

Centerville-Abington Community Schools Transportation Building



Centerville, Indiana

Commission No. 473003.00

March 2, 2022

Volume 2 of 2

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PROJECT MANUAL

for

CENTERVILLE-ABINGTON SCHOOL CORPORATION

Transportation Building

Centerville, IN

Commission No.: 473003.00

March 2, 2022

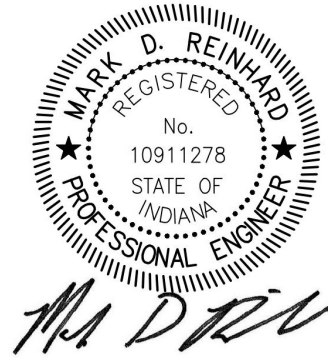
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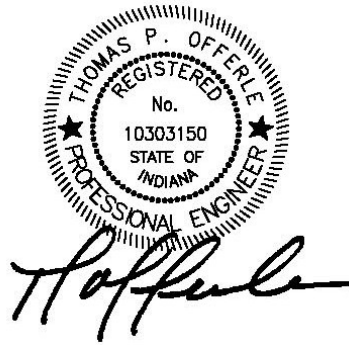
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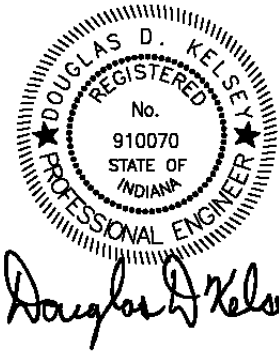
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DIVISION 21

1 SECTION 210500 - COMMON WORK RESULTS FOR FIRE SUPPRESSION

2 PART 1 - GENERAL

3 1.1 RELATED DOCUMENTS

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

6 1.2 SUMMARY

- 7 A. This Section includes the following:

- 8 1. Piping materials and installation instructions common to most piping systems.
9 2. Grout.
10 3. Equipment installation requirements common to equipment sections.
11 4. Painting and Finishing.
12 5. Concrete Bases.
13 6. Supports and anchorages.

14 1.3 DEFINITIONS

- 15 A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred
16 spaces, pipe chases, unheated spaces immediately below roof, spaces above ceilings,
17 unexcavated spaces, crawlspaces, and tunnels.

- 18 B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied
19 spaces and mechanical equipment rooms.

- 20 C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient
21 temperatures and weather conditions. Examples include rooftop locations.

- 22 D. Concealed, Interior Installations: Concealed from view and protected from physical contact by
23 building occupants. Examples include above ceilings and in chases.

- 24 E. Concealed, Exterior Installations: Concealed from view and protected from weather
25 conditions and physical contact by building occupants but subject to outdoor ambient
26 temperatures. Examples include installations within unheated shelters.

- 27 F. The following are industry abbreviations for rubber materials:

- 1 1. EPDM: Ethylene-propylene-diene terpolymer rubber.
- 2 2. NBR: Acrylonitrile-butadiene rubber.

- 3 1.4 QUALITY ASSURANCE

- 4 A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural
- 5 Welding Code--Steel."

- 6 B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure
- 7 Vessel Code: Section IX, "Welding and Brazing Qualifications."

- 8 1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
- 9 2. Certify that each welder has passed AWS qualification tests for welding processes
- 10 involved and that certification is current.

- 11 C. Electrical Characteristics for Fire-Suppression Equipment: Equipment of different electrical
- 12 characteristics may be furnished provided such proposed equipment is approved in writing
- 13 and connecting electrical services, circuit breakers, and conduit sizes are appropriately
- 14 modified at the cost of the equipment manufacturer. If minimum energy ratings or efficiencies
- 15 are specified, equipment shall comply with requirements.

- 16 1.5 DELIVERY, STORAGE, AND HANDLING

- 17 A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping,
- 18 storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and
- 19 moisture.

- 20 1.6 COORDINATION

- 21 A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of
- 22 construction, to allow for fire-suppression installations.

- 23 B. Coordinate installation of required supporting devices and set sleeves in poured-in-place
- 24 concrete and other structural components as they are constructed.

- 25 C. Coordinate requirements for access panels and doors for fire-suppression items requiring
- 26 access that are concealed behind finished surfaces. Access panels and doors are specified in
- 27 Division 08 Section "Access Doors and Frames."

1 PART 2 - PRODUCTS

2 2.1 MANUFACTURERS

3 A. In other Part 2 articles where subparagraph titles below introduce lists, the following
4 requirements apply for product selection:

5 1. Manufacturers: Subject to compliance with requirements, provide products by the
6 manufacturers specified.

7 2.2 PIPE, TUBE, AND FITTINGS

8 A. Refer to individual Division 21 Sections for pipe, tube, and fitting materials and joining
9 methods.

10 B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

11 2.3 JOINING MATERIALS

12 A. Refer to individual Division 21 Sections for special joining materials not listed below.

13 B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system
14 contents.

15 1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless
16 thickness or specific material is indicated.

17 a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.

18 b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.

19 2. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full-face
20 or ring type, unless otherwise indicated.

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

22 D. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to
23 ASTM B 813.

24 E. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty
25 brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping,
26 unless otherwise indicated.

1 F. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall
2 thickness and chemical analysis of steel pipe being welded.

3 2.4 GROUT

4 A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.

5 1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive,
6 nongaseous, and recommended for interior and exterior applications.

7 2. Design Mix: 5000-psi, 28-day compressive strength.

8 3. Packaging: Premixed and factory packaged.

9 PART 3 - EXECUTION

10 3.1 PIPING SYSTEMS - COMMON REQUIREMENTS

11 A. Install piping according to the following requirements and Division 21 Sections specifying
12 piping systems.

13 B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping
14 systems. Indicated locations and arrangements were used to size pipe and calculate friction
15 loss, expansion, pump sizing, and other design considerations. Install piping as indicated
16 unless deviations to layout are approved on Coordination Drawings.

17 C. Install piping in concealed locations, unless otherwise indicated and except in equipment
18 rooms and service areas.

19 D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right
20 angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated
21 otherwise.

22 E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

23 F. Install piping to permit valve servicing.

24 G. Install piping at indicated slopes.

25 H. Install piping free of sags and bends.

26 I. Install fittings for changes in direction and branch connections.

27 J. Install piping to allow application of insulation.

- 1 K. Select system components with pressure rating equal to or greater than system operating
2 pressure.
- 3 L. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors
4 at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07
5 Section "Penetration Firestopping" for materials.
- 6 M. Verify final equipment locations for roughing-in.
- 7 N. Refer to equipment specifications in other Sections of these Specifications for roughing-in
8 requirements.
- 9 3.3 PIPING JOINT CONSTRUCTION
- 10 A. Join pipe and fittings according to the following requirements and Division 21 Sections
11 specifying piping systems.
- 12 B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- 13 C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before
14 assembly.
- 15 D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube
16 end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-
17 free solder alloy complying with ASTM B 32.
- 18 E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube"
19 Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.
- 20 F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut
21 threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore
22 full ID. Join pipe fittings and valves as follows:
- 23 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal
24 threading is specified.
- 25 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or
26 damaged. Do not use pipe sections that have cracked or open welds.
- 27 G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and
28 welding operators according to Part 1 "Quality Assurance" Article.
- 29 H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service
30 application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

- 1 3.4 PAINTING
- 2 A. Painting of fire-suppression systems, equipment, and components is specified in Division 09
- 3 Sections "Interior Painting" and "Exterior Painting."
- 4 B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials
- 5 and procedures to match original factory finish.

- 6 3.5 CONCRETE BASES
- 7 A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's
- 8 written instructions and according to seismic codes at Project.

- 9 1. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in
- 10 both directions than supported unit.
- 11 2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise
- 12 indicated, install dowel rods on 18-inch centers around the full perimeter of the base.
- 13 3. Install epoxy-coated anchor bolts for supported equipment that extend through
- 14 concrete base, and anchor into structural concrete floor.
- 15 4. Place and secure anchorage devices. Use supported equipment manufacturer's setting
- 16 drawings, templates, diagrams, instructions, and directions furnished with items to be
- 17 embedded.
- 18 5. Install anchor bolts to elevations required for proper attachment to supported
- 19 equipment.
- 20 6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
- 21 7. Use 3000-psi, 28-day compressive-strength concrete and reinforcement as specified in
- 22 Division 03 Section "Cast-in-Place Concrete."
- 23
- 24 3.6 ERECTION OF METAL SUPPORTS AND ANCHORAGES
- 25 A. Refer to Division 05 Section "Metal Fabrications" for structural steel.
- 26 B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and
- 27 elevation to support and anchor fire-suppression materials and equipment.
- 28 C. Field Welding: Comply with AWS D1.1.

- 29 3.7 ERECTION OF WOOD SUPPORTS AND ANCHORAGES
- 30 A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor fire-
- 31 suppression materials and equipment.

- 1 B. Select fastener sizes that will not penetrate members if opposite side will be exposed to view
- 2 or will receive finish materials. Tighten connections between members. Install fasteners
- 3 without splitting wood members.

- 4 C. Attach to substrates as required to support applied loads.

- 5 3.8 GROUTING

- 6 A. Mix and install grout for fire-suppression equipment base bearing surfaces, pump and other
- 7 equipment base plates, and anchors.

- 8 B. Clean surfaces that will come into contact with grout.

- 9 C. Provide forms as required for placement of grout.

- 10 D. Avoid air entrapment during placement of grout.

- 11 E. Place grout, completely filling equipment bases.

- 12 F. Place grout on concrete bases and provide smooth bearing surface for equipment.

- 13 G. Place grout around anchors.

- 14 H. Cure placed grout.

- 15 END OF SECTION 210500

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1 SECTION 210517 - SLEEVES AND SLEEVE SEALS FOR FIRE-SUPPRESSION PIPING

2 PART 1 - GENERAL

3 1.1 RELATED DOCUMENTS

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

6 1.2 SUMMARY

7 A. Section Includes:

- 8 1. Sleeves.
- 9 2. Stack-sleeve fittings.
- 10 3. Sleeve-seal systems.
- 11 4. Grout.

12 1.3 ACTION SUBMITTALS

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

14 PRODUCTS

15 2.1 SLEEVES

16 B. Cast-Iron Wall Pipes: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron
17 pressure pipe, with plain ends and integral waterstop unless otherwise indicated.

18 C. Galvanized-Steel Wall Pipes: ASTM A 53/A 53M, Schedule 40, with plain ends and welded
19 steel collar; zinc coated.

20 D. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated,
21 with plain ends.

22 E. Galvanized-Steel-Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with
23 welded longitudinal joint.

1 2.2 STACK-SLEEVE FITTINGS

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

- 4 1. Smith, Jay R. Mfg. Co.
- 5 2. Zurn Specification Drainage Operation; Zurn Plumbing Products Group.

6 B. Description: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping
7 ring, bolts, and nuts for membrane flashing.

- 8 1. Underdeck Clamp: Clamping ring with setscrews.

9 2.3 SLEEVE-SEAL SYSTEMS

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

- 12 1. Advance Products & Systems, Inc.
- 13 2. CALPICO, Inc.
- 14 3. GPT, an ENPRO Industries, Inc.
- 15 4. Metraflex Company (The).
- 16 5. Pipeline Seal and Insulator, Inc.
- 17 6. Proco Products, Inc.

18 B. Description: Modular sealing-element unit, designed for field assembly, for filling annular
19 space between piping and sleeve.

- 20 1. Sealing Elements: EPDM-rubber or NBR interlocking links shaped to fit surface of pipe.
21 Include type and number required for pipe material and size of pipe.
- 22 2. Pressure Plates: Stainless steel.
- 23 3. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates
24 to sealing elements.

25 2.4 GROUT

26 A. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry,
27 hydraulic-cement grout.

28 B. Characteristics: Nonshrink; recommended for interior and exterior applications.

29 C. Design Mix: 5000-psi, 28-day compressive strength.

30 D. Packaging: Premixed and factory packaged.

1 EXECUTION

2 3.1 SLEEVE INSTALLATION

3 A. Install sleeves for piping passing through penetrations in floors, partitions, and walls.

4 B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to
5 provide 1-inch annular clear space between piping and concrete slabs and walls.

6 1. Sleeves are not required for core-drilled holes.

7 C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls
8 are constructed.

9 1. Permanent sleeves are not required for holes in slabs formed by molded-PE or -PP
10 sleeves.

11 2. Cut sleeves to length for mounting flush with both surfaces.

12 a. Exception: Extend sleeves installed in floors of mechanical equipment areas or
13 other wet areas 2 inches above finished floor level.

14 3. Using grout, seal the space outside of sleeves in slabs and walls without sleeve-seal
15 system.

16 D. Install sleeves for pipes passing through interior partitions.

17 1. Cut sleeves to length for mounting flush with both surfaces.

18 2. Install sleeves that are large enough to provide 1/4-inch annular clear space between
19 sleeve and pipe or pipe insulation.

20 3. Seal annular space between sleeve and piping or piping insulation; use joint sealants
21 appropriate for size, depth, and location of joint. Comply with requirements for
22 sealants specified in Section 079200 "Joint Sealants."

23 E. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors
24 at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with
25 requirements for firestopping specified in Section 078413 "Penetration Firestopping."

26 3.2 STACK-SLEEVE-FITTING INSTALLATION

27 A. Install stack-sleeve fittings in new slabs as slabs are constructed.

28 1. Install fittings that are large enough to provide 1/4-inch annular clear space between
29 sleeve and pipe or pipe insulation.

- 1 2. Secure flashing between clamping flanges for pipes penetrating floors with membrane
2 waterproofing. Comply with requirements for flashing specified in Section 076200
3 "Sheet Metal Flashing and Trim."
4
 - 5 3. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor
6 level.
 - 7 4. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if
8 ring is specified.
 - 9 5. Using grout, seal the space around outside of stack-sleeve fittings.
- 10 B. Fire-Resistance-Rated Penetrations, Horizontal Assembly Penetrations, and Smoke Barrier
11 Penetrations: Maintain indicated fire or smoke rating of floors at pipe penetrations. Seal pipe
12 penetrations with fire- or smoke-stop materials. Comply with requirements for firestopping
13 specified in Section 078413 "Penetration Firestopping."
- 14 3.3 SLEEVE-SEAL-SYSTEM INSTALLATION
- 15 A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service
16 piping entries into building.
 - 17 B. Select type, size, and number of sealing elements required for piping material and size and for
18 sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration,
19 assemble sleeve-seal system components, and install in annular space between piping and
20 sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make
21 a watertight seal.
- 22 3.4 SLEEVE AND SLEEVE-SEAL SCHEDULE
- 23 A. Use sleeves and sleeve seals for the following piping-penetration applications:
24 1. Exterior Concrete Walls above Grade:
25 a. Piping Smaller Than NPS 6: Galvanized-steel wall sleeves.
26 b. Piping NPS 6 and Larger: Galvanized-steel wall sleeves or Galvanized-steel-pipe
27 sleeves.
 - 28 2. Exterior Concrete Walls below Grade:
29 a. Piping Smaller Than NPS 6: steel wall sleeves with sleeve-seal system or
30 Galvanized-steel-pipe sleeves with sleeve-seal system.
31 1) Select sleeve size to allow for 1-inch annular clear space between piping
32 and sleeve for installing sleeve-seal system.

- 1 b. Piping NPS 6 and Larger: Galvanized-steel-pipe sleeves with sleeve-seal system.
- 2 1) Select sleeve size to allow for 1-inch annular clear space between piping
3 and sleeve for installing sleeve-seal system.
- 4 3. Concrete Slabs-on-Grade:
- 5 a. Piping Smaller Than NPS 6: Galvanized-steel wall sleeves with sleeve-seal system
6 or Galvanized-steel-pipe sleeves with sleeve-seal system.
- 7 1) Select sleeve size to allow for 1-inch annular clear space between piping
8 and sleeve for installing sleeve-seal system.
- 9 b. Piping NPS 6 and Larger: Galvanized-steel-pipe sleeves with sleeve-seal system.
- 10 1) Select sleeve size to allow for 1-inch annular clear space between piping
11 and sleeve for installing sleeve-seal system.
- 12
- 13 4. Interior Partitions:
- 14 a. Piping Smaller Than NPS 6: Galvanized-steel-pipe sleeves.
- 15 b. Piping NPS 6 and Larger: Galvanized-steel-sheet sleeves.
- 16 3.5 FIELD QUALITY CONTROL
- 17 A. Perform the following tests and inspections:
- 18 1. Leak Test: After allowing for a full cure, test sleeves and sleeve seals for leaks. Repair
19 leaks and retest until no leaks exist.
- 20 B. Sleeves and sleeve seals will be considered defective if they do not pass tests and inspections.
- 21 C. Prepare test and inspection reports.
- 22 END OF SECTION 210517

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1 SECTION 210518 - ESCUTCHEONS FOR FIRE-SUPPRESSION PIPING

2 PART 1 - GENERAL

3 1.1 RELATED DOCUMENTS

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

6 1.2 SUMMARY

- 7 A. Section Includes:

- 8 1. Escutcheons.
9 2. Floor plates.

10 1.3 ACTION SUBMITTALS

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

12 PART 2 - PRODUCTS

13 2.1 ESCUTCHEONS

- 14 A. One-Piece, Cast-Brass Type: With polished, chrome-plated finish and setscrew fastener.

- 15 B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with chrome-plated finish and
16 spring-clip fasteners.

- 17 C. One-Piece, Stamped-Steel Type: With chrome-plated finish and spring-clip fasteners.

- 18 D. Split-Casting Brass Type: With polished, chrome-plated finish and with concealed hinge and
19 setscrew.

- 20 E. Split-Plate, Stamped-Steel Type: With chrome-plated finish, concealed hinge, and spring-clip
21 fasteners.

1 2.2 FLOOR PLATES

2 A. One-Piece Floor Plates: Cast-iron flange with holes for fasteners.

3 B. Split-Casting Floor Plates: Cast brass with concealed hinge.

4 PART 3 - EXECUTION

5 3.1 INSTALLATION

6 A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.

7 B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of insulated piping
8 and with OD that completely covers opening.

9 1. Escutcheons for New Piping:

10 a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.

11 b. Chrome-Plated Piping: One-piece, cast-brass or split-casting brass type with
12 polished, chrome-plated finish.

13 c. Insulated Piping: One-piece, stamped-steel type or split-plate, stamped-steel
14 type with concealed hinge.

15 d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-
16 brass type with polished, chrome-plated finish.

17 e. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, cast-brass.

18 f. Bare Piping in Unfinished Service Spaces: One-piece, stamped-steel type.

19 g. Bare Piping in Equipment Rooms: One-piece, stamped-steel type.
20

21 C. Install floor plates for piping penetrations of equipment-room floors.

22 D. Install floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD
23 that completely covers opening.

24 1. New Piping: One-piece, floor-plate type.

25 2. Existing Piping: Split-casting, floor-plate type.

26 3.2 FIELD QUALITY CONTROL

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

1 END OF SECTION 210518

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1 SECTION 210523 – GENERAL-DUTY VALVES FOR FIRE-SUPPRESSION PIPING

2 PART 1 - GENERAL

3 1.1 RELATED DOCUMENTS

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

6 1.2 SUMMARY

- 7 A. Section Includes:

- 8 1. Two-piece ball valves with indicators.
9 2. Bronze butterfly valves with indicators.
10 3. Iron butterfly valves with indicators.
11 4. Check valves.
12 5. Bronze OS&Y gate valves.
13 6. Iron OS&Y gate valves.
14 7. NRS gate valves.
15 8. Indicator posts.
16 9. Trim and drain valves.

17 1.3 DEFINITIONS

- 18 A. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.
19 B. NRS: Nonrising stem.
20 C. OS&Y: Outside screw and yoke.
21 D. SBR: Styrene-butadiene rubber.

22 1.4 ACTION SUBMITTALS

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

- 1 1.5 DELIVERY, STORAGE, AND HANDLING
- 2 A. Prepare valves for shipping as follows:
- 3 1. Protect internal parts against rust and corrosion.
- 4 2. Protect threads, flange faces, and weld ends.
- 5 3. Set valves open to minimize exposure of functional surfaces.
- 6 B. Use the following precautions during storage:
- 7 1. Maintain valve end protection.
- 8 2. Store valves indoors and maintain at higher than ambient dew point temperature. If
- 9 outdoor storage is necessary, store valves off the ground in watertight enclosures.
- 10 C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use
- 11 operating handles or stems as lifting or rigging points.
- 12 D. Protect flanges and specialties from moisture and dirt.
- 13 PART 2 - PRODUCTS
- 14 2.1 GENERAL REQUIREMENTS FOR VALVES
- 15 A. UL Listed: Valves shall be listed in UL's "Online Certifications Directory" under the headings
- 16 listed below and shall bear UL mark:
- 17 1. Main Level: HAMV - Fire Main Equipment.
- 18 a. Level 1: HCBZ - Indicator Posts, Gate Valve.
- 19 b. Level 1: HLOT - Valves.
- 20 1) Level 3: HLUG - Ball Valves, System Control.
- 21 2) Level 3: HLXS - Butterfly Valves.
- 22 3) Level 3: HMER - Check Valves.
- 23 4) Level 3: HMRZ - Gate Valves.
- 24 2. Main Level: VDGT - Sprinkler System & Water Spray System Devices.
- 25 a. Level 1: VQGU - Valves, Trim and Drain.
- 26 B. FM Global Approved: Valves shall be listed in its "Approval Guide," under the headings listed
- 27 below:
- 28 1. Automated Sprinkler Systems:

- 1 a. Indicator posts.
- 2 b. Valves.
 - 3 1) Gate valves.
 - 4 2) Check valves.
 - 5 a) Single check valves.
 - 6 3) Miscellaneous valves.
- 7 C. Source Limitations for Valves: Obtain valves for each valve type from single manufacturer.
- 8 D. ASME Compliance:
 - 9 1. ASME B16.1 for flanges on iron valves.
 - 10 2. ASME B1.20.1 for threads for threaded-end valves.
 - 11 3. ASME B31.9 for building services piping valves.
- 12 E. AWWA Compliance: Comply with AWWA C606 for grooved-end connections.
- 13 F. NFPA Compliance: Comply with NFPA 24 for valves.
- 14 G. Valve Pressure Ratings: Not less than the minimum pressure rating indicated or higher as
15 required by system pressures.
- 16 H. Valve Sizes: Same as upstream piping unless otherwise indicated.
- 17 I. Valve Actuator Types:
 - 18 1. Worm-gear actuator with handwheel for quarter-turn valves, except for trim and drain
19 valves.
 - 20 2. Handwheel: For other than quarter-turn trim and drain valves.
 - 21 3. Handlever: For quarter-turn trim and drain valves NPS 2 (DN 50) and smaller.
- 22 2.2 TWO-PIECE BALL VALVES WITH INDICATORS
 - 23 A. Manufacturers: Subject to compliance with requirements, provide products by one of the
24 following:
 - 25 1. NIBCO INC.
 - 26 2. Victaulic Company.
 - 27 B. Description:

- 1 1. UL 1091, except with ball instead of disc and FM Global standard for indicating valves
- 2 (butterfly or ball type), Class Number 1112.
- 3 2. Minimum Pressure Rating: 175 psig (1200 kPa).
- 4 3. Body Design: Two piece.
- 5 4. Body Material: Forged brass or bronze.
- 6 5. Port Size: Full.
- 7 6. Seats: PTFE.
- 8 7. Stem: Bronze or stainless steel.
- 9 8. Ball: Chrome-plated brass.
- 10 9. Actuator: Worm gear or traveling nut.
- 11 10. Supervisory Switch: Internal or external.
- 12 11. End Connections for Valves NPS 1 (DN 25) through NPS 2 (DN 50): Threaded ends.
- 13 12. End Connections for Valves NPS 2-1/2 (DN 65): Grooved ends.

14 2.3 BRONZE BUTTERFLY VALVES WITH INDICATORS

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

- 17 1. Fivalco Inc.
- 18 2. Globe Fire Sprinkler Corporation.
- 19 3. Milwaukee Valve Company.

- 20 B. Description:

- 21 1. Standard: UL 1091 and FM Global standard for indicating valves, (butterfly or ball
22 type), Class Number 1112.
- 23 2. Minimum: Pressure rating: 175 psig (1200 kPa).
- 24 3. Body Material: Bronze.
- 25 4. Seat Material: EPDM.
- 26 5. Stem Material: Bronze or stainless steel.
- 27 6. Disc: Bronze.
- 28 7. Actuator: Worm gear or traveling nut.
- 29 8. Supervisory Switch: Internal or external.
- 30 9. Ends Connections for Valves NPS 1 (DN 25) through NPS 2 (DN 50): Threaded ends.
- 31 10. Ends Connections for Valves NPS 2-1/2 (DN 65): Grooved ends.

32 2.4 IRON BUTTERFLY VALVES WITH INDICATORS

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

- 35 1. Anvil International, Inc.

- 1 2. Fivalco Inc.
- 2 3. Globe Fire Sprinkler Corporation.
- 3 4. Kennedy Valve; a division of McWane, Inc.
- 4 5. NIBCO INC.
- 5 6. Tyco Fire & Building Products LP.
- 6 7. Victaulic Company.

7 B. Description:

- 8 1. Standard: UL 1091 and FM Global standard for indicating valves, (butterfly or ball type),
- 9 Class Number 112.
- 10 2. Minimum Pressure Rating: 175 psig (1200 kPa).
- 11 3. Body Material: Cast or ductile iron with nylon, EPDM, epoxy, or polyamide coating.
- 12 4. Seat Material: EPDM.
- 13 5. Stem: Stainless steel.
- 14 6. Disc: Ductile iron, nickel plated and EPDM or SBR coated.
- 15 7. Actuator: Worm gear or traveling nut.
- 16 8. Supervisory Switch: Internal or external.
- 17 9. Body Design: Lug or wafer.

18 2.5 CHECK VALVES

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

- 21 1. Anvil International, Inc.
- 22 2. Fire Protection Products, Inc.
- 23 3. Globe Fire Sprinkler Corporation.
- 24 4. Mueller Co.; Water Products Division.
- 25 5. NIBCO INC.
- 26 6. Reliable Automatic Sprinkler Co., Inc.
- 27 7. Shurjoint Piping Products.
- 28 8. Tyco Fire & Building Products LP.
- 29 9. Venus Fire Protection Ltd.
- 30 10. Victaulic Company.
- 31 11. Viking Corporation.
- 32 12. Watts Water Technologies, Inc.

33 B. Description:

- 34 1. Standard: UL 312 and FM Global standard for swing check valves, Class Number 1210.
- 35 2. Minimum Pressure Rating: 175 psig (1200 kPa).
- 36 3. Type: Single swing check.
- 37 4. Body Material: Cast iron, ductile iron, or bronze.

- 1 5. Clapper: Bronze, ductile iron, or stainless steel with elastomeric seal.
- 2 6. Clapper Seat: Brass, bronze, or stainless steel.
- 3 7. Hinge Shaft: Bronze or stainless steel.
- 4 8. Hinge Spring: Stainless steel.
- 5 9. End Connections: Flanged, grooved, or threaded.

6 2.6 BRONZE OS&Y GATE VALVES

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

- 9 1. Milwaukee Valve Company.
- 10 2. NIBCO INC.
- 11 3. United Brass Works, Inc.

- 12 B. Description:

- 13 1. Standard: UL 262 and FM Global standard for fire-service water control valves (OS&Y-
14 and NRS-type gate valves).
- 15 2. Minimum Pressure Rating: 175 psig (1200 kPa).
- 16 3. Body and Bonnet Material: Bronze or brass.
- 17 4. Wedge: One-piece bronze or brass.
- 18 5. Wedge Seat: Bronze.
- 19 6. Stem: Bronze or brass.
- 20 7. Packing: Non-asbestos PTFE.
- 21 8. Supervisory Switch: External.
- 22 9. End Connections: Threaded.

23 2.7 IRON OS&Y GATE VALVES

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

- 26 1. American Cast Iron Pipe Company; Waterous Company subsidiary.
- 27 2. Clow Valve Company; a division of McWane, Inc.
- 28 3. Hammond Valve.
- 29 4. Kennedy Valve; a division of McWane, Inc.
- 30 5. Mueller Co.; Water Products Division.
- 31 6. NIBCO INC.
- 32 7. Victaulic Company.
- 33 8. Watts Water Technologies, Inc.

- 34 B. Description:

- 1 1. Standard: UL 262 and FM Global standard for fire-service water control valves (OS&Y-
2 and NRS-type gate valves).
- 3 2. Minimum Pressure Rating: 175 psig (1200 kPa).
- 4 3. Body and Bonnet Material: Cast or ductile iron.
- 5 4. Wedge: Cast or ductile iron, or bronze with elastomeric coating.
- 6 5. Wedge Seat: Cast or ductile iron, or bronze with elastomeric coating.
- 7 6. Stem: Brass or bronze.
- 8 7. Packing: Non-asbestos PTFE.
- 9 8. Supervisory Switch: External.
- 10 9. End Connections: Flanged, Grooved, or threaded.

11 2.8 NRS GATE VALVES

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

- 14 1. American Cast Iron Pipe Company; Waterous Company subsidiary.
- 15 2. Clow Valve Company; a division of McWane, Inc.
- 16 3. Kennedy Valve; a division of McWane, Inc.
- 17 4. Mueller Co.; Water Products Division.
- 18 5. NIBCO INC.
- 19 6. Victaulic Company.

- 20 B. Description:

- 21 1. Standard: UL 262 and FM Global standard for fire-service water control valves (OS&Y-
22 and NRS-type gate valves).
- 23 2. Minimum Pressure Rating: 175 psig (1200 kPa).
- 24 3. Body and Bonnet Material: Cast or ductile iron.
- 25 4. Wedge: Cast or ductile iron with elastomeric coating.
- 26 5. Wedge Seat: Cast or ductile iron, or bronze with elastomeric coating.
- 27 6. Stem: Brass or bronze.
- 28 7. Packing: Non-asbestos PTFE.
- 29 8. Supervisory Switch: External.
- 30 9. End Connections: Flanged, Grooved, or threaded.

31 2.9 INDICATOR POSTS

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

- 34 1. American Cast Iron Pipe Company; Waterous Company subsidiary.
- 35 2. Clow Valve Company; a division of McWane, Inc.

- 1 3. Kennedy Valve; a division of McWane, Inc.
- 2 4. Mueller Co.; Water Products Division.
- 3 5. NIBCO INC.

4 B. Description:

- 5 1. Standard: UL 789 and FM Global standard for indicator posts.
- 6 2. Base Barrel Material: Cast or ductile iron.
- 7 3. Extension Barrel: Cast or ductile iron.
- 8 4. Cap: Cast or ductile iron.
- 9 5. Operation: Wrench.

10 2.10 TRIM AND DRAIN VALVES

11 A. Ball Valves:

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

- 14 a. Conbraco Industries, Inc.; Apollo Valves.
- 15 b. Fire-End & Croker Corporation.
- 16 c. Fire Protection Products, Inc.
- 17 d. Legend Valve.
- 18 e. Milwaukee Valve Company.
- 19 f. NIBCO INC.
- 20 g. Potter Roemer.
- 21 h. Red-White Valve Corporation.
- 22 i. Tyco Fire & Building Products LP.
- 23 j. Victaulic Company.
- 24 k. Watts Water Technologies, Inc.

25

26 2. Description:

- 27 a. Pressure Rating: 175 psig.
- 28 b. Body Design: Two piece.
- 29 c. Body Material: Forged brass or bronze.
- 30 d. Port size: Full or standard.
- 31 e. Seats: PTFE.
- 32 f. Stem: Bronze or stainless steel.
- 33 g. Ball: Chrome-plated brass.
- 34 h. Actuator: Handlever.
- 35 i. End Connections for Valves NPS 1 (DN 25) through NPS 2-1/2 (DN 65): Threaded
36 ends.
- 37 j. End Connections for Valves NPS 1-1/4 and NPS 2-1/2 (DN 32 and DN 65): Grooved
38 ends.

- 1 B. Angle Valves:
- 2 1. Manufacturers: Subject to compliance with requirements, provide products by one of
- 3 the following:
- 4 a. Fire Protection Products, Inc.
- 5 b. NIBCO INC.
- 6 c. United Brass Works, Inc.
- 7
- 8 2. Description:
- 9 a. Pressure Rating: 175 psig.
- 10 b. Body Material: Brass or bronze.
- 11 c. Ends: Threaded.
- 12 d. Stem: Bronze.
- 13 e. Disc: Bronze.
- 14 f. Packing: Asbestos free.
- 15 g. Handwheel: Malleable iron, bronze, or aluminum.
- 16 C. Globe Valves:
- 17 1. Manufacturers: Subject to compliance with requirements, provide products by one of
- 18 the following:
- 19 a. NIBCO INC.
- 20 b. United Brass Works, Inc.
- 21
- 22 2. Description:
- 23 a. Pressure Rating: 175 psig.
- 24 b. Body Material: Bronze with integral seat and screw-in bonnet.
- 25 c. Ends: Threaded.
- 26 d. Stem: Bronze.
- 27 e. Disc Holder and Nut: Bronze.
- 28 f. Disc Seat: Nitrile.
- 29 g. Packing: Asbestos free.
- 30 h. Handwheel: Malleable iron, bronze, or aluminum.

1 PART 3 - EXECUTION

2 3.1 EXAMINATION

3 A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove
4 special packing materials, such as blocks, used to prevent disc movement during shipping and
5 handling.

6 B. Operate valves in positions from fully open to fully closed. Examine guides and seats made
7 accessible by such operations.

8 C. Examine threads on valve and mating pipe for form and cleanliness.

9 D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper
10 size, length, and material. Verify that gasket is of proper size, that its material composition is
11 suitable for service, and that it is free from defects and damage.

12 E. Do not attempt to repair defective valves; replace with new valves.

13 3.2 GENERAL REQUIREMENTS FOR VALVE INSTALLATION

14 A. Comply with requirements in the following Sections for specific valve installation requirements
15 and applications:

16 1. Section 211313 "Wet-Pipe Sprinkler Systems" for application of valves in wet-pipe, fire-
17 suppression sprinkler systems.

18 2. Section 211316 "Dry-Pipe Sprinkler Systems" for application of valves in dry-pipe, fire-
19 suppression sprinkler systems.

20 B. Install listed fire-protection shutoff valves supervised-open, located to control sources of
21 water supply except from fire-department connections. Install permanent identification signs
22 indicating portion of system controlled by each valve.

23 C. Install check valve in each water-supply connection. Install backflow preventers instead of
24 check valves in potable-water-supply sources.

25 D. Install valves having threaded connections with unions at each piece of equipment arranged to
26 allow easy access, service, maintenance, and equipment removal without system shutdown.
27 Provide separate support where necessary.

28 E. Install valves in horizontal piping with stem at or above the pipe center.

29 F. Install valves in position to allow full stem movement.

- 1 G. Install valve tags. Comply with requirements in Section 210553 "Identification for Fire-
2 Suppression Piping and Equipment" for valve tags and schedules and signs on surfaces
3 concealing valves; and the NFPA standard applying to the piping system in which valves are
4 installed. Install permanent identification signs indicating the portion of system controlled by
5 each valve.

- 6 H. Install listed fire-protection shutoff valves supervised-open, located to control sources of
7 water supply except from fire-department connections.

- 8 I. Install check valve in each water-supply connection. Install backflow preventers instead of
9 check valves in potable-water-supply sources.

- 10 END OF SECTION 210523

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1 SECTION 210529 – HANGERS AND SUPPORTS FOR FIRE-SUPPRESSION PIPING AND EQUIPMENT

2 PART 1 - GENERAL

3 1.1 RELATED DOCUMENTS

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

6 1.2 SUMMARY

- 7 A. Section Includes:

- 8 1. Metal pipe hangers and supports.
9 2. Trapeze pipe hangers.
10 3. Metal framing systems.
11 4. Thermal hanger-shield inserts.
12 5. Fastener systems.
13 6. Equipment supports.

14 1.3 ACTION SUBMITTALS

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

- 16 B. Shop Drawings: Show fabrication and installation details and include calculations for the
17 following:

- 18 1. Trapeze pipe hangers.
19 2. Metal framing systems.
20 3. Equipment supports.

21 1.4 INFORMATIONAL SUBMITTALS

- 22 A. Welding certificates.

1 1.5 QUALITY ASSURANCE

2 A. Structural-Steel Welding Qualifications: Qualify procedures and personnel according to
3 AWS D1.1/D1.1M.

4 B. Pipe Welding Qualifications: Qualify procedures and operators according to 2015 ASME Boiler
5 and Pressure Vessel Code, Section IX.

6 PART 2 - PRODUCTS

7 2.1 PERFORMANCE REQUIREMENTS

8 A. Structural Performance: Hangers and supports for fire-suppression piping and equipment shall
9 withstand the effects of gravity loads and stresses within limits and under conditions indicated
10 according to ASCE/SEI 7.

- 11 1. Design supports for multiple pipes, including pipe stands, capable of supporting
12 combined weight of supported systems, system contents, and test water.
13 2. Design equipment supports capable of supporting combined operating weight of
14 supported equipment and connected systems and components.

15 B. NFPA Compliance: Comply with NFPA 13.

16 C. UL Compliance: Comply with UL 203.

17 2.2 METAL PIPE HANGERS AND SUPPORTS

18 A. Carbon-Steel Pipe Hangers and Supports:

- 19 1. Description: Factory-fabricated components, NFPA approved, UL listed, or FM approved
20 for fire-suppression piping support.
21 2. Galvanized Metallic Coatings: Pregalvanized or hot-dip galvanized.
22 3. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.

23 B. Copper Pipe and Tube Hangers:

- 24 1. Description: Copper-coated-steel, factory-fabricated components, NFPA approved, UL
25 listed, or FM approved for fire-suppression piping support.
26 2. Hanger Rods: Continuous-thread rod, nuts, and washer made of copper-coated steel or
27 stainless steel.

- 1 2.3 TRAPEZE PIPE HANGERS
- 2 A. Description: MSS SP-58, Type 59, shop- or field-fabricated pipe-support assembly, made from
3 structural-carbon-steel shapes, with NFPA-approved, UL-listed, or FM-approved carbon-steel
4 hanger rods, nuts, saddles, and U-bolts.
- 5 2.4 METAL FRAMING SYSTEMS
- 6 A. MFMA Manufacturer Metal Framing Systems:
- 7 1. Manufacturers: Subject to compliance with requirements, provide products by one of
8 the following:
- 9 a. B-line, an Eaton business.
10 b. Unistrut; Part of Atkore International.
- 11 2. Description: Shop- or field-fabricated pipe-support assembly, made of steel channels,
12 accessories, fittings, and other components for supporting multiple parallel pipes.
- 13 3. Standard: Comply with MFMA-4, factory-fabricated components for field assembly.
- 14 4. Channels: Continuous slotted carbon-steel channel with inturned lips.
- 15 5. Channel Width: Selected for applicable load criteria.
- 16 6. Channel Nuts: Formed or stamped nuts or other devices designed to fit into channel slot
17 and, when tightened, prevent slipping along channel.
- 18 7. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon-steel.
- 19 2.5 THERMAL HANGER-SHIELD INSERTS
- 20 A. Manufacturers: Subject to compliance with requirements, provide products by one of the
21 following:
- 22 1. ERICO International Corporation.
23 2. Pipe Shields Inc.
- 24 B. Insulation-Insert Material: Water-repellent-treated, ASTM C 533, Type I calcium silicate with
25 100-psi or ASTM C 552, Type II cellular glass with 100-psi minimum compressive strength.
- 26 C. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
- 27 D. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.

- 1 E. Insert Length: Extend 2 inches (50 mm) beyond sheet metal shield for piping operating below
2 ambient air temperature.

3 2.6 FASTENER SYSTEMS

- 4 A. Powder-Actuated Fasteners: NFPA-approved, UL-listed, or FM-approved threaded-steel stud,
5 for use in hardened portland cement concrete, with pull-out, tension, and shear capacities
6 appropriate for supported loads and building materials where used.

