install cleanout fitting with closure plug inside the building in sanitary drainage force-main piping.
 - b. Comply with requirements for cleanouts specified in Section 221319 "Sanitary Waste Piping Specialties."
3. Install drains in sanitary waste gravity-flow piping.
 - a. Comply with requirements for drains specified in Section 221319 "Sanitary Waste Piping Specialties."
- R. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
- S. Install sleeves for piping penetrations of walls, ceilings, and floors.
 1. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
- T. Install sleeve seals for piping penetrations of concrete walls and slabs.
 1. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
- U. Install escutcheons for piping penetrations of walls, ceilings, and floors.
 1. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

3.3 JOINT CONSTRUCTION

- A. Join hub-and-spigot, cast-iron soil piping with gasket joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.
- B. Join hub-and-spigot, cast-iron soil piping with calked joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for lead-and-oakum calked joints.
- C. Join hubless, cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-piping coupling joints.
- D. Join copper tube and fittings with soldered joints according to ASTM B 828. Use ASTM B 813, water-flushable, lead-free flux and ASTM B 32, lead-free-alloy solder.
- E. Grooved Joints: Cut groove ends of pipe according to AWWA C606. Lubricate and install gasket over ends of pipes or pipe and fitting. Install coupling housing sections, over gasket, with keys seated in piping grooves. Install and tighten housing bolts.

- F. Flanged Joints: Align bolt holes. Select appropriate gasket material, size, type, and thickness. Install gasket concentrically positioned. Use suitable lubricants on bolt threads. Torque bolts in cross pattern.

3.4 SPECIALTY PIPE FITTING INSTALLATION

A. Transition Couplings:

1. Install transition couplings at joints of piping with small differences in ODs.
2. In Waste Drainage Piping: Shielded, nonpressure transition couplings.
3. In Aboveground Force Main Piping: Fitting-type transition couplings.
4. In Underground Force Main Piping:
 - a. 1-1/2-inch and Smaller: Fitting-type transition couplings.
 - b. 2-inch and Larger: Pressure transition couplings.

B. Dielectric Fittings:

1. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
2. Dielectric Fittings for 2-inch and Smaller: Use dielectric nipples or unions.
3. Dielectric Fittings for 2-1/2-inch to 4-inch: Use dielectric flanges flange kits or nipples.
4. Dielectric Fittings for 6-inch and Larger: Use dielectric flange kits.

3.5 VALVE INSTALLATION

- A. Comply with requirements in Section 220523.12 "Ball Valves for Plumbing Piping," Section 220523.13 "Butterfly Valves for Plumbing Piping," Section 220523.14 "Check Valves for Plumbing Piping," and Section 220523.15 "Gate Valves for Plumbing Piping" for general-duty valve installation requirements.

B. Shutoff Valves:

1. Install shutoff valve on each sewage pump discharge.
2. Install gate or full-port ball valve for piping 2-inch and smaller.
3. Install gate valve for piping 2-1/2-inch and larger.

- C. Check Valves: Install swing check valve, between pump and shutoff valve, on each sewage pump discharge.

D. Backwater Valves: Install backwater valves in piping subject to backflow.

1. Horizontal Piping: Horizontal backwater valves, use normally closed type unless otherwise indicated.
2. Floor Drains: Drain outlet backwater valves unless drain has integral backwater valve.
3. Install backwater valves in accessible locations.
4. Comply with requirements for backwater valve specified in Section 221319 "Sanitary Waste Piping Specialties."

3.6 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

- B. Comply with requirements for pipe hanger and support devices and installation specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment. "Also Section 220548.13 "Vibration Controls for Plumbing Piping and Equipment."
1. Install carbon-steel pipe hangers for horizontal piping in noncorrosive environments.
 2. Install carbon-steel pipe support clamps for vertical piping in noncorrosive environments.
 3. Install stainless-steel pipe support clamps for vertical piping in corrosive environments.
 4. Vertical Piping: MSS Type 8 or Type 42, clamps.
 5. Install individual, straight, horizontal piping runs:
 - a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
 - b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
 - c. Longer Than 100 Feet if Indicated: MSS Type 49, spring cushion rolls.
 6. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
 7. Base of Vertical Piping: MSS Type 52, spring hangers.
- C. Support horizontal piping and tubing within 12 inches of each fitting, valve, and coupling.
- D. Support vertical piping and tubing at base and at each floor.
- E. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch minimum rods.
- F. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:
1. 1-1/2 and 2-inch: 60 inches with 3/8-inch rod.
 2. 3-inch: 60 inches with 1/2-inch rod.
 3. 4 and 5-inch: 60 inches with 5/8-inch rod.
 4. 6 and 8-inch: 60 inches with 3/4-inch rod.
 5. 10 and 12-inch: 60 inches with 7/8-inch rod.
 6. Spacing for 10-foot lengths may be increased to 10 feet. Spacing for fittings is limited to 60 inches.
- G. Install supports for vertical cast-iron soil piping every 15 feet.
- H. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
1. 1-1/4-inch: 72 inches with 3/8-inch rod.
 2. 1-1/2 and 2-inch: 96 inches with 3/8-inch rod.
 3. 2-1/2-inch: 108 inches with 1/2-inch rod.
 4. 3 to 5-inch: 10 feet with 1/2-inch rod.
 5. 6-inch: 10 feet with 5/8-inch rod.
 6. 8-inch: 10 feet with 3/4-inch rod.
- I. Install supports for vertical copper tubing every 10 feet.
- J. Support piping and tubing not listed above according to MSS SP-58 and manufacturer's written instructions.

3.7 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.
- C. Connect waste and vent piping to the following:
 - 1. Plumbing Fixtures: Connect waste piping in sizes indicated, but not smaller than required by plumbing code.
 - 2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
 - 3. Plumbing Specialties: Connect waste and vent piping in sizes indicated, but not smaller than required by plumbing code.
 - 4. Install test tees (wall cleanouts) in conductors near floor and floor cleanouts with cover flush with floor.
 - 5. Install horizontal backwater valves with cleanout cover flush with floor.
 - 6. Comply with requirements for backwater valves, cleanouts and drains specified in Section 221319 "Sanitary Waste Piping Specialties."
 - 7. Equipment: Connect waste piping as indicated.
 - a. Provide shutoff valve if indicated and union for each connection.
 - b. Use flanges instead of unions for connections 2-1/2-inch and larger.
- D. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.
- E. Make connections according to the following unless otherwise indicated:
 - 1. Install unions, in piping 2-inch and smaller, adjacent to each valve and at final connection to each piece of equipment.
 - 2. Install flanges, in piping 2-1/2-inch and larger, adjacent to flanged valves and at final connection to each piece of equipment.

3.8 IDENTIFICATION

- A. Identify exposed sanitary waste and vent piping.
- B. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.9 FIELD QUALITY CONTROL

- A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
 - 1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
 - 2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

- B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
- C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- D. Test sanitary waste and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
 - 1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired.
 - a. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
 - 2. Leave uncovered and unconcealed new, altered, extended, or replaced waste and vent piping until it has been tested and approved.
 - a. Expose work that was covered or concealed before it was tested.
 - 3. Roughing-in Plumbing Test Procedure: Test waste and vent piping except outside leaders on completion of roughing-in.
 - a. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water.
 - b. From 15 minutes before inspection starts to completion of inspection, water level must not drop.
 - c. Inspect joints for leaks.
 - 4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight.
 - a. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch wg.
 - b. Use U-tube or manometer inserted in trap of water closet to measure this pressure.
 - c. Air pressure must remain constant without introducing additional air throughout period of inspection.
 - d. Inspect plumbing fixture connections for gas and water leaks.
 - 5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
 - 6. Prepare reports for tests and required corrective action.

3.10 CLEANING AND PROTECTION

- A. Clean interior of piping. Remove dirt and debris as work progresses.
- B. Protect sanitary waste and vent piping during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- C. Place plugs in ends of uncompleted piping at end of day and when work stops.
- D. Repair damage to adjacent materials caused by waste and vent piping installation.

3.11 PIPING SCHEDULE

- A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.
- B. Aboveground, soil, waste and grease waste piping 4-inch and smaller shall be any of the following:
 - 1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
 - 2. Hubless, cast-iron soil pipe and fittings; CISPI heavy-duty hubless-piping couplings; and coupled joints.
 - 3. Copper Type DWV tube, copper drainage fittings, and soldered joints.
 - 4. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.
- C. Aboveground, soil, waste and grease waste piping 5-inch and larger shall be any of the following:
 - 1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
 - 2. Hubless, cast-iron soil pipe and fittings; CISPI heavy-duty hubless-piping couplings; and coupled joints.
 - 3. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.
- D. Aboveground, vent piping 4-inch and smaller shall be any of the following:
 - 1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
 - 2. Hubless, cast-iron soil pipe and fittings; CISPI heavy-duty hubless-piping couplings; and coupled joints.
 - 3. Copper Type DWV tube, copper drainage fittings, and soldered joints.
 - a. Option for Vent Piping, 2-1/2-inch and 4-inch: Hard copper tube, Type M; copper pressure fittings; and soldered joints.
 - 4. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.
- E. Aboveground, vent piping 5-inch and larger shall be any of the following:
 - 1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
 - 2. Hubless, cast-iron soil pipe and fittings; CISPI heavy-duty hubless-piping couplings; and coupled joints.
 - 3. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.
- F. Underground, soil, waste, and vent piping 4-inch and smaller shall be any of the following:
 - 1. Service Extra Heavy class, cast-iron soil piping; gaskets; and gasketed calking materials;
 - 2. Hubless, cast-iron soil pipe and fittings; CISPI heavy-duty cast-iron hubless-piping couplings; and coupled joints.
 - 3. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.
- G. Underground, Grease waste piping 5-inch and larger shall be any of the following:
 - 1. Service Extra Heavy class, cast-iron soil piping; gaskets; and gasketed joints.
 - 2. Dissimilar Pipe-Material Couplings: shielded, nonpressure transition couplings.
- H. Underground Grease waste piping 4-inch and smaller shall be any of the following:
 - 1. Service Extra Heavy class, cast-iron soil piping; gaskets; and gasketed calking materials;

2. Hubless, cast-iron soil pipe and fittings; CISPI heavy-duty cast-iron hubless-piping couplings; and coupled joints.
3. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.

END OF SECTION 221316

SECTION 221319 - SANITARY WASTE PIPING SPECIALTIES

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. Backwater valves.
 - 2. Cleanouts.
 - 3. Air-admittance valves.
 - 4. Roof flashing assemblies.
 - 5. Through-penetration firestop assemblies.
 - 6. Miscellaneous sanitary drainage piping specialties.

PART 2 - PRODUCTS

2.1 BACKWATER VALVES

- A. Horizontal, Cast-Iron Backwater Valves:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Jay R. Smith Mfg. Co.
 - b. Josam Company.
 - c. MIFAB, Inc.
 - d. Tyler Pipe; a subsidiary of McWane Inc.
 - e. WATTS.
 - 2. Standard: ASME A112.14.1.
 - 3. Size: Same as connected piping.
 - 4. Body: Cast iron.
 - 5. Cover: Cast iron with bolted or threaded access check valve.
 - 6. End Connections: Hub and spigot Hub and spigot or hubless.
 - 7. Type Check Valve: Removable, bronze, swing check, factory assembled or field modified to hang closed.
 - 8. Extension: ASTM A 74, Service class; full-size, cast-iron, soil-pipe extension to field-installed cleanout at floor; replaces backwater valve cover.

2.2 CLEANOUTS

A. Cast-Iron Exposed Cleanouts:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Jay R. Smith Mfg. Co.
 - b. Josam Company.
 - c. MIFAB, Inc.
 - d. Tyler Pipe; a subsidiary of McWane Inc.
 - e. WATTS.
2. Standard: ASME A112.36.2M.
3. Size: Same as connected drainage piping
4. Body Material: Hub-and-spigot, cast-iron soil pipe T-branch or Hubless, cast-iron soil pipe test tee as required to match connected piping.
5. Closure: Countersunk or raised-head, brass plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.

B. Cast-Iron Exposed Floor Cleanouts:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Jay R. Smith Mfg. Co.
 - b. Josam Company.
 - c. Oatey.
 - d. Sioux Chief Manufacturing Company, Inc.
 - e. Tyler Pipe; a subsidiary of McWane Inc.
 - f. WATTS.
2. Standard: ASME A112.36.2M for heavy-duty, adjustable housing cleanout.
3. Size: Same as connected branch.
4. Type: Heavy-duty, adjustable housing.
5. Body or Ferrule: Cast iron.
6. Clamping Device: Not required.
7. Outlet Connection: Inside calk or Spigot.
8. Closure: Brass plug with straight threads and gasket or Brass plug with taper.
9. Adjustable Housing Material: Cast iron with setscrews or another device.
10. Frame and Cover Material and Finish: Nickel-bronze, copper alloy.
11. Frame and Cover Shape: Round.
12. Top Loading Classification: Heavy Duty.
13. Riser: ASTM A 74, Service class, cast-iron drainage pipe fitting and riser to cleanout.

2.3 AIR-ADMITTANCE VALVES

A. Fixture Air-Admittance Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Ayrlett, LLC.

- b. Durgo, Inc.
 - c. Oatey.
 - d. ProSet Systems Inc.
 - e. RectorSeal.
 - f. Studor, Inc.
2. Standard: ASSE 1051, Type A for single fixture or Type B for branch piping.
 3. Housing: Plastic.
 4. Operation: Mechanical sealing diaphragm.
 5. Size: Same as connected fixture or branch vent piping.

2.4 ROOF FLASHING ASSEMBLIES

A. Roof Flashing Assemblies:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Acorn Engineering Company.
 - b. Thaler Metal Industries Ltd.
2. Description: Manufactured assembly made of 4.0-lb/sq. ft., 0.0625-inch-thick, lead flashing collar and skirt extending at least 6 inches from pipe, with galvanized-steel boot reinforcement and counterflashing fitting.
 - a. Open-Top Vent Cap: Without cap.
 - b. Low-Silhouette Vent Cap: With vandal-proof vent cap.
 - c. Extended Vent Cap: With field-installed, vandal-proof vent cap.

2.5 THROUGH-PENETRATION FIRESTOP ASSEMBLIES

A. Through-Penetration Firestop Assemblies:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. ProSet Systems Inc.
2. Standard: UL 1479 assembly of sleeve-and-stack fitting with firestopping plug.
3. Size: Same as connected soil, waste, or vent stack.
4. Sleeve: Molded-PVC plastic, of length to match slab thickness and with integral nailing flange on one end for installation in cast-in-place concrete slabs.
5. Stack Fitting: ASTM A 48/A 48M, gray-iron, hubless-pattern wye branch with neoprene O-ring at base and gray-iron plug in thermal-release harness. Include PVC protective cap for plug.
6. Special Coating: Corrosion resistant on interior of fittings.

2.6 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

A. Open Drains:

1. Description: Shop or field fabricate from ASTM A 74, Service class, hub-and-spigot, cast-iron soil-pipe fittings. Include P-trap, hub-and-spigot riser section; and where required, increaser fitting joined with ASTM C 564 rubber gaskets.
 2. Size: Same as connected waste piping with increaser fitting of size indicated.
- B. Floor-Drain, Trap-Seal Primer Fittings:
1. Description: Cast iron, with threaded inlet and threaded or spigot outlet, and trap-seal primer valve connection.
 2. Size: Same as floor drain outlet with NPS 1/2 side inlet.
- C. Air-Gap Fittings:
1. Standard: ASME A112.1.2, for fitting designed to ensure fixed, positive air gap between installed inlet and outlet piping.
 2. Body: Bronze or cast iron.
 3. Inlet: Opening in top of body.
 4. Outlet: Larger than inlet.
 5. Size: Same as connected waste piping and with inlet large enough for associated indirect waste piping.
- D. Sleeve Flashing Device:
1. Description: Manufactured, cast-iron fitting, with clamping device that forms sleeve for pipe floor penetrations of floor membrane. Include galvanized-steel pipe extension in top of fitting that will extend 1 inch above finished floor and galvanized-steel pipe extension in bottom of fitting that will extend through floor slab.
 2. Size: As required for close fit to riser or stack piping.
- E. Expansion Joints:
1. Standard: ASME A112.6.4.
 2. Body: Cast iron with bronze sleeve, packing, and gland.
 3. End Connections: Matching connected piping.
 4. Size: Same as connected soil, waste, or vent piping.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install backwater valves in building drain piping.
1. For interior installation, provide cleanout deck plate flush with floor and centered over backwater valve cover, and of adequate size to remove valve cover for servicing.
- B. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:
1. Size same as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
 2. Locate at each change in direction of piping greater than 45 degrees.

3. Locate at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
 4. Locate at base of each vertical soil and waste stack.
- C. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.
- D. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.
- E. Install fixture air-admittance valves on fixture drain piping.
- F. Install stack air-admittance valves at top of stack vent and vent stack piping.
- G. Install roof flashing assemblies on sanitary stack vents and vent stacks that extend through roof. Comply with requirements in Section 076200 "Sheet Metal Flashing and Trim."
- H. Install flashing fittings on sanitary stack vents and vent stacks that extend through roof. Comply with requirements in Section 076200 "Sheet Metal Flashing and Trim."
- I. Install through-penetration firestop assemblies in steel conductors and stacks at floor penetrations.
1. Comply with requirements in Section 078413 "Penetration Firestopping."
- J. Assemble open drain fittings and install with top of hub 2 inches above floor.
- K. Install deep-seal traps on floor drains and other waste outlets, if indicated.
- L. Install floor-drain, trap-seal primer fittings on inlet to floor drains that require trap-seal primer connection.
1. Exception: Fitting may be omitted if trap has trap-seal primer connection.
 2. Size: Same as floor drain inlet.
- M. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.
- N. Install sleeve and sleeve seals with each riser and stack passing through floors with waterproof membrane.
- O. Install vent caps on each vent pipe passing through roof.
- P. Install expansion joints on vertical stacks and conductors. Position expansion joints for easy access and maintenance.
- Q. Install wood-blocking reinforcement for wall-mounting-type specialties.
- R. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.

3.2 CONNECTIONS

- A. Comply with requirements in Section 221316 "Sanitary Waste and Vent Piping" for piping installation requirements. Drawings indicate general arrangement of piping, fittings, and specialties.

- B. Install piping adjacent to equipment to allow service and maintenance.
- C. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
- D. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.3 FLASHING INSTALLATION

- A. Comply with requirements in Section 076200 "Sheet Metal Flashing and Trim."
- B. Fabricate flashing from single piece unless large pans, sumps, or other drainage shapes are required.
- C. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.
 - 1. Pipe Flashing: Sleeve type, matching pipe size, with minimum length of 10 inches, and skirt or flange extending at least 8 inches around pipe.
 - 2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches around sleeve.
 - 3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches around specialty.
- D. Set flashing on floors and roofs in solid coating of bituminous cement.
- E. Secure flashing into sleeve and specialty clamping ring or device.
- F. Install flashing for piping passing through roofs with counterflashing or commercially made flashing fittings, according to Section 076200 "Sheet Metal Flashing and Trim."
- G. Extend flashing up vent pipe passing through roofs and turn down into pipe, or secure flashing into cast-iron sleeve having calking recess.

3.4 LABELING AND IDENTIFYING

- 1. Nameplates and signs are specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.5 FIELD QUALITY CONTROL

- A. Tests and Inspections:
 - 1. Leak Test: After installation, charge system 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.

3.6 PROTECTION

- A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.

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SUNY PURCHASE HUB - CAFE RENOVATION
PHASE ZERO DESIGN PROJECT #1518416

- B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION 221319

SECTION 221433 - SODA MACHINE PIPING CONDUIT

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. Nonmetal conduit, tubing and fittings.

1.3 ACTION SUBMITTALS

- A. Product Data: For surface Conduit and fittings.
- B. Shop Drawings: For custom pathway of conduits from soda machine equipment to soda bottle filling area. Include plans, elevations, sections, and attachment details.

1.4 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 electrical items and architectural features in paths of conduit groups with common supports.
 - 3. Coordinate final locations with Food Service vending contractor of equipment locations and storage bottle locations.

PART 2 - PRODUCTS

2.1 NONMETALLIC CONDUITS, TUBING, AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. AFC Cable Systems; a part of Atkore International.
 - 2. RACO; Hubbell.
 - 3. Thomas & Betts Corporation; A Member of the ABB Group.
- B. RNC: Type EPC-40-PVC, complying with NEMA TC 2 and UL 651 unless otherwise indicated.
- C. Fittings for RNC: Comply with NEMA TC 3; match to conduit or tubing type and material.

- D. Solvents and Adhesives: As recommended by conduit manufacturer.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

- A. Indoors: Apply raceway products as specified below unless otherwise indicated:
1. Exposed Conduit: Type EPC-40-PVC.
 2. Concealed Conduit, Aboveground: Type EPC-40-PVC.
 3. Underground Conduit: Type EPC-40-PVC, Type EPC-80-PVC, direct buried, concrete encased.
 - a. Loading dock.
 - b. Corridors used for traffic.
 - c. Mechanical rooms.
 4. Concealed in Ceilings and Interior Walls and Partitions: Type EPC-40-PVC.
- B. Minimum Raceway Size: 6-inch trade size.

3.2 INSTALLATION

- A. Keep conduit at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
- B. Complete raceway installation before starting conductor installation.
- C. Comply with requirements in Section "Hangers and Supports for Plumbing Systems" for hangers and supports.
- D. Arrange stub-ups so curved portions of bends are not visible above finished slab.
- E. Conceal PVC conduit within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
- F. Support conduit within 12 inches of enclosures to which attached.
- G. Stub-ups to Above Recessed Ceilings:
1. Use PVC stub up minimum 12 inches above floor. Coordinate with soda vender.
- H. Install pull tag line in empty conduit. 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 tag line.
- I. Comply with manufacturer's written instructions for solvent welding PVC pipe and fittings.

3.3 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR PVC CONDUIT PENETRATIONS

- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section "Sleeves and Sleeve Seals for PLUMBING PIPING."

3.4 FIRESTOPPING

- A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Section "Penetration Firestopping."

END OF SECTION 221433

SECTION 224300 - PLUMBING FIXTURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following conventional plumbing fixtures and related components:
 - 1. Service basins.
 - 2. Owner-furnished fixtures.
- B. Related Sections include the following:
 - 1. Division 22 Section "Domestic Water Piping Specialties" for backflow preventers, floor drains, and specialty fixtures not included in this Section.
 - 2. Division 22 Section "Emergency Plumbing Fixtures."

1.3 DEFINITIONS

- A. Accessible Fixture: Plumbing fixture that can be approached, entered, and used by people with disabilities.
- B. Cast Polymer: Cast-filled-polymer-plastic material. This material includes cultured-marble and solid-surface materials.
- C. Cultured Marble: Cast-filled-polymer-plastic material with surface coating.
- D. Fitting: Device that controls the flow of water into or out of the plumbing fixture. Fittings specified in this Section include supplies and stops, faucets and spouts, shower heads and tub spouts, drains and tailpieces, and traps and waste pipes. Piping and general-duty valves are included where indicated.
- E. Solid Surface: Nonporous, homogeneous, cast-polymer-plastic material with heat-, impact-, scratch-, and stain-resistance qualities.

1.4 SUBMITTALS

- A. Product Data: For each type of plumbing fixture indicated. Include selected fixture and trim, fittings, accessories, appliances, appurtenances, equipment, and supports. Indicate materials and finishes, dimensions, construction details, and flow-control rates.

- B. Shop Drawings: Diagram power, signal, and control wiring.
- C. Operation and Maintenance Data: For plumbing fixtures to include in emergency, operation, and maintenance manuals.
- D. Warranty: Special warranty specified in this Section.

1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain plumbing fixtures, faucets, and other components of each category through one source from a single manufacturer.
 - 1. Exception: If fixtures, faucets, or other components are not available from a single manufacturer, obtain similar products from other manufacturers specified for that category.
- B. Regulatory Requirements: Comply with requirements in ICC A117.1, "Accessible and Usable Buildings and Facilities"; Public Law 90-480, "Architectural Barriers Act"; and Public Law 101-336, "Americans with Disabilities Act"; for plumbing fixtures for people with disabilities.
- C. Regulatory Requirements: Comply with requirements in Public Law 102-486, "Energy Policy Act," about water flow and consumption rates for plumbing fixtures.
- D. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.
- E. Comply with the following applicable standards and other requirements specified for plumbing fixtures:
 - 1. Plastic Mop-Service Basins: ANSI Z124.6.
- F. Comply with the following applicable standards and other requirements specified for miscellaneous fittings:
 - 1. Atmospheric Vacuum Breakers: ASSE 1001.
 - 2. Brass and Copper Supplies: ASME A112.18.1.

1.6 WARRANTY

- A. Special Warranties: Manufacturer's standard form in which manufacturer agrees to repair or replace components of whirlpools that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures of unit shell.
 - b. Faulty operation of controls, blowers, pumps, heaters, and timers.
 - c. Deterioration of metals, metal finishes, and other materials beyond normal use.
 - 2. Warranty Period for Commercial Applications: One year(s) from date of Substantial Completion.

1.7 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Faucet Washers and O-Rings: Equal to 10 percent of amount of each type and size installed.
 - 2. Faucet Cartridges and O-Rings: Equal to 5 percent of amount of each type and size installed.

1.8 SERVICE BASINS

- A. Service Basins:
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Acorn Engineering Company.
 - b. Crane Plumbing, L.L.C./Fiat Products.
 - c. Precast Terrazzo Enterprises, Inc.
 - d. Stern-Williams Co., Inc.
 - e. Florestone Products Co., Inc.
 - f. Mustee, E. L. & Sons, Inc.
 - 2. Description: Flush-to-wall, floor-mounting, precast terrazzo fixture with rim guard.
 - a. Shape: Square.
 - b. Size: 36 by 36 inches.
 - c. Height: 10 inches with dropped front.
 - d. Tiling Flange: Not required.
 - e. Rim Guard: On all top surfaces.
 - f. Color: Not applicable.
 - g. Faucet: with integral vacuum breaker.
 - h. Drain: Grid with NPS 3 outlet.

PART 2 - EXECUTION

2.1 EXAMINATION

- A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before plumbing fixture installation.
- B. Examine cabinets, counters, floors, and walls for suitable conditions where fixtures will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

2.2 INSTALLATION

- A. Assemble plumbing fixtures, trim, fittings, and other components according to manufacturers' written instructions.
- B. Install fixtures level and plumb according to roughing-in drawings.

- C. Install water-supply piping with stop on each supply to each fixture to be connected to water distribution piping. Attach supplies to supports or substrate within pipe spaces behind fixtures. Install stops in locations where they can be easily reached for operation.
 - 1. Exception: Use ball, gate, or globe valves if supply stops are not specified with fixture. Valves are specified in Division 22 Section "General-Duty Valves for Plumbing Piping."
- D. Install traps on fixture outlets.
 - 1. Exception: Omit trap on fixtures with integral traps.
 - 2. Exception: Omit trap on indirect wastes, unless otherwise indicated.
- E. Install escutcheons at piping wall ceiling penetrations in exposed, finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding fittings. Escutcheons are specified in Division 22 Section "Escutcheons for Plumbing Piping."
- F. Seal joints between fixtures and walls, floors, and countertops using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Sealants are specified in Division 07 Section "Joint Sealants."

2.3 CONNECTIONS

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

2.4 CONTROL

- A. Verify that installed plumbing fixtures are categories and types specified for locations where installed.
- B. Check that plumbing fixtures are complete with trim, faucets, fittings, and other specified components.
- C. Inspect installed plumbing fixtures for damage. Replace damaged fixtures and components.
- D. Test installed fixtures after water systems are pressurized for proper operation. Replace malfunctioning fixtures and components, then retest. Repeat procedure until units operate properly.

2.5 ADJUSTING

- A. Operate and adjust faucets and controls. Replace damaged and malfunctioning fixtures, fittings, and controls.
- B. Replace washers and seals of leaking and dripping faucets and stops.

2.6 CLEANING

- A. Clean fixtures, faucets, and other fittings with manufacturers' recommended cleaning methods and materials. Do the following:

1. Remove faucet spouts and strainers, remove sediment and debris, and reinstall strainers and spouts.
 2. Remove sediment and debris from drains.
- B. After completing installation of exposed, factory-finished fixtures, faucets, and fittings, inspect exposed finishes and repair damaged finishes.

2.7 PROTECTION

- A. Provide protective covering for installed fixtures and fittings.
- B. Do not allow use of plumbing fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION 224000

SECTION 224500 - EMERGENCY PLUMBING FIXTURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Eyewash equipment.
 - 2. Water-tempering equipment.

1.3 DEFINITIONS

- A. Accessible Fixture: Emergency plumbing fixture that can be approached, entered, and used by people with disabilities.
- B. Plumbed Emergency Plumbing Fixture: Fixture with fixed, potable-water supply.
- C. Self-Contained Emergency Plumbing Fixture: Fixture with flushing-fluid-solution supply.
- D. Tepid: Moderately warm.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated. Include flow rates and capacities, furnished specialties, and accessories.
- B. Product Certificates: Submit certificates of performance testing specified in "Source Quality Control" Article.
- C. Field quality-control test reports.
- D. Operation and Maintenance Data: For emergency plumbing fixtures to include in operation and maintenance manuals.

1.5 QUALITY ASSURANCE

- A. ANSI Standard: Comply with ANSI Z358.1, "Emergency Eyewash and Shower Equipment."
- B. NSF Standard: Comply with NSF 61, "Drinking Water System Components - Health Effects," for fixture materials that will be in contact with potable water.

- C. Regulatory Requirements: Comply with requirements in ICC/ANSI A117.1, "Accessible and Usable Buildings and Facilities"; Public Law 90-480, "Architectural Barriers Act"; and Public Law 101-336, "Americans with Disabilities Act"; for plumbing fixtures for people with disabilities.

PART 2 - PRODUCTS

2.1 EMERGENCY

A. Wall-Mounted, Plumbed Drench Hoses:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Acorn Safety; a division of Acorn Engineering Company.
 - b. Bradley Corporation.
 - c. Guardian Equipment Co.
 - d. Haws Corporation.
 - e. Speakman Company.
2. Capacity: Not less than 3.0 gpm for at least 15 minutes.
3. Supply Fitting: NPS 1/2 brass with flow regulator.
4. Drench Hose: Hand-held spray head with squeeze-handle actuation and hose.
5. Mounting: Wall bracket.

2.2 WATER-TEMPERING EQUIPMENT

A. Hot- and Cold-Water, Water-Tempering Equipment:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Acorn Safety; a division of Acorn Engineering Company.
 - b. Bradley Corporation.
 - c. Guardian Equipment Co.
 - d. Haws Corporation.
 - e. Lawler Manufacturing Co., Inc.
 - f. Leonard Valve Company.
 - g. Powers; a division of Watts Water Technologies, Inc.
 - h. Speakman Company.
2. Description: Factory-fabricated equipment with thermostatic mixing valve.
 - a. Thermostatic Mixing Valve: Designed to provide 85 deg F tepid, potable water at emergency plumbing fixtures, to maintain temperature at plus or minus 5 deg F throughout required 15-minute test period, and in case of unit failure to continue cold-water flow, with union connections, controls, metal piping, and corrosion-resistant enclosure.
 - b. Supply Connections: For hot and cold water.

2.3 SOURCE QUALITY CONTROL

- A. Certify performance of emergency plumbing fixtures by independent testing organization acceptable to authorities having jurisdiction.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in for water piping systems to verify actual locations of piping connections before plumbed emergency plumbing fixture installation.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 EMERGENCY PLUMBING FIXTURE INSTALLATION

- A. Assemble emergency plumbing fixture piping, fittings, control valves, and other components.
- B. Install fixtures level and plumb.
- C. Fasten fixtures to substrate.
- D. Install shutoff valves in water-supply piping to fixtures. Use ball, gate, or globe valve if specific type valve is not indicated. Install valves chained or locked in open position if permitted. Install valves in locations where they can easily be reached for operation. Comply with requirements for valves specified in Division 22 Section "General-Duty Valves for Plumbing Piping."
 - 1. Exception: Omit shutoff valve on supply to group of plumbing fixtures that includes emergency equipment.
 - 2. Exception: Omit shutoff valve on supply to emergency equipment if prohibited by authorities having jurisdiction.
- E. Install dielectric fitting in supply piping to emergency equipment if piping and equipment connections are made of different metals. Comply with requirements for dielectric fittings specified in Division 22 Section "Domestic Water Piping."
- F. Install thermometers in supply and outlet piping connections to water-tempering equipment. Comply with requirements for thermometers specified in Division 22 Section "Meters and Gages for Plumbing Piping."
- G. Install escutcheons on piping wall and ceiling penetrations in exposed, finished locations. Comply with requirements for escutcheons specified in Division 22 Section "Escutcheons for Plumbing Piping."

3.3 CONNECTIONS

- A. Connect hot- and cold-water-supply piping to hot- and cold-water, water-tempering equipment. Connect output from water-tempering equipment to emergency plumbing fixtures. Comply with requirements for hot- and cold-water piping specified in Division 22 Section "Domestic Water Piping."

- B. Where installing piping adjacent to emergency plumbing fixtures, allow space for service and maintenance of fixtures.

3.4 IDENTIFICATION

- A. Install equipment nameplates or equipment markers on emergency plumbing fixtures and equipment and equipment signs on water-tempering equipment. Comply with requirements for identification materials specified in Division 22 Section "Identification for Plumbing Piping and Equipment."

3.5 FIELD QUALITY CONTROL

- A. Mechanical-Component Testing: After plumbing connections have been made, test for compliance with requirements. Verify ability to achieve indicated capacities.
- B. Tests and Inspections:
 - 1. Perform each visual and mechanical inspection.
 - 2. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 - 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- C. Emergency plumbing fixtures and water-tempering equipment will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports.

3.6 ADJUSTING

- A. Adjust or replace fixture flow regulators for proper flow.
- B. Adjust equipment temperature settings.

END OF SECTION 224500

SECTION 230100 – MECHANICAL GENERAL REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. All of the Contract Documents, as listed on the Table of Contents and including General and Supplementary Conditions and Division 1, General Requirements, shall be included in, and made part of, this Section.

1.2 DESCRIPTION OF WORK

- A. Carefully examine all of the Contract Documents, criteria sheets and all other Sections of the specifications for requirements which affect work under this Section, whether or not such work is specifically mentioned in this Section.
- B. The work under this Contract shall include all labor, materials, tools, equipment, transportation, insurance, temporary protection, supervision and incidental items essential for proper installation and operation, even though not specifically mentioned or indicated on the drawings, but which are usually provided or are essential for proper installation and operation, of all systems as indicated on the drawings and specified herein.
- C. The specifications and drawings describe the minimum requirements that must be met by the HVAC Subcontractor for the installation of all work as shown on the drawings and as specified hereinunder.
- D. Coordinate work with that of all other Trades affecting or affected by the work of this Section. Cooperate with such Trades to assure the steady progress of all work under the Contract.

1.3 RELATED WORK

- A. For work to be included as part of this Section, to be furnished and installed by the HVAC Subcontractor, refer to the following Sections:

Section 230130	HVAC AIR DUCT CLEANING
Section 230400	GENERAL CONDITIONS FOR MECHANICAL TRADES
Section 230513	COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT
Section 230516	EXPANSION FITTINGS AND LOOPS FOR HVAC PIPING
Section 230517	SLEEVES AND SLEEVE SEALS FOR HVAC PIPING
Section 230519	METERS AND GAGES FOR HVAC PIPING
Section 230523	GENERAL-DUTY VALVES FOR HVAC PIPING
Section 230529	HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT
Section 230548	VIBRATION AND SEISMIC CONTROLS FOR HVAC PIPING AND EQUIPMENT
Section 230553	IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT
Section 230593	TESTING, ADJUSTING, AND BALANCING FOR HVAC
Section 230713	DUCT INSULATION

Section 230719	HVAC PIPING INSULATION
Section 232113	HYDRONIC PIPING
Section 232116	HYDRONIC PIPING SPECIALTIES
Section 232123	HYDRONIC PUMPS
Section 233113	METAL DUCTS
Section 233300	AIR DUCT ACCESSORIES
Section 233346	FLEXIBLE DUCTS
Section 233713.13	AIR DIFFUSERS
Section 233713.23	REGISTERS, AND GRILLES
Section 238216.11	HYDRONIC AIR COILS
Section 238239.19	WALL AND CEILING UNIT HEATERS

- B. For work related to, and to be coordinated with the HVAC work, but not included in this Section and required to be performed under other designated Sections, see the following:
1. Division 4 Section "Masonry Work" for HVAC construction.
 2. Division 7 Section "Firestopping".
 3. Division 7 Section "Caulking, Flashing, Waterproofing, Roofing and setting of Roof Drains".
 4. Division 8 Section "Access Panels".
 5. Division 9 Section "Painting".

1.4 REFERENCES

- A. All materials and workmanship shall comply with all applicable Codes, Specifications, Local and State Ordinances, Industry Standards and Utility Company Regulations, latest editions.
- B. In case of difference between Building Codes, State Laws, Local Ordinances, Industry Standards and Utility Company Regulations and the Contract Documents, the HVAC Subcontractor shall promptly notify the Architect in writing of any such difference.
- C. In case of conflict between the Contract Documents and the requirements of any Code or Authorities having jurisdiction, the most stringent requirements of the aforementioned shall govern.
- D. Should the HVAC Subcontractor perform any work that does not comply with the requirements of the applicable Building Codes, State Laws, Local Ordinances, Industry Standards and Utility Company Regulations, he shall bear all costs arising in correcting the deficiencies, as approved by the Architect/Owner.
- E. Applicable Codes and Standards shall include all State Laws, Local Ordinances, Utility Company Regulations, and the applicable requirements of the latest adopted edition of the following Codes and Standards, without limiting the number, as follows:
1. National Electrical Code (NEC)
 2. Environmental Protection Agency (EPA)
 3. New York - Environmental Air Quality Protection Agency
 4. New York - Energy Code
 5. New York - Building Code (Latest Adopted Edition), including all adopted New York - Supplements
 6. New York - Fire Prevention Regulations and Elevator Regulations

7. Local Ordinances, Regulations of the Local Building Department and Fire Department
 8. International Mechanical Code
 9. Recommendations of the National Fire Protection Association (NFPA), latest applicable edition adopted, in general and in particular:
 - a. Life Safety, NFPA 101
 - b. HVAC, NFPA 90A, 90B
 - c. Equipment, NFPA 96
 10. Recommendations of ASHRAE (American Society of Heating, Refrigeration and Air Conditioning Engineers), including:
 - a. ASHRAE 90.1
 - b. ANSI/ASHRAE 62-Ventilation for Acceptable Indoor Air Quality
 - c. ANSI/ASHRAE 15-Safety Code for Mechanical Refrigeration
- F. ANSI/ASHRAE 55-Thermal Environmental Conditions for Human Occupancy. In these specifications, references made to the following Industry Standards and Code Bodies are intended to indicate the latest volume or publication of the Standard. All equipment, materials and details of installation shall comply with the requirements and latest revisions of the following Bodies, as applicable:
- | | |
|-------|---------------------------------------|
| ANSI: | American National Standards Institute |
| ASTM: | American Society of Testing Materials |
| FM: | Factory Mutual |
| UL: | Underwriters' Laboratories |
| IRI: | Industrial Risk Insurers |
| ISO: | Insurance Services Office |
| NBS: | National Bureau of Standards |
| NSC: | National Safety Council |
- G. HVAC Subcontractor for the work in his scope of work shall give all necessary notices, obtain all permits, pay all governmental taxes, fees and other costs in connection with his work; file for necessary approvals with the jurisdiction under which the work is to be performed. HVAC Subcontractor shall obtain all required Certificates of Inspection for his respective work and deliver same to the Architect before request for acceptance of his portion of work is made and before final payment.

1.5 QUALITY ASSURANCE

- A. The manufacturers listed within these specifications have been preselected for use on this project. No submittal will be accepted from a manufacturer other than specified.
- B. HVAC Subcontractor shall furnish and install all equipment, accessories, connections and incidental items necessary to fully complete the work under his Contract for use, occupancy and operation by the Owner.
- C. Where equipment of a substitute manufacturer differ from that specified and require different arrangement or connections from those shown, it shall be the responsibility of the Subcontractor responsible for the substitution to modify the installation of the equipment/system to operate properly and in harmony with the original intent of the drawings and specifications. When directed by the Architect, the HVAC Subcontractor shall submit drawings showing the proposed, substitute installation. If the proposed installation is accepted, the HVAC Subcontractor shall make all necessary changes in all affected related work provided under his and other Sections including location of roughing-in connections by other Trades, supports, etc. All changes shall be made at no increase in the Contract amount or additional cost to the Owner. The General Contractor shall be

responsible to assure that the Subcontractor responsible for the substitution bears the cost arising to all other Trades as a result of the substitution.

- D. Unless specifically indicated otherwise, all equipment and materials required for installation under these specifications shall be new, unused and without blemish or defect. Equipment and materials shall be products which will meet with the acceptance of the Authorities having jurisdiction over the work and as specified hereinbefore. Where such acceptance is contingent upon having the products listed and/or labeled by FM or UL or another testing laboratory, the products shall be so listed and/or labeled. Where no specific indication as to the type or quality of material or equipment is indicated, a first class standard article shall be provided.

1.6 WARRANTY

- A. Attention is directed to provisions of the General Requirements and Supplementary General Requirements regarding and warranties for work under this Contract.
- B. All warranties shall begin on the Date of Substantial Completion of the entire project or the Owner's acceptance of the workmanship and/or material covered by the warranty, whichever is later. The warranty coverage shall continue for the specified period. Refer to individual specification sections for warranty period. If no specific warranty period is specified, the warranty shall extend for a minimum of 365 days.
- C. Manufacturers shall provide their standard warranties for work under the HVAC Trades. However, such warranties shall be in addition to, and not in lieu of, all other liabilities which the manufacturer and HVAC Subcontractor may have by law or by other provisions of the Contract Documents.
- D. All materials, items of equipment and workmanship furnished under the HVAC Section shall carry the standard warranty against all defects in material and workmanship. Any fault due to defective or improper material, equipment, workmanship or design which may develop shall be made good, forthwith, by and at the expense of the HVAC Subcontractor for the work under his Contract, including all other damage done to areas, materials and other systems resulting from this failure.
- E. The HVAC Subcontractor shall warranty that all elements of the systems which are to be provided under his Contract, are of sufficient capacity to meet the specified performance requirements as set forth herein or as indicated.
- F. Upon receipt of notice from the Owner or Architect of failure of any part of the systems or equipment during the warranty period, the affected part or parts shall be replaced by the HVAC Subcontractor for his work or any other work affected by the failure(s).
- G. HVAC Subcontractor shall furnish, before the final payment is made, a written warranty covering the above requirements in accordance with the General Requirements.

1.7 DEFINITIONS

- A. Words in the singular shall also mean and include the plural, wherever the context so indicates, and words in the plural shall mean the singular, wherever the context so indicates.
- B. Wherever the terms "shown on drawings" are used in the specifications, they shall mean "noted", "indicated", "scheduled", "detailed", or any other diagrammatic or written reference made on the drawings.

- C. Wherever the term "provide" is used in the specifications it will mean "furnish" and "install", "connect", "apply", "erect", "construct", or similar terms, unless otherwise indicated in the specifications.
- D. "Work": Labor, materials, equipment, apparatus, controls and accessories required for proper and complete installation.
- E. "Concealed": Embedded in masonry or other construction; or installed in furred spaces, trenches or crawl spaces; or installed within double partitions or hung ceilings; or in enclosures.
- F. "Exposed": Visible to building occupants, excluding mechanical room and utility tunnel locations.
- G. "Acceptable equivalent" or "Equal": Of weight, size, design, capacity and efficiency to meet requirements specified and shown, and of acceptable manufacturer, as determined in the opinion of the Architect.
- H. "Acceptable": Acceptable, as determined in the opinion of the Architect.
- I. "Contractor": General Contractor.
- J. "Named" Product: Manufacturer's name for product, as recorded in published documents of latest issue as of date of Contract Documents. Obtain Architect's permission before using products of later or earlier model.
- K. Wherever the term "material" is used in the specifications it will mean any "product", "equipment", "device", "assembly", or "item" required under the Contract, as indicated by trade or brand name, manufacturer's name, standard specification reference or other description.
- L. The terms "approved", or "approval" shall mean the written approval of the Architect.
- M. The term "Contract Documents" shall mean the entire set of Drawings and Specifications as listed in the Table of Contents of the General Conditions including all bound and unbound material and all items officially issued to date such as addenda, bulletins, job modifications, etc.
- N. The term "specification" shall mean all information contained in the bound or unbound volume, including all "Contract Documents" defined therein, except for the drawings.
- O. The terms "directed", "required", "permitted", "ordered", "designated", "prescribed", and similar words shall mean the direction, requirement, permission, order, designation or prescription of the Architect; the terms "approved", "acceptable", "satisfactory", and similar words shall mean approved by, acceptable or satisfactory to the Architect; and, the terms "necessary", "reasonable", "proper", "correct", and similar words shall mean necessary, reasonable, proper or correct in the judgment of the Architect.
- P. "Accessible" indicates ease of access with or without the use of ladders and without requiring extensive removal of other equipment, such as ductwork, piping, etc. to gain access. "Accessible ceiling" indicates acoustic tile type hung ceilings. Concealed spline or sheetrock ceilings with access panels shall not be considered accessible ceilings.
- Q. "Concealed" means hidden from sight in chases, furred spaces, shafts, hung ceilings, embedded in construction or in crawl spaces.
- R. "Exposed" means not installed underground or "concealed" as defined above.

- S. "HVAC Subcontractor" refers to the Subcontractor responsible for furnishing and installation of all work indicated on the HVAC drawings and in the HVAC specifications.
- T. "Architect" shall refer to the Architect: "Phase Zero" and/or the Engineer "Innovative Engineering Services, LLC."
- U. "Owner" shall refer to the Owner or designated representative.
- V. "Other Work Contractor" (O.W.C.) refers to the Contractor(s), or Subcontractor(s) performing work under other Sections of the Contract Documents.

1.8 THE SUBCONTRACTOR

- A. The HVAC Subcontractor shall visit the site of the proposed new facility and base his bids from his own site examinations and estimates. The HVAC Subcontractor shall not hold the Architect, Engineer, Owner or their agents or employees responsible for, or bound by, any schedule, estimate or of any plan thereof. The HVAC Subcontractor shall study the Contract Documents included under this Contract to determine exactly the extent of work provided under this Contract, as well as to ascertain the difficulty to be encountered in performing the work, in installing new equipment and systems and coordinating the work with the other Trades and existing building conditions.
- B. The HVAC Subcontractor shall faithfully execute his work according to the terms and conditions of the Contract and specifications, and shall take all responsibility for and bear all losses resulting to him in the execution of his work.
- C. The HVAC Subcontractor shall be responsible for the location and performance of work provided under his Contract as indicated on the Contract Documents. All parties employed directly or indirectly by the HVAC Subcontractor shall perform their work according to all the conditions as set forth in these specifications.
- D. The HVAC Subcontractor shall furnish all materials and do all work in accordance with these specifications, and any supplementary documents provided by the Architect. The work shall include everything shown on the drawings and/or required by the specifications as interpreted by the Architect, regardless of where such information is indicated in the Contract Documents (Architectural, Electrical, Plumbing, Fire Protection, etc.). Unless specifically indicated otherwise, all work and materials furnished and installed shall be new, unused and of the best quality and workmanship. The HVAC Subcontractor shall cooperate with the Architect so that no error or discrepancy in the Contract Documents shall cause defective materials to be used or poor workmanship to be performed.

1.9 COORDINATION OF WORK

- A. The HVAC Subcontractor shall compare his drawings and specifications with those of other Trades as well as the Architectural drawings and specifications, and report any discrepancies between them to the Architect and obtain from the Architect written instructions for changes necessary in the HVAC work.
- B. Coordinate work with that of all other Trades affecting or affected by the work of this Section. Cooperate with such Trades to assure the steady progress of all work under the Contract.
- C. All work shall be installed in cooperation with other Trades installing interrelated work. Before installation, HVAC Subcontractor shall make proper provisions to avoid interferences in a manner approved by the Architect. All changes required in the work of the HVAC Subcontractor or that of

any other trade caused by the HVAC Subcontractor's neglect, shall be made by him at his own expense, to the Architect's satisfaction.

- D. The HVAC Subcontractor must include in his bid sufficient dollar amounts to coordinate the work of this Contract. This project is complex and will require additional time to coordinate all Trades and allow implementation of the Owners Standards and maintenance serviceability requirements. This requirement shall include, but not be limited to, producing the coordination drawings, as many times and as many drawings as required, to ensure serviceability of equipment, as approved by the Architect.
- E. Locations of ductwork and piping distribution, equipment, systems, etc. shall be adjusted to accommodate the work with interferences anticipated and encountered. The HVAC Subcontractor shall determine the exact routing and location of his systems prior to fabrication or installation of any system component. Accurate measurements and coordination drawings shall be completed to verify dimensions and characteristics of the various systems installations.
- F. Lines which pitch shall have the right-of-way over those which do not pitch. For example, steam piping shall normally have the right-of-way. Lines whose elevations cannot be changed shall have the right-of-way over lines whose elevations can be changed.
- G. Offsets, transitions and changes of direction in all systems shall be made as required to maintain proper headroom and pitch of sloping lines whether or not indicated on the drawings. The HVAC Subcontractor shall provide elbows, fittings, offsets in ductwork and piping, etc. as required for his work to affect these offsets, transitions and changes in direction.
- H. All work shall be installed in a way to permit removal (without damage to other parts) all other system components provided under this Contract requiring periodic replacement or maintenance. All work shall be done to allow easy access for maintaining equipment. The Owner and Engineer will require proof via the preparation of large scale sections and part plans that pull and junction boxes, etc. are accessible after the work is completed. Any items in the field discovered to be in non-compliance shall be removed and relocated, as required, and as directed by the Architect.
- I. The Contract Drawings are diagrammatic only intending to show general runs and locations of the ductwork, piping, equipment, systems equipment, etc. and not necessarily showing all required offsets, details and accessories and equipment to be connected. All work shall be accurately laid out with other Trades to avoid conflicts and to obtain a neat and workmanlike installation which will afford maximum accessibility for operation, maintenance and headroom.
- J. Where discrepancies in scope of work as to what Trade provides items, such conflicts shall be reported to the Architect during bidding and prior to signing of the Contract. If such action is not taken, the HVAC Subcontractor shall furnish such items as part of his work as necessary, for complete and operable systems and equipment, as determined by the Architect.
- K. The HVAC Subcontractor shall coordinate the installation of all equipment.
- L. Where drawing details, plans, specification requirements and/or scheduled equipment capacities are in conflict or equipment are shown to be different between plans and/or between plans and riser diagrams, details or specifications, the most stringent requirement will be included in the Contract. HVAC systems and equipment called for in the specification and/or shown on the drawings shall be provided under this Contract as if it were required by both the drawings and specifications. However, prior to ordering or installation of any portion of work which appears to be in conflict, such work shall be brought to Architect's attention for direction as to what is to be provided.

- M. Any equipment shown on the HVAC and/or Architectural drawings to be provided with services shall be included under this Contract as applicable to make equipment complete and operable. Additional equipment, etc., shall be provided to accomplish the above requirement, as required, all as part of this Contract, at no extra cost to the Owner. This requirement necessitates that the HVAC Subcontractor review the Architectural drawings and the drawings of other Trades during bidding to ascertain the extent of all requirements, and interface between the Trades and scope of work.
- N. The HVAC Subcontractor shall coordinate his work with other Trades' work so that all equipment and systems can be easily, safely and properly serviced and maintained. It is imperative that service personnel can safely access all equipment. Provide safety rails, steps, ladders, valve chains, handle extensions, etc. as required, in addition to the ones shown on the drawings, to ensure safe and easy access to all equipment is provided in a manner approved by the Architect.

1.10 GIVING INFORMATION

- A. HVAC Subcontractor shall keep himself fully informed as to the shape, size and position of all openings required for his apparatus and shall give information to the General Contractor and other Subcontractors sufficiently in advance of the work so that all openings may be built in advance.

1.11 EQUIPMENT AND MATERIALS

- A. Equipment and materials shall be delivered to the site and stored in original sealed containers, suitably sheltered from the elements, but readily accessible for inspection by the Architect until installed. All items subject to moisture damage such as controls shall be stored in dry, heated spaces.
- B. Equipment shall be tightly covered and protected against dirt, water, and chemical or mechanical injury and theft. At the completion of the work, equipment and materials shall be cleaned and polished thoroughly and turned over to the Owner in a condition satisfactory to the Architect. Damage or defects that develop before acceptance of the work shall be made good at the HVAC Subcontractor's expense.
- C. The HVAC Subcontractor shall make necessary field measurements to ascertain space requirements, for equipment and connections to be provided under his respective Trade and shall furnish and install such sizes and shapes of equipment to allow for the final installation to conform to the drawings and specifications.
- D. Manufacturer's directions shall be followed completely in the delivery, storage, protection and installation. Promptly notify the Architect in writing of any conflict between any requirements of the Contract Documents and the manufacturer's directions. Obtain the Architect's written instructions before proceeding with the work. Should HVAC Subcontractor perform any work that does not comply with the manufacturer's directions or written instructions from the Architect, he shall bear all costs arising in correcting any deficiencies that should arise.
- E. All equipment of one type shall be the products of one manufacturer.
- F. Equipment prepurchased by the General Contractor on behalf of the Owner or by the Owner himself, if assigned to the HVAC Subcontractor, shall be received, installed, tested, etc., as if the equipment was purchased by the HVAC Subcontractor. All guarantees, service contracts, etc., shall be the same as for all other equipment provided under this Contract.

1.12 USE OF PREMISES

- A. The HVAC Subcontractor shall confine all apparatus, storage of materials and construction to the limits as directed by the Architect and he shall not encumber the premises with his materials. The HVAC Subcontractor shall be held responsible for repairs, patching, or cleaning arising from any unauthorized use of premises.
- B. Notwithstanding any approvals or instructions which must be obtained by the HVAC Subcontractor from the Architect in connection with the use of the premises, the responsibility for the safe working conditions at the site shall remain that of the HVAC Subcontractor. The Architect, Engineer or Owner shall not be deemed to have any responsibility or liability in connection with safe working conditions at the site.

1.13 PROTECTION

- A. Materials, equipment, etc., shall be properly protected during construction and all conduit openings shall be temporarily closed so as to prevent obstruction and damage. Post notice prohibiting the use of all systems provided under the HVAC Contract, prior to completion of work and acceptance of all systems by the Owner except as otherwise, instructed by Architect. Take precautions to protect all materials furnished from damage and theft.
- B. The HVAC Subcontractor shall furnish, place and maintain proper safety guards for the prevention of accidents that might be caused by the workmanship, materials, equipment or HVAC systems provided under his Contract.

1.14 DAMAGE TO OTHER WORK

- A. The HVAC Subcontractor shall be held responsible and shall pay for all damages caused by his work to the building structures, equipment, systems, etc., and all work and finishes installed under this Contract. Repair of such damage shall be done by the General Contractor at the expense of the HVAC Subcontractor, to the Architect's satisfaction.

1.15 CORRECTION OF WORK

- A. The HVAC Subcontractor shall promptly correct all work provided under his Contract and rejected by the Architect as defective or as failing to conform to the Contract Documents, whether observed before or after completion of work, and whether or not fabricated, installed or completed.

1.16 EXTRA WORK

- A. No claim for extra work will be allowed unless it is authorized by the Architect before commencement of the extra said work.

1.17 TOUCH-UP PAINTING

- A. All equipment and systems shall be thoroughly cleaned of rust, splatters and other foreign matter of discoloration leaving every part of all systems in an acceptable prime condition. The HVAC Subcontractor for the work under his Contract shall refinish and restore to the original condition all equipment which has sustained damage to the manufacturer's prime and finish coats of paint and/or enamel during the course of construction, regardless of the source of damage.

1.18 PARTS LIST AND INSTRUCTIONS FOR OPERATION AND MAINTENANCE

- A. The HVAC Subcontractor shall thoroughly instruct the Owner, to the complete satisfaction of the Architect, in the proper operation of all systems and equipment provided by him. The HVAC Subcontractor shall make arrangements, via the Architect, as to whom the instructions are to be given in the operation of the basic and auxiliary systems and the period of time in which they are to be given. The Architect shall be completely satisfied that the Owner has been thoroughly and completely instructed in the proper operation of all systems and equipment before final payment is made. If the Architect determines that complete and thorough instructions have not been given by the HVAC Subcontractor to the Owner's representative, then the HVAC Subcontractor shall be directed by the Architect to provide whatever instructions are necessary until the intent of this specification has been complied with.
- B. HVAC Subcontractor shall submit to the Architect for approval, the required typed sets (see General Conditions and Division 1) bound neatly in loose-leaf binders, of all instructions for the installation, operation, emergency operation, start-up, care and maintenance of all equipment and systems (including instructions for the ordering and stocking of spare parts for all equipment installed under this Contract). The lists shall include part numbers and suggested supplier. Each set shall also include an itemized list of component parts that should be kept on hand and where such parts can be purchased.
- C. Information shall indicate possible problems with equipment and suggested corrective action. The manuals shall be indexed for each type of equipment. Each section shall be clearly divided from the other sections. A sub-index for each section shall also be provided. The methodology of setting-up the manuals shall be submitted to the Architect and Owner for review prior to final submission of manuals.

1.19 MANUFACTURER'S REPRESENTATIVE

- A. The HVAC Subcontractor shall provide, at the appropriate time or as directed by Architect, the on-site services of a competent factory trained Engineer of the manufacturer of specific equipment, to inspect, test, adjust and place in proper operating condition any and all items of the same manufacturer. No additional compensation will be allowed for such services. A written report shall be issued by the particular manufacturer with his findings for the Architect's record.

1.20 COORDINATION DRAWINGS

- A. Before materials are purchased, fabricated or work is begun, each Subcontractor shall prepare and obtain approval of coordination drawings, and sections for all floors/areas, including buried system/services, resulting in one (1) set of all-Trade-composite at 3/8" scale drawings, showing the size and location of all equipment, in the manner described hereinunder General Requirements. Architects review and approval of coordination drawings must be obtained prior to any fabrication or installation of any equipment or systems.
- B. The coordination drawings shall be generated from a computer CAD program compatible with AutoCAD Release 2013, in DWG or DXF format. The HVAC Subcontractor shall take the lead, supervise, and coordinate production of coordinated layout drawings, to show and coordinate all equipment. These drawings shall then be circulated to the HVAC Subcontractor so that he can indicate all his work as directed by the General Contractor and Architect and as required, to result in a fully coordinated installation.

- C. All costs associated with all aspects of coordination drawings, regardless as to how long they take to produce and how many times they have to be redrawn, shall be borne by the HVAC Subcontractor.
- D. The HVAC Subcontractor may purchase the HVAC AutoCAD computer drawing files from the HVAC Contract set on disk or via modem from the Engineer at the nominal cost of \$500.00, if he so chooses.

1.21 RECORD DRAWINGS/AS-BUILT DRAWINGS

- A. The HVAC Subcontractor shall maintain current at the site a set of his drawings on which he shall accurately show the actual installation of all work provided under his Contract indicating hereon any variation from the Contract Drawings, in accordance with the General Conditions and Division 1. Changes, whether resulting from formal change orders or other instructions issued by the Architect, shall be recorded. Include changes in sizes, location, and dimensions of equipment, etc.
- B. The HVAC Subcontractor shall indicate progress by coloring-in equipment and associated appurtenances exactly as they are erected. This process shall incorporate both the changes noted above and all other deviations from the original drawings whether resulting from job conditions encountered or from any other causes.
- C. The marked-up and colored-up prints will be used as a guide for determining the progress of the work installed. They shall be inspected periodically by the Architect and Owner and they shall be corrected immediately if found either inaccurate or incomplete. This procedure is mandatory.
- D. At the completion of the job, these prints shall be submitted to the General Contractor and then to the Architect for final review and comment. The prints will be returned with appropriate comments and recommendations. These corrected prints, together with corrected prints indicating all the revisions, additions and deletions of work, shall form the basis for preparing a set of As-built Record Drawings.
- E. The Subcontractor shall be responsible for generating as-built Record Drawings utilizing CAD based documents in AutoCAD Release 2013 DWG or DXF format. A bound set of plans, as well as the computer files, on disk, shall be turned over to the Architect for review. After acceptance of the as-built documents by the Architect, the HVAC Subcontractor shall make any corrections necessary to the as-built documents and prepare one reproducible set of drawings as well as bound blueprint set(s) (quantity as determined by the Architect) for distribution to the Owner via the Architect.
- F. The HVAC Subcontractor may use the computer drawing files used for coordination drawings or purchase the Engineers most recently updated computer drawing files at a nominal charge of \$500.00 per drawing file. The updated drawings may not include all changes made during the course of construction and it shall be the HVAC Subcontractors responsibility to update the as-built documents to include all changes brought forth to the project resulting from bulletins, request for information (RFI's), change orders, etc. The HVAC Subcontractor may review the Engineers latest computer files for completeness prior to purchase, however the Engineer will not be responsible for updating the computer files.
- G. Included with the above shall be a complete drawing list and a standard layering system, which shall be required to be maintained within the as-built Record CAD documents.
- H. The HVAC Subcontractor shall be issued bulletins in the same manner as the original Design Documents described above.

- I. The as-built CAD documents required shall be in addition to other requirements stated elsewhere.

1.22 SUBMITTALS

- A. Prepare and submit shop drawings in accordance with the requirements hereinbefore specified, and with Division 1 Section "Submittal Procedures" in the manner described therein, modified as noted hereinafter.
- B. The selection and intention to use a product specified by name shall not excuse the need for timely submission of shop drawings for that product.
- C. Prior to submitting shop drawings, submit for review preliminary list of intended or proposed manufacturers for all items for which shop drawings are required.
- D. Submission of shop drawings of an unnamed manufacture or shop drawings at variance with the Contract Documents is not a proper request for substitution.
- E. Samples that are submitted in lieu of shop drawings shall be clearly identified and shall be submitted in duplicate. Only one sample will be returned and that accepted sample shall be kept available at appropriate job site office. Accepted sample retained by Architect will be kept available at Architect's home office.
- F. Upon completion of shop drawing review, shop drawings will be returned, marked with one of following notations: No Exception Taken, Revise as Noted, Revise and Resubmit, or Rejected. Only products whose shop drawings are marked "No Exception Taken" or "Revise as Noted" shall be used on the project.
- G. Submittals shall include the following information:
 1. Descriptive and product data necessary to verify compliance with Contract Documents.
 2. Manufacturer's specifications including materials of construction, metal gauge, thickness and finish.
 3. Certified dimensional drawings including clearances required for maintenance or access.
 4. Performance data, ratings, operating characteristics, and operating limits.
 5. Electrical ratings and characteristics.
 6. Wiring and control diagrams, where applicable.
 7. Certifications requested, including UL label or listing.
 8. List of accessories, which are required but are not being provided by the product manufacturer or are not being furnished under this Section. Identify the Section(s) under which the accessories are being furnished.
- H. In addition, submittals shall be clearly marked for the following:
 1. Specification Section and Paragraph, or Drawing Schedule/Note/Detail/etc., where equipment is specified.
 2. Equipment or fixture identification corresponding to that used in Contract Documents.
 3. Accessories and special or non-standard features and materials which are being furnished.

1.23 INTENT

- A. It is the intent of the Contract Documents to require finished work, tested and ready for operation.
- B. It is not intended that Contract Documents show every pipe, fitting and appurtenance; however, such parts as may be necessary to complete the systems in accordance with best trade practice and Code requirements and to Architect's satisfaction shall be deemed to be included.
- C. Drawings are diagrammatic and indicate the general arrangement of systems and work included in the Contract. DO NOT SCALE THE DRAWINGS.

1.24 PRODUCT SELECTION

- A. Contractor's options for selecting products are limited by Contract Document requirements and governing regulations and are not controlled by industry traditions or procedures experienced by Contractor on previous construction projects. Required procedures include, but are not necessarily limited to, following various methods of specifying:
 - 1. Single Product Manufacturer Named: Provide product indicated. Advise Architect, and obtain instructions before proceeding, when named product is known to be unacceptable or not feasible.
 - 2. Two or More Manufacturers' Products Named: Provide one of the named products, at Contractor's option, but excluding products which do not comply with requirements. Do not provide, nor offer to provide, an unnamed product unless named products do not comply with requirements or are not feasible.
 - 3. "Acceptable Equivalent" or "Or Equal": Where named products are accompanied by this term or words of similar effect, provide named products or propose substitute product according to paragraph 1.25, SUBSTITUTIONS.
 - 4. Standards, Codes and Regulations: Where specification requires only compliance with a standard, code or regulation, Contractor may select any product which complies with requirements of that standard, code or regulation.
 - 5. Performance Requirements: Provide products which comply with specific performances indicated and which are recommended by manufacturer (in published product literature or by individual certification) for application intended. Overall performance of product is implied where product is specified with only certain specific performance requirements.
 - 6. Prescriptive Requirements: Provide products which have been produced in accordance with prescriptive requirements using specified materials and components, and complying with specified requirements for fabricating, finishing, testing and other manufacturing processes.
 - 7. Visual Matching: Where matching with an established material is required, Architect's judgment of whether proposed product matches established material shall be final. Where product specified does NOT match established material, propose substitute product according to paragraph 1.25, SUBSTITUTIONS. Follow requirements for CHANGE ORDERS, also, if matching product within cost category of specified product is not available.
 - 8. "Color as Selected by Architect": Unless otherwise noted, where specified product requirements include "Color as Selected by Architect" or words of similar effect, the selection of manufacturer and basic product complying with Contract Documents is Contractor's option and subsequent selection of color is Architect's option.
- B. Inclusion by name, of more than one manufacturer or fabricator, does not necessarily imply acceptability of standard products of those named. All manufacturers, named or proposed, shall conform, with modification as necessary, to criteria established by contract documents for performance, efficiency, materials and special accessories.

1.25 SUBSTITUTIONS

- A. Contractor shall pay Architect/Engineer for time spent reviewing substitution requests. Charges shall be \$120/hour. Submittal of substitution request will be construed as evidence of Contractor's agreement to pay such charges, with no added cost to Owner.
- B. Contractor's request for substitution may be submitted only after award of Contract. Requests shall be in writing on Contractor's letterhead and shall include:
1. Contractor's detailed comparison of significant qualities between specified item and proposed substitution.
 2. Statement of effect on construction time, coordination with other affected work, and cost information or proposal.
 3. Contractor's statement to the effect that proposed substitution will result in overall work equal to, or better than, work originally intended.
- C. Substitution requests will be considered: If extensive revisions to Contract Documents are not required; if changes are in keeping with general intent of Contract Documents; if submitted in timely and proper manner, fully documented; and if one or more of following conditions is satisfied; all as judged by Architect:
1. Where request is directly related to "acceptable equivalent" clause, "or equal" clause or words of similar effect in Contract Documents.
 2. Where specified product, material or method cannot be provided within Contract Time; but not as a result of Contractor's failure to pursue the work promptly or to coordinate various activities properly.
 3. Where specified product, material or method cannot be provided in manner which is compatible with other materials of the work and where Contractor certifies that proposed substitution is compatible.
 4. Where specified product, material or method cannot be properly coordinated with other materials of the work and where Contractor certifies that proposed substitution can be properly coordinated.
 5. Where specified product, material or method cannot be warranted as required and where Contractor certifies that proposed substitution can be so warranted.
 6. Where specified product, material or method cannot be used without adversely affecting Owner's insurance coverage on completed work and where Contractor certifies that proposed substitution can be so used.
 7. Where specified product, material or method will encounter other substantial non-compliance, which are not possible to otherwise overcome except by using proposed substitution.
 8. Where specified product, material or method cannot receive required approval by governing authority and proposed substitution can be so approved.
 9. Where substantial advantage is offered to the Owner; in terms of cost, time, energy conservation or other valuable considerations; after deducting offsetting responsibilities that Owner may be required to bear, including additional compensation to Architect for redesign and evaluation services, increased cost of other work by Owner or separate contractors, and similar considerations.
- D. The burden is upon the Contractor, supplier and manufacturer to satisfy Architect that:
1. Proposed substitute is equal to, or superior to, the item specified.
 2. Intent of the Contract Documents, including required performance, capacity, efficiency, quality, durability, safety, function, appearance, space clearances and delivery date, will be equaled or bettered.

- E. Submission of shop drawings of unspecified manufacturer or shop drawings at variance with the Contract Documents is not a proper request for substitution.
- F. Changes in work of other trades, such as structural supports, which are required as a result of substitution and the associated costs for such changes, shall be the complete responsibility of Contractor proposing substitution. Except as noted in subparagraph 1.25.C.9 above, there shall be no additional expense to the Owner.

1.26 SAMPLES

- A. Submit samples as requested by Architect.

PART 2 - PRODUCTS

2.1 GENERAL PRODUCT REQUIREMENTS

- A. Products shall be undamaged and unused at time of installation and shall be complete with accessories, trim, finish, safety guards and other devices and details needed for complete installation and for intended use.
- B. Where available, products shall be standard products of types which have been produced and used previously and successfully on other projects and in similar applications.
- C. Where products by their nature and their use are likely to need replacement parts on future date, for maintenance and repair or replacement work, products shall be standard domestically produced products likely to have such parts available to Owner in future.
- D. Labels and stamps which are required for observation after installation shall be located on accessible surfaces which, in occupied spaces, are not conspicuous. Other labels and stamps shall be located on concealed surfaces.

PART 3 - EXECUTION

3.1 COOPERATION AND WORK PROGRESS

- A. The HVAC work shall be carried on under the usual construction conditions, in conjunction with all other work at the site. The HVAC Subcontractor shall cooperate with the Architect, General Contractor, all other Subcontractors and equipment suppliers working at the site. The HVAC Subcontractor shall coordinate the work and proceed in a manner so as not to delay the progress of the project.
- B. The HVAC Subcontractor shall coordinate his work with the progress of the building and other Trades so that he will complete his work as soon as conditions permit and such that interruptions of the building functions will be at a minimum. Any overtime hours worked or additional costs incurred due to lack of or improper coordination with other Trades or the Owner by the HVAC Subcontractor, shall be assumed by him without any additional cost to the Owner.
- C. The HVAC Subcontractor shall furnish information on all equipment that is furnished under this Section but installed under another Section to the installing Subcontractor as specified herein.

- D. The HVAC Subcontractor shall provide all materials, equipment and workmanship to provide for adequate protection of all HVAC equipment during the course of construction of the project. This shall also include protection from moisture and all foreign matter. The HVAC Subcontractor shall also be responsible for damage which he causes to the work of other Trades, and he shall remedy such injury at his own expense.
- E. Waste materials shall be removed promptly from the premises. All material and equipment stored on the premises shall be kept in a neat and orderly fashion. Material or equipment shall not be stored where exposed to the weather. The HVAC Subcontractor shall be responsible for the security, safekeeping and damages, including acts of vandalism, of all material and equipment stored at the job site.
- F. The HVAC Subcontractor shall be responsible for unloading all HVAC equipment and materials delivered to the site. This shall also include all large and heavy items or equipment which require hoisting. Consult with the General Contractor for hoisting/crane requirements. During construction of the building, the HVAC Subcontractor shall provide additional protection against moisture, dust accumulation and physical damage of the main service and distribution equipment. This shall include furnishing and installing temporary heaters within these units, as approved, to evaporate excessive moisture and ventilate it from the room, as may be required.
- G. It shall be the responsibility of the HVAC Subcontractor to coordinate the delivery of the HVAC equipment to the project prior to the time installation of equipment will be required; but he shall also make sure such equipment is not delivered too far in advance of such required installation, to ensure that possible damage and deterioration of such equipment will not occur. Such equipment stored for an excessively long period of time (as determined in the opinion of the Architect) on the project site prior to installation may be subject to rejection by the Architect.
- H. The HVAC Subcontractor shall erect and maintain, at all times, necessary safeguards for the protection of life and property of the Owner, Workmen, Staff and the Public.
- I. Prior to installation, the HVAC Subcontractor has the responsibility to coordinate the exact mounting arrangement and location of HVAC equipment to allow proper space requirements as indicated in the NEC. Particular attention shall be given in the field to group installations. If it is questionable that sufficient space, conflict with the work of other Subcontractors, architectural or structural obstructions will result in an arrangement which will prevent proper access, operation or maintenance of the indicated equipment, the HVAC Subcontractor shall immediately notify the Contractor and not proceed with this part of the Contract work until definite instructions have been given to him by the Architect.
- J. The HVAC Subcontractor shall obtain from the Plumbing and Electrical Subcontractors copies of all shop drawing prints showing the ductwork and piping installation as they will be put in place on the project. These drawings shall be thoroughly checked by the HVAC Subcontractor and coordinated with the work of other trades so as to prevent any installation conflict.

3.2 INSTALLATION

A. General:

- 1. Unless specifically noted or indicated otherwise, all equipment and material specified in Division 23 of this specification or indicated on the drawings shall be installed under this Contract whether or not specifically itemized herein. This Section covers particular installation methods and requirements peculiar to certain items and classes of material and equipment.

2. The HVAC Subcontractor shall obtain detailed information from manufacturers of equipment as to proper methods of installation.
3. The HVAC Subcontractor shall obtain final roughing dimensions and other information as needed for complete installation of items furnished under other Sections or furnished by the Owner.
4. The HVAC Subcontractor shall keep fully informed of size, shape and position of openings required for material and equipment provided under this and other Sections. Ensure that openings required for work of this Section are coordinated with work of other Sections. Provide cutting and patching as necessary.
5. All miscellaneous hardware and support accessories, including support rods, nuts, bolts, screws and other such items, shall be of a galvanized or cadmium plated finish or of another approved rust-inhibiting coating.
6. Throughout this Section where reference is made to steel channel supports, it shall be understood to mean that the minimum size shall be 1 5/8" mild strip steel with minimum wall thickness of 0.105", similar to Unistrut P1000 or equal products manufactured by Kindorf or Husky Products Co.

3.3 MATERIALS AND WORKMANSHIP

- A. All materials and equipment shall be new and unused and shall meet requirements of the latest Standards of NEMA, UL, IPCEA, ANSI and IEEE. Equipment shall have components required or recommended by OSHA, applicable NFPA documents and shall be UL listed and labeled.
- B. Despite references in the specifications or on the drawings to materials or pieces of equipment by name, make or catalog number, such references shall be interpreted as establishing standards of quality for materials and performance.
- C. Finish of materials, components and equipment shall not be less than Industry good practice. When material or equipment is visible or subject to corrosive or atmospheric conditions, the finish shall be as approved by the Architect.
- D. Provide proper access to material or equipment that requires inspection, replacement, repair or service. If proper access cannot be provided, confer with the Architect as to the best method of approach to minimize effects of reduced access.
- E. All work shall be installed in a neat and workmanlike manner and shall be done in accordance with all Local and State Codes.
- F. The Owner will not be responsible for material, equipment or the installation of same before testing and acceptance.

3.4 CLEANING

- A. This Section of the specifications shall include the cleaning of all equipment on a day-to-day basis and final cleaning of all HVAC equipment prior to turning building over to the Owner. All necessary cleaning referred to herein shall be cleaned to the satisfaction of the Architect.

3.5 FINAL INSPECTION

- A. When all HVAC work on the project has been completed and is ready for final inspection, such an inspection shall be made. At this time, and in addition to all other requirements in the Contract

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Documents, the HVAC Subcontractor, for the work under this Contract, shall demonstrate that the requirements of these specifications have been met to the Architect's satisfaction.

END OF SECTION

SECTION 230130 - HVAC AIR-DISTRIBUTION SYSTEM CLEANING

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 cleaning HVAC air-distribution equipment, ducts, plenums, and system components.

1.3 DEFINITIONS

- A. ASCS: Air systems cleaning specialist.
- B. NADCA: National Air Duct Cleaners Association.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For an ASCS.
- B. Strategies and procedures plan.
- C. Cleanliness verification report.

1.5 QUALITY ASSURANCE

- A. ASCS Qualifications: A certified member of NADCA.
 - 1. Certification: Employ an ASCS certified by NADCA on a full-time basis.
 - 2. Supervisor Qualifications: Certified as an ASCS by NADCA.
- B. Cleaning Conference: Conduct conference at Project site.
 - 1. Review methods and procedures related to HVAC air-distribution system cleaning including, but not limited to, review of the cleaning strategies and procedures plan.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine HVAC air-distribution equipment, ducts, plenums, and system components to determine appropriate methods, tools, and equipment required for performance of the Work.
- B. Perform "Project Evaluation and Recommendation" according to NADCA ACR 2006.

- C. Prepare written report listing conditions detrimental to performance of the Work.
- D. Proceed with work only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Prepare a written plan that includes strategies and step-by-step procedures. At a minimum, include the following:
 - 1. Supervisor contact information.
 - 2. Work schedule including location, times, and impact on occupied areas.
 - 3. Methods and materials planned for each HVAC component type.
 - 4. Required support from other trades.
 - 5. Equipment and material storage requirements.
 - 6. Exhaust equipment setup locations.
- B. Use the existing service openings wherever possible, as required for proper cleaning, at various points of the HVAC system for physical and mechanical entry and for inspection.
- C. Comply with NADCA ACR 2006, "Guidelines for Constructing Service Openings in HVAC Systems" Section.

3.3 CLEANING

- A. Comply with NADCA ACR 2006.
- B. Remove visible surface contaminants and deposits from within the HVAC system.
- C. Systems and Components to Be Cleaned:
 - 1. Air devices for supply and return air.
 - 2. Air-terminal units.
 - 3. Ductwork:
 - a. Supply-air ducts, including turning vanes and reheat coils, to the air-handling unit.
 - b. Return-air ducts to the air-handling unit.
 - c. Exhaust-air ducts.
 - 4. Air-Handling Units:
 - a. Interior surfaces of the unit casing.
 - b. Coil surfaces compartment.
 - c. Condensate drain pans.
 - d. Fans, fan blades, and fan housings.
 - 5. Filters and filter housings.
- D. Collect debris removed during cleaning. Ensure that debris is not dispersed outside the HVAC system during the cleaning process.
- E. Particulate Collection:
 - 1. For particulate collection equipment, include adequate filtration to contain debris removed. Locate equipment downwind and away from all air intakes and other points of entry into the building.
 - 2. HEPA filtration with 99.97 percent collection efficiency for particles sized 0.3 micrometer or larger shall be used where the particulate collection equipment is exhausting inside the building.
- F. Control odors and mist vapors during the cleaning and restoration process.
- G. Mark the position of manual volume dampers and air-directional mechanical devices inside the system prior to cleaning. Restore them to their marked position on completion of cleaning.

- H. System components shall be cleaned so that all HVAC system components are visibly clean. On completion, all components must be returned to those settings recorded just prior to cleaning operations.
- I. Clean all air-distribution devices, registers, grilles, and diffusers.
- J. Clean visible surface contamination deposits according to NADCA ACR 2006 and the following:
 - 1. Clean air-handling units, airstream surfaces, components, condensate collectors, and drains.
 - 2. Ensure that a suitable operative drainage system is in place prior to beginning wash-down procedures.
 - 3. Clean evaporator coils, reheat coils, and other airstream components.
- K. Duct Systems:
 - 1. Create service openings in the HVAC system as necessary to accommodate cleaning.
 - 2. Mechanically clean duct systems specified to remove all visible contaminants so that the systems are capable of passing the HVAC System Cleanliness Tests (see NADCA ACR 2006).
- L. Debris removed from the HVAC system shall be disposed of according to applicable Federal, state, and local requirements.
- M. Mechanical Cleaning Methodology:
 - 1. Source-Removal Cleaning Methods: The HVAC system shall be cleaned using source-removal mechanical cleaning methods designed to extract contaminants from within the HVAC system and to safely remove these contaminants from the facility. No cleaning method, or combination of methods, shall be used that could potentially damage components of the HVAC system or negatively alter the integrity of the system.
 - a. Use continuously operating vacuum-collection devices to keep each section being cleaned under negative pressure.
 - b. Cleaning methods that require mechanical agitation devices to dislodge debris that is adhered to interior surfaces of HVAC system components shall be equipped to safely remove these devices. Cleaning methods shall not damage the integrity of HVAC system components or damage porous surface materials such as duct and plenum liners.
 - 2. Cleaning Mineral-Fiber Insulation Components:
 - a. Fibrous-glass thermal or acoustical insulation elements present in equipment or ductwork shall be thoroughly cleaned with HEPA vacuuming equipment while the HVAC system is under constant negative pressure and shall not be permitted to get wet according to NADCA ACR 2006.
 - b. Cleaning methods used shall not cause damage to fibrous-glass components and will render the system capable of passing the HVAC System Cleanliness Tests (see NADCA ACR 2006).
 - c. Fibrous materials that become wet shall be discarded and replaced.
- N. Coil Cleaning:
 - 1. Measure static-pressure differential across each coil.
 - 2. See NADCA ACR 2006, "Coil Surface Cleaning" Section. Type 1, or Type 1 and Type 2, cleaning methods shall be used to render the coil visibly clean and capable of passing Coil Cleaning Verification (see applicable NADCA ACR 2006).
 - 3. Coil drain pans shall be subject to NADCA ACR 2006, "Non-Porous Surfaces Cleaning Verification." Ensure that condensate drain pans are operational.
 - 4. Electric-resistance coils shall be de-energized, locked out, and tagged before cleaning.
 - 5. Cleaning methods shall not cause any appreciable damage to, cause displacement of, inhibit heat transfer, or cause erosion of the coil surface or fins, and shall comply with coil manufacturer's written recommendations when available.
 - 6. Rinse thoroughly with clean water to remove any latent residues.
- O. Antimicrobial Agents and Coatings:

1. Apply antimicrobial agents and coatings if active fungal growth is reasonably suspected or where unacceptable levels of fungal contamination have been verified. Apply antimicrobial agents and coatings according to manufacturer's written recommendations and EPA registration listing after the removal of surface deposits and debris.
2. When used, antimicrobial treatments and coatings shall be applied after the system is rendered clean.
3. Apply antimicrobial agents and coatings directly onto surfaces of interior ductwork.
4. Sanitizing agent products shall be registered by the EPA as specifically intended for use in HVAC systems and ductwork.

3.4 CLEANLINESS VERIFICATION

- A. Verify cleanliness according to NADCA ACR 2006, "Verification of HVAC System Cleanliness" Section.
- B. Verify HVAC system cleanliness after mechanical cleaning and before applying any treatment or introducing any treatment-related substance to the HVAC system, including biocidal agents and coatings.
- C. Perform visual inspection for cleanliness. If no contaminants are evident through visual inspection, the HVAC system shall be considered clean. If visible contaminants are evident through visual inspection, those portions of the system where contaminants are visible shall be re-cleaned and subjected to re-inspection for cleanliness.
- D. Additional Verification:
 1. Perform surface comparison testing or NADCA vacuum test.
 2. Conduct NADCA vacuum gravimetric test analysis for nonporous surfaces.
- E. Verification of Coil Cleaning:
 1. Measure static-pressure differential across each coil.
 2. Coil will be considered clean if cleaning restored the coil static-pressure differential within 10 percent of the differential measured when the coil was first installed.
 3. If no information on existing coil initial pressure drop, coil will be considered clean if the coil is free of foreign matter and chemical residue, based on a thorough visual inspection.
- F. Prepare a written cleanliness verification report. At a minimum, include the following:
 1. Written documentation of the success of the cleaning.
 2. Site inspection reports, initialed by supervisor, including notation on areas of inspection, as verified through visual inspection.
 3. Surface comparison test results if required.
 4. Gravimetric analysis (nonporous surfaces only).
 5. System areas found to be damaged.

3.5 RESTORATION

- A. Restore and repair HVAC air-distribution equipment, ducts, plenums, and components according to NADCA ACR 2006, "Restoration and Repair of Mechanical Systems" Section.
- B. Restore service openings capable of future reopening. Comply with requirements in Section 233113 "Metal Ducts." Include location of service openings in Project closeout report.
- C. Replace fibrous-glass materials that cannot be restored by cleaning or resurfacing. Comply with requirements in Section 233113 "Metal Ducts" and Section 233116 "Nonmetal Ducts."
- D. Replace damaged insulation according to Section 230713 "Duct Insulation."

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- E. Ensure that closures do not hinder or alter airflow.
- F. New closure materials, including insulation, shall match opened materials and shall have removable closure panels fitted with gaskets and fasteners.

END OF SECTION 230130

SECTION 230400 - GENERAL CONDITIONS FOR MECHANICAL TRADES

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Section 01 90 00 -Building Commissioning Requirements.

1.2 DESCRIPTION

- A. The General Conditions and Supplementary General Conditions are a part of this Division and are to be considered a part of this Contract.
- B. Demolition and renovation work shall be performed in accordance with SMACNA IAQ Guidelines for Occupied Buildings under Construction.

1.3 INTENT

- A. It is the intent of the Specifications and Drawings to call for finished work, tested and ready for operation.
- B. Any apparatus, appliance, material or work not shown on drawings but mentioned in the specifications, or vice versa, or any incidental accessories necessary to make the work complete and perfect in all respects and ready for operation as determined by good trade practice even if not particularly specified, shall be furnished, delivered and installed under their respective Divisions without any additional expense to the Owner.
- C. Minor details not usually shown or specified but necessary for proper installation and operation shall be included in the work as though they were hereinafter shown or specified.
- D. Work under each Section shall include giving written notice to the Owner and Engineer of any materials or apparatus believed inadequate or unsuitable; in violation of laws, ordinances, rules or regulations of authorities having jurisdiction; and any necessary items of work omitted. In the absence of such written notice, it is mutually agreed that the work under each Section includes the cost of all required items for the accepted, satisfactory functioning of the entire system without extra compensation.

1.4 DEFINITIONS

- A. "Approve": The term "approve", where used in conjunction with the Engineer's action on the Contractor's submittals, applications, and requests, is limited to the Engineer's duties and responsibilities as stated in General and Supplementary Conditions.
- B. "Approved equal" means any product which in the opinion of the Engineer is equal in quality, arrangement, appearance, and performance to the product specified.
- C. "Directed": Terms such as "directed", "requested", "authorized", "selected", "approved", "required", and "permitted" mean "directed by the Engineer", "requested by the Engineer", and similar phrases.

- D. "Finished" refers to all rooms and areas to be specified to receive architectural treatment as indicated on the drawings. All rooms and areas not covered, including underground tunnels and areas above ceilings shall be considered not finished, unless otherwise noted.
- E. "Furnish" or "supply" shall mean purchase, deliver to, and off-load at the job site, ready to be installed including where appropriate all necessary interim storage and protection.
- F. "Indicated": The term "indicated" refers to graphic representations, notes, or schedules on the Drawings, other paragraphs or schedules in the Specifications, and similar requirements in the Contract Documents. Where terms such as "shown", "noted", "scheduled" and "specified" are used, it is to help the reader locate the reference; no limitation on location is intended.
- G. "Install" shall mean set in place complete with all mounting facilities and connections as necessary ready for normal use or service.
- H. "Product" shall mean any item of equipment, material, fixture, apparatus, appliance or accessory installed under this Division.
- I. "Provide" shall mean furnish (or supply) and install as necessary.
- J. "Regulation": The term "Regulation" includes laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, as well as rules, conventions, and agreements within the construction industry that control performance of the Work.
- K. "Remove": The term "remove" means "to disconnect from its present position, remove from the premises and to dispose of in a legal manner".
- L. "Special Warranties": The term "Special Warranties" are written warranties required by or incorporated in the Contract Documents, either to extend time limits provided by standard warranties or to provide greater rights for the Owner.
- M. "Standard Product Warranties": The term "Standard Product Warranties" are preprinted written warranties published by individual manufacturers for particular products and are specifically endorsed by the manufacturer to the Owner.
- N. "Subcontractor" means specifically the subcontractor working under this Division. Other Contractors are specifically designated "Mechanical Subcontractor", "General Contractor" and so on. Note: Take care to ascertain limits of responsibility for connecting equipment which requires connections by two or more trades.
- O. "Substitutions": Requests for changes in products, materials, equipment, and methods of construction proposed by the Contractor are considered requests for "substitutions".
- P. "Wiring" shall mean cable assembly, raceway, conductors, fittings and any other necessary accessories to make a complete wiring system.

1.5 DRAWINGS

- A. Drawings are diagrammatic and indicate the general arrangement of systems and work included in the Contract. Consult the Architectural Drawings and Details for exact location of fixtures and equipment; where same are not definitely located, obtain this information from the Architect. (Do not scale the drawings)
- B. Work under each Section shall closely follow Drawings in layout of work; check

Drawings of other Divisions to verify spaces in which work will be installed. Maintain maximum headroom; where space conditions appear inadequate, Owner and Engineer shall be notified before proceeding with installations.

- C. The Owner may, without extra charge, make reasonable modifications in the layout as needed to prevent conflict with work of other trades and/or for proper execution of the work.
- D. Where variances occur between the Drawings and Specifications or within either of the Documents, the item or arrangement of better quality, shall be included in the Contract price. The Owner and Engineer shall decide on the item and the manner in which the work shall be installed.

1.6 SURVEYS AND MEASUREMENTS

- A. Before submitting his Bid, the Contractors shall visit the site and become thoroughly familiar with all existing conditions under which work will be installed. This Contract includes all modifications of existing systems required for the installation of new equipment. This Contract includes all necessary offsets, transitions and modifications required to install all new equipment in existing spaces. All new and existing equipment and systems shall be fully operational under this Contract before the job is considered complete. The Contractors shall be held responsible for any assumptions he makes, any omissions or errors he makes as a result of his failure to become fully familiar with the existing conditions at the site and the Contract Documents.
- B. The Contractor shall base all measurements, both horizontal and vertical, from established bench marks. All work shall agree with these established lines and levels. Verify all measurements at the site and check the correctness of same as related to the work.
- C. Should the Contractor discover any discrepancies between actual measurements and those indicated which prevent following good practice or which interfere with the intent of the Drawings and Specifications, the Engineer will be notified and work will not proceed until instructions from the Engineer are received.

1.7 DEMOLITION

- A. Demolition work shall be performed in a neat and orderly fashion. After piping, ductwork, equipment, etc., has been removed, neatly cap remaining ductwork and piping, and insulate caps in accordance to Section 230700 – HVAC Insulation. In finished areas, all ductwork and piping shall be cut back to a concealed location, i.e., within walls, above ceilings, etc., before capping.
- B. Before submitting his Bid, the Contractor shall visit the site with Architectural and Mechanical Plans in hand, and shall inspect all existing systems to determine the extent of demolition work involved. Particular attention is drawn to the removal of existing walls or portions of existing walls. In those areas, all exposed and concealed piping, ductwork, equipment, etc., running across or through affected areas shall be removed as required. Piping and ductwork shall then be either capped, or, if required for the proper continuing operation of an existing system to remain, piping and ductwork shall be rerouted around the affected areas and reconnected as required.
- C. Cut, remove and legally dispose of selected mechanical equipment, components, and materials as indicated, including but not limited to removal of mechanical piping, heating units, and other mechanical items made obsolete by the new Work.

- D. Location of existing systems and equipment shown on the drawings is based on the best available information. The Contractor shall verify dimensions and locations of existing systems and equipment in the field and adjust as necessary.
- E. Certain items of existing equipment and piping or ductwork may be indicated for removal or relocation. Items noted for removal shall be disconnected and disposed of by the Contractor or turned over to the Owner if requested. If instructed to dispose of items, the Contractor shall remove the items from the premises and dispose of them in a safe, legal and responsible manner and location. Items noted for relocation are intended for reuse in another location as designated on the Drawings. It shall be the responsibility of the Contractor to remove the material from its present location, store the material in a safe place and reinstall the material in its new location. Questions regarding the suitability of the material or equipment shall be brought to the attention of the Owner and Engineer in writing.
- F. Demolition work shall be performed in accordance with SMACNA IAQ Guidelines for Occupied Buildings Under Construction.

1.8 REFRIGERANT RECLAMATION

- A. The Contractor shall provide all required equipment and labor to reclaim all chlorofluorocarbon refrigerant liquids and vapors from all refrigeration equipment being demolished under this Contract, including all existing equipment, freon storage tanks and piping. When work on an existing system would otherwise release refrigerant to the environment, the Contractor shall reclaim all refrigerant before commencing with such work.

1.9 CODES AND STANDARDS

- A. Reference Standard Compliance
 - 1. Where equipment or materials are specified to conform to industry and technical society reference standards of the organizations such as American National Standards Institute (ANSI), American Society for Testing and Materials (ASTM), National Electrical Manufacturers Association (NEMA), and Underwriters Laboratories Inc. (UL), submit proof of such compliance. The label or listing by the specified organization will be acceptable evidence of compliance.
 - 2. Independent Testing Organization Certificate: In lieu of the label or listing indicated above, submit a certificate from an independent testing organization, competent to perform testing, and approved by the Engineer. The certificate shall state that the item has been tested in accordance with the specified organization's test methods and that the item complies with the specified organization's reference standard.
- B. The Following Codes and Standards listed below apply to all mechanical work.
 - 1. Wherever Codes and/or Standards are mentioned in these Specifications, the latest applicable edition or revision shall be followed:
 - 2. New York State Building Code – New York Supplement
 - 3. The International Building Code
 - 4. The International Energy Conservation Code
 - 5. The International Mechanical Code
 - 6. The National Electrical Code
 - 7. NFPA 101 Life Safety
 - 8. ASHRAE 90.1 and International Energy Conservation Code

C. The following Standards shall be used where referenced by the following abbreviations:

AABC	Associated Air Balance Council
ACGIH	American Conference of Governmental Industrial Hygienists
ADC	Air Diffusion Council
AGA	American Gas Association
AIA	American Institute of Architects
AMCA	Air Moving and Conditioning Association
ANSI	American National Standards Institute
ARI	Air Conditioning and Refrigeration Institute
ASHRAE	American Society of Heating Refrigeration and Air Conditioning Engineers.
ASME	American Society of Mechanical Engineers
ASTM	American Society of Testing and Materials
AWS	American Welding Society
EJMA	Expansion Joint Manufacturing Association
EPA	Environmental Protection Agency
FM	Factory Mutual
FSSC	Federal Specification
HIS	Hydraulic Institute Standards
IEEE	Institute of Electrical and Electronic Engineers
IRI	Industrial Risk Insurers
ISO	Insurance Services Office
MCAA	Mechanical Contractors Association of America
NBS	National Bureau of Standards
NEBB	National Environmental Balancing Bureau
NEMA	National Electrical Manufacturers Association
NFPA	National Fire Protection Association
NOFI	National Oil Fuel Institute
NSC	National Safety Council
NSF	National Sanitation Foundation
OSHA	Occupational Safety and Health Administration
SBI	Steel Boiler Industry (Division of Hydraulics Institute)
SMACNA	Sheet Metal and Air Conditioning Contractors National Association
STI	Steel Tank Institute
UL	Underwriters Laboratories

- D. All materials furnished and all work installed shall comply with the rules and recommendations of the NFPA, the requirements of the local utility companies, the recommendations of the fire insurance rating organization having jurisdiction and the requirements of all Governmental departments having jurisdiction.
- E. The Contractor shall include in the work, without extra cost to the Owner, any labor, materials, services, apparatus and Drawings in order to comply with all applicable laws, ordinances, rules and regulations, whether shown on Drawings and/or specified or not.

1.10 PERMITS AND FEES

- A. The Contractor shall give all necessary notices, obtain all permits; and pay all Government and State sales taxes and fees where applicable, and other costs, including utility connections or extensions in connection with the work, file all necessary Drawings, prepare all documents and obtain all necessary approvals of all Governmental and State departments having jurisdiction, obtain all required certificates of inspection for his work, and deliver a copy to the Owner and Engineer before request

for acceptance and final payment for the work.

1.11 EQUIPMENT SUBSTITUTIONS

- A. In these Specifications and on the accompanying Drawings, one or more makes of materials, apparatus or appliances may have been specified for use in this installation. This has been done for convenience in fixing the standard of workmanship, finish and design required for installation. The details of workmanship, finish and design, and the guaranteed performance of any material, apparatus or appliance which the Contractor desires to deviate from those mentioned herein shall also conform to these standards.
- B. Where no specific make of material, apparatus or appliance is mentioned any first-class product made by a reputable manufacturer may be submitted for the Engineers review.
- C. Where two or more names are given as equivalents, the Contractor must use the specified item or one of the named equivalents. Where one name only is used and is followed by the words "or approved equal", the Contractor must use the item named or he may apply for a substitution. Where one name only is used, the Contractor must use that item named.
- D. Equipment, material or devices submitted for review as an "equivalent" shall meet the following requirements:
 - 1. The equivalent shall have the same construction features such as, but not limited to:
 - a. Material thickness, gauge, weight, density, etc.
 - b. Welded, riveted, bolted, etc., construction.
 - c. Finish, undercoating, corrosion protection.
 - 2. The equivalent shall perform with the same or better operating efficiency.
 - 3. The equivalent shall be locally represented by the manufacturer for service, parts and technical information.
 - 4. The equivalent shall bear the same labels of performance certification as is applicable to the specified item, such as AMCA or ARI labels.
- E. Where the Contractor proposes to deviate from the equipment or materials as hereinafter specified, he shall do so by making a request in writing. The Contractor shall state in his request the amount of credit or extra cost involved. A copy of said request shall be included in the Mechanical Base Bid with manufacturer's equipment cuts. The Base Bid shall be based on using the materials and equipment as specified with no exceptions.
- F. Where the Contractor proposes to use an item of equipment other than specified or detailed on the Drawings which requires any redesign of the structure, partitions, foundations, piping, wiring or any other part of the mechanical, electrical or architectural layout, all such redesign and all new drawings and detailing required therefore shall be prepared by the Designers of Record at the expense of the Contractor and at no additional cost to the Owner.
- G. Where such accepted substitution requires a different quantity and arrangement of piping, ductwork, valves, pumps, insulation, wiring, conduit and equipment from that specified or indicated on the Drawings, the Contractor shall, with the acceptance by the Engineer, furnish and install any such additional equipment required by the system at no additional cost to the Owner, including any costs added to other trades due to the substitution.

- H. Equipment, material or devices submitted for review as a "substitution" shall meet the following requirements:
1. Substitution Request Submittal: Requests for substitution will be considered if received in writing 14 days before the bid date. Requests received later than 14 days before the bid date may be considered or rejected at the discretion of the Engineer.
 - a. Submit three (3) copies of each request for substitution for consideration.
 - b. Identify the product, or the fabrication or installation method to be replaced in each request. Include related Specification Section and Drawing numbers. Provide complete documentation showing compliance with the requirements for substitutions, and the following information, as appropriate:
 - 1) Product Data, including Drawings and descriptions of products, fabrication and installation procedures.
 - 2) Samples, where applicable or requested.
 - 3) A detailed comparison of significant qualities of the proposed substitution with those of the Work specified. Significant qualities may include elements such as size, weight, durability, performance and visual effect.
 - 4) Coordination information, including a list of changes or modifications needed to other parts of the Work and to construction performed by the Owner and separate Contractors that will become necessary to accommodate the proposed substitution.
 - 5) A statement indicating the substitution's effect on the Contractor's Construction Schedule compared to the schedule without approval of the substitution. Indicate the effect of the proposed substitution on overall Contract Time.
 - 6) Cost information, including a proposal of the net change, if any in the Contract Sum.
 - 7) Certification by the Contractor that the substitution proposed is equal to or better in every significant respect to that required by the Contract Documents, and that it will perform adequately in the application indicated. Include the Contractor's waiver of rights to additional payment or time, that may subsequently become necessary because of the failure of the substitution to perform adequately.
 2. Engineer's Action: Within one week of receipt of the request for substitution, the Engineer will notify the Contractor of acceptance or rejection of the proposed substitution. If a decision on use of a proposed substitute cannot be made or obtained within the time allocated, use the product specified by name. Acceptance of a product substitution will be in the form of an Addendum.
 3. Other Conditions: The Contractor's substitution request will be received and considered by the Engineer when one or more of the following conditions are satisfied, as determined by the Engineer; otherwise requests will be returned without action except to record noncompliance with these requirements.
 - a. The specified product or method of construction cannot be provided within the Contract Time. The request will not be considered if the product or method cannot be provided as a result of failure to pursue the Work promptly or coordinate activities properly.
 - b. A substantial advantage is offered to the Owner, in terms of cost, time, energy conservation or other considerations of merit, after deducting offsetting responsibilities the Owner may be required to bear. Additional responsibilities for the Owner may include additional compensation to the

Engineer for redesign and evaluation services, increased cost of other construction by the Owner or separate Contractors, and similar considerations.

1.12 SUBMITTAL PROCEDURES

- A. Provide Submittals in accordance with the requirements of Division I and as indicated in the following.
- B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities. Transmit each submittal sufficiently in advance of performance of related construction activities to avoid delay.
1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals and related activities that require sequential activity.
 2. Coordinate transmittal of different types of submittals for related elements of the Work so processing will not be delayed by the need to review submittals concurrently for coordination. The Engineer reserves the right to withhold action in a submittal requiring coordination with other submittals until related submittals are received.
- C. Processing: Allow sufficient review time so that installation will not be delayed as a result of the time required to process submittals, including time for resubmittals.
1. Allow two weeks for initial review. Allow additional time if processing must be delayed to permit coordination with subsequent submittals. The Engineer will promptly advise the Contractor when a submittal being processed must be delayed for coordination.
 2. If an intermediate submittal is necessary, process the same as the initial submittal.
 3. Allow two weeks for reprocessing each submittal.
 4. No extension of Contract Time will be authorized because of failure to transmit submittals to the Engineer sufficiently in advance of the Work to permit processing.
- D. Submittal Preparation: Place a permanent label or title block on each submittal for identification. Indicate the name of the entity that prepared each submittal on the label or title block. Submittals shall be arranged in order of specification sections.
1. Include the following information on the label for processing and recording action taken.
 - a. Project name.
 - b. Date.
 - c. Name and address of Engineer.
 - d. Name and address of Contractor.
 - e. Name and address of subcontractor.
 - f. Name and address of supplier.
 - g. Name of manufacturer.
 - h. Number, title and paragraph of appropriate Specification Section.
 - i. Drawing number and detail references, as appropriate.
- E. Submittal Transmittal: Package each submittal appropriately for transmittal and handling. Transmit each submittal from Contractor to Architect or Engineer using a transmittal form. Submittals received from sources other than the Contractor will be returned without action. On the transmittal, record relevant information and requests for data. On the form, or separate sheet, record deviations from Contract Document requirements, including minor

variations and limitations. Include Contractor's certification that information complies with Contract Document requirements.

- F. Except for submittals for record, information or similar purposes, the Engineer will review each submittal, mark to indicate action taken, and return promptly. Compliance with specified characteristics is the Contractor's responsibility.
- G. Action Stamp: The Engineer will stamp each submittal with a uniform, self-explanatory action stamp. The stamp will be appropriately marked, to indicate the action taken.

1.13 SHOP DRAWINGS

- A. Submit neatly prepared information, drawn to accurate scale. Highlight, encircle, or otherwise indicate deviations from the Contract Documents. Do not reproduce Contract Documents or copy standard information as a basis for Shop Drawings. Standard information without specific reference to the Project is not considered Shop Drawings.
- B. The Contractor shall submit for review detailed shop drawings of all equipment and material specified in each section and coordinated ductwork layouts. No material or equipment may be delivered to the job site or installed until the Contractor has received shop drawings for the particular material or equipment which have been properly reviewed. Shop drawings shall be submitted within 60 days after award of Contract before any material or equipment is purchased. The Contractor shall submit for review copies of all shop drawings to be incorporated in the Mechanical Contract. Refer to Division 1 for the quantity of copies required for submission. Where quantities are not specified, provide seven (7) copies for review.
- C. Provide shop drawings for all devices specified under equipment specifications for all systems. Shop drawings shall include manufacturers' names, catalog numbers, cuts, diagrams, dimensions, identification of products and materials included, compliance with specified standards, notation of coordination requirements, notation of dimensions established by field measurement and other such descriptive data as may be required to identify and accept the equipment. A complete list in each category (example: all fixtures), of all shop drawings, catalog cuts, material lists, etc., shall be submitted to the Engineer at one time. No consideration will be given to a partial shop drawing submittal.
- D. When a submittal could involve more than one trade, e.g., valves, piping, etc., the submitted shall be separated by traded involved, i.e. HVAC, plumbing, fire protection, etc.
- E. Where multiple quantities or types of equipment are being submitted, provide a cover sheet (with a list of contents) on the submittal identifying the equipment or material being submitted.
- F. The Contractor shall furnish all necessary templates, patterns, etc., for installation work and for the purpose of making adjoining work conform; furnish setting plans and shop details to other trades as required.
- G. "No Exception Taken" rendered on shop drawings shall not be considered as a guarantee of measurements or building conditions. Where drawings are reviewed, review does not mean that drawings have been checked in detail; said approval does not in any way relieve the Contractor from his responsibility or necessity of furnishing material or performing work as required by the Contract Drawings and Specifications. Verify available space prior to submitting shop drawings. Review of shop drawings shall not apply to quantity of material.

- H. After shop drawings have been reviewed, with no exceptions taken, no further changes will be allowed without the written consent of the Engineer.
- I. Shop drawing submittal sheets which may show items that are not being furnished shall have those items crossed off to clearly indicate which items will be furnished.
- J. Bidders shall not rely on any verbal clarification of the Drawings and/or Specifications. Any questions shall be referred to the Engineer in writing at least five (5) working days prior to bidding to allow for issuance of an Addendum.
- K. Do not use Shop Drawings without an appropriate final stamp indicating action taken in connection with construction.
- L. Prepare sheet metal shop drawings drawn in the latest AutoCAD version to a minimum scale of 1/4"=1'-0". Final approved drawings shall be turned over to the Owner on floppy disk or CD Rom.

1.14 COORDINATION DRAWINGS

- A. Prepare coordination drawings drawn in the latest AutoCAD version in accordance with Division 1 to a minimum scale of 1/4" 1'-0" detailing major elements, components, and systems of mechanical equipment and materials in relationship with other systems, installations, and building components. Indicate locations where space is limited for installation and access and where sequencing and coordination of installations are of importance to the efficient flow of the Work, including (but not necessarily limited to) the following:
 - B. The Contractor shall indicate the proposed locations of piping, conduit, ductwork, equipment, and materials. Include the following:
 - a. Clearances for servicing and maintaining equipment, including tube removal, filter removal, and space for equipment disassembly required for periodic maintenance.
 - b. Equipment connections and support.
 - c. Exterior wall and foundation penetrations.
 - d. Fire-rated wall and floor penetrations.
 - e. Sizes and locations of required concrete pads and bases.
- C. Coordination drawings will include all major systems, including but not limited to:
 - i. HVAC ductwork and equipment.
 - ii. HVAC piping.
 - iii. Sprinkler piping and sprinkler head location.
 - iv. Sanitary waste and domestic water piping.
 - v. Fuel oil and gas piping.
- D. Indicate scheduling, sequencing, movement, and positioning of large equipment into the building during construction.
- E. Prepare floor plans, elevations, and details to indicate penetrations in floors, walls, and ceilings and their relationship to other penetrations and installations.
- F. Prepare reflected ceiling plans to coordinate and integrate installations, air outlets and inlets, light fixtures, communication systems components, sprinklers, and other ceiling-mounted items.
- G. The Contractor and each major subcontractor (HVAC, Plumbing, Fire Protection and

Electrical) shall sign and date each coordination drawing prior to submission.

- H. Work shall not be performed until coordination drawings have been approved by the architect and engineer.
- I. Electronic copies of the MEP floor plans are available to use as a basis for preparing coordination drawings and can be provided by the Engineer. If the Contractor elects to obtain the Engineers electronic files a CADD File Release Form must be submitted. This form must be signed by the Contractor, Owner, and Architect. Upon receipt of a signed copy of the CADD File Release Form, the Engineer will provide copies of the electronic files for the Contractor's use. A copy of the CADD File Release Form is appended to the end of this specification section.

1.15 COORDINATION WITH OTHER DIVISIONS

- A. All work shall be carried out in conjunction with other trades and full cooperation shall be given in order that all work may proceed with a minimum of delay and interference. Particular emphasis is placed on timely installation of major apparatus and furnishing other Contractors, especially the Contractor or Construction Manager, with information as to openings, chases, sleeves, bases, inserts, equipment locations, panels, etc., required by other trades.
- B. The Contractors are required to examine all of the Project Drawings and mutually arrange work so as to avoid interference with the work of other trades. In general, ductwork, HVAC piping, sprinkler piping and drainage lines take precedence over water, gas and electrical conduits. The Engineer shall make final decisions regarding the arrangement of work which cannot be agreed upon by the Contractors.
- C. Where the work of the Contractor will be installed in close proximity to or will interfere with work of other trades, the Contractors will cooperate in working out space conditions to make a satisfactory adjustment.
- D. If the work under a Section is installed before coordinating with other Divisions or Sections or so as to cause interference with work of other Sections, the necessary changes to correct the condition shall be made by the Contractor causing the interference without extra charge to the Owner.

1.16 WORKMANSHIP

- A. Service Support: The equipment items shall be supported by service organizations which are reasonably convenient to the equipment installation in order to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract. Reasonably convenient, unless specifically approved otherwise shall be considered within a fifty-mile radius of the project site.
- B. Modification of References: In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears.
- C. The Contractor shall furnish the services of an experienced superintendent who shall be constantly in charge of the installation of the work together with all skilled workmen, fitters, metal workers, welders, helpers and laborers required to unload, transfer, erect, connect, adjust, start, operate and test each system.
- D. Unless otherwise specifically indicated on the Drawings or Specifications, all equipment and materials shall be installed with the acceptance of the Engineer and in accordance with

the recommendations of the manufacturer. This includes the performance of such tests as the manufacturer recommends.

- E. All labor for installation of mechanical systems shall be performed by experienced, skilled tradesmen under the supervision of a licensed journeyman foreman. All work shall be of a quality consistent with good trade practice and shall be installed in a neat, workmanlike manner. The Engineer reserves the right to reject any work which, in his opinion, has been installed in a substandard, dangerous or unserviceable manner. The Contractor shall replace said work in a satisfactory manner at no extra cost to the Owner.

1.17 SHUTDOWNS

- A. When installation of a new system requires the temporary shutdown of an existing operating system, the connection of the new system shall be performed at such time as designated by the Owner.
- B. The Engineer and the Owner shall be notified in writing of the estimated duration of the shutdown period at least ten (10) days in advance of the date the work is to be performed.
- C. Work shall be arranged for continuous performance whenever possible. The Contractor shall provide all necessary labor, including overtime if required, to assure that existing operating services will be shut down only during the time actually required to make necessary connections.

1.18 TEMPORARY UTILITIES

- A. General: Provide new materials and equipment; if acceptable to the Engineer, undamaged previously used materials in serviceable condition may be used. Provide materials suitable for the use intended.
- B. Conditions of Use: Keep temporary services and facilities clean and neat in appearance. Operate in a safe and efficient manner. Take necessary fire prevention measures. Do not overload facilities, or permit them to interfere with progress. Do not allow hazardous dangerous or unsanitary conditions, or public nuisances to develop or persist on the site.
- C. First Aid Supplies: Comply with governing regulations.
- D. Fire Extinguishers: Provide hand-carried, portable UL-rated, class "A" fire extinguishers for temporary offices and similar spaces. In other locations provide hand-carried, portable, UL-rated, class "ABC" dry chemical extinguishers, or a combination of extinguishers of NFPA recommended classes for the exposures.
- E. Temporary Heat-Cool-Dehumidification: Provide temporary services required by construction activities, for curing or drying of completed installations or protection of installed construction from adverse effects of low temperatures or high humidity. Select safe equipment that will not have a harmful effect on completed installations or elements being installed. Coordinate temporary services to produce the ambient condition required and minimize consumption of energy. The building's permanent HVAC systems shall not be used for these purposes. When propane is used for temporary heat, contractor shall be trained per state's department of public safety or equivalent requirements in storing, use and emergency planning of propane systems for temporary heat at construction sites. Documentation of trained personnel shall be kept on site.
- F. Environmental Protection: Provide protection, operate temporary facilities and conduct construction in ways and by methods that comply with environmental regulations, and

eliminate the possibility that air, waterways and subsoil might be contaminated or polluted, or that other undesirable effects might result. Avoid use of tools and equipment which produce harmful noise. Restrict use of noise making tools and equipment to hours that will minimize complaints from persons or firms near the site.

- G. Termination and Removal: Unless the Engineer requires that it be maintained longer, remove each temporary facility when the need has ended, or when replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with the temporary facility. Repair damaged Work, clean exposed surfaces and replace construction that cannot be satisfactorily repaired. Materials and facilities that constitute temporary facilities are property of the Contractor. The Owner reserves the right to take possession of Project identification signs.

1.19 BUILDING FLUSH-OUT

- A. Building flush-out shall begin after construction ends and finishes are installed but prior to building occupancy. Prior to building flush-out, HVAC systems shall be balanced per Specification Section 23 05 93. Flush-out shall not occur until contractor receives permission to proceed from the Owner or Owner's representative. Flush-out shall continue during the first weeks of occupancy as scheduled below.
- B. Building flush-out procedures shall include continuously operating all the building's new ventilation systems at maximum design outside air flow rates. For constant volume HVAC systems, ventilation systems shall operate at maximum design supply air flow rates. For VAV systems, supply air flow shall be allowed to vary to maintain space temperatures. HVAC systems shall be set to maintain internal space temperatures at minimum 60°F and maximum 78°F and relative humidity at maximum 60% RH.
- C. Building flush-out prior to occupancy: HVAC systems shall operate continuously, 24 hours per day, for a minimum period of 12 days. Commissioning and testing of the HVAC systems' temperature controls shall be allowed during this time frame.
- D. Building flush-out at start of occupancy: HVAC systems shall operate continuously, 24 hours per day, for a minimum period of 40 days.

1.20 PROJECT PHASING

- A. Work under each Section shall include all necessary temporary connections, equipment, piping, heating, temperature control work, fire stopping, water heaters, labor, and material as necessary to accommodate the phasing of Construction as developed by the General Contractor or Construction Manager and approved by the Owner. All existing systems that pass-thru an area of the building shall remain operational during all phases of construction. No extra compensation shall be granted the Contractor for work required to maintain existing systems operational or to accommodate the construction phasing of the project.

1.21 PROTECTION OF MATERIALS AND EQUIPMENT

- A. Work under each Section shall include protecting the work and material of all other Sections from damage by work or workmen and shall include corrective actions to damage thus caused.
- B. The Contractor shall be responsible for work and equipment until the facility has been accepted by the Owner. Protect work against theft, injury or damage and carefully

store material and equipment received on site which is not immediately installed. Close open ends of work with temporary covers or plugs during construction to prevent entry of foreign material.

- C. Work under each Section includes receiving, unloading, uncrating, storing, protecting, setting in place and completely connecting equipment supplied under each Section. Work under each Section shall also include exercising special care in handling and protecting equipment and fixtures, and shall include the cost of replacing any of the equipment and fixtures which are missing or damaged.
- D. Equipment and material stored on the job site shall be protected from the weather, vehicles, dirt and/or damage by workmen or machinery. Insure that all electrical or absorbent equipment or material is protected from moisture during storage.

1.22 ADJUSTING AND TESTING

- A. After all the equipment and accessories to be furnished are in place, they shall be put in final adjustment and subjected to such operating tests so as to assure the Engineer that they are in proper adjustment and in satisfactory, permanent operating condition.
- B. Where requested by the Engineer, a factory-trained service representative shall inspect the installation and assist in the initial startup and adjustment to the equipment. The period of these services shall be for such time as necessary to secure proper installation and adjustments. After the equipment is placed in permanent operation, the service representative shall supervise the initial operation of the equipment and instruct personnel responsible for operation and maintenance of the equipment. The service representative shall notify the Contractor in writing that the equipment was installed according to manufacturer's recommendations and is operating as intended by the manufacturer.
- C. Contractor is responsible for completing all pre-functional and functional checklist items to the satisfaction of the Commissioning Agent. See Sections 01 90 00 and 23 08 00 for additional requirements.

1.23 CLEANING

- A. The Contractor shall thoroughly clean and flush all piping, ducts and equipment of all foreign substances, oils, burrs, solder, flux, etc., inside and out before being placed in operation.
- B. If any part of a system should be stopped or damaged by any foreign matter after being placed in operation, the system shall be disconnected, cleaned and reconnected wherever necessary to locate and/or remove obstructions. Any work damaged in the course of removing obstructions shall be repaired or replaced when the system is reconnected at no additional cost to the Owner.
- C. During the course of construction, all ducts and pipes shall be capped in an acceptable manner to insure adequate protection against the entrance of foreign matter.
- D. Upon completion of all work under the Contract, the Contractor shall remove from the premises all rubbish, debris and excess materials left over from his work. Any oil or grease stains on floor areas caused by the Contractor shall be removed and floor areas left clean.
- E. Complete the following cleaning operations before requesting inspection for Certification of Substantial Completion.

1. Remove labels that are not permanent labels.
 2. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compound and other substances that are noticeable vision-obscuring materials. Replace chipped or broken glass and other damaged transparent materials.
 3. Clean exposed exterior and interior hard-surfaced finishes to a dust-free condition, free of stains, films and similar foreign substances. Restore reflective surfaces to their original reflective condition. Leave concrete floors broom clean. Vacuum carpeted surfaces.
 4. Wipe surfaces of mechanical and electrical equipment. Remove excess lubrication and other substances.
- F. Comply with regulations of authorities having jurisdiction and safety standards for cleaning. Do not burn waste materials. Do not bury debris or excess materials on the Owner's property. Do not discharge volatile, harmful or dangerous materials into drainage systems. Remove and dispose of ALL waste materials, packaging material, skids etc. from the site and dispose of in a lawful manner in accordance with municipal, state and federal regulations.
- G. Where extra materials of value remaining after completion of associated Work have become the Owner's property, arrange for disposition of these materials as directed.

1.24 OPERATING AND MAINTENANCE

- A. Upon completion of all work and tests, the Contractor shall furnish the necessary skilled labor and helpers for operating his system and equipment for a period specified under each applicable Section of this Division. During this period, he shall fully instruct the Owner or the Owner's representative in the operation, adjustment and maintenance of all equipment furnished. The Contractor shall give at least seven (7) days notice to the Owner and the Engineer in advance of this period.
- B. The Contractor shall include the maintenance schedule for the principal items of equipment furnished under this Division.
- C. The Contractor shall physically demonstrate procedures for all routine maintenance of all equipment furnished under each respective Section to assure accessibility to all devices.
- D. An authorized manufacturer's representative shall attest in writing that the equipment has been properly installed prior to startup of any major equipment. The following equipment will require this inspection: pumps; air conditioning equipment, controls, air handling equipment, compressors, boilers etc. These letters shall be bound into the operating and maintenance books.
- E. Refer to individual trade Sections for any other particular requirements related to operating instructions.

1.25 OPERATING AND MAINTENANCE MANUALS

- A. Prepare operating and maintenance manuals in accordance with the requirements of Division I and requirements listed below. The Contractor shall prepare six (6) copies of a complete maintenance and operating instructions manual, bound in booklet form. Organize operating and maintenance data into

suitable sets of manageable size. Bind properly indexed data in individual heavy-duty 3-ring vinyl-covered binders, with pocket folders for folded sheet information and designation partitions with identification tabs. Mark appropriate identification on front and spine of each binder.

- B. Manual shall include the following:
1. Description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and commercial numbers of replacement parts.
 2. Manufacturer's printed operating procedures to include start-up, break-in, and routine and normal operating instructions; regulation, control, stopping, shutdown, and emergency instructions; and summer and winter operating instructions.
 3. Maintenance procedures for routine preventative maintenance and trouble-shooting; disassembly, repair, and reassembly; aligning and adjusting instructions.
 4. Servicing and operating instructions including lubrication charts and schedules.
 5. Emergency and safety instructions.
 6. Spare parts list.
 7. Copies of warranties.
 8. Wiring diagrams.
 9. Recommended "turn around" cycles.
 10. Inspection procedures.
 11. Approved Shop Drawings and Product Data.
 12. Equipment Start-up Reports.
 13. Temperature control diagrams and written sequences of operations.
 14. Balance reports.
- C. Include in the manual, a tabulated equipment schedule for all equipment. Schedule shall include pertinent data such as: make, model number, serial number, voltage, normal operating current, belt size, filter quantities and sizes, bearing number, etc. Schedule shall include maintenance to be done and frequency.
- D. Maintenance and instruction manuals shall be submitted to the Owner at the same time as the seven (7) day notice is given prior to the instruction period.

1.26 ACCEPTANCES

- A. The equipment, materials, workmanship, design and arrangement of all work installed under the Mechanical Sections shall be subject to the review of the Engineer.
- B. Within 30 days after the awarding of a Contract, the Mechanical Contractor shall submit to the Engineer, for review, a list of manufacturers of equipment proposed for the work under the Mechanical Sections. The intent to use the exact manufacturers and models specified does not relieve the Contractor of the responsibility of submitting such a list.
- C. If extensive or unacceptable delivery time is expected on a particular item of equipment specified, the Contractor shall notify the Owner and Engineer, in writing, within 30 days of award of the Contract. In such instances, equipment substitutions may be made pending acceptance by the Engineer or the Owner's representative.
- D. Where any specific material, process or method of construction or manufactured article is specified by reference to the catalog number of a manufacturer, the Specifications are to be used as a guide and are not intended to take precedence over the basic duty and performance specified or noted on the Drawings. In all cases, the Mechanical Contractor shall verify the duty specified with the specific characteristics of the equipment offered for review. Equipment characteristics are to be used as mandatory requirements where the Contractor proposes to use an acceptable equivalent.

- E. If material or equipment is installed before it is reviewed and/or approved, the Contractor shall be liable for its removal and replacement at no extra charge to the Owner if, in the opinion of the Engineer, the material or equipment does not meet the intent of, or standard of quality implied by, the Drawings and Specifications.
- F. Failure on the part of the Engineer to reject shop drawings or to reject work in progress shall not be interpreted as acceptance of work not in conformance with the Drawings and/or Specifications. Work not in conformance with the Drawings and/or Specifications shall be corrected whenever it is discovered.

1.27 RECORD DRAWINGS

- A. General: Do not use record documents for construction purposes; protect from deterioration and loss in a secure, fire-resistive location; provide access to record documents for the Engineer's reference during normal working hours.
- B. Maintain a clean, undamaged set of blue or black line white-prints of Contract Drawings and Shop Drawings. Mark the set to show the actual installation where the installation varies from the Work as originally shown. Mark whichever drawing is most capable of showing conditions fully and accurately. Give particular attention to concealed elements that would be difficult to measure and record at a later date. Items to be indicated include but are not limited to:
 - 1. Dimensional change
 - 2. Revision to drawing detail
 - 3. Location and depth of underground utility
 - 4. Revision to pipe routing
 - 5. Revision to electrical circuitry
 - 6. Actual equipment location
 - 7. Duct size and routing
 - 8. Location of concealed internal utility
 - 9. Changes made by Change Order
 - 10. Details not on original Contract Drawing
 - 11. Information on concealed elements which would be difficult to identify or measure later
- C. Mark record sets with red erasable pencil; use other colors to distinguish between variations in separate categories of the Work.
- D. Mark new information that is important to the Owner, but was not shown on Contract Drawings or Shop Drawings.
- E. Note related Change Order numbers where applicable.
- F. Organize record drawing sheets into manageable sets, bind with durable paper cover sheets, and print suitable titles, dates and other identification on the cover of each set.
- G. Final record documents shall be prepared in the latest AutoCAD version and CD Rom of all drawings and a clean set of reproducible drawings shall be turned over to the Owner at the completion of the work.

1.28 WARRANTIES AND BONDS

- A. The following general administrative and procedural requirements for warranties and

bonds required by the Contract Documents, including manufacturer's standard warranties on products and special warranties are to be included:

1. General close-out requirements included in Division 1 .
 2. Specific requirements for warranties for the Work and products and installation that are specified to be warranted are included in the individual Sections of Divisions-23.
 3. Certifications and other commitments and agreements for continuing services to Owner are specified elsewhere in the Contract Documents.
- B. Disclaimers and Limitations: Manufacturer's disclaimers and limitations on product warranties do not relieve the Contractor of the warranty on the Work that incorporates the products, nor does it relieve suppliers, manufacturers, and subcontractors required to countersign special warranties with the Contractor.
- C. Separate Prime Contracts: Each prime Contractor is responsible for warranties related to its own Contract.

1.29 WARRANTY REQUIREMENTS

- A. Related Damages and Losses: When correcting warranted Work that has failed, remove and replace other Work that has been damaged as a result of such failure or that must be removed and replaced to provide access for correction of warranted Work.
- B. Reinstatement of Warranty: When Work covered by a warranty has failed and been corrected by replacement or rebuilding, reinstate the warranty by written endorsement. The reinstated warranty shall be equal to the original warranty with an equitable adjustment for depreciation.
- C. Replacement Cost: Upon determination that Work covered by a warranty has failed, replace or rebuild the Work to an acceptable condition complying with requirements of Contract Documents. The Contractor is responsible for the cost of replacing or rebuilding defective Work regardless of whether the Owner has benefited from use of the Work through a portion of its anticipated useful service life.
- D. Owner's Recourse: Written warranties made to the Owner are in addition to implied warranties, and shall not limit the duties, obligations, right and remedies otherwise available under the law, nor shall warranty periods be interpreted as limitations on time in which the Owner can enforce such other duties, obligations, rights, or remedies.
- E. Rejection of Warranties: The Owner reserves the right to reject warranties and to limit selections to products with warranties not in conflict with requirements of the Contract Documents.
- F. The Owner reserves the right to refuse to accept Work for the Project where a special warranty, certification, or similar commitment is required on such Work or part of the Work, until evidence is presented that entities required to countersign such commitments are willing to do so.
- G. Submit written warranties to the Engineer prior to the date certified for Substantial Completion. If the Engineer's Certificate of Substantial Completion designates a commencement date for warranties other than the date of Substantial Completion for the Work, or a designated portion of the Work, submit written warranties upon request of the Engineer.
- H. When a designated portion of the Work is completed and occupied or used by the Owner,

by separate agreement with the Contractor during the construction period, submit properly executed warranties to the Engineer within fifteen days of completion of that designated portion of the Work.

- I. When a special warranty is required to be executed by the Contractor, or the Contractor and a subcontractor, supplier or manufacturer, prepare a written document that contains appropriate terms and identification, ready for execution by the required parties. Submit a draft to the Owner through the Engineer for approval prior to final execution.
 - 1. Refer to individual Sections of Divisions-23 for specific content requirements, and particular requirements for submittal of special warranties.
- J. Form of Submittal: At Final Completion compile two copies of each required warranty and bond properly executed by the Contractor, or by the Contractor, subcontractor, supplier, or manufacturer. Organize the warranty documents into an orderly sequence based on the table of contents of the Project Manual.
- K. Bind warranties and bonds in heavy-duty, commercial quality, durable 3-ring vinyl covered loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2" by 11" paper.
 - 1. Provide heavy paper dividers with celluloid covered tabs for each separate warranty. Mark the tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product, and the name, address and telephone number of the installer.
 - 2. Identify each binder on the front and the spine with the typed or printed title "WARRANTIES AND BONDS," the Project title or name, and the name of the Contractor.
 - 3. When operating and maintenance manuals are required for warranted construction, provide additional copies of each required warranty, as necessary, for inclusion in each required manual.

1.30 GUARANTEES

- A. The Contractor shall guarantee all material and workmanship under these Specifications and the Contract for a period of one (1) year from the date of final acceptance by Owner. During this guarantee period, all defects developing through faulty equipment, materials or workmanship shall be corrected or replaced immediately by this Contractor without expense to the Owner. Such repairs or replacements shall be made to the Engineer's satisfaction.
- B. Contractor shall provide name, address, and phone number of all contractors and subcontractors and associated equipment they provided.

1.31 PROJECT CLOSE-OUT

- A. Submit specific warranties, workmanship bonds, maintenance agreements, final certifications and similar documents in accordance with Division 1.
- B. Deliver tools, spare parts, extra stock, and similar items.
- C. Complete start-up testing of systems, and instruction of the Owner's operating and maintenance personnel. Discontinue or change over and remove temporary facilities from the site, along with construction tools, mock-ups, and similar elements.
- D. Complete final clean up requirements, including touch-up painting. Touch-up and

otherwise repair and restore marred exposed finishes.

- E. Field Observation Procedures: On receipt of a request for an Engineers Field Observation, the Engineer will advise the Contractor of unfulfilled requirements. The Engineer will advise the Contractor of construction that must be completed or corrected before the certificate will be issued.
1. The Engineer will repeat the Field Observation when requested and assured that the Work has been substantially completed.
 2. Results of the completed list of unfulfilled items will form the basis of requirements for final acceptance.

END OF SECTION 230400

SECTION 230513 - COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on ac power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

1.3 COORDINATION

- A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:
 - 1. Motor controllers.
 - 2. Torque, speed, and horsepower requirements of the load.
 - 3. Ratings and characteristics of supply circuit and required control sequence.
 - 4. Ambient and environmental conditions of installation location.

PART 2 - PRODUCTS

2.1 GENERAL MOTOR REQUIREMENTS

- A. Comply with NEMA MG 1 unless otherwise indicated.
- B. Comply with IEEE 841 for severe-duty motors.

2.2 MOTOR CHARACTERISTICS

- A. Duty: Continuous duty at ambient temperature of 40 degrees C and at altitude of 3300 feet above sea level.
- B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

2.3 POLYPHASE MOTORS

- A. Description: NEMA MG 1, Design B, medium induction motor.
- B. Efficiency: Premium efficient, as defined in NEMA MG 1.
- C. Service Factor: 1.15.

- D. Multispeed Motors: Variable torque.
 - 1. For motors with 2:1 speed ratio, consequent pole, single winding.
 - 2. For motors with other than 2:1 speed ratio, separate winding for each speed.
- E. Multispeed Motors: Separate winding for each speed.
- F. Rotor: Random-wound, squirrel cage.
- G. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.
- H. Temperature Rise: Match insulation rating.
- I. Insulation: Class F.
- J. Code Letter Designation:
 - 1. Motors 15 HP and Larger: NEMA starting Code F or Code G.
 - 2. Motors Smaller than HP: Manufacturer's standard starting characteristic.
- K. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T

2.4 POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS

- A. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.
- B. Motors Used with Variable Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.
 - 1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.
 - 2. Premium-Efficient Motors: Class B temperature rise; Class F insulation.
 - 3. Inverter-Duty Motors: Class F temperature rise; Class H insulation.
 - 4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.
- C. Severe-Duty Motors: Comply with IEEE 841, with 1.15 minimum service factor.

2.5 SINGLE-PHASE MOTORS

- A. Motors larger than 1/20 HP shall be one of the following, to suit starting torque and requirements of specific motor application:
 - 1. Permanent-split capacitor.
 - 2. Split phase.
 - 3. Capacitor start, inductor run.
 - 4. Capacitor start, capacitor run.
- B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.
- C. Bearings: Pre-lubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.

- D. Motors 1/20 HP and Smaller: Shaded-pole type.
- E. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 230513

SECTION 230516 - EXPANSION FITTINGS AND LOOPS 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. Flexible, ball-joint packed expansion joints.
 - 2. Slip-joint, packed expansion joints.
 - 3. Metal, compensator pack-less expansion joints.
 - 4. Flexible-hose pack-less expansion joints.
 - 5. Metal-bellows pack-less expansion joints.
 - 6. Externally pressurized metal-bellows pack-less expansion joints.
 - 7. Grooved-joint expansion joints.
 - 8. Alignment guides and anchors.
 - 9. Pipe loops and swing connections.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Delegated-Design Submittal: For each anchor and alignment guide, including analysis data, signed and sealed by the qualified professional engineer responsible for their preparation.
 - 1. Design Calculations: Calculate requirements for thermal expansion of piping systems and for selecting and designing expansion joints, loops, and swing connections.
 - 2. Anchor Details: Detail fabrication of each anchor indicated. Show dimensions and methods of assembly and attachment to building structure.
 - 3. Alignment Guide Details: Detail field assembly and attachment to building structure.
 - 4. Schedule: Indicate type, manufacturer's number, size, material, pressure rating, end connections, and location for each expansion joint.

1.4 INFORMATIONAL SUBMITTALS

- A. Welding certificates.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For expansion joints to include in maintenance manuals.

1.6 QUALITY ASSURANCE

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

- B. Pipe and Pressure-Vessel Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Compatibility: Products shall be suitable for piping service fluids, materials, working pressures, and temperatures.
- B. Capability: Products to absorb 200 percent of maximum axial movement between anchors.

2.2 PACKED EXPANSION JOINTS

- A. Flexible, Ball-Joint Packed Expansion Joints:
 - 1. Acceptable Manufacturers:
 - a. Advanced Thermal Systems
 - b. Hyspan Precision Products
 - c. Mason Industries
 - 2. Standards: ASME Boiler and Pressure Vessel Code: Section II, "Materials"; ASME B31.9, "Building Services Piping," for materials and design of pressure-containing parts and bolting.
 - 3. Material: Carbon-steel assembly with asbestos-free composition packing.
 - 4. Design: Provide 360-degree rotation and angular deflection.
 - 5. Minimum Pressure Rating: 250 psig at 400 degrees F.
 - 6. Angular Deflection for NPS 6 and Smaller: 30 degree minimum.
 - 7. Angular Deflection for NPS 8 and Larger: 15 degree minimum.
 - 8. Seal Type: Two carbon steel and graphite seals suitable for continuous operation at temperature up to 650 degrees F.
 - 9. Internal Ball: Plated with minimum 1-mil chrome cover.
 - 10. Ball Socket: One- or two-piece design with integral socket/retainer.
 - a. Stuffing Box: Incorporates containment seals and compression seals for containment of injectable packing.
 - b. Packing Cylinders: Provides packing under full line pressure with check valves to prevent blow-back.
 - 11. End Connections for NPS 2 and Smaller: Threaded.
 - 12. End Connections for NPS 2-1/2 and Larger: Flanged.
- B. Slip-Joint Packed Expansion Joints:
 - 1. Acceptable Manufacturers:
 - a. Advanced Thermal Systems
 - b. Hyspan Precision Products
 - c. Mason Industries
 - 2. Standard: ASTM F 1007.
 - 3. Material: Carbon steel with asbestos-free PTFE packing.
 - 4. Design: With internal guide and injection ports for repacking under full system pressure. Housing shall be furnished with drain ports and lifting ring. Include drip connection if used for steam piping.
 - 5. Configuration: Single joint with base and double joint with base classes unless otherwise indicated.
 - 6. Slip Tube for sizes NPS 1-1/2 through NPS 16: Schedule 80.
 - 7. Sliding Surface: 2 mil thick chrome finish.
 - 8. End Connections: Flanged or welded ends to match piping system.

2.3 PACKLESS EXPANSION JOINTS

A. Metal, Compensator Pack-less Expansion Joints

1. Acceptable Manufacturers:
 - a. Flex-Hose
 - b. Flexicraft
 - c. Flex-Weld
 - d. Metraflex
 - e. Hyspan Precision Products
 - f. Mason Industries
2. Minimum Pressure Rating: 175 psig, unless otherwise indicated.
3. Description: Totally enclosed, externally pressurized, multi-ply bellows isolated from fluid flow by an internal pipe sleeve and external housing.
4. Joint Axial Movement: 2 inches of compression and 1/2 inch of extension.
5. Configuration for Copper Tubing: Multi-ply, phosphor-bronze bellows with copper pipe ends.
 - a. End Connections for Copper Tubing NPS 2 and Smaller: Solder joint or threaded.
 - b. End Connections for Copper Tubing NPS 2-1/2 to NPS 4: Threaded.
6. Configuration for Steel Piping: Multi-ply, stainless-steel bellows; steel-pipe end connections; and carbon-steel shroud.
 - a. End Connections for Steel Pipe NPS 2 and Smaller: Threaded.
 - b. End Connections for Steel Pipe NPS 2-1/2 to NPS 4: Flanged or Welded.

B. Flexible-Hose Pack-less Expansion Joints:

- a. Flex-Hose
- b. Flexicraft
- c. Flex-Weld
- d. Metraflex
- e. Hyspan Precision Products
- f. Mason Industries
2. Description: Manufactured assembly with inlet and outlet elbow fittings and two flexible-metal-hose legs joined by long-radius, 180-degree return bend or center section of flexible hose.
3. Flexible Hose: Corrugated-metal inner hoses and braided outer sheaths.
4. Expansion Joints for Copper Tubing NPS 2 and Smaller: Copper-alloy fittings with soldered joint end connections: Bronze hoses and single-braid bronze sheaths with 340 psig at 450 degree F rating.
5. Expansion Joints for Copper Tubing NPS 2-1/2 to NPS 4: Copper-alloy fittings with threaded end connections: Stainless-steel hoses and single-braid, stainless-steel sheaths with 225 psig at 450 degree F ratings.
6. Expansion Joints for Steel Piping NPS 2 and Smaller: Carbon-steel fittings with threaded end connections: Stainless-steel hoses and single-braid, stainless-steel sheaths with 325 psig at 600 degree F ratings.
7. Expansion Joints for Steel Piping NPS 2-1/2 to NPS 6: Carbon-steel fittings with flanged or welded end connections: Stainless-steel hoses and single-braid, stainless-steel sheaths with 145 psig at 600 degree F rating.

C. Metal-Bellows Pack-less Expansion Joints:

- a. Flex-Hose
- b. Flexicraft
- c. Flex-Weld
- d. Metraflex
- e. Hyspan Precision Products
- f. Mason Industries
2. Standards: ASTM F 1120 and EJMA's "Standards of the Expansion Joint Manufacturers Association, Inc."
3. Type: Circular, corrugated bellows with external tie rods.

4. Minimum Pressure Rating: 175 psig unless otherwise indicated.
5. Configuration: Single joint with base and double joint with base classes, unless otherwise indicated.
6. Expansion Joints for Copper Tubing: Single- or multi-ply phosphor-bronze bellows, copper pipe ends, and brass shrouds.
 - a. End Connections for Copper Tubing NPS 2 and Smaller: Solder joint or threaded.
 - b. End Connections for Copper Tubing NPS 2 ½ and Larger: Flanged.
7. Expansion Joints for Steel Piping: Single- or multi-ply stainless-steel bellows, steel pipe ends, and carbon-steel shroud.
 - a. End Connections for Steel Pipe NPS 2 and Smaller: Threaded.
 - b. End Connections for Steel Pipe NPS 2-1/2 and Larger: Flanged.

D. Externally Pressurized Metal-Bellows Pack-less Expansion

1. Acceptable manufacturers:
 - a. Flex-Hose
 - b. Flexicraft
 - c. Flex-Weld
 - d. Metraflex
 - e. Hyspan Precision Products
 - f. Mason Industries
2. Minimum Pressure Rating: 150 psig, unless otherwise indicated.
3. Description:
 - a. Totally enclosed, externally pressurized, multi-ply, stainless-steel bellows isolated from fluid flow by an internal pipe sleeve.
 - b. Carbon-steel housing.
 - c. Drain plugs and lifting lug for the NPS 3 and larger.
 - d. Bellows shall have operating clearance between the internal pipe sleeves and the external shrouds.
 - e. Joints shall be supplied with a built-in scale to confirm the starting position and operating movement.
 - f. Joint Axial Movement: 6 inches of compression and 0.75 inch of extension.
4. Permanent Locking Bolts: Set locking bolts to maintain joint lengths during installation. Temporary welding tabs that are removed after installation in lieu of locking bolts are not acceptable.
5. End Connection Configuration: Flanged; one raised, fixed and one floating flange.

2.4 GROOVED-JOINT EXPANSION JOINTS

- A. Acceptable Manufacturers:
 1. Victaulic Company
 2. Anvil International
 3. Shurjoint Piping Products.
- B. Description: Factory-assembled expansion joint made of several grooved-end pipe nipples, couplings, and grooved joints.
- C. Standard: AWWA C606, for grooved joints.
- D. Nipples: ASTM A 53/A 53M, Schedule 40, Type E or S, steel pipe with grooved ends.
- E. Couplings: Five flexible type for steel-pipe dimensions. Include ferrous housing sections, Buna-N gasket or ethylene-propylene-diene terpolymer rubber gasket suitable for cold and hot water, and bolts and nuts.

2.5 ALIGNMENT GUIDES AND ANCHORS

A. Alignment Guides:

1. Acceptable manufacturers:
 - a. Flex-Hose
 - b. Flexicraft
 - c. Flex-Weld
 - d. Metraflex
 - e. Hyspan Precision Products
 - f. Mason Industries
2. Description: Steel, factory-fabricated alignment guide, with bolted two-section outer cylinder and base for attaching to structure; with two-section guiding slider for bolting to pipe.