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

- 9 a. Hilti, Inc.
10 b. ITW Ramset/Red Head; Illinois Tool Works, Inc.

- 11 B. Mechanical-Expansion Anchors: NFPA-approved, UL-listed, or FM-approved, insert-wedge-type
12 anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear
13 capacities appropriate for supported loads and building materials where used.

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

- 16 a. B-line, an Eaton business.
17 b. Hilti, Inc.
18 c. ITW Ramset/Red Head; Illinois Tool Works, Inc.

- 19 2. Indoor Applications: Zinc-coated or stainless steel.

20 2.7 EQUIPMENT SUPPORTS

- 21 A. Description: NFPA-approved, UL-listed, or FM-approved, welded, shop- or field-fabricated
22 equipment support, made from structural-carbon-steel shapes.

23 2.8 MATERIALS

- 24 A. Aluminum: ASTM B 221 (ASTM B 221M).

- 25 B. Carbon Steel: ASTM A 1011/A 1011M.

- 26 C. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and
27 galvanized.

- 1 D. Stainless Steel: ASTM A 240/A 240M.
- 2 E. Grout: ASTM C 1107/C 1107M, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink
3 and nonmetallic grout, suitable for interior and exterior applications.
- 4 1. Properties: Nonstaining, noncorrosive, and nongaseous.
- 5 2. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.

6 PART 3 - EXECUTION

7 3.1 APPLICATION

- 8 A. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping
9 materials and installation, for penetrations through fire-rated walls, ceilings, and assemblies.
- 10 B. Strength of Support Assemblies: Where not indicated, select sizes of components, so strength
11 will be adequate to carry present and future static loads within specified loading limits.
12 Minimum static design load used for strength determination shall be weight of supported
13 components plus 200 lb.

14 3.2 HANGER AND SUPPORT INSTALLATION

- 15 A. Metal Pipe-Hanger Installation: Comply with installation requirements of approvals and
16 listings. Install hangers, supports, clamps, and attachments as required to properly support
17 piping from building structure.
- 18 B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-58. Arrange for grouping of
19 parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe
20 hangers.
 - 21 1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size, or
22 install intermediate supports for smaller-diameter pipes as specified for individual pipe
23 hangers.
 - 24 2. Field fabricate from ASTM A 36/A 36M carbon-steel shapes selected for loads being
25 supported. Weld steel according to AWS D1.1/D1.1M.
- 26 C. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support
27 together on field-assembled metal strut systems.
- 28 D. Thermal Hanger-Shield Installation: Install in pipe hanger or shield for insulated piping.

- 1 E. Fastener System Installation:
- 2 1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less
3 than 4 inches (100 mm) thick in concrete, after concrete is placed and completely cured.
4 Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners
5 according to powder-actuated tool manufacturer's operating manual. Install in
6 accordance with approvals and listings.
- 7 2. Install mechanical-expansion anchors in concrete, after concrete is placed and
8 completely cured. Install fasteners according to manufacturer's written instructions.
9 Install in accordance with approvals and listings.
- 10 F. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts,
11 washers, and other accessories.
- 12 G. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- 13 H. Install hangers and supports to allow controlled thermal and seismic movement of piping
14 systems, to permit freedom of movement between pipe anchors, and to facilitate action of
15 expansion joints, expansion loops, expansion bends, and similar units.
- 16 I. Install lateral bracing with pipe hangers and supports to prevent swaying.
- 17 J. Install building attachments within concrete slabs or attach to structural steel. Install
18 additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-
19 1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is
20 placed; fasten inserts to forms, and install reinforcing bars through openings at top of inserts.
- 21 K. Load Distribution: Install hangers and supports, so that piping live and dead loads and stresses
22 from movement will not be transmitted to connected equipment.
- 23 L. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed
24 maximum pipe deflections allowed by ASME B31.9 for building services piping.
- 25 3.3 EQUIPMENT SUPPORTS
- 26 A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support
27 equipment above floor.
- 28 B. Grouting: Place grout under supports for equipment, and make bearing surface smooth.
- 29 C. Provide lateral bracing, to prevent swaying, for equipment supports.

- 1 3.4 METAL FABRICATIONS
- 2 A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment
3 supports.
- 4 B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be
5 shop welded because of shipping size limitations.
- 6 C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding;
7 appearance and quality of welds; and methods used in correcting welding work; and with the
8 following:
- 9 1. Use materials and methods that minimize distortion and develop strength and corrosion
10 resistance of base metals.
- 11 2. Obtain fusion without undercut or overlap.
- 12 3. Remove welding flux immediately.
- 13 4. Finish welds at exposed connections, so no roughness shows after finishing and so
14 contours of welded surfaces match adjacent contours.
- 15 3.5 ADJUSTING
- 16 A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve
17 indicated slope of pipe.
- 18 B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.
- 19 3.6 PAINTING
- 20 A. Touchup: Clean field welds and abraded, shop-painted areas. Paint exposed areas immediately
21 after erecting hangers and supports. Use same materials as those used for shop painting.
22 Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
- 23 1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils (0.05
24 mm).
- 25 B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas, and apply
26 galvanizing-repair paint to comply with ASTM A 780/A 780M.

- 1 3.7 HANGER AND SUPPORT SCHEDULE
- 2 A. Specific hanger and support requirements are in Sections specifying piping systems and
3 equipment.
- 4 B. Comply with NFPA requirements for pipe-hanger selections and applications that are not
5 specified in piping system Sections.
- 6 C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will
7 not have field-applied finishes.
- 8 D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in
9 direct contact with copper tubing.
- 10 E. Use carbon-steel pipe hangers and supports, metal trapeze pipe hangers, and metal framing
11 systems and attachments for general service applications.
- 12 F. Use stainless-steel pipe hangers and stainless-steel or corrosion-resistant attachments for
13 hostile environment applications.
- 14 G. Use copper-plated pipe hangers and copper or stainless-steel attachments for copper piping
15 and tubing.
- 16 H. Horizontal-Piping Hangers and Supports: Comply with NFPA requirements. Unless otherwise
17 indicated and except as specified in piping system Sections, install the following types:
- 18 1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or
19 insulated, stationary pipes NPS 1/2 to NPS 30.
- 20 2. Steel Pipe Clamps (MSS Type 4): For suspension of NPS 1/2 to NPS 24 if little or no
21 insulation is required.
- 22 3. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated,
23 stationary pipes NPS 1/2 to NPS 8.
- 24 4. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of
25 noninsulated, stationary pipes NPS 3/8 to NPS 8.
- 26 5. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of
27 noninsulated, stationary pipes NPS 3/8 to NPS 3.
- 28 6. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.
- 29 7. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36, with steel-
30 pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
- 31 8. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36, with steel-
32 pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-
33 bolt to retain pipe.

- 1 9. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes
2 NPS 2-1/2 to NPS 36 if vertical adjustment is required, with steel-pipe base stanchion
3 support and cast-iron floor flange.
- 4 I. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system
5 Sections, install the following types:
- 6 1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to
7 NPS 24.
8 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to
9 NPS 24 if longer ends are required for riser clamps.
- 10 J. Hanger-Rod Attachments: Comply with NFPA requirements.
- 11 K. Building Attachments: Comply with NFPA requirements. Unless otherwise indicated and
12 except as specified in piping system Sections, install the following types:
- 13 1. Steel or Malleable-Concrete Inserts (MSS Type 18): For upper attachment to suspend
14 pipe hangers from concrete ceiling.
15 2. C-Clamps (MSS Type 23): For structural shapes.
16 3. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
- 17 L. Saddles and Shields: Comply with NFPA requirements. Unless otherwise indicated and except
18 as specified in piping system Sections, install the following types:
- 19 1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with
20 insulation that matches adjoining insulation.
21 2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer
22 to prevent crushing insulation.
23 3. Thermal Hanger-Shield Inserts: For supporting insulated pipe.
- 24 M. Comply with NFPA requirements for trapeze pipe-hanger selections and applications that are
25 not specified in piping system Sections.
- 26 N. Comply with MFMA-103 for metal framing system selections and applications that are not
27 specified in piping system Sections.
- 28 O. Use powder-actuated fasteners or mechanical-expansion anchors instead of building
29 attachments where required in concrete construction.

30 END OF SECTION 210529

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1 SECTION 210553 – IDENTIFICATION FOR FIRE-SUPPRESSION PIPING AND EQUIPMENT

2 PART 1 - GENERAL

3 1.1 RELATED DOCUMENTS

- 4
5 A. Drawings and general provisions of the Contract, including General and Supplementary
6 Conditions and Division 01 Specification Sections, apply to this Section.
7

8 1.2 SUMMARY

- 9 A. Section Includes:
10 1. Equipment labels.
11 2. Warning signs and labels.
12 3. Pipe labels.
13 4. Stencils.
14 5. Valve tags.
15 6. Warning tags.
16

17 1.3 ACTION SUBMITTALS

- 18 A. Product Data: For each type of product.
19 B. Samples: For color, letter style, and graphic representation required for each identification
20 material and device.
21 C. Equipment-Label Schedule: Include a listing of all equipment to be labeled and the proposed
22 content for each label.
23 D. Valve Schedules: Valve numbering scheme.
24

25 PART 2 - PRODUCTS

26 2.1 EQUIPMENT LABELS

- 27 A. Plastic Labels for Equipment:

- 1 1. Manufacturers: Subject to compliance with requirements, provide products by one of
2 the following:
- 3 a. Brady Corporation.
4 b. Brimar Industries, Inc.
5 c. Carlton Industries, LP.
6 d. Champion America.
7 e. Craftmark.
8 f. emedco.
9 g. Kolbi Pipe Marker Co.
10 h. LEM Products Inc.
11 i. Marking Services Inc.
12 j. Seton Identification Products.
- 13 2. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical
14 engraving, 1/8-inch thick, with predrilled holes for attachment hardware.
15 3. Letter Color: White.
16 4. Background Color: Black.
17 5. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
18 6. Minimum Label Size: Length and width vary for required label content, but not less than
19 2-1/2 by 3/4 inch.
20 7. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24
21 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger
22 lettering for greater viewing distances. Include secondary lettering two-thirds to three-
23 fourths the size of principal lettering.
24 8. Fasteners: Stainless-steel rivets or self-tapping screws.
25 9. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- 26 B. Label Content: Include equipment's Drawing designation or unique equipment number,
27 Drawing numbers where equipment is indicated (plans, details, and schedules), and the
28 Specification Section number and title where equipment is specified.
- 29 C. Equipment-Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch
30 bond paper. Tabulate equipment identification number and identify Drawing numbers where
31 equipment is indicated (plans, details, and schedules) and the Specification Section number
32 and title where equipment is specified. Equipment schedule shall be included in operation and
33 maintenance data.
- 34 2.2 WARNING SIGNS AND LABELS
- 35 A. Manufacturers: Subject to compliance with requirements, provide products by one of the
36 following:
- 37 1. Brady Corporation.
38 2. Brimar Industries, Inc.

- 1 3. Carlton Industries, LP.
- 2 4. Champion America.
- 3 5. Craftmark.
- 4 6. emedco.
- 5 7. LEM Products Inc.
- 6 8. Marking Services Inc.
- 7 9. National Marker Company.
- 8 10. Seton Identification Products.
- 9 11. Stranco, Inc.

- 10 B. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8-
- 11 inch thick, with predrilled holes for attachment hardware.
- 12 C. Letter Color: White.
- 13 D. Background Color: Red.
- 14 E. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
- 15 F. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2
- 16 by 3/4 inch.
- 17 G. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2
- 18 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater
- 19 viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal
- 20 lettering.
- 21 H. Fasteners: Stainless-steel rivets or self-tapping screws.
- 22 I. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- 23 J. Label Content: Include caution and warning information, plus emergency notification
- 24 instructions.
- 25
- 26 2.3 PIPE LABELS
- 27 A. Manufacturers: Subject to compliance with requirements, provide products by one of the
- 28 following:
- 29 1. ActionCraft Products, Inc.; a division of Industrial Test Equipment Co., Inc.
- 30 2. Brady Corporation.

- 1 3. Brimar Industries, Inc.
- 2 4. Carlton Industries, LP.
- 3 5. Champion America.
- 4 6. Craftmark.
- 5 7. emedco.
- 6 8. Kolbi Pipe Marker Co.
- 7 9. LEM Products Inc.
- 8 10. Marking Services Inc.
- 9 11. Seton Identification Products.

- 10 B. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering
11 indicating service and showing flow direction according to ASME A13.1.
- 12 C. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of
13 pipe and to attach to pipe without fasteners or adhesive.
- 14 D. Self-adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
- 15 E. Pipe-Label Contents: Include identification of piping service using same designations or
16 abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.
- 17 1. Flow-Direction Arrows: Integral with piping-system service lettering to accommodate
18 both directions or as separate unit on each pipe label to indicate flow direction.
- 19 2. Lettering Size: Size letters according to ASME A13.1 for piping.
- 20 F. Pipe-Label Colors:
- 21 1. Background Color: Safety Red.
- 22 2. Letter Color: White.

- 23
- 24 2.4 STENCILS
- 25 A. Stencils for Piping:
- 26 1. Manufacturers: Subject to compliance with requirements, provide products by one of
27 the following:
- 28 a. Brimar Industries, Inc.
- 29 b. Carlton Industries, LP.
- 30 c. Champion America.

- 1 d. Craftmark.
- 2 e. Kolbi Pipe Marker Co.
- 3 f. Marking Services Inc.

- 4 2. Lettering Size: Size letters according to ASME A13.1 for piping or at least 1/2 inch for
5 viewing distances up to 72 inches and proportionately larger lettering for greater
6 viewing distances.
- 7 3. Stencil Material: Fiberboard or metal.
- 8 4. Stencil Paint: Safety Red, exterior, gloss, acrylic enamel. Paint may be in pressurized
9 spray-can form.
- 10 5. Identification Paint: White, exterior, acrylic enamel. Paint may be in pressurized spray-
11 can form.
- 12
- 13 2.5 VALVE TAGS
- 14 A. Manufacturers: Subject to compliance with requirements, provide products by one of the
15 following:
- 16 1. ActionCraft Products, Inc.
- 17 2. Brady Corporation.
- 18 3. Brimar Industries, Inc.
- 19 4. Carlton Industries, LP.
- 20 5. Champion America.
- 21 6. Craftmark.
- 22 7. emedco.
- 23 8. Kolbi Pipe Marker Co.
- 24 9. LEM Products Inc.
- 25 10. Marking Services Inc.
- 26 11. Seton Identification Products.
- 27
- 28 B. Description: Stamped or engraved with 1/4-inch letters for piping-system abbreviation and
29 1/2-inch numbers.
- 30 1. Tag Material: Brass, 0.032-inch thick, with predrilled holes for attachment hardware.

- 1 2. Fasteners: Brass beaded chain or S-hook.
- 2 3. Valve-Tag Color: Safety Red.
- 3 4. Letter Color: White.

- 4 C. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve
5 number, piping system, system abbreviation (as shown on valve tag), location of valve (room
6 or space), normal-operating position (open, closed, or modulating), and variations for
7 identification. Mark valves for emergency shutoff and similar special uses.
 - 8 1. Valve-tag schedule shall be included in operation and maintenance data.

- 9
- 10 2.6 WARNING TAGS
- 11 A. Manufacturers: Subject to compliance with requirements, provide products by one of the
12 following:
 - 13 1. Brady Corporation.
 - 14 2. Brimar Industries, Inc.
 - 15 3. Carlton Industries, LP.
 - 16 4. Champion America.
 - 17 5. Craftmark.
 - 18 6. emedco.
 - 19 7. Kolbi Pipe Marker Co.
 - 20 8. LEM Products Inc.
 - 21 9. Marking Services Inc.
 - 22 10. Seton Identification Products.

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

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PART 3 - EXECUTION

3.1 PREPARATION

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

3.2 GENERAL INSTALLATION REQUIREMENTS

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

3.3 EQUIPMENT LABEL INSTALLATION

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

3.4 PIPE LABEL INSTALLATION

- A. Piping: Painting of piping is specified in Division 09 – Finishes.
- 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, on each piping system.
 - 1. Identification Paint: Use for contrasting background.
 - 2. Stencil Paint: Use for pipe marking.
- 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.

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

- 11 D. Directional Flow Arrows: Arrows shall be used to indicate direction of flow in pipes including
- 12 pipes where flow is allowed in both directions.

13

14 3.5 VALVE-TAG INSTALLATION

- 15 A. Install tags on valves and control devices in fire-suppression piping systems. List tagged valves
- 16 in a valve-tag schedule.
- 17 B. Valve-Tag Application Schedule: Tag valves according to size, shape, and with captions similar
- 18 to those indicated in "Valve-Tag Size and Shape" Subparagraph below:
- 19 1. Valve-Tag Size and Shape:
- 20 a. Fire-Suppression Standpipe: 2 inches round.
- 21 b. Wet-Pipe Sprinkler System: 2 inches round.

22

23 3.6 WARNING-TAG INSTALLATION

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

26 END OF SECTION 210553

1 SECTION 211119 – FIRE-DEPARTMENT CONNECTION

2 PART 1 - GENERAL

3 1.1 RELATED DOCUMENTS

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

6 1.2 SUMMARY

- 7 A. Section Includes:

- 8 1. Exposed-type fire-department connections.

9 1.3 ACTION SUBMITTALS

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

- 11 1. Include construction details, material descriptions, dimensions of individual components
12 and profiles, and finishes for each fire-department connection.

13 PART 2 - PRODUCTS

14 2.1 EXPOSED-TYPE FIRE-DEPARTMENT CONNECTION

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

- 17 1. American Fire Hose & Cabinet.
18 2. Elkhart Brass Mfg. Co., Inc.
19 3. Fire Protection Products, Inc.
20 4. Fire-End & Croker Corporation.
21 5. GMR International Equipment Corporation.
22 6. Guardian Fire Equipment, Inc.

- 23 B. Standard: UL 405.

- 24 C. Type: Exposed, projecting, for wall mounting.

- 1 D. Pressure Rating: 175 psig minimum.
- 2 E. Body Material: Corrosion-resistant metal.
- 3 F. Inlets: Brass with threads according to NFPA 1963 and matching local fire-department sizes
4 and threads. Include extension pipe nipples, brass lugged swivel connections, and check
5 devices or clappers.
- 6 G. Caps: Brass, lugged type, with gasket and chain.
- 7 H. Escutcheon Plate: Round, brass, floor type.
- 8 I. Outlet: Bottom, with pipe threads.
- 9 J. Number of Inlets: One.
- 10 K. Escutcheon Plate Marking: Similar to "AUTO SPKR & STANDPIPE."
- 11 L. Finish, Including Sleeve: Rough chrome plated.
- 12 M. Outlet Size: 6" NPT, 5" Storz.

13 PART 3 - EXECUTION

14 3.1 EXAMINATION

- 15 A. Examine conditions, with Installer present, for compliance with requirements for installation
16 tolerances and other conditions affecting performance of fire-department connections.
- 17 B. Examine roughing-in for fire-suppression standpipe system to verify actual locations of piping
18 connections before fire-department connection installation.
- 19 C. Proceed with installation only after unsatisfactory conditions have been corrected.

20 3.2 INSTALLATION

- 21 A. Install wall-type fire-department connections.
- 22 B. Install automatic (ball-drip) drain valve at each check valve for fire-department connection.

23 END OF SECTION 211119

1 SECTION 211313 - WET-PIPE SPRINKLER SYSTEMS

2 PART 1 - GENERAL

3 1.1 RELATED DOCUMENTS

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

6 1.2 SUMMARY

7 A. Section Includes:

- 8 1. Pipes, fittings, and specialties.
9 2. Fire-protection valves.
10 3. Sprinklers.
11 4. Alarm devices.
12 5. Manual control stations.
13 6. Control panels.
14 7. Pressure gages.

15 B. Related Sections:

- 16 1. Section 211119 "Fire-Department Connections" for exposed-fire-department
17 connections.

18 1.3 DEFINITIONS

- 19 A. Standard-Pressure Sprinkler Piping: Wet-pipe sprinkler system piping designed to operate at
20 working pressure of 175 psig maximum.

21 1.4 SYSTEM DESCRIPTIONS

- 22 A. Wet-Pipe Sprinkler System: Automatic sprinklers are attached to piping containing water and
23 that is connected to water supply through alarm valve. Water discharges immediately from
24 sprinklers when they are opened. Sprinklers open when heat melts fusible link or destroys
25 frangible device. Hose connections are included if indicated.

- 1 B. Deluge Sprinkler System: Open sprinklers are attached to piping connected to water supply
2 through deluge valve. Fire-detection system, in same area as sprinklers, opens valve. Water
3 flows into piping system and discharges from attached sprinklers when valve opens.
- 4 1.5 PERFORMANCE REQUIREMENTS
- 5 A. Sprinkler system equipment, specialties, accessories, installation, and testing shall comply with
6 the following:
- 7 1. NFPA 13.
- 8 B. Standard-Pressure Piping System Component: Listed for 175-psig minimum working pressure.
- 9 C. Delegated Design: Design sprinkler system(s), including comprehensive engineering analysis by
10 a qualified professional engineer, using performance requirements and design criteria
11 indicated.
- 12 D. Sprinkler system design shall be approved by authorities having jurisdiction.
- 13 1. Margin of Safety for Available Water Flow and Pressure: 5 percent, including losses
14 through water-service piping, valves, and backflow preventers.
- 15 2. Sprinkler Occupancy Hazard Classifications:
- 16 a. Building Service Areas: Ordinary Hazard, Group 1.
17 b. Electrical Equipment Rooms: Ordinary Hazard, Group 1.
18 c. General Storage Areas: Ordinary Hazard, Group 1.
19 d. Laundries: Ordinary Hazard, Group 1.
20 e. Mechanical Equipment Rooms: Ordinary Hazard, Group 1.
21 f. Office and Public Areas: Light Hazard.
- 22 3. Minimum Density for Automatic-Sprinkler Piping Design:
- 23 a. Light-Hazard Occupancy: 0.10 gpm over 1500-sq. ft. area.
24 b. Ordinary-Hazard, Group 1 Occupancy: 0.15 gpm over 1500-sq. ft. area.
25 c. Ordinary-Hazard, Group 2 Occupancy: 0.20 gpm over 1500-sq. ft. area.
26 d. Extra-Hazard, Group 1 Occupancy: 0.30 gpm over 2500-sq. ft. area.
27 e. Extra-Hazard, Group 2 Occupancy: 0.40 gpm over 2500-sq. ft. area.
28 f. Special Occupancy Hazard: As determined by authorities having jurisdiction.
- 29 4. Maximum Protection Area per Sprinkler: Per UL listing.
- 30 5. Maximum Protection Area per Sprinkler:
- 31 a. Office Spaces: 225 sq. ft.
32 b. Storage Areas: 130 sq. ft.
33 c. Mechanical Equipment Rooms: 130 sq. ft.

- 1 d. Electrical Equipment Rooms: 130 sq. ft.
- 2 e. Other Areas: According to NFPA 13 recommendations unless otherwise indicated.
- 3 6. Total Combined Hose-Stream Demand Requirement: According to NFPA 13 unless
- 4 otherwise indicated:
- 5 a. Light-Hazard Occupancies: 100 gpm for 30 minutes.
- 6 b. Ordinary-Hazard Occupancies: 250 gpm for 60 to 90 minutes.
- 7 c. Extra-Hazard Occupancies: 500 gpm for 90 to 120 minutes
- 8 1.6 SUBMITTALS
- 9 A. Product Data: For each type of product indicated. Include rated capacities, operating
- 10 characteristics, electrical characteristics, and furnished specialties and accessories.
- 11 B. Shop Drawings: For wet-pipe sprinkler systems. Include plans, elevations, sections, details, and
- 12 attachments to other work.
- 13 1. Wiring Diagrams: For power, signal, and control wiring.
- 14 C. Delegated-Design Submittal: For sprinkler systems indicated to comply with performance
- 15 requirements and design criteria, including analysis data signed and sealed by the qualified
- 16 professional engineer responsible for their preparation.
- 17 D. Coordination Drawings: Sprinkler systems, drawn to scale, on which the following items are
- 18 shown and coordinated with each other, using input from installers of the items involved:
- 19 1. Domestic water piping.
- 20 2. Natural Gas Piping.
- 21 3. HVAC Ductwork.
- 22 4. Items penetrating finished ceiling include the following:
- 23 a. Lighting fixtures.
- 24 b. Air outlets and inlets.
- 25 E. Qualification Data: For qualified Installer and professional engineer.
- 26 F. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, that have
- 27 been approved by authorities having jurisdiction, including hydraulic calculations if applicable.
- 28 G. Welding certificates.
- 29 H. Fire-hydrant flow test report.

- 1 I. Field Test Reports and Certificates: Indicate and interpret test results for compliance with
2 performance requirements and as described in NFPA 13. Include "Contractor's Material and
3 Test Certificate for Aboveground Piping."
- 4 J. Field quality-control reports.
- 5 K. Operation and Maintenance Data: For sprinkler specialties to include in emergency, operation,
6 and maintenance manuals.
- 7 1.7 QUALITY ASSURANCE
- 8 A. Installer Qualifications:
- 9 1. Installer's responsibilities include designing, fabricating, and installing sprinkler systems
10 and providing professional engineering services needed to assume engineering
11 responsibility. Base calculations on results of fire-hydrant flow test.
- 12 a. Engineering Responsibility: Preparation of working plans, calculations, and field
13 test reports by a qualified professional engineer.
- 14 B. Welding Qualifications: Qualify procedures and operators according to ASME Boiler and
15 Pressure Vessel Code.
- 16 C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by
17 a qualified testing agency, and marked for intended location and application.
- 18 D. NFPA Standards: Sprinkler system equipment, specialties, accessories, installation, and testing
19 shall comply with the following:
- 20 1. NFPA 13, "Installation of Sprinkler Systems."
21 2. NFPA 24, "Installation of Private Fire Service Mains and Their Appurtenances."
- 22 1.8 COORDINATION
- 23 A. Coordinate layout and installation of sprinklers with other construction that penetrates
24 ceilings, including light fixtures, HVAC equipment, and partition assemblies.
- 25 1.9 EXTRA MATERIALS
- 26 A. Furnish extra materials that match products installed and that are packaged with protective
27 covering for storage and identified with labels describing contents.

- 1 1. Sprinkler Cabinets: Finished, wall-mounted, steel cabinet with hinged cover, and with
2 space for minimum of six spare sprinklers plus sprinkler wrench. Include number of
3 sprinklers required by NFPA 13 and sprinkler wrench. Include separate cabinet with
4 sprinklers and wrench for each type of sprinkler used on Project.

5 PART 2 - PRODUCTS

6 2.1 PIPING MATERIALS

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

9

10

11 2.2 STEEL PIPE AND FITTINGS

- 12 A. Standard Weight, Galvanized and Black-Steel Pipe: ASTM A 53/A 53M, Type E, Grade B. Pipe
13 ends may be factory or field formed to match joining method.

- 14 B. Schedule 30, Galvanized and Black-Steel Pipe: ASTM A 135; ASTM A 795/A 795M, Type E; or
15 ASME B36.10M, wrought steel; with wall thickness not less than Schedule 30 and not more
16 than Schedule 40. Pipe ends may be factory or field formed to match joining method.

- 17 C. Thinwall Galvanized and Black-Steel Pipe: ASTM A 135 or ASTM A 795/A 795M, threadable,
18 with wall thickness less than Schedule 30 and equal to or greater than Schedule 10. Pipe ends
19 may be factory or field formed to match joining method.

- 20 D. Schedule 10, Black-Steel Pipe: ASTM A 135 or ASTM A 795/A 795M, Schedule 10 in NPS 5 and
21 smaller; and NFPA 13-specified wall thickness in NPS 6 to NPS 10, plain end.

- 22 E. Black Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M, standard-weight, seamless
23 steel pipe with threaded ends.

- 24 F. Galvanized and Uncoated, Steel Couplings: ASTM A 865, threaded.

- 25 G. Galvanized and Uncoated, Gray-Iron Threaded Fittings: ASME B16.4, Class 125, standard
26 pattern.

- 27 H. Malleable- or Ductile-Iron Unions: UL 860.

- 1 I. Cast-Iron Flanges: ASME 16.1, Class 125.
- 2 J. Steel Flanges and Flanged Fittings: ASME B16.5, Class 150.
- 3 K. Steel Welding Fittings: ASTM A 234/A 234M and ASME B16.9.
- 4 L. Grooved-Joint, Steel-Pipe Appurtenances:
- 5 1. Manufacturers: Subject to compliance with requirements, provide products by one of
- 6 the following:
- 7 a. Anvil International, Inc.
- 8 b. Corcoran Piping System Co.
- 9 c. National Fittings, Inc.
- 10 d. Shurjoint Piping Products.
- 11 e. Tyco Fire & Building Products LP.
- 12 f. Victaulic Company.
- 13 2. Pressure Rating: 175 psig minimum.
- 14 3. Galvanized and Uncoated, Grooved-End Fittings for Steel Piping: ASTM A 47/A 47M,
- 15 malleable-iron casting or ASTM A 536, ductile-iron casting; with dimensions matching
- 16 steel pipe.
- 17 4. Grooved-End-Pipe Couplings for Steel Piping: AWWA C606 and UL 213, rigid pattern,
- 18 unless otherwise indicated, for steel-pipe dimensions. Include ferrous housing sections,
- 19 EPDM-rubber gasket, and bolts and nuts.
- 20 M. Steel Pressure-Seal Fittings: UL 213, FM-approved, 175-psig pressure rating with steel housing,
- 21 rubber O-rings, and pipe stop; for use with fitting manufacturers' pressure-seal tools.
- 22 1. Manufacturers: Subject to compliance with requirements, provide products by one of
- 23 the following:
- 24 a. Victaulic Company.
- 25 2.3 COPPER TUBE AND FITTINGS
- 26 A. Hard Copper Tube: ASTM B 88, Type L water tube, drawn temper.
- 27 B. Cast-Copper, Solder-Joint Fittings: ASME B16.18, pressure fittings.
- 28 C. Wrought-Copper, Solder-Joint Fittings: ASME B16.22, pressure fittings.
- 29 D. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.

- 1 E. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket,
2 metal-to-metal seating surfaces, and solder-joint or threaded ends.
- 3 F. Copper Pressure-Seal Fittings:
- 4 1. Manufacturers: Subject to compliance with requirements, provide products by one of
5 the following:
- 6 a. Viega; Plumbing & Heating Systems.
- 7 2. Standard: UL 213.
- 8 3. NPS 2 and Smaller: Wrought-copper fitting with EPDM-rubber O-ring seal in each end.
- 9 4. NPS 2-1/2 to NPS 4: Cast-bronze fitting with EPDM-rubber O-ring seal in each end.
- 10 G. Grooved-Joint, Copper-Tube Appurtenances:
- 11 1. Manufacturers: Subject to compliance with requirements, provide products by one of
12 the following:
- 13 a. Anvil International, Inc.
- 14 b. Shurjoint Piping Products.
- 15 c. Victaulic Company.
- 16 2. Grooved-End, Copper Fittings: ASTM B 75, copper tube or ASTM B 584, bronze castings.
- 17 3. Grooved-End-Tube Couplings: To fit copper-tube dimensions, with design similar to
18 AWWA C606. Include ferrous housing sections, EPDM-rubber gasket suitable for hot
19 and cold water, and bolts and nuts.
- 20 2.4 PIPING JOINING MATERIALS
- 21 A. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch thick or ASME B16.21,
22 nonmetallic and asbestos free.
- 23 1. Class 125, Cast-Iron Flanges and Class 150, Bronze Flat-Face Flanges: Full-face gaskets.
- 24 2. Class 250, Cast-Iron Flanges and Class 300, Steel Raised-Face Flanges: Ring-type gaskets.
- 25 B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
- 26 C. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-
27 duty brazing unless otherwise indicated.
- 28 D. Welding Filler Metals: Comply with AWS D10.12M/D10.12 for welding materials appropriate
29 for wall thickness and chemical analysis of steel pipe being welded.

- 1 2.5 LISTED FIRE-PROTECTION VALVES
- 2 A. General Requirements:
- 3 1. Valves shall be UL listed or FM approved.
- 4 2. Minimum Pressure Rating for Standard-Pressure Piping: 175 psig.
- 5 B. Ball Valves:
- 6 1. Manufacturers: Subject to compliance with requirements, provide products by one of
- 7 the following:
- 8 a. Anvil International, Inc.
- 9 b. Victaulic Company.
- 10 2. Standard: UL 1091 except with ball instead of disc.
- 11 3. Valves NPS 1-1/2 and Smaller: Bronze body with threaded ends.
- 12 4. Valves NPS 2 and NPS 2-1/2: Bronze body with threaded ends or ductile-iron body with
- 13 grooved ends.
- 14 5. Valves NPS 3: Ductile-iron body with grooved ends.
- 15
- 16
- 17
- 18
- 19 C. Bronze Butterfly Valves:
- 20 1. Manufacturers: Subject to compliance with requirements, provide products by one of
- 21 the following:
- 22 a. Fivalco Inc.
- 23 b. Global Safety Products, Inc.
- 24 c. Milwaukee Valve Company.
- 25 2. Standard: UL 1091.
- 26 3. Pressure Rating: 175 psig.
- 27 4. Body Material: Bronze.
- 28 5. End Connections: Threaded.
- 29 D. Iron Butterfly Valves:
- 30 1. Manufacturers: Subject to compliance with requirements, provide products by one of
- 31 the following:

- 1 a. Anvil International, Inc.
- 2 b. Fivalco Inc.
- 3 c. Global Safety Products, Inc.
- 4 d. Kennedy Valve; a division of McWane, Inc.
- 5 e. Milwaukee Valve Company.
- 6 f. NIBCO INC.
- 7 g. Pratt, Henry Company.
- 8 h. Shurjoint Piping Products.
- 9 i. Tyco Fire & Building Products LP.
- 10 j. Victaulic Company.

- 11 2. Standard: UL 1091.
- 12 3. Pressure Rating: 175 psig.
- 13 4. Body Material: Cast or ductile iron.
- 14 5. Style: Lug or wafer.
- 15 6. End Connections: Grooved.

- 16 E. Check Valves:
 - 17 1. Manufacturers: Subject to compliance with requirements, provide products by one of
 - 18 the following:
 - 19 a. AFAC Inc.
 - 20 b. American Cast Iron Pipe Company; Waterous Company Subsidiary.
 - 21 c. Anvil International, Inc.
 - 22 d. Clow Valve Company; a division of McWane, Inc.
 - 23 e. Crane Co.; Crane Valve Group; Crane Valves.
 - 24 f. Crane Co.; Crane Valve Group; Jenkins Valves.
 - 25 g. Crane Co.; Crane Valve Group; Stockham Division.
 - 26 h. Fire-End & Croker Corporation.
 - 27 i. Fire Protection Products, Inc.
 - 28 j. Fivalco Inc.
 - 29 k. Globe Fire Sprinkler Corporation.
 - 30 l. Groeniger & Company.
 - 31 m. Kennedy Valve; a division of McWane, Inc.
 - 32 n. Matco-Norca.
 - 33 o. Metraflex, Inc.
 - 34 p. Milwaukee Valve Company.
 - 35 q. Mueller Co.; Water Products Division.
 - 36 r. NIBCO INC.
 - 37 s. Potter Roemer.
 - 38 t. Reliable Automatic Sprinkler Co., Inc.
 - 39 u. Shurjoint Piping Products.

- 1 v. Tyco Fire & Building Products LP.
- 2 w. United Brass Works, Inc.
- 3 x. Venus Fire Protection Ltd.
- 4 y. Victaulic Company.
- 5 z. Viking Corporation.
- 6 aa. Watts Water Technologies, Inc.

- 7 2. Standard: UL 312.
- 8 3. Pressure Rating: 250 psig minimum.
- 9 4. Type: Swing check.
- 10 5. Body Material: Cast iron.
- 11 6. End Connections: Flanged or grooved.

- 12 F. Bronze OS&Y Gate Valves:
 - 13 1. Manufacturers: Subject to compliance with requirements, provide products by one of
 - 14 the following:
 - 15 a. Crane Co.; Crane Valve Group; Crane Valves.
 - 16 b. Crane Co.; Crane Valve Group; Stockham Division.
 - 17 c. Milwaukee Valve Company.
 - 18 d. NIBCO INC.
 - 19 e. United Brass Works, Inc.
 - 20 2. Standard: UL 262.
 - 21 3. Pressure Rating: 175 psig.
 - 22 4. Body Material: Bronze.
 - 23 5. End Connections: Threaded.

- 24 G. Iron OS&Y Gate Valves:
 - 25 1. Manufacturers: Subject to compliance with requirements, provide products by one of
 - 26 the following:
 - 27 a. American Cast Iron Pipe Company; Waterous Company Subsidiary.
 - 28 b. American Valve, Inc.
 - 29 c. Clow Valve Company; a division of McWane, Inc.
 - 30 d. Crane Co.; Crane Valve Group; Crane Valves.
 - 31 e. Crane Co.; Crane Valve Group; Jenkins Valves.
 - 32 f. Crane Co.; Crane Valve Group; Stockham Division.
 - 33 g. Hammond Valve.
 - 34 h. Milwaukee Valve Company.
 - 35 i. Mueller Co.; Water Products Division.

- 1 j. NIBCO INC.
- 2 k. Shurjoint Piping Products.
- 3 l. Tyco Fire & Building Products LP.
- 4 m. United Brass Works, Inc.
- 5 n. Watts Water Technologies, Inc.

- 6 2. Standard: UL 262.
- 7 3. Pressure Rating: 250 psig minimum.
- 8 4. Body Material: Cast or ductile iron.
- 9 5. End Connections: Flanged or grooved.

- 10 H. Indicating-Type Butterfly Valves:

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

- 13 a. Anvil International, Inc.
- 14 b. Fivalco Inc.
- 15 c. Global Safety Products, Inc.
- 16 d. Kennedy Valve; a division of McWane, Inc.
- 17 e. Milwaukee Valve Company.
- 18 f. NIBCO INC.
- 19 g. Shurjoint Piping Products.
- 20 h. Tyco Fire & Building Products LP.
- 21 i. Victaulic Company.

- 22 2. Standard: UL 1091.
- 23 3. Pressure Rating: 175 psig minimum.
- 24 4. Valves NPS 2 and Smaller:

- 25 a. Valve Type: Ball or butterfly.
- 26 b. Body Material: Bronze.
- 27 c. End Connections: Threaded.

- 28 5. Valves NPS 2-1/2 and Larger:

- 29 a. Valve Type: Butterfly.
- 30 b. Body Material: Cast or ductile iron.
- 31 c. End Connections: Flanged, grooved, or wafer.

- 32 6. Valve Operation: Integral electrical, 115-V ac, prewired, two-circuit, supervisory switch
- 33 and visual indicating device.

- 1 I. NRS Gate Valves:
- 2 1. Manufacturers: Subject to compliance with requirements, provide products by one of
3 the following:
- 4 a. American Cast Iron Pipe Company; Waterous Company Subsidiary.
5 b. American Valve, Inc.
6 c. Clow Valve Company; a division of McWane, Inc.
7 d. Crane Co.; Crane Valve Group; Stockham Division.
8 e. Kennedy Valve; a division of McWane, Inc.
9 f. Mueller Co.; Water Products Division.
10 g. NIBCO INC.
11 h. Tyco Fire & Building Products LP.
- 12 2. Standard: UL 262.
13 3. Pressure Rating: 250 psig minimum.
14 4. Body Material: Cast iron with indicator post flange.
15 5. Stem: Nonrising.
16 6. End Connections: Flanged or grooved.
- 17 J. Indicator Posts:
- 18 1. Manufacturers: Subject to compliance with requirements, provide products by one of
19 the following:
- 20 a. American Cast Iron Pipe Company; Waterous Company Subsidiary.
21 b. American Valve, Inc.
22 c. Clow Valve Company; a division of McWane, Inc.
23 d. Crane Co.; Crane Valve Group; Stockham Division.
24 e. Kennedy Valve; a division of McWane, Inc.
25 f. Mueller Co.; Water Products Division.
26 g. NIBCO INC.
27 h. Tyco Fire & Building Products LP.
- 28 2. Standard: UL 789 and FM Global standard for indicator posts.
29 3. Type: Underground.
30 4. Base Barrel Material: Cast or ductile iron.
31 5. Extension Barrel: Cast or ductile iron with extension rod and locking device.
32 6. Cap: Cast or ductile iron.
33 7. Operation: Wrench.