B. Anchor Materials:

1. Steel Shapes and Plates: ASTM A 36/A 36M.
2. Bolts and Nuts: ASME B18.10 or ASTM A 183, steel hex head.
3. Washers: ASTM F 844, steel, plain, flat washers.
4. Mechanical Fasteners: Insert-wedge-type stud with expansion plug anchor for use in hardened Portland cement concrete, with tension and shear capacities appropriate for application.
 - a. Stud: Threaded, zinc-coated carbon steel.
 - b. Expansion Plug: Zinc-coated steel.
 - c. Washer and Nut: Zinc-coated steel.
5. Chemical Fasteners: Insert-type stud, bonding-system anchor for use with hardened Portland cement concrete, with tension and shear capacities appropriate for application.
 - a. Bonding Material: ASTM C 881/C 881M, Type IV, Grade 3, two-component epoxy resin suitable for surface temperature of hardened concrete where fastener is to be installed.
 - b. Stud: ASTM A 307, zinc-coated carbon steel with continuous thread on stud, unless otherwise indicated.
 - c. Washer and Nut: Zinc-coated steel.

PART 3 - EXECUTION

3.1 EXPANSION JOINT INSTALLATION

- A. Install expansion joints of sizes matching sizes of piping in which they are installed.
- B. Install packed-type expansion joints with packing suitable for fluid service.
- C. Install metal-bellows expansion joints according to EJMA's "Standards of the Expansion Joint Manufacturers Association, Inc."
- D. Install grooved-joint expansion joints to grooved-end steel piping.

3.2 PIPE LOOP AND SWING CONNECTION INSTALLATION

- A. Install pipe loops cold-sprung in tension or compression as required to partly absorb tension or compression produced during anticipated change in temperature.
- B. Connect risers and branch connections to mains with at least five pipe fittings, including tee in main.
- C. Connect risers and branch connections to terminal units with at least four pipe fittings, including tee in riser.
- D. Connect mains and branch connections to terminal units with at least four pipe fittings, including tee in main.

3.3 ALIGNMENT-GUIDE AND ANCHOR INSTALLATION

- A. Install alignment guides to guide expansion and to avoid end-loading and torsional stress.
- B. Install one guide on each side of pipe expansion fittings and loops. Install guides nearest to expansion joint not more than four pipe diameters from expansion joint.
- C. Attach guides to pipe, and secure guides to building structure.
- D. Install anchors at locations to prevent stresses from exceeding those permitted by ASME B31.9 and to prevent transfer of loading and stresses to connected equipment.
- E. Anchor Attachments:
 - 1. Anchor Attachment to Steel Pipe: Attach by welding. Comply with ASME B31.9 and ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
 - 2. Anchor Attachment to Copper Tubing: Attach with pipe hangers. Use MSS SP-69, Type 24; U bolts bolted to anchor.
- F. Fabricate and install steel anchors by welding steel shapes, plates, and bars. Comply with ASME B31.9 and AWS D1.1/D1.1M.
 - 1. Anchor Attachment to Steel Structural Members: Attach by welding.
 - 2. Anchor Attachment to Concrete Structural Members: Attach by fasteners. Follow fastener manufacturer's written instructions.
- G. Use grout to form flat bearing surfaces for guides and anchors attached to concrete.

END OF SECTION 230516

SECTION 230517 – SLEEVES, SLEEVE SEALS AND 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. Sleeves.
 - 2. Grout.
 - 3. Escutcheons
 - 4. Floor Plates

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 water-stop unless otherwise indicated.
- B. Galvanized-Steel Wall Pipes: ASTM A 53/A 53M, Schedule 40, with plain ends and welded steel collar; zinc coated.
- C. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, with plain ends.
- D. Galvanized-Steel-Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

2.2 GROUT

- A. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- B. Characteristics: Non-shrink; recommended for interior and exterior applications.
- C. Design Mix: 5000-psi, 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

2.3 ESCUTCHEONS

- A. One-Piece, Cast-Brass Type: With polished, chrome-plated and 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. Split-Casting Brass Type: With polished, chrome-plated and rough-brass finish and with concealed hinge and setscrew.

2.4 FLOOR PLATES

- A. One-Piece Floor Plates: Cast-iron flange with holes for fasteners.
- B. Split-Casting Floor Plates: Cast brass with concealed hinge.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION

- A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.
- B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch annular clear space between piping and concrete slabs and walls.
 - 1. Sleeves are not required for core-drilled holes.
- C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.
 - 1. Permanent sleeves are not required for holes in slabs formed by molded-PE or -PP sleeves.
 - 2. Cut sleeves to length for mounting flush with both surfaces.
 - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level.
 - 3. Using grout, seal the space outside of sleeves in slabs and walls without sleeve-seal system.
- D. Install sleeves for pipes passing through interior partitions.
 - 1. Cut sleeves to length for mounting flush with both surfaces.
 - 2. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
 - 3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint. Comply with requirements for sealants specified in Division 07 Section "Joint Sealants."
- E. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with fire-stop materials. Comply with requirements for fire-stopping specified in Division 07 Section "Penetration Fire-stopping."

3.2 SLEEVE SCHEDULE

- A. Use sleeves for the following piping-penetration applications:
 - 1. Interior Partitions:
 - a. Piping Smaller Than NPS 6: Galvanized-steel-pipe sleeves.

3.3 ESCUTCHEON INSTALLATION

- A. 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. Chrome-Plated Piping: One-piece, cast-brass or split-casting brass type with polished, chrome-plated finish.
 - c. Insulated Piping: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge or split-plate, stamped-steel type with exposed-rivet hinge.
 - d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass or split-casting brass type with polished, chrome-plated
 - e. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, cast-brass or split-casting brass type with polished, chrome-plated finish.
 - f. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass or split-casting brass type with polished, chrome-plated or rough-brass finish.
 - g. Bare Piping in Equipment Rooms: One-piece, cast-brass or split-casting brass type with polished, chrome-plated or rough-brass finish.
 - 2. Escutcheons for Existing Piping:
 - a. Chrome-Plated Piping: Split-casting brass type with polished, chrome-plated finish.
 - b. Insulated Piping: Split-plate, stamped-steel type with concealed or exposed-rivet hinge.
 - c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-casting brass type with polished, chrome-plated finish.
 - d. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-casting brass type with polished, chrome-plated finish.
 - e. Bare Piping in Unfinished Service Spaces: Split-casting brass type with polished, chrome-plated or rough-brass finish.
 - f. Bare Piping in Equipment Rooms: Split-casting brass type with polished, chrome-plated or rough-brass finish.
- B. Install floor plates for piping penetrations of equipment-room floors.
- C. 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.

3.4 FIELD QUALITY CONTROL

- A. Replace broken and damaged escutcheons and floor plates using new materials.

CHARTWELLS
735 ANDERSON HILL RD, PURCHASE, NY

SUNY PURCHASE HUB - CAFE RENOVATION
PHASE ZERO DESIGN PROJECT #1518416

END OF SECTION 230517

SECTION 230519 - METERS AND GAGES FOR HVAC PIPING

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. Bimetallic-actuated thermometers.
 - 2. Thermo-wells.
 - 3. Dial-type pressure gages.
 - 4. Gage attachments.
 - 5. Test plugs.
 - 6. Test-plug kits.
 - 7. Sight flow indicators.

1.3 ACTION SUBMITTALS

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

1.4 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each type of meter and gage, from manufacturer.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For meters and gages to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 BIMETALLIC-ACTUATED THERMOMETERS

- A. Acceptable manufacturers:
 - 1. Ashcroft Inc.
 - 2. Terrice, H.O. Company
 - 3. Weiss Instruments
- B. Standard: ASME B40.200.
- C. Case: Liquid-filled and sealed type; stainless steel with 3-inch nominal diameter.
- D. Dial: Non-reflective aluminum with permanently etched scale markings and scales in degrees F.
- E. Connector Type: Union joint, adjustable angle, with unified-inch screw threads.
- F. Connector Size: 1/2 inch, with ASME B1.1 screw threads.

- G. Stem: 0.25 or 0.375 inch in diameter; stainless steel.
- H. Window: Plastic.
- I. Ring: Stainless steel.
- J. Element: Bimetal coil.
- K. Pointer: Dark-colored metal.
- L. Accuracy: Plus or minus 1 percent of scale range.

2.2 DUCT-THERMOMETER MOUNTING BRACKETS

- A. Description: Flanged bracket with screw holes, for attachment to air duct and made to hold thermometer stem.

2.3 THERMOWELLS

- A. Standard: ASME B40.200.
- B. Description: Pressure-tight, socket-type fitting made for insertion into piping tee fitting.
- C. Material for Use with Copper Tubing: CNR or CUNI.
- D. Material for Use with Steel Piping: CRES or CSA.
- E. Type: Stepped shank unless straight or tapered shank is indicated.
- F. External Threads: NPS 1/2, NPS 3/4, or NPS 1, ASME B1.20.1 pipe threads.
- G. Internal Threads: 1/2, 3/4, and 1 inch, with ASME B1.1 screw threads.
- H. Bore: Diameter required to match thermometer bulb or stem.
- I. Insertion Length: Length required to match thermometer bulb or stem.
- J. Lagging Extension: Include on thermos-wells for insulated piping and tubing.
- K. Bushings: For converting size of thermos-well's internal screw thread to size of thermometer connection.
- L. Heat-Transfer Medium: Mixture of graphite and glycerin.

2.4 PRESSURE GAGES

- A. Acceptable manufacturers:
 - 1. Ashcroft Inc.
 - 2. Trerice, H.O. Company
 - 3. Weiss Instruments.
- B. Standard: ASME B40.100.
- C. Case: Liquid-filled type; cast aluminum or drawn steel; 4-1/2-inch nominal diameter.

- D. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
- E. Pressure Connection: Brass, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
- F. Movement: Mechanical, with link to pressure element and connection to pointer.
- G. Dial: Non-reflective aluminum with permanently etched scale markings graduated in psi.
- H. Pointer: Dark-colored metal.
- I. Window: Plastic.
- J. Ring: Metal.
- K. Accuracy: Grade B, plus or minus 2 percent of middle half of scale range.

2.5 GAGE ATTACHMENTS

- A. Snubbers: ASME B40.100, brass; with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and piston or porous-metal-type surge-dampening device. Include extension for use on insulated piping.
- B. Valves: Brass or stainless-steel needle, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads.

2.6 TEST PLUGS

- A. Acceptable manufacturers:
 - 1. Trerice, H.O. Company
 - 2. Weiss Instruments
- B. Description: Test-station fitting made for insertion into piping tee fitting.
- C. Body: Brass or stainless steel with core inserts and gasketed threaded cap. Include extended stem on units to be installed in insulated piping.
- D. Thread Size: NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe thread.
- E. Minimum Pressure and Temperature Rating: 500 psig at 200 degrees F.
- F. Core Inserts: Chlorosulfonated polyethylene synthetic and EPDM self-sealing rubber.

2.7 TEST-PLUG KITS

- A. Acceptable manufacturers:
 - 1. Trerice, H.O. Company
 - 2. Weiss Instruments
- B. Furnish one test-plug kit containing two thermometer(s), one pressure gage and adapter, and carrying case. Thermometer sensing elements, pressure gage, and adapter probes shall be of diameter to fit test plugs and of length to project into piping.
- C. Low-Range Thermometer: Small, bimetallic insertion type with 1- to 2-inch- diameter dial and tapered-end sensing element. Dial range shall be at least 25 to 125 degrees F.

- D. High-Range Thermometer: Small, bimetallic insertion type with 1- to 2-inch- diameter dial and tapered-end sensing element. Dial range shall be at least 0 to 220 degrees F.
- E. Pressure Gage: Small, Bourdon-tube insertion type with 2- to 3-inch- diameter dial and probe. Dial range shall be at least 0 to 200 psig.
- F. Carrying Case: Metal or plastic, with formed instrument padding.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install thermos-wells with socket extending to center of pipe and in vertical position in piping tees.
- B. Install thermos-wells of sizes required to match thermometer connectors. Include bushings if required to match sizes.
- C. Install thermos-wells with extension on insulated piping.
- D. Fill thermos-wells with heat-transfer medium.
- E. Install direct-mounted thermometers in thermos-wells and adjust vertical and tilted positions.
- F. Install duct-thermometer mounting brackets in walls of ducts. Attach to duct with screws.
- G. Install direct-mounted pressure gages in piping tees with pressure gage located on pipe at the most readable position.
- H. Install valve and snubber in piping for each pressure gage for fluids (except steam).
- I. Install test plugs in piping tees.
- J. Install thermometers in the following locations:
 - 1. Inlet and outlet of each hydronic zone.
 - 2. Outside-, return-, supply-, and mixed-air ducts.
- K. Install pressure gages in the following locations:
 - 1. Inlet and outlet of each chiller chilled-water and condenser-water connection.
 - 2. Suction and discharge of each pump.

3.2 CONNECTIONS

- A. Install thermometers and gages adjacent to machines and equipment to allow service and maintenance of meters, gages, machines, and equipment.

3.3 ADJUSTING

- A. After installation, calibrate thermometers according to manufacturer's written instructions.
- B. Adjust faces of thermometers and gages to proper angle for best visibility.

3.4 THERMOMETER SCALE-RANGE SCHEDULE

- A. Scale Range for Chilled-Water Piping: Minus 40 to plus 160 degrees F
- B. Scale Range for Heating, Hot-Water Piping: 0 to 250 degrees F.

3.5 PRESSURE-GAGE SCALE-RANGE SCHEDULE

- A. Scale Range for Chilled-Water Piping: 0 to 100 psi.
- B. Scale Range for Heating, Hot-Water Piping: 0 to 100 psi

END OF SECTION 230519

SECTION 230523 - GENERAL DUTY VALVES 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. Globe valves
 - 2. Ball valves
 - 3. Butterfly valves
 - 4. Check 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. PTFE: Poly-tetra-flouro-ethylene (Teflon)

1.4 ACTION SUBMITTALS

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

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves for shipping as follows:
 - 1. Protect internal parts against rust and corrosion.
 - 2. Protect threads, flange faces, grooves, and weld ends.
 - 3. Set globe valves closed to prevent rattling.
 - 4. Set ball valves open to minimize exposure of functional surfaces.
 - 5. Set butterfly valves closed or slightly open.
 - 6. Block check valves in either the 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 operating handles, hand-wheels or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

- A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.
- B. ASME Compliance:
 - 1. ASME B1.20.1 for threads for threaded-end valves.
 - 2. ASME B16.1 for flanges on iron valves.
 - 3. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
 - 4. ASME B16.18 for solder joint.
 - 5. ASME B31.9 for building services piping valves.
- C. Refer to HVAC valve schedule articles for applications of valves.
- D. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- E. Valve Sizes: Same as upstream piping unless otherwise indicated.
- F. Valves in Insulated Piping:
 - 1. With 2-inch stem extensions.
 - 2. Extended necks for butterfly valves.
 - 3. Extended operating handle of non-thermal conductive material, and protective sleeves that allow operation of valves without breaking the vapor seals or disturbing insulation.
 - 4. Memory stops that are fully adjustable after insulation is applied.

2.2 BRONZE GLOBE VALVES

- A. Acceptable manufacturers for bronze globe valves:
 - 1. Hammond
 - 2. Milwaukee
 - 3. Nibco.
 - 4. Stockham
- B. Class 125 Bronze Globe Valves:
 - 1. Description:
 - a. Standard: MSS SP-80, Type 1.
 - b. CWP Rating: 200 psig.
 - c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
 - d. Ends: Threaded or solder joint.
 - e. Stem and Disc: Bronze or PTFE.
 - f. Packing: Asbestos free.
 - g. Hand-wheel: Malleable iron, bronze, or aluminum.

2.3 IRON GLOBE VALVES

- A. Acceptable manufacturers for iron globe valves:
 - 1. Hammond
 - 2. Milwaukee
 - 3. Nibco.
 - 4. Stockham

- B. Class 125 Iron Globe Valves:
 - 1. Description:
 - a. Standard: MSS SP-85, Type I.
 - b. CWP Rating: 200 psig.
 - c. Body Material: ASTM A 126, gray iron with bolted bonnet.
 - d. Ends: Flanged.
 - e. Trim: Bronze.
 - f. Packing and Gasket: Asbestos free.
 - g. Operator: Hand-wheel or chain-wheel.

2.4 BRONZE BALL VALVES

- A. Acceptable manufacturers for bronze ball valves:
 - 1. Hammond
 - 2. Milwaukee
 - 3. Nibco
 - 4. Stockham.
- B. Two-Piece Bronze Ball Valves with Full Port and Bronze Trim:
 - 1. Description:
 - a. Standard: MSS SP-110.
 - b. CWP Rating: 600 psig.
 - c. Body Design: Two piece.
 - d. Body Material: Bronze.
 - e. Ends: Threaded.
 - f. Seats: PTFE.
 - g. Stem: Bronze.
 - h. Ball: Chrome-plated brass.
 - i. Port: Full.

2.5 IRON, SINGLE-FLANGE BUTTERFLY VALVES

- A. Acceptable manufacturers for iron single flange butterfly valves:
 - 1. Hammond
 - 2. Milwaukee
 - 3. Nibco
 - 4. Stockham
- B. Iron, Single-Flange Butterfly Valves with Aluminum-Bronze Disc:
 - 1. Description:
 - a. Standard: MSS SP-67, Type I.
 - b. CWP Rating: 150 psig.
 - c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
 - d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
 - e. Seat: EPDM or NBR.
 - f. Stem: One- or two-piece stainless steel.
 - g. Disc: Aluminum bronze.

2.6 DUCTILE-IRON, GROOVED-END BUTTERFLY VALVES

- A. Acceptable Manufacturers for ductile iron grooved-end butterfly valves:
 - 1. Grinnell
 - 2. Kennedy
 - 3. Victaulic

- B. 175 CWP, Iron, Grooved-End Butterfly Valves:
 - 1. Description:
 - a. Standard: MSS SP-67, Type I.
 - b. CWP Rating: 175 psig.
 - c. Body Material: Coated, ductile iron.
 - d. Stem: Two-piece stainless steel.
 - e. Disc: Coated, ductile iron.
 - f. Seal: EPDM.

2.7 BRONZE SWING CHECK VALVES

- A. Acceptable manufacturers for bronze swing check valves:
 - 1. Hammond
 - 2. Milwaukee
 - 3. Nibco
 - 4. Stockham
- B. Class 125, Bronze Swing Check Valves with Nonmetallic Disc:
 - 1. Description:
 - a. Standard: MSS SP-80, Type 4.
 - b. CWP Rating: 200 psig.
 - c. Body Design: Horizontal flow.
 - d. Body Material: ASTM B 62, bronze.
 - e. Ends: Threaded.
 - f. Disc: PTFE.

2.8 IRON SWING CHECK VALVES

- A. Acceptable manufacturers for iron swing check valves:
 - 1. Hammond
 - 2. Milwaukee
 - 3. Nibco
 - 4. Stockham
- B. Class 125, Iron Swing Check Valves with Nonmetallic-to-Metal Seats:
 - 1. Description:
 - a. Standard: MSS SP-71, Type I.
 - b. NPS 2-1/2 to NPS 12, CWP Rating: 200 psig.
 - c. Body Material: ASTM A 126, gray iron with bolted bonnet.
 - d. Ends: Flanged.
 - e. Trim: Composition.
 - f. Seat Ring: Bronze.
 - g. Disc Holder: Bronze.
 - h. Disc: PTFE.
 - i. Gasket: Asbestos free.

2.9 IRON, GROOVED-END SWING CHECK VALVES

- A. Acceptable Manufacturers for ductile iron grooved-end swing check valves:
 - 1. Grinnell
 - 2. Kennedy
 - 3. Victaulic
- B. 300 CWP, Iron, Grooved-End Swing Check Valves:
 - 1. Description:

- a. CWP Rating: 300 psig.
- b. Body Material: ASTM A 536, ductile iron.
- c. Seal: EPDM.
- d. Disc: Spring operated, ductile iron or stainless steel.

2.10 IRON, CENTER-GUIDED CHECK VALVES

- A. Acceptable manufacturers for iron center-guided check valves:
 1. Hammond
 2. Milwaukee
 3. Nibco
 4. Stockham
- B. Class 125, Iron, Compact-Wafer, Center-Guided Check Valves with Resilient Seat:
 1. Description:
 - a. Standard: MSS SP-125.
 - b. NPS 2-1/2 to NPS 12, CWP Rating: 200 psig.
 - c. Body Material: ASTM A 126, gray iron.
 - d. Style: Compact wafer.
 - e. Seat: EPDM or NBR.

2.11 CHAINWHEELS

- A. Description: Valve actuation assembly with sprocket rim, chain guides, chain, and attachment brackets for mounting chain-wheels directly to hand-wheels.
 1. Sprocket Rim with Chain Guides: Ductile or cast iron, of type and size required for valve. Include zinc or epoxy coating.
 2. Chain: Hot-dip-galvanized steel, of size required to fit sprocket rim.

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 close. 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. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

- B. Locate valves for easy access and provide separate support where necessary.
- C. Install valves in horizontal piping with stem at or above center of pipe.
- D. Install valves in position to allow full stem movement.
- E. Install check valves for proper direction of flow and as follows:
 - 1. Swing Check Valves: In horizontal position with hinge pin level.
 - 2. Center-Guided Check Valves: In horizontal or vertical position, between flanges.
- F. Install chain-wheels on operators for valves NPS 4 and larger and more than 84 inches above floor. Extend chains to 60 inches above finished floor.
- G. Install valve tags. Comply with requirements in Section 230553 "Identification for HVAC Piping and Equipment" for valve tags and schedules.

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.

3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

- A. If valve applications are not indicated, use the following:
 - 1. Throttling Service: Globe valves.
 - 2. Shut-off service: Ball or butterfly
- B. If valves with specified CWP ratings are unavailable, the same types of valves with higher CWP ratings may be substituted.
- C. Select valves with the following end connections:
 - 1. For Copper Tubing, NPS 2 and Smaller: Threaded ends or solder-joint valve-end as indicated in valve schedules.
 - 2. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged ends or threaded valve-end as indicated in valve schedules.
 - 3. For Steel Piping, NPS 5 and Larger: Flanged ends.
 - 4. For grooved end piping, all sizes, grooved end valves are acceptable.

3.5 CHILLED-WATER VALVE SCHEDULE

- A. Pipe NPS 2-1/2 and Larger:
 - 1. Iron globe valves, Class 125 with flanged ends.
 - 2. Iron, Single-Flange Butterfly Valves, NPS 2-1/2 to NPS 12: 200 CWP, EPDM or NBR seat, aluminum-bronze disc.
 - 3. Iron, Grooved-End Butterfly Valves, NPS 2-1/2 to NPS 12: 175 CWP.
 - 4. Iron Swing Check Valves: Class 125, nonmetallic-to-metal seats.
 - 5. Iron, Grooved-End Check Valves, NPS 3 to NPS 12: 300 CWP.
 - 6. Iron, Center-Guided Check Valves: Class 125, compact-wafer, resilient seat.

3.6 HEATING-WATER VALVE SCHEDULE

- A. Pipe NPS 2 and Smaller:
 - 1. Bronze globe valves, Class 125, bronze or nonmetallic disc, with soldered or threaded ends.

2. Ball valves, two piece, full port, bronze with bronze trim, with solder-joint or threaded ends.
3. Bronze Swing Check Valves: Class 125, nonmetallic disc, with soldered-joint or threaded ends.

B. Pipe NPS 2-1/2 and Larger:

1. Iron globe valves, Class 125 with flanged ends.
2. Iron, Single-Flange Butterfly Valves, NPS 2-1/2 to NPS 12: 200 CWP, EPDM or NBR seat, aluminum-bronze disc.
3. Iron, Grooved-End Butterfly Valves, NPS 2-1/2 to NPS 12: 175 CWP.
4. Iron Swing Check Valves: Class 125, nonmetallic-to-metal seats.
5. Iron, Grooved-End Check Valves, NPS 3 to NPS 12: 300 CWP.
6. Iron, Center-Guided Check Valves: Class 125, compact-wafer, resilient seat.

END OF SECTION 230523

SECTION 230529 - HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Metal pipe hangers and supports.
2. Trapeze pipe hangers.
3. Thermal-hanger shield inserts.
4. Fastener systems.
5. Equipment supports.

B. Related Requirements:

1. Section 055000 "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
2. Section 230516 "Expansion Fittings and Loops for HVAC Piping" for pipe guides and anchors.
3. Section 230548 "Vibration and Seismic Controls for HVAC" or Section 230548.13 "Vibration Controls for HVAC" for vibration isolation devices.
4. Section 233113 "Metal Ducts" for duct hangers and supports.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:

1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.
2. Product Certificates: For materials manufactured within 100 miles of Project, indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include distance to Project and cost for each raw material.

C. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following; include Product Data for components:

1. Trapeze pipe hangers.
2. Equipment supports.

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

1. Detail fabrication and assembly of trapeze hangers.
2. Include design calculations for designing trapeze hangers.

1.3 INFORMATIONAL SUBMITTALS

- A. Welding certificates.

1.4 QUALITY ASSURANCE

- A. Structural-Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code, Section IX.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design trapeze pipe hangers and equipment supports.
- B. Structural Performance: Hangers and supports for HVAC piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.
1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
 2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
 3. Design seismic-restraint hangers and supports for piping and equipment and obtain approval from authorities having jurisdiction.

2.2 METAL PIPE HANGERS AND SUPPORTS

- A. Carbon-Steel Pipe Hangers and Supports:
1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
 2. Galvanized Metallic Coatings: Pregalvanized, hot-dip galvanized, or electro-galvanized.
 3. Nonmetallic Coatings: Plastic coated, or epoxy powder-coated.
 4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
 5. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.
- B. Copper Pipe and Tube Hangers:
1. Description: MSS SP-58, Types 1 through 58, copper-plated steel, factory-fabricated components.
 2. Hanger Rods: Continuous-thread rod, nuts, and washer made of copper-plated steel.

2.3 TRAPEZE PIPE HANGERS

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

2.4 THERMAL-HANGER SHIELD INSERTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Pipe Shields Inc.
 - 2. Rilco Manufacturing Co., Inc.
 - 3. Value Engineered Products, Inc.
- B. Insulation-Insert Material for Hot Piping: Water-repellent-treated, ASTM C 533, Type I calcium silicate with 100-psi minimum compressive strength.
- C. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
- D. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
- E. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.5 FASTENER SYSTEMS

- A. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. B-line, an Eaton business.
 - b. Hilti, Inc.
 - c. MKT Fastening, LLC.

2.6 EQUIPMENT SUPPORTS

- A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

2.7 MATERIALS

- A. Aluminum: ASTM B 221.
- B. Carbon Steel: ASTM A 1011/A 1011M.
- C. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.
- D. Stainless Steel: ASTM A 240/A 240M.

- E. Grout: ASTM C 1107/C 1107M, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
 - 1. Properties: Nonstaining, noncorrosive, and nongaseous.
 - 2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 APPLICATION

- A. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping materials and installation for penetrations through fire-rated walls, ceilings, and assemblies.
- 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.

3.2 HANGER AND SUPPORT INSTALLATION

- A. Metal Pipe-Hanger Installation: Comply with MSS SP-58. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.
- B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-58. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.
 - 1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.
 - 2. Field fabricate from ASTM A 36/A 36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.
- C. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
- D. Fastener System Installation:
 - 1. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- E. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- F. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- G. Install hangers and supports to allow controlled thermal 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 that 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 to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.
- L. Insulated Piping:
 - 1. Attach clamps and spacers to piping.
 - a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
 - b. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.
 - 2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
 - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
 - 3. Shield Dimensions for Pipe: Not less than the following:
 - a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
 - 4. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.3 EQUIPMENT SUPPORTS

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

3.4 METAL FABRICATIONS

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

3.5 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.

3.6 PAINTING

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

3.7 HANGER AND SUPPORT SCHEDULE

- A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-58 for pipe-hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.
- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Use carbon-steel pipe hangers and supports and metal trapeze pipe hangers and attachments for general service applications.
- F. Use copper-plated pipe hangers and copper attachments for copper piping and tubing.
- G. Use padded hangers for piping that is subject to scratching.
- H. Use thermal-hanger shield inserts for insulated piping and tubing.
- I. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30.
 - 2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F, pipes NPS 4 to NPS 24, requiring up to 4 inches of insulation.
 - 3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36, requiring clamp flexibility and up to 4 inches of insulation.

4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes NPS 1/2 to NPS 24 if little or no insulation is required.
 5. Pipe Hangers (MSS Type 5): For suspension of pipes NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
 6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes NPS 3/4 to NPS 8.
 7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
 8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
 9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
 10. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 8.
 11. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 3.
 12. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.
 13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
 14. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30, from two rods if longitudinal movement caused by expansion and contraction might occur.
 15. Complete Pipe Rolls (MSS Type 44): For support of pipes NPS 2 to NPS 42 if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is unnecessary.
 16. Pipe Roll and Plate Units (MSS Type 45): For support of pipes NPS 2 to NPS 24 if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is unnecessary.
 17. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes NPS 2 to NPS 30 if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.
- J. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.
 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.
- K. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
 2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
 3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
 4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
 5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.
- L. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
 2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape.

3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
 4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
 5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
 6. C-Clamps (MSS Type 23): For structural shapes.
 7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
 8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
 9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
 10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
 11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
 12. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:
 - a. Light (MSS Type 31): 750 lb.
 - b. Medium (MSS Type 32): 1500 lb.
 - c. Heavy (MSS Type 33): 3000 lb.
 13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
 14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
 15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.
- M. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
 2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
 3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.
- N. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
 2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
 3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41, roll hanger with springs.
 4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
 5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from hanger.
 6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from base support.
 7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from trapeze support.
 8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:

- a. Horizontal (MSS Type 54): Mounted horizontally.
 - b. Vertical (MSS Type 55): Mounted vertically.
 - c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.
- O. Comply with MSS SP-58 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.
- P. Use mechanical-expansion anchors instead of building attachments where required in concrete construction.

END OF SECTION 230529

SECTION 230548 - VIBRATION AND SEISMIC CONTROLS FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Elastomeric isolation pads.
2. Elastomeric isolation mounts.
3. Restrained elastomeric isolation mounts.
4. Open-spring isolators.
5. Housed-spring isolators.
6. Restrained-spring isolators.
7. Housed-restrained-spring isolators.
8. Pipe-riser resilient supports.
9. Resilient pipe guides.
10. Elastomeric hangers.
11. Spring hangers.
12. Snubbers.
13. Restraint channel bracings.
14. Restraint cables.
15. Seismic-restraint accessories.
16. Mechanical anchor bolts.
17. Adhesive anchor bolts.
18. Vibration isolation equipment bases.
19. Restrained isolation roof-curb rails.

B. Related Requirements:

1. Section 210548 "Vibration and Seismic Controls for Fire Suppression" for devices for fire-suppression equipment and systems.
2. Section 220548 "Vibration and Seismic Controls for Plumbing" for devices for plumbing equipment and systems.

1.3 DEFINITIONS

- A. IBC: International Building Code.
- B. ICC-ES: ICC-Evaluation Service.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.

2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of vibration isolation device and seismic-restraint component required.
 - a. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by an agency acceptable to authorities having jurisdiction.
 - b. Annotate to indicate application of each product submitted and compliance with requirements.
 3. Interlocking Snubbers: Include ratings for horizontal, vertical, and combined loads.
- B. Shop Drawings:
1. Detail fabrication and assembly of equipment bases. Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.
 2. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.
- C. Delegated-Design Submittal: For each vibration isolation and seismic-restraint device.
1. Include design calculations and details for selecting vibration isolators, seismic restraints, and vibration isolation bases complying with performance requirements, design criteria, and analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
 2. Design Calculations: Calculate static and dynamic loading due to equipment weight, operation, and seismic and wind forces required to select vibration isolators and seismic and wind restraints and for designing vibration isolation bases.
 - a. Coordinate design calculations with wind load calculations required for equipment mounted outdoors. Comply with requirements in other Sections for equipment mounted outdoors.
 3. Riser Supports: Include riser diagrams and calculations showing anticipated expansion and contraction at each support point, initial and final loads on building structure, spring deflection changes, and seismic loads. Include certification that riser system was examined for excessive stress and that none exists.
 4. Seismic and Wind-Restraint Details:
 - a. Design Analysis: To support selection and arrangement of seismic and wind restraints. Include calculations of combined tensile and shear loads.
 - b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events. Indicate association with vibration isolation devices.
 - c. Coordinate seismic-restraint and vibration isolation details with wind-restraint details required for equipment mounted outdoors. Comply with requirements in other Sections for equipment mounted outdoors.
 - d. Preapproval and Evaluation Documentation: By an agency acceptable to authorities having jurisdiction, showing maximum ratings of restraint items and the basis for approval (tests or calculations).
- 1.5 INFORMATIONAL SUBMITTALS
- A. Coordination Drawings: Show coordination of vibration isolation device installation and seismic bracing for HVAC piping and equipment with other systems and equipment in the vicinity, including other supports and restraints, if any.
- B. Qualification Data: For professional engineer and testing agency.

- C. Welding certificates.
- D. Air-Mounting System Performance Certification: Include natural frequency, load, and damping test data performed by an independent agency.
- E. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For air-spring mounts and restrained-air-spring mounts to include in operation and maintenance manuals.

1.7 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7 and that is acceptable to authorities having jurisdiction.
- B. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.
- C. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- D. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear anchorage preapproval OPA number from OSHPD, preapproval by ICC-ES, or preapproval by another agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are unavailable, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Wind-Restraint Loading:
 - 1. Basic Wind Speed: 130 mph
 - 2. Building Classification Category: III.
 - 3. Minimum 10 lb/sq. ft. multiplied by maximum area of HVAC component projected on vertical plane normal to wind direction, and 45 degrees either side of normal.
- B. Seismic-Restraint Loading:
 - 1. Site Class as Defined in the IBC: Site Class C
 - 2. Assigned Seismic Use Group or Building Category as Defined in the IBC: III
 - a. Component Importance Factor: 1.0.
 - b. Component Response Modification Factor: 2.5.
 - c. Component Amplification Factor:
 - 1) For stacks (including discharge from laboratory exhaust fans), pressure vessels (i.e. expansion tanks), and HVAC equipment that is externally vibration isolated = 2.5
 - 2) For all other HVAC equipment = 1.0.
 - 3. Design Spectral Response Acceleration at Short Periods (0.2 Second): $S_s = 0.267$

4. Design Spectral Response Acceleration at 1.0-Second Period: $S1 = 0.071$
5. Rated strengths, features, and applications shall be as defined in reports by an agency acceptable to authorities having jurisdiction.
 - a. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they are subjected.

- C. All vibration isolation supports will be designed and selected in accordance with Table 47 "Selection Guide for Vibration Isolation" in the ASHRAE Handbook-HVAC Applications. Isolators shall also meet the requirements of Paragraph 2.2 through 2.21.

2.2 MANUFACTURERS

- A. All vibration isolation components shall be manufactured by one of the following manufacturers:

1. Ace Mountings Co., Inc.
2. Amber/Booth Company, Inc.
3. Isolation Technology, Inc.
4. Kinetics Noise Control.
5. Mason Industries.
6. Vibration Eliminator Co., Inc.
7. Vibration Isolation.
8. Vibration Mountings & Controls, Inc.

2.3 ELASTOMERIC ISOLATION PADS

- A. Elastomeric Isolation Pad.

1. Fabrication: Single or multiple layers of sufficient durometer stiffness for uniform loading over pad area.
2. Size: Factory or field cut to match requirements of supported equipment.
3. Pad Material: Oil and water resistant with elastomeric properties.
4. Surface Pattern: Smooth, Ribbed or Waffle pattern.
5. Infused nonwoven cotton or synthetic fibers.
6. Load-bearing metal plates adhered to pads.
7. Sandwich-Core Material: Resilient and elastomeric.
 - a. Surface Pattern: Smooth, Ribbed or Waffle pattern.
 - b. Infused nonwoven cotton or synthetic fibers.

2.4 ELASTOMERIC ISOLATION MOUNTS

- A. Double-Deflection, Elastomeric Isolation Mounts:

1. Mounting Plates:
 - a. Top Plate: Encapsulated steel load transfer top plates, factory drilled and threaded with threaded studs or bolts.
 - b. Baseplate: Encapsulated steel bottom plates with holes provided for anchoring to support structure.
2. Elastomeric Material: Molded, oil-resistant rubber, neoprene, or other elastomeric material.

2.5 RESTRAINED ELASTOMERIC ISOLATION MOUNTS

- A. Restrained Elastomeric Isolation Mounts:

1. Description: All-directional isolator with seismic restraints containing two separate and opposing elastomeric elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.
 - a. Housing: Cast-ductile iron or welded steel.

- b. Elastomeric Material: Molded, oil-resistant rubber, neoprene, or other elastomeric material.

2.6 OPEN-SPRING ISOLATORS

- A. Freestanding, Laterally Stable, Open-Spring Isolators:
 - 1. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 - 2. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 - 3. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 - 4. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
 - 5. Baseplates: Factory-drilled steel plate for bolting to structure with an elastomeric isolator pad attached to the underside. Baseplates shall limit floor load to 500 psig.
 - 6. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.

2.7 HOUSED-SPRING ISOLATORS

- A. Freestanding, Laterally Stable, Open-Spring Isolators in Two-Part Telescoping Housing:
 - 1. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 - 2. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 - 3. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 - 4. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
 - 5. Two-Part Telescoping Housing: A steel top and bottom frame separated by an elastomeric material and enclosing the spring isolators.
 - a. Drilled base housing for bolting to structure with an elastomeric isolator pad attached to the underside. Bases shall limit floor load to 500 psig.
 - b. Top housing with attachment and leveling bolt, threaded mounting holes and internal leveling device or elastomeric pad.

2.8 RESTRAINED-SPRING ISOLATORS

- A. Freestanding, Laterally Stable, Open-Spring Isolators with Vertical-Limit Stop Restraint:
 - 1. Housing: Steel housing with vertical-limit stops to prevent spring extension due to weight being removed.
 - a. Base with holes for bolting to structure with an elastomeric isolator pad attached to the underside. Bases shall limit floor load to 500 psig.
 - b. Top plate with threaded mounting holes or elastomeric pad.
 - c. Internal leveling bolt that acts as blocking during installation.
 - 2. Restraint: Limit stop as required for equipment and authorities having jurisdiction.
 - 3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 - 4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 - 5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 - 6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

2.9 HOUSED-RESTRAINED-SPRING ISOLATORS

- A. Freestanding, Steel, Open-Spring Isolators with Vertical-Limit Stop Restraint in Two-Part Telescoping Housing:

1. Two-Part Telescoping Housing: A steel top and bottom frame separated by an elastomeric material and enclosing the spring isolators. Housings are equipped with adjustable or non-adjustable snubbers to limit vertical movement.
 - a. Drilled base housing for bolting to structure with an elastomeric isolator pad attached to the underside. Bases shall limit floor load to 500 psig.
 - b. Threaded top housing with adjustment bolt and cap screw to fasten and level equipment.
2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

2.10 PIPE-RISER RESILIENT SUPPORT

- A. Description: All-directional, acoustical pipe anchor consisting of two steel tubes separated by a minimum 1/2-inch-thick neoprene.
 1. Vertical-Limit Stops: Steel and neoprene vertical-limit stops arranged to prevent vertical travel in both directions.
 2. Maximum Load Per Support: 500 psig on isolation material providing equal isolation in all directions.

2.11 RESILIENT PIPE GUIDES

- A. Description: Telescopic arrangement of two steel tubes or post and sleeve arrangement separated by a minimum 1/2-inch-thick neoprene.
 1. Factory-Set Height Guide with Shear Pin: Shear pin shall be removable and reinsertable to allow for selection of pipe movement. Guides shall be capable of motion to meet location requirements.

2.12 ELASTOMERIC HANGERS

- A. Elastomeric Mount in a Steel Frame with Upper and Lower Steel Hanger Rods:
 1. Frame: Steel, fabricated with a connection for an upper threaded hanger rod and an opening on the underside to allow for a maximum of 30 degrees of angular lower hanger-rod misalignment without binding or reducing isolation efficiency.
 2. Dampening Element: Molded, oil-resistant rubber, neoprene, or other elastomeric material with a projecting bushing for the underside opening preventing steel to steel contact.

2.13 SPRING HANGERS

- A. Combination Coil-Spring and Elastomeric-Insert Hanger with Spring and Insert in Compression:
 1. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
 2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
 6. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.
 7. Adjustable Vertical Stop: Steel washer with neoprene washer "up-stop" on lower threaded rod.
 8. Self-centering hanger-rod cap to ensure concentricity between hanger rod and support spring coil.

2.14 SNUBBERS

- A. Description: Factory fabricated using welded structural-steel shapes and plates, anchor bolts, and replaceable resilient isolation washers and bushings.
1. Anchor bolts for attaching to concrete shall be seismic-rated, drill-in, and stud-wedge or female-wedge type.
 2. Resilient Isolation Washers and Bushings: Oil- and water-resistant neoprene.
 3. Maximum 1/4-inch air gap, and minimum 1/4-inch- thick resilient cushion.

2.15 RESTRAINT CHANNEL BRACINGS

- A. Description: MFMA-4, shop- or field-fabricated bracing assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end and other matching components and with corrosion-resistant coating; rated in tension, compression, and torsion forces.

2.16 RESTRAINT CABLES

- A. Restraint Cables: ASTM A 492 stainless-steel cables. End connections made of steel assemblies with thimbles, brackets, swivel, and bolts designed for restraining cable service; with a minimum of two clamping bolts for cable engagement.

2.17 SEISMIC-RESTRAINT ACCESSORIES

- A. Hanger-Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections or reinforcing steel angle clamped to hanger rod.
- B. Hinged and Swivel Brace Attachments: Multifunctional steel connectors for attaching hangers to rigid channel bracings and restraint cables.
- C. Bushings for Floor-Mounted Equipment Anchor Bolts: Neoprene bushings designed for rigid equipment mountings, and matched to type and size of anchor bolts and studs.
- D. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings, and matched to type and size of attachment devices used.
- E. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.

2.18 MECHANICAL ANCHOR BOLTS

- A. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

2.19 ADHESIVE ANCHOR BOLTS

- A. Adhesive Anchor Bolts: Drilled-in and capsule anchor system containing PVC or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

2.20 VIBRATION ISOLATION EQUIPMENT BASES

- A. Steel Rails: Factory-fabricated, welded, structural-steel rails.
 - 1. Design Requirements: Lowest possible mounting height with not less than 1-inch clearance above the floor. Include equipment anchor bolts and auxiliary motor slide rails.
 - a. Include supports for suction and discharge elbows for pumps.
 - 2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A 36/A 36M. Rails shall have shape to accommodate supported equipment.
 - 3. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.

- B. Steel Bases: Factory-fabricated, welded, structural-steel bases and rails.
 - 1. Design Requirements: Lowest possible mounting height with not less than 1-inch clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails.
 - a. Include supports for suction and discharge elbows for pumps.
 - 2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A 36/A 36M. Bases shall have shape to accommodate supported equipment.
 - 3. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.

- C. Concrete Inertia Base: Field-fabricated, welded, structural-steel bases and rails ready for placement of cast-in-place concrete.
 - 1. Design Requirements: Lowest possible mounting height with not less than 1-inch clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails.
 - a. Include supports for suction and discharge elbows for pumps.
 - 2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A 36/A 36M. Bases shall have shape to accommodate supported equipment.
 - 3. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.
 - 4. Fabrication: Fabricate steel templates to hold equipment anchor-bolt sleeves and anchors in place during placement of concrete. Obtain anchor-bolt templates from supported equipment manufacturer.

2.21 RESTRAINED ISOLATION ROOF-CURB RAILS

- A. Description: Factory-assembled, fully enclosed, insulated, air- and watertight curb rail designed to resiliently support equipment and to withstand seismic and wind forces.

- B. Upper Frame: The upper frame shall provide continuous support for equipment and shall be captive to resiliently resist seismic and wind forces.

- C. Lower Support Assembly: The lower support assembly shall be formed sheet metal section containing adjustable and removable steel springs that support the upper frame. The lower support assembly shall have a means for attaching to building structure and a wood nailer for attaching roof materials, and shall be insulated with a minimum of 2 inches of rigid, glass-fiber insulation on inside of assembly. Adjustable, restrained-spring isolators shall be mounted on elastomeric vibration isolation pads and shall have access ports, for level adjustment, with removable waterproof covers at all isolator locations. Isolators shall be located so they are accessible for adjustment at any time during the life of the installation without interfering with the integrity of the roof.

- D. Snubber Bushings: All-directional, elastomeric snubber bushings at least 1/4 inch thick.

- E. Water Seal: Galvanized sheet metal with EPDM seals at corners, attached to upper support frame, extending down past wood nailer of lower support assembly, and counter-flashed over roof materials.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and equipment to receive vibration isolation and seismic and wind-control devices for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

- A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application by an agency acceptable to authorities having jurisdiction.
- B. Hanger-Rod Stiffeners: Install hanger-rod stiffeners where required to prevent buckling of hanger rods due to seismic forces.
- C. Strength of Support and Seismic-Restraint Assemblies: Select sizes of components so strength is adequate to carry present and future static and seismic loads within specified loading limits.

3.3 VIBRATION CONTROL AND SEISMIC-RESTRAINT DEVICE INSTALLATION

- A. Coordinate the location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork specified in Section 033000 "Cast-in-Place Concrete."
- B. Installation of vibration isolators must not cause any change of position of equipment, piping, or ductwork resulting in stresses or misalignment.
- C. Comply with requirements in Section 077200 "Roof Accessories" for installation of roof curbs, equipment supports, and roof penetrations.
- D. Equipment Restraints:
 - 1. Install seismic snubbers on HVAC equipment mounted on vibration isolators. Locate snubbers as close as possible to vibration isolators and bolt to equipment base and supporting structure.
 - 2. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch.
 - 3. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction that provides required submittals for component.
- E. Piping Restraints:
 - 1. Comply with requirements in MSS SP-127.
 - 2. Space lateral supports a maximum of 40 feet o.c., and longitudinal supports a maximum of 80 feet o.c.
 - 3. Brace a change of direction longer than 12 feet.

- F. Install cables so they do not bend across edges of adjacent equipment or building structure.
- G. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction that provides required submittals for component.
- H. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.
- I. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.
- J. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.
- K. Drilled-in Anchors:
 - 1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid pre-stressed tendons, electrical and telecommunications conduit, and gas lines.
 - 2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
 - 3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
 - 4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
 - 5. Set anchors to manufacturer's recommended torque, using a torque wrench.
 - 6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.4 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

- A. Install flexible connections in piping where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where the connections terminate with connection to equipment that is anchored to a different structural element from the one supporting the connections as they approach equipment. Comply with requirements in Section 232113 "Hydronic Piping" for piping flexible connections.

3.5 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. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
 - 2. Schedule test with Owner, through Architect, before connecting anchorage device to restrained component (unless post-connection testing has been approved), and with at least seven days' advance notice.
 - 3. Obtain Architect's approval before transmitting test loads to structure. Provide temporary load-spreading members.
 - 4. Test at least four of each type and size of installed anchors and fasteners selected by Architect.

5. Test to 90 percent of rated proof load of device.
6. Measure isolator restraint clearance.
7. Measure isolator deflection.
8. Verify snubber minimum clearances.
9. Test and adjust restrained-air-spring isolator controls and safeties.

D. Remove and replace malfunctioning units and retest as specified above.

E. Prepare test and inspection reports.

3.6 ADJUSTING

A. Adjust isolators after piping system is at operating weight.

B. Adjust limit stops on restrained-spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.

3.7 VIBRATION ISOLATION EQUIPMENT BASES INSTALLATION

A. Coordinate the location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork specified in Section 033000 "Cast-in-Place Concrete."

END OF SECTION 230548

SECTION 230553 - IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 1. Equipment labels.
 2. Warning signs and labels.
 3. Pipe labels.
 4. Duct labels.
 5. Valve tags.
 6. Warning tags.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For color, letter style, and graphic representation required for each identification material and device.
- C. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.
- D. Valve numbering scheme.
- E. Valve Schedules: For each piping system to include in maintenance manuals.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Acceptable manufacturers for all labels and tags:
 1. Seton
 2. Brady
 3. Kolbi Pipe Markers
 4. Craftmart

2.2 EQUIPMENT LABELS

- A. Metal Labels for Equipment:
 1. Material and Thickness: Brass, 0.032-inch, stainless steel, 0.025-inch, aluminum, 0.032-inch or anodized aluminum, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
 2. Letter Color: White.

3. Background Color: Black.
 4. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
 5. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
 6. Fasteners: Stainless-steel rivets or self-tapping screws.
 7. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- B. Plastic Labels for Equipment:
1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
 2. Letter Color: White.
 3. Background Color: Black.
 4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
 5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
 6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
 7. Fasteners: Stainless-steel rivets or self-tapping screws.
 8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- C. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), and the Specification Section number and title where equipment is specified.
- D. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number, and identify Drawing numbers where equipment is indicated (plans, details, and schedules) and the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.
- 2.3 WARNING SIGNS AND LABELS
- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
 - B. Letter Color: Black
 - C. Background Color: Yellow.
 - D. Maximum Temperature: Able to withstand temperatures up to 160 degrees F.
 - E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
 - F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
 - G. Fasteners: Stainless-steel rivets or self-tapping screws.
 - H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

- I. Label Content: Include caution and warning information plus emergency notification instructions.

2.4 PIPE LABELS

- A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction according to ASME A13.1.
- B. Pre-tensioned Pipe Labels: Pre-coiled, semi-rigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.
- C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
- D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings; also include pipe size and an arrow indicating flow direction.
 - 1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions or as separate unit on each pipe label to indicate flow direction.
 - 2. Lettering Size: Size letters according to ASME A13.1 for piping.

2.5 DUCT LABELS

- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
- B. Letter Color: White.
- C. Background Color: Black.
- D. Maximum Temperature: Able to withstand temperatures up to 160 degrees F.
- E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
- F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 in, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
- G. Fasteners: Stainless-steel rivets or self-tapping screws.
- H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- I. Duct Label Contents: Include identification of duct service using same designations or abbreviations as used on Drawings; also include duct size and an arrow indicating flow direction.
 - 1. Flow-Direction Arrows: Integral with duct system service lettering to accommodate both directions or as separate unit on each duct label to indicate flow direction.

2.6 VALVE TAGS

- A. Description: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.
 - 1. Tag Material: Brass, 0.032-inch, stainless steel, 0.025-inch, aluminum, 0.032-inch or anodized aluminum, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.

2. Fasteners: Brass wire-link chain, beaded chain or S-hook.

B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.

1. Valve-tag schedule shall be included in operation and maintenance data.

2.7 WARNING TAGS

A. Description: Preprinted or partially preprinted accident-prevention tags of plasticized card stock with matte finish suitable for writing.

1. Size: Approximately 4 by 7 inches.

2. Fasteners: Reinforced grommet and wire or string.

3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."

4. Color: Safety-yellow background with black lettering.

PART 3 - EXECUTION

3.1 PREPARATION

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

3.2 GENERAL INSTALLATION REQUIREMENTS

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Coordinate installation of identifying devices with locations of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

3.3 EQUIPMENT LABEL INSTALLATION

A. Install or permanently fasten labels on each major item of mechanical equipment.

B. Locate equipment labels where accessible and visible.

3.4 PIPE LABEL INSTALLATION

A. Piping Color Coding: Painting of piping is specified in Section 099123 "Interior Painting."

B. Pipe Label Locations: Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:

1. Near each valve and control device.

2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
3. Near penetrations and on both sides of through walls, floors, ceilings, and inaccessible enclosures.
4. At access doors, manholes, and similar access points that permit view of concealed piping.
5. Near major equipment items and other points of origination and termination.
6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.

C. Directional Flow Arrows: Arrows shall be used to indicate direction of flow in pipes, including pipes where flow is allowed in both directions.

D. Pipe Label Color Schedule:

1. Heating Water Piping: White letters on a safety-green background.

3.5 DUCT LABEL INSTALLATION

A. Install plastic-laminated or self-adhesive duct labels with permanent adhesive on air ducts in the following color codes:

1. Blue: For cold-air supply ducts.
2. Yellow: For hot-air supply ducts.
3. Green: For exhaust-, outside-, relief-, return-, and mixed-air ducts.

B. Locate labels near points where ducts enter into and exit from concealed spaces and at maximum intervals of 50 feet in each space where ducts are exposed or concealed by removable ceiling system.

3.6 VALVE-TAG INSTALLATION

A. Install tags on valves and control devices in piping systems, except check valves, valves within factory-fabricated equipment units, shutoff valves, 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:

1. Valve-Tag Size and Shape: 2" round for all valves.
2. Valve-Tag Colors:
 - a. Potable and Other Water: White letters on a safety-green background.

3.7 WARNING-TAG INSTALLATION

A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION 230553

SECTION 230593 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Balancing Air Systems:
 - a. Constant-volume air systems.
 - 2. Balancing Hydronic Piping Systems:
 - a. Constant-flow hydronic systems.
 - 3. Testing, Adjusting, and Balancing Equipment:
 - a. Motors.
 - b. Heat-transfer coils.
 - 4. Testing, adjusting, and balancing existing systems and equipment.
 - 5. Sound tests.
 - 6. Vibration tests.
 - 7. Control system verification.

1.3 DEFINITIONS

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

1.4 PREINSTALLATION MEETINGS

- A. TAB Conference: If requested by the Owner, conduct a TAB conference at project site after approval of the TAB strategies and procedures plan to develop a mutual understanding of the details. Provide a minimum of 14 days advance notice of scheduled meeting time and location.
 - 1. Minimum Agenda Items:
 - a. The Contract Documents examination report.
 - b. The TAB plan.
 - c. Needs for coordination and cooperation of trades and subcontractors.
 - d. Proposed procedures for documentation and communication flow.

1.5 ACTION SUBMITTALS

A. LEED Submittals:

1. Air-Balance Report for Prerequisite IEQ 1: Documentation indicating that work complies with ASHRAE 62.1, Section 7.2.2 - "Air Balancing."
2. TAB Report for Prerequisite EA 2: Documentation indicating that work complies with ASHRAE/IESNA 90.1, Section 6.7.2.3 - "System Balancing."

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: Within 30 days of Contractor's Notice to Proceed, submit documentation that the TAB specialist and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.
- B. Contract Documents Examination Report: Within 30 days of Contractor's Notice to Proceed, submit the Contract Documents review report as specified in Part 3.
- C. Strategies and Procedures Plan: Within 30 days of Contractor's Notice to Proceed, submit TAB strategies and step-by-step procedures as specified in "Preparation" Article.
- D. System Readiness Checklists: Within 60 days of Contractor's Notice to Proceed, submit system readiness checklists as specified in "Preparation" Article.
- E. Examination Report: Submit a summary report of the examination review required in "Examination" Article.
- F. Certified TAB reports.
- G. Sample report forms.
- H. Instrument calibration reports, to include the following:
 1. Instrument type and make.
 2. Serial number.
 3. Application.
 4. Dates of use.
 5. Dates of calibration.

1.7 QUALITY ASSURANCE

- A. TAB Specialists Qualifications: Certified by AABC, NEBB or TABB.
 1. TAB Field Supervisor: Employee of the TAB specialist and certified by AABC, NEBB or TABB.
 2. TAB Technician: Employee of the TAB specialist and certified by AABC, NEBB or TABB as a TAB technician.
- B. Instrumentation Type, Quantity, Accuracy, and Calibration: Comply with requirements in ASHRAE 111, Section 4, "Instrumentation."
- C. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 7.2.2 - "Air Balancing."
- D. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.7.2.3 - "System Balancing."

1.8 FIELD CONDITIONS

- A. Full Owner Occupancy: Owner will occupy the site and existing building during entire TAB period. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.
- B. 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.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems designs that may preclude proper TAB of systems and equipment.
- B. Examine installed systems for balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Verify that locations of these balancing devices are applicable for intended purpose and are accessible.
- C. Examine the approved submittals for HVAC systems and equipment.
- D. Examine design data including HVAC system descriptions, statements of design assumptions for environmental conditions and systems output, and statements of philosophies and assumptions about HVAC system and equipment controls.
- E. Examine ceiling plenums and underfloor air plenums used for supply, return, or relief air to verify that they are properly separated from adjacent areas. Verify that penetrations in plenum walls are sealed and fire-stopped if required.
- F. Examine equipment performance data including fan and pump curves.
 - 1. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
 - 2. Calculate system-effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from the conditions used to rate equipment performance. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," or in SMACNA's "HVAC Systems - Duct Design." Compare results with the design data and installed conditions.
- G. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.
- H. Examine test reports specified in individual system and equipment Sections.
- I. Examine HVAC equipment and verify that bearings are greased, belts are aligned and tight, filters are clean, and equipment with functioning controls is ready for operation.

- J. Examine terminal units, such as variable-air-volume boxes, and verify that they are accessible and their controls are connected and functioning.
- K. Examine strainers. Verify that startup screens have been replaced by permanent screens with indicated perforations.
- L. Examine control valves for proper installation for their intended function of throttling, diverting, or mixing fluid flows.
- M. Examine heat-transfer coils for correct piping connections and for clean and straight fins.
- N. Examine system pumps to ensure absence of entrained air in the suction piping.
- O. Examine operating safety interlocks and controls on HVAC equipment.
- P. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.2 PREPARATION

- A. Prepare a TAB plan that includes the following:
 - 1. Equipment and systems to be tested.
 - 2. Strategies and step-by-step procedures for balancing the systems.
 - 3. Instrumentation to be used.
 - 4. Sample forms with specific identification for all equipment.
- B. Perform system-readiness checks of HVAC systems and equipment to verify system readiness for TAB work. Include, at a minimum, the following:
 - 1. Airside:
 - a. Verify that leakage and pressure tests on air distribution systems have been satisfactorily completed.
 - b. Duct systems are complete with terminals installed.
 - c. Volume, smoke, and fire dampers are open and functional.
 - d. Clean filters are installed.
 - e. Fans are operating, free of vibration, and rotating in correct direction.
 - f. Variable-frequency controllers' startup is complete and safeties are verified.
 - g. Automatic temperature-control systems are operational.
 - h. Ceilings are installed.
 - i. Windows and doors are installed.
 - j. Suitable access to balancing devices and equipment is provided.
 - 2. Hydronics:
 - a. Verify leakage and pressure tests on water distribution systems have been satisfactorily completed.
 - b. Piping is complete with terminals installed.
 - c. Water treatment is complete.
 - d. Systems are flushed, filled, and air purged.
 - e. Strainers are pulled and cleaned.
 - f. Control valves are functioning per the sequence of operation.
 - g. Shutoff and balance valves have been verified to be 100 percent open.
 - h. Pumps are started and proper rotation is verified.
 - i. Pump gage connections are installed directly at pump inlet and outlet flanges or in discharge and suction pipe prior to valves or strainers.
 - j. Variable-frequency controllers' startup is complete and safeties are verified.
 - k. Suitable access to balancing devices and equipment is provided.

3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

- A. Perform testing and balancing procedures on each system according to the procedures contained in AABC's "National Standards for Total System Balance", ASHRAE 111, NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" or SMACNA's "HVAC Systems - Testing, Adjusting, and Balancing" and in this Section.
- B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary for TAB procedures
 - 1. After testing and balancing, install test ports and duct access doors that comply with requirements in Section 233300 "Air Duct Accessories."
 - 2. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish according to Section 230713 "Duct Insulation," Section 230716 "HVAC Equipment Insulation," and Section 230719 "HVAC Piping Insulation."
- C. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.
- D. Take and report testing and balancing measurements in inch-pound (IP) units.

3.4 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 outdoor-air louvers and dampers and the return- and exhaust-air dampers through the supply-fan discharge and mixing dampers.
- F. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
- G. Verify that motor starters are equipped with properly sized thermal protection.
- H. Check dampers for proper position to achieve desired airflow path.
- I. Check for airflow blockages.
- J. Check condensate drains for proper connections and functioning.
- K. Check for proper sealing of air-handling-unit components.
- L. Verify that air duct system is sealed as specified in Section 233113 "Metal Ducts."

3.5 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

- A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.

1. Measure total airflow.
 - a. Set outside-air, return-air, and relief-air dampers for proper position that simulates minimum outdoor-air conditions.
 - b. Where duct conditions allow, measure airflow by Pitot-tube traverse. If necessary, perform multiple Pitot-tube traverses to obtain total airflow.
 - c. Where duct conditions are not suitable for Pitot-tube traverse measurements, a coil traverse may be acceptable.
 2. Measure fan static pressures as follows:
 - a. Measure static pressure directly at the fan outlet or through the flexible connection.
 - b. Measure static pressure directly at the fan inlet or through the flexible connection.
 - c. Measure static pressure across each component that makes up the air-handling system.
 - d. Report artificial loading of filters at the time static pressures are measured
 3. Review Record Documents to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors. Recommend adjustments to accommodate actual conditions.
 4. Obtain approval from the project engineer or from the commissioning authority for adjustment of fan speed higher or lower than indicated speed. Comply with requirements in HVAC Sections for air-handling units for adjustment of fans, belts, and pulley sizes to achieve indicated air-handling-unit performance.
 5. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload occurs. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.
- B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows.
1. Measure airflow of submain and branch ducts.
 2. Adjust submain and branch duct volume dampers for specified airflow.
 3. Re-measure each submain and branch duct after all have been adjusted.
- C. Adjust air inlets and outlets for each space to indicated airflows.
1. Set airflow patterns of adjustable outlets for proper distribution without drafts.
 2. Measure inlets and outlets airflow.
 3. Adjust each inlet and outlet for specified airflow.
 4. Re-measure each inlet and outlet after they have been adjusted.
- D. Verify final system conditions.
1. Re-measure and confirm that minimum outdoor, return, and relief airflows are within design. Readjust to design if necessary.
 2. Re-measure and confirm that total airflow is within design.
 3. Re-measure all final fan operating data, rpms, volts, amps, and static profile.
 4. Mark all final settings.
 5. Test system in economizer mode. Verify proper operation and adjust if necessary.
 6. Measure and record all operating data.
 7. Record final fan-performance data.
- 3.6 GENERAL PROCEDURES FOR HYDRONIC SYSTEMS
- A. Prepare test reports for pumps, coils, and heat exchangers. Obtain approved submittals and manufacturer-recommended testing procedures. Crosscheck the summation of required coil and heat exchanger flow rates with pump design flow rate.
- B. Prepare schematic diagrams of systems' "as-built" piping layouts.

- C. In addition to requirements in "Preparation" Article, prepare hydronic systems for testing and balancing as follows:
1. Check liquid level in expansion tank.
 2. Check highest vent for adequate pressure.
 3. Check flow-control valves for proper position.
 4. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
 5. Verify that motor starters are equipped with properly sized thermal protection.
 6. Check that air has been purged from the system.

3.7 PROCEDURES FOR CONSTANT-FLOW HYDRONIC SYSTEMS

- A. Adjust pumps to deliver total design gpm.
1. Measure total water flow.
 - a. Position valves for full flow through coils.
 - b. Measure flow by main flow meter, if installed.
 - c. If main flow meter is not installed, determine flow by pump TDH or exchanger pressure drop.
 2. Measure pump TDH as follows:
 - a. Measure discharge pressure directly at the pump outlet flange or in discharge pipe prior to any valves.
 - b. Measure inlet pressure directly at the pump inlet flange or in suction pipe prior to any valves or strainers.
 - c. Convert pressure to head and correct for differences in gage heights.
 - d. Verify pump impeller size by measuring the TDH with the discharge valve closed. Note the point on manufacturer's pump curve at zero flow, and verify that the pump has the intended impeller size.
 - e. With valves open, read pump TDH. Adjust pump discharge valve until design water flow is achieved.
 3. Monitor motor performance during procedures and do not operate motor in an overloaded condition.
- B. Adjust flow-measuring devices installed in mains and branches to design water flows.
1. Measure flow in main and branch pipes.
 2. Adjust main and branch balance valves for design flow.
 3. Re-measure each main and branch after all have been adjusted.
- C. Adjust flow-measuring devices installed at terminals for each space to design water flows.
1. Measure flow at terminals.
 2. Adjust each terminal to design flow.
 3. Re-measure each terminal after it is adjusted.
 4. Position three-way control valves to bypass the coil, and adjust the bypass valve to maintain design flow.
 5. Perform temperature tests after flows have been balanced.
- D. For systems with pressure-independent flow control valves at terminals:
1. Measure differential pressure and verify that it is within manufacturer's specified range.
 2. Perform temperature tests after flows have been verified.
- E. For systems without pressure-independent valves or flow-measuring devices at terminals:
1. Measure and balance coils by either coil pressure drop or temperature method.
 2. If balanced by coil pressure drop, perform temperature tests after flows have been verified.
- F. Verify final system conditions as follows:
1. Re-measure and confirm that total water flow is within design.

2. Re-measure final pumps' operating data, TDH, volts, amps, and static profile.
 3. Mark final settings.
- G. Verify that memory stops have been set.

3.8 PROCEDURES FOR MOTORS

- A. Motors 1/2 HP and Larger: Test at final balanced conditions and record the following data:
1. Manufacturer's name, model number, and serial number.
 2. Motor horsepower rating.
 3. Motor rpm.
 4. Phase and hertz.
 5. Nameplate and measured voltage, each phase.
 6. Nameplate and measured amperage, each phase.
 7. Starter size and thermal-protection-element rating.
 8. Service factor and frame size.
- B. Motors Driven by Variable-Frequency Controllers: Test manual bypass of controller to prove proper operation.

3.9 PROCEDURES FOR HEAT-TRANSFER COILS

- A. Measure, adjust, and record the following data for each water coil:
1. Entering- and leaving-water temperature.
 2. Water flow rate.
 3. Water pressure drop for equipment coils.
 4. Dry-bulb temperature of entering and leaving air.
 5. Wet-bulb temperature of entering and leaving air for cooling coils.
 6. Airflow.

3.10 SOUND TESTS

- A. After the systems are balanced and construction is Substantially Complete, measure and record sound levels at 5 locations as designated by the Architect.
- B. Instrumentation:
1. The sound-testing meter shall be a portable, general-purpose testing meter consisting of a microphone, processing unit, and readout.
 2. The sound-testing meter shall be capable of showing fluctuations at minimum and maximum levels, and measuring the equivalent continuous sound pressure level (LEQ).
 3. The sound-testing meter must be capable of using 1/3 octave band filters to measure mid-frequencies from 31.5 Hz to 8000 Hz.
 4. The accuracy of the sound-testing meter shall be plus or minus one decibel.
- C. Test Procedures:
1. Perform test at quietest background noise period. Note cause of unpreventable sound that affects test outcome.

2. Equipment should be operating at design values.
3. Calibrate the sound-testing meter prior to taking measurements.
4. Use a microphone suitable for the type of noise levels measured that is compatible with meter. Provide a windshield for outside or in-duct measurements.
5. Record a set of background measurements in dBA and sound pressure levels in the eight un-weighted octave bands 63 Hz to 8000 Hz (NC) with the equipment off.
6. Take sound readings in dBA and sound pressure levels in the eight un-weighted octave bands 63 Hz to 8000 Hz (NC) with the equipment operating.
7. Take readings no closer than 36 inches from a wall or from the operating equipment and approximately 60 inches from the floor, with the meter held or mounted on a tripod.
8. For outdoor measurements, move sound-testing meter slowly and scan area that has the most exposure to noise source being tested. Use A-weighted scale for this type of reading.

D. Reporting:

1. Report shall record the following:
 - a. Location.
 - b. System tested.
 - c. dBA reading.
 - d. Sound pressure level in each octave band with equipment on and off.
2. Plot sound pressure levels on NC worksheet with equipment on and off.

3.11 VIBRATION TESTS

- A. After systems are balanced and construction is Substantially Complete, measure and record vibration levels on equipment having motor horsepower equal to or greater than 10.
- B. Instrumentation:
1. Use portable, battery-operated, and microprocessor-controlled vibration meter with or without a built-in printer.
 2. The meter shall automatically identify engineering units, filter bandwidth, amplitude, and frequency scale values.
 3. The meter shall be able to measure machine vibration displacement in mils of deflection, velocity in inches per second, and acceleration in inches per second squared.
 4. Verify calibration date is current for vibration meter before taking readings.
- C. Test Procedures:
1. To ensure accurate readings, verify that accelerometer has a clean, flat surface and is mounted properly.
 2. With the unit running, set up vibration meter in a safe, secure location. Connect transducer to meter with proper cables. Hold magnetic tip of transducer on top of the bearing, and measure unit in mils of deflection. Record measurement, then move transducer to the side of the bearing and record in mils of deflection. Record an axial reading in mils of deflection by holding nonmagnetic, pointed transducer tip on end of shaft.
 3. Change vibration meter to velocity (inches per second) measurements. Repeat and record above measurements.
 4. Record CPM or rpm.
 5. Read each bearing on motor, fan, and pump as required. Track and record vibration levels from rotating component through casing to base.
- D. Reporting:
1. Report shall record location and the system tested.
 2. Include horizontal-vertical-axial measurements for tests.

3. Verify that vibration limits follow Specifications, or, if not specified, follow the General Machinery Vibration Severity Chart or Vibration Acceleration General Severity Chart from the AABC National Standards. Acceptable levels of vibration are normally "smooth" to "good."
4. Include in report General Machinery Vibration Severity Chart, with conditions plotted.

3.12 CONTROLS VERIFICATION

- A. In conjunction with system balancing, perform the following:
 1. Verify temperature control system is operating within the design limitations.
 2. Confirm that the sequences of operation are in compliance with Contract Documents.
 3. Verify that controllers are calibrated and function as intended.
 4. Verify that controller set points are as indicated.
 5. Verify the operation of lockout or interlock systems.
 6. Verify the operation of valve and damper actuators.
 7. Verify that controlled devices are properly installed and connected to correct controller.
 8. Verify that controlled devices travel freely and are in position indicated by controller: open, closed, or modulating.
 9. Verify location and installation of sensors to ensure that they sense only intended temperature, humidity, or pressure.
- B. Reporting: Include a summary of verifications performed, remaining deficiencies, and variations from indicated conditions.

3.13 PROCEDURES FOR TESTING, ADJUSTING, AND BALANCING EXISTING SYSTEMS

- A. Perform a preconstruction inspection of existing equipment that is to remain and be reused.
 1. Measure and record the operating speed, airflow, and static pressure of each fan.
 2. Measure motor voltage and amperage. Compare the values to motor nameplate information.
 3. Check the condition of filters.
 4. Check the condition of coils.
 5. Check the operation of the drain pan and condensate-drain trap.
 6. Check bearings and other lubricated parts for proper lubrication.
 7. Report on the operating condition of the equipment and the results of the measurements taken. Report deficiencies.
- B. Before performing testing and balancing of existing systems, inspect existing equipment that is to remain and be reused to verify that existing equipment has been cleaned and refurbished. Verify the following:
 1. New filters are installed.
 2. Coils are clean and fins combed.
 3. Drain pans are clean.
 4. Fans are clean.
 5. Bearings and other parts are properly lubricated.
 6. Deficiencies noted in the preconstruction report are corrected.
- C. Perform testing and balancing of existing systems to the extent that existing systems are affected by the renovation work.
 1. Compare the indicated airflow of the renovated work to the measured fan airflows, and determine the new fan speed and the face velocity of filters and coils.
 2. Verify that the indicated airflows of the renovated work result in filter and coil face velocities and fan speeds that are within the acceptable limits defined by equipment manufacturer.
 3. If calculations increase or decrease the airflow rates and water flow rates by more than 5 percent, make equipment adjustments to achieve the calculated rates. If increase or decrease is 5 percent or less, equipment adjustments are not required.

4. Balance each air outlet.

3.14 TOLERANCES

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

3.15 PROGRESS REPORTING

- A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for systems balancing devices. Recommend changes and additions to systems balancing devices to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.
- B. Status Reports: Prepare monthly progress reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.

3.16 FINAL REPORT

- A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.
 1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
 2. Include a list of instruments used for procedures, along with proof of calibration.
 3. Certify validity and accuracy of field data.
- B. Final Report Contents: In addition to certified field-report data, include the following:
 1. 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; do not include Shop Drawings and Product Data.
- C. General Report Data: In addition to form titles and entries, include the following data:
 1. Title page.
 2. Name and address of the TAB specialist.
 3. Project name.
 4. Project location.
 5. Architect's name and address.
 6. Engineer's name and address.
 7. Contractor's name and address.
 8. Report date.
 9. Signature of TAB supervisor who certifies the report.
 10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
 11. Summary of contents including the following:

- a. Indicated versus final performance.
- b. Notable characteristics of systems.
- c. Description of system operation sequence if it varies from the Contract Documents.
12. Nomenclature sheets for each item of equipment.
13. Data for terminal units, including manufacturer's name, type, size, and fittings.
14. Notes to explain why certain final data in the body of reports vary from indicated values.
15. Test conditions for fans and pump performance forms including the following:
 - a. Settings for outdoor-, return-, and exhaust-air dampers.
 - b. Conditions of filters.
 - c. Cooling coil, wet- and dry-bulb conditions.
 - d. Face and bypass damper settings at coils.
 - e. Fan drive settings including settings and percentage of maximum pitch diameter.
 - f. Settings for supply-air, static-pressure controller.
 - g. Other system operating conditions that affect performance.
- D. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:
 1. Quantities of outdoor, supply, return, and exhaust airflows.
 2. Water flow rates.
 3. Duct, outlet, and inlet sizes.
 4. Pipe and valve sizes and locations.
 5. Terminal units.
 6. Balancing stations.
 7. Position of balancing devices.
- E. Air-Handling-Unit Test Reports: For air-handling units with coils, include the following:
 1. Unit Data:
 - a. Unit identification.
 - b. Location.
 - c. Make and type.
 - d. Model number and unit size.
 - e. Manufacturer's serial number.
 - f. Unit arrangement and class.
 - g. Discharge arrangement.
 - h. Sheave make, size in inches and bore.
 - i. Center-to-center dimensions of sheave and amount of adjustments in inches.
 - j. Number, make, and size of belts.
 - k. Number, type, and size of filters.
 2. Motor Data:
 - a. Motor make, and frame type and size.
 - b. Horsepower and rpm.
 - c. Volts, phase, and hertz.
 - d. Full-load amperage and service factor.
 - e. Sheave make, size in inches, and bore.
 - f. Center-to-center dimensions of sheave and amount of adjustments in inches.
 3. Test Data (Indicated and Actual Values):
 - a. Total airflow rate in cfm.
 - b. Total system static pressure in inches wg.
 - c. Fan rpm.
 - d. Discharge static pressure in inches wg.
 - e. Filter static-pressure differential in inches wg.
 - f. Preheat-coil static-pressure differential in inches wg.
 - g. Cooling-coil static-pressure differential in inches wg.
 - h. Heating-coil static-pressure differential in inches wg.
 - i. Outdoor airflow in cfm.

- j. Return airflow in cfm.
 - k. Outdoor-air damper position.
 - l. Return-air damper position.
- F. Fan Test Reports: For supply, return, and exhaust fans, include the following:
- 1. Fan Data:
 - a. System identification.
 - b. Location.
 - c. Make and type.
 - d. Model number and size.
 - e. Manufacturer's serial number.
 - f. Arrangement and class.
 - g. Sheave make, size in inches and bore.
 - h. Center-to-center dimensions of sheave and amount of adjustments in inches.
 - 2. Motor Data:
 - a. Motor make, and frame type and size.
 - b. Horsepower and rpm.
 - c. Volts, phase, and hertz.
 - d. Full-load amperage and service factor.
 - e. Sheave make, size in inches, and bore.
 - f. Center-to-center dimensions of sheave, and amount of adjustments in inches.
 - g. Number, make, and size of belts.
 - 3. Test Data (Indicated and Actual Values):
 - a. Total airflow rate in cfm.
 - b. Total system static pressure in inches wg.
 - c. Fan rpm.
 - d. Discharge static pressure in inches wg.
 - e. Suction static pressure in inches wg.
- G. 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. Traverse air temperature in deg F.
 - d. Duct static pressure in inches wg.
 - e. Duct size in inches.
 - f. Duct area in sq. ft.
 - g. Indicated airflow rate in cfm.
 - h. Indicated velocity in fpm.
 - i. Actual airflow rate in cfm.
 - j. Actual average velocity in fpm.
 - k. Barometric pressure in psig.
- H. Air-Terminal-Device Reports:
- 1. Unit Data:
 - a. System and air-handling unit identification.
 - b. Location and zone.
 - c. Apparatus used for test.
 - d. Area served.
 - e. Make.
 - f. Number from system diagram.
 - g. Type and model number.
 - h. Size.
 - i. Effective area in sq. ft.

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.

- I. System-Coil Reports: For reheat coils and water coils, 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.

- J. Pump Test Reports: Calculate impeller size by plotting the shutoff head on pump curves and include the following:
 1. Unit Data:
 - a. Unit identification.
 - b. Location.
 - c. Service.
 - d. Make and size.
 - e. Model number and serial number.
 - 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.

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

3.17 VERIFICATION OF TAB REPORT

- A. Engineer or Commissioning authority shall randomly select measurements, documented in the final report, to be rechecked. Rechecking shall be limited to either 10 percent of the total measurements recorded or the extent of measurements that can be accomplished in a normal 8-hour business day.
- B. If rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."
- C. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the testing and balancing shall be considered incomplete and shall be rejected.
- D. If TAB work fails, proceed as follows:
 - 1. TAB specialists shall recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes; resubmit the final report and request a second final inspection.
 - 2. If the second final inspection also fails, Owner may contract the services of another TAB specialist to complete TAB work according to the Contract Documents and deduct the cost of the services from the original TAB specialist's final payment.
 - 3. If the second verification also fails, design professional may contact AABC Headquarters regarding the AABC National Performance Guaranty.
- E. Prepare test and inspection reports.

3.18 ADDITIONAL TESTS

- A. Within 90 days of completing TAB, perform additional TAB to verify that balanced conditions are being maintained throughout and to correct unusual conditions.
- B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional TAB during near-peak summer and winter conditions.

END OF SECTION 230593

SECTION 230713 - DUCT INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes insulating the following duct services:
 - 1. Indoor, concealed and exposed supply and outdoor air.
 - 2. Indoor, concealed and exposed return located in unconditioned space.
 - 3. Indoor, concealed and exposed, Type I, commercial, kitchen hood exhaust.
- B. Related Sections:
 - 1. Section 230716 "HVAC Equipment Insulation."
 - 2. Section 230719 "HVAC Piping Insulation."
 - 3. Section 233113 "Metal Ducts" for duct liners.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance, thickness and jackets (both factory- and field-applied if any).
- B. Sustainable Design Submittals:
 - 1. Product Data: For adhesives, indicating VOC content.
 - 2. Sustainable Design Submittals.
 - 3. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting materials.
 - 4. Laboratory Test Reports: For coatings, indicating compliance with requirements for low-emitting materials.
 - 5. Product Data: For sealants, indicating VOC content.
 - 6. Laboratory Test Reports: For sealants, indicating compliance with requirements for low-emitting materials.
- C. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
 - 1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
 - 2. Detail insulation application at elbows, fittings, dampers, specialties and flanges for each type of insulation.
 - 3. Detail application of field-applied jackets.
 - 4. Detail application at linkages of control devices.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers,

attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.

- C. Field quality-control reports.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.
- B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.
 - 1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
 - 2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.
- C. Mockups: Before installing insulation, build mockups for each type of insulation and finish listed below to demonstrate quality of insulation application and finishes. Build mockups in the location indicated or, if not indicated, as directed by Architect. Use materials indicated for the completed Work.
 - 1. Ductwork Mockups:
 - a. One six (6) foot section each of rectangular and round straight duct.
 - b. One each of a 90-degree mitered round and rectangular elbow, and one each of a 90-degree radius round and rectangular elbow.
 - c. One rectangular branch takeoff and one round branch takeoff from a rectangular duct. One round tee fitting.
 - d. One rectangular and round transition fitting.
 - e. Four support hangers for round and rectangular ductwork.
 - f. Each type of damper and specialty.
 - 2. For each mockup, fabricate cutaway sections to allow observation of application details for insulation materials, adhesives, mastics, attachments, and jackets.
 - 3. Notify Architect seven days in advance of dates and times when mockups will be constructed.
 - 4. Obtain Architect's approval of mockups before starting insulation application.
 - 5. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 - 6. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
 - 7. Demolish and remove mockups when directed.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.7 COORDINATION

- A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."
- B. Coordinate clearance requirements with duct Installer for duct insulation application. Before preparing ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

- A. Comply with requirements in "Indoor and Outdoor Above Ground Duct Insulation Schedule, General " articles for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- E. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type III with factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
 - 1. Acceptable manufacturers for mineral fiber blanket insulation are:
 - a. Certain Teed Corporation
 - b. Johns Manville
 - c. Knauf Insulation
 - d. Owens Corning
- F. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB. For duct and plenum applications, provide insulation with factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
 - 1. Acceptable manufacturers for mineral fiber board insulation are:
 - a. Certain Teed Corporation
 - b. Johns Manville
 - c. Knauf Insulation
 - d. Owens Corning

2.2 FIRE-RATED INSULATION SYSTEMS

- A. Fire-Rated Blanket: High-temperature, flexible, blanket insulation with FSK jacket that is tested and certified to provide a 2-hour fire rating by an NRTL acceptable to authorities having jurisdiction.
 - 1. Acceptable manufacturers of fire rated blanket insulation are:
 - a. 3M
 - b. Certain Teed Corporation
 - c. Johns Manville
 - d. Nelson Firestop

2.3 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.
- B. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
 - 1. Acceptable manufacturers for mineral fiber adhesive are:
 - a. Childers Brand
 - b. Eagle Bridges

- c. Foster Brand
 2. Fiberglass adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 3. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- C. FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
1. Acceptable manufacturers FSK jacket adhesive adhesive are:
 - a. Childers Brand
 - b. Eagle Bridges
 - c. Foster Brand
 2. Adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 3. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

2.4 MASTICS

- A. The following are acceptable manufacturers for mastics:
1. Childers Brand
 2. Eagle Bridges
 3. Foster Brand
 4. Vimasco
- B. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II."
1. VOC Content: 300g/L or less.
 2. Low-Emitting Materials: Mastic coatings shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- C. Vapor-Barrier Mastic: Water based; suitable for indoor use on below ambient services.
1. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm at 43-mil dry film thickness.
 2. Service Temperature Range: Minus 20 to plus 180 deg F.
 3. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
 4. Color: White.
- D. Vapor-Barrier Mastic: Solvent based; suitable for outdoor use on below ambient services.
1. Water-Vapor Permeance: ASTM F 1249, 0.05 perm at 30-mil dry film thickness.
 2. Service Temperature Range: Minus 50 to plus 220 deg F.
 3. Solids Content: ASTM D 1644, 33 percent by volume and 46 percent by weight.
 4. Color: White.
- E. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.
1. Water-Vapor Permeance: ASTM F 1249, 1.8 perms at 0.0625-inch dry film thickness.
 2. Service Temperature Range: Minus 20 to plus 180 deg F.
 3. Solids Content: 60 percent by volume and 66 percent by weight.
 4. Color: White.

2.5 LAGGING ADHESIVES

- A. Description: Comply with MIL-A-3316C, Class I, Grade A and shall be compatible with insulation materials, jackets, and substrates.
1. Acceptable manufacturers for lagging adhesive are:
 - a. Childers Brand
 - b. Foster Brand
 - c. Vimasco
 2. Adhesives shall have a VOC content of 50 g/L or less.
 3. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
 4. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over duct insulation.
 5. Service Temperature Range: 0 to plus 180 deg F.
 6. Color: White.

2.6 SEALANTS

- A. FSK and Metal Jacket Flashing Sealants:
1. Acceptable manufacturers for flashing sealants are:
 - a. Childers Brand
 - b. Eagle Bridges
 - c. Foster Brand
 2. Materials shall be compatible with insulation materials, jackets, and substrates.
 3. Fire- and water-resistant, flexible, elastomeric sealant.
 4. Service Temperature Range: Minus 40 to plus 250 deg F
 5. Color: Aluminum.
 6. Sealant shall have a VOC content of 420 g/L or less.
 7. Sealant shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

2.7 FACTORY-APPLIED JACKETS

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

2.8 FIELD-APPLIED JACKETS

- A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
- B. Metal Jacket:
1. Acceptable manufacturers for metal jackets are:
 - a. Childers Brand
 - b. ITW Insulation Systems
 - c. RPR Products, Inc.
 2. Aluminum Jacket: Comply with ASTM B 209, Alloy 3003, 3005, 3105, or 5005, Temper H-14.
 - a. Sheet and roll stock ready for shop or field sizing.
 - b. Finish and thickness are indicated in field-applied jacket schedules.
 - c. Moisture Barrier for Outdoor Applications: 3-mil-thick, heat-bonded polyethylene and kraft paper.

3. Stainless-Steel Jacket: ASTM A 167 or ASTM A 240/A 240M.
 - a. Sheet and roll stock ready for shop or field sizing.
 - b. Material, finish, and thickness are indicated in field-applied jacket schedules.
 - c. Moisture Barrier for Outdoor Applications: 3-mil-thick, heat-bonded polyethylene and kraft paper.

- C. Self-Adhesive Outdoor Jacket: 60-mil thick, laminated vapor barrier and waterproofing membrane for installation over insulation located aboveground outdoors; consisting of a rubberized bituminous resin on a cross-laminated polyethylene film covered with white aluminum-foil facing.
 1. Acceptable manufacturer of self-adhesive outdoor jacket is Polyguard Alumaguard All Weather with Cool Wrap finish of approved equal.

2.9 TAPES

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

2.10 SECUREMENTS

- A. Bands:
 1. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316; 0.015 inch thick, 3/4 inch wide with wing seal or closed seal.
 2. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 3/4 inch wide with wing seal or closed seal.
 3. Springs: Twin spring set constructed of stainless steel with ends flat and slotted to accept metal bands. Spring size determined by manufacturer for application.

- B. Insulation Pins and Hangers:
 1. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.135-inch- diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.

- C. Staples: Outward-clinching insulation staples, nominal 3/4-inch- wide, stainless steel or Monel.

- D. Wire: 0.080-inch nickel-copper alloy, 0.062-inch soft-annealed, stainless steel or 0.062-inch soft-annealed, galvanized steel.

2.11 CORNER ANGLES

- A. PVC Corner Angles: 30 mils thick, minimum 1 by 1 inch, PVC according to ASTM D 1784, Class 16354-C. White or color-coded to match adjacent surface.

- B. Aluminum Corner Angles: 0.040 inch thick, minimum 1 by 1 inch, aluminum according to ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105, or 5005; Temper H-14.

- C. Stainless-Steel Corner Angles: 0.024 inch thick, minimum 1 by 1 inch, stainless steel according to ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.
 - 1. Verify that systems to be insulated have been tested and are free of defects.
 - 2. Verify that surfaces to be insulated are clean and dry.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

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

3.3 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of ducts and fittings.
- B. Install insulation materials, vapor barriers or retarders, jackets, and thicknesses required for each item of duct system as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Keep insulation materials dry during application and finishing.
- G. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- H. Install insulation with least number of joints practical.
- I. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
 - 1. Install insulation continuously through hangers and around anchor attachments.
 - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
 - 3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
- J. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

- K. Install insulation with factory-applied jackets as follows:
 - Draw jacket tight and smooth.
 - 1. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
 - 2. Overlap jacket longitudinal seams at least 1-1/2 inches. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 4 inches o.c.
 - a. For below ambient services, apply vapor-barrier mastic over staples.
 - 3. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
 - 4. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct flanges and fittings.
- L. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- M. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- N. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

3.4 PENETRATIONS

- A. Insulation Installation at Roof and Aboveground Exterior Wall Penetrations: Install insulation continuously through roof penetrations.
 - 1. Seal penetrations with flashing sealant.
 - 2. For applications requiring only indoor insulation, terminate insulation above roof surface or inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 - 3. Extend jacket of outdoor insulation outside roof flashing or outside wall flashing at least 2 inches below top of roof flashing.
 - 4. Seal jacket to roof or wall flashing with flashing sealant.
- B. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- C. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches.
 - 1. Comply with requirements in Section 078413 "Penetration Fire-stopping."
- D. Insulation Installation at Floor Penetrations:
 - 1. Duct: For penetrations through fire-rated assemblies, terminate insulation at fire damper sleeves and externally insulate damper sleeve beyond floor to match adjacent duct insulation. Overlap damper sleeve and duct insulation at least 2 inches.
 - 2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 078413 "Penetration Fire-stopping."

3.5 INSTALLATION OF MINERAL-FIBER INSULATION

- A. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins. Verify application coverage recommendations with insulation manufacturer.
 - 1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
 - 2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.

3. Install cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
 - a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
 - b. On duct sides with dimensions larger than 18 inches, place pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
 - c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
 - d. Do not over-compress insulation during installation.
 - e. Impale insulation over pins and attach speed washers.
 - f. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
 4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
 - a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
 - b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches.
 5. Overlap un-faced blankets a minimum of 2 inches on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches o.c.
 6. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
 7. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch-wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.
- B. Board Insulation Installation on Ducts and Plenums:
1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
 2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
 3. Install cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
 - a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
 - b. On duct sides with dimensions larger than 18 inches, space pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
 - c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
 - d. Do not over-compress insulation during installation.
 - e. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
 4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
 - a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.

- b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches.
5. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Groove and score insulation to fit as closely as possible to outside and inside radius of elbows. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
6. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch-wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

3.6 FIELD-APPLIED JACKET INSTALLATION

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

3.7 FIRE-RATED INSULATION SYSTEM INSTALLATION

- A. Where fire-rated insulation system is indicated, secure system to ducts and duct hangers and supports to maintain a continuous fire rating.
- B. Insulate duct access panels and doors to achieve same fire rating as duct.
- C. Install fire-stopping at penetrations through fire-rated assemblies. Fire-stop systems are specified in Section 078413 "Penetration Fire-stopping."

3.8 FIELD QUALITY CONTROL

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

3.9 DUCT INSULATION SCHEDULE, GENERAL

- A. Plenums and Ducts Requiring Insulation:
 1. Indoor, concealed supply and indoor, concealed or exposed outdoor air.
 2. Indoor, concealed return located in unconditioned space.
 3. Indoor, concealed and exposed, Type I, commercial, kitchen hood exhaust.
- B. Items Not Insulated:
 1. Metal ducts with duct liner of sufficient thickness to comply with energy code and ASHRAE/IESNA 90.1.

2. Exhaust ductwork, except as noted above.
3. Return air ductwork in conditioned spaces.
4. Factory-insulated flexible ducts.
5. Factory-insulated plenums and casings.
6. Flexible connectors.
7. Vibration-control devices.
8. Factory-insulated access panels and doors. Consider the exposure of installed insulation to damage. Concealed applications have less risk than exposed.

3.10 INDOOR DUCT INSULATION SCHEDULE

- A. Concealed, round and flat-oval and rectangular, supply-air duct insulation shall be the following:
 1. Mineral-Fiber Blanket: 1-1/2 inches thick and minimum R value of 3.5.
- B. Concealed, round and flat-oval and rectangular, return-air duct insulation shall be the following:
 1. Mineral-Fiber Blanket: 1-1/2 inches thick and minimum R value of 3.5.
- C. Concealed or exposed, round and flat-oval and rectangular, outdoor-air duct insulation shall be the following:
 1. Mineral-Fiber Board: 2 inches thick and minimum R value of 6.0
 2. Provide exterior exposed ductwork with aluminum jacket.
- D. Concealed or exposed, Type I, Commercial, Kitchen Hood Exhaust Duct and Plenum Insulation: Fire-rated blanket or board; thickness as required to achieve 2-hour fire rating.

END OF SECTION 230713

SECTION 230719 - HVAC PIPING INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes insulating the following HVAC piping systems:
 - 1. Heating hot-water piping, indoors.
- B. Related Sections:
 - 1. Section 230713 "Duct Insulation."
 - 2. Section 230716 "HVAC Equipment Insulation."

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory and field applied if any).
- B. Sustainable Design Submittals:
 - 1. Product Data: For adhesives, indicating VOC content.
 - 2. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting materials.
 - 3. Product Data: For coatings, indicating VOC content.
 - 4. Laboratory Test Reports: For coatings, indicating compliance with requirements for low-emitting materials.
 - 5. Product Data: For sealants, indicating VOC content.
 - 6. Laboratory Test Reports: For sealants, indicating compliance with requirements for low-emitting materials.
- C. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
 - 1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
 - 2. Detail attachment and covering of heat tracing inside insulation.
 - 3. Detail insulation application at pipe expansion joints for each type of insulation.
 - 4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
 - 5. Detail removable insulation at piping specialties.
 - 6. Detail application of field-applied jackets.
 - 7. Detail application at linkages of control devices.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers,

attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.

- C. Field quality-control reports.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.
- B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.
 - 1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
 - 2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.
- C. Mockups: Before installing insulation, build mockups for each type of insulation and finish listed below to demonstrate quality of insulation application and finishes. Build mockups in the location indicated or, if not indicated, as directed by Architect. Use materials indicated for the completed Work.
 - 1. Piping Mockups:
 - a. One 10-foot section of NPS 2 straight pipe.
 - b. One each of a 90-degree threaded, welded, and flanged elbow.
 - c. One each of a threaded, welded, and flanged tee fitting.
 - d. One NPS 2 or smaller valve, and one NPS 2-1/2 or larger valve.
 - e. Four support hangers including hanger shield and insert.
 - f. One threaded strainer and one flanged strainer with removable portion of insulation.
 - g. One threaded reducer and one welded reducer.
 - h. One pressure temperature tap.
 - i. One mechanical coupling.
 - 2. For each mockup, fabricate cutaway sections to allow observation of application details for insulation materials, adhesives, mastics, attachments, and jackets.
 - 3. Notify Architect seven days in advance of dates and times when mockups will be constructed.
 - 4. Obtain Architect's approval of mockups before starting insulation application.
 - 5. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 - 6. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
 - 7. Demolish and remove mockups when directed.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.7 COORDINATION

- A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."

- B. Coordinate clearance requirements with piping installer for piping insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.
- C. Coordinate installation and testing of heat tracing.

1.8 SCHEDULING

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

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

- A. Comply with requirements in "Piping Insulation Schedule, General," "Indoor Piping Insulation Schedule," and "Outdoor, Aboveground Piping Insulation Schedule," articles for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- F. Calcium Silicate:
 - 1. Acceptable manufacturer for this product is Johns Manville Industrial Insulation Group, LLC or approved equal.
 - 2. Preformed Pipe Sections: Flat-, curved-, and grooved-block sections of noncombustible, inorganic, hydrous calcium silicate with a non-asbestos fibrous reinforcement. Comply with ASTM C 533, Type I.
 - 3. Prefabricated Fitting Covers: Comply with ASTM C 450 and ASTM C 585 for dimensions used in preforming insulation to cover valves, elbows, tees, and flanges.
- G. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials.
 - 1. Acceptable manufacturers for this product are:
 - a. Aeroflex USA
 - b. Armacell LLC
 - c. K-Flex USA
- H. Mineral-Fiber, Preformed Pipe Insulation:
 - 1. Acceptable manufacturers of this product are:
 - a. Johns Manville
 - b. Knauf

- c. Owens Corning
2. Type I, 850 deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

2.2 INSULATING CEMENTS

- A. Acceptable manufacturer of this product is Ramco or approved equal.
- B. Mineral-Fiber Insulating Cement: Comply with ASTM C 195.
- C. Expanded or Exfoliated Vermiculite Insulating Cement: Comply with ASTM C 196.
- D. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449.

2.3 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.
- B. Calcium Silicate Adhesive: Fibrous, sodium-silicate-based adhesive with a service temperature range of 50 to 800 deg F.
 1. Acceptable manufacturers of this product are:
 - a. Childers Brand
 - b. Eagle Bridges
 - c. Foster Brand
 - d. Vimasco Corporation
 2. Adhesives shall have a VOC content of 50 g/L or less.
 3. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- C. Flexible Elastomeric Adhesive: Comply with MIL-A-24179A, Type II, Class I.
 1. Acceptable manufacturers for this product are:
 - a. Aeroflex USA
 - b. Armacell LLC
 - c. Foster Brand
 - d. K-Flex USA
 2. Adhesives shall have a VOC content of 50 g/L or less.
 3. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- D. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
 1. Acceptable manufacturers of this product are:
 - a. Childers Brand
 - b. Eagle Bridges
 - c. Foster Brand
 - d. Mon-Eco Industries
 2. Adhesives shall have a VOC content of 50 g/L or less.

3. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- E. ASJ Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
1. Acceptable manufacturers of this product are:
 - a. Childers Brand
 - b. Eagle Bridges
 - c. Foster Brand
 - d. Mon-Eco Industries
 2. Adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 3. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

2.4 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.
1. VOC Content: 300 g/L or less.
 2. Low-Emitting Materials: Mastic coatings shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- B. Acceptable manufacturers for mastics are:
1. Childers Brand
 2. Eagle Bridges
 3. Foster Brand
 4. Knauf
 5. Mon-Eco Industries
 6. Vimasco Corporation
- C. Vapor-Barrier Mastic: Water based; suitable for indoor use on below-ambient services.
1. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm at 43-mil dry film thickness.
 2. Service Temperature Range: Minus 20 to plus 180 deg F.
 3. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
 4. Color: White.
- D. Vapor-Barrier Mastic: Solvent based; suitable for outdoor use on below-ambient services.
1. Water-Vapor Permeance: ASTM F 1249, 0.05 perm at 30-mil dry film thickness.
 2. Service Temperature Range: Minus 50 to plus 220 deg F.
 3. Solids Content: ASTM D 1644, 33 percent by volume and 46 percent by weight.
 4. Color: White.
- E. Breather Mastic: Water based; suitable for indoor and outdoor use on above-ambient services.
1. Water-Vapor Permeance: ASTM F 1249, 1.8 perms at 0.0625-inch dry film thickness.
 2. Service Temperature Range: Minus 20 to plus 180 deg F.
 3. Solids Content: 60 percent by volume and 66 percent by weight.
 4. Color: White.

2.5 LAGGING ADHESIVES

- A. Description: Comply with MIL-A-3316C, Class I, Grade A and shall be compatible with insulation materials, jackets, and substrates.
1. Acceptable manufacturers of this product are:
 - a. Childers Brand
 - b. Foster Brand
 - c. Vimasco Corporation
 2. Adhesives shall have a VOC content of 50 g/L or less.
 3. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
 4. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over pipe insulation.
 5. Service Temperature Range: 0 to plus 180 deg F.
 6. Color: White.

2.6 SEALANTS

- A. Acceptable manufacturers for sealants are:
1. Childers Brand
 2. Eagle Bridges
 3. Foster Brand
 4. Mon-Eco Industries
- B. FSK and Metal Jacket Flashing Sealants:
1. Materials shall be compatible with insulation materials, jackets, and substrates.
 2. Fire- and water-resistant, flexible, elastomeric sealant.
 3. Service Temperature Range: Minus 40 to plus 250 deg F.
 4. Color: Aluminum.
 5. Sealant shall have a VOC content of 420 g/L or less.
 6. Sealant shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- C. ASJ Flashing Sealants:
1. Materials shall be compatible with insulation materials, jackets, and substrates.
 2. Fire- and water-resistant, flexible, elastomeric sealant.
 3. Service Temperature Range: Minus 40 to plus 250 deg F.
 4. Color: White.
 5. Sealant shall have a VOC content of 420 g/L or less.
 6. Sealant shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

2.7 FACTORY-APPLIED JACKETS

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

2.8 FIELD-APPLIED JACKETS

- A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
- B. Metal Jacket:
1. Acceptable manufacturers for metal jackets are:
 - a. Childers Brand
 - b. ITW Insulation
 - c. RPR Products
 2. Aluminum Jacket: Comply with ASTM B 209, Alloy 3003, 3005, 3105, or 5005, Temper H-14.
 - a. Factory cut and rolled to size.
 - b. Finish and thickness are indicated in field-applied jacket schedules.
 - c. Moisture Barrier for Outdoor Applications: 3-mil-thick, heat-bonded polyethylene and kraft paper
 - d. Factory-Fabricated Fitting Covers:
 - 1) Same material, finish, and thickness as jacket.
 - 2) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
 - 3) Tee covers.
 - 4) Flange and union covers.
 - 5) End caps.
 - 6) Beveled collars.
 - 7) Valve covers.
 - 8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.
 3. Stainless-Steel Jacket: ASTM A 167 or ASTM A 240/A 240M.
 - a. Factory cut and rolled to size.
 - b. Material, finish, and thickness are indicated in field-applied jacket schedules.
 - c. Moisture Barrier for Outdoor Applications: 3-mil-thick, heat-bonded polyethylene and kraft paper.
 - d. Factory-Fabricated Fitting Covers:
 - 1) Same material, finish, and thickness as jacket.
 - 2) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
 - 3) Tee covers.
 - 4) Flange and union covers.
 - 5) End caps.
 - 6) Beveled collars.
 - 7) Valve covers.
 - 8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.
- C. Self-Adhesive Outdoor Jacket: 60-mil- thick, laminated vapor barrier and waterproofing membrane for installation over insulation located aboveground outdoors; consisting of a rubberized bituminous resin on a cross-laminated polyethylene film covered with white aluminum-foil facing.
1. Acceptable manufacturer for this product is Polyguard Alumaguard All Weather with Cool Wrap finish or approved equal

2.9 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
1. Acceptable manufacturers for this product are:
 - a. Compac
 - b. Ideal Tape
 - c. Venture Tape

2. Width: 3 inches.
3. Thickness: 11.5 mils.
4. Adhesion: 90 ounces force/inch in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

2.10 SECUREMENTS

- A. Bands:
1. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304 or [Type 316]; 0.015 inch thick, 3/4 inch wide with wing seal or closed seal.
 2. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 3/4 inch wide with wing seal or closed seal.
 3. Springs: Twin spring set constructed of stainless steel with ends flat and slotted to accept metal bands. Spring size determined by manufacturer for application.
- B. Staples: Outward-clinching insulation staples, nominal 3/4-inch- wide, stainless steel or Monel.
- C. Wire: 0.080-inch nickel-copper alloy, 0.062-inch soft-annealed, stainless steel or 0.062-inch soft-annealed, galvanized steel.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.
1. Verify that systems to be insulated have been tested and are free of defects.
 2. Verify that surfaces to be insulated are clean and dry.
 3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Surface Preparation: Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:
1. Carbon Steel: Coat carbon steel operating at a service temperature between 32 and 300 deg F with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
- C. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.
- D. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.3 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of pipe system as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- G. Keep insulation materials dry during application and finishing.
- H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- I. Install insulation with least number of joints practical.
- J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
 - 1. Install insulation continuously through hangers and around anchor attachments.
 - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
 - 3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
 - 4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- L. Install insulation with factory-applied jackets as follows:
 - 1. Draw jacket tight and smooth.
 - 2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
 - 3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install 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. For below-ambient services, apply vapor-barrier mastic over staples.
 - 4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
 - 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.
- M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

- N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.
- P. For above-ambient services, do not install insulation to the following:
 - 1. Vibration-control devices.
 - 2. Testing agency labels and stamps.
 - 3. Nameplates and data plates.
 - 4. Manholes.
 - 5. Hand-holes.
 - 6. Cleanouts.

3.4 PENETRATIONS

- A. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- B. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.
 - 1. Comply with requirements in Section 078413 "Penetration Fire-stopping" for fire-stopping and fire-resistive joint sealers.
- C. Insulation Installation at Floor Penetrations:
 - 1. Pipe: Install insulation continuously through floor penetrations.
 - 2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 078413 "Penetration Fire-stopping."

3.5 GENERAL PIPE INSULATION INSTALLATION

- A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.
- B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:
 - 1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
 - 2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
 - 3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
 - 4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
 - 5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints,

- seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.
6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
 7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
 8. For services not specified to receive a field-applied jacket except for flexible elastomeric, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
 9. Stencil or label the outside insulation jacket of each union with the word "union." Match size and color of pipe labels.
- C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.
- D. Install removable insulation covers at locations indicated. Installation shall conform to the following:
1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
 2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
 3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.
 4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
 5. Finish outdoor exposed surfaces with a metal jacket.

3.6 INSTALLATION OF CALCIUM SILICATE INSULATION

- A. Insulation Installation on Straight Pipes and Tubes:
1. Secure single-layer insulation with stainless-steel bands at 12-inch intervals and tighten bands without deforming insulation materials.
 2. Install two-layer insulation with joints tightly butted and staggered at least 3 inches. Secure inner layer with wire spaced at 12-inch intervals. Secure outer layer with stainless-steel bands at 12-inch intervals.
 3. Apply a skim coat of mineral-fiber, hydraulic-setting cement to insulation surface. When cement is dry, apply flood coat of lagging adhesive and press on one layer of glass cloth or tape. Overlap edges at least 1 inch. Apply finish coat of lagging adhesive over glass cloth or tape. Thin finish coat to achieve smooth, uniform finish.
- B. Insulation Installation on Pipe Flanges:
1. Install preformed pipe insulation to outer diameter of pipe flange.

2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of block insulation of same material and thickness as pipe insulation.
4. Finish flange insulation same as pipe insulation.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
2. When preformed insulation sections of insulation are not available, install mitered sections of calcium silicate insulation. Secure insulation materials with wire or bands.
3. Finish fittings insulation same as pipe insulation.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install mitered segments of calcium silicate insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
2. Install insulation to flanges as specified for flange insulation application.
3. Finish valve and specialty insulation same as pipe insulation.
4. Install insulation to flanges as specified for flange insulation application.

3.7 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

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

B. Insulation Installation on Pipe Flanges:

1. Install pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturers recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install mitered sections of pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed valve covers manufactured of same material as pipe insulation when available.
2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.8 INSTALLATION OF MINERAL-FIBER INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.

2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above-ambient surfaces, secure laps with outward-clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets on below-ambient surfaces, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

3.9 FIELD-APPLIED JACKET INSTALLATION

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

3.10 FINISHES

- A. Pipe Insulation with ASJ Material: Paint jacket with paint system identified below and as specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."
1. Flat Acrylic Finish□Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.
 - a. Finish Coat Material: Interior, flat, latex-emulsion size.
- B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
- C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.
- D. Do not field paint aluminum or stainless-steel jackets.

3.11 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Perform tests and inspections.
- C. Tests and Inspections:
 - 1. Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations of threaded strainers, two locations of welded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.
- D. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements

3.12 PIPING INSULATION SCHEDULE, GENERAL

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

3.13 INDOOR PIPING INSULATION SCHEDULE

- A. Heating-Hot-Water Supply and Return, 200 Deg F and Below:
 - 1. NPS 3 and Smaller: Insulation shall be the following:
 - a. Mineral-Fiber, Preformed Pipe, Type I: 1 inch thick.

END OF SECTION 230719

SECTION 232113 - HYDRONIC 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 pipe and fitting materials and joining methods for the following:
 - 1. Hot-water heating piping.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of the following:
 - 1. Pressure-seal fittings.
- B. Sustainable Design Submittals:
 - 1. Product Data: For adhesives, indicating VOC content.
 - 2. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting materials.
- C. Delegated-Design Submittal:
 - 1. Design calculations and detailed fabrication and assembly of pipe anchors and alignment guides, hangers and supports for multiple pipes, expansion joints and loops, and attachments of the same to the building structure.
 - 2. Locations of pipe anchors and alignment guides and expansion joints and loops.
 - 3. Locations of and details for penetrations, including sleeves and sleeve seals for exterior walls, floors, basement, and foundation walls.
 - 4. Locations of and details for penetration and fire-stopping for fire- and smoke-rated wall and floor and ceiling assemblies.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Piping layout, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 - 1. Suspended ceiling components.
 - 2. Other building services.
 - 3. Structural members.
- B. Qualification Data: For Installer.
- C. Welding certificates.
- D. Field quality-control reports.
- E. Water Analysis: Submit a copy of the water analysis to illustrate water quality available at Project site.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications:
 - 1. Installers of Pressure-Sealed Joints: Installers shall be certified by pressure-seal joint manufacturer as having been trained and qualified to join piping with pressure-seal pipe couplings and fittings.
- B. Steel Support Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- C. Pipe Welding: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code: Section IX.
 - 1. Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation.
 - 2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Hydronic piping components and installation shall be capable of withstanding the following minimum working pressure and temperature unless otherwise indicated:
 - 1. Hot-Water Heating Piping: 100 psig at 250 degrees F.

2.2 COPPER TUBE AND FITTINGS

- A. Drawn-Temper Copper Tubing: ASTM B 88, Type L.
- B. Annealed-Temper Copper Tubing: ASTM B 88, Type K.
- C. DWV Copper Tubing: ASTM B 306, Type DWV.
- D. Grooved, Mechanical-Joint, Wrought-Copper Fittings:
 - 1. Grooved-End Copper Fittings: ASTM B 75, copper tube or ASTM B 584, bronze casting.
 - 2. Grooved-End-Tube Couplings: Rigid pattern unless otherwise indicated; gasketed fitting. Ductile-iron housing with keys matching pipe and fitting grooves, pre-lubricated EPDM gasket rated for minimum 230 degrees F for use with housing, and steel bolts and nuts.
- E. Copper or Bronze Pressure-Seal Fittings:
 - 1. Housing: Copper.
 - 2. O-Rings and Pipe Stops: EPDM.
 - 3. Tools: Manufacturer's special tools.
 - 4. Minimum 200-psig working-pressure rating at 250 degrees F.
- F. Wrought-Copper Unions: ASME B16.22.

2.3 STEEL PIPE AND FITTINGS

- A. Steel Pipe: ASTM A 53/A 53M, black steel with plain ends; welded and seamless, Grade B, and wall thickness as indicated in "Piping Applications" Article.

- B. Cast-Iron Threaded Fittings: ASME B16.4; Classes 125 and 250 as indicated in "Piping Applications" Article.
- C. Malleable-Iron Threaded Fittings: ASME B16.3, Classes 150 and 300 as indicated in "Piping Applications" Article.
- D. Malleable-Iron Unions: ASME B16.39; Classes 150, 250, and 300 as indicated in "Piping Applications" Article.
- E. Cast-Iron Pipe Flanges and Flanged Fittings: ASME B16.1, Classes 25, 125, and 250; raised ground face, and bolt holes spot faced as indicated in "Piping Applications" Article.
- F. Wrought-Steel Fittings: ASTM A 234/A 234M, wall thickness to match adjoining pipe.
- G. Wrought Cast- and Forged-Steel Flanges and Flanged Fittings: ASME B16.5, including bolts, nuts, and gaskets of the following material group, end connections, and facings:
 - 1. Material Group: 1.1.
 - 2. End Connections: Butt welding.
 - 3. Facings: Raised face.
- H. Grooved Mechanical-Joint Fittings and Couplings:
 - 1. Joint Fittings: ASTM A 536, Grade 65-45-12 ductile iron; ASTM A 47/A 47M, Grade 32510 malleable iron; ASTM A 53/A 53M, Type F, E, or S, Grade B fabricated steel; or ASTM A 106/A 106M, Grade B steel fittings with grooves or shoulders constructed to accept grooved-end couplings; with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings.
 - 2. Couplings: Ductile- or malleable-iron housing and EPDM or nitrile gasket of central cavity pressure-responsive design; with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings.
- I. Steel Pipe Nipples: ASTM A 733, made of same materials and wall thicknesses as pipe in which they are installed.

2.4 JOINING MATERIALS

- A. 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 otherwise 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.
- B. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
- C. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- D. Welding Filler Metals: Comply with AWS D10.12M/D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

2.5 DIELECTRIC FITTINGS

- A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.

- B. Dielectric Unions:
 - 1. Description:
 - a. Standard: ASSE 1079.
 - b. Pressure Rating: 125 psig minimum at 180 degrees F.
 - c. End Connections: Solder-joint copper alloy and threaded ferrous.

- C. Dielectric Flanges:
 - 1. Description:
 - a. Standard: ASSE 1079.
 - b. Factory-fabricated, bolted, companion-flange assembly.
 - c. Pressure Rating: 125 psig minimum at 180 degrees F.
 - d. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

- D. Dielectric-Flange Insulating Kits:
 - 1. Description:
 - a. Non-conducting materials for field assembly of companion flanges.
 - b. Pressure Rating: 150 psig.
 - c. Gasket: Neoprene or phenolic.
 - d. Bolt Sleeves: Phenolic or polyethylene.
 - e. Washers: Phenolic with steel backing washers.

- E. Dielectric Nipples:
 - 1. Description:
 - a. Standard: IAPMO PS 66.
 - b. Electroplated steel nipple, complying with ASTM F 1545.
 - c. Pressure Rating: 300 psig at 225 degrees F
 - d. End Connections: Male threaded or grooved.
 - e. Lining: Inert and noncorrosive, propylene.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

- A. Hot-water heating piping, aboveground, NPS 2 and smaller, shall be any of the following:
 - 1. Type L, drawn-temper copper tubing, wrought-copper fittings, and soldered or pressure-seal joints.
 - 2. Schedule 40, Grade B, Type 96 steel pipe; Class 125, cast-iron fittings; cast-iron flanges and flange fittings; and threaded joints.

- B. Hot-water heating piping, aboveground, NPS 2-1/2, shall be any of the following:
 - 1. Type L, drawn-temper copper tubing, wrought-copper fittings, and soldered joints.
 - 2. Schedule 40 steel pipe, wrought-steel fittings and wrought-cast or forged-steel flanges and flange fittings, and welded and flanged joints.
 - 3. Schedule 40 steel pipe; grooved, mechanical joint coupling and fittings; and grooved, mechanical joints.

3.2 PIPING INSTALLATIONS

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

- B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- E. Install piping to permit valve servicing.
- F. Install piping at indicated slopes.
- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.
- I. Install piping to allow application of insulation.
- J. Select system components with pressure rating equal to or greater than system operating pressure.
- K. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.
- L. Install drains, consisting of a tee fitting, NPS 3/4 ball valve, and short NPS 3/4 threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.
- M. Install piping at a uniform grade of 0.2 percent upward in direction of flow.
- N. Reduce pipe sizes using eccentric reducer fitting installed with level side up.
- O. Install branch connections to mains using tee fittings in main pipe, with the branch connected to the bottom of the main pipe. For up-feed risers, connect the branch to the top of the main pipe.
- P. Install valves according to Section 230523 "General Valves for HVAC Piping,"
- Q. Install unions in piping, NPS 2 and smaller, adjacent to valves, at final connections of equipment, and elsewhere as indicated.
- R. Install flanges in piping, NPS 2-1/2 and larger, at final connections of equipment and elsewhere as indicated.
- S. Install shutoff valve immediately upstream of each dielectric fitting.
- T. Comply with requirements in Section 230516 "Expansion Fittings and Loops for HVAC Piping" for installation of expansion loops, expansion joints, anchors, and pipe alignment guides.
- U. Comply with requirements in Section 230553 "Identification for HVAC Piping and Equipment" for identifying piping.
- V. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 230517 "Sleeves, Sleeve Seals and Escutcheons for HVAC Piping."
- W. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 230517 "Sleeves, Sleeve Seals and Escutcheons for HVAC Piping."

- X. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 230518 "Sleeves, Sleeve Seals and Escutcheons for HVAC Piping."

3.3 DIELECTRIC FITTING INSTALLATION

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

3.4 HANGERS AND SUPPORTS

- A. Comply with requirements in Section 230529 "Hangers and Supports for HVAC Piping and Equipment" for hanger, support, and anchor devices. Comply with the following requirements for maximum spacing of supports.
- B. Comply with requirements in Section 230548 "Vibration and Seismic Controls for HVAC" for seismic restraints.
- C. Install the following pipe attachments:
 - 1. Adjustable steel clevis hangers for individual horizontal piping less than 20 feet long.
 - 2. Adjustable roller hangers and spring hangers for individual horizontal piping 20 feet or longer.
 - 3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet or longer, supported on a trapeze.
 - 4. Spring hangers to support vertical runs.
 - 5. Provide copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.
- D. Install hangers for steel piping with the following maximum spacing and minimum rod sizes:
 - 1. NPS 3/4: Maximum span, 7 feet; minimum rod size, 1/4 inch.
 - 2. NPS 1: Maximum span, 7 feet; minimum rod size, 1/4 inch
 - 3. NPS 1-1/2: Maximum span, 9 feet; minimum rod size 3/8"
 - 4. NPS 2: Maximum span, 10 feet; minimum rod size 3/8"
 - 5. NPS 2-1/2: Maximum span, 11 feet; minimum rod size 3/8"
- E. 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 1-1/4: Maximum span, 7 feet; minimum rod size, 3/8 inch.
 - 4. NPS 1-1/2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
 - 5. NPS 2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
 - 6. NPS 2-1/2: Maximum span, 9 feet; minimum rod size, 3/8 inch.
- F. Support vertical runs at roof, at each floor, and at 10-foot intervals between floors.

3.5 PIPE JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

- C. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
- D. 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.
- E. Welded Joints: Construct joints according to AWS D10.12M/D10.12, using qualified processes and welding operators according to "Quality Assurance" Article.
- F. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
- G. Grooved Joints: Assemble joints with coupling and gasket, lubricant, and bolts. Cut or roll grooves in ends of pipe based on pipe and coupling manufacturer's written instructions for pipe wall thickness. Use grooved-end fittings and rigid, grooved-end-pipe couplings.
- H. Pressure-Sealed Joints: Use manufacturer-recommended tool and procedure. Leave insertion marks on pipe after assembly.

3.6 TERMINAL EQUIPMENT CONNECTIONS

- A. Sizes for supply and return piping connections shall be the same as or larger than equipment connections.
- B. Install control valves in accessible locations close to connected equipment.
- C. Install bypass piping with globe valve around control valve. If parallel control valves are installed, only one bypass is required.
- D. Install ports for pressure gages and thermometers at coil inlet and outlet connections. Comply with requirements in Section 230519 "Meters and Gages for HVAC Piping."

3.7 FIELD QUALITY CONTROL

- A. Prepare hydronic piping according to ASME B31.9 and as follows:
 - 1. Leave joints, including welds, uninsulated and exposed for examination during test.
 - 2. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.
 - 3. Flush hydronic piping systems with clean water; then remove and clean or replace strainer screens.
 - 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 air. Use drains installed at low points for complete draining of test liquid.
 3. Isolate expansion tanks and determine that hydronic system is full of water.
 4. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the system's working 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 90 percent of specified minimum yield strength or 1.7 times the "SE" value in Appendix A in ASME B31.9, "Building Services Piping."
 5. After hydrostatic test pressure has been applied for at least 10 minutes, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks.
 6. Prepare written report of testing.
- C. Perform the following before operating the system:
1. Open manual valves fully.
 2. Inspect pumps for proper rotation.
 3. Set makeup pressure-reducing valves for required system pressure.
 4. Inspect air vents at high points of system and determine if all are installed and operating freely (automatic type), or bleed air completely (manual type).
 5. Set temperature controls so all coils are calling for full flow.
 6. Inspect and set operating temperatures of hydronic equipment, such as boilers, chillers, cooling towers, to specified values.
 7. Verify lubrication of motors and bearings.

END OF SECTION 232113

SECTION 232116 - HYDRONIC PIPING SPECIALTIES

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 special-duty valves and specialties for the following:
 - 1. Hot-water heating piping.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of the following:
 - 1. Valves: Include flow and pressure drop curves based on manufacturer's testing for calibrated-orifice balancing valves and automatic flow-control valves.
 - 2. Air-control devices.
 - 3. Hydronic specialties.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For air-control devices, hydronic specialties, and special-duty valves to include in emergency, operation, and maintenance manuals.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Differential Pressure Meter: For each type of balancing valve and automatic flow control valve, include flowmeter, probes, hoses, flow charts, and carrying case.

1.6 QUALITY ASSURANCE

- A. Pipe Welding: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code: Section IX.
 - 1. Safety valves and pressure vessels shall bear the appropriate ASME label. Fabricate and stamp air separators and expansion tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Hydronic piping components and installation shall be capable of withstanding the following minimum working pressure and temperature unless otherwise indicated:
 - 1. Hot-Water Heating Piping: 100 psig at 200 degrees F

2.2 VALVES

- A. Valves: Comply with requirements specified in Section 23052 "General Valves for HVAC Piping,"
- B. Automatic Temperature-Control Valves, Actuators, and Sensors: Comply with requirements specified in Section 230923 " Direct Digital Controls for HVAC
- C. Cast-Iron or Steel, Calibrated-Orifice, Balancing Valves:
 - 1. Acceptable manufacturers:
 - a. Armstrong Pump
 - b. Bell & Gossett
 - c. Taco
 - 2. Body: Cast-iron or steel body, ball, plug, or globe pattern with calibrated orifice or venturi.
 - 3. Ball: Brass or stainless steel.
 - 4. Stem Seals: EPDM O-rings.
 - 5. Disc: Glass and carbon-filled PTFE.
 - 6. Seat: PTFE.
 - 7. End Connections: Flanged or grooved.
 - 8. Pressure Gage Connections: Integral seals for portable differential pressure meter.
 - 9. Handle Style: Lever, with memory stop to retain set position.
 - 10. CWP Rating: Minimum 125 psig.
 - 11. Maximum Operating Temperature: 250 degrees F.
- D. Automatic Flow-Control Valves:
 - 1. Acceptable manufacturers:
 - a. Flow Design, Inc.
 - b. Flowcon Americas LLC
 - c. Griswold
 - 2. Body: Brass or ferrous metal.
 - 3. Piston and Spring Assembly: Corrosion resistant, tamper proof, self-cleaning, and removable.
 - 4. Combination Assemblies: Include bronze or brass-alloy ball valve.
 - 5. Identification Tag: Marked with zone identification, valve number, and flow rate.
 - 6. Size: Same as pipe in which installed.
 - 7. Performance: Maintain constant flow, plus or minus 5 percent over system pressure fluctuations.
 - 8. Minimum CWP Rating: 175 psig.
 - 9. Maximum Operating Temperature: 200 degrees F.

2.3 AIR-CONTROL DEVICES

- A. Manual Air Vents:
 - 1. Acceptable manufacturers:
 - a. Amtrol, Inc.
 - b. Bell & Gossett
 - c. Taco
 - 2. Body: Bronze.
 - 3. Internal Parts: Nonferrous.
 - 4. Operator: Screwdriver or thumbscrew.
 - 5. Inlet Connection: NPS 1/2.
 - 6. Discharge Connection: NPS 1/8.
 - 7. CWP Rating: 150 psig.
 - 8. Maximum Operating Temperature: 225 degrees F.

2.4 HYDRONIC PIPING SPECIALTIES

- A. Expansion Fittings: Comply with requirements in Section 230516 "Expansion Fittings and Loops for HVAC Piping."

PART 3 - EXECUTION

3.1 VALVE APPLICATIONS

- A. Install shutoff-duty valves at each branch connection to supply mains and at supply connection to each piece of equipment.
- B. Install throttling-duty valves at each branch connection to return main.
- C. Install calibrated-orifice, balancing valves in the return pipe of each heating or cooling terminal.

3.2 HYDRONIC SPECIALTIES INSTALLATION

- A. Install manual air vents at high points in piping, at heat-transfer coils, and elsewhere as required for system air venting.

END OF SECTION 232116

ADD ALTERNATE #1 – CHWP-1

SECTION 232123 - HYDRONIC PUMPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Close-coupled, in-line centrifugal pumps.

1.3 DEFINITIONS

- A. Buna-N: Nitrile rubber.
- B. EPT: Ethylene propylene terpolymer.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of pump. Include certified performance curves and rated capacities, operating characteristics, furnished specialties, final impeller dimensions, and accessories for each type of product indicated. Indicate pump's operating point on curves.
- B. Shop Drawings: For each pump.
 - 1. Show pump layout and connections.
 - 2. Include setting drawings with templates for installing foundation and anchor bolts and other anchorages.
 - 3. Include diagrams for power, signal, and control wiring.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For pumps to include in emergency, operation, and maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Mechanical Seals: One mechanical seal(s) for each pump.

PART 2 - PRODUCTS

2.1 CLOSE-COUPLED, IN-LINE CENTRIFUGAL PUMPS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Armstrong Pumps, Inc.
 2. Bell & Gossett.
 3. Grundfos Pumps Corporation.
- B. Description: Factory-assembled and -tested, centrifugal, overhung-impeller, close-coupled, in-line pump as defined in HI 1.1-1.2 and HI 1.3; designed for installation with pump and motor shafts mounted horizontally or vertically.
- C. Pump Construction:
 1. Casing: Cast iron, ASTM A48 Class B with threaded gage tappings at inlet and outlet, replaceable bronze wear rings, and threaded companion-flange connections.
 2. Impeller: ASTM B 584, cast bronze; statically and dynamically balanced, keyed to shaft, and secured with a locking cap screw. For constant-speed pumps, trim impeller to match specified performance.
 3. Pump Shaft: Carbon steel.
 4. Seal: Mechanical seal consisting of carbon rotating ring against a ceramic seat held by a stainless-steel spring, and Buna-N bellows and gasket. Include water slinger on shaft between motor and seal.
 5. Seal: Packing seal consisting of stuffing box with a minimum of four rings of graphite-impregnated braided yarn with bronze lantern ring between center two graphite rings, and bronze packing gland.
 6. Pump Bearings: Permanently lubricated ball bearings.
- D. Motor: Single speed and rigidly mounted to pump casing.
 1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 2. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
 - a. Enclosure: Open, drip proof or Totally enclosed, fan cooled.
 - b. Enclosure Materials: Cast iron.
 - c. Motor Bearings: Permanently lubricated ball bearings.
 - d. Efficiency: Premium efficient.
 - e. NEMA Design: NEMA Premium JM
- E. Capacities and Characteristics:
 1. Capacity: 318 GPM
 2. Total Dynamic Head: 52 feet.
 3. Maximum Operating Pressure: 175 psig.
 4. Maximum Continuous Operating Temperature: 225 deg F.
 5. Inlet and Outlet Size: NPS.

6. Impeller Size: 7.875 Inches.
7. Motor Speed: 1800 RPM
8. Motor Horsepower: 7.5 HP
9. Electrical Characteristics:
 - a. Volts: 208.
 - b. Phase: Three.
 - c. Hertz: 60.

2.2 PUMP SPECIALTY FITTINGS

A. Suction Diffuser:

1. Angle pattern.
2. 175-psig pressure rating, cast-iron body and end cap, pump-inlet fitting.
3. Bronze startup and bronze or stainless-steel permanent strainers.
4. Bronze or stainless-steel straightening vanes.
5. Drain plug.
6. Factory-fabricated support.

B. Triple-Duty Valve:

1. Angle or straight pattern.
2. 175-psig pressure rating, cast-iron body, pump-discharge fitting.
3. Drain plug and bronze-fitted shutoff, balancing, and check valve features.
4. Brass gage ports with integral check valve and orifice for flow measurement.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine equipment foundations and anchor-bolt locations for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for piping systems to verify actual locations of piping connections before pump installation.
- C. Examine foundations and inertia bases for suitable conditions where pumps are to be installed.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PUMP INSTALLATION

- A. Comply with HI 1.4 and HI 2.4.
- B. Install pumps to provide access for periodic maintenance including removing motors, impellers, couplings, and accessories.
- C. Independently support pumps and piping so weight of piping is not supported by pumps and weight of pumps is not supported by piping.

- D. Automatic Condensate Pump Units: Install units for collecting condensate and extend to open drain.
- E. Equipment Mounting:
 - 1. Comply with requirements for vibration isolation and seismic control devices specified in Section 230548 "Vibration and Seismic Controls for HVAC."

3.3 ALIGNMENT

- A. Engage a factory-authorized service representative to perform alignment service.
- B. Comply with requirements in Hydronics Institute standards for alignment of pump and motor shaft. Add shims to the motor feet and bolt motor to base frame. Do not use grout between motor feet and base frame.
- C. Comply with pump and coupling manufacturers' written instructions.
- D. After alignment is correct, tighten foundation bolts evenly but not too firmly. Completely fill baseplate with nonshrink, nonmetallic grout while metal blocks and shims or wedges are in place. After grout has cured, fully tighten foundation bolts.

3.4 CONNECTIONS

- A. Drawings and details indicate general arrangement of piping, fittings, and specialties.
- B. Where installing piping adjacent to pump, allow space for service and maintenance.
- C. Connect piping to pumps. Install valves that are same size as piping connected to pumps.
- D. Install suction and discharge pipe sizes equal to or greater than diameter of pump nozzles.
- E. Install check, shutoff, and throttling valves or triple-duty valve on discharge side of pumps.
- F. Install Y-type strainer, suction diffuser and shutoff valve on suction side of pumps.
- G. Install flexible connectors on suction and discharge sides of base-mounted pump between pump casing and valves.
- H. Install pressure gages on pump suction and discharge or at integral pressure-gage tapping, or install single gage with multiple-input selector valve.
- I. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
- J. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.5 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
 - 1. Complete installation and startup checks according to manufacturer's written instructions.
 - 2. Check piping connections for tightness.
 - 3. Clean strainers on suction piping.

4. Perform the following startup checks for each pump before starting:
 - a. Verify bearing lubrication.
 - b. Verify that pump is free to rotate by hand and that pump for handling hot liquid is free to rotate with pump hot and cold. If pump is bound or drags, do not operate until cause of trouble is determined and corrected.
 - c. Verify that pump is rotating in the correct direction.
5. Prime pump by opening suction valves and closing drains, and prepare pump for operation.
6. Start motor.
7. Open discharge valve slowly.

3.6 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain hydronic pumps.

END OF SECTION 232123

SECTION 233113 - METAL DUCTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Single-wall rectangular ducts and fittings.
2. Single-wall round ducts and fittings.
3. Sheet metal materials.
4. Sealants and gaskets.
5. Hangers and supports.
6. Seismic-restraint devices.

B. Related Sections:

1. Section 230593 "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.
2. Section 233300 "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of the following products:

1. Liners and adhesives.
2. Sealants and gaskets.
3. Seismic-restraint devices.

B. Sustainable Design Submittals:

1. Product Data: For ventilation equipment, indicating compliance with ASHRAE 62.1, Section 5 - "Systems and Equipment."
2. Product Data: For adhesives, indicating VOC content.
3. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting materials.
4. Product Data: For sealants, indicating VOC content.
5. Laboratory Test Reports: For sealants, indicating compliance with requirements for low-emitting materials.
6. Laboratory Test Reports: For antimicrobial coatings, indicating compliance with requirements for low-emitting materials.

C. Shop Drawings:

1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
2. Factory- and shop-fabricated ducts and fittings.
3. Duct layout indicating sizes, configuration, liner material, and static-pressure classes.
4. Elevation of top and bottom of ducts.
5. Dimensions of all duct runs from building grid lines.
6. Fittings.
7. Reinforcement and spacing.
8. Seam and joint construction.
9. Penetrations through fire-rated and other partitions.
10. Equipment installation based on equipment being used on Project.
11. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.
12. Hangers and supports, including methods for duct and building attachment, seismic restraints, and vibration isolation.
13. Provide shop drawings for all supply, return, exhaust and make-up air ducts.

D. Delegated-Design Submittal:

1. Sheet metal thicknesses.
2. Joint and seam construction and sealing.
3. Reinforcement details and spacing.
4. Materials, fabrication, assembly, and spacing of hangers and supports.
5. Design Calculations: Calculations, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation for selecting hangers and supports and seismic restraints.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: A single set of plans or BIM model, drawn to scale, showing the items described in this Section, and coordinated with all building trades.
- B. Welding certificates.
- C. Field quality-control reports.

1.5 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel in accordance with the following:
 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.
 2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum," for aluminum supports.
 3. AWS D9.1/D9.1M, "Sheet Metal Welding Code," for duct joint and seam welding.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct

Construction Standards - Metal and Flexible" and with performance requirements and design criteria indicated in "Duct Schedule" Article.

- B. Structural Performance: Duct hangers, supports and seismic restraints shall withstand the effects of gravity and seismic loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and ASCE/SEI 7. Seismically brace duct hangers and supports in accordance with SMACNA's "Seismic Restraint Manual: Guidelines for Mechanical Systems."
 - 1. Seismic Hazard Level (SHL): B
 - 2. Connection Level: Connection Level as Defined in the IBC: Refer to geotechnical report and architectural/structural plans.
- C. Airstream Surfaces: Surfaces in contact with airstream shall comply with requirements in ASHRAE 62.1.
- D. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment," and Section 7 - "Construction and System Startup."
- E. ASHRAE/IES Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."
- F. Duct Dimensions: Unless otherwise indicated, all duct dimensions indicated on Drawings are inside clear dimensions and do not include insulation or duct wall thickness.

2.2 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.
 - 1. Construct ducts of galvanized sheet steel unless otherwise indicated.
 - 2. For ducts exposed to weather, construct of Type 304 or Type 316 stainless steel indicated by manufacturer to be suitable for outdoor installation.
- B. Transverse Joints: Fabricate joints in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
 - 1. For ducts with longest side less than 36 inches, select joint types in accordance with Figure 2-1.
 - 2. For ducts with longest side 36 inches or greater, use flange joint connector Type T-22, T-24, T-24A, T-25a, or T-25b. Factory-fabricated flanged duct connection system may be used if submitted and approved by engineer of record.
 - 3. Where specified for specific applications, all joints shall be welded.
- C. Longitudinal Seams: Select seam types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible." All longitudinal seams shall be Pittsburgh lock seams unless otherwise specified for specific application.
 - 1. Where specified for specific applications, all joints shall be welded.

- D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Ch. 4, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.3 SINGLE-WALL ROUND DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Ch. 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.
 - 1. Construct ducts of galvanized sheet steel unless otherwise indicated.
 - 2. For ducts exposed to weather, construct of Type 304 or Type 316 stainless steel indicated by manufacturer to be suitable for outdoor installation.
 - 3. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Ductmate Industries, Inc.
 - b. MKT Metal Manufacturing.
 - c. Spiral Manufacturing Co., Inc.
- B. Transverse Joints: Select joint types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Round Duct Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- C. Longitudinal Seams: Select seam types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Round Duct Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- D. Tees and Laterals: Select types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.4 SHEET METAL MATERIALS

- A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
- B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
 - 1. Galvanized Coating Designation: G60 or G90.
 - 2. Finishes for Surfaces Exposed to View: Mill phosphatized.
- C. Carbon-Steel Sheets: Comply with ASTM A 1008/A 1008M, with oiled, matte finish for exposed ducts.

- D. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304 or 316, as indicated in "Duct Schedule" Article; cold rolled, annealed, sheet. Exposed surface finish shall be No. 2B, No. 2D, No. 3, or No. 4 as indicated in "Duct Schedule" Article.
- E. Aluminum Sheets: Comply with ASTM B 209 Alloy 3003, H14 temper; with mill finish for concealed ducts, and standard, one-side bright finish for duct surfaces exposed to view.
- F. Factory- or Shop-Applied Antimicrobial Coating:
 - 1. Apply to the surface of sheet metal that will form the interior surface of the duct. An untreated clear coating shall be applied to the exterior surface.
 - 2. Antimicrobial compound shall be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.
 - 3. Coating containing the antimicrobial compound shall have a hardness of 2H, minimum, when tested in accordance with ASTM D 3363.
 - 4. Surface-Burning Characteristics: Maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested in accordance with UL 723; certified by an NRTL.
 - 5. Shop-Applied Coating Color: White.
 - 6. Antimicrobial coating on sheet metal is not required for duct containing liner treated with antimicrobial coating.
- G. Reinforcement Shapes and Plates: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
 - 1. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.
- 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.

2.5 SEALANT AND GASKETS

- A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested in accordance with UL 723; certified by an NRTL.
- B. Two-Part Tape Sealing System:
 - 1. Tape: Woven cotton fiber impregnated with mineral gypsum and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.
 - 2. Tape Width: 6 inches.
 - 3. Sealant: Modified styrene acrylic.
 - 4. Water resistant.
 - 5. Mold and mildew resistant.
 - 6. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
 - 7. Service: Indoor and outdoor.
 - 8. Service Temperature: Minus 40 to plus 200 deg F.
 - 9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum.
 - 10. Sealant shall have a VOC content of 420 g/L or less.
- C. Water-Based Joint and Seam Sealant:

1. Application Method: Brush on.
2. Solids Content: Minimum 65 percent.
3. Shore A Hardness: Minimum 20.
4. Water resistant.
5. Mold and mildew resistant.
6. VOC: Maximum 75 g/L (less water).
7. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
8. Service: Indoor or outdoor.
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.
10. Sealant shall have a VOC content of 420 g/L or less.
11. Maximum Static-Pressure Class: 10-inch wg, positive or negative.
12. Service: Indoor or outdoor.
13. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

D. Flanged Joint Sealant: Comply with ASTM C 920.

1. General: Single-component, acid-curing, silicone, elastomeric.
2. Type: S.
3. Grade: NS.
4. Class: 25.
5. Use: O.
6. Sealant shall have a VOC content of 420 g/L or less.

E. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

F. Round Duct Joint O-Ring Seals:

1. Seal shall provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg and shall be rated for 10-inch wg static-pressure class, positive or negative.
2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.
3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

2.6 HANGERS AND SUPPORTS

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

- G. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- H. Trapeze and Riser Supports:
 - 1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
 - 2. Supports for Stainless-Steel Ducts: Stainless-steel shapes and plates.
 - 3. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.

2.7 SEISMIC-RESTRAINT DEVICES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. B-line, an Eaton business.
 - 2. Ductmate Industries, Inc.
 - 3. Hilti, Inc.
- B. General Requirements for Restraint Components: Rated strengths, features, and applications shall be as defined in reports by an agency acceptable to authorities having jurisdiction
 - 1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they will be subjected.
- C. Channel Support System: Shop- or field-fabricated support assembly made of slotted steel channels rated in tension, compression, and torsion forces and with accessories for attachment to braced component at one end and to building structure at the other end. Include matching components and corrosion-resistant coating.
- D. Restraint Cables: ASTM A 603, galvanized-steel cables with end connections made of galvanized-steel assemblies with brackets, swivel, and bolts designed for restraining cable service; and with an automatic-locking and clamping device or double-cable clips.
- E. Hanger Rod Stiffener: Reinforcing steel angle clamped to hanger rod.
- F. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type. Select anchor bolts with strength required for anchor and as tested in accordance with ASTM E 488/E 488M.

PART 3 - EXECUTION

3.1 DUCT INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and coordination drawings.
- B. Install ducts in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.
- C. Install ducts in maximum practical lengths with fewest possible joints.

- D. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.
- E. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.
- F. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
- G. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.
- H. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.
- I. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches.
- J. Install fire, combination fire/smoke, and smoke dampers where indicated on Drawings and as required by code, and by local authorities having jurisdiction. Comply with requirements in Section 233300 "Air Duct Accessories" for fire and smoke dampers and specific installation requirements of the damper UL listing.
- K. Install heating coils, cooling coils, air filters, dampers, and all other duct-mounted accessories in air ducts where indicated on Drawings.
- L. Protect duct interiors from moisture, construction debris and dust, and other foreign materials both before and after installation. Comply with SMACNA's "IAQ Guidelines for Occupied Buildings Under Construction," Appendix G, "Duct Cleanliness for New Construction Guidelines."
- M. Elbows: Use long-radius elbows wherever they fit.
 - 1. Fabricate 90-degree rectangular mitered elbows to include turning vanes.
 - 2. Fabricate 90-degree round elbows with a minimum of three segments for 12 inches and smaller and a minimum of five segments for 14 inches and larger.
- N. Branch Connections: Use lateral or conical branch connections.

3.2 INSTALLATION OF EXPOSED DUCTWORK

- A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.
- B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.
- C. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.
- D. Maintain consistency, symmetry, and uniformity in arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.
- E. Repair or replace damaged sections and finished work that does not comply with these requirements.

3.3 ADDITIONAL INSTALLATION REQUIREMENTS FOR TYPE 1 COMMERCIAL KITCHEN GREASE HOOD EXHAUST DUCT

- A. Install ducts in accordance with NFPA 96, "Ventilation Control and Fire Protection of Commercial Cooking Operation"; SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; and SMACNA's "Kitchen Ventilation Systems and Food Service Equipment Fabrication and Installation Guidelines" unless otherwise indicated.
- B. Install all ducts without dips and traps that may hold grease, and sloped a minimum of 2 percent to drain grease back to the hood.
- C. All ducts exposed to view shall be constructed of stainless steel as per "Duct Schedule" Article. All ducts concealed from view shall be stainless steel as per "Duct Schedule" Article.
- D. All joints shall be welded and shall be telescoping, bell, or flange joint as per NFPA 96.
- E. Install fire-rated access panel assemblies at each change in direction and at maximum intervals of 12 feet in horizontal ducts, and at every floor for vertical ducts, or as indicated on Drawings.
- F. Do not penetrate fire-rated assemblies except as allowed by applicable building codes and authorities having jurisdiction.

3.4 ADDITIONAL INSTALLATION REQUIREMENTS FOR EXHAUST DUCTS SERVING COMMERCIAL DISHWASHERS AND OTHER HIGH-HUMIDITY LOCATIONS

- A. Install dishwasher exhaust ducts and other exhaust ducts from wet, high-humidity locations without dips and traps that may hold water. Slope ducts a minimum of 2 percent back to dishwasher or toward drain.
- B. Provide a drain pocket at each low point and at the base of each riser with a 1-inch trapped copper drain from each drain pocket to open site floor drain.
- C. Minimize number of transverse seams.
- D. Do not locate longitudinal seams on bottom of duct.