34 2.6 TRIM AND DRAIN VALVES

- 1 A. General Requirements:
- 2 1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide,"
- 3 published by FM Global, listing.
- 4 2. Pressure Rating: 175 psig minimum.
- 5 B. Angle Valves:
- 6 1. Manufacturers: Subject to compliance with requirements, provide products by one of
- 7 the following:
- 8 a. Fire Protection Products, Inc.
- 9 b. United Brass Works, Inc.
- 10 C. Ball Valves:
- 11 1. Manufacturers: Subject to compliance with requirements, provide products by one of
- 12 the following:
- 13 a. Affiliated Distributors.
- 14 b. Anvil International, Inc.
- 15 c. Conbraco Industries, Inc.; Apollo Valves.
- 16 d. Fire-End & Croker Corporation.
- 17 e. Fire Protection Products, Inc.
- 18 f. Flowserve.
- 19 g. FNW.
- 20 h. Jomar International, Ltd.
- 21 i. Kennedy Valve; a division of McWane, Inc.
- 22 j. Kitz Corporation.
- 23 k. Legend Valve.
- 24 l. Metso Automation USA Inc.
- 25 m. Milwaukee Valve Company.
- 26 n. NIBCO INC.
- 27 o. Potter Roemer.
- 28 p. Red-White Valve Corporation.
- 29 q. Southern Manufacturing Group.
- 30 r. Stewart, M. A. and Sons Ltd.
- 31 s. Tyco Fire & Building Products LP.
- 32 t. Victaulic Company.
- 33 u. Watts Water Technologies, Inc.
- 34 D. Globe Valves:

- 1 1. Manufacturers: Subject to compliance with requirements, provide products by one of
2 the following:
- 3 a. Fire Protection Products, Inc.
4 b. United Brass Works, Inc.
- 5 E. Plug Valves:
- 6 1. Manufacturers: Subject to compliance with requirements, provide products by one of
7 the following:
- 8 a. Southern Manufacturing Group.
- 9 2.7 SPECIALTY VALVES
- 10 A. General Requirements:
- 11 1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide,"
12 published by FM Global, listing.
13 2. Pressure Rating:
- 14 a. Standard-Pressure Piping Specialty Valves: 175 psig minimum.
- 15 3. Body Material: Cast or ductile iron.
16 4. Size: Same as connected piping.
17 5. End Connections: Flanged or grooved.
- 18 B. Alarm Valves:
- 19 1. Manufacturers: Subject to compliance with requirements, provide products by one of
20 the following:
- 21 a. AFAC Inc.
22 b. Globe Fire Sprinkler Corporation.
23 c. Reliable Automatic Sprinkler Co., Inc.
24 d. Tyco Fire & Building Products LP.
25 e. Venus Fire Protection Ltd.
26 f. Victaulic Company.
27 g. Viking Corporation.
- 28 2. Standard: UL 193.
29 3. Design: For horizontal or vertical installation.

- 1 4. Include trim sets for bypass, drain, electrical sprinkler alarm switch, pressure gages, and
2 fill-line attachment with strainer.
- 3 C. Automatic (Ball Drip) Drain Valves:
- 4 1. Manufacturers: Subject to compliance with requirements, provide products by one of
5 the following:
- 6 a. AFAC Inc.
7 b. Reliable Automatic Sprinkler Co., Inc.
8 c. Tyco Fire & Building Products LP.
- 9 2. Standard: UL 1726.
10 3. Pressure Rating: 175 psig minimum.
11 4. Type: Automatic draining, ball check.
12 5. Size: NPS 3/4.
13 6. End Connections: Threaded.
14
- 15 2.8 SPRINKLER SPECIALTY PIPE FITTINGS
- 16 A. Branch Outlet Fittings:
- 17 1. Manufacturers: Subject to compliance with requirements, provide products by one of
18 the following:
- 19 a. Anvil International, Inc.
20 b. National Fittings, Inc.
21 c. Shurjoint Piping Products.
22 d. Tyco Fire & Building Products LP.
23 e. Victaulic Company.
- 24 2. Standard: UL 213.
25 3. Pressure Rating: 175 psig minimum.
26 4. Body Material: Ductile-iron housing with EPDM seals and bolts and nuts.
27 5. Type: Mechanical-T and -cross fittings.
28 6. Configurations: Snap-on and strapless, ductile-iron housing with branch outlets.
29 7. Size: Of dimension to fit onto sprinkler main and with outlet connections as required to
30 match connected branch piping.
31 8. Branch Outlets: Grooved, plain-end pipe, or threaded.
- 32 B. Flow Detection and Test Assemblies:

- 1 1. Manufacturers: Subject to compliance with requirements, provide products by one of
2 the following:
 - 3 a. AGF Manufacturing Inc.
 - 4 b. Reliable Automatic Sprinkler Co., Inc.
 - 5 c. Tyco Fire & Building Products LP.
 - 6 d. Victaulic Company.

- 7 2. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide,"
8 published by FM Global, listing.
- 9 3. Pressure Rating: 175 psig minimum.
- 10 4. Body Material: Cast- or ductile-iron housing with orifice, sight glass, and integral test
11 valve.
- 12 5. Size: Same as connected piping.
- 13 6. Inlet and Outlet: Threaded.

- 14 C. Branch Line Testers:
 - 15 1. Manufacturers: Subject to compliance with requirements, provide products by one of
16 the following:
 - 17 a. Elkhart Brass Mfg. Company, Inc.
 - 18 b. Fire-End & Croker Corporation.
 - 19 c. Potter Roemer.

 - 20 2. Standard: UL 199.
 - 21 3. Pressure Rating: 175 psig.
 - 22 4. Body Material: Brass.
 - 23 5. Size: Same as connected piping.
 - 24 6. Inlet: Threaded.
 - 25 7. Drain Outlet: Threaded and capped.
 - 26 8. Branch Outlet: Threaded, for sprinkler.

- 27 D. Sprinkler Inspector's Test Fittings:
 - 28 1. Manufacturers: Subject to compliance with requirements, provide products by one of
29 the following:
 - 30 a. AGF Manufacturing Inc.
 - 31 b. Triple R Specialty.
 - 32 c. Tyco Fire & Building Products LP.
 - 33 d. Victaulic Company.
 - 34 e. Viking Corporation.

- 1 2. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide,"
- 2 published by FM Global, listing.
- 3 3. Pressure Rating: 175 psig minimum.
- 4 4. Body Material: Cast- or ductile-iron housing with sight glass.
- 5 5. Size: Same as connected piping.
- 6 6. Inlet and Outlet: Threaded.

- 7 E. Adjustable Drop Nipples:

- 8 1. Manufacturers: Subject to compliance with requirements, provide products by one of
- 9 the following:
- 10 a. CECA, LLC.
- 11 b. Corcoran Piping System Co.
- 12 c. Merit Manufacturing; a division of Anvil International, Inc.

- 13 2. Standard: UL 1474.
- 14 3. Pressure Rating: 250 psig minimum.
- 15 4. Body Material: Steel pipe with EPDM-rubber O-ring seals.
- 16 5. Size: Same as connected piping.
- 17 6. Length: Adjustable.
- 18 7. Inlet and Outlet: Threaded.
- 19

- 20 F. Flexible, Sprinkler Hose Fittings:

- 21 1. Manufacturers: Subject to compliance with requirements, provide products by one of
- 22 the following:
- 23 a. Fivalco Inc.
- 24 b. FlexHead Industries, Inc.
- 25 c. Gateway Tubing, Inc.

- 26 2. Standard: UL 1474.
- 27 3. Type: Flexible hose for connection to sprinkler, and with bracket for connection to
- 28 ceiling grid.
- 29 4. Pressure Rating: 175 psig minimum.
- 30 5. Size: Same as connected piping, for sprinkler.

- 31 2.9 SPRINKLERS

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

- 1 1. AFAC Inc.
- 2 2. Globe Fire Sprinkler Corporation.
- 3 3. Reliable Automatic Sprinkler Co., Inc.
- 4 4. Tyco Fire & Building Products LP.
- 5 5. Venus Fire Protection Ltd.
- 6 6. Victaulic Company.
- 7 7. Viking Corporation.

- 8 B. General Requirements:
 - 9 1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide,"
 - 10 published by FM Global, listing.
 - 11 2. Pressure Rating for Residential Sprinklers: 175 psig maximum.
 - 12 3. Pressure Rating for Automatic Sprinklers: 175 psig minimum.

- 13 C. Automatic Sprinklers with Heat-Responsive Element:
 - 14 1. Early-Suppression, Fast-Response Applications: UL 1767.
 - 15 2. Nonresidential Applications: UL 199.
 - 16 3. Residential Applications: UL 1626.
 - 17 4. Characteristics: Nominal 1/2-inch orifice with Discharge Coefficient K of 5.6, and for
 - 18 "Ordinary" temperature classification rating unless otherwise indicated or required by
 - 19 application.

- 20 D. Sprinkler Finishes:
 - 21 1. White.

- 22 E. Sprinkler Escutcheons: Materials, types, and finishes for the following sprinkler mounting
- 23 applications. Escutcheons for concealed, flush, and recessed-type sprinklers are specified with
- 24 sprinklers.
 - 25 1. Ceiling Mounting: White finish, one piece, flat.
 - 26 2. Sidewall Mounting: White finish, one piece, flat.

- 27 F. Sprinkler Guards:
 - 28 1. Manufacturers: Subject to compliance with requirements, provide products by one of
 - 29 the following:
 - 30 a. Reliable Automatic Sprinkler Co., Inc.
 - 31 b. Tyco Fire & Building Products LP.
 - 32 c. Victaulic Company.
 - 33 d. Viking Corporation.

- 1 2. Standard: UL 199.
- 2 3. Type: Wire cage with fastening device for attaching to sprinkler.

3 2.10 ALARM DEVICES

4 A. Alarm-device types shall match piping and equipment connections.

5 B. Water-Motor-Operated Alarm:

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

- 8 a. Globe Fire Sprinkler Corporation.
- 9 b. Tyco Fire & Building Products LP.
- 10 c. Victaulic Company.
- 11 d. Viking Corporation.

12 2. Standard: UL 753.

13 3. Type: Mechanically operated, with Pelton wheel.

14 4. Alarm Gong: Cast aluminum with red-enamel factory finish.

15 5. Size: 10-inch diameter.

16 6. Components: Shaft length, bearings, and sleeve to suit wall construction.

17 7. Inlet: NPS 3/4.

18 8. Outlet: NPS 1 drain connection.

19 C. Electrically Operated Alarm Bell:

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

- 22 a. Fire-Lite Alarms, Inc.; a Honeywell company.
- 23 b. Notifier; a Honeywell company.
- 24 c. Potter Electric Signal Company.

25 2. Standard: UL 464.

26 3. Type: Vibrating, metal alarm bell.

27 4. Size: 10-inch diameter.

28 5. Finish: Red-enamel factory finish, suitable for outdoor use.

29 D. Water-Flow Indicators:

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

- 1 a. ADT Security Services, Inc.
- 2 b. McDonnell & Miller; ITT Industries.
- 3 c. Potter Electric Signal Company.
- 4 d. System Sensor; a Honeywell company.
- 5 e. Viking Corporation.
- 6 f. Watts Industries (Canada) Inc.

- 7 2. Standard: UL 346.
- 8 3. Water-Flow Detector: Electrically supervised.
- 9 4. Components: Two single-pole, double-throw circuit switches for isolated alarm and
- 10 auxiliary contacts, 7 A, 125-V ac and 0.25 A, 24-V dc; complete with factory-set, field-
- 11 adjustable retard element to prevent false signals and tamperproof cover that sends
- 12 signal if removed.
- 13 5. Type: Paddle operated.
- 14 6. Pressure Rating: 250 psig.
- 15 7. Design Installation: Horizontal or vertical.

- 16 E. Pressure Switches:

- 17 1. Manufacturers: Subject to compliance with requirements, provide products by one of
- 18 the following:
- 19 a. AFAC Inc.
- 20 b. Barksdale, Inc.
- 21 c. Detroit Switch, Inc.
- 22 d. Potter Electric Signal Company.
- 23 e. System Sensor; a Honeywell company.
- 24 f. Tyco Fire & Building Products LP.
- 25 g. United Electric Controls Co.
- 26 h. Viking Corporation.

- 27 2. Standard: UL 346.
- 28 3. Type: Electrically supervised water-flow switch with retard feature.
- 29 4. Components: Single-pole, double-throw switch with normally closed contacts.
- 30 5. Design Operation: Rising pressure signals water flow.

- 31 F. Valve Supervisory Switches:

- 32 1. Manufacturers: Subject to compliance with requirements, provide products by one of
- 33 the following:
- 34 a. Fire-Lite Alarms, Inc.; a Honeywell company.
- 35 b. Kennedy Valve; a division of McWane, Inc.

- 1 c. Potter Electric Signal Company.
- 2 d. System Sensor; a Honeywell company.
- 3 2. Standard: UL 346.
- 4 3. Type: Electrically supervised.
- 5 4. Components: Single-pole, double-throw switch with normally closed contacts.
- 6 5. Design: Signals that controlled valve is in other than fully open position.
- 7 G. Indicator-Post Supervisory Switches:
- 8 1. Manufacturers: Subject to compliance with requirements, provide products by one of
- 9 the following:
- 10 a. Potter Electric Signal Company.
- 11 b. System Sensor; a Honeywell company.
- 12 2. Standard: UL 346.
- 13 3. Type: Electrically supervised.
- 14 4. Components: Single-pole, double-throw switch with normally closed contacts.
- 15 5. Design: Signals that controlled indicator-post valve is in other than fully open position.
- 16 2.11 MANUAL CONTROL STATIONS
- 17 A. Description: UL listed or FM approved, hydraulic operation, with union, NPS 1/2 pipe nipple,
- 18 and bronze ball valve. Include metal enclosure labeled "MANUAL CONTROL STATION" with
- 19 operating instructions and cover held closed by breakable strut to prevent accidental opening.
- 20 2.12 PRESSURE GAGES
- 21 A. Manufacturers: Subject to compliance with requirements, provide products by one of the
- 22 following:
- 23 1. AMETEK; U.S. Gauge Division.
- 24 2. Ashcroft, Inc.
- 25 3. Brecco Corporation.
- 26 4. WIKA Instrument Corporation.
- 27 B. Standard: UL 393.
- 28 C. Dial Size: 3-1/2- to 4-1/2-inch diameter.
- 29 D. Pressure Gage Range: 0 to 250 psig minimum.

1 E. Water System Piping Gage: Include "WATER" label on dial face.

2

3 PART 3 - EXECUTION

4 3.1 PREPARATION

5 A. Perform fire-hydrant flow test according to NFPA 13 and NFPA 291. Use results for system
6 design calculations required in "Quality Assurance" Article.

7 B. Report test results promptly and in writing.

8 3.2 SERVICE-ENTRANCE PIPING

9 A. Connect sprinkler piping to water-service piping for service entrance to building. Comply with
10 requirements for exterior piping in Section 211100 "Facility Fire-Suppression Water-Service
11 Piping."

12 B. Install shutoff valve, backflow preventer, pressure gage, drain, and other accessories indicated
13 at connection to water-service piping.

14 C. Install shutoff valve, check valve, pressure gage, and drain at connection to water service.

15 3.3 WATER-SUPPLY CONNECTIONS

16 A. Connect sprinkler piping to building's interior water-distribution piping. Comply with
17 requirements for interior piping in Section 221116 "Domestic Water Piping."

18 B. Install shutoff valve, backflow preventer, pressure gage, drain, and other accessories indicated
19 at connection to water-distribution piping.

20 C. Install shutoff valve, check valve, pressure gage, and drain at connection to water supply.

21 3.4 PIPING INSTALLATION

22 A. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general
23 location and arrangement of piping. Install piping as indicated, as far as practical.

- 1 1. Deviations from approved working plans for piping require written approval from
2 authorities having jurisdiction. File written approval with Architect before deviating
3 from approved working plans.

- 4 B. Piping Standard: Comply with requirements for installation of sprinkler piping in NFPA 13.

- 5 C. Install seismic restraints on piping. Comply with requirements for seismic-restraint device
6 materials and installation in NFPA 13.

- 7 D. Use listed fittings to make changes in direction, branch takeoffs from mains, and reductions in
8 pipe sizes.

- 9 E. Install unions adjacent to each valve in pipes NPS 2 and smaller.

- 10 F. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and
11 equipment having NPS 2-1/2 and larger end connections.

- 12 G. Install "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve,
13 and sized and located according to NFPA 13.

- 14 H. Install sprinkler piping with drains for complete system drainage.

- 15 I. Install sprinkler control valves, test assemblies, and drain risers adjacent to standpipes when
16 sprinkler piping is connected to standpipes.

- 17 J. Install automatic (ball drip) drain valve at each check valve for fire-department connection, to
18 drain piping between fire-department connection and check valve. Install drain piping to and
19 spill over floor drain or to outside building.

- 20 K. Install alarm devices in piping systems.

- 21 L. Install hangers and supports for sprinkler system piping according to NFPA 13. Comply with
22 requirements for hanger materials in NFPA 13.

- 23 M. Install pressure gages on riser or feed main, at each sprinkler test connection, and at top of
24 each standpipe. Include pressure gages with connection not less than NPS 1/4 and with soft
25 metal seated globe valve, arranged for draining pipe between gage and valve. Install gages to
26 permit removal, and install where they will not be subject to freezing.

- 27 N. Fill sprinkler system piping with water.

- 28 O. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements
29 for sleeves specified in Section 210517 "Sleeves and Sleeve Seals for Fire-Suppression Piping."

- 1 P. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with
2 requirements for sleeve seals specified in Section 210517 "Sleeves and Sleeve Seals for Fire-
3 Suppression Piping."
- 4 Q. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with
5 requirements for escutcheons specified in Section 210518 "Escutcheons for Fire-Suppression
6 Piping."
- 7 3.5 JOINT CONSTRUCTION
- 8 A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings
9 that have finish and pressure ratings same as or higher than system's pressure rating for
10 aboveground applications unless otherwise indicated.
- 11 B. Install unions adjacent to each valve in pipes NPS 2 and smaller.
- 12 C. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and
13 equipment having NPS 2-1/2 and larger end connections.
- 14 D. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- 15 E. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before
16 assembly.
- 17 F. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for
18 water service. Join flanges with gasket and bolts according to ASME B31.9.
- 19 G. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut
20 threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore
21 full ID. Join pipe fittings and valves as follows:
- 22 1. Apply appropriate tape or thread compound to external pipe threads.
23 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or
24 damaged.
- 25 H. Twist-Locked Joints: Insert plain end of steel pipe into plain-end-pipe fitting. Rotate retainer
26 lugs one-quarter turn or tighten retainer pin.
- 27 I. Steel-Piping, Pressure-Sealed Joints: Join lightwall steel pipe and steel pressure-seal fittings
28 with tools recommended by fitting manufacturer.
- 29 J. Welded Joints: Construct joints according to AWS D10.12M/D10.12, using qualified processes
30 and welding operators according to "Quality Assurance" Article.

- 1 1. Shop weld pipe joints where welded piping is indicated. Do not use welded joints for
2 galvanized-steel pipe.
- 3 K. Steel-Piping, Roll-Grooved Joints: Roll rounded-edge groove in end of pipe according to
4 AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and
5 grooved-end fittings according to AWWA C606 for steel-pipe grooved joints.
- 6 L. Steel-Piping, Pressure-Sealed Joints: Join Schedule 5 steel pipe and steel pressure-seal fittings
7 with tools recommended by fitting manufacturer.
- 8 M. Braze Joints: Join copper tube and fittings according to CDA's "Copper Tube Handbook,"
9 "Braze Joints" Chapter.
- 10 N. Copper-Tubing Grooved Joints: Roll rounded-edge groove in end of tube according to
11 AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join copper tube
12 and grooved-end fittings according to AWWA C606 for steel-pipe grooved joints.
- 13 O. Copper-Tubing, Pressure-Sealed Joints: Join copper tube and copper pressure-seal fittings with
14 tools recommended by fitting manufacturer.
- 15 P. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both
16 piping systems.

17 3.6 VALVE AND SPECIALTIES INSTALLATION

- 18 A. Install listed fire-protection valves, trim and drain valves, specialty valves and trim, controls,
19 and specialties according to NFPA 13 and authorities having jurisdiction.
- 20 B. Install listed fire-protection shutoff valves supervised open, located to control sources of water
21 supply except from fire-department connections. Install permanent identification signs
22 indicating portion of system controlled by each valve.
- 23 C. Install check valve in each water-supply connection. Install backflow preventers instead of
24 check valves in potable-water-supply sources.
- 25 D. Specialty Valves:
- 26 1. General Requirements: Install in vertical position for proper direction of flow, in main
27 supply to system.
- 28 2. Alarm Valves: Include bypass check valve and retarding chamber drain-line connection.

29 3.7 SPRINKLER INSTALLATION

- 1 A. Install sprinklers in suspended ceilings in center of narrow dimension of acoustical ceiling
2 panels.
- 3 B. Install sprinklers into flexible, sprinkler hose fittings and install hose into bracket on ceiling
4 grid.
- 5 3.8 IDENTIFICATION
- 6 A. Install labeling and pipe markers on equipment and piping according to requirements in
7 NFPA 13.
- 8 B. Identify system components, wiring, cabling, and terminals. Comply with requirements for
9 identification specified in Section 260553 "Identification for Electrical Systems."
- 10 3.9 FIELD QUALITY CONTROL
- 11 A. Perform tests and inspections.
- 12 B. Tests and Inspections:
- 13 1. Leak Test: After installation, charge systems and test for leaks. Repair leaks and retest
14 until no leaks exist.
- 15 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and
16 equipment.
- 17 3. Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance"
18 Chapter.
- 19 4. Energize circuits to electrical equipment and devices.
- 20 5. Coordinate with fire-alarm tests. Operate as required.
- 21 6. Verify that equipment hose threads are same as local fire-department equipment.
- 22 C. Sprinkler piping system will be considered defective if it does not pass tests and inspections.
- 23 D. Prepare test and inspection reports.
- 24 3.10 CLEANING
- 25 A. Clean dirt and debris from sprinklers.
- 26 B. Remove and replace sprinklers with paint other than factory finish.

- 1 3.11 DEMONSTRATION
- 2 A. Train Owner's maintenance personnel to adjust, operate, and maintain specialty valves.
- 3 3.12 PIPING SCHEDULE
- 4 A. Piping between Fire-Department Connections and Check Valves: Galvanized, standard-weight
5 steel pipe with grooved ends; grooved-end fittings; grooved-end-pipe couplings; and grooved
6 joints.
- 7 B. Sprinkler specialty fittings may be used, downstream of control valves, instead of specified
8 fittings.
- 9 C. Standard-pressure, wet-pipe sprinkler system, NPS 2 and smaller, shall be one of the following:
- 10 1. Standard-weight, black-steel pipe with threaded ends; uncoated, gray-iron threaded
11 fittings; and threaded joints.
- 12 2. Standard-weight, galvanized-steel pipe with threaded ends; galvanized, gray-iron
13 threaded fittings; and threaded joints.
- 14 3. Standard-weight, black-steel pipe with plain ends; uncoated, plain-end-pipe fittings; and
15 twist-locked joints.
- 16 4. Standard-weight, galvanized-steel pipe with plain ends; galvanized, plain-end-pipe
17 fittings; and twist-locked joints.
- 18 5. Standard-weight, black-steel pipe with roll-grooved ends; uncoated, grooved-end
19 fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
- 20 6. Standard-weight, black-steel pipe with plain ends; steel welding fittings; and welded
21 joints.
- 22 7. Type L, hard copper tube with plain ends; wrought-copper solder-joint fittings; and
23 brazed joints.
- 24 8. Type L, hard copper tube with plain ends; copper pressure-seal fittings; and pressure-
25 sealed joints.
- 26 9. NPS 2, Type L, hard copper tube with roll-grooved ends; copper, grooved-end fittings;
27 grooved-end-tube couplings; and grooved joints.
- 28 D. Standard-pressure, wet-pipe sprinkler system, NPS 2-1/2 to NPS 4, shall be one of the
29 following:
- 30 1. Standard-weight or Schedule 30, black-steel pipe with threaded ends; uncoated, gray-
31 iron threaded fittings; and threaded joints.
- 32 2. Standard-weight or Schedule 30, galvanized-steel pipe with threaded ends; galvanized,
33 gray-iron threaded fittings; and threaded joints.

- 1 3. Standard-weight or Schedule 30, black-steel pipe with roll-grooved ends; uncoated,
2 grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and
3 grooved joints.
- 4 4. Standard-weight or Schedule 30, black-steel pipe with plain ends; steel welding fittings;
5 and welded joints.
- 6 5. Thinwall Schedule 10, nonstandard OD, thinwall or hybrid black-steel pipe with roll-
7 grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe
8 couplings for steel piping; and grooved joints.
- 9 6. Schedule 10, black-steel pipe with plain ends; welding fittings; and welded joints.

- 10 E. Standard-pressure, wet-pipe sprinkler system, NPS 5 and larger, shall be one of the following:
 - 11 1. Standard-weight or Schedule 30, black-steel pipe with threaded ends; uncoated, gray-
12 iron threaded fittings; and threaded joints.
 - 13 2. Standard-weight or Schedule 30, galvanized-steel pipe with threaded ends; galvanized,
14 gray-iron threaded fittings; and threaded joints.
 - 15 3. Standard-weight or Schedule 30, black-steel pipe with roll-grooved ends; uncoated,
16 grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and
17 grooved joints.
 - 18 4. Standard-weight or Schedule 30, galvanized-steel pipe with cut-grooved ends;
19 galvanized, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel
20 piping; and grooved joints.
 - 21 5. Standard-weight or Schedule 30, black-steel pipe with plain ends; steel welding fittings;
22 and welded joints.
 - 23 6. Thinwall Schedule 10, black-steel pipe with roll-grooved ends; uncoated, grooved-end
24 fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
 - 25 7. Thinwall Schedule 10, black-steel pipe with plain ends; welding fittings; and welded
26 joints.

27 3.13 SPRINKLER SCHEDULE

- 28 A. Use sprinkler types in subparagraphs below for the following applications:
 - 29 1. Rooms without Ceilings: Upright sprinklers.
 - 30 2. Rooms with Suspended Ceilings: Pendant sprinklers.
 - 31 3. Wall Mounting: Sidewall sprinklers.
 - 32 4. Special Applications: Extended-coverage, flow-control, and quick-response sprinklers
33 where indicated.

- 34 B. Provide sprinkler types in subparagraphs below with finishes indicated.
 - 35 1. Concealed Sprinklers: Rough brass, with factory-painted white cover plate.

- 1
 - 2
 - 3
 - 4
 - 5
2. Flush Sprinklers: White, with painted white escutcheon.
 3. Recessed Sprinklers: White, with bright chrome escutcheon.
 4. Upright Pendent and Sidewall Sprinklers: White in finished spaces exposed to view; rough bronze in unfinished spaces not exposed to view; wax coated where exposed to acids, chemicals, or other corrosive fumes.
- 6 END OF SECTION 211313

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1 SECTION 211316 – DRY-PIPE SPRINKLER SYSTEMS

2 PART 1 - GENERAL

3 1.1 RELATED DOCUMENTS

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

6 1.2 SUMMARY

7 A. Section Includes:

- 8 1. Pipes, fittings, and specialties.
9 2. Specialty valves.
10 3. Sprinkler specialty pipe fittings.
11 4. Sprinklers.
12 5. Alarm devices.
13 6. Manual control stations.
14 7. Control panels.
15 8. Pressure gages.

16 B. Related Requirements:

- 17 1. Section 211119 "Fire Department Connections" for exposed-, flush-, and yard-type fire
18 department connections.
19 2. Section 210523 "Fire Protection Piping" for ball, butterfly, check, gate, post-indicator,
20 and trim and drain valves.

21 1.3 DEFINITIONS

- 22 A. Standard-Pressure Sprinkler Piping: Dry-pipe sprinkler system piping designed to operate at
23 working pressure of 175-psig (1200-kPa) maximum.

24 1.4 ACTION SUBMITTALS

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

- 1 1. Include rated capacities, operating characteristics, electrical characteristics, and
2 furnished specialties and accessories.
- 3 B. Shop Drawings: For dry-pipe sprinkler systems.
 - 4 1. Include plans, elevations, sections, and attachment details.
 - 5 2. Include diagrams for power, signal, and control wiring.
- 6 C. Delegated-Design Submittal: For dry-pipe sprinkler systems indicated to comply with
7 performance requirements and design criteria, including analysis data signed and sealed by
8 the qualified professional engineer responsible for their preparation.
- 9 1.5 INFORMATIONAL SUBMITTALS
 - 10 A. Coordination Drawings: Sprinkler systems, drawn to scale, on which the following items are
11 shown and coordinated with each other, using input from installers of the items involved:
 - 12 1. Domestic water piping.
 - 13 2. Items penetrating finished ceiling including the following:
 - 14 a. Lighting fixtures.
 - 15 b. Air outlets and inlets.
 - 16 B. Qualification Data: For qualified Installer and professional engineer.
 - 17 C. Design Data:
 - 18 1. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13,
19 that have been approved by authorities having jurisdiction, including hydraulic
20 calculations if applicable.
 - 21 D. Fire-hydrant flow test report.
 - 22 E. Field Test Reports:
 - 23 1. Fire-hydrant flow test report.
 - 24 2. Indicate and interpret test results for compliance with performance requirements and
25 as described in NFPA 13. Include "Contractor's Material and Test Certificate for
26 Aboveground Piping."
 - 27 F. Field quality-control reports.

- 1 1.6 CLOSEOUT SUBMITTALS
- 2 A. Operation and Maintenance Data: For dry-pipe sprinkler systems and specialties to include in
3 emergency, operation, and maintenance manuals.
- 4 1.7 MAINTENANCE MATERIAL SUBMITTALS
- 5 A. Furnish extra materials that match products installed and that are packaged with protective
6 covering for storage and identified with labels describing contents.
- 7 1. Sprinkler Cabinets: Finished, wall-mounted, steel cabinet with hinged cover, and with
8 space for minimum of six spare sprinklers plus sprinkler wrench. Include number of
9 sprinklers required by NFPA 13 and sprinkler wrench. Include separate cabinet with
10 sprinklers and wrench for each type of sprinkler used on Project.
- 11 1.8 QUALITY ASSURANCE
- 12 A. Installer Qualifications:
- 13 1. Installer's responsibilities include designing, fabricating, and installing sprinkler systems
14 and providing professional engineering services needed to assume engineering
15 responsibility. Base calculations on results of fire-hydrant flow test.
- 16 a. Engineering Responsibility: Preparation of working plans, calculations, and field
17 test reports by a qualified professional engineer.
- 18 PART 2 - PRODUCTS
- 19 2.1 SYSTEM DESCRIPTIONS
- 20 A. Dry-Pipe Sprinkler System: Automatic sprinklers are attached to piping containing compressed
21 air. Opening of sprinklers releases compressed air and permits water pressure to open dry-
22 pipe valve. Water then flows into piping and discharges from opened sprinklers.
- 23 2.2 PERFORMANCE REQUIREMENTS
- 24 A. Sprinkler system equipment, specialties, accessories, installation, and testing shall comply with
25 the following:
- 26 1. NFPA 13.

- 1 2. NFPA 13R.
- 2 B. Standard-Pressure Piping System Component: Listed for 175-psig (1200-kPa) minimum
3 working pressure.
- 4 C. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000
5 "Quality Requirements," to design dry-pipe sprinkler systems.
- 6 D. Sprinkler system design shall be approved by authorities having jurisdiction.
- 7 1. Margin of Safety for Available Water Flow and Pressure: 10 percent, including losses
8 through water-service piping, valves, and backflow preventers.
- 9 2. Sprinkler Occupancy Hazard Classifications:
10 a. Automobile Parking Areas: Ordinary Hazard, Group 1.
11 b. Building Service Areas: Ordinary Hazard, Group 1.
12 c. Electrical Equipment Rooms: Ordinary Hazard, Group 1.
13 d. General Storage Areas: Ordinary Hazard, Group 1.
14 e. Mechanical Equipment Rooms: Ordinary Hazard, Group 1.
- 15 3. Minimum Density for Automatic-Sprinkler Piping Design:
16 a. Ordinary-Hazard, Group 1 Occupancy: 0.15 gpm over 1500-sq. ft. area.
- 17 4. Maximum Protection Area per Sprinkler: According to UL listing.
- 18 5. Maximum Protection Area per Sprinkler:
19 a. Storage Areas: 130 sq. ft..
20 b. Mechanical Equipment Rooms: 130 sq. ft..
21 c. Electrical Equipment Rooms: 130 sq. ft..
22 d. Other Areas: According to NFPA 13 recommendations unless otherwise indicated.
- 23 6. Total Combined Hose-Stream Demand Requirement: According to NFPA 13 unless
24 otherwise indicated:
25 a. Ordinary-Hazard Occupancies: 250 gpm for 60 to 90 minutes.
- 26 2.3 STEEL PIPE AND FITTINGS
- 27 A. Standard-Weight, Galvanized-Steel Pipe: ASTM A 53/A 53M, Type E, Grade B. Pipe ends may
28 be factory or field formed to match joining method.
- 29 B. Schedule 30, Galvanized-Steel Pipe: ASTM A 135/A 135M; ASTM A 795/A 795M, Type E; or
30 ASME B36.10M wrought steel, with wall thickness not less than Schedule 30 and not more
31 than Schedule 40. Pipe ends may be factory or field formed to match joining method.

- 1 C. Thinwall Galvanized-Steel Pipe: ASTM A 135/A 135M or ASTM A 795/A 795M, threadable, with
2 wall thickness less than Schedule 30 and equal to or greater than Schedule 10. Pipe ends may
3 be factory or field formed to match joining method.
- 4 D. Galvanized-Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M, standard-weight,
5 seamless steel pipe with threaded ends.
- 6 E. Galvanized-Steel Couplings: ASTM A 865/A 865M, threaded.
- 7 F. Galvanized, Gray-Iron Threaded Fittings: ASME B16.4, Class 125, standard pattern.
- 8 G. Malleable- or Ductile-Iron Unions: UL 860.
- 9 H. Cast-Iron Flanges: ASME B16.1, Class 125.
- 10 I. Plain-End-Pipe Fittings: UL 213, ductile-iron body with retainer lugs that require one-quarter
11 turn or screwed retainer pin to secure pipe in fitting.
 - 12 1. Manufacturers: Subject to compliance with requirements, provide products by one of
13 the following:
 - 14 a. Anvil International.
 - 15 b. Shurjoint Piping Products USA Inc.
 - 16
 - 17
 - 18
 - 19 J. Grooved-Joint, Steel-Pipe Appurtenances:
 - 20 1. Manufacturers: Subject to compliance with requirements, provide products by one of
21 the following:
 - 22 a. Anvil International.
 - 23 b. Corcoran Piping System Co.
 - 24 c. National Fittings, Inc.
 - 25 d. Shurjoint Piping Products USA Inc.
 - 26 e. Tyco Fire Products LP.
 - 27 f. Victaulic Company.
 - 28 2. Pressure Rating: 175-psig minimum.
 - 29 3. Galvanized, Grooved-End Fittings for Steel Piping: ASTM A 47/A 47M, malleable-iron
30 casting or ASTM A 536, ductile-iron casting, with dimensions matching steel pipe.

- 1 4. Grooved-End-Pipe Couplings for Steel Piping: AWWA C606 and UL 213 rigid pattern,
2 unless otherwise indicated, for steel-pipe dimensions. Include ferrous housing sections,
3 EPDM-rubber gasket, and bolts and nuts.

- 4 2.4 SPECIALTY VALVES

- 5 A. Listed in UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."

- 6 B. Pressure Rating:
 - 7 1. Standard-Pressure Piping Specialty Valves: 175-psig (1200-kPa) minimum.

- 8 C. Body Material: Cast or ductile iron.

- 9 D. Size: Same as connected piping.

- 10 E. End Connections: Flanged or grooved.

- 11 F. Dry-Pipe Valves:
 - 12 1. Manufacturers: Subject to compliance with requirements, provide products by one of
13 the following:
 - 14 a. AFAC Inc.
 - 15 b. Globe Fire Sprinkler Corporation.
 - 16 c. Reliable Automatic Sprinkler Co., Inc. (The).
 - 17 d. Tyco Fire Products LP.
 - 18 e. Venus Fire Protection Ltd.
 - 19 f. Victaulic Company.
 - 20 g. Viking Corporation.

 - 21 2. Standard: UL 260.
 - 22 3. Design: Differential-pressure type.
 - 23 4. Include UL 1486, quick-opening devices, trim sets for air supply, drain, priming level,
24 alarm connections, ball drip valves, pressure gages, priming chamber attachment, and
25 fill-line attachment.
 - 26 5. Air Compressor:
 - 27 a. Manufacturers: Subject to compliance with requirements, provide products by
28 one of the following:
 - 29 1) Gast Manufacturing Inc.
 - 30 2) General Air Products, Inc.

- 1 3) Viking Corporation.
- 2 b. Standard: UL's "Fire Protection Equipment Directory" or FM Global's "Approval
- 3 Guide."
- 4 c. Motor Horsepower: Fractional.
- 5 d. Power: 120-V ac, 60 Hz, single phase.

- 6 G. Automatic (Ball Drip) Drain Valves:

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

- 9 a. AFAC Inc.
- 10 b. Reliable Automatic Sprinkler Co., Inc. (The).
- 11 c. Tyco Fire Products LP.

- 12 2. Standard: UL 1726.
- 13 3. Pressure Rating: 175-psig (1200-kPa) minimum.
- 14 4. Type: Automatic draining, ball check.
- 15 5. Size: NPS 3/4 (DN 20).
- 16 6. End Connections: Threaded.

- 17 2.5 SPRINKLER PIPING SPECIALTIES

- 18 A. General Requirements for Dry-Pipe System Fittings: UL listed for dry-pipe service.

- 19 B. Branch Outlet Fittings:

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

- 22 a. Anvil International.
- 23 b. National Fittings, Inc.
- 24 c. Shurjoint Piping Products USA Inc.
- 25 d. Tyco Fire Products LP.
- 26 e. Victaulic Company.

- 27 2. Standard: UL 213.
- 28 3. Pressure Rating: 175-psig (1200-kPa) minimum.
- 29 4. Body Material: Ductile-iron housing with EPDM seals and bolts and nuts.
- 30 5. Type: Mechanical-tee and -cross fittings.
- 31 6. Configurations: Snap-on and strapless, ductile-iron housing with branch outlets.

- 1 7. Size: Of dimension to fit onto sprinkler main and with outlet connections as required to
- 2 match connected branch piping.
- 3 8. Branch Outlets: Grooved, plain-end pipe, or threaded.

- 4 C. Flow Detection and Test Assemblies:

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

- 7 a. AGF Manufacturing, Inc.
- 8 b. Reliable Automatic Sprinkler Co., Inc. (The).
- 9 c. Tyco Fire Products LP.
- 10 d. Victaulic Company.

- 11 2. Standard: UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."
- 12 3. Pressure Rating: 175-psig (1200-kPa) minimum.
- 13 4. Body Material: Cast- or ductile-iron housing with orifice, sight glass, and integral test
- 14 valve.
- 15 5. Size: Same as connected piping.
- 16 6. Inlet and Outlet: Threaded.

- 17 D. Branch Line Testers:

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

- 20 a. Elkhart Brass Mfg. Co., Inc.
- 21 b. Fire-End & Croker Corporation.
- 22 c. Potter Roemer LLC.

- 23 2. Standard: UL 199.
- 24 3. Pressure Rating: 175-psig (1200-kPa) minimum.
- 25 4. Body Material: Brass.
- 26 5. Size: Same as connected piping.
- 27 6. Inlet: Threaded.
- 28 7. Drain Outlet: Threaded and capped.
- 29 8. Branch Outlet: Threaded, for sprinkler.

- 30 E. Sprinkler Inspector's Test Fittings:

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

- 33 a. AGF Manufacturing, Inc.

- 1 b. Triple R Specialty.
- 2 c. Tyco Fire Products LP.
- 3 d. Victaulic Company.
- 4 e. Viking Corporation.

- 5 2. Standard: UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."
- 6 3. Pressure Rating: 175-psig (1200-kPa) minimum.
- 7 4. Body Material: Cast- or ductile-iron housing with sight glass.
- 8 5. Size: Same as connected piping.
- 9 6. Inlet and Outlet: Threaded.

- 10 F. Adjustable Drop Nipples:

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

- 13 a. CECA, LLC.
- 14 b. Corcoran Piping System Co.
- 15 c. Merit Manufacturing.

- 16 2. Standard: UL 1474.
- 17 3. Pressure Rating: 250-psig (1725-kPa) minimum.
- 18 4. Body Material: Steel pipe with EPDM O-ring seals.
- 19 5. Size: Same as connected piping.
- 20 6. Length: Adjustable.
- 21 7. Inlet and Outlet: Threaded.

- 22 G. Flexible Sprinkler Hose Fittings:

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

- 25 a. Fivalco Inc.
- 26 b. FlexHead Industries, Inc.
- 27 c. Gateway Tubing, Inc.

- 28 2. Standard: UL 1474.
- 29 3. Type: Flexible hose for connection to sprinkler, and with bracket for connection to
- 30 ceiling grid.
- 31 4. Pressure Rating: 175-psig (1200-kPa) minimum.
- 32 5. Size: Same as connected piping, for sprinkler.

- 1 2.6 SPRINKLERS
- 2 A. Manufacturers: Subject to compliance with requirements, provide products by one of the
3 following:
- 4 1. AFAC Inc.
5 2. Globe Fire Sprinkler Corporation.
6 3. Reliable Automatic Sprinkler Co., Inc. (The).
7 4. Tyco Fire Products LP.
8 5. Venus Fire Protection Ltd.
9 6. Victaulic Company.
10 7. Viking Corporation.
- 11 B. Listed in UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."
- 12 C. Pressure Rating for Automatic Sprinklers: 175-psig (1200-kPa) minimum.
- 13 D. Automatic Sprinklers with Heat-Responsive Element:
- 14 1. Nonresidential Applications: UL 199.
15 2. Characteristics: Nominal 1/2-inch (12.7-mm) orifice with Discharge Coefficient K of 5.6,
16 and for "Ordinary" temperature classification rating unless otherwise indicated or
17 required by application.
- 18 E. Sprinkler Finishes: Bronze.
- 19 F. Sprinkler Escutcheons: Materials, types, and finishes for the following sprinkler mounting
20 applications. Escutcheons for concealed, flush, and recessed-type sprinklers are specified with
21 sprinklers.
- 22 1. Ceiling Mounting: Chrome-plated steel, one piece, flat.
23 2. Sidewall Mounting: Chrome-plated steel, one piece, flat.
- 24 G. Sprinkler Guards:
25 1. Standard: UL 199.
26 2. Type: Wire cage with fastening device for attaching to sprinkler.
- 27 2.7 ALARM DEVICES
- 28 A. Alarm-device types shall match piping and equipment connections.
- 29 B. Electrically Operated Alarm Bell:

- 1 1. Manufacturers: Subject to compliance with requirements, provide products by one of
2 the following:
- 3 a. Fire-Lite Alarms, Inc.; a Honeywell International company.
4 b. Notifier.
5 c. Potter Electric Signal Company, LLC.
- 6 2. Standard: UL 464.
7 3. Type: Vibrating, metal alarm bell.
8 4. Size: 6-inch (150-mm) minimum diameter or as required by AHJ.
9 5. Finish: Red-enamel factory finish, suitable for outdoor use.
10 6. Electrical Components, Devices, and Accessories: Listed and labeled as defined in
11 NFPA 70, by a qualified testing agency, and marked for intended location and
12 application.
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- 18 C. Pressure Switches:
- 19 1. Manufacturers: Subject to compliance with requirements, provide products by one of
20 the following:
- 21 a. AFAC Inc.
22 b. Barksdale, Inc.
23 c. Detroit Switch, Inc.
24 d. Potter Electric Signal Company, LLC.
25 e. System Sensor.
26 f. Tyco Fire Products LP.
27 g. United Electric Controls Co.
28 h. Viking Corporation.
- 29 2. Standard: UL 346.
30 3. Type: Electrically supervised water-flow switch with retard feature.
31 4. Components: Single-pole, double-throw switch with normally closed contacts.
32 5. Design Operation: Rising pressure signals water flow.
- 33 D. Valve Supervisory Switches:
- 34 1. Manufacturers: Subject to compliance with requirements, provide products by one of
35 the following:

- 1 a. Fire-Lite Alarms, Inc.; a Honeywell International company.
- 2 b. Kennedy Valve Company; a division of McWane, Inc.
- 3 c. Potter Electric Signal Company, LLC.
- 4 d. System Sensor.

- 5 2. Standard: UL 346.
- 6 3. Type: Electrically supervised.
- 7 4. Components: Single-pole, double-throw switch with normally closed contacts.
- 8 5. Design: Signals that controlled valve is in other than fully open position.
- 9 6. Electrical Components, Devices, and Accessories: Listed and labeled as defined in
- 10 NFPA 70, by a qualified testing agency, and marked for intended location and
- 11 application

12 2.8 PRESSURE GAGES

- 13 A. Manufacturers: Subject to compliance with requirements, provide products by one of the
- 14 following:
 - 15 1. AMETEK, Inc.
 - 16 2. Ashcroft Inc.
 - 17 3. Brecco Corporation.
 - 18 4. WIKA Instrument Corporation.
- 19 B. Standard: UL 393.
- 20 C. Dial Size: 3-1/2- to 4-1/2-inch (90- to 115-mm) diameter.
- 21 D. Pressure Gage Range: 0- to 250-psig (0- to 1725-kPa) minimum.
- 22 E. Label: Include "WATER" or "AIR/WATER" label on dial face.
- 23 F. Air System Piping Gage: Include "AIR" or "AIR/WATER" label on dial face.

24 PART 3 - EXECUTION

25 3.1 PREPARATION

- 26 A. Perform fire-hydrant flow test according to NFPA 13 and NFPA 291. Use results for system
- 27 design calculations required in "Quality Assurance" Article.
- 28 B. Report test results promptly and in writing.

- 1 3.2 SERVICE-ENTRANCE PIPING
- 2 A. Connect sprinkler piping to water-service piping for service entrance to building. Comply with
3 requirements in Section 211100 "Facility Fire-Suppression Water-Service Piping" for exterior
4 piping.
- 5 B. Install shutoff valve, backflow preventer, pressure gage, drain, and other accessories indicated
6 at connection to water-service piping. Comply with requirements for backflow preventers in
7 Section 211100 "Facility Fire-Suppression Water-Service Piping."
- 8 C. Install shutoff valve, check valve, pressure gage, and drain at connection to water service.
- 9 3.3 PIPING INSTALLATION
- 10 A. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general
11 location and arrangement of piping. Install piping as indicated on approved working plans.
- 12 1. Deviations from approved working plans for piping require written approval from
13 authorities having jurisdiction. File written approval with Architect before deviating
14 from approved working plans.
- 15 2. Coordinate layout and installation of sprinklers with other construction that penetrates
16 ceilings, including light fixtures, HVAC equipment, and partition assemblies.
- 17 B. Piping Standard: Comply with NFPA 13 requirements for installation of sprinkler piping.
- 18 C. Use listed fittings to make changes in direction, branch takeoffs from mains, and reductions in
19 pipe sizes.
- 20 D. Install unions adjacent to each valve in pipes NPS 2 (DN 50) and smaller.
- 21 E. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and
22 equipment having NPS 2-1/2 (DN 65) and larger end connections.
- 23 F. Install "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve,
24 and sized and located according to NFPA 13.
- 25 G. Install sprinkler piping with drains for complete system drainage.
- 26 H. Install sprinkler control valves, test assemblies, and drain risers adjacent to standpipes when
27 sprinkler piping is connected to standpipes.
- 28 I. Install automatic (ball drip) drain valves to drain piping between fire department connections
29 and check valves. Drain to floor drain or to outside building.

- 1 J. Connect compressed-air supply to dry-pipe sprinkler piping.
- 2 K. Connect air compressor to the following piping and wiring:
 - 3 1. Pressure gages and controls.
 - 4 2. Electrical power system.
 - 5 3. Fire-alarm devices, including low-pressure alarm.
- 6 L. Install alarm devices in piping systems.
- 7 M. Install hangers and supports for sprinkler system piping according to NFPA 13. Comply with
8 requirements in NFPA 13. In seismic-rated areas, refer to Section 210548 "Vibration and
9 Seismic Controls for Fire-Suppression Piping and Equipment."
- 10 N. Install pressure gages on riser or feed main, at each sprinkler test connection, and at top of
11 each standpipe. Include pressure gages with connection not less than NPS 1/4 (DN 8) and with
12 soft-metal seated globe valve, arranged for draining pipe between gage and valve. Install gages
13 to permit removal, and install where they are not subject to freezing.
- 14 O. Drain dry-pipe sprinkler piping.
- 15 P. Pressurize and check dry-pipe sprinkler system piping and air compressors.
- 16 Q. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements
17 for sleeves specified in Section 210517 "Sleeves and Sleeve Seals for Fire-Suppression Piping."
- 18 R. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with
19 requirements for sleeve seals specified in Section 210517 "Sleeves and Sleeve Seals for Fire-
20 Suppression Piping."
- 21 S. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with
22 requirements for escutcheons specified in Section 210518 "Escutcheons for Fire-Suppression
23 Piping."
- 24 3.4 JOINT CONSTRUCTION
 - 25 A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings
26 that have finish and pressure ratings same as or higher than system's pressure rating for
27 aboveground applications unless otherwise indicated.
 - 28 B. Install unions adjacent to each valve in pipes NPS 2 (DN 50) and smaller.

- 1 C. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and
2 equipment having NPS 2-1/2 (DN 65) and larger end connections.
- 3 D. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- 4 E. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before
5 assembly.
- 6 F. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for
7 water service. Join flanges with gasket and bolts according to ASME B31.9.
- 8 G. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut
9 threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore
10 full ID. Join pipe fittings and valves as follows:
- 11 1. Apply appropriate tape or thread compound to external pipe threads.
12 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or
13 damaged.
- 14 H. Twist-Locked Joints: Insert plain end of steel pipe into plain-end-pipe fitting. Rotate retainer
15 lugs one-quarter turn or tighten retainer pin.
- 16 I. Steel-Piping, Cut-Grooved Joints: Cut square-edge groove in end of pipe according to
17 AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and
18 grooved-end fittings according to AWWA C606 for steel-pipe joints.
- 19 J. Brazed Joints: Join copper tube and fittings according to CDA's "Copper Tube Handbook,"
20 "Braze Joints" Chapter.
- 21 K. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both
22 piping systems.

23 3.5 VALVE AND SPECIALTIES INSTALLATION

- 24 A. Install listed fire-protection valves, trim and drain valves, specialty valves and trim, controls,
25 and specialties according to NFPA 13 and authorities having jurisdiction.
- 26 B. Install listed fire-protection shutoff valves supervised open, located to control sources of water
27 supply except from fire-department connections. Install permanent identification signs
28 indicating portion of system controlled by each valve.
- 29 C. Install check valve in each water-supply connection. Install backflow preventers instead of
30 check valves in potable-water-supply sources.

- 1 D. Specialty Valves:
- 2 1. Install valves in vertical position for proper direction of flow, in main supply to system.
- 3 2. Install dry-pipe valves with trim sets for air supply, drain, priming level, alarm
- 4 connections, ball drip valves, pressure gages, priming chamber attachment, and fill-line
- 5 attachment.
- 6 a. Install air compressor and compressed-air-supply piping.
- 7 3.6 SPRINKLER INSTALLATION
- 8 A. Install sprinklers with water supply from heated space. Do not install pendent or sidewall
- 9 sprinklers in areas subject to freezing.
- 10 3.7 IDENTIFICATION
- 11 A. Install labeling and pipe markers on equipment and piping according to requirements in
- 12 NFPA 13.
- 13 B. Identify system components, wiring, cabling, and terminals. Comply with requirements for
- 14 identification specified in Section 260553 "Identification for Electrical Systems."
- 15 3.8 FIELD QUALITY CONTROL
- 16 A. Perform the following tests and inspections with the assistance of a factory-authorized service
- 17 representative:
- 18 1. Leak Test: After installation, charge systems and test for leaks. Repair leaks and retest
- 19 until no leaks exist.
- 20 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and
- 21 equipment.
- 22 3. Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance"
- 23 Chapter.
- 24 4. Energize circuits to electrical equipment and devices.
- 25 5. Start and run air compressors.
- 26 6. Coordinate with fire-alarm tests. Operate as required.
- 27 7. Verify that equipment hose threads are same as local fire department equipment.
- 28 B. Sprinkler piping system will be considered defective if it does not pass tests and inspections.
- 29 C. Prepare test and inspection reports.

- 1 3.9 CLEANING
- 2 A. Clean dirt and debris from sprinklers.
- 3 B. Only sprinklers with their original factory finish are acceptable. Remove and replace any
4 sprinklers that are painted or have any other finish than their original factory finish.
- 5 3.10 DEMONSTRATION
- 6 A. Train Owner's maintenance personnel to adjust, operate, and maintain specialty valves.
- 7 3.11 PIPING SCHEDULE
- 8 A. Piping between Fire Department Connections and Check Valves: Galvanized, standard-weight
9 steel pipe with threaded ends, cast-iron threaded fittings, and threaded or grooved joints.
- 10 B. Sprinkler specialty fittings may be used, downstream of control valves, instead of specified
11 fittings.
- 12 C. Standard-pressure, dry-pipe sprinkler system, NPS 2 (DN 50) and smaller, shall be one of the
13 following:
- 14 1. Standard-weight or Schedule 30, galvanized-steel pipe with threaded ends; galvanized,
15 gray-iron threaded fittings; and threaded joints.
- 16 2. Standard-weight, Schedule 30 or thinwall, galvanized-steel pipe with plain ends; plain-
17 end-pipe fittings; and twist-locked joints.
- 18 3. Standard-weight or Schedule 30, galvanized-steel pipe with cut-grooved ends;
19 galvanized, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel
20 piping; and grooved joints.
- 21 D. Standard-pressure, dry-pipe sprinkler system, NPS 2-1/2 to NPS 4 (DN 65 to DN 100), shall
22 be one of the following:
- 23 1. Standard-weight or Schedule 30, galvanized-steel pipe with threaded ends; galvanized,
24 gray-iron threaded fittings; and threaded joints.
- 25 2. Standard-weight or Schedule 30, galvanized-steel pipe with cut-grooved ends;
26 galvanized, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel
27 piping; and grooved joints.
- 28 E. Standard-pressure, dry-pipe sprinkler system, NPS 5 and NPS 6 (DN 125 and DN 150) shall
29 be one of the following:

- 1 1. Standard-weight or Schedule 30, galvanized-steel pipe with threaded ends; galvanized,
2 gray-iron threaded fittings; and threaded joints.
- 3 2. Standard-weight or Schedule 30, galvanized-steel pipe with cut-grooved ends;
4 galvanized, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel
5 piping; and grooved joints.

6 3.12 SPRINKLER SCHEDULE

7 A. Use sprinkler types in subparagraphs below for the following applications:

- 8 1. Rooms without Ceilings: Upright sprinklers.
- 9 2. Rooms with Suspended Ceilings: Dry Pendant sprinklers.
- 10 3. Wall Mounting: Dry sidewall sprinklers.
- 11 4. Spaces Subject to Freezing: Upright, dry pendent sprinklers; and dry sidewall sprinklers
12 as indicated.

13 B. Provide sprinkler types in subparagraphs below with finishes indicated.

- 14 1. Concealed Sprinklers: Rough brass, with factory-painted white cover plate.
- 15 2. Recessed Sprinklers: Bright chrome, with bright chrome escutcheon.
- 16 3. Upright, Pendent and Sidewall Sprinklers: Chrome plated in finished spaces exposed to
17 view; rough bronze in unfinished spaces not exposed to view; wax coated where
18 exposed to acids, chemicals, or other corrosive fumes.

19 END OF SECTION 211316

DIVISION 22

1 SECTION 220500 - COMMON WORK RESULTS FOR PLUMBING

2 PART 1 - GENERAL

3 1.1 RELATED DOCUMENTS

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

6 1.2 SUMMARY

- 7 A. This Section includes the following:

- 8 1. Piping materials and installation instructions common to most piping systems.
9 2. Transition fittings.
10 3. Dielectric fittings.
11 4. Mechanical sleeve seals.
12 5. Sleeves.
13 6. Escutcheons.
14 7. Grout.
15 8. Plumbing demolition.
16 9. Equipment installation requirements common to equipment sections.
17 10. Painting and finishing.
18 11. Concrete bases.
19 12. Supports and anchorages.

20 1.3 DEFINITIONS

- 21 A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred
22 spaces, pipe chases, unheated spaces immediately below roof, spaces above ceilings,
23 unexcavated spaces, crawlspaces, and tunnels.
- 24 B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied
25 spaces and mechanical equipment rooms.
- 26 C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient
27 temperatures and weather conditions. Examples include rooftop locations.
- 28 D. Concealed, Interior Installations: Concealed from view and protected from physical contact by
29 building occupants. Examples include above ceilings and in chases.

- 1 E. Concealed, Exterior Installations: Concealed from view and protected from weather
2 conditions and physical contact by building occupants but subject to outdoor ambient
3 temperatures. Examples include installations within unheated shelters.
- 4 F. The following are industry abbreviations for plastic materials:
- 5 1. ABS: Acrylonitrile-butadiene-styrene plastic.
6 2. CPVC: Chlorinated polyvinyl chloride plastic.
7 3. PE: Polyethylene plastic.
8 4. PVC: Polyvinyl chloride plastic.
- 9 G. The following are industry abbreviations for rubber materials:
- 10 1. EPDM: Ethylene-propylene-diene terpolymer rubber.
11 2. NBR: Acrylonitrile-butadiene rubber.
- 12 1.4 SUBMITTALS
- 13 A. Product Data: For the following:
- 14 1. Transition fittings.
15 2. Dielectric fittings.
16 3. Mechanical sleeve seals.
17 4. Escutcheons.
- 18 B. Welding certificates.
- 19 1.5 QUALITY ASSURANCE
- 20 A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural
21 Welding Code--Steel."
- 22 B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure
23 Vessel Code: Section IX, "Welding and Brazing Qualifications."
- 24 1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
25 2. Certify that each welder has passed AWS qualification tests for welding processes
26 involved and that certification is current.
- 27 C. Electrical Characteristics for Plumbing Equipment: Equipment of different electrical
28 characteristics may be furnished provided such proposed equipment is approved in writing
29 and connecting electrical services, circuit breakers, and conduit sizes are appropriately

1 modified at the cost of the equipment manufacturer. If minimum energy ratings or efficiencies
2 are specified, equipment shall comply with requirements.

3 1.6 DELIVERY, STORAGE, AND HANDLING

4 A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping,
5 storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and
6 moisture.

7 1.7 COORDINATION

8 A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of
9 construction, to allow for plumbing installations.

10 B. Coordinate installation of required supporting devices and set sleeves in poured-in-place
11 concrete and other structural components as they are constructed.

12 C. Coordinate requirements for access panels and doors for plumbing items requiring access that
13 are concealed behind finished surfaces. Access panels and doors are specified in Division 08
14 Section "Access Doors and Frames."

15 PART 2 - PRODUCTS

16 2.1 MANUFACTURERS

17 A. In other Part 2 articles where subparagraph titles below introduce lists, the following
18 requirements apply for product selection:

19 1. Manufacturers: Subject to compliance with requirements, provide products by the
20 manufacturers specified.

21 2.2 PIPE, TUBE, AND FITTINGS

22 A. Refer to individual Division 22 piping Sections for pipe, tube, and fitting materials and joining
23 methods.

24 B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

25 2.3 JOINING MATERIALS

- 1 A. Refer to individual Division 22 piping Sections for special joining materials not listed below.
- 2 B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system
3 contents.
- 4 1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless
5 thickness or specific material is indicated.
- 6 a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
7 b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
- 8 2. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full-face
9 or ring type, unless otherwise indicated.
- 10 C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
- 11 D. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to
12 ASTM B 813.
- 13 E. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty
14 brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping,
15 unless otherwise indicated.
- 16 F. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall
17 thickness and chemical analysis of steel pipe being welded.
- 18 2.4 TRANSITION FITTINGS
- 19 A. AWWA Transition Couplings: Same size as, and with pressure rating at least equal to and with
20 ends compatible with, piping to be joined.
- 21 1. Manufacturers:
- 22 a. Cascade Waterworks Mfg. Co.
23 b. Dresser Industries, Inc.; DMD Div.
24 c. Ford Meter Box Company, Incorporated (The); Pipe Products Div.
25 d. JCM Industries.
26 e. Smith-Blair, Inc.
27 f. Viking Johnson.
- 28 2. Underground Piping NPS 1-1/2 and Smaller: Manufactured fitting or coupling.
29 3. Underground Piping NPS 2 and Larger: AWWA C219, metal sleeve-type coupling.
30 4. Aboveground Pressure Piping: Pipe fitting.

- 1 2.5 DIELECTRIC FITTINGS
- 2 A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-
3 joint, plain, or weld-neck end connections that match piping system materials.
- 4 B. Insulating Material: Suitable for system fluid, pressure, and temperature.
- 5 C. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig minimum working pressure
6 at 180 deg F.
- 7 1. Manufacturers:
- 8 a. Capitol Manufacturing Co.
9 b. Central Plastics Company.
10 c. Eclipse, Inc.
11 d. Epco Sales, Inc.
12 e. Hart Industries, International, Inc.
13 f. Watts Industries, Inc.; Water Products Div.
14 g. Zurn Industries, Inc.; Wilkins Div.
- 15 D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig
16 minimum working pressure as required to suit system pressures.
- 17 1. Manufacturers:
- 18 a. Capitol Manufacturing Co.
19 b. Central Plastics Company.
20 c. Epco Sales, Inc.
21 d. Watts Industries, Inc.; Water Products Div.
- 22 E. Dielectric-Flange Kits: Companion-flange assembly for field assembly. Include flanges, full-
23 face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic
24 washers, and steel backing washers.
- 25 1. Manufacturers:
- 26 a. Advance Products & Systems, Inc.
27 b. Calpico, Inc.
28 c. Central Plastics Company.
29 d. Pipeline Seal and Insulator, Inc.
- 30 2. Separate companion flanges and steel bolts and nuts shall have 150- or 300-psig
31 minimum working pressure where required to suit system pressures.

1 F. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic
 2 lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.

3 1. Manufacturers:

- 4 a. Calpico, Inc.
- 5 b. Lochinvar Corp.

6 G. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining;
 7 plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 deg F.

8 1. Manufacturers:

- 9 a. Perfection Corp.
- 10 b. Precision Plumbing Products, Inc.
- 11 c. Sioux Chief Manufacturing Co., Inc.
- 12 d. Victaulic Co. of America.

16 2.6 MECHANICAL SLEEVE SEALS

17 A. Description: Modular sealing element unit, designed for field assembly, to fill annular space
 18 between pipe and sleeve.

19 1. Manufacturers:

- 20 a. Advance Products & Systems, Inc.
- 21 b. Calpico, Inc.
- 22 c. Metraflex Co.
- 23 d. Pipeline Seal and Insulator, Inc.

24 2. Sealing Elements: EPDM or NBR interlocking links shaped to fit surface of pipe. Include
 25 type and number required for pipe material and size of pipe.

26 3. Pressure Plates: Carbon steel. Include two for each sealing element.

27 4. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating or stainless
 28 steel of length required to secure pressure plates to sealing elements. Include one for
 29 each sealing element.

30 2.7 SLEEVES

- 1 A. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded
2 longitudinal joint.
- 3 B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.
- 4 C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain
5 ends and integral waterstop, unless otherwise indicated.
- 6 D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include
7 clamping ring and bolts and nuts for membrane flashing.
- 8 1. Underdeck Clamp: Clamping ring with set screws.
- 9 2.8 ESCUTCHEONS
- 10 A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely
11 fit around pipe, tube, and insulation of insulated piping and an OD that completely covers
12 opening.
- 13 B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated
14 finish.
- 15 C. One-Piece, Cast-Brass Type: With set screw.
- 16 1. Finish: Polished chrome-plated.
- 17 D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.
- 18 1. Finish: Polished chrome-plated.
- 19 E. One-Piece, Stamped-Steel Type: With set screw or spring clips and chrome-plated finish.
- 20 F. Split-Plate, Stamped-Steel Type: With concealed hinge, set screw or spring clips, and chrome-
21 plated finish.
- 22 G. One-Piece, Floor-Plate Type: Cast-iron floor plate.
- 23 H. Split-Casting, Floor-Plate Type: Cast brass with concealed hinge and set screw.
- 24 2.9 GROUT
- 25 A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.

- 1 1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive,
2 nongaseous, and recommended for interior and exterior applications.
3 2. Design Mix: 5000-psi, 28-day compressive strength.
4 3. Packaging: Premixed and factory packaged.

5 PART 3 - EXECUTION

6 3.1 PLUMBING DEMOLITION

- 7 A. Refer to Division 01 Section "Cutting and Patching" and Division 02 Section "Selective Structure
8 Demolition" for general demolition requirements and procedures.
- 9 B. Disconnect, demolish, and remove plumbing systems, equipment, and components indicated
10 to be removed.
- 11 1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or
12 plug remaining piping with same or compatible piping material.
13 2. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or
14 compatible piping material.
15 3. Equipment to Be Removed: Disconnect and cap services and remove equipment.
16 4. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove,
17 clean, and store equipment; when appropriate, reinstall, reconnect, and make
18 equipment operational.
19 5. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove
20 equipment and deliver to Owner.
- 21 C. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable,
22 remove damaged or unserviceable portions and replace with new products of equal capacity
23 and quality.

24 3.2 PIPING SYSTEMS - COMMON REQUIREMENTS

- 25 A. Install piping according to the following requirements and Division 22 Sections specifying
26 piping systems.
- 27 B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping
28 systems. Indicated locations and arrangements were used to size pipe and calculate friction
29 loss, expansion, pump sizing, and other design considerations. Install piping as indicated
30 unless deviations to layout are approved on Coordination Drawings.
- 31 C. Install piping in concealed locations, unless otherwise indicated and except in equipment
32 rooms and service areas.

- 1 D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right
2 angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated
3 otherwise.
- 4 E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- 5 F. Install piping to permit valve servicing.
- 6 G. Install piping at indicated slopes.
- 7 H. Install piping free of sags and bends.
- 8 I. Install fittings for changes in direction and branch connections.
- 9 J. Install piping to allow application of insulation.
- 10 K. Select system components with pressure rating equal to or greater than system operating
11 pressure.
- 12 L. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:
- 13 1. New Piping:
- 14 a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
15 b. Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated
16 finish.
17 c. Insulated Piping: One-piece, stamped-steel type with spring clips.
18 d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-
19 brass type with polished chrome-plated finish.
20 e. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece or split-casting,
21 cast-brass type with polished chrome-plated finish.
22 f. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with
23 polished chrome-plated finish.
24 g. Bare Piping in Equipment Rooms: One-piece, cast-brass type.
25 h. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate
26 type.
- 27 M. Sleeves are not required for core-drilled holes.
- 28 N. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and
29 roof slabs.
- 30 1. Cut sleeves to length for mounting flush with both surfaces.

- 1 a. Exception: Extend sleeves installed in floors of mechanical equipment areas or
2 other wet areas 2 inches above finished floor level. Extend cast-iron sleeve
3 fittings below floor slab as required to secure clamping ring if ring is specified.
- 4 2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
- 5 3. Install sleeves that are large enough to provide 1/4-inch annular clear space between
6 sleeve and pipe or pipe insulation. Use the following sleeve materials:
- 7 a. Steel Pipe Sleeves: For pipes smaller than NPS 6.
- 8 b. Steel Sheet Sleeves: For pipes NPS 6 and larger, penetrating gypsum-board
9 partitions.
- 10 c. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing.
11 Secure flashing between clamping flanges. Install section of cast-iron soil pipe to
12 extend sleeve to 2 inches above finished floor level.
- 13 1) Seal space outside of sleeve fittings with grout.
- 14 4. Except for underground wall penetrations, seal annular space between sleeve and pipe
15 or pipe insulation, using joint sealants appropriate for size, depth, and location of joint.
- 16 O. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and
17 mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between
18 pipe and sleeve for installing mechanical sleeve seals.
- 19 1. Install steel pipe for sleeves smaller than 6 inches in diameter.
- 20 2. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.
- 21 3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements
22 required for pipe material and size. Position pipe in center of sleeve. Assemble
23 mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten
24 bolts against pressure plates that cause sealing elements to expand and make
25 watertight seal.
- 26 P. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal
27 pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch annular
28 clear space between pipe and sleeve for installing mechanical sleeve seals.
- 29 1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements
30 required for pipe material and size. Position pipe in center of sleeve. Assemble
31 mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten
32 bolts against pressure plates that cause sealing elements to expand and make
33 watertight seal.

- 1 Q. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors
2 at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07
3 Section "Penetration Firestopping" for materials.
- 4 R. Verify final equipment locations for roughing-in.
- 5 S. Refer to equipment specifications in other Sections of these Specifications for roughing-in
6 requirements.
- 7 3.3 PIPING JOINT CONSTRUCTION
- 8 A. Join pipe and fittings according to the following requirements and Division 22 Sections
9 specifying piping systems.
- 10 B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- 11 C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before
12 assembly.
- 13 D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube
14 end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-
15 free solder alloy complying with ASTM B 32.
- 16 E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube"
17 Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.
- 18 F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut
19 threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore
20 full ID. Join pipe fittings and valves as follows:
- 21 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal
22 threading is specified.
- 23 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or
24 damaged. Do not use pipe sections that have cracked or open welds.
- 25 G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and
26 welding operators according to Part 1 "Quality Assurance" Article.
- 27 H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service
28 application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
- 29 3.4 PIPING CONNECTIONS

- 1 A. Make connections according to the following, unless otherwise indicated:
- 2 1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection
- 3 to each piece of equipment.
- 4 2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final
- 5 connection to each piece of equipment.
- 6 3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of
- 7 dissimilar metals.
- 8 4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping
- 9 materials of dissimilar metals.

10 3.5 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

- 11 A. Install equipment to allow maximum possible headroom unless specific mounting heights are
- 12 not indicated.
- 13 B. Install equipment level and plumb, parallel and perpendicular to other building systems and
- 14 components in exposed interior spaces, unless otherwise indicated.
- 15 C. Install plumbing equipment to facilitate service, maintenance, and repair or replacement of
- 16 components. Connect equipment for ease of disconnecting, with minimum interference to
- 17 other installations. Extend grease fittings to accessible locations.
- 18 D. Install equipment to allow right of way for piping installed at required slope.

19 3.6 PAINTING

- 20 A. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials
- 21 and procedures to match original factory finish.

22 3.7 CONCRETE BASES

- 23 A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's
- 24 written instructions and according to seismic codes at Project.
- 25 1. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in
- 26 both directions than supported unit.
- 27 2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise
- 28 indicated, install dowel rods on 18-inch centers around the full perimeter of the base.
- 29 3. Install epoxy-coated anchor bolts for supported equipment that extend through
- 30 concrete base, and anchor into structural concrete floor.

- 1 4. Place and secure anchorage devices. Use supported equipment manufacturer's setting
2 drawings, templates, diagrams, instructions, and directions furnished with items to be
3 embedded.
- 4 5. Install anchor bolts to elevations required for proper attachment to supported
5 equipment.
- 6 6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
- 7 7. Use 3000-psi, 28-day compressive-strength concrete and reinforcement as specified in
8 Division 03 Section.

9 3.8 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- 10 A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and
11 elevation to support and anchor plumbing materials and equipment.
- 12 B. Field Welding: Comply with AWS D1.1.

13 3.9 ERECTION OF WOOD SUPPORTS AND ANCHORAGES

- 14 A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor
15 plumbing materials and equipment.
- 16 B. Select fastener sizes that will not penetrate members if opposite side will be exposed to view
17 or will receive finish materials. Tighten connections between members. Install fasteners
18 without splitting wood members.
- 19 C. Attach to substrates as required to support applied loads.

20 3.10 GROUTING

- 21 A. Mix and install grout for plumbing equipment base bearing surfaces, pump and other
22 equipment base plates, and anchors.
- 23 B. Clean surfaces that will come into contact with grout.
- 24 C. Provide forms as required for placement of grout.
- 25 D. Avoid air entrapment during placement of grout.
- 26 E. Place grout, completely filling equipment bases.
- 27 F. Place grout on concrete bases and provide smooth bearing surface for equipment.

- 1 G. Place grout around anchors.
- 2 H. Cure placed grout.
- 3 END OF SECTION 220500

1 SECTION 220519 - METERS AND GAGES FOR PLUMBING PIPING

2 PART 1 - GENERAL

3 1.1 RELATED DOCUMENTS

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

6 1.2 SUMMARY

- 7 A. Section Includes:

- 8 1. Bimetallic-actuated thermometers.
9 2. Thermowells.
10 3. Dial-type pressure gages.
11 4. Gage attachments.
12 5. Test plugs.

13 1.3 ACTION SUBMITTALS

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

15 1.4 INFORMATIONAL SUBMITTALS

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

17 1.5 CLOSEOUT SUBMITTALS

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

1 PART 2 - PRODUCTS

2 2.1 BIMETALLIC-ACTUATED THERMOMETERS

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

- 5 1. Miljoco Corporation.
- 6 2. Trerice, H. O. Co.
- 7 3. Weiss Instruments, Inc.

8 B. Standard: ASME B40.200.

9 C. Case: Sealed type(s); stainless steel with 3-inch nominal diameter.

10 D. Dial: Nonreflective aluminum with permanently etched scale markings and scales in deg F.

11 E. Connector Type(s): Union joint, adjustable angle with unified-inch screw threads.

12 F. Connector Size: 1/2 inch, with ASME B1.1 screw threads.

13 G. Stem: 0.25 or 0.375 inch in diameter; stainless steel.

14 H. Window: Plain glass.

15 I. Ring: Stainless steel.

16 J. Element: Bimetal coil.

17 K. Pointer: Dark-colored metal.

18 L. Accuracy: Plus or minus 1 1.5 percent of scale range.

19 2.2 THERMOWELLS

20 A. Thermowells:

- 21 1. Standard: ASME B40.200.
- 22 2. Description: Pressure-tight, socket-type fitting made for insertion into piping tee fitting.
- 23 3. Material for Use with Copper Tubing: CNR or CUNI.
- 24 4. Material for Use with Steel Piping: CRES.
- 25 5. Type: Stepped shank unless straight or tapered shank is indicated.
- 26 6. External Threads: NPS 1/2, NPS 3/4, or NPS 1, ASME B1.20.1 pipe threads.
- 27 7. Internal Threads: 1/2, 3/4, and 1 inch, with ASME B1.1 screw threads.

- 1 8. Bore: Diameter required to match thermometer bulb or stem.
- 2 9. Insertion Length: Length required to match thermometer bulb or stem.
- 3 10. Lagging Extension: Include on thermowells for insulated piping and tubing.
- 4 11. Bushings: For converting size of thermowell's internal screw thread to size of
- 5 thermometer connection.

6 B. Heat-Transfer Medium: Mixture of graphite and glycerin.

7

8 2.3 PRESSURE GAGES

9 A. Direct-Mounted, Metal-Case, Dial-Type Pressure Gages:

- 10 1. Manufacturers: Subject to compliance with requirements, provide products by one of
- 11 the following:
 - 12 a. Miljoco Corporation.
 - 13 b. Trerice, H. O. Co.
 - 14 c. Weiss Instruments, Inc.
- 15 2. Standard: ASME B40.100.
- 16 3. Case: Sealed, solid front, pressure relief type(s); cast aluminum or drawn steel; 4-1/2-
- 17 inch nominal diameter.
- 18 4. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
- 19 5. Pressure Connection: Brass, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and
- 20 bottom-outlet type unless back-outlet type is indicated.
- 21 6. Movement: Mechanical, with link to pressure element and connection to pointer.
- 22 7. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi.
- 23 8. Pointer: Dark-colored metal.
- 24 9. Window: Glass.
- 25 10. Ring: Stainless steel.
- 26 11. Accuracy: Grade B, plus or minus 2 percent of middle half of scale range.

27 2.4 TEST PLUGS

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

29 following:

- 30 1. Miljoco Corporation.
- 31 2. Trerice, H. O. Co.
- 32 3. Weiss Instruments, Inc.
- 33 4. Peterson Equipment Co., Inc.

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

7 PART 3 - EXECUTION

8 3.1 INSTALLATION

- 9 A. Install thermowells with socket extending to center of pipe and in vertical position in piping
10 tees.
- 11 B. Install thermowells of sizes required to match thermometer connectors. Include bushings if
12 required to match sizes.
- 13 C. Install thermowells with extension on insulated piping.
- 14 D. Fill thermowells with heat-transfer medium.
- 15 E. Install direct-mounted thermometers in thermowells and adjust vertical and tilted positions.
- 16 F. Install direct-mounted pressure gages in piping tees with pressure gage located on pipe at the
17 most readable position.
- 18 G. Install valve and snubber in piping for each pressure gage for fluids.
- 19 H. Install test plugs in piping tees.
- 20 I. Install thermometers in the following locations:
 - 21 1. Inlet and outlet of each water heater.
- 22 J. Install pressure gages in the following locations:
 - 23 1. Building water service entrance into building.

- 1 3.2 CONNECTIONS
- 2 A. Install meters and gages adjacent to machines and equipment to allow service and
3 maintenance of meters, gages, machines, and equipment.
- 4 3.3 ADJUSTING
- 5 A. Adjust faces of meters and gages to proper angle for best visibility.
- 6 3.4 THERMOMETER SCHEDULE
- 7 A. Thermometers at inlet and outlet of each domestic water heater shall be one of the following:
- 8 1. Sealed, bimetallic-actuated type.
9 2. Test plug with chlorosulfonated polyethylene synthetic self-sealing rubber inserts.
- 10 3.5 THERMOMETER SCALE-RANGE SCHEDULE
- 11 A. Scale Range for Domestic Cold-Water Piping: 0 to 100 deg F.
12 B. Scale Range for Domestic Hot-Water Piping: 20 to 240 deg F.
- 13 3.6 PRESSURE-GAGE SCHEDULE
- 14 A. Pressure gages at discharge of each water service into building shall be one of the following:
- 15 1. Sealed solid-front, pressure-relief, direct-mounted, metal case.
16 2. Test plug with chlorosulfonated polyethylene synthetic self-sealing rubber inserts.
- 17 3.7 PRESSURE-GAGE SCALE-RANGE SCHEDULE
- 18 A. Scale Range for Water Service Piping: 0 to 100 psi.
- 19 END OF SECTION 220519

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1 SECTION 220523.12 - BALL VALVES FOR PLUMBING PIPING

2 PART 1 - GENERAL

3 1.1 RELATED DOCUMENTS

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

6 1.2 SUMMARY

- 7 A. Section Includes:

- 8 1. Bronze ball valves.