3.5 DUCT SEALING

- A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- B. Seal ducts at a minimum to the following seal classes in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible":
 - 1. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
 - 2. Unconditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal Class B.
 - 3. Unconditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg: Seal Class A.
 - 4. Unconditioned Space, Exhaust Ducts: Seal Class C.
 - 5. Unconditioned Space, Return-Air Ducts: Seal Class B.
 - 6. Conditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal Class C.
 - 7. Conditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg: Seal Class B.
 - 8. Conditioned Space, Exhaust Ducts: Seal Class B.

9. Conditioned Space, Return-Air Ducts: Seal Class C.

3.6 HANGER AND SUPPORT INSTALLATION

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

3.7 SEISMIC-RESTRAINT-DEVICE INSTALLATION

- A. Install ducts with hangers and braces designed to support the duct and to restrain against seismic forces required by applicable building codes. Comply with SMACNA's "Seismic Restraint Manual: Guidelines for Mechanical Systems."
 1. Space lateral supports a maximum of 40 feet o.c., and longitudinal supports a maximum of 80 feet o.c.
 2. Brace a change of direction longer than 12 feet.
- B. Select seismic-restraint devices with capacities adequate to carry present and future static and seismic loads.
- C. Install cables so they do not bend across edges of adjacent equipment or building structure.
- D. Install cable restraints on ducts that are suspended with vibration isolators.
- E. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction.

- F. Attachment to Structure: If specific attachment is not indicated, anchor bracing and restraints to structure, to flanges of beams, to upper truss chords of bar joists, or to concrete members.
- G. Drilling for and Setting Anchors:
 - 1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcement or embedded items during drilling. Notify Architect if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
 - 2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
 - 3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
 - 4. Set anchors to manufacturer's recommended torque, using a torque wrench.
 - 5. Install zinc-coated steel anchors for interior applications and stainless-steel anchors for applications exposed to weather.

3.8 CONNECTIONS

- A. Make connections to equipment with flexible connectors complying with Section 233300 "Air Duct Accessories."
- B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.9 PAINTING

- A. Paint interior of metal ducts that are visible through registers and grilles and that do not have duct liner. Apply one coat of flat, black, latex paint over a compatible galvanized-steel primer. Paint materials and application requirements are specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

3.10 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Leakage Tests:
 - 1. Comply with SMACNA's "HVAC Air Duct Leakage Test Manual." Submit a test report for each test.
 - 2. Test the following systems:
 - a. Ducts with a Pressure Class Higher Than 3-Inch wg: Test representative duct sections, totaling no less than 25 percent of total installed duct area for each designated pressure class.
 - b. Supply Ducts with a Pressure Class of 2-Inch wg or Higher: Test representative duct sections, totaling no less than 100 percent of total installed duct area for each designated pressure class.

- c. Return Ducts with a Pressure Class of 2-Inch wg or Higher: Test representative duct sections, totaling no less than 100 percent of total installed duct area for each designated pressure class.
 - d. Exhaust Ducts with a Pressure Class of 1-Inch wg or Higher: Test representative duct sections, totaling no less than 100 percent of total installed duct area for each designated pressure class.
 - e. Outdoor-Air Ducts with a Pressure Class of 1-Inch wg or Higher: Test representative duct sections, totaling no less than 100 percent of total installed duct area for each designated pressure class.
 3. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
 4. Testing of each duct section is to be performed with access doors, coils, filters, dampers, and other duct-mounted devices in place as designed. No devices are to be removed or blanked off so as to reduce or prevent additional leakage.
 5. Test for leaks before applying external insulation.
 6. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If static-pressure classes are not indicated, test system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure.
 7. Give seven days advance notice for testing.
 - C. Duct System Cleanliness Tests:
 1. Visually inspect duct system to ensure that no visible contaminants are present.
 2. Test sections of metal duct system, chosen randomly by Owner, for cleanliness in accordance with "Description of Method 3 - NADCA Vacuum Test" in NADCA ACR, "Assessment, Cleaning and Restoration of HVAC Systems."
 - a. Acceptable Cleanliness Level: Net weight of debris collected on the filter media shall not exceed 0.75 mg/100 sq. cm.
 - D. Duct system will be considered defective if it does not pass tests and inspections.
 - E. Prepare test and inspection reports.
- 3.11 DUCT CLEANING
- A. Clean new duct system(s) before testing, adjusting, and balancing.
 - B. For cleaning of existing ductwork, see Section 230130.52 "Existing HVAC Air Distribution System Cleaning."
 - C. Use duct cleaning methodology as indicated in NADCA ACR.
 - D. Use service openings for entry and inspection.
 1. Provide openings with access panels appropriate for duct static-pressure and leakage class at dampers, coils, and any other locations where required for inspection and cleaning access. Provide insulated panels for insulated or lined duct. Patch insulation and liner as recommended by duct liner manufacturer. Comply with Section 233300 "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.

E. 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.

F. 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.

G. 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 in accordance with NADCA ACR. 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 in accordance with manufacturer's written instructions after removal of surface deposits and debris.

3.12 STARTUP

- A. Air Balance: Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC."

3.13 DUCT SCHEDULE

- A. Fabricate ducts with galvanized sheet steel except as otherwise indicated and as follows:

1. Fabricate all ducts to achieve SMACNA pressure class, seal class, and leakage class as indicated below.

B. Supply Ducts:

1. Ducts Connected to Air Outlets:
 - a. Pressure Class: Up to Positive 2-inch wg.
 - b. Minimum SMACNA Seal Class: C.
 - c. SMACNA Leakage Class for Rectangular: 24.
 - d. SMACNA Leakage Class for Round: 12.
2. Ducts Connected to Constant-Volume Air-Handling Units:
 - a. Pressure Class: Positive 3-inch wg.
 - b. Minimum SMACNA Seal Class: B.
 - c. SMACNA Leakage Class for Rectangular: 12.
 - d. SMACNA Leakage Class for Round: 6.
3. Ducts Connected to Equipment Not Listed Above:
 - a. Pressure Class: Positive 4-inch wg.
 - b. Minimum SMACNA Seal Class: A.
 - c. SMACNA Leakage Class for Rectangular: 6.
 - d. SMACNA Leakage Class for Round and Flat Oval: 3.

C. Return Ducts:

1. Ducts Connected to Air Outlets:
 - a. Pressure Class: Up to Positive or Negative 2-inch wg.
 - b. Minimum SMACNA Seal Class: C.
 - c. SMACNA Leakage Class for Rectangular: 24.
 - d. SMACNA Leakage Class for Round: 12.
2. Ducts Connected to Air-Handling Units.
 - a. Pressure Class: Positive or Negative 3-inch wg.
 - b. Minimum SMACNA Seal Class: B.
 - c. SMACNA Leakage Class for Rectangular: 12.
 - d. SMACNA Leakage Class for Round: 6.
3. Ducts Connected to Equipment Not Listed above:
 - a. Pressure Class: Positive or negative 4-inch wg.
 - b. Minimum SMACNA Seal Class: A.
 - c. SMACNA Leakage Class for Rectangular: 6.
 - d. SMACNA Leakage Class for Round: 3.

D. Exhaust Ducts:

1. Ducts Connected to Fans Exhausting (ASHRAE 62.1, Class 1 and 2) Air:
 - a. Pressure Class: Negative 1-inch wg.
 - b. Minimum SMACNA Seal Class: C if negative pressure, and A if positive pressure.
 - c. SMACNA Leakage Class for Rectangular: 24.
 - d. SMACNA Leakage Class for Round and Flat Oval: 12.

2. Ducts Connected to Commercial Kitchen Hoods: Comply with NFPA 96.
 - a. Exposed to View: Type 304, stainless-steel sheet, No. 4 finish.
 - b. Concealed: Type 304, stainless-steel sheet, No. 2D finish.
 - c. Welded seams and joints.
 - d. Pressure Class: Positive or negative 2-inch wg.
 - e. Airtight/watertight.

3. Ducts Connected to Dishwashers, Dishwasher Hoods, and Other High-Humidity Locations:
 - a. Type 304, stainless-steel sheet.
 - b. Exposed to View: No. 4 finish.
 - c. Concealed: No. 2D finish.
 - d. Welded longitudinal seams; welded or flanged transverse joints with watertight EPDM gaskets.
 - e. Pressure Class: Positive or negative 2-inch wg.
 - f. Airtight/watertight.

- E. Outdoor-Air (Filtered, Heated) Ducts:
 1. Ducts Connected to Make-Up Air Units:
 - a. Pressure Class: Positive 2-inch wg.
 - b. Minimum SMACNA Seal Class: C
 - c. SMACNA Leakage Class for Rectangular: 24.
 - d. SMACNA Leakage Class for Round: 12.

- F. Intermediate Reinforcement:
 1. Galvanized-Steel Ducts: Galvanized steel.
 2. Stainless-Steel Ducts:
 - a. Exposed to Airstream: Match duct material.
 - b. Not Exposed to Airstream: Match duct material.
 3. Aluminum Ducts: Aluminum.

- G. Elbow Configuration:
 1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."
 - a. Velocity 1000 fpm or Lower:
 - 1) Radius Type RE 1 with minimum 0.5 radius-to-diameter ratio.
 - 2) Mitered Type RE 4 without vanes.
 - b. Velocity 1000 to 1500 fpm:
 - 1) Radius Type RE 1 with minimum 1.0 radius-to-diameter ratio.
 - 2) Radius Type RE 3 with minimum 0.5 radius-to-diameter ratio and two vanes.
 - 3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."

- c. Velocity 1500 fpm or Higher:
 - 1) Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
 - 2) Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
 - 3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."
 2. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."
 - a. Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
 - b. Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
 - c. Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."
 3. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "Round Duct Elbows."
 - a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.
 - 1) Velocity 1000 fpm or Lower: 0.5 radius-to-diameter ratio and three segments for 90-degree elbow.
 - 2) Velocity 1000 to 1500 fpm: 1.0 radius-to-diameter ratio and four segments for 90-degree elbow.
 - 3) Velocity 1500 fpm or Higher: 1.5 radius-to-diameter ratio and five segments for 90-degree elbow.
 - 4) Radius-to Diameter Ratio: 1.5.
 - b. Round Elbows, 12 Inches and Smaller in Diameter: Stamped or pleated.
 - c. Round Elbows, 14 Inches and Larger in Diameter: Welded.
- H. Branch Configuration:
1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-6, "Branch Connection."
 - a. Rectangular Main to Rectangular Branch: 45-degree entry.
 - b. Rectangular Main to Round Branch: Conical spin in.
 2. Round: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees." Saddle taps are permitted in existing duct.
 - a. Velocity 1000 fpm or Lower: 90-degree tap.
 - b. Velocity 1000 to 1500 fpm: Conical tap.
 - c. Velocity 1500 fpm or Higher: 45-degree lateral.

END OF SECTION 233113

SECTION 233300 - AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Backdraft and pressure relief dampers.
2. Manual volume dampers.
3. Control dampers.
4. Fire dampers.
5. Smoke dampers.
6. Flange connectors.
7. Turning vanes.
8. Duct-mounted access doors.
9. Flexible connectors.
10. Duct accessory hardware.

B. Related Requirements:

1. Section 233723 "HVAC Gravity Ventilators" for roof-mounted ventilator caps.
2. Section 284621.11 "Addressable Fire-Alarm Systems" for duct-mounted fire and smoke detectors.
3. Section 284621.13 "Conventional Fire-Alarm Systems" for duct-mounted fire and smoke detectors.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:

1. Product data showing compliance with ASHRAE 62.1.
2. Detail duct accessories fabrication and installation in ducts and other construction. Include dimensions, weights, loads, and required clearances; and method of field assembly into duct systems and other construction. Include the following:
 - a. Special fittings.
 - b. Manual volume damper installations.
 - c. Control-damper installations.
 - d. Fire-damper and smoke-damper installations, including sleeves; and duct-mounted access doors.
 - e. Wiring Diagrams: For power, signal, and control wiring.

1.3 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

PART 2 - PRODUCTS

2.1 ASSEMBLY DESCRIPTION

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

2.2 MATERIALS

- A. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
 - 1. Galvanized Coating Designation: G60 or G90.
 - 2. Exposed-Surface Finish: Mill phosphatized.
- B. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304, and having a No. 2 finish for concealed ducts.
- C. Aluminum Sheets: Comply with ASTM B 209, Alloy 3003, Temper H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.
- D. Extruded Aluminum: Comply with ASTM B 221, Alloy 6063, Temper T6.
- E. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.
- F. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.3 BACKDRAFT AND PRESSURE RELIEF DAMPERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Greenheck Fan Corporation.
 - 2. Pottorff.
 - 3. Ruskin Company.
- B. Description: Gravity balanced.
- C. Maximum Air Velocity: 1000 fpm.
- D. Maximum System Pressure: 1 to 2-inch wg.
- E. Frame: Hat-shaped, 0.094-inch-thick, galvanized sheet steel, with welded corners or mechanically attached and mounting flange.

- F. Blades: Multiple single-piece blades, center or end pivoted, maximum 6-inch width, 0.025-inch-thick, roll-formed aluminum with sealed edges.
- G. Blade Action: Parallel.
- H. Blade Seals: Neoprene, mechanically locked.
- I. Blade Axles:
 - 1. Material: Nonferrous metal.
 - 2. Diameter: 0.20 inch.
- J. Tie Bars and Brackets: Aluminum or Galvanized steel.
- K. Return Spring: Adjustable tension.
- L. Bearings: Steel ball or synthetic pivot bushings.
- M. Accessories:
 - 1. Adjustment device to permit setting for varying differential static pressure.
 - 2. Counterweights and spring-assist kits for vertical airflow installations.
 - 3. Electric actuators.
 - 4. Chain pulls.
 - 5. Screen Mounting: Front mounted in sleeve.
 - a. Sleeve Thickness: 20 gage minimum.
 - b. Sleeve Length: 6 inches minimum.
 - 6. Screen Mounting: Rear mounted.
 - 7. Screen Material: Aluminum.
 - 8. Screen Type: Insect.
 - 9. 90-degree stops.

2.4 MANUAL VOLUME DAMPERS

- A. Standard, Steel, Manual Volume Dampers:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Nailor Industries Inc.
 - b. Pottorff.
 - c. Ruskin Company.
 - 2. Standard leakage rating, with linkage outside airstream.
 - 3. Suitable for horizontal or vertical applications.
 - 4. Frames:
 - a. Frame: Hat-shaped, 0.094-inch-thick, galvanized sheet steel.
 - b. Mitered and welded corners.
 - c. Flanges for attaching to walls and flangeless frames for installing in ducts.

5. Blades:
 - a. Multiple or single blade.
 - b. Parallel- or opposed-blade design.
 - c. Stiffen damper blades for stability.
 - d. Galvanized steel, 0.064 inch thick.
 6. Blade Axles: Nonferrous metal.
 7. Bearings:
 - a. Oil-impregnated bronze or Molded synthetic.
 - b. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
 8. Tie Bars and Brackets: Galvanized steel.
- B. Standard, Aluminum, Manual Volume Dampers:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Nailor Industries Inc.
 - b. Pottorff.
 - c. Ruskin Company.
 2. Standard leakage rating, with linkage outside airstream.
 3. Suitable for horizontal or vertical applications.
 4. Frames: Hat-shaped, 0.10-inch-thick, aluminum sheet channels; frames with flanges for attaching to walls and flangeless frames for installing in ducts.
 5. Blades:
 - a. Multiple or single blade.
 - b. Parallel- or opposed-blade design.
 - c. Stiffen damper blades for stability.
 - d. Roll-Formed Aluminum Blades: 0.10-inch-thick aluminum sheet.
 - e. Extruded-Aluminum Blades: 0.050-inch-thick extruded aluminum.
 6. Blade Axles: Nonferrous metal.
 7. Bearings:
 - a. Oil-impregnated bronze or Molded synthetic.
 - b. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
 8. Tie Bars and Brackets: Aluminum.
- C. Jackshaft:
1. Size: 0.5-inch to 1-inch diameter.
 2. Material: Galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.
 3. Length and Number of Mountings: As required to connect linkage of each damper in multiple-damper assembly.

D. Damper Hardware:

1. Zinc-plated, die-cast core with dial and handle made of 3/32-inch-thick zinc-plated steel, and a 3/4-inch hexagon locking nut.
2. Include center hole to suit damper operating-rod size.
3. Include elevated platform for insulated duct mounting.

2.5 CONTROL DAMPERS

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

1. Greenheck Fan Corporation.
2. Nailor Industries Inc.
3. Pottorff.
4. Ruskin Company.

B. Frames:

1. Hat, U or Angle shaped.
2. 0.094-inch-thick, galvanized sheet steel or 0.05-inch-thick stainless steel.
3. Mitered and welded or Interlocking, gusseted corners.

C. Blades:

1. Multiple blade with maximum blade width of 6 inches.
2. Parallel, Parallel- and opposed, or Opposed-blade design.
3. Galvanized-steel, Stainless steel or Aluminum.
4. 0.064 inch thick single skin or 0.0747-inch-thick dual skin.
5. Blade Edging: Closed-cell neoprene.
6. Blade Edging: Inflatable seal blade edging, or replaceable rubber seals.

D. Blade Axles: 1/2-inch-diameter; nonferrous metal; blade-linkage hardware of zinc-plated steel and brass; ends sealed against blade bearings.

1. Operating Temperature Range: From minus 40 to plus 200 deg F.

E. Bearings:

1. Oil-impregnated bronze or Molded synthetic.
2. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
3. Thrust bearings at each end of every blade.

2.6 FIRE DAMPERS

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

1. Greenheck Fan Corporation.
2. Nailor Industries Inc.

3. Pottorff.
 4. Ruskin Company.
- B. Type: Static and dynamic; rated and labeled according to UL 555 by an NRTL.
- C. Closing rating in ducts up to 4-inch wg static pressure class and minimum 2000-fpm velocity.
- D. Fire Rating: 1-1/2 to 3 hours.
- E. Frame: Curtain type with blades outside airstream; fabricated with roll-formed, 0.034-inch-thick galvanized steel; with mitered and interlocking corners.
- F. Mounting Sleeve: Factory- or field-installed, galvanized sheet steel.
1. Minimum Thickness: 0.138 inch to 0.39 inch thick, as indicated, and of length to suit application.
 2. Exception: Omit sleeve where damper-frame width permits direct attachment of perimeter mounting angles on each side of wall or floor; thickness of damper frame must comply with sleeve requirements.
- G. Mounting Orientation: Vertical or horizontal as indicated.
- H. Blades: Roll-formed, interlocking, 0.024-inch to 0.034-inch-thick, galvanized sheet steel. In place of interlocking blades, use full-length, 0.034-inch-thick, galvanized-steel blade connectors.
- I. Horizontal Dampers: Include blade lock and stainless-steel closure spring.
- J. Heat-Responsive Device: Replaceable, 212 deg F rated, fusible links.
- 2.7 SMOKE DAMPERS
- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Greenheck Fan Corporation.
 2. Nailor Industries Inc.
 3. Pottorff.
 4. Ruskin Company.
- B. General Requirements: Label according to UL 555S by an NRTL.
- C. Smoke Detector: Integral, factory wired for single-point connection.
- D. Frame: Hat-shaped, 0.094-inch-thick, galvanized sheet steel, with interlocking, gusseted or mechanically attached corners and mounting flange.
- E. Blades: Roll-formed, horizontal, interlocking or overlapping, 0.034-inch or 0.063-inch-thick, galvanized sheet steel.
- F. Leakage: [Class I] [Class II] <Insert class>.
- G. Rated pressure and velocity to exceed design airflow conditions.

- H. Mounting Sleeve: Factory-installed, 0.039-inch-thick, galvanized sheet steel; length to suit wall or floor application with factory-furnished silicone calking.
- I. Damper Motors: two-position action.
- J. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
 - 1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
 - 2. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Section 230923 "Direct Digital Control (DDC) System for HVAC"
 - 3. Permanent-Split-Capacitor or Shaded-Pole Motors: With oil-immersed and sealed gear trains.
 - 4. Spring-Return Motors: Equip with an integral spiral-spring mechanism where indicated. Enclose entire spring mechanism in a removable housing designed for service or adjustments. Size for running torque rating of 150 in. x lbf and breakaway torque rating of 150 in. x lbf.
 - 5. Outdoor Motors and Motors in Outdoor-Air Intakes: Equip with O-ring gaskets designed to make motors weatherproof. Equip motors with internal heaters to permit normal operation at minus 40 deg F.
 - 6. Nonspring-Return Motors: For dampers larger than 25 sq. ft., size motor for running torque rating of 150 in. x lbf and breakaway torque rating of 300 in. x lbf.
 - 7. Electrical Connection: 115 V, single phase, 60 Hz.
- K. Accessories:
 - 1. Auxiliary switches for signaling, fan control or position indication.
 - 2. Test and reset switches, remote mounted.

2.8 FLANGE CONNECTORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Ductmate Industries, Inc.
 - 2. Hardcast, Inc.
 - 3. Ward Industries; a brand of Hart & Cooley, Inc.
- B. Description: Add-on or roll-formed, factory-fabricated, slide-on transverse flange connectors, gaskets, and components.
- C. Material: Galvanized steel.
- D. Gage and Shape: Match connecting ductwork.

2.9 TURNING VANES

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

2. METALAIRE, Inc.
 3. SEMCO LLC.
- B. Manufactured Turning Vanes for Metal Ducts: Curved blades of galvanized sheet steel; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.
1. Acoustic Turning Vanes: Fabricate airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill.
- C. Manufactured Turning Vanes for Nonmetal Ducts: Fabricate curved blades of resin-bonded fiberglass with acrylic polymer coating; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.
- D. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 4-3, "Vanes and Vane Runners," and 4-4, "Vane Support in Elbows."
- E. Vane Construction: Double wall.

2.10 DUCT-MOUNTED ACCESS DOORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Greenheck Fan Corporation.
 2. Nailor Industries Inc.
 3. Pottorff.
- B. Duct-Mounted Access Doors: Fabricate access panels according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 7-2, "Duct Access Doors and Panels," and 7-3, "Access Doors - Round Duct."
1. Door:
 - a. Double wall, rectangular.
 - b. Galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class.
 - c. Vision panel.
 - d. Hinges and Latches: 1-by-1-inch butt or piano hinge and cam latches.
 - e. Fabricate doors airtight and suitable for duct pressure class.
 2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.
 3. Number of Hinges and Locks:
 - a. Access Doors Less Than 12 Inches Square: No hinges and two sash locks.
 - b. Access Doors up to 18 Inches Square: Two hinges and two sash locks.
 - c. Access Doors up to 24 by 48 Inches: Three hinges and two compression latches with outside handles.
 - d. Access Doors Larger Than 24 by 48 Inches: Four hinges and two compression latches with outside and inside handles.

2.11 DUCT ACCESS PANEL ASSEMBLIES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. 3M.
 - 2. Ductmate Industries, Inc.
 - 3. Flame Gard, Inc.
- B. Labeled according to UL 1978 by an NRTL.
- C. Panel and Frame: Minimum thickness 0.0428-inch stainless steel.
- D. Fasteners: Stainless steel. Panel fasteners shall not penetrate duct wall.
- E. Gasket: Comply with NFPA 96; grease-tight, high-temperature ceramic fiber, rated for minimum 2000 deg F.
- F. Minimum Pressure Rating: 10-inch wg, positive or negative.

2.12 FLEXIBLE CONNECTORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Ductmate Industries, Inc.
 - 2. Duro Dyne Inc.
 - 3. Ward Industries; a brand of Hart & Cooley, Inc.
- B. Materials: Flame-retardant or noncombustible fabrics.
- C. Coatings and Adhesives: Comply with UL 181, Class 1.
- D. Metal-Edged Connectors: Factory fabricated with a fabric strip 3-1/2 inches wide attached to two strips of 2-3/4-inch-wide, 0.028-inch-thick, galvanized sheet steel or 0.032-inch-thick aluminum sheets. Provide metal compatible with connected ducts.
- E. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.
 - 1. Minimum Weight: 26 oz./sq. yd..
 - 2. Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
 - 3. Service Temperature: Minus 40 to plus 200 deg F.

2.13 DUCT ACCESSORY HARDWARE

- A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct-insulation thickness.
- B. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.
- B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.
- C. Install backdraft and control dampers at inlet of exhaust fans or exhaust ducts as close as possible to exhaust fan unless otherwise indicated.
- D. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.
 - 1. Install steel volume dampers in steel ducts.
 - 2. Install aluminum volume dampers in aluminum ducts.
- E. Set dampers to fully open position before testing, adjusting, and balancing.
- F. Install test holes at fan inlets and outlets and elsewhere as indicated.
- G. Install fire and smoke dampers according to UL listing.
- H. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:
 - 1. On both sides of duct coils.
 - 2. At outdoor-air intakes and mixed-air plenums.
 - 3. At drain pans and seals.
 - 4. Downstream from manual volume dampers, control dampers, backdraft dampers, and equipment.
 - 5. Adjacent to and close enough to fire or smoke dampers, to reset or reinstall fusible links. Access doors for access to fire or smoke dampers having fusible links shall be pressure relief access doors and shall be outward operation for access doors installed upstream from dampers and inward operation for access doors installed downstream from dampers.
 - 6. At each change in direction and at maximum 50-foot spacing.
 - 7. Upstream and downstream from turning vanes.
 - 8. Control devices requiring inspection.
 - 9. Elsewhere as indicated.
- I. Install access doors with swing against duct static pressure.
- J. Access Door Sizes:
 - 1. One-Hand or Inspection Access: 8 by 5 inches.
 - 2. Two-Hand Access: 12 by 6 inches.
 - 3. Head and Hand Access: 18 by 10 inches.
 - 4. Head and Shoulders Access: 21 by 14 inches.
 - 5. Body Access: 25 by 14 inches.

- 6. Body plus Ladder Access: 25 by 17 inches.
- K. Label access doors according to Section 230553 "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.
- L. Install flexible connectors to connect ducts to equipment.
- M. Connect terminal units to supply ducts directly or with maximum 12-inch lengths of flexible duct. Do not use flexible ducts to change directions.
- N. Connect diffusers or light troffer boots to ducts directly or with maximum 96-inch lengths of flexible duct clamped or strapped in place.
- O. Connect flexible ducts to metal ducts with liquid adhesive plus tape.
- P. Install duct test holes where required for testing and balancing purposes.

3.2 FIELD QUALITY CONTROL

- A. Tests and Inspections:
 - 1. Operate dampers to verify full range of movement.
 - 2. Inspect locations of access doors and verify that purpose of access door can be performed.
 - 3. Operate fire and smoke dampers to verify full range of movement and verify that proper heat-response device is installed.
 - 4. Inspect turning vanes for proper and secure installation.

END OF SECTION 233300

SECTION 233346 - FLEXIBLE DUCTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Insulated flexible ducts.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Sustainable Design Submittals:
 - 1. Product data showing compliance with ASHRAE 62.1.
 - 2. Product Data: For adhesives and sealants, indicating VOC content.
 - 3. Laboratory Test Reports: For adhesives and sealants, indicating compliance with requirements for low-emitting materials.
 - 4. Laboratory Test Reports: For insulation, indicating compliance with requirements for low-emitting materials.
 - 5. Product Data : For insulation, indicating that R-values comply with tables in ASHRAE/IES 90.1, Section 6 - "Heating, Ventilating, and Air Conditioning."
- C. Shop Drawings: For flexible ducts.
 - 1. Include plans showing locations and mounting and attachment details.

1.3 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plans, drawn to scale, and coordinated with each other, using input from installers of the items involved.

PART 2 - PRODUCTS

2.1 ASSEMBLY DESCRIPTION

- A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."
- B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
- C. Comply with the Air Diffusion Council's "ADC Flexible Air Duct Test Code FD 72-R1."

- D. Comply with ASTM E 96/E 96M, "Test Methods for Water Vapor Transmission of Materials."

2.2 INSULATED FLEXIBLE DUCTS

- A. Insulated, Flexible Duct: UL 181, Class 1, two-ply vinyl film supported by helically wound, spring-steel wire; fibrous-glass insulation; polyethylene or aluminized vapor-barrier film.
 - 1. Pressure Rating: 10-inch wg positive and 1.0-inch wg negative.
 - 2. Maximum Air Velocity: 4000 fpm.
 - 3. Temperature Range: Minus 10 to plus 160 deg F.
 - 4. Insulation R-Value: Comply with ASHRAE/IES 90.1.
- B. Insulated, Flexible Duct: UL 181, Class 1, multiple layers of aluminum laminate supported by helically wound, spring-steel wire; fibrous-glass insulation; polyethylene or aluminized vapor-barrier film.
 - 1. Pressure Rating: 10-inch wg positive and 1.0-inch wg negative.
 - 2. Maximum Air Velocity: 4000 fpm.
 - 3. Temperature Range: Minus 20 to plus 210 deg F.
 - 4. Insulation R-Value: Comply with ASHRAE/IES 90.1.

2.3 FLEXIBLE DUCT CONNECTORS

- A. Clamps: Nylon strap in sizes 3 through 18 inches, to suit duct size.
- B. Non-Clamp Connectors: Liquid adhesive plus tape.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install flexible ducts according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.
- B. Install in indoor applications only. Flexible ductwork should not be exposed to UV lighting.
- C. Connect terminal units to supply ducts directly or with maximum 12-inch lengths of flexible duct. Do not use flexible ducts to change directions.
- D. Connect diffusers or light troffer boots to ducts directly or with maximum 96-inch lengths of flexible duct clamped or strapped in place.
- E. Connect flexible ducts to metal ducts with liquid adhesive plus tape.
- F. Install duct test holes where required for testing and balancing purposes.
- G. Installation:
 - 1. Install ducts fully extended.
 - 2. Do not bend ducts across sharp corners.

3. Bends of flexible ducting shall not exceed a minimum of one duct diameter.
4. Avoid contact with metal fixtures, water lines, pipes, or conduits.
5. Install flexible ducts in a direct line, without sags, twists, or turns.

H. Supporting Flexible Ducts:

1. Suspend flexible ducts with bands 1-1/2 inches wide or wider and spaced a maximum of 48 inches apart. Maximum centerline sag between supports shall not exceed 1/2 inch per 12 inches.
2. Install extra supports at bends placed approximately one duct diameter from center line of the bend.
3. Ducts may rest on ceiling joists or truss supports. Spacing between supports shall not exceed the maximum spacing per manufacturer's written installation instructions.
4. Vertically installed ducts shall be stabilized by support straps at a maximum of 72 inches o.c.

END OF SECTION 233346

SECTION 233713.13 - AIR DIFFUSERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Rectangular and square ceiling diffusers.
2. Louver face diffusers.
3. Linear slot diffusers.

B. Related Requirements:

1. Section 233300 "Air Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to diffusers.
2. Section 233713.23 "Air Registers and Grilles" for adjustable-bar register and grilles, fixed-face registers and grilles, and linear bar grilles.
3. Section 233713.43 "Security Registers and Grilles" for security registers and security grilles.
4. Section 233716 "Fabric Air-Diffusion Devices" for continuous tubular diffusers.

1.2 ACTION SUBMITTALS

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

PART 2 - PRODUCTS

2.1 RECTANGULAR AND SQUARE CEILING DIFFUSERS

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

1. METALAIRE, Inc.
2. Price Industries.
3. Titus.

- B. Devices shall be specifically designed for variable-air-volume flows.

- C. Material: Aluminum.

- D. Finish: Baked enamel, color selected by Architect.

- E. Face Size: 24 by 24 inches.

- F. Face Style: Louvered Face.

- G. Mounting: T-bar (Lay-In).

- H. Pattern: Adjustable.
- I. Dampers: Radial opposed blade.
- J. Accessories:
 - 1. See Mechanical Schedules Sheet.

2.2 LOUVER FACE DIFFUSERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. METALAIRE, Inc.
 - 2. Price Industries.
 - 3. Titus.
- B. Devices shall be specifically designed for variable-air-volume flows.
- C. Material: Aluminum.
- D. Finish: Baked enamel, color selected by Architect.
- E. Face Size: Varies. See Plans and Mechanical Schedules Sheet.
- F. Mounting: Surface.
- G. Pattern: Adjustable core style.
- H. Dampers: Radial opposed blade.
- I. Accessories:
 - 1. See Mechanical Schedules Sheet.

2.3 LINEAR SLOT DIFFUSERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. METALAIRE, Inc.
 - 2. Price Industries.
 - 3. Titus.
- B. Devices shall be specifically designed for variable-air-volume flows.
- C. Material - Shell: Aluminum, insulated.
- D. Material - Pattern Controller and Tees: Aluminum.
- E. Finish - Face and Shell: Baked enamel, color by architect.

- F. Finish - Pattern Controller: Baked enamel, color by architect.
- G. Finish - Tees: Baked enamel, color selected by Architect.
- H. Slot Width: See Plans and Mechanical Schedules Sheet.
- I. Number of Slots: See Plans and Mechanical Schedules Sheet.
- J. Length: See Plans and Mechanical Schedules Sheet.
- K. Accessories: See Plans and Mechanical Schedules Sheet.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install diffusers level and plumb.
- B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practical. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.
- C. Install diffusers with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.2 ADJUSTING

- A. After installation, adjust diffusers to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION 233713.13

SECTION 233713.23 - REGISTERS AND GRILLES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Fixed face registers and grilles.
- B. Related Requirements:
 - 1. Section 233300 "Air Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to registers and grilles.
 - 2. Section 233713.13 "Air Diffusers" for various types of air diffusers.

1.2 ACTION SUBMITTALS

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

PART 2 - PRODUCTS

2.1 REGISTERS

- A. Fixed Face Register:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Metalaire.
 - b. Price Industries.
 - c. Titus.
 - 2. Material: Aluminum.
 - 3. Finish: Baked enamel, color selected by Architect.
 - 4. Face Arrangement: Perforated core.
 - 5. Core Construction: Integral or Removable.
 - 6. Frame: 1-1/4 inches wide.
 - 7. Mounting Frame: 24"x24".
 - 8. Mounting: Lay in.
 - 9. Damper Type: Adjustable opposed blade.

2.2 GRILLES

- A. Fixed Face Grille:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Metalaire.
 - b. Price Industries.
 - c. Titus.
2. Material: Aluminum.
3. Finish: Baked enamel, color selected by Architect.
4. Face Blade Arrangement: Horizontal spaced 3/4 inch or 1/2 inch.
5. Frame: 1-1/4 inches wide.
6. Mounting Frame: Surface Mount.
7. Mounting: Countersunk screw or Concealed.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install registers and grilles level and plumb.
- B. Outlets and Inlets Locations: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practical. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.
- C. Install registers and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.2 ADJUSTING

- A. After installation, adjust registers and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION 233713.23

SECTION 238216.11 - HYDRONIC AIR COILS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes hydronic heating coils.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Sustainable Design Submittals:
 - 1. Product data showing compliance with ASHRAE 62.1.

1.3 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

PART 2 - PRODUCTS

2.1 DESCRIPTION

- A. ASHRAE Compliance: Comply with applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."

2.2 COILS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. McQuay.
 - 2. Greenheck Fan Corporation.
 - 3. Trane.
- B. Performance Ratings: Tested and rated according to AHRI 410 and ASHRAE 33.
- C. Minimum Working-Pressure/Temperature Ratings: 250 psig, 300 deg F.
- D. Source Quality Control: Factory tested to 315 psig.
- E. Tubes: ASTM B 743 copper. Round, seamless 5/8" O.D. or 1/2" O.D. copper tube staggered in the direction of airflow. Tubes shall be on 1-1/2" or 3" centers. High pressure coils shall have cupro-nickel tubes and headers.

- F. Fins: Rippled, aluminum plate fins for higher capacity and structural strength. Fins shall have drawn collars to provide a continuous surface cover over the entire tube for maximum heat transfer. Bare copper tube shall not be visible between fins. Tubes shall be mechanical expanded into the fins to provide a continuous primary to secondary compression bond over the entire finned length for maximum heat transfer rates.
- G. Frames: Shall be constructed of continuous galvanized steel with 3/8" diameter bolt holes for mounting on 6" centers. Coil side plates shall be of reinforced flange type for greater strength and ease of stacking coils in banks. Furnish coils with flanges for slip-and-drive fasteners or full flanged casings for standard installation.
- H. Coils: Shall have the connections located to permit (unique) (universal) mounting of the coil for (right- or left-) hand airflow and have equal pressure drop through all circuits. Coils shall be circuited to provide the maximum mean effective temperature difference for maximum heat transfer rates. All coils over 45" fin length shall be furnished with four fin angles to properly position the coil core.
- I. Hot-Water Coil Capacities and Characteristics:
 - 1. See Mechanical Schedules Sheet.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install coils level and plumb.
- B. Install coils in metal ducts and casings constructed according to SMACNA's "HVAC Duct Construction Standards, Metal and Flexible."
- C. Straighten bent fins on air coils.
- D. Clean coils using materials and methods recommended in writing by manufacturers, and clean inside of casings and enclosures to remove dust and debris.

3.2 CONNECTIONS

- A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to coils to allow service and maintenance.
- C. Connect water piping with unions and shutoff valves to allow coils to be disconnected without draining piping. Control valves are specified in Section 230923.11 "Control Valves," and other piping specialties are specified in Section 232116 "Hydronic Piping Specialties."

END OF SECTION 238216.11

SECTION 238239.16 - PROPELLER UNIT HEATERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes propeller unit heaters with hot-water coils.

1.2 ACTION SUBMITTALS

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

1. Include rated capacities, operating characteristics, furnished specialties, and accessories.

- B. Sustainable Design Submittals:

1. Product Data: For ventilation equipment, indicating compliance with ASHRAE 62.1, Section 5 - "Systems and Equipment."

- C. Shop Drawings:

1. Include plans, elevations, sections, and details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include location and size of each field connection.
4. Include details of anchorages and attachments to structure and to supported equipment.
5. Include equipment schedules to indicate rated capacities, operating characteristics, furnished specialties, and accessories.
6. Indicate location and arrangement of piping valves and specialties.
7. Indicate location and arrangement of integral controls.
8. Wiring Diagrams: Power, signal, and control wiring.

1.3 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Floor plans, reflected ceiling plans, and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Suspended ceiling components.
2. Structural members to which propeller unit heaters will be attached.
3. Method of attaching hangers to building structure.
4. Size and location of initial access modules for acoustical tile.
5. Items penetrating finished ceiling, including the following:
 - a. Lighting fixtures.
 - b. Air outlets and inlets.
 - c. Speakers.
 - d. Sprinklers.
 - e. Access panels.

f. Plumbing Piping.

- B. Seismic Qualification Data: Submit certification that propeller unit heaters, accessories, and components will withstand seismic forces defined in Section 230548 "Vibration and Seismic Controls for HVAC."
- C. Field quality-control reports.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Airtherm; a Mestek company.
 - 2. Daikin.
 - 3. Modine.

2.2 DESCRIPTION

- A. Assembly including casing, coil, fan, and motor in horizontal discharge configuration with adjustable discharge louvers.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.3 PERFORMANCE REQUIREMENTS

- A. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."
- B. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."
- C. Seismic Performance: Propeller unit heaters shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
 - 1. The term "withstand" means "the unit will remain in place without separation of any parts when subjected to the seismic forces specified."

2.4 HOUSINGS

- A. Finish: Manufacturer's standard baked enamel applied to factory-assembled and -tested propeller unit heaters before shipping.

- B. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
- C. Discharge Louver: Adjustable fin diffuser for horizontal units and conical diffuser for vertical units.

2.5 COILS

- A. General Coil Requirements: Test and rate hot-water propeller unit-heater coils according to ASHRAE 33.
- B. Hot-Water Coil: Copper tube, minimum 0.025-inch wall thickness, with mechanically bonded aluminum fins spaced no closer than 0.1 inch and rated for a minimum working pressure of 200 psig and a maximum entering-water temperature of 325 deg F, with manual air vent. Test for leaks to 350 psig underwater.

2.6 FAN AND MOTOR

- A. Fan: Propeller type with aluminum wheel directly mounted on motor shaft in the fan venturi.
- B. Motor: Permanently lubricated. Comply with requirements in Section 230513 "Common Motor Requirements for HVAC Equipment."

2.7 CONTROLS

- A. Control Devices:
 - 1. Wall-mounted thermostat.

2.8 CAPACITIES AND CHARACTERISTICS

- A. Refer to Mechanical Schedules Sheet.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas to receive propeller unit heaters for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for piping and electrical connections to verify actual locations before unit-heater installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install propeller unit heaters to comply with NFPA 90A.
- B. Install propeller unit heaters level and plumb.

- C. Suspend propeller unit heaters from structure with all-thread hanger rods and elastomeric hangers. Hanger rods and attachments to structure are specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment." Vibration hangers are specified in Section 230548 "Vibration and Seismic Controls for HVAC."
- D. Install wall-mounted thermostats and switch controls in electrical outlet boxes at heights to match lighting controls. Verify location of thermostats and other exposed control sensors with Drawings and room details before installation.

3.3 CONNECTIONS

- A. Piping installation requirements are specified in Section 232113 "Hydronic Piping" and Section 232116 "Hydronic Piping Specialties." Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to machine to allow service and maintenance.
- C. Connect piping to propeller unit heater's factory, hot-water piping package. Install the piping package if shipped loose.
- D. Comply with safety requirements in UL 1995.
- E. Unless otherwise indicated, install union and gate or ball valve on supply-water connection and union and calibrated balancing valve on return-water connection of propeller unit heater. Hydronic specialties are specified in Section 232116 "Hydronic Piping Specialties."
- F. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
- G. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
 - 1. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 - 2. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.
- B. Units will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports.

END OF SECTION 238239.16

SECTION 238239.19 - WALL AND CEILING UNIT HEATERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes wall and ceiling heaters with propeller fans and electric-resistance heating coils.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include rated capacities, operating characteristics, furnished specialties, and accessories.
- B. Shop Drawings:
 - 1. Include plans, elevations, sections, and details.
 - 2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 3. Include details of anchorages and attachments to structure and to supported equipment.
 - 4. Include equipment schedules to indicate rated capacities, operating characteristics, furnished specialties, and accessories.
 - 5. Wiring Diagrams: Power, signal, and control wiring.
- C. Samples: For each exposed product and for each color and texture specified.

1.3 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Berko; Marley Engineered Products.
 - 2. Marley Engineered Products.
 - 3. QMark; Marley Engineered Products.

2.2 DESCRIPTION

- A. Assembly including chassis, electric heating coil, fan, motor, and controls. Comply with UL 2021.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.3 CABINET

- A. Front Panel: Stamped-steel louver or Extruded-aluminum bar grille, with removable panels fastened with tamperproof fasteners.
- B. Finish: Baked enamel over baked-on primer with manufacturer's standard color selected by Architect, applied to factory-assembled and -tested wall and ceiling heaters before shipping.
- C. Surface-Mounted Cabinet Enclosure: Steel with finish to match cabinet.

2.4 COIL

- A. Electric-Resistance Heating Coil: Nickel-chromium heating wire, free from expansion noise and 60-Hz hum, embedded in magnesium oxide refractory and sealed in corrosion-resistant metallic sheath. Terminate elements in stainless-steel, machine-staked terminals secured with stainless-steel hardware, and limit controls for high-temperature protection. Provide integral circuit breaker for overcurrent protection.

2.5 FAN AND MOTOR

- A. Fan: Aluminum propeller directly connected to motor.
- B. Motor: Permanently lubricated. Comply with requirements in Section 230513 "Common Motor Requirements for HVAC Equipment."

2.6 CONTROLS

- A. Controls: Integral, Unit-mounted thermostat.
- B. Electrical Connection: Factory wire motors and controls for a single field connection with disconnect switch.

2.7 CAPACITIES AND CHARACTERISTICS

- A. Airflow: See Mechanical Schedules Sheet.
- B. Fan Speed: See Mechanical Schedules Sheet.
- C. Heating Coil: See Mechanical Schedules Sheet.
- D. Electrical Characteristics for Single-Point Connection:
 - 1. Volts: 208.
 - 2. Phase: 1.
 - 3. Hertz: 60.
 - 4. Full-Load Amperes: See Mechanical Schedules Sheet.
 - 5. Minimum Circuit Ampacity: See Mechanical Schedules Sheet.
 - 6. Maximum Overcurrent Protection: See Mechanical Schedules Sheet.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install wall and ceiling unit heaters to comply with NFPA 90A.
- B. Install wall and ceiling unit heaters level and plumb.
- C. Install wall-mounted thermostats and switch controls in electrical outlet boxes at heights to match lighting controls. Verify location of thermostats and other exposed control sensors with Drawings and room details before installation.
- D. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
- E. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

END OF SECTION 238239.19

SECTION 260100 - ELECTRICAL GENERAL REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. All of the Contract Documents, as listed on the Table of Contents and including General and Supplementary Conditions and Division 1, General Requirements, shall be included in, and made part of, this Section.

1.2 DESCRIPTION OF WORK

- A. Carefully examine all of the Contract Documents, criteria sheets and all other Sections of the specifications for requirements which affect work under this Section, whether or not such work is specifically mentioned in this Section.
- B. The work under this Contract shall include all labor, materials, tools, equipment, transportation, insurance, temporary protection, supervision and incidental items essential for proper installation and operation, even though not specifically mentioned or indicated on the drawings, but which are usually provided or are essential for proper installation and operation, of all systems as indicated on the drawings and specified herein.
- C. The specifications and drawings describe the minimum requirements that must be met by the Electrical Subcontractor for the installation of all work as shown on the drawings and as specified hereunder.
- D. Coordinate work with that of all other Trades affecting or affected by the work of this Section. Cooperate with such Trades to assure the steady progress of all work under the Contract.

1.3 RELATED WORK

- A. For work to be included as part of this Section, to be furnished and installed by the Electrical Subcontractor, refer to the following Sections:
 - 1. Section 260519 LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES
 - 2. Section 260523 CONTROL-VOLTAGE ELECTRICAL POWER CABLES
 - 3. Section 260526 GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS
 - 4. Section 260529 HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS
 - 5. Section 260533 RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS
 - 6. Section 260544 SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS AND CABLING
 - 7. Section 260548 SEISMIC CONTROLS FOR ELECTRICAL SYSTEMS
 - 8. Section 260553 IDENTIFICATION FOR ELECTRICAL SYSTEMS
 - 9. Section 260573.13 SHORT-CIRCUIT STUDIES
 - 10. Section 260573.16 COORDINATION STUDIES
 - 11. Section 260573.19 ARC-FAULT HAZARD ANALYSIS
 - 12. Section 260923 LIGHTING CONTROL DEVICES
 - 13. Section 262416 PANELBOARDS

- | | | |
|-----|-------------------|--|
| 14. | Section 262726 | WIRING DEVICES |
| 15. | Section 262813 | FUSES |
| 16. | Section 262816 | ENCLOSED SWITCHES AND CIRCUIT BREAKERS |
| 17. | Section 262913.03 | MANUAL AND MAGNETIC MOTOR CONTROLLERS |
| 18. | Section 265119 | LED INTERIOR LIGHTING |
| 19. | Section 265219 | EMERGENCY AND EXIT LIGHTING |

B. For work related to, and to be coordinated with the electrical work, but not included in this Section and required to be performed under other designated Sections, see the following:

1. Division 4 Section "Masonry Work" for electrical construction.
2. Division 7 Section "Firestopping".
3. Division 7 Section "Caulking, Flashing, Waterproofing, Roofing and setting of Roof Drains".
4. Division 8 Section "Access Panels".
5. Division 9 Section "Painting".

1.4 REFERENCES

- A. All materials and workmanship shall comply with all applicable Codes, Specifications, Local and State Ordinances, Industry Standards and Utility Company Regulations, latest editions.
- B. In case of difference between Building Codes, State Laws, Local Ordinances, Industry Standards and Utility Company Regulations and the Contract Documents, the Electrical Subcontractor shall promptly notify the Architect in writing of any such difference.
- C. In case of conflict between the Contract Documents and the requirements of any Code or Authorities having jurisdiction, the most stringent requirements of the aforementioned shall govern.
- D. Should the Electrical Subcontractor perform any work that does not comply with the requirements of the applicable Building Codes, State Laws, Local Ordinances, Industry Standards and Utility Company Regulations, he shall bear all costs arising in correcting the deficiencies, as approved by the Architect/Owner.
- E. Applicable Codes and Standards shall include all State Laws, Local Ordinances, Utility Company Regulations, and the applicable requirements of the latest adopted edition of the following Codes and Standards, without limiting the number, as follows:
1. NFPA 13: Sprinkler Systems
 2. NFPA 70: National Electrical Code
 3. NFPA 72: National Fire Alarm Code
 4. NFPA 101: Life Safety Code
 5. Occupational Safety and Health Standards
 6. Environmental Protection Agency
 7. National Fire Protection Association
 8. Department of Environmental Protection
 9. Uniform Building Code (UBC)
 10. International Building Code (IBC)
 11. International Energy Conservation Code
 12. State Demolition Code
 13. State Fire Safety Code
 14. Local Building Code.
 15. ICC/ANSI A117.1, Accessible and Usable Buildings and Facilities

- F. In these specifications, references made to the following Industry Standards and Code Bodies are intended to indicate the latest volume or publication of the Standard. All equipment, materials and details of installation shall comply with the requirements and latest revisions of the following Bodies, as applicable:

ANSI:	AMERICAN NATIONAL STANDARDS INSTITUTE
ASTM:	AMERICAN SOCIETY OF TESTING MATERIALS
AWG:	AMERICAN WIRE GAUGE
FM:	FACTORY MUTUAL
IEEE:	INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS
IES:	ILLUMINATING ENGINEERING SOCIETY
NEMA:	NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION
UL:	UNDERWRITERS' LABORATORIES
IRI:	INDUSTRIAL RISK INSURERS
ISO:	INSURANCE SERVICES OFFICE
NBS:	NATIONAL BUREAU OF STANDARDS
NSC:	NATIONAL SAFETY COUNCIL

- G. Electrical Subcontractor for the work in his scope of work shall give all necessary notices, obtain all permits, pay all governmental taxes, fees and other costs in connection with his work; file for necessary approvals with the jurisdiction under which the work is to be performed. Electrical Subcontractor shall obtain all required Certificates of Inspection for his respective work and deliver same to the Architect before request for acceptance of his portion of work is made and before final payment.

1.5 QUALITY ASSURANCE

- A. The manufacturers listed within these specifications have been preselected for use on this project. No submittal will be accepted from a manufacturer other than specified.
- B. Electrical Subcontractor shall furnish and install all equipment, accessories, connections and incidental items necessary to fully complete the work under his Contract for use, occupancy and operation by the Owner.
- C. Where equipment of a substitute manufacturer differ from that specified and require different arrangement or connections from those shown, it shall be the responsibility of the Subcontractor responsible for the substitution to modify the installation of the equipment/system to operate properly and in harmony with the original intent of the drawings and specifications. When directed by the Architect, the Electrical Subcontractor shall submit drawings showing the proposed, substitute installation. If the proposed installation is accepted, the Electrical Subcontractor shall make all necessary changes in all affected related work provided under his and other Sections including location of roughing-in connections by other Trades, conduit, supports, etc. All changes shall be made at no increase in the Contract amount or additional cost to the Owner. The General Contractor shall be responsible to assure that the Subcontractor responsible for the substitution bears the cost arising to all other Trades as a result of the substitution.
- D. Unless specifically indicated otherwise, all equipment and materials required for installation under these specifications shall be new, unused and without blemish or defect. Equipment and materials shall be products which will meet with the acceptance of the Authorities having jurisdiction over the work and as

specified hereinbefore. Where such acceptance is contingent upon having the products listed and/or labeled by FM or UL or another testing laboratory, the products shall be so listed and/or labeled. Where no specific indication as to the type or quality of material or equipment is indicated, a first class standard article shall be provided.

1.6 WARRANTY

- A. Attention is directed to provisions of the General Requirements and Supplementary General Requirements regarding and warranties for work under this Contract.
- B. All warranties shall begin on the Date of Substantial Completion of the entire project or the Owner's acceptance of the workmanship and/or material covered by the warranty, whichever is later. The warranty coverage shall continue for the specified period. Refer to individual specification sections for warranty period. If no specific warranty period is specified, the warranty shall extend for a minimum of 365 days.
- C. Manufacturers shall provide their standard warranties for work under the Electrical Trades. However, such warranties shall be in addition to, and not in lieu of, all other liabilities which the manufacturer and Electrical Subcontractor may have by law or by other provisions of the Contract Documents.
- D. All materials, items of equipment and workmanship furnished under the Electrical Section shall carry the standard warranty against all defects in material and workmanship. Any fault due to defective or improper material, equipment, workmanship or design which may develop shall be made good, forthwith, by and at the expense of the Electrical Subcontractor for the work under his Contract, including all other damage done to areas, materials and other systems resulting from this failure.
- E. The Electrical Subcontractor shall warranty that all elements of the systems which are to be provided under his Contract, are of sufficient capacity to meet the specified performance requirements as set forth herein or as indicated.
- F. Upon receipt of notice from the Owner or Architect of failure of any part of the systems or equipment during the warranty period, the affected part or parts shall be replaced by the Electrical Subcontractor for his work or any other work affected by the failure(s).
- G. Electrical Subcontractor shall furnish, before the final payment is made, a written warranty covering the above requirements in accordance with the General Requirements.

1.7 DEFINITIONS

- A. Words in the singular shall also mean and include the plural, wherever the context so indicates, and words in the plural shall mean the singular, wherever the context so indicates.
- B. Wherever the terms "shown on drawings" are used in the specifications, they shall mean "noted", "indicated", "scheduled", "detailed", or any other diagrammatic or written reference made on the drawings.
- C. Wherever the term "provide" is used in the specifications it will mean "furnish" and "install", "connect", "apply", "erect", "construct", or similar terms, unless otherwise indicated in the specifications.
- D. "Work": Labor, materials, equipment, apparatus, controls and accessories required for proper and complete installation.

- E. "Concealed": Embedded in masonry or other construction; or installed in furred spaces, trenches or crawl spaces; or installed within double partitions or hung ceilings; or in enclosures.
- F. "Exposed": Visible to building occupants, excluding mechanical room and utility tunnel locations.
- G. "Acceptable equivalent" or "Equal": Of weight, size, design, capacity and efficiency to meet requirements specified and shown, and of acceptable manufacturer, as determined in the opinion of the Architect.
- H. "Acceptable": Acceptable, as determined in the opinion of the Architect.
- I. "Contractor": General Contractor.
- J. "Named" Product: Manufacturer's name for product, as recorded in published documents of latest issue as of date of Contract Documents. Obtain Architect's permission before using products of later or earlier model.
- K. Wherever the term "material" is used in the specifications it will mean any "product", "equipment", "device", "assembly", or "item" required under the Contract, as indicated by trade or brand name, manufacturer's name, standard specification reference or other description.
- L. The terms "approved", or "approval" shall mean the written approval of the Architect.
- M. The term "Contract Documents" shall mean the entire set of Drawings and Specifications as listed in the Table of Contents of the General Conditions including all bound and unbound material and all items officially issued to date such as addenda, bulletins, job modifications, etc.
- N. The term "specification" shall mean all information contained in the bound or unbound volume, including all "Contract Documents" defined therein, except for the drawings.
- O. The terms "directed", "required", "permitted", "ordered", "designated", "prescribed", and similar words shall mean the direction, requirement, permission, order, designation or prescription of the Architect; the terms "approved", "acceptable", "satisfactory", and similar words shall mean approved by, acceptable or satisfactory to the Architect; and, the terms "necessary", "reasonable", "proper", "correct", and similar words shall mean necessary, reasonable, proper or correct in the judgment of the Architect.
- P. "Accessible" indicates ease of access with or without the use of ladders and without requiring extensive removal of other equipment, such as ductwork, piping, etc. to gain access. "Accessible ceiling" indicates acoustic tile type hung ceilings. Concealed spline or sheetrock ceilings with access panels shall not be considered accessible ceilings.
- Q. "Concealed" means hidden from sight in chases, furred spaces, shafts, hung ceilings, embedded in construction or in crawl spaces.
- R. "Exposed" means not installed underground or "concealed" as defined above.
- S. "Electrical Subcontractor" refers to the Subcontractor responsible for furnishing and installation of all work indicated on the Electrical drawings and in the Electrical specifications.
- T. "Architect" shall refer to the Architect: "Phase Zero Design" and/or the Engineer "Innovative Engineering Services, LLC."
- U. "Owner" shall refer to the Owner or designated representative.

- V. "Other Work Contractor" (O.W.C.) refers to the Contractor(s), or Subcontractor(s) performing work under other Sections of the Contract Documents.

1.8 THE SUBCONTRACTOR

- A. The Electrical Subcontractor shall visit the site of the proposed new facility and base his bids from his own site examinations and estimates. The Electrical Subcontractor shall not hold the Architect, Engineer, Owner or their agents or employees responsible for, or bound by, any schedule, estimate or of any plan thereof. The Electrical Subcontractor shall study the Contract Documents included under this Contract to determine exactly the extent of work provided under this Contract, as well as to ascertain the difficulty to be encountered in performing the work, in installing new equipment and systems and coordinating the work with the other Trades and existing building conditions.
- B. The Electrical Subcontractor shall faithfully execute his work according to the terms and conditions of the Contract and specifications, and shall take all responsibility for and bear all losses resulting to him in the execution of his work.
- C. The Electrical Subcontractor shall be responsible for the location and performance of work provided under his Contract as indicated on the Contract Documents. All parties employed directly or indirectly by the Electrical Subcontractor shall perform their work according to all the conditions as set forth in these specifications.
- D. The Electrical Subcontractor shall furnish all materials and do all work in accordance with these specifications, and any supplementary documents provided by the Architect. The work shall include everything shown on the drawings and/or required by the specifications as interpreted by the Architect, regardless of where such information is indicated in the Contract Documents (Architectural, HVAC, Plumbing, Fire Protection, etc.). Unless specifically indicated otherwise, all work and materials furnished and installed shall be new, unused and of the best quality and workmanship. The Electrical Subcontractor shall cooperate with the Architect so that no error or discrepancy in the Contract Documents shall cause defective materials to be used or poor workmanship to be performed.

1.9 COORDINATION OF WORK

- A. The Electrical Subcontractor shall compare his drawings and specifications with those of other Trades as well as the Architectural drawings and specifications, and report any discrepancies between them to the Architect and obtain from the Architect written instructions for changes necessary in the electrical work.
- B. Coordinate work with that of all other Trades affecting or affected by the work of this Section. Cooperate with such Trades to assure the steady progress of all work under the Contract.
- C. All work shall be installed in cooperation with other Trades installing interrelated work. Before installation, Electrical Subcontractor shall make proper provisions to avoid interferences in a manner approved by the Architect. All changes required in the work of the Electrical Subcontractor or that of any other trade caused by the Electrical Subcontractor's neglect, shall be made by him at his own expense, to the Architect's satisfaction.
- D. The Electrical Subcontractor must include in his bid sufficient dollar amounts to coordinate the work of this Contract. This project is complex and will require additional time to coordinate all Trades and allow implementation of the Owners Standards and maintenance serviceability requirements. This requirement shall include, but not be limited to, producing the coordination drawings, as many times and as many drawings as required, to ensure serviceability of equipment, as approved by the Architect.

- E. Locations of conduits, boxes distribution equipment, systems, etc. shall be adjusted to accommodate the work with interferences anticipated and encountered. The Electrical Subcontractor shall determine the exact routing and location of his systems prior to fabrication or installation of any system component. Accurate measurements and coordination drawings shall be completed to verify dimensions and characteristics of the various systems installations.
- F. Lines which pitch shall have the right-of-way over those which do not pitch. For example, steam piping shall normally have the right-of-way. Lines whose elevations cannot be changed shall have the right-of-way over lines whose elevations can be changed.
- G. Offsets, transitions and changes of direction in all systems shall be made as required to maintain proper headroom and pitch of sloping lines whether or not indicated on the drawings. The Electrical Subcontractor shall provide elbows, conduit bends, "LB" fittings, offsets in busway, etc. as required for his work to affect these offsets, transitions and changes in direction.
- H. All work shall be installed in a way to permit removal (without damage to other parts) of pull and junction box covers, wiring, lighting fixtures, and all other system components provided under this Contract requiring periodic replacement or maintenance. All pull and junction boxes shall be arranged in a manner to clear the openings of swinging overhead access doors as well as ceiling tiles. All work shall be done to allow easy access for maintaining equipment. The Owner and Engineer will require proof via the preparation of large scale sections and part plans that pull and junction boxes, etc. are accessible after the work is completed. Any items in the field discovered to be in non-compliance shall be removed and relocated, as required, and as directed by the Architect.
- I. The Contract Drawings are diagrammatic only intending to show general runs and locations of conduits, distribution equipment, lighting fixtures, systems equipment, etc. and not necessarily showing all required offsets, details and accessories and equipment to be connected. All work shall be accurately laid out with other Trades to avoid conflicts and to obtain a neat and workmanlike installation which will afford maximum accessibility for operation, maintenance and headroom.
- J. Where discrepancies in scope of work as to what Trade provides items, such as starters, disconnects, flow switches, etc., exist, such conflicts shall be reported to the Architect during bidding and prior to signing of the Contract. If such action is not taken, the Electrical Subcontractor shall furnish such items as part of his work as necessary, for complete and operable systems and equipment, as determined by the Architect.
- K. The Electrical Subcontractor shall coordinate the installation of all equipment.
- L. Where drawing details, plans, specification requirements and/or scheduled equipment capacities are in conflict and where feeders, branch circuits or equipment are shown to be different between plans and/or between plans and riser diagrams, details or specifications, the most stringent requirement will be included in the Contract. Electrical systems and equipment called for in the specification and/or shown on the drawings shall be provided under this Contract as if it were required by both the drawings and specifications. However, prior to ordering or installation of any portion of work which appears to be in conflict, such work shall be brought to Architect's attention for direction as to what is to be provided.
- M. Final location of all CCTV cameras, smoke detectors, exit signs, switches, receptacles, fire alarm devices, etc., shall be coordinated with the Architectural reflected ceiling plans, architectural elevations, and/or other Architectural details, as applicable and shall not be scaled from locations indicated on the electrical drawings. Obtain approval of locations of all devices from Architect in the field. The Owner/Architect reserves the right to relocate any receptacle, device, lighting fixture, etc. 10'-0" in any direction prior to installation at no additional cost to the Project.
- N. Any equipment shown on the Electrical and/or Architectural drawings to be provided with services, shall be included under this Contract as applicable, including all conduit and wiring connections to systems, to

make equipment complete and operable. Additional wiring, equipment, etc., shall be provided to accomplish the above requirement, as required, all as part of this Contract, at no extra cost to the Owner. This requirement necessitates that the Electrical Subcontractor review the Architectural drawings and the drawings of other Trades during bidding to ascertain the extent of all requirements, and interface between the Trades and scope of work.

- O. The Electrical Subcontractor shall coordinate his work with other Trades' work so that all equipment and systems can be easily, safely and properly serviced and maintained. It is imperative that service personnel can safely access all equipment. Provide safety rails, steps, ladders, valve chains, handle extensions, etc. as required, in addition to the ones shown on the drawings, to ensure safe and easy access to all equipment is provided in a manner approved by the Architect.

1.10 GIVING INFORMATION

- A. Electrical Subcontractor shall keep himself fully informed as to the shape, size and position of all openings required for his apparatus and shall give information to the General Contractor and other Subcontractors sufficiently in advance of the work so that all openings may be built in advance.

1.11 EQUIPMENT AND MATERIALS

- A. Equipment and materials shall be delivered to the site and stored in original sealed containers, suitably sheltered from the elements, but readily accessible for inspection by the Architect until installed. All items subject to moisture damage such as controls shall be stored in dry, heated spaces. Equipment such as switchgear with heater elements installed shall have the heater elements energized after the equipment is received by the Electrical Subcontractor.
- B. Equipment shall be tightly covered and protected against dirt, water, and chemical or mechanical injury and theft. At the completion of the work, equipment and materials shall be cleaned and polished thoroughly and turned over to the Owner in a condition satisfactory to the Architect. Damage or defects that develop before acceptance of the work shall be made good at the Electrical Subcontractor's expense.
- C. The Electrical Subcontractor shall make necessary field measurements to ascertain space requirements, for equipment and connections to be provided under his respective Trade and shall furnish and install such sizes and shapes of equipment to allow for the final installation to conform to the drawings and specifications.
- D. Manufacturer's directions shall be followed completely in the delivery, storage, protection and installation. Promptly notify the Architect in writing of any conflict between any requirements of the Contract Documents and the manufacturer's directions. Obtain the Architect's written instructions before proceeding with the work. Should Electrical Subcontractor perform any work that does not comply with the manufacturer's directions or written instructions from the Architect, he shall bear all costs arising in correcting any deficiencies that should arise.
- E. All equipment of one type (such as CCTV cameras, cable, wiring devices, fire alarm system, etc.) shall be the products of one manufacturer.
- F. Equipment prepurchased by the General Contractor on behalf of the Owner or by the Owner himself, if assigned to the Electrical Subcontractor, shall be received, installed, tested, etc., as if the equipment was purchased by the Electrical Subcontractor. All guarantees, service contracts, etc., shall be the same as for all other equipment provided under this Contract.

1.12 USE OF PREMISES

- A. The Electrical Subcontractor shall confine all apparatus, storage of materials and construction to the limits as directed by the Architect and he shall not encumber the premises with his materials. The Electrical Subcontractor shall be held responsible for repairs, patching, or cleaning arising from any unauthorized use of premises.
- B. Notwithstanding any approvals or instructions which must be obtained by the Electrical Subcontractor from the Architect in connection with the use of the premises, the responsibility for the safe working conditions at the site shall remain that of the Electrical Subcontractor. The Architect, Engineer or Owner shall not be deemed to have any responsibility or liability in connection with safe working conditions at the site.

1.13 PROTECTION

- A. Materials, conduit, lighting fixtures, switchgear, etc., shall be properly protected during construction and all conduit openings shall be temporarily closed so as to prevent obstruction and damage. Post notice prohibiting the use of all systems provided under the Electrical Contract, prior to completion of work and acceptance of all systems by the Owner except as otherwise, instructed by Architect. Take precautions to protect all materials furnished from damage and theft.
- B. The Electrical Subcontractor shall furnish, place and maintain proper safety guards for the prevention of accidents that might be caused by the workmanship, materials, equipment or electrical systems provided under his Contract.

1.14 DAMAGE TO OTHER WORK

- A. The Electrical Subcontractor shall be held responsible and shall pay for all damages caused by his work to the building structures, equipment, conduits, systems, etc., and all work and finishes installed under this Contract. Repair of such damage shall be done by the General Contractor at the expense of the Electrical Subcontractor, to the Architect's satisfaction.

1.15 CORRECTION OF WORK

- A. The Electrical Subcontractor shall promptly correct all work provided under his Contract and rejected by the Architect as defective or as failing to conform to the Contract Documents, whether observed before or after completion of work, and whether or not fabricated, installed or completed.

1.16 EXTRA WORK

- A. No claim for extra work will be allowed unless it is authorized by the Architect before commencement of the extra said work.

1.17 TOUCH-UP PAINTING

- A. All equipment and systems shall be thoroughly cleaned of rust, splatters and other foreign matter of discoloration leaving every part of all systems in an acceptable prime condition. The Electrical Subcontractor for the work under his Contract shall refinish and restore to the original condition all

equipment which has sustained damage to the manufacturer's prime and finish coats of paint and/or enamel during the course of construction, regardless of the source of damage.

1.18 PARTS LIST AND INSTRUCTIONS FOR OPERATION AND MAINTENANCE

- A. The Electrical Subcontractor shall thoroughly instruct the Owner, to the complete satisfaction of the Architect, in the proper operation of all systems and equipment provided by him. The Electrical Subcontractor shall make arrangements, via the Architect, as to whom the instructions are to be given in the operation of the basic and auxiliary systems and the period of time in which they are to be given. The Architect shall be completely satisfied that the Owner has been thoroughly and completely instructed in the proper operation of all systems and equipment before final payment is made. If the Architect determines that complete and thorough instructions have not been given by the Electrical Subcontractor to the Owner's representative, then the Electrical Subcontractor shall be directed by the Architect to provide whatever instructions are necessary until the intent of this specification has been complied with.
- B. Electrical Subcontractor shall submit to the Architect for approval, the required typed sets (see General Conditions and Division 1) bound neatly in loose-leaf binders, of all instructions for the installation, operation, emergency operation, start-up, care and maintenance of all equipment and systems (including instructions for the ordering and stocking of spare parts for all equipment installed under this Contract). The lists shall include part numbers and suggested supplier. Each set shall also include an itemized list of component parts that should be kept on hand and where such parts can be purchased.
- C. Information shall indicate possible problems with equipment and suggested corrective action. The manuals shall be indexed for each type of equipment. Each section shall be clearly divided from the other sections. A sub-index for each section shall also be provided. The methodology of setting-up the manuals shall be submitted to the Architect and Owner for review prior to final submission of manuals.

1.19 MANUFACTURER'S REPRESENTATIVE

- A. The Electrical Subcontractor shall provide, at the appropriate time or as directed by Architect, the on-site services of a competent factory trained Engineer of the manufacturer of specific equipment, such as the fire alarm system, CCTV camera system, etc., to inspect, test, adjust and place in proper operating condition any and all items of the same manufacturer. No additional compensation will be allowed for such services. A written report shall be issued by the particular manufacturer with his findings for the Architect's record.

1.20 COORDINATION DRAWINGS

- A. Before materials are purchased, fabricated or work is begun, each Subcontractor shall prepare and obtain approval of coordination drawings, and sections for all floors/areas, including buried system/services, resulting in one (1) set of all-Trade-composite at 3/8" scale drawings, showing the size and location of all equipment, in the manner described hereinunder General Requirements. Architects review and approval of coordination drawings must be obtained prior to any fabrication or installation of any equipment or systems.
- B. The coordination drawings shall be generated from a computer CAD program compatible with AutoCAD Release 2000, in DWG or DXF format. The HVAC Subcontractor shall take the lead, supervise, and coordinate production of coordinated layout drawings, to show and coordinate all equipment. These drawings shall then be circulated to the Electrical Subcontractor so that he can indicate all his work as directed by the General Contractor and Architect and as required, to result in a fully coordinated installation.

- C. The Electrical Subcontractor shall indicate all electrical equipment and conduit provided by him or his Sub-subcontractors on the coordination drawings. This equipment and conduit shall include, but not be limited to, the following:
 - 1. Conduit routing and rack locations for all conduits regardless of conduit size when more than 4 conduits are grouped in a rack.
 - 2. All pull and splice boxes over 8" in any direction.
 - 3. MC cable routing and rack locations for all MC cable when more than 4 runs are grouped in a rack.
 - 4. Smoke detector locations relative to supply and return grilles.
- D. All costs associated with all aspects of coordination drawings, regardless as to how long they take to produce and how many times they have to be redrawn, shall be borne by the Electrical Subcontractor.
- E. The Electrical Subcontractor may purchase the electrical AutoCAD computer drawing files from the Electrical Contract set on disk or via modem from the Engineer at the nominal cost of \$500.00, if he so chooses.
- F. The Electrical Subcontractor shall issue to the HVAC Subcontractor, via diskette, a complete set of equipment installation layout documents in AutoCAD Release 2000 (DWG or DXF) format, for use in developing the required coordination drawings.
- G. The Electrical Subcontractor shall be responsible for coordinating the Electrical AutoCAD coordination drawings, including, but not limited to, the drawing lists, layering system, producing copies of the drawings for the Architect as directed, etc.

1.21 RECORD DRAWINGS/AS-BUILT DRAWINGS

- A. The Electrical Subcontractor shall maintain current at the site a set of his drawings on which he shall accurately show the actual installation of all work provided under his Contract indicating hereon any variation from the Contract Drawings, in accordance with the General Conditions and Division 1. Changes, whether resulting from formal change orders or other instructions issued by the Architect, shall be recorded. Include changes in sizes, location, and dimensions of conduit, switchgear, lighting fixtures, fire alarm equipment, wiring devices, etc.
- B. The Electrical Subcontractor shall indicate progress by coloring-in various conduits, equipment and associated appurtenances exactly as they are erected. This process shall incorporate both the changes noted above and all other deviations from the original drawings whether resulting from job conditions encountered or from any other causes.
- C. The marked-up and colored-up prints will be used as a guide for determining the progress of the work installed. They shall be inspected periodically by the Architect and Owner and they shall be corrected immediately if found either inaccurate or incomplete. This procedure is mandatory.
- D. At the completion of the job, these prints shall be submitted to the General Contractor and then to the Architect for final review and comment. The prints will be returned with appropriate comments and recommendations. These corrected prints, together with corrected prints indicating all the revisions, additions and deletions of work, shall form the basis for preparing a set of As-built Record Drawings.
- E. The Subcontractor shall be responsible for generating as-built Record Drawings utilizing CAD based documents in AutoCAD Release 2000 DWG or DXF format. A bound set of plans, as well as the computer files, on disk, shall be turned over to the Architect for review. After acceptance of the as-built documents by the Architect, the Electrical Subcontractor shall make any corrections necessary to the

as-built documents and prepare one reproducible set of drawings as well as bound blueprint set(s) (quantity as determined by the Architect) for distribution to the Owner via the Architect.

- F. The Electrical Subcontractor may use the computer drawing files used for coordination drawings or purchase the Engineers most recently updated computer drawing files at a nominal charge of \$500.00 per drawing file. The updated drawings may not include all changes made during the course of construction and it shall be the Electrical Subcontractors responsibility to update the as-built documents to include all changes brought forth to the project resulting from bulletins, request for information (RFI's), change orders, etc. The Electrical Subcontractor may review the Engineers latest computer files for completeness prior to purchase, however the Engineer will not be responsible for updating the computer files.
- G. Included with the above shall be a complete drawing list and a standard layering system, which shall be required to be maintained within the as-built Record CAD documents.
- H. The Subcontractor shall be issued bulletins in the same manner as the original Design Documents described above.
- I. The as-built CAD documents required shall be in addition to other requirements stated elsewhere.

1.22 SUBMITTALS

- A. Prepare and submit shop drawings in accordance with the requirements hereinbefore specified, and with Division 1 Section "Submittal Procedures" in the manner described therein, modified as noted hereinafter.
- B. The selection and intention to use a product specified by name shall not excuse the need for timely submission of shop drawings for that product.
- C. Prior to submitting shop drawings, submit for review preliminary list of intended or proposed manufacturers for all items for which shop drawings are required.
- D. Submission of shop drawings of an unnamed manufacture or shop drawings at variance with the Contract Documents is not a proper request for substitution.
- E. Samples that are submitted in lieu of shop drawings shall be clearly identified and shall be submitted in duplicate. Only one sample will be returned and that accepted sample shall be kept available at appropriate job site office. Accepted sample retained by Architect will be kept available at Architect's home office.
- F. Upon completion of shop drawing review, shop drawings will be returned, marked with one of following notations: No Exception Taken, Revise as Noted, Revise and Resubmit, or Rejected. Only products whose shop drawings are marked "No Exception Taken" or "Revise as Noted" shall be used on the project.
- G. Submittals shall include the following information:
 - 1. Descriptive and product data necessary to verify compliance with Contract Documents.
 - 2. Manufacturer's specifications including materials of construction, metal gauge, thickness and finish.
 - 3. Certified dimensional drawings including clearances required for maintenance or access.
 - 4. Performance data, ratings, operating characteristics, and operating limits.
 - 5. Electrical ratings and characteristics.
 - 6. Wiring and control diagrams, where applicable.
 - 7. Certifications requested, including UL label or listing.

8. List of accessories, which are required but are not being provided by the product manufacturer or are not being furnished under this Section. Identify the Section(s) under which the accessories are being furnished.
- H. In addition, submittals shall be clearly marked for the following:
1. Specification Section and Paragraph, or Drawing Schedule/Note/Detail/etc., where equipment is specified.
 2. Equipment or fixture identification corresponding to that used in Contract Documents.
 3. Accessories and special or non-standard features and materials which are being furnished.
- I. The following is a list of electrical items that must be submitted for review:
1. Service and Metering Equipment
 2. Panelboards
 3. Interior light fixtures
 4. Exterior light fixtures
 5. Lighting control devices
 6. Network lighting controls
 7. Safety/disconnect switches
 8. Circuit breakers
 9. Raceways, wire and cable
 10. Fire alarm equipment
 11. Devices (receptacles, toggle switches, etc.)

1.23 INTENT

- A. It is the intent of the Contract Documents to require finished work, tested and ready for operation.
- B. It is not intended that Contract Documents show every pipe, wire, conduit, fitting and appurtenance; however, such parts as may be necessary to complete the systems in accordance with best trade practice and Code requirements and to Architect's satisfaction shall be deemed to be included.
- C. Drawings are diagrammatic and indicate the general arrangement of systems and work included in the Contract. DO NOT SCALE THE DRAWINGS.

1.24 PRODUCT SELECTION

- A. Contractor's options for selecting products are limited by Contract Document requirements and governing regulations and are not controlled by industry traditions or procedures experienced by Contractor on previous construction projects. Required procedures include, but are not necessarily limited to, following various methods of specifying:
 1. Single Product Manufacturer Named: Provide product indicated. Advise Architect, and obtain instructions before proceeding, when named product is known to be unacceptable or not feasible.
 2. Two or More Manufacturers' Products Named: Provide one of the named products, at Contractor's option, but excluding products which do not comply with requirements. Do not provide, nor offer to provide, an unnamed product unless named products do not comply with requirements or are not feasible.
 3. "Acceptable Equivalent" or "Or Equal": Where named products are accompanied by this term or words of similar effect, provide named products or propose substitute product according to paragraph 1.25, SUBSTITUTIONS.

4. Standards, Codes and Regulations: Where specification requires only compliance with a standard, code or regulation, Contractor may select any product which complies with requirements of that standard, code or regulation.
5. Performance Requirements: Provide products which comply with specific performances indicated and which are recommended by manufacturer (in published product literature or by individual certification) for application intended. Overall performance of product is implied where product is specified with only certain specific performance requirements.
6. Prescriptive Requirements: Provide products which have been produced in accordance with prescriptive requirements using specified materials and components, and complying with specified requirements for fabricating, finishing, testing and other manufacturing processes.
7. Visual Matching: Where matching with an established material is required, Architect's judgment of whether proposed product matches established material shall be final. Where product specified does NOT match established material, propose substitute product according to paragraph 1.25, SUBSTITUTIONS. Follow requirements for CHANGE ORDERS, also, if matching product within cost category of specified product is not available.
8. "Color as Selected by Architect": Unless otherwise noted, where specified product requirements include "Color as Selected by Architect" or words of similar effect, the selection of manufacturer and basic product complying with Contract Documents is Contractor's option and subsequent selection of color is Architect's option.

- B. Inclusion by name, of more than one manufacturer or fabricator, does not necessarily imply acceptability of standard products of those named. All manufacturers, named or proposed, shall conform, with modification as necessary, to criteria established by contract documents for performance, efficiency, materials and special accessories.

1.25 SUBSTITUTIONS

- A. Contractor shall pay Architect/Engineer for time spent reviewing substitution requests. Charges shall be \$120/hour. Submittal of substitution request will be construed as evidence of Contractor's agreement to pay such charges, with no added cost to Owner.
- B. Contractor's request for substitution may be submitted only after award of Contract. Requests shall be in writing on Contractor's letterhead and shall include:
1. Contractor's detailed comparison of significant qualities between specified item and proposed substitution.
 2. Statement of effect on construction time, coordination with other affected work, and cost information or proposal.
 3. Contractor's statement to the effect that proposed substitution will result in overall work equal to, or better than, work originally intended.
- C. Substitution requests will be considered: If extensive revisions to Contract Documents are not required; if changes are in keeping with general intent of Contract Documents; if submitted in timely and proper manner, fully documented; and if one or more of following conditions is satisfied; all as judged by Architect:
1. Where request is directly related to "acceptable equivalent" clause, "or equal" clause or words of similar effect in Contract Documents.
 2. Where specified product, material or method cannot be provided within Contract Time; but not as a result of Contractor's failure to pursue the work promptly or to coordinate various activities properly.
 3. Where specified product, material or method can not be provided in manner which is compatible with other materials of the work and where Contractor certifies that proposed substitution is compatible.

4. Where specified product, material or method can not be properly coordinated with other materials of the work and where Contractor certifies that proposed substitution can be properly coordinated.
 5. Where specified product, material or method cannot be warranted as required and where Contractor certifies that proposed substitution can be so warranted.
 6. Where specified product, material or method can not be used without adversely affecting Owner's insurance coverage on completed work and where Contractor certifies that proposed substitution can be so used.
 7. Where specified product, material or method will encounter other substantial non-compliance, which are not possible to otherwise overcome except by using proposed substitution.
 8. Where specified product, material or method cannot receive required approval by governing authority and proposed substitution can be so approved.
 9. Where substantial advantage is offered to the Owner; in terms of cost, time, energy conservation or other valuable considerations; after deducting offsetting responsibilities that Owner may be required to bear, including additional compensation to Architect for redesign and evaluation services, increased cost of other work by Owner or separate contractors, and similar considerations.
- D. The burden is upon the Contractor, supplier and manufacturer to satisfy Architect that:
1. Proposed substitute is equal to, or superior to, the item specified.
 2. Intent of the Contract Documents, including required performance, capacity, efficiency, quality, durability, safety, function, appearance, space clearances and delivery date, will be equaled or bettered.
- E. Submission of shop drawings of unspecified manufacturer or shop drawings at variance with the Contract Documents is not a proper request for substitution.
- F. Changes in work of other trades, such as structural supports, which are required as a result of substitution and the associated costs for such changes, shall be the complete responsibility of Contractor proposing substitution. Except as noted in subparagraph 1.25.C.9 above, there shall be no additional expense to the Owner.
- 1.26 SAMPLES
- A. Submit samples as requested by Architect.
- 1.27 EQUIPMENT AND BRANCH CIRCUITING DESIGN CRITERIA
- A. Receptacle Branch Circuit Criteria:
1. Convenience receptacles for general use, such as Classrooms, Gross Motor areas, Lobbies, etc., will have a maximum of six (6) duplex receptacles per 20 ampere, single-pole circuit.
 2. All duplex and special purpose receptacles indicated for specific equipment will be on a dedicated circuit.
- B. Motors:
1. All motors 1/8 HP and under shall be maximum wired three (3) per 20 ampere, single-pole circuit, 120 volt.
 2. All motors above 1/8 HP shall be served from an individual branch circuit.
 3. Refer to HVAC and Plumbing drawings for location and ratings of motors.
 4. All motors 1 HP and above shall be 208 volt, 3 phase and be on individual circuits.

- C. Telephone/Data Outlets:
 - 1. Telephone/data outlets shall be provided as indicated on plans.

PART 2 - PRODUCTS

2.1 GENERAL PRODUCT REQUIREMENTS

- A. Products shall be undamaged and unused at time of installation and shall be complete with accessories, trim, finish, safety guards and other devices and details needed for complete installation and for intended use.
- B. Where available, products shall be standard products of types which have been produced and used previously and successfully on other projects and in similar applications.
- C. Where products by their nature and their use are likely to need replacement parts on future date, for maintenance and repair or replacement work, products shall be standard domestically produced products likely to have such parts available to Owner in future.
- D. Labels and stamps which are required for observation after installation shall be located on accessible surfaces which, in occupied spaces, are not conspicuous. Other labels and stamps shall be located on concealed surfaces.

PART 3 - EXECUTION

3.1 COOPERATION AND WORK PROGRESS

- A. The Electrical work shall be carried on under the usual construction conditions, in conjunction with all other work at the site. The Electrical Subcontractor shall cooperate with the Architect, General Contractor, all other Subcontractors and equipment suppliers working at the site. The Electrical Subcontractor shall coordinate the work and proceed in a manner so as not to delay the progress of the project.
- B. The Electrical Subcontractor shall coordinate his work with the progress of the building and other Trades so that he will complete his work as soon as conditions permit and such that interruptions of the building functions will be at a minimum. Any overtime hours worked or additional costs incurred due to lack of or improper coordination with other Trades or the Owner by the Electrical Subcontractor, shall be assumed by him without any additional cost to the Owner.
- C. The Electrical Subcontractor shall furnish information on all equipment that is furnished under this Section but installed under another Section to the installing Subcontractor as specified herein.
- D. The Electrical Subcontractor shall provide all materials, equipment and workmanship to provide for adequate protection of all electrical equipment during the course of construction of the project. This shall also include protection from moisture and all foreign matter. The Electrical Subcontractor shall also be responsible for damage which he causes to the work of other Trades, and he shall remedy such injury at his own expense.
- E. Waste materials shall be removed promptly from the premises. All material and equipment stored on the premises shall be kept in a neat and orderly fashion. Material or equipment shall not be stored where

exposed to the weather. The Electrical Subcontractor shall be responsible for the security, safekeeping and damages, including acts of vandalism, of all material and equipment stored at the job site.

- F. The Electrical Subcontractor shall be responsible for unloading all electrical equipment and materials delivered to the site. This shall also include all large and heavy items or equipment which require hoisting. Consult with the General Contractor for hoisting/crane requirements. During construction of the building, the Electrical Subcontractor shall provide additional protection against moisture, dust accumulation and physical damage of the main service and distribution equipment. This shall include furnishing and installing temporary heaters within these units, as approved, to evaporate excessive moisture and ventilate it from the room, as may be required.
- G. It shall be the responsibility of the Electrical Subcontractor to coordinate the delivery of the electrical equipment to the project prior to the time installation of equipment will be required; but he shall also make sure such equipment is not delivered too far in advance of such required installation, to ensure that possible damage and deterioration of such equipment will not occur. Such equipment stored for an excessively long period of time (as determined in the opinion of the Architect) on the project site prior to installation may be subject to rejection by the Architect.
- H. The Electrical Subcontractor shall erect and maintain, at all times, necessary safeguards for the protection of life and property of the Owner, Workmen, Staff and the Public.
- I. Prior to installation, the Electrical Subcontractor has the responsibility to coordinate the exact mounting arrangement and location of electrical equipment to allow proper space requirements as indicated in the NEC. Particular attention shall be given in the field to group installations. If it is questionable that sufficient space, conflict with the work of other Subcontractors, architectural or structural obstructions will result in an arrangement which will prevent proper access, operation or maintenance of the indicated equipment, the Electrical Subcontractor shall immediately notify the Contractor and not proceed with this part of the Contract work until definite instructions have been given to him by the Architect.
- J. The Electrical Subcontractor shall not allow any equipment or piping foreign to the electrical installation to be installed or pass through any room in which electrical systems or equipment are located, such as electric rooms, electric closets, telephone or data closets. The Electrical Subcontractor shall notify the Contractor of such violations and request immediate removal.
- K. The Electrical Subcontractor shall obtain from the Plumbing and HVAC Subcontractors copies of all shop drawing prints showing the ductwork and piping installation as they will be put in place on the project. These drawings shall be thoroughly checked by the Electrical Subcontractor and the routing of all conduits and installation of all outlets and electrical equipment shall be coordinated with the ductwork and piping so as to prevent any installation conflict. Such coordination shall be done prior to roughing in conduits, outlets and electrical equipment.
- L. Location of all wall outlets shall be verified with the Architect prior to roughing in conduits. Refer to details and wall elevations on the Architectural drawings. Mounting heights indicated on these drawings and/or specific dimensional information given to the Electrical Subcontractor by the Architect shall take precedence over such information indicated on the Electrical drawings.
- M. Refer to all other drawings associated with this project. Any and all equipment which require an electrical supply circuit, switch, controls or connections, whether indicated on the Electrical drawings or not, shall be furnished and installed as directed by the Architect. Locations of lighting fixtures shall conform to the Architectural reflected ceiling plans.
- N. Refer to the Architectural drawings for areas in which the concrete slab is poured on grade. In these areas a waterproofing membrane will be installed on the grade fill or earth prior to pouring of slab. Electrical conduits shall be installed to avoid the necessity of penetrating this waterproofing membrane. Penetration

of the membrane, if required, shall only be made when specifically allowed by the Architect, and shall be made only at locations directed by the Architect.

3.2 INSTALLATION

A. General:

1. Unless specifically noted or indicated otherwise, all equipment and material specified in Division 26 of this specification or indicated on the drawings shall be installed under this Contract whether or not specifically itemized herein. This Section covers particular installation methods and requirements peculiar to certain items and classes or material and equipment.
2. The Electrical Subcontractor shall obtain detailed information from manufacturers of equipment as to proper methods of installation.
3. The Electrical Subcontractor shall obtain final roughing dimensions and other information as needed for complete installation of items furnished under other Sections or furnished by the Owner.
4. The Electrical Subcontractor shall keep fully informed of size, shape and position of openings required for material and equipment provided under this and other Sections. Ensure that openings required for work of this Section are coordinated with work of other Sections. Provide cutting and patching as necessary.
5. All miscellaneous hardware and support accessories, including support rods, nuts, bolts, screws and other such items, shall be of a galvanized or cadmium plated finish or of another approved rust-inhibiting coating.
6. Throughout this Section where reference is made to steel channel supports, it shall be understood to mean that the minimum size shall be 1 5/8" mild strip steel with minimum wall thickness of 0.105", similar to Unistrut P1000 or equal products manufactured by Kindorf or Husky Products Co.

3.3 MATERIALS AND WORKMANSHIP

- A. All materials and equipment shall be new and unused and shall meet requirements of the latest Standards of NEMA, UL, IPCEA, ANSI and IEEE. Equipment shall have components required or recommended by OSHA, applicable NFPA documents and shall be UL listed and labeled.
- B. Despite references in the specifications or on the drawings to materials or pieces of equipment by name, make or catalog number, such references shall be interpreted as establishing standards of quality for materials and performance.
- C. Finish of materials, components and equipment shall not be less than Industry good practice. When material or equipment is visible or subject to corrosive or atmospheric conditions, the finish shall be as approved by the Architect.
- D. Provide proper access to material or equipment that requires inspection, replacement, repair or service. If proper access cannot be provided, confer with the Architect as to the best method of approach to minimize effects of reduced access.
- E. All work shall be installed in a neat and workmanlike manner and shall be done in accordance with all Local and State Codes.
- F. The Owner will not be responsible for material, equipment or the installation of same before testing and acceptance.

3.4 CLEANING

- A. This Section of the specifications shall include the cleaning of all equipment on a day-to-day basis and final cleaning of all electrical equipment prior to turning building over to the Owner. All necessary cleaning referred to herein shall be cleaned to the satisfaction of the Architect.
- B. Electrical Distribution Equipment:
1. All electrical distribution equipment shall be completely cleaned and dried inside and out prior to initial energizing.
 2. Cleaning shall consist of vacuuming all busses, windings, enclosures (inside and out), etc. After vacuuming is complete, all equipment shall be wiped down. If equipment is wet or contains moisture, it shall be thoroughly dried and inspected by the manufacturer's representative before energizing.
- C. Raceways and Junction Boxes:
1. All raceways and junction boxes shall be blown out and dried prior to installation of feeder conductors and branch circuit conductors.
- D. Electric and Telephone Rooms:
1. Upon completion of cleaning electrical equipment as described in Paragraph B. above, but before energizing equipment, the entire room shall be swept clean and material storage and garbage shall be removed from the room. At this time, equipment may be energized.
 2. Once equipment and room are cleaned and energized, the area shall remain clean and doors shall remain closed and locked until completion of job. Electric rooms shall not be used to store material after equipment is energized. If rooms and equipment are subject to dust and moisture after energizing equipment, the equipment shall be de-energized and recleaned to the same specifications.
- E. Final Cleaning:
1. All lighting fixtures, devices, device plates, etc., shall be cleaned and left in "like new" condition to the satisfaction of the Architect, prior to occupancy.
 2. All rubbish and discarded materials shall be disposed of and removed from the site on a day-to-day basis.
 3. All equipment, whether part of the Electrical Subcontractor's Contract or not, which must be cleaned due to the Electrical Subcontractor's work, shall be cleaned by the Electrical Subcontractor to the satisfaction of the Architect.

3.5 FINAL INSPECTION

- A. When all Electrical work on the project has been completed and is ready for final inspection, such an inspection shall be made. At this time, and in addition to all other requirements in the Contract Documents, the Electrical Subcontractor, for the work under this Contract, shall demonstrate that the requirements of these specifications have been met to the Architect's satisfaction.

END OF SECTION 260100

SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Copper building wire rated 600 V or less.
 - 2. Metal-clad cable, Type MC, rated 600 V or less.
 - 3. Connectors, splices, and terminations rated 600 V and less.
- B. Related Requirements:
 - 1. Section 260523 "Control-Voltage Electrical Power Cables" for control systems communications cables and Classes 1, 2, and 3 control cables.

1.3 DEFINITIONS

- A. RoHS: Restriction of Hazardous Substances.

1.4 ACTION SUBMITTALS

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

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing agency.
- B. Field quality-control reports.

1.6 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Member company of NETA.
 - 1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

PART 2 - PRODUCTS

2.1 COPPER BUILDING WIRE

- A. Description: Flexible, insulated and uninsulated, drawn copper current-carrying conductor with an overall insulation layer or jacket, or both, rated 600 V or less.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Belden Inc.
 - 2. Encore Wire Corporation.
 - 3. General Cable Technologies Corporation.
 - 4. Service Wire Co.
 - 5. Southwire Company.
- C. Standards:
 - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
 - 2. RoHS compliant.
 - 3. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."
- D. Conductors: Copper, complying with ASTM B 3 for bare annealed copper and with ASTM B 8 for stranded conductors.
- E. Conductor Insulation:
 - 1. Type NM: Comply with UL 83 and UL 719.
 - 2. Type THHN and Type THWN-2: Comply with UL 83.

2.2 METAL-CLAD CABLE, TYPE MC.

- A. Description: A factory assembly of one or more current-carrying insulated conductors in an overall metallic sheath.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Belden Inc.
 - 2. Encore Wire Corporation.
 - 3. Encore Wire Corporation.
 - 4. General Cable Technologies Corporation.
 - 5. Southwire Company.
- C. Standards:
 - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
 - 2. Comply with UL 1569.
 - 3. RoHS compliant.
 - 4. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."
- D. Circuits:
 - 1. Single circuit and multicircuit with color-coded conductors.
 - 2. Power-Limited Fire-Alarm Circuits: Comply with UL 1424.

- E. Conductors: Copper, complying with ASTM B 3 for bare annealed copper and with ASTM B 8 for stranded conductors.
- F. Ground Conductor: Insulated.
- G. Conductor Insulation:
 - 1. Type TFN/THHN/THWN-2: Comply with UL 83.
- H. Armor: Steel, interlocked.

2.3 CONNECTORS AND SPLICES

- A. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated; listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. AFC Cable Systems; a part of Atkore International.
 - 2. Hubbell Power Systems, Inc.
 - 3. Ideal Industries, Inc.
 - 4. O-Z/Gedney; a brand of Emerson Industrial Automation.
 - 5. Thomas & Betts Corporation; A Member of the ABB Group.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

- A. Feeders: Copper; solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
- B. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
- C. Power-Limited Fire Alarm and Control: Solid for No. 12 AWG and smaller.

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 or Metal-clad cable, Type MC with ground wire, Nonmetallic-sheathed cable, Type NM.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

- A. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.

- B. Complete raceway installation between conductor and cable termination points according to Section 260533 "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables.
- C. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
- D. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
- E. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.
- F. Support cables according to Section 260529 "Hangers and Supports for Electrical Systems."

3.4 CONNECTIONS

- A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.
- B. Make splices, terminations, and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
 - 1. Use oxide inhibitor in each splice, termination, and tap for aluminum conductors.
- C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches of slack.

3.5 IDENTIFICATION

- A. Identify and color-code conductors and cables according to Section 260553 "Identification for Electrical Systems."
- B. Identify each spare conductor at each end with identity number and location of other end of conductor, and identify as spare conductor.

3.6 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. 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 tests and inspections with the assistance of a factory-authorized service representative.
 - 1. After installing conductors and cables and before electrical circuitry has been energized, test conductors feeding the following critical equipment and services for compliance with requirements:

- a. Panelboards
 2. Perform each of the following visual and electrical tests:
 - a. Inspect exposed sections of conductor and cable for physical damage and correct connection according to the single-line diagram.
 - b. Test bolted connections for high resistance using one of the following:
 - 1) A low-resistance ohmmeter.
 - 2) Calibrated torque wrench.
 - 3) Thermographic survey.
 - c. Inspect compression-applied connectors for correct cable match and indentation.
 - d. Inspect for correct identification.
 - e. Inspect cable jacket and condition.
 - f. Insulation-resistance test on each conductor for ground and adjacent conductors. Apply a potential of 500-V dc for 300-V rated cable and 1000-V dc for 600-V rated cable for a one-minute duration.
 - g. Continuity test on each conductor and cable.
 - h. Uniform resistance of parallel conductors.
 3. Initial Infrared Scanning: After Substantial Completion, but before Final Acceptance, perform an infrared scan of each splice in conductors No. 3 AWG and larger. Remove box and equipment covers so splices are accessible to portable scanner. Correct deficiencies determined during the scan.
 - a. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
 - b. Record of Infrared Scanning: Prepare a certified report that identifies switches checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.
 4. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each switch 11 months after date of Substantial Completion.
- B. Cables will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports to record the following:
1. Procedures used.
 2. Results that comply with requirements.
 3. Results that do not comply with requirements, and corrective action taken to achieve compliance with requirements.

END OF SECTION 260519

SECTION 260523 - CONTROL-VOLTAGE ELECTRICAL POWER CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 1. UTP cabling.
 2. RS-485 cabling.
 3. Low-voltage control cabling.
 4. Control-circuit conductors.
 5. Identification products.

1.3 DEFINITIONS

- A. EMI: Electromagnetic interference.
- B. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control and signaling power-limited circuits.
- C. Plenum: A space forming part of the air distribution system to which one or more air ducts are connected. An air duct is a passageway, other than a plenum, for transporting air to or from heating, ventilating, or air-conditioning equipment.
- D. RCDD: Registered Communications Distribution Designer.
- E. UTP: Unshielded twisted pair.

1.4 ACTION SUBMITTALS

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

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing agency, RCDD, layout technician, installation supervisor, and field inspector.
- B. Source quality-control reports.
- C. Field quality-control reports.

1.6 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Accredited by NETA.
 - 1. Testing Agency's Field Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.

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.

2.2 PERFORMANCE REQUIREMENTS

- A. Flame Travel and Smoke Density in Plenums: As determined by testing identical products according to NFPA 262, by a qualified testing agency. Identify products for installation in plenums with appropriate markings of applicable testing agency.
 - 1. Flame Travel Distance: 60 inches or less.
 - 2. Peak Optical Smoke Density: 0.5 or less.
 - 3. Average Optical Smoke Density: 0.15 or less.
- B. Flame Travel and Smoke Density for Riser Cables in Non-Plenum Building Spaces: As determined by testing identical products according to UL 1666.
- C. Flame Travel and Smoke Density for Cables in Non-Riser Applications and Non-Plenum Building Spaces: As determined by testing identical products according to UL 1685.

2.3 BACKBOARDS

- A. Description: Plywood, fire-retardant treated, 3/4 by 48 by 96 inches. Comply with requirements for plywood backing panels in Section 061000 "Rough Carpentry."
- B. Painting: Paint plywood on all sides and edges with flat black latex paint. Comply with requirements in Section 099123 "Interior Painting."

2.4 UTP CABLE

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Belden CDT Networking Division/NORDX.
 - 2. CommScope, Inc.
 - 3. General Cable; General Cable Corporation.
- B. Description: 100-ohm, four-pair UTP.
 - 1. Comply with ICEA S-90-661 for mechanical properties of Category 5e cables.
 - 2. Comply with ICEA S-102-700 for mechanical properties of Category 6 cables.
 - 3. Comply with TIA-568-C.1 for performance specifications.
 - 4. Comply with TIA-568-C.2, Category 6.
 - 5. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with NFPA 70 for the following types:
 - a. Communications, Plenum Rated: Type CMP complying with UL 1685.

- b. Communications, Plenum Rated: Type CM, Type CMG, Type CMP, Type CMR, or Type CMX in metallic conduit installed per NFPA 70, Article 300.22, "Wiring in Ducts, Plenums, and Other Air-Handling Spaces."
- c. Communications, Riser Rated: Type CMR complying with UL 1666 and ICEA S-103-701.
- d. Communications, Riser Rated: Type CMP, or Type CMR in listed plenum or riser communications raceway.
- e. Communications, Riser Rated: Type CMP or Type CMR in metallic conduit installed per NFPA 70, Article 300.22, "Wiring in Ducts, Plenums, and Other Air-Handling Spaces."
- f. Communications, General Purpose: Type CM or Type CMG.
- g. Communications, General Purpose: Type CM, Type CMG, Type CMP, Type CMR, or Type CMX in metallic conduit installed per NFPA 70, Article 300.22, "Wiring in Ducts, Plenums, and Other Air-Handling Spaces."
- h. Communications, Limited Purpose: Type CMX.

2.5 UTP CABLE HARDWARE

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Belden Inc.
 - 2. Hubbell Incorporated; Wiring Device-Kellems.
 - 3. Leviton Manufacturing Co., Inc.
- B. General Requirements for Cable Connecting Hardware: Comply with TIA-568-C.2, IDC type, with modules designed for punch-down caps or tools. Cables shall be terminated with connecting hardware of same category or higher.
- C. Connecting Blocks: 110-style IDC for Category 6. Provide blocks for the number of cables terminated on the block, plus 25 percent spare. Integral with connector bodies, including plugs and jacks where indicated.
- D. Cross-Connect: Modular array of connecting blocks arranged to terminate building cables and permit interconnection between cables.
 - 1. Number of Terminals per Field: One for each conductor in assigned cables.
- E. Patch Panel: Modular panels housing multiple-numbered jack units with IDC-type connectors at each jack for permanent termination of pair groups of installed cables.
 - 1. Number of Jacks per Field: One for each four-pair conductor group of indicated cables, plus spares and blank positions adequate to suit specified expansion criteria.
- F. Jacks and Jack Assemblies: 100-ohm, balanced, twisted-pair connector; four-pair, eight-position modular. Comply with TIA-568-C.1.
- G. Patch Cords: Factory-made, four-pair cables in 36-inch lengths; terminated with eight-position modular plug at each end.
 - 1. Patch cords shall have bend-relief-compliant boots and color-coded icons to ensure Category 6 performance. Patch cords shall have latch guards to protect against snagging.
 - 2. Patch cords shall have color-coded boots for circuit identification.
- H. Faceplates:
 - 1. Metal Faceplate: Stainless steel, complying with requirements in Section 262726 "Wiring Devices."
 - 2. For use with snap-in jacks accommodating any combination of UTP, and coaxial work area cords.
 - a. Flush-mounted jacks, positioning the cord at a 45-degree angle.
- I. Legend:
 - 1. Factory labeled by silk-screening or engraving for stainless steel faceplates.
 - 2. Machine printed, in the field, using adhesive-tape label.

3. Snap-in, clear-label covers and machine-printed paper inserts.

2.6 RS-485 CABLE

- A. Standard Cable: NFPA 70, Type CMG.
 1. Paired, one pair, twisted, No. 22 AWG, stranded (7x30) tinned-copper conductors.
 2. PVC insulation.
 3. Unshielded.
 4. PVC jacket.
 5. Flame Resistance: Comply with UL 1685.
- B. Plenum-Rated Cable: NFPA 70, Type CMP.
 1. Paired, [one pair] [two pairs], No. 22 AWG, stranded (7x30) tinned-copper conductors.
 2. Fluorinated ethylene propylene insulation.
 3. Unshielded.
 4. Fluorinated ethylene propylene jacket.
 5. Flame Resistance: NFPA 262.

2.7 LOW-VOLTAGE CONTROL CABLE

- A. Paired Cable: NFPA 70, Type CMG.
 1. One-pair, twisted, No. 16 AWG, stranded (19x29) tinned-copper conductors.
 2. PVC insulation.
 3. Unshielded.
 4. PVC jacket.
 5. Flame Resistance: Comply with UL 1685.
- B. Plenum-Rated, Paired Cable: NFPA 70, Type CMP.
 1. One-pair, twisted, No. 16 AWG, stranded (19x29) tinned-copper conductors.
 2. PVC insulation.
 3. Unshielded.
 4. PVC jacket.
 5. Flame Resistance: Comply with NFPA 262.

2.8 CONTROL-CIRCUIT CONDUCTORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Encore Wire Corporation.
 2. General Cable; General Cable Corporation.
 3. Southwire Company.
- B. Class 1 Control Circuits: Stranded copper, Type THHN/THWN-2, complying with UL 83 in raceway.
- C. Class 2 Control Circuits: Stranded copper, Type THHN/THWN-2, complying with UL 83 in raceway.
- D. Class 3 Remote-Control and Signal Circuits: Stranded copper, Type THHN/THWN-2, complying with UL 83 in raceway.
- E. Class 2 Control Circuits and Class 3 Remote-Control and Signal Circuits That Supply Critical Circuits: Circuit Integrity (CI) cable.
 1. Smoke control signaling and control circuits.

2.9 SOURCE QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to evaluate cables.
- B. Factory test UTP cables according to TIA-568-C.2.
- C. Factory test optical-fiber cables according to TIA-568-C.3.
- D. Cable will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Test cables on receipt at Project site.
 - 1. Test each pair of UTP cable for open and short circuits.

3.2 INSTALLATION OF RACEWAYS AND BOXES

- A. Comply with requirements in Section 260533 "Raceways and Boxes for Electrical Systems" for raceway selection and installation requirements for boxes, conduits, and wireways as supplemented or modified in this Section.
 - 1. Outlet boxes shall be no smaller than 2 inches wide, 3 inches high, and 2-1/2 inches deep.
 - 2. Outlet boxes for optical-fiber cables shall be no smaller than 4 inches square by 2-1/8 inches deep with extension ring sized to bring edge of ring to within 1/8 inch of the finished wall surface.
 - 3. Flexible metal conduit shall not be used.
- B. Comply with TIA-569-C for pull-box sizing and length of conduit and number of bends between pull points.
- C. Install manufactured conduit sweeps and long-radius elbows if possible.
- D. Raceway Installation in Equipment Rooms:
 - 1. Position conduit ends adjacent to a corner on backboard if a single piece of plywood is installed, or in the corner of the room if multiple sheets of plywood are installed around perimeter walls of the room.
 - 2. Install cable trays to route cables if conduits cannot be located in these positions.
 - 3. Secure conduits to backboard if entering the 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.
- E. Backboards: Install backboards with 96-inch dimension vertical. Butt adjacent sheets tightly and form smooth gap-free corners and joints.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

- A. Comply with NECA 1.
- B. General Requirements for Cabling:
 - 1. Comply with TIA-568-C Series of standards.
 - 2. Comply with BICSI ITSIMM, Ch. 5, "Copper Structured Cabling Systems" and Ch. 6, "Optical Fiber Structured Cabling Systems."

3. Terminate all conductors and optical fibers; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, and cross-connect and patch panels.
 4. Cables may not be spliced.
 5. 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.
 6. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIMM, Ch. 5, "Copper Structured Cabling Systems" and Ch. 6, "Optical Fiber Structured Cabling Systems." Install lacing bars and distribution spools.
 7. 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.
 8. Cold-Weather Installation: Bring cable to room temperature before dereeling. Do not use heat lamps for heating.
 9. Pulling Cable: Comply with BICSI ITSIMM, Ch. 5, "Copper Structured Cabling Systems" and Ch. 6, "Optical Fiber Structured Cabling Systems." Monitor cable pull tensions.
 10. Support: Do not allow cables to lay on removable ceiling tiles.
 11. Secure: Fasten securely in place with hardware specifically designed and installed so as to not damage cables.
- C. UTP Cable Installation:
1. Comply with TIA-568-C.2.
 2. Install termination hardware as specified in Section 271500 "Communications Horizontal Cabling" unless otherwise indicated.
 3. Do not untwist UTP cables more than 1/2 inch at the point of termination to maintain cable geometry.
- D. Installation of Control-Circuit Conductors:
1. Install wiring in raceways. Comply with requirements specified in Section 260533 "Raceways and Boxes for Electrical Systems."
- E. Optical-Fiber Cable Installation:
1. Comply with TIA-568-C.3.
 2. Terminate cable on connecting hardware that is rack or cabinet mounted.
- F. Open-Cable Installation:
1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
 2. Suspend copper cable not in a wireway or pathway a minimum of 8 inches above ceilings by cable supports not more than 30 inches apart.
 3. Cable shall not be run through or on structural members or in contact with pipes, ducts, or other potentially damaging items. Do not run cables between structural members and corrugated panels.
- G. Separation from EMI Sources:
1. Comply with BICSI TDMM and TIA-569-C recommendations for separating unshielded copper voice and data communications 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 or Circuit Rating Less Than 2 kVA: A minimum of 5 inches.
 - b. Electrical Equipment or Circuit Rating between 2 and 5 kVA: A minimum of 12 inches.
 - c. Electrical Equipment or Circuit 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 or Circuit Rating Less Than 2 kVA: A minimum of 2-1/2 inches.
 - b. Electrical Equipment or Circuit Rating between 2 and 5 kVA: A minimum of 6 inches.
 - c. Electrical Equipment or Circuit 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 or Circuit Rating Less Than 2 kVA: No requirement.
 - b. Electrical Equipment or Circuit Rating between 2 and 5 kVA: A minimum of 3 inches.
 - c. Electrical Equipment or Circuit Rating More Than 5 kVA: A minimum of 6 inches.
5. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or 5 HP and Larger: A minimum of 48 inches.
 6. Separation between Communications Cables and Fluorescent Fixtures: A minimum of 5 inches.

3.4 REMOVAL OF CONDUCTORS AND CABLES

- A. Remove abandoned conductors and cables. Abandoned conductors and cables are those installed that are not terminated at equipment and are not identified with a tag for future use.

3.5 CONTROL-CIRCUIT CONDUCTORS

- A. Minimum Conductor Sizes:
 1. Class 1 remote-control and signal circuits; No 14 AWG.
 2. Class 2 low-energy, remote-control, and signal circuits; No. 16 AWG.
 3. Class 3 low-energy, remote-control, alarm, and signal circuits; No 12 AWG.

3.6 FIRESTOPPING

- A. Comply with requirements in Section 078413 "Penetration Firestopping."
- B. Comply with TIA-569-C, Annex A, "Firestopping."
- C. Comply with BICSI TDMM, "Firestopping" Chapter.

3.7 GROUNDING

- A. For data communication wiring, comply with TIA-607-B and with BICSI TDMM, "Bonding and Grounding (Earthing)" Chapter.
- B. For low-voltage control wiring and cabling, comply with requirements in Section 260526 "Grounding and Bonding for Electrical Systems."

3.8 IDENTIFICATION

- A. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- B. Identify data and communications system components, wiring, and cabling according to TIA-606-A; label printers shall use label stocks, laminating adhesives, and inks complying with UL 969.

3.9 FIELD QUALITY CONTROL

- A. Perform tests and inspections with the assistance of a factory-authorized service representative.
- B. Tests and Inspections:

1. Visually inspect UTP and optical-fiber cable jacket materials for UL or third-party certification markings. Inspect cabling terminations to confirm color-coding for pin assignments, and inspect cabling connections to confirm compliance with TIA-568-C.1.
 2. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
 3. Test UTP cabling for direct-current loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination, but not after cross-connection.
 - a. Test instruments shall meet or exceed applicable requirements in TIA-568-C.2. Perform tests with a tester that complies with performance requirements in its "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in its "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
 4. Optical-Fiber Cable Tests:
 - a. Test instruments shall meet or exceed applicable requirements in TIA-568-C.0. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
 - b. Link End-to-End Attenuation Tests:
 - 1) Multimode Link Measurements: Test at 850 or 1300 nm in one direction according to TIA/EIA-526-14-A, Method B, One Reference Jumper.
 - 2) Attenuation test results for links shall be less than 2.0 dB that calculated according to equation in TIA-568-C.0.
- C. Document data for each measurement. Print data for submittals in a summary report that is formatted using Table 10.1 in BICSI TDMM as a guide, or transfer the data from the instrument to the computer, save as text files, print, and submit.
- D. End-to-end cabling will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

END OF SECTION 260523

SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes grounding and bonding systems and equipment.
- B. Section includes grounding and bonding systems and equipment, plus the following special applications:
 - 1. Underground distribution grounding.
 - 2. Foundation steel electrodes.
 - 3. Grounding conductors.
 - 4. Grounding connectors.
 - 5. Grounding busbars.
 - 6. Grounding rods.
 - 7. Grounding labeling.

1.3 DEFINITIONS

- A. BCT: Bonding conductor for telecommunications.
- B. EMT: Electrical metallic tubing.
- C. TGB: Telecommunications grounding busbar.
- D. TMGB: Telecommunications main grounding busbar.

1.4 ACTION SUBMITTALS

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

1.5 INFORMATIONAL SUBMITTALS

- A. As-Built Data: Plans showing dimensioned as-built locations of grounding features specified in "Field Quality Control" Article, including the following:
 - 1. Test wells.
 - 2. Ground rods.
 - 3. Ground rings.
 - 4. Grounding arrangements and connections for separately derived systems.
- B. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For grounding to include in emergency, operation, and maintenance manuals.
 - 1. In addition to items specified in "Operation and Maintenance Data," include the following:
 - a. Instructions for periodic testing and inspection of grounding features at test wells based on NFPA 70B.
 - 1) Tests shall determine if ground-resistance or impedance values remain within specified maximums, and instructions shall recommend corrective action if values do not.
 - 2) Include recommended testing intervals.

1.7 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with UL 467 for grounding and bonding materials and equipment.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Burndy; Part of Hubbell Electrical Systems.
 - 2. O-Z/Gedney; a brand of Emerson Industrial Automation.
 - 3. Thomas & Betts Corporation; A Member of the ABB Group.

2.2 SYSTEM DESCRIPTION

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with UL 467 for grounding and bonding materials and equipment.

2.3 CONNECTORS

- A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.
- B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy.
- C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.
- D. Bus-Bar Connectors: Mechanical type, cast silicon bronze, solderless compression-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.

2.4 CONDUCTORS

- A. Insulated Conductors: Stranded copper wire, green or green with yellow stripe insulation, insulated for 600 V, and complying with UL 83.
 - 1. Ground wire for custom-length equipment ground jumpers shall be No. 6 AWG, 19-strand, UL-listed, Type THHN wire.
- B. Cable Tray Equipment Grounding Wire: No. 8 AWG.
- C. Bare Copper Conductors:
 - 1. Solid Conductors: ASTM B 3.
 - 2. Stranded Conductors: ASTM B 8.
 - 3. Tinned Conductors: ASTM B 33.
 - 4. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch in diameter.
 - 5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
 - 6. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
 - 7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.

2.5 GROUNDING BUSBARS

- A. TMGB: Predrilled, wall-mounted, rectangular bars of hard-drawn solid copper, 1/4 by 4 inches in cross section, length as indicated on Drawings. The busbar shall be NRTL listed for use as TMGB and shall comply with J-STD-607-A.
 - 1. Predrilling shall be with holes for use with lugs specified in this Section.
 - 2. Mounting Hardware: Stand-off brackets that provide a 4-inch clearance to access the rear of the busbar. Brackets and bolts shall be stainless steel.
 - 3. Stand-off insulators for mounting shall be Lexan or PVC. Comply with UL 891 for use in 600-V switchboards, impulse tested at 5000 V.
- B. TGB: Predrilled rectangular bars of hard-drawn solid copper, 1/4 by 2 inches in cross section, length as indicated on Drawings. The busbar shall be for wall mounting, shall be NRTL listed as complying with UL 467, and shall comply with J-STD-607-A.
 - 1. Predrilling shall be with holes for use with lugs specified in this Section.
 - 2. Mounting Hardware: Stand-off brackets that provide at least a 2-inch clearance to access the rear of the busbar. Brackets and bolts shall be stainless steel.
 - 3. Stand-off insulators for mounting shall be Lexan or PVC. Comply with UL 891 for use in 600-V switchboards, impulse tested at 5000 V.
- C. Rack and Cabinet Grounding Busbars: Rectangular bars of hard-drawn solid copper, accepting conductors ranging from No. 14 to No. 2/0 AWG, NRTL listed as complying with UL 467, and complying with J-STD-607-A. Predrilling shall be with holes for use with lugs specified in this Section.
 - 1. Cabinet-Mounted Busbar: Terminal block, with stainless-steel or copper-plated hardware for attachment to the cabinet.
 - 2. Rack-Mounted Horizontal Busbar: Designed for mounting in 19- or 23-inch equipment racks. Include a copper splice bar for transitioning to an adjoining rack, and stainless-steel or copper-plated hardware for attachment to the rack.
 - 3. Rack-Mounted Vertical Busbar: 72 or 36 inches long, with stainless-steel or copper-plated hardware for attachment to the rack.

2.6 GROUND RODS

- A. Ground Rods: Copper-clad steel 3/4 inch by 10 feet in diameter.

2.7 LABELING

- A. Comply with TIA/EIA-606-A and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.
- B. Adhesive Film Label with Clear Protective Overlay: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch. Overlay shall provide a weatherproof and UV-resistant seal for label.

PART 3 - EXECUTION

3.1 APPLICATIONS

- A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger unless otherwise indicated.
- B. Underground Grounding Conductors: Install bare copper conductor, No. 2/0 AWG minimum.
 - 1. Bury at least 24 inches below grade.
 - 2. Duct-Bank Grounding Conductor: Bury 12 inches above duct bank when indicated as part of duct-bank installation.
- C. Isolated Grounding Conductors: Green-colored insulation with continuous yellow stripe. On feeders with isolated ground, identify grounding conductor where visible to normal inspection, with alternating bands of green and yellow tape, with at least three bands of green and two bands of yellow.
- D. Grounding Bus: Install in electrical equipment rooms, in rooms housing service equipment, and elsewhere as indicated.
 - 1. Install bus horizontally, on insulated spacers 2 inches minimum from wall, 6 inches above finished floor unless otherwise indicated.
 - 2. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, and down; connect to horizontal bus.
- E. Conductor Terminations and Connections:
 - 1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
 - 2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
 - 3. Connections to Ground Rods at Test Wells: Bolted connectors.
 - 4. Connections to Structural Steel: Welded connectors.

3.2 GROUNDING AT THE SERVICE

- A. Equipment grounding conductors and grounding electrode conductors shall be connected to the ground bus.

3.3 EQUIPMENT GROUNDING

- A. Install insulated equipment grounding conductors with all feeders and branch circuits.
- B. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:
 - 1. Feeders and branch circuits.
 - 2. Lighting circuits.
 - 3. Receptacle circuits.
 - 4. Single-phase motor and appliance branch circuits.
 - 5. Three-phase motor and appliance branch circuits.
 - 6. Flexible raceway runs.
 - 7. Armored and metal-clad cable runs.
- C. 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.
- D. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install a separate insulated equipment grounding conductor to each electric water heater and heat-tracing cable. Bond conductor to heater units, piping, connected equipment, and components.
- E. Isolated Equipment Enclosure Circuits: For designated equipment supplied by a branch circuit or feeder, isolate equipment enclosure from supply circuit raceway with a nonmetallic raceway fitting listed for the purpose. Install fitting where raceway enters enclosure, and install a separate insulated equipment grounding conductor. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service unless otherwise indicated.
- F. Metallic Fences: Comply with requirements of IEEE C2.
 - 1. Grounding Conductor: Bare copper, not less than No. 8 AWG.
 - 2. Gates: Shall be bonded to the grounding conductor with a flexible bonding jumper.
 - 3. Barbed Wire: Strands shall be bonded to the grounding conductor.

3.4 INSTALLATION

- A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
- B. Ground Bonding Common with Lightning Protection System: Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system. Bond electrical power system ground directly to lightning protection system grounding conductor at closest point to electrical service grounding electrode. Use bonding conductor sized same as system grounding electrode conductor, and install in conduit.
- C. Ground Rods: Drive rods until tops are 2 inches below finished floor or final grade unless otherwise indicated.
 - 1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating if any.
 - 2. For grounding electrode system, install at least three rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor.

- D. Test Wells: Ground rod driven through drilled hole in bottom of handhole. Handholes are specified in Section "Underground Ducts and Raceways for Electrical Systems," and shall be at least 12 inches deep, with cover.
 - 1. Test Wells: Install at least one test well for each service unless otherwise indicated. Install at the ground rod electrically closest to service entrance. Set top of test well flush with finished grade or floor.

 - E. 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.

 - F. Grounding and Bonding for Piping:
 - 1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes; use a bolted clamp connector or bolt a lug-type connector to a pipe flange by using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
 - 2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
 - 3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.

 - G. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install bonding jumper to bond across flexible duct connections to achieve continuity.

 - H. Grounding for Steel Building Structure: Install a driven ground rod at base of each corner column and at intermediate exterior columns at distances not more than 60 feet apart.

 - I. Ground Ring: Install a grounding conductor, electrically connected to each building structure ground rod and to each indicated item, extending around the perimeter of the building or area or item indicated.
 - 1. Install tinned-copper conductor not less than No. 2/0 AWG for ground ring and for taps to building steel.
 - 2. Bury ground ring not less than 24 inches from building's foundation.

 - J. Concrete-Encased Grounding Electrode (Ufer Ground): Fabricate according to NFPA 70; use a minimum of 20 feet of bare copper conductor not smaller than No. 4 AWG.
 - 1. If concrete foundation is less than 20 feet long, coil excess conductor within base of foundation.
 - 2. Bond grounding conductor to reinforcing steel in at least four locations and to anchor bolts. Extend grounding conductor below grade and connect to building's grounding grid or to grounding electrode external to concrete.
- 3.5 FIELD QUALITY CONTROL
- A. Perform tests and inspections.
 - B. Tests and Inspections:

1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
 2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
 3. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, and at ground test wells. Make tests at ground rods before any conductors are connected.
 - a. Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
 - b. Perform tests by fall-of-potential method according to IEEE 81.
 4. Prepare dimensioned Drawings locating each test well, ground rod and ground-rod assembly, and other grounding electrodes. Identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location, and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.
- C. Grounding system will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.
- E. Report measured ground resistances that exceed the following values:
1. Power and Lighting Equipment or System with Capacity of 500 kVA and Less: 10 ohms.
 2. Power and Lighting Equipment or System with Capacity of 500 to 1000 kVA: 5 ohms.
 3. Power and Lighting Equipment or System with Capacity More Than 1000 kVA: 3 ohms.
 4. Power Distribution Units or Panelboards Serving Electronic Equipment: 3 ohm(s).
 5. Substations and Pad-Mounted Equipment: 5 ohms.
 6. Manhole Grounds: 10 ohms.
- F. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

END OF SECTION 260526

SECTION 260529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Hangers and supports for electrical equipment and systems.
 - 2. Construction requirements for concrete bases.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for the following:
 - a. Hangers.
 - b. Steel slotted support systems.
 - c. Trapeze hangers.
 - d. Clamps.
 - e. Turnbuckles.
 - f. Sockets.
 - g. Eye nuts.
 - h. Saddles.
 - i. Brackets.
 - 2. Include rated capacities and furnished specialties and accessories.
- B. Shop Drawings: Signed and sealed by a qualified professional engineer. For fabrication and installation details for electrical hangers and support systems.
 - 1. Trapeze hangers. Include product data for components.
 - 2. Steel slotted-channel systems.
 - 3. Equipment supports.
 - 4. Vibration Isolation Base Details: Detail fabrication, including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.
- C. Delegated-Design Submittal: For hangers and supports for electrical systems.
 - 1. Include design calculations and details of trapeze hangers.
 - 2. Include design calculations for seismic restraints.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Suspended ceiling components.
 2. Structural members to which hangers and supports will be attached.
 3. Size and location of initial access modules for acoustical tile.
 4. Items penetrating finished ceiling, including the following:
 - a. Lighting fixtures.
 - b. Air outlets and inlets.
 - c. Access panels.
- B. Seismic Qualification Certificates: For hangers and supports for electrical equipment and systems, accessories, and components, from manufacturer.
1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- C. Welding certificates.

1.5 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to the following:
1. AWS D1.1/D1.1M.
 2. AWS D1.2/D1.2M.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design hanger and support system.
- B. Seismic Performance: Hangers and supports shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
1. The term "withstand" means "the supported equipment and systems will remain in place without separation of any parts when subjected to the seismic forces specified and the system will be fully operational after the seismic event."
 2. Component Importance Factor: 1.5.
- C. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
1. Flame Rating: Class 1.
 2. Self-extinguishing according to ASTM D 635.

2.2 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

- A. Steel Slotted Support Systems: Comply with MFMA-4 factory-fabricated components for field assembly.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Allied Tube & Conduit; a part of Atkore International.
 - b. B-line, an Eaton business.

- c. ERICO International Corporation.
 - d. Unistrut; Part of Atkore International.
 2. Material: Galvanized steel.
 3. Channel Width: 1-5/8 inches.
 4. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
 5. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
 6. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
 7. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
 8. Channel Dimensions: Selected for applicable load criteria.
- B. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- C. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for nonarmored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be made of malleable iron.
- D. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M steel plates, shapes, and bars; black and galvanized.
- E. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Hilti, Inc.
 - 2) ITW Ramset/Red Head; Illinois Tool Works, Inc.
 - 3) MKT Fastening, LLC.
 - 4) Simpson Strong-Tie Co., Inc.
 2. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel or stainless steel, for use in hardened portland cement concrete, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) B-line, an Eaton business.
 - 2) Hilti, Inc.
 - 3) ITW Ramset/Red Head; Illinois Tool Works, Inc.
 - 4) MKT Fastening, LLC.
 3. Concrete Inserts: Steel or malleable-iron, slotted support system units are similar to MSS Type 18 units and comply with MFMA-4 or MSS SP-58.
 4. Clamps for Attachment to Steel Structural Elements: MSS SP-58 units are suitable for attached structural element.
 5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
 6. Toggle Bolts: All-steel or Stainless-steel springhead type.
 7. Hanger Rods: Threaded steel.

2.3 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

- A. Description: Welded or bolted structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.

- B. Materials: Comply with requirements in Section 055000 "Metal Fabrications" for steel shapes and plates.

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 required by 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 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 single-bolt conduit clamps using spring friction action for retention in support channel.
- E. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.

3.2 SUPPORT INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this article.
- B. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.
- C. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
 - 1. To Wood: Fasten with lag screws or through bolts.
 - 2. To New Concrete: Bolt to concrete inserts.
 - 3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
 - 4. To Existing Concrete: Expansion anchor fasteners.
 - 5. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches thick.
 - 6. To Steel: Beam clamps (MSS SP-58, Type 19, 21, 23, 25, or 27), complying with MSS SP-69.
 - 7. To Light Steel: Sheet metal screws.
 - 8. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate by means that comply with seismic-restraint strength and anchorage requirements.

- D. Drill holes for expansion anchors in concrete at locations and to depths that avoid the need for reinforcing bars.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

- A. Comply with installation requirements in Division 05 Section "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 CONCRETE BASES

- A. Construct concrete bases of dimensions indicated but not less than 4 inches larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.
- B. Use 3000-psi, 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Division 03 Section "Cast-in-Place Concrete."
- C. Anchor equipment to concrete base as follows:
 - 1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 2. Install anchor bolts to elevations required for proper attachment to supported equipment.
 - 3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

3.5 PAINTING

- A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 - 1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.
- B. Touchup: Comply with requirements in Division 09 painting Sections for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 260529

SECTION 260533 - RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.

1.3 DEFINITIONS

- A. EMT: Electrical metallic tubing.
- B. ENT: Electrical nonmetallic tubing.
- C. EPDM: Ethylene-propylene-diene terpolymer rubber.
- D. FMC: Flexible metal conduit.
- E. IMC: Intermediate metal conduit.
- F. LFMC: Liquidtight flexible metal conduit.
- G. LFNC: Liquidtight flexible nonmetallic conduit.
- H. NBR: Acrylonitrile-butadiene rubber.
- I. RNC: Rigid nonmetallic conduit.

1.4 SUBMITTALS

- A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.
- B. Shop Drawings: For the following raceway components. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Custom enclosures and cabinets.
 - 2. For handholes and boxes for underground wiring, including the following:
 - a. Duct entry provisions, including locations and duct sizes.
 - b. Frame and cover design.
 - c. Grounding details.
 - d. Dimensioned locations of cable rack inserts, and pulling-in and lifting irons.

- e. Joint details.

- C. Samples for Verification: For each type of exposed finish required for surface raceways, prepared on Samples of size indicated below.
 - 1. Size: 4".

- D. Coordination Drawings: Conduit routing plans, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:
 - 1. Structural members in the paths of conduit groups with common supports.
 - 2. HVAC and plumbing items and architectural features in the paths of conduit groups with common supports.

- E. Manufacturer Seismic Qualification Certification: Submit certification that enclosures and cabinets and their mounting provisions, including those for internal components, will withstand seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems." Include the following:
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - a. The term "withstand" means "the cabinet or enclosure will remain in place without separation of any parts when subjected to the seismic forces specified and the unit will retain its enclosure characteristics, including its interior accessibility, after the seismic event."
 - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

- F. Qualification Data: For professional engineer and testing agency.

- G. Source quality-control test reports.

1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

- B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 METAL CONDUIT AND TUBING

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. AFC Cable Systems, Inc.
 - 2. Alflex Inc.

3. Allied Tube & Conduit; a Tyco International Ltd. Co.
 4. Anamet Electrical, Inc.; Anaconda Metal Hose.
 5. Manhattan/CDT/Cole-Flex.
 6. Maverick Tube Corporation.
 7. O-Z Gedney; a unit of General Signal.
 8. Wheatland Tube Company.
- B. Rigid Steel Conduit: ANSI C80.1.
- C. IMC: ANSI C80.6.
- D. EMT: ANSI C80.3.
- E. FMC: Zinc-coated steel.
- F. LFMC: Flexible steel conduit with PVC jacket.
- G. Fittings for Conduit (Including all Types and Flexible and Liquidtight), EMT, and Cable: NEMA FB 1; listed for type and size raceway with which used, and for application and environment in which installed.
1. Fittings for EMT: Steel set-screw type.
 2. Coating for Fittings for PVC-Coated Conduit: Minimum thickness, 0.040 inch, with overlapping sleeves protecting threaded joints.
- H. Joint Compound for Rigid Steel Conduit or IMC: Listed for use in cable connector assemblies, and compounded for use to lubricate and protect threaded raceway joints from corrosion and enhance their conductivity.

2.2 NONMETALLIC CONDUIT AND TUBING

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. AFC Cable Systems, Inc.
 2. Anamet Electrical, Inc.; Anaconda Metal Hose.
 3. Arco Corporation.
 4. CANTEX Inc.
 5. CertainTeed Corp.; Pipe & Plastics Group.
 6. Condux International, Inc.
 7. ElecSYS, Inc.
 8. Lamson & Sessions; Carlon Electrical Products.
 9. Manhattan/CDT/Cole-Flex.
 10. RACO; a Hubbell Company.
 11. Thomas & Betts Corporation.
- B. RNC: NEMA TC 2, Type EPC-40-PVC, unless otherwise indicated.
- C. LFNC: UL 1660.
- D. Fittings for RNC: NEMA TC 3; match to conduit or tubing type and material.
- E. Fittings for LFNC: UL 514B.

2.3 METAL WIREWAYS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Cooper B-Line, Inc.
 - 2. Hoffman.
 - 3. Square D; Schneider Electric.
- B. Description: Sheet metal sized and shaped as indicated, NEMA 250, Type 1, unless otherwise indicated.
- C. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.
- D. Wireway Covers: Hinged type.
- E. Finish: Manufacturer's standard enamel finish.

2.4 NONMETALLIC WIREWAYS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Hoffman.
 - 2. Lamson & Sessions; Carlon Electrical Products.
- B. Description: Fiberglass polyester, extruded and fabricated to size and shape indicated, with no holes or knockouts. Cover is gasketed with oil-resistant gasket material and fastened with captive screws treated for corrosion resistance. Connections are flanged, with stainless-steel screws and oil-resistant gaskets.
- C. Description: PVC plastic, extruded and fabricated to size and shape indicated, with snap-on cover and mechanically coupled connections with plastic fasteners.
- D. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

2.5 SURFACE RACEWAYS

- A. Surface Metal Raceways: Galvanized steel with snap-on covers. Manufacturer's standard enamel finish in color selected by Architect.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Thomas & Betts Corporation.
 - b. Walker Systems, Inc.; Wiremold Company (The).
 - c. Wiremold Company (The); Electrical Sales Division.

2.6 BOXES, ENCLOSURES, AND CABINETS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Cooper Crouse-Hinds; Div. of Cooper Industries, Inc.
 - 2. EGS/Appleton Electric.

3. Hoffman.
 4. Hubbell Incorporated; Killark Electric Manufacturing Co. Division.
 5. O-Z/Gedney; a unit of General Signal.
 6. RACO; a Hubbell Company.
 7. Spring City Electrical Manufacturing Company.
 8. Thomas & Betts Corporation.
 9. Walker Systems, Inc.; Wiremold Company (The).
 10. Woodhead, Daniel Company; Woodhead Industries, Inc. Subsidiary.
- B. Sheet Metal Outlet and Device Boxes: NEMA OS 1.
- C. Cast-Metal Outlet and Device Boxes: NEMA FB 1, aluminum, Type FD, with gasketed cover.
- D. Metal Floor Boxes: Cast metal, fully adjustable, rectangular.
- E. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- F. Cast-Metal Access, Pull, and Junction Boxes: NEMA FB 1, cast aluminum with gasketed cover.
- G. Hinged-Cover Enclosures: 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.
- H. 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.

2.7 GENERATOR TAP BOX

- A. Manufacturers: Generator tap boxes shall be TempTap Inlet Boxes as manufactured by ESL Power Systems, Inc. or equal as approved by the Engineer.
- B. Generator tap box shall consist of cam-style male connectors and grounding terminals, all housed within a padlockable enclosure.
- C. Generator tap box enclosure shall be Type 3R, constructed of continuous seam-welded, powder coated galvanized steel. The main access shall be through a hinged door that extends the full height of the enclosure. Access for portable generator cables with female cam-style plugs shall be via cable entry openings in the bottom of the enclosure. A hinged flap door shall be provided to cover the cable openings when cables are not connected; the hinged flap door shall allow cable entry only after the main access door has been opened. Enclosure shall be powder coated after fabrication; color shall be wrinkle gray RAL 7038.
- D. Cam-style male connectors (inlets) shall be UL Listed single-pole separable type and rated 400 amps at 600VAC. Cam-style male connectors shall be color coded. Cam-style male connectors shall be provided for each phase and for ground, and shall also be provided for neutral if required. The ground cam-style male connectors shall be bonded to the enclosure, and a ground lug shall be provided for connection of

the facility ground conductor. None of the cam-style male connectors shall be accessible unless the main access door is open.

2.8 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND WIRING

- A. Description: Comply with SCTE 77.
1. Color of Frame and Cover: Green.
 2. Configuration: Units shall be designed for flush burial and have integral closed bottom, unless otherwise indicated.
 3. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure.
 4. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
 5. Cover Legend: Molded lettering, as indicated for each service.
 6. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
 7. Handholes 12 inches wide by 24 inches long and larger shall have inserts for cable racks and pulling-in irons installed before concrete is poured.
- B. Polymer-Concrete Handholes and Boxes with Polymer-Concrete Cover: Molded of sand and aggregate, bound together with polymer resin, and reinforced with steel or fiberglass or a combination of the two.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Quazite (Hubbell Power Systems)
 - b. Armorcast Products Company.
 - c. Carson Industries LLC.
 - d. CDR Systems Corporation.

2.9 SLEEVES FOR RACEWAYS

- 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 with minimum 0.052- or 0.138-inch thickness as indicated and of length to suit application.
- D. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."

2.10 SLEEVE SEALS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Advance Products & Systems, Inc.
 2. Calpico, Inc.
 3. Metraflex Co.
 4. Pipeline Seal and Insulator, Inc.

- B. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and cable.
1. 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.
 2. Pressure Plates: Carbon steel. Include two for each sealing element.
 3. 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.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

- A. Outdoors: Apply raceway products as specified below, unless otherwise indicated:
1. Exposed Conduit: Rigid steel conduit.
 2. Concealed Conduit, Aboveground: Rigid steel conduit.
 3. Underground Conduit: RNC, Type EPC- 40 -PVC, direct buried.
 4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
 5. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.
 6. Application of Handholes and Boxes for Underground Wiring:
 - a. Handholes and Pull Boxes in Driveway, Parking Lot, and Off-Roadway Locations, Subject to Occasional, Nondeliberate Loading by Heavy Vehicles: Polymer concrete, SCTE 77, Tier 15 structural load rating.
 - b. Handholes and Pull Boxes in Sidewalk and Similar Applications with a Safety Factor for Nondeliberate Loading by Vehicles: Polymer-concrete units, SCTE 77, Tier 8 structural load rating.
 - c. Handholes and Pull Boxes Subject to Light-Duty Pedestrian Traffic Only: Fiberglass-reinforced polyester resin, structurally tested according to SCTE 77 with 3000-lbf vertical loading.
- B. Comply with the following indoor applications, unless otherwise indicated:
1. Exposed, Not Subject to Physical Damage: EMT.
 2. Exposed, Not Subject to Severe Physical Damage: EMT.
 3. Exposed and Subject to Severe Physical Damage: Rigid steel conduit. Includes raceways in the following locations:
 - 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: Rigid steel conduit.
 7. Raceways for Optical Fiber or Communications Cable in Spaces Used for Environmental Air: Plenum-type, optical fiber/communications cable raceway.
 8. Raceways for Concealed General Purpose Distribution of Optical Fiber or Communications Cable: EMT.

9. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 3R, in damp or wet locations.
- C. Minimum Raceway Size: 3/4-inch trade size.
- D. Raceway Fittings: Compatible with raceways and suitable for use and location.
 1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings, unless otherwise indicated.
 2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with that material. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer.
- E. Do not install aluminum conduits in contact with concrete.

3.2 INSTALLATION

- A. Comply with NECA 1 for installation requirements applicable to products specified in Part 2 except where requirements on Drawings or in this Article are stricter.
- 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. Complete raceway installation before starting conductor installation.
- D. Support raceways as specified in Division 26 Section "Hangers and Supports for Electrical Systems."
- E. Arrange stub-ups so curved portions of bends are not visible above the finished slab.
- F. Install no more than the equivalent of three 90-degree bends in any conduit run except for communications conduits, for which fewer bends are allowed.
- G. Conceal conduit and EMT within finished walls, ceilings, and floors, unless otherwise indicated.
- H. Raceways Embedded in Slabs:
 1. Run conduit larger than 1-inch trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support.
 2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
- 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. 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.
- L. Install raceway sealing fittings at suitable, approved, and accessible locations and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover

plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings at the following points:

1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
 2. Where otherwise required by NFPA 70.
 3. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F of temperature change.
 4. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at the time of installation.
- M. Flexible Conduit Connections: Use maximum of 72 inches of flexible conduit for recessed and semirecessed lighting fixtures, 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.
- N. 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.
- O. Set metal floor boxes level and flush with finished floor surface.
- P. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

3.3 INSTALLATION OF UNDERGROUND CONDUIT

- A. Direct-Buried Conduit:
1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom as specified in Division 31 Section "Earth Moving" for pipe less than 6 inches in nominal diameter.
 2. Install backfill as specified in Division 31 Section "Earth Moving."
 3. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified in Division 31 Section "Earth Moving."
 4. Install manufactured duct elbows for stub-ups at poles and equipment and at building entrances through the floor, unless otherwise indicated. Encase elbows for stub-up ducts throughout the length of the elbow.
 5. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through the floor.
 - a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches of concrete.
 - b. For stub-ups at equipment mounted on outdoor concrete bases, extend steel conduit horizontally a minimum of 60 inches from edge of equipment pad or foundation. Install insulated grounding bushings on terminations at equipment.

3.4 INSTALLATION OF UNDERGROUND HANDHOLES AND BOXES

- A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting conduits to minimize bends and deflections required for proper entrances.
- B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.
- C. Elevation: In paved areas, set so cover surface will be flush with finished grade. Set covers of other enclosures 1 inch above finished grade.
- D. Install handholes and boxes with bottom below the frost line, Insert depth of frost line below grade at Project site below grade.
- E. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated. Select arm lengths to be long enough to provide spare space for future cables, but short enough to preserve adequate working clearances in the enclosure.
- F. Field-cut openings for conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

3.5 INSTALLATION OF GENERATOR TAP BOXES

- A. Prior to installation of generator tap boxes, Contractor shall examine the areas and conditions under which the generator tap box is to be installed and notify the Engineer in writing if unsatisfactory conditions exist.
- B. Generator tap box shall be installed as shown on the drawings and per the manufacturer's written instructions. In addition, the installation shall meet the requirements of local codes, the National Electrical Code and National Electrical Contractors Association's "Standard of Installation".
- C. Conduit entry into the manual transfer switch shall be by Contractor; Contractor shall furnish and install listed watertight conduit hubs, as manufactured by MYERS or T&B, for each conduit entry on the generator tap box. The hub size shall match the conduit size for conductors and ground as shown on the drawings. Hubs shall be properly installed and tightened to maintain Type 3R integrity of the generator tap box.
- D. Contractor shall terminate conductors and ground per the manufacturer's instructions. Use copper wire only for all conductors and grounds. All field wiring terminations in the generator tap box shall be torqued as required per the instructions on the generator tap box.