9 1.3 DEFINITIONS

- 10 A. CWP: Cold working pressure.

11 1.4 ACTION SUBMITTALS

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

- 13 1. Certification that products comply with NSF 61.

14 1.5 DELIVERY, STORAGE, AND HANDLING

- 15 A. Prepare valves for shipping as follows:

- 16 1. Protect internal parts against rust and corrosion.
17 2. Protect threads, flange faces, and soldered ends.
18 3. Set ball valves open to minimize exposure of functional surfaces.

- 19 B. Use the following precautions during storage:

- 20 1. Maintain valve end protection.
21 2. Store valves indoors and maintain at higher-than-ambient-dew-point temperature. If
22 outdoor storage is necessary, store valves off the ground in watertight enclosures.

- 1 C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use
2 operating handles or stems as lifting or rigging points.

3 PART 2 - PRODUCTS

4 2.1 GENERAL REQUIREMENTS FOR VALVES

- 5 A. Source Limitations for Valves: Obtain each type of valve from single source from single
6 manufacturer.

7 B. ASME Compliance:

- 8 1. ASME B1.20.1 for threads for threaded end valves.
9 2. ASME B16.1 for flanges on iron valves.
10 3. ASME B16.5 for flanges on steel valves.
11 4. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
12 5. ASME B16.18 for solder-joint connections.
13 6. ASME B31.9 for building services piping valves.

- 14 C. NSF Compliance: NSF 61 for valve materials for potable-water service.

- 15 D. Bronze valves shall be made with dezincification-resistant materials. Bronze valves made with
16 copper alloy (brass) containing more than 15 percent zinc are not permitted.

- 17 E. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system
18 pressures and temperatures.

- 19 F. Valve Sizes: Same as upstream piping unless otherwise indicated.

20 G. Valve Actuator Types:

- 21 1. Gear Actuator: For quarter-turn valves NPS 4 and larger.
22 2. Handlever: For quarter-turn valves smaller than NPS 4.

23 H. Valves in Insulated Piping:

- 24 1. Include 2-inch stem extensions.
25 2. Extended operating handles of nonthermal-conductive material and protective sleeves
26 that allow operation of valves without breaking vapor seals or disturbing insulation.
27 3. Memory stops that are fully adjustable after insulation is applied.

- 1 2.2 BRONZE BALL VALVES
- 2 A. Two-Piece, Bronze Ball Valves with Full Port, and Bronze or Brass Trim:
- 3 1. Manufacturers: Subject to compliance with requirements, provide products by one of
- 4 the following:
- 5 a. Conbraco Industries, Inc.; Apollo Valves.
- 6 b. Crane Co.; Crane Valve Group; Crane Valves.
- 7 c. Hammond Valve.
- 8 d. Milwaukee Valve Company.
- 9 e. NIBCO INC.
- 10 f. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
- 11 2. Description:
- 12 a. Standard: MSS SP-110.
- 13 b. CWP Rating: 600 psig.
- 14 c. Body Design: Two piece.
- 15 d. Body Material: Bronze.
- 16 e. Ends: Threaded and soldered.
- 17 f. Seats: PTFE.
- 18 g. Stem: Bronze or brass.
- 19 h. Ball: Chrome-plated brass.
- 20 i. Port: Full.
- 21 B. Two-Piece, Bronze Ball Valves with Full Port and Stainless-Steel Trim:
- 22 1. Manufacturers: Subject to compliance with requirements, provide products by one of
- 23 the following:
- 24 a. Conbraco Industries, Inc.; Apollo Valves.
- 25 b. Crane Co.; Crane Valve Group; Crane Valves.
- 26 c. Hammond Valve.
- 27 d. Milwaukee Valve Company.
- 28 e. NIBCO INC.
- 29 f. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
- 30 2. Description:
- 31 a. Standard: MSS SP-110.
- 32 b. CWP Rating: 600 psig.
- 33 c. Body Design: Two piece.
- 34 d. Body Material: Bronze.
- 35 e. Ends: Threaded or soldered.

- 1 f. Seats: PTFE.
- 2 g. Stem: Stainless steel.
- 3 h. Ball: Stainless steel, vented.
- 4 i. Port: Full.

5 PART 3 - EXECUTION

6 3.1 EXAMINATION

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

17 3.2 VALVE INSTALLATION

- 18 A. Install valves with unions or flanges at each piece of equipment arranged to allow service,
19 maintenance, and equipment removal without system shutdown.
- 20 B. Locate valves for easy access and provide separate support where necessary.
- 21 C. Install valves in horizontal piping with stem at or above center of pipe.
- 22 D. Install valves in position to allow full stem movement.
- 23 E. Install valve tags. Comply with requirements in Section 220553 "Identification for Plumbing
24 Piping and Equipment" for valve tags and schedules.

25 3.3 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

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

- 1 B. Select valves with the following end connections:
- 2 1. For Copper Tubing, NPS 2 and Smaller: Threaded ends except where solder-joint valve-
- 3 end option is indicated in valve schedules below.
- 4 2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end
- 5 option is indicated in valve schedules below.

6 3.4 DOMESTIC HOT- AND COLD-WATER VALVE SCHEDULE

- 7 A. Pipe NPS 2 and Smaller:
- 8 1. Bronze Valves: May be provided with solder-joint ends instead of threaded ends.
- 9 2. Two-piece, bronze ball valves with full port and bronze trim.

10 END OF SECTION 220523.12

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1 SECTION 220523.13 - BUTTERFLY VALVES FOR PLUMBING PIPING

2 PART 1 - GENERAL

3 1.1 RELATED DOCUMENTS

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

6 1.2 SUMMARY

7 A. Section Includes:

- 8 1. Iron, single-flange butterfly valves.
9 2. Iron, grooved-end butterfly valves.
10 3. Chainwheels.

11 1.3 DEFINITIONS

- 12 A. CWP: Cold working pressure.
13 B. EPDM: Ethylene propylene-diene terpolymer rubber.
14 C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.

15 1.4 ACTION SUBMITTALS

- 16 A. Product Data: For each type of valve.
17 1. Certification that products comply with NSF 61.

18 1.5 DELIVERY, STORAGE, AND HANDLING

19 A. Prepare valves for shipping as follows:

- 20 1. Protect internal parts against rust and corrosion.
21 2. Protect threads, flange faces, grooves, and weld ends.
22 3. Set butterfly valves closed or slightly open.
23

- 1 B. Use the following precautions during storage:
- 2 1. Maintain valve end protection.
- 3 2. Store valves indoors and maintain at higher-than-ambient-dew-point temperature. If
- 4 outdoor storage is necessary, store valves off the ground in watertight enclosures.
- 5 C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use
- 6 handwheels or stems as lifting or rigging points.

7 PART 2 - PRODUCTS

8 2.1 GENERAL REQUIREMENTS FOR VALVES

- 9 A. Source Limitations for Valves: Obtain each type of valve from single source from single
- 10 manufacturer.
- 11 B. ASME Compliance:
- 12 1. ASME B16.1 for flanges on iron valves.
- 13 2. ASME B16.5 for flanges on steel valves.
- 14 3. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
- 15 4. ASME B31.9 for building service piping valves.
- 16 C. AWWA Compliance: Comply with AWWA C606 for grooved-end connections.
- 17 D. NSF Compliance: NSF 61 for valve materials for potable-water service.
- 18 E. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system
- 19 pressures and temperatures.
- 20 F. Valve Sizes: Same as upstream piping unless otherwise indicated.
- 21 G. Valve Actuator Types:
- 22 1. Gear Actuator: For valves NPS 8 and larger.
- 23 2. Handlever: For valves NPS 6 and smaller.
- 24 3. Chainwheel: Device for attachment to gear, handlever, or stem; of size and with chain
- 25 for mounting height, according to "Valve Installation" Article.
- 26 H. Valves in Insulated Piping: With 2-inch stem extensions.

- 1 2.2 IRON, SINGLE-FLANGE BUTTERFLY VALVES
- 2 A. Iron, Single-Flange Butterfly Valves with Aluminum-Bronze Disc:
- 3 1. Manufacturers: Subject to compliance with requirements, provide products by the
4 following:
- 5 a. Conbraco Industries, Inc.; Apollo Valves.
6 b. Crane Co.; Crane Valve Group; Jenkins Valves.
7 c. Crane Co.; Crane Valve Group; Stockham Valves.
8 d. Hammond Valve.
9 e. Kitz Corporation.
10 f. Milwaukee Valve Company.
11 g. NIBCO INC.
12 h. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
- 13 2. Description:
- 14 a. Standard: MSS SP-67, Type I.
15 b. CWP Rating: 200 psig.
16 c. Body Design: Lug type; suitable for bidirectional dead-end service at rated
17 pressure without use of downstream flange.
18 d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
19 e. Seat: EPDM.
20 f. Stem: One- or two-piece stainless steel.
21 g. Disc: Aluminum bronze.
- 22 B. Iron, Single-Flange Butterfly Valves with Stainless-Steel Disc:
- 23 1. Manufacturers: Subject to compliance with requirements, provide products by the
24 following:
- 25
26 a. Conbraco Industries; Apollo Valves.
27 b. Crane Co.; Crane Valve Group; Jenkins Valves.
28 c. Crane Co.; Crane Valve Group; Stockham Valves.
29 d. Hammond Valve.
30 e. Kitz Corporation.
31 f. Milwaukee Valve Company.
32 g. NIBCO INC.
33 h. Watts Regulator Co.; a division of Watts Water Technologies Inc.
- 34 2. Description:
- 35 a. Standard: MSS SP-67, Type I.
36 b. CWP Rating, NPS 12 and Smaller: 200 psig.

- 1 c. Body Design: Lug type; suitable for bidirectional dead-end service at rated
- 2 pressure without use of downstream flange.
- 3 d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
- 4 e. Seat: EPDM.
- 5 f. Stem: One- or two-piece stainless steel.
- 6 g. Disc: Stainless steel.

7 2.3 CHAINWHEELS

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

- 10 1. Babbitt Steam Specialty Co.
- 11 2. Roto Hammer Industries.
- 12 3. Trumbull Industries.

- 13 B. Description: Valve actuation assembly with sprocket rim, chain guides, chain.

- 14 1. Sprocket Rim with Chain Guides: Aluminum, of type and size required for valve. Include
- 15 zinc or epoxy coating.
- 16 2. Chain: Hot-dip, galvanized steel, of size required to fit sprocket rim.

17 PART 3 - EXECUTION

18 3.1 EXAMINATION

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

- 1 3.2 VALVE INSTALLATION
- 2 A. Install valves with unions or flanges at each piece of equipment arranged to allow service,
3 maintenance, and equipment removal without system shutdown.
- 4 B. Locate valves for easy access and provide separate support where necessary.
- 5 C. Install valves in horizontal piping with stem at or above center of pipe.
- 6 D. Install valves in position to allow full stem movement.
- 7 E. Install chainwheels on operators for butterfly valves NPS 4 and larger and more than 96 inches
8 above floor. Extend chains to 60 inches above finished floor.
- 9 F. Install valve tags. Comply with requirements in Section 220553 "Identification for Plumbing
10 Piping and Equipment" for valve tags and schedules.
- 11 3.3 ADJUSTING
- 12 A. Adjust or replace valve packing after piping systems have been tested and put into service but
13 before final adjusting and balancing. Replace valves if persistent leaking occurs.
- 14 3.4 DOMESTIC HOT- AND COLD-WATER VALVE SCHEDULE
- 15 A. Iron, Single-Flange Butterfly Valves: 200 CWP, EPDM seat, aluminum-bronze or stainless-steel
16 disc.
- 17 B. Ductile-Iron, Grooved-End Butterfly Valves: 175 CWP.
- 18 END OF SECTION 220523.13

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1 SECTION 220523.14 - CHECK VALVES FOR PLUMBING PIPING

2 PART 1 - GENERAL

3 1.1 RELATED DOCUMENTS

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

6 1.2 SUMMARY

- 7 A. Section Includes:

- 8 1. Bronze lift check valves.
9 2. Bronze swing check valves.
10 3. Iron swing check valves.
11 4. Iron, plate-type check valves.

12 1.3 DEFINITIONS

- 13 A. CWP: Cold working pressure.
14 B. EPDM: Ethylene propylene-diene terpolymer rubber.
15 C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.

16 1.4 ACTION SUBMITTALS

- 17 A. Product Data: For each type of valve.
18 1. Certification that products comply with NSF 61.

19 1.5 DELIVERY, STORAGE, AND HANDLING

- 20 A. Prepare valves for shipping as follows:
21 1. Protect internal parts against rust and corrosion.
22 2. Protect threads, flange faces, grooves, and weld ends.
23 3. Set check valves in either closed or open position.
24 B. Use the following precautions during storage:

- 1 1. Maintain valve end protection.
- 2 2. Store valves indoors and maintain at higher-than-ambient-dew-point temperature. If
- 3 outdoor storage is necessary, store valves off the ground in watertight enclosures.
- 4 C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use
- 5 handwheels or stems as lifting or rigging points.

6 PART 2 - PRODUCTS

7 2.1 GENERAL REQUIREMENTS FOR VALVES

- 8 A. Source Limitations for Valves: Obtain each type of valve from single source from single
- 9 manufacturer.
- 10 B. ASME Compliance:
 - 11 1. ASME B1.20.1 for threads for threaded end valves.
 - 12 2. ASME B16.1 for flanges on iron valves.
 - 13 3. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
 - 14 4. ASME B16.18 for solder joint.
 - 15 5. ASME B31.9 for building services piping valves.
- 16 C. AWWA Compliance: Comply with AWWA C606 for grooved-end connections.
- 17 D. NSF Compliance: NSF 61 for valve materials for potable-water service.
- 18 E. Bronze valves shall be made with dezincification-resistant materials. Bronze valves made with
- 19 copper alloy (brass) containing more than 15 percent zinc are not permitted.
- 20 F. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system
- 21 pressures and temperatures.
- 22 G. Valve Sizes: Same as upstream piping unless otherwise indicated.
- 23 H. Valve Bypass and Drain Connections: MSS SP-45.

24 2.2 BRONZE LIFT CHECK VALVES

- 25 A. Class 125, Lift Check Valves with Bronze Disc:
 - 26 1. Manufacturers: Subject to compliance with requirements, provide products by one of
 - 27 the following:
 - 28 a. Crane Co.; Crane Valve Group; Crane Valves.

- 1 b. Crane Co.; Crane Valve Group; Jenkins Valves.
- 2 c. Crane Co.; Crane Valve Group; Stockham Valves.
- 3

4 2. Description:

- 5 a. Standard: MSS SP-80, Type 1.
- 6 b. CWP Rating: 200 psig.
- 7 c. Body Design: Vertical flow.
- 8 d. Body Material: ASTM B 61 or ASTM B 62, bronze.
- 9 e. Ends: Threaded or soldered. See valve schedule articles.
- 10 f. Disc: Bronze.

11 2.3 BRONZE SWING CHECK VALVES

12 A. Class 125, Bronze, Swing Check Valves with Bronze Disc:

- 13 1. Manufacturers: Subject to compliance with requirements, provide products by one of
- 14 the following:
- 15 a. Crane Co.; Crane Valve Group; Crane Valves.
- 16 b. Crane Co.; Crane Valve Group; Jenkins Valves.
- 17 c. Crane Co.; Crane Valve Group; Stockham Valves.
- 18 d. Hammond Valve.
- 19 e. Kitz Corporation.
- 20 f. Milwaukee Valve Company.
- 21 g. NIBCO INC.
- 22 h. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

23 2. Description:

- 24 a. Standard: MSS SP-80, Type 3.
- 25 b. CWP Rating: 200 psig.
- 26 c. Body Design: Horizontal flow.
- 27 d. Body Material: ASTM B 62, bronze.
- 28 e. Ends: Threaded or soldered. See valve schedule articles.
- 29 f. Disc: Bronze.

30 2.4 IRON SWING CHECK VALVES

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

- 32 1. Manufacturers: Subject to compliance with requirements, provide products by one of
- 33 the following:
- 34 a. Crane Co.; Crane Valve Group; Crane Valves.

- 1 b. Crane Co.; Crane Valve Group; Jenkins Valves.
- 2 c. Crane Co.; Crane Valve Group; Stockham Valves.
- 3 d. Hammond Valve.
- 4 e. Kitz Corporation.
- 5 f. Milwaukee Valve Company.
- 6 g. NIBCO INC.
- 7 h. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

8 2. Description:

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

16 PART 3 - EXECUTION

17 3.1 EXAMINATION

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

28 3.2 VALVE INSTALLATION

- 29 A. Install valves with unions or flanges at each piece of equipment arranged to allow service,
30 maintenance, and equipment removal without system shutdown.
- 31 B. Locate valves for easy access and provide separate support where necessary.

- 1 C. Install valves in horizontal piping with stem at or above center of pipe.
- 2 D. Install valves in position to allow full stem movement.
- 3 E. Install check valves for proper direction of flow and as follows:
- 4 1. Swing Check Valves: In horizontal position with hinge pin level.
- 5 2. Plate-Type Check Valves: In horizontal or vertical position, between flanges.
- 6 3. Lift Check Valves: With stem upright and plumb.
- 7 F. Install valve tags. Comply with requirements in Section 220553 "Identification for Plumbing
- 8 Piping and Equipment" for valve tags and schedules.
- 9 3.3 ADJUSTING
- 10 A. Adjust or replace valve packing after piping systems have been tested and put into service but
- 11 before final adjusting and balancing. Replace valves if persistent leaking occurs.
- 12 3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS
- 13 A. If valve applications are not indicated, use the following:
- 14 1. Pump-Discharge Check Valves:
- 15 a. NPS 2 and Smaller: Bronze swing check valves with bronze disc.
- 16 b. NPS 2-1/2 and Larger for Domestic Water: Iron swing check valves with lever and
- 17 weight or spring; or iron, center-guided, metal-seat check valves.
- 18 B. If valves with specified CWP ratings are unavailable, the same types of valves with higher CWP
- 19 ratings may be substituted.
- 20 C. End Connections:
- 21 1. For Copper Tubing, NPS 2 and Smaller: Threaded or soldered.
- 22 2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged or threaded.
- 23 3.5 DOMESTIC HOT- AND COLD-WATER VALVE SCHEDULE
- 24 A. Pipe NPS 2 and Smaller: Bronze swing check valves, Class 125, bronze disc with soldered or
- 25 threaded end connections.
- 26 B. Pipe NPS 2-1/2 and Larger:

- 1
 - 2
 - 3
1. Iron swing check valves, Class 125, metal seats with threaded or flanged end connections.
- END OF SECTION 220523.14

1 SECTION 220523.15 - GATE VALVES FOR PLUMBING PIPING

2 PART 1 - GENERAL

3 1.1 RELATED DOCUMENTS

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

6 1.2 SUMMARY

- 7 A. Section Includes:

- 8 1. Bronze gate valves.
9 2. Iron gate valves.
10 3. Chainwheels.

11 1.3 DEFINITIONS

- 12 A. CWP: Cold working pressure.
13 B. NRS: Nonrising stem.
14 C. OS&Y: Outside screw and yoke.
15 D. RS: Rising stem.

16 1.4 ACTION SUBMITTALS

- 17 A. Product Data: For each type of valve.
18 1. Certification that products comply with NSF 61.

19 1.5 DELIVERY, STORAGE, AND HANDLING

- 20 A. Prepare valves for shipping as follows:
21 1. Protect internal parts against rust and corrosion.
22 2. Protect threads, flange faces, grooves, and weld ends.
23 3. Set gate valves closed to prevent rattling.

1
2

- 3 B. Use the following precautions during storage:
- 4 1. Maintain valve end protection.
- 5 2. Store valves indoors and maintain at higher-than-ambient-dew-point temperature. If
- 6 outdoor storage is necessary, store valves off the ground in watertight enclosures.
- 7 C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use
- 8 handwheels or stems as lifting or rigging points.

9 **PART 2 - PRODUCTS**

10 **2.1 GENERAL REQUIREMENTS FOR VALVES**

- 11 A. Source Limitations for Valves: Obtain each type of valve from single source from single
- 12 manufacturer.
- 13 B. ASME Compliance:
- 14 1. ASME B1.20.1 for threads for threaded end valves.
- 15 2. ASME B16.1 for flanges on iron valves.
- 16 3. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
- 17 4. ASME B16.18 for solder joint.
- 18 5. ASME B31.9 for building services piping valves.
- 19 C. NSF Compliance: NSF 61 for valve materials for potable-water service.
- 20 D. Bronze valves shall be made with dezincification-resistant materials. Bronze valves made with
- 21 copper alloy (brass) containing more than 15 percent zinc are not permitted.
- 22 E. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system
- 23 pressures and temperatures.
- 24 F. Valve Sizes: Same as upstream piping unless otherwise indicated.
- 25 G. RS Valves in Insulated Piping: With 2-inch stem extensions.
- 26 H. Valve Bypass and Drain Connections: MSS SP-45.

27 **2.2 BRONZE GATE VALVES**

- 28 A. Class 125, NRS, Bronze Gate Valves:

- 1 1. Manufacturers: Subject to compliance with requirements, provide products by one of
2 the following:
3 a. Crane Co.; Crane Valve Group; Crane Valves.
4 b. Crane Co.; Crane Valve Group; Jenkins Valves.
5 c. Crane Co.; Crane Valve Group; Stockham Valves.
6 d. Hammond Valve.
7 e. Kitz Corporation.
8 f. Milwaukee Valve Company.
9 g. NIBCO INC.
10 h. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
- 11 2. Description:
12 a. Standard: MSS SP-80, Type 1.
13 b. CWP Rating: 200 psig.
14 c. Body Material: Bronze with integral seat and screw-in bonnet.
15 d. Ends: Threaded or solder joint.
16 e. Stem: Bronze.
17 f. Disc: Solid wedge; bronze.
18 g. Packing: Asbestos free.
19 h. Handwheel: Malleable iron, bronze, or aluminum.

20 2.3 IRON GATE VALVES

21 A. Class 125, NRS, Iron Gate Valves:

- 22 1. Manufacturers: Subject to compliance with requirements, provide products by one of
23 the following:
24 a. Crane Co.; Crane Valve Group; Crane Valves.
25 b. Crane Co.; Crane Valve Group; Jenkins Valves.
26 c. Crane Co.; Crane Valve Group; Stockham Valves.
27 d. Hammond Valve.
28 e. Kitz Corporation.
29 f. Milwaukee Valve Company.
30 g. NIBCO INC.
31 h. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
- 32 2. Description:
33 a. Standard: MSS SP-70, Type I.
34 b. CWP Rating: 200 psig.
35 c. Body Material: Gray iron with bolted bonnet.
36 d. Ends: Flanged.
37 e. Trim: Bronze.

- 1 f. Disc: Solid wedge.
- 2 g. Packing and Gasket: Asbestos free.

3 2.4 CHAINWHEELS

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

- 6 1. Babbitt Steam Specialty Co.
- 7 2. Roto Hammer Industries.
- 8 3. Trumbull Industries.

9 B. Description: Valve actuation assembly with sprocket rim, chain guides, chain.

- 10 1. Sprocket Rim with Chain Guides: Aluminum, of type and size required for valve. Include
11 zinc or epoxy coating.
- 12 2. Chain: Hot-dip galvanized steel, of size required to fit sprocket rim.

13 PART 3 - EXECUTION

14 3.1 EXAMINATION

15 A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove
16 special packing materials, such as blocks, used to prevent disc movement during shipping and
17 handling.

18 B. Operate valves in positions from fully open to fully closed. Examine guides and seats made
19 accessible by such operations.

20 C. Examine threads on valve and mating pipe for form and cleanliness.

21 D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper
22 size, length, and material. Verify that gasket is of proper size, that its material composition is
23 suitable for service, and that it is free from defects and damage.

24 E. Do not attempt to repair defective valves; replace with new valves.

25 3.2 VALVE INSTALLATION

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

28 B. Locate valves for easy access and provide separate support where necessary.

- 1 C. Install valves in horizontal piping with stem at or above center of pipe.
- 2 D. Install valves in position to allow full stem movement.
- 3 E. Install chainwheels on operators for gate valves NPS 4 and larger and more than 96 inches
4 above floor. Extend chains to 60 inches above finished floor.
- 5 F. Install valve tags. Comply with requirements in Section 220553 "Identification for Plumbing
6 Piping and Equipment" for valve tags and schedules.

7 3.3 ADJUSTING

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

10 3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

- 11 A. Use gate valves for shutoff service only.
- 12 B. If valves with specified CWP ratings are unavailable, the same types of valves with higher CWP
13 ratings may be substituted.
- 14 C. For Grooved-End Copper Tubing: Valve ends may be grooved.

15 3.5 DOMESTIC HOT- AND COLD-WATER VALVE SCHEDULE

- 16 A. Pipe NPS 2 and Smaller: Bronze gate valves, Class 125, NRS with soldered ends.
- 17 B. Pipe NPS 2-1/2 and Larger: Iron gate valves, Class 125, NRS with flanged ends.

18 END OF SECTION 220523.15

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1 SECTION 220529 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

2 PART 1 - GENERAL

3 1.1 RELATED DOCUMENTS

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

6 1.2 SUMMARY

- 7 A. Section Includes:

- 8 1. Metal pipe hangers and supports.
9 2. Trapeze pipe hangers.
10 3. Metal framing systems.
11 4. Fiberglass strut systems.
12 5. Thermal-hanger shield inserts.
13 6. Fastener systems.
14 7. Pipe stands.
15 8. Pipe positioning systems.
16 9. Equipment supports.

17 1.3 DEFINITIONS

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

19 1.4 PERFORMANCE REQUIREMENTS

- 20 A. Design supports for multiple pipes, including pipe stands, capable of supporting combined
21 weight of supported systems, system contents, and test water.
22 B. Design equipment supports capable of supporting combined operating weight of supported
23 equipment and connected systems and components.

24 1.5 ACTION SUBMITTALS

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

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- 1 B. Shop Drawings: Show fabrication and installation details and include calculations for the
2 following; include Product Data for components:
- 3 1. Trapeze pipe hangers.
4 2. Metal framing systems.
5 3. Pipe stands.
6 4. Equipment supports.
- 7 1.6 INFORMATIONAL SUBMITTALS
- 8 A. Welding certificates.
- 9 1.7 QUALITY ASSURANCE
- 10 A. Structural Steel Welding Qualifications: Qualify procedures and personnel according to
11 AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- 12 B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and
13 Pressure Vessel Code.
- 14 PART 2 - PRODUCTS
- 15 2.1 METAL PIPE HANGERS AND SUPPORTS
- 16 A. Carbon-Steel Pipe Hangers and Supports:
- 17 1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
18 2. Galvanized Metallic Coatings: Pregalvanized or hot dipped.
19 3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
20 4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to
21 support bearing surface of piping.
22 5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel or
23 stainless steel.
- 24 B. Stainless-Steel Pipe Hangers and Supports:
- 25 1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
26 2. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to
27 support bearing surface of piping.
28 3. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.

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- 1 C. Copper Pipe Hangers:
- 2 1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated
3 components.
- 4 2. Hanger Rods: Continuous-thread rod, nuts, and washer made of copper-coated steel or
5 stainless steel.
- 6 2.2 TRAPEZE PIPE HANGERS
- 7 A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from
8 structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-
9 bolts.
- 10 2.3 METAL FRAMING SYSTEMS
- 11 A. MFMA Manufacturer Metal Framing Systems:
- 12 1. Manufacturers: Subject to compliance with requirements, provide products by one of
13 the following:
- 14 a. Cooper B-Line, Inc.
15 b. Unistrut Corporation; Tyco International, Ltd.
- 16 2. Description: Shop- or field-fabricated pipe-support assembly for supporting multiple
17 parallel pipes.
- 18 3. Standard: MFMA-4.
- 19 4. Channels: Continuous slotted steel channel with inturred lips.
- 20 5. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into
21 channel slot and, when tightened, prevent slipping along channel.
- 22 6. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel or
23 stainless steel.
- 24 7. Plastic Coating: PVC.
- 25 2.4 THERMAL-HANGER SHIELD INSERTS
- 26 A. Manufacturers: Subject to compliance with requirements, provide products by one of the
27 following:
- 28 1. ERICO International Corporation.
29 2. Pipe Shields, Inc.; a subsidiary of Piping Technology & Products, Inc.

- 1 B. Insulation-Insert Material for Cold Piping: Water-repellent treated, ASTM C533, Type I calcium
2 silicate or ASTM C522 Type II cellular glass with vapor barrier.
- 3 C. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium
4 silicate or ASTM C 552, Type II cellular glass with 100-psig minimum compressive strength.
- 5 D. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
- 6 E. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
- 7 F. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient
8 air temperature.
- 9 2.5 FASTENER SYSTEMS
- 10 A. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated or stainless- steel anchors, for
11 use in hardened portland cement concrete; with pull-out, tension, and shear capacities
12 appropriate for supported loads and building materials where used.
- 13 2.6 PIPE STANDS
- 14 A. General Requirements for Pipe Stands: Shop- or field-fabricated assemblies made of
15 manufactured corrosion-resistant components to support roof-mounted piping.
- 16 B. Compact Pipe Stand: One-piece plastic unit with integral-rod roller, pipe clamps, or V-shaped
17 cradle to support pipe, for roof installation without membrane penetration.
- 18 C. Low-Type, Single-Pipe Stand: One-piece plastic base unit with plastic roller, for roof
19 installation without membrane penetration.
- 20 D. High-Type, Single-Pipe Stand:
- 21 1. Description: Assembly of base, vertical and horizontal members, and pipe support, for
22 roof installation without membrane penetration.
- 23 2. Base: Plastic.
- 24 3. Vertical Members: Two or more cadmium-plated-steel or stainless-steel, continuous-
25 thread rods.
- 26 4. Horizontal Member: Cadmium-plated-steel or stainless-steel rod with plastic or
27 stainless-steel, roller-type pipe support.
- 28 E. High-Type, Multiple-Pipe Stand:

- 1 1. Description: Assembly of bases, vertical and horizontal members, and pipe supports, for
- 2 roof installation without membrane penetration.
- 3 2. Bases: One or more; plastic.
- 4 3. Vertical Members: Two or more protective-coated-steel channels.
- 5 4. Horizontal Member: Protective-coated-steel channel.
- 6 5. Pipe Supports: Galvanized-steel, clevis-type pipe hangers.

- 7 F. Curb-Mounting-Type Pipe Stands: Shop- or field-fabricated pipe supports made from
- 8 structural-steel shapes, continuous-thread rods, and rollers, for mounting on permanent
- 9 stationary roof curb.

10 2.7 PIPE POSITIONING SYSTEMS

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

13 2.8 EQUIPMENT SUPPORTS

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

16 2.9 MISCELLANEOUS MATERIALS

- 17 A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and
- 18 galvanized.

- 19 B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and
- 20 nonmetallic grout; suitable for interior and exterior applications.

- 21 1. Properties: Nonstaining, noncorrosive, and nongaseous.

- 22 2. Design Mix: 5000-psi, 28-day compressive strength.

23 PART 3 - EXECUTION

24 3.1 HANGER AND SUPPORT INSTALLATION

- 25 A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers,
- 26 supports, clamps, and attachments as required to properly support piping from the building
- 27 structure.

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- 1 B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for
2 grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze
3 pipe hangers.
- 4 1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or
5 install intermediate supports for smaller diameter pipes as specified for individual pipe
6 hangers.
- 7 2. Field fabricate from ASTM A 36/A 36M, carbon-steel shapes selected for loads being
8 supported. Weld steel according to AWS D1.1/D1.1M.
- 9 C. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support
10 together on field-assembled metal framing systems.
- 11 D. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
- 12 E. Fastener System Installation:
- 13 1. Install mechanical-expansion anchors in concrete after concrete is placed and
14 completely cured. Install fasteners according to manufacturer's written instructions.
- 15 F. Pipe Stand Installation:
- 16 1. Pipe Stand Types except Curb-Mounted Type: Assemble components and mount on
17 smooth roof surface. Do not penetrate roof membrane.
- 18 2. Curb-Mounted-Type Pipe Stands: Assemble components or fabricate pipe stand and
19 mount on permanent, stationary roof curb. See Section 077200 "Roof Accessories" for
20 curbs.
- 21 G. Pipe Positioning-System Installation: Install support devices to make rigid supply and waste
22 piping connections to each plumbing fixture.
- 23 H. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts,
24 washers, and other accessories.
- 25 I. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- 26 J. Install hangers and supports to allow controlled thermal and seismic movement of piping
27 systems, to permit freedom of movement between pipe anchors, and to facilitate action of
28 expansion joints, expansion loops, expansion bends, and similar units.
- 29 K. Install lateral bracing with pipe hangers and supports to prevent swaying.
- 30 L. Install building attachments within concrete slabs or attach to structural steel. Install
31 additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-

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- 1 1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is
2 placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.
- 3 M. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses
4 from movement will not be transmitted to connected equipment.
- 5 N. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed
6 maximum pipe deflections allowed by ASME B31.9 for building services piping.
- 7 O. Insulated Piping:
- 8 1. Attach clamps and spacers to piping.
- 9 a. Piping Operating above Ambient Air Temperature: Clamp may project through
10 insulation.
- 11 b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield
12 insert with clamp sized to match OD of insert.
- 13 c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services
14 piping.
- 15 2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is
16 indicated. Fill interior voids with insulation that matches adjoining insulation.
- 17 a. Option: Thermal-hanger shield inserts may be used. Include steel weight-
18 distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
- 19 3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields
20 shall span an arc of 180 degrees.
- 21 a. Option: Thermal-hanger shield inserts may be used. Include steel weight-
22 distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
- 23 4. Shield Dimensions for Pipe: Not less than the following:
- 24 a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
- 25 b. NPS 4: 12 inches long and 0.06 inch thick.
- 26 c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
- 27 d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
- 28 5. Pipes NPS 8 and Larger: Include wood or reinforced calcium-silicate-insulation inserts of
29 length at least as long as protective shield.
- 30 6. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

- 1 3.2 EQUIPMENT SUPPORTS
- 2 A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support
3 equipment above floor.
- 4 B. Grouting: Place grout under supports for equipment and make bearing surface smooth.
- 5 C. Provide lateral bracing, to prevent swaying, for equipment supports.
- 6 3.3 METAL FABRICATIONS
- 7 A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment
8 supports.
- 9 B. Fit exposed connections together to form hairline joints. Field weld connections that cannot
10 be shop welded because of shipping size limitations.
- 11 C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding;
12 appearance and quality of welds; and methods used in correcting welding work; and with the
13 following:
- 14 1. Use materials and methods that minimize distortion and develop strength and corrosion
15 resistance of base metals.
- 16 2. Obtain fusion without undercut or overlap.
- 17 3. Remove welding flux immediately.
- 18 4. Finish welds at exposed connections so no roughness shows after finishing and so
19 contours of welded surfaces match adjacent contours.
- 20 3.4 ADJUSTING
- 21 A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to
22 achieve indicated slope of pipe.
- 23 B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.
- 24 3.5 PAINTING
- 25 A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately
26 after erecting hangers and supports. Use same materials as used for shop painting. Comply
27 with SSPC-PA 1 requirements for touching up field-painted surfaces.
- 28 1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.

- 1 B. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded
2 areas of shop paint on miscellaneous metal are specified in Division 09 painting sections.
- 3 C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply
4 galvanizing-repair paint to comply with ASTM A 780.
- 5 3.6 HANGER AND SUPPORT SCHEDULE
- 6 A. Specific hanger and support requirements are in Sections specifying piping systems and
7 equipment.
- 8 B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in
9 piping system Sections.
- 10 C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will
11 not have field-applied finish.
- 12 D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in
13 direct contact with copper tubing.
- 14 E. Use padded hangers for piping that is subject to scratching.
- 15 F. Use thermal-hanger shield inserts for insulated piping and tubing.
- 16 G. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in
17 piping system Sections, install the following types:
- 18 1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or
19 insulated, stationary pipes NPS 1/2 to NPS 30.
- 20 2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F, pipes NPS 4
21 to NPS 24, requiring up to 4 inches of insulation.
- 22 3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes
23 NPS 3/4 to NPS 36, requiring clamp flexibility and up to 4 inches of insulation.
- 24 4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes NPS 1/2 to NPS 24
25 if little or no insulation is required.
- 26 5. Pipe Hangers (MSS Type 5): For suspension of pipes NPS 1/2 to NPS 4, to allow off-
27 center closure for hanger installation before pipe erection.
- 28 6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of
29 noninsulated, stationary pipes NPS 3/4 to NPS 8.
- 30 7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated,
31 stationary pipes NPS 1/2 to NPS 8.
- 32 8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated, stationary
33 pipes NPS 1/2 to NPS 8.

- 1 9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated,
2 stationary pipes NPS 1/2 to NPS 8.
- 3 10. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of
4 noninsulated, stationary pipes NPS 3/8 to NPS 8.
- 5 11. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of
6 noninsulated, stationary pipes NPS 3/8 to NPS 3.
- 7 12. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.
- 8 13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or
9 contraction.
- 10 14. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36, with steel-
11 pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
- 12 15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36, with steel-
13 pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-
14 bolt to retain pipe.
- 15 16. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes
16 NPS 2-1/2 to NPS 36 if vertical adjustment is required, with steel-pipe base stanchion
17 support and cast-iron floor flange.
- 18 17. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30, from two rods
19 if longitudinal movement caused by expansion and contraction might occur.
- 20 18. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes NPS 2-1/2 to NPS 24,
21 from single rod if horizontal movement caused by expansion and contraction might
22 occur.
- 23 19. Complete Pipe Rolls (MSS Type 44): For support of pipes NPS 2 to NPS 42 if longitudinal
24 movement caused by expansion and contraction might occur but vertical adjustment is
25 not necessary.
- 26 20. Pipe Roll and Plate Units (MSS Type 45): For support of pipes NPS 2 to NPS 24 if small
27 horizontal movement caused by expansion and contraction might occur and vertical
28 adjustment is not necessary.
- 29 21. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes NPS 2 to
30 NPS 30 if vertical and lateral adjustment during installation might be required in
31 addition to expansion and contraction.

- 32 H. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system
33 Sections, install the following types:
 - 34 1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to
35 NPS 24.
 - 36 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to
37 NPS 24 if longer ends are required for riser clamps.

- 38 I. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system
39 Sections, install the following types:
 - 40 1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.

- 1 2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
- 2 3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
- 3 4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of
- 4 building attachments.
- 5 5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.

- 6 J. Building Attachments: Unless otherwise indicated and except as specified in piping system
- 7 Sections, install the following types:
 - 8 1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend
 - 9 pipe hangers from concrete ceiling.
 - 10 2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist
 - 11 construction, to attach to top flange of structural shape.
 - 12 3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams,
 - 13 channels, or angles.
 - 14 4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
 - 15 5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads
 - 16 are considerable and rod sizes are large.
 - 17 6. C-Clamps (MSS Type 23): For structural shapes.
 - 18 7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to
 - 19 flange edge.
 - 20 8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
 - 21 9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-
 - 22 beams for heavy loads.
 - 23 10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-
 - 24 beams for heavy loads, with link extensions.
 - 25 11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to
 - 26 structural steel.
 - 27 12. Welded-Steel Brackets: For support of pipes from below or for suspending from above
 - 28 by using clip and rod. Use one of the following for indicated loads:
 - 29 a. Light (MSS Type 31): 750 lb.
 - 30 b. Medium (MSS Type 32): 1500 lb.
 - 31 c. Heavy (MSS Type 33): 3000 lb.
 - 32 13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
 - 33 14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
 - 34 15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear
 - 35 horizontal movement where headroom is limited.

- 36 K. Saddles and Shields: Unless otherwise indicated and except as specified in piping system
- 37 Sections, install the following types:

- 1 1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with
2 insulation that matches adjoining insulation.
- 3 2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer
4 to prevent crushing insulation.
- 5 3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.