3.6 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."
- 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. Rectangular Sleeve Minimum Metal Thickness:
 - 1. For sleeve cross-section rectangle perimeter less than 50 inches and no side greater than 16 inches, thickness shall be 0.052 inch.
 - 2. For sleeve cross-section rectangle perimeter equal to, or greater than, 50 inches and 1 or more sides equal to, or greater than, 16 inches, thickness shall be 0.138 inch.
- E. 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.
- F. Cut sleeves to length for mounting flush with both surfaces of walls.
- G. Extend sleeves installed in floors 2 inches above finished floor level.
- H. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and raceway unless sleeve seal is to be installed or unless seismic criteria require different clearance.
- I. Seal space outside of sleeves with grout for penetrations of concrete and masonry and with approved joint compound for gypsum board assemblies.
- J. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway, using joint sealant appropriate for size, depth, and location of joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.
- K. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway penetrations. Install sleeves and seal with firestop materials. Comply with Division 07 Section "Penetration Firestopping."
- L. Roof-Penetration Sleeves: Seal penetration of individual raceways with flexible, boot-type flashing units applied in coordination with roofing work.
- M. Aboveground, Exterior-Wall 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.
- N. Underground, Exterior-Wall Penetrations: Install cast-iron "wall pipes" for sleeves. Size sleeves to allow for 1-inch annular clear space between raceway and sleeve for installing mechanical sleeve seals.

3.7 SLEEVE-SEAL INSTALLATION

- A. Install to seal underground, exterior wall penetrations.
- B. Use type and number of sealing elements recommended by manufacturer for raceway material and size. Position raceway in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.8 FIRESTOPPING

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section "Penetration Firestopping."

3.9 PROTECTION

- A. Provide final protection and maintain conditions that ensure coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.
 - 1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
 - 2. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION 260533

SECTION 260544 - SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS AND CABLING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Sleeves for raceway and cable penetration of non-fire-rated construction walls and floors.
2. Sleeve-seal systems.
3. Sleeve-seal fittings.
4. Grout.
5. Silicone sealants.

B. Related Requirements:

1. Section 078413 "Penetration Firestopping" for penetration firestopping installed in fire-resistance-rated walls, horizontal assemblies, and smoke barriers, with and without penetrating items.

1.3 ACTION SUBMITTALS

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

PART 2 - PRODUCTS

2.1 SLEEVES

A. Wall Sleeves:

1. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, plain ends.
2. 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 Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies: Galvanized-steel sheet; 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint, with tabs for screw-fastening the sleeve to the board.

C. Sleeves for Rectangular Openings:

1. Material: Galvanized sheet steel.
2. Minimum Metal Thickness:

- a. For sleeve cross-section rectangle perimeter less than 50 inches and with no side larger than 16 inches, thickness shall be 0.052 inch.
- b. For sleeve cross-section rectangle perimeter 50 inches or more and one or more sides larger than 16 inches, thickness shall be 0.138 inch.

2.2 SLEEVE-SEAL SYSTEMS

- A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Advance Products & Systems, Inc.
 - b. CALPICO, Inc.
 - c. Metraflex Company (The).
 - d. Pipeline Seal and Insulator, Inc.
 - e. Proco Products, Inc.
 2. Sealing Elements: EPDM rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
 3. Pressure Plates: Stainless steel.
 4. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements.

2.3 SLEEVE-SEAL FITTINGS

- A. Description: Manufactured plastic, sleeve-type, waterstop assembly made for embedding in concrete slab or wall. Unit shall have plastic or rubber waterstop collar with center opening to match piping OD.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. HOLDRITE.

2.4 GROUT

- A. Description: Nonshrink; recommended for interior and exterior sealing openings in non-fire-rated walls or floors.
- B. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- C. Design Mix: 5000-psi, 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

2.5 SILICONE SEALANTS

- A. 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 that are not fire rated.
- B. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION FOR NON-FIRE-RATED ELECTRICAL PENETRATIONS

- A. Comply with NECA 1.
- B. Comply with NEMA VE 2 for cable tray and cable penetrations.
- C. Sleeves for Conduits Penetrating Above-Grade Non-Fire-Rated Concrete and Masonry-Unit Floors and Walls:
 - 1. Interior Penetrations of Non-Fire-Rated Walls and Floors:
 - a. Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Section 079200 "Joint Sealants."
 - b. Seal space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect material while curing.
 - 2. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
 - 3. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and raceway or cable unless sleeve seal is to be installed or unless seismic criteria require different clearance.
 - 4. Install sleeves for wall penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of walls. Cut sleeves to length for mounting flush with both surfaces of walls. Deburr after cutting.
 - 5. Install sleeves for floor penetrations. Extend sleeves installed in floors 2 inches above finished floor level. Install sleeves during erection of floors.
- D. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies:
 - 1. Use circular metal sleeves unless penetration arrangement requires rectangular sleeved opening.
 - 2. Seal space outside of sleeves with approved joint compound for gypsum board assemblies.
- E. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.
- F. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

- G. Underground, Exterior-Wall and Floor Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch annular clear space between raceway or cable and sleeve for installing sleeve-seal system.

3.2 SLEEVE-SEAL-SYSTEM INSTALLATION

- A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at raceway entries into building.
- B. Install type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.3 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.

END OF SECTION 260544

SECTION 260548.16 - SEISMIC CONTROLS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Restraint channel bracings.
 - 2. Restraint cables.
 - 3. Seismic-restraint accessories.
 - 4. Mechanical anchor bolts.
 - 5. Adhesive anchor bolts.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of seismic-restraint component used.
 - a. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by an agency acceptable to authorities having jurisdiction.
 - b. Annotate to indicate application of each product submitted and compliance with requirements.
- B. Delegated-Design Submittal: For each seismic-restraint device.
 - 1. Include design calculations and details for selecting seismic restraints complying with performance requirements, design criteria, and analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
 - 2. Design Calculations: Calculate static and dynamic loading caused by equipment weight, operation, and seismic and wind forces required to select seismic and wind restraints.
 - a. Coordinate design calculations with wind load calculations required for equipment mounted outdoors. Comply with requirements in other Sections for equipment mounted outdoors.
 - 3. Seismic- and Wind-Restraint Details:
 - a. Design Analysis: To support selection and arrangement of seismic and wind restraints. Include calculations of combined tensile and shear loads.

- b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events.
- c. Preapproval and Evaluation Documentation: By an agency acceptable to authorities having jurisdiction, showing maximum ratings of restraint items and the basis for approval (tests or calculations).

1.4 QUALITY ASSURANCE

- A. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.
- B. Seismic-restraint devices shall have horizontal and vertical load testing and analysis. They shall bear anchorage preapproval from OSHPD in addition to preapproval, showing maximum seismic-restraint ratings, by ICC-ES or another agency acceptable to authorities having jurisdiction. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are not available, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) that support seismic-restraint designs must be signed and sealed by a qualified professional engineer.
- C. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Wind-Restraint Loading: (Refer to Structural and Architectural drawings if no value indicated)
 - 1. Basic Wind Speed: 110MPH.
 - 2. Minimum 10 lb. /sq. ft. multiplied by maximum area of HVAC component projected on vertical plane normal to wind direction and 45 degrees either side of normal.
- B. Seismic-Restraint Loading:
 - 1. Site Class as Defined in the Applicable edition of the building code governing the installation.
 - a. Class C Seismic Design Category B
 - b. Component Importance Factor: 1.5. (varies per specific component)
 - c. Component Response Modification Factor:
 - 1) Equipment: 2.5
 - 2) Conduit, bus duct, cable tray: 5.0.
 - d. Component Amplification Factor:
 - 1) Equipment: 1.0
 - 2) Conduit, bus duct, cable tray: 2.5.
 - 2. Design Spectral Response Acceleration at Short Periods (0.2 Second): 0.29g.
 - 3. Design Spectral Response Acceleration at 1.0-Second Period: 0.076g.

2.2 RESTRAINT CHANNEL BRACINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. B-line, an Eaton business.
 2. Hilti, Inc.
 3. Mason Industries, Inc.
 4. Unistrut; Part of Atkore International.
- B. Description: MFMA-4, shop- or field-fabricated bracing assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end, with other matching components, and with corrosion-resistant coating; rated in tension, compression, and torsion forces.

2.3 RESTRAINT CABLES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Kinetics Noise Control, Inc.
 2. Loos & Co., Inc.
 3. Vibration Mountings & Controls, Inc.
- B. Restraint Cables: ASTM A 603 galvanized ASTM A 492 stainless-steel cables. End connections made of steel assemblies with thimbles, brackets, swivel, and bolts designed for restraining cable service; with a minimum of two clamping bolts for cable engagement.

2.4 SEISMIC-RESTRAINT ACCESSORIES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. B-line, an Eaton business.
 2. Kinetics Noise Control, Inc.
 3. Mason Industries, Inc.
 4. TOLCO; a brand of NIBCO INC.
- B. Hanger-Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections to hanger rod.
- C. Hinged and Swivel Brace Attachments: Multifunctional steel connectors for attaching hangers to rigid channel bracings and restraint cables.
- D. Bushings for Floor-Mounted Equipment Anchor Bolts: Neoprene bushings designed for rigid equipment mountings and matched to type and size of anchor bolts and studs.
- E. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings and matched to type and size of attachment devices used.
- F. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.

2.5 MECHANICAL ANCHOR BOLTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. B-line, an Eaton business.
 - 2. Hilti, Inc.
 - 3. Kinetics Noise Control, Inc.
 - 4. Mason Industries, Inc.
- B. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

2.6 ADHESIVE ANCHOR BOLTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Hilti, Inc.
 - 2. Kinetics Noise Control, Inc.
 - 3. Mason Industries, Inc.
- B. Adhesive Anchor Bolts: Drilled-in and capsule anchor system containing PVC or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

PART 3 - EXECUTION

3.1 APPLICATIONS

- A. Multiple Raceways or Cables: Secure raceways and cables to trapeze member with clamps approved for application by an agency acceptable to authorities having jurisdiction.
- B. Hanger-Rod Stiffeners: Install hanger-rod stiffeners where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods caused by seismic forces.
- C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static and seismic loads within specified loading limits.

3.2 SEISMIC-RESTRAINT DEVICE INSTALLATION

- A. Equipment and Hanger Restraints:
 - 1. Install resilient, bolt-isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch.
 - 2. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction providing required submittals for component.
- B. Install cables so they do not bend across edges of adjacent equipment or building structure.

- C. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.
- D. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.
- E. Drilled-in Anchors:
 - 1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
 - 2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
 - 3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
 - 4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
 - 5. Set anchors to manufacturer's recommended torque using a torque wrench.
 - 6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.3 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

- A. Install flexible connections in runs of raceways, cables, wireways, cable trays, and busways where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where connection is terminated to equipment that is anchored to a different structural element from the one supporting them as they approach equipment.

3.4 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 - 1. Obtain Architect's approval before transmitting test loads to structure. Provide temporary load-spreading members.
 - 2. Test at least four of each type and size of installed anchors and fasteners selected by Architect.
 - 3. Test to 90 percent of rated proof load of device.
- B. Seismic controls will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports.

3.5 ADJUSTING

- A. Adjust restraints to permit free movement of equipment within normal mode of operation.

END OF SECTION 260548.16

SECTION 260553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Color and legend requirements for raceways, conductors, and warning labels and signs.
 - 2. Labels.
 - 3. Bands and tubes.
 - 4. Tapes and stencils.
 - 5. Tags.
 - 6. Signs.
 - 7. Cable ties.
 - 8. Paint for identification.
 - 9. Fasteners for labels and signs.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for electrical identification products.
- B. Samples: For each type of label and sign to illustrate composition, size, colors, lettering style, mounting provisions, and graphic features of identification products.
- C. Identification Schedule: For each piece of electrical equipment and electrical system components to be an index of nomenclature for electrical equipment and system components used in identification signs and labels. Use same designations indicated on Drawings.
- D. Delegated-Design Submittal: For arc-flash hazard study.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Comply with ASME A13.1.
- 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.
- F. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
 - 1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

2.2 COLOR AND LEGEND REQUIREMENTS

- A. Raceways and Cables Carrying Circuits at 600 V or Less:
 - 1. Black letters on an orange field.
 - 2. Legend: Indicate voltage.
- B. Color-Coding for Phase and Voltage Level Identification, 600 V or Less: Use colors listed below for ungrounded feeder and branch-circuit conductors.
 - 1. Color shall be factory applied or field applied for sizes larger than No. 8 AWG if authorities having jurisdiction permit.
 - 2. Colors for 208/120-V Circuits:
 - a. Phase A: Black.
 - b. Phase B: Red.
 - c. Phase C: Blue.
 - 3. Color for Neutral: White.
 - 4. Color for Equipment Grounds: Green.
 - 5. Colors for Isolated Grounds: Green with white stripe.
- C. Warning Label Colors:
 - 1. Identify system voltage with black letters on an orange background.
- D. Warning labels and signs shall include, but are not limited to, the following legends:
 - 1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
 - 2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES."

2.3 LABELS

- A. Vinyl Wraparound Labels: Preprinted, flexible labels laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing label ends.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Brady Corporation.
 - b. Champion America.
 - c. LEM Products Inc.
 - d. Panduit Corp.
- B. Snap-around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeves, with diameters sized to suit diameters and that stay in place by gripping action.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Brady Corporation.
 - b. Marking Services, Inc.
 - c. Panduit Corp.
 - d. Seton Identification Products.

- C. Self-Adhesive Wraparound Labels: Preprinted, 3-mil-thick, polyester flexible label with acrylic pressure-sensitive adhesive.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Brady Corporation.
 - b. Emedco.
 - c. LEM Products Inc.
 - d. Panduit Corp.
 - 2. Self-Lamination: Clear; UV-, weather- and chemical-resistant; self-laminating, protective shield over the legend. Labels sized such that the clear shield overlaps the entire printed legend.
 - 3. Marker for Labels: Permanent, waterproof, black ink marker recommended by tag manufacturer.
 - 4. Marker for Labels: Machine-printed, permanent, waterproof, black ink recommended by printer manufacturer.

- D. Self-Adhesive Labels: Polyester, thermal, transfer-printed, 3-mil-thick, multicolor, weather- and UV-resistant, pressure-sensitive adhesive labels, configured for intended use and location.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Brady Corporation.
 - b. Emedco.
 - c. LEM Products Inc.
 - d. Panduit Corp.
 - 2. Minimum Nominal Size:
 - a. 1-1/2 by 6 inches for raceway and conductors.
 - b. 3-1/2 by 5 inches for equipment.
 - c. As required by authorities having jurisdiction.

2.4 BANDS AND TUBES

- A. Snap-around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeves, 2 inches long, with diameters sized to suit diameters and that stay in place by gripping action.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Brady Corporation.
 - b. Panduit Corp.

- B. Heat-Shrink Preprinted Tubes: Flame-retardant polyolefin tubes with machine-printed identification labels, sized to suit diameter and shrunk to fit firmly. Full shrink recovery occurs at a maximum of 200 deg F. Comply with UL 224.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Brady Corporation.
 - b. Panduit Corp.

2.5 TAPES AND STENCILS

- A. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Ideal Industries, Inc.
 - b. Panduit Corp.

- B. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; not less than 3 mils thick by 1 to 2 inches wide; compounded for outdoor use.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Brady Corporation.
 - b. Emedco.

- C. Tape and Stencil: 4-inch-wide black stripes on 10-inch centers placed diagonally over orange background and is 12 inches wide. Stop stripes at legends.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. LEM Products Inc.
 - b. Seton Identification Products.

- D. Floor Marking Tape: 2-inch-wide, 5-mil pressure-sensitive vinyl tape, with yellow and black stripes and clear vinyl overlay.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Carlton Industries, LP.
 - b. Seton Identification Products.

2.6 TAGS

- A. Metal Tags: Brass or aluminum, 2 by 2 by 0.05 inch, with stamped legend, punched for use with self-locking cable tie fastener.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Brady Corporation.
 - b. Carlton Industries, LP.

- B. Nonmetallic Preprinted Tags: Polyethylene tags, [0.015 inch] [0.023 inch] thick, color-coded for phase and voltage level, with factory [screened] [printed] permanent designations; punched for use with self-locking cable tie fastener.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Brady Corporation.
 - b. Carlton Industries, LP.

- C. Write-on Tags:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Carlton Industries, LP.
 - b. LEM Products Inc.
 - 2. Polyester Tags: 0.010 inch thick, with corrosion-resistant grommet and cable tie for attachment.
 - 3. Marker for Tags: Permanent, waterproof, black ink marker recommended by tag manufacturer.
 - 4. Marker for Tags: Machine-printed, permanent, waterproof, black ink marker recommended by printer manufacturer.

2.7 SIGNS

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

- a. Carlton Industries, LP.
 - b. Champion America.
 2. Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application.
 3. 1/4-inch grommets in corners for mounting.
 4. Nominal Size: 7 by 10 inches.
- B. Metal-Backed Butyrate Signs:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Brady Corporation.
 - b. Champion America.
 2. Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs, with 0.0396-inch galvanized-steel backing, punched and drilled for fasteners, and with colors, legend, and size required for application.
 3. 1/4-inch grommets in corners for mounting.
 4. Nominal Size: 10 by 14 inches.
- C. Laminated Acrylic or Melamine Plastic Signs:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Brady Corporation.
 - b. Carlton Industries, LP.
 2. Engraved legend.
 3. Thickness:
 - a. For signs up to 20 sq. in., minimum 1/16 inch.
 - b. For signs larger than 20 sq. in., 1/8 inch thick.
 - c. Engraved legend with black letters on white face.
 - d. Self-adhesive.
 - e. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

2.8 CABLE TIES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Ideal Industries, Inc.
 2. Panduit Corp.
- B. General-Purpose Cable Ties: Fungus inert, self-extinguishing, one piece, self-locking, and 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.
- C. UV-Stabilized Cable Ties: Fungus inert, designed for continuous exposure to exterior sunlight, self-extinguishing, one piece, self-locking, and 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.
- D. Plenum-Rated Cable Ties: Self-extinguishing, UV stabilized, one piece, and self-locking.
1. Minimum Width: 3/16 inch.
 2. Tensile Strength at 73 Deg F according to ASTM D 638: 7000 psi.
 3. UL 94 Flame Rating: 94V-0.

4. Temperature Range: Minus 50 to plus 284 deg F.
5. Color: Black.

2.9 MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. Paint: Comply with requirements in painting Sections for paint materials and application requirements. Retain paint system applicable for surface material and location (exterior or interior).
- B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Self-Adhesive Identification Products: Before applying electrical identification products, clean substrates of substances that could impair bond, using materials and methods recommended by manufacturer of identification product.

3.2 INSTALLATION

- A. Verify and coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and operation and maintenance manual. Use consistent designations throughout Project.
- B. Install identifying devices before installing acoustical ceilings and similar concealment.
- C. Verify identity of each item before installing identification products.
- D. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and operation and maintenance manual.
- E. Apply identification devices to surfaces that require finish after completing finish work.
- F. Install signs with approved legend to facilitate proper identification, operation, and maintenance of electrical systems and connected items.
- G. System Identification for Raceways and Cables under 600 V: Identification shall completely encircle cable or conduit. Place identification of two-color markings in contact, side by side.
 1. Secure tight to surface of conductor, cable, or raceway.
- H. System Identification for Raceways and Cables over 600 V: Identification shall completely encircle cable or conduit. Place adjacent identification of two-color markings in contact, side by side.
 1. Secure tight to surface of conductor, cable, or raceway.
- I. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.
- J. Elevated Components: Increase sizes of labels, signs, and letters to those appropriate for viewing from the floor.

- K. Accessible Fittings for Raceways: Identify the covers of each junction and pull box of the following systems with the wiring system legend and system voltage. System legends shall be as follows:
 - 1. "POWER."
 - 2. "FIRE ALARM"

- L. Vinyl Wraparound Labels:
 - 1. Secure tight to surface of raceway or cable at a location with high visibility and accessibility.
 - 2. Attach labels that are not self-adhesive type with clear vinyl tape, with adhesive appropriate to the location and substrate.

- M. Snap-around Labels: Secure tight to surface at a location with high visibility and accessibility.

- N. Self-Adhesive Wraparound Labels: Secure tight to surface at a location with high visibility and accessibility.

- O. Self-Adhesive Labels:
 - 1. On each item, install unique designation label that is consistent with wiring diagrams, schedules, and operation and maintenance manual.
 - 2. Unless otherwise indicated, provide a single line of text with 1/2-inch-high letters on 1-1/2-inch-high label; where two lines of text are required, use labels 2 inches high.

- P. Snap-around Color-Coding Bands: Secure tight to surface at a location with high visibility and accessibility.

- Q. Heat-Shrink, Preprinted Tubes: Secure tight to surface at a location with high visibility and accessibility.

- R. Marker Tapes: Secure tight to surface at a location with high visibility and accessibility.

- S. Self-Adhesive Vinyl Tape: Secure tight to surface at a location with high visibility and accessibility.
 - 1. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding.

- T. Tape and Stencil: Comply with requirements in painting Sections for surface preparation and paint application.

- U. Floor Marking Tape: Apply stripes to finished surfaces following manufacturer's written instructions.

- V. Metal Tags:
 - 1. Place in a location with high visibility and accessibility.
 - 2. Secure using plenum-rated cable ties.

- W. Nonmetallic Preprinted Tags:
 - 1. Place in a location with high visibility and accessibility.
 - 2. Secure using plenum-rated cable ties.

- X. Write-on Tags:
 - 1. Place in a location with high visibility and accessibility.
 - 2. Secure using plenum-rated cable ties.

- Y. Baked-Enamel Signs:
 - 1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
 - 2. Unless otherwise indicated, provide a single line of text with 1/2-inch-high letters on minimum 1-1/2-inch-high sign; where two lines of text are required, use signs minimum 2 inches high.

- Z. Metal-Backed Butyrate Signs:
 - 1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
 - 2. Unless otherwise indicated, provide a single line of text with 1/2-inch-high letters on 1-1/2-inch-high sign; where two lines of text are required, use labels 2 inches high.
- AA. Laminated Acrylic or Melamine Plastic Signs:
 - 1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
 - 2. Unless otherwise indicated, provide a single line of text with 1/2-inch-high letters on 1-1/2-inch-high sign; where two lines of text are required, use labels 2 inches high.
- BB. Cable Ties: General purpose, for attaching tags, except as listed below:
 - 1. Outdoors: UV-stabilized nylon.
 - 2. In Spaces Handling Environmental Air: Plenum rated.

3.3 IDENTIFICATION SCHEDULE

- A. Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment. Install access doors or panels to provide view of identifying devices.
- B. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, pull points, and locations of high visibility. Identify by system and circuit designation.
- C. Accessible Raceways and Metal-Clad Cables, 600 V or Less, for Service, Feeder, and Branch Circuits, More Than 30A and 120V to Ground: Identify with self-adhesive vinyl tape applied in bands.
 - 1. Locate identification at changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.
- D. Accessible Fittings for Raceways and Cables within Buildings: Identify the covers of each junction and pull box of the following systems with self-adhesive labels containing the wiring system legend and system voltage. System legends shall be as follows:
 - 1. "POWER."
 - 2. "FIRE ALARM"
- E. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use self-adhesive vinyl wraparound labels to identify the phase.
 - 1. Locate identification at changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.
- F. Control-Circuit Conductor Identification: For conductors and cables in pull and junction boxes, manholes, and handholes, use self-adhesive labels with the conductor or cable designation, origin, and destination.
- G. Control-Circuit Conductor Termination Identification: For identification at terminations, provide self-adhesive labels with the conductor designation.
- H. Conductors to Be Extended in the Future: Attach write-on tags to conductors and list source.
- I. Auxiliary Electrical Systems Conductor Identification: Self-adhesive vinyl tape that is uniform and consistent with system used by manufacturer for factory-installed connections.
 - 1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.

- J. Workspace Indication: Apply floor marking tape to finished surfaces. 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.
- K. Instructional Signs: Self-adhesive labels, including the color code for grounded and ungrounded conductors.
- L. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Self-adhesive labels.
 - 1. Apply to exterior of door, cover, or other access.
 - 2. For equipment with multiple power or control sources, apply to door or cover of equipment, including, but not limited to, the following:
 - a. Power-transfer switches.
 - b. Controls with external control power connections.
- M. Arc Flash Warning Labeling: Self-adhesive labels.
- N. Operating Instruction Signs: Self-adhesive labels, Baked-enamel warning signs, Laminated acrylic or melamine plastic signs.
- O. Emergency Operating Instruction Signs: Self-adhesive labels, Baked-enamel warning signs, Laminated acrylic or melamine plastic signs with white legend on a red background with minimum 3/8-inch-high letters for emergency instructions at equipment used for power transfer and load shedding.
- P. Equipment Identification Labels:
 - 1. Indoor Equipment: Self-adhesive label, Baked-enamel signs, laminated acrylic or melamine plastic sign.
 - 2. Outdoor Equipment: Laminated acrylic or melamine sign.
 - 3. Equipment to Be Labeled:
 - a. Panelboards/Load Centers: Typewritten directory of circuits in the location provided by panelboard manufacturer. Panelboard identification shall be in the form of a self-adhesive, engraved, laminated acrylic or melamine label.
 - b. Enclosures and electrical cabinets.
 - c. Access doors and panels for concealed electrical items.
 - d. Switchgear.
 - e. Enclosed switches.
 - f. Enclosed circuit breakers.
 - g. Enclosed controllers.
 - h. Push-button stations.
 - i. Contactors.
 - j. Remote-controlled switches, dimmer modules, and control devices.
 - k. Monitoring and control equipment.

END OF SECTION 260553

SECTION 260573.13 - SHORT-CIRCUIT STUDIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes a computer-based, fault-current study to determine the minimum interrupting capacity of circuit protective devices.

1.3 DEFINITIONS

- A. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed and salvaged, or removed and reinstalled. Existing to remain items shall remain functional throughout the construction period.
- B. Field Adjusting Agency: An independent electrical testing agency with full-time employees and the capability to adjust devices and conduct testing indicated and that is a member company of NETA.
- C. One-Line Diagram: A diagram that shows, by means of single lines and graphic symbols, the course of an electric circuit or system of circuits and the component devices or parts used therein.
- D. Power System Analysis Software Developer: An entity that commercially develops, maintains, and distributes computer software used for power system studies.
- E. Power Systems Analysis Specialist: Professional engineer in charge of performing the study and documenting recommendations, licensed in the state where Project is located.
- F. Protective Device: A device that senses when an abnormal current flow exists and then removes the affected portion of the circuit from the system.
- G. SCCR: Short-circuit current rating.
- H. Service: The conductors and equipment for delivering electric energy from the serving utility to the wiring system of the premises served.
- I. Single-Line Diagram: See "One-Line Diagram."

1.4 ACTION SUBMITTALS

- A. Product Data:
 - 1. For computer software program to be used for studies.

2. Submit the following after the approval of system protective devices submittals. Submittals shall be in digital form.
 - a. Short-circuit study input data, including completed computer program input data sheets.
 - b. Short-circuit study and equipment evaluation report; signed, dated, and sealed by a qualified professional engineer.
 - 1) Submit study report for action prior to receiving final approval of distribution equipment submittals. If formal completion of studies will cause delay in equipment manufacturing, obtain approval from Architect for preliminary submittal of sufficient study data to ensure that selection of devices and associated characteristics is satisfactory.
 - 2) Revised one-line diagram, reflecting field investigation results and results of short-circuit study.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data:

1. For Power Systems Analysis Software Developer.
2. For Power System Analysis Specialist.
3. For Field Adjusting Agency.

B. Product Certificates: For short-circuit study software, certifying compliance with IEEE 399.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data:

1. For overcurrent protective devices to include in emergency, operation, and maintenance manuals.
2. The following are from the Short-Circuit Study Report:
 - a. Final one-line diagram.
 - b. Final Short-Circuit Study Report.
 - c. Short-circuit study data files.
 - d. Power system data.

1.7 QUALITY ASSURANCE

- A. Study shall be performed using commercially developed and distributed software designed specifically for power system analysis.
- B. Software algorithms shall comply with requirements of standards and guides specified in this Section.
- C. Manual calculations are unacceptable.
 1. Power System Analysis Software Qualifications: Computer program shall be designed to perform short-circuit studies or have a function, component, or add-on module designed to perform short-circuit studies.
 2. Computer program shall be developed under the charge of a licensed professional engineer who holds IEEE Computer Society's Certified Software Development Professional certification.

- D. Power Systems Analysis Specialist Qualifications: Professional engineer licensed in the state where Project is located. All elements of the study shall be performed under the direct supervision and control of this professional engineer.
- E. Short-Circuit Study Certification: Short-Circuit Study Report shall be signed and sealed by Power Systems Analysis Specialist.
- F. Field Adjusting Agency Qualifications:
 - 1. Employer of a NETA ETT-Certified Technician Level III or NICET Electrical Power Testing Level III certification responsible for all field adjusting of the Work.
 - 2. A member company of NETA.
 - 3. Acceptable to authorities having jurisdiction.

PART 2 - PRODUCTS

2.1 POWER SYSTEM ANALYSIS SOFTWARE DEVELOPERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. CGI CYME.
 - 2. Power Analytics, Corporation.
 - 3. SKM Systems Analysis, Inc.
- B. Comply with IEEE 399 and IEEE 551.
 - 1. Analytical features of power systems analysis software program shall have capability to calculate "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.
- C. Computer software program shall be capable of plotting and diagramming time-current-characteristic curves as part of its output.

2.2 SHORT-CIRCUIT STUDY REPORT CONTENTS

- A. Executive summary of study findings.
- B. Study descriptions, purpose, basis, and scope. Include case descriptions, definition of terms, and guide for interpretation of results.
- C. One-line diagram of modeled power system, showing the following:
 - 1. Protective device designations and ampere ratings.
 - 2. Conductor types, sizes, and lengths.
 - 3. Transformer kilovolt ampere (kVA) and voltage ratings.
 - 4. Motor and generator designations and kVA ratings.
 - 5. Switchgear, switchboard, motor-control center, and panelboard designations and ratings.
 - 6. Derating factors and environmental conditions.
 - 7. Any revisions to electrical equipment required by the study.
- D. Comments and recommendations for system improvements or revisions in a written document, separate from one-line diagram.

E. Protective Device Evaluation:

1. Evaluate equipment and protective devices and compare to available short-circuit currents. Verify that equipment withstand ratings exceed available short-circuit current at equipment installation locations.
2. Tabulations of circuit breaker, fuse, and other protective device ratings versus calculated short-circuit duties.
3. For 600-V overcurrent protective devices, ensure that interrupting ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.
4. For devices and equipment rated for asymmetrical fault current, apply multiplication factors listed in standards to 1/2-cycle symmetrical fault current.
5. Verify adequacy of phase conductors at maximum three-phase bolted fault currents; verify adequacy of equipment grounding conductors and grounding electrode conductors at maximum ground-fault currents. Ensure that short-circuit withstand ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.

F. Short-Circuit Study Input Data:

1. One-line diagram of system being studied.
2. Power sources available.
3. Manufacturer, model, and interrupting rating of protective devices.
4. Conductors.
5. Transformer data.

G. Short-Circuit Study Output Reports:

1. Low-Voltage Fault Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:
 - a. Voltage.
 - b. Calculated fault-current magnitude and angle.
 - c. Fault-point X/R ratio.
 - d. Equivalent impedance.
2. Momentary Duty Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:
 - a. Voltage.
 - b. Calculated symmetrical fault-current magnitude and angle.
 - c. Fault-point X/R ratio.
 - d. Calculated asymmetrical fault currents:
 - 1) Based on fault-point X/R ratio.
 - 2) Based on calculated symmetrical value multiplied by 1.6.
 - 3) Based on calculated symmetrical value multiplied by 2.7.
3. Interrupting Duty Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:
 - a. Voltage.
 - b. Calculated symmetrical fault-current magnitude and angle.
 - c. Fault-point X/R ratio.
 - d. No AC Decrement (NACD) ratio.
 - e. Equivalent impedance.

- f. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a symmetrical basis.
- g. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a total basis.

PART 3 - EXECUTION

3.1 POWER SYSTEM DATA

- A. Obtain all data necessary for conduct of the study.
 - 1. Verify completeness of data supplied on one-line diagram. Call any discrepancies to Architect's attention.
 - 2. For equipment included as Work of this Project, use characteristics submitted under provisions of action submittals and information submittals for this Project.
 - 3. For relocated equipment, obtain required electrical distribution system data by field investigation and surveys, conducted by qualified technicians and engineers. Qualifications of technicians and engineers shall be as defined by NFPA 70E.
- B. Gather and tabulate the required input data to support the short-circuit study. Comply with requirements in Section 017839 "Project Record Documents" for recording circuit protective device characteristics. Record data on a Record Document copy of one-line diagram. Comply with recommendations in IEEE 551 as to the amount of detail that is required to be acquired in the field. Field data gathering shall be under direct supervision and control of the engineer in charge of performing the study, and shall be by the engineer or its representative who holds NETA ETT-Certified Technician Level III or NICET Electrical Power Testing Level III certification. Data include, but are not limited to, the following:
 - 1. Product Data for Project's overcurrent protective devices involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
 - 2. Obtain electrical power utility impedance at the service.
 - 3. Power sources and ties.
 - 4. For transformers, include kVA, primary and secondary voltages, connection type, impedance, X/R ratio, taps measured in percent, and phase shift.
 - 5. For reactors, provide manufacturer and model designation, voltage rating, and impedance.
 - 6. For circuit breakers and fuses, provide manufacturer and model designation. List type of breaker, type of trip, SCCR, current rating, and breaker settings.
 - 7. Generator short-circuit current contribution data, including short-circuit reactance, rated kVA, rated voltage, and X/R ratio.
 - 8. Busway manufacturer and model designation, current rating, impedance, lengths, and conductor material.
 - 9. Motor horsepower and NEMA MG 1 code letter designation.
 - 10. Conductor sizes, lengths, number, conductor material and conduit material (magnetic or nonmagnetic).
 - 11. Derating factors.

3.2 SHORT-CIRCUIT STUDY

- A. Perform study following the general study procedures contained in IEEE 399.
- B. Calculate short-circuit currents according to IEEE 551.

- C. Base study on device characteristics supplied by device manufacturer.
- D. Extent of electrical power system to be studied is indicated on Drawings.
- E. Begin short-circuit current analysis at the service, extending down to system overcurrent protective devices as follows:
 - 1. To normal system low-voltage load buses where fault current is 10 kA or less.
 - 2. Exclude equipment rated 240 V ac or less when supplied by a single transformer rated less than 125 kVA.
- F. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for Project. Study all cases of system-switching configurations and alternate operations that could result in maximum fault conditions.
- G. Include the ac fault-current decay from induction motors, synchronous motors, and asynchronous generators and apply to low- and medium-voltage, three-phase ac systems. Also account for the fault-current dc decrement to address asymmetrical requirements of interrupting equipment.
- H. Calculate short-circuit momentary and interrupting duties for a three-phase bolted fault and a single line-to-ground fault at each equipment indicated on one-line diagram.
 - 1. For grounded systems, provide a bolted line-to-ground fault-current study for areas as defined for the three-phase bolted fault short-circuit study.
- I. Include in the report identification of any protective device applied outside its capacity.

END OF SECTION 260573.13

SECTION 260573.16 - COORDINATION STUDIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes computer-based, overcurrent protective device coordination studies to determine overcurrent protective devices and to determine overcurrent protective device settings for selective tripping.
 - 1. Study results shall be used to determine coordination of series-rated devices.

1.3 DEFINITIONS

- A. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled. Existing to remain items shall remain functional throughout the construction period.
- B. Field Adjusting Agency: An independent electrical testing agency with full-time employees and the capability to adjust devices and conduct testing indicated and that is a member company of NETA.
- C. One-Line Diagram: A diagram that shows, by means of single lines and graphic symbols, the course of an electric circuit or system of circuits and the component devices or parts used therein.
- D. Power System Analysis Software Developer: An entity that commercially develops, maintains, and distributes computer software used for power system studies.
- E. Power System Analysis Specialist: Professional engineer in charge of performing the study and documenting recommendations, licensed in the state where Project is located.
- F. Protective Device: A device that senses when an abnormal current flow exists and then removes the affected portion of the circuit from the system.
- G. SCCR: Short-circuit current rating.
- H. Service: The conductors and equipment for delivering electric energy from the serving utility to the wiring system of the premises served.
- I. Single-Line Diagram: See "One-Line Diagram."

1.4 ACTION SUBMITTALS

- A. Product Data:

1. For computer software program to be used for studies.
2. Submit the following after the approval of system protective devices submittals. Submittals shall be in digital form.
 - a. Coordination-study input data, including completed computer program input data sheets.
 - b. Study and equipment evaluation reports.
3. Overcurrent protective device coordination study report; signed, dated, and sealed by a qualified professional engineer.
 - a. Submit study report for action prior to receiving final approval of distribution equipment submittals. If formal completion of studies will cause delay in equipment manufacturing, obtain approval from Architect for preliminary submittal of sufficient study data to ensure that selection of devices and associated characteristics is satisfactory.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data:

1. For Power System Analysis Software Developer.
2. For Power Systems Analysis Specialist.
3. For Field Adjusting Agency.

B. Product Certificates: For overcurrent protective device coordination study software, certifying compliance with IEEE 399.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For overcurrent protective devices to include in emergency, operation, and maintenance manuals.

1. The following are from the Coordination Study Report:
 - a. Final one-line diagram.
 - b. Final protective device coordination study.
 - c. Coordination study data files.
 - d. List of all protective device settings.
 - e. Time-current coordination curves.
 - f. Power system data.

1.7 QUALITY ASSURANCE

- A. Studies shall be performed using commercially developed and distributed software designed specifically for power system analysis.
- B. Software algorithms shall comply with requirements of standards and guides specified in this Section.
- C. Manual calculations are unacceptable.
- D. Power System Analysis Software Qualifications:

1. Computer program shall be designed to perform coordination studies or have a function, component, or add-on module designed to perform coordination studies.
 2. Computer program shall be developed under the charge of a licensed professional engineer who holds IEEE Computer Society's Certified Software Development Professional certification.
- E. Power Systems Analysis Specialist Qualifications: Professional engineer licensed in the state where Project is located. All elements of the study shall be performed under the direct supervision and control of this professional engineer.
- F. Field Adjusting Agency Qualifications:
1. Employer of a NETA ETT-Certified Technician Level III responsible for all field adjusting of the Work.
 2. A member company of NETA.
 3. Acceptable to authorities having jurisdiction.

PART 2 - PRODUCTS

2.1 POWER SYSTEM ANALYSIS SOFTWARE DEVELOPERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. CGI CYME.
 2. Power Analytics, Corporation.
 3. SKM Systems Analysis, Inc.
- B. Comply with IEEE 242 and IEEE 399.
- C. Analytical features of device coordination study computer software program shall have the capability to calculate "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.
- D. Computer software program shall be capable of plotting and diagramming time-current-characteristic curves as part of its output. Computer software program shall report device settings and ratings of all overcurrent protective devices and shall demonstrate selective coordination by computer-generated, time-current coordination plots.
1. Optional Features:
 - a. Arcing faults.
 - b. Simultaneous faults.
 - c. Explicit negative sequence.
 - d. Mutual coupling in zero sequence.

2.2 COORDINATION STUDY REPORT CONTENTS

- A. Executive summary of study findings.
- B. Study descriptions, purpose, basis, and scope. Include case descriptions, definition of terms, and guide for interpretation of results.
- C. One-line diagram of modeled power system, showing the following:

1. Protective device designations and ampere ratings.
 2. Conductor types, sizes, and lengths.
 3. Transformer kilovolt ampere (kVA) and voltage ratings.
 4. Motor and generator designations and kVA ratings.
 5. Switchgear, switchboard, motor-control center, and panelboard designations.
 6. Any revisions to electrical equipment required by the study.
 7. Study Input Data: As described in "Power System Data" Article.
 - a. Short-Circuit Study Output: As specified in "Short-Circuit Study Output Reports" Paragraph in "Short-Circuit Study Report Contents" Article in Section 260573.13 "Short-Circuit Studies."
- D. Protective Device Coordination Study:
1. Report recommended settings of protective devices, ready to be applied in the field. Use manufacturer's data sheets for recording the recommended setting of overcurrent protective devices when available.
 - a. Phase and Ground Relays:
 - 1) Device tag.
 - 2) Relay current transformer ratio and tap, time dial, and instantaneous pickup value.
 - 3) Recommendations on improved relaying systems, if applicable.
 - b. Circuit Breakers:
 - 1) Adjustable pickups and time delays (long time, short time, and ground).
 - 2) Adjustable time-current characteristic.
 - 3) Adjustable instantaneous pickup.
 - 4) Recommendations on improved trip systems, if applicable.
 - c. Fuses: Show current rating, voltage, and class.
- E. Time-Current Coordination Curves: Determine settings of overcurrent protective devices to achieve selective coordination. Graphically illustrate that adequate time separation exists between devices installed in series, including power utility company's upstream devices. Prepare separate sets of curves for the switching schemes and for emergency periods where the power source is local generation. Show the following information:
1. Device tag and title, one-line diagram with legend identifying the portion of the system covered.
 2. Terminate device characteristic curves at a point reflecting maximum symmetrical or asymmetrical fault current to which the device is exposed.
 3. Identify the device associated with each curve by manufacturer type, function, and, if applicable, tap, time delay, and instantaneous settings recommended.
 4. Plot the following listed characteristic curves, as applicable:
 - a. Power utility's overcurrent protective device.
 - b. Medium-voltage equipment overcurrent relays.
 - c. Medium- and low-voltage fuses including manufacturer's minimum melt, total clearing, tolerance, and damage bands.
 - d. Low-voltage equipment circuit-breaker trip devices, including manufacturer's tolerance bands.
 - e. Transformer full-load current, magnetizing inrush current, and ANSI through-fault protection curves.

- f. Cables and conductors damage curves.
 - g. Ground-fault protective devices.
 - h. Motor-starting characteristics and motor damage points.
 - i. Generator short-circuit decrement curve and generator damage point.
 - j. The largest feeder circuit breaker in each motor-control center and panelboard.
5. Maintain selectivity for tripping currents caused by overloads.
 6. Maintain maximum achievable selectivity for tripping currents caused by overloads on series-rated devices.
 7. Provide adequate time margins between device characteristics such that selective operation is achieved.
 8. Comments and recommendations for system improvements.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine Project overcurrent protective device submittals for compliance with electrical distribution system coordination requirements and other conditions affecting performance of the Work. Devices to be coordinated are indicated on Drawings.
 1. Proceed with coordination study only after relevant equipment submittals have been assembled. Overcurrent protective devices that have not been submitted and approved prior to coordination study may not be used in study.

3.2 POWER SYSTEM DATA

- A. Obtain all data necessary for conduct of the overcurrent protective device study.
 1. Verify completeness of data supplied in one-line diagram on Drawings. Call any discrepancies to Architect's attention.
 2. For equipment included as Work of this Project, use characteristics submitted under provisions of action submittals and information submittals for this Project.
 3. For relocated equipment and that which is existing to remain, obtain required electrical distribution system data by field investigation and surveys, conducted by qualified technicians and engineers. Qualifications of technicians and engineers shall be as defined by NFPA 70E.
- B. Gather and tabulate all required input data to support the coordination study. List below is a guide. Comply with recommendations in IEEE 551 for the amount of detail required to be acquired in the field. Field data gathering shall be under direct supervision and control of the engineer in charge of performing the study, and shall be by the engineer or its representative who holds NETA ETT-Certified Technician Level III or NICET Electrical Power Testing Level III certification. Data include, but are not limited to, the following:
 1. Product Data for overcurrent protective devices specified in other Sections and involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
 2. Electrical power utility impedance at the service.
 3. Power sources and ties.
 4. Short-circuit current at each system bus (three phase and line to ground).

5. Full-load current of all loads.
6. Voltage level at each bus.
7. For transformers, include kVA, primary and secondary voltages, connection type, impedance, X/R ratio, taps measured in percent, and phase shift.
8. For reactors, provide manufacturer and model designation, voltage rating, and impedance.
9. For circuit breakers and fuses, provide manufacturer and model designation. List type of breaker, type of trip and available range of settings, SCCR, current rating, and breaker settings.
10. Generator short-circuit current contribution data, including short-circuit reactance, rated kVA, rated voltage, and X/R ratio.
11. For relays, provide manufacturer and model designation, current transformer ratios, potential transformer ratios, and relay settings.
12. Maximum demands from service meters.
13. Busway manufacturer and model designation, current rating, impedance, lengths, size, and conductor material.
14. Motor horsepower and NEMA MG 1 code letter designation.
15. Low-voltage cable sizes, lengths, number, conductor material, and conduit material (magnetic or nonmagnetic).
16. Medium-voltage cable sizes, lengths, conductor material, cable construction, metallic shield performance parameters, and conduit material (magnetic or nonmagnetic).
17. Data sheets to supplement electrical distribution system one-line diagram, cross-referenced with tag numbers on diagram, showing the following:
 - a. Special load considerations, including starting inrush currents and frequent starting and stopping.
 - b. Transformer characteristics, including primary protective device, magnetic inrush current, and overload capability.
 - c. Motor full-load current, locked rotor current, service factor, starting time, type of start, and thermal-damage curve.
 - d. Generator thermal-damage curve.
 - e. Ratings, types, and settings of utility company's overcurrent protective devices.
 - f. Special overcurrent protective device settings or types stipulated by utility company.
 - g. Time-current-characteristic curves of devices indicated to be coordinated.
 - h. Manufacturer, frame size, interrupting rating in amperes root mean square (rms) symmetrical, ampere or current sensor rating, long-time adjustment range, short-time adjustment range, and instantaneous adjustment range for circuit breakers.
 - i. Manufacturer and type, ampere-tap adjustment range, time-delay adjustment range, instantaneous attachment adjustment range, and current transformer ratio for overcurrent relays.
 - j. Switchgear, switchboards, motor-control centers, and panelboards ampacity, and SCCR in amperes rms symmetrical.
 - k. Identify series-rated interrupting devices for a condition where the available fault current is greater than the interrupting rating of downstream equipment. Obtain device data details to allow verification that series application of these devices complies with NFPA 70 and UL 489 requirements.

3.3 COORDINATION STUDY

- A. Comply with IEEE 242 for calculating short-circuit currents and determining coordination time intervals.
- B. Comply with IEEE 399 for general study procedures.
- C. Base study on device characteristics supplied by device manufacturer.
- D. Extent of electrical power system to be studied is indicated on Drawings.

- E. Begin analysis at the service, extending down to system overcurrent protective devices as follows:
 - 1. To normal system low-voltage load buses where fault current is 10 kA or less.
 - 2. Exclude equipment rated 240 V ac or less when supplied by a single transformer rated less than 125 kVA.

- F. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for Project. Study all cases of system-switching configurations and alternate operations that could result in maximum fault conditions.

- G. Transformer Primary Overcurrent Protective Devices:
 - 1. Device shall not operate in response to the following:
 - a. Inrush current when first energized.
 - b. Self-cooled, full-load current or forced-air-cooled, full-load current, whichever is specified for that transformer.
 - c. Permissible transformer overloads according to IEEE C57.96 if required by unusual loading or emergency conditions.
 - 2. Device settings shall protect transformers according to IEEE C57.12.00, for fault currents.

- H. Motor Protection:
 - 1. Select protection for low-voltage motors according to IEEE 242 and NFPA 70.
 - 2. Select protection for motors served at voltages more than 600 V according to IEEE 620.

- I. Conductor Protection: Protect cables against damage from fault currents according to ICEA P-32-382, ICEA P-45-482, and protection recommendations in IEEE 242. Demonstrate that equipment withstands the maximum short-circuit current for a time equivalent to the tripping time of the primary relay protection or total clearing time of the fuse. To determine temperatures that damage insulation, use curves from cable manufacturers or from listed standards indicating conductor size and short-circuit current.

- J. Generator Protection: Select protection according to manufacturer's written instructions and to IEEE 242.

- K. Include the ac fault-current decay from induction motors, synchronous motors, and asynchronous generators and apply to low- and medium-voltage, three-phase ac systems. Also account for fault-current dc decrement, to address asymmetrical requirements of interrupting equipment.

- L. Calculate short-circuit momentary and interrupting duties for a three-phase bolted fault and a single line-to-ground fault at each equipment indicated on one-line diagram.
 - 1. For grounded systems, provide a bolted line-to-ground fault-current study for areas as defined for the three-phase bolted fault short-circuit study.

- M. Protective Device Evaluation:
 - 1. Evaluate equipment and protective devices and compare to short-circuit ratings.
 - 2. Adequacy of switchgear, motor-control centers, and panelboard bus bars to withstand short-circuit stresses.
 - 3. Any application of series-rated devices shall be recertified, complying with requirements in NFPA 70.
 - 4. Include in the report identification of any protective device applied outside its capacity.

3.4 LOAD-FLOW AND VOLTAGE-DROP STUDY

- A. Perform a load-flow and voltage-drop study to determine the steady-state loading profile of the system. Analyze power system performance two times as follows:
 - 1. Determine load flow and voltage drop based on full-load currents obtained in "Power System Data" Article.
 - 2. Determine load flow and voltage drop based on 80 percent of the design capacity of load buses.
 - 3. Prepare load-flow and voltage-drop analysis and report to show power system components that are overloaded, or might become overloaded; show bus voltages that are less than as prescribed by NFPA 70.

3.5 MOTOR-STARTING STUDY

- A. Perform a motor-starting study to analyze the transient effect of system's voltage profile during motor starting. Calculate significant motor-starting voltage profiles and analyze the effects of motor starting on the power system stability.
- B. Prepare the motor-starting study report, noting light flicker for limits proposed by IEEE 141, and voltage sags so as not to affect operation of other utilization equipment on system supplying the motor.

3.6 FIELD ADJUSTING

- A. Adjust relay and protective device settings according to recommended settings provided by the coordination study. Field adjustments shall be completed by the engineering service division of equipment manufacturer under the "Startup and Acceptance Testing" contract portion.
- B. Make minor modifications to equipment as required to accomplish compliance with short-circuit and protective device coordination studies.
- C. Testing and adjusting shall be by a full-time employee of the Field Adjusting Agency, who holds NETA ETT-Certified Technician Level III or NICET Electrical Power Testing Level III certification.
 - 1. Perform each visual and mechanical inspection and electrical test stated in NETA ATS. Certify compliance with test parameters. Perform NETA tests and inspections for all adjustable overcurrent protective devices.

3.7 DEMONSTRATION

- A. Engage Power Systems Analysis Specialist to train Owner's maintenance personnel in the following:
 - 1. Acquaint personnel in fundamentals of operating the power system in normal and emergency modes.
 - 2. Hand-out and explain the coordination study objectives, study descriptions, purpose, basis, and scope. Include case descriptions, definition of terms, and guide for interpreting time-current coordination curves.
 - 3. For Owner's maintenance staff certified as NETA ETT-Certified Technicians Level III or NICET Electrical Power Testing Level III Technicians, teach how to adjust, operate, and maintain overcurrent protective device settings.

CHARTWELLS
735 ANDERSON HILL RD, PURCHASE, NY

SUNY PURCHASE HUB - CAFE RENOVATION
PHASE ZERO DESIGN PROJECT #1518416

END OF SECTION 260573.16

SECTION 260573.19 - ARC-FLASH HAZARD ANALYSIS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes a computer-based, arc-flash study to determine the arc-flash hazard distance and the incident energy to which personnel could be exposed during work on or near electrical equipment.

1.3 DEFINITIONS

- A. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.
- B. Field Adjusting Agency: An independent electrical testing agency with full-time employees and the capability to adjust devices and conduct testing indicated and that is a member company of NETA.
- C. One-Line Diagram: A diagram that shows, by means of single lines and graphic symbols, the course of an electric circuit or system of circuits and the component devices or parts used therein.
- D. Power System Analysis Software Developer: An entity that commercially develops, maintains, and distributes computer software used for power system studies.
- E. Power Systems Analysis Specialist: Professional engineer in charge of performing the study and documenting recommendations, licensed in the state where Project is located.
- F. Protective Device: A device that senses when an abnormal current flow exists and then removes the affected portion from the system.
- G. SCCR: Short-circuit current rating.
- H. Service: The conductors and equipment for delivering electric energy from the serving utility to the wiring system of the premises served.
- I. Single-Line Diagram: See "One-Line Diagram."

1.4 ACTION SUBMITTALS

- A. Product Data: For computer software program to be used for studies.
- B. Study Submittals: Submit the following submittals after the approval of system protective devices submittals. Submittals shall be in digital form:

1. Arc-flash study input data, including completed computer program input data sheets.
2. Arc-flash study report; signed, dated, and sealed by Power Systems Analysis Specialist.
3. Submit study report for action prior to receiving final approval of distribution equipment submittals. If formal completion of studies will cause delay in equipment manufacturing, obtain approval from Architect for preliminary submittal of sufficient study data to ensure that selection of devices and associated characteristics is satisfactory.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data:

1. For Power Systems Analysis Software Developer.
2. For Power System Analysis Specialist.
3. For Field Adjusting Agency.

B. Product Certificates: For arc-flash hazard analysis software, certifying compliance with IEEE 1584 and NFPA 70E.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data:

1. Provide maintenance procedures in equipment manuals according to requirements in NFPA 70E.
2. Operation and Maintenance Procedures: In addition to items specified in Section 017823 "Operation and Maintenance Data," provide maintenance procedures for use by Owner's personnel that comply with requirements in NFPA 70E.

1.7 QUALITY ASSURANCE

- A. Study shall be performed using commercially developed and distributed software designed specifically for power system analysis.
- B. Software algorithms shall comply with requirements of standards and guides specified in this Section.
- C. Manual calculations are unacceptable.
- D. Power System Analysis Software Qualifications: An entity that owns and markets computer software used for studies, having performed successful studies of similar magnitude on electrical distribution systems using similar devices.
 1. Computer program shall be designed to perform arc-flash analysis or have a function, component, or add-on module designed to perform arc-flash analysis.
 2. Computer program shall be developed under the charge of a licensed professional engineer who holds IEEE Computer Society's Certified Software Development Professional certification.
- E. Power Systems Analysis Specialist Qualifications: Professional engineer in charge of performing the arc-flash study, analyzing the arc flash, and documenting recommendations, licensed in the state where Project is located. All elements of the study shall be performed under the direct supervision and control of this professional engineer.

- F. Arc-Flash Study Certification: Arc-Flash Study Report shall be signed and sealed by Power Systems Analysis Specialist.
- G. Field Adjusting Agency Qualifications:
 - 1. Employer of a NETA ETT-Certified Technician Level III or NICET Electrical Power Testing Level III certification responsible for all field adjusting of the Work.
 - 2. A member company of NETA.
 - 3. Acceptable to authorities having jurisdiction.

PART 2 - PRODUCTS

2.1 COMPUTER SOFTWARE DEVELOPERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. CGI CYME.
 - 2. Power Analytics, Corporation.
 - 3. SKM Systems Analysis, Inc.
- B. Comply with IEEE 1584 and NFPA 70E.
- C. Analytical features of device coordination study computer software program shall have the capability to calculate "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.

2.2 ARC-FLASH STUDY REPORT CONTENT

- A. Executive summary of study findings.
- B. Study descriptions, purpose, basis, and scope. Include case descriptions, definition of terms, and guide for interpretation of results.
- C. One-line diagram, showing the following:
 - 1. Protective device designations and ampere ratings.
 - 2. Conductor types, sizes, and lengths.
 - 3. Transformer kilovolt ampere (kVA) and voltage ratings, including derating factors and environmental conditions.
 - 4. Motor and generator designations and kVA ratings.
 - 5. Switchgear, switchboard, motor-control center, panelboard designations, and ratings.
- D. Study Input Data: As described in "Power System Data" Article.
- E. Short-Circuit Study Output Data: As specified in "Short-Circuit Study Output Reports" Paragraph in "Short-Circuit Study Report Contents" Article in Section 260573.13 "Short-Circuit Studies."
- F. Protective Device Coordination Study Report Contents: As specified in "Coordination Study Report Contents" Article in Section 260573.16 "Coordination Studies."
- G. Arc-Flash Study Output Reports:

1. Interrupting Duty Report: Three-phase and unbalanced fault calculations, showing the following for each equipment location included in the report:
 - a. Voltage.
 - b. Calculated symmetrical fault-current magnitude and angle.
 - c. Fault-point X/R ratio.
 - d. No AC Decrement (NACD) ratio.
 - e. Equivalent impedance.
 - f. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a symmetrical basis.
 - g. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a total basis.

H. Incident Energy and Flash Protection Boundary Calculations:

1. Arcing fault magnitude.
2. Protective device clearing time.
3. Duration of arc.
4. Arc-flash boundary.
5. Restricted approach boundary.
6. Limited approach boundary.
7. Working distance.
8. Incident energy.
9. Hazard risk category.
10. Recommendations for arc-flash energy reduction.

I. Fault study input data, case descriptions, and fault-current calculations including a definition of terms and guide for interpretation of computer printout.

2.3 ARC-FLASH WARNING LABELS

- A. Comply with requirements in Section 260553 "Identification for Electrical Systems" for self-adhesive equipment labels. Produce a 3.5-by-5-inch self-adhesive equipment label for each work location included in the analysis.
- B. Label shall have an orange header with the wording, "WARNING, ARC-FLASH HAZARD," and shall include the following information taken directly from the arc-flash hazard analysis:
 1. Location designation.
 2. Nominal voltage.
 3. Protection boundaries.
 - a. Arc-flash boundary.
 - b. Restricted approach boundary.
 - c. Limited approach boundary.
 4. Arc flash PPE category.
 5. Required minimum arc rating of PPE in Cal/cm squared.
 6. Available incident energy.
 7. Working distance.
 8. Engineering report number, revision number, and issue date.
- C. Labels shall be machine printed, with no field-applied markings.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine Project overcurrent protective device submittals. Proceed with arc-flash study only after relevant equipment submittals have been assembled. Overcurrent protective devices that have not been submitted and approved prior to arc-flash study may not be used in study.

3.2 ARC-FLASH HAZARD ANALYSIS

- A. Comply with NFPA 70E and its Annex D for hazard analysis study.
- B. Preparatory Studies: Perform the Short-Circuit Protective Device Coordination studies prior to starting the Arc-Flash Hazard Analysis.
 - 1. Short-Circuit Study Output: As specified in "Short-Circuit Study Output Reports" Paragraph in "Short-Circuit Study Report Contents" Article in Section 260573.13 "Short-Circuit Studies."
 - 2. Coordination Study Report Contents: As specified in "Coordination Study Report Contents" Article in Section 260573.16 "Coordination Studies."
- C. Calculate maximum and minimum contributions of fault-current size.
 - 1. Maximum calculation shall assume a maximum contribution from the utility and shall assume motors to be operating under full-load conditions.
 - 2. Calculate arc-flash energy at 85 percent of maximum short-circuit current according to IEEE 1584 recommendations.
 - 3. Calculate arc-flash energy at 38 percent of maximum short-circuit current according to NFPA 70E recommendations.
 - 4. Calculate arc-flash energy with the utility contribution at a minimum and assume no motor contribution.
- D. Calculate the arc-flash protection boundary and incident energy at locations in electrical distribution system where personnel could perform work on energized parts.
- E. Include medium- and low-voltage equipment locations, except equipment rated 240 V ac or less fed from transformers less than 125 kVA.
- F. Calculate the limited, restricted, and prohibited approach boundaries for each location.
- G. Incident energy calculations shall consider the accumulation of energy over time when performing arc-flash calculations on buses with multiple sources. Iterative calculations shall take into account the changing current contributions, as the sources are interrupted or decremented with time. Fault contribution from motors and generators shall be decremented as follows:
 - 1. Fault contribution from induction motors shall not be considered beyond three to five cycles.
 - 2. Fault contribution from synchronous motors and generators shall be decayed to match the actual decrement of each as closely as possible (for example, contributions from permanent magnet generators will typically decay from 10 per unit to three per unit after 10 cycles).
- H. Arc-flash energy shall generally be reported for the maximum of line or load side of a circuit breaker. However, arc-flash computation shall be performed and reported for both line and load side of a circuit breaker as follows:

1. When the circuit breaker is in a separate enclosure.
 2. When the line terminals of the circuit breaker are separate from the work location.
- I. Base arc-flash calculations on actual overcurrent protective device clearing time. Cap maximum clearing time at two seconds based on IEEE 1584, Section B.1.2.

3.3 POWER SYSTEM DATA

- A. Obtain all data necessary for conduct of the arc-flash hazard analysis.
1. Verify completeness of data supplied on one-line diagram on Drawings and under "Preparatory Studies" Paragraph in "Arc-Flash Hazard Analysis" Article. Call discrepancies to Architect's attention.
 2. For new equipment, use characteristics from approved submittals under provisions of action submittals and information submittals for this Project.
 3. For existing equipment, whether or not relocated, obtain required electrical distribution system data by field investigation and surveys conducted by qualified technicians and engineers.
- B. Electrical Survey Data: Gather and tabulate the following input data to support study. Comply with recommendations in IEEE 1584 and NFPA 70E as to the amount of detail that is required to be acquired in the field. Field data gathering shall be under the direct supervision and control of the engineer in charge of performing the study, and shall be by the engineer or its representative who holds NETA ETT-Certified Technician Level III or NICET Electrical Power Testing Level III certification. Data include, but are not limited to, the following:
1. Product Data for overcurrent protective devices specified in other Sections and involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
 2. Obtain electrical power utility impedance or available short circuit current at the service.
 3. Power sources and ties.
 4. Short-circuit current at each system bus (three phase and line to ground).
 5. Full-load current of all loads.
 6. Voltage level at each bus.
 7. For transformers, include kVA, primary and secondary voltages, connection type, impedance, X/R ratio, taps measured in percent, and phase shift.
 8. For reactors, provide manufacturer and model designation, voltage rating and impedance.
 9. For circuit breakers and fuses, provide manufacturer and model designation. List type of breaker, type of trip and available range of settings, SCCR, current rating, and breaker settings.
 10. Generator short-circuit current contribution data, including short-circuit reactance, rated kVA, rated voltage, and X/R ratio.
 11. For relays, provide manufacturer and model designation, current transformer ratios, potential transformer ratios, and relay settings.
 12. Busway manufacturer and model designation, current rating, impedance, lengths, size, and conductor material.
 13. Motor horsepower and NEMA MG 1 code letter designation.
 14. Low-voltage conductor sizes, lengths, number, conductor material and conduit material (magnetic or nonmagnetic).
 15. Medium-voltage conductor sizes, lengths, conductor material, conductor construction and metallic shield performance parameters, and conduit material (magnetic or nonmagnetic).

3.4 LABELING

- A. Apply one arc-flash label on the front cover of each section of the equipment and on side or rear covers with accessible live parts and hinged doors or removable plates for each equipment included in the study. Base arc-flash label data on highest values calculated at each location.
- B. Each piece of equipment listed below shall have an arc-flash label applied to it:
 - 1. Low-voltage switchboard.
 - 2. Switchgear.
 - 3. Medium-voltage switch.
 - 4. Medium voltage transformers
 - 5. Low voltage transformers
 - 6. Panelboard and safety switch over 250 V.
 - 7. Applicable panelboard and safety switch under 250 V.
 - 8. Control panel.
- C. Note on record Drawings the location of equipment where the personnel could be exposed to arc-flash hazard during their work.
 - 1. Indicate arc-flash energy.
 - 2. Indicate protection level required.

3.5 APPLICATION OF WARNING LABELS

- A. Install arc-flash warning labels under the direct supervision and control of Power System Analysis Specialist.

3.6 DEMONSTRATION

- A. Engage Power Systems Analysis Specialist to train Owner's maintenance personnel in potential arc-flash hazards associated with working on energized equipment and the significance of arc-flash warning labels.

END OF SECTION 260573.19

SECTION 260923 - LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

- 1. Time switches.
- 2. Photoelectric switches.
- 3. Indoor occupancy and vacancy sensors.
- 4. Switchbox-mounted occupancy sensors.
- 5. Digital timer light switches.

- B. Related Requirements:

- 1. Section 262726 "Wiring Devices" for wall-box dimmers, non-networkable wall-switch occupancy sensors, and manual light switches.

1.3 ACTION SUBMITTALS

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

- B. Shop Drawings:

- 1. Show installation details for the following:
 - a. Occupancy sensors.
 - b. Vacancy sensors.
- 2. Interconnection diagrams showing field-installed wiring.
- 3. Include diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plan(s) and elevations, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

- 1. Suspended ceiling components.
- 2. Structural members to which equipment will be attached.
- 3. Items penetrating finished ceiling, including the following:
 - a. Luminaires.

- b. Air outlets and inlets.
- c. Access panels.
- d. Control modules.

- B. Field quality-control reports.
- C. Sample Warranty: For manufacturer's warranties.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For each type of lighting control device to include in operation and maintenance manuals.
- B. Software and Firmware Operational Documentation:
 - 1. Software operating and upgrade manuals.
 - 2. Program Software Backup: On USB media. Provide names, versions, and website addresses for locations of installed software.
 - 3. Device address list.
 - 4. Printout of software application and graphic screens.

1.6 WARRANTY

- A. Manufacturer's Warranty: Manufacturer and Installer agree to repair or replace lighting control devices that fail(s) in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Faulty operation of lighting control software.
 - b. Faulty operation of lighting control devices.
 - 2. Warranty Period: Two year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 TIME SWITCHES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Intermatic, Inc.
 - 2. NSi Industries LLC.
- B. Electronic Time Switches: Solid state, programmable, with alphanumeric display; complying with UL 917.
 - 1. Listed and labeled as defined in NFPA 70 and marked for intended location and application.
 - 2. Contact Configuration: SPDT.
 - 3. Contact Rating: 30-A inductive or resistive, 240-V AC.
 - 4. Programs: 99 on-off set points on a 24-hour schedule and an annual holiday schedule that overrides the weekly operation on holidays.

5. Programs: 2 channels; each channel is individually programmable with 99 ON/OFF set points on a 24-hour schedule.
6. Circuitry: Allow connection of a photoelectric relay as substitute for on-off function of a program.
7. Astronomic Time: All channels.
8. Automatic daylight savings time changeover.
9. Battery Backup: Not less than seven days reserve, to maintain schedules and time clock.

2.2 INDOOR OCCUPANCY AND VACANCY SENSORS

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

1. Hubbell Building Automation, Inc.
2. Leviton Manufacturing Co., Inc.
3. Lutron Electronics Co., Inc.
4. Sensor Switch, Inc.
5. Watt Stopper.

B. General Requirements for Sensors:

1. Wall or Ceiling-mounted, solid-state indoor occupancy and vacancy sensors.
2. Passive infrared, Ultrasonic, Dual technology.
3. Separate power pack.
4. Hardwired connection to switch and BAS.
5. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
6. Operation:
 - a. Occupancy Sensor: Unless otherwise indicated, turn lights on when coverage area is occupied, and turn them off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
 - b. Vacancy Sensor: Unless otherwise indicated, lights are manually turned on and sensor turns lights off when the room is unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
 - c. Combination Sensor: Unless otherwise indicated, sensor shall be programmed to turn lights on when coverage area is occupied and turn them off when unoccupied, or to turn off lights that have been manually turned on; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
7. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A. Sensor is powered from the power pack.
8. Power: Line voltage.
9. Power Pack: Dry contacts rated for 20-A ballast or LED load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Sensor has 24-V dc, 150-mA, Class 2 power source, as defined by NFPA 70.
10. Mounting:
 - a. Sensor: Suitable for mounting in any position on a standard outlet box.
 - b. Relay: Externally mounted through a 1/2-inch knockout in a standard electrical enclosure.
 - c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.
11. Indicator: Digital display, to show when motion is detected during testing and normal operation of sensor.
12. Bypass Switch: Override the "on" function in case of sensor failure.

13. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc; turn lights off when selected lighting level is present.
- C. PIR Type: Wall or Ceiling mounted; detect occupants in coverage area by their heat and movement.
1. Detector Sensitivity: Detect occurrences of 6-inch-minimum movement of any portion of a human body that presents a target of not less than 36 sq. in.
 2. Detection Coverage (Room, Ceiling Mounted): Detect occupancy anywhere in a circular area of 1000 sq. ft. when mounted on a 96-inch-high ceiling.
 3. Detection Coverage (Corridor, Ceiling Mounted): Detect occupancy within 90 feet when mounted on a 10-foot-high ceiling.
 4. Detection Coverage (Room, Wall Mounted): Detect occupancy anywhere within a 180-degree pattern centered on the sensor over an area of 1000 square feet when mounted 48 inches above finished floor.
- D. Ultrasonic Type: Wall or Ceiling mounted; detect occupants in coverage area through pattern changes of reflected ultrasonic energy.
1. Detector Sensitivity: Detect a person of average size and weight moving not less than 12 inches in either a horizontal or a vertical manner at an approximate speed of 12 inches/s.
 2. Detection Coverage (Small Room): Detect occupancy anywhere within a circular area of 600 sq. ft. when mounted on a 96-inch-high ceiling.
 3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. when mounted on a 96-inch-high ceiling.
 4. Detection Coverage (Large Room): Detect occupancy anywhere within a circular area of 2000 sq. ft. when mounted on a 96-inch-high ceiling.
 5. Detection Coverage (Corridor): Detect occupancy anywhere within 90 feet when mounted on a 10-foot-high ceiling in a corridor not wider than 14 feet.
 6. Detection Coverage (Room, Wall Mounted): Detect occupancy anywhere within a 180-degree pattern centered on the sensor over an area of 2000 square feet when mounted 84 inches above finished floor.
- E. Dual-Technology Type: Wall or Ceiling mounted; detect occupants in coverage area using PIR and ultrasonic detection methods. The particular technology or combination of technologies that control on-off functions is selectable in the field by operating controls on unit.
1. Sensitivity Adjustment: Separate for each sensing technology.
 2. Detector Sensitivity: Detect occurrences of 6-inch-minimum movement of any portion of a human body that presents a target of not less than 36 sq. in., and detect a person of average size and weight moving not less than 12 inches in either a horizontal or a vertical manner at an approximate speed of 12 inches/s.
 3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. when mounted on a 96-inch-high ceiling.
 4. Detection Coverage (Room, Wall Mounted): Detect occupancy anywhere within a 180-degree pattern centered on the sensor over an area of 1000 square feet when mounted 48 inches above finished floor.
- 2.3 SWITCHBOX-MOUNTED OCCUPANCY SENSORS
- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Sensor Switch, Inc.
 2. Hubbell Building Automation, Inc.

3. Leviton Manufacturing Co., Inc.
 4. Lutron Electronics Co., Inc.
 5. Watt Stopper.
- B. General Requirements for Sensors: Automatic-wall-switch occupancy sensor with manual on-off switch, suitable for mounting in a single gang switchbox.
1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 2. Occupancy Sensor Operation: Unless otherwise indicated, turn lights on when coverage area is occupied, and turn lights off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
 3. Operating Ambient Conditions: Dry interior conditions, 32 to 120 deg F.
 4. Switch Rating: Not less than 800-VA ballast or LED load at 120 V, 1200-VA ballast or LED load at 277 V, and 800-W incandescent.
- C. Wall-Switch Sensor, WS1:
1. Standard Range: 180-degree field of view, field adjustable from 180 to 40 degrees; with a minimum coverage area of 2100 sq. ft.
 2. Sensing Technology: Dual technology - PIR and ultrasonic.
 3. Switch Type: SP, field-selectable automatic "on," or manual "on," automatic "off."
 4. Capable of controlling load in three-way application.
 5. Voltage: Dual voltage - 120 and 277 V.
 6. Ambient-Light Override: Concealed, field-adjustable, light-level sensor from 10 to 150 fc. The switch prevents the lights from turning on when the light level is higher than the set point of the sensor.
 7. Concealed, field-adjustable, "off" time-delay selector at up to 30 minutes.
 8. Concealed, "off" time-delay selector at 30 seconds and 5, 10, and 20 minutes.
 9. Adaptive Technology: Self-adjusting circuitry detects and memorizes usage patterns of the space and helps eliminate false "off" switching.
 10. Color: White.
 11. Faceplate: Color matched to switch.
- D. Wall-Switch Sensor, WS2:
1. Standard Range: 210-degree field of view, with a minimum coverage area of 900 sq. ft.
 2. Sensing Technology: PIR.
 3. Switch Type: SP, field-selectable automatic "on," or manual "on," automatic "off."
 4. Capable of controlling load in three-way application.
 5. Voltage: Dual voltage, 120 and 277 V.
 6. Ambient-Light Override: Concealed, field-adjustable, light-level sensor from 10 to 150 fc. The switch prevents the lights from turning on when the light level is higher than the set point of the sensor.
 7. Concealed, field-adjustable, "off" time-delay selector at up to 30 minutes.
 8. Concealed, "off" time-delay selector at 30 seconds and 5, 10, and 20 minutes.
 9. Adaptive Technology: Self-adjusting circuitry detects and memorizes usage patterns of the space and helps eliminate false "off" switching.
 10. Color: White.
 11. Faceplate: Color matched to switch.

2.4 DIGITAL TIMER LIGHT SWITCH

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Intermatic, Inc.
 2. Watt Stopper.
 3. Leviton Manufacturing Co., Inc.
 4. NSi Industries LLC.
- B. Description: Combination digital timer and conventional switch lighting control unit. Switchbox-mounted, backlit LCD display, with selectable time interval in 10 minute increments.
1. Rated 960 W at 120-V ac for tungsten lighting, 10 A at 120-V ac or 10 amps at 277-V ac for ballast or LED, and 1/4 horsepower at 120-V ac.
 2. Integral relay for connection to BAS.
 3. Voltage: Dual voltage - 120 and 277 V.
 4. Color: White.
 5. Faceplate: Color matched to switch.
- C. Description: NC, electrically held relay, arranged for wiring in parallel with manual or automatic switching contacts; complying with UL 924.
1. Coil Rating: 120 V.

2.5 CONDUCTORS AND CABLES

- A. Power Wiring to Supply Side of Remote-Control Power Sources: Not smaller than No. 12 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- B. Classes 2 and 3 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 18 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- C. Class 1 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 14 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine lighting control devices before installation. Reject lighting control devices that are wet, moisture damaged, or mold damaged.
- B. Examine walls and ceilings for suitable conditions where lighting control devices will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 SENSOR INSTALLATION

- A. Comply with NECA 1.
- B. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke detectors, fire-suppression systems, and partition assemblies.
- C. Install and aim sensors in locations to achieve not less than 90-percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions.

3.3 CONTACTOR INSTALLATION

- A. Comply with NECA 1.
- B. 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.

3.4 WIRING INSTALLATION

- A. Comply with NECA 1.
- B. Wiring Method: Comply with Section 260519 "Low-Voltage Electrical Power Conductors and Cables." Minimum conduit size is 1/2 inch.
- C. Wiring within Enclosures: Comply with NECA 1. Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.
- D. Size conductors according to lighting control device manufacturer's written instructions unless otherwise indicated.
- E. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

3.5 IDENTIFICATION

- A. Identify components and power and control wiring according to Section 260553 "Identification for Electrical Systems."
 - 1. Identify controlled circuits in lighting contactors.
 - 2. Identify circuits or luminaires controlled by photoelectric and occupancy sensors at each sensor.
- B. Label time switches and contactors with a unique designation.

3.6 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. Operational Test: After installing time switches and sensors, and after electrical circuitry has been energized, start units to confirm proper unit operation.
 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- B. Lighting control devices will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports.

3.7 ADJUSTING

- A. Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting lighting control devices to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.
1. For occupancy and motion sensors, verify operation at outer limits of detector range. Set time delay to suit Owner's operations.
 2. For daylighting controls, adjust set points and deadband controls to suit Owner's operations.
 3. Align high-bay occupancy sensors using manufacturer's laser aiming tool.

3.8 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain lighting control devices.

END OF SECTION 260923

SECTION 262416 - PANELBOARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Lighting and appliance branch-circuit panelboards.

1.3 DEFINITIONS

- A. ATS: Acceptance testing specification.
- B. GFCI: Ground-fault circuit interrupter.
- C. GFEP: Ground-fault equipment protection.
- D. HID: High-intensity discharge.
- E. MCCB: Molded-case circuit breaker.
- F. SPD: Surge protective device.
- G. VPR: Voltage protection rating.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of panelboard.
 - 1. Include materials, switching and overcurrent protective devices, SPDs, accessories, and components indicated.
 - 2. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
- B. Shop Drawings: For each panelboard and related equipment.
 - 1. Include dimensioned plans, elevations, sections, and details.
 - 2. Show tabulations of installed devices with nameplates, conductor termination sizes, equipment features, and ratings.
 - 3. Detail enclosure types including mounting and anchorage, environmental protection, knockouts, corner treatments, covers and doors, gaskets, hinges, and locks.
 - 4. Detail bus configuration, current, and voltage ratings.

5. Short-circuit current rating of panelboards and overcurrent protective devices.
6. Include evidence of NRTL listing for series rating of installed devices.
7. Include evidence of NRTL listing for SPD as installed in panelboard.
8. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
9. Include wiring diagrams for power, signal, and control wiring.
10. Key interlock scheme drawing and sequence of operations.
11. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards. Submit on translucent log-log graph paper; include selectable ranges for each type of overcurrent protective device. Include an Internet link for electronic access to downloadable PDF of the coordination curves.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing agency.
- B. Panelboard Schedules: For installation in panelboards. Submit final versions after load balancing.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
 1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
 2. Time-current curves, including selectable ranges for each type of overcurrent protective device that allows adjustments.

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 1. Keys: Two spares for each type of panelboard cabinet lock.
 2. Circuit Breakers Including GFCI and GFEP Types: Include quantity of spares for each panelboard per panelboard schedules on drawings.
 3. Fuses for Fused Switches: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
 4. Fuses for Fused Power-Circuit Devices: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.

1.8 QUALITY ASSURANCE

- A. Manufacturer Qualifications: ISO 9001 or 9002 certified.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Remove loose packing and flammable materials from inside panelboards; install temporary electric heating (250 W per panelboard) to prevent condensation.

- B. Handle and prepare panelboards for installation according to NECA 407.

1.10 FIELD CONDITIONS

- A. Environmental Limitations:

1. Do not deliver or install panelboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above panelboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:
 - a. Ambient Temperature: Not exceeding 23 deg F to plus 104 deg F.
 - b. Altitude: Not exceeding 6600 feet.

- B. Service Conditions: NEMA PB 1, usual service conditions, as follows:

1. Ambient temperatures within limits specified.
2. Altitude not exceeding 6600 feet.

1.11 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to repair or replace panelboards that fail in materials or workmanship within specified warranty period.

1. Panelboard Warranty Period: 18 months from date of Substantial Completion.

- B. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace SPD that fails in materials or workmanship within specified warranty period.

1. SPD Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PANELBOARDS COMMON REQUIREMENTS

- A. Fabricate and test panelboards according to IEEE 344 to withstand seismic forces defined in Section 260548 "Vibration and Seismic Controls for Electrical Systems."
- B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for panelboards including clearances between panelboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- D. Comply with NEMA PB 1.
- E. Comply with NFPA 70.

- F. Enclosures: Flush and Surface-mounted, dead-front cabinets.
1. Rated for environmental conditions at installed location.
 - a. Indoor Dry and Clean Locations: NEMA 250, Type 1.
 - b. Outdoor Locations: NEMA 250, Type 3R.
 - c. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.
 - d. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.
 2. Height: 84 inches maximum.
 3. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box. Trims shall cover all live parts and shall have no exposed hardware.
 4. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover. Trims shall cover all live parts and shall have no exposed hardware.
 5. Skirt for Surface-Mounted Panelboards: Same gage and finish as panelboard front with flanges for attachment to panelboard, wall, and ceiling or floor.
 6. Gutter Extension and Barrier: Same gage and finish as panelboard enclosure; integral with enclosure body. Arrange to isolate individual panel sections.
 7. Finishes:
 - a. Panels and Trim: galvanized steel, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
 - b. Back Boxes: Galvanized steel, same finish as panels and trim.
- G. Incoming Mains:
1. Location: Convertible between top and bottom.
 2. Main Breaker: Main lug interiors up to 400 amperes shall be field convertible to main breaker.
- H. Phase, Neutral, and Ground Buses:
1. Material: Hard-drawn copper, 98 percent conductivity.
 - a. Plating shall run entire length of bus.
 - b. Bus shall be fully rated the entire length.
 2. Interiors shall be factory assembled into a unit. Replacing switching and protective devices shall not disturb adjacent units or require removing the main bus connectors.
 3. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.
 4. Isolated Ground Bus: Adequate for branch-circuit isolated ground conductors; insulated from box.
 5. Full-Sized Neutral: Equipped with full-capacity bonding strap for service entrance applications. Mount electrically isolated from enclosure. Do not mount neutral bus in gutter.
 6. Extra-Capacity Neutral Bus: Neutral bus rated 200 percent of phase bus and listed and labeled by an NRTL acceptable to authority having jurisdiction, as suitable for nonlinear loads in electronic-grade panelboards and others designated on Drawings. Connectors shall be sized for double-sized or parallel conductors as indicated on Drawings. Do not mount neutral bus in gutter.
 7. Split Bus: Vertical buses divided into individual vertical sections.
- I. Conductor Connectors: Suitable for use with conductor material and sizes.

1. Material: Hard-drawn copper, 98 percent conductivity.
 2. Terminations shall allow use of 75 deg C rated conductors without derating.
 3. Size: Lugs suitable for indicated conductor sizes, with additional gutter space, if required, for larger conductors.
 4. Main and Neutral Lugs: Mechanical type, with a lug on the neutral bar for each pole in the panelboard.
 5. Ground Lugs and Bus-Configured Terminators: Mechanical type, with a lug on the bar for each pole in the panelboard.
 6. Feed-Through Lugs: Mechanical type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
 7. Subfeed (Double) Lugs: Mechanical type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.
 8. Gutter-Tap Lugs: Mechanical type suitable for use with conductor material and with matching insulating covers. Locate at same end of bus as incoming lugs or main device.
 9. Extra-Capacity Neutral Lugs: Rated 200 percent of phase lugs mounted on extra-capacity neutral bus.
- J. NRTL Label: Panelboards or load centers shall be labeled by an NRTL acceptable to authority having jurisdiction for use as service equipment with one or more main service disconnecting and overcurrent protective devices. Panelboards or load centers shall have meter enclosures, wiring, connections, and other provisions for utility metering. Coordinate with utility company for exact requirements.
- K. Future Devices: Panelboards shall have mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.
1. Percentage of Future Space Capacity: 20 percent.
- L. Panelboard Short-Circuit Current Rating: Rated for series-connected system with integral or remote upstream overcurrent protective devices and labeled by an NRTL. Include label or manual with size and type of allowable upstream and branch devices listed and labeled by an NRTL for series-connected short-circuit rating.
1. Panelboards rated 240 V or less shall have short-circuit ratings as shown on Drawings, but not less than 10,000 A rms symmetrical.
 2. Panelboards rated above 240 V and less than 600 V shall have short-circuit ratings as shown on Drawings, but not less than 14,000 A rms symmetrical.
- M. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals. Assembly listed by an NRTL for 100 percent interrupting capacity.
1. Panelboards and overcurrent protective devices rated 240 V or less shall have short-circuit ratings as shown on Drawings, but not less than 10,000 A rms symmetrical.
 2. Panelboards and overcurrent protective devices rated above 240 V and less than 600 V shall have short-circuit ratings as shown on Drawings, but not less than 14,000 A rms symmetrical.
- 2.2 PERFORMANCE REQUIREMENTS
- A. Seismic Performance: Panelboards shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."

- B. Surge Suppression: Factory installed as an integral part of indicated panelboards, complying with UL 1449 SPD Type 2.

2.3 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. General Electric Company; GE Energy Management - Electrical Distribution.
 - 2. Siemens Energy.
 - 3. Square D; by Schneider Electric.
- B. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.
- C. Mains: Circuit breaker or lugs only.
- D. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.
- E. Contactors in Main Bus: NEMA ICS 2, Class A, mechanically held, general-purpose controller, with same short-circuit interrupting rating as panelboard.
 - 1. Internal Control-Power Source: Control-power transformer, with fused primary and secondary terminals, connected to main bus ahead of contactor connection.
 - 2. External Control-Power Source: 120-V branch circuit.
- F. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.
- G. Doors: Door-in-door construction with concealed hinges; secured with multipoint latch with tumbler lock; keyed alike. Outer door shall permit full access to the panel interior. Inner door shall permit access to breaker operating handles and labeling, but current carrying terminals and bus shall remain concealed.

2.4 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. General Electric Company; GE Energy Management - Electrical Distribution.
 - 2. Siemens Energy.
 - 3. Square D; by Schneider Electric.
- B. MCCB: Comply with UL 489, with interrupting capacity to meet available fault currents.
 - 1. Thermal-Magnetic Circuit Breakers:
 - a. Inverse time-current element for low-level overloads.
 - b. Instantaneous magnetic trip element for short circuits.
 - c. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
 - 2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
 - 3. Electronic Trip Circuit Breakers:
 - a. RMS sensing.

- b. Field-replaceable rating plug or electronic trip.
 - c. Digital display of settings, trip targets, and indicated metering displays.
 - d. Multi-button keypad to access programmable functions and monitored data.
 - e. Ten-event, trip-history log. Each trip event shall be recorded with type, phase, and magnitude of fault that caused the trip.
 - f. Integral test jack for connection to portable test set or laptop computer.
 - g. Field-Adjustable Settings:
 - 1) Instantaneous trip.
 - 2) Long- and short-time pickup levels.
 - 3) Long and short time adjustments.
 - 4) Ground-fault pickup level, time delay, and I squared T response.
4. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
5. GFCI Circuit Breakers: Single- and double-pole configurations with Class A ground-fault protection (6-mA trip).
6. GFEP Circuit Breakers: Class B ground-fault protection (30-mA trip).
7. Arc-Fault Circuit Interrupter Circuit Breakers: Comply with UL 1699; 120/240-V, single-pole configuration.
8. Subfeed Circuit Breakers: Vertically mounted.
9. MCCB Features and Accessories:
- a. Standard frame sizes, trip ratings, and number of poles.
 - b. Breaker handle indicates tripped status.
 - c. UL listed for reverse connection without restrictive line or load ratings.
 - d. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.
 - e. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and HID lighting circuits.
 - f. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
 - g. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 75 percent of rated voltage.
 - h. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage with field-adjustable 0.1- to 0.6-second time delay.
 - i. Rating Plugs: Three-pole breakers with ampere ratings greater than 150 amperes shall have interchangeable rating plugs or electronic adjustable trip units.
 - j. Auxiliary Contacts: Two, SPDT switches with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts and "b" contacts operate in reverse of circuit-breaker contacts.
 - k. Alarm Switch: Single-pole, normally open contact that actuates only when circuit breaker trips.
 - l. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.
 - m. Zone-Selective Interlocking: Integral with electronic trip unit; for interlocking ground-fault protection function with other upstream or downstream devices.
 - n. Multipole units enclosed in a single housing with a single handle or factory assembled to operate as a single unit.
 - o. Handle Padlocking Device: Fixed attachment, for locking circuit-breaker handle in "on" or "off" position.
 - p. Handle Clamp: Loose attachment, for holding circuit-breaker handle in on position.

2.5 IDENTIFICATION

- A. Panelboard Label: Manufacturer's name and trademark, voltage, amperage, number of phases, and number of poles shall be located on the interior of the panelboard door.
- B. Breaker Labels: Faceplate shall list current rating, UL and IEC certification standards, and AIC rating.
- C. Circuit Directory: Directory card inside panelboard door, mounted in transparent card holder.
 - 1. Circuit directory shall identify specific purpose with detail sufficient to distinguish it from all other circuits.
- D. Circuit Directory: Computer-generated circuit directory mounted inside panelboard door with transparent plastic protective cover.
 - 1. Circuit directory shall identify specific purpose with detail sufficient to distinguish it from all other circuits.

2.6 ACCESSORY COMPONENTS AND FEATURES

- A. Accessory Set: Include tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.
- B. Portable Test Set: For testing functions of solid-state trip devices without removing from panelboard. Include relay and meter test plugs suitable for testing panelboard meters and switchboard class relays.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify actual conditions with field measurements prior to ordering panelboards to verify that equipment fits in allocated space in, and comply with, minimum required clearances specified in NFPA 70.
- B. Receive, inspect, handle, and store panelboards according to NECA 407.
- C. Examine panelboards before installation. Reject panelboards that are damaged, rusted, or have been subjected to water saturation.
- D. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

- B. Comply with NECA 1.
- C. Install panelboards and accessories according to NECA 407.
- D. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from panelboards.
- E. Comply with mounting and anchoring requirements specified in Section 260548.16 "Seismic Controls for Electrical Systems."
- F. Mount top of trim 90 inches above finished floor unless otherwise indicated.
- G. Mount panelboard cabinet plumb and rigid without distortion of box.
- H. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.
- I. Mount surface-mounted panelboards to steel slotted supports 1 1/4 inch in depth. Orient steel slotted supports vertically.
- J. Install overcurrent protective devices and controllers not already factory installed.
 - 1. Set field-adjustable, circuit-breaker trip ranges.
 - 2. Tighten bolted connections and circuit breaker connections using calibrated torque wrench or torque screwdriver per manufacturer's written instructions.
- K. Make grounding connections and bond neutral for services and separately derived systems to ground. Make connections to grounding electrodes, separate grounds for isolated ground bars, and connections to separate ground bars.
- L. Install filler plates in unused spaces.
- M. Stub four 1-inch empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub four 1-inch empty conduits into raised floor space or below slab not on grade.
- N. Arrange conductors in gutters into groups and bundle and wrap with wire ties after completing load balancing.
- O. Mount spare fuse cabinet in accessible location.

3.3 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; install warning signs complying with requirements in Section 260553 "Identification for Electrical Systems."
- B. Create a directory to indicate installed circuit loads after balancing panelboard loads; incorporate Owner's final room designations. Obtain approval before installing. Handwritten directories are not acceptable. Install directory inside panelboard door.
- C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

- D. Device Nameplates: Label each branch circuit device in power panelboards with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- E. Install warning signs complying with requirements in Section 260553 "Identification for Electrical Systems" identifying source of remote circuit.

3.4 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- B. 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.
- C. Acceptance Testing Preparation:
 - 1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
 - 2. Test continuity of each circuit.
- D. Tests and Inspections:
 - 1. Perform each visual and mechanical inspection and electrical test for low-voltage air circuit breakers stated in NETA ATS, Paragraph 7.6 Circuit Breakers. Certify compliance with test parameters.
 - 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
 - 3. Perform the following infrared scan tests and inspections and prepare reports:
 - a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each panelboard. Remove front panels so joints and connections are accessible to portable scanner.
 - b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each panelboard 11 months after date of Substantial Completion.
 - c. Instruments and Equipment:
 - 1) Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
- E. Panelboards will be considered defective if they do not pass tests and inspections.
- F. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results, with comparisons of the two scans. 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. Load Balancing: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes. Prior to making circuit changes to achieve load balancing, inform Architect of effect on phase color coding.
1. Measure loads during period of normal facility operations.
 2. Perform circuit changes to achieve load balancing outside normal facility operation schedule or at times directed by the Architect. Avoid disrupting services such as fax machines and on-line data processing, computing, transmitting, and receiving equipment.
 3. After changing circuits to achieve load balancing, recheck loads during normal facility operations. Record load readings before and after changing circuits to achieve load balancing.
 4. Tolerance: Maximum difference between phase loads, within a panelboard, shall not exceed 20 percent.

3.6 PROTECTION

- A. Temporary Heating: Prior to energizing panelboards, apply temporary heat to maintain temperature according to manufacturer's written instructions.

END OF SECTION 262416

SECTION 262726 - WIRING DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Straight-blade convenience, isolated-ground, and tamper-resistant receptacles.
 - 2. GFCI receptacles.
 - 3. Toggle switches.
 - 4. Wall switch sensor light switches with dual technology sensors.
 - 5. Wall switch sensor light switches with passive infrared sensors.
 - 6. Digital timer light switches.
 - 7. Wall-box dimmers.
 - 8. Wall plates.
 - 9. Prefabricated multioutlet assemblies.

1.3 DEFINITIONS

- A. Abbreviations of Manufacturers' Names:
 - 1. Cooper: Cooper Wiring Devices; Division of Cooper Industries, Inc.
 - 2. Hubbell: Hubbell Incorporated: Wiring Devices-Kellems.
 - 3. Leviton: Leviton Mfg. Company, Inc.
 - 4. Pass & Seymour: Pass& Seymour/Legrand.
- B. BAS: Building automation system.
- C. EMI: Electromagnetic interference.
- D. GFCI: Ground-fault circuit interrupter.
- E. Pigtail: Short lead used to connect a device to a branch-circuit conductor.
- F. RFI: Radio-frequency interference.
- G. UTP: Unshielded twisted pair.

1.4 ACTION SUBMITTALS

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

- B. Shop Drawings: List of legends and description of materials and process used for premarking wall plates.

1.5 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing-label warnings and instruction manuals that include labeling conditions.

PART 2 - PRODUCTS

2.1 GENERAL WIRING-DEVICE REQUIREMENTS

- A. Wiring Devices, Components, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with NFPA 70.
- C. Devices that are manufactured for use with modular plug-in connectors may be substituted under the following conditions:
 - 1. Connectors shall comply with UL 2459 and shall be made with stranding building wire.
 - 2. Devices shall comply with the requirements in this Section.
- D. Devices for Owner-Furnished Equipment:
 - 1. Receptacles: Match plug configurations.
 - 2. Cord and Plug Sets: Match equipment requirements.
- E. Source Limitations: Obtain each type of wiring device and associated wall plate from single source from single manufacturer.

2.2 STRAIGHT-BLADE RECEPTACLES

- A. Duplex Convenience Receptacles: 125 V, 20 A; comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498, and FS W-C-596.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Hubbell Incorporated; Wiring Device-Kellems.
 - b. Leviton Manufacturing Co., Inc.
 - c. Pass & Seymour/Legrand (Pass & Seymour).
- B. Isolated-Ground, Duplex Convenience Receptacles: 125 V, 20 A; comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498, and FS W-C-596.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Hubbell Incorporated; Wiring Device-Kellems.
 - b. Leviton Manufacturing Co., Inc.
 - c. Pass & Seymour/Legrand (Pass & Seymour).
 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.
- C. Tamper-Resistant Convenience Receptacles: 125 V, 20 A; comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498, and FS W-C-596.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Hubbell Incorporated; Wiring Device-Kellems.
 - b. Leviton Manufacturing Co., Inc.
 - c. Pass & Seymour/Legrand (Pass & Seymour).

2.3 GFCI RECEPTACLES

- A. General Description:
1. 125 V, 20 A, straight blade, feed-through type.
 2. Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498, UL 943 Class A, and FS W-C-596.
 3. Include indicator light that shows when the GFCI has malfunctioned and no longer provides proper GFCI protection.
- B. Duplex GFCI Convenience Receptacles:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Hubbell Incorporated; Wiring Device-Kellems.
 - b. Leviton Manufacturing Co., Inc.
 - c. Pass & Seymour/Legrand (Pass & Seymour).
- C. Tamper-Resistant, Duplex GFCI Convenience Receptacles:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Hubbell Incorporated; Wiring Device-Kellems.
 - b. Pass & Seymour/Legrand (Pass & Seymour).

2.4 TOGGLE SWITCHES

- A. Comply with NEMA WD 1, UL 20, and FS W-S-896.

- B. Switches, 120/277 V, 20 A:
1. Single Pole:
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Hubbell Incorporated; Wiring Device-Kellems.
 - 2) Leviton Manufacturing Co., Inc.
 - 3) Pass & Seymour/Legrand (Pass & Seymour).
 2. Two Pole:
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Hubbell Incorporated; Wiring Device-Kellems.
 - 2) Leviton Manufacturing Co., Inc.
 - 3) Pass & Seymour/Legrand (Pass & Seymour).
 3. Three Way:
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Hubbell Incorporated; Wiring Device-Kellems.
 - 2) Leviton Manufacturing Co., Inc.
 - 3) Pass & Seymour/Legrand (Pass & Seymour).
 4. Four Way:
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Hubbell Incorporated; Wiring Device-Kellems.
 - 2) Leviton Manufacturing Co., Inc.
 - 3) Pass & Seymour/Legrand (Pass & Seymour).
- C. Pilot-Light Switches: 120/277 V, 20 A.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Hubbell Incorporated; Wiring Device-Kellems.
 - b. Leviton Manufacturing Co., Inc.
 - c. Pass & Seymour/Legrand (Pass & Seymour).
 2. Description: Single pole, with LED-lighted handle, illuminated when switch is off.
- D. Key-Operated Switches: 120/277 V, 20 A.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

- a. Hubbell Incorporated; Wiring Device-Kellems.
 - b. Leviton Manufacturing Co., Inc.
 - c. Pass & Seymour/Legrand (Pass & Seymour).
2. Description: Single pole, with factory-supplied key in lieu of switch handle.
- E. Single-Pole, Double-Throw, Momentary-Contact, Center-off Switches: 120/277 V, 20 A; for use with mechanically held lighting contactors.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Hubbell Incorporated; Wiring Device-Kellems.
 - b. Leviton Manufacturing Co., Inc.
 - c. Pass & Seymour/Legrand (Pass & Seymour).
- F. Key-Operated, Single-Pole, Double-Throw, Momentary-Contact, Center-off Switches: 120/277 V, 20 A; for use with mechanically held lighting contactors, with factory-supplied key in lieu of switch handle.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Hubbell Incorporated; Wiring Device-Kellems.
 - b. Leviton Manufacturing Co., Inc.
 - c. Pass & Seymour/Legrand (Pass & Seymour).
- 2.5 WALL SWITCH SENSOR LIGHT SWITCH, DUAL TECHNOLOGY
- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Hubbell Incorporated; Wiring Device-Kellems.
 2. Leviton Manufacturing Co., Inc.
 3. Pass & Seymour/Legrand (Pass & Seymour).
- B. Description: Switchbox-mounted, combination lighting-control sensor and conventional switch lighting-control unit using dual technology.
1. Connections: Provisions for connection to BAS.
 2. Connections: Hard wired.
 3. Connections: Wireless.
 4. Rated 960 W at 120-V ac for tungsten lighting, 10 A at 120-V ac or 10 A at 277-V ac for fluorescent or LED lighting, and 1/4 HP at 120-V ac.
 5. Integral relay for connection to BAS.
 6. Adjustable time delay of 20 minutes.
 7. Able to be locked to Automatic-On, Manual-On mode.
 8. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc.
 9. Comply with NEMA WD 1, UL 20, and FS W-S-896.
- 2.6 WALL SWITCH SENSOR LIGHT SWITCH, PASSIVE INFRARED
- 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. Hubbell Premise Wiring.
 2. Leviton Manufacturing Co., Inc.
 3. Pass & Seymour/Legrand (Pass & Seymour).
- B. Description: Switchbox-mounted, combination, lighting-control sensor and conventional switch lighting-control unit using passive infrared technology.
1. Connections: Provisions for connection to BAS.
 2. Connections: Hard wired.
 3. Connections: Wireless.
 4. Rated 960 W at 120-V ac for tungsten lighting, 10 A at 120-V ac or 10 A at 277-V ac for fluorescent or LED lighting, and 1/4 HP at 120-V ac.
 5. Integral relay for connection to BAS.
 6. Adjustable time delay of 20 minutes.
 7. Able to be locked to Automatic-On or Manual-On mode.
 8. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc.
 9. Comply with NEMA WD 1, UL 20, and FS W-S-896.

2.7 DIGITAL TIMER LIGHT SWITCH

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Hubbell Incorporated; Wiring Device-Kellems.
 2. Watt Stopper.
 3. Leviton Manufacturing Co., Inc.
 4. Pass & Seymour/Legrand (Pass & Seymour).
- B. Description: Switchbox-mounted, combination digital timer and conventional switch lighting-control unit, with backlit digital display, with selectable time interval in 10-minute increments.
1. Rated 960 W at 120-V ac for tungsten lighting, 10 A at 120-V ac or 10 A at 277-V ac for fluorescent or LED lighting, and 1/4 HP at 120-V ac.
 2. Integral relay for connection to BAS.

2.8 WALL-BOX DIMMERS

- A. Dimmer Switches: Modular, full-wave, solid-state units with integral, quiet on-off switches, with audible frequency and EMI/RFI suppression filters.
- B. Control: Continuously adjustable slider; with single-pole or three-way switching. Comply with UL 1472.
- C. Incandescent Lamp Dimmers: 120 V; control shall follow square-law dimming curve. On-off switch positions shall bypass dimmer module.
1. 600 W; dimmers shall require no derating when ganged with other devices.
- D. Fluorescent Lamp Dimmer Switches: Modular; compatible with dimmer ballasts; trim potentiometer to adjust low-end dimming; dimmer-ballast combination capable of consistent dimming with low end not greater than 20 percent of full brightness.
- E. LED Lamp Dimmer Switches: Modular; compatible with LED lamps; trim potentiometer to adjust low-end dimming; capable of consistent dimming with low end not greater than 20 percent of full brightness.

2.9 WALL PLATES

- A. Single and combination types shall match corresponding wiring devices.
 - 1. Plate-Securing Screws: Metal with head color to match plate finish.
 - 2. Material for Finished Spaces: wall plates shall be stainless steel 302/304 or steel with white baked enamel, suitable for field painting. Nylon plates are not acceptable.
 - 3. Material for Unfinished Spaces: Galvanized steel.
 - 4. Material for Damp Locations: Thermoplastic with spring-loaded lift cover, and listed and labeled for use in wet and damp locations.
- B. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with Type 3R, weather-resistant, thermoplastic with lockable cover.

2.10 PREFABRICATED MULTIOUTLET ASSEMBLIES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Hubbell Incorporated; Wiring Device-Kellems.
 - 2. Wiremold / Legrand.
- B. Description:
 - 1. Two-piece surface metal raceway, with factory-wired multioutlet harness.
 - 2. Components shall be products from single manufacturer designed for use as a complete, matching assembly of raceways and receptacles.
- C. Raceway Material: Metal, with manufacturer's standard finish.
- D. Multioutlet Harness:
 - 1. Receptacles: 15-A, 125-V, NEMA WD 6 Configuration 5-15R receptacles complying with NEMA WD 1, UL 498, and FS W-C-596.
 - 2. Receptacle Spacing: 12 inches.
 - 3. Wiring: No. 12 AWG solid, Type THHN copper, two circuit, connecting alternating receptacles.

2.11 FINISHES

- A. Device Color:
 - 1. Wiring Devices Connected to Normal Power System: As selected by Architect unless otherwise indicated or required by NFPA 70 or device listing.
- B. Wall Plate Color: For plastic covers, match device color.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with NECA 1, including mounting heights listed in that standard, unless otherwise indicated.

B. Coordination with Other Trades:

1. Protect installed devices and their boxes. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of boxes.
2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
4. Install wiring devices after all wall preparation, including painting, is complete.

C. Conductors:

1. Do not strip insulation from conductors until right before they are spliced or terminated on devices.
2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.
4. Existing Conductors:
 - a. Cut back and pigtail, or replace all damaged conductors.
 - b. Straighten conductors that remain and remove corrosion and foreign matter.
 - c. Pigtailing existing conductors is permitted, provided the outlet box is large enough.

D. Device Installation:

1. Replace devices that have been in temporary use during construction and that were installed before building finishing operations were complete.
2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
4. Connect devices to branch circuits using pigtails that are not less than 6 inches in length.
5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, two-thirds to three-fourths of the way around terminal screw.
6. Use a torque screwdriver when a torque is recommended or required by manufacturer.
7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
8. Tighten unused terminal screws on the device.
9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device-mounting screws in yokes, allowing metal-to-metal contact.

E. Receptacle Orientation:

1. Install ground pin of vertically mounted receptacles up, and on horizontally mounted receptacles to the right.
2. Install hospital-grade receptacles in patient-care areas with the ground pin or neutral blade at the top.

F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

G. 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 GFCI RECEPTACLES

A. Install non-feed-through-type GFCI receptacles where protection of downstream receptacles is not required.

3.3 IDENTIFICATION

A. Comply with Section 260553 "Identification for Electrical Systems."

B. Identify each receptacle with panelboard identification and circuit number. Use hot, stamped, or engraved machine printing with black-filled lettering on face of plate, and durable wire markers or tags inside outlet boxes.

3.4 FIELD QUALITY CONTROL

A. Test Instruments: Use instruments that comply with UL 1436.

B. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. In healthcare facilities, prepare reports that comply with recommendations in NFPA 99.
2. Test Instruments: Use instruments that comply with UL 1436.
3. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated digital-display indicators of measurement.

C. Tests for Convenience Receptacles:

1. Line Voltage: Acceptable range is 105 to 132 V.
2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is unacceptable.
3. Ground Impedance: Values of up to 2 ohms are acceptable.
4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
5. Using the test plug, verify that the device and its outlet box are securely mounted.
6. Tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.

D. Test straight-blade hospital-grade convenience outlets for the retention force of the grounding blade according to NFPA 99. Retention force shall be not less than 4 oz.

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- E. Wiring device will be considered defective if it does not pass tests and inspections.
- F. Prepare test and inspection reports.

END OF SECTION 262726

SECTION 262813 - FUSES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

1. Cartridge fuses rated 600 V ac and less for use in the following:
 - a. Control circuits.
 - b. Enclosed controllers.
 - c. Enclosed switches.
2. Spare-fuse cabinets.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for spare-fuse cabinets. Include the following for each fuse type indicated:
 1. Ambient Temperature Adjustment Information: If ratings of fuses have been adjusted to accommodate ambient temperatures, provide list of fuses with adjusted ratings.
 - a. For each fuse having adjusted ratings, include location of fuse, original fuse rating, local ambient temperature, and adjusted fuse rating.
 - b. Provide manufacturer's technical data on which ambient temperature adjustment calculations are based.
 2. Dimensions and manufacturer's technical data on features, performance, electrical characteristics, and ratings.
 3. Current-limitation curves for fuses with current-limiting characteristics.
 4. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse. Submit in electronic format suitable for use in coordination software and in PDF format.
 5. Coordination charts and tables and related data.
 6. Fuse sizes for elevator feeders and elevator disconnect switches.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For fuses to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 01 "Closeout Procedures," and "Operation and Maintenance Data," include the following:
1. Ambient temperature adjustment information.
 2. Current-limitation curves for fuses with current-limiting characteristics.
 3. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse used on the Project. Submit in electronic format suitable for use in coordination software and in PDF format.
 4. Coordination charts and tables and related data.

1.5 FIELD CONDITIONS

- A. Where ambient temperature to which fuses are directly exposed is less than 40 deg F or more than 100 deg F, apply manufacturer's ambient temperature adjustment factors to fuse ratings.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Bussmann, an Eaton business.
 2. Edison; a brand of Bussmann by Eaton.
 3. Littelfuse, Inc.
- B. Source Limitations: Obtain fuses, for use within a specific product or circuit, from single source from single manufacturer.

2.2 CARTRIDGE FUSES

- A. Characteristics: NEMA FU 1, current-limiting, nonrenewable cartridge fuses with voltage ratings consistent with circuit voltages.
1. Type RK-1: 600-V, zero- to 600-A rating, 200 kAIC, time delay.
 2. Type RK-5: 600-V, zero- to 600-A rating, 200 kAIC, time delay.
 3. Type J: 600-V, zero- to 600-A rating, 200 kAIC, time delay.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Comply with NEMA FU 1 for cartridge fuses.
- D. Comply with NFPA 70.
- E. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size and with system short-circuit current levels.

2.3 SPARE-FUSE CABINET

- A. Characteristics: Wall-mounted steel unit with full-length, recessed piano-hinged door and key-coded cam lock and pull.
 - 1. Size: Adequate for storage of spare fuses specified with 15 percent spare capacity minimum.
 - 2. Finish: Gray, baked enamel.
 - 3. Identification: "SPARE FUSES" in 1-1/2-inch-high letters on exterior of door.
 - 4. Fuse Pullers: For each size of fuse, where applicable and available, from fuse manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine fuses before installation. Reject fuses that are moisture damaged or physically damaged.
- B. Examine holders to receive fuses for compliance with installation tolerances and other conditions affecting performance, such as rejection features.
- C. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.
- D. Evaluate ambient temperatures to determine if fuse rating adjustment factors must be applied to fuse ratings.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 FUSE APPLICATIONS

- A. Cartridge Fuses:
 - 1. Feeders: Class RK1, time delay.
 - 2. Motor Branch Circuits: Class RK1, time delay.
 - 3. Power Electronics Circuits: Class J, high speed.
 - 4. Other Branch Circuits: Class RK5, time delay.

3.3 INSTALLATION

- A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.
- B. Install spare-fuse cabinet(s) as indicated in the field by Owner.

3.4 IDENTIFICATION

- A. Install labels complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems" and indicating fuse replacement information inside of door of each fused switch and adjacent to each fuse block, socket, and holder.

END OF SECTION 262813

SECTION 262816 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Fusible switches.
 - 2. Nonfusible switches.
 - 3. Molded-case circuit breakers (MCCBs).
 - 4. Enclosures.

1.3 DEFINITIONS

- A. NC: Normally closed.
- B. NO: Normally open.
- C. SPDT: Single pole, double throw.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include nameplate ratings, dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.
 - 1. Enclosure types and details for types other than NEMA 250, Type 1.
 - 2. Current and voltage ratings.
 - 3. Short-circuit current ratings (interrupting and withstand, as appropriate).
 - 4. Include evidence of a nationally recognized testing laboratory (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. Provide in PDF electronic format.
- B. Shop Drawings: For enclosed switches and circuit breakers.
 - 1. Include plans, elevations, sections, details, and attachments to other work.
 - 2. Include wiring diagrams for power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified testing agency.
- B. Seismic Qualification Certificates: For enclosed switches and circuit breakers, accessories, and components, from manufacturer.
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- C. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals.
 - 1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
 - a. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.
 - b. Time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device. Provide in PDF electronic format.

1.7 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Accredited by NETA.
 - 1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

1.8 FIELD CONDITIONS

- A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:
 - 1. Ambient Temperature: Not less than minus 22 deg F and not exceeding 104 deg F.
 - 2. Altitude: Not exceeding 6600 feet.

1.9 WARRANTY

- A. Manufacturer's Warranty: Manufacturer and Installer agree to repair or replace components that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: One year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Enclosed switches and circuit breakers shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
 - 1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

2.2 GENERAL REQUIREMENTS

- A. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single manufacturer.
- B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
- D. Comply with NFPA 70.

2.3 FUSIBLE SWITCHES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Eaton.
 - 2. General Electric Company.
 - 3. Siemens Industry, Inc.
 - 4. Square D; by Schneider Electric.
- B. Type HD, Heavy Duty:
 - 1. Single throw.
 - 2. Two pole.
 - 3. 240-V ac.
 - 4. 200 A and smaller.
 - 5. UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate fuses.
 - 6. Lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- C. Accessories:
 - 1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
 - 2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.

3. Isolated Ground Kit: Internally mounted; insulated, labeled for copper and aluminum neutral conductors.
4. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
5. Auxiliary Contact Kit: One NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open. Contact rating - 120-V ac.
6. Hookstick Handle: Allows use of a hookstick to operate the handle.
7. Lugs: Mechanical type, suitable for number, size, and conductor material.
8. Service-Rated Switches: Labeled for use as service equipment.

2.4 NONFUSIBLE SWITCHES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Eaton.
 2. General Electric Company.
 3. Siemens Industry, Inc.
 4. Square D; by Schneider Electric.
- B. Type HD, Heavy Duty, Two Pole, Single Throw, 240-V ac, 200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- C. Accessories:
1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
 2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
 3. Isolated Ground Kit: Internally mounted; insulated, labeled for copper and aluminum neutral conductors.
 4. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
 5. Auxiliary Contact Kit: One NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open. Contact rating - 120-V ac.
 6. Hookstick Handle: Allows use of a hookstick to operate the handle.
 7. Lugs: Mechanical type, suitable for number, size, and conductor material.
 8. Service-Rated Switches: Labeled for use as service equipment.

2.5 MOLDED-CASE CIRCUIT BREAKERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Eaton.
 2. General Electric Company.
 3. Siemens Industry, Inc.
 4. Square D; by Schneider Electric.
- B. Circuit breakers shall be constructed using glass-reinforced insulating material. Current carrying components shall be completely isolated from the handle and the accessory mounting area.
- C. Circuit breakers shall have a toggle operating mechanism with common tripping of all poles, which provides quick-make, quick-break contact action. The circuit-breaker handle shall be over center, be trip free, and reside in a tripped position between on and off to provide local trip indication. Circuit-breaker

escutcheon shall be clearly marked on and off in addition to providing international I/O markings. Equip circuit breaker with a push-to-trip button, located on the face of the circuit breaker to mechanically operate the circuit-breaker tripping mechanism for maintenance and testing purposes.

- D. The maximum ampere rating and UL, IEC, or other certification standards with applicable voltage systems and corresponding interrupting ratings shall be clearly marked on face of circuit breaker. Circuit breakers shall be 100 percent rated or series rated as indicated on the Drawings. Circuit breaker/circuit breaker or Fuse/circuit breaker combinations for series connected interrupting ratings shall be listed by UL as recognized component combinations. Any series rated combination used shall be marked on the end-use equipment along with the statement "Caution - Series Rated System. _____ Amps Available. Identical Replacement Component Required."
- E. MCCBs shall be equipped with a device for locking in the isolated position.
- F. Lugs shall be suitable for 167 deg F rated wire.
- G. Standards: Comply with UL 489 and NEMA AB 3, with interrupting capacity to comply with available fault currents.
- H. Thermal-Magnetic Circuit Breakers: Inverse time-current thermal element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
- I. Adjustable, Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
- J. Electronic Trip Circuit Breakers: Field-replaceable rating plug, rms sensing, with the following field-adjustable settings:
 - 1. Instantaneous trip.
 - 2. Long- and short-time pickup levels.
 - 3. Long- and short-time time adjustments.
 - 4. Ground-fault pickup level, time delay, and I-squared t response.
- K. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller, and let-through ratings less than NEMA FU 1, RK-5.
- L. Integrally Fused Circuit Breakers: Thermal-magnetic trip element with integral limiter-style fuse listed for use with circuit breaker and trip activation on fuse opening or on opening of fuse compartment door.
- M. Ground-Fault Circuit-Interrupter (GFCI) Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).
- N. Ground-Fault Equipment-Protection (GFEP) Circuit Breakers: With Class B ground-fault protection (30-mA trip).
- O. Features and Accessories:
 - 1. Standard frame sizes, trip ratings, and number of poles.
 - 2. Lugs: Mechanical type, suitable for number, size, trip ratings, and conductor material.
 - 3. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge lighting circuits.
 - 4. Ground-Fault Protection: Comply with UL 1053; integrally mounted, self-powered type with mechanical ground-fault indicator; relay with adjustable pickup and time-delay settings, push-to-

- test feature, internal memory, and shunt trip unit; and three-phase, zero-sequence current transformer/sensor.
5. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact.
 6. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.
 7. Auxiliary Contacts: One SPDT switch with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts.
 8. Alarm Switch: One contact that operates only when circuit breaker has tripped.
 9. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.
 10. Zone-Selective Interlocking: Integral with ground-fault trip unit; for interlocking ground-fault protection function.
 11. Electrical Operator: Provide remote control for on, off, and reset operations.
 12. Accessory Control Power Voltage: Integrally mounted, self-powered 120-V ac.

2.6 ENCLOSURES

- A. Enclosed Switches and Circuit Breakers: UL 489, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.
- B. Enclosure Finish: The enclosure shall be finished with gray baked enamel paint, electrodeposited on cleaned, phosphatized galvanized steel (NEMA 250 Types 3R, 12 or a brush finish on Type 304 stainless steel (NEMA 250 Type 4-4X stainless steel).
- C. Conduit Entry: NEMA 250 Types 4, 4X, and 12 enclosures shall contain no knockouts.
- D. Operating Mechanism: The circuit-breaker operating handle shall be externally operable with the operating mechanism being an integral part of the box, not the cover. The cover interlock mechanism shall have an externally operated override. The override shall not permanently disable the interlock mechanism, which shall return to the locked position once the override is released. The tool used to override the cover interlock mechanism shall not be required to enter the enclosure in order to override the interlock.
- E. Enclosures designated as NEMA 250 Type 4, 4X stainless steel, 12, or 12K shall have a dual cover interlock mechanism to prevent unintentional opening of the enclosure cover when the circuit breaker is ON and to prevent turning the circuit breaker ON when the enclosure cover is open.

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.
 1. Commencement of work shall indicate Installer's acceptance of the areas and conditions as satisfactory.

3.2 PREPARATION

- A. 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 Construction Manager and Owner no fewer than seven days in advance of proposed interruption of electric service.
 2. Indicate method of providing temporary electric service.
 3. Do not proceed with interruption of electric service without Construction Manager's or Owner's written permission.
 4. Comply with NFPA 70E.
 - 5.

3.3 ENCLOSURE ENVIRONMENTAL RATING APPLICATIONS

- A. Enclosed Switches and Circuit Breakers: Provide enclosures at installed locations with the following environmental ratings.
1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.
 2. Outdoor Locations: NEMA 250, Type 3R.
 3. 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.

3.4 INSTALLATION

- 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.
- B. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.
- C. Comply with mounting and anchoring requirements specified in Section 260548 "Vibration and Seismic Controls for Electrical Systems."
- D. Temporary Lifting Provisions: Remove temporary lifting of eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.
- E. Install fuses in fusible devices.
- F. Comply with NFPA 70 and NECA 1.

3.5 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.

3.6 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- C. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- D. Perform tests and inspections with the assistance of a factory-authorized service representative.
- E. Tests and Inspections for Switches:
 - 1. Visual and Mechanical Inspection:
 - a. Inspect physical and mechanical condition.
 - b. Inspect anchorage, alignment, grounding, and clearances.
 - c. Verify that the unit is clean.
 - d. Verify blade alignment, blade penetration, travel stops, and mechanical operation.
 - e. Verify that fuse sizes and types match the Specifications and Drawings.
 - f. Verify that each fuse has adequate mechanical support and contact integrity.
 - g. Inspect bolted electrical connections for high resistance using one of the two following methods:
 - 1) Use a low-resistance ohmmeter.
 - a) Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from those of similar bolted connections by more than 50 percent of the lowest value.
 - 2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or NETA ATS Table 100.12.
 - a) Bolt-torque levels shall be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS Table 100.12.
 - h. Verify that operation and sequencing of interlocking systems is as described in the Specifications and shown on the Drawings.
 - i. Verify correct phase barrier installation.
 - j. Verify lubrication of moving current-carrying parts and moving and sliding surfaces.
 - 2. Electrical Tests:
 - a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter. Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
 - b. Measure contact resistance across each switchblade fuseholder. Drop values shall not exceed the high level of the manufacturer's published data. If manufacturer's published data are not available, investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.

- c. Perform insulation-resistance tests for one minute on each pole, phase-to-phase and phase-to-ground with switch closed, and across each open pole. Apply voltage in accordance with manufacturer's published data. In the absence of manufacturer's published data, use Table 100.1 from the NETA ATS. Investigate values of insulation resistance less than those published in Table 100.1 or as recommended in manufacturer's published data.
- d. Measure fuse resistance. Investigate fuse-resistance values that deviate from each other by more than 15 percent.
- e. Perform ground fault test according to NETA ATS 7.14 "Ground Fault Protection Systems, Low-Voltage."

F. Tests and Inspections for Molded Case Circuit Breakers:

1. Visual and Mechanical Inspection:

- a. Verify that equipment nameplate data are as described in the Specifications and shown on the Drawings.
- b. Inspect physical and mechanical condition.
- c. Inspect anchorage, alignment, grounding, and clearances.
- d. Verify that the unit is clean.
- e. Operate the circuit breaker to ensure smooth operation.
- f. Inspect bolted electrical connections for high resistance using one of the two following methods:
 - 1) Use a low-resistance ohmmeter.
 - a) Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from those of similar bolted connections by more than 50 percent of the lowest value.
 - 2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or NETA ATS Table 100.12.
 - a) Bolt-torque levels shall be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS Table 100.12.
- g. Inspect operating mechanism, contacts, and chutes in unsealed units.
- h. Perform adjustments for final protective device settings in accordance with the coordination study.

2. Electrical Tests:

- a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter. Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
- b. Perform insulation-resistance tests for one minute on each pole, phase-to-phase and phase-to-ground with circuit breaker closed, and across each open pole. Apply voltage in accordance with manufacturer's published data. In the absence of manufacturer's published data, use Table 100.1 from the NETA ATS. Investigate values of insulation resistance less than those published in Table 100.1 or as recommended in manufacturer's published data.
- c. Perform a contact/pole resistance test. Drop values shall not exceed the high level of the manufacturer's published data. If manufacturer's published data are not available,

- investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
- d. Perform insulation resistance tests on all control wiring with respect to ground. Applied potential shall be 500-V dc for 300-V rated cable and 1000-V dc for 600-V rated cable. Test duration shall be one minute. For units with solid state components, follow manufacturer's recommendation. Insulation resistance values shall be no less than two megohms.
 - e. Determine the following by primary current injection:
 - 1) Long-time pickup and delay. Pickup values shall be as specified. Trip characteristics shall not exceed manufacturer's published time-current characteristic tolerance band, including adjustment factors.
 - 2) Short-time pickup and delay. Short-time pickup values shall be as specified. Trip characteristics shall not exceed manufacturer's published time-current characteristic tolerance band, including adjustment factors.
 - 3) Ground-fault pickup and time delay. Ground-fault pickup values shall be as specified. Trip characteristics shall not exceed manufacturer's published time-current characteristic tolerance band, including adjustment factors.
 - 4) Instantaneous pickup. Instantaneous pickup values shall be as specified and within manufacturer's published tolerances.
 - f. Test functionality of the trip unit by means of primary current injection. Pickup values and trip characteristics shall be as specified and within manufacturer's published tolerances.
 - g. Perform minimum pickup voltage tests on shunt trip and close coils in accordance with manufacturer's published data. Minimum pickup voltage of the shunt trip and close coils shall be as indicated by manufacturer.
 - h. Verify correct operation of auxiliary features such as trip and pickup indicators; zone interlocking; electrical close and trip operation; trip-free, anti-pump function; and trip unit battery condition. Reset all trip logs and indicators. Investigate units that do not function as designed.
 - i. Verify operation of charging mechanism. Investigate units that do not function as designed.
3. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
 4. Perform the following infrared scan tests and inspections and prepare reports:
 - a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each enclosed switch and circuit breaker. Remove front panels so joints and connections are accessible to portable scanner.
 - b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each enclosed switch and circuit breaker 11 months after date of Substantial Completion.
 - c. Instruments and Equipment: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
 5. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.
- G. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.
- H. Prepare test and inspection reports.
1. Test procedures used.
 2. Include identification of each enclosed switch and circuit breaker tested and describe test results.

3. List deficiencies detected, remedial action taken, and observations after remedial action.

3.7 ADJUSTING

- A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer. Retain first option in paragraph below if the indicated Section is included in the Contract Documents. Retain second option and include settings on the Drawings or in a schedule attached to this Section if indicated Section is not included in the Contract Documents.

END OF SECTION 262816

SECTION 262913.03 - MANUAL AND MAGNETIC MOTOR CONTROLLERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Manual motor controllers.
 - 2. Enclosed full-voltage magnetic motor controllers.
 - 3. Combination full-voltage magnetic motor controllers.
 - 4. Enclosed reduced-voltage magnetic motor controllers.
 - 5. Combination reduced-voltage magnetic motor controllers.
 - 6. Multispeed magnetic motor controllers.
 - 7. Combination multispeed magnetic motor controllers.
 - 8. Enclosures.
 - 9. Accessories.
 - 10. Identification.

1.3 DEFINITIONS

- A. CPT: Control power transformer.
- B. MCCB: Molded-case circuit breaker.
- C. MCP: Motor circuit protector.
- D. NC: Normally closed.
- E. OCPD: Overcurrent protective device.
- F. SCCR: Short-circuit current rating.
- G. SCPD: Short-circuit protective device.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings: For each type of magnetic controller.
 - 1. Include plans, elevations, sections, and mounting details.
 - 2. Indicate dimensions, weights, required clearances, and location and size of each field connection.

3. Wire Termination Diagrams and Schedules: Include diagrams for signal, and control wiring. Identify terminals and wiring designations and color-codes to facilitate installation, operation, and maintenance. Indicate recommended types, wire sizes, and circuiting arrangements for field-installed wiring, and show circuit protection features. Differentiate between manufacturer-installed and field-installed wiring.
 4. Include features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
- C. Product Schedule: List the following for each enclosed controller:
1. Each installed magnetic controller type.
 2. NRTL listing.
 3. Factory-installed accessories.
 4. Nameplate legends.
 5. SCCR of integrated unit.
 6. For each combination magnetic controller include features, characteristics, ratings, and factory setting of the SCPD and OCPD.
 - a. Listing document proving Type 2 coordination.
 7. For each series-rated combination state the listed integrated short-circuit current (withstand) rating of SCPD and OCPDs by an NRTL acceptable to authorities having jurisdiction.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing agency.
- B. Seismic Qualification Data: Certificates, for magnetic controllers, from manufacturer.
1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- C. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For magnetic controllers to include in operation and maintenance manuals.
1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
 - a. Routine maintenance requirements for magnetic controllers and installed components.
 - b. Manufacturer's written instructions for testing and adjusting circuit breaker and MCP trip settings.
 - c. Manufacturer's written instructions for setting field-adjustable overload relays.
 - d. Load-Current and Overload-Relay Heater List: Compile after motors have been installed, and arrange to demonstrate that selection of heaters suits actual motor nameplate full-load currents.
 - e. Load-Current and List of Settings of Adjustable Overload Relays: Compile after motors have been installed, and arrange to demonstrate that switch settings for motor-running overload protection suit actual motors to be protected.

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Fuses for Fused Switches: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
 - 2. Control Power Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than two of each size and type.
 - 3. Indicating Lights: Two of each type and color installed.
 - 4. Auxiliary Contacts: Furnish one spare(s) for each size and type of magnetic controller installed.
 - 5. Power Contacts: Furnish three spares for each size and type of magnetic contactor installed.

1.8 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Accredited by NETA.
 - 1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Store controllers indoors in clean, dry space with uniform temperature to prevent condensation. Protect controllers from exposure to dirt, fumes, water, corrosive substances, and physical damage.
- B. If stored in areas subject to weather, cover controllers to protect them from weather, dirt, dust, corrosive substances, and physical damage. Remove loose packing and flammable materials from inside controllers; install temporary electric heating, with at least 50 W per controller.

1.10 FIELD CONDITIONS

- A. Ambient Environment Ratings: Rate equipment for continuous operation under the following conditions unless otherwise indicated:
 - 1. Ambient Temperature: Not less than 23 deg F and not exceeding 104 deg F.
 - 2. Altitude: Not exceeding 6600 feet for electromagnetic and manual devices.
 - 3. The effect of solar radiation is not significant.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
- B. UL Compliance: Fabricate and label magnetic motor controllers to comply with UL 508 and UL 60947-4-1.
- C. NEMA Compliance: Fabricate motor controllers to comply with ICS 2.
- D. Seismic Performance: Magnetic controllers shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. The term "withstand" means "the controller will remain in place without separation of any parts when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."
2. Component Importance Factor: 1.5.

2.2 MANUAL MOTOR CONTROLLERS

- A. Motor-Starting Switches (MSS): "Quick-make, quick-break" toggle or push-button action; marked to show whether unit is off or on.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Eaton.
 - b. General Electric Company.
 - c. SIEMENS Industry, Inc.; Energy Management Division.
 - d. Square D; by Schneider Electric.
 2. Standard: Comply with NEMA ICS 2, general purpose, Class A.
 3. Configuration: Non-reversing.
 4. Surface mounting.
 5. Red pilot light.
- B. Fractional Horsepower Manual Controllers (FHPMC): "Quick-make, quick-break" toggle or push-button action; marked to show whether unit is off, on, or tripped.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Eaton.
 - b. General Electric Company.
 - c. SIEMENS Industry, Inc.; Energy Management Division.
 - d. Square D; by Schneider Electric.
 2. Configuration: Non-reversing.
 3. Overload Relays: Inverse-time-current characteristics; NEMA ICS 2, Class 10 tripping characteristics; heaters matched to nameplate full-load current of actual protected motor; external reset push button; bimetallic type.
 4. Overload Relays: NEMA ICS 2, bimetallic class as schedule on Drawings.
 5. Pilot Light: Red.
- C. Integral Horsepower Manual Controllers (IHPMC): "Quick-make, quick-break" toggle or push-button action; marked to show whether unit is off, on, or tripped.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Eaton.
 - b. General Electric Company.
 - c. SIEMENS Industry, Inc.; Energy Management Division.
 - d. Square D; by Schneider Electric.
 2. Configuration: Non-reversing.
 3. Overload Relays: Inverse-time-current characteristics; NEMA ICS 2, Class 10 class tripping characteristics; heaters matched to nameplate full-load current of actual protected motor; external reset push button; bimetallic type.
 4. Overload Relays: NEMA ICS 2, bimetallic class as scheduled on Drawings.

2.3 ENCLOSED FULL-VOLTAGE MAGNETIC MOTOR CONTROLLERS

- A. Description: Across-the-line start, electrically held, for nominal system voltage of 600-V ac and less.

- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Eaton.
 - 2. General Electric Company.
 - 3. SIEMENS Industry, Inc.; Energy Management Division.
 - 4. Square D; by Schneider Electric.
- C. Standard: Comply with NEMA ICS 2, general purpose, Class A.
- D. Configuration: Nonreversing.
- E. Contactor Coils: Pressure-encapsulated type with coil transient suppressors when indicated.
 - 1. Operating Voltage: Manufacturer's standard, unless indicated.
- F. Control Power:
 - 1. For on-board control power, obtain from line circuit or from integral CPT. The CPT shall have capacity to operate integral devices and remotely located pilot, indicating, and control devices.
- G. Overload Relays:
 - 1. Thermal Overload Relays:
 - a. Inverse-time-current characteristic.
 - b. Class 10 tripping characteristic.
 - c. Heaters in each phase shall be matched to nameplate full-load current of actual protected motor and with appropriate adjustment for duty cycle.
 - d. Ambient compensated.
 - e. Automatic resetting.
 - 2. Solid-State Overload Relay:
 - a. Switch or dial selectable for motor-running overload protection.
 - b. Sensors in each phase.
 - c. Class 10/20 selectable tripping characteristic selected to protect motor against voltage and current unbalance and single phasing.
 - d. Class II ground-fault protection shall comply with UL 1053 to interrupt low-level ground faults. The ground-fault detection system shall include circuitry that will prevent the motor controller from tripping when the fault current exceeds the interrupting capacity of the controller. Equip with start and run delays to prevent nuisance trip on starting, and a trip indicator.
- H. Digital communication module, using RS-485 Modbus, RTU protocol, 4-wire connection to host devices with a compatible port to transmit the following to the LAN:
 - 1. Instantaneous RMS current each phase, and 3-phase average.
 - 2. Voltage: L-L for each phase, L-L 3-phase average, L-N each phase and L-N 3-phase average - rms.
 - 3. Active Energy (kWh): 3-phase total.
 - 4. Power Factor: Each phase and 3-phase total.

2.4 COMBINATION FULL-VOLTAGE MAGNETIC MOTOR CONTROLLER

- A. Description: Factory-assembled, combination full-voltage magnetic motor controller consisting of the controller described in this article, indicated disconnecting means, SCPD and OCPD, in a single enclosure.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Eaton.
 - 2. General Electric Company.
 - 3. SIEMENS Industry, Inc.; Energy Management Division.

4. Square D; by Schneider Electric.
- C. Standard: Comply with NEMA ICS 2, general purpose, Class A.
- D. Configuration: Non-reversing.
- E. Contactor Coils: Pressure-encapsulated type with coil transient suppressors when indicated.
 1. Operating Voltage: Manufacturer's standard, unless indicated.
- F. Control Power:
 1. For on-board control power, obtain from line circuit or from integral CPT. The CPT shall have capacity to operate integral devices and remotely located pilot, indicating, and control devices.
- G. Overload Relays:
 1. Thermal Overload Relays:
 - a. Inverse-time-current characteristic.
 - b. Class 10 tripping characteristic.
 - c. Heaters in each phase shall be matched to nameplate full-load current of actual protected motor and with appropriate adjustment for duty cycle.
 - d. Ambient compensated.
 - e. Automatic resetting.
 2. Solid-State Overload Relay:
 - a. Switch or dial selectable for motor-running overload protection.
 - b. Sensors in each phase.
 - c. Class 10/20 selectable tripping characteristic selected to protect motor against voltage and current unbalance and single phasing.
- H. Class II ground-fault protection shall comply with UL 1053 to interrupt low-level ground faults. The ground-fault detection system shall include circuitry that will prevent the motor controller from tripping when the fault current exceeds the interrupting capacity of the controller. Equip with start and run delays to prevent nuisance trip on starting, and a trip indicator.
- I. Digital communication module, using RS-485 Modbus, RTU protocol, 4-wire connection to host devices with a compatible port to transmit the following to the LAN:
 1. Instantaneous RMS current each phase, and 3-phase average.
 2. Voltage: L-L for each phase, L-L 3-phase average, L-N each phase and L-N 3-phase average - rms.
 3. Active Energy (kWh): 3-phase total.
 4. Power Factor: Each phase and 3-phase total.
- J. Fusible Disconnecting Means:
 1. NEMA KS 1, heavy-duty, horsepower-rated, fusible switch with clips or bolt pads to accommodate indicated fuses.
 2. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.
- K. Non-fusible Disconnecting Means:
 1. NEMA KS 1, heavy-duty, horsepower-rated, non-fusible switch.
 2. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.
- L. MCP Disconnecting Means:
 1. UL 489 and NEMA AB 3, with interrupting capacity to comply with available fault currents, instantaneous-only circuit breaker with front-mounted, field-adjustable, short-circuit trip coordinated with motor locked-rotor amperes.
 2. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.

- M. MCCB Disconnecting Means:
1. UL 489 and NEMA AB 3, with interrupting capacity to comply with available fault currents; thermal-magnetic MCCB, with inverse-time-current element for low-level overloads and instantaneous magnetic trip element for short circuits.
 2. Front-mounted, adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
 3. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.

2.5 ENCLOSED REDUCED-VOLTAGE MAGNETIC MOTOR CONTROLLERS

- A. Description: Electrically held; closed-transition; adjustable time delay on transition, 600-V ac or less.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Eaton.
 2. General Electric Company.
 3. SIEMENS Industry, Inc.; Energy Management Division.
 4. Square D; by Schneider Electric.
- C. Standard: Comply with NEMA ICS 2, general purpose, Class A.
- D. Configuration:
1. Wye-Delta Controller: Four contactors, with a three-phase starting resistor/reactor bank.
 2. Part-Winding Controller: Separate START and RUN contactors, field-selectable for 1/2- or 2/3-winding start mode, with either six- or nine-lead motors; with separate overload relays for starting and running sequences.
 3. Autotransformer Reduced-Voltage Controller: Medium-duty service, with integral overtemperature protection; taps for starting at 50, 65, and 80 percent of line voltage; two START and one RUN contactors.
- E. Contactor Coils: Pressure-encapsulated type with coil transient suppressors when indicated.
1. Operating Voltage: Manufacturer's standard, unless indicated.
- F. Control Power: 120-V ac; obtained from integral CPT, with primary and secondary fuses, with CPT of sufficient capacity to operate integral devices and remotely located pilot, indicating, and control devices.
- G. Overload Relays:
1. Thermal Overload Relays: Bimetallic type.
 - a. Inverse-time-current characteristic.
 - b. Class 10 tripping characteristic.
 - c. Heaters in each phase matched to nameplate full-load current of actual protected motor and with appropriate adjustment for duty cycle.
 - d. Ambient compensated.
 - e. Automatic resetting.
 2. Solid-State Overload Relay:
 - a. Switch or dial selectable for motor-running overload protection.
 - b. Sensors in each phase.
 - c. Class 10/20 selectable tripping characteristic selected to protect motor against voltage and current unbalance and single phasing.
 - d. Class II Ground-Fault Protection: Comply with UL 1053 to interrupt low-level ground faults. The ground-fault detection system shall include circuitry that will prevent the motor controller from tripping when the fault current exceeds the interrupting capacity of the controller. Equip with start and run delays to prevent nuisance trip on starting, and a trip indicator.

- H. Digital Communication Module: RS-485 Modbus, RTU protocol, 4-wire connection to host devices with a compatible port to transmit the following to the LAN:
 - 1. Instantaneous RMS current each phase, and 3-phase average.
 - 2. Voltage: L-L for each phase, L-L 3-phase average, L-N each phase and L-N 3-phase average - rms.
 - 3. Active Energy (kWh): 3-phase total.
 - 4. Power Factor: Each phase and 3-phase total.

2.6 COMBINATION REDUCED-VOLTAGE MOTOR CONTROLLERS

- A. Description: Factory-assembled, combination reduced-voltage magnetic motor controller consisting of the controller described in this article, indicated disconnecting means, and SCPD and OCPD, in a single enclosure.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Eaton.
 - 2. General Electric Company.
 - 3. SIEMENS Industry, Inc.; Energy Management Division.
 - 4. Square D; by Schneider Electric.
- C. Configuration:
 - 1. Wye-Delta Controller: Four contactors, with a three-phase starting resistor/reactor bank.
 - 2. Part-Winding Controller: Separate START and RUN contactors, field-selectable for 1/2- or 2/3-winding start mode, with either six- or nine-lead motors; with separate overload relays for starting and running sequences.
 - 3. Autotransformer Reduced-Voltage Controller: Medium-duty service, with integral overtemperature protection; taps for starting at 50, 65, and 80 percent of line voltage; two START and one RUN contactors.
- D. Contactor Coils: Pressure-encapsulated type with coil transient suppressors when indicated.
 - 1. Operating Voltage: Manufacturer's standard, unless indicated.
- E. Control Power: 120-V ac; obtained from integral CPT, with primary and secondary fuses, with CPT of sufficient capacity to operate integral devices and remotely located pilot, indicating, and control devices.
- F. Overload Relays:
 - 1. Thermal Overload Relays: Bimetallic type.
 - a. Inverse-time-current characteristic.
 - b. Class 10 tripping characteristic.
 - c. Heaters in each phase matched to nameplate full-load current of actual protected motor and with appropriate adjustment for duty cycle.
 - d. Ambient compensated.
 - e. Automatic resetting.
 - 2. Solid-State Overload Relay:
 - a. Switch or dial selectable for motor-running overload protection.
 - b. Sensors in each phase.
 - c. Class 10/20 selectable tripping characteristic selected to protect motor against voltage and current unbalance and single phasing.
- G. Class II Ground-Fault Protection: Comply with UL 1053 to interrupt low-level ground faults. The ground-fault detection system shall include circuitry that will prevent the motor controller from tripping when the fault current exceeds the interrupting capacity of the controller. Equip with start and run delays to prevent nuisance trip on starting, and a trip indicator.

- H. Digital Communication Module: RS-485 Modbus, RTU protocol, 4-wire connection to host devices with a compatible port to transmit the following to the LAN:
 - 1. Instantaneous RMS current each phase, and 3-phase average.
 - 2. Voltage: L-L for each phase, L-L 3-phase average, L-N each phase and L-N 3-phase average - rms.
 - 3. Active Energy (kWh): 3-phase total.
 - 4. Power Factor: Each phase and 3-phase total.
- I. Fusible Disconnecting Means:
 - 1. NEMA KS 1, heavy-duty, horsepower-rated, fusible switch with clips or bolt pads to accommodate indicated fuses.
 - 2. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.
- J. Non-fusible Disconnecting Means:
 - 1. NEMA KS 1, heavy-duty, horsepower-rated, non-fusible switch.
 - 2. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.
- K. MCP Disconnecting Means:
 - 1. UL 489 and NEMA AB 3, with interrupting capacity to comply with available fault currents, instantaneous-only circuit breaker with front-mounted, field-adjustable, short-circuit trip coordinated with motor locked-rotor amperes.
 - 2. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.
- L. MCCB Disconnecting Means:
 - 1. UL 489 and NEMA AB 3, with interrupting capacity to comply with available fault currents; thermal-magnetic MCCB, with inverse-time-current element for low-level overloads and instantaneous magnetic trip element for short circuits.
 - 2. Front-mounted, adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
 - 3. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.