- 6 L. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping
7 system Sections, install the following types:
 - 8 1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
 - 9 2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-
10 1/4 inches.
 - 11 3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41, roll hanger with
12 springs.
 - 13 4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal
14 expansion in piping systems.
 - 15 5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability
16 factor to 25 percent to allow expansion and contraction of piping system from hanger.
 - 17 6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit
18 variability factor to 25 percent to allow expansion and contraction of piping system from
19 base support.
 - 20 7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit
21 variability factor to 25 percent to allow expansion and contraction of piping system from
22 trapeze support.
 - 23 8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress
24 from one support to another support, critical terminal, or connected equipment.
25 Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability.
26 These supports include the following types:
 - 27 a. Horizontal (MSS Type 54): Mounted horizontally.
 - 28 b. Vertical (MSS Type 55): Mounted vertically.
 - 29 c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.

- 30 M. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not
31 specified in piping system Sections.

- 32 N. Comply with MFMA-103 for metal framing system selections and applications that are not
33 specified in piping system Sections.

- 34 O. Use pipe positioning systems in pipe spaces behind plumbing fixtures to support supply and
35 waste piping for plumbing fixtures.

36 END OF SECTION 220529

1 SECTION 220553 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

2 PART 1 - GENERAL

3 1.1 RELATED DOCUMENTS

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

6 1.2 SUMMARY

- 7 A. Section Includes:

- 8 1. Equipment labels.
9 2. Warning signs and labels.
10 3. Pipe labels.
11 4. Stencils.
12 5. Valve tags.
13 6. Warning tags.

14 1.3 ACTION SUBMITTALS

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

22 1.4 COORDINATION

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

1 PART 2 - PRODUCTS

2 2.1 EQUIPMENT LABELS

3 A. Plastic Labels for Equipment:

- 4 1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving,
5 1/16 inch thick, and having predrilled holes for attachment hardware.
6 2. Letter Color: White.
7 3. Background Color: Black.
8 4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
9 5. Minimum Label Size: Length and width vary for required label content, but not less than
10 2-1/2 by 3/4 inch.
11 6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24
12 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger
13 lettering for greater viewing distances. Include secondary lettering two-thirds to three-
14 fourths the size of principal lettering.
15 7. Fasteners: Stainless-steel rivets or self-tapping screws.
16 8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

17 B. Label Content: Include equipment's Drawing designation or unique equipment number.

18 C. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch
19 bond paper. Tabulate equipment identification number. Equipment schedule shall be
20 included in operation and maintenance data.

21 2.2 WARNING SIGNS AND LABELS

22 A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16
23 inch thick, and having predrilled holes for attachment hardware.

24 B. Letter Color: White.

25 C. Background Color: Red.

26 D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

27 E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2
28 by 3/4 inch.

29 F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2
30 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater
31 viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal
32 lettering.

- 1 G. Fasteners: Stainless-steel rivets or self-tapping screws.
- 2 H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- 3 I. Label Content: Include caution and warning information, plus emergency notification
- 4 instructions.

5 2.3 PIPE LABELS

- 6 A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering
- 7 indicating service, and showing flow direction.
- 8 B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of
- 9 pipe and to attach to pipe without fasteners or adhesive.
- 10 C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
- 11 D. Pipe Label Contents: Include identification of piping service using same designations or
- 12 abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.
- 13 1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate
- 14 both directions or as separate unit on each pipe label to indicate flow direction.
- 15 2. Lettering Size: At least 1-1/2 inches high.

16 2.4 STENCILS

- 17 A. Stencils: Prepared with letter sizes according to ASME A13.1 for piping; and minimum letter
- 18 height of 3/4 inch for access panel and door labels, equipment labels, and similar operational
- 19 instructions.
- 20 1. Stencil Material: Fiberboard or metal.
- 21 2. Stencil Paint: Exterior, gloss, alkyd enamel black unless otherwise indicated. Paint may
- 22 be in pressurized spray-can form.
- 23 3. Identification Paint: Exterior, alkyd enamel in colors according to ASME A13.1 unless
- 24 otherwise indicated.

25 2.5 VALVE TAGS

- 26 A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-
- 27 inch numbers.
- 28 1. Tag Material: Brass, 0.032-inch minimum thickness, and having predrilled or stamped
- 29 holes for attachment hardware.
- 30 2. Fasteners: Brass wire-link or beaded chain; or S-hook.

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

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

6 2.6 WARNING TAGS

7 A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card
8 stock with matte finish suitable for writing.

9 1. Size: 3 by 5-1/4 inches minimum.

10 2. Fasteners: Brass grommet and wire.

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

13 4. Color: Yellow background with black lettering.

14 PART 3 - EXECUTION

15 3.1 PREPARATION

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

19 3.2 EQUIPMENT LABEL INSTALLATION

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

21 B. Locate equipment labels where accessible and visible.

22 3.3 PIPE LABEL INSTALLATION

23 A. Piping Color-Coding: Painting of piping is specified in Division 09 painting sections.

24 B. Stenciled Pipe Label Option: Stenciled labels may be provided instead of manufactured pipe
25 labels, at Installer's option. Install stenciled pipe labels complying with ASME A13.1, on each
26 piping system.

27 1. Identification Paint: Use for contrasting background.

28 2. Stencil Paint: Use for pipe marking.

- 1 C. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces;
2 machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and
3 exterior exposed locations as follows:
- 4 1. Near each valve and control device.
5 2. Near each branch connection, excluding short takeoffs for fixtures and terminal units.
6 Where flow pattern is not obvious, mark each pipe at branch.
7 3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
8 4. At access doors, manholes, and similar access points that permit view of concealed
9 piping.
10 5. Near major equipment items and other points of origination and termination.
11 6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in
12 areas of congested piping and equipment.
13 7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.
- 14 D. Pipe Label Color Schedule:
- 15 1. Domestic Water Piping:
- 16 a. Background Color: Black.
17 b. Letter Color: White
- 18 2. Sanitary Waste Piping:
- 19 a. Background Color: Yellow.
20 b. Letter Color: Black.
- 21 3.4 VALVE-TAG INSTALLATION
- 22 A. Install tags on valves and control devices in piping systems, except check valves; valves within
23 factory-fabricated equipment units; shutoff valves; faucets; convenience and lawn-watering
24 hose connections; and similar roughing-in connections of end-use fixtures and units. List
25 tagged valves in a valve schedule.
- 26 B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and
27 with captions similar to those indicated in the following subparagraphs:
- 28 1. Valve-Tag Size and Shape:
29 a. Cold Water: 1-1/2 inches, round.
30 b. Hot Water: 1-1/2 inches, round.
- 31 2. Valve-Tag Color:
32 a. Cold Water: Natural.
33 b. Hot Water: Natural.
- 34 3. Letter Color:

- 1 a. Cold Water: Black.
- 2 b. Hot Water: Black.

3 3.5 WARNING-TAG INSTALLATION

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

6 END OF SECTION 220553

1 SECTION 220719 - PLUMBING PIPING INSULATION

2 PART 1 - GENERAL

3 1.1 RELATED DOCUMENTS

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

6 1.2 SUMMARY

- 7 A. Section includes insulating the following plumbing piping services:

- 8 1. Domestic cold-water piping.
9 2. Domestic hot-water piping.
10 3. Supplies and drains for handicap-accessible lavatories and sinks.

11 1.3 ACTION SUBMITTALS

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

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

- 15 1. Detail application of protective shields, saddles, and inserts at hangers for each type of
16 insulation and hanger.
17 2. Detail insulation application at pipe expansion joints for each type of insulation.
18 3. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each
19 type of insulation.
20 4. Detail removable insulation at piping specialties, equipment connections, and access
21 panels.

22 1.4 INFORMATIONAL SUBMITTALS

- 23 A. Qualification Data: For qualified Installer.

- 24 B. Material Test Reports: From a qualified testing agency acceptable to authorities having
25 jurisdiction indicating, interpreting, and certifying test results for compliance of insulation
26 materials, sealers, attachments, cements, and jackets, with requirements indicated. Include
27 dates of tests and test methods employed.

- 28 C. Field quality-control reports.

- 1 1.5 QUALITY ASSURANCE
- 2 A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship
3 program or another craft training program certified by the Department of Labor, Bureau of
4 Apprenticeship and Training.
- 5 B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing
6 identical products according to ASTM E 84 by a testing agency acceptable to authorities having
7 jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and
8 cement material containers, with appropriate markings of applicable testing agency.
- 9 1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed
10 index of 50 or less.
- 11 2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed
12 index of 150 or less.
- 13 C. Comply with the following applicable standards and other requirements specified for
14 miscellaneous components:
- 15 1. Supply and Drain Protective Shielding Guards: ICC A117.1.
- 16 1.6 DELIVERY, STORAGE, AND HANDLING
- 17 A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate
18 ASTM standard designation, type and grade, and maximum use temperature.
- 19 1.7 COORDINATION
- 20 A. Coordinate sizes and locations of supports, hangers, and insulation shields.
- 21 B. Coordinate clearance requirements with piping Installer for piping insulation application.
22 Before preparing piping Shop Drawings, establish and maintain clearance requirements for
23 installation of insulation and field-applied jackets and finishes and for space required for
24 maintenance.
- 25 1.8 SCHEDULING
- 26 A. Schedule insulation application after pressure testing systems. Insulation application may
27 begin on segments that have satisfactory test results.
- 28 B. Complete installation and concealment of plastic materials as rapidly as possible in each area
29 of construction.

1 PART 2 - PRODUCTS

2 2.1 INSULATION MATERIALS

3 A. Comply with requirements in "Piping Insulation Schedule, General," and "Indoor Piping
4 Insulation Schedule," articles for where insulating materials shall be applied.

5 B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

6 C. Products that come in contact with stainless steel shall have a leachable chloride content of
7 less than 50 ppm when tested according to ASTM C 871.

8 D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable
9 according to ASTM C 795.

10 E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing
11 process.

12 F. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply
13 with ASTM C 534, Type I for tubular materials.

14 1. Products: Subject to compliance with requirements, provide one of the following:

15 a. Aeroflex USA, Inc.; Aerocel.

16 b. Armacell LLC; AP Armaflex.

17 G. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin.
18 Comply with ASTM C 553, Type II and ASTM C 1290, Type I. Factory-applied jacket
19 requirements are specified in "Factory-Applied Jackets" Article.

20 1. Products: Subject to compliance with requirements, provide one of the following:

21 a. CertainTeed Corp.; SoftTouch Duct Wrap.

22 b. Johns Manville; Microlite.

23 c. Knauf Insulation; Friendly Feel Duct Wrap.

24 d. Owens Corning; SOFTR All-Service Duct Wrap.

25 H. Mineral-Fiber, Preformed Pipe Insulation:

26 1. Products: Subject to compliance with requirements, provide one of the following:

27 a. Johns Manville; Micro-Lok.

28 b. Knauf Insulation; 1000-Degree Pipe Insulation.

29 c. Owens Corning; Fiberglas Pipe Insulation.

1 2.2 INSULATING CEMENTS

2 A. Mineral-Fiber Insulating Cement: Comply with ASTM C 195.

3 1. Products: Subject to compliance with requirements, provide one of the following:

4 a. Ramco Insulation, Inc.; Super-Stik.

5 B. Expanded or Exfoliated Vermiculite Insulating Cement: Comply with ASTM C 196.

6 1. Products: Subject to compliance with requirements, provide one of the following:

7 a. Ramco Insulation, Inc.; Thermokote V.

8 C. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449.

9 1. Products: Subject to compliance with requirements, provide one of the following:

10 a. Ramco Insulation, Inc.; Ramcote 1200 and Quik-Cote.

11 2.3 ADHESIVES

12 A. Materials shall be compatible with insulation materials, jackets, and substrates and for
13 bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.

14 B. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.

15 1. Products: Subject to compliance with requirements, provide one of the following:

16 a. Aeroflex USA, Inc.; Aero seal.

17 b. Armacell LLC; Armaflex 520 Adhesive.

18 c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller
19 Company; 85-75.

20 2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when
21 calculated according to 40 CFR 59, Subpart D (EPA Method 24).

22 C. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

23 1. Products: Subject to compliance with requirements, provide one of the following:

24 a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller
25 Company; CP-127.

26 b. Eagle Bridges - Marathon Industries; 225.

27 c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller
28 Company; 85-60/85-70.

29 d. Mon-Eco Industries, Inc.; 22-25.

- 1 2. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when
2 calculated according to 40 CFR 59, Subpart D (EPA Method 24).

- 3
4 D. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for
5 bonding insulation jacket lap seams and joints.

- 6 1. Products: Subject to compliance with requirements, provide one of the following:
7 a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller
8 Company; CP-82.
9 b. Eagle Bridges - Marathon Industries; 225.
10 c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller
11 Company; 85-20.
12 d. Mon-Eco Industries, Inc.; 22-25.

- 13 2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when
14 calculated according to 40 CFR 59, Subpart D (EPA Method 24).

15 2.4 SEALANTS

16 A. Joint Sealants:

- 17 1. Joint Sealants for Cellular-Glass and Phenolic Products: Subject to compliance with
18 requirements, provide one of the following:

- 19 a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller
20 Company; CP-76.
21 b. Eagle Bridges - Marathon Industries; 405.
22 c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller
23 Company; 30-45.
24 d. Mon-Eco Industries, Inc.; 44-05.
25 e. Pittsburgh Corning Corporation; Pittseal 444.

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

32 B. FSK and Metal Jacket Flashing Sealants:

- 33 1. Products: Subject to compliance with requirements, provide one of the following:

- 1 a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller
2 Company; CP-76.
- 3 b. Eagle Bridges - Marathon Industries; 405.
- 4 c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller
5 Company; 95-44.
- 6 d. Mon-Eco Industries, Inc.; 44-05.

- 7 2. Materials shall be compatible with insulation materials, jackets, and substrates.
- 8 3. Fire- and water-resistant, flexible, elastomeric sealant.
- 9 4. Service Temperature Range: Minus 40 to plus 250 deg F.
- 10 5. Color: Aluminum.
- 11 6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when
12 calculated according to 40 CFR 59, Subpart D (EPA Method 24).

- 13 C. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:

- 14 1. Products: Subject to compliance with requirements, provide one of the following:
- 15 a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller
16 Company; CP-76.
- 17 2. Materials shall be compatible with insulation materials, jackets, and substrates.
- 18 3. Fire- and water-resistant, flexible, elastomeric sealant.
- 19 4. Service Temperature Range: Minus 40 to plus 250 deg F.
- 20 5. Color: White.
- 21 6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when
22 calculated according to 40 CFR 59, Subpart D (EPA Method 24).

- 23 2.5 FACTORY-APPLIED JACKETS

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

- 30 2.6 TAPES

- 31 A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive,
32 complying with ASTM C 1136.

- 33 1. Products: Subject to compliance with requirements, provide one of the following:

- 1 a. ABI, Ideal Tape Division; 428 AWF ASJ.
- 2 b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0836.
- 3 c. Compac Corporation; 104 and 105.
- 4 d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.

- 5 2. Width: 3 inches.
- 6 3. Thickness: 11.5 mils.
- 7 4. Adhesion: 90 ounces force/inch in width.
- 8 5. Elongation: 2 percent.
- 9 6. Tensile Strength: 40 lbf/inch in width.
- 10 7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.
- 11

- 12 B. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.

- 13 1. Products: Subject to compliance with requirements, provide one of the following:
- 14 a. ABI, Ideal Tape Division; 488 AWF.
- 15 b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.
- 16 c. Compac Corporation; 120.
- 17 d. Venture Tape; 3520 CW.

- 18 2. Width: 2 inches.
- 19 3. Thickness: 3.7 mils.
- 20 4. Adhesion: 100 ounces force/inch in width.
- 21 5. Elongation: 5 percent.
- 22 6. Tensile Strength: 34 lbf/inch in width.

- 23 2.7 SECUREMENTS

- 24 A. Bands:

- 25 1. Products: Subject to compliance with requirements, provide one of the following:
- 26 a. ITW Insulation Systems; Gerrard Strapping and Seals.
- 27 b. RPR Products, Inc.; Insul-Mate Strapping and Seals.

- 28 2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316; 0.015 inch
- 29 thick, 1/2 inch wide with wing seal or closed seal.
- 30 3. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch
- 31 thick, 1/2 inch wide with wing seal or closed seal.

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

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

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

3 a. C & F Wire.

4 2.8 PROTECTIVE SHIELDING GUARDS

5 A. Protective Shielding Pipe Covers,:

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

8 a. Plumberex.

9 b. Truebro; a brand of IPS Corporation.

10 c. Zurn Industries, LLC; Tubular Brass Plumbing Products Operation.

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

14 B. Protective Shielding Piping Enclosures,:

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

17 a. Truebro; a brand of IPS Corporation.

18 b. Zurn Industries, LLC; Tubular Brass Plumbing Products Operation.

19 2. Description: Manufactured plastic enclosure for covering plumbing fixture hot- and
20 cold-water supplies and trap and drain piping. Comply with ADA requirements.

21 PART 3 - EXECUTION

22 3.1 EXAMINATION

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

25 1. Verify that systems to be insulated have been tested and are free of defects.

26 2. Verify that surfaces to be insulated are clean and dry.

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

- 1 3.2 PREPARATION
- 2 A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will
3 adversely affect insulation application.
- 4 B. Mix insulating cements with clean potable water; if insulating cements are to be in contact
5 with stainless-steel surfaces, use demineralized water.
- 6 3.3 GENERAL INSTALLATION REQUIREMENTS
- 7 A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces;
8 free of voids throughout the length of piping including fittings, valves, and specialties.
- 9 B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses
10 required for each item of pipe system as specified in insulation system schedules.
- 11 C. Install accessories compatible with insulation materials and suitable for the service. Install
12 accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet
13 or dry state.
- 14 D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- 15 E. Install multiple layers of insulation with longitudinal and end seams staggered.
- 16 F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- 17 G. Keep insulation materials dry during application and finishing.
- 18 H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with
19 adhesive recommended by insulation material manufacturer.
- 20 I. Install insulation with least number of joints practical.
- 21 J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers,
22 supports, anchors, and other projections with vapor-barrier mastic.
- 23 1. Install insulation continuously through hangers and around anchor attachments.
- 24 2. For insulation application where vapor barriers are indicated, extend insulation on
25 anchor legs from point of attachment to supported item to point of attachment to
26 structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
- 27 3. Install insert materials and install insulation to tightly join the insert. Seal insulation to
28 insulation inserts with adhesive or sealing compound recommended by insulation
29 material manufacturer.
- 30 4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over
31 jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

- 1 K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet
2 and dry film thicknesses.
- 3 L. Install insulation with factory-applied jackets as follows:
- 4 1. Draw jacket tight and smooth.
- 5 2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation
6 jacket. Secure strips with adhesive and outward clinching staples along both edges of
7 strip, spaced 4 inches o.c.
- 8 3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with
9 longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap.
10 Staple laps with outward clinching staples along edge at 2 inches o.c.
- 11 a. For below-ambient services, apply vapor-barrier mastic over staples.
- 12 4. Cover joints and seams with tape, according to insulation material manufacturer's
13 written instructions, to maintain vapor seal.
- 14 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and
15 at ends adjacent to pipe flanges and fittings.
- 16 M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its
17 nominal thickness.
- 18 N. Finish installation with systems at operating conditions. Repair joint separations and cracking
19 due to thermal movement.
- 20 O. Repair damaged insulation facings by applying same facing material over damaged areas.
21 Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches
22 similar to butt joints.
- 23 P. For above-ambient services, do not install insulation to the following:
- 24 1. Vibration-control devices.
- 25 2. Testing agency labels and stamps.
- 26 3. Nameplates and data plates.
- 27 4. Cleanouts.
- 28 3.4 PENETRATIONS
- 29 A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof
30 penetrations.
- 31 1. Seal penetrations with flashing sealant.
- 32 2. For applications requiring only indoor insulation, terminate insulation above roof
33 surface and seal with joint sealant. For applications requiring indoor and outdoor

- 1 insulation, install insulation for outdoor applications tightly joined to indoor insulation
2 ends. Seal joint with joint sealant.
- 3 3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of
4 roof flashing.
- 5 4. Seal jacket to roof flashing with flashing sealant.
- 6 B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush
7 with sleeve seal. Seal terminations with flashing sealant.
- 8 C. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated):
9 Install insulation continuously through walls and partitions.
- 10 D. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation
11 continuously through penetrations of fire-rated walls and partitions.
- 12 1. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping
13 and fire-resistive joint sealers.
- 14 E. Insulation Installation at Floor Penetrations:
- 15 1. Pipe: Install insulation continuously through floor penetrations.
16 2. Seal penetrations through fire-rated assemblies. Comply with requirements in
17 Section 078413 "Penetration Firestopping."
- 18 3.5 GENERAL PIPE INSULATION INSTALLATION
- 19 A. Requirements in this article generally apply to all insulation materials except where more
20 specific requirements are specified in various pipe insulation material installation articles.
- 21
- 22 B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:
- 23 1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties
24 with continuous thermal and vapor-retarder integrity unless otherwise indicated.
- 25 2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from
26 same material and density as adjacent pipe insulation. Each piece shall be butted tightly
27 against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular
28 surfaces with insulating cement finished to a smooth, hard, and uniform contour that is
29 uniform with adjoining pipe insulation.
- 30 3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same
31 material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit.
32 Butt each section closely to the next and hold in place with tie wire. Bond pieces with
33 adhesive.
- 34 4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same
35 material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe

- 1 insulation by not less than two times the thickness of pipe insulation, or one pipe
2 diameter, whichever is thicker. For valves, insulate up to and including the bonnets,
3 valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with
4 insulating cement.
- 5 5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same
6 material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe
7 insulation by not less than two times the thickness of pipe insulation, or one pipe
8 diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating
9 cement. Insulate strainers so strainer basket flange or plug can be easily removed and
10 replaced without damaging the insulation and jacket. Provide a removable reusable
11 insulation cover. For below-ambient services, provide a design that maintains vapor
12 barrier.
- 13 6. Insulate flanges and unions using a section of oversized preformed pipe insulation.
14 Overlap adjoining pipe insulation by not less than two times the thickness of pipe
15 insulation, or one pipe diameter, whichever is thicker.
- 16 7. For services not specified to receive a field-applied jacket except for flexible elastomeric
17 and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and
18 unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation
19 facing using PVC tape.
- 20 8. Stencil or label the outside insulation jacket of each union with the word "union."
21 Match size and color of pipe labels.
- 22 C. Insulate instrument connections for thermometers, pressure gages, pressure temperature
23 taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes.
24 Shape insulation at these connections by tapering it to and around the connection with
25 insulating cement and finish with finishing cement, mastic, and flashing sealant.
- 26 D. Install removable insulation covers at locations indicated. Installation shall conform to the
27 following:
- 28 1. Make removable flange and union insulation from sectional pipe insulation of same
29 thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe
30 insulation.
- 31 2. When flange and union covers are made from sectional pipe insulation, extend
32 insulation from flanges or union long at least two times the insulation thickness over
33 adjacent pipe insulation on each side of flange or union. Secure flange cover in place
34 with stainless-steel or aluminum bands. Select band material compatible with insulation
35 and jacket.
- 36 3. Construct removable valve insulation covers in same manner as for flanges, except
37 divide the two-part section on the vertical center line of valve body.
- 38 4. When covers are made from block insulation, make two halves, each consisting of
39 mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached
40 insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent
41 pipe insulation on each side of valve. Fill space between flange or union cover and pipe
42 insulation with insulating cement. Finish cover assembly with insulating cement applied
43 in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.

- 1 3.6 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION
- 2 A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to
3 eliminate openings in insulation that allow passage of air to surface being insulated.
- 4 B. Insulation Installation on Pipe Flanges:
- 5 1. Install pipe insulation to outer diameter of pipe flange.
6 2. Make width of insulation section same as overall width of flange and bolts, plus twice
7 the thickness of pipe insulation.
8 3. Fill voids between inner circumference of flange insulation and outer circumference of
9 adjacent straight pipe segments with cut sections of sheet insulation of same thickness
10 as pipe insulation.
11 4. Secure insulation to flanges and seal seams with manufacturer's recommended
12 adhesive to eliminate openings in insulation that allow passage of air to surface being
13 insulated.
- 14 C. Insulation Installation on Pipe Fittings and Elbows:
- 15 1. Install mitered sections of pipe insulation.
16 2. Secure insulation materials and seal seams with manufacturer's recommended adhesive
17 to eliminate openings in insulation that allow passage of air to surface being insulated.
- 18 D. Insulation Installation on Valves and Pipe Specialties:
- 19 1. Install preformed valve covers manufactured of same material as pipe insulation when
20 available.
21 2. When preformed valve covers are not available, install cut sections of pipe and sheet
22 insulation to valve body. Arrange insulation to permit access to packing and to allow
23 valve operation without disturbing insulation.
24 3. Install insulation to flanges as specified for flange insulation application.
25 4. Secure insulation to valves and specialties and seal seams with manufacturer's
26 recommended adhesive to eliminate openings in insulation that allow passage of air to
27 surface being insulated.
- 28 3.7 INSTALLATION OF MINERAL-FIBER INSULATION
- 29 A. Insulation Installation on Straight Pipes and Tubes:
- 30 1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten
31 bands without deforming insulation materials.
32 2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions
33 with vapor-barrier mastic and joint sealant.
34 3. For insulation with factory-applied jackets on above-ambient surfaces, secure laps with
35 outward clinched staples at 6 inches o.c.

1 4. For insulation with factory-applied jackets on below-ambient surfaces, do not staple
2 longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by
3 insulation material manufacturer and seal with vapor-barrier mastic and flashing
4 sealant.

5 B. Insulation Installation on Pipe Flanges:

- 6 1. Install preformed pipe insulation to outer diameter of pipe flange.
- 7 2. Make width of insulation section same as overall width of flange and bolts, plus twice
8 the thickness of pipe insulation.
- 9 3. Fill voids between inner circumference of flange insulation and outer circumference of
10 adjacent straight pipe segments with mineral-fiber blanket insulation.
- 11 4. Install jacket material with manufacturer's recommended adhesive, overlap seams at
12 least 1 inch, and seal joints with flashing sealant.
- 13

14 C. Insulation Installation on Pipe Fittings and Elbows:

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

20 D. Insulation Installation on Valves and Pipe Specialties:

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

28 3.8 FINISHES

- 29 A. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of
30 insulation manufacturer's recommended protective coating.

31 3.9 PIPING INSULATION SCHEDULE, GENERAL

- 32 A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for
33 each piping system and pipe size range. If more than one material is listed for a piping system,
34 selection from materials listed is Contractor's option.

- 1 B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:
- 2 1. Drainage piping located in crawl spaces.
- 3 2. Underground piping.
- 4 3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

5 3.10 INDOOR PIPING INSULATION SCHEDULE

6 A. Domestic Cold Water:

- 7 1. NPS 1 and Smaller: Insulation shall be the following:
- 8 a. Flexible Elastomeric: 3/4 inch thick.
- 9 b. Mineral Fiber: 3/4 inch thick.
- 10 2. NPS 1-1/4 and Larger: Insulation shall be the following:
- 11 a. Flexible Elastomeric: 1 inch thick.
- 12 b. Mineral Fiber: 1 inch thick.

13 B. Domestic Hot Water:

- 14 1. NPS 1-1/4 and Smaller: Insulation shall be the following:
- 15 a. Flexible Elastomeric: 3/4 inch thick.
- 16 b. Mineral Fiber: 3/4 inch thick.
- 17 2. NPS 1-1/2 and Larger: Insulation shall be the following:
- 18 a. Flexible Elastomeric: 1 inch thick.
- 19 b. Mineral Fiber: 1 inch thick.

20 C. Floor Drains, Traps, and Sanitary Drain Piping Drain Receiving Condensate and Equipment
21 Drain Water below 60 Deg F:

- 22 1. All Pipe Sizes: Insulation shall be one of the following:
- 23 a. Flexible Elastomeric: 3/4 inch thick.
- 24 b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
- 25

26 END OF SECTION 220719

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1 SECTION 221116 - DOMESTIC WATER PIPING

2 PART 1 - GENERAL

3 1.1 RELATED DOCUMENTS

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

6 1.2 SUMMARY

- 7 A. Section Includes:

- 8 1. Under-building-slab and aboveground domestic water pipes, tubes, and fittings inside
9 buildings.

10 1.3 ACTION SUBMITTALS

- 11 A. Product Data: For transition fittings and dielectric fittings.

12 1.4 INFORMATIONAL SUBMITTALS

- 13 A. System purging and disinfecting activities report.

- 14 B. Field quality-control reports.

15 1.5 FIELD CONDITIONS

- 16 A. Interruption of Existing Water Service: Do not interrupt water service to facilities occupied by
17 Owner or others unless permitted under the following conditions and then only after arranging
18 to provide temporary water service according to requirements indicated:

- 19 1. Notify Owner no fewer than two days in advance of proposed interruption of water
20 service.
21 2. Do not interrupt water service without Owner's written permission.

1 PART 2 - PRODUCTS

2 2.1 PIPING MATERIALS

- 3 A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting
4 materials, and joining methods for specific services, service locations, and pipe sizes.
- 5 B. Potable-water piping and components shall comply with NSF 14 and NSF 61.

6 2.2 COPPER TUBE AND FITTINGS

- 7 A. Hard Copper Tube: ASTM B 88, Type L water tube, drawn temper.
- 8 B. Soft Copper Tube: ASTM B 88, Type K water tube, annealed temper.
- 9 C. Cast-Copper, Solder-Joint Fittings: ASME B16.18, pressure fittings.
- 10 D. Wrought-Copper, Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.
- 11 E. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.
- 12 F. Copper Unions:
- 13 1. MSS SP-123.
- 14 2. Cast-copper-alloy, hexagonal-stock body.
- 15 3. Ball-and-socket, metal-to-metal seating surfaces.
- 16 4. Solder-joint or threaded ends.
- 17 G. Copper Pressure-Seal-Joint Fittings:
- 18 1. Manufacturers: Subject to compliance with requirements, provide products by one of
19 the following:
- 20 a. Elkhart Products Corporation.
- 21 b. NIBCO Inc.
- 22 c. Viega.
- 23 d. Mueller Industries Streamline PRS.
- 24 2. Fittings for NPS 2 and Smaller: Wrought-copper fitting with EPDM-rubber, O-ring seal in
25 each end.
- 26 3. Fittings for NPS 2-1/2 to NPS 4: Cast-bronze or wrought-copper fitting with EPDM-
27 rubber, O-ring seal in each end.

- 1 2.3 PIPING JOINING MATERIALS
- 2 A. Pipe-Flange Gasket Materials:
- 3 1. AWWA C110/A21.10, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and
4 asbestos free unless otherwise indicated.
- 5 2. Full-face or ring type unless otherwise indicated.
- 6 B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
- 7 C. Solder Filler Metals: ASTM B 32, lead-free alloys.
- 8 D. Flux: ASTM B 813, water flushable.
- 9 E. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-
10 duty brazing unless otherwise indicated.
- 11 2.4 TRANSITION FITTINGS
- 12 A. General Requirements:
- 13 1. Same size as pipes to be joined.
- 14 2. Pressure rating at least equal to pipes to be joined.
- 15 3. End connections compatible with pipes to be joined.
- 16 B. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system
17 fitting.
- 18 C. Sleeve-Type Transition Coupling: AWWA C219.
- 19 1. Manufacturers: Subject to compliance with requirements, provide products by one of
20 the following:
- 21 a. Cascade Waterworks Manufacturing.
- 22 b. Dresser, Inc.; Piping Specialties Products.
- 23 c. Ford Meter Box Company, Inc. (The).
- 24 d. JCM Industries.
- 25 e. Romac Industries, Inc.
- 26 f. Smith-Blair, Inc.; a Sensus company.
- 27 g. Viking Johnson.

- 1 2.5 DIELECTRIC FITTINGS
- 2 A. General Requirements: Assembly of copper alloy and ferrous materials with separating
3 nonconductive insulating material. Include end connections compatible with pipes to be
4 joined.
- 5 B. Dielectric Unions:
- 6 1. Manufacturers: Subject to compliance with requirements, provide products by one of
7 the following:
- 8 a. Capitol Manufacturing Company; member of the Phoenix Forge Group.
9 b. Central Plastics Company.
10 c. Hart Industries International, Inc.
11 d. Watts; a division of Watts Water Technologies, Inc.
12 e. Wilkins; a Zurn company.
- 13 2. Standard: ASSE 1079.
14 3. Pressure Rating: 150 psig at 180 deg F.
15 4. End Connections: Solder-joint copper alloy and threaded ferrous.
- 16 C. Dielectric Flanges:
- 17 1. Manufacturers: Subject to compliance with requirements, provide products by one of
18 the following:
- 19 a. Capitol Manufacturing Company; member of the Phoenix Forge Group.
20 b. Central Plastics Company.
21 c. Watts; a division of Watts Water Technologies, Inc.
22 d. Wilkins; a Zurn company.
- 23 2. Standard: ASSE 1079.
24 3. Factory-fabricated, bolted, companion-flange assembly.
25 4. Pressure Rating: 150 psig.
26 5. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint
27 copper alloy and threaded ferrous.
- 28 D. Dielectric-Flange Insulating Kits:
- 29 1. Manufacturers: Subject to compliance with requirements, provide products by one of
30 the following:
- 31 a. Advance Products & Systems, Inc.
32 b. Calpico, Inc.
33 c. Central Plastics Company.
34 d. Pipeline Seal and Insulator, Inc.

- 1 2. Nonconducting materials for field assembly of companion flanges.
- 2 3. Pressure Rating: 150 psig.
- 3 4. Gasket: Neoprene or phenolic.
- 4 5. Bolt Sleeves: Phenolic or polyethylene.
- 5 6. Washers: Phenolic with steel backing washers.
- 6
- 7 E. Dielectric Nipples:
 - 8 1. Manufacturers: Subject to compliance with requirements, provide products by one of
 - 9 the following:
 - 10 a. Elster Perfection Corporation.
 - 11 b. Grinnell Mechanical Products; Tyco Fire Products LP.
 - 12 c. Matco-Norca.
 - 13 d. Precision Plumbing Products, Inc.
 - 14 e. Victaulic Company.
 - 15 2. Standard: IAPMO PS 66.
 - 16 3. Electroplated steel nipple complying with ASTM F 1545.
 - 17 4. Pressure Rating and Temperature: 300 psig at 225 deg F.
 - 18 5. End Connections: Male threaded or grooved.
 - 19 6. Lining: Inert and noncorrosive, propylene.
- 20 PART 3 - EXECUTION
- 21 3.1 PIPING INSTALLATION
 - 22 A. Drawing plans, schematics, and diagrams indicate general location and arrangement of
 - 23 domestic water piping. Indicated locations and arrangements are used to size pipe and
 - 24 calculate friction loss, expansion, and other design considerations. Install piping as indicated
 - 25 unless deviations to layout are approved on coordination drawings.
 - 26 B. Install copper tubing under building slab according to CDA's "Copper Tube Handbook."
 - 27 C. Install shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve
 - 28 inside the building at each domestic water-service entrance. Comply with requirements for
 - 29 pressure gages in Section 220519 "Meters and Gages for Plumbing Piping" and with
 - 30 requirements for drain valves and strainers in Section 221119 "Domestic Water Piping
 - 31 Specialties."
 - 32 D. Install shutoff valve immediately upstream of each dielectric fitting.
 - 33 E. Install domestic water piping level and plumb.

- 1 F. Install piping concealed from view and protected from physical contact by building occupants
2 unless otherwise indicated and except in equipment rooms and service areas.
- 3 G. Install piping indicated to be exposed and piping in equipment rooms and service areas at right
4 angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated
5 otherwise.
- 6 H. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and
7 coordinate with other services occupying that space.
- 8 I. Install piping to permit valve servicing.
- 9 J. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher
10 than the system pressure rating used in applications below unless otherwise indicated.
- 11 K. Install piping free of sags and bends.
- 12 L. Install fittings for changes in direction and branch connections.
- 13 M. Install unions in copper tubing at final connection to each piece of equipment, machine, and
14 specialty.
- 15 N. Install thermometers on outlet piping from each water heater. Comply with requirements for
16 thermometers in Section 220519 "Meters and Gages for Plumbing Piping."
- 17 O. Install sleeves for piping penetrations of walls, ceilings, and floors.
- 18 P. Install escutcheons for piping penetrations of walls, ceilings, and floors.
- 19 3.2 JOINT CONSTRUCTION
- 20 A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- 21 B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before
22 assembly.
- 23 C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut
24 threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore
25 full ID. Join pipe fittings and valves as follows:
- 26 1. Apply appropriate tape or thread compound to external pipe threads.
- 27 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or
28 damaged.

- 1 D. Brazed Joints for Copper Tubing: Comply with CDA's "Copper Tube Handbook," "Brazed Joints"
2 chapter.
- 3 E. Soldered Joints for Copper Tubing: Apply ASTM B 813, water-flushable flux to end of tube. Join
4 copper tube and fittings according to ASTM B 828 or CDA's "Copper Tube Handbook."
- 5 F. Joint Construction for Grooved-End Copper Tubing: Make joints according to AWWA C606. Roll
6 groove ends of tubes. Lubricate and install gasket over ends of tubes or tube and fitting. Install
7 coupling housing sections over gasket with keys seated in tubing grooves. Install and tighten
8 housing bolts.
- 9 G. Flanged Joints: Select appropriate asbestos-free, nonmetallic gasket material in size, type, and
10 thickness suitable for domestic water service. Join flanges with gasket and bolts according to
11 ASME B31.9.
- 12 H. Joints for Dissimilar-Material Piping: Make joints using adapters compatible with materials of
13 both piping systems.
- 14 3.3 DIELECTRIC FITTING INSTALLATION
- 15 A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
- 16 B. Dielectric Fittings for NPS 2 and Smaller: Use dielectric couplings or nipples.
- 17 C. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric flanges or nipples.
- 18 D. Dielectric Fittings for NPS 5 and Larger: Use dielectric flange kits.
- 19 3.4 HANGER AND SUPPORT INSTALLATION
- 20 A. Comply with requirements for pipe hanger, support products, and installation.
- 21 1. Vertical Piping: MSS Type 8 or 42, clamps.
- 22 2. Individual, Straight, Horizontal Piping Runs:
- 23 a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
- 24 b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
- 25 3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls.
26 Support pipe rolls on trapeze.
- 27 4. Base of Vertical Piping: MSS Type 52, spring hangers.
- 28 B. Support vertical piping and tubing at base and at each floor.
- 29 C. Rod diameter may be reduced one size for double-rod hangers, to a minimum of 3/8 inch.