2.7 MULTISPEED MAGNETIC CONTROLLERS

- A. Description: Two speed, full voltage, across the line, electrically held.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Eaton.
 - 2. General Electric Company.
 - 3. SIEMENS Industry, Inc.; Energy Management Division.
 - 4. Square D; by Schneider Electric.
- C. Standard: Comply with NEMA ICS 2, general purpose, Class A.
 - 1. Configuration: Non-reversing, multispeed.
 - 2. Contactor Coils: Pressure-encapsulated type with coil transient suppressors.
 - a. Operating Voltage: Manufacturer's standard, unless indicated.
 - 3. Power Contacts: Totally enclosed, double break, silver-cadmium oxide; assembled to allow inspection and replacement without disturbing line or load wiring.
 - 4. Control Power: 120-V ac; obtained from integral CPT, with primary and secondary fuses, with CPT of sufficient capacity to operate integral devices and remotely located pilot, indicating, and control devices.
 - 5. Compelling relays shall ensure that motor will start only at low speed.
 - 6. Accelerating timer relays shall ensure properly timed acceleration through speeds lower than that selected.
 - 7. Decelerating timer relays shall ensure automatically timed deceleration through each speed.

8. Anti-plugging timer relays shall ensure a time delay when transferring from FORWARD to REVERSE and back.
- D. Overload Relays:
1. Thermal Overload Relays: Bimetallic type.
 - a. Inverse-time-current characteristic.
 - b. Class 10 tripping characteristic.
 - c. Heaters in each phase matched to nameplate full-load current of actual protected motor and with appropriate adjustment for duty cycle.
 - d. Ambient compensated.
 - e. Automatic resetting.
 2. Solid-State Overload Relay:
 - a. Switch or dial selectable for motor-running overload protection.
 - b. Sensors in each phase.
 - c. Class 10/20 selectable tripping characteristic selected to protect motor against voltage and current unbalance and single phasing.
- E. Class II ground-fault protection shall comply with UL 1053 to interrupt low-level ground faults. The ground-fault detection system shall include circuitry that will prevent the motor controller from tripping when the fault current exceeds the interrupting capacity of the controller. Equip with start and run delays to prevent nuisance trip on starting, and a trip indicator.
- F. Digital communication module, using RS-485 Modbus, RTU protocol, 4-wire connection to host devices with a compatible port to transmit the following to the LAN:
1. Instantaneous rms current each phase, and 3-phase average.
 2. Voltage: L-L for each phase, L-L 3-phase average, L-N each phase and L-N 3-phase average - rms.
 3. Active Energy (kWh): 3-phase total.
 4. Power Factor: Each phase and 3-phase total.
 - 5.
- 2.8 Combination Multispeed Magnetic Motor Controller
- A. Description: Factory-assembled, combination of multispeed magnetic motor controller, consisting of the controller, indicated disconnecting means, and SCPD and OCPD, in a single enclosure.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Eaton.
 2. General Electric Company.
 3. SIEMENS Industry, Inc.; Energy Management Division.
 4. Square D; by Schneider Electric.
- C. Standard: Comply with NEMA ICS 2, general purpose, Class A.
1. Configuration: Non-reversing.
 2. Contactor Coils: Pressure-encapsulated type with coil transient suppressors.
 - a. Operating Voltage: Manufacturer's standard, unless indicated.
 3. Power Contacts: Totally enclosed, double break, silver-cadmium oxide; assembled to allow inspection and replacement without disturbing line or load wiring.
 4. Control Power: 120-V ac; obtained from integral CPT, with primary and secondary fuses, with CPT of sufficient capacity to operate integral devices and remotely located pilot, indicating, and control devices.
 5. Compelling relays shall ensure that motor will start only at low speed.
 6. Accelerating timer relays shall ensure properly timed acceleration through speeds lower than that selected.

7. Decelerating timer relays shall ensure automatically timed deceleration through each speed.
 8. Anti-plugging timer relays shall ensure a time delay when transferring from FORWARD to REVERSE and back.
- D. Overload Relays:
1. Thermal Overload Relays: Bimetallic type.
 - a. Inverse-time-current characteristic.
 - b. Class 10 tripping characteristic.
 - c. Heaters in each phase matched to nameplate full-load current of actual protected motor and with appropriate adjustment for duty cycle.
 - d. Ambient compensated.
 - e. Automatic resetting.
 2. Solid-State Overload Relay:
 - a. Switch or dial selectable for motor-running overload protection.
 - b. Sensors in each phase.
 - c. Class 10/20 selectable tripping characteristic selected to protect motor against voltage and current unbalance and single phasing.
- E. Class II ground-fault protection shall comply with UL 1053 to interrupt low-level ground faults. The ground-fault detection system shall include circuitry that will prevent the motor controller from tripping when the fault current exceeds the interrupting capacity of the controller. Equip with start and run delays to prevent nuisance trip on starting, and a trip indicator.
- F. Digital communication module, using RS-485 Modbus, RTU protocol, 4-wire connection to host devices with a compatible port to transmit the following to the LAN:
1. Instantaneous RMS current each phase, and 3-phase average.
 2. Voltage: L-L for each phase, L-L 3-phase average, L-N each phase and L-N 3-phase average - rms.
 3. Active Energy (kWh): 3-phase total.
 4. Power Factor: Each phase and 3-phase total.
- G. Fusible Disconnecting Means:
1. NEMA KS 1, heavy-duty, horsepower-rated, fusible switch with clips or bolt pads to accommodate indicated fuses.
 2. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.
 3. NEMA KS 1, heavy-duty, horsepower-rated, nonfusible switch.
 4. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.
- H. MCP Disconnecting Means:
1. UL 489 and NEMA AB 3, with interrupting capacity to comply with available fault currents, instantaneous-only circuit breaker with front-mounted, field-adjustable, short-circuit trip coordinated with motor locked-rotor amperes.
 2. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.
- I. MCCB Disconnecting Means:
1. UL 489 and NEMA AB 3, with interrupting capacity to comply with available fault currents; thermal-magnetic MCCB, with inverse-time-current element for low-level overloads and instantaneous magnetic trip element for short circuits.
 2. Front-mounted, adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
 3. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.

2.9 ENCLOSURES

- A. Comply with NEMA 250, type designations as indicated on Drawings, complying with environmental conditions at installed location.
- B. The construction of the enclosures shall comply with NEMA ICS 6.
- C. Controllers in hazardous (classified) locations shall comply with UL 1203.

2.10 ACCESSORIES

- A. General Requirements for Control Circuit and Pilot Devices: NEMA ICS 5; factory installed in controller enclosure cover unless otherwise indicated.
 - 1. Push Buttons, Pilot Lights, and Selector Switches: Standard-duty, except as needed to match enclosure type. Heavy-duty or oil-tight where indicated in the controller schedule.
 - a. Push Buttons: As indicated in the controller schedule.
 - b. Pilot Lights: As indicated in the controller schedule.
 - 2. Elapsed Time Meters: Heavy duty with digital readout in hours.
 - 3. Meters: Panel type, 2-1/2-inch minimum size with 90- or 120-degree scale and plus or minus two percent accuracy. Where indicated, provide selector switches with an off position.
- B. Motor protection relays shall be with solid-state sensing circuit and isolated output contacts for hardwired connections.
 - 1. Phase-failure.
 - 2. Phase-reversal, with bicolor LED to indicate normal and fault conditions. Automatic reset when phase reversal is corrected.
 - 3. Under/overvoltage, operate when the circuit voltage reaches a preset value, and drop out when the operating voltage drops to a level below the preset value. Include adjustable time-delay setting.
- C. Breather assemblies, to maintain interior pressure and release condensation in Type 4 enclosures installed outdoors or in unconditioned interior spaces subject to humidity and temperature swings.
- D. Space heaters, with NC auxiliary contacts, to mitigate condensation in Type 12 enclosures installed outdoors or in unconditioned interior spaces subject to humidity and temperature swings.
- E. Sun shields installed on fronts, sides, and tops of enclosures installed outdoors and subject to direct and extended sun exposure.

2.11 IDENTIFICATION

- A. Controller Nameplates: Laminated acrylic or melamine plastic signs, as described in Section 260553 "Identification for Electrical Systems," for each compartment, mounted with corrosion-resistant screws.
- B. Arc-Flash Warning Labels:
 - 1. Comply with requirements in Section 260573.19 "Arc-Flash Hazard Analysis." Produce a 3.5-by-5-inch self-adhesive equipment label for each work location included in the analysis.
 - 2. Comply with requirements in Section 260553 "Identification for Electrical Systems." Produce a 3.5-by-5-inch self-adhesive equipment label for each work location included in the analysis. Labels shall be machine printed, with no field-applied markings.
 - a. The label shall have an orange header with the wording, "WARNING, ARC-FLASH HAZARD," and shall include the following information taken directly from the arc-flash hazard analysis:

- 1) Location designation.
 - 2) Nominal voltage.
 - 3) Flash protection boundary.
 - 4) Hazard risk category.
 - 5) Incident energy.
 - 6) Working distance.
 - 7) Engineering report number, revision number, and issue date.
- b. Labels shall be machine printed, with no field-applied markings.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and space conditions for compliance with requirements for motor controllers, their relationship with the motors, and other conditions affecting performance of the Work.

3.2 INSTALLATION

- A. Comply with NECA 1.
- B. Wall-Mounted Controllers: Install magnetic controllers on walls with tops at uniform height indicated, and by bolting units to wall or mounting on lightweight structural-steel channels bolted to wall. For controllers not at walls, provide freestanding racks complying with Section 260529 "Hangers and Supports for Electrical Systems" unless otherwise indicated.
- C. Comply with requirements for seismic control devices specified in Section 260548.16 "Seismic Controls for Electrical Systems."
- D. Maintain minimum clearances and workspace at equipment according to manufacturer's written instructions and NFPA 70.
- E. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.
- F. Setting of Overload Relays: Select and set overloads on the basis of full-load current rating as shown on motor nameplate. Adjust setting value for special motors as required by NFPA 70 for motors that are high-torque, high-efficiency, and so on.

3.3 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.4 FIELD QUALITY CONTROL

- A. Perform tests and inspections with the assistance of a factory-authorized service representative.
- B. Tests and Inspections:
1. Comply with the provisions of NFPA 70B, "Testing and Test Methods" Chapter.

2. Visual and Mechanical Inspection:
 - a. Compare equipment nameplate data with drawings and specifications.
 - b. Inspect physical and mechanical condition.
 - c. Inspect anchorage, alignment, and grounding.
 - d. Verify the unit is clean.
 - e. Inspect contactors:
 - 1) Verify mechanical operation.
 - 2) Verify contact gap, wipe, alignment, and pressure are according to manufacturer's published data.
 - f. Motor-Running Protection:
 - 1) Verify overload element rating is correct for its application.
 - 2) If motor-running protection is provided by fuses, verify correct fuse rating.
 - g. Inspect bolted electrical connections for high resistance using one of the two following methods:
 - 1) Use a low-resistance ohmmeter. Compare bolted connection resistance values with values of similar connections. Investigate values that deviate from those of similar bolted connections by more than 50 percent of the lowest value.
 - 2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method according to manufacturer's published data or NETA ATS Table 100.12. Bolt-torque levels shall be according to manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS Table 100.12.
 - h. Verify appropriate lubrication on moving current-carrying parts and on moving and sliding surfaces.
3. Electrical Tests:
 - a. Perform insulation-resistance tests for one minute on each pole, phase-to-phase and phase-to-ground with switch closed, and across each open pole. Insulation-resistance values shall be according to manufacturer's published data or NETA ATS Table 100.1. In the absence of manufacturer's published data, use Table 100.5. Values of insulation resistance less than those of this table or manufacturer's recommendations shall be investigated and corrected.
 - b. Measure fuse resistance. Investigate fuse-resistance values that deviate from each other by more than 15 percent.
 - c. Test motor protection devices according to manufacturer's published data.
 - d. Test circuit breakers as follows:
 - 1) Operate the circuit breaker to ensure smooth operation.
 - 2) For adjustable circuit breakers, adjust protective device settings according to the coordination study. Comply with coordination study recommendations.
 - e. Perform operational tests by initiating control devices.
4. Infrared Inspection: Perform the survey during periods of maximum possible loading. Remove all necessary covers prior to the inspection.
 - a. Comply with the recommendations of NFPA 70B, "Testing and Test Methods" Chapter, "Infrared Inspection" Article.
 - b. After Substantial Completion, but not more than 60 days after Final Acceptance, perform infrared inspection of the electrical power connections of each motor controller.
 - c. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each motor controller 11 months after date of Substantial Completion.
 - d. Report of Infrared Inspection: Prepare a certified report that identifies the testing technician and equipment used, and lists the following results:
 - 1) Description of equipment to be tested.
 - 2) Discrepancies.
 - 3) Temperature difference between the area of concern and the reference area.
 - 4) Probable cause of temperature difference.
 - 5) Areas inspected. Identify inaccessible and unobservable areas and equipment.
 - 6) Load conditions at time of inspection.
 - 7) Photographs and thermograms of the deficient area.
 - 8) Recommended action.

- e. Equipment: Inspect distribution systems with imaging equipment capable of detecting a minimum temperature difference of 1 degree C at 30 degrees C. The equipment shall detect emitted radiation and convert detected radiation to a visual signal.
 - f. Act on inspection results and recommended action, and considering the recommendations of NETA ATS, Table 100.18. Correct possible and probable deficiencies as soon as Owner's operations permit. Retest until deficiencies are corrected.
- C. Motor controller will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

3.5 SYSTEM FUNCTION TESTS

- A. System function tests shall prove the correct interaction of sensing, processing, and action devices. Perform system function tests after field quality control tests have been completed and all components have passed specified tests.
- 1. Develop test parameters and perform tests for the purpose of evaluating performance of integral components and their functioning as a complete unit within design requirements and manufacturer's published data.
 - 2. Verify the correct operation of interlock safety devices for fail-safe functions in addition to design function.
 - 3. Verify the correct operation of sensing devices, alarms, and indicating devices.
- B. Motor controller will be considered defective if it does not pass the system function tests and inspections.
- C. Prepare test and inspection reports.

3.6 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain switchgear.

END OF SECTION 262913.03

SECTION 263600 - TRANSFER SWITCHES

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 transfer switches rated 600 V and less, including the following:
 - 1. Non-automatic transfer switches.
 - 2. Remote annunciation and control systems.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, weights, operating characteristics, furnished specialties, and accessories.
- B. Shop Drawings: Dimensioned plans, elevations, sections, and details showing minimum clearances, conductor entry provisions, gutter space, installed features and devices, and material lists for each switch specified.
- C. Manufacturer Seismic Qualification Certification: Submit certification that transfer switches accessories, and components will withstand seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems." Include the following:
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."
 - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- D. Qualification Data: For testing agency.
- E. Field quality-control test reports.
- F. Operation and Maintenance Data: For each type of product 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. Features and operating sequences, both automatic and manual.

2. List of all factory settings of relays; provide relay-setting and calibration instructions, including software, where applicable.

1.4 QUALITY ASSURANCE

- A. **Manufacturer Qualifications:** Maintain a service center capable of providing training, parts, and emergency maintenance repairs within a response period of less than eight hours from time of notification.
- B. **Testing Agency Qualifications:** An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.
 1. **Testing Agency's Field Supervisor:** Person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.
- C. **Source Limitations:** Obtain automatic transfer switches, remote annunciator and control panels through one source from a single manufacturer.
- D. **Electrical Components, Devices, and Accessories:** Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- E. Comply with NEMA ICS 1.
- F. Comply with NFPA 70.
- G. Comply with NFPA 110.
- H. Comply with UL 1008 unless requirements of these Specifications are stricter.

1.5 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

PART 2 - PRODUCTS

2.1 GENERAL TRANSFER-SWITCH PRODUCT REQUIREMENTS

- A. **Indicated Current Ratings:** Apply as defined in UL 1008 for continuous loading and total system transfer, including tungsten filament lamp loads not exceeding 30 percent of switch ampere rating, unless otherwise indicated.
- B. **Tested Fault-Current Closing and Withstand Ratings:** Adequate for duty imposed by protective devices at installation locations in Project under the fault conditions indicated, based on testing according to UL 1008.

1. Where transfer switch includes internal fault-current protection, rating of switch and trip unit combination shall exceed indicated fault-current value at installation location.
- C. Solid-State Controls: Repetitive accuracy of all settings shall be plus or minus 2 percent or better over an operating temperature range of minus 20 to plus 70 deg C.
- D. Resistance to Damage by Voltage Transients: Components shall meet or exceed voltage-surge withstand capability requirements when tested according to IEEE C62.41. Components shall meet or exceed voltage-impulse withstand test of NEMA ICS 1.
- E. Electrical Operation: Accomplish by a nonfused, momentarily energized solenoid or electric-motor-operated mechanism, mechanically and electrically interlocked in both directions.
- F. Switch Characteristics: Designed for continuous-duty repetitive transfer of full-rated current between active power sources.
 1. Switch Action: Double throw; mechanically held in both directions.
 2. Contacts: Silver composition or silver alloy for load-current switching. Conventional automatic transfer-switch units, rated 225 A and higher, shall have separate arcing contacts.
- G. Neutral Terminal: Solid and fully rated, unless otherwise indicated.
- H. Battery Charger: For generator starting batteries.
 1. Float type rated 10 A.
 2. Fused ac inputs and dc outputs.
- I. Annunciation, Control, and Programming Interface Components: Devices at transfer switches for communicating with remote programming devices, annunciators, or annunciator and control panels shall have communication capability matched with remote device.
- J. Factory Wiring: Train and bundle factory wiring and label, consistent with Shop Drawings, either by color-code or by numbered or lettered wire and cable tape markers at terminations. Color-coding and wire and cable tape markers are specified in Division 26 Section "Identification for Electrical Systems."
 1. Designated Terminals: Pressure type, suitable for types and sizes of field wiring indicated.
 2. Power-Terminal Arrangement and Field-Wiring Space: Suitable for top, side, or bottom entrance of feeder conductors as indicated.
 3. Control Wiring: Equipped with lugs suitable for connection to terminal strips.
- K. Enclosures: General-purpose NEMA 250, Type 1, complying with NEMA ICS 6 and UL 508, unless otherwise indicated.

2.2 NON-AUTOMATIC TRANSFER SWITCHES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. ASCO: a brand of Vertiv.
 2. ESL Power Systems, Inc.
 3. Russelectric, Inc.

- B. Electrically Operated: Electrically actuated by push buttons designated "Normal Source" and "Alternative Source." Switch shall be capable of transferring load in either direction with either or both sources energized.
- C. Manual and Electrically Operated: Electrically actuated by push buttons designated "Normal Source" and "Alternative Source." Manual handle provides quick-make, quick-break manual-switching action. Switch shall be capable of electrically or manually transferring load in either direction with either or both sources energized. Control circuit disconnects from electrical operator during manual operation.
- D. Double-Throw Switching Arrangement: Incapable of pauses or intermediate position stops during switching sequence.
- E. Pilot Lights: Indicate source to which load is connected.
- F. Source-Available Indicating Lights: Supervise sources via transfer-switch normal- and alternative-source sensing circuits.
 - 1. Normal Power Supervision: Green light with nameplate engraved "Normal Source Available."
 - 2. Emergency Power Supervision: Red light with nameplate engraved "Alternative Source Available."
- G. Unassigned Auxiliary Contacts: Switch shall have one set of normally closed contacts for each switch position, rated 10 A at 240-V ac.
- H. Switch Characteristics: Designed for continuous-duty repetitive transfer of full-rated current between active power sources.
 - 1. Switch Action: Double throw; mechanically held in both directions.
 - 2. Contacts: Silver composition or silver alloy for load-current switching.
 - 3. Conductor Connectors: Suitable for use with conductor material and sizes.
 - 4. Material: Hard-drawn copper, 98 percent conductivity.
 - 5. Main and Neutral Lugs: Mechanical type.
 - 6. Ground Lugs and Bus-Configured Terminators: Mechanical type.
 - 7. Ground bar.
 - 8. Connectors shall be marked for conductor size and type according to UL 1008.

2.3 REMOTE ANNUNCIATOR AND CONTROL SYSTEM

- A. Functional Description: Include the following functions for indicated transfer switches:
 - 1. Indication of sources available.
 - 2. Indication of switch position.
 - 3. Indication of switch in test mode.
 - 4. Indication of failure of digital communication link.
 - 5. Key-switch or user-code access to control functions of panel.
 - 6. Control of switch-test initiation.
 - 7. Control of switch operation in either direction.

- B. Malfunction of annunciator, annunciation and control panel, or communication link shall not affect functions of transfer switch. In the event of failure of communication link, automatic transfer switch automatically reverts to stand-alone, self-contained operation. Automatic transfer-switch sensing, controlling, or operating function shall not depend on remote panel for proper operation.
- C. Remote Annunciation and Control Panel: Solid-state components. Include the following features:
 - 1. Controls and indicating lights grouped together for each transfer switch.
 - 2. Label each indicating light control group. Indicate transfer switch it controls, location of switch, and load it serves.
 - 3. Digital Communication Capability: Matched to that of transfer switches supervised.
 - 4. Mounting: Flush, modular, steel cabinet, unless otherwise indicated.

2.4 SOURCE QUALITY CONTROL

- A. Factory test and inspect components, assembled switches, and associated equipment. Ensure proper operation. Check transfer time and voltage, frequency, and time-delay settings for compliance with specified requirements. Perform dielectric strength test complying with NEMA ICS 1.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Design each fastener and support to carry load indicated by seismic requirements and according to seismic-restraint details. See Division 26 Section "Vibration and Seismic Controls for Electrical Systems."
- B. Annunciator and Control Panel Mounting: Flush in wall, unless otherwise indicated.
- C. Identify components according to Division 26 Section "Identification for Electrical Systems."
- D. Set field-adjustable intervals and delays, relays, and engine exerciser clock.

3.2 CONNECTIONS

- A. Wiring to Remote Components: Match type and number of cables and conductors to control and communication requirements of transfer switches as recommended by manufacturer. Increase raceway sizes at no additional cost to Owner if necessary to accommodate required wiring.
- B. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- C. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.3 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 installation, including connections, and to assist in testing.
 2. After installing equipment and after electrical circuitry has been energized, test for compliance with requirements.
 3. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 4. Measure insulation resistance phase-to-phase and phase-to-ground with insulation-resistance tester. Include external annunciation and control circuits. Use test voltages and procedure recommended by manufacturer. Comply with manufacturer's specified minimum resistance.
 - a. Check for electrical continuity of circuits and for short circuits.
 - b. Inspect for physical damage, proper installation and connection, and integrity of barriers, covers, and safety features.
 - c. Verify that manual transfer warnings are properly placed.
 - d. Perform manual transfer operation.
 5. After energizing circuits, demonstrate interlocking sequence and operational function for each switch at least three times.
 - a. Simulate power failures of normal source to automatic transfer switches and of emergency source with normal source available.
 - b. Simulate loss of phase-to-ground voltage for each phase of normal source.
 - c. Verify time-delay settings.
 - d. Verify pickup and dropout voltages by data readout or inspection of control settings.
 - e. Test bypass/isolation unit functional modes and related automatic transfer-switch operations.
 - f. Verify proper sequence and correct timing of automatic engine starting, transfer time delay, retransfer time delay on restoration of normal power, and engine cool-down and shutdown.
- C. Coordinate tests with tests of generator and run them concurrently.
- D. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation and contact resistances and time delays. Attach a label or tag to each tested component indicating satisfactory completion of tests.
- E. Remove and replace malfunctioning units and retest as specified above.
- F. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each switch. Remove all access panels so joints and connections are accessible to portable scanner.
1. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
 2. Record of Infrared Scanning: Prepare a certified report that identifies switches checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.4 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain transfer switches and related equipment as specified below. Refer to Division 01 Section "Demonstration and Training."
- B. Coordinate this training with that for generator equipment.

END OF SECTION 263600

SECTION 265119 - LED INTERIOR LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

- 1. Interior solid-state luminaires that use LED technology.
- 2. Lighting fixture supports.

- B. Related Requirements:

- 1. Section 260923"Lighting Control Devices" for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, and multipole lighting relays and contactors.

1.3 DEFINITIONS

- A. CCT: Correlated color temperature.
- B. CRI: Color Rendering Index.
- C. Fixture: See "Luminaire."
- D. IP: International Protection or Ingress Protection Rating.
- E. LED: Light-emitting diode.
- F. Lumen: Measured output of lamp and luminaire, or both.
- G. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.4 ACTION SUBMITTALS

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

- 1. Arrange in order of luminaire designation.
- 2. Include data on features, accessories, and finishes.
- 3. Include physical description and dimensions of luminaires.
- 4. Include emergency lighting units, including batteries and chargers.
- 5. Include life, output (lumens, CCT, and CRI), and energy efficiency data.
- 6. Photometric data and adjustment factors based on laboratory tests, complying with IESNA Lighting Measurements Testing and Calculation Guides, of each lighting fixture type. The

adjustment factors shall be for lamps and accessories identical to those indicated for the lighting fixture as applied in this Project IES LM-79 and IES LM-80.

- a. Manufacturers' Certified Data: Photometric data certified by manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.
 - b. Testing Agency Certified Data: For indicated luminaires, photometric data certified by a qualified independent testing agency. Photometric data for remaining luminaires shall be certified by manufacturer.
- B. Shop Drawings: For nonstandard or custom luminaires.
1. Include plans, elevations, sections, and mounting and attachment details.
 2. Include details of luminaire assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 3. Include diagrams for power, signal, and control wiring.
- C. Samples: For each luminaire and for each color and texture with standard factory-applied finish.
- D. Samples for Initial Selection: For each type of luminaire with custom factory-applied finishes.
1. Include Samples of luminaires and accessories involving color and finish selection.
- E. Samples for Verification: For each type of luminaire.
1. Include Samples of luminaires and accessories to verify finish selection.
- F. Product Schedule: For luminaires and lamps. Use same designations indicated on Drawings.

1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
1. Lighting luminaires.
 2. Partitions and millwork that penetrate the ceiling or extend to within 12 inches of the plane of the luminaires.
 3. Structural members to which equipment and or luminaires will be attached.
 4. Initial access modules for acoustical tile, including size and locations.
 5. Items penetrating finished ceiling, including the following:
 - a. Other luminaires.
 - b. Air outlets and inlets.
 - c. Access panels.
 6. Moldings.
- B. Qualification Data: For testing laboratory providing photometric data for luminaires.
- C. Seismic Qualification Certificates: For luminaires, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
- D. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- E. Product Certificates: For each type of luminaire.
- F. Product Test Reports: For each luminaire, for tests performed by a qualified testing agency.
- G. Sample warranty.
- 1.6 CLOSEOUT SUBMITTALS
- A. Operation and Maintenance Data: For luminaires and lighting systems to include in operation and maintenance manuals.
1. Provide a list of all lamp types used on Project; use ANSI and manufacturers' codes.
- 1.7 QUALITY ASSURANCE
- A. Luminaire Photometric Data Testing Laboratory Qualifications: Luminaire manufacturer's laboratory that is accredited under the NVLAP for Energy Efficient Lighting Products.
- B. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7, accredited under the NVLAP for Energy Efficient Lighting Products, and complying with the applicable IES testing standards.
- C. Provide luminaires from a single manufacturer for each luminaire type.
- D. Each luminaire type shall be binned within a three-step MacAdam Ellipse to ensure color consistency among luminaires.
- 1.8 DELIVERY, STORAGE, AND HANDLING
- A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering before shipping.
- 1.9 WARRANTY
- A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.
- B. Warranty Period: Five year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Luminaires shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
- B. Seismic Performance: Luminaires and lamps shall be labeled vibration and shock resistant.
 - 1. The term "withstand" means "the luminaire will remain in place without separation of any parts when subjected to the seismic forces specified and the luminaire will be fully operational during and after the seismic event."

2.2 LUMINAIRE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. NRTL Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by an NRTL.
- C. FM Global Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.
- D. Recessed Fixtures: Comply with NEMA LE 4.
- E. Bulb shape complying with ANSI C79.1.
- F. Lamp base complying with ANSI C81.61 or IEC 60061-1.
- G. CRI of minimum 80. CCT of 3000 K.
- H. Rated lamp life of 50,000 hours.
- I. Lamps dimmable from 100 percent to 0 percent of maximum light output.
- J. Internal driver.
- K. Nominal Operating Voltages: 120 V ac, 12 V dc, 24 V dc.
 - 1. Lens Thickness: At least 0.125 inch minimum unless otherwise indicated.

2.3 MATERIALS

- A. Metal Parts:
 - 1. Free of burrs and sharp corners and edges.
 - 2. Sheet metal components shall be steel unless otherwise indicated.
 - 3. Form and support to prevent warping and sagging.

- B. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.
- C. Diffusers and Globes:
 - 1. Acrylic Diffusers: One hundred percent virgin acrylic plastic, with high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
 - 2. Glass: Annealed crystal glass unless otherwise indicated.
 - 3. Lens Thickness: At least 0.125 inch minimum unless otherwise indicated.
- D. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps. Locate labels where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.
 - 1. Label shall include the following lamp characteristics:
 - a. "USE ONLY" and include specific lamp type.
 - b. Lamp diameter, shape, size, wattage, and coating.
 - c. CCT and CRI for all luminaires.

2.4 METAL FINISHES

- A. Variations in finishes are unacceptable in the same piece. Variations in finishes of adjoining components are acceptable if they are within the range of approved Samples and if they can be and are assembled or installed to minimize contrast.

2.5 LUMINAIRE FIXTURE SUPPORT COMPONENTS

- A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.
- B. Single-Stem Hangers: 1/2-inch steel tubing with swivel ball fittings and ceiling canopy. Finish same as luminaire.
- C. Wires: ASTM A 641/A 641 M, Class 3, soft temper, zinc-coated steel, 12 gage.
- D. Rod Hangers: 3/16-inch minimum diameter, cadmium-plated, threaded steel rod.
- E. Hook Hangers: Integrated assembly matched to luminaire, line voltage, and equipment with threaded attachment, cord, and locking-type plug.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

- B. Examine roughing-in for luminaire to verify actual locations of luminaire and electrical connections before fixture installation. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 TEMPORARY LIGHTING

- A. If approved by the Architect, use selected permanent luminaires for temporary lighting. When construction is sufficiently complete, clean luminaires used for temporary lighting and install new lamps.

3.3 INSTALLATION

- A. Comply with NECA 1.
- B. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.
- C. Install lamps in each luminaire.
- D. Supports:
 - 1. Sized and rated for luminaire weight.
 - 2. Able to maintain luminaire position after cleaning and relamping.
 - 3. Provide support for luminaire without causing deflection of ceiling or wall.
 - 4. Luminaire mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and vertical force of 400 percent of luminaire weight.
- E. Flush-Mounted Luminaire Support:
 - 1. Secured to outlet box.
 - 2. Attached to ceiling structural members at four points equally spaced around circumference of luminaire.
 - 3. Trim ring flush with finished surface.
- F. Wall-Mounted Luminaire Support:
 - 1. Attached to a minimum 20 gauge backing plate attached to wall structural members.
 - 2. Do not attach luminaires directly to gypsum board.
- G. Ceiling-Mounted Luminaire Support:
 - 1. Ceiling mount with two 5/32-inch diameter aircraft cable supports adjustable to 120 inches in length.
 - 2. Ceiling mount with four-point pendant mount with 5/32-inch-diameter aircraft cable supports adjustable to 120 inches in length.
 - 3. Ceiling mount with hook mount.
- H. Ceiling-Grid-Mounted Luminaires:
 - 1. Secure to any required outlet box.
 - 2. Secure luminaire to the luminaire opening using approved fasteners in a minimum of four locations, spaced near corners of luminaire.
 - 3. Use approved devices and support components to connect luminaire to ceiling grid and building structure in a minimum of four locations, spaced near corners of luminaire.

- I. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" for wiring connections.

3.4 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.5 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 - 1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
 - 2. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.
- B. Luminaire will be considered defective if it does not pass operation tests and inspections.
- C. Prepare test and inspection reports.

3.6 ADJUSTING

- A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting the direction of aim of luminaires to suit occupied conditions. Make up to two visits to Project during other-than-normal hours for this purpose. Some of this work may be required during hours of darkness.
 - 1. During adjustment visits, inspect all luminaires. Replace lamps or luminaires that are defective.
 - 2. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
 - 3. Adjust the aim of luminaires in the presence of the Architect.

END OF SECTION 265119

SECTION 265219 - EMERGENCY AND EXIT LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Emergency lighting units.
 - 2. Exit signs.
 - 3. Luminaire supports.

1.3 DEFINITIONS

- A. CCT: Correlated color temperature.
- B. CRI: Color Rendering Index.
- C. Emergency Lighting Unit: A lighting unit with internal or external emergency battery powered supply and the means for controlling and charging the battery and unit operation.
- D. Fixture: See "Luminaire" Paragraph.
- E. Lumen: Measured output of lamp and luminaire, or both.
- F. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of emergency lighting unit, exit sign, and emergency lighting support.
 - 1. Include data on features, accessories, and finishes.
 - 2. Include physical description of the unit and dimensions.
 - 3. Battery and charger for light units.
 - 4. Include life, output of luminaire (lumens, CCT, and CRI), and energy-efficiency data.
 - 5. Include photometric data and adjustment factors based on laboratory tests, complying with IES LM-45, for each luminaire type.
 - a. Manufacturers' Certified Data: Photometric data certified by manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.
- B. Shop Drawings: For nonstandard or custom luminaires.
 - 1. Include plans, elevations, sections, and mounting and attachment details.
 - 2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 3. Include diagrams for power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 - 1. Luminaires.
 - 2. Suspended ceiling components.
 - 3. Partitions and millwork that penetrate the ceiling or extend to within 12 inches of the plane of the luminaires.
 - 4. Structural members to which equipment will be attached.
 - 5. Size and location of initial access modules for acoustical tile.
 - 6. Items penetrating finished ceiling including the following:
 - a. Other luminaires.
 - b. Air outlets and inlets.
 - c. Speakers.
 - d. Ceiling-mounted projectors.
 - e. Sprinklers.
 - f. Access panels.
 - 7. Moldings.
- B. Qualification Data: For testing laboratory providing photometric data for luminaires.
- C. Product Certificates: For each type of luminaire.
- D. Seismic Qualification Data: For luminaires, accessories, and components, from manufacturer.
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
 - 4. Provide seismic qualification certificate for each piece of equipment.
- E. Product Test Reports: For each luminaire for tests performed by a qualified testing agency.
- F. Sample Warranty: For manufacturer's special warranty.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For luminaires and lighting systems to include in emergency, operation, and maintenance manuals.
 - 1. Provide a list of all lamp types used on Project; use ANSI and manufacturers' codes.

1.7 QUALITY ASSURANCE

- A. Luminaire Photometric Data Testing Laboratory Qualifications: Luminaire manufacturer's laboratory that is accredited under the National Volunteer Laboratory Accreditation Program for Energy Efficient Lighting Products.
- B. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7, accredited under the National Volunteer Laboratory Accreditation Program for Energy Efficient Lighting Products, and complying with the applicable IES testing standards.

- C. FM Global Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.
- D. Mockups: For interior luminaires in room or module mockups, complete with power and control connections.
 - 1. Obtain Architect's approval of luminaires and signs in mockups before starting installations.
 - 2. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
 - 3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 - 4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering before shipping.

1.9 WARRANTY

- A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Two year(s) from date of Substantial Completion.
- B. Special Warranty for Emergency Lighting Batteries: Manufacturer's standard form in which manufacturer of battery-powered emergency lighting unit agrees to repair or replace components of rechargeable batteries that fail in materials or workmanship within specified warranty period.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Luminaires shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
 - 1. The term "withstand" means "the luminaire will remain in place without separation of any parts when subjected to the seismic forces specified and the luminaire will be fully operational during and after the seismic event."

2.2 GENERAL REQUIREMENTS FOR EMERGENCY LIGHTING

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. NRTL Compliance: Fabricate and label emergency lighting units, exit signs, and batteries to comply with UL 924.
- C. Comply with NFPA 70.
- D. Comply with NEMA LE 4 for recessed luminaires.
- E. Comply with UL 1598 for fluorescent luminaires.
- F. Lamp Base: Comply with ANSI C81.61.

- G. Bulb Shape: Complying with ANSI C79.1.
- H. Internal Type Emergency Power Unit: Self-contained, modular, battery-inverter unit, factory mounted within luminaire body and compatible with ballast.
1. Emergency Connection: Operate one lamp continuously at an output of 1100 lumens each upon loss of normal power. Connect unswitched circuit to battery-inverter unit and switched circuit to luminaire ballast.
 2. Operation: Relay automatically turns lamp on when power-supply circuit voltage drops to 80 percent of nominal voltage or below. Lamp automatically disconnects from battery when voltage approaches deep-discharge level. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
 3. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:
 - a. Ambient Temperature: Less than 0 deg F or exceeding 104 deg F, with an average value exceeding 95 deg F over a 24-hour period.
 - b. Ambient Storage Temperature: Not less than minus 4 deg F and not exceeding 140 deg F.
 - c. Humidity: More than 95 percent (condensing).
 - d. Altitude: Exceeding 3300 feet.
 4. Test Push-Button and Indicator Light: Visible and accessible without opening luminaire or entering ceiling space.
 - a. Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
 - b. Indicator Light: LED indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
 5. Battery: Sealed, maintenance-free, nickel-cadmium type.
 6. Charger: Fully automatic, solid-state, constant-current type with sealed power transfer relay.
 7. Remote Test: Switch in handheld remote device aimed in direction of tested unit initiates coded infrared signal. Signal reception by factory-installed infrared receiver in tested unit triggers simulation of loss of its normal power supply, providing visual confirmation of either proper or failed emergency response.
 8. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and a flashing red LED.
- I. External Type: Self-contained, modular, battery-inverter unit, suitable for powering one or more lamps, remote mounted from luminaire.
1. Emergency Connection: Operate one fluorescent, incandescent, or multiple LED lamps continuously. Connect unswitched circuit to battery-inverter unit and switched circuit to luminaire and/or ballast.
 2. Operation: Relay automatically turns lamp on when power-supply circuit voltage drops to 80 percent of nominal voltage or below. Lamp automatically disconnects from battery when voltage approaches deep-discharge level. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
 3. Nightlight Connection: Operate lamp in a remote luminaire continuously.
 4. Battery: Sealed, maintenance-free, nickel-cadmium type.
 5. Charger: Fully automatic, solid-state, constant-current type.
 6. Housing: NEMA 250, Type 1 enclosure listed for installation inside, on top of, or remote from luminaire. Remote assembly shall be located no less than half the distance recommended by the ballast or emergency power unit manufacturer, whichever is less.
 7. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
 8. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
 9. Remote Test: Switch in handheld remote device aimed in direction of tested unit initiates coded infrared signal. Signal reception by factory-installed infrared receiver in tested unit triggers simulation of loss of its normal power supply, providing visual confirmation of either proper or failed emergency response.
 10. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and a flashing red LED.

2.3 EMERGENCY LIGHTING

- A. General Requirements for Emergency Lighting Units: Self-contained units.
- B. Emergency Luminaires:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Cooper Lighting, an Eaton business.
 - b. Dual-Lite.
 - c. Lithonia Lighting; Acuity Brands Lighting, Inc.
 - 2. Emergency Luminaires: as indicated on Lighting Fixture Schedule with the following additional features:
 - a. Operating at nominal voltage of 120 V ac, 277 V ac, 6 V dc, 12 V dc, 24 V dc.
 - b. Internal or external emergency power unit.
 - c. Rated for installation in damp locations, and for sealed and gasketed luminaires in wet locations.
 - d. UL 94 flame rating.
- C. Emergency Lighting Unit:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Cooper Lighting, an Eaton business.
 - b. Dual-Lite.
 - c. Lithonia Lighting; Acuity Brands Lighting, Inc.
 - 2. Emergency Lighting Unit: as indicated on Lighting Fixture Schedule.
 - 3. Operating at nominal voltage of 120 V ac, 277 V ac, 6 V dc, 12 V dc, 24 V dc.
 - 4. Universal mount with universal junction box adaptor.
 - 5. UV stable thermoplastic housing, rated for damp locations.
 - 6. Two LED lamp heads.
 - 7. Internal or External emergency power unit.

2.4 EXIT SIGNS

- A. General Requirements for Exit Signs: Comply with UL 924; for sign colors, visibility, luminance, and lettering size, comply with authorities having jurisdiction.
- B. Internally Lighted Signs:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Exitronix, Emergency Lighting
 - b. Cooper Lighting, an Eaton business.
 - c. Hubbell Industrial Lighting; Hubbell Incorporated.
 - d. Lithonia Lighting; Acuity Brands Lighting, Inc.
 - 2. Operating at nominal voltage of 120 V ac, 277 V ac, 6 V dc, 12 V dc, 24 V dc.
 - 3. Lamps for AC Operation: Fluorescent, two for each luminaire; 20,000 hours of rated lamp life.
 - 4. Lamps for AC Operation: LEDs; 50,000 hours minimum rated lamp life.
 - 5. Self-Powered Exit Signs (Battery Type): Internal emergency power unit.
 - 6. Master/Remote Sign Configurations:
 - a. Master Unit: Comply with requirements above for self-powered exit signs, and provide additional capacity in LED power supply, ballast, or battery for power connection to remote unit.
 - b. Remote Unit: Comply with requirements above for self-powered exit signs, except omit power supply, battery, and test features. Arrange to receive full power requirements from master unit. Connect for testing concurrently with master unit as a unified system.
- C. Self-Luminous Signs:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Exitronix, Emergency Lighting
 - b. Cooper Lighting, an Eaton business.
 - c. Dual-Lite.

- d. Isolite Corporation.
2. Powered by tritium gas, with universal bracket for flush-ceiling, wall, or end mounting. Signs shall be guaranteed by manufacturer to maintain the minimum brightness requirements in UL 924 for 20 years.
3. Use strontium oxide aluminate compound to store ambient light and release the stored energy when the light is removed. Include universal bracket for flush-ceiling, wall, or end mounting.

2.5 MATERIALS

- A. Metal Parts:
 1. Free of burrs and sharp corners and edges.
 2. Sheet metal components shall be steel unless otherwise indicated.
 3. Form and support to prevent warping and sagging.
- B. Doors, Frames, and Other Internal Access:
 1. Smooth operating, free of light leakage under operating conditions.
 2. Designed to permit relamping without use of tools.
 3. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.
- C. Diffusers and Globes:
 1. Glass: Annealed crystal glass unless otherwise indicated.
 2. Acrylic: 100 percent virgin acrylic plastic, with high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
 3. Lens Thickness: At least 0.125 inch minimum unless otherwise indicated.
- D. Housings:
 1. As indicated in the Lighting Fixture Schedule indicated on drawings.

2.6 METAL FINISHES

- A. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.7 LUMINAIRE SUPPORT COMPONENTS

- A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for conditions affecting performance of luminaires.
- B. Examine roughing-in for luminaire to verify actual locations of luminaire and electrical connections before luminaire installation.

- C. Examine walls, floors, roofs, and ceilings for suitable conditions where emergency lighting luminaires will be installed.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Comply with NECA 1.
- B. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.
- C. Install lamps in each luminaire.
- D. Supports:
 - 1. Sized and rated for luminaire and emergency power unit weight.
 - 2. Able to maintain luminaire position when testing emergency power unit.
 - 3. Provide support for luminaire and emergency power unit without causing deflection of ceiling or wall.
 - 4. Luminaire-mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire and emergency power unit weight and vertical force of 400 percent of luminaire weight.
- E. Wall-Mounted Luminaire Support:
 - 1. Attached to structural members in walls.
 - 2. Do not attach luminaires directly to gypsum board.
- F. Suspended Luminaire Support:
 - 1. Pendants and Rods: Where longer than 48 inches, brace to limit swinging.
 - 2. Stem-Mounted, Single-Unit Luminaires: Suspend with twin-stem hangers. Support with approved outlet box and accessories that hold stem and provide damping of luminaire oscillations. Support outlet box vertically to building structure using approved devices.
 - 3. Continuous Rows of Luminaires: Use tubing or stem for wiring at one point and rod or wire support for suspension for each unit length of luminaire chassis, including one at each end.
 - 4. Do not use ceiling grid as support for pendant luminaires. Connect support wires or rods to building structure.
- G. Ceiling Grid Mounted Luminaires:
 - 1. Secure to any required outlet box.
 - 2. Secure emergency power unit using approved fasteners in a minimum of four locations, spaced near corners of emergency power unit.
 - 3. Use approved devices and support components to connect luminaire to ceiling grid and building structure in a minimum of four locations, spaced near corners of luminaire.

3.3 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.4 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 - 1. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.

- B. Luminaire will be considered defective if it does not pass operation tests and inspections.
- C. Prepare test and inspection reports.

3.5 STARTUP SERVICE

- A. Perform startup service:
 - 1. Charge emergency power units and batteries minimum of 24 hours and conduct one-hour discharge test.

3.6 ADJUSTING

- A. Adjustments: Within 12 months of date of Substantial Completion, provide on-site visit to do the following:
 - 1. Inspect all luminaires. Replace lamps, emergency power units, batteries, signs, or luminaires that are defective.
 - a. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
 - 2. Conduct short-duration tests on all emergency lighting.

END OF SECTION 265219

SECTION 270528 - PATHWAYS FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Metal conduits and fittings.
 - 2. Optical-fiber-cable pathways and fittings.
 - 3. Metal wireways and auxiliary gutters.
 - 4. Metallic surface pathways.
 - 5. Tele-power poles
 - 6. Hooks.
 - 7. Boxes, enclosures, and cabinets.

1.3 DEFINITIONS

- A. ARC: Aluminum rigid conduit.
- B. GRC: Galvanized rigid conduit.
- C. IMC: Intermediate metal conduit.
- D. RTRC: Reinforced thermosetting resin conduit.

1.4 ACTION SUBMITTALS

- A. Product data for the following:
 - 1. Surface pathways
 - 2. Wireways and fittings.
 - 3. Boxes, enclosures, and cabinets.
- B. Shop Drawings: For custom enclosures and cabinets. Include plans, elevations, sections, and attachment details.

1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Pathway 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 pathway groups with common supports.
 - 2. HVAC and plumbing items and architectural features in paths of conduit groups with common supports.
 - 3. Underground ducts, piping, and structures in location of underground enclosures and handholes.

- B. Qualification Data: For professional engineer.
- C. Seismic Qualification Data: Provide seismic bracing for all pathway racks, enclosures, cabinets, equipment racks, and their mounting provisions, including those for internal components, from manufacturer.
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - 3. Detailed description of equipment anchorage devices on which certification is based and their installation requirements.
 - 4. Detailed description of conduit support devices and interconnections on which certification is based and their installation requirements.
- D. Source quality-control reports.

PART 2 - PRODUCTS

2.1 METAL CONDUITS AND FITTINGS

- A. Description: Metal raceway of circular cross section with manufacturer-fabricated fittings.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Allied Tube & Conduit; a part of Atkore International.
 - 2. O-Z/Gedney; a brand of Emerson Industrial Automation.
 - 3. Western Tube and Conduit Corporation.
 - 4. Wheatland Tube Company.
- C. General Requirements for Metal Conduits and Fittings:
 - 1. Listed and labeled as defined in NFPA 70, by a nationally recognized testing laboratory, and marked for intended location and application.
 - 2. Comply with TIA-569-C.
- D. GRC: Comply with ANSI C80.1 and UL 6.
- E. ARC: Comply with ANSI C80.5 and UL 6A.
- F. IMC: Comply with ANSI C80.6 and UL 1242.
- G. EMT: Comply with ANSI C80.3 and UL 797.
- H. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.
 - 1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 1203 and NFPA 70.
 - 2. Fittings for EMT:
 - a. Material: Steel.
 - b. Type: Compression.
 - 3. Expansion Fittings: PVC or steel to match conduit type, complying with UL-467, rated for environmental conditions where installed, and including flexible external bonding jumper.
 - 4. Coating for Fittings for PVC-Coated Conduit: Minimum thickness of 0.040 inch, with overlapping sleeves protecting threaded joints.

- I. Joint Compound for IMC, GRC, or ARC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

2.2 OPTICAL-FIBER-CABLE PATHWAYS AND FITTINGS

- A. Description: Comply with UL 2024; flexible-type pathway with a circular cross section, approved for plenum, riser or general-use installation unless otherwise indicated.
- B. 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. Alpha Wire.
 - 2. Dura-Line.
 - 3. IPEX USA LLC.
- C. Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
- D. Comply with TIA-569-C.

2.3 METAL WIREWAYS AND AUXILIARY GUTTERS

- A. Description: Sheet metal trough of rectangular cross section fabricated to required size and shape, without holes or knockouts, and with hinged or removable covers.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. B-line, an Eaton business.
 - 2. Hoffman; a brand of Pentair Equipment Protection.
 - 3. Square D; by Schneider Electric.
- C. General Requirements for Metal Wireways and Auxiliary Gutters:
 - 1. Comply with UL 870 and NEMA 250, Type 1, Type 3R, Type 12 unless otherwise indicated, and sized according to NFPA 70.
 - 2. Metal wireways installed outdoors shall be listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
 - 3. Comply with TIA-569-C.
- D. 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.
- E. Wireway Covers: Screw-cover type unless otherwise indicated.
- F. Finish: Manufacturer's standard enamel finish.

2.4 SURFACE METAL PATHWAYS

- A. Description: Galvanized steel with snap-on covers, complying with UL 5.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Panduit Corp.
 - 2. Wiremold / Legrand.

- C. Finish: Manufacturer's standard enamel finish in color selected by Architect.
- D. Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
- E. Comply with TIA-569-C.

2.5 TELE-POWER POLES:

- A. Description: Prefabricated, finished metal pole with prewired power and communications outlets.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Panduit Corp.
 - 2. Wiremold / Legrand.
- C. Material: Aluminum with clear anodized finish.
- D. Fittings and Accessories: Dividers, end caps, covers, cutouts, wiring harnesses, devices, mounting materials, and other fittings shall match and mate with tele-power pole as required for complete system.
- E. Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
- F. Comply with TIA-569-C.

2.6 HOOKS

- A. Description: Prefabricated sheet metal cable supports for telecommunications cable.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Panduit Corp.
 - 2. Wiremold / Legrand.
- C. Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
- D. Comply with TIA-569-C.
- E. Stainless steel.
- F. "J" shape.

2.7 BOXES, ENCLOSURES, AND CABINETS

- A. Description: Enclosures for communications.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Crouse-Hinds, an Eaton business.
 - 2. Hoffman; a brand of Pentair Equipment Protection.
 - 3. O-Z/Gedney; a brand of Emerson Industrial Automation.
- C. General Requirements for Boxes, Enclosures, and Cabinets:

1. Comply with TIA-569-C.
 2. Boxes, enclosures, and cabinets installed in wet locations shall be listed and labeled as defined in NFPA 70, by an NRTL, and marked for use in wet locations.
 3. Box extensions used to accommodate new building finishes shall be of same material as recessed box.
 4. Device Box Dimensions: 4 inches square by 2-1/8 inches deep.
 5. Gangable boxes are prohibited.
- D. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.
- E. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, ferrous alloy, Type FD, with gasketed cover.
- F. Metal Floor Boxes:
1. Material: Cast metal or sheet metal.
 2. Type: Fully adjustable.
 3. Shape: Rectangular.
 4. Metal floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- G. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- H. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, galvanized, cast iron with gasketed cover.
- I. Nonmetallic Outlet and Device Boxes: Comply with NEMA OS 2 and UL 514C.
- J. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 1, Type 3R, Type 12, 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.
- K. Cabinets:
1. NEMA 250, Type 1, Type 3R, Type 12 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 PATHWAY APPLICATION

- A. Outdoors: Apply pathway products as specified below unless otherwise indicated:
1. Exposed Conduit: GRC, IMC, RNC.
 2. Concealed Conduit, Aboveground: GRC, IMC, EMT, RNC.
 3. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R, Type 4.
- B. Indoors: Apply pathway products as specified below unless otherwise indicated:
1. Exposed, Not Subject to Physical Damage: EMT or RNC.
 2. Exposed, Not Subject to Severe Physical Damage: EMT, RNC identified for such use.
 3. Exposed and Subject to Severe Physical Damage: GRC, IMC. Pathway locations include the following:

- a. Corridors used for traffic of mechanized carts and pallet-handling units.
 - b. Mechanical rooms.
 4. Concealed in Ceilings and Interior Walls and Partitions: EMT.
 5. Damp or Wet Locations: GRC, IMC.
 6. Pathways for Optical-Fiber or Communications Cable in Spaces Used for Environmental Air: Plenum-type, optical-fiber-cable pathway, Plenum-type, communications-cable pathway or EMT.
 7. Pathways for Optical-Fiber or Communications-Cable Risers in Vertical Shafts: EMT.
 8. Pathways for Concealed General-Purpose Distribution of Optical-Fiber or Communications Cable: General-use, optical-fiber-cable pathway, Plenum-type, optical-fiber-cable pathway, General-use, communications-cable pathway, Plenum-type, communications-cable pathway or EMT.
 9. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4 stainless steel units in institutional and damp or wet locations.
- C. Minimum Pathway Size: 1-1/4-inch trade size.
- D. Pathway Fittings: Compatible with pathways and suitable for use and location.
1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
 2. EMT: Use compression, steel fittings. Comply with NEMA FB 2.10.
- E. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.
- F. Install surface pathways only where indicated on Drawings.

3.2 INSTALLATION

- A. Comply with the following standards for installation requirements except where requirements on Drawings or in this Section are stricter:
1. NECA 1.
 2. NECA/BICSI 568.
 3. TIA-569-C.
 4. NECA 101
 5. NECA 102.
 6. NECA 105.
 7. NECA 111.
- B. Comply with NFPA 70 limitations for types of pathways allowed in specific occupancies and number of floors.
- C. Comply with requirements in Section 07 84 13 "Penetration Firestopping" for firestopping materials and installation for penetrations through fire-rated walls, ceilings, and assemblies.
- D. Comply with requirements in Section 26 05 29 "Hangers and Supports for Electrical Systems" for hangers and supports.
- E. Keep pathways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal pathway runs above water and steam piping.
- F. Complete pathway installation before starting conductor installation.
- G. Arrange stub-ups so curved portions of bends are not visible above finished slab.
- H. Install no more than the equivalent of two 90-degree bends in any pathway run. Support within 12 inches of changes in direction. Utilize long radius ells for all optical-fiber cables.

- I. Conceal rigid conduit within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
- J. Support conduit within 12 inches of enclosures to which attached.
- K. Pathways Embedded in Slabs:
 - 1. Run conduit larger than 1-inch trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support. Secure pathways to reinforcement at maximum 10-foot intervals.
 - 2. Arrange pathways to cross building expansion joints at right angles with expansion fittings. Comply with requirements for expansion joints specified in this article.
 - 3. Arrange pathways to keep a minimum of 2 inches of concrete cover in all directions.
 - 4. Do not embed threadless fittings in concrete unless specifically approved by Architect for each specific location.
- L. Stub-ups to Above Recessed Ceilings:
 - 1. Use EMT, IMC, or RMC for pathways.
 - 2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.
- M. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of pathway and fittings before making up joints. Follow compound manufacturer's written instructions.
- N. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install insulated bushings on conduits terminated with locknuts.
- O. Install pathways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus one additional quarter-turn.
- P. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure, to assure a continuous ground path.
- Q. Cut conduit perpendicular to the length. For conduits of 2-inch trade size and larger, use roll cutter or a guide to ensure cut is straight and perpendicular to the length.
- R. Install pull wires in empty pathways. 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. Secure pull wire, so it cannot fall into conduit. Cap pathways designated as spare alongside pathways in use.
- S. Surface Pathways:
 - 1. Install surface pathway for surface telecommunications outlet boxes only where indicated on Drawings.
 - 2. Install surface pathway with a minimum 2-inch radius control at bend points.
 - 3. Secure surface pathway with screws or other anchor-type devices at intervals not exceeding 48 inches and with no less than two supports per straight pathway section. Support surface pathway according to manufacturer's written instructions. Tape and glue are not acceptable support methods.
- T. Pathways for Optical-Fiber and Communications Cable: Install pathways, metal and nonmetallic, rigid and flexible, as follows:
 - 1. 1-Inch Trade Size and Larger: Install pathways in maximum lengths of 75 feet.
 - 2. Install with a maximum of two 90-degree bends or equivalent for each length of pathway unless Drawings show stricter requirements. Separate lengths with pull or junction boxes or terminations at distribution frames or cabinets where necessary to comply with these requirements.

- U. Install pathway-sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed pathways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install pathway-sealing fittings according to NFPA 70.
- V. Install devices to seal pathway 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 pathways at the following points:
 - 1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
 - 2. Where an underground service pathway enters a building or structure.
 - 3. Where otherwise required by NFPA 70.
- W. Comply with manufacturer's written instructions for solvent welding PVC conduit and fittings.
- X. Expansion-Joint Fittings:
 - 1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed 30 deg F, and that has straight-run length that exceeds 25 feet. Install in each run of aboveground RMC and EMT that is located where environmental temperature change may exceed 100 deg F, and that has straight-run length that exceeds 100 feet.
 - 2. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:
 - a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F temperature change.
 - b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F temperature change.
 - c. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F temperature change.
 - d. Attics: 135 deg F temperature change.
 - 3. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F of temperature change for PVC conduits. Install fitting(s) that provide expansion and contraction for at least 0.000078 inch per foot of length of straight run per deg F of temperature change for metal conduits.
 - 4. Install expansion fittings at all locations where conduits cross building or structure expansion joints.
 - 5. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.
- Y. Hooks:
 - 1. Size to allow a minimum of 25 percent future capacity without exceeding design capacity limits.
 - 2. Shall be supported by dedicated support wires. Do not use ceiling grid support wire or support rods.
 - 3. Hook spacing shall allow no more than 6 inches of slack. The lowest point of the cables shall be no less than 6 inches adjacent to ceilings, mechanical ductwork and fittings, luminaires, power conduits, power and telecommunications outlets, and other electrical and communications equipment.
 - 4. Space hooks no more than 5 feet o.c.
 - 5. Provide a hook at each change in direction.
- Z. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to center of box unless otherwise indicated.
- AA. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surface to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box.

- BB. Horizontally separate boxes mounted on opposite sides of walls, so they are not in the same vertical channel.
- CC. 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.
- DD. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.
- EE. Set metal floor boxes level and flush with finished floor surface.
- FF. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

3.3 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR COMMUNICATIONS PENETRATIONS

- A. Install sleeves and sleeve seals at penetrations of floor and wall assemblies. Comply with requirements in Section 26 05 44 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.4 FIRESTOPPING

- A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Section 07 84 13 "Penetration Firestopping."

3.5 PROTECTION

- A. Protect coatings, finishes, and cabinets from damage or 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 270528

31 2000 EARTH MOVING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Excavation, filling, and backfilling for structures, and pavement.
 - 2. Trenching and backfilling for utilities.
 - 3. Dewatering.
 - 4. Boring under crossings.

- B. Related Sections
 - 1. 31 3200 Soil Stabilization
 - 2. 31 2500 Erosion Control and Sedimentation.
 - 3. 31 3500 Slope Protection

1.2 REFERENCES

- A. The publications listed below form a part of this specification to the extent referenced. Publications are referenced within the text by the basic designation only.

- B. ASTM International (ASTM)
 - 1. ASTM D 422 - Standard Test Method For Particle Size Analysis of Soil
 - 2. ASTM D 698 - Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN.m/m³))
 - 3. ASTM D 1557 - Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 Kn.m/m³))
 - 4. ASTM D 2922 - Density of Soil and Soil-Aggregate In Place by Nuclear Methods (Shallow Depth)
 - 5. ASTM D 4318 - Liquid Limit, Plastic Limit, and Plasticity Index of Soils

- C. American Association of State Highway and Transportation Officials (AASHTO)
 - 1. AASHTO T 88 - Particle Size Analysis of Soils

- D. New York State Department of Transportation (NYSDOT) Standard Specifications (latest addition January 1, 2018).

- E. National Fire Protection Association (NFPA)
 - 1. NFPA 70 - National Electrical Code

- F. American Water Works Association (AWWA)
 - 1. AWWA C200 - Standard For Steel Water Pipe - 6 In. (150 Mm) And Larger
 - 2. AWWA C206 - Field Welding Of Steel Water Pipe

1.3 QUALITY ASSURANCE

- A. An Independent Testing Laboratory (ITL), selected and paid for by the Owner, is recommended to be retained to perform construction testing on site.
 - 1. The ITL shall prepare test reports that indicate test location, elevation data, and test results. Owner, Civil Engineering Consultant, and Contractor shall be provided with copies of reports within 96 hours of time

that test was performed. In event that test performed fails to meet Specifications, the independent testing laboratory shall notify Owner and Contractor immediately.

2. Costs related to retesting due to failures shall be paid for by the Contractor at no additional expense to Owner. Contractor shall provide free access to site for testing activities.
3. Quality assurance testing will be conducted in accordance with Paragraph "Field Testing" in Part 3 hereinafter.

1.4 DEFINITIONS

- A. Satisfactory Materials: ASTM D 2487 soil classification groups GW, GP, GM, SW, SP, SM, ML, CL, or a combination of these group symbols.
1. Fill material shall further conform to the plasticity index and liquid limits (PI and LL) specified in Paragraph FILLING hereinafter.
 2. Satisfactory materials shall be free of rock or gravel larger than allowed for fill or backfill material as specified hereinafter or as shown on the drawings.
 3. Satisfactory materials shall contain no debris, waste, frozen materials, vegetation, and other deleterious matter.
 4. Unless specifically stated otherwise on the Drawings, the following table stipulates maximum allowable values for plasticity index (PI) and liquid limit (LL) of satisfactory materials to be used as fill in specified areas:

<u>Location</u>	<u>PI</u>	<u>LL</u>
Building area (below upper four feet)	20	50
Building area (upper four feet)	12	40
Areas outside the building pad (below upper two feet)	20	50
(upper two feet, except for depth to receive topsoil)	15	40

(References to depth are to proposed subgrade elevations)

- B. Unsatisfactory Materials: Materials which do not comply with the requirements for satisfactory materials are unsatisfactory.
1. Unsatisfactory materials also include man-made fills; trash; refuse; backfills from previous construction; and material classified as satisfactory materials which contains root and other organic matter or frozen material. The ITL shall be notified of any contaminated materials.
 2. Unsatisfactory materials also include satisfactory materials not maintained within 2 percent of optimum moisture content at time of compaction.

1.5 SUBMITTALS

- A. Submit 30-pound sample of each type of off-site fill material that is to be used at the site in airtight containers to the independent testing laboratory or submit gradation and certification of aggregate material that is to be used at the site to the independent testing laboratory for review.
- B. Submit certification that all material obtained from off-site sources complies with specification requirements.
- C. Submit name of each material supplier and specific type and source of each material. Change in source throughout project requires approval of Owner.
- D. If fabrics or geogrids are to be used, design shall be submitted for approval to Owner.
- E. Submit Dewatering Plans upon request by Owner.

- F. Shop drawings or details pertaining to excavating and filling are not required unless otherwise shown on the Drawings or if contrary procedures to Construction Documents are proposed.
- G. Shop drawings or details pertaining to site utilities are not required unless required by regulatory authorities or unless uses of materials, methods, equipment, or procedures that are contrary to The Drawings or Specifications are proposed. Do not perform work until Owner has accepted required shop drawings.
- H. Contact utility companies and determine if additional easements will be required to complete project. Provide written confirmation of the status of all easements to Owner at time of Preconstruction Conference or no later than 90 days prior to project possession date.

PART 2 - PRODUCTS

2.1 SOIL AND ROCK MATERIALS

- A. Bedding: Aggregate Type as indicated on the plans or naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; except with 100 percent passing a 1-inch sieve and not more than 8 percent passing a No.200 sieve.
- B. Common Fill: Common fill should have a maximum particle size of 6 inches and no more than 25 percent by weight passing the US No. 200 sieve.
- C. Granular Fill: Subgrade fill needed 12”below the structure slab base should be a mixture of sand, gravel and silt similar to that of the existing fill and native soils. Fill should be a material free from organic matter, frozen material and other deleterious substances meeting the requirements of Granular Borrow, as given below.

Granular Fill	
Sieve Size	Percent Finer by Weight
4 Inch	100
#40	30 to 90
#40	10 to 70
#200	0 to 15

- D. Structural Fill: We recommend that backfill placed against the exterior side of the perimeter foundations, base materials below sidewalks, be a clean granular material meeting the gradation for Structural Fill, as given below.

(* Maximum 2 inch particle size within 12 inches of the underside of footings or slabs.)

Structural Fill (Terracon Recommendation)	
Sieve Size	Percent Finer by Weight
6 inch	100
3 inch	70 - 100
2 inch	(100)*
3/4 inch	45 to 95
#4	30 to 90

#10	25 - 80
#40	10 to 50
#200	0 to 12

- E. Gravel Borrow: Shall conform New York State Department of Transportation (NYSDOT) Standard Specifications. Maximum size of stone in the gravel shall be 2” in its largest dimension. The gradation requirements for Gravel Borrow are as follows:

Gravel Borrow	
Sieve Size	Percent Finer by Weight
1/2 Inch	50 to 85
#4	40 to 75
#10	30-60
#40	10-35
#50	8 to 28
#100	5-20
#200	0 to 10

Processed Gravel: Aggregate Base for Pavements should be used as the base course layer below the asphalt pavements.

Processed Gravel for Subbase	
Sieve Size	Percent Finer by Weight
3 Inch	100
1 ½ Inch	70 to 100
¾ Inch	50 to 85
#4	30 to 60
#200	0 to 10

- F. Trench Backfill: Trench backfill used above specified pipe bedding materials should be material similar to that in the trench sidewalls to lessen the potential for differential frost action between the trench and the adjacent materials.
- G. ADS Crushed Stone: Class I – clean ¾ - 2 inch angular
- H. Filter Material: Narrowly graded mixture of natural or crushed gravel, or crushed stone and natural sand; ASTM D 448; coarse-aggregate grading Size 67; with 100 percent passing a 1-inch sieve and 0 to 5 percent passing a No.4 sieve.

- I. Topsoil: Topsoil shall consist of stripping material excavated from the site. Topsoil shall consist of organic surficial soil found in depth of not more than 6-inches. Topsoil shall be as further defined in Section 32 9000 – Planting.

2.2 APPURTENANT MATERIALS

- A. Stabilization fabrics and geogrids: As specified in Section 31 3200.
- B. Filter and drainage fabrics: As specified in Section 31 3200.
- C. Steel Casing Pipe: Comply with AWWA C200 minimum grade B, size, and wall thickness as indicated on The Drawings.
- D. Trench Utility Locator Tape: Heavy duty 6" wide underground warning tape. Tape shall be made from polyethylene material, 3.5 mils thick, with a minimum tensile strength of 1,750 psi. Place the tape at one-half the minimum depth of cover for the utility line or a maximum of 3 feet, which ever is the less, but never above the top of subgrade. Color of tape shall be determined by as follows:
 1. Natural Gas or Propane - Yellow
 2. Electric - Red
 3. Telephone – Orange
 4. Water – Blue
 5. Sanitary Sewer – Green

2.3 EQUIPMENT

- A. Transport off-site materials to project using well-maintained and operating vehicles. Once on site, transporting vehicles shall stay on designated haul roads and shall at no time endanger improvements by rutting, overloading, or pumping.

2.4 SOURCE QUALITY CONTROL

- A. Laboratory testing of materials proposed for use in the project shall be by the Independent Testing Laboratory at no cost to Contractor. The Contractor shall provide samples of material obtained off-site.
- B. Perform California Bearing Ratio (CBR) or Limerock Bearing Ratio (LBR) tests in outparcels and areas to receive pavement for each type of material that is imported from off-site. CBR or LBR value shall be equal to or above pavement design subgrade CBR or LBR value indicated on Construction Drawings
- C. Following tests shall be performed on each type of on-site or imported soil material used as compacted fill:
 1. Moisture and Density Relationship: ASTM D 698 or ASTM D 1557.
 2. Mechanical Analysis: AASHTO T 88 or ASTM D422.
 3. Plasticity Index: ASTM D 4318

PART 3 - EXECUTION

3.1 PREPARATION

- A. Identify required lines, levels, contours, datum, elevations, and grades necessary for construction as shown on the drawings.
- B. Notify utility companies to remove or relocate public utilities that are in conflict with proposed improvements.

- C. Protect plant life, lawns, fences, existing structures, sidewalks, paving, and curbs, unless otherwise noted on the drawings from excavating equipment and vehicular traffic.
- D. Protect benchmarks, property corners, and other survey monuments from damage or displacement. If marker needs to be removed it shall be referenced by licensed land surveyor and replaced, as necessary, by same.
- E. Remove from site, material encountered in grading operations that, in opinion of Owner or the Owner's Independent Testing Laboratory (ITL) is unsatisfactory material or undesirable for backfilling, subgrade, or foundation purposes. Dispose of in manner satisfactory to Owner and local governing agencies. Backfill areas with layers of satisfactory material and compact as specified herein.
- F. Prior to placing fill in low areas, such as previously existing creeks, ponds, or lakes, perform following procedures:
 - 1. Drain water out by gravity with ditch having flow line lower than lowest elevation in low area. If drainage cannot be performed by gravity ditch, use adequate pump to obtain the same results.
 - 2. After drainage of low area is complete, remove muck, mud, debris, and other unsatisfactory material by using acceptable equipment and methods that will keep natural soils underlying low area dry and undisturbed.
 - 3. All muck, mud, and other materials removed from low areas shall be dried on-site by spreading in thin layers for observation by the ITL. Material shall be inspected and, if found to be satisfactory for use as fill material, shall be incorporated into lowest elevation of site filling operation, but not under building subgrade or within 10'-0" of perimeter of building subgrade, paving or outparcell subgrade. If, after observation by the ITL, material is found to be shall be removed from site.
- G. Locate and identify utilities that have previously been installed and protect from damage.
- H. Locate and identify existing utilities that are to remain and protect from damage.
- I. Maintain in operating condition existing utilities, previously installed utilities, and drainage systems encountered in utility installation. Repair surface or subsurface improvements shown on The Drawings.
- J. Verify location, size, elevation, and other pertinent data required making connections to existing utilities and drainage systems as indicated on The Drawings.
- K. Over excavate and properly prepare areas of subgrade that are not capable of supporting proposed systems. Stabilize these areas by using acceptable geotextile fabrics or aggregate material placed and compacted as specified in Section 31 3200.

3.2 DEWATERING

- A. General:
 - 1. Provide dewatering systems as required for excavations.
 - 2. Design and provide dewatering system using accepted and professional methods consistent with current industry practice to eliminate water entering the excavation under hydrostatic head from the bottom or sides. Design system to prevent differential hydrostatic head, which would result in floating out soil particles in a manner, termed as a "quick" or "boiling" condition. System shall not be dependent solely upon sumps or pumping water from within the excavation where differential head would result in a quick condition, which would continue to worsen the integrity of the excavation's stability.
 - 3. Provide dewatering system of sufficient size and capacity to prevent ground and surface water flow into the excavation and to allow Work to be installed in a dry condition.
 - 4. Control, by acceptable means, all water regardless of source. Contractor shall be responsible for disposal of the water.
 - 5. Confine discharge piping or ditches to available easement or to additional easement obtained by Contractor. Provide necessary permits or easement.

6. Control groundwater in a manner that preserves strength of foundation soils, does not cause instability or raveling of excavation slopes, and does not result in damage to existing structures. Where necessary, lower water level in advance of excavation utilizing wells, wellpoints, jet educators, or similar positive methods. The water level as measured by piezometers shall be maintained a minimum of 3 feet below prevailing excavation level.
 7. Commence dewatering prior to any appearance of water in excavation and continue until Work is complete to the extent that no damage results from hydrostatic pressure, flotation, or other causes.
 8. Open pumping with sumps and ditches will be allowed provided it does not result in boils, loss of fines, softening of the ground, or instability of slopes.
 9. Install wells or wellpoints, if required, with suitable screens and filters so that continuous pumping of fines does not occur. Arrange discharge to facilitate collection of samples by the Owner. During normal pumping and upon development of wells, levels of fine sand or silt in the discharge water shall not exceed 5 ppm. Install sand tester on discharge of each pump during testing to verify that levels are not exceeded.
 10. Control grading around excavations to prevent surface water from flowing into excavation areas.
 11. No additional payment will be made for any supplemental measures to control seepage, groundwater, or artesian head.
- B. Design:
1. Designate and obtain the services of a qualified dewatering specialist to provide dewatering plan as may be necessary to complete the Work.
 2. Contractor shall be responsible for the accuracy of the drawings, design data, and operational records required.
 3. Contractor shall be responsible for the design, installation, operation, maintenance, and any failure of any component of the system.
- C. Damages:
1. Contractor shall be responsible for and shall repair any damage to work in place, other contractor's equipment, utilities, residences, highways, roads, railroads, private and municipal well systems, adjacent structures, natural resources, habitat, existing wells, and the excavation. Contractor responsibility shall also include, damage to the bottom due to heave and including but not limited to, removal and pumping out of the excavated area that may result from Contractor's negligence, inadequate or improper design and operation of the dewatering system, and any mechanical or electrical failure of the dewatering system.
 2. Remove subgrade materials rendered unsatisfactory by excessive wetting and replace with approved backfill material at no additional cost to the Owner.
- D. Maintaining Excavation in Dewatering Condition:
1. Dewatering shall be a continuous operation. Interruptions due to power outages, or any other reason will not be permitted.
 2. Continuously maintain excavation in a dry condition with positive dewatering methods during preparation of subgrade, installation of pipe, and construction of structures until the critical period of construction or backfill is completed to prevent damage of subgrade support, piping, structure, side slopes, or adjacent facilities from flotation or other hydrostatic pressure imbalance.
 3. Provide standby equipment on site, installed, wired, and available for immediate operation if required to maintain dewatering on a continuous basis in the event any part of the system becomes inadequate or fails. If dewatering requirements are not satisfied due to inadequacy or failure of dewatering system, perform such work as may be required to restore damaged structures and foundation soils at no additional cost to Owner.
 4. System maintenance shall include but not be limited to 24-hour supervision by personnel skilled in the operation, maintenance, and replacement of system components, and any other work required to maintain excavation in dewatered condition.
- E. System Removal: Upon completion of the work, remove dewatering equipment from the site, including related temporary electrical service.

- F. Wells shall be removed or cut off a minimum of 3 feet below final ground surface, capped, and abandoned in accordance with regulations by agencies having jurisdiction.

3.3 TOPSOIL EXCAVATION

- A. Cut heavy growths of grass from areas before stripping and remove cuttings with remainder of cleared vegetative material.
- B. Strip topsoil to a depth of not less than 6 inches from areas that are to be filled, excavated, landscaped, or re-graded to such depth that it prevents intermingling with underlying subsoil or questionable material.
- C. Stockpile topsoil in storage piles in areas shown on The Drawings or where directed by Owner. Construct storage piles to freely drain surface water. Cover storage piles as required to prevent windblown dust. Dispose of unsuitable topsoil as specified for waste material, unless otherwise specified by Owner. Remove excess topsoil from site unless specifically noted otherwise on The Drawings.

3.4 GENERAL EXCAVATION

- A. Classification of Excavation: The Contractor shall assure himself by site investigation or other necessary means that he is familiar with the type, quantity, quality, and character of excavation work to be performed. Excavation shall be considered unclassified excavation, except as indicated in the Contract Documents.
- B. When performing grading operations during periods of wet weather, provide adequate dewatering, drainage and ground water management to control moisture of soils.
- C. Shore, brace, and drain excavations as necessary to maintain excavation as safe, secure, and free of water at all times.
- D. Excavate building areas to line and grade as shown on the Drawings being careful not to over excavate beyond elevations needed for building subgrades.
- E. Place satisfactory excavated material into project fill areas.
- F. Unsatisfactory excavated material shall be disposed of in manner and location that is acceptable to Owner and local governing agencies.
- G. Perform excavation using capable, well-maintained equipment and methods acceptable to Owner and local governing agencies.

3.5 TRENCHING EXCAVATION FOR UTILITIES

- A. Contact local utility companies before excavation begins. Dig trench at proper width and depth for laying pipe, conduit, or cable. Cut trench banks vertical, if possible, and remove stones from bottom of trench as necessary to avoid point-bearing. Over-excavate wet or unstable soil, if encountered, from trench bottom as necessary to provide suitable base for continuous and uniform bedding. Replace over-excavation with satisfactory material and dispose of unsatisfactory material.
- B. Trench excavation sidewalls shall be sloped, shored, sheeted, braced, or otherwise supported by means of sufficient strength to protect workmen in accordance with applicable rules and regulations established for construction by the Department of Labor, Occupational Safety and Health Administration (OSHA), and by local ordinances. Lateral travel distance to exit ladder or steps shall not be greater than 25 feet in trenches 4 feet or deeper.

- C. Perform trench excavation as indicated on the Drawings for specified depths. During excavation, stockpile materials suitable for backfilling in orderly manner far enough from bank of trench to avoid overloading, slides, or cave-ins.
- D. Remove excavated materials not required or not satisfactory as backfill or embankments and waste off-site or at on-site locations approved by the Owner and in accordance with governing regulations. Dispose of structures discovered during excavation as specified in Section 31 1000.
- E. Prevent surface water from flowing into trenches or other excavations by temporary grading or other methods, as required. Remove accumulated water in trenches and other excavations as specified.
- F. Open cut excavation with trenching machine or backhoe. Where machines other than ladder or wheel-type trenching machines are used, do not use clods for backfill.
- G. Accurately grade trench bottom to provide uniform bearing and support for each section of pipe on bedding material at every point along entire length except where necessary to excavate for bell holes, proper sealing of pipe joints, or other required connections. Dig bell holes and depressions for joints after trench bottom has been graded. Dig no deeper, longer, or wider than needed to make joint connection properly.
- H. Trench width below top of pipe shall not be less than 12 inches nor more than 18 inches wider than outside surface of pipe or conduit that is to be installed to designated elevations and grades. Other trench width for pipe, conduit, or cable shall be least practical width that will allow for proper compaction of trench backfill.
- I. Trench depth requirements measured from finished grade or paved surface shall meet the following requirements or applicable codes and ordinances, whichever is more stringent:
 - 1. Water Mains: 30 inches to top of pipe barrel or 6 inches below frost line, established by local building official, whichever is deeper.
 - 2. Sanitary Sewer: Elevations and grades as indicated on the drawings and as specified.
 - 3. Storm Sewer: Elevations and grades as indicated on the Drawings.
 - 4. Electrical Conduits: 24 inches minimum to top of conduit or as required by NEC 300-5, NEC 710-36 codes, or local utility company requirements, whichever is deeper.
 - 5. TV Conduits: 18 inches minimum to top of conduit or as required by local utility company, whichever is deeper.
 - 6. Telephone Conduits: 18 inches minimum to top of conduit, or as required by local utility company, whichever is deeper.
 - 7. Gas Mains and Service: 30 inches minimum to top of pipe, or as required by local utility company, whichever is deeper.

3.6 SUBGRADE PREPARATION

- A. Scarification and Compaction: Areas exposed by excavation or stripping and on which subgrade preparations are to be performed shall be scarified to minimum depth of 8 inches and compacted as specified hereinafter.
- B. Proofrolling: Subgrades shall be proofrolled to detect areas of insufficient compaction. Proofrolling shall be accomplished by making minimum of 2 complete passes with a vibratory roller compactor with a static weight of 12 tons and a dynamic impact of 20 tons, in each of 2 perpendicular directions while under the supervision and direction of the independent testing laboratory. Document and explain proofrolling inspection procedures and results in the laboratory inspection report. Areas of failure shall be excavated and recompacted as specified herein. Continual failure areas shall be stabilized in accordance with Section 31 3200 at no additional cost to Owner. Subgrade exposed longer than 48 hours or on which precipitation has occurred shall be re-proofrolled.

3.7 FILLING

- A. Fill areas to contours and elevations shown on the Drawings with materials deemed satisfactory.
- B. Place fills in continuous lifts specified herein.
- C. Fill within proposed building subgrade, paving subgrade, and outparcel subgrades shall not contain rock or stone greater than 6 inches in any dimension.
- D. Unless otherwise specified for rock fill, rock or stone less than 6-inches in largest dimension may be used in fill below structures, paving, outparcels, and graded areas, up to 24 inches below surface of proposed subgrade or finish grade of graded areas when mixed with satisfactory material. Rock or stone less than 2 inches in largest dimension may be used in fill within the upper 24 inches of proposed subgrade or finish grade of graded areas when mixed with satisfactory material.
- E. Fill materials used in preparation of subgrade shall be placed in lifts or layers not to exceed 8 inches loose measure and compacted as specified hereinafter.
- F. Material imported from off-site shall have CBR or LBR value equal to or above pavement design subgrade CBR or LBR value indicated on The Drawings.
- G. Building area subgrade pad shall be that portion of site directly beneath and 10 feet beyond building and appurtenances, including limits of future building expansion areas as shown on the Drawings.
- H. Prepare building area subgrade pad in strict accordance with the Drawings.

3.8 ROCK FILL

- A. Rock fill shall include on-site excavated material classified as rock excavation. Rock fill may be utilized in fill up to 48 inches below top of subgrade or finish grade of graded areas unless otherwise permitted in higher elevations by the ITL. Rock fill shall consist of rock having a maximum dimension not greater than 12 inches in any dimension. Rock fill shall be placed in successive horizontal layers of loose material having a thickness of approximately the maximum size of the larger rock in the lift, but not greater than 12 inches. Each layer of material shall be spread uniformly, completely saturated, and compacted. Shot rock shall not be dumped into place, but shall be distributed in horizontal lifts by blading and dozing in such a manner as to ensure proper placement into final position in the embankment. Voids shall be filled with finer material including shot rock fines and limited soil fines during the spreading operation. Successive layers shall not be placed until all voids of the current lift are filled and the lift is compacted. Each successive layer of material shall adequately bond to the material on which it is placed. Compaction shall be accomplished with vibratory compactors, heavy rubber-tired rollers, or steel-wheeled rollers. Compaction shall be by uniform passes of compaction equipment in sufficient number of passes, but not less than two passes, such that no further consolidation is evident as determined by the ITL.

3.9 PIPE BEDDING

- A. Excavate trenches for pipe or conduit to 4 inches below bottom of pipe and to the width as specified herein. Place 4 inches of bedding material, compact in bottom of trench, and shape to conform to lower portion of pipe barrel.
- B. Place geotextile fabric as specified on the Drawings and in accordance with Section 31 3200.

3.10 TRENCH BACKFILLING

- A. Materials used for trench backfill shall comply with requirements as specified herein.

- B. Backfill and compact trench backfill above specified pipe bedding materials with a material similar in gradation and density to that in the trench sidewalls to lessen the potential for differential settling and frost action between the trench and the adjacent materials..
- C. Do not backfill trenches until required tests are performed and utility systems comply with and are accepted by applicable governing authorities.
- D. Backfill trenches to contours and elevations shown on the Drawings.
- E. Do not backfill over porous, wet, frozen, or spongy subgrade surfaces.

3.11 BORINGS AND CASINGS UNDER ROADS, HIGHWAYS, AND RAILROAD CROSSINGS

- A. When indicated by the Drawings, street, road, highway, or railroad crossings for utility mains installed by jacking and boring method shall be in accordance with area specifications and governing authorities.
- B. Excavation of approach pits and trenches within right-of-way of street, road, highway, or railroad shall be of sufficient distance from paving or railroad tracks to permit traffic to pass without interference. Tamp backfill for approach pits and trenches within right-of-way in layers not greater than 6-inches thick for entire length and depth of trench or pit. Compact backfill to 98 percent of maximum density in accordance with ASTM D698, (or 95 percent of maximum density, in accordance with ASTM D1557) obtained at optimum moisture as determined by AASHTO T 180. Mechanical tampers may be used after cover of 6 inches has been obtained over top of barrel of pipe.
- C. Accomplish boring operation using commercial type boring rig. Bore hole to proper alignment and grade. Bore hole shall be within 2 inches of same diameter as largest outside joint diameter of pipe installed. Install pipe in hole immediately after bore has been made and in no instance shall hole be left unattended while open.
- D. In event subsurface operations result in failure or damage to pavement or railroad tracks within 1 year of construction, make necessary repairs to pavement or railroad tracks. If paving cracks on either side of pipe line or is otherwise disturbed or broken due to construction operations, repair or replace disturbed or broken area.
- E. Clean, prime, and line interior and exterior of casing pipe with two coats of asphalt coating in accordance with and governing authorities.
- F. Butt weld steel casing. Welds shall be full penetration single butt-welds in accordance with AWWA C206.
- G. Install casing and utility pipe with end seals, vent pipe, and other special equipment in accordance with area specifications and governing authorities.

3.12 COMPACTION

- A. Compact as follows:

<u>Location</u>	Percent of Maximum Laboratory Density	
	<u>ASTM D698</u>	<u>ASTM D1557</u>
Subgrade & Fill Below Structures and Pavement	98	95
Subgrade & Fill in All other Areas	95	92

- B. Maintain moisture content of not less than 1 percent below and not more than 3 percent above optimum moisture content of fill materials to attain required compaction density.

- C. Exercise proper caution when compacting immediately over top of pipes or conduits. Water jetting or flooding is not permitted as method of compaction.
- D. Corrective Measures for Non-Complying Compaction: Remove and recompact deficient areas until proper compaction is obtained. Continual failure areas shall be stabilized in accordance with Section 31 3200 at no additional cost to Owner.

3.13 MAINTENANCE OF SUBGRADE

- A. Verify finished subgrades to ensure proper elevation and conditions for construction above subgrade.
- B. Protect subgrade from excessive wheel loading during construction, including concrete trucks, dump trucks, and other construction equipment.
- C. Remove areas of finished subgrade found to have insufficient compaction density to depth necessary and replace in manner that will comply with compaction requirements by use of material with CBR or LBR equal to or better than that specified on the drawings. Surface of subgrade after compaction shall be firm, uniform, smooth, stable, and true to grade and cross-section.
- D. Construct temporary ditches and perform such grading as necessary to maintain positive drainage away from subgrade at all times.
- E. Should the subgrade become yielding or difficult to work, the subgrade should be over-excavated and backfilled with new compacted Structural Fill or Crushed Stone.

3.14 BORROW AND SPOIL SITES

- A. Comply with NPDES and local erosion control permitting requirements for any and all on-site and off-site, disturbed spoil and borrow areas. Upon completion of spoil or borrow operations, clean up spoil or borrow areas in a neat and reasonable manner to the satisfaction of Owner or off-site property owner, if applicable.

3.15 FINISH GRADING

- A. Check grading of building subgrades by string line from grade stakes (blue tops) set at not more than 50-foot centers. Allowable tolerance shall be plus or minus 0.10 feet from plan grade. Provide engineering and field staking as necessary for verification of lines, grades, and elevations.
- B. Grade areas where finish grade elevations or contours are indicated on the Drawings, other than paved areas, outparcels, and buildings, including excavated areas, filled and transition areas, and landscaped areas. Graded areas shall be uniform and smooth, free from rock, debris, or irregular surface changes. Ground surfaces shall vary uniformly between indicated elevations. Grade finished ditches to allow for proper drainage without ponding and in manner that will minimize erosion potential. For topsoil, sodding, and seeding requirements refer to Section 32 9000.
- C. Correct settled and eroded areas within 1 year after date of completion at no additional expense to Owner. Bring grades to proper elevation.

3.16 QUALITY ASSURANCE TESTING AND INSPECTION

- A. Responsibilities: Unless otherwise specified, quality control tests and inspection specified below will be conducted by the Owner's Independent Testing Laboratory (ITL) at no cost to the Contractor. The Contractor shall perform additional testing or inspection as considered necessary by the Contractor for assurance of quality control.

- B. Field testing, frequency, and methods may vary as determined by and between the Owner and the ITL.
- C. Work shall be preformed by a Special Inspector – Technical I unless specified otherwise. Report of testing and inspection results shall be made upon the completion of testing.
- D. Classification of Materials: Perform test for classification of materials used and encountered during construction in accordance with ASTM D2488 and ASTM D2487.
- E. Laboratory Testing Of Materials: Perform laboratory testing of materials (Proctor, Sieve Analysis, Atterberg Limits, Consolidation Test, etc.) as specified.
- F. Field Density Tests.
 - 1. Building Subgrade Areas, Including 10'-0" Outside of Exterior Building Lines: In cut areas, not less than 1 compaction test for every 2,500 sq. ft. In fill areas, same rate of testing for each 8-inch lift, measured loose.
 - 2. Paving Areas and other Areas of Construction Exclusive of Building Subgrade: In cut areas, not less than 1 compaction test for every 10,000 sq. ft. In fill areas, same rate of testing for each 8-inch lift, measured loose.
 - 3. Utility Trench Backfill: Intervals not exceeding 200-feet of trench for first and every other 8-inch lift of compacted trench backfill.
 - 4. Test Method: In-place nuclear density, ASTM D 2922 (Method B-Direct Transmission).
- G. Corrective Measures For Non-Complying Compaction: Remove and recompact deficient areas until proper compaction is obtained at no additional expense to Owner. Adjust moisture content as necessary to conform to the requirements of this section.
- H. Observation and Inspection:
 - 1. Observe all subgrades/excavation bases below footings and slabs and verify design bearing capacity is achieved as required. Work shall be preformed by a Special Inspector – Technical II.
 - 2. Observe and document presence of groundwater within excavations.
 - 3. Verify cut and fill slopes as specified in the contract documents. Work shall be preformed by a Special Inspector – Technical III.

END OF SECTION

33 1000 - WATER DISTRIBUTION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Site water piping and fittings including domestic potable waterline and fire protection system supply waterline, valves, and fire hydrants. All work shall be in accordance with the City of Springfield DPW and Springfield Water & Sewer Commission Rules and Regulations and these site work specifications. In the event of a discrepancy between the two documents. The more stringent shall apply.
- B. Related Requirements:
1. Section 31 2000 – Earth Moving

1.2 REFERENCES

- A. The publications listed below form a part of this specification to the extent referenced. Publications are referenced within the text by the basic designation only.
- B. American Society of Mechanical Engineers (ASME):
1. ASME B 16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
- C. ASTM International (ASTM):
1. ASTM B88 - Seamless Copper Water Tube.
 2. ASTM F477 - Elastomeric Gaskets And Lubricant.
- D. American Water Works Association (AWWA):
1. AWWA C104 - Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water.
 2. AWWA C105 - Polyethylene Encasement for Ductile Iron Piping for Water and other Liquids.
 3. AWWA C111 - Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
 4. AWWA C116 - Protective Fusion-Bonded Epoxy Coatings for the Interior and Exterior Surfaces of Ductile-Iron and Gray-Iron Fittings for Watersupply Service.
 5. AWWA C151 - Ductile-Iron Pipe, Centrifugally Cast, for Water or Other Liquids.
 6. AWWA C153 - Ductile-Iron Compact Fittings for Water Service.
 7. AWWA C504 - Rubber-Seated Butterfly Valves.
 8. AWWA C509 - Resilient-Seated Gate Valves for Water Supply Service.
 9. AWWA C550 - Protective Interior Coatings for Valves And Hydrants.
 10. AWWA C600 - Installation of Ductile-Iron Water Mains and Appurtenances.
 11. AWWA C651 - Disinfecting Water Mains.
- E. American National Standards Institute Standards (ANSI):
1. ANSI A21.4 CementMortar Lining for CastIron and DuctileIron Pipe and Fittings for Water
 2. ANSI A21.11 RubberGasket Joints for CastIron and DuctileIron Pressure Pipe and Fittings
 3. ANSI A21.51 DuctileIron Pipe, Centrifugally Cast in Metal Molds or SandLined Molds, for Water or Other Liquids
 4. ANSI A21.53 DuctileIron Compact Fittings, 3in. through 16in. for Water and Other Liquids
- F. The New York Bureau of Water & Sewer Operations, Standard Water Main Specifications (latest issue)

G. Westchester Joint Water Works Rule and Regulations

1.3 QUALITY ASSURANCE

- A. Products, where marked for compliance with code or test standards, shall also mark specific standard as required in the Contract Documents.
- B. Perform installation in accordance with utility company or municipality requirements.
- C. Valves: Mark manufacturer's name and pressure rating on valve body.
- D. Perform disinfection of potable lines in accordance with AWWA C651.

1.4 SUBMITTALS

- A. Furnish 1 copy of results of meter test and hydrostatic pressure test to Owner, Owners Civil Engineering Consultant (CEC), and utility company upon completion of water distribution backfilling operations.
- B. Project Record Documents:
 - 1. Disinfection report: Record the following:
 - a. Type and form of disinfectant used.
 - b. Date and time disinfectant injection start and time of completion.
 - c. Test locations.
 - d. Initial and 24 hour disinfectant residuals (quantity in treated water) in ppm for each outlet tested.
 - e. Date and time of flushing start and completion.
 - f. Disinfectant residual after flushing in ppm for each outlet tested.
 - 2. Bacteriological report: Record the following:
 - a. Date issued, project name, testing laboratory name, address, and telephone number.
 - b. Time and date of water sample collection.
 - c. Name of person collecting samples.
 - d. Test locations.
 - e. Initial and 24 hour disinfectant residuals in ppm for each outlet tested.
 - f. Coliform bacteria test results for each outlet tested.
 - g. Certification that water conforms, or fails to conform, to bacterial standards.
 - h. Bacteriologist's signature and authority.
 - 3. Accurately record actual locations of piping mains, valves, connections, and top of pipe elevations.
 - 4. Identify and describe unexpected variations to subsoil conditions and location of uncharted utilities.

PART 2 - PRODUCTS

2.1 PIPE

- A. Pipe sizes 3-inches and smaller for installation below grade and outside building shall comply with the following:
 - 1. Seamless Copper Tubing: Type "K" soft copper, ASTM B88.
 - a. Fittings: Wrought copper (95-5 Tin Antimony solder joint), ASME B 16.22.
- B. Pipe sizes 4 to 16 inches for installation below grade and outside building shall comply with the following:
 - 1. Ductile Iron Water Pipe: Class 52 (in accordance with AWWA C151), (4-12"), double cement mortar-lined, double bituminous seal coated inside (in accordance with AWWA C104) and polyethylene encased (in accordance with AWWA C105)

- a. Fittings: Either mechanical joint or push-on joint, AWWA C153, and shall be coated with a 6-8 mil nominal thickness fusion bonded epoxy conforming to the requirements of AWWA C550 and C116, or cement mortar lined in accordance with AWWA C104.
- b. All pipe joints shall be Tyton push-on type, unless otherwise specified, employing ringtype rubber gasket to affect the joint seal (in accordance with AWWA C111).
- c. All mechanical-joints shall be formed using a restrained mechanical gland.
- d. Restrained mechanical gland shall be EBAA Iron's Mega-Lug retainer gland or other non-set-screw type retainer gland that will not void the warrantee of the pipe manufacturer.
- e. Couplings shall be HYMAX with high strength, low alloy, corrosion resistant bolts and nuts.
- f. Elastomeric gaskets and lubricant: ASTM F477.

2.2 VALVES

- A. Gate Valves, 2-Inches and Larger:
 1. Manufacturer and Model: M&H, Clow or U.S. Pipe Resilient Seated Wedge Gate Valves.
 2. Gate valves shall open right.
 3. AWWA C509, iron body, non-rising stem with square nut, single wedge, resilient seat, flanged or mechanical joint ends, control rod, post indicator where indicated on Construction Drawings, extension box and valve key.
- B. Ball Valves, 2-Inches and Smaller:
 1. Manufacturer and Model: Ford with compression grip ring.
 2. Brass body, teflon coated brass ball, rubber seats and stem seals, Tee stem pre-drilled for control rod, AWWA compression inlet end, compression outlet with electrical ground connector, with control rod, extension box and valve key.
- C. Butterfly Valves, From 2-Inch to 24-Inch: AWWA C504, Iron body, bronze disc, resilient replaceable seat, water or lug ends, infinite position lever handle.
- D. Check Valves, Post Indicator Valves, And Backflow Preventors
 1. Refer to Section 13900 - Fire Suppression in Architectural/Building Specifications

2.3 FIRE HYDRANTS

- A. Fire Hydrants: M&H Dresser 929.
 1. Main Valve Opening: 5.25 inches
 2. Operating Nut Size: Pentagon 1.50 inches point to flat
 3. Direction of Opening: Clockwise (OPEN RIGHT)
 4. Bury Length: 5.5 feet
 5. Sub-Seat Material: Bronze
 6. Model: Traffic (breakaway design)
- B. Hydrant Extensions: Fabricate in multiples of 6-inches with rod and coupling to increase barrel length.
- C. Hose and Steamer Connections: National Standard Thread; 2 – 2.50 inch hose connections and 1 – 4.50 inch steamer connection
- D. FDC Connection: 4" Storz Connection
- E. Finish: Apply primer and 2 coats of enamel or special coating to color; match service zone fire hydrant standards.

2.4 ACCESSORIES

- A. Thrust Blocking: Place 2500 psi concrete to provide sufficient bearing area to transmit unbalanced thrust from bends, tees, caps, or plugs to undisturbed soil without loading undisturbed soil in excess of 2,500 pounds per square foot when water main pressure is 100 psi.

MINIMUM THRUST BLOCKING BEARING AREAS

Pipe Diameter	Tees Sq. Ft	90° Bend Sq. Ft	45° Bend Sq. Ft	22½° Bend Sq. Ft.	11¼° Bend Sq. Ft.	5 5/8 Bend Sq. Ft.	Cap/Plug Sq. Ft.
3"	1.0	1.0	1.0	1.0	1.0	1.0	1.5
4"	1.0	1.0	1.0	1.0	1.0	1.0	2.0
6"	1.5	2.0	1.0	1.0	1.0	1.0	3.0
8"	2.5	3.5	1.8	1.0	1.0	1.0	4.0
10"	4.0	5.5	2.8	1.5	1.0	1.0	6.0
12"	6.0	8.0	4.0	2.0	1.5	1.0	8.5
14"	8.0	11.0	5.5	3.0	2.0	1.5	12.0
16"	10.0	14.2	7.0	4.0	3.0	2.5	15.0
18"	21.0	21.0	12.0	6.0	4.0	3.5	24.0

- B. Locked mechanical joint fittings shall be installed where vertical changes in direction are required and, if approved by Owner and governing authority, can be installed in lieu of above thrust blocking requirements.
- C. Polyethylene Encasement: Single layer of two ply cross-laminated high density polyethylene encasement per AWWA C105, Section 4.1.2, Type III, Class C (Black), Grade 33, tensile strength 5,000 psi minimum, elongation 100 percent, thickness nominal 0.004 inch (4 mil).
- D. Trace Wire: Magnetic detectable conductor, (#12 Copper) brightly colored plastic covering imprinted with "Water Service" in large letters.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that building service connection and municipal utility water main size, location, and depth are as indicated on Construction Drawings.

3.2 PREPARATION

- A. Ream pipe and tube ends and remove burrs.
- B. Remove scale and dirt, on inside and outside, before assembly.
- C. Prepare pipe for connections to equipment with flanges or unions.
- D. Protect benchmarks, property corners, and other survey monuments from damage or displacement. If marker needs to be removed it shall be referenced by licensed land surveyor and replaced, as necessary, by same.

3.3 TRENCHING AND BEDDING

- A. Excavate pipe trench and place bedding material in accordance with Section 31 2000 Earth Moving.

3.4 INSTALLATION - PIPE AND FITTINGS

- A. Maintain separation of water main from sanitary and storm sewer piping in accordance with state or local codes.
- B. Install ductile iron pipe and fittings in accordance with AWWA C600.
- C. Ductile iron pipe and fittings shall be installed with polyethylene encasement around the pipe for the entire length of the project except where water main is within steel casing or is concrete encased. Install polyethylene encasement in accordance with AWWA C105, Method A.
- D. Install pipe to allow for expansion and contraction without stressing pipe or joints or as specified by pipe manufacturer.
- E. Install access fittings in accordance with local codes to permit disinfection of water system performed under this Section.
- F. Connections with Existing Pipelines: Where connections are made between new work and existing piping, make connection using suitable fittings for conditions encountered. Make each connection with existing pipe at time and under conditions with least interference with operation of existing pipeline and in compliance with local utility company.
- G. Form and place concrete for thrust blocks or other specified methods of retainage at each change of direction or end of pipe main.
- H. Place pipe to depth in accordance with Section 31 2000 Earth Moving.
- I. Backfill trench in accordance with Section 31 2000 Earth Moving.
- J. Install trace wire continuous over top of non-metal pipe. Bury a minimum of 6 inches below finish grade, and above pipeline.

3.5 INSTALLATION - VALVES AND HYDRANTS

- A. Install gate valves as indicated on Construction Drawings. Support valve on concrete pads with valve stem vertical and plumb. Install valve boxes in manner that will not transmit loads, stress, or shock to valve body. Center valve box over operating nut of valve vertical and plumb. Securely fit valve box together leaving cover flush with finished surface.
- B. Install fire hydrant assemblies as indicated on Construction Drawings in vertical and plumb position with steamer/pumper nozzle pointed perpendicular to traffic where hydrant is adjacent to street, roadway, or parking lot drive or toward protected building unless otherwise directed by local authorities. Support hydrant assembly on concrete pad and firmly brace on side opposite inlet pipe against undisturbed soil and concrete blocking. Place minimum of 6-cubic feet of crushed stone or gravel around hydrant base and barrel after thrust blocking has cured at least 24 hours. Maintain vertical position of hydrant backfilling and compacting.

3.6 DISINFECTION OF DOMESTIC WATER PIPING SYSTEM

- A. Disinfect distribution system with chlorine before acceptance for domestic operation. Chlorine dosage shall be not less than 50 parts per million. Flush lines before introduction of chlorinating materials and after contact period of not less than 24 hours. Flush with clean water after contact period until residual chlorine content is not greater than 1.0 part per million. Flush water discharged from water supply lines or hydrants shall not be allowed to discharge directly onto exposed soil or turf which could result in erosion of soil. If potential for erosion exists at discharge point, measures shall be taken to prevent erosion. Open and close valves in lines being disinfected several times

during contact period. After disinfection, take water sample and bacteriological test in accordance with AWWA C651. Do not place distribution system in service until approval is obtained from local governing authorities.

- B. Contractor shall provide a means of neutralizing the super-chlorinated water before releasing into the environment. This may be accomplished by either a method of dechlorination, direct release into a detention area approved by the Municipality, or any method acceptable to federal, state, and local codes. Direct release to open ground shall not be allowed, unless contained within an on site detention facility with 6" permanent storage. In this case, the Contractor shall time the release to assure that no rainstorms are imminent. The intent of this condition is to allow the majority of the chlorine to evaporate into the atmosphere before a rainstorm has the opportunity to wash the residual downstream. Contractor shall not release super-chlorinated water directly into the sanitary sewer system, private or public, nor any storm drain system not directly discharging into the detention facility.

3.7 SERVICE CONNECTIONS

- A. Provide water service connection in compliance with utility company requirements including reduced pressure backflow preventor (if required) and water meter with by-pass valves and sand strainer.

3.8 FIELD QUALITY CONTROL

- A. Test water distribution system pipe installed below grade and outside building in accordance with the following procedures:
 1. Perform testing of pipe materials, joints, and other materials incorporated into construction of water mains and force mains to determine leakage and water tightness. In the event state or local code requires more stringent test, more stringent test shall take precedence.
 2. Conduct piping tests before joints are covered and after concrete thrust blocks have hardened sufficiently. Fill pipeline 24 hours before testing and apply test pressure to stabilize system. Use only potable water. Test at not less than one-and-one-half times working pressure for two hours. Increase pressure in 50-psig increments and inspect each joint between increments. Hold at test pressure for 1 hour; decrease to 0 psig. Slowly increase again to test pressure and hold for 1 more hour. Maximum allowable leakage shall be 2 quarts per hour per 100 joints. Remake leaking joints with new materials and repeat test until leakage is within allowed limits.
- B. Prepare reports of testing activities.



10/16/2018

REV.1

10/16/2018

Project:
CW-205.4.2 - SUNY
PURCHASE NORTH DINING
HUB

From:

To:

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Submittal Sheet

10/16/2018

ITEM# 01 - HD RANGE, 36", 6 SOLID BURNERS (1 EA REQ'D)

Southbend SE36A-BBB

Heavy Duty Range, electric, 36", (6) round hot plates, 3-heat switch, (1) convection oven, includes (3) racks, stainless steel front, sides, top & oven lining, 6" legs, cETLus, ETL-Sanitiation (Note: Qualifies for Southbend's Service First™ Program, see Service First document for details)

ACCESSORIES

Mfr	Qty	Model	Spec
Southbend	1		Domestic Shipping, inside of North America (Contact factory for price)
Southbend	1		Standard one year limited warranty (range)
Southbend	1		208v/60/3-ph, 21.6kw, standard
Southbend	1	ACCS06K	Casters, set of four, 2 swivel with locks

**CORD & PLUG SUITABLE FOR EQUIPMENT PROVIDED
BY K.E.C.**

ELECTRICAL

	VOLTS	CYCLE	PHASE	CONN	AFF	NEMA	AMPS	KW	HP	MCA	MOCP
1	208	60	3					21.6			



SE36 SERIES ELECTRIC RANGE

Convection Oven SE36A

Standard Oven SE36D

Truvection Oven SE36T



*SE36A-TTB
with optional
casters and
marine kit.*

450°F in 20 minutes.

Controls

Range-top section controls are mounted in a central ventilated control panel, hinged for easy service access. 9" solid round hotplates are controlled by an indicating 3-heat switch. The 12" x 24" hotplate sections on the HHH, HHB and TTH are controlled by a thermostat with a temperature range of 250°F to 850°F. The griddle sections on the TTT, TTB and TTH are controlled by a thermostat with a temperature range of 150°F to 450°F. Range is provided with a 2 hour timer adjustable from 6 to 120 minutes (timer has a bell signal). The oven temperature is controlled by a thermostat adjustable from 150°F to 450°F. Each thermostat is provided with an "OFF" position. Each 9" diameter hotplate is provided with a 4-position, 3-heat switch "HIGH"/"MEDIUM"/"LOW" and "OFF" settings. An indicator light is associated with each thermostat, indicating when preset temperature is reached and cycles on or off. Oven section includes a "HIGH"/"LOW" fan speed switch.

Convection Oven Capacity

The convection oven has a capacity for (6) 20-7/8" x 28-1/4" racks. Three racks with positive stops are furnished. Oven has a clearance height of 13-1/4".

Standard Oven Capacity

The standard oven is provided with a slide out removable rack. Oven has a total meat capacity of 60 lbs. Oven has a clearance height of 12-1/2".

Each oven rack will accommodate (2) 12" x 20" #200 pans, (1) 18" x 26" roll pan, (1) 18" x 24" meat pan, (10) standard 1 lb. loaf pans or (6) 9" pie tins.

Truvection Oven Capacity

Heavy-duty removable wire rack guides spaced on 1-5/8" centers offer 5 different rack positions. 3 wire racks provided with each oven. Oven interior dimensions: 29"x21.5"x 14".

Warranty

Warranted for one year covering parts and labor.

Ordering Information

Basic Models - 208VAC or 240VAC or 480VAC (3 phase) voltage must be specified. If unit has a standard oven or a convection oven base, specify "assembled" or "hatchable". Hatchable is packaged in two sections that can pass through a 26" wide door for assembly in kitchen. Truvection units are NOT hatchable.

Application

You can saute, braise, pan fry, griddle, boil, stew, simmer, bake, brown, roast and reconstitute with the Southbend heavy-duty range.

General Information

Heavy-duty electric range with deck oven, convection oven, or Truvection oven base. Range is 36"W x 38-1/2"D x 38-1/4"H including legs.

Construction

The frame of the range and oven is welded aluminized steel with stainless steel front, sides and top. Grease troughs are located at front and rear for drainage, with grease chutes into two wide, drawer-type receptacles. The griddle models are furnished with splash guards surrounding back and side of the griddle section. Range is 100% front serviceable.

Convection Oven (SE36A)

The convection oven is provided with stainless steel inner lining, stainless steel throat, vent with damper and shelf-type, stainless steel lined door. Removable rack supports to accommodate six racks are installed on the interior sides of the oven. The blower fan is powered by a sealed ball bearing motor. Oven is fully insulated on all sides.

Standard Oven (SE36D)

The deck oven is provided with aluminized steel inner lining; removable deck of rigidized steel; vent with damper; and shelf-type, stainless steel lined door. The oven is insulated on all sides. Comes with 1 rack capacity(1 rack position and 1 rack).

Truvection Oven (SE36T)

7.5KW, deck oven is provided with coved porcelain enamel finish, dependent doors with windows (Full180°opening), oven interior light, 1/2 hp two-speed fan motor, electronic ignition, cool down fan mode, oven "ready" light, and standard controls (150°F to 500°F solid state thermostat and 60 minute mechanical cook timer). Oven heating is regulated by an adjustable thermostat control. Blower fan circulates air within the cavity "scrubbing" heat to the oven interior for even heat distribution within the cavity.

Electrical

Wiring is connected at a terminal compartment in the base. Knockouts are provided in the bottom and back for power supply entrance. See electrical data for kW rating of range tops, ovens and Truvection oven base.

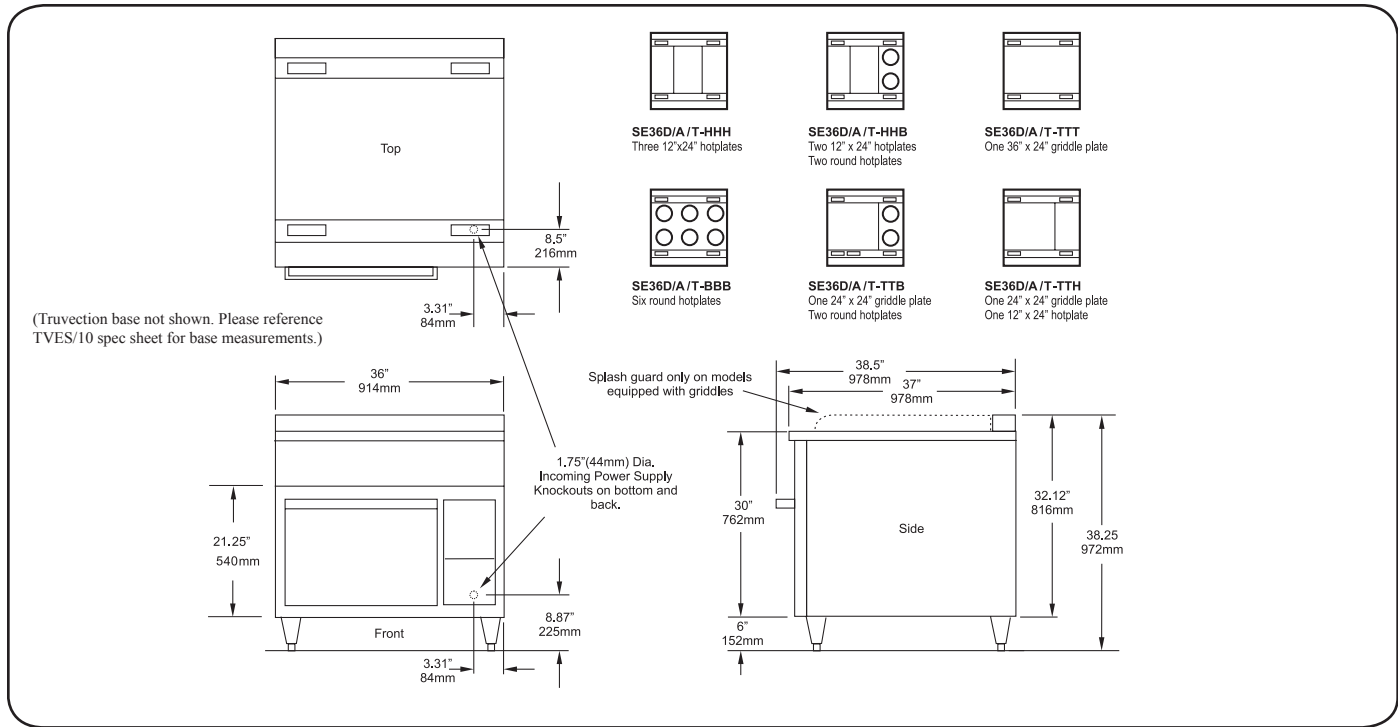
Heating

Heating is accomplished with formed tubular elements clamped underneath each griddle and rectangular hotplate. The TTT has 4 heating sections for the 36" x 24" griddle. The TTB and the TTH have two heating sections under the 24" x 24" griddle. The oven heating element is located on the side of the cavity encircling the oven blower fan. Oven will preheat to



Models: SE36D SE36A SE36T

*See TVES/10SC spec sheet for TruVection oven information.



UTILITY INFORMATION

Model	in(mm) Height	in(mm) Width	Depth Overall	Convection Oven kW	Standard Oven kW	Range Top kW	12" x 24" Hotplate kW (QTY)	9" Round Hotplate kW (QTY)	Griddle Heating Element kW (QTY)	Installed	Weights lbs(kg) Ship/Hatch	Ship/Assm	
SE36-HHH	36(914)	36(914)	38.5(978)	6.0	6.0	15.9	5.3 (3)	-	-	599(271.7)	700(317.5)	654(296.6)	
SE36-HHB	36(914)	36(914)	38.5(978)	6.0	6.0	15.8	5.3 (2)	2.6 (2)	-	559(253.5)	660(299.4)	624(283.0)	
SE36-TTT	36(914)	36(914)	38.5(978)	6.0	6.0	16.5	-	-	4.125 (4)	599(271.7)	700(317.5)	654(296.6)	
SE36-BBB	36(914)	36(914)	38.5(978)	6.0	6.0	15.6	-	2.6 (6)	-	549(249.0)	650(294.8)	627(284.4)	
SE36-TTB	36(914)	36(914)	38.5(978)	6.0	6.0	15.8	-	2.6 (2)	5.3 (2)	559(253.5)	660(299.4)	624(283.0)	
SE36-TTH	36(914)	36(914)	38.5(978)	6.0	6.0	15.9	-	-	5.3 (2)	559(253.5)	660(299.4)	624(283.0)	
TruVection Oven Models													
SE36T-HHH	36(914)	36(914)	38.5(978)	*	-	15.9	5.3 (3)	-	-	-	-	700 (317.5)	
SE36T-HHB	36(914)	36(914)	38.5(978)	*	-	15.8	5.3 (2)	2.6 (2)	-	-	-	660 (299.4)	
SE36T-TTT	36(914)	36(914)	38.5(978)	*	-	16.5	-	-	4.125 (4)	-	-	700 (317.5)	
SE36T-BBB	36(914)	36(914)	38.5(978)	*	-	15.6	-	2.6 (6)	-	-	-	650 (294.8)	
SE36T-TTB	36(914)	36(914)	38.5(978)	*	-	15.8	-	2.6 (2)	5.3 (2)	-	-	660 (299.4)	
SE36T-TTH	36(914)	36(914)	38.5(978)	*	-	15.9	5.3 (1)	-	5.3 (2)	-	-	660 (299.4)	
Conv Oven Models													
Total kW	3 Phase Loading kW per Phase			208V			240V			480V			
	X-Y	Y-Z	X-Z	X	Y	Z	X	Y	Z	X	Y	Z	
SE36A-HHH	21.9	6.0	10.6	5.3	49.2	72.0	67.4	43.0	62.6	58.4	21.9	31.6	29.2
SE36A-HHB	21.8	6.0	10.5	5.3	49.2	71.4	67.0	43.2	62.4	58.0	21.9	31.6	29.0
SE36A-TTT	22.5	6.0	8.25	8.25	51.6	61.6	68.7	53.9	55.9	59.5	27.2	27.2	29.8
SE36A-BBB	21.6	6.0	7.8	7.8	59.6	59.6	65.0	52.2	52.2	56.3	26.4	26.4	28.1
SE36A-TTB	21.8	6.0	10.5	5.3	71.4	49.2	67.0	62.4	43.2	58.0	31.5	21.9	29.0
SE36A-TTH	21.9	6.0	10.5	5.3	49.2	72.0	67.4	43.2	32.8	58.3	21.9	31.6	29.2
Std Oven Models													
Total kW	3 Phase Loading kW per Phase			208V			240V			480V			
	X-Y	Y-Z	X-Z	X	Y	Z	X	Y	Z	X	Y	Z	
SE36D-HHH	21.9	6.0	10.6	5.3	47.1	70.0	67.4	40.8	60.7	58.4	20.4	30.3	29.2
SE36D-HHB	21.8	6.0	10.5	5.3	47.1	69.5	66.9	40.8	60.3	58.0	20.4	30.1	29.0
SE36D-TTT	22.5	6.0	8.25	8.25	59.6	59.6	68.7	51.5	51.6	59.5	25.8	25.8	29.9
SE36D-BBB	21.6	6.0	7.8	7.8	57.6	57.6	64.9	49.9	49.9	56.3	25.0	25.0	28.1
SE36D-TTB	21.8	6.0	10.5	5.3	47.1	69.5	67.0	40.8	60.3	58.0	20.4	30.1	29.0
SE36D-TTH	21.9	6.0	10.6	5.3	47.1	70.0	67.4	40.8	60.7	58.4	20.4	330.3	29.2

*See TVES/10SC spec sheet for TruVection oven information.

OPTIONS AND ACCESSORIES

- 480VAC, 3 Phase
- Set of four, 6-1/4" high casters
- Extra intermediate slide-out oven rack
- Stainless steel rear
- Marine Kit Top

**INTENDED FOR COMMERCIAL USE ONLY.
NOT FOR HOUSEHOLD USE.**



1100 Old Honeycutt Road, Fuquay-Varina, NC 27526
(919) 762-1000 www.southbendnc.com

Submittal Sheet

10/16/2018

ITEM# 02 - ICE CUBER (1 EA REQ'D)

Manitowoc IDT-1500N

Indigo NXT™ Series Ice Maker, cube-style, air-cooled, designed for remote refrigeration, 48"W x 24"D x 29-1/2"H, production capacity up to 1710 lb/24 hours at 70°/50° (1425 lb AHRI certified at 90°/70°), DuraTech™ exterior, regular dice size cubes, R410 refrigerant, NSF, cULus, CE, ENERGY STAR®

ACCESSORIES

Mfr	Qty	Model	Spec
Manitowoc	1	WARRANTY-ICE-R	3 year parts & labor (Machine), 5 year parts & labor (Evaporator), standard
Manitowoc	1		(-261) 208-230v/60/1-ph, 14.0 amps
Manitowoc	1	D-970	Ice Bin, 48"W x 34"D, 50"H, with side-hinged front-opening door, side grips, AHRI certified 882 lb ice storage capacity (29.7 cu. ft.), for top-mounted ice maker, Duratech exterior, NSF
Manitowoc	1	WARRANTY-BIN/DISP	3 year parts & labor warranty, standard
Manitowoc	1		Legs, 6" adjustable stainless steel, standard

ELECTRICAL

	VOLTS	CYCLE	PHASE	CONN	AFF	NEMA	AMPS	KW	HP	MCA	MOCP
1	208-230	60	1				14				

WATER

	HOT SIZE	HOT AFF	HOT GPH	COLD SIZE	COLD AFF	FILTERED SIZE	FILTERED AFF	CONDENSER INLET SIZE	CONDENSER OUTLET SIZE
1									
2				3/8"					
3									

WASTE

	INDIRECT SIZE	DIRECT SIZE
1	1/2"	
2	1/2"	
3	3/4"	

PLUMBING 1 REMARKS

Dew Drain (Auxiliary)

PLUMBING 2 REMARKS

Drain for ice maker



iT1500 Ice Cube Machine

iT1500 Ice Cube Machine

Models

- IDT1500A IDT1500W IDT1500N
- IYT1500A IYT1500W IYT1500N



Indigo NXT Series iT1500 Ice Machine on D970 Bin

Designed for operators who know that ice is critical to their business, the Indigo NXT Series ice machine's preventative diagnostics continually monitor itself for reliable ice production. Improvements in cleanability and programmability make your ice machine easy to own and less expensive to operate.

- **New levels of Performance** - Showcasing an average of 6% lower energy consumption, up to 9% increase in ice production and a 9% reduction in condenser water usage. This translates into lower cost of ownership over the life of your machine.
- **easyTouch® Display** - New icon based touch screen takes the guess work out of owning and operating an ice machine.
- **Programmable Ice Production** - Now its super easy to program your ice machine to be off at certain times of the day to save money with fluctuating electrical rates. Also programmable by daily ice production volume.
- **Easy to Clean Foodzone** - Easy Access front door panel. Removable water-trough, distribution tube, curtain, and sensing probes for fast and efficient cleaning. Select components made with AlphaSan® antimicrobial.
- **Intelligent Diagnostics** - Provides 24 hour preventative maintenance and diagnostic feedback for trouble free operation.
- **Acoustical Ice Sensing Probe** - Unique patented technology allows for reliable operation in challenging water conditions and environments.
- **DuraTech® Exterior** - Provides superior corrosion resistant above stainless steel. Innovative clear-coat resists fingerprints and dirt making it easier to keep clean.
- Available **LuminIce® II Growth Inhibitor** - Controls the growth of bacteria and yeast within the Food zone keeping the machine cleaner longer. A new indicator in the display keeps you abreast of the operational status.

Ice Machine Electric

208-230/60/1 standard
(208-230/60/3 also available.)

Minimum circuit ampacity:

Air-cooled:	15.4 1ph	12.8 3ph
Water-cooled:	14 1ph	11.3 3ph
Remote-cooled:	14 1ph	11.3 3ph

Maximum fuse size:

Air-cooled:	25 1ph	20 3ph
Water-cooled:	25 1ph	20 3ph
Remote-cooled:	25 1ph	20 3ph

Specifications

Operating Limits:

BTU Per Hour:
23,000 (average),
and 27,000 (peak)

- Ambient Temperature Range: 40° to 110°F (4.4° to 43.3° C)
- Water Temperature Range: 40° to 90°F (4.4° to 32.2° C)

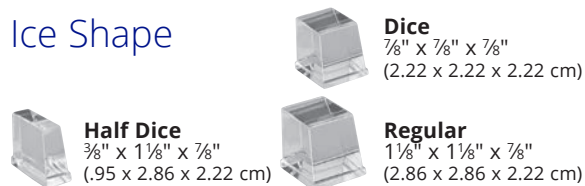
Refrigerant:

R-410 CFC-free

- Water Pressure Ice Maker Water In:
Min. 20 psi (137.9 kPa)
Max. 80 psi (551.1 kPa)



Ice Shape



COMPANY WITH QUALITY SYSTEM

2110 South 26th Street
Manitowoc, WI 54220

Tel: 1.920.682.0161
Fax: 1.920.683.7589

www.manitowocice.com

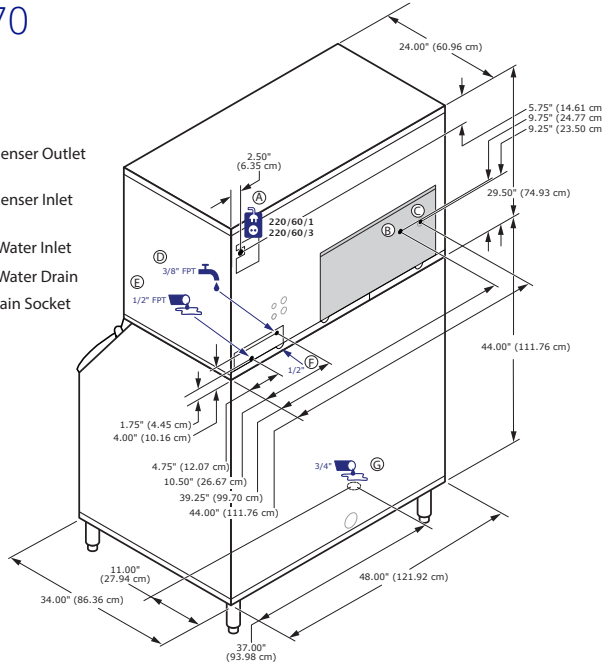




Indigo[®] NXT™ iT1500 Ice Cube Machine

iT1500 on D970 Storage Bin

- Ⓐ Electrical Entrance (2) Options
- Ⓑ 1/2" (1.27 cm) F.P.T. Water Condenser Outlet (water-cooled units)
- Ⓒ 3/8" (0.95 cm) F.P.T. Water Condenser Inlet (water-cooled units)
- Ⓓ 3/8" (0.95 cm) F.P.T. Ice Making Water Inlet
- Ⓔ 1/2" (1.27 cm) F.P.T. Ice Making Water Drain
- Ⓕ 1/2" (1.27 cm) Auxillary Base Drain Socket
- Ⓖ 3/4" (1.91 cm) Bin Drain



Installation Note

Air Cooled clearance:

Top: 24" (61.0 cm)
Sides: 24" (61.0 cm)
Back: 5" (30.5 cm)

Water Cooled clearance:

Top/Sides: 8" (20.3 cm)
Back: 5" (12.7 cm)

Space-Saving Design



	iT1500 D970
Height	79.50" / 201.90 cm
Width	48.00" / 121.92 cm
Depth	34.00" / 86.30 cm
Bin Storage	710lbs / 322.2 kgs

Height includes adjustable bin legs 6.00" to 8.00", (15.24 to 20.32 cm) set at 6.00" (15.24 cm).

Specifications

Model	Ice Shape	Ice Production 24 Hours		Power Usage kWh/100 lbs. @90°Air/70°F	Potable Water Usage/100 lbs. 45.4 kgs. of Ice
		70°Air/ 50°F Water	90°Air/ 70°F Water		
AIR-COOLED IDT1500A	dice	1,800 lbs.	1,320 lbs.	4.45	20 Gal.
		816 kgs	599 kgs		
IYT1500A	half-dice	1,800 lbs.	1,360 lbs.	4.45	20 Gal.
		862 kgs	617 kgs		
WATER-COOLED IDT1500W	dice	1,725 lbs.	1,480 lbs.	3.27	20 Gal.
		782 kgs	671 kgs		
IYT1500W	half-dice	1,725 lbs.	1,420 lbs.	3.50	20 Gal.
		782 kgs	644 kgs		
* Water-cooled Condenser Water Usage / 100 lbs. /45.4 kgs. Of Ice: 140 gal./ 530 L. * Water-cooled models are excluded from ENERGY STAR qualification.					
REMOTE-COOLED IDT1500N	dice	1,710 lbs.	1,425 lbs.	3.90 ★	20 Gal.
		776 kgs	646 kgs		
IYT1500N	half-dice	1,770 lbs.	1,460 lbs.	3.90 ★	20 Gal.
		803 kgs.	662 kgs		

Order separately: Ice storage bin for all units, line-set and remote condenser unit JCT1500 for remote cooled units.

★ENERGY STAR®

Accessories

LuminIce® II Growth Inhibitor
reduces yeast and bacteria growth for a cleaner ice machine.



External Scoop holder
Protect the ice scoop with the NSF approved versatile scoop holder.



Arctic Pure® Water Filters
Reduces sediment and chlorine odors for better tasting ice.



iAuCS®
schedules and performs routine ice machine cleaning automatically.



Welbilt reserves the right to make changes to the design or specifications without prior notice.

2110 South 26th Street
Manitowoc, WI 54220

Tel: 1.920.682.0161
Fax: 1.920.683.7589

www.manitowocice.com
6452 01/18





ICE MACHINE WARRANTY

Manitowoc Ice, Inc. (hereinafter referred to as the "COMPANY") warrants for a period of thirty-six months from the installation date (except as limited below) that new ice machines manufactured by the COMPANY shall be free of defects in material or workmanship under normal and proper use and maintenance as specified by the COMPANY and upon proper installation and start-up in accordance with the instruction manual supplied with the ice machine. The COMPANY'S warranty hereunder with respect to the compressor shall apply for an additional twenty-four months, excluding all labor charges, and with respect to the evaporator for an additional twenty-four months, including labor charges.

The obligation of the COMPANY under this warranty is limited to the repair or replacement of parts, components, or assemblies that in the opinion of the COMPANY are defective. This warranty is further limited to the cost of parts, components or assemblies and standard straight time labor charges at the servicing location.

Time and hourly rate schedules, as published from time to time by the COMPANY, apply to all service procedures. Additional expenses including without limitation, travel time, overtime premium, material cost, accessing or removal of the ice machine, or shipping are the responsibility of the owner, along with all maintenance, adjustments, cleaning, and ice purchases. Labor covered under this warranty must be performed by a COMPANY Contracted Service Representative or a refrigeration service agency as qualified and authorized by the COMPANY'S local Distributor. The COMPANY'S liability under this warranty shall in no event be greater than the actual purchase price paid by customer for the ice machine.

The foregoing warranty shall not apply to (1) any part or assembly that has been altered, modified, or changed; (2) any part or assembly that has been subjected to misuse, abuse, neglect, or accidents; (3) any ice machine that has been installed and/or maintained inconsistent with the technical instructions provided by the COMPANY; or (4) any ice machine initially installed more than five years from the serial number production date. This warranty shall not apply if the Ice Machine's refrigeration system is modified with a condenser, heat reclaim device, or parts and assemblies other than those manufactured by the COMPANY, unless the COMPANY approves these modifications for specific locations in writing.

THIS WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES OR GUARANTEES OF ANY KIND, EXPRESSED OR IMPLIED, INCLUDING ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.

In no event shall the COMPANY be liable for any special, indirect, incidental or consequential damages. Upon the expiration of the warranty period, the COMPANY'S liability under this warranty shall terminate.

The foregoing warranty shall constitute the sole liability of the COMPANY and the exclusive remedy of the customer or user. To secure prompt and continuing warranty service, the warranty registration card or register on line within five (5) days from the installation date.

MANITOWOC ICE, INC.

2110 So. 26th St., P.O. Box 1720, Manitowoc, WI 54221-1720

Telephone: 920-682-0161 • Fax: 920-683-7585

Web Site - www.manitowocice.com

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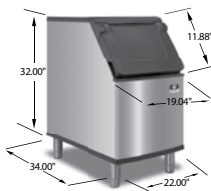
Ice Storage Bins

Model

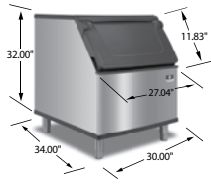
- D320 D400 D420 D570 D970

D Bins

.75" (1.90 cm) Bin drain



D320
210 lbs. (95 kgs)
(Available January)



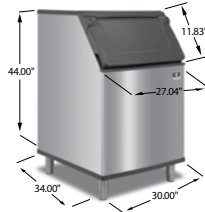
D400
290 lbs. (132 kgs)
(Available January)



D420
310 lbs. (141 kgs)
(Available January)



Ergonomic NSF approved sanitary ice scoop included



D570
430 lbs. (195 kgs)
(Available January)



D970
710 lbs. (323 kgs)

D Bin Features

New Sanitary Scoop Ergonomic NSF approved sanitary ice scoop included with each bin. Built-in knuckle and thumb guard. Unique molded retaining lip allows maximum scooping every time. Per scoop capacity approximately 5.3/ lbs (2.4 kg)

Scoop Holder options New built-in scoop holder, keeps the ice scoop handle above the ice, or purchases the optional NSF approved External Scoop Holder Kit # K00461. (Available January 2018)

New Door design Clever built in side grips allow you to lift the bin door from anywhere you are standing (left, right or center) even when you have just one hand free.

Foamed Insulated Door

Insulates the ice bin, reduces sweat on the door, helps keep ice lasting longer.

Stay up door Unique cammed bin door self-latch keeps the door in the open position and keeps the employee safe when scooping ice.

Ergonomic Door design Door is angled 53 degrees to allow for easier access to the ice in the bin especially when scooping from the bottom.

Duratech Metal Finish Manitowoc exterior material has better corrosion resistance than stainless steel, is smudge resistant and easy to keep clean.

New Bin liner Polyurethane Artic Blue bin liner accentuates the crisp clear ice from a Manitowoc Ice Machine.

Warranty

Bin & Accessories: 3 Year Parts & Labor.

D Bin Model	D-Bin Capacities						D-Bin Dimensions					
	*Application Capacity		**2017 AHRI Capacity		**2018 AHRI Capacity		Height		Width		Depth	
	lbs.	kgs	lbs.	kgs.	Cu. ft	Cu. M	in.	cm	in.	cm	in.	cm
D320	264	119.90	210	95.25	8.9	0.25	38	96.5	22	55.9	34	86.4
D420	383	173.79	310	140.61	12.9	0.37	50	127	22	55.9	34	86.4
D400	365	165.70	290	131.54	12.3	0.35	38	96.5	30	76.2	34	86.4
D570	532	241.14	430	195.05	17.9	0.51	50	127	30	76.2	34	86.4
D970	882	400.11	710	322.05	29.7	0.84	50	127	48	121.9	34	86.4

*Application Capacity is based on 90% of the volume x 33 lbs/ft³ average density of ice. Ice must be managed
 **2017 Approved AHRI capacity is based on 80% of the total volume x 30 lbs/ft³ average density of ice
 ***2018 AHRI certified measurement for bin capacity

Above bin heights include leg height of 6" / 15.24 cm
 All bins include sanitary plastic ice scoop and one set of adjustable (6 in to 7.75 in / 15.24 to 20.32 cm) chrome legs
 External Scoop holder order separately Kit # 000461



Welbilt reserves the right to make changes to the design or specifications without prior notice.

2110 South 26th Street
Manitowoc, WI 54220

Tel: 1.920.682.0161
Fax: 1.920.683.7589

www.manitowocice.com





Ice Storage Bins

D Bins

Indigo Ice Machines Series												
Machine			iT420	iT620	i300	iT450	iT500	i606, i686C	i906, i976C	iT1200, iT1200C	i1470C, i1870C, i2170C	iT1500, iT1900
Machine Capacity @90/70 F			375	465	235	378	440	555, 530	710, 710	950, 1000	1200, 1470, 1691	1360, 1455
Bins	Bin Cap	Width	22"	22"	30"	30"	30"	30"	30"	30"	30"	48"
D320	210	22"	*	*								
D420	290	22"	*	*								
D400	310	30"	K-00443	K-00443	*	*	*	*	NR	NR	NR	
D570	430	30"	K-00443	K-00443	*	*	*	*	*	*	NR	
D970	710	48"	NR	NR	NR	K-00458	K-00458	K-00458	K-00458	K-00458	K-00385	*

Manitowoc Flaker and Nugget Machines											
Machine			RNS0308 & RNF320	RFS0300 & RFF320	RNF620	RFF0620	RNF1020	RFF1220	RNF1100	RFF1300	RFF2200C
Machine cap			251	286	451	540	825	958	825	874	1702
Bins	Bin cap	Width	22"	22"	22"	22"	22"	22"	30"	30"	36.7"
D320	210	22"	*	*	NR	NR	NR	NR			
D420	310	22"	*	*	*	*	NR	NR			
D400	290	30"	K-00443	K-00443	K-00443	K-00443	NR	NR	NR	NR	
D570	430	30"	NR	K-00443	K-00443	K-00443	NR	NR	*	*	
D970	710	48"	NR	NR	K-00444	K-00444	K-00371 if 2 used.	K-00371 if 2 used.	K-00458	K-00458	K-00458

An optional adapter is required when putting a narrower ice machine on a wider bin.
 * No adapter is needed
 NR= Not Recommend. Bin too small or too large for application.
 Putting a wider machine on narrower bin is not an option.
 Machines side by side must be water cooled or remote.
 Bin Capacity shown in lbs using the AHRI rating base on 80% of total volume x 30lb/ft3 average density of ice.
 Machine capacity shown in lbs/24hrs using the AHRI rating base at 90F ambient, 70F water temperature

Available Accessories See price book for replacement: scoops, legs, specialty legs and casters

K00146 Convenient Ice Bagger

Includes bagger, D-bin adapter, and 250 bags and ties (Not for D320 or D400) Order K00068 replacement bags



K00461 External Scoop Holder

NSF approved. Can be mounted on the left or right side of bins, horizontally or vertically or on a wall.



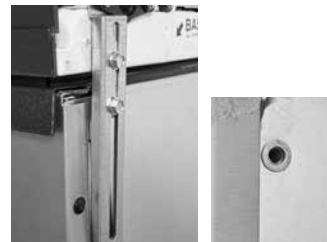
000013960 Metal Scoop

Indestructible aluminum alloy with sanitary knuckle and thumb guard. Works with K00461 external scoop holder or hangs inside the D-Bin series



K00462 Secure Fastening Kit

Securely fast the Indigo[®] ice machine head to the pre-drilled inserts on the back of the D-bin series. Stainless steel flanged feet attach to bin and can be screwed to the floor



©2017 Welbilt, Inc. Continuing product improvement may necessitate change of specifications without notice.



LIMITED WARRANTY FOR ICE STORAGE BIN & DISPENSERS

LIMITED WARRANTY

Manitowoc Ice a division of Manitowoc FSG Operations, LLC, ("Company") warrants that new Ice Storage Bins or Dispensers sold by Company shall be free of defects in material or workmanship under normal and proper use and maintenance as specified by the Company and upon proper installation and start-up in accordance with the instruction manual supplied.

WHAT IS COVERED

- Parts and Labor for a period of three (3) years.
 - Accessory Ice Transport Carts for two (2) years parts and labor.
- The Ice Storage Bin / Dispenser warranty begins on the date of the original installation. This warranty shall not apply to any Ice Storage Bin or Dispenser initially installed more than five (5) years from the serial number production date.

The obligation of the Company under this warranty is limited to the repair or replacement of parts, components, or assemblies that in the sole opinion of the Company are defective. This warranty is further limited to the cost of parts, components or assemblies and standard straight time labor charges at the servicing location.

Time and hourly rate schedules, as published from time to time by the Company, apply to all service procedures. Additional expenses including without limitation, travel time, overtime premium, material cost, accessing or removal of the Ice Storage Bin / Dispenser, or shipping are the responsibility of the purchaser, along with all maintenance, adjustments, cleaning, and ice purchases. Labor covered under this warranty must be performed by an approved Company contracted Service Representative or a refrigeration service agency as qualified and authorized by the Company's local Distributor. The Company's liability under this warranty shall in no event be greater than the actual purchase price paid by purchaser for the Ice Storage Bin or Dispenser.

EXCLUSIONS FROM COVERAGE

- Repair or replacement of parts required because of misuse, improper care or storage, negligence, alteration, use of incompatible supplies or lack of specified maintenance shall be excluded.
- Normal maintenance items.
- Failures caused by adverse environmental, water conditions, or improper drainage.
- Improper or unauthorized repair.
- Any Ice Storage Bin / Dispenser that has been installed and/or maintained inconsistent with the instructions provided by the Company.
- Parts subject to damage beyond the control of Company, or to Ice Storage Bin's / Dispenser's which have been subject to accidents, damage in shipment, fire, floods, other hazards or acts of God that are beyond the control of the Company.
- This Limited Warranty shall not apply if the Ice Storage Bin / Dispenser is modified with parts and assemblies other than those manufactured by the Company, unless the Company approves these modifications for specific locations in writing prior to the commencement of such modification.

LIMITATIONS OF LIABILITY

The preceding paragraphs set forth the exclusive remedy for all claims based on failure of, or defect in, Ice Storage Bins or Dispensers sold hereunder, whether the failure or defect arises before or during the warranty period, and whether a claim, however instituted, is based on contract, indemnity, warranty, tort (including negligence), strict liability, implied by statute, common-law or otherwise, and Company and agents shall not be liable for any claims for personal injuries or consequential damages or loss, howsoever caused. Upon the expiration of the warranty period, all such liability shall terminate. THE FOREGOING WARRANTIES ARE EXCLUSIVE AND IN LIEU OF ALL OTHER WARRANTIES, WHETHER WRITTEN, ORAL, IMPLIED OR STATUTORY NO IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR PARTICULAR PURPOSE SHALL APPLY, COMPANY DOES NOT WARRANT ANY PRODUCTS OR SERVICES OF OTHERS

REMEDIES

The liability of Company for breach of any warranty obligation hereunder is limited to: (i) the repair or replacement of the Ice Storage Bin or Dispenser on which the liability is based, or with respect to services, re-performance of the services; or (ii) at Company's option, the refund of the amount paid for said equipment or services. Any breach by Company with respect to any item or unit of equipment or services shall be deemed a breach with respect to that item or unit or service only

WARRANTY CLAIM PROCEDURE

Customer shall be responsible to:

- Complete and return warranty registration card or register on line within five (5) days from the installation date.
- All warranty service must be performed by an approved Manitowoc contracted or authorized Service Representative. To schedule a service appointment contact your local Manitowoc Service Representative or visit us at www.manitowocice.com to find a Service Representative near you.

GOVERNING LAW

This Limited Warranty shall be governed by the laws of the state of Wisconsin, USA, excluding their conflicts of law principles. The United Nations Convention on Contracts for the International Sale of Goods is hereby excluded in its entirety from application to this Limited Warranty

COMPLETE AND RETAIN FOR YOUR RECORD:

Distributor/Dealer _____

Model Number _____

Serial Number _____

Installation Date _____

Manitowoc Ice
2110 South 26th Street
P.O. Box 1720
Manitowoc, WI 54221-1720
Web site: www.manitowocice.com

Submittal Sheet

10/16/2018

ITEM# 03 - INGREDIENT BIN (3 EA REQ'D)

Cambro IBS20148

Ingredient Bin, mobile, 21 gallon capacity, molded polyethylene with sliding cover, S-hook on front (scoop NOT included), (4) 3" heavy duty casters (2 front swivel, 2 fixed), with bin securely attached to base plate, white with clear cover, NSF

CAMBRO**Ingredient Bins****Slant Top**

Models IBS20 – 21 gallon (81 L)
 IBS27 – 27 gallon (102 L)
 IBS37 – 37 gallon (140 L)

**Features & Benefits**

- Stores and transports a wide variety of dry ingredients such as flour, sugar, rice or grains. Perfect for restaurants, food manufacturers or commissaries.
- Available in 21, 27 and 37 gallon (81, 102, 140 L) capacity to meet standard industry requirements for storage and transportation of bulk foods.
- One-piece, seamless single-wall polyethylene bin construction is extremely durable. Won't rust or corrode. Liquids and dry foods will not stick or seep between seams.
- FDA accepted material. Meets all food contact requirements and eliminates need for liners.
- Smooth interior and exterior are easy to clean.
- Injection molded Camwear® polycarbonate lids are transparent, break resistant and offer quick and easy identification of contents. Slide-back feature means easy access.
- Working height permits storage under standard work tables.
- Heavy-duty 3" (7,6 cm) casters, 2 front swivel, 2 fixed.
- No assembly required.
- Available in White (148) only with Clear (135) cover.

Item No. _____

Specifier Identification No. _____

Model No. _____

Quantity _____

**IBS20****IBS27****IBS37**

Scoops not Included
Approvals

**CAMBRO**

© Cambro Manufacturing Company 5801 Skylab Road, Huntington Beach, CA 92647-2056, U.S.A.
 Telephone 714 848 1555 Toll Free 800 854 7631 Customer Service Department 800 833 3003

Ingredient Bins

Item No. _____

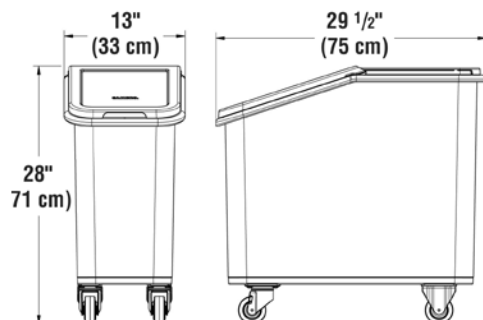
Specifier Identification No. _____

Model No. _____

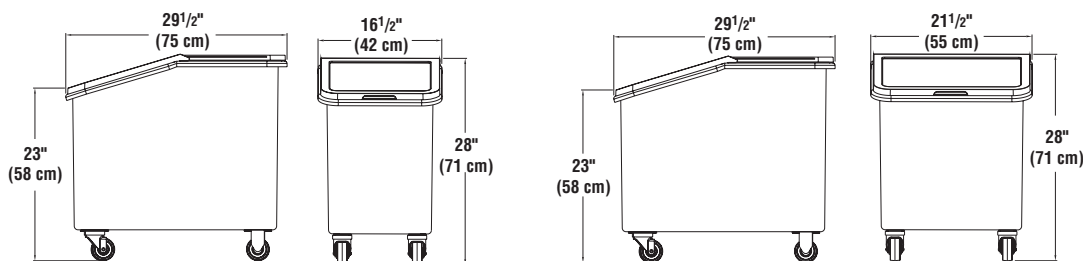
Quantity _____

Slant Top

Models IBS20 – 21 gallon (81 L)
 IBS27 – 27 gallon (102 L)
 IBS37 – 37 gallon (140 L)



IBS20



IBS27

IBS37

Specifications

Dimension Tolerance: +/- 1/4" (0,64 cm)

Code	Description	Volume Capacity	Load Capacity		Exterior Dimensions W x D x H	Case lbs./cube Kg/m ³
			Sugar	Flour		
IBS20	21 gal. Ingredient Bin (81 L)	2.87 Cubic feet (0,081) Cubic meters	170 lbs. (77 kg.)	140 lbs. (63 kg.)	13" x 29 1/2" x 28" (33 x 75 x 71 cm)	28 (6,57) 13 (0,19)
IBS27	27 gal. Ingredient Bin (102 L)	3.98 Cubic feet (0,113) Cubic meters	226 lbs. (103 kg.)	150 lbs. (68 kg.)	16 1/2" x 29 1/2" x 28" (42 x 75 x 71 cm)	24 (7,50) 11 (0,22)
IBS37	37 gal. Ingredient Bin (140 L)	5.55 Cubic feet (0,157) Cubic meters	314 lbs. (142 kg.)	225 lbs. (102 kg.)	21 1/2" x 29 1/2" x 28" (55 x 75 x 71 cm)	28 (10,10) 13 (0,29)

Architect Specs

The Ingredient Bins shall be Cambro Model..., manufactured by Cambro Mfg. Co., Huntington Beach, CA 92648 U.S.A. Each unit shall be one piece, seamless, single-wall molded construction made of FDA Approved white polyethylene. Unit capacity shall range from 21 - 37 gallons (81 - 140 L) and/or 2.87 - 5.55 cu. ft. (0,081 - 0,157 cubic meters).

It shall have four each 3" (7,6 cm) casters with 1 1/4" (3,2 cm) wide tread, 2 front swivel and 2 fixed. It shall have an injection molded, transparent, slide-back polycarbonate lid. It shall not exceed 29" (73,6 cm) in height so that it can store under standard work tables. It shall be available in white only with a clear cover.

Approvals



CAMBRO

© Cambro Manufacturing Company 5801 Skylab Road, Huntington Beach, CA 92647-2056, U.S.A.
 Telephone 714 848 1555 Toll Free 800 854 7631 Customer Service Department 800 833 3003



INGREDIENT BINS & CAMCRISPER®

Ingredient Bins

- Store bulk dry ingredients such as flour and grain.
- Hygienic clear sliding lid reduces handling and allows for quick content identification.
- Bin made of FDA-accepted material so no liners are needed.
- Designed to fit under standard work tables.

Camcrisper

- A self-contained system for brining or storing, washing and transporting bulk produce.
- Prevents cross contamination and minimizes unnecessary handling.
- Transfer dry produce out of cartons into bin, cover and roll into cooler for safe storage.
- Wash and rinse produce for easy and safe prep.

Soak and Brine Tank

- Designed for complete submersion of meats or poultry in brining solution for enhanced moisture retention, texture and flavor.
- Can also be used as a pre-soak tank for smallwares and dishes in sanitation solution to help reduce labor in pre-scrubbing.
- Clear sliding lid always stays on to help reduce the risk of cross-contamination.

3" Casters: 2 fixed, 2 swivel.

Bin Color: White (148).
Cover Color: Clear (135).

Scoops sold separately. S-Hook included.



Casters feature wide wheels for excellent stability and weight bearing capability.



Now with Sliding Lid.

CODE	IBS20	IBS27	IBS37	IBSF27
DIMENSIONS W x L x H	13" x 29½" x 28"	16⅝" x 29⅞" x 28"	21½" x 29½" x 28¼"	13" x 30⅞" x 28½"
CAPACITY	21 gal.	27 gal.	37 gal.	26.7 gal.
CUBIC FEET	2.87	3.98	5.55	3.56
LOAD CAPACITY (SUGAR)	170 lbs.	226 lbs.	314 lbs.	216 lbs.
LOAD CAPACITY (FLOUR)	140 lbs.	150 lbs.	225 lbs.	150 lbs.
LIST PRICE EACH	\$	\$	\$	\$

Case Pack: 1 InStock Color: White (148).



Camcrisper

Soak and Brine Tank

CODE	IB32	IB36	IB44	CC32	IBSD37
DIMENSIONS W x L x H	22" x 24" x 23"	15¼" x 29½" x 29"	18½" x 29½" x 29"	22" x 24" x 23"	21½" x 29½" x 28¼"
CAPACITY	32 gal.	34 gal.	42.5 gal.	32 gal.	37 gal.
CUBIC FEET	4.35	4.54	5.69	4.28	5.55
LOAD CAPACITY (SUGAR)	215 lbs.	252 lbs.	320 lbs.	24 lettuce heads (unfinished)	—
LOAD CAPACITY (FLOUR)	160 lbs.	180 lbs.	230 lbs.	42 lettuce heads (finished)	—
LIST PRICE EACH	\$	\$	\$	\$	\$

Case Pack: 1

Submittal Sheet

10/16/2018

ITEM# 04 - WIRE SHELVING (48 EA REQ'D)

Metro 2160BR

Super Erecta® Shelf, wire, 60"W x 21"D, Brite (zinc) finish, plastic split sleeves are included in each carton, NSF ACCESSORIES

Mfr	Qty	Model	Spec
Metro	48	74UP	Super Erecta® Post, 73-7/8"H, for use with stem casters, chrome plated finish
Metro	24	5MDA	Super Erecta® Stem Caster, swivel, 5"Diameter, 1-1/4" face, high modulus donut wheel tread, with donut bumpers, 250 lb. capacity
Metro	24	5MDBA	Super Erecta® Stem Caster, brake (foot operated), 5"Diameter, 1-1/4" face, high modulus donut wheel tread, with donut bumpers, 250 lb. capacity, brakes are foot operated



Item # _____

Job _____

SUPER ERECTA SHELF® WIRE SHELVING

- **Unique Design:** The open wire design of these shelves minimizes dust accumulation and allows free circulation of air, greater visibility of stored items and greater light penetration.
- **Durable Construction:** Super Erecta shelves and posts are constructed of heavy-gauge carbon steel or Type 304 stainless steel.
- **Choice of Finishes:** Super Erecta Brite™ and chrome-plated for dry storage; Metroseal 3™ with Microban® antimicrobial product protection and stainless steel for corrosive environments; and attractive epoxy color options for merchandising applications.
- **Versatile:** Super Erecta Shelf® wire shelving can adapt to your changing needs. By using various accessories, hundreds of shelving configurations become possible.
- **Fast, Secure Assembly:** SiteSelect™ Posts have a double groove visual guide feature every 8" (203mm), circular grooves at 1" (25mm) increments, and are numbered at 2" (50mm) intervals. A patented, tapered split sleeve snaps together around each post. Tapered openings in the shelf corners slide over the tapered split sleeves providing a positive lock. Shelf is assembled in minutes without the use of any special tools.
- **Adjustability:** Shelves can be adjusted at 1" (25mm) intervals along the entire length of the post.
- **Shelf Ribs:** Run front to back, allowing you to slide items on and off shelves smoothly.
- **Shelf Accessibility:** Shelves can be loaded/unloaded easily from all sides. This open construction allows maximum use of storage cube.
- **Adjustable Feet:** Bolt levelers compensate for surface irregularities.

Note: Stainless stationary posts are equipped with stainless steel leveling feet.



*MICROBAN® and the MICROBAN® symbol are registered trademarks of the Microban Products Company, Huntersville, NC.



InterMetro Industries Corporation
North Washington Street
Wilkes-Barre, PA 18705
www.metro.com



METRO

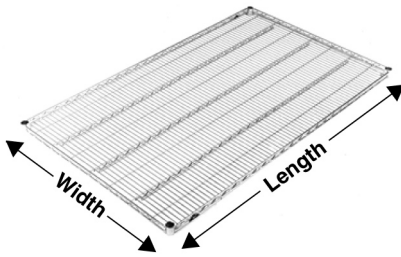
Wire Shelving

10-01



SUPER ERECTA SHELF® WIRE SHELVING

Wire Shelves



Split Sleeve



Aluminum
Split Sleeve

- **Metroseal 3:** Metro's proprietary epoxy coating contains Microban® antimicrobial product protection. Microban antimicrobial protects the epoxy coating from bacteria, mold, mildew, and fungus that cause odors, stains, and product degradation.
- See spec sheet 10.14 for epoxy color options.
- Plastic split sleeves are included with each shelf
Replacements are available: Cat. No. 9985 (bag of 4)
- Aluminum split sleeves are recommended for abusive mobile applications and autoclave applications.
Cat. No. 9986Z (bag of 4 with zinc C-rings)
Cat. No. 9986S (bag of 4 with stainless steel C-rings)
- Load capacity (evenly distributed) per shelf
Depths: 14" to 24" (355 to 610mm)
800 lbs. (363kg) for lengths of 18" to 48" (457 to 1219mm)
600 lbs. (272kg) for lengths of 54" (1370mm) or longer
- Load capacity (evenly distributed) per unit.
Stationary shelving units have a maximum load capacity (evenly distributed) of 2,000 lbs. (907kg)
Mobile units have a maximum capacity of three times the caster load rating up to but not exceeding 1,000 lbs. (453kg) total. Consult the Metro catalog for caster load ratings
- SUPER ERECTA SHELF meets Government Specifications MIL-S-40144E.

Model No. Super Erecta Brite	Model No. Chrome	Model No. Metroseal 3 with Microban®	Model No. Stainless	Nominal Width/Length (in.) (mm)	Approx. Pkd. Wt. (lbs.) (kg)
1424BR	1424NC	1424NK3	1424NS	14x24 355x610	6 2.7
1430 BR	1430NC	1430NK3	1430NS	14x30 355x760	7 3.2
1436BR	1436NC	1436NK3	1436NS	14x36 355x914	8 3.6
1442BR	1442NC	1442NK3	1442NS	14x42 355x1066	9½ 4.3
1448BR	1448NC	1448NK3	1448NS	14x48 355x1219	10½ 4.7
1460BR	1460NC	1460NK3	1460NS	14x60 355x1524	14 6.3
1472BR	1472NC	1472NK3	1472NS	14x72 355x1829	17 7.7
1824BR	1824NC	1824NK3	1824NS	18x24 457x610	7 3.2
1830BR	1830NC	1830NK3	1830NS	18x30 457x760	8 3.6
1836BR	1836NC	1836NK3	1836NS	18x36 457x914	9½ 4.3
1842BR	1842NC	1842NK3	1842NS	18x42 457x1066	11 5.0
1848BR	1848NC	1848NK3	1848NS	18x48 457x1219	12 5.4
1854BR	1854NC	1854NK3	1854NS	18x54 457x1370	14½ 6.6
1860BR	1860NC	1860NK3	1860NS	18x60 457x1524	17 7.7
1872BR	1872NC	1872NK3	1872NS	18x72 457x1829	20 9.1
2124BR	2124NC	2124NK3	2124NS	21x24 530x610	8 3.6
2130BR	2130NC	2130NK3	2130NS	21x30 530x760	9 4.1
2136BR	2136NC	2136NK3	2136NS	21x36 530x914	11 5.0
2142BR	2142NC	2142NK3	2142NS	21x42 530x1066	12 5.4
2148BR	2148NC	2148NK3	2148NS	21x48 530x1219	14 6.4
2154BR	2154NC	2154NK3	2154NS	21x54 530x1370	16 7.3
2160BR	2160NC	2160NK3	2160NS	21x60 530x1524	18 8.2
2172BR	2172NC	2172NK3	2172NS	21x72 530x1829	24 10.9
2424BR	2424NC	2424NK3	2424NS	24x24 610x610	9 4.1
2430BR	2430NC	2430NK3	2430NS	24x30 610x760	11 5.0
2436BR	2436NC	2436NK3	2436NS	24x36 610x914	13 5.9
2442BR	2442NC	2442NK3	2442NS	24x42 610x1066	15 6.8
2448BR	2448NC	2448NK3	2448NS	24x48 610x1219	16 7.3
2454BR	2454NC	2454NK3	2454NS	24x54 610x1370	19 8.6
2460BR	2460NC	2460NK3	2460NS	24x60 610x1524	21 9.5
2472BR	2472NC	2472NK3	2472NS	24x72 610x1829	26 11.8

Note: 14" (355mm) deep units.

Free-standing units: Foot plates should be used and secured to the floor.
Mobile units: maximum allowable post height is 54" (1370mm).

SUPER ERECTA SHELF® WIRE SHELVING



SiteSelect™ Posts

Stationary Posts

Stationary posts are equipped with a leveling bolt to account for uneven floors.

- Height includes leveling bolt (completely tightened) and post cap. Leveling bolt can be adjusted 1/2" (13mm).
- Foot plates may be ordered separately and installed in place of leveling foot.
- Replacement leveling bolts
Zinc Cat. No. RPF04-004 Stainless Steel Cat. No. RPF04-004C
- Replacement post cap for standard posts
Black Cat. No. RPC06-035



SiteSelect Posts feature double grooves every 8" (203mm) to aid assembly.

Model No. Chrome	Model No. Metroseal 3 with Microban	Model No. Stainless Steel	Height		Approx. Pkd. Wt.	
			(in.)	(mm)	(lbs.)	(kg)
7P			7 ³ / ₈	187	1/2	0.3
13P	13PK3	13PS	14 ³ / ₈	365	1	0.5
27P		27PS	28 ³ / ₈	720	1 ³ / ₄	0.75
33P	33PK3	33PS	34 ³ / ₈	873	2	0.9
54P	54PK3	54PS	54 ⁷ / ₁₆	1382	3	1.4
63P	63PK3	63PS	62 ⁷ / ₁₆	1585	3 ¹ / ₂	1.6
74P	74PK3	74PS	74 ¹ / ₂	1892	4	1.8
86P	86PK3	86PS	86 ¹ / ₂	2197	5	2.3
*96P			96 ¹ / ₂	2450	5 ¹ / ₂	2.5

*96P should not be used on units less than 24" (610mm) deep. Consult Metro Engineering for alternate recommendations.

Mobile Posts (For use with Stem Casters)

- Height includes post cap.

Model No. Chrome	Model No. Metroseal 3 with Microban	Model No. Stainless Steel	Height		Approx. Pkd. Wt.	
			(in.)	(mm)	(lbs.)	(kg)
27UP		27UPS	27 ³ / ₄	704	1 ³ / ₄	0.75
33UP	33UPK3	33UPS	33 ³ / ₄	857	2	0.9
54UP	54UPK3	54UPS	53 ¹³ / ₁₆	1366	3	1.4
63UP	63UPK3	63UPS	61 ¹³ / ₁₆	1570	3 ¹ / ₂	1.6
	70UPK3		69 ³ / ₄	1771	3 ³ / ₄	1.7
74UP	74UPK3	74UPS	73 ⁷ / ₈	1876	4	1.8
86UP	86UPK3	86UPS	85 ⁷ / ₈	2181	4 ¹ / ₂	2.0

Staked Posts (For use with Truck Dollies)

- Each post connects to the truck dolly through the stem receptacle. The stem receptacle is staked into the bottom of the post to ensure a durable connection in abusive mobile applications.
- Each includes a leveling/connecting bolt.

Model No. Chrome	Model No. Stainless Steel	Height		Approx. Pkd. Wt.	
		(in.)	(mm)	(lbs.)	(kg)
54P-STKD	54PS-STKD	54 ⁷ / ₁₆	1382	3	1.4
63P-STKD	63PS-STKD	62 ⁷ / ₁₆	1585	3 ¹ / ₂	1.6
74P-STKD	74PS-STKD	74 ¹ / ₂	1892	4	1.8

Swedged Posts (For use with Stem Casters in Cart Wash Applications)

- Each post has an aluminum cap swedged into the top of the post.

Model No. Stainless Steel	Height		Approx. Pkd. Wt.	
	(in.)	(mm)	(lbs.)	(kg)
33UPS-SW	33 ³ / ₄	857	2	0.9
54UPS-SW	53 ¹³ / ₁₆	1366	3	1.4
63UPS-SW	61 ¹³ / ₁₆	1570	3 ¹ / ₂	1.6

Special Length Posts

Special length cut posts are available. Consult your Metro representative for more information.

Job _____

10.01

SUPER ERECTA SHELF® WIRE SHELVING



Super Wide Shelving

- **High-density Storage:** Super Wide™ shelves have a greater storage area for holding large quantities of supplies, especially large, bulky objects, providing maximum storage in minimum space.
- **Load Capacity** (evenly distributed) per shelf:
Depths: 30" and 36" (760 and 914mm)
600 lbs. (272kg) for lengths 48" (1219mm) or shorter.
400 lbs. (181kg) for lengths 54" (1370mm) or longer.

Model No. Chrome	Model No. Metroseal 3 with Microban	Model No. Stainless Steel	Nominal Width/Length		Approx. Pkd. Wt.	
			(in.)	(mm)	(lbs.)	(kg)
3036NC	3036NK3	3036NS	30x36	760x914	15	6.8
3048NC	3048NK3	3048NS	30x48	760x1219	21	9.5
3060NC	3060NK3	3060NS	30x60	760x1524	26 ^{1/2}	11.8
3072NC	3072NK3	3072NS	30x72	760x1829	31	14.0
3636NC	3636NK3	3636NS	36x36	910x914	18	8.2
3648NC	3648NK3	3648NS	36x48	910x1219	23	10.4
3660NC	3660NK3	3660NS	36x60	910x1524	29	13.1
3672NC	3672NK3	3672NS	36x72	910x1829	34 ^{1/2}	15.4



Foot Plates

- Use to bolt units to the floor, or when a broader, more stable foot is desired. Foot plates also help to protect floors by distributing the point load of the shelving unit across a larger contact point.
- Foot plates (completely tightened) add 1/8" (3mm) to the specified heights of each stationary post on the table.
Zinc Cat. No. 9993Z
Stainless Steel Cat. No. 9993S



"S" Hook

- Used to add on shelving units with only two posts required. Order two per shelf level.
Cat. No. 9995Z



All Metro Catalog Sheets are available on our Web Site: www.metro.com



InterMetro Industries Corporation
North Washington Street, Wilkes-Barre, PA 18705
Phone: 570-825-2741
Fax: 570-825-2852

L02-006
Printed in U.S.A. Rev. 11/08

Information and specifications are subject to change without notice. Please confirm at time of order.

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For Product Information:
U.S. and Canada: 1.800.433.2232

Latin America: 1.561.333.3824
Europe: +31.76.587.7550

Asia/Pacific: +65.6567.8003
Middle East/Africa: +971.4.811.8286



Item # _____

Job _____



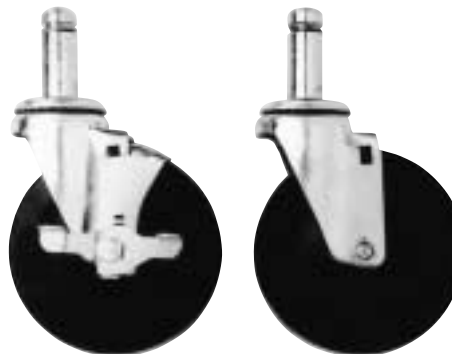
Casters (Stem Type)

METRO® STEM CASTERS

- **Metro Stem-Type Casters** are designed to fit Super Erecta Shelf® posts to form shelf carts and other mobile units.
- **Stainless Steel, Cart-Washable Casters** offer grease seals and zerk fittings. Can withstand high-pressure washings.
- **Polymer Horn Casters:** Innovative polymer stem casters offer corrosion resistance and enhanced durability. For all medium-duty applications.
- **Resilient Rubber Tread:** A molded, soft tread that provides good floor protection along with quiet operation. Non-marking.
- **Polyurethane Tread:** Long-wearing; resists abrasion. Non-marking, shock absorbing.
- **Wheel Brakes:** Foot-operated. Available on all caster models.
- **Caster Load Ratings:** From 125 lbs. to 300 lbs. (57 to 136kg) See chart.
- **Donut Bumpers:** Furnished standard on all Metro stem casters.
- **Additional Caster Types Available.**

Note: SPECIAL WHEELS — V-groove, Conductive, Steel and Phenolic — are available on request. For additional information, contact InterMetro Industries Corporation or your InterMetro representative.

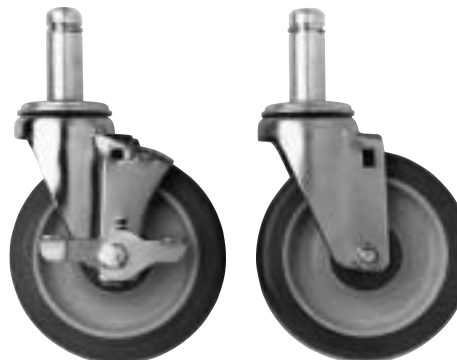
Resilient Rubber



5MB Wheel Brake
Includes Donut Bumper
(not shown)

5M Resilient
Includes Donut Bumper
(not shown)

Stainless Steel, Cart Washable



5MDBGSA

5MDGSA

Polymer Horn Casters



5PCB

5PC



InterMetro Industries Corporation
North Washington Street
Wilkes-Barre, PA 18705
www.metro.com

Job _____



METRO® STEM CASTERS

Dimensions Standard Casters — Stem Type

Cat. No.	Wheel Diameter		Face		Load Rating		Type	Wheel Tread	Approx. Pkd. Wt.	
	(in.)	(mm)	(in.)	(mm)	(lbs.)	(kg)			(lbs.)	(kg)
4LD	4	102	1/2	12	125	56	Stem/Swivel	Resilient	1 1/2	.6
5LD	5	127	1/2	12	125	56	Stem/Swivel	Resilient	2	.9
5M	5	127	1 1/4	32	200	90	Stem/Swivel	Resilient	2 1/2	1.1
5MB	5	127	1 1/4	32	200	90	Stem/Brake	Resilient	2 3/4	1.2
5MR	5	127	1 1/4	32	200	90	Stem/Rigid	Resilient	3 1/2	1.5
5MDA	5	127	1 1/4	32	250	111	Stem/Swivel	High Modulus Donut	2 1/2	1.1
5MDBA	5	127	1 1/4	32	250	111	Stem/Brake	High Modulus Donut	2 5/8	1.17
5MDRA	5	127	1 1/4	32	250	111	Stem/Rigid	High Modulus Donut	2 3/8	1.08
5MP	5	127	1 1/4	32	300	135	Stem/Swivel	Polyurethane	2 1/8	.94
5MPB	5	127	1 1/4	32	300	135	Stem/Brake	Polyurethane	2 1/4	1
5MPR	5	127	1 1/4	32	300	135	Stem/Rigid	Polyurethane	2	.9

NOTE 1: Stem casters are shipped with donut bumper **at no additional charge.**

NOTE 2: Rigid casters are held in position by a connecting channel. When ordering rigid casters, shelf width **must be** known.

NOTE 3: Load Height for all 5M, 5MD and 5MP casters — $6\frac{3}{32}'' \pm \frac{1}{16}''$ (155 ± 1.5mm).

NOTE 4: Load Height for 4LD caster — $4\frac{5}{8}'' \pm \frac{1}{16}''$ (118 ± 1.5mm).

NOTE 5: Load Height for 5LD caster — $5\frac{5}{8}'' \pm \frac{1}{16}''$ (143 ± 1.5mm).

NOTE 6: Brakes are foot-operated.

Stainless Steel Cart-Washable Casters — Stem Type

Cat. No.	Wheel Diameter		Face		Load Rating		Type	Wheel Tread	Approx. Pkd. Wt.	
	(in.)	(mm)	(in.)	(mm)	(lbs.)	(kg)			(lbs.)	(kg)
5MDGSA	5	122	1 1/4	32	150	68	Swivel	High Modulus Donut	2 1/2	1.1
5MDBGSA	5	122	1 1/4	32	150	68	Brake	High Modulus Donut	2 5/8	1.17
5MDRGSA	5	122	1 1/4	32	150	68	Rigid	High Modulus Donut	2 3/8	1.08
5MPGSA	5	127	1 1/4	32	300	135	Swivel	Polyurethane	2 1/8	.94
5MPBGSA	5	127	1 1/4	32	300	135	Brake	Polyurethane	2 1/4	1
5MPRGSA	5	127	1 1/4	32	300	135	Rigid	Polyurethane	2	.9

NOTE 1: Stem casters are shipped with donut bumper **at no additional charge.**

NOTE 2: Rigid casters are held in position by a connecting channel. When ordering rigid casters, shelf width **must be** known.

NOTE 3: Load Height for all 5MD and 5MP casters — $6\frac{3}{32}'' \pm \frac{1}{16}''$ (155 ± 1.5mm).

NOTE 4: All casters are grease sealed with zerk fittings in swivel and axle.

NOTE 5: Brakes are foot-operated.

NOTE 6: "D" in model number designates donut wheel made of high-modulus rubber.

Polymer Casters — Stem Type

Cat. No.	Wheel Diameter		Face		Load Rating		Type	Wheel Tread	Approx. Pkd. Wt.	
	(in.)	(mm)	(in.)	(mm)	(lbs.)	(kg)			(lbs.)	(kg)
5PC	5	127	1 1/4	32	300	135	Swivel	Polyurethane	2	.9
5PCB	5	127	1 1/4	32	300	135	Brake	Polyurethane	2	.9
5PCR	5	127	1 1/4	32	300	135	Rigid	Polyurethane	2	.9

NOTE 1: Optional thread guards (blue) may be ordered by adding "-TG" to the desired model number (eg. 5PC-TG, 5PCB-TG, 5PCR-TG).

NOTE 2: Stem casters are shipped with donut bumper **at no additional charge.**

NOTE 3: Rigid casters are held in place by a connecting channel. When ordering, shelf depth **must be** provided.

Manufactured by:



InterMetro Industries Corporation

North Washington Street, Wilkes-Barre, PA 18705

Phone: 570-825-2741 • Fax: 570-825-2852

For Product Information Call: 1-800-433-2232

Visit Our Web Site: www.metro.com

L02-041
Rev. 9/00
Printed in U.S.A.

Information and specifications are subject to change without notice. Please confirm at time of order.

Submittal Sheet

10/16/2018

ITEM# 08 - DISHWASHER, UNDERCOUNTER (1 EA REQ'D)

MEIKO UM+

M-iClean Series Dishwasher, undercounter, 23-5/8"W x 23-5/8"D x 33-1/2"H, high temperature with built-in booster, fully automatic operation, (37) racks/hour capacity, 0.61 gallons/rack, illuminated door handle, glass touch-screen display, M-iClean active wash water filtration, Blue Touch component color coding for intuitive manual cleaning, Auto-Safe temperature control for guaranteed sanitization, Soft Start fine china & glassware protection, leak detection, pumped drain & rinse, standard liquid detergent & rinse aid pumps, double-wall stainless steel construction, (1) flat rack & (1) peg rack included, 3/4 HP wash pump, NSF, cETLus, ENERGY STAR®

ACCESSORIES

Mfr	Qty	Model	Spec
MEIKO	1		1 year standard warranty: Parts, labor & travel within the continental US, no overtime charges
MEIKO	1		208-230v/60/3-ph, 31.1/33.9 amps, standard
MEIKO	1		Drain water tempering kit, reduces drain water temperature to below 140°F, factory-installed
MEIKO	1		Inline slide base, adds 1" to machine height
MEIKO	1		Drain board top
MEIKO	1		Freight Note: FOB factory freight allowed standard delivery service within the continental US
MEIKO	1		Startup + Performance & Installation inspection which activates 1 year standard warranty, contact your local MEIKO authorized service agent or MEIKO service directly at 1-800-868-3840 (contact factory)

ELECTRICAL

	VOLTS	CYCLE	PHASE	CONN	AFF	NEMA	AMPS	KW	HP	MCA	MOCP
1									3/4		
2	208-230	60	3	Cord Only			31.1/33.9				

WATER

	HOT SIZE	HOT AFF	HOT GPH	COLD SIZE	COLD AFF	FILTERED SIZE	FILTERED AFF	CONDENSER INLET SIZE	CONDENSER OUTLET SIZE
1	3/4"								

WASTE

	INDIRECT SIZE	DIRECT SIZE
1	1-1/2"	

PLUMBING 1 REMARKS

Hose & Y strainer supplied, Hose supplied



The clean solution



<h1>M-iClean</h1> <h2>UM+</h2>	<h3>HOT WATER SANITIZING UNDERCOUNTER DISHWASHER</h3>
--------------------------------	---

Special Features:

- **Illuminated door handle** - Provides visual cues to the operator on the machine operating status. The color of the illumination will show the operating state of the machine (ready for operation, washing, or displaying an important message)
- **Glass touchscreen display** - Provides a range of information in plain text, including wash and rinse tank temperatures, selection of different cycle times, a graphical progress bar, operating state, and service information
- **M-iClean Filter** - Food soil is continually strained from the wash water by the two-stage M-iClean Filter. Captured soil is removed at the end of each cycle., improving washing results and minimizing both detergent use and manual cleaning
- **Blue Touch color coding** - Components that require manual cleaning are colored blue for intuitive operation and easier staff training
- **Auto Safe** - The internal booster heater is automatically regulated to ensure proper sanitizing temperatures, regardless of the incoming water temperature
- **Soft Start** - The wash water is pumped at a reduced pressure for the first few seconds of the wash cycle, protecting the ware from being moved by a sudden burst of pressure
- **Pumped Final Rinse** - An internal rinse pump ensures that the final rinse pressure is constant, for efficient operation and consistent results
- **Leak Detection System** - Stops machine operation if an internal leak is detected

Standard Features:

- **ENERGY STAR** Qualified
- Capacity **37** racks per hour
- Water consumption **0.61** gallons (2.31 liters) per rack
- Double-wall construction improves energy efficiency and provides a cooler exterior
- Variable programmed time cycles - 95, 150 and 210 seconds
- Built-in liquid detergent and rinse aid pumps
- Detergent empty indicator
- Easily-accessed pump priming and deliming modes
- Machine shutdown automatically rinses the wash chamber with hot, fresh water to ease cleaning, then drains the machine
- Stainless steel non-clogging combination wash/rinse arms provide simpler disassembly for cleaning
- Sloped ceiling is safer for the user and minimizes dripping of soiled water onto sanitized ware
- 3/4 Hp (0.56 kW) wash pump
- 304 and 316Ti stainless steel construction for corrosion resistance
- Type A air gap system eliminates water leaks and maintenance associated with vacuum breaker
- Pumped drain for both floor and wall drain applications

Options:

- Inline slide base - adds 1" (25mm) to height
- Framed base with individual legs - adds 6" (152mm) to height
- Flush-paneled stainless steel base - adds 4-3/4" (120mm) to height
- Flush-paneled stainless steel cabinet base - adds 15-3/4" (400mm) to height
- Flush-paneled stainless steel cabinet base with individual 6" legs - adds 21-3/4" (550mm) to height
- NEMA plug kit (three phase only - installed by others - incl. receptacle and plate). 208-230/60/3 = NEMA 15-50P
- Drain water tempering kit (installed by others)
- Drain water tempering kit (factory installed)
- Drain board top

Technical Specifications:

Maximum Capacity 37 racks/hour / 925 dishes/hour / 1332 glasses/hour

Minimum Cycle Time (Seconds):

Wash Cycle	80.0
Dwell / Drain Time	8.4
Rinse Cycle	6.6
Total Cycle	95.0

Water Requirements:

Incoming Water Temperature (Optimum)	140°F (60°C)
Recommended Water Hardness	1-3 grains per U.S. gal.
Water Consumption per Rack	0.61 gals. (2.31 liters)
Water Consumption per Hour (max.)	22.57 gals. (85.44 liters)
Flow Pressure	8.7-72.5 psi (0.6-5.0 bars)
Incoming Waterline	3/4" garden hose
Drain line size	7/8" ID, 1-1/8" OD flexible hose
Maximum drain flow rate	5.3 gals. (20.0 liters) per minute

Required Operating Temperatures:

Wash (Minimum)	150°F (66°C)
Rinse (Minimum)	180°F (82°C)

Tank Capacities:

Wash Tank	2.9 gals. (11.0 liters)
Booster Heater	2.1 gals. (7.9 liters)

Electrical Requirements:

Wash Tank Heat	3.27 kW @ 208V, 4.0 kW @ 230V
Booster Heater	3.68 kW @ 208V, 4.5 kW @ 230V
Wash Pump	0.74 hp (0.55 kW)
Final Rinse Pump	0.27 hp (0.20 kW)
Drain Pump	0.09 hp (0.07 kW)

Electrical supply	Peak load ampacity	Min. supply circuit ampacity	Max. breaker/disconnect
208-230V/60Hz/1 Ph	38.6A @ 208V	60A	60A
208-230V/60Hz/3Ph	42.1A @ 230V	60A	60A
208-230V/60Hz/3Ph	31.1A @ 208V	50A	50A
208-230V/60Hz/3Ph	33.9A @ 230V	50A	50A

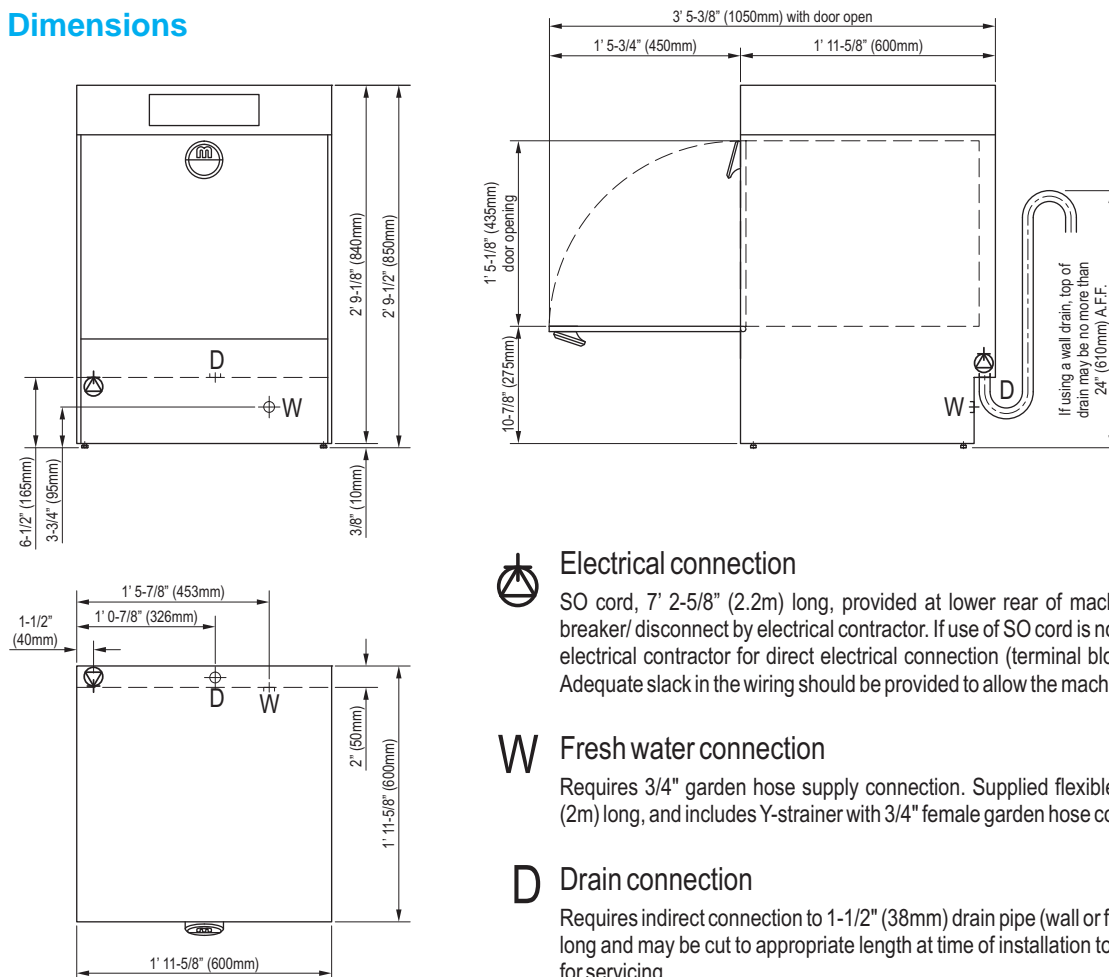
Dimensions:

Overall (W x D x H)	23-5/8" x 23-5/8" x 33-1/2" (600 x 600 x 850mm)
Inside Clearance Height	17-1/8" (435mm)
Wall Clearance	Rear 1" (25mm) min.

Machine / Shipping Details:

Shipping Weight	183 lbs. (83 kg)
Shipping Size (W x D x H)	27-5/8" x 27-5/8" x 41-3/8" (700 x 700 x 1050mm)

Dimensions



All dimensions from floor +/- 1/2" (12mm) due to adjustable feet.



Electrical connection

SO cord, 7' 2-5/8" (2.2m) long, provided at lower rear of machine, to be routed to local circuit breaker/disconnect by electrical contractor. If use of SO cord is not permitted, it may be removed by electrical contractor for direct electrical connection (terminal block is located behind rear panel). Adequate slack in the wiring should be provided to allow the machine to be moved for servicing.



Fresh water connection

Requires 3/4" garden hose supply connection. Supplied flexible stainless steel hose is 6' 6-3/4" (2m) long, and includes Y-strainer with 3/4" female garden hose connection.



Drain connection

Requires indirect connection to 1-1/2" (38mm) drain pipe (wall or floor). Supplied hose is 5' 3" (1.6m) long and may be cut to appropriate length at time of installation to allow machine to be repositioned for servicing.

Specification

M-iClean UM+ Item Number _____

Unit will be an NSF and cETL-listed MEIKO UM+ hot water sanitizing undercounter dishwasher.

Operating voltage will be:

_____ 208-230V / 60Hz / 1Ph _____ 208-230V / 60Hz / 3Ph

Unit will have three user-selectable cycles (of 95, 150 and 210 seconds) and will utilize 0.61 gallons (2.31 liters) of fresh rinse water per cycle.

Unit will include an illuminated door handle to provide visual feedback to the operator on machine status. The color of the illumination will show the operating state of the machine (ready for operation, washing, or displaying an important message).

Unit will feature a glass touch screen control panel and display. Display will provide customized graphical and text information based on the machine operating mode, including temperatures, machine status, service diagnostics and machine logs. Display will be capable of displaying information in multiple selectable languages, to include English, French, Spanish and German.

Unit will have integral M-iClean Filter system to automatically filter and remove soil from the wash tank during the washing process.

Final rinse water will be delivered via an integrated final rinse pump to ensure consistent results and water consumption, regardless of variations in water supply pressure.

Unit will automatically extend wash cycle if required to permit final rinse water to heat to a minimum sanitizing 180°F (82°C), regardless of incoming water temperature.

Wash pump will permit differing water pressures for each selectable cycle to accommodate varying amounts of soiling.

Unit will incorporate a soft start feature, building wash pressure slowly, to reduce risk of chipped or broken ware.

Unit will incorporate features to stop operation and turn off fill valve if an internal leak is detected.

Unit will include built-in liquid detergent and rinse aid pumps.

Unit will include a detergent sensor with a message in plain text on the machine display indicating if the detergent is empty.

Unit will include user-selectable delimiting and pump priming modes.

Unit will feature double-wall, insulated stainless steel construction on all exterior panels to retain heat inside the machine, conserve energy and provide a cool-to-the-touch exterior.

Unit will include Blue Touch color-coding of components that require frequent manual cleaning for simpler staff training.

Unit will include one peg rack and one combination (flat) rack.

Note: All specifications are subject to change without notice based on MEIKO's dedicated product improvement program.

This dishwasher is compliant with the Reduction of Lead in Drinking Water Act (2011) amendment to the Safe Drinking Water Act (SDWA).



Submittal Sheet

10/16/2018

ITEM# 09 - REACH-IN REFRIGERATOR (1 EA REQ'D)

Continental Refrigerator 1R

Refrigerator, reach-in, one-section, 20 cu. ft., self-contained refrigeration, stainless steel front, aluminum interior & ends, standard depth, full-height solid door, electronic control with digital display, hi-low alarm, electric condensate evaporator, 1/4 HP, cETLus, NSF, Made in USA

ACCESSORIES

Mfr	Qty	Model	Spec
Continental Refrigerator	1		Standard warranty (for the United States & Canada Only): 3 year parts and labor; 5 year compressor
Continental Refrigerator	1		115v/60/1-ph, 5.5 amps, cord, NEMA 5-15P, standard
Continental Refrigerator	1		Door hinged on right, standard
Continental Refrigerator	1		5" Casters, standard

ELECTRICAL

	VOLTS	CYCLE	PHASE	CONN	AFF	NEMA	AMPS	KW	HP	MCA	MOCP
1									1/4		
2	115	60	1	Cord & Plug		5-15P	5.5				

REACH-IN REFRIGERATOR

Model: 1R

1-Section Reach-In Refrigerator

1R - Stainless steel front, aluminum end panels and interior
1R-SA - Stainless steel exterior, aluminum interior
1R-SS - Stainless steel exterior and interior
Designed to maintain NSF-7 temperatures in 100°F ambient.



Options and Accessories

(upcharge and lead times may apply)

Stainless steel case back	Pass-Thru
Add'l epoxy-coated steel shelves	Shallow depth
Chrome or stainless steel shelves	Hinged glass door
Heavy-duty pilaster strips	Increased refrigeration systems
Pan slide assemblies	Special electrical req. (consult factory)
Expansion valve system	Correctional Facility Options
Wine display	<ul style="list-style-type: none"> One way security screws
Adjustable legs	<ul style="list-style-type: none"> Locking hasp (lock not included)
Custom laminates	<ul style="list-style-type: none"> Stainless steel mesh cover
Half doors	<ul style="list-style-type: none"> Coverless hinges

Consult factory for other model configurations, options and accessories.


Continental
 Refrigerator

Toll-Free: 800-523-7138
 Phone: 215-244-1400
 Fax: 215-244-9579

539 Dunksferry Road
 Bensalem, PA 19020
www.continentalrefrigerator.com

Project Name:

Model Specified:

Location:

Item No:

Quantity:

AIA #:

SIS #:

Standard Model Features

REFRIGERATION SYSTEM

Environmentally-safe R-134a refrigerant

Self contained, performance-rated refrigeration system

Automatic, electric condensate evaporator

CABINET ARCHITECTURE

3" non-CFC polyurethane foam insulation

Smooth, polished chrome workflow door handle

Cam action, lift off hinges

Self-closing door

Magnetic snap-in door gasket

Cylinder lock in door

Heavy-duty, epoxy-coated steel shelves

5" casters

MODEL FEATURES

LED interior lighting

Electronic controller w/ digital display & hi-low alarm

Rehinging of door (in the field)

APPROVAL:

Model Specifications

DIMENSIONAL DATA

Net Capacity (cu. ft.)	20 (566 cu l)
Width, Overall (in.)	26 (660 mm)
Depth, Overall (in.) (incl. handle)	35 3/8 (899 mm)
Depth [less door] (in.)	32 (813 mm)
Depth [door open 90°] (in.)	55 1/2 (1410 mm)
Clear Door Width (in.)	19 3/8 (492 mm)
Clear Door Height (in.)	58 5/8 (1489 mm)
Height, Overall (in.) (incl. 5" casters)	82 1/4 (2096 mm)
No. of Door(s)	1
No. of Shelves	3
Shelf Area (sq. ft.)	20.4 (1.9 sq m)
Tray Slide Capacity	24

REFRIGERANT DATA

Condensing Unit Size (H.P.)	1/4
Capacity (BTU/Hr)*	1940

ELECTRICAL DATA

Voltage (int'l)	115/60/1 (220/50/1)
Feed Wires (incl. ground)	3
Total Amps (int'l)	5.5 (3.5)
10 ft. Cord/Plug [attached] (int'l)	Yes (No)

SHIPPING DATA

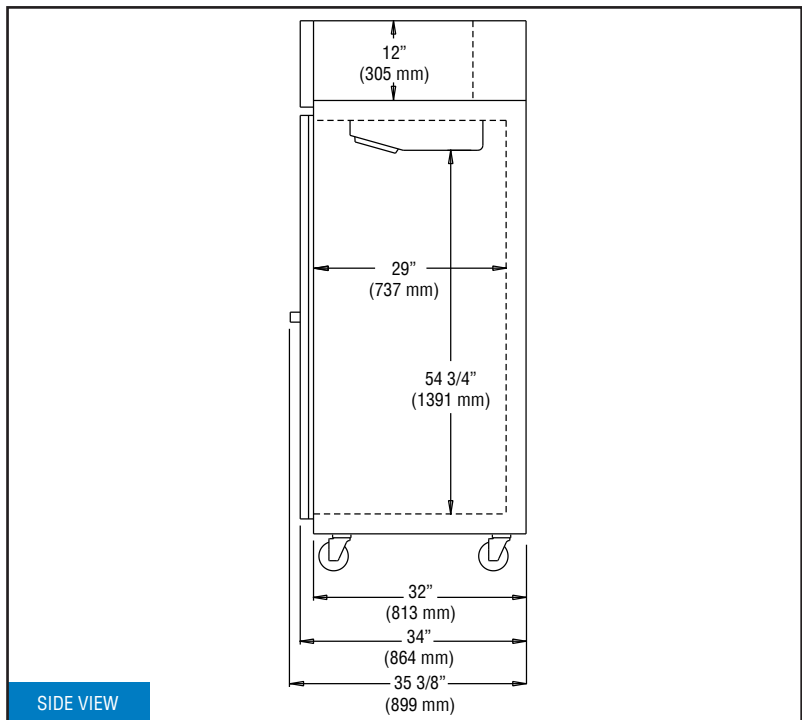
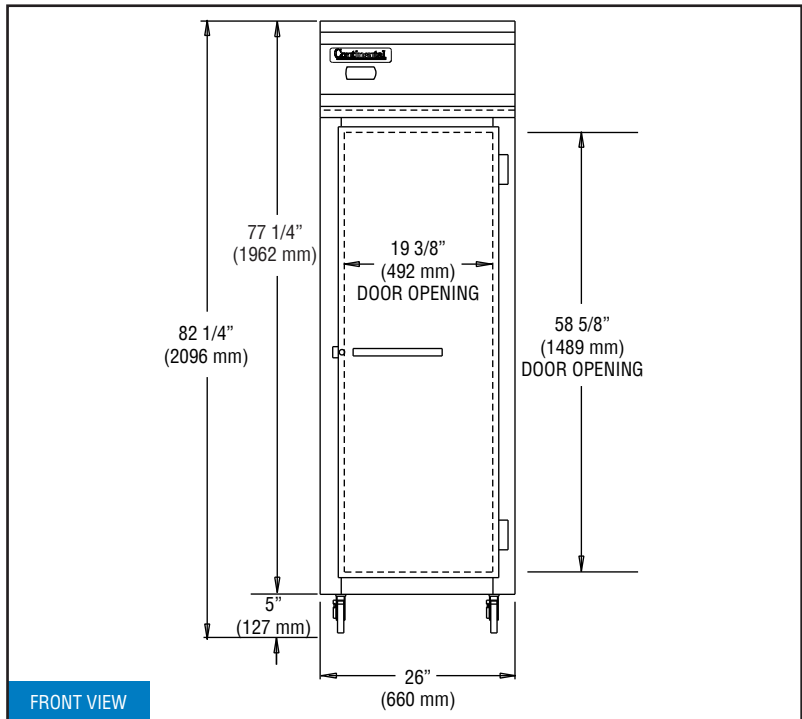
Height - Crated (in.)	85 1/2 (2172 mm)
Width - Crated (in.)	31 5/8 (803 mm)
Depth - Crated (in.)	42 (1067 mm)
Volume - Crated (cu. ft.)	65 (1841 cu l)
Weight Std - Crated (lbs.)	310 (141 kg)
Weight SS - Crated (lbs.)	370 (168 kg)
Weight Std - Uncrated (lbs.)	210 (95 kg)
Weight SS - Uncrated (lbs.)	270 (122 kg)

* Rating @ +25°F evaporator, 90°F ambient
 Figures in parentheses reflect metric equivalents rounded to the nearest whole unit.



Equipped with one NEMA-5-15P Plug (varies by country)

Model Plan Views



IMPORTANT NOTE: If the cabinet is located directly against a wall and/or under a low ceiling, a minimum clearance of 12" is required on top and 3" on sides and rear.



Toll-Free: 800-523-7138
 Phone: 215-244-1400
 Fax: 215-244-9579
 539 Dunkserry Road
 Bensalem, PA 19020
www.continentalrefrigerator.com

Due to our continued efforts in developing innovative products, specifications subject to change without notice.



MADE IN THE U.S.A.

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Submittal Sheet

10/16/2018

ITEM# 10 - WORK TABLE, STAINLESS STEEL TOP (1 EA REQ'D)

Eagle Group T3036SE-BS

Spec-Master® Series Work Table, 36"W x 30"D, 4-1/2"H backsplash, 14/300 series stainless steel top, rolled front edge, adjustable 18/300 series stainless steel undershelf with marine edge, Uni-Lok® gusset system, (4) stainless steel legs & adjustable bullet feet, NSF



Profit from the Eagle Advantage®

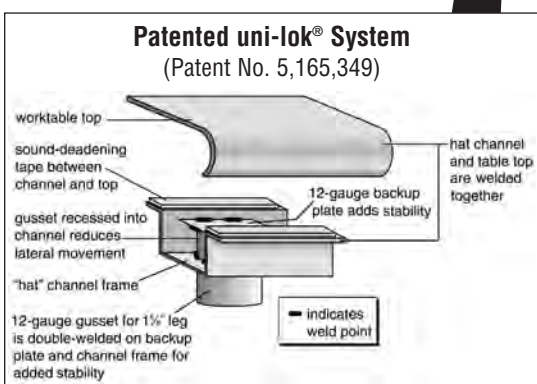
Specification Sheet

Short Form Specifications

Eagle worktables, Spec-Master® series, model _____.
Top constructed of 14 gauge 300 series stainless steel with 1½" roll on front, 4½" backsplash, and sides turned down 90°. Adjustable undershelf constructed of 18 gauge 300 series stainless steel with marine edge. Top reinforced with stainless steel hat channels and sound deadened. Constructed with uni-lok® patented gusset system with the gussets recessed into the hat channels to reduce lateral movement. 1½"-diameter stainless steel legs, with stainless steel gussets and 1" stainless steel adjustable bullet feet.



worktable with backsplash
and adjustable undershelf



EAGLE GROUP

100 Industrial Boulevard, Clayton, DE 19938-8903 USA

Phone: 302-653-3000 • Fax: 302-653-2065

www.eaglegrp.com

Foodservice Division: Phone 800-441-8440

MHC/Retail Display Divisions: Phone 800-637-5100

For custom configuration or fabrication needs, contact our SpecFAB® Division.

Phone: 302-653-3000 • Fax: 302-653-2065 • e-mail: quotes@eaglegrp.com

Spec sheets available for viewing, printing or downloading from our online literature library at www.eaglegrp.com

Eagle Foodservice Equipment, Eagle MHC, SpecFAB®, and Retail Display are divisions of Eagle Group. ©2015 by the Eagle Group

Item No.: _____

Project No.: _____

S.I.S. No.: _____

Worktables with Backsplash and Stainless Steel Base with Undershelf —Spec-Master® Series

MODELS:

- | | | | |
|-------------------------------------|--------------------------------------|--------------------------------------|--------------------------------------|
| <input type="checkbox"/> T2424SE-BS | <input type="checkbox"/> T24108SE-BS | <input type="checkbox"/> T3072SE-BS | <input type="checkbox"/> T3660SE-BS |
| <input type="checkbox"/> T2430SE-BS | <input type="checkbox"/> T24120SE-BS | <input type="checkbox"/> T3084SE-BS | <input type="checkbox"/> T3672SE-BS |
| <input type="checkbox"/> T2436SE-BS | <input type="checkbox"/> T24132SE-BS | <input type="checkbox"/> T3096SE-BS | <input type="checkbox"/> T3684SE-BS |
| <input type="checkbox"/> T2448SE-BS | <input type="checkbox"/> T24144SE-BS | <input type="checkbox"/> T30108SE-BS | <input type="checkbox"/> T3696SE-BS |
| <input type="checkbox"/> T2460SE-BS | <input type="checkbox"/> T3030SE-BS | <input type="checkbox"/> T30120SE-BS | <input type="checkbox"/> T36108SE-BS |
| <input type="checkbox"/> T2472SE-BS | <input type="checkbox"/> T3036SE-BS | <input type="checkbox"/> T30132SE-BS | <input type="checkbox"/> T36120SE-BS |
| <input type="checkbox"/> T2484SE-BS | <input type="checkbox"/> T3048SE-BS | <input type="checkbox"/> T30144SE-BS | <input type="checkbox"/> T36132SE-BS |
| <input type="checkbox"/> T2496SE-BS | <input type="checkbox"/> T3060SE-BS | <input type="checkbox"/> T3648SE-BS | <input type="checkbox"/> T36144SE-BS |

Tabletop

- Patented uni-lok® gusset system (patent #5,165,349): gussets are recessed into hat channel, reducing lateral movement.
- Top reinforced with welded-on hat channel.
- Sound-deadened between top and channels.
- 4½" (114mm)-high 90° backsplash with 1" (25mm) turn at 90°.
- 1½" (38mm)-diameter 180° rolled edge on front. Ends are turned down 90°, providing for flush installations when required.
- 14 gauge 300 series polished stainless steel.

Adjustable Undershelf

- Heavy gauge stainless steel.
- Gusset welded to each corner.
- Heavy duty marine edge design.

Legs—1½" (41mm)-diameter

- Tables 96" (2438mm) and longer come with six legs or more.
- Heavy gauge stainless steel.
- 1" (25mm) adjustable stainless steel feet.

Options / Accessories

- | | |
|--|---|
| <input type="checkbox"/> Drawer | <input type="checkbox"/> Duplex receptacles |
| <input type="checkbox"/> Lock | <input type="checkbox"/> Pot rack |
| <input type="checkbox"/> Casters | <input type="checkbox"/> Sink |
| <input type="checkbox"/> Stainless steel bullet feet | <input type="checkbox"/> Additional undershelf |
| <input type="checkbox"/> Overshelves | <input type="checkbox"/> Stabilizer Bar (for 30"- |
| <input type="checkbox"/> Power strip (for material handling) | and 36"-wide tables) |

Certifications / Approvals



AUTOQUOTES



EG10.45C Rev. 10/15



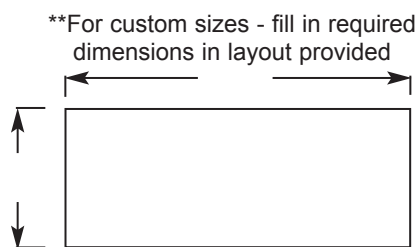
Profit from the Eagle Advantage®

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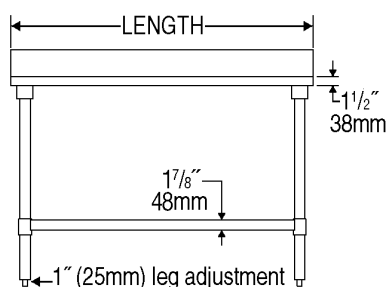
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S.I.S. No.: _____

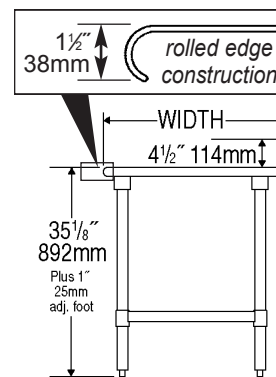
Worktables with Backsplash and Stainless Steel Base with Undershelf—Spec-Master® Series



TOP VIEW



FRONT VIEW



SIDE VIEW

model #	# of legs	width		length		weight	
		in.	mm	in.	mm	lbs.	kg
T2424SE-BS	4	24"	610	24"	610	47	21.3
T2430SE-BS	4	24"	610	30"	762	53	24.0
T2436SE-BS	4	24"	610	36"	914	58	26.3
T2448SE-BS	4	24"	610	48"	1219	69	31.3
T2460SE-BS	4	24"	610	60"	1524	80	36.3
T2472SE-BS	4	24"	610	72"	1829	94	42.6
T2484SE-BS	4	24"	610	84"	2134	107	48.5
T2496SE-BS	6	24"	610	96"	2438	125	56.7
T24108SE-BS	6	24"	610	108"	2743	156	70.3
T24120SE-BS	6	24"	610	120"	3048	169	76.7
T24132SE-BS	8	24"	610	132"	3353	183	83.0
T24144SE-BS	8	24"	610	144"	3658	196	88.9
T3030SE-BS	4	30"	762	30"	762	55	24.9
T3036SE-BS	4	30"	762	36"	914	58	26.3
T3048SE-BS	4	30"	762	48"	1219	77	34.9
T3060SE-BS	4	30"	762	60"	1524	89	40.4
T3072SE-BS	4	30"	762	72"	1829	103	46.3
T3084SE-BS	4	30"	762	84"	2134	119	54.0
T3096SE-BS	6	30"	762	96"	2438	143	64.9
T30108SE-BS	6	30"	762	108"	2743	165	74.4
T30120SE-BS	6	30"	762	120"	3048	187	84.8
T30132SE-BS	8	30"	762	132"	3353	207	93.9
T30144SE-BS	8	30"	762	144"	3658	228	103.4
T3648SE-BS	4	36"	914	48"	1219	85	38.6
T3660SE-BS	4	36"	914	60"	1524	99	44.9
T3672SE-BS	4	36"	914	72"	1829	117	53.1
T3684SE-BS	4	36"	914	84"	2134	135	61.2
T3696SE-BS	6	36"	914	96"	2438	145	65.8
T36108SE-BS	6	36"	914	108"	2743	186	84.4
T36120SE-BS	6	36"	914	120"	3048	211	95.7
T36132SE-BS	8	36"	914	132"	3353	238	108.0
T36144SE-BS	8	36"	914	144"	3658	263	119.3

EAGLE GROUP

100 Industrial Boulevard, Clayton, DE 19938-8903 USA

Phone: 302-653-3000 • Fax: 302-653-2065

www.eaglegrp.com

Foodservice Division: Phone 800-441-8440

MHC/Retail Display Divisions: Phone 800-637-5100

Spec sheets available for viewing, printing or downloading from our online literature library at www.eaglegrp.com

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Rev. 10/15

Submittal Sheet

10/16/2018

ITEM# 11 - SPEEDELIGHT SANDWICH PRESS (2 EA REQ'D)

Electrolux 603869

(HSP2RPRS) SpeeDelight Sandwich Press, electric, manual adjustable top ribbed contact plate, 3-cooking technologies (contact, infrared radiation & microwave), digital display, (8) programs (4 pre-loaded), USB & wi-fi connections, dark grey, includes: glass saver (653527), brush (653623), spatula (653625), stainless steel feet (653791), spacer ventilation kit (653794) & detergent (653796), 5.0 kW, 208v/60/1-ph, cETLus, ETL-Sanitation

ACCESSORIES

Mfr	Qty	Model	Spec
Electrolux	2		<p>The following are included in the purchase of Electrolux Professional - SPEEDELIGHT units.</p> <ol style="list-style-type: none"> 1.) Start-up performed by a Factory Authorized Agent 2.) Platinum Warranty: 2 years parts & 1 year labor (Warranty activated upon completion of mandatory Factory Authorized Agent start-up) 3.) Performance Check: 12th month performance maintenance check

Please contact Electrolux to schedule all of the above 1-866-449-4200

ELECTRICAL

	VOLTS	CYCLE	PHASE	CONN	AFF	NEMA	AMPS	KW	HP	MCA	MOCP
1	208	60	1	Cord & Plug		6-30P	26	5.0			



Cooking Sandwich Press SpeeDelight with adjustable tube, ribbed removable teflon upper plate

ITEM # _____
MODEL # _____
NAME # _____
SIS # _____
AIA # _____



Cooking Sandwich Press

SpeeDelight with adjustable tube, ribbed removable teflon upper plate

603869 (HSPP2RPRS)

SpeeDelight with manual adjustable top ribbed contact plate, dark grey

Short Form Specification

Item No.

SpeeDelight High Speed Cooking Platform - Fast, Friendly, Easy and Smart. Lid and top plate constructed in 304 AISI stainless steel and with external high-grade composite material paneling and handle. Possibility to manually adjust the maximum movement of the upper plate. Ribbed top contact plate 8 7/16" x 8 7/16" (215 x 215 mm) in aluminum with non-stick coating. Can accept food products from 25/64" to 2 61/64" (10 to 75 mm) thick. Smooth 5/32" (4 mm) thick quartz glass bottom cooking surface 10" x 10" (250 x 250 mm). Two (2) probes independently control the temperature of the top and bottom plates from 212 to 536°F (100 to 250 °C). Automatic lid holding and lifting of the lid at the end of the cooking cycle via mechanical spring. Electronic control with digital 4.3" LED display, countdown display and buzzer at the end of the cycle.

Green technology - The exclusive Energy Saving Mode works when the lid is closed to activate the stand-by mode; SpeeDelight consumes 60% less energy.



APPROVAL: _____

Main Features

- It combines 3 cooking technologies: contact, infrared radiation and microwaves to provide perfectly cooked food, heated to the core.
- Adjusting upper plate to heat food up to a minimum height.
- The Energy Saving Mode automatically switches to stand-by after an amount of time settled by the operator (from 1 to 60 minutes).
- Delivered with USB port and wi-fi connection to optimize workflows allowing local and remote interaction (temperatures, countdowns, warnings).
- Electronic control with digital 4.3" LED display with adjustable brightness.
- Countdown display and buzzer with adjustable volume at the end of the cycle.
- 8 programs selectable on the display. The 8 programs can be adjusted by the user. The programmable parameters are:
 - top plate temperature
 - bottom plate temperature
 - total duration of each cycle
 - duration and distribution of microwaves within each cycle.
- 4 pre-loaded Programs (editable):
 - P1 = 30 sec. (20 sec. MW)
 - P2 = 40 sec. (30 sec. MW)
 - P3 = 50 sec. (40 sec. MW)
 - P4 = 60 sec.
 The remaining four are not pre-loaded and should be programmed by Users according to their specific menus.
- Automatic mechanical lid holding and opening system controlled.
- Ergonomic handle for easy movement of the lid.
- ETL safety approved, complies with UL 923 and CAN/CSA 22.2 standards.
- ETL sanitation approved, complies with NSF/ANSI 4 standard.
- IPX4 water resistance certification.

Construction

- Two (2) temperature probes for an independent control of the top and bottom plate temperature.
- Aluminum ribbed top contact plate 8 7/16" x 8 7/16" (215 x 215 mm) treated with a special non-stick coating.
- Smooth 5/32" (4 mm) thick quartz glass bottom cooking surface 9 13/16" x 9 13/16" (250 x 250 mm).
- Independent temperature setting of the top and bottom plates from 212 to 536°F (100 to 250 °C).
- Automatic lifting of the lid at the end of the cooking cycle via mechanical spring.
- Lid, back cover and bottom all in AISI 304 S/S.
- Lid covers, handle and side panels in high-grade reinforced composite material.
- 800W heating element on the top plate.
- 800W electrical armored heating elements on the



SpeedDelight with adjustable tube, ribbed removable teflon upper plate

Cooking Sandwich Press

Electrolux Professional, Inc.

www.electroluxusa.com/professional

10200 David Taylor Drive, Charlotte, NC 28262 • Telephone Number: 866-449-4200 • Fax Number: 704-547-7401



Electrolux

Cooking Sandwich Press SpeeDelight with adjustable tube, ribbed removable teflon upper plate

bottom plate.

- 2 x 1050W magnetrons for microwave.
- Front air inlet and back outlet for efficient cooling ventilation allows easy air filters removal and side by side installation.
- Included accessories: brush, spatula, scraper, 2 3/4" (75 mm) high stainless steel feet and de-greaser cleaning agent.

Included Accessories

- 1 of Glass saver for SpeeDelight PNC 653527
- 1 of Cleaning brush for SpeeDelight PNC 653623
- 1 of 4x1qt "GREASE EXPRESS" detergent bottles for High Speed Sandwich Press PNC 653624
- 1 of Spatula for SpeeDelight PNC 653625
- 1 of SpeeDelight Spacer Stop Kit for Rear Ventilation PNC 653794

Optional Accessories

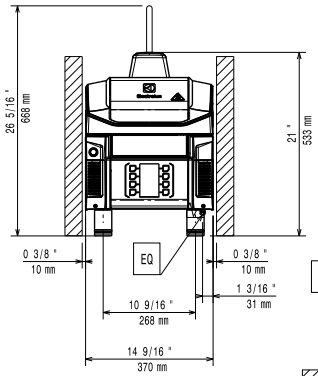
- Glass saver for SpeeDelight PNC 653527
- Cleaning brush for SpeeDelight PNC 653623
- 4x1qt "GREASE EXPRESS" detergent bottles for High Speed Sandwich Press
- Spatula for SpeeDelight PNC 653625
- Special scraper for HSG Panini PNC 653690
- 16 ounce Spray Bottle for detergent for High Speed Sandwich Press PNC 653695
- Removable ribbed teflon plate for SpeeDelight PNC 653787
- Four (4) Rubber Feet 1 1/32" (26mm) PNC 653792
- Four (4) Rubber Feet 1 37/64" (40mm) PNC 653793
- SpeeDelight Spacer Stop Kit for Rear Ventilation PNC 653794



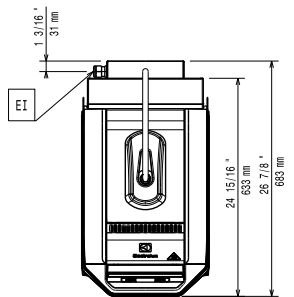
Electrolux

Cooking Sandwich Press SpeedLight with adjustable tube, ribbed removable teflon upper plate

Front



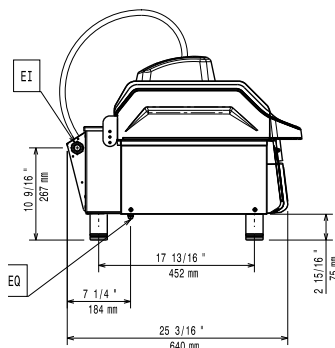
Top



EI = Electrical connection

EO = Electrical Outlet

Side



Electric

Supply voltage:

603869 (HSPP2RPRS) 208 V/1 ph/60 Hz

Amps:

26 A

Electrical power, max:

5 kW

Total Watts:

5 kW

Plug type:

NEMA 6 -30

Minimum Circuit Ampacity (MCA):

30A

Installation:

Clearance: 7 1/2" (190mm) from rear vertical panel

Key Information:

External dimensions, Width:	14 3/16" (361 mm)
External dimensions, Depth:	26 9/16" (675 mm)
External dimensions, Height:	24 13/16" (630 mm)
Net weight:	79 lbs (36 kg)
Shipping width:	17 3/4" (450 mm)
Shipping depth:	30 11/16" (780 mm)
Shipping height:	26 3/4" (680 mm)
Shipping weight:	119 lbs (54 kg)
Shipping volume:	8.43 ft ³ (0.24 m ³)

Cooking Sandwich Press
SpeedLight with adjustable tube, ribbed removable teflon upper plate

The company reserves the right to make modifications to the products
without prior notice. All information correct at time of printing.

2017.03.15

Page: 34

Submittal Sheet

10/16/2018

ITEM# 12 - HAND SINK (1 EA REQ'D)

Eagle Group HSA-10-F

Hand Sink, wall mount, 13-1/2" wide x 9-3/4" front-to-back x 6-3/4" deep bowl, 304 stainless steel construction, splash mount gooseneck faucet, basket drain, deep-drawn seamless design-positive drain, inverted "V" edge, NSF

WATER

	HOT SIZE	HOT AFF	HOT GPH	COLD SIZE	COLD AFF	FILTERED SIZE	FILTERED AFF	CONDENSER INLET SIZE	CONDENSER OUTLET SIZE
1									

WASTE

	INDIRECT SIZE	DIRECT SIZE
1		1-1/2"



Profit from the Eagle Advantage®

Specification Sheet

Short Form Specifications

Eagle Hand Sink, model HSA-10. Constructed of type 304 stainless steel, all-welded with deep-drawn positive drain sink bowl, inverted "V" edge to prevent spillage and basket drain. Unit less faucet.

Eagle Hand Sink, model HSA-10-F. Features the same as sink #HSA-10, plus splash mounted gooseneck faucet.

Eagle Hand Sink, model HSA-10-FA. Features the same as sink #HSA-10, plus p-trap, tailpiece, and splash mounted gooseneck faucet.

Eagle Hand Sink, model HSA-10-FAW. Features the same as sink #HSA-10, plus p-trap, tailpiece, and splash mounted gooseneck faucet with wrist handles.

Eagle Hand Sink, model HSA-10-FL. Constructed of type 304 stainless steel, all-welded with deep-drawn positive drain sink bowl, inverted "V" edge to prevent spillage, polymer lever drain, and splash mounted gooseneck faucet.

Eagle Hand Sink, model HSA-10-FO. Features the same as sink #HSA-10-FL, plus polymer lever drain includes overflow.



#HSA-10-F

EAGLE GROUP

100 Industrial Boulevard, Clayton, DE 19938-8903 USA

Phone: 302-653-3000 • Fax: 302-653-2065

www.eaglegrp.com

Foodservice Division: Phone 800-441-8440

MHC/Retail Display Divisions: Phone 800-637-5100

For custom configuration or fabrication needs, contact our **SpecFAB®** Division.

Phone: 302-653-3000 • Fax: 302-653-3091 • e-mail: quotes@eaglegrp.com

Item No.: _____
Project No.: _____
S.I.S. No.: _____

Traditional Hand Sinks

MODELS:

- HSA-10
- HSA-10-F
- HSA-10-FAW
- HSA-10-FA
- HSA-10-FL
- HSA-10-FO

Design & Construction Features

- Heavy gauge type 304 stainless steel all-welded construction.
- Inverted "V" edge rim retards spillage.
- Unique deep-drawn positive-drain bowl assures complete drainage to meet the most stringent health code requirements.
- Water inlet: ½" (13mm) NPS.
- Drain outlet: 1½" (38mm) NPS.
- Six models to choose from.

Options / Accessories

- P-trap
- Tail piece
- End splashes
- Front skirt
- Side mount wall bracket
- MICROGARD®* antimicrobial protection

* For hand sinks #HSA-10, HSA-10-F, HSA-10-FA, and HSA-10-FAW

Certifications / Approvals



AUTOQUOTES



EG20.40 Rev. 02/13

Spec sheets available for viewing, printing or downloading from our online literature library at www.eaglegrp.com

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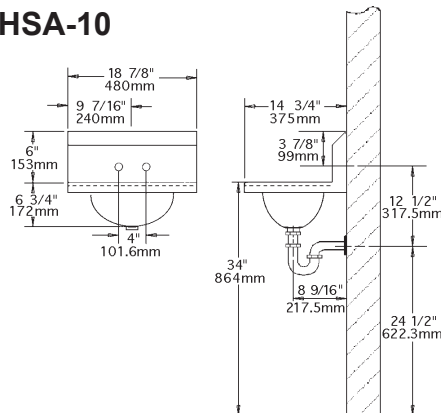


Profit from the Eagle Advantage®

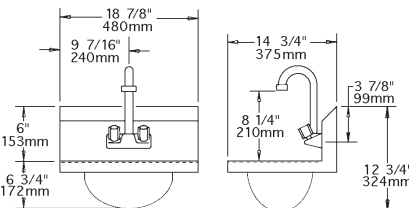
Item No.: _____
 Project No.: _____
 S.I.S. No.: _____

Traditional Hand Sinks

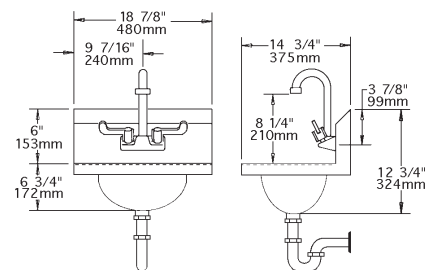
HSA-10



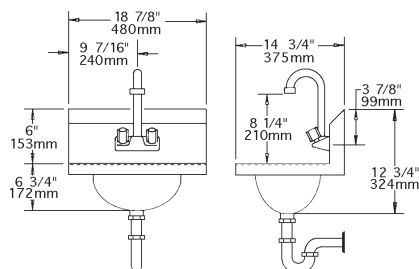
HSA-10-F



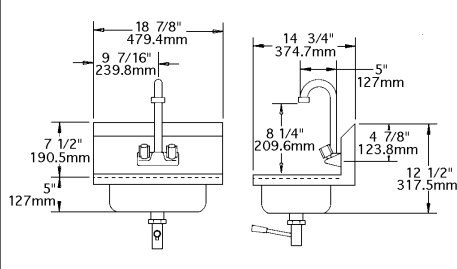
HSA-10-FAW



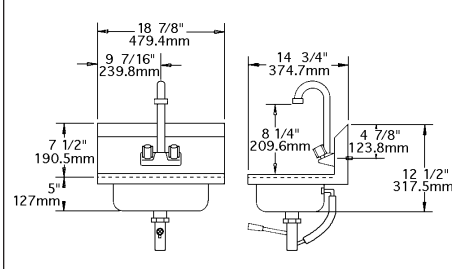
HSA-10-FA



HSA-10-FL



HSA-10-FO



model #	includes	bowl size		overall size		weight	
		width	length x depth	width	length x height	lbs.	kg
HSA-10 *	4" (102mm) centerline faucet holes, basket drain	9 3/4"	13 1/2" x 6 3/4"	248 x 343 x 173	14 3/4" x 18 7/8" x 12 3/4"	376 x 480 x 324	10 4.5
HSA-10-F	faucet, basket drain	9 3/4"	13 1/2" x 6 3/4"	248 x 343 x 173	14 3/4" x 18 7/8" x 12 3/4"	376 x 480 x 324	12 5.2
HSA-10-FA	faucet, p-trap, tail piece, basket drain	9 3/4"	13 1/2" x 6 3/4"	248 x 343 x 173	14 3/4" x 18 7/8" x 12 3/4"	376 x 480 x 324	14 6.4
HSA-10-FAW	faucet w/wrist handles, p-trap, tail piece, basket drain	9 3/4"	13 1/2" x 6 3/4"	248 x 343 x 173	14 3/4" x 18 7/8" x 12 3/4"	376 x 480 x 324	14 6.4
HSA-10-FL	faucet, polymer lever drain	10"	14" x 5"	254 x 256 x 127	14 3/4" x 18 7/8" x 12 1/2"	376 x 480 x 318	15 6.6
HSA-10-FO	faucet, polymer lever drain w/overflow	10"	14" x 5"	254 x 256 x 127	14 3/4" x 18 7/8" x 12 1/2"	376 x 480 x 318	13 5.9

* To order hand sink with no faucet holes, add suffix "-NH" to model number (example: HSA-10-NH).

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100 Industrial Boulevard, Clayton, DE 19938-8903 USA

Phone: 302-653-3000 • Fax: 302-653-2065

www.eaglegrp.com

Foodservice Division: Phone 800-441-8440

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Rev. 02/13

Submittal Sheet

10/16/2018

ITEM# 13 - REFRIGERATED DISPLAY CASE, SLIDE IN COUNTER (1 EA REQ'D)

Structural Concepts NE3627RSV

Reveal® Service Refrigerated Slide In Counter Case, 35-3/4"W, 27-7/8"H (above counter) 47-1/8"H (overall), Breeze-E (Type II) with EnergyWise self-contained refrigeration, (2) removable & adjustable clear glass shelving, LED top & shelf lights, vertical, fixed front & side uv frameless glass, slide in base, glass ends, clear glass rear sliding doors, blue fin coated coil, condensate pan, black exterior & interior, cETLus, ETL-Sanitation

ACCESSORIES

Mfr	Qty	Model	Spec
Structural Concepts	1		NOTE: If GFCI is required, a GFCI breaker MUST be used in lieu of a GFCI receptacle
Structural Concepts	1		NOTE: Contact Factory for lead time
Structural Concepts	1	NESHIPNOTE	Must ship prepaid/add Direct dock to dock delivery only Glass warranty only applicable to first point of delivery
Structural Concepts	1		1 yr. parts & labor warranty, 5 yr. compressor warranty, standard
Structural Concepts	1	HEIGHTNOTE1	Minimum of 19-1/4" space required beneath counter surface
Structural Concepts	1		Breeze-E (Type II) with EnergyWise self-contained refrigeration rear access, (see important notes) standard
Structural Concepts	1		110-120v/60/1-ph, 9.76 amps, standard
Structural Concepts	1		6 ft Straight blade power cord (self-contained), NEMA 5-15P, standard
Structural Concepts	1		Interior: Black, standard
Structural Concepts	1		Exterior: Stainless steel
Structural Concepts	1		Left end glass: Glass end, standard
Structural Concepts	1		Right end glass: Glass end, standard
Structural Concepts	1		Rear door: Clear Glass rear sliding doors, standard
Structural Concepts	1		Lights: LED 3500K with frost lens, standard
Structural Concepts	1		Rear vented panel: None, standard

ELECTRICAL

	VOLTS	CYCLE	PHASE	CONN	AFF	NEMA	AMPS	KW	HP	MCA	MOCP
1	110-120	60	1	Cord & Plug		5-15P	9.76				
2				Cord & Plug		5-15P					

Reveal

Product Specifications

ITEM NO. _____
 PROJECT: _____
 DATE: _____

Refrigerated Service Slide In Counter Case

- NE3627RSV
- NE4827RSV

Lengths include end panels
 35-3/4"L x 33"D x 27-7/8"H
 47-3/4"L x 33"D x 27-7/8"H



STANDARD FEATURES

- NOTE: Contact Factory for lead time
- Breeze~E (Type-II) w/ EnergyWise s/c refrigeration
- (2) Levels of clear glass shelving removable and adjustable on 1" centers
- Blue Fin coated coil
- Compressor air rear intake, front discharge
- Condensate pan (self-contained refrig. only)
- Integrated average product temperature of 40°F or less
- LED top & shelf lights
- NOTE: Overall case height is 47-1/8" (includes below counter)
- One piece formed ABS plastic tub
- One year parts & labor; 5 year compressor warranty
- Slide in base
- Vertical, fixed front & side uv bonded frameless glass

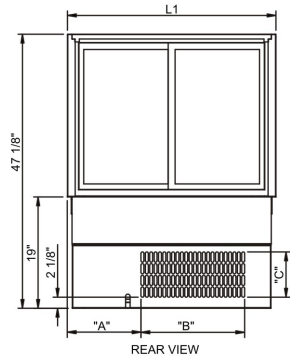
Features	Standard	Options
EXTERIOR COLOR	<input type="checkbox"/> Black	<input type="checkbox"/> Painted (non-stock colors, specify RAL#) <input type="checkbox"/> Painted (stock colors, specify RAL#) <input type="checkbox"/> Stainless steel
INTERIOR COLOR	<input type="checkbox"/> Black	<input type="checkbox"/> NOTE: Interior color must be FDA & NSF approved <input type="checkbox"/> Painted (stock colors, specify RAL#) <input type="checkbox"/> Stainless steel
LEFT END GLASS	<input type="checkbox"/> Glass end	<input type="checkbox"/> No end glass w/ synchronized defrost
RIGHT END GLASS	<input type="checkbox"/> Glass end	<input type="checkbox"/> No end glass w/ synchronized defrost
UPPER REAR	<input type="checkbox"/> Clear glass rear sliding doors	<input type="checkbox"/> Reflective glass rear sliding doors
LIGHTS	<input type="checkbox"/> LED 3500K w/ frosted lens	<input type="checkbox"/> LED 3000K w/ frosted lens <input type="checkbox"/> LED 4000K w/ frosted lens
ELECTRICAL CONNECT	<input type="checkbox"/> 6' straight blade power cord (self-cont.)	<input type="checkbox"/> 6' locking power cord (self-cont.) <input type="checkbox"/> Electrical leads (remote)
REAR VENTED PANEL	<input type="checkbox"/> None	<input type="checkbox"/> Painted (stock colors, specify RAL#) <input type="checkbox"/> Stainless steel
REFRIGERATION	<input type="checkbox"/> Breeze~E (Type-II) w/ EnergyWise s/c refrigeration (rear access)	<input type="checkbox"/> Breeze~E (Type-II) w/ EnergyWise s/c refrigeration (front access) (see important notes) <input type="checkbox"/> Remote w/thermostat, solenoid & TXV (front access) <input type="checkbox"/> Remote w/thermostat, solenoid & TXV (rear access)
MISCELLANEOUS		<input type="checkbox"/> False front panel <input type="checkbox"/> Rear door lock <input type="checkbox"/> Second year parts & labor warranty (excludes compressor)
ACCESSORIES		<input type="checkbox"/> Clean Sweep® coil cleaner (n/a w/remote)

Reveal

Product Specifications

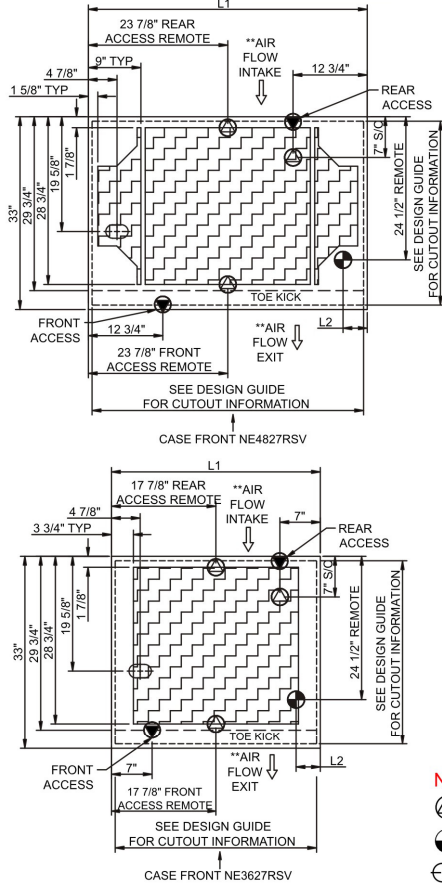
Intended Environment: Type II - Designed to operate in ambient conditions of 80°F and 60% relative humidity unless noted otherwise in system information below.		
Zone	Intended Product To Be Displayed	Warmest Avg Prod Temp ° F
All	Unpackaged refrigerated products	40

REAR VIEW

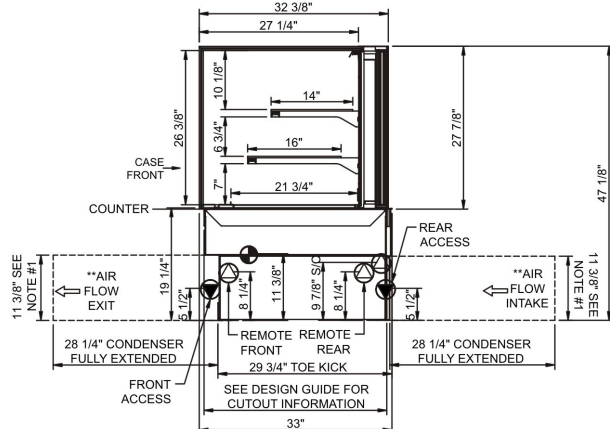


	"A"	"B"	"C"
NE3627RSV	12 5/8"	17 3/4"	7 3/4"
NE4827RSV	18 5/8"	17 3/4"	7 3/4"

PLAN VIEW



SIDE VIEW



- NOTES:
- 11 3/8" TALL, FULL WIDTH OF CASE OPENING IN CABINET OR COUNTER IS REQUIRED TO PULL OUT REFRIGERATION SYSTEM.
 - SEE DESIGN GUIDE FOR CUTOUT SIZE IN CABINET FOR CASE TO DROP INTO.
 - BACK OF COUNTER / CABINET MUST BE VENTED PROPERLY FOR ADEQUATE AIRFLOW TO CONDENSER.
 - **REPRESENTS REAR PULLOUT REFRIGERATION. AIR FLOW INTAKE AND EXIT DETAILS ARE REVERSED WITH FRONT PULLOUT REFRIGERATION OPTION.
 - SELF-CONTAINED ACCESS ONLY BY PULLING OUT CONDENSER UNIT.

NOTE: ALL DIMENSIONS APPROXIMATE

- ELECTRICAL JUNCTION BOX (SUPPLIED WITH 6" LEADS OR POWER CORD).
- REMOTE FLOOR SINK & UTILITIES ACCESS AREA.
- LOCATION OF DRAIN TUBE FOR REMOTE REF. ONLY (SUPPLIED WITH 3/4" OR 1 1/2" PVC TUBE).
- SELF-CONTAINED CASE SERVICE ACCESS AREA.
- REFRIGERATION LINE CONNECTION.
- DRY CASE SERVICE ACCESS AREA.

Model Technical Specifications															
Model	L"	L1"	L2"	System Circuit Volts			Phs	Freq	Amps ***	Watts	Wires	NEMA Plug	SST	BTUH	Est Wt
NE3627RSV	N/A	35.75	4.13	Remote(Type II)	Circuit #1	110-120	1	60	1.08	35	2+G	Leads Single	24.00	1175	750
				Self-Contained	Circuit #1	110-120	1	60	9.76	765	2+G	5-15P or L5-15P	N/A	N/A	
NE4827RSV	N/A	47.75	4.13	Remote(Type II)	Circuit #1	110-120	1	60	1.08	41	2+G	Leads Single	24.00	1525	850
				Self-Contained	Circuit #1	110-120	1	60	9.76	770	2+G	5-15P or L5-15P	N/A	N/A	

*** Does not include electric defrost on freezer models.

Regulatory Approvals:

All Models	Accordance with AHRI Std 1200 ETL Listed to UL 471 ETL Listed to CAN/CSA 22.2 No. 120 ETL Sanitation to NSF 7
------------	--



In Accordance with
AHRI Std 1200

DOE 2017
Energy Efficiency
Compliant

Important Notes:

- 1) ELECTRICAL NOTE: If GFCI is required, a GFCI breaker MUST be used in lieu of a GFCI receptacle
- 2) Back side of counter must be open or vented the full length of the unit to allow proper ventilation for the refrigeration system.
- 3) A vent in the front of the counter recommended to help dissipate compressor heat.
- 4) Rear Access Standard - Counter must be configured to allow air to be drawn in the rear and discharged out the front.
- 5) Front Access Option - Counter must be configured to allow air to be drawn in the front and discharged out the rear.
- 6) Unit can intake and discharge from rear with optional rear vented panel.
- 7) 19.25" minimum space required beneath counter surface.

Submittal Sheet

10/16/2018

ITEM# 14 - MEGA TOP SANDWICH / SALAD PREPARATION REFRIGERATOR (3 EA REQ'D)

Continental Refrigerator SW48-18M-HGL

Mighty Top Sandwich Unit with Hinged Glass Lid, 48"W, 13.4 cu ft capacity, two-section, (18) 1/6 size x 4" deep pans with 8" cutting board, (2) field rehingeable doors, stainless steel top, front & end panels, aluminum back & interior, electronic control with digital display, hi-low alarm, rear mounted self-contained refrigeration, 1/5 hp, cETLus, NSF, Made in USA

ACCESSORIES

Mfr	Qty	Model	Spec
Continental Refrigerator	3		Standard warranty (for the United States & Canada Only): 3 year parts and labor; 5 year compressor
Continental Refrigerator	3		115v/60/1-ph, 7.3 amps, cord, NEMA 5-15P, standard
Continental Refrigerator	3		Casters, 5" standard

ELECTRICAL

	VOLTS	CYCLE	PHASE	CONN	AFF	NEMA	AMPS	KW	HP	MCA	MOCP
1									1/5		
2	115	60	1	Cord & Plug		5-15P	7.3				

SANDWICH UNIT REFRIGERATOR

Model: SW48-18M-HGL

48" Mighty Top Sandwich Unit Refrigerator with Solid Doors and Hinged Glass Lid - 18 Pans

Stainless steel front and top, aluminum end panels, case back and interior.
Certified under NSF-7 to maintain temperatures in 86°F ambient and designed to maintain NSF-7 temperatures in 100°F ambient.



Options and Accessories

(upcharge and lead times may apply)

Stainless steel exterior and interior - SS models	Expansion valve system
Stainless steel end panels - SA models	Rear-mounted cutting board
Glass doors in lieu of solid doors - GD models	Remote models
Stainless steel finished back in lieu of aluminum	Door locks
Drawers in lieu of doors	Adjustable legs
Additional epoxy-coated steel shelves	Digital thermometer
Automatic, electric condensate evaporator	Crumb catcher
Stainless steel shelves	

Consult factory for other model configurations, options and accessories.

Continental
 Refrigerator

Toll-Free: 800-523-7138
 Phone: 215-244-1400
 Fax: 215-244-9579

539 Dunksferry Road
 Bensalem, PA 19020
www.continentalrefrigerator.com

Project Name:

Model Specified:

Location:

Item No:

Quantity:

AIA #:

SIS #:

Standard Model Features

REFRIGERATION SYSTEM

- Performance-rated refrigeration system
- Environmentally-safe R-134a refrigerant
- Unique air flow distribution allows pan product to maintain 33° - 41°F
- Automatic, energy saving, non-electric condensate evaporator
- Non-corrosive, plasticized fin evaporator coil
- Easily serviceable, back mounted compressor

CABINET ARCHITECTURE

- 2" non-CFC polyurethane foam insulation
- Spring loaded, self closing doors
- Magnetic snap-in door gaskets
- Heavy-duty, epoxy-coated steel shelves
- 8" deep, full length nylon cutting board
- 5" casters
- Completely enclosed, vented and removable case back
- Energy-efficient, 2-pane, Low-E glass lid
- Aluminum glass frame with satin finish
- Concealed lid hinges
- Integral stainless steel gas spring lid supports

MODEL FEATURES

- (18) 1/6 size non-recessed pans, 4" deep
- Interior hanging thermometer
- Field rehingeable doors

APPROVAL:

Model Specifications

DIMENSIONAL DATA

Net Capacity (cu. ft.)	13.4 (379 cu l)
1/6 Size Pans (4" deep)	18
Width, Overall (in.)	48 (1219 mm)
Depth, Overall (in.) (incl. handles & bumpers)	35 (889 mm)
Depth, Body Only (less doors) (in.)	27 1/2 (699 mm)
Depth, Cutting Board (in.)	8 (203 mm)
Height, Overall (in.) (incl. 5" casters)	37 (940 mm)
Shelf Area (sq. ft.)	6.8 (.6 sq m)
No. of Shelves	2
No. of Doors	2
Interior Depth (in.)	19 3/8 (492 mm)
Interior Height (in.)	26 1/4 (667 mm)
Interior Width (in.)	44 (1118 mm)

REFRIGERANT DATA

Condensing Unit Size (H.P.)	1/5
Capacity (BTU/Hr)*	1620

ELECTRICAL DATA

Voltage (int'l)	115/60/1 (220/50/1)
Fans	3
Total Amps (int'l)	7.3 (3.6)
10 ft. Cord/Plug [attached] (int'l)	Yes (No)

SHIPPING DATA

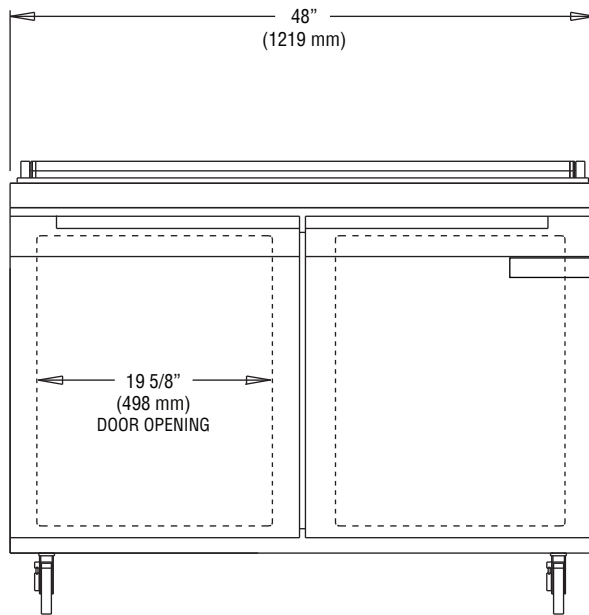
Weight (lbs.)	313 (142 kg)
Height - Crated (in.)	43 1/4 (1099 mm)
Width - Crated (in.)	64 (1626 mm)
Depth - Crated (in.)	46 (1168 mm)

* Rating @ +25°F evaporator, 90°F ambient
 Figures in parentheses reflect metric equivalents rounded to the nearest whole unit.

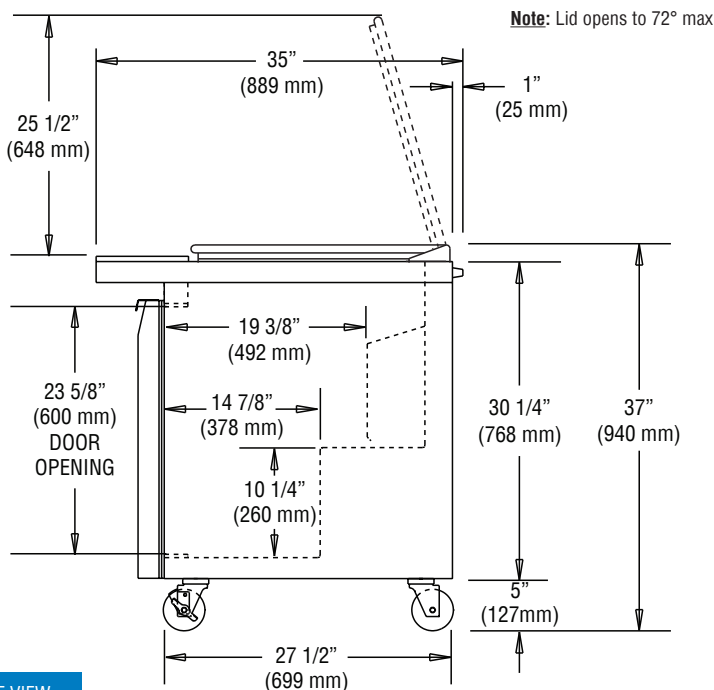


Equipped with one NEMA-5-15P Plug
 (varies by country)

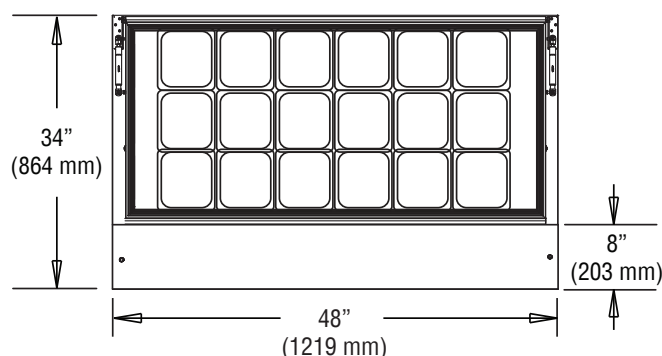
Model Plan Views



FRONT VIEW



SIDE VIEW



PAN TOP CONFIGURATION



Toll-Free: 800-523-7138
 Phone: 215-244-1400
 Fax: 215-244-9579
 539 Dunkserry Road
 Bensalem, PA 19020
www.continentalrefrigerator.com

Due to our continued efforts in developing innovative products, specifications subject to change without notice.



MADE IN THE U.S.A.

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Submittal Sheet

10/16/2018

ITEM# 15 - OMS SCREEN (7 EA REQ'D)

Provided by Operations CONTACT OPERATIONS

Submittal Sheet

10/16/2018

ITEM# 16.1 - SNEEZE GUARD (1 EA REQ'D)

Versa-Gard VP1.3

VG Series. Full service food protector with vertical glass and top shelf. 1" OD Solid Supports. End glass panels are 1/4" clear tempered. All glass meets ANSI Z97.1 specifications for safety performance and ASTM C1048-04 specifications for heat treated glass. All hardware supplied in a brushed stainless steel finish. All glass with ground and polished edges. Conceal mount hardware.

ACCESSORIES

Mfr	Qty	Model	Spec
			LED LIGHT



VP1.3

Protected by US Patent 7,040,723
Other Patents Pending

Single-Sided Full Service Protector

FINISH:

- Brushed Stainless Steel
- Clear Anodized Aluminum
- Powder Coat:
 - Black
 - Silver

RAL # _____

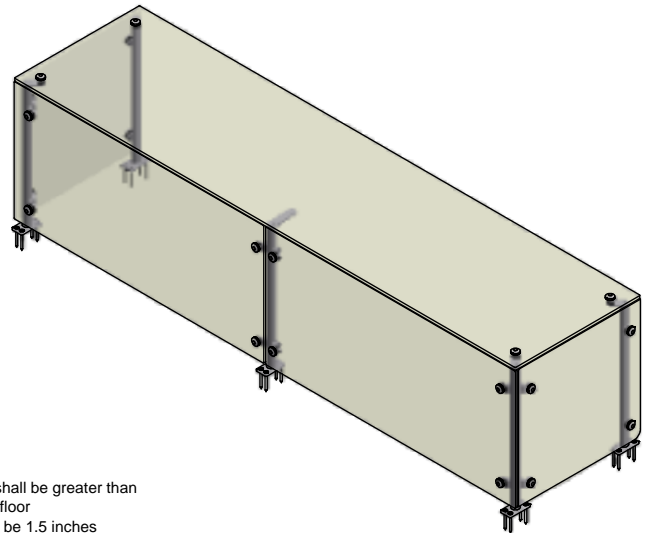
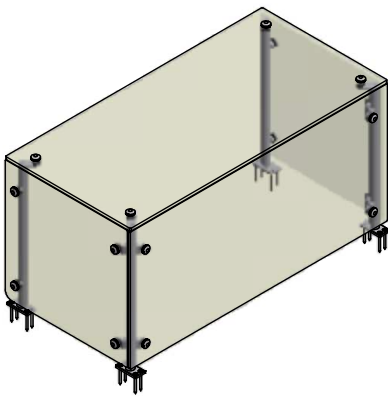
GLASS (Clear Tempered):

- 1/4" Front - Std
- 3/8" Front
- 1/2" Front
- Frosted
- 3/8" Top - Std
- 1/2" Top

OPTIONS(*):

- End Panel - RT
- End Panel - LT
- Light Fixture
- Warmer
- Shelf Kit

(*) Not all options available on all models
Contact factory for specific information
For Mounting Options see Mounting Specifications



NSF/ANSI 2 - 2010 Standards Requirements:

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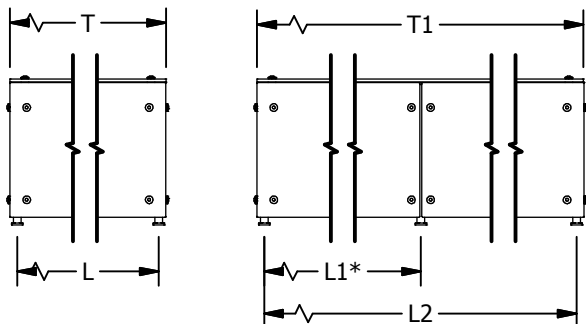
5.35.12 Food Shields for use on cafeteria counters

- 5.35.12.1 The sum of a shield's protected horizontal plane (X) and its protected vertical plane (Y) shall be greater than or equal to 32 inches. When (X) = 0, (Y) shall be a minimum of 60 inches from finished floor
- 5.35.12.2 Maximum distance from the bottom edge of the front vertical glass and counter top shall be 1.5 inches
- 5.35.12.3 Maximum distance between the vertical glass and horizontal glass is 3/4 inch
- 5.35.12.4 Minimum horizontal distance between the front inside edge of displayed food and the bottom leading edge of the shield s 1.5 inches

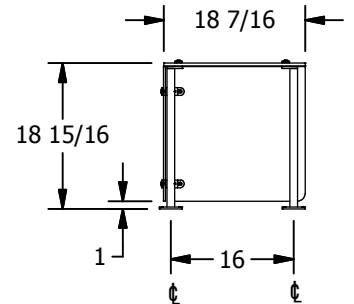
- 5.35.6 A vertical barrier (end shield) shall be provided at each end of a foodshield. The vertical barrier shall be a minimum of 18 inches deep (front to back) beginning at the bottom leading edge of the foodshield. The minimum height of the vertical barrier shall be equal to the overall height of the foodshield. The maximum distance from the bottom edge of the vertical barrier and counter top shall be 1.5 inches.

- 5.35.6.1 A foodshield intended to be installed a maximum of 3" (76mm) from a building wall perpendicular to the foodshield is exempt from the requirements of 5.35.6 provided that the height of the building wall is not lower than the overall height of the foodshield.

(2) End Panels per unit unless otherwise specified. End panels are 1/4" clear tempered glass unless otherwise specified.



- L / L1 - 48" Max (1/4" Glass)
- 60" Max (3/8" Glass)
- 66" Max (1/2" Glass)
- T - 60" Max (3/8" Glass)
- T1 - 96" Max in a Single Section



(* - Middle support is centered unless L1 dimension is specified)



Submittal Sheet

10/16/2018

ITEM# 16.2 - SNEEZE GUARD (1 EA REQ'D)

Versa-Gard VP1.3

VG Series. Full service food protector with vertical glass and top shelf. 1" OD Solid Supports. End glass panels are 1/4" clear tempered. All glass meets ANSI Z97.1 specifications for safety performance and ASTM C1048-04 specifications for heat treated glass. All hardware supplied in a brushed stainless steel finish. All glass with ground and polished edges. Conceal mount hardware.

The spec sheet for this item can be viewed on item 16.1)

ACCESSORIES

Mfr	Qty	Model	Spec
			LED LIGHT

Submittal Sheet

10/16/2018

ITEM# 16.3 - SNEEZE GUARD (1 EA REQ'D)

Versa-Gard VP1.3

VG Series. Full service food protector with vertical glass and top shelf. 1" OD Solid Supports. End glass panels are 1/4" clear tempered. All glass meets ANSI Z97.1 specifications for safety performance and ASTM C1048-04 specifications for heat treated glass. All hardware supplied in a brushed stainless steel finish. All glass with ground and polished edges. Conceal mount hardware.

The spec sheet for this item can be viewed on item 16.1)

ACCESSORIES

Mfr	Qty	Model	Spec
			LED LIGHT

Submittal Sheet

10/16/2018

ITEM# 17 - MENU BOARD (1 EA REQ'D)

Provided by Operations CONTACT OPERATIONS

Submittal Sheet

10/16/2018

ITEM# 17.1 - OMS SCREEN (1 EA REQ'D)

Provided by Operations CONTACT OPERATIONS

Submittal Sheet

10/16/2018

ITEM# 20 - DROP-IN SINK (1 EA REQ'D)

Eagle Group SR14-16-9.5-1

Self-Rimming Drop-In Sink, one compartment, 14" wide x 16" front-to-back x 9-1/2" deep bowl, 4" OC deck mount faucet with gooseneck spout (302004), includes basket drain, 20/304 stainless steel construction, NSF

ACCESSORIES

Mfr	Qty	Model	Spec
Eagle Group	1		Faucet hole punched on 4" centers, standard
Eagle Group	1		Standard faucet



Profit from the Eagle Advantage®

Specification Sheet

Short Form Specifications

Eagle Countertop Self Rimming Drop-In Sink, model _____ . Sinks are type 304 stainless steel, deep-drawn and self rimming. Faucet holes are punched on 4" centers. Positive holddown clamping tabs for top mount. Faucet and drain included.



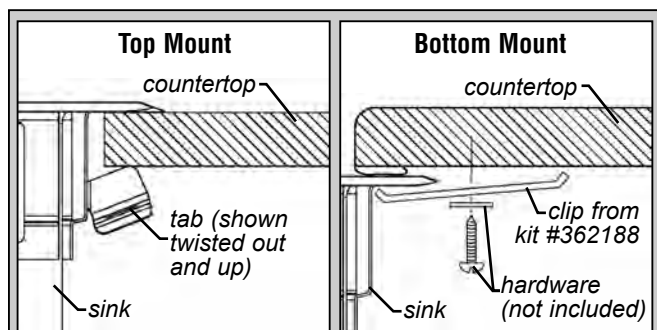
SRU14-10-5-1



SR10-14-9.5-2



SR10-14-9.5-3



For Top Mount: Positive holddown clamping twist-tabs designed for up to 1" (25mm)-thick countertops. FOR COUNTERTOPS THICKER THAN 1", CONTACT FACTORY.

For Bottom Mount: Kit sold separately—see back page.

EAGLE GROUP

100 Industrial Boulevard, Clayton, DE 19938-8903 USA

Phone: 302-653-3000 • Fax: 302-653-2065

www.eaglegrp.com

Foodservice Division: Phone 800-441-8440

MHC/Retail Display Divisions: Phone 800-637-5100

For custom configuration or fabrication needs, contact our SpecFAB® Division.

Phone: 302-653-3000 • Fax: 302-653-2065 • e-mail: quotes@eaglegrp.com

Spec sheets available for viewing, printing or downloading from our online literature library at www.eaglegrp.com

Eagle Foodservice Equipment, Eagle MHC, SpecFAB®, and Retail Display are divisions of Eagle Group. ©2017 by the Eagle Group

Item No.: _____
Project No.: _____
S.I.S. No.: _____

Countertop Drop-In Sinks with Self Rim Design*

MODELS:

- | | | |
|---|---|---|
| <input type="checkbox"/> SR10-14-5-1 | <input type="checkbox"/> SR18-24-13.5-1 | <input type="checkbox"/> SR16-19-13.5-2 |
| <input type="checkbox"/> SR10-14-9.5-1 | <input type="checkbox"/> SR19-16-8-1 | <input type="checkbox"/> SR18-24-13.5-2 |
| <input type="checkbox"/> SR12-14-9.5-1 | <input type="checkbox"/> SR19-16-13.5-1 | <input type="checkbox"/> SR22-22-13.5-2 |
| <input type="checkbox"/> SR14-10-5-1 | <input type="checkbox"/> SR20-12-6.5-1 | <input type="checkbox"/> SR24-24-13.5-2 |
| <input type="checkbox"/> SRU14-10-5-1 | <input type="checkbox"/> SR22-22-13.5-1 | <input type="checkbox"/> SR10-14-9.5-3 |
| <input type="checkbox"/> SR14-10-9.5-1 | <input type="checkbox"/> SR24-18-13.5-1 | <input type="checkbox"/> SR12-14-9.5-3 |
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| <input type="checkbox"/> SR16-19-8-1 | <input type="checkbox"/> SR14-16-9.5-2 | <input type="checkbox"/> SR18-24-13.5-3 |
| <input type="checkbox"/> SR16-19-13.5-1 | <input type="checkbox"/> SR16-19-8-2 | |

Design and Construction Features

- Sinks can be mounted onto top or bottom of countertop. For bottom mount, order kit #362188 (see back page).
- Heavy gauge type 304 series stainless steel covered bowls with large radius.
- All sinks feature 3½" (89mm)-diameter drain hole in the center of the bowl.
- Crumb cup strainer assembly features 4½" (114mm)-diameter top flange and 1½" (38mm) NPS outlet.
- All sinks feature deck-mounted faucet on 4" (102mm)** centers; one-compartment sinks with 10" x 14" (254 x 356) and 14" x 16" (356 x 406mm) bowls include faucet with gooseneck spout.
- Self rimming.
- Deep-drawn.
- 18 or 20 gauge*** industrial grade construction and quality.

* Not intended for NSF installation into stainless steel worksurface. Please consult factory if need arises.

** To order sinks with faucet holes punched on 8" (203mm) centers, add suffix "-8CL". Example: SR10-14-9.5-2-8CL

*** Varies per model sink. Refer to charts on back page.

Options / Accessories

- Faucets (see back page)
- Electronic-eye faucets^Δ (add suffix "-FE")
- P-trap (#300789)

^Δ Electronic-Eye Faucets are available for One-Compartment Sinks only.

Certifications / Approvals





Profit from the Eagle Advantage®



Item No.: _____
 Project No.: _____
 S.I.S. No.: _____

NOTE: width = front-to-back, length = side-to-side

One-Compartment Sinks — Furnished with a #302004 faucet with gooseneck spout, except where noted.

model #	inside bowl dimensions		overall dimensions		cutout for top mount		cutout for bottom mount		weight lbs. kg	18 or 20 gauge
	width	length x depth	width	length	width	length	width	length		
	in.	mm	in.	mm	in.	mm	in.	mm		
SR10-14-5-1	14" x 10" x 5"	356 x 254 x 127	19" x 12 1/2"	483 x 324	17 1/2" x 11 1/4"	448 x 286	14 1/8" x 10 1/8"	376 x 275	10 4.5	20
SR10-14-9.5-1	14" x 10" x 9 1/2"	356 x 254 x 241	18 1/2" x 12 1/2"	480 x 324	17 1/2" x 11 1/4"	445 x 286	14 1/8" x 10 1/8"	376 x 275	12 5.4	18
SR12-14-9.5-1	14" x 12" x 9 1/2"	356 x 305 x 241	19" x 14 1/2"	483 x 375	17 1/2" x 13 1/4"	448 x 337	14 3/8" x 12 3/8"	321 x 314	14 6.4	20
SR14-10-5-1	10" x 14" x 5"	254 x 356 x 127	15" x 16 1/2"	381 x 426	13 3/8" x 15 1/4"	346 x 387	10 1/8" x 14 1/8"	275 x 376	10 4.5	20
SRU14-10-5-1	10" x 14" x 5"	254 x 356 x 127	15" x 16 1/2"	381 x 426	13 3/8" x 15 1/4"	346 x 387	n/a	n/a	12 5.4	20
SR14-10-9.5-1	10" x 14" x 9 1/2"	254 x 356 x 241	15" x 16 1/2"	381 x 422	13 3/8" x 15 1/4"	346 x 384	10 1/8" x 14 1/8"	275 x 376	12 5.4	18
SR14-12-9.5-1	12" x 14" x 9 1/2"	305 x 356 x 241	17" x 16 1/2"	432 x 426	15 3/8" x 15 1/4"	397 x 387	12 3/8" x 14 3/8"	314 x 365	14 6.4	20
SR14-16-9.5-1	16" x 14" x 9 1/2"	406 x 356 x 241	21" x 16 1/2"	533 x 425	19 3/8" x 15 1/4"	499 x 387	16 3/8" x 14 3/8"	422 x 372	23 10.4	20
SR16-14-9.5-1	14" x 16" x 9 1/2"	356 x 406 x 241	19" x 18 1/2"	483 x 476	17 3/8" x 17 1/4"	448 x 438	14 3/8" x 16 3/8"	372 x 422	23 10.4	20
SR16-19-8-1	20" x 16" x 8"	508 x 406 x 203	24 3/8" x 18 1/2"	629 x 470	23 3/8" x 17"	594 x 432	20 3/8" x 16 3/8"	524 x 422	26 11.8	18
SR16-19-13.5-1	20" x 16" x 13 1/2"	508 x 406 x 343	24 3/8" x 18 1/2"	629 x 470	23 3/8" x 17"	594 x 432	20 3/8" x 16 3/8"	524 x 422	28 12.7	18
SR18-24-13.5-1	24" x 18" x 13 1/2"	610 x 457 x 343	28 3/8" x 20 1/2"	730 x 521	27 3/8" x 19"	695 x 483	24 3/8" x 18 3/8"	626 x 473	32 14.5	18
SR19-16-8-1*	16" x 20" x 8"	406 x 508 x 203	20 3/8" x 22 1/2"	527 x 572	19 3/8" x 21"	492 x 533	16 3/8" x 20 3/8"	422 x 524	24 10.9	18
SR19-16-13.5-1*	16" x 20" x 13 1/2"	406 x 508 x 343	20 3/8" x 22 1/2"	527 x 572	19 3/8" x 21"	492 x 533	16 3/8" x 20 3/8"	422 x 524	25 11.3	18
SR20-12-6.5-1	12" x 20" x 6 1/2"	305 x 508 x 165	17" x 22 3/4"	432 x 578	15 3/8" x 21 1/4"	397 x 540	12 3/8" x 20 3/8"	310 x 511	28 12.7	20
SR22-22-13.5-1*	22" x 22" x 13 1/2"	559 x 559 x 343	27" x 24 3/4"	686 x 629	25 3/8" x 23 3/4"	651 x 591	see template **	see template **	34 15.4	18
SR24-18-13.5-1*	18" x 24" x 13 1/2"	457 x 610 x 343	22 3/8" x 26 1/2"	578 x 673	21 3/8" x 25"	543 x 635	18 3/8" x 24 3/8"	473 x 626	32 14.5	18
SR24-24-13.5-1*	24" x 24" x 13 1/2"	610 x 610 x 343	28 3/8" x 26 1/2"	730 x 673	27 3/8" x 25"	695 x 635	24 1/8" x 24 1/8"	627 x 627	36 16.3	18

* #SRU14-10-5-1 features an upturn on sides and rear; *These sinks utilize a #300490 faucet with 12" (305mm) swivel spout; ** Template included with sink.

Two-Compartment Sinks — Furnished with a #300490 faucet with 12" (203mm) spout, except where noted.

model #	inside bowl dimensions		overall dimensions		cutout for top mount		cutout for bottom mount		weight lbs. kg	18 or 20 gauge
	width	length x depth	width	length	width	length	width	length		
	in.	mm	in.	mm	in.	mm	in.	mm		
SR10-14-9.5-2*	14" x 10" x 9 1/2"	356 x 254 x 241	18 3/8" x 24 3/4"	480 x 629	17 1/2" x 23 1/4"	445 x 591	14 1/8" x 23"	376 x 584	25 11.3	18
SR12-14-9.5-2	14" x 12" x 9 1/2"	356 x 305 x 241	19" x 28 3/4"	483 x 730	17 3/8" x 27 1/4"	448 x 692	14 3/8" x 26 3/8"	365 x 676	27 12.2	20
SR14-16-9.5-2	16" x 14" x 9 1/2"	406 x 356 x 241	21" x 32 3/4"	525 x 832	19 3/8" x 31 1/4"	499 x 794	16 3/8" x 30 3/8"	422 x 778	42 19.1	20
SR16-19-8-2	20" x 16" x 8"	508 x 406 x 203	24 3/8" x 36 1/4"	527 x 921	23 3/8" x 34 3/4"	594 x 883	20 3/8" x 34 3/4"	524 x 870	48 21.8	18
SR16-19-13.5-2	20" x 16" x 13 1/2"	508 x 406 x 343	24 3/8" x 36 1/4"	527 x 921	23 3/8" x 34 3/4"	594 x 883	20 3/8" x 34 3/4"	524 x 870	52 23.6	18
SR18-24-13.5-2	24" x 18" x 13 1/2"	610 x 457 x 343	28 3/8" x 40 1/4"	730 x 1022	27 3/8" x 38 3/4"	695 x 984	24 3/8" x 38 1/8"	626 x 978	56 24.9	18
SR22-22-13.5-2	22" x 22" x 13 1/2"	559 x 559 x 343	27" x 48 3/4"	686 x 1238	25 3/8" x 47 1/4"	651 x 1200	see template **	see template **	57 25.9	18
SR24-24-13.5-2	24" x 24" x 13 1/2"	610 x 610 x 343	28 3/8" x 52 3/4"	730 x 1324	27 3/8" x 50 3/4"	695 x 1286	24 1/8" x 50 1/4"	630 x 1276	64 29.0	18

* Model #SR10-14-9.5-2 utilizes a #301248 faucet with 8" (203mm) swivel spout; ** Template included with sink.

Three-Compartment Sinks — Furnished with a #300490 faucet with 12" (305mm) spout, except where noted.

model #	inside bowl dimensions		overall dimensions		cutout for top mount		cutout for bottom mount		weight lbs. kg	18 or 20 gauge
	width	length x depth	width	length	width	length	width	length		
	in.	mm	in.	mm	in.	mm	in.	mm		
SR10-14-9.5-3	14" x 10" x 9 1/2"	356 x 254 x 241	18 3/8" x 36 3/4"	480 x 933	17 1/2" x 35 1/4"	445 x 895	14 1/8" x 35"	376 x 889	37 16.8	18
SR12-14-9.5-3	14" x 12" x 9 1/2"	356 x 305 x 241	19" x 42 3/4"	483 x 1086	17 3/8" x 41 1/4"	448 x 1031	14 3/8" x 40 3/8"	331 x 1032	39 17.6	20
SR14-16-9.5-3	16" x 14" x 9 1/2"	406 x 356 x 241	21" x 48 3/4"	533 x 1238	19 3/8" x 47 1/4"	498 x 1200	16 3/8" x 46 3/8"	422 x 1184	66 29.9	20
SR16-19-8-3	20" x 16" x 8"	508 x 406 x 203	24 3/8" x 54"	629 x 1372	23 3/8" x 52 1/2"	594 x 1334	20 3/8" x 52 1/4"	524 x 1327	72 32.7	18
SR16-19-13.5-3	20" x 16" x 13 1/2"	508 x 406 x 343	24 3/8" x 54"	629 x 1372	23 3/8" x 52 1/2"	594 x 1334	20 3/8" x 52 1/4"	524 x 1327	77 34.9	18
SR18-24-13.5-3*	24" x 18" x 13 1/2"	610 x 457 x 343	28 3/8" x 60"	730 x 1524	27 3/8" x 58 3/4"	695 x 1486	24 3/8" x 58 1/4"	626 x 1480	82 37.2	18

* These sinks utilize a #301440 faucet with 14" (356mm) swivel spout.

Optional Deck Mount Faucets

description	#313306 T&S faucet	
	Standard model #	T&S model #
gooseneck faucet, 4" (102mm) center, for single bowls	302004	313308
8" (203mm) spout, 4" (102mm) center, for single and double bowls	301248	313306
12" (305mm) spout, 4" (102mm) center, for triple bowls	300490	313303
14" (356mm) spout, 8" (203mm) center, for triple bowls	301440	313307
8" (203mm) spout, 4" (102mm) center, for single and double bowls, w/spray arm	—	377430
8" (203mm) spout, 8" (203mm) center, for single and double bowls, w/spray arm	—	303560*
12" (305mm) spout, 8" (203mm) center, for triple bowls, w/spray arm	—	303561*
14" (356mm) spout, 8" (203mm) center, for triple bowls, w/spray arm	—	303562*

* Faucets with spray arm require special faucet holes.

Bottom-Mount Kit

One kit per one-compartment sink,
 two kits per two-compartment sink,
 three kits per three-compartment sink.

description	model #
8 undermount clips per kit	362188



EAGLE GROUP • 100 Industrial Boulevard, Clayton, DE 19938-8903 USA

Phone: 302-653-3000 • Fax: 302-653-2065 • www.eaglegrp.com

Foodservice Division: Phone 800-441-8440 • MHC/Retail Display Divisions: Phone 800-637-5100

Spec sheets available for viewing, printing or downloading from our online literature library at www.eaglegrp.com

Although every attempt has been made to ensure the accuracy of the information provided, we cannot be held responsible for typographical or printing errors. Information and specifications are subject to change without notice. Please confirm at time of order.

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Rev. 08/17

Submittal Sheet

10/16/2018

ITEM# 21 - UNDERCOUNTER REFRIGERATOR (2 EA REQ'D)

Continental Refrigerator SW60-GD-U

Undercounter Display Refrigerator, 60"W, 17.0 cu ft capacity, two-section, (2) glass doors, LED lighting, stainless steel front, top & end panels, aluminum interior, 1-3/8" diameter plate casters, front breathing, electronic control with digital display, hi-low alarm, rear-mounted self-contained refrigeration, 1/4 HP, cETLus, NSF, Made in USA

ACCESSORIES

Mfr	Qty	Model	Spec
Continental Refrigerator	2		Standard warranty (for the United States & Canada Only): 3 year parts and labor; 5 year compressor
Continental Refrigerator	2		115v/60/1-ph, 7.4 amps, cord, NEMA 5-15P, standard

ELECTRICAL

	VOLTS	CYCLE	PHASE	CONN	AFF	NEMA	AMPS	KW	HP	MCA	MOCP
1									1/4		
2	115	60	1	Cord & Plug		5-15P	7.4				

UNDERCOUNTER REFRIGERATOR

Model: SW60-GD-U

60" Undercounter Refrigerator with Hinged Glass Doors

Stainless steel front, top and end panels, aluminum back and interior.

Designed to maintain NSF-7 temperatures in 100°F ambient.



Options and Accessories

(upcharge and lead times may apply)

Stainless steel interior	Solid doors in lieu of glass doors
Stainless steel back	Automatic electric condensate evaporator
Stainless steel shelves	Expansion valve system
Add'l epoxy-coated steel shelves	Door locks
Drawers in lieu of doors	Special electrical requirements (consult factory)

Consult factory for other model configurations, options and accessories.

Project Name:

Model Specified:

Location:

Item No:

Quantity:

AIA #:

SIS #:

Standard Model Features

REFRIGERATION SYSTEM

Performance-rated refrigeration system

Environmentally-safe R-134a refrigerant

Automatic, energy-saving, non-electric
condensate evaporator

Non-corrosive, plasticized fin evaporator coil

Easily serviceable back mounted compressor

CABINET ARCHITECTURE

2" non-CFC polyurethane foam insulation

Double pane, low-e tempered hinged glass doors

Magnetic snap-in door gaskets

Heavy-duty, epoxy-coated steel shelf

Completely enclosed, vented and removable case back

1 3/8" diameter plate casters (factory installed)

MODEL FEATURES

Electronic controller w/ digital display & hi-low alarm

2" high, bottom mounted front breather air divider

LED interior lighting

APPROVAL:

Continental[®]
Refrigerator

Toll-Free: 800-523-7138
Phone: 215-244-1400
Fax: 215-244-9579

539 Dunksferry Road
Bensalem, PA 19020
www.continentalrefrigerator.com

Model Specifications

DIMENSIONAL DATA

Net Capacity (cu. ft.)	17.0 (481 cu l)
Width, Overall (in.)	60 (1524 mm)
Depth, Overall (in.) (incl. handles & bumpers)	31 7/16 (798 mm)
Height, Overall (in.) (incl. 1 3/8" plate casters)	31 13/16 (808 mm)
Shelf Area (sq. ft.)	8.1 (.8 sq m)
No. of Shelves	2
No. of Doors	2
Interior Depth (in.)	See Drawing
Interior Height (in.)	26 1/4 (667 mm)
Interior Width (in.)	56 (1422 mm)

REFRIGERANT DATA

Condensing Unit Size (H.P.)	1/4
Capacity (BTU/Hr)*	1940

ELECTRICAL DATA

Voltage (int'l)	115/60/1 (220/50/1)
Fans	3
Total Amps (int'l)	7.4 (4.0)
10 ft. Cord/Plug [attached] (int'l)	Yes (No)

SHIPPING DATA

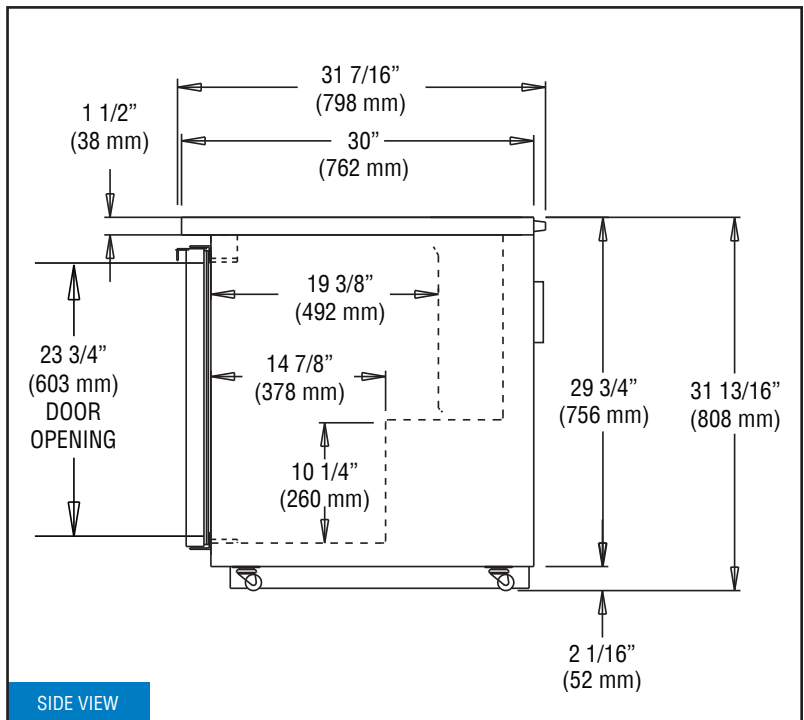
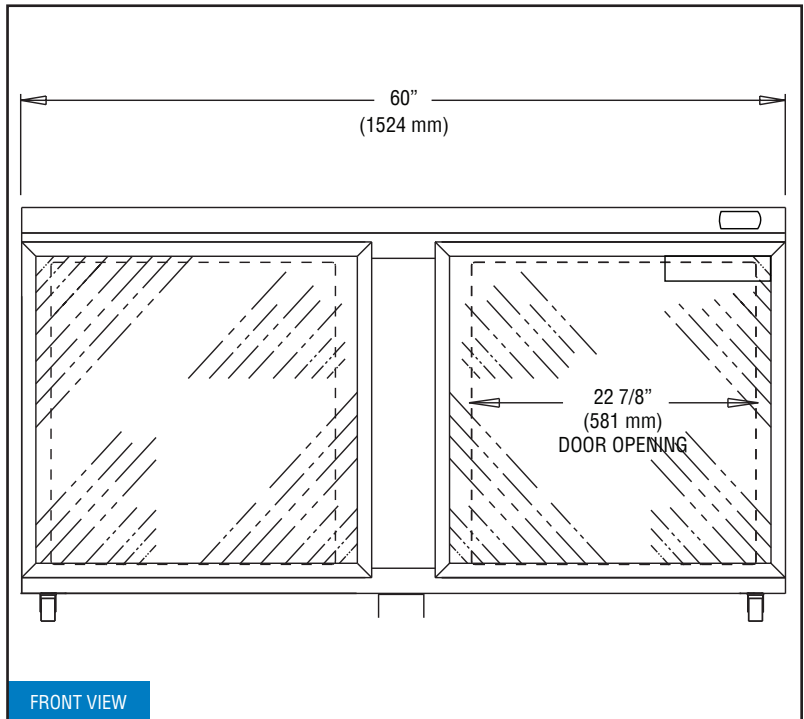
Weight (lbs.)	300 (136 kg)
Height - Crated (in.)	40 (1016 mm)
Width - Crated (in.)	68 (1727 mm)
Depth - Crated (in.)	37 1/4 (946 mm)

* Rating @ +25°F evaporator, 90°F ambient
 Figures in parentheses reflect metric equivalents rounded to the nearest whole unit.



Equipped with one NEMA-5-15P Plug
 (varies by country)

Model Plan Views



NOTE: For proper operation, the area under and in front of the cabinet **must** not be obstructed in any way.



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Submittal Sheet

10/16/2018

ITEM# 22 - RICE COOKER (2 EA REQ'D)

Panasonic SR-42HZP

Commercial Rice Cooker, electric, 23 cups uncooked rice capacity, serves approximately (74) 3 oz. portion servings, keep warm feature, push button start, automatic shut-off, built-in thermal fuse, dent resistant pan, 67" cord, silver exterior, 120v/60/1-ph, 12.9 amps, 1550 watts, UL, ETL, NSF

ACCESSORIES

Mfr	Qty	Model	Spec
Panasonic	2		6 months parts & labor warranty (mail-in replacement - see website for details)

ELECTRICAL

	VOLTS	CYCLE	PHASE	CONN	AFF	NEMA	AMPS	KW	HP	MCA	MOCP
1	120	60	1				12.9	1.55			



SR-42HZP Commercial Electric Rice Cooker

Panasonic's electric Rice Cooker is ideal for restaurants, convenience stores and vending coffee service use.

- Large Cooking Capacity – 74 servings of 3 oz. portions
- Thermal Safety Fuse built-in
- Automatic Shut-off
- Stainless Steel Lid
- Easy-to-clean Removable Pan Liner



Panasonic ideas for life

SR-42HZIP**Commercial Electric Rice Cooker****Thermostat for Precision Control**

The rice cooker will maintain the cooked rice warm for up to 2 hours under nominal* operating conditions, virtually eliminating burning or overcooking of the rice. As a result, rice is cooked to the Chef's preference.

Easy Push-Button Operation

The push of a button starts the rice cooking. As soon as the rice is cooked, the unit shuts itself off.

Alternate Uses

Not only does it cook rice but can braise, heat liquids and cook many different items – call or see our web page for Chefs Technical Support for recipes.

Large Capacity

SR-42HZIP can cook up to 23 cups (4.4 qts) in approximately 30 minutes.

Direct Heating System

Specially sheathed heating elements heat the pan bottom directly which minimizes heat loss and in turn saves energy costs. A thermal safety fuse will protect the unit from possible temperature rise.

Easy-to-clean Removable Pan Liner

The included Aluminum Alloy pan liner lifts easily out of the cooker to make washing and rinsing a breeze. An Optional "Non-Stick" pan liner is available.

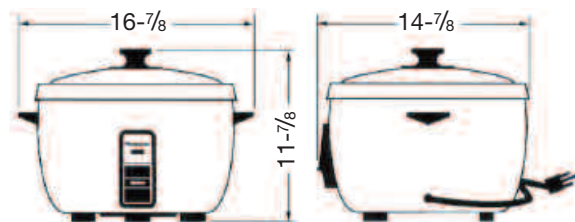
* Ambient room temperature of 70°F and pan covered.

UL and NSF Approved

SR-42HZIP is built with a durability and attention to safety that has earned certification from both Underwriters Laboratories and the National Sanitation Foundation for **commercial use**.

SR-42HZIP Specifications

Servings	
Raw Rice	8.6 lbs. (23 - 6 oz. cups)
Servings	74 - 3 oz. portions, 54 - 4 oz. portions
Cook Time	Approximately 30 minutes
Technical Specifications	
Power Source	120 V AC, 60 Hz
Power Consumption	1550 W
Amperage	12.9 Amps
Cord Length	67"
Net Weight	12.1 lbs. (5.5Kg)
Carton Size	17"W x 17"D x 10-1/2"H
Master Carton	2 cartons in shrink wrap
Master Carton Weight	27 lbs.
Master Carton Cu. Ft.	3.51
Color	Silver

**Panasonic ideas for life****Panasonic Consumer Electronics Company**

Division of Panasonic Corporation of North America
Executive Offices: One Panasonic Way, Panazip 1H-2
Secaucus, NJ 07094

Toll-free: **888-350-9590**

Sales Support, Recipes and Training at: www.panasonic.com/cm0

For a Panasonic Distributor nearest you, 1-888-350-9590

For Panasonic Chef Support, 1-201-348-7305

For Panasonic Technical Support, 1-201-392-6894

For Panasonic HQ Sales, 1-201-348-7258

For Panasonic In Warranty Replacements, 1-866-907-9111



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CM070034SS

Submittal Sheet

10/16/2018

ITEM# 23 - DROP-IN SINK (1 EA REQ'D)

Eagle Group SR10-14-5-1

Self-Rimming Drop-In Sink, one compartment, 10" wide x 14" front-to-back x 5" deep bowl, 4" OC deck mount faucet with gooseneck spout (302004), includes basket drain, 20/304 stainless steel construction, NSF

The spec sheet for this item can be viewed on item 20)

ACCESSORIES

Mfr	Qty	Model	Spec
Eagle Group	1		Faucet hole punched on 4" centers, standard
Eagle Group	1		Standard faucet

Submittal Sheet

10/16/2018

ITEM# 24 - ROLL-IN REFRIGERATOR (1 EA REQ'D)

Continental Refrigerator DL1RI

Designer Line Refrigerator, roll-in, one-section, self-contained refrigeration, stainless steel front, aluminum interior & ends, standard depth cabinet, full-height solid door, electronic control with digital display, hi-low alarm, removable stainless steel ramp, 1/3 HP

ACCESSORIES

Mfr	Qty	Model	Spec
Continental Refrigerator	1		Standard warranty (for the United States & Canada Only): 3 year parts and labor; 5 year compressor
Continental Refrigerator	1		115v/60/1-ph, 9.6 amps, cord & plug, standard
Continental Refrigerator	1		Door hinged on right, standard

ELECTRICAL

	VOLTS	CYCLE	PHASE	CONN	AFF	NEMA	AMPS	KW	HP	MCA	MOCP
1									1/3		
2	115	60	1	Cord & Plug			9.6				

DESIGNER LINE ROLL-IN REFRIGERATOR

Model: DL1RI

1-Section Roll-In Refrigerator with 66¼" Cart Capacity

DL1RI - Stainless steel front, aluminum end panels and interior
DL1RI-SA - Stainless steel exterior, aluminum interior
DL1RI-SS - Stainless steel exterior and interior
Designed to maintain NSF-7 temperatures in 100°F ambient.



Designer Line

Options and Accessories

(upcharge and lead times may apply)

Stainless steel case back	Hinged glass door
Epoxy-coated steel shelves	Increased refrigeration systems
Chrome or stainless steel shelves	Special electrical req. (consult factory)
Rehinging of door (consult factory)	Correctional Facility Options
Expansion valve system	• One way security screws
Custom laminates	• Locking hasp (lock not included)
Half doors	• Stainless steel mesh cover
Roll-Thru	• Coverless hinges

Consult factory for other model configurations, options and accessories.

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Project Name:

Model Specified:

Location:

Item No:

Quantity:

AIA #:

SIS #:

Standard Model Features

REFRIGERATION SYSTEM

Environmentally-safe R-134a refrigerant

Self contained, performance-rated
 "plug" refrigeration system

Refrigeration system is accessible on top of cabinet,
 separate from the "food zone"

Automatic hot gas condensate evaporator

CABINET ARCHITECTURE

Removable stainless steel rack guides

Removable stainless steel ramp

Reinforced stainless steel floor

3" non-CFC polyurethane foam insulation

Smooth, polished chrome workflow door handle

Cam action, lift off hinges

Self-closing door

Magnetic snap-in door gasket

Cylinder lock in door

66 1/2" high door opening (66 1/4"H rack capacity*)

MODEL FEATURES

Electronic controller w/digital display & hi-low alarm

Top and side air distribution ducts
 evenly distribute air to all pan levels

Cabinet upper side panels and refrigeration "plug"
 system can be removed and reinstalled at job site

* Rack not supplied

IMPORTANT NOTE: Cabinet upper side panels and refrigeration "plug"
 system can be easily removed and reinstalled at installation site where
 space limitations are confining.

APPROVAL:

Model Specifications

DIMENSIONAL DATA

Net Capacity (cu. ft.)	32 (906 cu l)
Width, Overall (in.)	35 1/4 (895 mm)
Depth, Overall (in.) (incl. handles)	35 3/8 (899 mm)
Depth [less door] (in.)	32 (813 mm)
Depth [door open 90°] (in.)	65 (1651 mm)
Clear Door Width (in.)	27 3/8 (695 mm)
Clear Full Door Height (in.)	66 1/2 (1676 mm)
Height, Overall (in.)	86 (2184 mm)
No. of Doors	1
Rack Capacity**	1

REFRIGERANT DATA

Condensing Unit Size (H.P.)	1/3
Capacity (BTU/Hr)*	2560

ELECTRICAL DATA

Voltage (int'l)	115/60/1 (220/50/1)
Feed Wires (incl. ground)	3
Total Amps (int'l)	6.5 (5.1)
10 ft. Cord/Plug [attached] (int'l)	Yes (No)

SHIPPING DATA

Height - Crated (in.)	90 (2286 mm)
Width - Crated (in.)	43 (1092 mm)
Depth - Crated (in.)	42 (1067 mm)
Volume - Crated (cu. ft.)	94 (2661 cu l)
Weight Std - Crated (lbs.)	415 (188 kg)
Weight SS - Crated (lbs.)	505 (229 kg)
Weight Std - Uncrated (lbs.)	330 (150 kg)
Weight SS - Uncrated (lbs.)	405 (184 kg)

* Rating @ +25°F evaporator, 90°F ambient

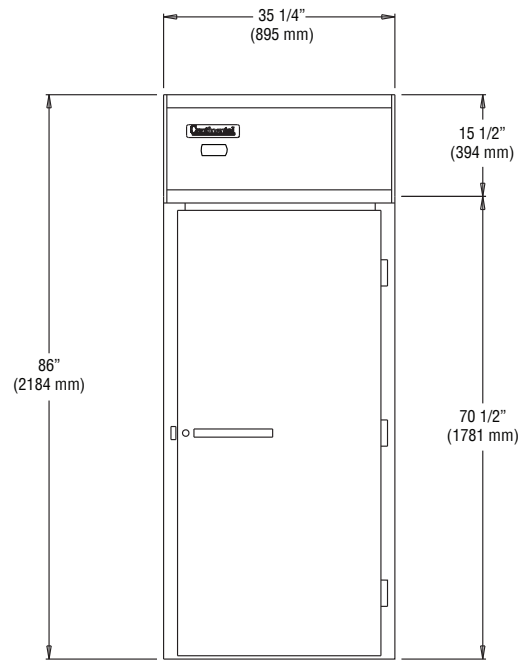
** Maximum rack size including wheels - 27"W x 29"D x 66 1/4"H

Figures in parentheses reflect metric equivalents rounded to the nearest whole unit.

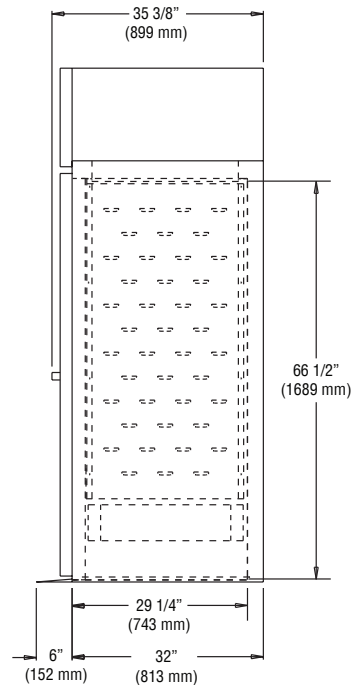


Equipped with one NEMA-5-15P Plug (varies by country)

Model Plan Views



FRONT VIEW



SIDE VIEW

IMPORTANT NOTE: If the cabinet is located directly against a wall and/or under a low ceiling, a minimum clearance of 12" is required on top and 3" on sides and rear.