- 1 D. Install hangers for copper tubing with the following maximum horizontal spacing and
2 minimum rod diameters:
- 3 1. NPS 3/4 and Smaller: 60 inches with 3/8-inch rod.
4 2. NPS 1 and NPS 1-1/4: 72 inches with 3/8-inch rod.
5 3. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
6 4. NPS 2-1/2: 108 inches with 1/2-inch rod.
7 5. NPS 3 to NPS 5: 10 feet with 1/2-inch rod.
- 8 E. Install supports for vertical copper tubing every 10 feet.
- 9 F. Support piping and tubing not listed in this article according to MSS SP-69 and manufacturer's
10 written instructions.
- 11 3.5 CONNECTIONS
- 12 A. Drawings indicate general arrangement of piping, fittings, and specialties.
- 13 B. When installing piping adjacent to equipment and machines, allow space for service and
14 maintenance.
- 15 C. Connect domestic water piping to exterior water-service piping. Use transition fitting to join
16 dissimilar piping materials.
- 17 D. Connect domestic water piping to water-service piping with shutoff valve; extend and connect
18 to the following:
- 19 1. Water Heaters: Cold-water inlet and hot-water outlet piping in sizes indicated, but not
20 smaller than sizes of water heater connections.
21 2. Plumbing Fixtures: Cold- and hot-water-supply piping in sizes indicated, but not smaller
22 than that required by plumbing code.
23 3. Equipment: Cold- and hot-water-supply piping as indicated, but not smaller than
24 equipment connections. Provide shutoff valve and union for each connection. Use
25 flanges instead of unions for NPS 2-1/2 and larger.
- 26 3.6 IDENTIFICATION
- 27 A. Identify system components. Comply with requirements for identification materials and
28 installation in Section 220553 "Identification for Plumbing Piping and Equipment."
- 29 3.7 FIELD QUALITY CONTROL
- 30 A. Perform the following tests and inspections:

- 1 1. Piping Inspections:
- 2 a. Do not enclose, cover, or put piping into operation until it has been inspected and
- 3 approved by authorities having jurisdiction.
- 4 b. During installation, notify authorities having jurisdiction at least one day before
- 5 inspection must be made. Perform tests specified below in presence of
- 6 authorities having jurisdiction:
- 7 1) Roughing-in Inspection: Arrange for inspection of piping before concealing
- 8 or closing in after roughing in and before setting fixtures.
- 9 2) Final Inspection: Arrange for authorities having jurisdiction to observe tests
- 10 specified in "Piping Tests" Subparagraph below and to ensure compliance
- 11 with requirements.
- 12 c. Reinspection: If authorities having jurisdiction find that piping will not pass tests
- 13 or inspections, make required corrections and arrange for reinspection.
- 14 d. Reports: Prepare inspection reports and have them signed by authorities having
- 15 jurisdiction.
- 16
- 17
- 18
- 19 2. Piping Tests:
- 20 a. Fill domestic water piping. Check components to determine that they are not air
- 21 bound and that piping is full of water.
- 22 b. Test for leaks and defects in new piping and parts of existing piping that have
- 23 been altered, extended, or repaired. If testing is performed in segments, submit a
- 24 separate report for each test, complete with diagram of portion of piping tested.
- 25 c. Leave new, altered, extended, or replaced domestic water piping uncovered and
- 26 unconcealed until it has been tested and approved. Expose work that was
- 27 covered or concealed before it was tested.
- 28 d. Cap and subject piping to static water pressure of 50 psig above operating
- 29 pressure, without exceeding pressure rating of piping system materials. Isolate
- 30 test source and allow it to stand for four hours. Leaks and loss in test pressure
- 31 constitute defects that must be repaired.
- 32 e. Repair leaks and defects with new materials, and retest piping or portion thereof
- 33 until satisfactory results are obtained.
- 34 f. Prepare reports for tests and for corrective action required.
- 35 B. Domestic water piping will be considered defective if it does not pass tests and inspections.
- 36 C. Prepare test and inspection reports.

- 1 3.8 ADJUSTING
- 2 A. Perform the following adjustments before operation:
- 3 1. Close drain valves, hydrants, and hose bibbs.
- 4 2. Open shutoff valves to fully open position.
- 5 3. Open throttling valves to proper setting.
- 6 4. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.
- 7 a. Manually adjust ball-type balancing valves in hot-water-circulation return piping
- 8 to provide hot-water flow in each branch.
- 9 b. Adjust calibrated balancing valves to flows indicated.
- 10 5. Remove plugs used during testing of piping and for temporary sealing of piping during
- 11 installation.
- 12 6. Remove and clean strainer screens. Close drain valves and replace drain plugs.
- 13 7. Remove filter cartridges from housings and verify that cartridges are as specified for
- 14 application where used and are clean and ready for use.
- 15 8. Check plumbing specialties and verify proper settings, adjustments, and operation.
- 16 3.9 CLEANING
- 17 A. Clean and disinfect potable domestic water piping as follows:
- 18 1. Purge new piping and parts of existing piping that have been altered, extended, or
- 19 repaired before using.
- 20 2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if
- 21 methods are not prescribed, use procedures described in either AWWA C651 or
- 22 AWWA C652 or follow procedures described below:
- 23 a. Flush piping system with clean, potable water until dirty water does not appear at
- 24 outlets.
- 25 b. Fill and isolate system according to either of the following:
- 26 1) Fill system or part thereof with water/chlorine solution with at least
- 27 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.
- 28 2) Fill system or part thereof with water/chlorine solution with at least
- 29 200 ppm of chlorine. Isolate and allow to stand for three hours.
- 30 c. Flush system with clean, potable water until no chlorine is in water coming from
- 31 system after the standing time.
- 32 d. Repeat procedures if biological examination shows contamination.
- 33 e. Submit water samples in sterile bottles to authorities having jurisdiction.

1 B. Prepare and submit reports of purging and disinfecting activities. Include copies of water-
2 sample approvals from authorities having jurisdiction.

3 C. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

4 3.10 PIPING SCHEDULE

5 A. Transition and special fittings with pressure ratings at least equal to piping rating may be used
6 in applications below unless otherwise indicated.

7 B. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.

8 C. Under-building-slab, domestic water piping, NPS 2 and smaller, shall be the following:

9 1. Soft copper tube, ASTM B 88, Type L; wrought-copper, solder-joint fittings; and brazed
10 joints.

11 D. Aboveground domestic water piping, NPS 2 and smaller, shall be one of the following:

12 1. Hard copper tube, ASTM B 88, Type L; cast- or wrought-copper, solder-joint fittings; and
13 soldered joints.

14 2. Hard copper tube, ASTM B 88, Type L; copper pressure-seal-joint fittings; and pressure-
15 sealed joints.

16 E. Aboveground domestic water piping, NPS 2-1/2 to NPS 4, shall be one of the following:

17 1. Hard copper tube, ASTM B 88, Type L; cast- or wrought-copper, solder-joint fittings; and
18 soldered joints.

19 2. Hard copper tube, ASTM B 88, Type L; copper pressure-seal-joint fittings; and pressure-
20 sealed joints.

21 3. Hard copper tube, ASTM B 88, Type L; grooved-joint, copper-tube appurtenances; and
22 grooved joints.

23 3.11 VALVE SCHEDULE

24 A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the
25 following requirements apply:

26 1. Shutoff Duty: Use ball or gate valves for piping NPS 2 and smaller. Use butterfly, ball, or
27 gate valves with flanged ends for piping NPS 2-1/2 and larger.

28 2. Throttling Duty: Use ball or globe valves for piping NPS 2 and smaller. Use butterfly or
29 ball valves with flanged ends for piping NPS 2-1/2 and larger.

30 3. Hot-Water Circulation Piping, Balancing Duty: Calibrated balancing valves.

31 4. Drain Duty: Hose-end drain valves.

- 1 B. Use check valves to maintain correct direction of domestic water flow to and from equipment.

- 2 END OF SECTION 221116

1 SECTION 221119 - DOMESTIC WATER PIPING SPECIALTIES

2 PART 1 - GENERAL

3 1.1 RELATED DOCUMENTS

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

6 1.2 SUMMARY

7 A. Section Includes:

- 8 1. Vacuum breakers.
9 2. Backflow preventers.
10 3. Water pressure-reducing valves.
11 4. Balancing valves.
12 5. Temperature-actuated, water mixing valves.
13 6. Strainers.
14 7. Outlet boxes.
15 8. Hose bibbs.
16 9. Wall hydrants.
17 10. Drain valves.
18 11. Water-hammer arresters.
19 12. Air vents.
20 13. Flexible connectors.

21 B. Related Requirements:

- 22 1. Section 220519 "Meters and Gages for Plumbing Piping" for thermometers, pressure
23 gages, and flow meters in domestic water piping.
24 2. Section 221116 "Domestic Water Piping" for water meters.

25 1.3 ACTION SUBMITTALS

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

- 27 B. Shop Drawings: For domestic water piping specialties.

- 28 1. Include diagrams for power, signal, and control wiring.

1 1.4 INFORMATIONAL SUBMITTALS

2 A. Field quality-control reports.

3 1.5 CLOSEOUT SUBMITTALS

4 A. Operation and Maintenance Data: For domestic water piping specialties to include in
5 emergency, operation, and maintenance manuals.

6 PART 2 - PRODUCTS

7 2.1 GENERAL REQUIREMENTS FOR PIPING SPECIALTIES

8 A. Potable-water piping and components shall comply with NSF 61.

9 2.2 PERFORMANCE REQUIREMENTS

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

12 2.3 VACUUM BREAKERS

13 A. Pipe-Applied, Atmospheric-Type Vacuum Breakers:

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

- 16 a. Ames Fire & Waterworks; a division of Watts Water Technologies, Inc.
- 17 b. Cash Acme; a division of Reliance Worldwide Corporation.
- 18 c. Conbraco Industries, Inc.
- 19 d. FEBCO; a division of Watts Water Technologies, Inc.
- 20 e. Rain Bird Corporation.
- 21 f. Toro Company (The); Irrigation Div.
- 22 g. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
- 23 h. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.

24 2. Standard: ASSE 1001.

25 3. Size: NPS 1/4 to NPS 3, as required to match connected piping.

26 4. Body: Bronze.

27 5. Inlet and Outlet Connections: Threaded.

28 6. Finish: Rough bronze.

- 1 B. Hose-Connection Vacuum Breakers:
- 2 1. Manufacturers: Subject to compliance with requirements, provide products by one of
3 the following:
- 4 a. Arrowhead Brass Products.
5 b. Cash Acme; a division of Reliance Worldwide Corporation.
6 c. Conbraco Industries, Inc.
7 d. Legend Valve.
8 e. MIFAB, Inc.
9 f. Prier Products, Inc.
10 g. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
11 h. Woodford Manufacturing Company; a division of WCM Industries, Inc.
12 i. Zurn Industries, LLC; Plumbing Products Group; Light Commercial Products.
13 j. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.
- 14 2. Standard: ASSE 1011.
15 3. Body: Bronze, nonremovable, with manual drain.
16 4. Outlet Connection: Garden-hose threaded complying with ASME B1.20.7.
17 5. Finish: Chrome or nickel plated.
- 18 C. Pressure Vacuum Breakers:
- 19 1. Manufacturers: Subject to compliance with requirements, provide products by one of
20 the following:
- 21 a. Ames Fire & Waterworks; a division of Watts Water Technologies, Inc.
22 b. Conbraco Industries, Inc.
23 c. FEBCO; a division of Watts Water Technologies, Inc.
24 d. Flomatic Corporation.
25 e. Toro Company (The); Irrigation Div.
26 f. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
27 g. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.
- 28 2. Standard: ASSE 1020.
29 3. Operation: Continuous-pressure applications.
30 4. Pressure Loss: 5 psig maximum, through middle third of flow range.
- 31 2.4 BACKFLOW PREVENTERS
- 32 A. Reduced-Pressure-Principle Backflow Preventers:
- 33 1. Manufacturers: Subject to compliance with requirements, provide products by one of
34 the following:

- 1 a. Ames Fire & Waterworks; a division of Watts Water Technologies, Inc.
- 2 b. Conbraco Industries, Inc.
- 3 c. FEBCO; a division of Watts Water Technologies, Inc.
- 4 d. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
- 5 e. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.

- 6 2. Standard: ASSE 1013.
- 7 3. Operation: Continuous-pressure applications.
- 8 4. Pressure Loss: 12 psig maximum, through middle third of flow range.
- 9 5. Body: Bronze for NPS 2 and smaller; stainless steel for NPS 2-1/2 and larger.
- 10 6. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
- 11 7. Accessories:
 - 12 a. Valves NPS 2 and Smaller: Ball type with threaded ends on inlet and outlet.
 - 13 b. Valves NPS 2-1/2 and Larger: Outside-screw and yoke-gate type with flanged ends
14 on inlet and outlet.
 - 15 c. Air-Gap Fitting: ASME A112.1.2, matching backflow-preventer connection.

- 16 B. Hose-Connection Backflow Preventers:
 - 17 1. Manufacturers: Subject to compliance with requirements, provide products by one of
18 the following:
 - 19 a. Conbraco Industries, Inc.
 - 20 b. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
 - 21 c. Woodford Manufacturing Company; a division of WCM Industries, Inc.
 - 22 2. Standard: ASSE 1052.
 - 23 3. Operation: Up to 10-foot head of water back pressure.
 - 24 4. Inlet Size: NPS 1/2 or NPS 3/4.
 - 25 5. Outlet Size: Garden-hose thread complying with ASME B1.20.7.
 - 26 6. Capacity: At least 3-gpm flow.

- 27 2.5 BALANCING VALVES
 - 28 A. Copper-Alloy Calibrated Balancing Valves:
 - 29 1. Manufacturers: Subject to compliance with requirements, provide products by one of
30 the following:
 - 31 a. Armstrong International, Inc.
 - 32 b. ITT Corporation; Bell & Gossett Div.
 - 33 c. NIBCO Inc.
 - 34 d. TAC.
 - 35 e. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.

- 1 2. Type: Y-pattern globe valve with two readout ports and memory-setting indicator.
- 2 3. Body: Bronze.
- 3 4. Size: Same as connected piping, but not larger than NPS 2.
- 4 5. Accessories: Meter hoses, fittings, valves, differential pressure meter, and carrying case.

5 2.6 TEMPERATURE-ACTUATED, WATER MIXING VALVES

6 A. Primary, Thermostatic, Water Mixing Valves:

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

- 9 a. Lawler Manufacturing Company, Inc.
- 10 b. Leonard Valve Company.

- 11 2. Standard: ASSE 1017.
- 12 3. Pressure Rating: 125 psig minimum unless otherwise indicated.
- 13 4. Type: Exposed-mounted, thermostatically controlled, water mixing valve.
- 14 5. Material: Bronze body with corrosion-resistant interior components.
- 15 6. Connections: Threaded union inlets and outlet.
- 16 7. Accessories: Manual temperature control, check stops on hot- and cold-water supplies,
- 17 and adjustable, temperature-control handle.
- 18 8. Valve Finish: Rough bronze.
- 19 9. Piping Finish: Copper.

20 B. Manifold, Thermostatic, Water Mixing-Valve Assemblies:

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

- 23 a. Lawler Manufacturing Company, Inc.
- 24 b. Leonard Valve Company.

- 25 2. Description: Factory-fabricated, exposed-mounted, thermostatically controlled, water
- 26 mixing-valve assembly in two-valve parallel arrangement.
- 27 3. Large-Flow Parallel: Thermostatic, water mixing valve and downstream-pressure
- 28 regulator with pressure gages on inlet and outlet.
- 29 4. Intermediate-Flow Parallel: Thermostatic, water mixing valve and downstream-pressure
- 30 regulator with pressure gages on inlet and outlet.
- 31 5. Small-Flow Parallel: Thermostatic, water mixing valve.
- 32 6. Thermostatic Mixing Valves: Comply with ASSE 1017. Include check stops on hot- and
- 33 cold-water inlets and shutoff valve on outlet.
- 34 7. Water Regulator(s): Comply with ASSE 1003. Include pressure gage on inlet and outlet.
- 35 8. Pressure Rating: 125 psig minimum unless otherwise indicated.
- 36 9. Thermostatic Mixing Valve and Water Regulator Finish: Rough bronze.

- 1 10. Piping Finish: Copper.
- 2 C. Individual-Fixture, Water Tempering Valves:
- 3 1. Manufacturers: Subject to compliance with requirements, provide products by one of
- 4 the following:
- 5 a. Lawler Manufacturing Company, Inc.
- 6 b. Leonard Valve Company.
- 7 2. Standard: ASSE 1016, thermostatically controlled, water tempering valve.
- 8 3. Pressure Rating: 125 psig minimum unless otherwise indicated.
- 9 4. Body: Bronze body with corrosion-resistant interior components.
- 10 5. Temperature Control: Adjustable.
- 11 6. Inlets and Outlet: Threaded.
- 12 7. Finish: Rough or chrome-plated bronze.

13 2.7 STRAINERS FOR DOMESTIC WATER PIPING

- 14 A. Y-Pattern Strainers:
- 15 1. Pressure Rating: 125 psig minimum unless otherwise indicated.
- 16 2. Body: Bronze for NPS 2 and smaller; cast iron with interior lining that complies with
- 17 AWWA C550 or that is FDA approved, epoxy coated and for NPS 2-1/2 and larger.
- 18 3. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
- 19 4. Screen: Stainless steel with round perforations unless otherwise indicated.
- 20 5. Perforation Size:
- 21 a. Strainers NPS 2 and Smaller: 0.020 inch.
- 22 b. Strainers NPS 2-1/2 to NPS 4: 0.045 inch.
- 23 c. Strainers NPS 5 and Larger: 0.10 inch.
- 24 6. Drain: Factory-installed, hose-end drain valve.

25 2.8 OUTLET BOXES

- 26 A. Icemaker Outlet Boxes:
- 27 1. Manufacturers: Subject to compliance with requirements, provide products by one of
- 28 the following:
- 29 a. Acorn Engineering Company.
- 30 b. Guy Gray Manufacturing Co. Inc.

- 1 c. IPS Corporation.
- 2 d. Oatey.
- 3 2. Mounting: Recessed.
- 4 3. Material and Finish: Enameled-steel or epoxy-painted-steel box and faceplate.
- 5 4. Faucet: Valved fitting complying with ASME A112.18.1. Include NPS 1/2 or smaller
- 6 copper tube outlet.
- 7 5. Supply Shutoff Fitting: NPS 1/2 gate, globe, or ball valve and NPS 1/2 copper, water
- 8 tubing.
- 9 2.9 HOSE BIBBS
- 10 A. Hose Bibbs:
- 11 1. Standard: ASME A112.18.1 for sediment faucets.
- 12 2. Body Material: Bronze.
- 13 3. Seat: Bronze, replaceable.
- 14 4. Supply Connections: NPS 1/2 or NPS 3/4 threaded or solder-joint inlet.
- 15 5. Outlet Connection: Garden-hose thread complying with ASME B1.20.7.
- 16 6. Pressure Rating: 125 psig.
- 17 7. Vacuum Breaker: Integral nonremovable, drainable, hose-connection vacuum breaker
- 18 complying with ASSE 1011.
- 19 8. Finish for Equipment Rooms: Rough bronze, or chrome or nickel plated.
- 20 9. Finish for Service Areas: Rough bronze.
- 21 10. Finish for Finished Rooms: Chrome or nickel plated.
- 22 11. Operation for Equipment Rooms: Wheel handle or operating key.
- 23 12. Operation for Service Areas: Operating key.
- 24 13. Operation for Finished Rooms: Operating key.
- 25 14. Include operating key with each operating-key hose bibb.
- 26 15. Include wall flange with each chrome- or nickel-plated hose bibb.
- 27 2.10 WALL HYDRANTS
- 28 A. Nonfreeze Wall Hydrants:
- 29 1. Manufacturers: Subject to compliance with requirements, provide products by one of
- 30 the following:
- 31 a. Josam Company.
- 32 b. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
- 33 c. Watts Drainage Products.
- 34 d. Zurn Industries, LLC; Plumbing Products Group; Light Commercial Products.
- 35 2. Standard: ASME A112.21.3M for concealed-outlet, self-draining wall hydrants.

- 1 3. Pressure Rating: 125 psig.
- 2 4. Operation: Loose key.
- 3 5. Casing and Operating Rod: Of length required to match wall thickness. Include wall
- 4 clamp.
- 5 6. Inlet: NPS 3/4 or NPS 1.
- 6 7. Outlet: Concealed, with integral vacuum breaker and garden-hose thread complying
- 7 with ASME B1.20.7.
- 8 8. Box: Deep, flush mounted with cover.
- 9 9. Box and Cover Finish: Polished nickel bronze.
- 10 10. Operating Keys(s): One with each wall hydrant.

11 2.11 DRAIN VALVES

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

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

23 2.12 WATER-HAMMER ARRESTERS

24 A. Water-Hammer Arresters:

- 25 1. Manufacturers: Subject to compliance with requirements, provide products by one of
- 26 the following:
 - 27 a. Josam Company.
 - 28 b. Sioux Chief Manufacturing Company, Inc.
 - 29 c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - 30 d. Watts Drainage Products.
 - 31 e. Zurn Industries, LLC; Plumbing Products Group; Specification Drainage Products.
- 32 2. Standard: ASSE 1010 or PDI-WH 201.
- 33 3. Size: ASSE 1010, Sizes AA and A through F, or PDI-WH 201, Sizes A through F.

- 1 2.13 AIR VENTS
- 2 A. Bolted-Construction Automatic Air Vents:
- 3 1. Body: Bronze.
- 4 2. Pressure Rating and Temperature: 125-psig minimum pressure rating at 140 deg F.
- 5 3. Float: Replaceable, corrosion-resistant metal.
- 6 4. Mechanism and Seat: Stainless steel.
- 7 5. Size: NPS 3/8 or NPS 1/2 minimum inlet.
- 8 6. Inlet and Vent Outlet End Connections: Threaded.
- 9 B. Welded-Construction Automatic Air Vents:
- 10 1. Body: Stainless steel.
- 11 2. Pressure Rating: 150-psig minimum pressure rating.
- 12 3. Float: Replaceable, corrosion-resistant metal.
- 13 4. Mechanism and Seat: Stainless steel.
- 14 5. Size: NPS 3/8 minimum inlet.
- 15 6. Inlet and Vent Outlet End Connections: Threaded.
- 16 2.14 FLEXIBLE CONNECTORS
- 17 A. Manufacturers: Subject to compliance with requirements, provide products by one of the
- 18 following:
- 19 1. Flex-Hose Co., Inc.
- 20 2. Flexicraft Industries.
- 21 3. Flex Pression, Ltd.
- 22 4. Flex-Weld Incorporated.
- 23 5. Hyspan Precision Products, Inc.
- 24 6. Mercer Gasket & Shim, Inc.
- 25 7. Metraflex, Inc.
- 26 8. Proco Products, Inc.
- 27 9. Unaflex.Universal Metal Hose; a Hyspan company.
- 28 B. Bronze-Hose Flexible Connectors: Corrugated-bronze tubing with bronze wire-braid covering
- 29 and ends brazed to inner tubing.
- 30 1. Working-Pressure Rating: Minimum 200 psig.
- 31 2. End Connections NPS 2 and Smaller: Threaded copper pipe or plain-end copper tube.
- 32 3. End Connections NPS 2-1/2 and Larger: Flanged copper alloy.
- 33 C. Stainless-Steel-Hose Flexible Connectors: Corrugated-stainless-steel tubing with stainless-steel
- 34 wire-braid covering and ends welded to inner tubing.

- 1 1. Working-Pressure Rating: Minimum 200 psig.
- 2 2. End Connections NPS 2 and Smaller: Threaded steel-pipe nipple.
- 3 3. End Connections NPS 2-1/2 and Larger: Flanged steel nipple.

4 PART 3 - EXECUTION

5 3.1 INSTALLATION

- 6 A. Install backflow preventers in each water supply to mechanical equipment and systems and to
7 other equipment and water systems that may be sources of contamination. Comply with
8 authorities having jurisdiction.
 - 9 1. Locate backflow preventers in same room as connected equipment or system.
 - 10 2. Install drain for backflow preventers with atmospheric-vent drain connection with air-
11 gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two
12 pipe diameters in drain piping and pipe-to-floor drain. Locate air-gap device attached to
13 or under backflow preventer. Simple air breaks are unacceptable for this application.
 - 14 3. Do not install bypass piping around backflow preventers.
- 15 B. Install water regulators with inlet and outlet shutoff valves. Install pressure gages on inlet and
16 outlet.
- 17 C. Install water-control valves with inlet and outlet shutoff valves and bypass with globe valve.
18 Install pressure gages on inlet and outlet.
- 19 D. Install balancing valves in locations where they can easily be adjusted.
- 20 E. Install temperature-actuated, water mixing valves with check stops or shutoff valves on inlets
21 and with shutoff valve on outlet.
- 22 F. Install Y-pattern strainers for water on supply side of each control valve water pressure-
23 reducing valve solenoid valve and pump.
- 24 G. Install outlet boxes recessed in wall or surface mounted on wall. Install 2-by-4-inch fire-
25 retardant-treated-wood blocking, wall reinforcement between studs.
- 26 H. Install air vents at high points of water piping. Install drain piping and discharge onto floor
27 drain.

- 1 3.2 LABELING AND IDENTIFYING
- 2 A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or
3 sign on or near each of the following:
- 4 1. Pressure vacuum breakers.
5 2. Intermediate atmospheric-vent backflow preventers.
6 3. Reduced-pressure-principle backflow preventers.
7 4. Calibrated balancing valves.
8 5. Primary, thermostatic, water mixing valves.
9 6. Manifold, thermostatic, water mixing-valve assemblies.
10 7. Hose stations.
11
- 12 B. Distinguish among multiple units, inform operator of operational requirements, indicate safety
13 and emergency precautions, and warn of hazards and improper operations, in addition to
14 identifying unit. Nameplates and signs are specified in Section 220553 "Identification for
15 Plumbing Piping and Equipment."
- 16 3.3 FIELD QUALITY CONTROL
- 17 A. Perform the following tests and inspections:
- 18 1. Test each pressure vacuum breaker reduced-pressure-principle backflow preventer
19 according to authorities having jurisdiction and the device's reference standard.
- 20 B. Domestic water piping specialties will be considered defective if they do not pass tests and
21 inspections.
- 22 C. Prepare test and inspection reports.
- 23 3.4 ADJUSTING
- 24 A. Set field-adjustable pressure set points of water pressure-reducing valves.
25 B. Set field-adjustable flow set points of balancing valves.
26 C. Set field-adjustable temperature set points of temperature-actuated, water mixing valves.
- 27 END OF SECTION 221119

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1 SECTION 221316 - SANITARY WASTE AND VENT PIPING

2 PART 1 - GENERAL

3 1.1 RELATED DOCUMENTS

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

6 1.2 SUMMARY

- 7 A. Section Includes:

- 8 1. Pipe, tube, and fittings.

9 1.3 PERFORMANCE REQUIREMENTS

- 10 A. Components and installation shall be capable of withstanding the following minimum working
11 pressure unless otherwise indicated:

- 12 1. Soil, Waste, and Vent Piping: 10-foot head of water.

13 1.4 ACTION SUBMITTALS

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

15 1.5 INFORMATIONAL SUBMITTALS

- 16 A. Field quality-control reports.

17 1.6 QUALITY ASSURANCE

- 18 A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

- 19 B. Comply with NSF/ANSI 14, "Plastics Piping Systems Components and Related Materials," for
20 plastic piping components. Include marking with "NSF-dwv" for plastic drain, waste, and vent
21 piping and "NSF-sewer" for plastic sewer piping.

1 1.7 PROJECT CONDITIONS

2 A. Interruption of Existing Sanitary Waste Service: Do not interrupt service to facilities occupied
3 by Owner or others unless permitted under the following conditions and then only after
4 arranging to provide temporary service according to requirements indicated:

- 5 1. Notify Owner no fewer than two days in advance of proposed interruption of sanitary
6 waste service.
7 2. Do not proceed with interruption of sanitary waste service without Owner's written
8 permission.

9 PART 2 - PRODUCTS

10 2.1 PIPING MATERIALS

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

13 2.2 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

14 A. Pipe and Fittings: ASTM A 888 or CISPI 301.

15 B. Heavy-Duty, Hubless-Piping Couplings:

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

- 18 a. ANACO-Husky.
19 b. Clamp-All Corp.
20 c. Mission Rubber Company; a division of MCP Industries, Inc.
21 d. Tyler Pipe.

22 2. Types:

- 23 a. NPS 1-1/2 to NPS 4: 3-inch wide shield with 4 bands.
24 b. NPS 5 to 15: 4-inch wide shield with 6 bands.

25 3. Standards: ASTM C 1277 and ASTM C 1540.

26 4. Description: Stainless-steel shield with stainless-steel bands and tightening devices; and
27 ASTM C 564, rubber sleeve with integral, center pipe stop.

- 1 2.3 PVC PIPE AND FITTINGS
- 2 A. Solid-Wall PVC Pipe: ASTM D 2665, drain, waste, and vent.
- 3 B. PVC Socket Fittings: ASTM D 2665, made to ASTM D 3311, drain, waste, and vent patterns and
4 to fit Schedule 40 pipe.
- 5 C. Adhesive Primer: ASTM F 656.
- 6 1. Adhesive primer shall have a VOC content of 550 g/L or less when calculated according
7 to 40 CFR 59, Subpart D (EPA Method 24).
- 8 D. Solvent Cement: ASTM D 2564.
- 9 1. PVC solvent cement shall have a VOC content of 510 g/L or less when calculated
10 according to 40 CFR 59, Subpart D (EPA Method 24).
- 11 PART 3 - EXECUTION
- 12 3.1 PIPING INSTALLATION
- 13 A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping
14 systems. Indicated locations and arrangements were used to size pipe and calculate friction
15 loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless
16 deviations to layout are approved on coordination drawings.
- 17 B. Install piping in concealed locations unless otherwise indicated and except in equipment
18 rooms and service areas.
- 19 C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right
20 angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated
21 otherwise.
- 22 D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- 23 E. Install piping to permit valve servicing.
- 24 F. Install piping at indicated slopes.
- 25 G. Install piping free of sags and bends.
- 26 H. Install fittings for changes in direction and branch connections.
- 27 I. Install piping to allow application of insulation.

- 1 J. Make changes in direction for soil and waste drainage and vent piping using appropriate
2 branches, bends, and long-sweep bends. Sanitary tees and short-sweep 1/4 bends may be
3 used on vertical stacks if change in direction of flow is from horizontal to vertical. Use long-
4 turn, double Y-branch and 1/8-bend fittings if two fixtures are installed back to back or side by
5 side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do
6 not change direction of flow more than 90 degrees. Use proper size of standard increasers and
7 reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction
8 of flow is prohibited.
- 9 K. Lay buried building drainage piping beginning at low point of each system. Install true to
10 grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping
11 upstream. Install required gaskets according to manufacturer's written instructions for use of
12 lubricants, cements, and other installation requirements. Maintain swab in piping and pull past
13 each joint as completed.
- 14 L. Install soil and waste drainage and vent piping at the following minimum slopes unless
15 otherwise indicated:
- 16 1. Building Sanitary Drain: 2 percent downward in direction of flow for piping NPS 3 and
17 smaller; 1 percent downward in direction of flow for piping NPS 4 and larger.
18 2. Horizontal Sanitary Drainage Piping: 2 percent downward in direction of flow.
19 3. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.
- 20 M. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook,"
21 Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
- 22 N. Install aboveground PVC piping according to ASTM D 2665.
- 23 O. Install underground PVC piping according to ASTM D 2321.
- 24 P. Do not enclose, cover, or put piping into operation until it is inspected and approved by
25 authorities having jurisdiction.
- 26 Q. Install sleeves for piping penetrations of walls, ceilings, and floors.
- 27 R. Install sleeve seals for piping penetrations of concrete walls and slabs.
- 28 S. Install escutcheons for piping penetrations of walls, ceilings, and floors.
- 29 3.2 JOINT CONSTRUCTION
- 30 A. Join hubless, cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and
31 Fittings Handbook" for hubless-piping coupling joints.

- 1 3.3 HANGER AND SUPPORT INSTALLATION
- 2 A. Comply with requirements for pipe hanger and support devices and installation.
- 3 1. Vertical Piping: MSS Type 8 or Type 42, clamps.
- 4 2. Install individual, straight, horizontal piping runs:
- 5 a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
- 6 b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
- 7 3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls.
- 8 Support pipe rolls on trapeze.
- 9 4. Base of Vertical Piping: MSS Type 52, spring hangers.
- 10 B. Support horizontal piping and tubing within 12 inches of each fitting, valve, and coupling.
- 11 C. Support vertical piping and tubing at base and at each floor.
- 12 D. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch minimum rods.
- 13 E. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and
- 14 minimum rod diameters:
- 15 1. NPS 1-1/2 and NPS 2: 60 inches with 3/8-inch rod.
- 16 2. NPS 3: 60 inches with 1/2-inch rod.
- 17 3. NPS 4 and NPS 5: 60 inches with 5/8-inch rod.
- 18 4. NPS 6 and NPS 8: 60 inches with 3/4-inch rod.
- 19 5. Spacing for 10-foot lengths may be increased to 10 feet. Spacing for fittings is limited to
- 20 60 inches.
- 21 F. Install supports for vertical cast-iron soil piping every 15 feet.
- 22 3.4 CONNECTIONS
- 23 A. Drawings indicate general arrangement of piping, fittings, and specialties.
- 24 B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join
- 25 dissimilar piping materials.
- 26 C. Connect drainage and vent piping to the following:
- 27 1. Plumbing Fixtures: Connect drainage piping in sizes indicated, but not smaller than
- 28 required by plumbing code.
- 29 2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated,
- 30 but not smaller than required by authorities having jurisdiction.

- 1 3. Plumbing Specialties: Connect drainage and vent piping in sizes indicated, but not
2 smaller than required by plumbing code.
3 4. Equipment: Connect drainage piping as indicated. Provide shutoff valve if indicated and
4 union for each connection. Use flanges instead of unions for connections NPS 2-1/2 and
5 larger.

6 3.5 IDENTIFICATION

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

9 3.6 FIELD QUALITY CONTROL

- 10 A. During installation, notify authorities having jurisdiction at least 24 hours before inspection
11 must be made. Perform tests specified below in presence of authorities having jurisdiction.

- 12 1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in
13 after roughing-in and before setting fixtures.
14 2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to
15 observe tests specified below and to ensure compliance with requirements.

- 16 B. Re-inspection: If authorities having jurisdiction find that piping will not pass test or inspection,
17 make required corrections and arrange for re-inspection.

- 18 C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

- 19 D. Test sanitary drainage and vent piping according to procedures of authorities having
20 jurisdiction or, in absence of published procedures, as follows:

- 21 1. Test for leaks and defects in new piping and parts of existing piping that have been
22 altered, extended, or repaired. If testing is performed in segments, submit separate
23 report for each test, complete with diagram of portion of piping tested.

- 24 2. Leave uncovered and unconcealed new, altered, extended, or replaced drainage and
25 vent piping until it has been tested and approved. Expose work that was covered or
26 concealed before it was tested.

- 27 3. Roughing-in Plumbing Test Procedure: Test drainage and vent piping except outside
28 leaders on completion of roughing-in. Close openings in piping system and fill with
29 water to point of overflow, but not less than 10-foot head of water. From 15 minutes
30 before inspection starts to completion of inspection, water level must not drop. Inspect
31 joints for leaks.

- 32 4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled
33 with water, test connections and prove they are gastight and watertight. Plug vent-stack
34 openings on roof and building drains where they leave building. Introduce air into piping
35 system equal to pressure of 1-inch wg. Use U-tube or manometer inserted in trap of
36 water closet to measure this pressure. Air pressure must remain constant without

- 1 introducing additional air throughout period of inspection. Inspect plumbing fixture
2 connections for gas and water leaks.
- 3 5. Repair leaks and defects with new materials and retest piping, or portion thereof, until
4 satisfactory results are obtained.
- 5 6. Prepare reports for tests and required corrective action.
- 6 3.7 CLEANING AND PROTECTION
- 7 A. Clean interior of piping. Remove dirt and debris as work progresses.
- 8 B. Protect drains during remainder of construction period to avoid clogging with dirt and debris
9 and to prevent damage from traffic and construction work.
- 10 C. Place plugs in ends of uncompleted piping at end of day and when work stops.
- 11 3.8 PIPING SCHEDULE
- 12 A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.
- 13 B. Aboveground, soil and waste piping NPS 4 and smaller shall be any of the following:
- 14 1. Hubless, cast-iron soil pipe and fittings heavy-duty hubless-piping couplings; and
15 coupled joints.
- 16 2. Solid-wall PVC pipe, PVC socket fittings, and solvent cement joints. PVC piping is not
17 permitted in a return air plenum.
- 18 C. Aboveground, vent piping NPS 4 and smaller shall be any of the following:
- 19 1. Hubless, cast-iron soil pipe and fittings; heavy-duty hubless-piping couplings; and
20 coupled joints.
- 21 2. Solid-wall PVC pipe, PVC socket fittings, and solvent cement joints. PVC piping is not
22 permitted in a return air plenum.
- 23 D. Underground, soil, waste, and vent piping NPS 4 and smaller shall be any of the following:
- 24 1. Hubless, cast-iron soil pipe and fittings; heavy-duty hubless-piping couplings; and
25 coupled joints.
- 26 2. Solid wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
- 27 E. Underground, soil and waste piping NPS 5 and larger shall be any of the following:
- 28 1. Hubless, cast-iron soil pipe and fittings; heavy-duty hubless-piping couplings; coupled
29 joints.
- 30 2. Solid-wall PVC pipe; PVC socket fittings; and solvent-cemented joints.

1 END OF SECTION 221316

1 SECTION 221319 - SANITARY WASTE PIPING SPECIALTIES

2 PART 1 - GENERAL

3 1.1 RELATED DOCUMENTS

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

6 1.2 SUMMARY

7 A. Section Includes:

- 8 1. Cleanouts.
9 2. Floor drains.
10 3. Through-penetration firestop assemblies.
11 4. Miscellaneous sanitary drainage piping specialties.

12 B. Related Requirements:

- 13 1. Section 221423 "Storm Drainage Piping Specialties" for storm drainage piping inside the
14 building, drainage piping specialties, and drains.

15 1.3 DEFINITIONS

- 16 A. ABS: Acrylonitrile-butadiene-styrene plastic.
17 B. FOG: Fats, oils, and greases.
18 C. FRP: Fiberglass-reinforced plastic.
19 D. HDPE: High-density polyethylene plastic.
20 E. PE: Polyethylene plastic.
21 F. PP: Polypropylene plastic.
22 G. PVC: Polyvinyl chloride plastic.

- 1 1.4 INFORMATIONAL SUBMITTALS
- 2 A. Field quality-control reports.
- 3 1.5 CLOSEOUT SUBMITTALS
- 4 A. Operation and Maintenance Data: For drainage piping specialties to include in emergency,
5 operation, and maintenance manuals.
- 6 1.6 QUALITY ASSURANCE
- 7 A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing
8 agency.
- 9 B. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic sanitary
10 piping specialty components.
- 11 1.7 COORDINATION
- 12 A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete,
13 reinforcement, and formwork requirements are specified in Division 03.
- 14 B. Coordinate size and location of roof penetrations.
- 15 PART 2 - PRODUCTS
- 16 2.1 CLEANOUTS
- 17 A. Metal Floor Cleanouts:
- 18 1. ASME A112.36.2M, Cast-Iron Cleanouts:
- 19 a. Manufacturers: Subject to compliance with requirements, provide products by
20 one of the following:
- 21 1) Josam Company.
- 22 2) Smith, Jay R. Mfg. Co.
- 23 3) Watts Drainage Products.
- 24 4) Zurn Plumbing Products Group.
- 25 B. Cast-Iron Wall Cleanouts:

- 1 1. Manufacturers: Subject to compliance with requirements, provide products by one of
2 the following:
 - 3 a. Josam Company; Josam Div.
 - 4 b. Smith, Jay R. Mfg. Co.
 - 5 c. Watts Drainage Products.
 - 6 d. Zurn Plumbing Products Group; Specification Drainage Operation.
- 7 2. Standard: ASME A112.36.2M. Include wall access.
- 8 3. Size: Same as connected drainage piping.
- 9 4. Body: Hubless, cast-iron soil pipe test tee as required to match connected piping.
- 10 5. Closure: Countersunk or raised-head, drilled-and-threaded brass plug.
- 11 6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
- 12 7. Wall Access: Round, flat, chrome-plated brass or stainless-steel cover plate with screw.

13 2.2 FLOOR DRAINS

14 A. Cast-Iron Floor Drains:

- 15 1. Manufacturers: Subject to compliance with requirements, provide products by one of
16 the following:
 - 17 a. Josam Company; Josam Div.
 - 18 b. Smith, Jay R. Mfg. Co.
 - 19 c. Watts Drainage Products.
 - 20 d. Zurn Plumbing Products Group.
- 21 2. Standard: ASME A112.6.3.
- 22 3. Body Material: Gray iron.