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Submittal Sheet

10/16/2018

ITEM# 26 - REFRIGERATED SELF-SERVICE COUNTER HEIGHT CASE (1 EA REQ'D)

Structural Concepts CO53R-CH

Oasis® Self-Service Refrigerated Counter Height Case, 59-1/4"W, 33-3/4"H, Breeze-E (Type II) with EnergyWise self-contained refrigeration system, Blue Fin coated coil, top light, one piece formed ABS plastic tub, black interior, (2) square full end panels, casters with levelers, top & front panels extend over end panels to blend with adjacent counters (supplied by others), cETLus, ETL-Sanitation

ACCESSORIES

Mfr	Qty	Model	Spec
Structural Concepts	1		NOTE: If GFCI is required, a GFCI breaker MUST be used in lieu of a GFCI receptacle
Structural Concepts	1		1 yr. parts & labor warranty, 5 yr. compressor warranty, standard
Structural Concepts	1		Breeze-E (Type II) with EnergyWise refrigeration - NSF Type II compliant, standard
Structural Concepts	1		110-120v/60/1ph, 15.56 amps, standard
Structural Concepts	1		6 ft straight blade power cord with NEMA 5-20P, standard
Structural Concepts	1		NOTE: Compressor air rear intake, front discharge at toe kick, unit MUST remain 4" from wall & front & rear panels cannot be blocked (Not applicable with remote refrigeration option)
Structural Concepts	1		Interior: Stainless steel, in lieu of standard black
Structural Concepts	1		Exterior: Stainless steel
Structural Concepts	1		Exterior back panel: Solid back panel - stainless steel
Structural Concepts	1		Left end panel: Square full with mirrored interior, standard
Structural Concepts	1		Right end panel: Square full with mirrored interior, standard
Structural Concepts	1		Digital fahrenheit thermometer, standard

ELECTRICAL

	VOLTS	CYCLE	PHASE	CONN	AFF	NEMA	AMPS	KW	HP	MCA	MOCP
1	110-120	60	1				15.56				
2				Cord & Plug		5-20P					

Oasis®

ITEM NO. _____
 PROJECT: _____
 DATE: _____

Product Specifications

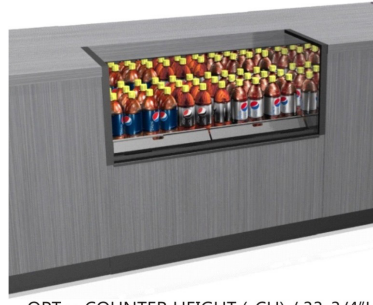
Refrigerated Self-Service Counter Case

- CO33R
- CO43R
- CO53R
- CO63R

Lengths include end panels
 36-1/4"L x 32-3/8"D x 33-3/4"H
 47-1/4"L x 32-3/8"D x 33-3/4"H
 59-1/4"L x 32-3/8"D x 33-3/4"H
 71-1/4"L x 32-3/8"D x 33-3/4"H



STD = FREESTANDING (-FS) / 33-3/4"H



OPT = COUNTER HEIGHT (-CH) / 33-3/4"H



OPT = UNDERCOUNTER HEIGHT (-UC) / 32-3/4"H



STANDARD FEATURES

- NOTE: ADD SUFFIX TO MODEL # LISTED ABOVE BASED ON MODEL CONFIGURATION CHOSEN BELOW
- Breeze~E (Type-II) w/ EnergyWise s/c refrigeration
- Blue Fin coated coil
- Casters (non-locking) w/ levelers
- Compressor air rear intake, front discharge at toe kick. Front and rear panels cannot be blocked. Must remain 4" from wall
- Condensate pan (self-contained refrig. only)
- Flat front panel
- Integrated average product temperature of 40°F or less
- LED 3500K top light(s)
- One piece formed ABS plastic tub
- One year parts & labor; 5 year compressor warranty
- Removable deck pans provide complete access to evaporator coil & refrigeration connections
- Toe kick, black

Features	Standard	Options
MODEL CONFIGURATION	<input type="checkbox"/> Freestanding (-FS) Counter ht. 33-3/4"H; freestanding unit w/2 end panels. Top & front panels positioned between end panels	<input type="checkbox"/> Counter height (-CH) Counter ht. 33-3/4"H; Top & front panels extended over end panels to blend w/adj. counters (supplied by others) <input type="checkbox"/> Undercounter height (-UC) Undercounter ht. 32-3/4"H; front panel extends over end panels to blend w/adj. counters (supplied by others). Counter surface (supplied by others) extends over top of unit
EXTERIOR COLOR	<input type="checkbox"/> Laminated (non-premium) Confirm pattern/grain direction	<input type="checkbox"/> Laminated (premium) Confirm pattern/grain direction <input type="checkbox"/> Stainless steel exterior
INTERIOR COLOR	<input type="checkbox"/> Black interior	<input type="checkbox"/> Stainless steel interior
END PANEL LEFT	<input type="checkbox"/> Square full end panel w/mirror	<input type="checkbox"/> Curved end panel w/mirror (-FS model only) <input type="checkbox"/> No end panel w/ synchronized defrost
END PANEL RIGHT	<input type="checkbox"/> Square full end panel w/mirror	<input type="checkbox"/> Curved end panel w/mirror (-FS model only) <input type="checkbox"/> No end panel w/ synchronized defrost
EXTERIOR BACK PANEL	<input type="checkbox"/> Solid back panel, black	<input type="checkbox"/> Solid back panel, stainless steel
ELECTRICAL CONNECT	<input type="checkbox"/> 6' straight blade power cord (self-cont.)	<input type="checkbox"/> 6' locking power cord (self-cont.) <input type="checkbox"/> Electrical leads (remote)
REFRIGERATION	<input type="checkbox"/> Breeze~E (Type-II) w/ EnergyWise s/c refrigeration	<input type="checkbox"/> Note: Remote doesn't incl Conds unit. Floor drain reqd. <input type="checkbox"/> Remote w/thermostat, solenoid & TXV
MISCELLANEOUS		<input type="checkbox"/> Second year parts & labor warranty (excludes compressor)
ACCESSORIES		<input type="checkbox"/> 2"H Full depth display riser(s) for lower display <input type="checkbox"/> Clean Sweep® coil cleaner (n/a w/remote) <input type="checkbox"/> Night curtain, retractable, non-locking <input type="checkbox"/> Solid security cover, removable, locking

Option Notes: 1 - See tech spec for remote load reqmts

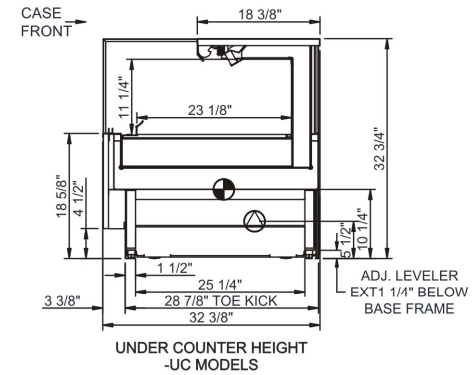
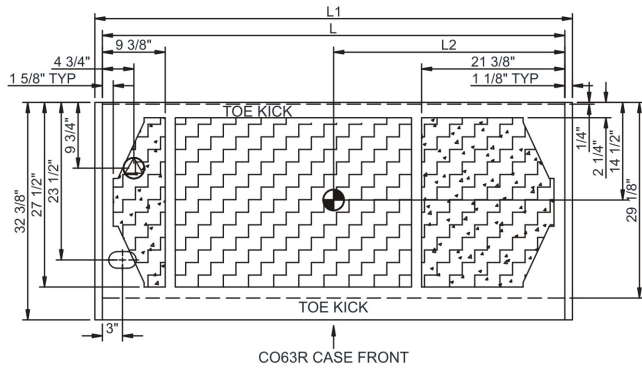
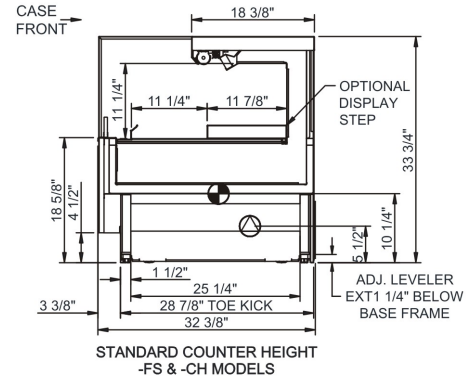
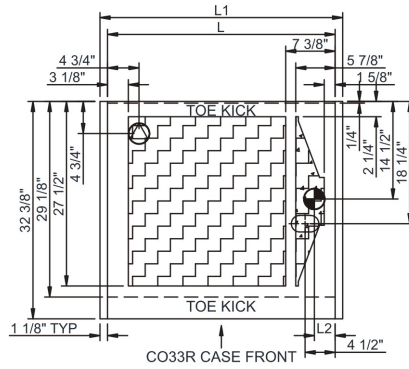
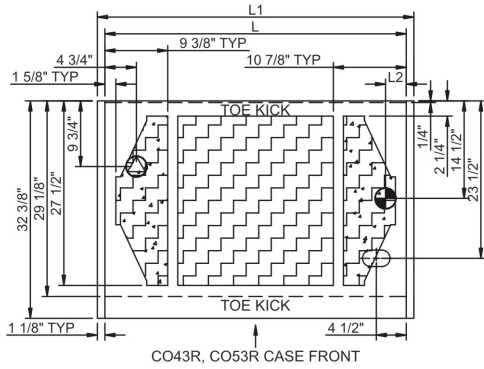
Oasis®

Product Specifications

Intended Environment: Type II - Designed to operate in ambient conditions of 80°F and 60% relative humidity unless noted otherwise in system information below.		
Zone	Intended Product To Be Displayed	Warmest Avg Prod Temp ° F
All	Packaged refrigerated products	40

PLAN VIEW

SIDE VIEW



NOTE: ALL DIMENSIONS APPROXIMATE

- ELECTRICAL JUNCTION BOX (SUPPLIED WITH 6" LEADS OR POWER CORD).
- LOCATION OF DRAIN TUBE FOR REMOTE REF. ONLY (SUPPLIED WITH 3/4" OR 1 1/2" PVC TUBE).

- REFRIGERATION LINE CONNECTION.
- REMOTE FLOOR SINK & UTILITIES ACCESS AREA.

- SELF-CONTAINED CASE SERVICE ACCESS AREA.
- DRY CASE SERVICE ACCESS AREA.

Model Technical Specifications															
Model	L"	L1"	L2"	System Circuit Volts			Phs	Freq	Amps ***	Watts	Wires	NEMA Plug	SST	BTUH	Est Wt
CO33R	N/A	36.25	3.13	Remote(Type II)	Circuit #1	110-120	1	60	1.12	42	2+G	Leads Multiple	20.00	1975	600
				Self-Contained	Circuit #1	110-120	1	60	11.98	1,050	2+G	5-15P or L5-15P	N/A	N/A	
CO43R	N/A	47.25	3.13	Remote(Type II)	Circuit #1	110-120	1	60	1.14	40	2+G	Leads Multiple	20.00	2225	700
				Self-Contained	Circuit #1	110-120	1	60	12.00	1,053	2+G	5-15P or L5-15P	N/A	N/A	
CO53R	N/A	59.25	3.13	Remote(Type II)	Circuit #1	110-120	1	60	1.22	52	2+G	Leads Multiple	20.00	2800	900
				Self-Contained	Circuit #1	110-120	1	60	15.56	1,318	2+G	5-20P or L5-20P	N/A	N/A	
CO63R	N/A	71.25	34.50	Remote(Type II)	Circuit #1	110-120	1	60	1.56	75	2+G	Leads Multiple	20.00	3450	1,000
				Self-Contained	Circuit #1	110-120	1	60	16.00	1,355	2+G	5-20P or L5-20P	N/A	N/A	

*** Does not include electric defrost on freezer models.

Important Notes:

- 1) ELECTRICAL NOTE: If GFCI is required, a GFCI breaker MUST be used in lieu of a GFCI receptacle
- 2) 33" Minimum entry door clearance required (w/out shipping skid)
- 3) Performance issues (product temperatures, water on floor, etc.) caused by adverse conditions are not covered by warranty.
- 4) Keep unit at least 15' from exterior doors, overhead HVAC vents, or any air curtain disruption.
- 5) Do not expose unit to direct sunlight or any heat source (ovens, fryers, etc.).

Regulatory Approvals:

All Models	Accordance with AHRI Std 1200 ETL Listed to UL 471 ETL Listed to CAN/CSA 22.2 No. 120 ETL Sanitation to NSF 7
------------	--



In Accordance with
AHRI Std 1200

DOE 2017
Energy Efficiency
Compliant

888 E. Porter Rd.
Muskegon, MI 49441
Ph. 231-798-8888
Fx. 231-798-4960
www.structuralconcepts.com

Note: Information is subject to change at any time.
Visit www.structuralconcepts.com for the most current specs.

Revised 7/31/2018

20030431

Submittal Sheet

10/16/2018

ITEM# 27 - HOT / COLD FOOD WELL UNIT, DROP-IN, ELECTRIC (1 EA REQ'D)

Delfield N8656

Drop-In Hot/Cold Food Well, 56-1/4", 4-pan size for 12" x 20" pans, 8" deep single tank with drain, remote control panel with single temperature control & three-way toggle switch, stainless steel top & well, galvanized steel exterior housing, self-contained refrigeration, 1/4 HP, (55-1/4" x 25" cutout required), cUL, UL, NSF

ACCESSORIES

Mfr	Qty	Model	Spec
Delfield	1		NOTE: Freight quotes are only valid from Delfield
Delfield	1	0460000N	1 year parts & labor warranty, standard
Delfield	1	W00003N	1 year compressor warranty, standard
Delfield	1		120-240v/60/1-ph, 21.0 amps, standard
Delfield	1	000-504-0030	Autofill assembly kit (shipped loose), for N8600 and N8800 series
Delfield	1	AS3547487	Gate valve assembly (shipped loose) for N8600 & N8800

ELECTRICAL

	VOLTS	CYCLE	PHASE	CONN	AFF	NEMA	AMPS	KW	HP	MCA	MOCP
1									1/4		
2	120-240	60	1				21.0				

WATER

	HOT SIZE	HOT AFF	HOT GPH	COLD SIZE	COLD AFF	FILTERED SIZE	FILTERED AFF	CONDENSER INLET SIZE	CONDENSER OUTLET SIZE
1									

WASTE

	INDIRECT SIZE	DIRECT SIZE
1	1"	



N8600

Drop-In Self-Contained Hot & Cold Combination Pan

Project _____
 Item _____
 Quantity _____
 CSI Section 11400
 Approved _____
 Date _____

N8600: Drop-In Self-Contained Hot & Cold Combination Pan

Models

- N8630 30" hot & cold combination pan drop-in
- N8643 43" hot & cold combination pan drop-in
- N8656 56" hot & cold combination pan drop-in
- N8669 69" hot & cold combination pan drop-in
- N8681 81" hot & cold combination pan drop-in



N8630

Standard Features

- NSF-4 and NSF-7 certified for hot and cold operation
- Stainless steel immersion heaters
- Remote control panel with 3-way hot/cold/off power switch and thermostat for hot operation
- Thermostat for cold operation located next to condensing unit
- Adjustable pan support for flush mounted hot operation or 2" recessed cold operation
- 1" stainless steel drain with screen
- Stainless steel louver provided
- High density environmentally friendly, Kyoto Protocol compliant, Non ODP (Ozone Depletion Potential), Non GWP (Global Warming Potential) polyurethane foam throughout
- Push-in flange gasket is standard
- Adaptor bars for 12"x20" pans provided
- Environmentally friendly HFC-404A refrigerant
- Standard 90 day labor and one year parts warranty
- Additional adaptor bars or plates

Options & Accessories

- Relocate compressor
- Remote refrigeration*
- Automatic water fill
- 220V/50C electrical*
- 3-phase electrical*
- Counter protectors
- Extended warranty

* Inclusion of this option will alter electrical specifications of the unit

Specifications

Top: Top is constructed of one-piece stainless steel.

Interior: Interior liner is constructed of stainless steel with a 1" (2.5cm) drain. Adjustable stainless steel pan rest for flush mount heating or 2" (5cm) recessed cooling to accommodate up to 6" (15cm) deep 12"x20" pans, supplied by others. Stainless steel immersion heater(s) installed in bottom for wet only heating operation.

Exterior: Exterior body is constructed of galvanized steel with high density environmentally friendly, Kyoto Protocol compliant, Non ODP (Ozone Depletion Potential), Non GWP (Global Warming Potential) polyurethane insulation throughout.

Refrigeration: Condensing unit is suspended on a galvanized steel frame. Environmentally friendly HFC-404A refrigerant is utilized. Temperature controlled by thermostat located next to condensing unit.

Operation: Remote control panel contains 3-way Hot/Cold/Off power switch and thermostat for heated operation. As a safety feature, the food well immersion heater includes a high limit safety switch. If the heater gets too hot the safety

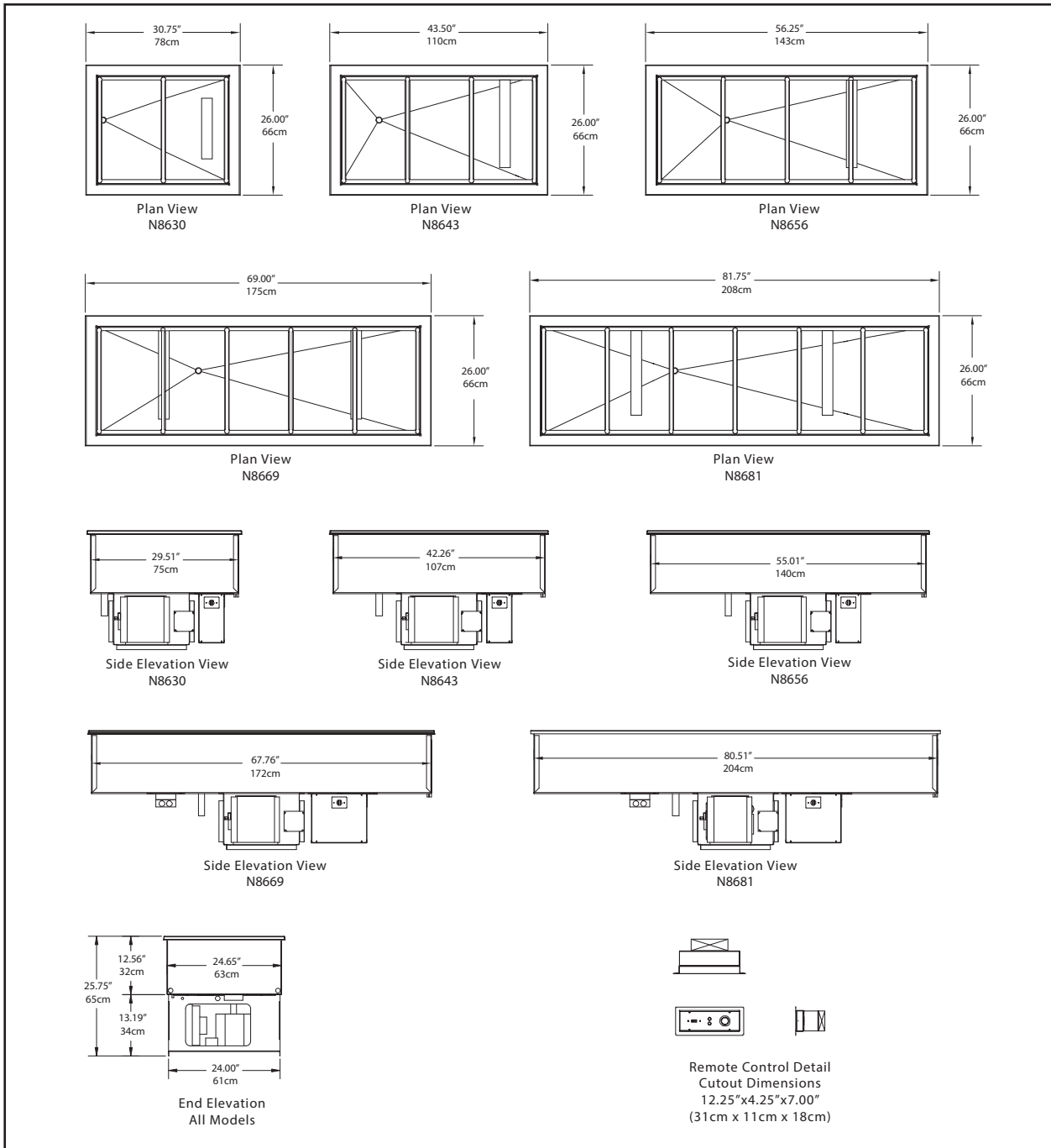
switch will trip, turn the heater off and illuminate a control panel pilot light.

Electrical: All units must be hard wired at installation.





Drop-in Self-Contained Hot & Cold Combination Pan



Specifications

Model	Cutout Dimensions	Volts/Hertz/Phase	Amps	H.P.	Ship Weight
N8630	29.75" X 25.00" (76cmX64cm)	120/60/1	25.0	1/4	164lbs/74kg
N8643	42.50" X 25.00" (108cmX64cm)	120-240/60/1	21.0	1/4	198lbs/90kg
N8656	55.25" X 25.00" (140cmX64cm)	120-240/60/1	21.0	1/4	233lbs/106kg
N8669	68.00" X 25.00" (173cmX64cm)	120-240/60/1	42.0	1/4	266lbs/121kg
N8681	80.75" X 25.00" (205cmX64cm)	120-240/60/1	42.0	1/3	301lbs/137kg

Delfield reserves the right to make changes to the design or specifications without prior notice.

N8600

980 S. Isabella Rd.
Mt. Pleasant, Michigan 48858

Phone: 800-733-8948 or 989-773-7981
Fax: 800-669-0619
www.delfield.com

Printed in the U.S.A.
5808_DEL_N8600
03/15



Submittal Sheet

10/16/2018

ITEM# 28 - HOT / COLD FOOD WELL UNIT, DROP-IN, ELECTRIC (1 EA REQ'D)

Delfield N8643

Drop-In Hot/Cold Food Well, 43-1/2", 3-pan size for 12" x 20" pans, 8" deep single tank with drain, remote control panel with single temperature control & three-way toggle switch, stainless steel top & well, galvanized steel exterior housing, self-contained refrigeration, 1/4 HP, (42-1/2" x 25" cutout required), cUL, UL, NSF

The spec sheet for this item can be viewed on item 27)

ACCESSORIES

Mfr	Qty	Model	Spec
Delfield	1		NOTE: Freight quotes are only valid from Delfield
Delfield	1	0460000N	1 year parts & labor warranty, standard
Delfield	1	W00003N	1 year compressor warranty, standard
Delfield	1		120-240v/60/1-ph, 21.0 amps, standard
Delfield	1	000-504-0030	Autofill assembly kit (shipped loose), for N8600 and N8800 series
Delfield	1	AS3547487	Gate valve assembly (shipped loose) for N8600 & N8800

ELECTRICAL

	VOLTS	CYCLE	PHASE	CONN	AFF	NEMA	AMPS	KW	HP	MCA	MOCP
1									1/4		
2	120-240	60	1				21.0				

WATER

	HOT SIZE	HOT AFF	HOT GPH	COLD SIZE	COLD AFF	FILTERED SIZE	FILTERED AFF	CONDENSER INLET SIZE	CONDENSER OUTLET SIZE
1									

WASTE

	INDIRECT SIZE	DIRECT SIZE
1	1"	

Submittal Sheet

10/16/2018

ITEM# 29 - VENTLESS EXHAUST SYSTEM (1 EA REQ'D)

Giles PO-VH

Ventless Hood, limited type 1 hood for use with specific UL appliances, stainless steel hood with 3-stage filtration: stainless steel baffle filter for large grease particles, electrostatic air cleaning filter, and disposable charcoal odor filter, (ILS) Interlocked Start, Use with electric ovens & conveyor ovens max. 50.0kw, rotisseries max. 6.2kw, CE, cULus, NSF, (fire suppression system is not included)

ACCESSORIES

Mfr	Qty	Model	Spec
Giles	1		2 year parts and labor warranty, standard
Giles	1		208v/60/1ph, 5.0 amps, direct, standard
Giles	1	91760	Fire Suppression Package, includes piping, nozzles & conduit only, ready to accept installation of a 3rd party fire suppression system
Giles	1	30248	Charcoal Filter (VH-Fryers / FSH-2, 3.5, 4 Series)

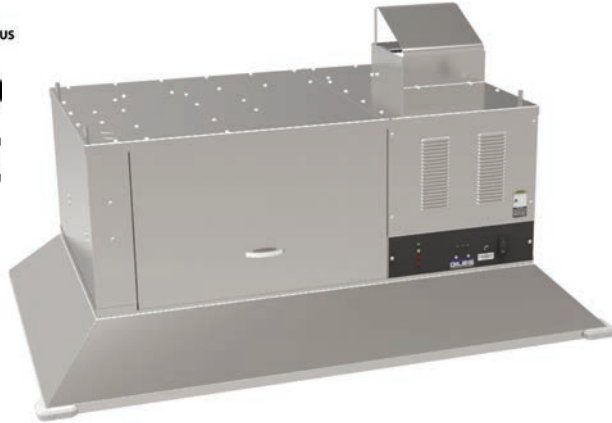
ELECTRICAL

	VOLTS	CYCLE	PHASE	CONN	AFF	NEMA	AMPS	KW	HP	MCA	MOCF
1	208	60	1				5				



Responsive. Reliable.

ISO 9001-2015



Project Name/No: _____ Item No: _____

Quantity: _____ SIS#: _____ AIA/CSI#: _____

Ventless Hood Model PO-VH

- The compact, simple design of the PO-VH Ventless Hood eliminates the need for expensive kitchen or building modifications, and the hassles of dealing with installation, or expansion, of a conventional ventilation hood system.
- Our one-of-a-kind, stainless steel, recirculating hood can be used with certain UL-listed appliances and features Giles proven 3-stage Electrostatic Air Cleaning system, which effectively meets requirements **(UL-197 & applicable UL-710B sections)** for capture and removal of grease-laden vapor for a variety of foodservice appliances.

Design Features

Ventless Hood System 3-Stage Air Cleaning:

Stage 1 - Stainless Steel Baffle Filter traps large grease particulate.

Stage 2 - Electrostatic Air Cleaner (EAC) negatively charges fine particulate allowing it to be electrostatically collected on fins within the cell.

Stage 3 - Disposable Charcoal Filter helps eliminate cooking odors.



Standard Features:

- Built-in interlock relay, Hood must be running properly before the served appliance is powered.
- Exhaust air diverter ... reduces required ceiling clearance.
- Interlocked power switch prevents unattended restart of Hood+Appliance after a power failure.
- Complete Filter set.
- Soaking Tank for cleaning the EAC Cell.

Options Available:

- Fire Suppression system configuration (piping, nozzles, fusible link brackets, conduit).
- HEPA Filter substitute for Electronic Air Cleaner (EAC).
- 50 Hz WYE configuration wiring.
- Extended width skirt, 72" [1829mm] ... Universal Ceiling Mount (UCM) model only.

Many different **POVH Hood Skirt** designs have been created, which allow for direct mounting of the Hood to specific makes and models of ovens, conveyor ovens and rotisseries. Contact Giles to see if there is one available for your particular application.

Appliance Constraints

Equipment Type	Max. Input Power (kW)	Clearances		
		Skirt Bottom to Top of Door or Conveyor Belt	Skirt Bottom to Top of Oven	Skirt Overhang @ Heated Oven Opening
Ovens	50	6" [153mm] max.	1" [25.4mm] min.	6" [153mm] min.
Conveyor Ovens	50	30" [762mm] max.	1" [25.4mm] min.	6" [153mm] min.
Rotisseries	6.2	6" [153mm] max.	1" [25.4mm] min.	6" [153mm] min.

IMPORTANT! Hood is listed **ONLY** for use with electrically heated appliances (Natural or LP Gas is **NOT** approved).

Giles Foodservice Equipment

2750 Gunter Park Drive West • Montgomery, AL 36109 USA
 Phone: 334.272.1457 • Toll Free: 800.554.4537 • Fax 334.239.4117
 Website: www.gfse.com • Email: services@gfse.com

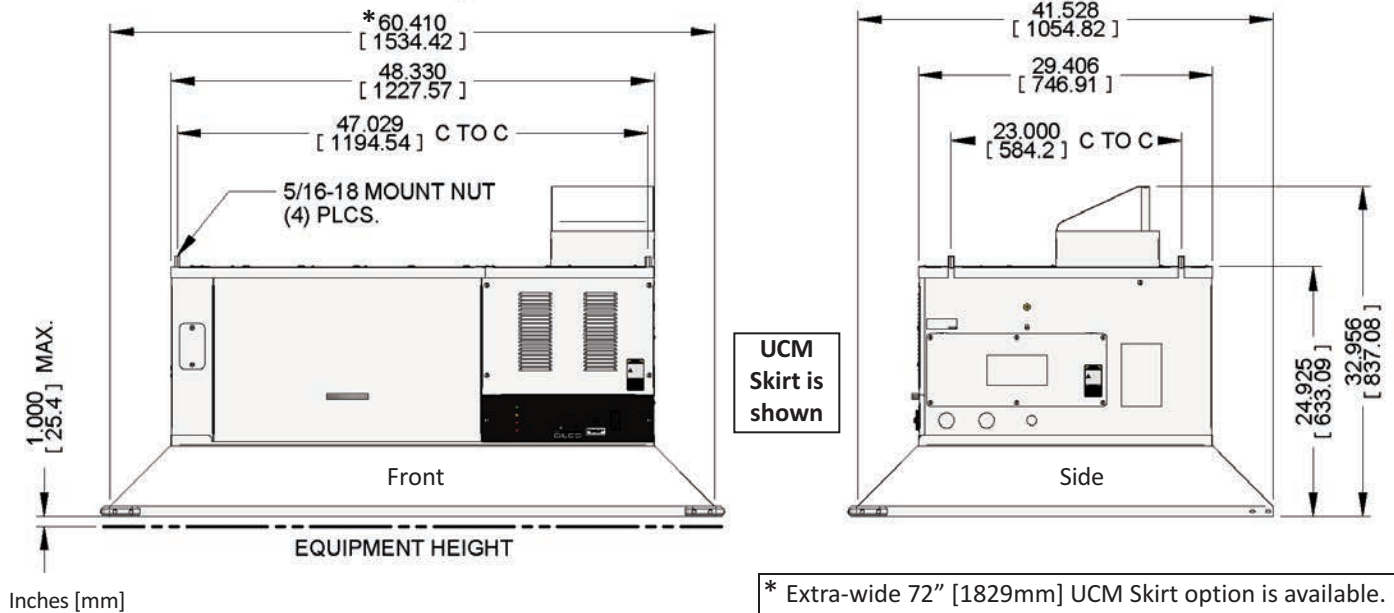
Form 65777 (Rel. Sep.1998, Rev. Feb.2016, Rev. E)

Ventless Hood

Model PO-VH

Project Name/No: _____ Item No: _____

Quantity: _____ SIS#: _____ AIA/CSI#: _____



Specifications

Construction: Exterior structure 18-Ga + 20-Ga Stainless Steel ... Interior structure 18-Ga Aluminized Mild Steel

Dimensions: for Hood with UCM Skirt; other styles will differ

Width	Depth	Height
60-7/16" [1535mm]	41-9/16" [1055mm]	32-15/16" [837mm]

Ventless Hood:

- Exhaust CFM: 314 - 448
- Approx. Sound Level: 65 dB
- Uncrated Weight: 221 lbs [100 kg] (will vary with skirt style)

Electrical Specifications: (Hood Only)

Voltage	Phase	Amps
208-240	1	5

▪ Power cord NOT provided; unit must be field wired.

Shipping Specifications: Freight Class 125

Width	Depth	Height	Cube	Crated Weight
68" [1727mm]	49" [1245mm]	34" [864mm]	65.5 ft ³ [1.86 m ³]	337 lbs [153 kg]

Included Accessories:

(1) Baffle Filter (1) EAC Filter Cell (1) Charcoal Filter (1) EAC Soaking Tank

How To Specify

- **Local Code**
Confirm that local code permits use of Ventless Recirculating Hoods.
- **Appliance Constraints**
Verify that the appliance meets the specified hood constraints (table on front). Please contact Giles if there is a question about whether the OVH-10 is approved for your intended appliance application.
- **Electrical Specifications**
Determine if available electrical specification of the Hood complies with the power supply at intended installation location.
- **Determine PO-VH Model**
See the Order Sheet for available Direct Mount PO-VH Hoods. If your specific appliance is not listed, specify the Universal Ceiling Mount (UCM) model, or contact Giles about the possibility of creating a skirt for the particular application.
- **Determine Options Desired:**
 - **Fire Extinguishing System**
Local code may require this type Hood be equipped with a Fire Extinguishing System. The option provides factory-installed piping, nozzles, and fusible link conduit and brackets. **Other components and final system installation must be preformed by a certified Fire Protection Agent, to be provided by the customer.**

Options (continued):

- **HEPA Filter**
Substitute for the Electronic Air Cleaner (EAC) system. Uses replaceable HEPA filter to provide ultimate filtration. Filter cannot be cleaned; must be replaced periodically. **This option may not be suitable for all applications; please contact Giles for additional information.**
- **50-Hz Configuration**
Typically for export locations requiring 50-Hz, WYE load configuration (4-wire + grnd).
- **Extra-Wide Skirt (UCM Model ONLY)**
72" [1829mm] wide skirt provides more useable space under the Hood to accommodate a larger appliance, meeting the Appliance Constraints.
- **Determine Additional Accessories needed:**
Purchased separately; specify part number & quantity.
- **Shipping:**
Specify preferred shipping method.

Specifications and/or product design are subject to change without notice. Such revisions do not entitle the buyer to corresponding changes, improvements, additions or replacements for previously purchased equipment.

Order Sheet: PO-VH

Select Hood Model (Choose Ceiling Mount - OR - one from the list of available Direct Mount models)

• Ceiling Mount Hood - Hanging over Appliance

<input checked="" type="checkbox"/>	Part No.	Hood Description	Hood Electrical Spec	Appliance Manufacturer	Model	Oven Type
	79769	PO-VH, UCM1, 60" WIDE SKIRT	208-240/60/1	All	Universal	See Appliance Constraints
	71136	PO-VH, UCM2, 72" WIDE SKIRT	208-240/60/1	All	Universal	See Appliance Constraints

• Direct Mount Hood - Attached to Appliance

<input checked="" type="checkbox"/>	Part No.	Hood Description	Hood Electrical Spec	Appliance Manufacturer	Model	Oven Type
	79797	PO-VH, BLODGETT MARK-V, CONVECTION	208-240/60/1	Blodgett	Mark-V	Oven
	79781	PO-VH, MIDDLEBY, CTX-26	208-240/60/1	Middleby-Marshall	Toastmaster CTX-26	Conveyor
	79785	PO-VH, MIDDLEBY, CTX-33	208-240/60/1	Middleby-Marshall	Toastmaster CTX-33	Conveyor
	79789	PO-VH, MIDDLEBY, CTX-55	208-240/60/1	Middleby-Marshall	Toastmaster CTX-55	Conveyor
	79777	PO-VH, EURO/OLIVER-4	208-240/60/1	Euro/Oliver	4" Frame	Oven
	71260	PO-VH, HOBART-HR7	208-240/60/1	Hobart	HR7	Rotisserie
	79793	PO-VH, LANG ECCO	208-240/60/1	Lang	ECCO	Conveyor
	71091	PO-VH, LINCOLN IMPINGER, DTF-4	208-240/60/1	Lincoln	1921 or 1922	Conveyor
	71111	PO-VH, LINCOLN IMPINGER, DTF-8	208-240/60/1	Lincoln	1980 or 1981	Conveyor
	79765	PO-VH, LINCOLN IMPINGER II	208-240/60/1	Lincoln	1100, 1132	Conveyor
	70947	PO-VH, MIDDLEBY PS536	208-240/60/1	Middleby-Marshall	PS536	Conveyor
	79801	PO-VH, RANDELL 101M	208-240/60/1	Randell Mfg	101M	Deck Oven

• Select Option(s) to be factory installed (Choose Standard or combination of Options)

To specify Hoods with Options, append desired Option Code (or multiple Codes in ascending order) to the base Hood Part Number as: **XXXXX-3, XXXXX-38, etc.** ONLY the base part number is needed for a standard Hood.

<input checked="" type="checkbox"/>	Option Code	Description
	-----	STANDARD - NO OPTIONS
	3	FIRE EXTINGUISHING SYSTEM PIPING & LINK CONDUIT
	6	50-Hz 'WYE' POWER CONFIGURATION
	8	HEPA FILTER VERSION HOOD

• Select Extra Items - Sold separately (specify quantity)

Qty.	Part No.	Description
	20520	EAC FILTER
	30248	CHARCOAL FILTER
	39325	EAC SOAK TANK

Giles Foodservice Equipment

2750 Gunter Park Drive West • Montgomery, AL 36109 USA

Phone: 334.272.1457 • Toll Free: 800.554.4537 • Fax 334.239.4117

Website: www.gfse.com • Email: services@gfse.com

Submittal Sheet

10/16/2018

ITEM# 30.1 - SNEEZE GUARD (1 EA REQ'D)

Versa-Gard VP24.3

VG Series. Full service food protector with 24" tall vertical glass. 1" OD Solid Supports. End glass panels are 1/4" clear tempered. All glass meets ANSI Z97.1 specifications for safety performance and ASTM C1048-04 specifications for heat treated glass. All hardware supplied in a brushed stainless steel finish. All glass with ground and polished edges. Conceal mount hardware.

ACCESSORIES

Mfr	Qty	Model	Spec
			LED LIGHT



VP24.3

Protected by US Patent 7,040,723
Other Patents Pending

Full Service Vertical Protector

- Cafeteria Counters
- Cooking Stations
- Carving Stations

FINISH:

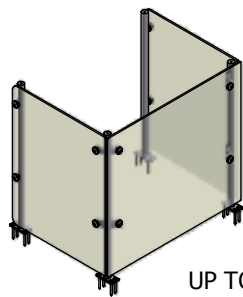
- Brushed Stainless Steel
- Clear Anodized Aluminum
- Powder Coat:
 - Black Silver
- RAL # _____

GLASS:

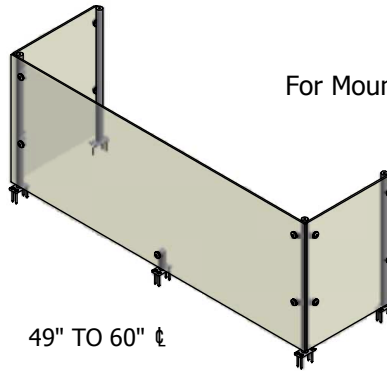
- 1/4" Clr Temp - Std
- Frosted

OPTIONS(*):

- End Panel - LT
- End Panel - RT
- Light Fixture
- Warmer
- Shelf Kit

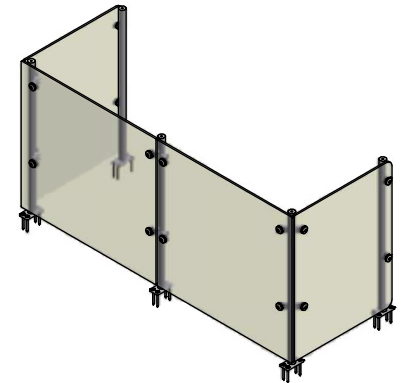


UP TO 48" \pm



49" TO 60" \pm

(*) Not all options available on all models
Contact factory for specific information
For Mounting Options see Mounting Hardware Guide



OVER 60" \pm

NSF/ANSI 2 - 2010 Standards Requirements:

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5.35.11 Food Shields for use on cooking and/or carving station operations

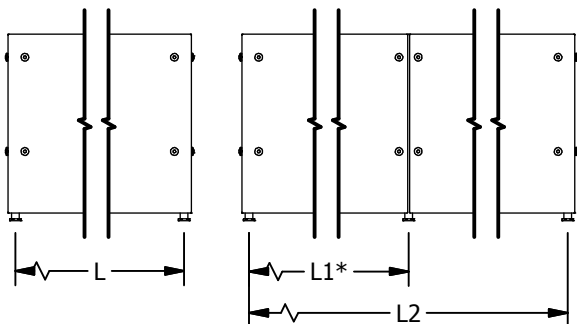
- 5.35.11.1 Shields for use on a cooking and/or carving station shall include a vertical barrier to a minimum height of 60 inches above the finished floor.
- 5.35.11.2 Maximum vertical distance from the bottom edge of the shield and counter top shall be 6 inches
- 5.35.11.3 Minimum horizontal distance between the front inside edge of displayed food and front (customer side) face of shield shall be 3/4 of the vertical distance (.75 x 6" = 4") of 5.35.11.2

5.35.12 Food Shields for use on cafeteria counters

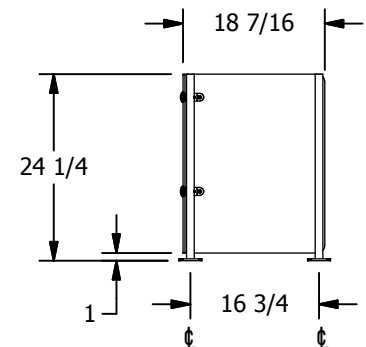
- 5.35.12.1 The sum of a shield's protected horizontal plane (X) and its protected vertical plane (Y) shall be greater than or equal to 32 inches. When (X) = 0, (Y) shall be a minimum of 60 inches from finished floor
- 5.35.12.2 Maximum distance from the bottom edge of the front vertical glass and counter top shall be 1.5 inches
- 5.35.12.3 Maximum distance between the vertical glass and horizontal glass is 3/4 inch
- 5.35.12.4 Minimum horizontal distance between the front inside edge of displayed food and the bottom leading edge of the shield s 1.5 inches
- 5.35.6 A vertical barrier (end shield) shall be provided at each end of a foodshield. The vertical barrier shall be a minimum of 18 inches deep (front to back) beginning at the bottom leading edge of the foodshield. The minimum height of the vertical barrier shall be equal to the overall height of the foodshield. The maximum distance from the bottom edge of the vertical barrier and counter top shall be 1.5 inches.
- 5.35.6.1 A foodshield intended to be installed a maximum of 3" (76mm) from a building wall perpendicular to the foodshield is exempt from the requirements of 5.35.6 provided that the height of the building wall is not lower than the overall height of the foodshield.

(2) End Panels per unit unless otherwise specified. End panels are 1/4" clear tempered glass unless otherwise specified.

-Centerline Dimensions -
L / L1 - 60" Max (1/4" Glass)



(* - Middle support is centered unless L1 dimension is specified)



Submittal Sheet

10/16/2018

ITEM# 30.2 - SNEEZE GUARD (1 EA REQ'D)

Versa-Gard VP24.3

VG Series. Full service food protector with 24" tall vertical glass. 1" OD Solid Supports. End glass panels are 1/4" clear tempered. All glass meets ANSI Z97.1 specifications for safety performance and ASTM C1048-04 specifications for heat treated glass. All hardware supplied in a brushed stainless steel finish. All glass with ground and polished edges. Conceal mount hardware.

The spec sheet for this item can be viewed on item 30.1)

ACCESSORIES

Mfr	Qty	Model	Spec
			LED LIGHT

Submittal Sheet

10/16/2018

ITEM# 30.3 - SNEEZE GUARD (1 EA REQ'D)

Versa-Gard VP24.3

VG Series. Full service food protector with 24" tall vertical glass. 1" OD Solid Supports. End glass panels are 1/4" clear tempered. All glass meets ANSI Z97.1 specifications for safety performance and ASTM C1048-04 specifications for heat treated glass. All hardware supplied in a brushed stainless steel finish. All glass with ground and polished edges. Conceal mount hardware.

The spec sheet for this item can be viewed on item 30.1)

ACCESSORIES

Mfr	Qty	Model	Spec
			LED LIGHT

Submittal Sheet

10/16/2018

ITEM# 30.4 - SNEEZE GUARD (1 EA REQ'D)

Versa-Gard VP24.3

VG Series. Full service food protector with 24" tall vertical glass. 1" OD Solid Supports. End glass panels are 1/4" clear tempered. All glass meets ANSI Z97.1 specifications for safety performance and ASTM C1048-04 specifications for heat treated glass. All hardware supplied in a brushed stainless steel finish. All glass with ground and polished edges. Conceal mount hardware.

The spec sheet for this item can be viewed on item 30.1)

ACCESSORIES

Mfr	Qty	Model	Spec
			LED LIGHT

Submittal Sheet

10/16/2018

ITEM# 31 - MENU BOARD (1 EA REQ'D)

Provided by Operations CONTACT OPERATIONS

Submittal Sheet

10/16/2018

ITEM# 31.1 - OMS SCREEN (1 EA REQ'D)

Provided by Operations CONTACT OPERATIONS

Submittal Sheet

10/16/2018

ITEM# 40 - OPEN MERCHANDISER (2 EA REQ'D)

Federal Industries RSSM-478SC

Specialty Display High Profile Self-Serve Refrigerated Merchandiser, 47"W x 35"D x 78"H, self contained refrigeration, energy saving night curtain, top light, (4) tiers of adjustable black metal shelves, stainless steel display deck, black interior, tempered glass ends, choice of laminate, designed for continuous lineups, condensate evaporator provided, DOE 2012 compliant, UL, UL EPH CLASSIFIED

ACCESSORIES

Mfr	Qty	Model	Spec
Federal Industries	2		One year parts & labor warranty
Federal Industries	2		Self-contained refrigeration standard
Federal Industries	2		Five year compressor warranty, standard (for self-contained units only)
Federal Industries	2		Stainless steel in lieu of laminate
Federal Industries	2		LED top light & below shelves, in lieu of fluorescent
Federal Industries	2		Condensate evaporator assembly (field install kit, dedicated 120v, 15.0 amp dedicated circuit required)
Federal Industries	2		Sound deadening kit, foam insulated base
Federal Industries	2		Stainless steel interior back
Federal Industries	2		Security night cover, black polycarbonate, removable
Federal Industries	2		Front condensing unit air discharge (for self-contained units ONLY)
Federal Industries	2		Casters (includes cord & plug) (for self-contained units only)

ELECTRICAL

	VOLTS	CYCLE	PHASE	CONN	AFF	NEMA	AMPS	KW	HP	MCA	MOCP
1	120	60	1				15				



a Standex company

ITEM: _____ PROJECT NAME: _____ DATE: _____

REFRIGERATED SELF-SERVE HIGH PROFILE SPECIALTY MERCHANDISER

MODEL RSSM-360SC RSSM-378SC
 RSSM-460SC RSSM-478SC
 RSSM-560SC RSSM-578SC
 RSSM-660SC RSSM-678SC



Designed with impulse sales in mind. Get maximum return from an attention-grabbing merchandiser and increase profits. Available in lengths of 3', 4', and 6', and 60" or 78" high.

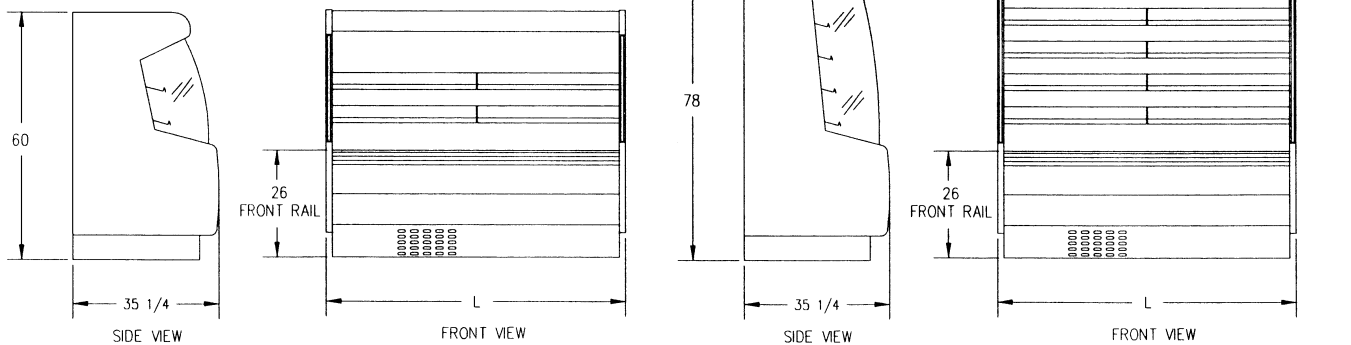
STANDARD FEATURES

- Adjustable black metal shelves with price tag molding. Shelves can be flat or slanted. The 60" case has two tiers of shelves, the 78" case has four tiers.
- Top mounted octron shielded light. Shelf lights optional.
- Choice of six standard laminates on exterior. Other color laminates are optional. Black metal front grill and galvanized steel back.
- Silver trim, gold, and black optional.
- Stainless steel display deck, glass and black interior ends, black interior back panel.
- Energy saving night curtain.
- Solid state timer provides automatic defrost.
- Condensate evaporator provided for a totally self-contained system. (Not available on RSSM-560SC and RSSM-660SC. Condensate pump provided.)
- Insulated with high-density urethane foam.
- Continuous line-ups are available for remote applications.
- Refrigeration controls maintain 40°F. Note: Case temperature will vary if the air curtain is disrupted.
- The rear of the unit needs to be 6" from a wall.
- Thermometer.
- UL Safety and UL Sanitation Listed.

REFRIGERATED SELF-SERVE HIGH PROFILE SPECIALTY MERCHANDISER

OPTIONAL ACCESSORIES:

- | | | |
|--|--|---|
| <input type="checkbox"/> Special Laminate Finish | <input type="checkbox"/> Light Below Shelves | <input type="checkbox"/> Condensate Pump |
| <input type="checkbox"/> Roll-up Security Cover or Removable Night Cover | <input type="checkbox"/> Black or Gold Trim | <input type="checkbox"/> Condensate Evaporator Assembly (Field Install) |
| <input type="checkbox"/> Wire Shelves in Lieu of Flat Metal | <input type="checkbox"/> Wire Baskets in Lieu of Flat Metal | |
| <input type="checkbox"/> Joining Kit for Continuous Line-ups | <input type="checkbox"/> Deli Meat Hooks or Pegs | |
| <input type="checkbox"/> Remote Refrigeration with Condensate Pump | <input type="checkbox"/> Casters (Self-Contained Models Only) Cord Included | |
| <input type="checkbox"/> Front Condensing Unit Air Discharger | <input type="checkbox"/> Cord & Plug (Self-Contained Models Only) (NEMA L14-20P) | |
| <input type="checkbox"/> Sliding and Hinged Rear Access Doors | <input type="checkbox"/> Reflective End Glass | |
| <input type="checkbox"/> Rear Side Panel Extensions (Six Inches) | <input type="checkbox"/> Legs | |
| <input type="checkbox"/> Slim 30" Deep Profile | | |
| <input type="checkbox"/> White Interior (Including Shelving) | | |



SPECIFICATIONS:

Model	Dimensions L W H	Shipping Weight (lbs)	Shelving	Self-Contained 3-Wire Plus Ground 208-240/60/1	Remote 120/60/1
<input type="checkbox"/> RSSM-360SC	36" x 35 1/4" x 60"	709	2 (15" x 34")	1/2 HP • 10 AMPS	3 AMPS
<input type="checkbox"/> RSSM-460SC	47 1/4" x 35 1/4" x 60"	800	2 (15" x 45")	3/4 HP • 13 AMPS	4 AMPS
<input type="checkbox"/> RSSM-560SC	59 1/4" x 35 1/4" x 60"	960	2 (15" x 57")	1 HP • 10 AMPS	5 AMPS
<input type="checkbox"/> RSSM-660SC	71 1/4" x 35 1/4" x 60"	1,020	4 (15" x 34")	1 HP • 10 AMPS	6 AMPS
<input type="checkbox"/> RSSM-378SC	36" x 35 1/4" x 78"	835	4 (15" x 34")	1/2 HP • 10 AMPS	3 AMPS
<input type="checkbox"/> RSSM-478SC	47 1/4" x 35 1/4" x 78"	925	4 (15" x 45")	3/4 HP • 13 AMPS	4 AMPS
<input type="checkbox"/> RSSM-578SC	59 1/4" x 35 1/4" x 78"	1,160	4 (15" x 57")	1 HP • 15 AMPS	5 AMPS
<input type="checkbox"/> RSSM-678SC	71 1/4" x 35 1/4" x 78"	1,220	8 (15" x 34")	1 HP • 15 AMPS	6 AMPS

- Case temperature will vary if the air curtain is disrupted.
- The rear of the unit needs to be 6" from a wall.
- Electrical Requirement – The minimum circuit ampacity and maximum fuse size is 20 amps.
A 120/208-240 volt, 60 hertz, 1 phase, 3-wire plus ground power supply.
- Refrigerated cases are designed to operate in a maximum of 75°F ambient and 55% relative humidity.
- Due to continuing engineering improvements, specifications are subject to change without notice.



The Signature of Quality

FEDERAL INDUSTRIES
A Standex Company

215 FEDERAL AVENUE, BELLEVILLE, WISCONSIN 53508-9201

PHONE: 800-356-4206

FAX: 608-424-3234

EMAIL: geninfo@federalind.com

WEBSITE: www.federalind.com



Submittal Sheet

10/16/2018

ITEM# 41 - INDUCTION RETHERMALIZER (4 EA REQ'D)

Vollrath 74110110

Mirage® Induction Soup Rethermalizer, 11 quart, dry use, temperature control in °F or °C, (4) soup presets, stir indicator LED, solid state controls with locking function, includes: induction ready inset & inset cover, natural & black finish, 800W, 6.7 amps, cord with NEMA 5-15P, 120v/60/1-ph, cULus, NSF, FCC, imported (cover not NSF)

ACCESSORIES

Mfr	Qty	Model	Spec
Vollrath	4		Requires use of included Vollrath induction-ready inset - failure to use these insets may damage the unit & will void the warranty
Vollrath	4	88204	Inset, 11 quart, induction ready, for Mirage induction rethermalizer, NSF
Vollrath	4	47490	Kool-Touch Hinged Cover, stainless with black phenolic knob, fits 78204 Inset & 77110 Double Boiler, imported

ELECTRICAL

	VOLTS	CYCLE	PHASE	CONN	AFF	NEMA	AMPS	KW	HP	MCA	MOCP
1	120	60	1	Cord & Plug		5-15P	6.7	.8			



Outperform every day.™

Project:
Item Number:
Quantity:

Mirage® Induction Countertop Rethermalizer

The Vollrath Company, L.L.C.

MIRAGE® INDUCTION COUNTERTOP RETHERMALIZER



ITEMS

- 7470110 7 Qt. Induction Rethermalizer, Natural (US/CAN)**
- 7470140 7 Qt. Induction Rethermalizer, Red (US/CAN)**
- 74110110 11 Qt. Induction Rethermalizer, Natural (US/CAN)**
- 74110140 11 Qt. Induction Rethermalizer, Red (US/CAN)**

FEATURES

- 800 watt 3D induction coil heats food evenly and efficiency.
- Dry use. Heat is transferred directly to the induction-ready inset, which eliminates the need to monitor and refill water levels.
- Three temperature sensors have direct contact with the inset to provide very accurate temperature control. Sensors help prevent food in near-empty insets from burning, which maintains food quality and reduces food waste.
- Sensors measure differences in food temperatures. This drives the Stir Indicator LED that informs operators the food product should be stirred.
- Advanced solid state controls with highly visible white LEDs include: temperature control in °F and °C; four presets - broth soups, crème soups, chili, mac and cheese; rethermalize mode; stirring indicator; and a locking function that prevents untrained operators from changing settings.
- Maximum temperature setting of 190°F.
- Includes cover – item 47488 for 7 Qt. or 47490 for 11 Qt., and inset – item 88184 for 7 Qt. or item 88204 for 11 Qt. Covers and insets are also sold separately.
- Requires use of included Vollrath induction-ready inset.
- Meets NSF4 Performance Requirements for rethermalization and hot food holding equipment.
- 6' power cord plugs into any NEMA 5-15R 15 or 20 amp 120V receptacle.

DESCRIPTION

Vollrath's Mirage® Induction Countertop Rethermalizers use innovative induction technology to run dry without a water bath, improve food quality and minimize food waste; while using a fraction of the energy.

Mirage® Induction Countertop Rethermalizers are shipped complete with an induction-ready inset and slotted hinged cover. The cover is not NSF.

PERFORMANCE CRITERIA

The Mirage® Induction Countertop Rethermalizer are designed to take a container of cooked food from a chilled state (below 40.0° F [4.4° C]) through the HACCP "danger zone" of 165° F (73.9° C) in less than 90 minutes. The performance standard is measured using the NSF mixture chilled to 35° F (1.7° C). The electric unit will raise the temperature of this product above 165° F (73.9° C) in less than 90 minutes. The temperature will be maintained above 150° F (65.6° C) when the food product and pan or inset are used with a standard pan or inset cover, and the food product is stirred regularly.

CLEARANCE AND ENVIRONMENT REQUIREMENTS

- Failure to use Vollrath induction-ready insets may damage the unit and will void the warranty.
- All models require unrestricted intake and exhaust air ventilation for proper operation of the controls. The maximum intake temperature must not exceed 110°F (43°C). Temperatures are measured in ambient air while all appliances in the kitchen are in operation.
- Countertop models require a minimum clearance of 4 inches (10.2 cm) at the rear and 1 inch (2.5 cm) at the bottom.

WARRANTY

All models shown come with Vollrath's standard warranty against defects in materials and workmanship. For full warranty details, please refer to www.Vollrath.com.

Agency Listings



This device complies with Part 18 FCC Rules.

Cover is not NSF.

Due to continued product improvement, please consult www.vollrath.com for current product specifications.

Approvals	Date



Outperform every day.™

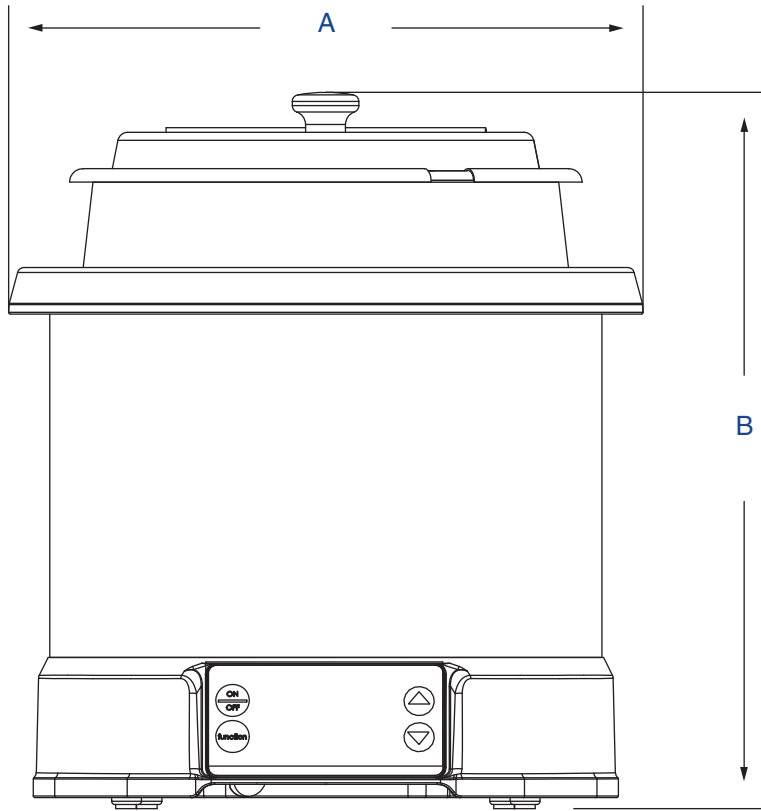
The Vollrath Company, L.L.C.

1236 North 18th Street
Sheboygan, WI 53081-3201 U.S.A.
Main Tel: 800.624.2051 or 920.457.4851
Main Fax: 800.752.5620 or 920.459.6573
Customer Service: 800.628.0830
Canada Customer Service: 800.695.8560

Technical Services
techservicereps@vollrathco.com
Induction Products: 800.825.6036
Countertop Warming Products: 800.354.1970
All Other Products: 800.628.0832

MIRAGE® INDUCTION COUNTERTOP RETHERMALIZER

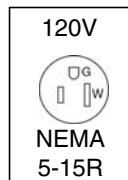
DIMENSIONS (shown in inches (cm))



SPECIFICATIONS

Item No.	Capacity QT (L)	Dimensions		Well Depth IN (CM)	Voltage	Watts	Amps	Plug	Shipping Dimensions IN (CM)	Shipping Weight LB (KG)
		(A) Width	(B) Height							
7470110	7	11 ⁷ / ₈	13 ¹ / ₂ (34.2)	6 ⁷ / ₈ (17.6)	120V	800W	6.7A	NEMA 5-15P	14 ³ / ₄ x 14 ³ / ₄ v 15 (37.3 x 37.3 x 38.1)	11.4
7470140	(6.6)	(30.3)								(5.2)
74110110	11	13 ⁷ / ₈	13 ¹ / ₂ (34.2)	6 ⁷ / ₈ (17.6)	120V	800W	6.7A	NEMA 5-15P	14 ³ / ₄ x 14 ³ / ₄ v 15 (37.3 x 37.3 x 38.1)	13.4
74110140	(10.4)	(35.3)								(6.1)

Receptacle



Outperform every day.™

www.vollrath.com

The Vollrath Company, L.L.C.

1236 North 18th Street
 Sheboygan, WI 53081-3201 U.S.A.
 Main Tel: 800.624.2051 or 920.457.4851
 Main Fax: 800.752.5620 or 920.459.6573
 Customer Service: 800.628.0830
 Canada Customer Service: 800.695.8560

Technical Services
techservicereps@vollrathco.com
 Induction Products: 800.825.6036
 Countertop Warming Products: 800.354.1970
 All Other Products: 800.628.0832

Countertop Rethermalizers

- Ships with induction-ready inset and hinged cover
- Set temperature in F° or C° for soup, cream soup, mac & cheese, or chili



ITEM #	DESCRIPTION	COLOR	DIMENSIONS IN (CM)	FREQUENCY	VOLTAGE	WATTS	AMPS	PLUG	CASE LOT
7470110	7 qt induction rethermalizer	Silver	11½ x 13½ (30.3 x 34.2)	50/60Hz	120	800	6.7	5-15P	1
7470140	7 qt induction rethermalizer	Red	11½ x 13½ (30.3 x 34.2)	50/60Hz	120	800	6.7	5-15P	1
74110110	11 qt induction rethermalizer	Silver	13½ x 13½ (35.3 x 34.2)	50/60Hz	120	800	6.7	5-15P	1
74110140	11 qt induction rethermalizer	Red	13½ x 13½ (35.3 x 34.2)	50/60Hz	120	800	6.7	5-15P	1

REPLACEMENT INSET ITEM #	REPLACEMENT INSET	REPLACEMENT COVERS	DESCRIPTION
88184	7 qt induction inset	47488	Hinged inset cover, fits 7 qt inset
88204	11 qt induction inset	47490	Hinged inset cover, fits 11 qt inset
88184NS*	7¼ qt nonstick induction inset	88184NS*	7¼ qt nonstick induction inset
88204NS*	11 qt nonstick induction inset	88204NS*	11 qt nonstick induction inset

*Nonstick insets are made to order; call Vollrath for minimums and leadtime

For 7 quart International models with 220-240V, change the fifth digit to "2" for Schuko, "3" for UK, "4" for China, or "5" for Australia (e.g., Schuko 7470110 to 7470210)
 For 11 quart International models with 220-240V, change the sixth digit to "2" for Schuko, "3" for UK, "4" for China, or "5" for Australia (e.g., Schuko 74110110 to 74110210)

Drop-In Warmers & Rethermalizers

- Includes mounting hardware
- Ships with induction-ready inset and hinged cover
- No manifolds or drains
- Warmers only available in drop-ins



ITEM #	DESCRIPTION	DIMENSIONS IN (CM)	DROP-IN MAX WIDTH	WELL DEPTH	CUTOUT DIAMETER	VOLTAGE	WATTS	AMPS	PLUG	CASE LOT
74701DW	7 qt induction warmer	11½ x 12½ (30.3 x 31.3)	10½ (26.5)	6½ (17.6)	10½ (27)	120	250	2.1	5-15P	1
74701D	7 qt induction rethermalizer	11½ x 13½ (30.3 x 34.2)	10½ (26.5)	6½ (17.6)	10½ (27)	120	800	6.7	5-15P	1
741101DW	11 qt induction warmer	13½ x 13½ (35.3 x 34.2)	12½ (31.2)	6½ (17.6)	12½ (32.1)	120	250	2.1	5-15P	1
741101D	11 qt induction rethermalizer	13½ x 13½ (35.3 x 34.2)	12½ (31.2)	6½ (17.6)	12½ (32.1)	120	800	6.7	5-15P	1

For 7 quart International models with 220-240V, change the fifth digit to "2" for Schuko, "3" for UK, "4" for China, or "5" for Australia (e.g., Schuko 7470110 to 7470210)
 For 11 quart International models with 220-240V, change the sixth digit to "2" for Schuko, "3" for UK, "4" for China, or "5" for Australia (e.g., Schuko 74110110 to 74110210)

NEW Stainless Steel Decorative Ring

- Easy to install
- Durable 22-gauge stainless steel
- Provides an upscale, aesthetically pleasing look



ITEM #	DESCRIPTION	COLOR
47491	7 qt stainless steel ring for induction soup drop-ins	Stainless Steel
47492	11 qt stainless steel ring for induction soup drop-ins	Stainless Steel

watch it on VOLLRATH.COM

Watch a video presentation about the award-winning features of the *Mirage® Soup Induction Rethermalizer*.

Submittal Sheet

10/16/2018

ITEM# 42.1 - SNEEZE GUARD (1 EA REQ'D)

Versa-Gard VG3.3-DS

VG Series. Double-sided adjustable self service food protector with straight glass and top shelf. Adjustable in 7 different self-service positions. 1" OD Solid Supports. End glass panels are 1/4" clear tempered. All glass meets ANSI Z97.1 specifications for safety performance and ASTM C1048-04 specifications for heat treated glass. All hardware supplied in a brushed stainless steel finish. All glass with ground and polished edges. Conceal mount hardware.

ACCESSORIES

Mfr	Qty	Model	Spec
			LED LIGHT



VG3.3-DS

Protected by US Patent 7,040,723
Other Patents Pending

Double Sided Adjustable Self-Service Protector w/ Shelf

FINISH:

- Brushed Stainless Steel
- Clear Anodized Aluminum
- Powder Coat:
 - Black Silver
- RAL # _____

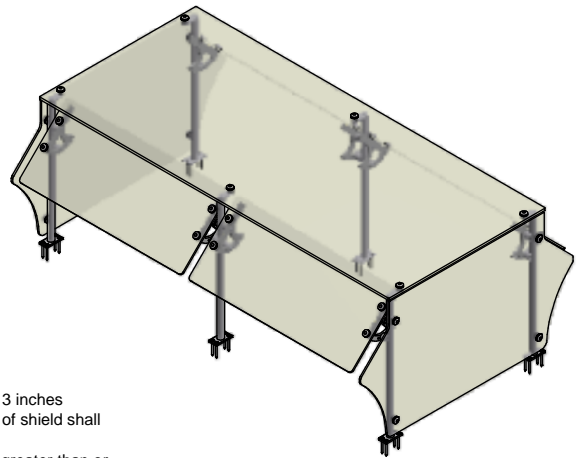
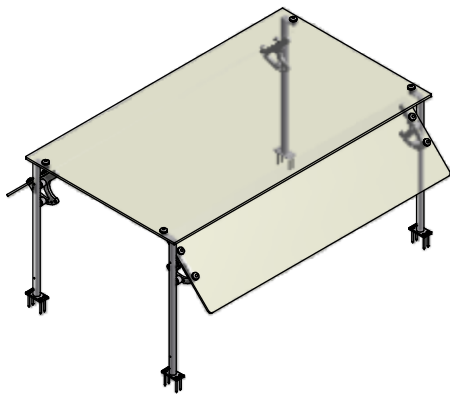
GLASS (Clear Tempered):

- 1/4" Front - Std
- 3/8" Top - Std
- 1/2" Top
- Frosted

OPTIONS(*):

- End Panel - LT
- End Panel - RT
- Light Fixture
- Warmer
- Shelf Kit

(*) Not all options available on all models
Contact factory for specific information
For Mounting Options see Mounting Hardware Guide



NSF/ANSI 2 - 2010 Standards Requirements:

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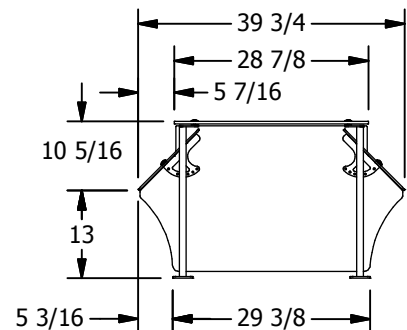
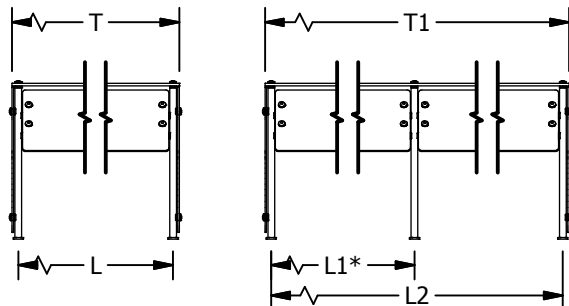
5.35.7 Self service food shields

- 5.35.7.1 Maximum vertical distance between counter top and bottom leading edge of shield shall be 13 inches
- 5.35.7.2 Minimum horizontal distance between the front inside edge of food and bottom leading edge of shield shall be 3/4 of the Max. vertical distance of 5.35.7.1 (.75 x 13" = 9.75")
- 5.35.7.3 The sum of a shield's projected vertical plane (Y) and projected horizontal plane (X) shall be greater than or equal to 20 inches. Either (X) or (Y) may equal 0
- 5.35.7.5 Maximum horizontal distance between vertical, horizontal, and angled panels at post and framing member locations shall be 2 inches
- 5.35.7.10 Food shields for use on mobile buffet counters shall conform to 5.35.7

- 5.35.6 A vertical barrier (end shield) shall be provided at each end of a foodshield. The vertical barrier shall be a minimum of 18 inches deep (front to back) beginning at the bottom leading edge of the foodshield. The minimum height of the vertical barrier shall be equal to the overall height of the foodshield. The maximum distance from the bottom edge of the vertical barrier and counter top shall be 1.5 inches.
- 5.35.6.1 A foodshield intended to be installed a maximum of 3" (76mm) from a building wall perpendicular to the foodshield is exempt from the requirements of 5.35.6 provided that the height of the building wall is not lower than the overall height of the foodshield.

(2) End Panels per unit unless otherwise specified. End panels are 1/4" clear tempered glass unless otherwise specified.

- Centerline Dimensions -
- L / L1 - 48" Max (1/4" Glass)
 - 60" Max (3/8" Glass)
 - 66" Max (1/2" Glass)
 - T - 60" Max (3/8" Glass)
 - T1 - 96" Max (1/2" Glass)



(* - Middle support is centered unless L1 dimension is specified)



Submittal Sheet

10/16/2018

ITEM# 42.2 - SNEEZE GUARD (1 EA REQ'D)

Versa-Gard VG3.3-DS

VG Series. Double-sided adjustable self service food protector with straight glass and top shelf. Adjustable in 7 different self-service positions. 1" OD Solid Supports. End glass panels are 1/4" clear tempered. All glass meets ANSI Z97.1 specifications for safety performance and ASTM C1048-04 specifications for heat treated glass. All hardware supplied in a brushed stainless steel finish. All glass with ground and polished edges. Conceal mount hardware.

The spec sheet for this item can be viewed on item 42.1)

ACCESSORIES

Mfr	Qty	Model	Spec
LED LIGHT			

Submittal Sheet

10/16/2018

ITEM# 42.3 - SNEEZE GUARD (1 EA REQ'D)

Versa-Gard VG3.3-DS

VG Series. Double-sided adjustable self service food protector with straight glass and top shelf. Adjustable in 7 different self-service positions. 1" OD Solid Supports. End glass panels are 1/4" clear tempered. All glass meets ANSI Z97.1 specifications for safety performance and ASTM C1048-04 specifications for heat treated glass. All hardware supplied in a brushed stainless steel finish. All glass with ground and polished edges. Conceal mount hardware.

The spec sheet for this item can be viewed on item 42.1)

ACCESSORIES

Mfr	Qty	Model	Spec
			LED LIGHT

Submittal Sheet

10/16/2018

ITEM# 42.4 - SNEEZE GUARD (1 EA REQ'D)

Versa-Gard VG3.3-DS

VG Series. Double-sided adjustable self service food protector with straight glass and top shelf. Adjustable in 7 different self-service positions. 1" OD Solid Supports. End glass panels are 1/4" clear tempered. All glass meets ANSI Z97.1 specifications for safety performance and ASTM C1048-04 specifications for heat treated glass. All hardware supplied in a brushed stainless steel finish. All glass with ground and polished edges. Conceal mount hardware.

The spec sheet for this item can be viewed on item 42.1)

ACCESSORIES

Mfr	Qty	Model	Spec
LED LIGHT			

Submittal Sheet

10/16/2018

ITEM# 42.5 - SNEEZE GUARD (1 EA REQ'D)

Versa-Gard VG3.3-DS

VG Series. Double-sided adjustable self service food protector with straight glass and top shelf. Adjustable in 7 different self-service positions. 1" OD Solid Supports. End glass panels are 1/4" clear tempered. All glass meets ANSI Z97.1 specifications for safety performance and ASTM C1048-04 specifications for heat treated glass. All hardware supplied in a brushed stainless steel finish. All glass with ground and polished edges. Conceal mount hardware.

The spec sheet for this item can be viewed on item 42.1)

ACCESSORIES

Mfr	Qty	Model	Spec
			LED LIGHT

Submittal Sheet

10/16/2018

ITEM# 50 - PIZZA OVEN, DECK-TYPE, ELECTRIC (1 EA REQ'D)

Bakers Pride EP-3-8-5736

Super Deck Series Pizza Deck Oven, electric, (3) 57"W x 36"D x 7"H cavities, Cordierite hearth decks, top & bottom "U" shaped heating elements every 9-1/2" with infinite heat controls range 300°F - 800°F (149°C - 427°C), 60 min. timer, stainless steel exterior, aluminized steel interior, 12" painted legs, 36kW, NSF, UL, CSA

ACCESSORIES

Mfr	Qty	Model	Spec
Bakers Pride	1		Two year parts & labor warranty standard
Bakers Pride	1		(3) 208v/60/1-ph, 58 amps, 12.0 kw
Bakers Pride	1		Pizza thermostat 800 degrees F, standard
Bakers Pride	1		36" Casters & legs, set of 4

ELECTRICAL

	VOLTS	CYCLE	PHASE	CONN	AFF	NEMA	AMPS	KW	HP	MCA	MOCP
1	208	60	1				58.0	12.0			
2	208	60	1				58.0	12.0			
3	208	60	1				58.0	12.0			



SUPERDECK SERIES 7" DECK HEIGHT ELECTRIC OVENS

SERIES: EP



Bakers Pride® EP series pizza ovens are ideal for high-volume pizza restaurants, offering the same durability and performance as our gas deck ovens but with the low maintenance of an electrical system. The independently controlled, U-shaped heating elements on top and bottom allow for uniform temperatures and perfectly balanced baking. Each oven chamber has one Cordierite deck with a 7" deck height. Choose from two different deck areas and overall widths (38" or 57").

This series is constructed with heavy-duty, .25" angle iron frame, which is full welded to allow for stacking up to three ovens to increase production without sacrificing space. Oven exteriors are all heavy-duty stainless steel and are fully insulated for cooler outer temperatures and consistent interior temperatures.

Options are available to accommodate the configuration of your kitchen, such as side-mounted controls and special-height legs.

FEATURES AT A GLANCE

- 8,000 or 12,000 watts in various voltages (see back)
- 300–800°F (148–343°C) pizza thermostat
- Choose overall width: 55" (1397 mm) or 74" (1880 mm)
- Choose deck area: 38" x 36" (965 x 914 mm) or 57" x 36" (1448 x 914 mm)
- Cordierite deck
- 7" (178 mm) deck height
- Stackable
- 60-minute timer
- Heavy-duty, slide-out flame diverters
- Independent top and bottom heat control dampers
- All stainless steel exteriors, aluminized steel interiors
- Spring-balanced, fully insulated doors
- Heavy-duty steel legs finished with durable Bakertone

- Fully insulated throughout
- Two-year limited warranty

OPTIONS & ACCESSORIES

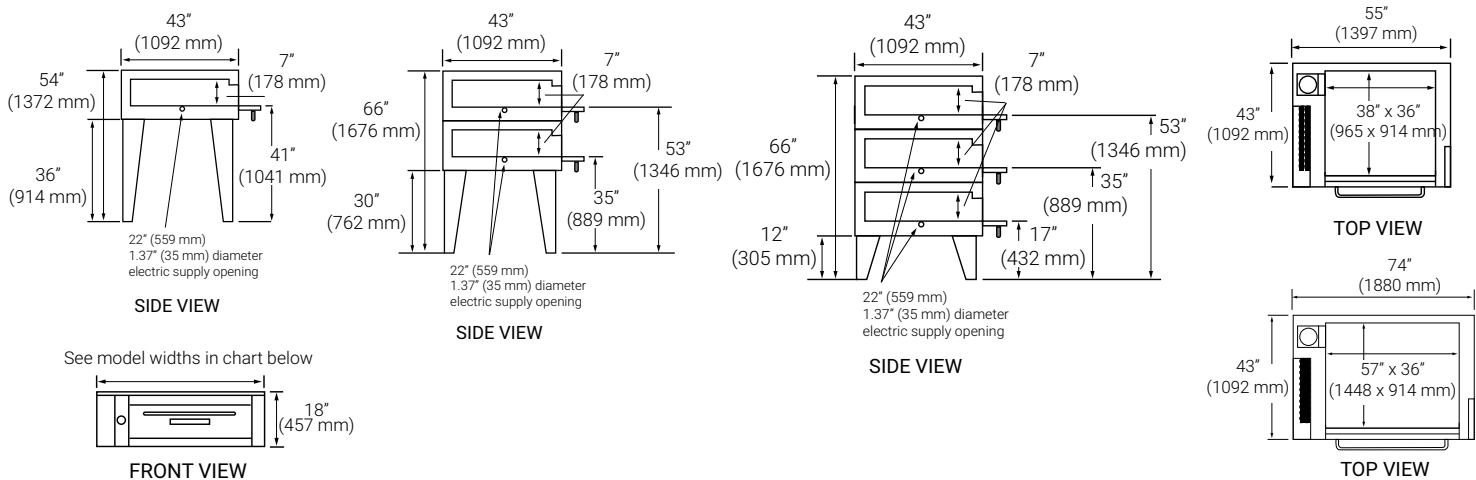
- Stainless steel leg covers (per pair)
- Special-height legs (per set of four)
- 150–550°F (65–287°C) bake thermostat
- 440–480 V
- Five-hour timer
- Automatic oven starter
- Deck brush and scraper (48" (1219 mm) long with wood handle)
- Stainless steel wood chip box
- Legs with casters
- Lightstone or steel decks



SUPERDECK SERIES 7" DECK HEIGHT ELECTRIC OVENS

SERIES: EP

EQUIPMENT DIMENSIONS



MECHANICAL SPECIFICATIONS

Model #	Overall Dim** (W x H x D)	Deck Height	Deck Size	Decks	Baking Chambers	Thermostat Range	Required Clearances	Carton Dim (W x H x D)	Cubic Feet	Cubic Meter	Ship Wt.*
EP-1-8-3836	55" x 54" x 43" (1397 x 1372 x 1092)	7"	38" x 36" (965 x 914)	1	1	300°-800°F (149-427°C)	0" (0 mm)	60" x 48" x 24" (1524 x 1219 x 610)	40	1.1	600 (273kg)
EP-2-8-3836	55" x 66" x 43" (1397 x 1676 x 1092)	7"	38" x 36" (965 x 914)	2	2	300°-800°F (149-427°C)	0" (0 mm)	*	*	*	1200 (544kg)
EP-3-8-3836	55" x 66" x 43" (1397 x 1676 x 1092)	7"	38" x 36" (965 x 914)	3	3	300°-800°F (149-427°C)	0" (0 mm)	*	*	*	1800 (819kg)
EP-1-8-5736	74" x 54" x 43" (1880 x 1372 x 1092)	7"	57" x 36" (1448 x 914)	1	1	300°-800°F (149-427°C)	0" (0 mm)	79" x 48" x 24" (2007 x 1219 x 610)	40	1.1	700 (318kg)
EP-2-8-5736	74" x 66" x 43" (1880 x 1676 x 1092)	7"	57" x 36" (1448 x 914)	2	2	300°-800°F (149-427°C)	0" (0 mm)	*	*	*	1500 (680kg)
EP-3-8-5736	74" x 66" x 43" (1880 x 1676 x 1092)	7"	57" x 36" (1448 x 914)	3	3	300°-800°F (149-427°C)	0" (0 mm)	*	*	*	2250 (1021kg)

*Each oven ships in separate carton as do the legs. Refer to the single unit for shipping specifications. Shipping weight shown includes all decks and legs.

**Height includes 36" (914 mm) on single units, 30" (762 mm) legs on double units, and 12" (305 mm) on triple stacked units.

POWER SUPPLY

Model #	Watts	Voltage	Phase	Amps			
				L1	L2	L3	N
All 3836 models	8,000	208	3	25	25	29	
	8,000	220/240	3	22	22	28	
	8,000	208	1	39	39		
	8,000	220/240	1	35	35		
	8,000	230	1	35			35
	8,000	440-480	3	12	12	14	
	8,000	440-480	1	18	18		

POWER SUPPLY

Model #	Watts	Voltage	Phase	Amps			
				L1	L2	L3	N
All 5736 models	12,000	208	3	39	39	39	
	12,000	220/240	3	35	35	35	
	12,000	208	1	58	58		
	12,000	220/240	1	52	52		
	12,000	230	1	52			52
	12,000	440-480	3	18	20	18	
	12,000	440-480	1	26	26		



Freight Class: 77.5,
FOB Allen 75013

Bakers Pride reserves the right to modify specifications or discontinue models without incurring obligation. Dimensions nominal.

Bakers Pride Oven Company, LLC is a wholly owned subsidiary of Standex International Corporation.



Submittal Sheet

10/16/2018

ITEM# 51 - HOT / COLD FOOD WELL UNIT, DROP-IN, ELECTRIC (1 EA REQ'D)

Delfield N8630

Drop-In Hot/Cold Food Well, 30-3/4", 2-pan size for 12" x 20" pans, 8" deep single tank with drain, remote control panel with single temperature control & three-way toggle switch, stainless steel top & well, galvanized steel exterior housing, self-contained refrigeration, 1/4 HP, (29-3/4" x 25" cutout required), cUL, UL, NSF

The spec sheet for this item can be viewed on item 27)

ACCESSORIES

Mfr	Qty	Model	Spec
Delfield	1		NOTE: Freight quotes are only valid from Delfield
Delfield	1	0460000N	1 year parts & labor warranty, standard
Delfield	1	W00003N	1 year compressor warranty, standard
Delfield	1		120v/60/1-ph, 25.0 amps, standard
Delfield	1	000-504-0030	Autofill assembly kit (shipped loose), for N8600 and N8800 series
Delfield	1	AS3547487	Gate valve assembly (shipped loose) for N8600 & N8800

ELECTRICAL

	VOLTS	CYCLE	PHASE	CONN	AFF	NEMA	AMPS	KW	HP	MCA	MOCP
1									1/4		
2	120	60	1				25.0				

WATER

	HOT SIZE	HOT AFF	HOT GPH	COLD SIZE	COLD AFF	FILTERED SIZE	FILTERED AFF	CONDENSER INLET SIZE	CONDENSER OUTLET SIZE
1									

WASTE

	INDIRECT SIZE	DIRECT SIZE
1	1"	

Submittal Sheet

10/16/2018

ITEM# 52 - HEATED SHELF FOOD WARMER (1 EA REQ'D)

Hatco GRSBF-48-I

Glo-Ray® Built In Heated Shelf with Flush Top, 49-1/2" x 21" surface area, hardcoat aluminum top, control thermostat, illuminated on/off switch & mounting bracket, NSF, cUL, UL, UL EPH Classified, ANSI/NSF 4, CSA

ACCESSORIES

Mfr	Qty	Model	Spec
Hatco	1		NOTE: Sale of this product must comply with Hatco's Minimum Resale Price Policy; consult order acknowledgement for details
Hatco	1		NOTE: Includes 24/7 parts & service assistance, call 800-558-0607
Hatco	1		1-Yr Warranty on Blanket Heating Elements against burnout, standard
Hatco	1		120v/60/1-ph, 1000 watts, 8.3 amps, NEMA 5-15P (Domestic voltage), standard
Hatco	1		NOTE: Recommended for use in metallic countertop, verify that the material is suitable for temperatures up to 200 degree F
Hatco	1		Thermostat control with lighted rocker switch (Available at time of purchase only), standard

ELECTRICAL

	VOLTS	CYCLE	PHASE	CONN	AFF	NEMA	AMPS	KW	HP	MCA	MOCP
1	120	60	1	Cord & Plug		5-15P	8.3	1.0			



Project _____
 Item # _____
 Quantity _____

Glo-Ray® Built-In Rectangular Heated Shelves with Flush Top

Models: GRSBF-24-F, -I, -S, -O; -30-F, -I, -S, -O;
 -36-F, -I, -S, -O; -42-F, -I, -S, -O; -48-F, -I, -S, -O;
 -60-F, -I, -S, -O; -72-F, -I, -S, -O

Let Hatco add heat to your serving surface with the Glo-Ray® Rectangular Built-In Heated Shelf with Flush Top. This flush top food warmer has a hardcoated aluminum surface and blanket-type element for uniform heat to extend your food holding time. Fiberglass insulation keeps heat at the holding surface while a built-in adjustable thermostat controls surface temperature.

Standard features

- Uniform heat distribution with hardcoated aluminum surface and blanket-type element
- 36" (914 mm) flexible conduit channels power lines from the shelf to a control box
- GRSBF models are available in widths from 25.5" to 73.5" (648-1867 mm) and depths of 17", 21", 25.5" or 31.5" (432, 533, 648 or 800 mm).
- Standard controller includes control thermostat, an illuminated power switch and mounting brackets
- Thermostatically-controlled heated base
- The Built-in Heated Shelf has a .75" (19 mm) flanged edge that allows the unit to fit into a countertop opening
- Recommended for use in metallic counters. For other surfaces, verify that the material is suitable for temperature up to 200°F (93°C)♦

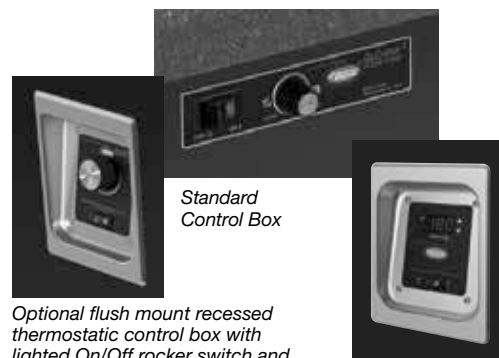
♦ Hatco is not responsible for counter damage caused by heat from the warmer.
 † Non-standard colors are non-returnable.
 * Models with flush mount recessed electronic control box are not CE approved.



GRSBF-60-O

Options (available at time of purchase only)

- Designer Colors for Flush Mount Control Bezel Box - Stainless Steel is standard color†
- Warm Red Black Gray Granite White Granite
 - Navy Blue Hunter Green Antique Copper
 - Stainless Steel Top Surface
 - Flush Mount Electronic Control Box with Lighted Power Switch with cord and plug
 - Flush Mount Thermostatic Control Box with Lighted Power Switch with cord and plug
- Conduit in lieu of standard 3' (914 mm) (Flush Mount ITC Control Box only)
- 6' (1829 mm) conduit 10' (3048 mm) conduit



Standard Control Box

Optional flush mount recessed thermostatic control box with lighted On/Off rocker switch and angled recessed controls

Optional flush mount recessed electronic control box with lighted On/Off rocker switch and angled recessed controls

Note for Built-in Heated Shelves with overhead Strip Heaters: For any size GRSBF, the next larger size GRA or GR2A Strip Heater will fit over the top. For example, a GRSBF-30 will require a GRA-36 or GR2A-36. The GRA will have a tight fit to the frame of the base. The GR2A will have approximately a 4" (102 mm) space.

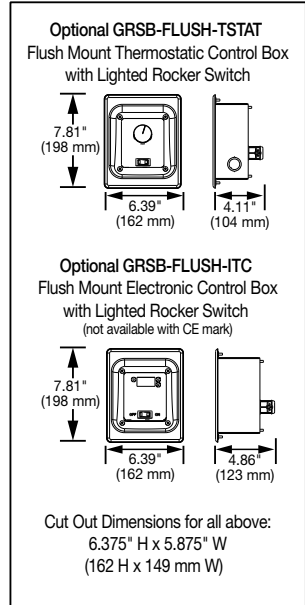
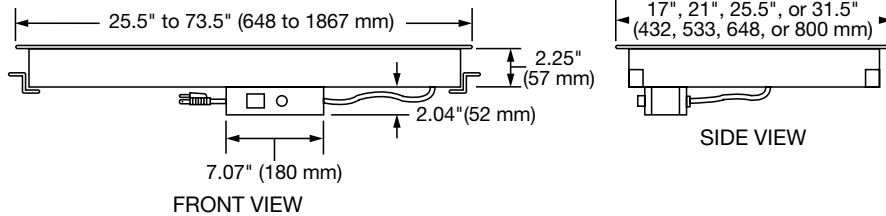




Glo-Ray® Flush Top Built-In Heated Shelves

Models: GRSBF-24-F, -I, -S, -O; -30-F, -I, -S, -O; -36-F, -I, -S, -O; -42-F, -I, -S, -O; -48-F, -I, -S, -O; -60-F, -I, -S, -O; -72-F, -I, -S, -O

GRSBF Models Shown with Standard Control Box



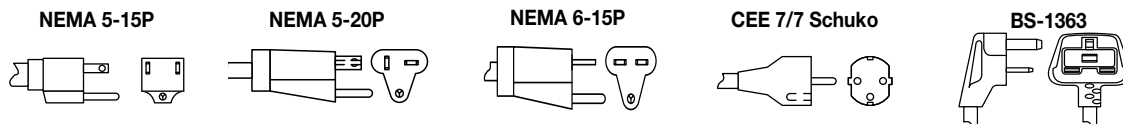
GRSBF Built-In Countertop Cut-Out Dimensions

Model	Minimum Width	Maximum Width	Minimum Depth	Maximum Depth
GRSBF-24-F	24.5" (622 mm)	24.75" (629 mm)	16" (406 mm)	16.25" (413 mm)
GRSBF-24-I	24.5" (622 mm)	24.75" (629 mm)	20" (508 mm)	20.25" (514 mm)
GRSBF-24-S	24.5" (622 mm)	24.75" (629 mm)	24.5" (622 mm)	24.75" (629 mm)
GRSBF-24-O	24.5" (622 mm)	24.75" (629 mm)	30.5" (775 mm)	30.75" (781 mm)
GRSBF-30-F	30.5" (775 mm)	30.75" (781 mm)	16" (406 mm)	16.25" (413 mm)
GRSBF-30-I	30.5" (775 mm)	30.75" (781 mm)	20" (508 mm)	20.25" (514 mm)
GRSBF-30-S	30.5" (775 mm)	30.75" (781 mm)	24.5" (622 mm)	24.75" (629 mm)
GRSBF-30-O	30.5" (775 mm)	30.75" (781 mm)	30.5" (775 mm)	30.75" (781 mm)
GRSBF-36-F	36.5" (927 mm)	36.75" (933 mm)	16" (406 mm)	16.25" (413 mm)
GRSBF-36-I	36.5" (927 mm)	36.75" (933 mm)	20" (508 mm)	20.25" (514 mm)
GRSBF-36-S	36.5" (927 mm)	36.75" (933 mm)	24.5" (622 mm)	24.75" (629 mm)
GRSBF-36-O	36.5" (927 mm)	36.75" (933 mm)	30.5" (775 mm)	30.75" (781 mm)
GRSBF-42-F	42.5" (1080 mm)	42.75" (1086 mm)	16" (406 mm)	16.25" (413 mm)
GRSBF-42-I	42.5" (1080 mm)	42.75" (1086 mm)	20" (508 mm)	20.25" (514 mm)
GRSBF-42-S	42.5" (1080 mm)	42.75" (1086 mm)	24.5" (622 mm)	24.75" (629 mm)
GRSBF-42-O	42.5" (1080 mm)	42.75" (1086 mm)	30.5" (775 mm)	30.75" (781 mm)
GRSBF-48-F	48.5" (1232 mm)	48.75" (1238 mm)	16" (406 mm)	16.25" (413 mm)
GRSBF-48-I	48.5" (1232 mm)	48.75" (1238 mm)	20" (508 mm)	20.25" (514 mm)
GRSBF-48-S	48.5" (1232 mm)	48.75" (1238 mm)	24.5" (622 mm)	24.75" (629 mm)
GRSBF-48-O	48.5" (1232 mm)	48.75" (1238 mm)	30.5" (775 mm)	30.75" (781 mm)
GRSBF-60-F	60.5" (1537 mm)	60.75" (1543 mm)	16" (406 mm)	16.25" (413 mm)
GRSBF-60-I	60.5" (1537 mm)	60.75" (1543 mm)	20" (508 mm)	20.25" (514 mm)
GRSBF-60-S	60.5" (1537 mm)	60.75" (1543 mm)	24.5" (622 mm)	24.75" (629 mm)
GRSBF-60-O	60.5" (1537 mm)	60.75" (1543 mm)	30.5" (775 mm)	30.75" (781 mm)
GRSBF-72-F	72.5" (1842 mm)	72.75" (1848 mm)	16" (406 mm)	16.25" (413 mm)
GRSBF-72-I	72.5" (1842 mm)	72.75" (1848 mm)	20" (508 mm)	20.25" (514 mm)
GRSBF-72-S	72.5" (1842 mm)	72.75" (1848 mm)	24.5" (622 mm)	24.75" (629 mm)
GRSBF-72-O	72.5" (1842 mm)	72.75" (1848 mm)	30.5" (775 mm)	30.75" (781 mm)

CORD LOCATION

Cord Location: Cord is attached to Control Box.

PLUG CONFIGURATIONS



HATCO CORPORATION | P.O. Box 340500 Milwaukee, WI 53234-0500 U.S.A.

(800) 558-0607 | (414) 671-6350 | www.hatcocorp.com | support@hatcocorp.com | intlsales@hatcocorp.com



Glo-Ray® Flush Top Built-In Heated Shelves

Models: GRSBF-24-F, -I, -S, -O; -30-F, -I, -S, -O; -36-F, -I, -S, -O; -42-F, -I, -S, -O; -48-F, -I, -S, -O; -60-F, -I, -S, -O; -72-F, -I, -S, -O

SPECIFICATIONS

Built-In Rectangular Heated Shelves with Flush Top

The shaded areas contain electrical information for international models

Model	Dimensions (W x D x H)	Usable Shelf (W x D)	Volts	Phase	Watts	Amps	Plug	Ship Weight*
GRSBF-24-F	25.5" x 17" x 2.25" (648 x 432 x 57 mm)	25.5" x 17" (648 x 432 mm)	120	Single	420	3.5	NEMA 5-15P	28 lbs. (13 kg)
			220		384	1.7	CEE 7/7 Schuko	28 lbs. (13 kg)
			240		458	1.9	BS-1363	
			220-230 (CE)		384-420	1.7-1.8	CEE 7/7 Schuko	
			230-240 (CE)		420-458	1.8-1.9	BS-1363	
GRSBF-24-I	25.5" x 21" x 2.25" (648 x 533 x 57 mm)	25.5" x 21" (648 x 533 mm)	100	Single	550	5.5	NEMA 5-15P	28 lbs. (13 kg)
			120		550	4.6	NEMA 5-15P	28 lbs. (13 kg)
			220		550	2.5	CEE 7/7 Schuko	28 lbs. (13 kg)
			240		550	2.3	BS-1363	
			220-230 (CE)		550-601	2.5-2.6	CEE 7/7 Schuko	
230-240 (CE)	505-550	2.2-2.3	BS-1363					
GRSBF-24-S	25.5" x 25.5" x 2.25" (648 x 648 x 57 mm)	25.5" x 25.5" (648 x 648 mm)	120	Single	700	5.8	NEMA 5-15P	32 lbs. (15 kg)
			220		640	2.9	CEE 7/7 Schuko	32 lbs. (15 kg)
			240		762	3.2	BS-1363	
			220-230 (CE)		640-700	2.9-3.0	CEE 7/7 Schuko	
			230-240 (CE)		700-762	3.0-3.2	BS-1363	
GRSBF-24-O	25.5" x 31.5" x 2.25" (648 x 800 x 57 mm)	25.5" x 31.5" (648 x 800 mm)	120	Single	790	6.6	NEMA 5-15P	35 lbs. (16 kg)
			220		722	3.3	CEE 7/7 Schuko	35 lbs. (16 kg)
			240		860	3.4	BS-1363	
			220-230 (CE)		722-790	3.3-3.4	CEE 7/7 Schuko	
			230-240 (CE)		790-860	3.4-3.6	BS-1363	
GRSBF-30-F	31.5" x 17" x 2.25" (800 x 432 x 57 mm)	31.5" x 17" (800 x 432 mm)	120	Single	505	4.2	NEMA 5-15P	24 lbs. (11 kg)
			220		462	2.1	CEE 7/7 Schuko	24 lbs. (11 kg)
			240		550	2.3	BS-1363	
			220-230 (CE)		462-505	2.1-2.2	CEE 7/7 Schuko	
			230-240 (CE)		505-550	2.2-2.3	BS-1363	
GRSBF-30-I	31.5" x 21" x 2.25" (800 x 533 x 57 mm)	31.5" x 21" (800 x 533 mm)	100	Single	665	6.7	NEMA 5-15P	30 lbs. (14 kg)
			120		665	5.6	NEMA 5-15P	30 lbs. (14 kg)
			220		665	3.0	CEE 7/7 Schuko	30 lbs. (14 kg)
			240		665	2.8	BS-1363	
			220-230 (CE)		665-727	3.0-3.2	CEE 7/7 Schuko	
230-240 (CE)	611-665	2.7-2.8	BS-1363					
GRSBF-30-S	31.5" x 25.5" x 2.25" (800 x 648 x 57 mm)	31.5" x 25.5" (800 x 648 mm)	120	Single	825	6.9	NEMA 5-15P	33 lbs. (15 kg)
			220		755	3.4	CEE 7/7 Schuko	33 lbs. (15 kg)
			240		898	3.7	BS-1363	
			220-230 (CE)		755-825	3.4-3.6	CEE 7/7 Schuko	
			230-240 (CE)		825-898	3.6-3.7	BS-1363	
GRSBF-30-O	31.5" x 31.5" x 2.25" (800 x 800 x 57 mm)	31.5" x 31.5" (800 x 800 mm)	120	Single	950	7.9	NEMA 5-15P	37 lbs. (17 kg)
			220		916	4.2	CEE 7/7 Schuko	37 lbs. (17 kg)
			240		985	4.5	BS-1363	
			220-230 (CE)		916-1001	4.2-4.4	CEE 7/7 Schuko	
			230-240 (CE)		904-985	3.9-4.1	BS-1363	
GRSBF-36-F	37.5" x 17" x 2.25" (953 x 432 x 57 mm)	37.5" x 17" (953 x 432 mm)	120	Single	590	4.9	NEMA 5-15P	32 lbs. (15 kg)
			220		540	2.5	CEE 7/7 Schuko	32 lbs. (15 kg)
			240		642	2.7	BS-1363	
			220-230 (CE)		540-590	2.5-2.6	CEE 7/7 Schuko	
			230-240 (CE)		590-643	2.6-2.7	BS-1363	
GRSBF-36-I	37.5" x 21" x 2.25" (953 x 533 x 57 mm)	37.5" x 21" (953 x 533 mm)	100	Single	780	7.8	NEMA 5-15P	30 lbs. (14 kg)
			120		780	6.5	NEMA 5-15P	30 lbs. (14 kg)
			220		780	3.5	CEE 7/7 Schuko	30 lbs. (14 kg)
			240		780	3.3	BS-1363	
			220-230 (CE)		780-853	3.5-3.7	CEE 7/7 Schuko	
230-240 (CE)	716-780	3.1-3.3	BS-1363					

* Shipping weight includes packaging.

HATCO CORPORATION | P.O. Box 340500 Milwaukee, WI 53234-0500 U.S.A.

(800) 558-0607 | (414) 671-6350 | www.hatcocorp.com | support@hatcocorp.com | intlsales@hatcocorp.com



Glo-Ray® Flush Top Built-In Heated Shelves

Models: GRSBF-24-F, -I, -S, -O; -30-F, -I, -S, -O; -36-F, -I, -S, -O; -42-F, -I, -S, -O; -48-F, -I, -S, -O; -60-F, -I, -S, -O; -72-F, -I, -S, -O

SPECIFICATIONS

Built-In Rectangular Heated Shelves with Flush Top

The shaded areas contain electrical information for international models

Model	Dimensions (W x D x H)	Usable Shelf (W x D)	Volts	Phase	Watts	Amps	Plug	Ship Weight*
GRSBF-36-S	37.5" x 25.5" x 2.25" (953 x 648 x 57 mm)	37.5" x 25.5" (953 x 648 mm)	120	Single	950	7.9	NEMA 5-15P	35 lbs. (16 kg)
			220		870	4.0	CEE 7/7 Schuko	35 lbs. (16 kg)
			240		1034	4.3	BS-1363	
			220-230 (CE)		870-951	4.0-4.1	CEE 7/7 Schuko	
			230-240 (CE)		950-1034	4.1-4.3	BS-1363	
GRSBF-36-O	37.5" x 31.5" x 2.25" (953 x 800 x 57 mm)	37.5" x 31.5" (953 x 800 mm)	120	Single	1110	9.3	NEMA 5-15P	37 lbs. (17 kg)
			220		1110	5.0	CEE 7/7 Schuko	37 lbs. (17 kg)
			240		1110	4.6	BS-1363	
			220-230 (CE)		1110-1213	5.0-5.3	CEE 7/7 Schuko	
			230-240 (CE)		1020-1110	4.4-4.6	BS-1363	
GRSBF-42-F	43.5" x 17" x 2.25" (1105 x 432 x 57 mm)	43.5" x 17" (1105 x 432 mm)	120	Single	685	5.7	NEMA 5-15P	38 lbs. (17 kg)
			220		627	2.9	CEE 7/7 Schuko	38 lbs. (17 kg)
			240		746	3.1	BS-1363	
			220-230 (CE)		627-685	2.9-3.0	CEE 7/7 Schuko	
			230-240 (CE)		685-746	3.0-3.1	BS-1363	
GRSBF-42-I	43.5" x 21" x 2.25" (1105 x 533 x 57 mm)	43.5" x 21" (1105 x 533 mm)	100	Single	885	8.9	NEMA 5-15P	32 lbs. (15 kg)
			120		885	7.4	NEMA 5-15P	32 lbs. (15 kg)
			220		885	4.0	CEE 7/7 Schuko	32 lbs. (15 kg)
			240		885	3.7	BS-1363	
			220-230 (CE)		885-967	4.0-4.2	CEE 7/7 Schuko	
			230-240 (CE)		813-885	3.5-3.7	BS-1363	
GRSBF-42-S	43.5" x 25.5" x 2.25" (1105 x 648 x 57 mm)	43.5" x 25.5" (1105 x 648 mm)	120	Single	1100	9.2	NEMA 5-15P	40 lbs. (18 kg)
			220		1006	4.6	CEE 7/7 Schuko	40 lbs. (18 kg)
			240		1198	5.0	BS-1363	
			220-230 (CE)		1006-1100	4.6-4.8	CEE 7/7 Schuko	
			230-240 (CE)		1100-1198	4.8-5.0	BS-1363	
GRSBF-42-O	43.5" x 31.5" x 2.25" (1105 x 800 x 57 mm)	43.5" x 31.5" (1105 x 800 mm)	120	Single	1270	10.6	NEMA 5-15P	48 lbs. (22 kg)
			220		1236	5.6	CEE 7/7 Schuko	48 lbs. (22 kg)
			240		1305	5.4	BS-1363	
			220-230 (CE)		1236-1351	5.6-5.9	CEE 7/7 Schuko	
			230-240 (CE)		1198-1305	5.2-5.4	BS-1363	
GRSBF-48-F	49.5" x 17" x 2.25" (1257 x 432 x 57 mm)	49.5" x 17" (1257 x 432 mm)	120	Single	770	6.4	NEMA 5-15P	35 lbs. (16 kg)
			220		705	3.2	CEE 7/7 Schuko	35 lbs. (16 kg)
			240		828	3.5	BS-1363	
			220-230 (CE)		704-770	3.2-3.3	CEE 7/7 Schuko	
			230-240 (CE)		770-839	3.3-3.5	BS-1363	
GRSBF-48-I	49.5" x 21" x 2.25" (1257 x 533 x 57 mm)	49.5" x 21" (1257 x 533 mm)	100	Single	1000	10.0	NEMA 5-15P	40 lbs. (18 kg)
			120		1000	8.3	NEMA 5-15P	40 lbs. (18 kg)
			220		1000	4.5	CEE 7/7 Schuko	40 lbs. (18 kg)
			240		1000	4.2	BS-1363	
			220-230 (CE)		1000-1093	4.5-4.7	CEE 7/7 Schuko	
			230-240 (CE)		918-1000	4.0-4.2	BS-1363	
GRSBF-48-S	49.5" x 25.5" x 2.25" (1257 x 648 x 57 mm)	49.5" x 25.5" (1257 x 648 mm)	120	Single	1225	10.2	NEMA 5-15P	42 lbs. (19 kg)
			220		1121	5.1	CEE 7/7 Schuko	42 lbs. (19 kg)
			240		1334	5.6	BS-1363	
			220-230 (CE)		1121-1225	5.1-5.3	CEE 7/7 Schuko	
			230-240 (CE)		1225-1334	5.3-5.6	BS-1363	
GRSBF-48-O	49.5" x 31.5" x 2.25" (1257 x 800 x 57 mm)	49.5" x 31.5" (1257 x 800 mm)	120	Single	1430	11.9	NEMA 5-15P	48 lbs. (22 kg)
			220		1430	6.5	CEE 7/7 Schuko	48 lbs. (22 kg)
			240		1430	6.0	BS-1363	
			220-230 (CE)		1430-1562	6.5-6.8	CEE 7/7 Schuko	
			230-240 (CE)		1313-1430	5.7-6.0	BS-1363	

* Shipping weight includes packaging.



Glo-Ray® Flush Top Built-In Heated Shelves

Models: GRSBF-24-F, -I, -S, -O; -30-F, -I, -S, -O; -36-F, -I, -S, -O; -42-F, -I, -S, -O; -48-F, -I, -S, -O; -60-F, -I, -S, -O; -72-F, -I, -S, -O

SPECIFICATIONS

Built-In Rectangular Heated Shelves with Flush Top

The shaded areas contain electrical information for International models

Model	Dimensions (W x D x H)	Usable Shelf (W x D)	Volts	Phase	Watts	Amps	Plug	Ship Weight*
GRSBF-60-F	61.5" x 17" x 2.25" (1562 x 432 x 57 mm)	61.5" x 17" (1562 x 432 mm)	120	Single	950	7.9	NEMA 5-15P	41 lbs. (19 kg)
			220		870	4.0	CEE 7/7 Schuko	41 lbs. (19 kg)
			240		1034	4.3	BS-1363	
			220-230 (CE)		869-950	4.0-4.1	CEE 7/7 Schuko	
			230-240 (CE)		950-1035	4.1-4.3	BS-1363	
GRSBF-60-I	61.5" x 21" x 2.25" (1562 x 533 x 57 mm)	61.5" x 21" (1562 x 533 mm)	100	Single	1220	12.2	NEMA 5-15P	48 lbs. (22 kg)
			120		1220	10.2	NEMA 5-15P	48 lbs. (22 kg)
			220		1220	5.5	CEE 7/7 Schuko	48 lbs. (22 kg)
			240		1220	5.1	BS-1363	
			220-230 (CE)		1220-1333	5.5-5.8	CEE 7/7 Schuko	
			230-240 (CE)		1120-1220	4.9-5.1	BS-1363	
GRSBF-60-S	61.5" x 25.5" x 2.25" (1562 x 648 x 57 mm)	61.5" x 25.5" (1562 x 648 mm)	120	Single	1500	12.5	NEMA 5-20P	55 lbs. (25 kg)
			220		1372	6.2	CEE 7/7 Schuko	55 lbs. (25 kg)
			240		1634	6.8	BS-1363	
			220-230 (CE)		1372-1500	6.2-6.5	CEE 7/7 Schuko	
			230-240 (CE)		1501-1634	6.5-6.8	BS-1363	
GRSBF-60-O	61.5" x 31.5" x 2.25" (1562 x 800 x 57 mm)	61.5" x 31.5" (1562 x 800 mm)	120	Single	1750	14.6	NEMA 5-20P	64 lbs. (29 kg)
			220		1750	8.0	CEE 7/7 Schuko	64 lbs. (29 kg)
			240		1750	7.3	BS-1363	
			220-230 (CE)		1750-1912	8.0-8.3	CEE 7/7 Schuko	
			230-240 (CE)		1607-1750	7.0-7.3	BS-1363	
GRSBF-72-F	73.5" x 17" x 2.25" (1867 x 432 x 57 mm)	73.5" x 17" (1867 x 432 mm)	120	Single	1130	9.4	NEMA 5-15P	44 lbs. (20 kg)
			220		1034	4.7	CEE 7/7 Schuko	44 lbs. (20 kg)
			240		1230	5.1	BS-1363	
			220-230 (CE)		1034-1130	4.7-4.9	CEE 7/7 Schuko	
			230-240 (CE)		1130-1231	4.9-5.1	BS-1363	
GRSBF-72-I	73.5" x 21" x 2.25" (1867 x 533 x 57 mm)	73.5" x 21" (1867 x 533 mm)	120	Single	1440	12.0	NEMA 5-15P	52 lbs. (24 kg)
			220		1440	6.5	CEE 7/7 Schuko	52 lbs. (24 kg)
			240		1440	6.0	BS-1363	
			220-230 (CE)		1440-1574	6.5-6.8	CEE 7/7 Schuko	
			230-240 (CE)		1322-1440	5.8-6.0	BS-1363	
GRSBF-72-S	73.5" x 25.5" x 2.25" (1867 x 648 x 57 mm)	73.5" x 25.5" (1867 x 648 mm)	120	Single	1750	14.6	NEMA 5-20P	59 lbs. (27 kg)
			220		1602	7.3	CEE 7/7 Schuko	59 lbs. (27 kg)
			240		1906	7.9	BS-1363	
			220-230 (CE)		1602-1751	7.3-7.6	CEE 7/7 Schuko	
			230-240 (CE)		1750-1906	7.6-7.9	BS-1363	
GRSBF-72-O	73.5" x 31.5" x 2.25" (1867 x 800 x 57 mm)	73.5" x 31.5" (1867 x 800 mm)	208	Single	2070	10.0	NEMA 6-15P	68 lbs. (31 kg)
			240		2070	9.4		68 lbs. (31 kg)
			220		1894	8.6	CEE 7/7 Schuko	68 lbs. (31 kg)
			240		2070	8.6	BS-1363	
			220-230 (CE)		2070-2262	9.4-9.8	CEE 7/7 Schuko	
			230-240 (CE)		1901-2070	8.3-8.6	BS-1363	

* Shipping weight includes packaging.

PRODUCT SPECS

Glo-Ray® Built-In Heated Shelves with Flush Top

The Built-in Rectangular Heated Shelf with Flush Top shall be a Glo-Ray® Model ... as manufactured by the Hatco Corporation, Milwaukee, WI 53234 U.S.A.

The Rectangular Heated Shelf shall be rated at ... watts, ... volts, and ... inches (millimeters) in overall width.

It shall consist of thermostatically-controlled heated base with 3' (914 mm) conduit to control box and a 6' (1829 mm) cord with plug attached.

Warranty consists of 24/7 parts and service assistance (U.S. and Canada only).

HATCO CORPORATION | P.O. Box 340500 Milwaukee, WI 53234-0500 U.S.A.

(800) 558-0607 | (414) 671-6350 | www.hatcocorp.com | support@hatcocorp.com | intlsales@hatcocorp.com

Submittal Sheet

10/16/2018

ITEM# 53 - HEATED SHELF FOOD WARMER (1 EA REQ'D)

Hatco GRSBF-30-I

Glo-Ray® Built In Heated Shelf with Flush Top, 31-1/2" x 21" surface area, hardcoat aluminum top, control thermostat, illuminated on/off switch & mounting bracket, NSF, cUL, UL, UL EPH Classified, ANSI/NSF 4, CSA

The spec sheet for this item can be viewed on item 52)

ACCESSORIES

Mfr	Qty	Model	Spec
Hatco	1		NOTE: Sale of this product must comply with Hatco's Minimum Resale Price Policy; consult order acknowledgement for details
Hatco	1		NOTE: Includes 24/7 parts & service assistance, call 800-558-0607
Hatco	1		1-Yr Warranty on Blanket Heating Elements against burnout, standard
Hatco	1		120v/60/1-ph, 665 watts, 5.6 amps, NEMA 5-15P (Domestic voltage), standard
Hatco	1		NOTE: Recommended for use in metallic countertop, verify that the material is suitable for temperatures up to 200 degree F
Hatco	1		Thermostat control with lighted rocker switch (Available at time of purchase only), standard

ELECTRICAL

	VOLTS	CYCLE	PHASE	CONN	AFF	NEMA	AMPS	KW	HP	MCA	MOCP
1	120	60	1	Cord & Plug		5-15P	5.6	.665			

Submittal Sheet

10/16/2018

ITEM# 54.1 - SNEEZE GUARD, STATIONARY (1 EA REQ'D)

Versa-Gard VG3.3-SK

VG Series. Adjustable self service food protector with straight glass and top shelf. Adjustable in 7 different self-service positions. 3/4" OD Solid Supports. End glass panels are 1/4" clear tempered. All glass meets ANSI Z97.1 specifications for safety performance and ASTM C1048-04 specifications for heat treated glass. All hardware supplied in a brushed stainless steel finish. All glass with ground and polished edges. Conceal mount hardware.

ACCESSORIES

Mfr	Qty	Model	Spec
Versa-Gard	1	LED LIGHT	LED Light by Versa Gard



VG3.3-SK

Protected by US Patent 7,040,723
Other Patents Pending

Adjustable Self-Service Protector w/ Shelf

FINISH:

- Brushed Stainless Steel
- Clear Anodized Aluminum
- Powder Coat:
 - Black Silver
- RAL # _____

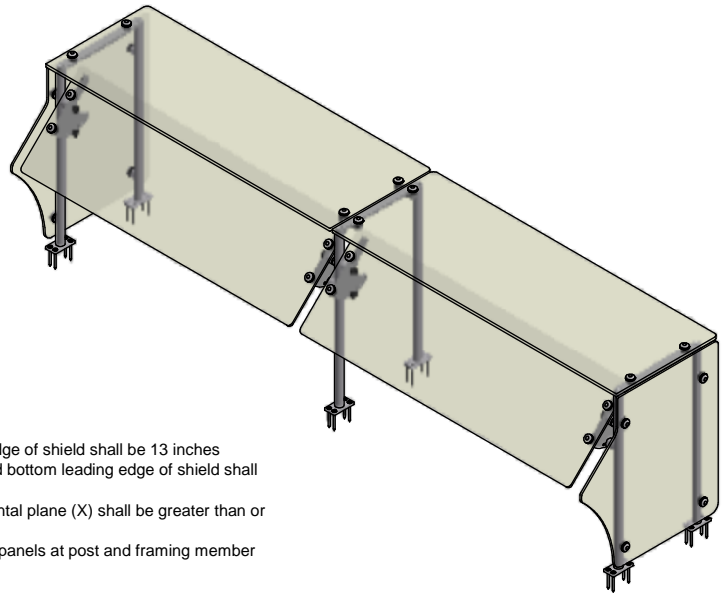
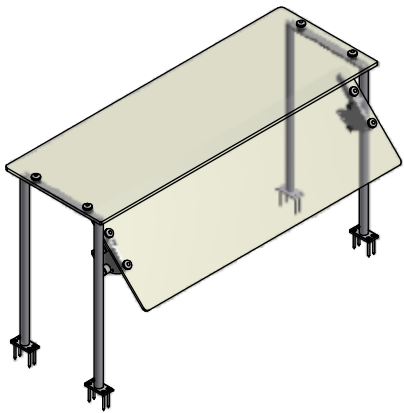
GLASS (Clear Tempered):

- 1/4" Front - Std
- 3/8" Top - Std
- 1/2" Top
- Frosted

OPTIONS(*):

- End Panel - LT
- End Panel - RT
- Light Fixture
- Warmer
- Shelf Kit

(*) Not all options available on all models
Contact factory for specific information
For Mounting Options see Mounting Hardware Guide



NSF/ANSI 2 - 2010 Standards Requirements:

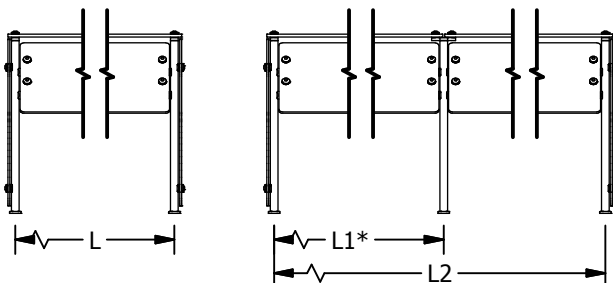
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5.35.7 Self service food shields

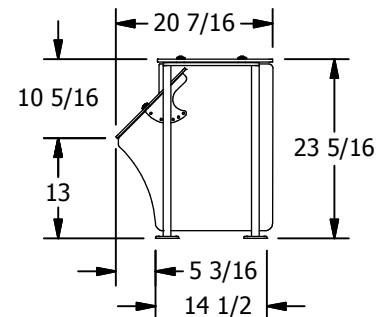
- 5.35.7.1** Maximum vertical distance between counter top and bottom leading edge of shield shall be 13 inches
- 5.35.7.2** Minimum horizontal distance between the front inside edge of food and bottom leading edge of shield shall be 3/4 of the Max. vertical distance of 5.35.7.1 (.75 x 13" = 9.75")
- 5.35.7.3** The sum of a shield's projected vertical plane (Y) and projected horizontal plane (X) shall be greater than or equal to 20 inches. Either (X) or (Y) may equal 0
- 5.35.7.5** Maximum horizontal distance between vertical, horizontal, and angled panels at post and framing member locations shall be 2 inches
- 5.35.7.10** Food shields for use on mobile buffet counters shall conform to 5.35.7
- 5.35.6** A vertical barrier (end shield) shall be provided at each end of a foodshield. The vertical barrier shall be a minimum of 18 inches deep (front to back) beginning at the bottom leading edge of the foodshield. The minimum height of the vertical barrier shall be equal to the overall height of the foodshield. The maximum distance from the bottom edge of the vertical barrier and counter top shall be 1.5 inches.
- 5.35.6.1** A foodshield intended to be installed a maximum of 3" (76mm) from a building wall perpendicular to the foodshield is exempt from the requirements of 5.35.6 provided that the height of the building wall is not lower than the overall height of the foodshield.

(2) End Panels per unit unless otherwise specified. End panels are 1/4" clear tempered glass unless otherwise specified.

-Centerline Dimensions -
L / L1 - 48" Max (1/4" Glass)



(* - Middle support is centered unless L1 dimension is specified)



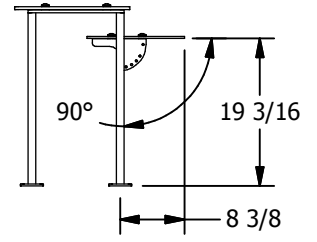
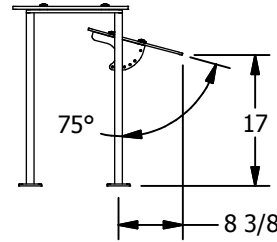
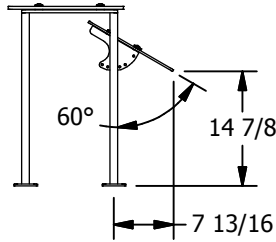
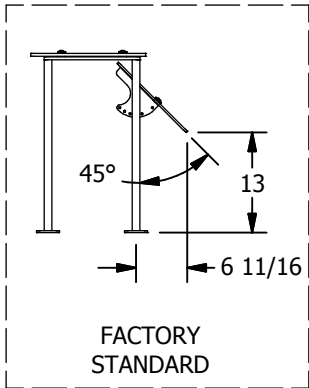


VG3.3-SK

Protected by US Patent 7,040,723
Other Patents Pending

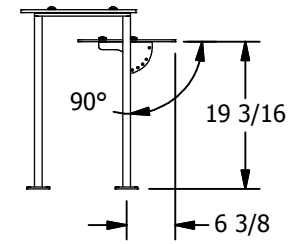
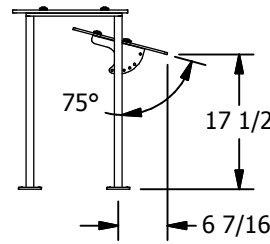
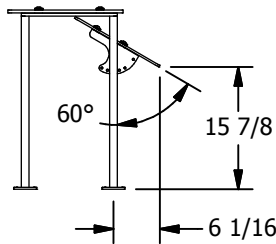
Adjustable Self-Service Protector w/ Shelf

GLASS SETTING - 1



GLASS SETTING - 2

FACTORY STANDARD
CONFIGURATION NOT
AVAILABLE AS
GLASS SETTING - 2



LED Lighting System

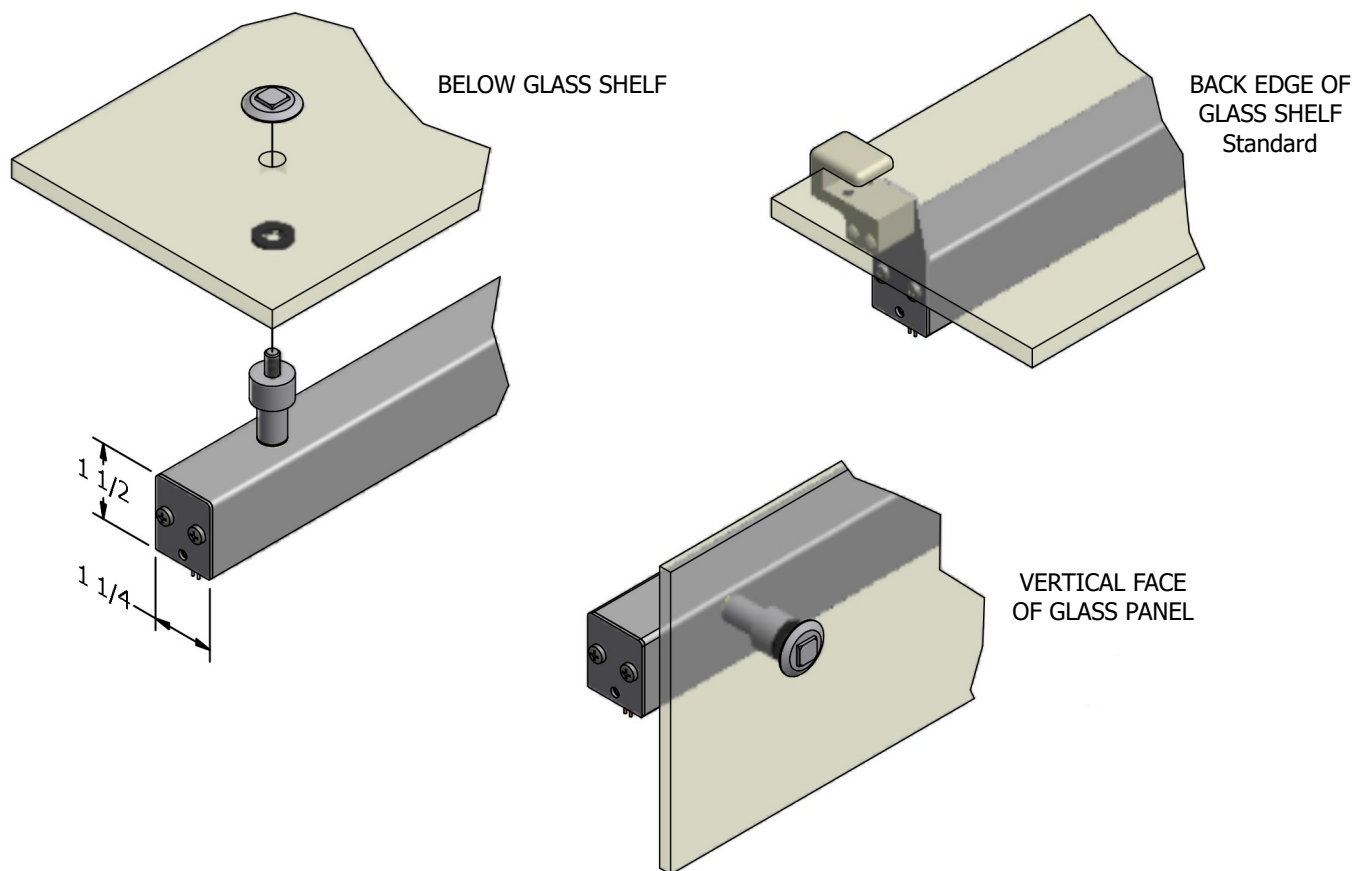
VERSA-GARD®

Lamp Information

LED - 5.0W/ft - up to 407 Lumens/ft

- 2 Wire operation
- Safe low voltage 12V DC operation
- 3500K Neutral white color temperature
- 84.0 CRI - Wide 120° light beam
- Supplied with remote class II direct wire power supply and remote switch
- Rated 50,000 hours
- 120 VAC, 60 Hz, Single-Phase input
- 2 year warranty
- Supplied in 1-1/4"w X 1-1/2"h aluminum housing

Fixture Attachments



WWW.VERSA-GARD.COM

1094 Parkway Industrial Park Drive
 Buford, GA 30518
 678-730-4155 office
 info@versa-gard.com

LED Lighting System

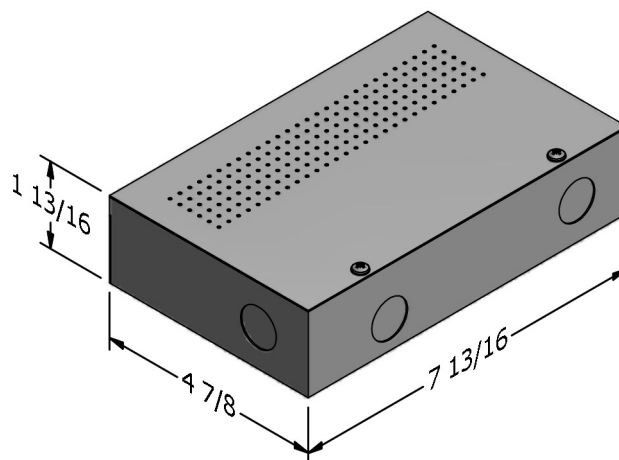
VERSA-GARD®

LED Driver Enclosure

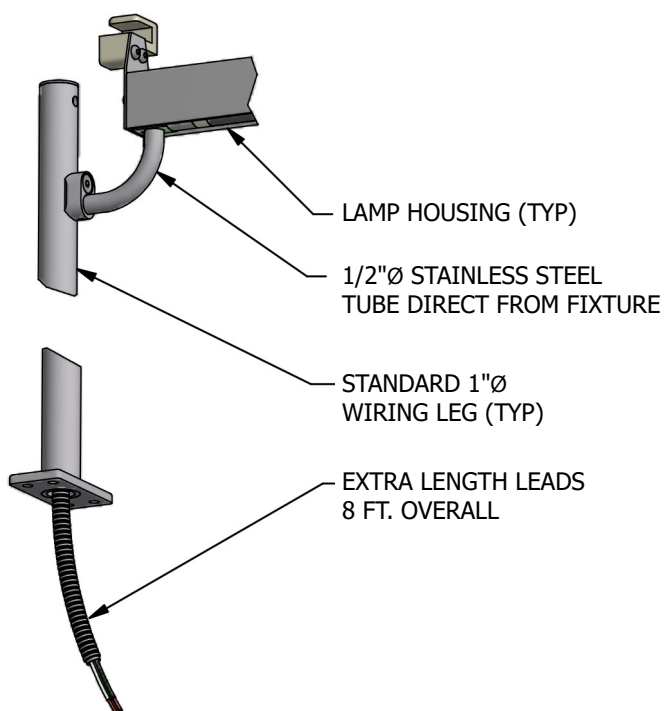
All installations require a remote-mounted power supply enclosure. Toggle Switch supplied with box for remote installation by certified electrician.

Wiring Notes:

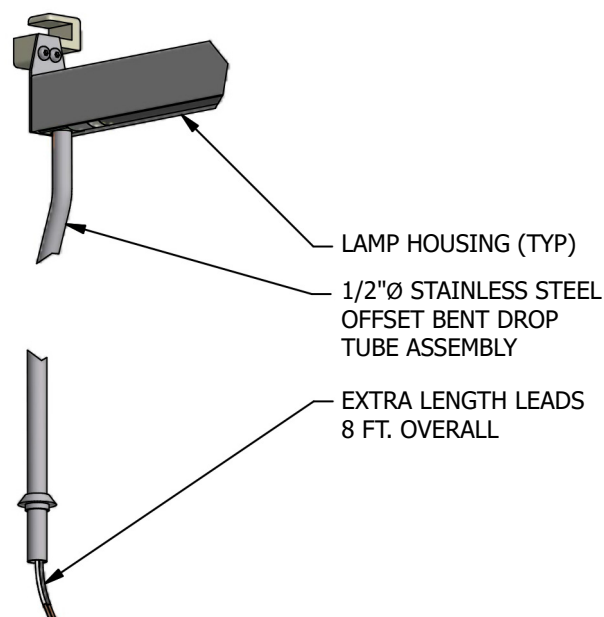
Examples shown are typical styles provided. Actual method will depend on design constraints, which are unique to each application.



Typical Lamp Wiring through Protector Leg



Typical Lamp Wiring with Offset Drop Tube



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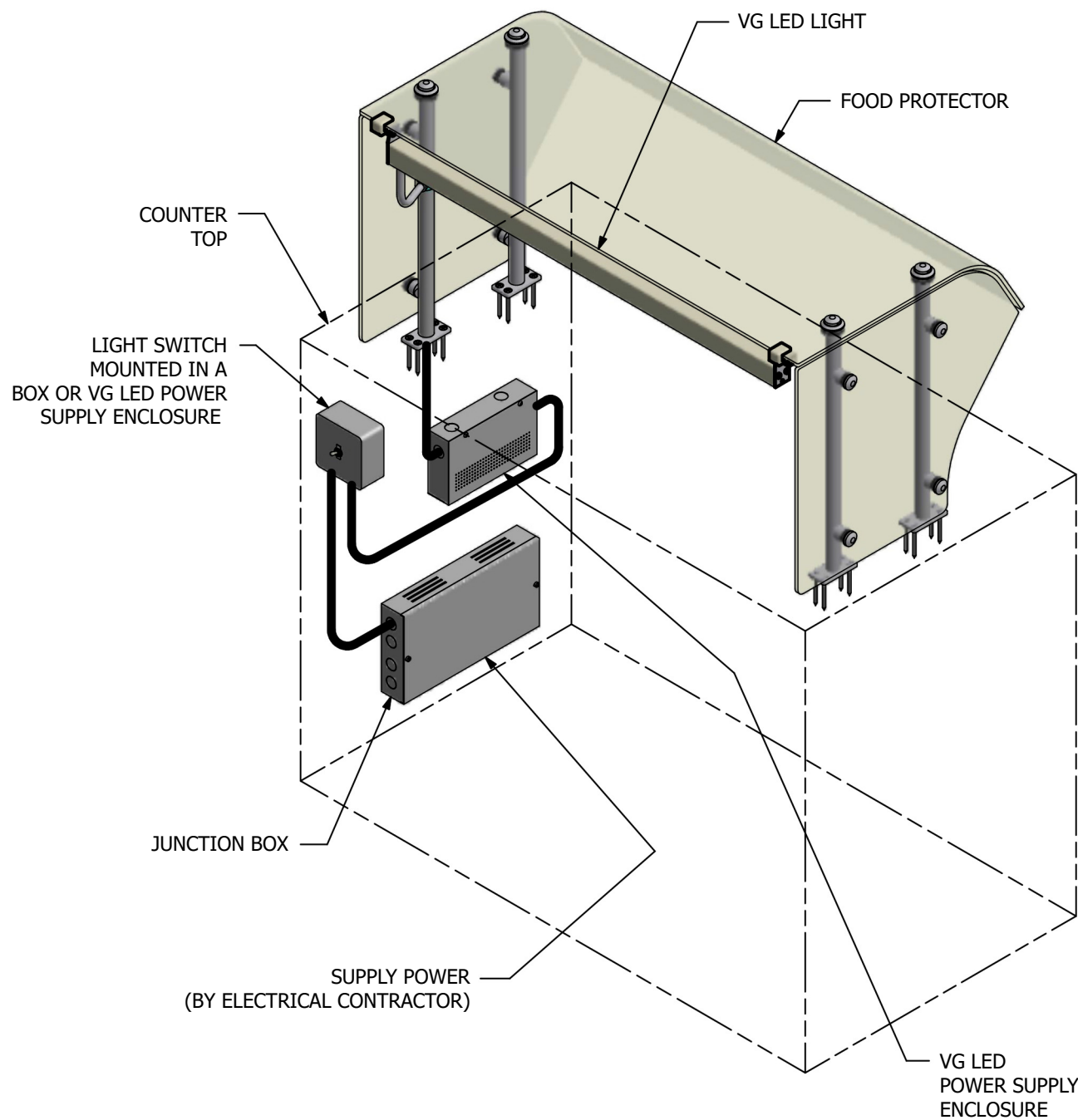
1094 Parkway Industrial Park Drive
Buford, GA 30518
678-730-4155 office
info@versa-gard.com

LED Lighting System



Power Supply / Enclosure / Switch

Typical LED Wiring Installation



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1094 Parkway Industrial Park Drive
Buford, GA 30518
678-730-4155 office
info@versa-gard.com

Submittal Sheet

10/16/2018

ITEM# 54.2 - SNEEZE GUARD, STATIONARY (1 EA REQ'D)

Versa-Gard VG3.3-SK

VG Series. Adjustable self service food protector with straight glass and top shelf. Adjustable in 7 different self-service positions. 3/4" OD Solid Supports. End glass panels are 1/4" clear tempered. All glass meets ANSI Z97.1 specifications for safety performance and ASTM C1048-04 specifications for heat treated glass. All hardware supplied in a brushed stainless steel finish. All glass with ground and polished edges. Conceal mount hardware.

The spec sheet for this item can be viewed on item 54.1)

ACCESSORIES

Mfr	Qty	Model	Spec
Versa-Gard	1	LED LIGHT	LED Light by Versa Gard

Submittal Sheet

10/16/2018

ITEM# 54.3 - SNEEZE GUARD, STATIONARY (1 EA REQ'D)

Versa-Gard VG3.3-SK

VG Series. Adjustable self service food protector with straight glass and top shelf. Adjustable in 7 different self-service positions. 3/4" OD Solid Supports. End glass panels are 1/4" clear tempered. All glass meets ANSI Z97.1 specifications for safety performance and ASTM C1048-04 specifications for heat treated glass. All hardware supplied in a brushed stainless steel finish. All glass with ground and polished edges. Conceal mount hardware.

The spec sheet for this item can be viewed on item 54.1)

ACCESSORIES

<u>Mfr</u>	<u>Qty</u>	<u>Model</u>	<u>Spec</u>
Versa-Gard	1	LED LIGHT	LED Light by Versa Gard

Submittal Sheet

10/16/2018

ITEM# 55 - MENU BOARD (1 EA REQ'D)

Provided by Operations CONTACT OPERATIONS

Submittal Sheet

10/16/2018

ITEM# 55.1 - OMS SCREEN (1 EA REQ'D)

Provided by Operations CONTACT OPERATIONS

Submittal Sheet

10/16/2018

ITEM# 56 - HEAT LAMP (1 EA REQ'D)

Hatco GRNM-54

Glo-Ray® Narrow Max Infrared Strip Heater, 54" L, tubular metal heater rod, single heater rod housing, stainless steel housing with angle mounting bracket, 1500 watts, cULus, UL EPH Classified, ANSI/NSF 4, Made in USA

ACCESSORIES

Mfr	Qty	Model	Spec
Hatco	1		NOTE: Sale of this product must comply with Hatco's Minimum Resale Price Policy; consult order acknowledgement for details
Hatco	1		NOTE: Includes 24/7 parts & service assistance, call 800-558-0607
Hatco	1		One year on-site parts and labor warranty, plus one additional year parts only warranty on all Glo-Ray metal sheathed elements
Hatco	1		120v/60/1-ph
Hatco	1	NO CONTROL	No control included, requires selection of RMB2 control box
Hatco	1		NOTE: If the current rating is under 20 amps. then select an RMB2-1R and RMB3-1R, if the current rating is between 20 and 40 amps select the RMB2-2R and RMB3-2R, RMB2-2R has (2) 20 amp outputs and RMB3-2R has (2) 15 amp outlets
Hatco	1		NOTE: Requires selection of RMB2 control

ELECTRICAL

	VOLTS	CYCLE	PHASE	CONN	AFF	NEMA	AMPS	KW	HP	MCA	MOCP
1								1.5			
2	120	60	1								



Project _____
 Item # _____
 Quantity _____

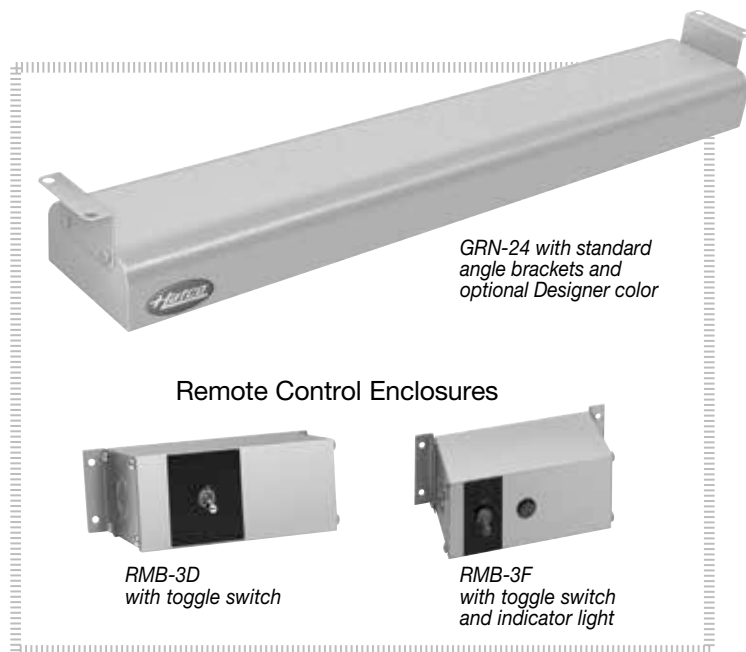
Glo-Ray® Narrow Infrared Strip Heaters

Models: GRN-18, -24, -30, -36, -42, -48, -54, -60, -66, -72
 GRNH-18, -24, -30, -36, -42, -48, -54, -60, -66, -72
 GRNM-18, -24, -30, -36, -42, -48, -54, -60, -66, -72

Hatco Glo-Ray® Narrow Strip Heaters are great for use in tight spaces and keep the focus on food items being displayed. Ideal for minimal sight obstruction of food product in heated buffet areas. Even the most delicate dishes hold that "just-prepared" look.

Standard features

- Sleek, slim design with just 2" (51 mm) height and 4" (102 mm) depth keeps the focus on the food in buffet lines
- Available in widths from 18" to 72" (457-1829 mm)
- Pre-focused heat maintains serving temperatures longer without continuing to cook the food
- Optional remote control enclosure in *Designer* colors†
- Sturdy continuous heavy duty Steel housings available in *Designer* colors: Warm Red, Black (standard), Gray Granite, White Granite, Navy Blue, Hunter Green, Antique Copper or Stainless Steel
- Accessorize units with non-adjustable tubular stands in *Designer* colors†
- Models come with non-adjustable 1.5" (38 mm) angle brackets available in *Designer* colors†
- An on-off switch and indicator light can be installed in front or back of unit, GRNM models use remote controls only (no built-ins)
- Lower wattage elements also available, please consult factory for more information



GRN-24 with standard angle brackets and optional *Designer* color

Remote Control Enclosures

RMB-3D with toggle switch

RMB-3F with toggle switch and indicator light

Options (available at time of purchase only)

- Housing in *Designer* Color† (Black standard)
- Warm Red Gray Granite White Granite Navy Blue
 - Hunter Green Antique Copper Stainless Steel
- Power Leads – Standard 6" (152 mm) – must specify lead length
- 1'-5' (305-1525 mm) 6'-10' (1829-3048 mm)
 - 11'-15' (3352-4572 mm) 16'-20' (4877-6096 mm)
- Remote Box – in *Designer* Color† (Clear Anodized standard)
- Warm Red Black Gray Granite White Granite
 - Navy Blue Hunter Green Antique Copper
- Stainless Steel Hanger tabs in lieu of angle brackets (GRN, GRNH only)
 - Attached 6' (1829 mm) Cord and Plug Set (120V GRN and GRNH only) on models up to 72" (1829 mm) wide with Standard Chain Mount Kit (two S hooks with two 6" (152 mm) lengths of chain) and hanger tabs (max.1800 watt)
 - Adjustable Tubular Stands 10"-14" (254-356 mm)
- Non-Adjustable Tubular Stands – choose clearance
- 10" (254 mm) 12" (305 mm) 14" (356 mm) 16" (406 mm)
- Designer* Color for Tubular Stands† (Clear Anodized standard)
- Warm Red Black Gray Granite White Granite
 - Navy Blue Hunter Green Antique Copper
- Indicator light

†Non-standard colors are non-returnable



HATCO CORPORATION | P.O. Box 340500 Milwaukee, WI 53234-0500 U.S.A.

(800) 558-0607 | (414) 671-6350 | www.hatcocorp.com | support@hatcocorp.com | intl@hatcocorp.com

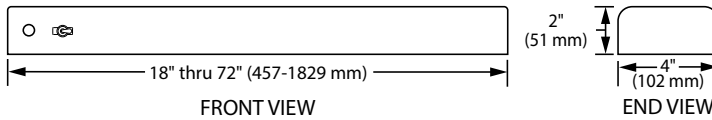


Glo-Ray® Narrow Infrared Strip Heaters

Models: GRN-18, -24, -30, -36, -42, -48, -54, -60, -66, -72
 GRNH-18, -24, -30, -36, -42, -48, -54, -60, -66, -72
 GRNM-18, -24, -30, -36, -42, -48, -54, -60, -66, -72

GRN, GRNH, GRNM

GRNM units use remote controls only (no built-ins)



SPECIFICATIONS - Glo-Ray® Narrow Infrared Strip Heaters

Phase: Single

The shaded areas contain electrical information for International models

Standard Watt				High Watt				Max Watt				All Models		
Model	Volts	Watts	Amps	Model	Volts	Watts	Amps	Model [○]	Volts	Watts	Amps	Dimensions W x D x H	Plug GRN, GRNH only	Ship Weight*
GRN-18	120	250	2.1	GRNH-18	120	350	2.9	GRNM-18	120	450	3.8	18" x 4" x 2" (457 x 102 x 51 mm)	NEMA 5-15P	6 lbs. (3 kg.)
	208		1.2		208		1.7		208		2.2			
	240		1.0		240		1.5		240		1.9			
	220	1.1	220		1.6	220	-		-					
	240	1.0	240		1.5	240	-		-					
	220-230 (CE)*	250-273	1.1-1.2		220-230 (CE)*	350-383	1.6-1.7		220-230	-	-			
230-240 (CE)*	230-250	1.0-1.0	230-240 (CE)*	321-350	1.4-1.5	230-240	-	-						
GRN-24	120	350	2.9	GRNH-24	120	500	4.2	GRNM-24	120	650	5.4	24" x 4" x 2" (610 x 102 x 51 mm)	NEMA 5-15P	7 lbs. (3 kg.)
	208		1.7		208		2.4		208		3.1			
	240		1.5		240		2.1		240		2.7			
	220	1.6	220		2.3	220	-		-					
	240	1.5	240		2.1	240	-		-					
	220-230 (CE)*	350-383	1.6-1.7		220-230 (CE)*	500-547	2.3-2.4		220-230	-	-			
230-240 (CE)*	321-350	1.4-1.5	230-240 (CE)*	459-500	2.0-2.1	230-240	-	-						
GRN-30	120	450	3.8	GRNH-30	120	660	5.5	GRNM-30	120	825	6.9	30" x 4" x 2" (762 x 102 x 51 mm)	NEMA 5-15P	8 lbs. (4 kg.)
	208		2.2		208		3.2		208		4.0			
	240		1.9		240		2.8		240		3.4			
	220	2.1	220		3.0	220	-		-					
	240	1.9	240		2.8	240	-		-					
	220-230 (CE)*	450-492	2.1-2.2		220-230 (CE)*	660-721	3.0-3.1		220-230	-	-			
230-240 (CE)*	413-450	1.8-1.9	230-240 (CE)*	606-660	2.6-2.8	230-240	-	-						
GRN-36	120	575	4.8	GRNH-36	120	800	6.7	GRNM-36	120	1000	8.3	36" x 4" x 2" (914 x 102 x 51 mm)	NEMA 5-15P	9 lbs. (4 kg.)
	208		2.8		208		3.8		208		4.8			
	240		2.4		240		3.3		240		4.2			
	220	2.6	220		3.6	220	-		-					
	240	2.4	240		3.3	240	-		-					
	220-230 (CE)*	575-629	2.6-2.7		220-230 (CE)*	800-875	3.6-3.8		220-230	-	-			
230-240 (CE)*	528-575	2.3-2.4	230-240 (CE)*	735-800	3.2-3.3	230-240	-	-						
GRN-42	120	675	5.6	GRNH-42	120	950	7.9	GRNM-42	120	1175	9.8	42" x 4" x 2" (1067 x 102 x 51 mm)	NEMA 5-15P	10 lbs. (5 kg.)
	208		3.2		208		4.7		208		5.6			
	240		2.8		240		4.0		240		4.9			
	220	3.1	220		4.3	220	-		-					
	240	2.8	240		4.0	240	-		-					
	220-230 (CE)*	675-738	3.1-3.2		220-230 (CE)*	950-1038	4.3-4.5		220-230	-	-			
230-240 (CE)*	620-675	2.7-2.8	230-240 (CE)*	873-950	3.8-4.0	230-240	-	-						
GRN-48	120	800	6.7	GRNH-48	120	1100	9.2	GRNM-48	120	1300	10.8	48" x 4" x 2" (1219 x 102 x 51 mm)	NEMA 5-15P	11 lbs. (5 kg.)
	208		3.8		208		5.3		208		6.3			
	240		3.3		240		4.6		240		5.4			
	220	3.6	220		5.0	220	-		-					
	240	3.3	240		4.6	240	-		-					
	220-230 (CE)*	800-874	3.6-3.8		220-230 (CE)*	1100-1202	5.0-5.2		220-230	-	-			
230-240 (CE)*	735-800	3.2-3.3	230-240 (CE)*	1010-1100	4.4-4.6	230-240	-	-						
GRN-54	120	925	7.7	GRNH-54	120	1250	10.4	GRNM-54	120 [‡]	1500	12.5	54" x 4" x 2" (1372 x 102 x 51 mm)	NEMA 5-15P	13 lbs. (6 kg.)
	208		4.4		208		6.0		208		7.2			
	240		3.9		240		5.2		240		6.3			
	220	4.2	220		5.7	220	-		-					
	240	3.9	240		5.2	240	-		-					
	220-230 (CE)*	925-1011	4.2-4.4		220-230 (CE)*	1250-1366	5.7-5.9		220-230	-	-			
230-240 (CE)*	850-925	3.7-3.9	230-240 (CE)*	1148-1250	5.0-5.2	230-240	-	-						
GRN-60	120	1050	8.8	GRNH-60	120	1400	11.7	GRNM-60	120 [‡]	1700	14.2	60" x 4" x 2" (1524 x 102 x 51 mm)	NEMA 5-15P	14 lbs. (6 kg.)
	208		5.0		208		6.7		208		8.2			
	240		4.4		240		5.8		240		7.1			
	220	4.8	220		6.4	220	-		-					
	240	4.4	240		5.8	240	-		-					
	220-230 (CE)*	1050-1148	4.8-5.0		220-230 (CE)*	1400-1530	6.4-6.7		220-230	-	-			
230-240 (CE)*	964-1050	4.2-4.4	230-240 (CE)*	1286-1400	5.6-5.8	230-240	-	-						

[○] All GRNM units must use Remote Controls (no Built-Ins), cord & plug not available. [‡] CE approved units for 220-230V utilize a 220V heating system; 230-240V CE units utilize a 240V heating system.
 * Shipping weight includes packaging and does not include RMB. [‡] Units not available with Infinite Switch in 120V. RMB2-1R or RMB2-2R series remote control box required.

HATCO CORPORATION | P.O. Box 340500 Milwaukee, WI 53234-0500 U.S.A.

(800) 558-0607 | (414) 671-6350 | www.hatcocorp.com | support@hatcocorp.com | intlSales@hatcocorp.com



Glo-Ray® Narrow Infrared Strip Heaters

Models: GRN-18, -24, -30, -36, -42, -48, -54, -60, -66, -72
 GRNH-18, -24, -30, -36, -42, -48, -54, -60, -66, -72
 GRNM-18, -24, -30, -36, -42, -48, -54, -60, -66, -72

SPECIFICATIONS - Glo-Ray® Narrow Infrared Strip Heaters

Phase: Single

The shaded areas contain electrical information for International models

Standard Watt				High Watt				Max Watt				All Models				
Model	Volts	Watts	Amps	Model	Volts	Watts	Amps	Model [Ⓛ]	Volts	Watts	Amps	Dimensions W x D x H	Plug GRN, GRNH only	Ship Weight*		
GRN-66	120	1160	9.7	GRNH-66	120 †	1560	13.0	GRNM-66	120 †	1875	15.6	66" x 4" x 2" (1676 x 102 x 51 mm)	NEMA 5-15P [▶]	16 lbs. (7 kg.)		
	208		5.6		208		7.5		208		9.0					
	240		4.8		240		6.5		240		7.8					
	220	1160	5.3		220	1560	7.1		220	-	220		-		-	-
	240		4.8		240		6.5		240	-	240		-		-	
	220-230 (CE)*		1160-1268		5.3-5.5		220-230 (CE)*		1560-1705	7.1-7.4	220-230		-		-	
	230-240 (CE)*	1066-1160	4.6-4.8		230-240 (CE)*	1433-1560	6.2-6.5		230-240	-	-		230-240		-	-
GRN-72	120	1275	10.6	GRNH-72	120 †	1725	14.4	GRNM-72	120 †	2075	17.3	72" x 4" x 2" (1829 x 102 x 51 mm)	NEMA 5-15P [▶]	17 lbs. (8 kg.)		
	208		6.1		208		8.3		208		10.0					
	240		5.3		240		7.2		240		8.6					
	220	1275	5.8		220	1725	7.8		220	-	220		-		-	-
	240		5.3		240		7.2		240	-	240		-		-	
	220-230 (CE)*		1275-1394		5.8-6.1		220-230 (CE)*		1725-1886	7.8-8.2	220-230		-		-	
	230-240 (CE)*	1171-1275	5.1-5.3		230-240 (CE)*	1584-1725	6.9-7.2		230-240	-	-		230-240		-	-

Ⓛ All GRNM units must use Remote Controls (no Built-Ins), and not available with cord and plug. ♦ CE approved units for 220-230V utilize a 220V heating system; 230-240V CE units utilize a 240V heating system.
 * Shipping weight includes packaging and does not include RMB. ▶ GRNH-66 and GRNH-72 require NEMA 5-20P cord for Canada.
 † Units not available with Infinite Switch in 120V. RMB2-1R or RMB2-2R series remote control box required.

TOGGLE SWITCH

Toggle Switch: Max. 15 amps
 Location: Chef's left side standard, other options available
 GRNM units use remote control enclosures only (no built-ins)

INFINITE SWITCH

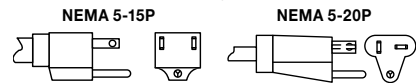
Max. 12.2 amps

LEADS

6" (152 mm) leads (on server's right)

PLUG CONFIGURATIONS

Please refer to electrical specifications shown in charts.



REMOTE CONTROL ENCLOSURES

RMB series uses one Control Box per Strip Heater - If RMB2 series is used, multiple warmers can be controlled from one box (U.S., Canada only). CE models require any remote switches be contained in a Remote Control Enclosure. For more details, see "Choose Remote Box" under "Resources" on Hatco website, or consult Price List.

Model	Volts	Width	Infinite/Toggle Switches
			U.S., Canada, Export U.S. Dollar
RMB-3A	120	5.5"(140 mm)	1 infinite
RMB-3B	208	5.5"(140 mm)	1 infinite
RMB-3C	240	5.5"(140 mm)	1 infinite
RMB-3D	120, 208, 240	5.5"(140 mm)	1 toggle
RMB-3F	120	5.5"(140 mm)	1 toggle, 1 indicator light
RMB-3G	208	5.5"(140 mm)	1 toggle, 1 indicator light
RMB-3H	240	5.5"(140 mm)	1 toggle, 1 indicator light
RMB-7F	120	9"(229 mm)	1 infinite, 1 indicator light
RMB-7G	208	9"(229 mm)	1 infinite, 1 indicator light
RMB-7H	240	9"(229 mm)	1 infinite, 1 indicator light
RMB2-1R	120, 208, 240	11" (280 mm)	1 toggle, 1 electronic infinite
RMB2-2R	120, 208, 240	14" (356 mm)	1 toggle, 1 electronic infinite

PRODUCT SPECS - Infrared Strip Heater

The Narrow Infrared Strip Heater shall be a Glo-Ray®, manufactured by the Hatco Corporation, Milwaukee, WI 53234 U.S.A.

The Foodwarmer shall be a Glo-Ray Model ..., rated at ... watts, ... volts, single phase and be ... inches (millimeters) in overall width.

The Glo-Ray shall consist of Stainless Steel or Designer painted housing and include as standard equipment non-adjustable 1.5" (38 mm) angle brackets.

RECOMMENDED MOUNTING HEIGHTS

(For diagrams, refer to the Product Installation Manual on the Hatco website)

GRN, GRNH

Standard Watt: 8"-11" (203-279 mm) High Watt: 11"-14" (279-356 mm)

GRNM

Max Watt: 14"-18" (356-457 mm)

MINIMUM CLEARANCES

GRN, GRNH

Combustibles

Unit to surface below: 11" (279 mm)
 Unit to back wall: 2" (51 mm)
 Below overshelf: 1" (25 mm) clearance

Non-Combustibles

Corded Units with Built-In Switches:

Must be installed in a pass through area, not allowed with back wall installation

Unit to surface below: 7" (178 mm)
 Unit to back wall: 2" (51 mm)
 Below overshelf: 3" (76 mm) clearance

Hardwired Units with Built-In Switches:

Must be installed in a pass through area, not allowed with back wall installation

With Infinite Control or Indicator Light
 Unit to surface below: 10" (254 mm)
 Below overshelf: 1" (25 mm) clearance
 With On/Off Toggle Switch
 Unit to surface below: 8" (203 mm)
 Below overshelf: 1" (25 mm) clearance

Hardwired Units with Remote Switches:

Unit to surface below: 8" (203 mm)
 Unit to wall: 0" (0 mm)
 Below overshelf: 0" (0 mm) clearance

GRNM

Combustibles

Must be installed in non-combustible surroundings only

Non-Combustibles

Unit to surface below: 12" (305 mm)
 Unit to wall: 3" (76 mm)
 Below overshelf: 1" (24 mm) clearance
 Set back 10" (254 mm) maximum from front of an overshelf

The infrared heating element shall be tubular metal sheathed. The foodwarmer shall be factory assembled ready for electrical installation.

Options shall include choice of Stainless Steel or Designer color, extended electrical leads, remote control box, and non-adjustable tubular stands.

Comes with 24/7 parts and service assistance (U.S. and Canada only).

HATCO CORPORATION | P.O. Box 340500 Milwaukee, WI 53234-0500 U.S.A.

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Submittal Sheet

10/16/2018

ITEM# 57 - HEAT LAMP (1 EA REQ'D)

Hatco GRNM-36

Glo-Ray® Narrow Max Infrared Strip Heater, 36" L, tubular metal heater rod, single heater rod housing, stainless steel housing with angle mounting bracket, 1000 watts, cULus, UL EPH Classified, ANSI/NSF 4, Made in USA

The spec sheet for this item can be viewed on item 56)

ACCESSORIES

Mfr	Qty	Model	Spec
Hatco	1		NOTE: Sale of this product must comply with Hatco's Minimum Resale Price Policy; consult order acknowledgement for details
Hatco	1		NOTE: Includes 24/7 parts & service assistance, call 800-558-0607
Hatco	1		One year on-site parts and labor warranty, plus one additional year parts only warranty on all Glo-Ray metal sheathed elements
Hatco	1		120v/60/1-ph
Hatco	1	NO CONTROL	No control included, requires selection of RMB2 control box
Hatco	1		NOTE: If the current rating is under 20 amps. then select an RMB2-1R and RMB3-1R, if the current rating is between 20 and 40 amps select the RMB2-2R and RMB3-2R, RMB2-2R has (2) 20 amp outputs and RMB3-2R has (2) 15 amp outlets
Hatco	1		NOTE: Requires selection of RMB2 control

ELECTRICAL

	VOLTS	CYCLE	PHASE	CONN	AFF	NEMA	AMPS	KW	HP	MCA	MOCP
1								1.0			
2	120	60	1								

Submittal Sheet

10/16/2018

ITEM# 60 - SANDWICH / SALAD PREPARATION REFRIGERATOR (1 EA REQ'D)

Continental Refrigerator CRA93-18-D

Refrigerated Base Sandwich Unit, 93"W, 300 series stainless steel top with (18) 1/6 size x 4" deep non-recessed pans, stainless steel front & sides, galvanized steel case back, aluminum interior, 12" deep nylon cutting board, (6) drawers - top drawers hold (1) 12" x 20" + (3) 1/6 pans each & Bottom drawers holds (2) 12" x 20" pans each, (1) half height field rehingeable door, electronic controller with digital display, 1/2 HP, side-mounted refrigeration, cETLus, NSF, Made in USA

ACCESSORIES

Mfr	Qty	Model	Spec
Continental Refrigerator	1		Standard warranty (for the United States & Canada Only): 3 year parts and labor; 5 year compressor
Continental Refrigerator	1		115v/60/1-ph, 13.0 amps, cord, NEMA 5-15P, standard
Continental Refrigerator	1		Condensing unit on the right, standard
Continental Refrigerator	1		(00FL) Stainless steel flat cover - without hinges
Continental Refrigerator	1		5" Swivel Casters standard

ELECTRICAL

	VOLTS	CYCLE	PHASE	CONN	AFF	NEMA	AMPS	KW	HP	MCA	MOCP
1									1/2		
2	115	60	1	Cord & Plug		5-15P	13.0				

BASE MODEL SANDWICH UNIT

Model: CRA93-18-D

93" Standard Top Sandwich Unit Refrigerator with Drawers - 18 Pans

Heavy gauge #300 Series stainless steel top, stainless steel front and end panels, galvanized steel rear and grill and aluminum interior.
Certified under NSF-7 to maintain temperatures in 86°F ambient and designed to maintain NSF-7 temperatures in 100°F ambient.



Options and Accessories

(upcharge and lead times may apply)

Doors in lieu of drawers	Expansion valve system
Drawer section above the condensing unit*	Flat insulated night cover
Overshelves (single or double)	Remote models
Condensing unit left or right	Door/drawer locks
Automatic, electric condensate evaporator	Adjustable legs
Exterior dial or digital thermometer	Crumb catcher
Rear-mounted cutting board	Front breathing
Stainless steel back and interior	

*Drawer section above condensing unit holds (1) 12 x 20 x 6 pan

Continental
Refrigerator

Toll-Free: 800-523-7138
 Phone: 215-244-1400
 Fax: 215-244-9579

539 Dunksferry Road
 Bensalem, PA 19020
www.continentalrefrigerator.com

Project Name:

Model Specified:

Location:

Item No:

Quantity:

AIA #:

SIS #:

Standard Model Features

REFRIGERATION SYSTEM

Performance-rated refrigeration system

Environmentally-safe R-134a refrigerant

Unique air flow distribution allows pan product to maintain 33° - 41°F

Automatic, energy saving, non-electric condensate evaporator

Non-corrosive, plasticized fin evaporator coil

Easily serviceable, slide-out condensing unit

CABINET ARCHITECTURE

2" non-CFC polyurethane foam insulation

Spring loaded, self closing door (over condensing unit)

Magnetic snap-in door/drawer gaskets

Stainless steel roll-out drawers

12" deep, full length nylon cutting board

Insulated lid

5" casters

Completely enclosed, vented and removable rear and side grills

Refrigerated door section above the condensing unit

MODEL FEATURES

(10) 1/6 size non-recessed pans, 4" deep

Interior hanging thermometer

Field rehingeable door

NOTE: CRA-D models come standard with a door over the condensing unit. A drawer over the condensing unit is an option.

APPROVAL:

Model Specifications

DIMENSIONAL DATA

Net Capacity (cu. ft.)	32 (906 cu l)
1/6 Size Pans (4" deep)	18
Width, Overall (in.)	93 (2362 mm)
Depth, Overall (in.) (incl. handles & bumpers)	36 1/16 (916 mm)
Depth, Cutting Board (in.)	12 (305 mm)
Height, Overall (in.) (incl. 5" casters)	42 (1067 mm)
No. of Drawers	6
No. of Half Doors	1
Interior Depth (in.) (above condenser)	30 (762 mm)
Interior Height (in.) (above condenser)	12 1/2 (318 mm)
Interior Width (in.) (above condenser)	17 (432 mm)

REFRIGERANT DATA

Condensing Unit Size (H.P.)	1/2
Capacity (BTU/Hr)*	4220

ELECTRICAL DATA

Voltage (int'l)	115/60/1 (220/50/1)
Fans	4
Total Amps (int'l)	13.0 (8.4)
10 ft. Cord/Plug [attached] (int'l)	Yes (No)

SHIPPING DATA

Weight (lbs.)	605 (274 kg)
Height - Crated (in.)	43 3/4 (1111 mm)
Width - Crated (in.)	95 (2413 mm)
Depth - Crated (in.)	47 (1194 mm)

DRAWER PAN CONFIGURATIONS

Two Tier: (1) 12 x 20 x 6 pan & (3) 1/6 x 6 pans (top)
(2) 12 x 20 x 6 pans (bottom). Three tier not available.

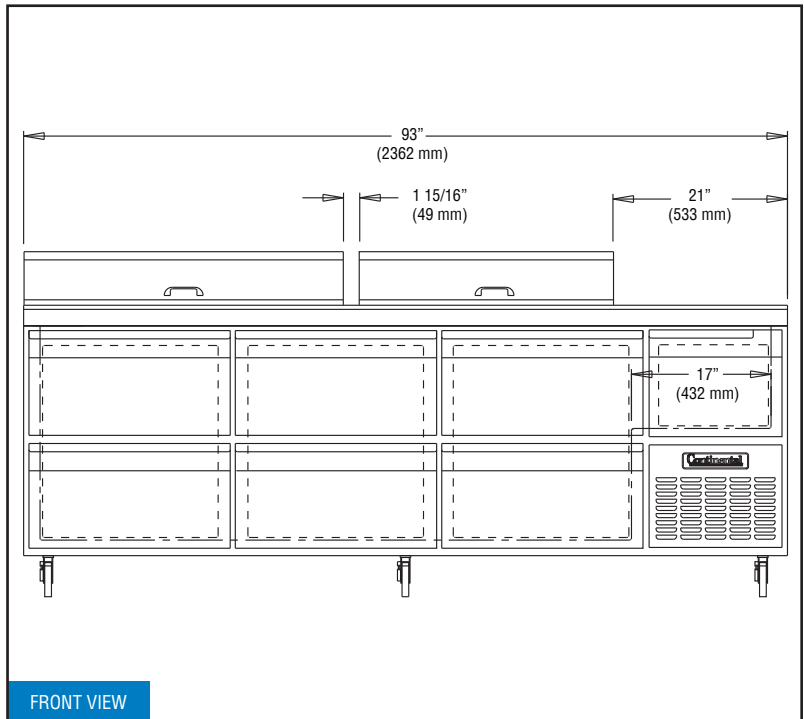
* Rating @ +25°F evaporator, 90°F ambient

Figures in parentheses reflect metric equivalents rounded to the nearest whole unit.

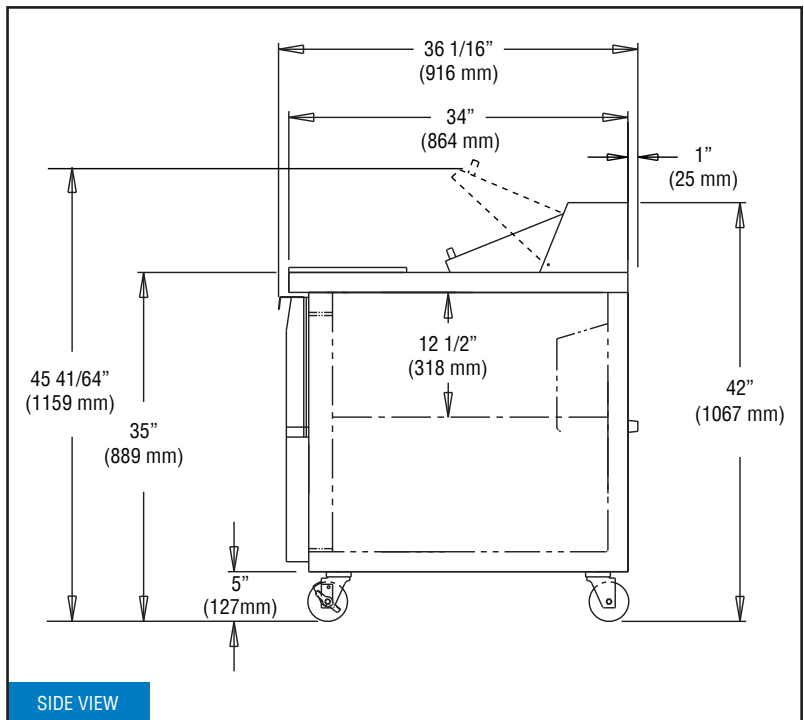


Equipped with one NEMA-5-15P Plug
(varies by country)

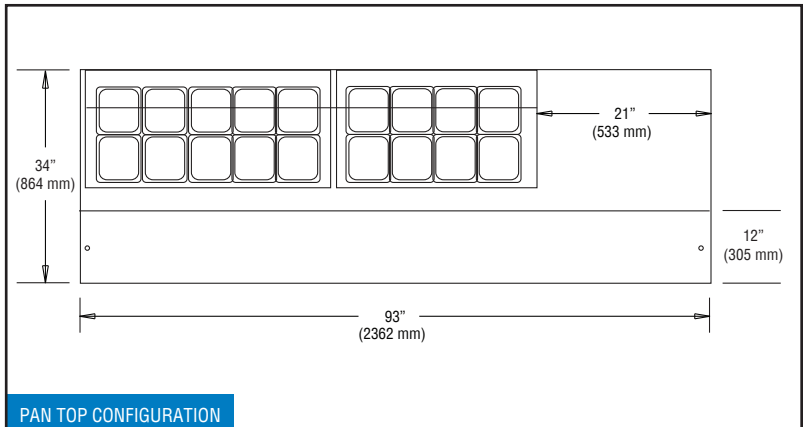
Model Plan Views



FRONT VIEW



SIDE VIEW



PAN TOP CONFIGURATION



Toll-Free: 800-523-7138
Phone: 215-244-1400
Fax: 215-244-9579

539 Dunkserry Road
Bensalem, PA 19020
www.continentalrefrigerator.com

Due to our continued efforts in developing innovative products, specifications subject to change without notice.



MADE IN THE U.S.A.

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Submittal Sheet

10/16/2018

ITEM# 61.1 - SNEEZE GUARD (1 EA REQ'D)

Versa-Gard VP24.3

VG Series. Full service food protector with 24" tall vertical glass. 1" OD Solid Supports. End glass panels are 1/4" clear tempered. All glass meets ANSI Z97.1 specifications for safety performance and ASTM C1048-04 specifications for heat treated glass. All hardware supplied in a brushed stainless steel finish. All glass with ground and polished edges. Conceal mount hardware.

The spec sheet for this item can be viewed on item 30.1)

Submittal Sheet

10/16/2018

ITEM# 61.2 - SNEEZE GUARD (1 EA REQ'D)

Versa-Gard VP24.3

VG Series. Full service food protector with 24" tall vertical glass. 1" OD Solid Supports. End glass panels are 1/4" clear tempered. All glass meets ANSI Z97.1 specifications for safety performance and ASTM C1048-04 specifications for heat treated glass. All hardware supplied in a brushed stainless steel finish. All glass with ground and polished edges. Conceal mount hardware.

The spec sheet for this item can be viewed on item 30.1)

Submittal Sheet

10/16/2018

ITEM# 61.3 - SNEEZE GUARD (1 EA REQ'D)

Versa-Gard VP24.3

VG Series. Full service food protector with 24" tall vertical glass. 1" OD Solid Supports. End glass panels are 1/4" clear tempered. All glass meets ANSI Z97.1 specifications for safety performance and ASTM C1048-04 specifications for heat treated glass. All hardware supplied in a brushed stainless steel finish. All glass with ground and polished edges. Conceal mount hardware.

The spec sheet for this item can be viewed on item 30.1)

Submittal Sheet

10/16/2018

ITEM# 62 - MENU BOARD (1 EA REQ'D)

Provided by Operations CONTACT OPERATIONS

Submittal Sheet

10/16/2018

ITEM# 62.1 - OMS SCREEN (1 EA REQ'D)

Provided by Operations CONTACT OPERATIONS

Submittal Sheet

10/16/2018

ITEM# 70 - HAND SINK (1 EA REQ'D)

Eagle Group HSA-10-F

Hand Sink, wall mount, 13-1/2" wide x 9-3/4" front-to-back x 6-3/4" deep bowl, 304 stainless steel construction, splash mount gooseneck faucet, basket drain, deep-drawn seamless design-positive drain, inverted "V" edge, NSF

The spec sheet for this item can be viewed on item 12)

WATER

	HOT SIZE	HOT AFF	HOT GPH	COLD SIZE	COLD AFF	FILTERED SIZE	FILTERED AFF	CONDENSER INLET SIZE	CONDENSER OUTLET SIZE
1									

WASTE

	INDIRECT SIZE	DIRECT SIZE
1		1-1/2"

Submittal Sheet

10/16/2018

ITEM# 71 - HD RANGE, 36", 6 SOLID BURNERS (1 EA REQ'D)

Southbend SE36A-BBB

Heavy Duty Range, electric, 36", (6) round hot plates, 3-heat switch, (1) convection oven, includes (3) racks, stainless steel front, sides, top & oven lining, 6" legs, cETLus, ETL-Sanitiation (Note: Qualifies for Southbend's Service First™ Program, see Service First document for details)

The spec sheet for this item can be viewed on item 01)

ACCESSORIES

Mfr	Qty	Model	Spec
Southbend	1		Domestic Shipping, inside of North America (Contact factory for price)
Southbend	1		Standard one year limited warranty (range)
Southbend	1		208v/60/3-ph, 21.6kw, standard
Southbend	1	ACCS06K	Casters, set of four, 2 swivel with locks

CORD & PLUG SUITABLE FOR EQUIPMENT PROVIDED BY K.E.C.

ELECTRICAL

	VOLTS	CYCLE	PHASE	CONN	AFF	NEMA	AMPS	KW	HP	MCA	MOCP
1	208	60	3					21.6			

Submittal Sheet

10/16/2018

ITEM# 72 - EQUIPMENT STAND, REFRIGERATED BASE (1 EA REQ'D)

Continental Refrigerator DL36G

Refrigerator Griddle Stand, one-section, (2) drawers - accommodates (1) 12" x 20" x 6" & (1) 6" x 20" x 6", stainless steel top with drip guard marine edge, stainless steel exterior & interior, electronic control with digital display, hi-low alarm, high/low temperature alarm, 4" casters, self-contained refrigeration, 1/5 hp, 10' cord, cETLus, NSF, Made in USA

ACCESSORIES

Mfr	Qty	Model	Spec
Continental Refrigerator	1		Standard warranty (for the United States & Canada Only): 3 year parts and labor; 5 year compressor
Continental Refrigerator	1		115v/60/1-ph, 6.0 amps, cord, NEMA 5-15P, standard
Continental Refrigerator	1		Condensing unit on the right, standard
Continental Refrigerator	1		4" Casters, standard

ELECTRICAL

	VOLTS	CYCLE	PHASE	CONN	AFF	NEMA	AMPS	KW	HP	MCA	MOCP
1									1/5		
2	115	60	1	Cord & Plug		5-15P	6.0				

GRIDDLE STAND REFRIGERATOR

Model: DL36G

36" Griddle Stand Refrigerator

Stainless steel exterior and interior.

Designed to maintain NSF-7 temperatures in 100°F ambient.



Options and Accessories

(upcharge and lead times may apply)

Doors in lieu of drawers	Integral heat shield top
Flat top in lieu of marine edge	Adjustable legs
16-gauge stainless steel top (flat or marine)	Cylinder locks
Condensing unit left or right	Stainless steel pans
Automatic, electric condensate evaporator	Special electrical requirements (consult factory)
Stainless steel top extensions (flat or marine)	

Consult factory for other model configurations, options and accessories.

Project Name:

Model Specified:

Location:

Item No:

Quantity:

AIA #:

SIS #:

Standard Model Features

REFRIGERATION SYSTEM

Performance-rated refrigeration system

Environmentally-safe R-134a refrigerant

Side-mounted, automatic, energy saving non-electric condensate evaporator

Non-corrosive, plasticized fin evaporator coil

Easily serviceable, front slide-out condensing unit

CABINET ARCHITECTURE

High density, non-CFC polyurethane foamed-in-place insulation

Easy glide, fully extendable drawers designed to hold 6" deep pans side-by-side

One-piece, snap-in magnetic drawer gaskets

Heavy-duty drawer track with built-in drawer safety clips

Drawers designed to hold 250 lb. capacity

4" casters on support plates

Stainless steel case back

Reinforced stainless steel work top with drip guard marine edge

MODEL FEATURES

Electronic controller w/digital display & hi-low alarm

Front breathing

APPROVAL:

Continental
Refrigerator

Toll-Free: 800-523-7138
Phone: 215-244-1400
Fax: 215-244-9579

539 Dunksferry Road
Bensalem, PA 19020
www.continentalrefrigerator.com

Model Specifications

DIMENSIONAL DATA

Net Capacity (cu. ft.)	6.5 (184 cu l)
Width, Overall (in.)	36 (914 mm)
Depth, Overall (incl. handles) (in.)	34 3/4 (883 mm)
Height, Overall (in.) (incl. 4" casters)	26 3/8 (670 mm)
No. of Drawers	2

REFRIGERANT DATA

Condensing Unit Size (H.P.)	1/5
Capacity (BTU/Hr)*	1620

ELECTRICAL DATA

Voltage (int'l)	115/60/1 (220/50/1)
Fans	1
Feed Wires (incl. ground)	3
Total Amps (int'l)	6.0 (3.1)
10 ft. Cord/Plug [attached] (int'l)	Yes (No)

SHIPPING DATA

Weight (lbs.)	360 (163 kg)
Height - Crated (in.)	44 (1118 mm)
Width - Crated (in.)	52 (1472 mm)
Depth - Crated (in.)	39 (991 mm)

TOP WEIGHT CAPACITY

Max. Top Weight Capacity (lbs.)	600 (272 kg)
---------------------------------	--------------

* Rating @ +25°F evaporator, 90°F ambient

Figures in parentheses reflect metric equivalents rounded to the nearest whole unit.



Equipped with one NEMA-5-15P Plug
(varies by country)

Continental
Refrigerator

Toll-Free: 800-523-7138
Phone: 215-244-1400
Fax: 215-244-9579

539 Dunkserry Road
Bensalem, PA 19020
www.continentalrefrigerator.com

Due to our continued efforts in developing innovative products, specifications subject to change without notice.



Intertek

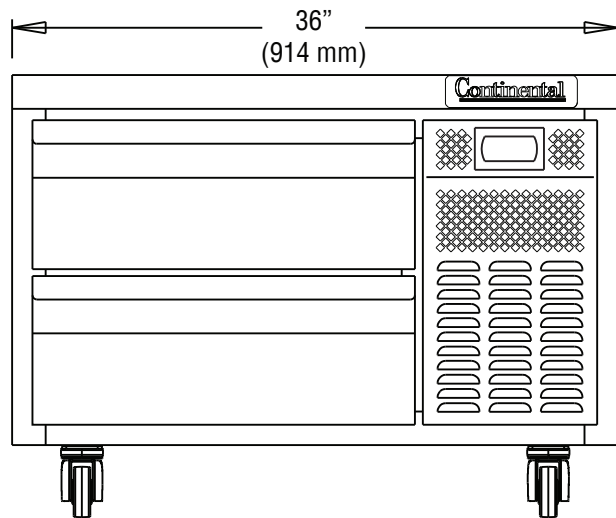
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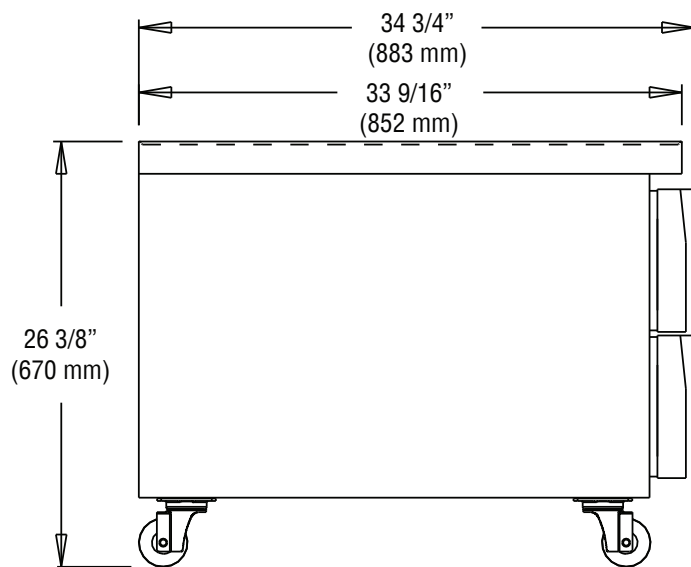


MADE IN THE U.S.A.

Model Plan Views

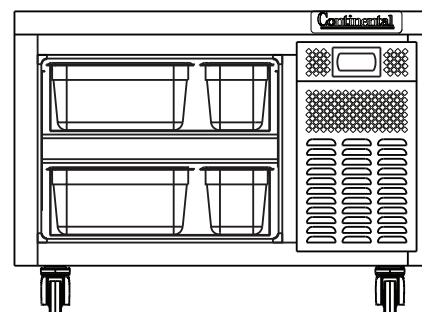


FRONT VIEW



SIDE VIEW

Shown with (2) 12 x 20 x 6 pans and (2) 6 x 20 x 6 pans (not furnished)



DRAWER PAN CONFIGURATION

Submittal Sheet

10/16/2018

ITEM# 73 - CHARBROILER, ELECTRIC, COUNTERTOP (1 EA REQ'D)

Star 5136CF

Star-Max® Heavy Duty Charbroiler, electric, countertop, 36"W x 26"D, heavy cast iron removable grids, swing-up 3300 watt elements every 12", chrome metal knobs, grease drawer, welded steel frame with stainless steel top, front and grease trough, aluminized steel sides, 4" legs, cULus, UL EPH

ACCESSORIES

Mfr	Qty	Model	Spec
Star	1		2 year parts & labor warranty, standard
Star	1		180 day warranty on cast iron grates, burners, & burner shields, standard
Star	1		(5136CF-208V) 208v/50/60/1-ph or 3-ph, 9.9 kW, field wired (Field convertible), standard CORD & PLUG SUITABLE FOR EQUIPMENT PROVIDED BY K.E.C.

ELECTRICAL

	VOLTS	CYCLE	PHASE	CONN	AFF	NEMA	AMPS	KW	HP	MCA	MOCP
1	208	50/60		Direct				9.9			

ELECTRICAL 1 REMARKS

1-ph or 3-ph (Field convertible)



Job _____ Item No. _____

Star-Max® Radiant Electric CharBroilers

□5124CF □5136CF



5136CF

DESCRIPTION

Star-Max electric charbroilers are designed to provide excellent heating and control when preparing a wide variety of product. The units are designed with durability and flexibility in mind with two types of heat transfer, radiation direct from elements and conduction through the grates. A control knob for each twelve [12] inch (304mm) section. The grates have been designed to hold a high capacity of product for maximum efficiency under demanding cooking situations.

SPECIFICATIONS

Star-Max® electric charbroilers are constructed of stainless steel and have a 6 qt. stainless steel water pan drawer on 24" models and a 9 qt. stainless steel water pan drawer on 36" models. Units feature heavy-duty cast iron grid sections and incoloy sheath-type heating elements. Charbroilers have an infinite control for every 12" of cooking surface. Units operate on 208 or 240 volts and have a rated wattage of 6,600 on 24" models and 9,900 on 36" models. Charbroilers are supplied with 4" (10.2 cm) high die cast nickel plated legs with a 1-3/8" (3.5 cm) adjustment. Bottom rear panels supplied with 1-3/8" diameter hole for installation of electrical conduit. Charbroilers units are listed by UL, CUL and UL-Sanitation classified to NSF Standard 4.

WARRANTY

These units come with a two [2] year warranty for parts and labor.

FEATURES

- Available in 24" and 36" widths
- Two types of heat transfer, radiation direct from elements and conduction through the grates, provide even heat distribution for maximum cooking performance
- High performance, incoloy sheath type heating elements, 4 on the 24" model and 6 on the 36" model, provide high speed charbroiling to accommodate high volume operations
- Infinite control every 12" of cooking surface for precise temperature control
- Heavy-duty cast iron grates are removable for fast and easy clean-up
- Heavy-duty metal knobs look great and are designed to last
- Stainless steel top, pan and front
- Large capacity stainless steel water pan
- Stainless steel, 2-3/4" high tapered splash guard
- Cool-to-the-touch stainless steel bull nose front provides knob protection and comfortable work zone
- 4 " adjustable legs
- Swing-up heating element assembly can be locked in a vertical position for easy and safe cleaning

CERTIFICATIONS



STAR MANUFACTURING INTERNATIONAL INC.

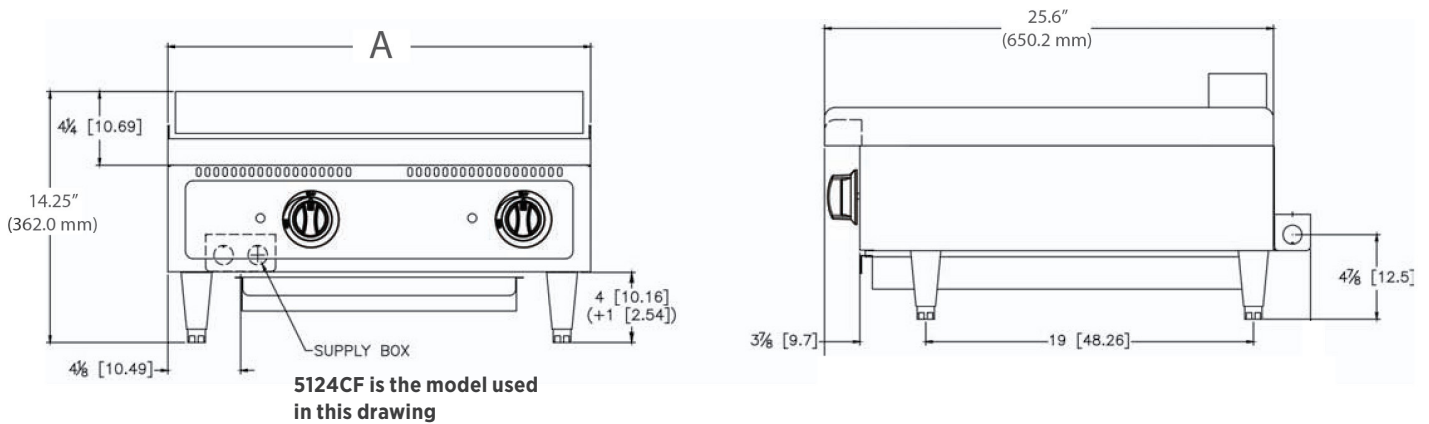
10 Sunnen Drive • Saint Louis, Missouri 63143
Telephone 800 264 7827 • Fax 314 781 5445
www.star-mfg.com

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Specifications are subject to change without notice
and are not intended for installation purposes.



Star-Max® Radiant Electric CharBroilers

□5124CF □5136CF



CLEARANCES

These units can be installed on non-combustible countertops using the provided four [4] inch (102 mm) legs or on a combustible floor using a minimum 27-inch (636 mm) tall stand. The back and both sides must be at least three [3] inches (76 mm) from any combustible surface.

MODEL	WIDTH [A] in. (mm)	DEPTH in. (mm)	HEIGHT in. (mm)	GRATE DEPTH	APPROX. SHIP WEIGHT	APPROX. WEIGHT INSTALLED
5124CF	24 (610.0)	25.6 (650.2)	14.25 (362.0)	21" (533.4mm)	124 lb. (55.8 kg)	98 lb. (45.0 kg)
5136CF	36 (914.4)	25.6 (650.2)	14.25 (362.0)		186 lb. (83.7 kg)	175 lb. (80.0 kg)

MODEL	WATTS ¹	NOMINAL AMPS PER LINE WIRE							
		208V 3PH			240V 3PH			208V	240V
		X	Y	Z	X	Y	X	1 PH	1 PH
5124CF	6,600	21.8	21.8	13.8	18.8	18.8	11.9	31.8	27.5
5136CF	9,900	27.6	27.6	27.6	23.9	23.9	23.9	47.6	41.3

¹ Specify 208V, 240V or 230V service All units must be hard-wired at installation 1-phase or 3-phase service

Due to periodic changes in designs, methods, procedures, policies and regulations, the specifications contained in this sheet are subject to change without notice. While Star Manufacturing exercises good faith efforts to provide information that is accurate, we are not responsible for errors or omissions in information provided or conclusions reached as a result of using the specifications. By using the information provided, the user assumes all risks in connection with such use.



STAR MANUFACTURING INTERNATIONAL INC.

10 Sunnen Drive • Saint Louis, Missouri 63143

Telephone 800 264 7827 • Fax 314 781 5445

www.star-mfg.com

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Submittal Sheet

10/16/2018

ITEM# 74 - COMBI OVEN, ELECTRIC (1 EA REQ'D)

RATIONAL B619106.12.202

(CMP 61E 208V) CombiMaster® Plus, Combi Oven/Steamer, electric, (6) 12" x 20" full size hotel or (6) 13" x 18" half size sheet pan capacity, mode selector control, 100 cooking programs, automatic cleaning, LED display, core temperature probe, 5-speed programmable fan, hand shower with automatic retracting system, hinging rack 2-5/8", interface USB, 208v/60/3-ph, 30.8 amps, 11.1 kW (dual voltage: retrofitable to 240v/60/3-ph, 35.5 amps, 11.1 kW), cULus, NSF, ENERGY STAR®

ACCESSORIES

Mfr	Qty	Model	Spec
RATIONAL	1		NOTE: All discounts subject to approval by manufacturer
RATIONAL	1		2 years parts and labor warranty
RATIONAL	1	CAP	Chef Assistance Program, a RATIONAL certified Chef conducts 4 hours/location specialized application training with personnel, no charge
RATIONAL	1	8720.1552US	Installation Kit, for electric SCC WE/CMP 61 (208/60/3 & 240/60/3); electric SCC WE/CMP 101 (440/60/3 & 480/60/3); electric SCC WE/CMP 62 (440/60/3 & 480/60/3) THIS ITEM IS NON-DISCOUNTABLE, USA ONLY (NET)
RATIONAL	1	1900.1154US	Water Filtration Single Cartridge System, for any single Combi model or Combi-Duo models XS/XS, 61/61 or 61/101, includes: (1) single head with pressure gauge, R95H filter & filter installation kit
RATIONAL	1		NOTE: The Rational Water Filtration Systems helps provide consistent high quality water to your RATIONAL SelfCooking Center or your CombiMaster Plus. The patented carbon block technology reduces the effects of sediment, chloramines and chlorine while providing the required flow rates
RATIONAL	1		NOTE: All public water systems using surface water and most ground water systems treat with either chlorine/chloramine or chlorine dioxide (EPA will allow levels as high as 4ppm safe for drinking water, exceeding our maximum level of .2ppm.
RATIONAL	1		NOTE: Chloride concentrations above 80ppm can cause corrosion. RATIONAL Water Filtration does NOT reduce chloride
RATIONAL	1		Free Water Testing Kits are available (contact factory for info)
RATIONAL	1	60.71.927	Combi-Duo Closed Stacking Kit, Mobile, casters, for electric or gas SCC 61 or CMP 61 stacked on electric SCC 61, SCC 101, CMP 61, or C P 101
RATIONAL	1	9999.9959	RCI Rational Certified Installation, new certified installation cost for a Combi-Duo stacked unit is \$200 for the first two units for double-stack (Pricing based on a 50 mile radius, Additional charges may apply, See attached installation flyer for details) THIS ITEM IS NON-DISCOUNTABLE. USA ONLY (NET)
RATIONAL	1		Door hinged on right std.

ELECTRICAL

	VOLTS	CYCLE	PHASE	CONN	AFF	NEMA	AMPS	KW	HP	MCA	MOCP
1	208	60	3	Direct			30.8	11.1			

ELECTRICAL 1 REMARKS

(dual voltage: retrofitable to 240v/60/3-ph, 35.5 amps, 11.1 kW)

WATER

	HOT SIZE	HOT AFF	HOT GPH	COLD SIZE	COLD AFF	FILTERED SIZE	FILTERED AFF	CONDENSER INLET SIZE	CONDENSER OUTLET SIZE
1				3/4"		3/4"			
2				3/4"					

WASTE

	INDIRECT SIZE	DIRECT SIZE
1		
2	2"	

PLUMBING 1 REMARKS

Optional Split Connection

PLUMBING 2 REMARKS

Common Water Connection

Project:	Quantity:	Item No:	FCSI Section:	Approval:	Date:
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Specification

Thu Apr 26 16:06:39 CEST 2018

CombiMaster® Plus CMP 61 E (6 x 12 x 20 inch/6 x 13 x 18 inch)



Capacity

- Six (6) Half-size sheet pans (13"x18") or Six (6) Steam table pans (12"x20"x2.5") GN1/1
- Removable, swivelling hinging rack
- Vertical distance between rails 2 5/8" (68 mm)

Standard Features

- Electrically heated table device for cooking of meat, poultry, fish, side dishes, vegetables, egg dishes, desserts, bakery products and for automatic rethermalization
- Combi-steamer according to DIN 18866, DIN 10535 for selective use of steam and hot air, separately, sequentially, or combined
- 2-Year parts and labor warranty
- 5-Year steam generator warranty
- No-charge 4-hour RATIONAL certified chef assistance program
- Probe for core temperature measurement
- ClimaPlus® – humidity measurement, 5 stage setting and regulation
- Combi-steamer mode °F/(°C): steam: 85 to 265/(30 to 130), hot air: 85 to 575/(30 to 300), combination: 85 to 575/(30 to 300)
- Individual programming of at least 100 cooking programs with up to 6 steps transferable via USB
- High-performance fresh steam generator, pressureless
- 5 programmable fan speeds

- Integral, maintenance-free grease extraction system with no additional grease filter
- Single water connection as shipped, can be split connection for treated and untreated water
- Turbo fan cool down function
- Dynamic air mixing
- Automatic adaptation to the installation location (elevation)
- Unit door with rear-ventilated double-glass panel and hinged inner panel
- Height adjustable feet +- 3/8" (10 mm)
- 304 (DIN 1.4301) stainless steel material inside and out
- Seamless interior and with rounded corners
- Temperature units can be set in °F/(°C)
- Digital temperature display
- Digital timer, 0-24 hours with permanent setting
- USB Interface
- Demand-related energy supply
- UL listed as Commercial Cooking Appliance with Integral Systems for Limiting the Emission of Grease-laden Air

Operation

- Mode selector for cooking modes, separate controls for temperature, core temperature and time settings
- LED illuminated display, visible from a distance
- Clear control panel

Safety features

- Detergent and rinse tabs (solid detergents) for optimum working safety
- VDE approved for unsupervised operation
- HACCP data output and software update via integral USB port
- Safety temperature limiter for steam generator and hot-air heating
- Maximum rack height 5 1/4 ft./1.60 m when original stand is used
- Integral fan impeller brake
- Door handle with right/left and slam function
- Splash an hose-proof to IPX5

Cleaning & care

- 3 automatic cleaning programs
- Service Diagnostic system (SDS) with automatic service notices displayed
- Menu-guided user descaling program
- Hand shower with automatic retracting system

Ventilation approvals

- This appliance conforms to the EPA 202 test in accordance to the ANSI/NFPA 96 "Ventilation Control and Fire Protection of Commercial Cooking Operations" Refer to UL Listing KNLZ.E148536 (America) or KNLZ7.E148536 (Canada).

Approval/Labels



Project:	Quantity:	Item No:	FCSI Section:	Approval:	Date:
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Specification

Thu Apr 26 16:06:39 CEST 2018

CombiMaster® Plus CMP 61 E (6 x 12 x 20 inch/6 x 13 x 18 inch)

Combi-Steamer mode



Steam between 85-265 °F (30-130 °C)



Hot-air from 85-575 °F (30-300 °C)



Combination of steam and hot-air 85-575 °F (30-300° C)

ClimaPlus



Climate management - humidity measurement, 5-stage setting and regulation

Technical Specification

Dimensions	Width	Depth	Height
Exterior	33 3/8" (847 mm)	30 1/2" (776 mm)	30 3/4" (782 mm)
Incl. Vent/Handle	-	33" (838 mm)	32 3/4" (832 mm)
Shipping	37 3/8" (950 mm)	36 1/4" (920 mm)	39 3/8" (1,000 mm)

Weight

Max Per Shelf	33 lbs
Max Load Size	66 lbs
Net	232 lbs
Shipping	265 lbs

Size	Electric. 60 hz	Breaker	Cable connection	Running Amps
61	208V 1 PH	60A	#4	53.4 amps
61	240V 1 PH	70A	#4	61.5 amps
61	208V 3 PH	35A	#8	30.8 amps
61	240V 3 PH	40A	#8	35.5 amps
61	480V 3 PH	25A	#14	15.8 amps
61	440V 3 PH	20A	#14	14.6 amps

Not supplied with cable connection. Use copper wire only. 3Ph 4-wire system (3 wire w/ ground)-dedicated 3 pole circuit breaker required. 1 Ph L1, L2, G-dedicated 2 pole circuit breaker required. 208 v is field retrofittable to 240v, 480v is field retrofittable to 440v. Special voltages available upon request. Do not use fuses.

Thermal load and airflow requirements

Latent	595 W
Sensible	758 W
Unit free standing	13314 ft ² /h
One side against a wall	8405 ft ² /h
Noise values	65 dBA

Connected load electric

Hot air connection:	10.6 kW
Steam connection:	9 kW
Connected load electric:	11.1 kW

Water Requirements

Connection	3/4"
Supply	Minimum 1/2" ID Drinking Quality Cold
Pressure	21-87 psi (1.5-6 bar)
Average Water Consumption	0.8 gal/h
Min/Max Flow Rate	3 gpm/5.27 gpm
Water Drain	2" OD (50 mm) hub

Connect only to 2" (XS = 1 5/8") high-temperature resistant pipe. Water discharge temperature can be field adjusted to meet section 701.7 of the International Plumbing Code. Contact RATIONAL for back flow recommendation.

Water Quality

Untreated water can be 0 to 24.5 gr/gal (0 to 420ppm) hardness. We do not recommend treated water hardness < 5 gr/gal (86ppm) because the water could be corrosive. Sodium ion exchangers are not recommended; H+ Ion exchange systems are recommended. Water that does not meet the following minimum standards will require the proper conditioning.

Contaminant	Water Requirements	If > than recommended
Sand/Particles	< 15 µm	Particle filter
Chlorine (Cl ₂)	< 0.12 gr/gal (0.2 ppm)	Active carbon filter
Chloride (Cl ⁻)	< 4.68 gr/gal (80 ppm)	RO or deionization

Clearance Requirements

To facilitate servicing, we recommend leaving a 18"-20" (450-500 mm) gap on the left-hand side of the unit. If there is not 18"-20" (450-500 mm) left side clearance available, provisions for moving the unit or appliance to the left for service access must be made. These include, but are not limited to, having quick connections (water, gas, etc.) and lengthened electrical connections with flexible cords. If there are no external heat sources acting on the unit, there should be a minimum gap of 2" (50 mm) to the left, right, and back of unit. If a high temperature heat source is on the left side of the unit, the left-hand gap must be a minimum of 14" (350 mm). This gap may be reduced to 2" (50 mm) by using a heat shield (see options). Recommended clearance from unobstructed rear exhaust pipes and any surface collecting grease or flammable material; 16" (400 mm) gas, 10" (254 mm) electric. It is recommended to have a hood overhang of 6" (150 mm) to 18" (450 mm) at the front of the unit and 6" (150 mm) on the side if installed at the end of the cooking line. Please refer to the Installation Manual for further technical data and for instructions on installation and setup. Installations must comply with all local electrical, plumbing, and ventilation codes. test test test

RATIONAL USA Inc.

1701 Golf Road, Suite C-120, Commerceium
Rolling Meadows, IL 60008
Toll Free: 888-320-7274, Fax.: 847-755-9583

Visit us on the internet: www.rationalusa.com

We reserve the right to make technical improvements

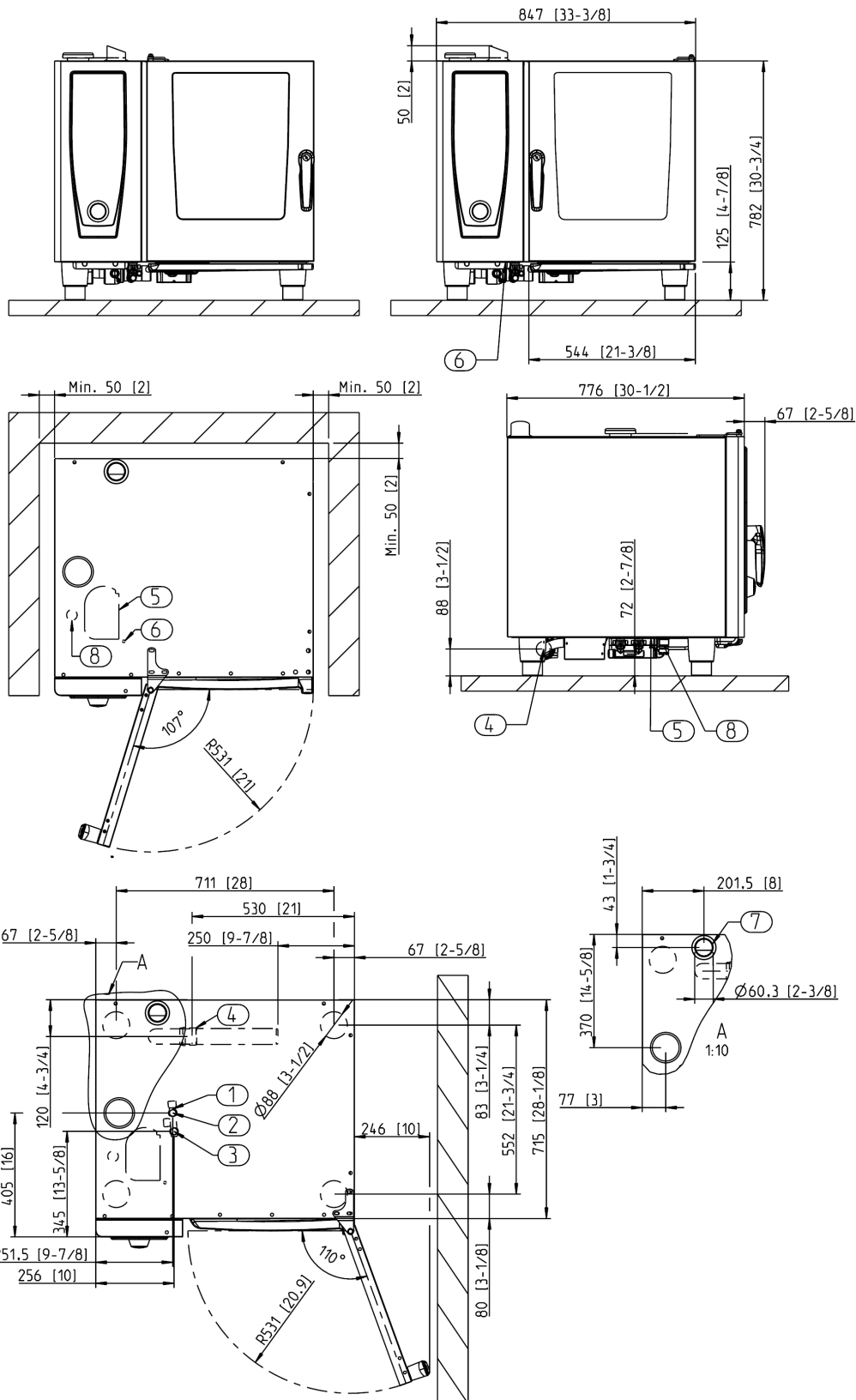
Project:	Quantity:	Item No:	FCSI Section:	Approval:	Date:
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Specification

Thu Apr 26 16:06:39 CEST 2018

CombiMaster® Plus CMP 61 E (6 x 12 x 20 inch/6 x 13 x 18 inch)



1. Common water supply (cold water) "Single" water connection as shipped 2. Water supply cold water / condensate "Split" water connection 3. Water supply cold / Treated "Split" water connection 4. Drain 2" OD 5. Electrical connection wire entrance 6. Chassis Ground connection 7. Steam Vent pipe 2 3/8" / 60mm Minimum Clearance 2" / 50 mm Left side clearance 20" recommended for servicing of unit without the ability to move unit while connected. Measurements in mm (inch)

RATIONAL USA Inc.

1701 Golf Road, Suite C-120, Commerce
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Project:	Quantity:	Item No:	FCSI Section:	Approval:	Date:
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Specification

Thu Apr 26 16:06:39 CEST 2018

CombiMaster® Plus CMP 61 E (6 x 12 x 20 inch/6 x 13 x 18 inch)

ELECTRICAL OPTIONS (all 60Hz) Special voltages available upon request

Voltage / breaker / running amps / AWG	field retrofittable to 240 V	Voltage / breaker / running amps / AWG	
<input type="checkbox"/> 208V 1 Ph / 60 / 53.4 / #4		<input type="checkbox"/> 240V 1 Ph / 70 / 61.5 / #4	
<input type="checkbox"/> 208V 3 Ph / 35 / 30.8 / #8		<input type="checkbox"/> 240V 3 Ph / 40 / 35.5 / #8	
<input type="checkbox"/> 480V 3 Ph / 25 / 15.8 / #14		<input type="checkbox"/> 440V 3 Ph / 20 / 14.6 / #14	

ACCESSORIES

<input type="checkbox"/> Installation Kits – include electrical, water and drainage connection	
<input type="checkbox"/> 208 or 240/60/1Ph	8720.1551US
<input type="checkbox"/> 208 or 240/60/3Ph	8720.1552US
<input type="checkbox"/> 480 or 440/60/3Ph	8720.1553US
<input type="checkbox"/> RATIONAL Cleaner Tabs without phosphorous – guarantee maximum cleaning power	56.00.210A
<input type="checkbox"/> RATIONAL Rinse Tabs	56.00.211
<input type="checkbox"/> Electric descaler pump	60.40.497
<input type="checkbox"/> Descaler, 4x 1 gallon case	6006.0110US
<input type="checkbox"/> Certified installation by RATIONAL SERVICE-PARTNERS	See document
<input type="checkbox"/> Preventative Maintenance Kits – door gaskets, air filters, interior light gasket, and light bulbs	87.00.520US
<input type="checkbox"/> Available stands – standard (stationary) and mobile (open or closed)	See accessories brochure
<input type="checkbox"/> Mobile catering stand – especially for heavy mobile catering usage	60.30.890
<input type="checkbox"/> Catering kit for mobile catering stand – support frame and feet	60.73.111
<input type="checkbox"/> Mobile oven racks and Finishing® plate racks – easier operation of full loads	See accessories brochure
<input type="checkbox"/> Run-in rail for mobile oven and plate racks	60.61.226
<input type="checkbox"/> Transport trolley for mobile oven and plate racks – standard and height adjustable	See accessories brochure
<input type="checkbox"/> Stackable Combi-Duo kit, – for stacking with 61 gas or electric - options: mobile or feet	See accessories brochure
<input type="checkbox"/> Heat shield – for installation next to heat source (e.g. range, grill)	60.70.390
<input type="checkbox"/> Condensation breaker – to divert steam from the unit into existing hood system	60.72.591
<input type="checkbox"/> UltraVent recirculating hood	60.74.971
<input type="checkbox"/> UltraVent Plus recirculating hood	60.74.975
<input type="checkbox"/> RATIONAL USB data-memory stick – for transferring cooking programs and HACCP data	42.00.162
<input type="checkbox"/> VarioSmoker – for a large variety of smoked products	60.73.010
<input type="checkbox"/> For ideal grilling, baking, roasting, frying, rotisserie, steaming, Finishing®, and much more	See accessories brochure

FACTORY INSTALLED OPTIONS (special order)

- Left-hinged door 208V / 240V / 1PH | 208V / 240V / 3PH | 480V / 440V / 3PH
- Ethernet card and port – for easy connection of LAN cable
- Door safety lock – handle is turned left then right before the door can be opened
- Sous-Vide core temperature probe (externally attached)
- Externally attached standard core temperature probe
- Lockable control panel cover
- Control panel protection
- Mobile oven rack package (mobile oven rack + run-in rail)
- Unit with special hinging racks for bakeries and supermarkets
- Integrated fat drain (only in conjunction with UG II or US IV stands)
- Marine version (electric units only)
- Security and prison version

RATIONAL USA Inc.

1701 Golf Road, Suite C-120, Commerceium
Rolling Meadows, IL 60008
Toll Free: 888-320-7274, Fax.: 847-755-9583

Visit us on the internet: www.rationalusa.com

We reserve the right to make technical improvements



Installation Kit

Article no. 8720.1552US

The RATIONAL Installation Kit ensures that the installer has all the essential connection materials on hand at the time of install. Not all parts are used in every installation.

Electric SelfCookingCenter® 5 Senses/CombiMaster® Plus 61 (208/60/3ph & 240/60/3ph)

Electric SelfCookingCenter® 5 Senses/CombiMaster® Plus 101 (440/60/3ph & 480/60/3ph)

Electric SelfCookingCenter® 5 Senses/CombiMaster® Plus 62 (440/60/3ph & 480/60/3ph)

The Installation Kit for the above models includes:

40	feet	THHN 8 AWG black stranded wire
12	feet	THHM 10 AWG Green stranded wire
10	feet	3/4" SEALTITE flexible conduit
2	ea	3/4" minnies
2	ea	2" minnies
1	ea	3/4" SEALTITE conn straight w/o ins
1	ea	3/4" SEALTITE 90 degree conn w/o ins
2	ea	3/4" Water Connector Hose, 5/8" ID, 3/4" female hose thread both ends, 60" long rubber coated, NSF approved
1	ea	Male union 3/4" x 3/4" MHT
2	ea	90 deg Fresh water elbow
8	feet	2" copper pipe (two 4' pieces)
2	ea	2" copper pipe 90 degree elbow
1	ea	2" copper pipe T fitting
2	ea	2" copper pipe 45 degree elbow
1	ea	2" copper pipe 90 degree elbow female to male
1	ea	2" copper pipe 90 degree long sweep
1	ea	2" copper pipe coupling

Please note that installation kits are non-discountable.

Water Filtration Products.



R195-CL



R195-CL

RATIONAL Water Filtration Products Model R195-CL single cartridge water filtration system helps provide consistent high quality water for your RATIONAL combi by reducing the effects of sediment, chloramines, chlorine, taste & odor while providing the required flow rates for any single Combi model or Combi-Duo models 61/61 or 61/101 or XS/XS.

Product Benefits

- > Carbon block technology effectively reduces chloramines, chlorine, taste, and odor for better equipment protection.
- > NSF Standard 42 and FDA CFR-21 compliant materials.
- > Sanitary Quick Change (SQC) encapsulated cartridge design allows for fast and easy cartridge change-outs with ¼" turn.
- > ½" FNPT horizontal inlet and outlet ports allow direct or easily adaptable connections to existing plumbing lines.

Model Number	Article No.	Reduction Claims	Nominal Micron Rating	Capacity	Service Flow Rate	Replacement Cartridge
R195-CL	1900.1154US	Sediment, Chloramines ¹ , Chlorine, Taste and Odor	5.0 ²	30,000 gallons (113,550 liters)	2.5 gpm (9.5 lpm)	R95-CL 1900.1155US

¹ As tested and certified by independent third party laboratory

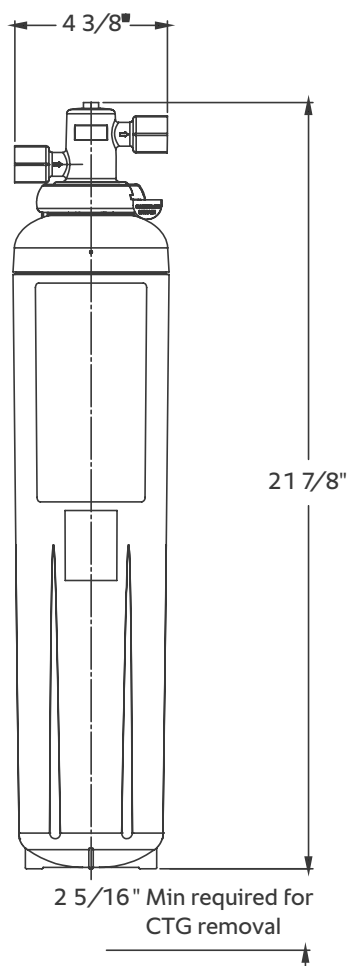
² NSF Certified for Particulate Reduction



Visit www.nsf.org for the claims associated with products that are NSF listed.

Water Filtration Products.

R195-CL



Application Guide

- > All single SCC or CMP units.
- > XS/XS Combi-Duo
- > 61/61 Combi-Duo
- > 61/101 Combi-Duo

Important: Installation Tips

These installation tips are for informational purposes only and are not intended to be used as actual installation instructions. **Caution:** To reduce the risk associated with property damage due to water leakage:

- > Read and follow Use Instructions before installation and use of this system.
- > Installation and use **must** comply with all state and local plumbing codes.
- > Protect from freezing, remove filter cartridge when temperatures are expected to drop below 40°F (4.4°C).
- > Do not install on hot water supply lines. The maximum operating water temperature of this filter system is 100°F (37.8°C).
- > Do not install if water pressure exceeds 125 psi (862 kPa). If your water pressure exceeds 80 psi (552 kPa), you must install a pressure limiting valve. Contact a plumbing professional if you are uncertain how to check your water pressure.
- > Do not install where water hammer conditions may occur. If water hammer conditions exist you must install a water hammer arrester. Contact a plumbing professional if you are uncertain how to check for this condition.
- > The disposable filter cartridge **must** be replaced every 12 months, at the rated capacity or sooner if a noticeable reduction in flow rate occurs.

Warning

To reduce the risk associated with the ingestion of contaminants:
Do not use with water that is microbiologically unsafe or of unknown quality without adequate disinfection before or after the system.
RATIONAL recommends regularly scheduled maintenance and replacement of the filter cartridge(s) in order for the product to perform as advertised/sold.
RATIONAL shall not be liable for system failures due to improper maintenance.

Limited Warranty

RATIONAL warrants this Product will be free from defects in material and manufacture for five (5) years from the date of purchase: The filter cartridge or filter membrane is warranted to be free from defects in material and manufacture for one (1) year. This warranty does not cover failures resulting from abuse, misuse, alteration or damage not caused by RATIONAL Water Filters or failure to follow installation and use instructions. No warranty is given as to the service life of any filter cartridge or membrane as it will vary with local water conditions and water consumption. RATIONAL MAKES NO OTHER WARRANTIES OR CONDITIONS, EXPRESS OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, ANY IMPLIED WARRANTY OR CONDITION OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE OR ANY IMPLIED WARRANTY OR CONDITION ARISING OUT OF A COURSE OF DEALING, CUSTOMER OR USAGE OF TRADE. If the Product fails to satisfy this Limited Warranty during the warranty period, RATIONAL will replace the Product or refund your Product purchase price. This warranty does not cover labor. The remedy stated in this paragraph is Customer's sole remedy and RATIONAL exclusive obligation. For additional information, see the entire Limited Warranty located in the product Installation and Operating Instruction Manual.

Limitation of Liability. RATIONAL will not be liable for any loss or damage arising from this RATIONAL product, whether direct, indirect, special, incidental, or consequential, regardless of the legal theory asserted, including warranty, contract, negligence or strict liability. Some states and countries do not allow the exclusion or limitation of incidental or consequential damages, so the above limitation or exclusion may not apply to you.

RATIONAL USA
1701 Golf Road
Suite C-120, Commerceium
Rolling Meadows, IL 60008

Tel. 888-320-7274 (Toll Free)
Fax 847-755-9583

info@rational-online.us
rationalusa.com

Submittal Sheet

10/16/2018

ITEM# 75 - EXHAUST HOOD (1 EA REQ'D)

Captive-Aire ND

Wall Type Exhaust Hood: 18 gauge 304 series stainless steel construction in accord with N.F.P.A. 96. Stainless steel baffle type U.L. classified grease extracting filters, with handles. Vapor-proof U.L. listed light fixtures as indicated on drawings. Provide stainless steel wall cabinet (located as shown on plan) for fire suppression system and control package. Fan and light switches to be located on face of hood in an accessible location. Hood to be furnished complete with Starter/contactor package for exhaust fan and make-up air fan (fans furnished by mechanical contractor, coordination of electrical service is required). Provide and install removable stainless steel perimeter trim and/or closure panels from top of hood to ceiling and 18 gauge stainless steel wall panels from floor to bottom of hood. Provide and install any secondary supporting members required to suspend hoods. Supports shall include seismic bracing, if required, in accord with SMACNA guidelines. Furnish unit complete with all standard accessories as normally supplied by the manufacturer.

ELECTRICAL

	VOLTS	CYCLE	PHASE	CONN	AFF	NEMA	AMPS	KW	HP	MCA	MOCP
1	120	60	1	JB	CLG		10.0				
2	120	60	1	JB	CLG		10.0				

ELECTRICAL 1 REMARKS

LIGHTS

ELECTRICAL 2 REMARKS

FAN CONTROLS



ND-2 Series

Exhaust Only Hood

CaptiveAire's Premier Canopy

The ND-2 Series is a Type I, Wall Canopy Hood for use over 450°F, 600°F and 700°F cooking surface temperatures. The aerodynamic design includes a mechanical baffle and performance enhancing lip for exceptional capture and containment.

Fully Integrated Package

CaptiveAire sells this hood as a stand-alone appliance to be integrated into a kitchen ventilation application, or provided as part of a FULLY INTEGRATED PACKAGE designed by CaptiveAire and pre-engineered for optimum performance. The package consists of the hood, an integral utility cabinet, factory pre-wired electrical controls, and a listed fire suppression system. Other options include a listed exhaust fan, a listed make-up air unit and listed, factory-built ductwork.



Advantages

- **Exhaust Flow Rates:** Superior exhaust flow rates. A 4' Hood can operate at 150 CFM/ft or 600 total CFM. Available in single or back-to-back configurations.
- **ETL Listed:** ETL Listed for use over 450°F, 600°F and 700°F cooking surface temperatures, which provides flexibility in designing kitchen ventilation systems. ETL Listed to US and Canadian safety standards, ETL Sanitation Listed and built in accordance with NFPA 96.
- **Capture and Containment:** Insulated, double-wall rigid front has aerodynamic design that reduces radiant heat into kitchen, prevents condensation and provides exceptional capture and containment of cooking vapors. This is accomplished with the signature ND-2 "mechanical baffle" on the front of the hood's capture area and the "C-shaped" design of the hood's capture area. Mechanical baffle provides a built-in wiring chase for optimal positioning of electrical controls and outlets on the front face of the hood without penetrating capture area or requiring external chase way.
- **Convenient Design:** Factory pre-wired lighting to illuminate the cooking surface is accessible from the bottom of the hood. Fitted with UL Listed, pre-wired, incandescent light fixtures and tempered glass globes to hold up to a standard 100 watt bulb. Pre-punched hanging angles on each end of hood and additional set provided for hoods longer than 12'.

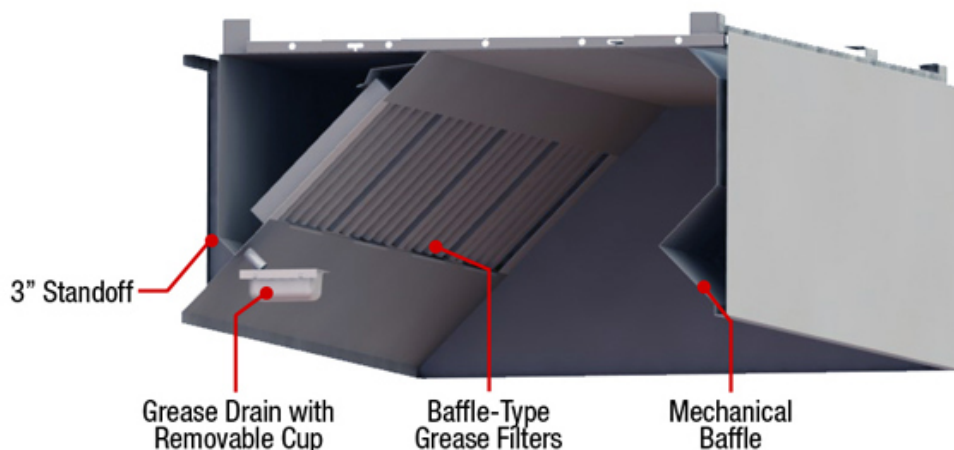
- **Construction:** Polished stainless steel on the interior and exterior of the front enhance aesthetics. Fully welded and polished front corners. Fabricated from Type 430 stainless steel with option of Type 304 available.
- **Channels:** Hood comes standard with structural channels on top and wrapper channels on the bottom.
- **Grease Extraction:** All hoods come standard with stainless steel baffle filters and a deep grease trough which allows for easy cleaning. Captrate Combo® and Captrate Solo® filters are optional. Grease drain system with removable 1/2 pint cup for easy cleaning. Standard filter stops eliminate gaps between filters.
- **Reduced Lead Times and Shipping Costs:** Produced on a high volume assembly line at one of five manufacturing facilities to reduce lead times and shipping costs.
- **Clearance to Combustibles:** Standard built in 3" rear standoff to meet NFPA 96 requirements, when installed in a wall application.
- **Controls:** Hoods can be equipped with modular utility cabinets and end standoffs. Optional listed light and fan control switches flush mounted and pre-wired through electrical chase way.
- **Optional Make-Up Air:** Up to 80% make-up air can be supplied through optional front and/or side plenums (ND-2 Series with PSP or AC-PSP Accessory).
- **Reduced Weight:** Rigid single wall end panels reduce weight.

Performance

AVG. COOKING SURFACE TEMP. (°F)	CONFIGURATION	MIN. EXHAUST CFM / FT.
450°F - Ovens, Steamers, Kettles, Open-Burner Ranges, Griddles, Fryers	Single Wall Hood 2 Wall Hoods Back-to-Back	150 300
600°F - Gas Charbroilers, Electric Charbroilers, Woks	Single Wall Hood 2 Wall Hoods Back-to-Back	200 400
700°F - Mesquite Grills, Charcoal Charbroilers, Wood Burning Appliances	Single Wall Hood 2 Wall Hoods Back-to-Back	250 500

Recommended Duct Sizing: Exhaust - Based on 1500 FPM

Features



Options

Utility Cabinet: Listed for integral side mount and fabricated of same material as hood. Cabinet can house listed fire suppression system and listed, pre-wired electrical controls.

Front Perforated Supply Plenum: Provides low velocity make-up air for the kitchen and is discharged in front of the hood. Perforated diffuser plates allow for even air distribution and supply riser includes a volume damper for easy balancing. Side Perforated Supply Plenums can be added to optimize the air flow if necessary.

Enclosure Panels: Constructed of stainless steel. Sized to extend from hood top to ceiling, enclosing pipe and hanging parts.

End Panels: Should be used to maximize hood performance and eliminate the effects of cross drafts in kitchen. units constructed of stainless steel and sized according to hood width and cooking equipment. Exposed edges hemmed for safety and rigidity.

Roof Top Package: Combination ETL Listed exhaust/supply air unit with factory prewired and mounted motors, trunkline and curb vented on exhaust side.

Separate Exhaust and/or Make-Up Air Fans: ETL Listed single exhaust fans and supply-air fans and curbs available.

Fire Suppression System: UL 300 fire suppression system.

Lighting: Recessed Incandescent, Recessed Fluorescent, Compact Fluorescent, LED, Recessed LED, Halogen

Certifications

The ND-2 Model has been certified by ITS. This certification mark indicates that the product has been tested to and has met the minimum requirements of a widely recognized (consensus) U.S. and Canadian products safety standard, that the manufacturing site has been audited, and that the applicant has agreed to a program of periodic factory follow-up inspections to verify continued performance.

Models ND-2 are ETL Listed under file number 3054804-001 and complies with UL710, ULC710 and ULC-S646 Standards.



Submittal Sheet

10/16/2018

ITEM# 76 - FIRE SUPPRESSION SYSTEM (1 EA REQ'D)

Ansul R-102

Wet chemical type fire suppression system. Installation in accord with N.F.P.A. 17A code requirements. Suppression system to be pre-piped at factory and hooked up in field by a local licensed agency. Local agency to perform certifications tests as required by local authorities. Furnish manual strike mechanism in accessible location. Furnish unit complete with all tanks, piping, relays, cable, fusible links, nozzles, etc. as required for a complete system.

Submittal Sheet

10/16/2018

ITEM# 77 - ROLL-IN REFRIGERATOR (1 EA REQ'D)

Continental Refrigerator DL1RI

Designer Line Refrigerator, roll-in, one-section, self-contained refrigeration, stainless steel front, aluminum interior & ends, standard depth cabinet, full-height solid door, electronic control with digital display, hi-low alarm, removable stainless steel ramp, 1/3 HP

The spec sheet for this item can be viewed on item 24)

ACCESSORIES

Mfr	Qty	Model	Spec
Continental Refrigerator	1		Standard warranty (for the United States & Canada Only): 3 year parts and labor; 5 year compressor
Continental Refrigerator	1		115v/60/1-ph, 9.6 amps, cord & plug, standard
Continental Refrigerator	1		Door hinged on right, standard

ELECTRICAL

	VOLTS	CYCLE	PHASE	CONN	AFF	NEMA	AMPS	KW	HP	MCA	MOCP
1									1/3		
2	115	60	1	Cord & Plug			9.6				

Submittal Sheet

10/16/2018

ITEM# 78 - ROLL-IN HEATED CABINET (1 EA REQ'D)

Continental Refrigerator DL1WI

Designer Line Warmer, roll-in, one-section, stainless steel front, aluminum interior & ends, standard depth cabinet, full-height solid door, electronic control with digital display, hi-low alarm

ACCESSORIES

Mfr	Qty	Model	Spec
Continental Refrigerator	1		Standard warranty (for the United States & Canada Only): 3 year parts and labor
Continental Refrigerator	1		208-230v/60/1, 7.9 amps, cord & plug supplied by others
Continental Refrigerator	1		Door hinged on right, standard

ELECTRICAL

	VOLTS	CYCLE	PHASE	CONN	AFF	NEMA	AMPS	KW	HP	MCA	MOCP
1	115/208-230	60	1				7.9				

DESIGNER LINE ROLL-IN WARMER

Model: DL1WI

1-Section Roll-In Warmer with 66¼" Cart Capacity

Standard - Stainless steel front, aluminum end panels and interior
 Suffix SA- Stainless steel exterior, aluminum interior
 Suffix SS - Stainless steel exterior and interior



Options and Accessories

(upcharge and lead times may apply)

Stainless steel case back	Special electrical req. (consult factory)
Chrome or stainless steel shelves	Correctional Facility Options
Rehinging of door (consult factory)	<ul style="list-style-type: none"> One way security screws
Custom laminates	<ul style="list-style-type: none"> Locking hasp (lock not included)
Half doors	<ul style="list-style-type: none"> Stainless steel mesh cover
Roll-Thru	<ul style="list-style-type: none"> Coverless hinges
Hinged glass door	

Consult factory for other model configurations, options and accessories.

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 Fax: 215-244-9579

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 Bensalem, PA 19020
www.continentalrefrigerator.com

Project Name:

Model Specified:

Location:

Item No:

Quantity:

AIA #:

SIS #:

Standard Model Features

HEATING SYSTEM

Self-contained, performance-rated "plug" warming system
 90°F - 180°F temperature range
 Humidity relief vent with master on/off control switch
 Unique air flow distribution ducts
 Heating system is accessible on top of cabinet, separate from the food zone

CABINET ARCHITECTURE

Removable stainless steel rack guides
 Removable stainless steel ramp
 Reinforced stainless steel floor
 3" non-CFC polyurethane foam insulation
 Chrome-plated flow line handle
 Cam action, lift off hinges
 Magnetic snap-in door gasket
 Cylinder lock in door
 Self-closing door
 66 1/2" high door openings (66 1/4"H rack capacity*)

Standard Finish

Stainless steel front, aluminum end panels and interior

-SA Finish

Stainless steel exterior, aluminum interior

-SS Finish

Stainless steel exterior and interior

MODEL FEATURES

External thermostat control
 External digital thermometer

* Racks not supplied

IMPORTANT NOTE: Cabinet upper side panels and heating "plug" system can be easily removed and reinstalled at installation site where space limitations are confining.

APPROVAL:

Model Specifications

DIMENSIONAL DATA

Net Capacity (cu. ft.)	32 (906 cu l)
Width, Overall (in.)	35 1/4 (895 mm)
Depth, Overall (incl. handles) (in.)	35 3/8 (899 mm)
Depth [less doors] (in.)	32 (813 mm)
Depth [doors open 90°] (in.)	65 (1651 mm)
Clear Door Width (in.)	27 3/8 (695 mm)
Clear Full Door Height (in.)	66 1/2 (1676 mm)
Height, Overall (in.)	86 (2184 mm)
No. of Door(s)	1
Rack Capacity**	1 ea.

ELECTRICAL DATA

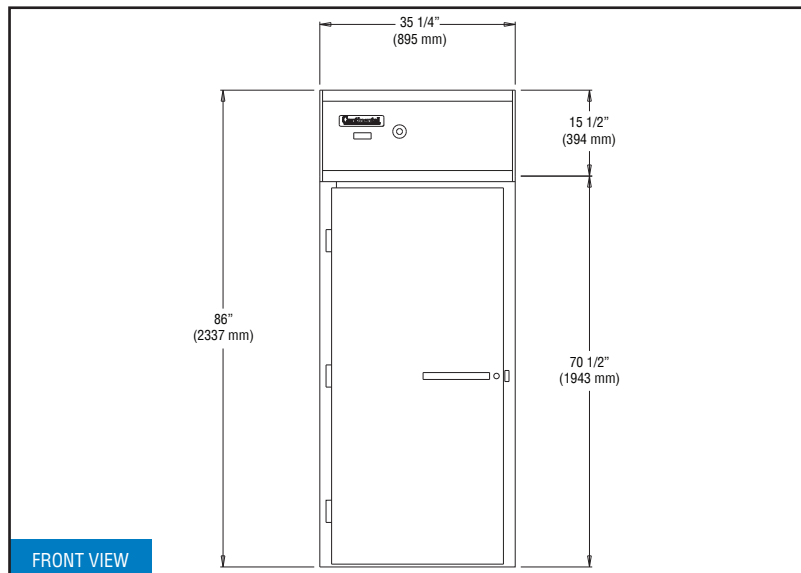
Voltage (int'l)	115/208-230/60/1 (220/50/1)
Total Wattage @ 208-230 Volts	1500
Feed Wires (incl. ground)	4
Total Amps (int'l)	7.9 (7.2)
10 ft. Cord/Plug [attached] (int'l)	No (No)

SHIPPING DATA

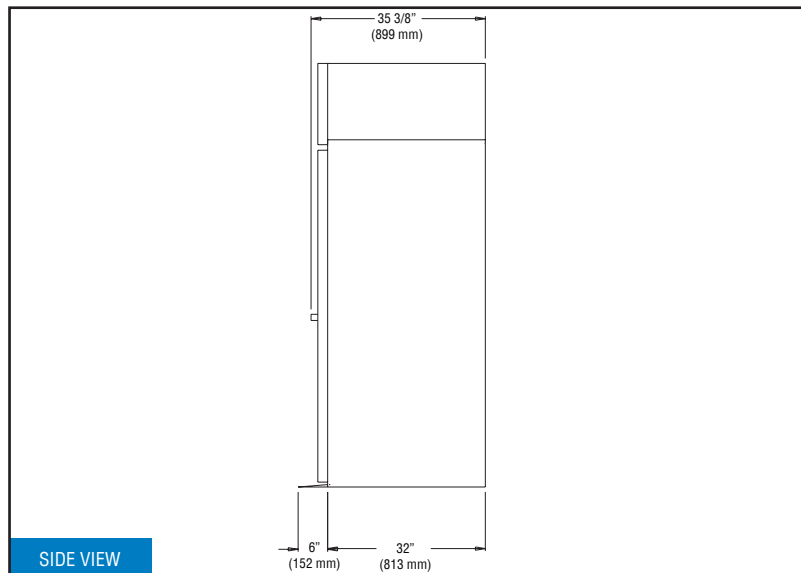
Height - Crated (in.)	90 (2286 mm)
Width - Crated (in.)	43 (1092 mm)
Depth - Crated (in.)	42 (1067 mm)
Volume - Crated (cu. ft.)	94 (2661 cu l)
Weight Std - Crated (lbs.)	415 (188 kg)
Weight SS - Crated (lbs.)	505 (229 kg)
Weight Std - Uncrated (lbs.)	330 (150 kg)
Weight SS - Uncrated (lbs.)	405 (184 kg)

** Maximum rack size including wheels - 27"W x 29"D x 66 1/4"H
Figures in parentheses reflect metric equivalents rounded to the nearest whole millimeter.

Model Plan Views



FRONT VIEW



SIDE VIEW

IMPORTANT NOTE: If the cabinet is located directly against a wall and/or under a low ceiling, a minimum clearance of 12" is required.

HEATING SYSTEM (Range 90°F - 180°F)

Electrically operated heating system is controlled by means of a highly sensitive calibrated thermostat mounted on the cabinet front. Fin strip heating elements are located at the base of the interior. Air circulating blower located in a top mounted, concealed "plug" housing distributes heat throughout product zone, assuring uniform cabinet temperatures. Cabinet top has a built-in humidity relief vent. The entire "plug" system is mounted on a sturdy steel, rail-type base which can be easily removed if refrigerator or freezer conversion is desired. A strict quality assurance team inspects all material and components to certify that each model conforms to the most exacting standards. All models are factory performance tested for a minimum of 16 hours prior to crating.

INSULATION

All cabinet walls, top and bottom have high density, foamed-in-place, non-CFC polyurethane insulation.

CABINET CONSTRUCTION

All materials are of top quality, assembled to conform with strict quality-assurance requirements.

The cabinet front is constructed of heavy-gauge polished stainless steel for durability. All cabinet joints and seams are sealed vapor-tight. Case is of all metal, welded construction and internally supported and braced for a rigid unit construction. Cabinet design eliminated overlapping panels with raw edges. Cabinet body is insulated with non-CFC, foamed-in-place polyurethane foam with an average thickness of 3 inches to ensure increased energy efficiency. Automatic interior lighting is controlled by door openings. Cabinets are equipped with an easily removable, stainless steel ramp and interior rack guides.

DOOR CONSTRUCTION

Solid hinged door shells are constructed of heavy-gauge stainless steel and are internally braced and urethane-foam-insulated for rigidity. Door corners are welded construction and polished. Replaceable snap-in door gaskets are self-adjusting, heavy-duty, magnetic type. Door handles and hinges are chrome-plated and non-corrosive. Doors are provided with built-in cylinder locks which are keyed alike. Hinges are cam action, lift-off type featuring positive safety stop at 120 degrees.

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Phone: 215-244-1400
Fax: 215-244-9579

539 Dunksferry Road
Bensalem, PA 19020
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Submittal Sheet

10/16/2018

ITEM# 79 - UNDERCOUNTER REFRIGERATOR (1 EA REQ'D)

Continental Refrigerator SW27-U

Undercounter Refrigerator, 27"W, 7.4 cu ft capacity, one-section, (1) field rehingeable door, stainless steel front, top & end panels, aluminum interior, 1-3/8" diameter plate casters, front breathing, electronic control with digital display, hi-low alarm, rear-mounted self-contained refrigeration, 1/5 hp, cETLus, NSF, Made in USA

ACCESSORIES

Mfr	Qty	Model	Spec
Continental Refrigerator	1		Standard warranty (for the United States & Canada Only): 3 year parts and labor; 5 year compressor
Continental Refrigerator	1		115v/60/1-ph, 6.3 amps, cord, NEMA 5-15P, standard

ELECTRICAL

	VOLTS	CYCLE	PHASE	CONN	AFF	NEMA	AMPS	KW	HP	MCA	MOCP
1									1/5		
2	115	60	1	Cord & Plug		5-15P	6.3				

UNDERCOUNTER REFRIGERATOR

Model: SW27-U

27" Undercounter Refrigerator with Solid Door

Stainless steel front, top and end panels, aluminum back and interior.

Designed to maintain NSF-7 temperatures in 100°F ambient.



Options and Accessories

(upcharge and lead times may apply)

Stainless steel interior	Glass door in lieu of solid door
Stainless steel back	Automatic electric condensate evaporator
Stainless steel shelves	Expansion valve system
Add'l epoxy-coated steel shelves	Door lock
Drawers in lieu of door	Special electrical requirements (consult factory)

Consult factory for other model configurations, options and accessories.

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www.continentalrefrigerator.com

Project Name:

Model Specified:

Location:

Item No:

Quantity:

AIA #:

SIS #:

Standard Model Features

REFRIGERATION SYSTEM

Performance-rated refrigeration system

Environmentally-safe R-134a refrigerant

Automatic, energy-saving, non-electric
condensate evaporator

Non-corrosive, plasticized fin evaporator coil

Easily serviceable back mounted compressor

CABINET ARCHITECTURE

2" non-CFC polyurethane foam insulation

Spring loaded, self closing door

Magnetic snap-in door gasket

Heavy-duty, epoxy-coated steel shelf

Completely enclosed, vented and removable case back

1 3/8" diameter plate casters (factory installed)

MODEL FEATURES

Electronic controller w/ digital display & hi-low alarm

Field rehingable door

2" high, bottom mounted front breather air divider

APPROVAL:

Model Specifications

DIMENSIONAL DATA

Net Capacity (cu. ft.)	7.4 (210 cu l)
Width, Overall (in.)	27 1/2 (699 mm)
Depth, Overall (in.) (incl. handle & bumpers)	31 9/16 (802 mm)
Height, Overall (in.) (incl. 1 3/8" plate casters)	31 13/16 (808 mm)
Shelf Area (sq. ft.)	3.5 (.3 sq m)
No. of Shelves	1
No. of Doors	1
Interior Depth (in.)	See Drawing
Interior Height (in.)	26 1/4 (667 mm)
Interior Width (in.)	24 1/2 (622 mm)

REFRIGERANT DATA

Condensing Unit Size (H.P.)	1/5
Capacity (BTU/Hr)*	1620

ELECTRICAL DATA

Voltage (int'l)	115/60/1 (220/50/1)
Fans	1
Total Amps (int'l)	6.3 (3.7)
10 ft. Cord/Plug [attached] (int'l)	Yes (No)

SHIPPING DATA

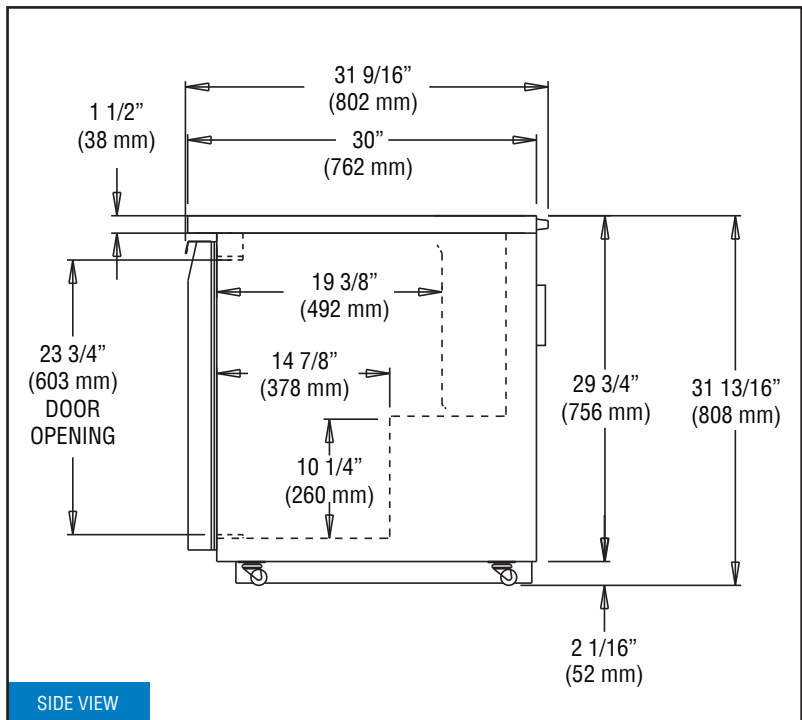
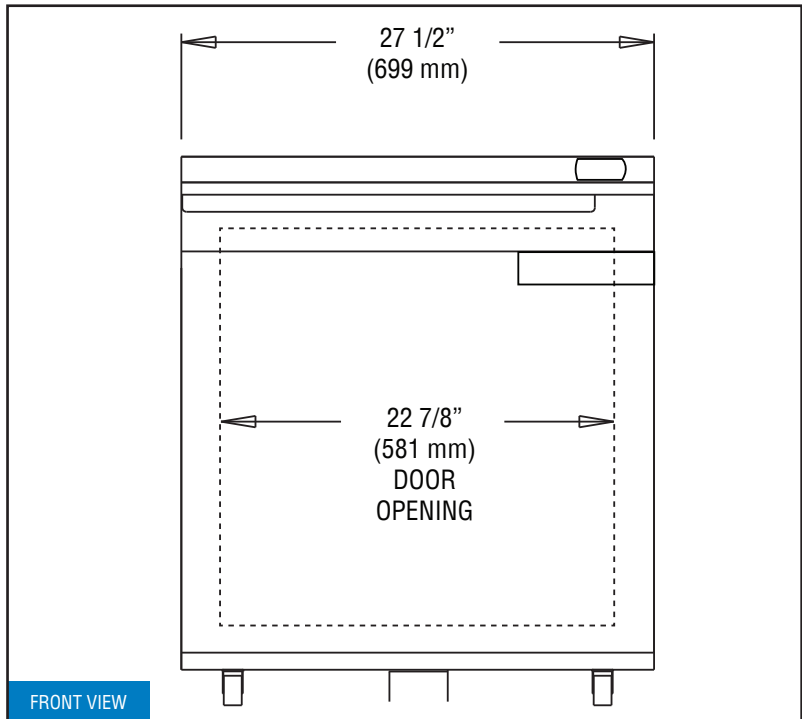
Weight (lbs.)	165 (75 kg)
Height - Crated (in.)	40 (1016 mm)
Width - Crated (in.)	35 1/2 (902 mm)
Depth - Crated (in.)	37 1/4 (946 mm)

* Rating @ +25°F evaporator, 90°F ambient
 Figures in parentheses reflect metric equivalents rounded to the nearest whole unit.



Equipped with one NEMA-5-15P Plug
 (varies by country)

Model Plan Views



NOTE: For proper operation, the area under and in front of the cabinet **must** not be obstructed in any way.



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Submittal Sheet

10/16/2018

ITEM# 80 - DROP-IN SINK (1 EA REQ'D)

Eagle Group SR14-16-9.5-1

Self-Rimming Drop-In Sink, one compartment, 14" wide x 16" front-to-back x 9-1/2" deep bowl, 4" OC deck mount faucet with gooseneck spout (302004), includes basket drain, 20/304 stainless steel construction, NSF

The spec sheet for this item can be viewed on item 20)

ACCESSORIES

Mfr	Qty	Model	Spec
Eagle Group	1		Faucet hole punched on 4" centers, standard
Eagle Group	1		Standard faucet

Submittal Sheet

10/16/2018

ITEM# 81 - HEATED SHELF FOOD WARMER (1 EA REQ'D)

Hatco GRSBF-48-I

Glo-Ray® Built In Heated Shelf with Flush Top, 49-1/2" x 21" surface area, hardcoat aluminum top, control thermostat, illuminated on/off switch & mounting bracket, NSF, cUL, UL, UL EPH Classified, ANSI/NSF 4, CSA

The spec sheet for this item can be viewed on item 52)

ACCESSORIES

Mfr	Qty	Model	Spec
Hatco	1		NOTE: Sale of this product must comply with Hatco's Minimum Resale Price Policy; consult order acknowledgement for details
Hatco	1		NOTE: Includes 24/7 parts & service assistance, call 800-558-0607
Hatco	1		1-Yr Warranty on Blanket Heating Elements against burnout, standard
Hatco	1		120v/60/1-ph, 1000 watts, 8.3 amps, NEMA 5-15P (Domestic voltage), standard
Hatco	1		NOTE: Recommended for use in metallic countertop, verify that the material is suitable for temperatures up to 200 degree F
Hatco	1		Thermostat control with lighted rocker switch (Available at time of purchase only), standard

ELECTRICAL

	VOLTS	CYCLE	PHASE	CONN	AFF	NEMA	AMPS	KW	HP	MCA	MOCP
1	120	60	1	Cord & Plug		5-15P	8.3	1.0			

Submittal Sheet

10/16/2018

ITEM# 82 - HOT / COLD FOOD WELL UNIT, DROP-IN, ELECTRIC (1 EA REQ'D)

Delfield N8656

Drop-In Hot/Cold Food Well, 56-1/4", 4-pan size for 12" x 20" pans, 8" deep single tank with drain, remote control panel with single temperature control & three-way toggle switch, stainless steel top & well, galvanized steel exterior housing, self-contained refrigeration, 1/4 HP, (55-1/4" x 25" cutout required), cUL, UL, NSF

The spec sheet for this item can be viewed on item 27)

ACCESSORIES

Mfr	Qty	Model	Spec
Delfield	1		NOTE: Freight quotes are only valid from Delfield
Delfield	1	0460000N	1 year parts & labor warranty, standard
Delfield	1	W00003N	1 year compressor warranty, standard
Delfield	1		120-240v/60/1-ph, 21.0 amps, standard
Delfield	1	000-504-0030	Autofill assembly kit (shipped loose), for N8600 and N8800 series
Delfield	1	AS3547487	Gate valve assembly (shipped loose) for N8600 & N8800

ELECTRICAL

	VOLTS	CYCLE	PHASE	CONN	AFF	NEMA	AMPS	KW	HP	MCA	MOCP
1									1/4		
2	120-240	60	1				21.0				

WATER

	HOT SIZE	HOT AFF	HOT GPH	COLD SIZE	COLD AFF	FILTERED SIZE	FILTERED AFF	CONDENSER INLET SIZE	CONDENSER OUTLET SIZE
1									

WASTE

	INDIRECT SIZE	DIRECT SIZE
1	1"	

Submittal Sheet

10/16/2018

ITEM# 83 - REFRIGERATED SELF-SERVICE UNDER COUNTER HEIGHT CASE (1 EA REQ'D)

Structural Concepts CO63R-UC

Oasis® Self-Service Refrigerated Under Counter Height Case, 71-1/4"W, 32-3/4"H, Breeze-E (Type II) with EnergyWise self-contained refrigeration system, Blue Fin coated coil, top light, one piece formed ABS plastic tub, black interior, (2) square full end panels, casters with levelers, front panel extends over end panels to blend with adjacent counters (supplied by others), counter surface (supplied by others) extends over top of unit, cETLus, ETL-Sanitation

The spec sheet for this item can be viewed on item 26)

ACCESSORIES

Mfr	Qty	Model	Spec
Structural Concepts	1		NOTE: If GFCI is required, a GFCI breaker MUST be used in lieu of a GFCI receptacle
Structural Concepts	1		1 yr. parts & labor warranty, 5 yr. compressor warranty, standard
Structural Concepts	1		Breeze-E (Type II) with EnergyWise refrigeration - NSF Type II compliant, standard
Structural Concepts	1		110-120v/60/1ph, 16.0 amps, standard
Structural Concepts	1		6 ft straight blade power cord with NEMA 5-20P, standard
Structural Concepts	1		NOTE: Compressor air rear intake, front discharge at toe kick, unit MUST remain 4" from wall & front & rear panels cannot be blocked (Not applicable with remote refrigeration option)
Structural Concepts	1		Exterior: Stainless steel
Structural Concepts	1		Exterior back panel: Solid back panel - black, standard
Structural Concepts	1		Left end panel: Square full with mirrored interior, standard
Structural Concepts	1		Right end panel: Square full with mirrored interior, standard
Structural Concepts	1		Digital fahrenheit thermometer, standard

ELECTRICAL

	VOLTS	CYCLE	PHASE	CONN	AFF	NEMA	AMPS	KW	HP	MCA	MOCP
1	110-120	60	1				16.0				
2				Cord & Plug		5-20P					

Submittal Sheet

10/16/2018

ITEM# 84.1 - SNEEZE GUARD, STATIONARY (1 EA REQ'D)

Versa-Gard VG3.3-SK

VG Series. Adjustable self service food protector with straight glass and top shelf. Adjustable in 7 different self-service positions. 3/4" OD Solid Supports. End glass panels are 1/4" clear tempered. All glass meets ANSI Z97.1 specifications for safety performance and ASTM C1048-04 specifications for heat treated glass. All hardware supplied in a brushed stainless steel finish. All glass with ground and polished edges. Conceal mount hardware.

The spec sheet for this item can be viewed on item 54.1)

ACCESSORIES

Mfr	Qty	Model	Spec
Versa-Gard	1	LED LIGHT	LED Light by Versa Gard

Submittal Sheet

10/16/2018

ITEM# 84.2 - SNEEZE GUARD, STATIONARY (1 EA REQ'D)

Versa-Gard VG3.3-SK

VG Series. Adjustable self service food protector with straight glass and top shelf. Adjustable in 7 different self-service positions. 3/4" OD Solid Supports. End glass panels are 1/4" clear tempered. All glass meets ANSI Z97.1 specifications for safety performance and ASTM C1048-04 specifications for heat treated glass. All hardware supplied in a brushed stainless steel finish. All glass with ground and polished edges. Conceal mount hardware.

The spec sheet for this item can be viewed on item 54.1)

ACCESSORIES

<u>Mfr</u>	<u>Qty</u>	<u>Model</u>	<u>Spec</u>
Versa-Gard	1	LED LIGHT	LED Light by Versa Gard

Submittal Sheet

10/16/2018

ITEM# 84.3 - SNEEZE GUARD (1 EA REQ'D)

Versa-Gard VP24.3

VG Series. Full service food protector with 24" tall vertical glass. 1" OD Solid Supports. End glass panels are 1/4" clear tempered. All glass meets ANSI Z97.1 specifications for safety performance and ASTM C1048-04 specifications for heat treated glass. All hardware supplied in a brushed stainless steel finish. All glass with ground and polished edges. Conceal mount hardware.

The spec sheet for this item can be viewed on item 30.1)

Submittal Sheet

10/16/2018

ITEM# 84.4 - SNEEZE GUARD (1 EA REQ'D)

Versa-Gard VP24.3

VG Series. Full service food protector with 24" tall vertical glass. 1" OD Solid Supports. End glass panels are 1/4" clear tempered. All glass meets ANSI Z97.1 specifications for safety performance and ASTM C1048-04 specifications for heat treated glass. All hardware supplied in a brushed stainless steel finish. All glass with ground and polished edges. Conceal mount hardware.

The spec sheet for this item can be viewed on item 30.1)

Submittal Sheet

10/16/2018

ITEM# 85 - MENU BOARD (1 EA REQ'D)

Provided by Operations CONTACT OPERATIONS

Submittal Sheet

10/16/2018

ITEM# 85.1 - OMS SCREEN (1 EA REQ'D)

Provided by Operations CONTACT OPERATIONS

Submittal Sheet

10/16/2018

ITEM# 86 - HEAT LAMP (1 EA REQ'D)

Hatco GRNM-54

Glo-Ray® Narrow Max Infrared Strip Heater, 54" L, tubular metal heater rod, single heater rod housing, stainless steel housing with angle mounting bracket, 1500 watts, cULus, UL EPH Classified, ANSI/NSF 4, Made in USA

The spec sheet for this item can be viewed on item 56)

ACCESSORIES

Mfr	Qty	Model	Spec
Hatco	1		NOTE: Sale of this product must comply with Hatco's Minimum Resale Price Policy; consult order acknowledgement for details
Hatco	1		NOTE: Includes 24/7 parts & service assistance, call 800-558-0607
Hatco	1		One year on-site parts and labor warranty, plus one additional year parts only warranty on all Glo-Ray metal sheathed elements
Hatco	1		120v/60/1-ph
Hatco	1	NO CONTROL	No control included, requires selection of RMB2 control box
Hatco	1		NOTE: If the current rating is under 20 amps. then select an RMB2-1R and RMB3-1R, if the current rating is between 20 and 40 amps select the RMB2-2R and RMB3-2R, RMB2-2R has (2) 20 amp outputs and RMB3-2R has (2) 15 amp outlets
Hatco	1		NOTE: Requires selection of RMB2 control

ELECTRICAL

	VOLTS	CYCLE	PHASE	CONN	AFF	NEMA	AMPS	KW	HP	MCA	MOCP
1								1.5			
2	120	60	1								

Submittal Sheet

10/16/2018

ITEM# 90 - ICE & WATER DISPENSER (2 EA REQ'D)

Hoshizaki DCM-270BAH

Ice Maker/Water Dispenser, Cubelet-Style, air-cooled, self-contained condenser, production capacity up to 282 lb/24 hours at 70°/50° (215 lb AHRI certified at 90°/70°), 10 lb built-in storage capacity, counter model, push button operation, stainless steel bin & exterior, protected with H-GUARD Plus Antimicrobial Agent, R-404A refrigerant, 4" legs, 115v/60/1-ph, 8.5 amps, NEMA 5-15P (optional stand sold separately), NSF, UL

ACCESSORIES

Mfr	Qty	Model	Spec
Hoshizaki	2		Warranty: 3-Year parts & labor on entire machine
Hoshizaki	2		Warranty: 5-Year parts on compressor, air-cooled condenser
Hoshizaki	2	H9320-51	Water Filtration System, single configuration, 18.4" H (manifold & cartridge)
Hoshizaki	2		Warranty: 1-Year on entire water filtration system & replaceable elements, standard

ELECTRICAL

	VOLTS	CYCLE	PHASE	CONN	AFF	NEMA	AMPS	KW	HP	MCA	MOCP
1	115	60	1	Cord & Plug		5-15P	8.5				

WATER

	HOT SIZE	HOT AFF	HOT GPH	COLD SIZE	COLD AFF	FILTERED SIZE	FILTERED AFF	CONDENSER INLET SIZE	CONDENSER OUTLET SIZE
1									
2				1/2"					

WASTE

	INDIRECT SIZE	DIRECT SIZE
1	3/4"	
2	3/4"	

PLUMBING 1 REMARKS

Drip Tray Drain

PLUMBING 2 REMARKS

Ice Bin Drain



DCM-270BAH

SANITARY CUBELET ICE MACHINE/DISPENSER



DCM-270BAH
06/22/18
Item # 13116

Item #: _____
Project: _____
Qty: _____
AIA#: _____

W x D x H
16⁹/₁₆" x 24¹/₈" x 31¹¹/₁₆"


SD-270
16¹/₂" x 24" x 35³/₁₆"


Ice Machine Shipping Dimensions
30¹/₂" x 20³/₄" x 37¹/₂"

DCM-270BAH
Air-Cooled
Shown with optional
SD-270 Stand
*SD-270 door is reversible



Features

- ▶ Durable stainless steel exterior
- ▶ Advanced CleanCycle24™ design 
- ▶ Stainless steel auger with greaseless bearing

- Up to 282 lbs. of ice production per 24 hours
- Built-in storage capacity of 0.3ft³/10 lbs.*
- 2 second flush cycle every hour
- Easy to chew, cubelet ice
- Flush cycle removes sediment for cleaner ice
- Protected by H-GUARD Plus Antimicrobial Agent 
- Dispenses ice and water
- 6 ft. cord with a NEMA 5-15 plug
- R-404A Refrigerant

Warranty:

3 Year Parts & Labor on entire machine.
5 Year Parts on Compressor; air-cooled condenser coil.
Valid in United States, Canada, Puerto Rico and U.S. Territories. Contact factory for warranty in other countries.

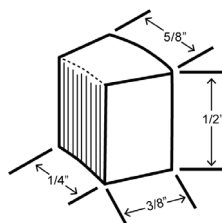
*Rated in accordance with AHRI Standard 820(I-P). Capacity based on 100% of total volume x 30 lb/ft³ average density of ice.



Condenser	Model	ICE PRODUCTION		WATER USAGE		ELECTRICAL			Heat Rejection BTU/hr.	Refrigerant Charge Amount	Net / Ship Weight (lbs.)	
		Air / Water Temp Lbs. per 24 hours 70°/ 50°F	90°/ 70°F	Potable Gal. per 100 lbs. 90°/ 70°F	Condenser Gal. per 100 lbs. 90°/ 70°F	kWh Used per 100 lbs. 90°/ 70°F	Max. Fuse Size or HACR Circuit Breaker	Amperage				Voltage
Air-Cooled	DCM-270BAH	282	215	12.0	N/A	7.6	15A	8.5A	115V/60/1	3,532	14.8 oz	152 / 170

Power cord included.

Cubelet Dimensions*



* approximate size in inches, image not to scale

Operating Limits

- Ambient Temp Range 45 - 100°F
- Water Temp Range 45 - 90°F
- Water Pressure 10 - 113 PSIG
- Voltage Range 104 - 127V

Service

- Allow 6" (15cm) clearance at rear and left side, 10" (25cm) at right side, and 20" (51cm) at top for proper air circulation and ease of maintenance/ service should they be required.

Not intended for outdoor use - avoid placement in direct sunlight.

Plumbing

- Icemaker Water Supply Line: Minimum 1/4" Nominal ID Copper Water Tubing or Equivalent
- Icemaker Drain Line: Minimum 3/4" Nominal ID Hard Pipe or Equivalent

Water Filter

Please refer to water filter specification sheet for recommendations.

Hoshizaki reserves the right to change specifications without notice.



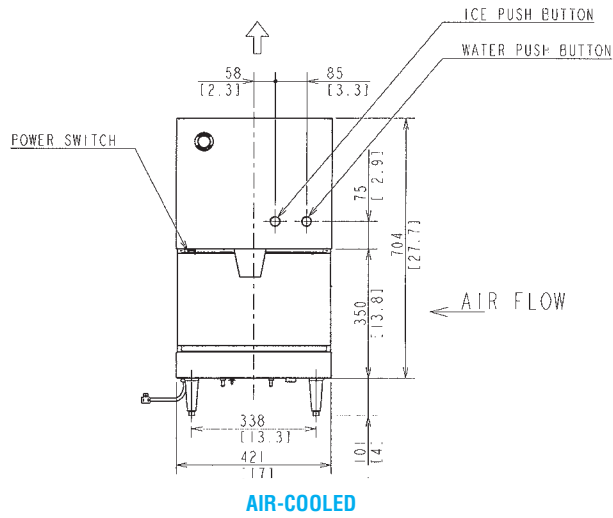
DCM-270BAH

SANITARY CUBELET ICE MACHINE/DISPENSER

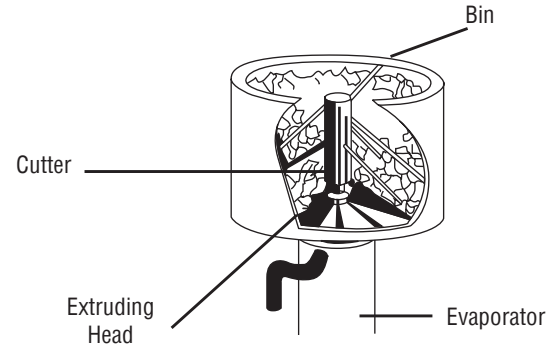


DCM-270BAH
06/22/18
Item # 13116

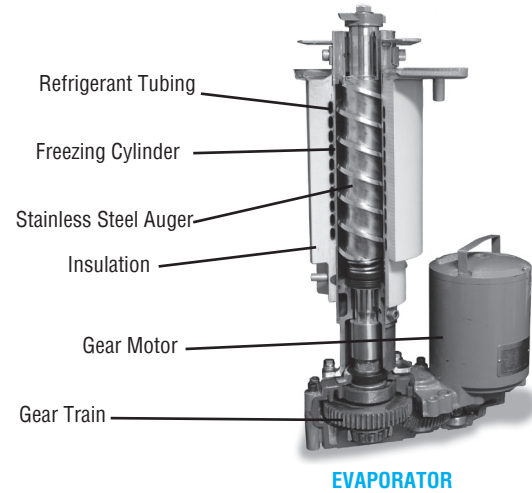
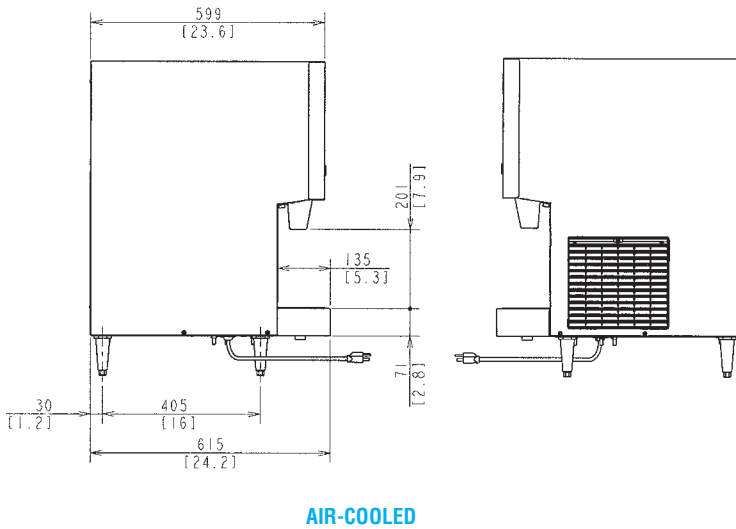
FRONT VIEW



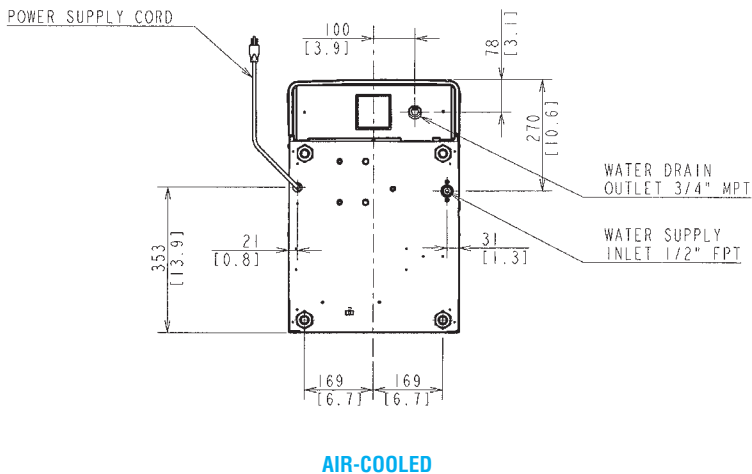
inch
[mm]



SIDE VIEW



BOTTOM VIEW





WATER FILTERS

FILTRATION SYSTEMS



WATER FILTERS
04/30/18
Item # 13076

Item #: _____
Project: _____
Qty: _____
AIA#: _____

H9320 FILTER

Single, Double, Triple

*height includes manifold and cartridge



Single Configuration
18.4" H*



Double Configuration
19.11" H*



Triple Configuration
19.15" H*

- Keep ice makers functioning at full capacity
- 93.7% average reduction of chlorine from incoming water supply, eliminating tastes and odors of the ice
- Filters are rated as one (1) micron nominal producing crystal clear ice
- Decrease machine maintenance by reducing lime scale build-up

HOSHIZAKI H9320 FILTER

Available in single, double and triple configurations. Rated NSF Class 1, STD 42, for taste, odor and chlorine reduction and for mechanical filtration (95.6% removal of particles one (1) micron and larger in size.)

The H9320 Filters and their respective cartridges have been tested and listed by NSF only for the functions listed above. Check for compliance with state and local laws and regulations. Do not use where the water is microbiologically unsafe, or with waters of unknown quality without adequate disinfection before or after the unit. The H9320 filter can be used with water that may contain filterable cysts.



The H9320 System is tested and certified by NSF International against NSF/ANSI Standard 42 for the reduction of:

Std. No. 42 - Aesthetic effects

- | | |
|---------------------------|------------------------------|
| <i>Aesthetic Effects</i> | <i>Mechanical Filtration</i> |
| Bacteriostatic Effects | Nominal Particulate Class 1 |
| <i>Chemical Reduction</i> | |
| Taste & Odor | |
| Chlorine | |

E-10 PREFILTER (9795-80)

E-20 PREFILTER (9795-90)



E-10 PREFILTER
(9795-80)
Recommended for single configuration

E-20 PREFILTER
(9795-90)
Recommended for twin and triple configuration

E-10 and E-20 Prefilters can be used for ice. Everpure prefilters are designed to increase the life of Hoshizaki 4HC-H water filters in areas with an unusual amount of dirt in the water. With a 10 micron (nominal) rating, the economical Everpure prefilter traps much of the dirt which contributes to scale buildup in ice makers, and clogs the delicate orifices of other water-using equipment.

When you install an Everpure prefilter, the Hoshizaki 4HC-H water filters can concentrate on what they do best: remove particles one (1) micron nominal and larger in size.

Replacement Cartridges:

E-10 Prefilters: 12 pack (9534-12)
40 pack (9534-40)

E-20 Prefilters: 6 pack (9534-26)
20 pack (9534-20)



Warranty:

- One Year replaceable elements*
- One Year the entire system

* Warranty applies to material defects in materials & workmanship only.

Hoshizaki reserves the right to change specifications without notice.



WATER FILTERS

FILTRATION SYSTEMS



WATER FILTERS
04/30/18
Item # 13076

Model Number	Description Flow Rate (Gal. per min.)	Undercounter KMs	KM Cubers	IM Cubers	Flakers	DCMs
H9320-51	Single (2 GPM)	AM-50B KM-61B KM-101B KM-151B KM-201B KM-260B	KM-340M, 515M KML-325M, 500M, 700M KMD-410M, 460M, 530M KMS-830M DKM-500B	IM-200BAA IM-500SAA	All Models	All Models
H9320-52	Twin 2 x (2 GPM)	N/A	KM-650M, 901M 1100M, 1340M, 1601M 1601S, 1900S, 2200S KMD-860M KMS-822M, 1122M 1402M KMH-2000S	N/A	N/A	N/A
H9320-53	Triple 3 x (2 GPM)	N/A	KM-1301S KMS-2000M KM-2600S	N/A	N/A	N/A
H9655-11	Replacement Cartridge (1) One each					

Recommended water filter configurations based on average ice machine usage and regular filter replacement. If your operation has challenging water conditions or higher usage, then it may be necessary to use an additional filter or prefilter.

Submittal Sheet

10/16/2018

ITEM# 91 - SODA ICE & BEVERAGE DISPENSER (2 EA REQ'D)

Provided by Vendor SPIRE 2.0

Submittal Sheet

10/16/2018

ITEM# 100 - COLD STORAGE ASSEMBLY (1 EA REQ'D)

American Panel CUSTOM

Submittal Sheet

10/16/2018

ITEM# 100.1 - COOLER LIGHT (1 EA REQ'D)

American Panel CUSTOM

Submittal Sheet

10/16/2018

ITEM# 100.2 - COOLER EVAPORATOR (1 EA REQ'D)

American Panel ADT070

Submittal Sheet

10/16/2018

ITEM# 100.3 - COOLER CONDENSING UNIT (1 EA REQ'D)

American Panel FFAP-020Z

Submittal Sheet

10/16/2018

ITEM# 100.4 - FREEZER LIGHT/HEATER TAPE (1 EA REQ'D)

American Panel CUSTOM

Submittal Sheet

10/16/2018

ITEM# 100.5 - FREEZER EVAPORATOR (1 EA REQ'D)

American Panel LET180

Submittal Sheet

10/16/2018

ITEM# 100.6 - FREEZER CONDENSING UNIT (1 EA REQ'D)

American Panel FFAP-060Z

Submittal Sheet

10/16/2018

ITEM# 101 - WIRE SHELVING (12 EA REQ'D)

Metro 2430NK3

Super Erecta® Shelf, wire, 30"W x 24"D, plastic split sleeves are included in each carton, Metroseal 3™ epoxy-coated corrosion-resistant finish with Microban® antimicrobial protection, NSF

The spec sheet for this item can be viewed on item 04)

ACCESSORIES

Mfr	Qty	Model	Spec
Metro	12	63UPK3	Super Erecta® SiteSelect™ Post, 61-13/16"H, for use with stem casters, Metroseal 3 epoxy coated corrosion-resistant finish with Microban® antimicrobial protection
Metro	6	5MDA	Super Erecta® Stem Caster, swivel, 5" diameter, 1-1/4" face, high modulus donut wheel tread, with donut bumpers, 250 lb. capacity
Metro	6	5MDBA	Super Erecta® Stem Caster, brake (foot operated), 5" diameter, 1-1/4" face, high modulus donut wheel tread, with donut bumpers, 250 lb. capacity, brakes are foot operated

Submittal Sheet

10/16/2018

ITEM# 102 - WIRE SHELVING (24 EA REQ'D)

Metro 2160NK3

Super Erecta® Shelf, wire, 60"W x 21"D, plastic split sleeves are included in each carton, Metroseal 3™ epoxy-coated corrosion-resistant finish with Microban® antimicrobial protection, NSF

The spec sheet for this item can be viewed on item 04)

ACCESSORIES

Mfr	Qty	Model	Spec
Metro	24	63UPK3	Super Erecta® SiteSelect™ Post, 61-13/16"H, for use with stem casters, Metroseal 3 epoxy coated corrosion-resistant finish with Microban® antimicrobial protection
Metro	12	5MDA	Super Erecta® Stem Caster, swivel, 5" diameter, 1-1/4" face, high modulus donut wheel tread, with donut bumpers, 250 lb. capacity
Metro	12	5MDBA	Super Erecta® Stem Caster, brake (foot operated), 5" diameter, 1-1/4" face, high modulus donut wheel tread, with donut bumpers, 250 lb. capacity, brakes are foot operated

Submittal Sheet

10/16/2018

ITEM# 103 - DUNNAGE RACK (4 EA REQ'D)

Metro HP2248PD

Metro Bow-Tie™ Dunnage Rack, 22" x 48" x 12"H, slotted, with separate polymer tie for joining racks, corrosion proof polymer construction, NSF

Job _____



METRO BOW TIE™ DUNNAGE RACKS



Racks joined in "end-to-end" and "back-to-back" configuration.

SPECIFICATIONS:

- Rotationally molded grey polyethylene construction
- Slotted top for air circulation
- Slots run front to back for easy loading and unloading
- All rack edges have generous radius to prevent product snagging or marking
- Weight capacity: 30" and 36" racks - 1,500 lbs.
48" and 60" racks - 3,000 lbs.
- Each rack provided with separate polymer tie for joining racks in "end-to-end" and "back-to-back" configurations. Rack has a recess centered each side of top surface to accept polymer tie.
- Joining system tie drops in and is removed from top without the use of tools.

Cat. No.	Width		Length		Height		Approx. Pkg. Wt.	
	(in.)	(mm)	(in.)	(mm)	(in.)	(mm)	(lb.)	(kg)
HP2230PD	22	550	30	760	12	305	24	10.8
HP2236PD	22	550	36	910	12	305	26	11.7
HP2248PD	22	550	48	1220	12	305	34	15.3
HP2260PD	22	550	60	1525	12	305	42	19

Manufactured by:



InterMetro Industries Corporation

North Washington Street, Wilkes-Barre, PA 18705
Phone: 570-825-2741 • Fax: 570-825-2852

For Product Information Call: 1-800-433-2232
Visit Our Web Site: www.metro.com

L03-105
Rev. 5/99
Printed in U.S.A.

Information and specifications are subject to change without notice. Please confirm at time of order.



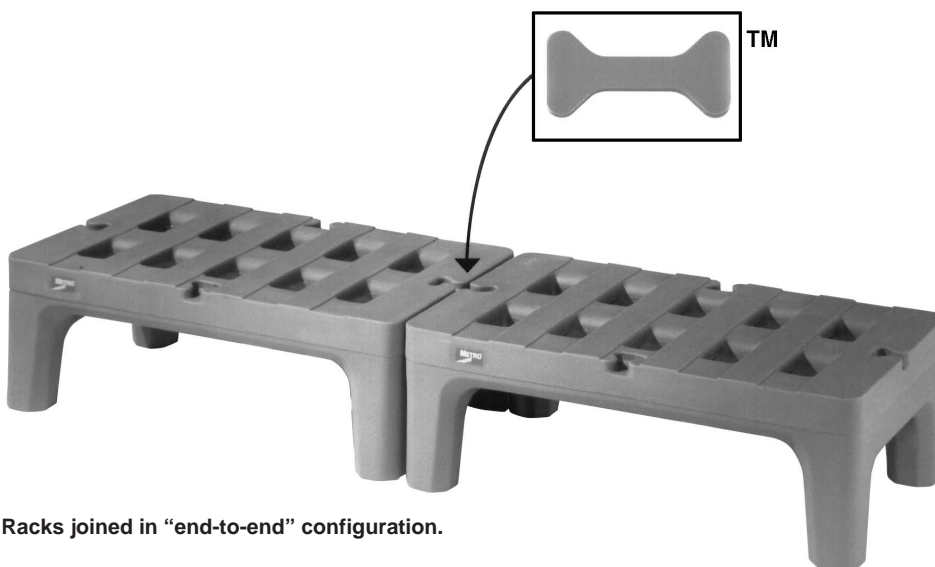
Item# _____

Job _____



METRO BOW TIE™ DUNNAGE RACKS

- **Versatile:** Racks join together easily without tools in “end-to-end” and “back-to-back” configurations with the exclusive bow-tie™ feature.
- **Durable:** Rust and corrosion proof polymer construction.
- **Strong:** Heavy-duty construction gives racks the strength to hold up to 3,000 lbs. per unit.
- **Unique Design:** Racks have front to back slots for easier loading and unloading and superior air flow which promotes longer shelf life.
- **Easy to Clean:** Smooth rotomolded polymer offers snag-free surfaces and promotes easy cleaning.
- **NSF Approved**
- **UPS Shippable**
- **No Assembly required.**



Racks joined in “end-to-end” configuration.



InterMetro Industries Corporation
North Washington Street
Wilkes-Barre, PA 18705
www.metro.com

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**Metro Bow Tie™
Dunnage Racks**

9.09

Submittal Sheet

10/16/2018

ITEM# 110 - WIRE SHELVING (16 EA REQ'D)

Metro 2160NK3

Super Erecta® Shelf, wire, 60"W x 21"D, plastic split sleeves are included in each carton, Metroseal 3™ epoxy-coated corrosion-resistant finish with Microban® antimicrobial protection, NSF

The spec sheet for this item can be viewed on item 04)

ACCESSORIES

Mfr	Qty	Model	Spec
Metro	16	63UPK3	Super Erecta® SiteSelect™ Post, 61-13/16"H, for use with stem casters, Metroseal 3 epoxy coated corrosion-resistant finish with Microban® antimicrobial protection
Metro	8	5MDA	Super Erecta® Stem Caster, swivel, 5" diameter, 1-1/4" face, high modulus donut wheel tread, with donut bumpers, 250 lb. capacity
Metro	8	5MDBA	Super Erecta® Stem Caster, brake (foot operated), 5" diameter, 1-1/4" face, high modulus donut wheel tread, with donut bumpers, 250 lb. capacity, brakes are foot operated

Submittal Sheet

10/16/2018

ITEM# 111 - WIRE SHELVING (4 EA REQ'D)

Metro 2442NK3

Super Erecta® Shelf, wire, 42"W x 24"D, plastic split sleeves are included in each carton, Metroseal 3™ epoxy-coated corrosion-resistant finish with Microban® antimicrobial protection, NSF

The spec sheet for this item can be viewed on item 04)

ACCESSORIES

Mfr	Qty	Model	Spec
Metro	4	63UPK3	Super Erecta® SiteSelect™ Post, 61-13/16"H, for use with stem casters, Metroseal 3 epoxy coated corrosion-resistant finish with Microban® antimicrobial protection
Metro	2	5MDA	Super Erecta® Stem Caster, swivel, 5" diameter, 1-1/4" face, high modulus donut wheel tread, with donut bumpers, 250 lb. capacity
Metro	2	5MDBA	Super Erecta® Stem Caster, brake (foot operated), 5" diameter, 1-1/4" face, high modulus donut wheel tread, with donut bumpers, 250 lb. capacity, brakes are foot operated

Submittal Sheet

10/16/2018

ITEM# 112 - WIRE SHELVING (20 EA REQ'D)

Metro 2472NK3

Super Erecta® Shelf, wire, 72"W x 24"D, plastic split sleeves are included in each carton, Metroseal 3™ epoxy-coated corrosion-resistant finish with Microban® antimicrobial protection, NSF

The spec sheet for this item can be viewed on item 04)

ACCESSORIES

Mfr	Qty	Model	Spec
Metro	20	63UPK3	Super Erecta® SiteSelect™ Post, 61-13/16"H, for use with stem casters, Metroseal 3 epoxy coated corrosion-resistant finish with Microban® antimicrobial protection
Metro	10	5MDA	Super Erecta® Stem Caster, swivel, 5" diameter, 1-1/4" face, high modulus donut wheel tread, with donut bumpers, 250 lb. capacity
Metro	10	5MDBA	Super Erecta® Stem Caster, brake (foot operated), 5" diameter, 1-1/4" face, high modulus donut wheel tread, with donut bumpers, 250 lb. capacity, brakes are foot operated

Submittal Sheet

10/16/2018

ITEM# 113 - WIRE SHELVING (4 EA REQ'D)

Metro 1848NK3

Super Erecta® Shelf, wire, 48"W x 18"D, plastic split sleeves are included in each carton, Metroseal 3™ epoxy-coated corrosion-resistant finish with Microban® antimicrobial protection, NSF

The spec sheet for this item can be viewed on item 04)

ACCESSORIES

Mfr	Qty	Model	Spec
Metro	4	63UPK3	Super Erecta® SiteSelect™ Post, 61-13/16"H, for use with stem casters, Metroseal 3 epoxy coated corrosion-resistant finish with Microban® antimicrobial protection
Metro	2	5MDA	Super Erecta® Stem Caster, swivel, 5" diameter, 1-1/4" face, high modulus donut wheel tread, with donut bumpers, 250 lb. capacity
Metro	2	5MDBA	Super Erecta® Stem Caster, brake (foot operated), 5" diameter, 1-1/4" face, high modulus donut wheel tread, with donut bumpers, 250 lb. capacity, brakes are foot operated

Submittal Sheet

10/16/2018

ITEM# 114 - DUNNAGE RACK (3 EA REQ'D)

Metro HP2260PD

Metro Bow-Tie™ Dunnage Rack, 22" x 60" x 12"H, slotted, with separate polymer tie for joining racks, corrosion proof polymer construction, NSF

The spec sheet for this item can be viewed on item 103)

Submittal Sheet

10/16/2018

ITEM# E06 - UNIVERSAL PAN RACK (3 EA REQ'D)

Existing TO BE RELOCATED

Submittal Sheet

10/16/2018

ITEM# E17 - COFFEE SHUTTLE (4 EA REQ'D)

Existing TO BE RELOCATED

Submittal Sheet

10/16/2018

ITEM# E41 - TRUCK, PLATFORM (1 EA REQ'D)

Existing TO BE RELOCATED

Submittal Sheet

10/16/2018

ITEM# E51 - WORKTOP REFRIGERATOR (1 EA REQ'D)

Existing TO BE RELOCATED

Submittal Sheet

10/16/2018

ITEM# E52 - SLICER (2 EA REQ'D)

Existing TO BE RELOCATED

Submittal Sheet

10/16/2018

ITEM# E53 - REFRIGERATOR, SANDWICH/SALAD PREP (1 EA REQ'D)

Existing TO BE RELOCATED

Submittal Sheet

10/16/2018

ITEM# E55 - WORKTOP REFRIGERATOR (2 EA REQ'D)

Existing TO BE RELOCATED

Submittal Sheet

10/16/2018

ITEM# E67 - COLD PAN (1 EA REQ'D)

Existing TO BE RELOCATED

Submittal Sheet

10/16/2018

ITEM# E71 - IPAD NUTRITION KIOSK (2 EA REQ'D)

Existing TO BE RELOCATED

Submittal Sheet

10/16/2018

ITEM# E74 - TEA URN (1 EA REQ'D)

Existing TO BE RELOCATED

Submittal Sheet

10/16/2018

ITEM# E75 - CAPPUCCINO DISPENSER (1 EA REQ'D)

Existing TO BE RELOCATED

Submittal Sheet

10/16/2018

ITEM# E77 - BEVERAGE DISPENSER (1 EA REQ'D)

Existing TO BE RELOCATED

Submittal Sheet

10/16/2018

ITEM# E78 - COFFEE GRINDER (2 EA REQ'D)

Existing TO BE RELOCATED

Submittal Sheet

10/16/2018

ITEM# E79 - HOT WATER DISPENSER (1 EA REQ'D)

Existing TO BE RELOCATED

Submittal Sheet

10/16/2018

ITEM# E80 - MILK DISPENSER (1 EA REQ'D)

Existing TO BE RELOCATED

Submittal Sheet

10/16/2018

ITEM# E81 - THERMAL COFFEE BREWER, DOUBLE (1 EA REQ'D)

Existing TO BE RELOCATED

Submittal Sheet

10/16/2018

ITEM# E82 - POS, SELF-CHECKOUT (2 EA REQ'D)

Existing TO BE RELOCATED

Submittal Sheet

10/16/2018

ITEM# E84 - GLASS DOOR MERCHANDISER REFRIGERATOR (1 EA REQ'D)

Existing TO BE RELOCATED

Submittal Sheet

10/16/2018

ITEM# E85 - REACH-IN REFRIGERATOR (1 EA REQ'D)

Existing TO BE RELOCATED

Submittal Sheet

10/16/2018

ITEM# E86 - GLASS DOOR MERCHANDISER REFRIGERATOR (1 EA REQ'D)

Existing TO BE RELOCATED

Submittal Sheet

10/16/2018

ITEM# E114 - HOT/COLD PAN, DROP-IN (1 EA REQ'D)

Existing TO BE RELOCATED

Submittal Sheet

10/16/2018

ITEM# E115 - HOT/COLD PAN, DROP-IN (1 EA REQ'D)

Existing TO BE RELOCATED

Submittal Sheet

10/16/2018

ITEM# E116 - HOT/COLD PAN, DROP-IN (1 EA REQ'D)

Existing TO BE RELOCATED

Submittal Sheet

10/16/2018

ITEM# E127 - P.O.S. (4 EA REQ'D)

Existing TO BE RELOCATED

Submittal Sheet

10/16/2018

ITEM# E127.1 - SCALE (4 EA REQ'D)

Existing TO BE RELOCATED

Submittal Sheet

10/16/2018

ITEM# E129 - LOW TEMPERATURE SMOKER OVEN (1 EA REQ'D)

Existing TO BE RELOCATED

Submittal Sheet

10/16/2018

ITEM# E132 - INDUCTION RANGE, COUNTERTOP (3 EA REQ'D)

Existing TO BE RELOCATED

Submittal Sheet

10/16/2018

ITEM# E143 - 47" (16:9) LCD SCREEN (6 EA REQ'D)

Existing TO BE RELOCATED

Submittal Sheet

10/16/2018

ITEM# E144 - HOT CABINET, ROLL-IN (1 EA REQ'D)

Existing TO BE RELOCATED