23 2.3 THROUGH-PENETRATION FIRESTOP ASSEMBLIES

24 A. Through-Penetration Firestop Assemblies:

- 25 1. Manufacturers: Subject to compliance with requirements, provide products by one of
26 the following:
 - 27 a. ProSet Systems Inc.
- 28 2. Standard: UL 1479 assembly of sleeve and stack fitting with firestopping plug.
- 29 3. Size: Same as connected soil, waste, or vent stack.

- 1 2.4 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES
- 2 A. Open Drains:
- 3 1. Description: Shop or field fabricate from ASTM A 74, Service class, hub-and-spigot, cast-
4 iron, soil-pipe fittings. Include P-trap, hub-and-spigot riser section; and where required,
5 increaser fitting joined with ASTM C 564, rubber gaskets.
- 6 2. Size: Same as connected waste piping with increaser fitting of size indicated.
- 7 B. Deep-Seal Traps:
- 8 1. Description: Cast-iron or bronze casting, with inlet and outlet matching connected
9 piping and cleanout trap-seal primer valve connection.
- 10 2. Size: Same as connected waste piping.
- 11 a. NPS 2: 4-inch- minimum water seal.
- 12 b. NPS 2-1/2 and Larger: 5-inch- minimum water seal.
- 13 C. Air-Gap Fittings:
- 14 1. Standard: ASME A112.1.2, for fitting designed to ensure fixed, positive air gap between
15 installed inlet and outlet piping.
- 16 2. Body: Bronze or cast iron.
- 17 3. Inlet: Opening in top of body.
- 18 4. Outlet: Larger than inlet.
- 19 5. Size: Same as connected waste piping and with inlet large enough for associated indirect
20 waste piping.
- 21 PART 3 - EXECUTION
- 22 3.1 INSTALLATION
- 23 A. Install cleanouts in aboveground piping and building drain piping according to the following,
24 unless otherwise indicated:
- 25 1. Size same as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless
26 larger cleanout is indicated.
- 27 2. Locate at each change in direction of piping greater than 45 degrees.
- 28 3. Locate at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for
29 larger piping.
- 30 4. Locate at base of each vertical soil and waste stack.
- 31 B. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with
32 finished floor.

- 1 C. For cleanouts located in concealed piping, install cleanout wall access covers, of types
2 indicated, with frame and cover flush with finished wall.
- 3 D. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with
4 finished floor, unless otherwise indicated.
- 5 1. Position floor drains for easy access and maintenance.
6 2. Set floor drains below elevation of surrounding finished floor to allow floor drainage. Set
7 with grates depressed according to the following drainage area radii:
- 8 a. Radius, 30 Inches or Less: Equivalent to 1 percent slope, but not less than 1/4-inch
9 total depression.
10 b. Radius, 30 to 60 Inches: Equivalent to 1 percent slope.
11 c. Radius, 60 Inches or Larger: Equivalent to 1 percent slope, but not greater than 1-
12 inch total depression.
- 13 3. Install floor-drain flashing collar or flange so no leakage occurs between drain and
14 adjoining flooring. Maintain integrity of waterproof membranes where penetrated.
15 4. Install individual traps for floor drains connected to sanitary building drain, unless
16 otherwise indicated.
- 17 E. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping
18 discharge into sanitary drainage system.
- 19 F. Install wood-blocking reinforcement for wall-mounting-type specialties.
- 20 G. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is
21 indicated.
- 22 3.2 CONNECTIONS
- 23 A. Comply with requirements in Section 221316 "Sanitary Waste and Vent Piping" for piping
24 installation requirements. Drawings indicate general arrangement of piping, fittings, and
25 specialties.
- 26 B. Install piping adjacent to equipment to allow service and maintenance.
- 27 3.3 FIELD QUALITY CONTROL
- 28 A. Tests and Inspections:
- 29 1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest
30 until no leaks exist.

1 SECTION 221319.13 - SANITARY DRAINS

2 PART 1 - GENERAL

3 1.1 RELATED DOCUMENTS

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

6 1.2 SUMMARY

- 7 A. Section Includes:

- 8 1. Floor drains.
9 2. Floor sinks.
10 3. Trench drains.
11 4. Channel drainage systems.

12 1.3 DEFINITIONS

- 13 A. ABS: Acrylonitrile-butadiene styrene.
14 B. FRP: Fiberglass-reinforced plastic.
15 C. HDPE: High-density polyethylene.
16 D. PE: Polyethylene.
17 E. PP: Polypropylene.
18 F. PVC: Polyvinyl chloride.

19 1.4 ACTION SUBMITTALS

- 20 A. Product Data: For each type of product.
21

1 PART 2 - PRODUCTS

2 2.1 DRAIN ASSEMBLIES

- 3 A. Sanitary drains shall bear label, stamp, or other markings of specified testing agency.
4 B. Comply with NSF 14 for plastic sanitary piping specialty components.

5 2.2 FLOOR DRAINS

6 A. Cast-Iron Floor Drains:

- 7 1. Manufacturers: Subject to compliance with requirements, provide products by one of
8 the following:
9 a. Josam Company; Josam Div.
10 b. Smith, Jay R. Mfg. Co.
11 c. Watts Drainage Products.
12 d. Zurn Plumbing Products Group.
- 13 2. Standard: ASME A112.6.3.
14 3. Pattern: Floor drain.
15 4. Body Material: Gray iron.
16 5. Seepage Flange: Required.
17 6. Anchor Flange: Required.
18 7. Clamping Device: Required.
19 8. Outlet: Bottom.
20 9. Coating on Interior and Exposed Exterior Surfaces: Not required.
21 10. Sediment Bucket: Not required.
22 11. Top or Strainer Material: Nickel bronze.
23 12. Top of Body and Strainer Finish: Nickel bronze.
24 13. Top Shape: Round
25 14. Inlet Fitting: Not required.

26 2.3 FLOOR SINKS

27 A. Cast-Iron Floor Sinks:

- 28 1. Manufacturers: Subject to compliance with requirements, provide products by one of
29 the following:
30 a. Commercial Enameling Company.
31 b. Jay R. Smith Mfg Co; a division of Morris Group International.
32 c. Josam Company.

- 1 d. Wade; a subsidiary of McWane Inc.
- 2 e. WATTS.
- 3 f. Zurn Industries, LLC.

- 4 2. Standard: ASME A112.6.7.
- 5 3. Pattern: Floor drain.
- 6 4. Body Material: Cast iron.
- 7 5. Anchor Flange: Required, with seepage holes.
- 8 6. Clamping Device: Required.
- 9 7. Outlet: Bottom, no-hub connection.
- 10 8. Coating on Interior Surfaces: Not required.
- 11 9. Sediment Bucket: Not required.
- 12 10. Internal Strainer: Dome.
- 13 11. Internal Strainer Material: Aluminum.
- 14 12. Top Grate Material: Cast iron, loose.
- 15 13. Top of Body and Grate Finish: Nickel bronze.
- 16 14. Top Shape: Square.
- 17 15. Top Loading Classification: No traffic.

18 2.4 TRENCH DRAINS

19 A. Trench Drains:

- 20 1. Manufacturers: Subject to compliance with requirements, provide products by one of
- 21 the following:
 - 22 a. East Jordan Company.

 - 23 2. Standard: ASME A112.6.3 for trench drains.
 - 24 3. Material: Ductile or gray iron.
 - 25 4. Flange: Anchor.
 - 26 5. Grate Material: Ductile iron.

27 PART 3 - EXECUTION

28 3.1 INSTALLATION

- 29 A. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with
- 30 finished floor, unless otherwise indicated.
 - 31 1. Position floor drains for easy access and maintenance.
 - 32 2. Set floor drains below elevation of surrounding finished floor to allow floor drainage.
 - 33 3. Set with grates depressed according to the following drainage area radii:

- 1 a. Radius, 30 Inches or Less: Equivalent to 1 percent slope, but not less than 1/4-inch
2 total depression.
- 3 b. Radius, 30 to 60 Inches: Equivalent to 1 percent slope.
- 4 c. Radius, 60 Inches or Larger: Equivalent to 1 percent slope, but not greater than 1-
5 inch total depression.
- 6 4. Install floor-drain flashing collar or flange, so no leakage occurs between drain and
7 adjoining flooring.
- 8 a. Maintain integrity of waterproof membranes where penetrated.
- 9 5. Install individual traps for floor drains connected to sanitary building drain, unless
10 otherwise indicated.
- 11 B. Install trench drains at low points of surface areas to be drained.
- 12 1. Set grates of drains flush with finished surface, unless otherwise indicated.
- 13 C. Install open drain fittings with top of hub 2 inches above floor.
- 14 3.2 CONNECTIONS
- 15 A. Comply with requirements in Section 221316 "Sanitary Waste and Vent Piping" for piping
16 installation requirements. Drawings indicate general arrangement of piping, fittings, and
17 specialties.
- 18 B. Comply with requirements in Section 221319 "Sanitary Waste Piping Specialties" for backwater
19 valves, air admittance devices and miscellaneous sanitary drainage piping specialties.
- 20 C. Comply with requirements in Section 221323 "Sanitary Waste Interceptors" for grease
21 interceptors, grease-removal devices, oil interceptors, sand interceptors, and solid
22 interceptors.
- 23 D. Install piping adjacent to equipment to allow service and maintenance.
- 24 E. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical
25 Systems."
- 26 F. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and
27 Cables."

- 1 3.3 LABELING AND IDENTIFYING
- 2 A. Distinguish among multiple units, inform operator of operational requirements, indicate safety
- 3 and emergency precautions, and warn of hazards and improper operations, in addition to
- 4 identifying unit. Nameplates and signs are specified in Section 220553 "Identification for
- 5 Plumbing Piping and Equipment."

- 6 3.4 PROTECTION
- 7 A. Protect drains during remainder of construction period to avoid clogging with dirt or debris
- 8 and to prevent damage from traffic or construction work.

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

- 10 END OF SECTION 221319.13

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1 SECTION 223300- ELECTRIC, DOMESTIC-WATER HEATERS

2 PART 1 - GENERAL

3 1.1 RELATED DOCUMENTS

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

6 1.2 SUMMARY

7 A. Section Includes:

- 8 1. Commercial, light-duty, storage, electric, domestic-water heaters.
9 2. Domestic-water heater accessories.

10 1.3 PERFORMANCE REQUIREMENTS

- 11 A. Seismic Performance: Commercial domestic-water heaters shall withstand the effects of
12 earthquake motions determined according to ASCE/SEI 7.

- 13 1. The term "withstand" means "the unit will remain in place without separation of any
14 parts from the device when subjected to the seismic forces specified and the unit will be
15 fully operational after the seismic event."

16 1.4 ACTION SUBMITTALS

- 17 A. Product Data: For each type and size of domestic-water heater indicated. Include rated
18 capacities, operating characteristics, electrical characteristics, and furnished specialties and
19 accessories.

20 B. Shop Drawings:

- 21 1. Wiring Diagrams: For power, signal, and control wiring.

22 1.5 INFORMATIONAL SUBMITTALS

- 23 A. Product Certificates: For each type of residential, electric, domestic-water heater, from
24 manufacturer.

- 1 B. Domestic-Water Heater Labeling: Certified and labeled by testing agency acceptable to
2 authorities having jurisdiction.
- 3 C. Source quality-control reports.
- 4 D. Field quality-control reports.
- 5 E. Warranty: Sample of special warranty.
- 6 1.6 CLOSEOUT SUBMITTALS
- 7 A. Operation and Maintenance Data: For electric, domestic-water heaters to include in
8 emergency, operation, and maintenance manuals.
- 9 1.7 QUALITY ASSURANCE
- 10 A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by
11 a qualified testing agency, and marked for intended location and application.
- 12 B. ASME Compliance: Where ASME-code construction is indicated, fabricate and label
13 commercial, domestic-water heater storage tanks to comply with ASME Boiler and Pressure
14 Vessel Code: Section VIII, Division 1.
- 15 C. NSF Compliance: Fabricate and label equipment components that will be in contact with
16 potable water to comply with NSF 61, "Drinking Water System Components - Health Effects."
- 17 1.8 COORDINATION
- 18 A. Coordinate sizes and locations of concrete bases with actual equipment provided.
- 19 1.9 WARRANTY
- 20 A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or
21 replace components of electric, domestic-water heaters that fail in materials or workmanship
22 within specified warranty period.
- 23 1. Failures include, but are not limited to, the following:
- 24 a. Structural failures including storage tank and supports.
- 25 b. Faulty operation of controls.
- 26 c. Deterioration of metals, metal finishes, and other materials beyond normal use.

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- 2. Warranty Periods: From date of Substantial Completion.
 - a. Commercial, Light-Duty, Storage, Electric, Domestic-Water Heaters:
 - 1) Storage Tank: Three years.
 - 2) Controls and Other Components: Two years.
 - b. Compression Tanks: Five years.

PART 2 - PRODUCTS

2.1 COMMERCIAL, ELECTRIC, DOMESTIC-WATER HEATERS

- A. Commercial, Light-Duty, Storage, Electric, Domestic-Water Heaters:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Bradford White Corporation.
 - b. Lochinvar Corporation.
 - c. Smith, A. O. Water Products Co.; a division of A. O. Smith Corporation.
 - d. State Industries.
 - 2. Standard: UL 174.
 - 3. Storage-Tank Construction: Steel, vertical arrangement.
 - a. Tappings: ASME B1.20.1 pipe thread.
 - b. Pressure Rating: 150 psig.
 - c. Interior Finish: Comply with NSF 61 barrier materials for potable-water tank linings, including extending lining material into tappings.
 - 4. Factory-Installed Storage-Tank Appurtenances:
 - a. Anode Rod: Replaceable magnesium.
 - b. Dip Tube: Required unless cold-water inlet is near bottom of tank.

- 1 c. Drain Valve: ASSE 1005.
- 2 d. Insulation: Comply with ASHRAE/IESNA 90.1 or ASHRAE 90.2.
- 3 e. Jacket: Steel with enameled finish.
- 4 f. Heat-Trap Fittings: Inlet type in cold-water inlet and outlet type in hot-water
5 outlet.
- 6 g. Heating Elements: Two; electric, screw-in immersion type; wired for simultaneous
7 operation unless otherwise indicated. Limited to 12 kW total.
- 8 h. Temperature Control: Adjustable thermostat.
- 9 i. Safety Control: High-temperature-limit cutoff device or system.
- 10 j. Relief Valve: ASME rated and stamped for combination temperature-and-
11 pressure relief valves. Include relieving capacity at least as great as heat input,
12 and include pressure setting less than domestic-water heater working-pressure
13 rating. Select relief valve with sensing element that extends into storage tank.

14 2.2 SOURCE QUALITY CONTROL

- 15 A. Factory Tests: Test and inspect domestic-water heaters specified to be ASME-code
16 construction, according to ASME Boiler and Pressure Vessel Code.
- 17 B. Hydrostatically test domestic-water heaters to minimum of one and one-half times pressure
18 rating before shipment.
- 19 C. Electric, domestic-water heaters will be considered defective if they do not pass tests and
20 inspections. Comply with requirements in Section 014000 "Quality Requirements" for retesting
21 and reinspecting requirements and Section 017300 "Execution" for requirements for
22 correcting the Work.
- 23 D. Prepare test and inspection reports.

24 PART 3 - EXECUTION

25 3.1 DOMESTIC-WATER HEATER INSTALLATION

- 26 A. Commercial, Electric, Domestic-Water Heater Mounting: Install commercial, electric, domestic-
27 water heaters on concrete base. Comply with requirements for concrete bases specified in
28 Section 033000 "Cast-in-Place Concrete."

- 1 1. Exception: Omit concrete bases for commercial, electric, domestic-water heaters if
2 installation on stand, bracket, suspended platform, or directly on floor is indicated.
- 3 2. Maintain manufacturer's recommended clearances.
- 4 3. Arrange units so controls and devices that require servicing are accessible.
- 5 B. Install electric, domestic-water heaters level and plumb, according to layout drawings, original
6 design, and referenced standards. Maintain manufacturer's recommended clearances. Arrange
7 units so controls and devices needing service are accessible.
- 8 1. Install shutoff valves on domestic-water-supply piping to domestic-water heaters and on
9 domestic-hot-water outlet piping. Comply with requirements for shutoff valves specified
10 in Section 220523.12 "Ball Valves for Plumbing Piping," Section 220523.13 "Butterfly
11 Valves for Plumbing Piping," and Section 220523.15 "Gate Valves for Plumbing Piping."
- 12 C. Install combination temperature-and-pressure relief valves in top portion of storage tanks. Use
13 relief valves with sensing elements that extend into tanks. Extend commercial-water-heater
14 relief-valve outlet, with drain piping same as domestic-water piping in continuous downward
15 pitch, and discharge by positive air gap onto closest floor drain.
- 16 D. Install water-heater drain piping as indirect waste to spill by positive air gap into open drains
17 or over floor drains. Install hose-end drain valves at low points in water piping for electric,
18 domestic-water heaters that do not have tank drains. Comply with requirements for hose-end
19 drain valves specified in Section 221119 "Domestic Water Piping Specialties."
- 20 E. Install thermometers on inlet and outlet piping of residential, solar, electric, domestic-water
21 heaters. Comply with requirements for thermometers specified in Section 220519 "Meters and
22 Gages for Plumbing Piping."
- 23 F. Install piping-type heat traps on inlet and outlet piping of electric, domestic-water heater
24 storage tanks without integral or fitting-type heat traps.
- 25 G. Fill electric, domestic-water heaters with water.
- 26 H. Charge domestic-water compression tanks with air.
- 27 3.2 CONNECTIONS
- 28 A. Comply with requirements for piping specified in Section 221116 "Domestic Water Piping."
29 Drawings indicate general arrangement of piping, fittings, and specialties.
- 30 B. Where installing piping adjacent to electric, domestic-water heaters, allow space for service
31 and maintenance of water heaters. Arrange piping for easy removal of domestic-water
32 heaters.

1 3.3 IDENTIFICATION

2 A. Identify system components. Comply with requirements for identification specified in
3 Section 220553 "Identification for Plumbing Piping and Equipment."

4 3.4 FIELD QUALITY CONTROL

5 A. Perform tests and inspections.

6 1. Manufacturer's Field Service: Engage a factory-authorized service representative to
7 inspect components, assemblies, and equipment installations, including connections,
8 and to assist in testing.

9 2. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest
10 until no leaks exist.

11 3. Operational Test: After electrical circuitry has been energized, start units to confirm
12 proper operation.

13 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and
14 equipment.

15 B. Electric, domestic-water heaters will be considered defective if they do not pass tests and
16 inspections. Comply with requirements in Section 014000 "Quality Requirements" for retesting
17 and reinspecting requirements and Section 017300 "Execution" for requirements for
18 correcting the Work.

19 C. Prepare test and inspection reports.

20 3.5 DEMONSTRATION

21 A. Train Owner's maintenance personnel to adjust, operate, and maintain electric, domestic-
22 water heaters.

23 END OF SECTION 223300

24

1 SECTION 224000 - PLUMBING FIXTURES

2 PART 1 - GENERAL

3 1.1 RELATED DOCUMENTS

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

6 1.2 SUMMARY

- 7 A. This Section includes the following conventional plumbing fixtures and related components:

- 8 1. Kitchen sinks.
9 2. Laundry Sinks.

- 10 B. Related Sections include the following:

- 11 1. Division 22 Section "Domestic Water Piping Specialties" for backflow preventers, floor
12 drains, and specialty fixtures not included in this Section.

13 1.3 DEFINITIONS

- 14 A. ABS: Acrylonitrile-butadiene-styrene plastic.

- 15 B. Accessible Fixture: Plumbing fixture that can be approached, entered, and used by people
16 with disabilities.

- 17 C. Cast Polymer: Cast-filled-polymer-plastic material. This material includes cultured-marble and
18 solid-surface materials.

- 19 D. Cultured Marble: Cast-filled-polymer-plastic material with surface coating.

- 20 E. Fitting: Device that controls the flow of water into or out of the plumbing fixture. Fittings
21 specified in this Section include supplies and stops, faucets and spouts, shower heads and tub
22 spouts, drains and tailpieces, and traps and waste pipes. Piping and general-duty valves are
23 included where indicated.

- 24 F. FRP: Fiberglass-reinforced plastic.

- 25 G. PMMA: Polymethyl methacrylate (acrylic) plastic.

- 26 H. PVC: Polyvinyl chloride plastic.

- 1 I. Solid Surface: Nonporous, homogeneous, cast-polymer-plastic material with heat-, impact-,
2 scratch-, and stain-resistance qualities.
- 3 1.4 SUBMITTALS
- 4 A. Product Data: For each type of plumbing fixture indicated. Include selected fixture and trim,
5 fittings, accessories, appliances, appurtenances, equipment, and supports. Indicate materials
6 and finishes, dimensions, construction details, and flow-control rates.
- 7 B. Operation and Maintenance Data: For plumbing fixtures to include in emergency, operation,
8 and maintenance manuals.
- 9 C. Warranty: Special warranty specified in this Section.
- 10 1.5 QUALITY ASSURANCE
- 11 A. Source Limitations: Obtain plumbing fixtures, faucets, and other components of each category
12 through one source from a single manufacturer.
- 13 1. Exception: If fixtures, faucets, or other components are not available from a single
14 manufacturer, obtain similar products from other manufacturers specified for that
15 category.
- 16 B. Regulatory Requirements: Comply with requirements in Public Law 102-486, "Energy Policy
17 Act," about water flow and consumption rates for plumbing fixtures.
- 18 C. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for
19 fixture materials that will be in contact with potable water.
- 20 D. Select combinations of fixtures and trim, faucets, fittings, and other components that are
21 compatible.
- 22 E. Comply with the following applicable standards and other requirements specified for plumbing
23 fixtures:
- 24 1. Plastic Laundry Trays: ANSI Z124.6.
- 25 F. Comply with the following applicable standards and other requirements specified for sink
26 faucets:
- 27 1. Backflow Protection Devices for Faucets with Hose-Thread Outlet: ASME A112.18.3M.
28 2. Faucets: ASME A112.18.1.
29 3. Hose-Connection Vacuum Breakers: ASSE 1011.
30 4. Hose-Coupling Threads: ASME B1.20.7.
31 5. Integral, Atmospheric Vacuum Breakers: ASSE 1001.
32 6. NSF Potable-Water Materials: NSF 61.
33 7. Pipe Threads: ASME B1.20.1.
34 8. Supply Fittings: ASME A112.18.1.

1 9. Brass Waste Fittings: ASME A112.18.2.

2 PART 2 - GENERAL

3 2.1 KITCHEN SINKS

4 A. Kitchen Sinks: counter mounted, stainless steel.

5 1. Stainless-Steel Kitchen Sinks:

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

8 1) American Standard.

9 2) Elkay.

10 3) Franke Consumer Products, Inc.

11 4) Kohler Co.

12 5) Sterling.

13 2. Fixture:

14 a. Standard: ASME A112.19.3/CSA B45.4 for stainless-steel kitchen sinks.

15 b. Bowl:

16 1) Drain: 3-1/2-inch outlet.

17 a) Location: Centered in bowl.

18 2.2 LAUNDRY SINKS

19 A. Laundry Sinks:

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

22 a. Eljer.

23 b. Crane Plumbing, L.L.C./Fiat Products.

24 c. Florestone Products Co., Inc.

25 d. Mustee, E. L. & Sons, Inc.

26 e. Swan Corporation (The).

27 2. Description: Stand-mounting, plastic laundry trays.

28 a. Faucet: Sink for fixture-ledge mounting.

29 b. Supplies: NPS 1/2 copper tubing with ball, valves.

30 c. Drain: Grid with NPS 1-1/2 outlet.

31 d. Drain Piping: NPS 1-1/2 chrome-plated, cast-brass P-trap;
32 0.045-inch- thick tubular brass waste to wall; and wall
33 escutcheon.

- 1 2.3 SINK FAUCETS
- 2 A. NSF Standard: Comply with NSF/ANSI 61 Annex G, "Drinking Water System Components -
3 Health Effects," for faucet materials that will be in contact with potable water.
- 4 B. Sink Faucets: Solid brass, kitchen sink and laundry sink.
- 5 1. General-Duty, Solid-Brass Faucets:
- 6 a. Manufacturers: Subject to compliance with requirements, provide products by
7 one of the following:
- 8 1) Chicago Faucets; Geberit Group.
9 2) Delta Faucet Company.
10 3) Moen Incorporated.
11 4) T&S Brass and Bronze Works, Inc.
- 12 2. Standard: ASME A112.18.1/CSA B125.1.
13 3. General: Include hot- and cold-water indicators; coordinate faucet inlets with supplies
14 and fixture holes; coordinate outlet with spout and fixture receptor.
15 4. Finish: Polished chrome plate.
16 5. Mounting: Deck.
17 6. Handle(s): Wrist blade, 4 inches.
18 7. Spout Outlet: Aerator.
- 19 PART 3 - EXECUTION
- 20 3.1 EXAMINATION
- 21 A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify
22 actual locations of piping connections before plumbing fixture installation.
- 23 B. Examine cabinets, counters, floors, and walls for suitable conditions where fixtures will be
24 installed.
- 25 C. Proceed with installation only after unsatisfactory conditions have been corrected.
- 26 3.2 INSTALLATION
- 27 A. Assemble plumbing fixtures, trim, fittings, and other components according to manufacturers'
28 written instructions.
- 29 B. Install fixtures level and plumb according to roughing-in drawings.

- 1 C. Install water-supply piping with stop on each supply to each fixture to be connected to water
2 distribution piping. Attach supplies to supports or substrate within pipe spaces behind
3 fixtures. Install stops in locations where they can be easily reached for operation.
- 4 1. Exception: Use ball, gate, or globe valves if supply stops are not specified with fixture.
5 Valves are specified in Division 22 Section "General-Duty Valves for Plumbing Piping."
- 6 D. Install trap and tubular waste piping on drain outlet of each fixture to be directly connected to
7 sanitary drainage system.
- 8 E. Install tubular waste piping on drain outlet of each fixture to be indirectly connected to
9 drainage system.
- 10 F. Install shower flow-control fittings with specified maximum flow rates in shower arms.
- 11 G. Install faucet-spout fittings with specified flow rates and patterns in faucet spouts if faucets
12 are not available with required rates and patterns. Include adapters if required.
- 13 H. Install traps on fixture outlets.
- 14 I. Set shower receptors in leveling bed of cement grout.
- 15 J. Install escutcheons at piping wall ceiling penetrations in exposed, finished locations and within
16 cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding
17 fittings.
- 18 K. Seal joints between fixtures and walls, floors, and countertops using sanitary-type, one-part,
19 mildew-resistant silicone sealant. Match sealant color to fixture color. Sealants are specified
20 in Division 07 Section "Joint Sealants."
- 21 3.3 CONNECTIONS
- 22 A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate
23 general arrangement of piping, fittings, and specialties.
- 24 B. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent
25 piping. Use size fittings required to match fixtures.
- 26 C. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste
27 and Vent Piping."
- 28 3.4 FIELD QUALITY CONTROL
- 29 A. Verify that installed plumbing fixtures are categories and types specified for locations where
30 installed.

1 B. Check that plumbing fixtures are complete with trim, faucets, fittings, and other specified
2 components.

3 C. Inspect installed plumbing fixtures for damage. Replace damaged fixtures and components.

4 D. Test installed fixtures after water systems are pressurized for proper operation. Replace
5 malfunctioning fixtures and components, then retest. Repeat procedure until units operate
6 properly.

7 3.5 ADJUSTING

8 A. Operate and adjust faucets and controls. Replace damaged and malfunctioning fixtures,
9 fittings, and controls.

10 B. Adjust water pressure at faucets to produce proper flow and stream.

11 C. Replace washers and seals of leaking and dripping faucets and stops.

12 3.6 CLEANING

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

15 1. Remove faucet spouts and strainers, remove sediment and debris, and reinstall strainers
16 and spouts.

17 2. Remove sediment and debris from drains.

18 B. After completing installation of exposed, factory-finished fixtures, faucets, and fittings, inspect
19 exposed finishes and repair damaged finishes.

20 3.7 PROTECTION

21 A. Provide protective covering for installed fixtures and fittings.

22 B. Do not allow use of plumbing fixtures for temporary facilities unless approved in writing by
23 Owner.

24 END OF SECTION 224000

1 SECTION 224213.13 - COMMERCIAL WATER CLOSETS

2 PART 1 - GENERAL

3 1.1 RELATED DOCUMENTS

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

6 1.2 SUMMARY

- 7 A. Section Includes:

- 8 1. Water closets.
9 2. Toilet seats.

10 1.3 ACTION SUBMITTALS

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

- 12 1. Include construction details, material descriptions, dimensions of individual components
13 and profiles, and finishes for water closets.
14 2. Include rated capacities, operating characteristics, electrical characteristics, and
15 furnished specialties and accessories.

16 1.4 CLOSEOUT SUBMITTALS

- 17 A. Operation and Maintenance Data: For flushometer valves to include in operation and
18 maintenance manuals.

19 PART 2 - PRODUCTS

- 20 A. Water Closets: Floor mounted, bottom outlet, close-coupled flushometer tank.

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

- 23 a. American Standard America.
24 b. Kohler Co.
25

- 1 2. Bowl:
- 2 a. Standards: ASME A112.19.2/CSA B45.1 and ASSE/ASME 1037/CSA B125.37.
- 3 b. Material: Vitreous china.
- 4 c. Type: Siphon jet.
- 5 d. Style: Pressure assisted.
- 6 e. Height: Handicapped/elderly, complying with ICC/ANSI A117.1.
- 7 f. Rim Contour: Elongated.
- 8 g. Water Consumption: Maximum 1.6 gal. per flush.
- 9 h. Color: White.
- 10 3. Bowl-to-Drain Connecting Fitting: ASME A112.4.3.
- 11 4. Flushometer Tank: Pressure assisted.

12 2.2 TOILET SEATS

13 A. Toilet Seats:

- 14 1. Manufacturers: Subject to compliance with requirements, provide products by one of
- 15 the following:
- 16 a. American Standard America.
- 17 b. Bemis Manufacturing Company.
- 18 c. Centoco Manufacturing Corporation.
- 19 d. Church Seats.
- 20 e. Kohler Co.
- 21 f. Olsonite Seat Co.
- 22 2. Standard: IAPMO/ANSI Z124.5.
- 23 3. Material: Plastic.
- 24 4. Type: Commercial (Heavy duty).
- 25 5. Shape: Elongated rim, open front.
- 26 6. Hinge: Self-sustaining, check.
- 27 7. Hinge Material: Noncorroding metal.
- 28 8. Seat Cover: Not required.
- 29 9. Color: White.

30 PART 3 - EXECUTION

31 3.1 EXAMINATION

- 32 A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify
- 33 actual locations of piping connections before water-closet installation.

- 1 B. Examine walls and floors for suitable conditions where water closets will be installed.
- 2 C. Proceed with installation only after unsatisfactory conditions have been corrected.
- 3 3.2 INSTALLATION
- 4 A. Water-Closet Installation:
- 5 1. Install level and plumb according to roughing-in drawings.
- 6 2. Install floor-mounted water closets on bowl-to-drain connecting fitting attachments to
- 7 piping or building substrate.
- 8 B. Install toilet seats on water closets.
- 9 C. Wall Flange and Escutcheon Installation:
- 10 1. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished
- 11 locations and within cabinets and millwork.
- 12 2. Install deep-pattern escutcheons if required to conceal protruding fittings.
- 13 D. Joint Sealing:
- 14 1. Seal joints between water closets and walls and floors using sanitary-type, one-part,
- 15 mildew-resistant silicone sealant.
- 16 2. Match sealant color to water-closet color.
- 17 3.3 CONNECTIONS
- 18 A. Connect water closets with water supplies and soil, waste, and vent piping. Use size fittings
- 19 required to match water closets.
- 20 B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."
- 21 C. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste
- 22 and Vent Piping."
- 23 D. Where installing piping adjacent to water closets, allow space for service and maintenance.
- 24 3.4 ADJUSTING
- 25 A. Operate and adjust water closets and controls. Replace damaged and malfunctioning water
- 26 closets, fittings, and controls.

- 1 3.5 CLEANING AND PROTECTION
- 2 A. Clean water closets and fittings with manufacturers' recommended cleaning methods and
- 3 materials.
- 4 B. Install protective covering for installed water closets and fittings.
- 5 C. Do not allow use of water closets for temporary facilities unless approved in writing by Owner.
- 6 END OF SECTION 224213.13

1 SECTION 224216.13 - COMMERCIAL LAVATORIES

2 PART 1 - GENERAL

3 1.1 RELATED DOCUMENTS

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

6 1.2 SUMMARY

- 7 A. Section Includes:

- 8 1. Lavatories.
9 2. Faucets.

10 1.3 ACTION SUBMITTALS

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

- 12 1. Include construction details, material descriptions, dimensions of individual components
13 and profiles, and finishes for lavatories.
14 2. Include rated capacities, operating characteristics, electrical characteristics, and
15 furnished specialties and accessories.

16 1.4 INFORMATIONAL SUBMITTALS

- 17 A. Coordination Drawings: Counter cutout templates for mounting of counter-mounted
18 lavatories.

19 1.5 CLOSEOUT SUBMITTALS

- 20 A. Operation and Maintenance Data: For lavatories and faucets to include in operation and
21 maintenance manuals.

1 PART 2 - PRODUCTS

2 2.1 VITREOUS-CHINA, WALL-MOUNTED LAVATORIES

3 A. Lavatory: Vitreous china, wall mounted, with back.

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

- 6 a. American Standard America.
- 7 b. Kohler Co.

8 2. Fixture:

- 9 a. Standard: ASME A112.19.2/CSA B45.1.
- 10 b. Type: For wall hanging.
- 11 c. Faucet-Hole Location: Top.
- 12 d. Color: White.
- 13 e. Mounting Material: Chair carrier.

14
15 3. Support: ASME A112.6.1M, Type II, concealed-arm lavatory carrier.

16 2.2 SOLID-BRASS, MANUALLY OPERATED FAUCETS

17 A. NSF Standard: Comply with NSF/ANSI 61, "Drinking Water System Components - Health
18 Effects," for faucet materials that will be in contact with potable water.

19 B. Lavatory Faucets: Manual-type, two-handle mixing, commercial, solid-brass valve.

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

- 22 a. Chicago Faucets.
- 23 b. Delta Faucets.
- 24 c. MOEN.
- 25 d. T & S Brass and Bronze Works, Inc.

26
27
28 2. Standard: ASME A112.18.1/CSA B125.1.

29 3. General: Include hot- and cold-water indicators; coordinate faucet inlets with supplies
30 and fixture hole punchings; coordinate outlet with spout and fixture receptor.

31 4. Body Material: Commercial, solid brass.

32 5. Finish: Polished chrome plate.

- 1 2.3 SUPPLY FITTINGS
- 2 A. NSF Standard: Comply with NSF/ANSI 61, "Drinking Water System Components - Health
3 Effects," for supply-fitting materials that will be in contact with potable water.
- 4 B. Standard: ASME A112.18.1/CSA B125.1.
- 5 C. Supply Piping: Chrome-plated-brass pipe or chrome-plated copper tube matching water-
6 supply piping size. Include chrome-plated-brass or stainless-steel wall flange.
- 7 D. Supply Stops: Chrome-plated-brass, one-quarter-turn, ball-type or compression valve with
8 inlet connection matching supply piping.
- 9 E. Operation: Loose key.
- 10 F. Risers:
- 11 1. NPS 3/8.
12 2. Chrome-plated, soft-copper flexible tube riser.
- 13 2.4 WASTE FITTINGS
- 14 A. Standard: ASME A112.18.2/CSA B125.2.
- 15 B. Drain: Grid type with NPS 1-1/4 offset and straight tailpiece.
- 16 C. Trap:
- 17 1. Size: NPS 1-1/2 by NPS 1-1/4.
18 2. Material: Chrome-plated, two-piece, cast-brass trap and swivel elbow with 0.032-inch-
19 thick brass tube to wall; and chrome-plated, brass or steel wall flange.
- 20 PART 3 - EXECUTION
- 21 3.1 EXAMINATION
- 22 A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify
23 actual locations of piping connections before lavatory installation.
- 24 B. Examine counters and walls for suitable conditions where lavatories will be installed.
- 25 C. Proceed with installation only after unsatisfactory conditions have been corrected.

- 1 3.2 INSTALLATION
- 2 A. Install lavatories level and plumb according to roughing-in drawings.
- 3 B. Install supports, affixed to building substrate, for wall-mounted lavatories.
- 4 C. Install accessible wall-mounted lavatories at handicapped/elderly mounting height for people
5 with disabilities, according to ICC/ANSI A117.1.
- 6 D. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations.
7 Use deep-pattern escutcheons if required to conceal protruding fittings.
- 8 E. Seal joints between lavatories, counters, and walls using sanitary-type, one-part, mildew-
9 resistant silicone sealant. Match sealant color to fixture color.
- 10 F. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of
11 accessible lavatories. Comply with requirements in Section 220719 "Plumbing Piping
12 Insulation."
- 13 3.3 CONNECTIONS
- 14 A. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent
15 piping. Use size fittings required to match fixtures.
- 16 B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."
- 17 C. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste
18 and Vent Piping."
- 19 3.4 ADJUSTING
- 20 A. Operate and adjust lavatories and controls. Replace damaged and malfunctioning lavatories,
21 fittings, and controls.
- 22 B. Adjust water pressure at faucets to produce proper flow.
- 23 3.5 CLEANING AND PROTECTION
- 24 A. After completing installation of lavatories, inspect and repair damaged finishes.
- 25 B. Clean lavatories, faucets, and other fittings with manufacturers' recommended cleaning
26 methods and materials.
- 27 C. Provide protective covering for installed lavatories and fittings.

- 1 D. Do not allow use of lavatories for temporary facilities unless approved in writing by Owner.

- 2 END OF SECTION 224216.13

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1 SECTION 224500 – EMERGENCY PLUMBING FIXTURES

2 PART 1 - GENERAL

3 1.1 RELATED DOCUMENTS

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

6 1.2 SUMMARY

- 7 A. Section Includes:

- 8 1. Combination units.
9 2. Water-tempering equipment.

10 1.3 DEFINITIONS

- 11 A. Accessible Fixture: Emergency plumbing fixture that can be approached, entered, and used by
12 people with disabilities.
13 B. Plumbed Emergency Plumbing Fixture: Fixture with fixed, potable-water supply.
14 C. Tepid: Moderately warm.

15 1.4 ACTION SUBMITTALS

- 16 A. Product Data: For each type of product indicated. Include flow rates and capacities, furnished
17 specialties, and accessories.
18 B. Shop Drawings: Diagram power, signal, and control wiring.

19 1.5 INFORMATIONAL SUBMITTALS

- 20 A. Product Certificates: Submit certificates of performance testing specified in "Source Quality
21 Control" Article.

1 B. Field quality-control test reports.

2 1.6 CLOSEOUT SUBMITTALS

3 A. Operation and Maintenance Data: For emergency plumbing fixtures to include in operation
4 and maintenance manuals.

5 1.7 QUALITY ASSURANCE

6

7 A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by
8 a qualified testing agency, and marked for intended location and application.

9 B. ANSI Standard: Comply with ANSI Z358.1, "Emergency Eyewash and Shower Equipment."

10 C. NSF Standard: Comply with NSF 61 Annex G, "Drinking Water System Components - Health
11 Effects," for fixture materials that will be in contact with potable water.

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

16 PART 2 - PRODUCTS

17 2.1 COMBINATION UNITS

18 A. Standard, Plumbed Emergency Shower with Eye/Face Wash Combination Units:

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

21 a. Acorn Safety; a Division of Morris Group International.

22 b. Bradley Corporation.

23 c. Guardian Equipment Co.

24 d. Haws Corporation.

25

26 2. Piping:

27 a. Material: PVC.

28 b. Unit Supply: NPS 1-1/4

- 1 c. Unit Drain: Outlet at back or side near bottom.
- 2 3. Shower:
- 3 a. Capacity: Not less than 20 gpm for at least 15 minutes.
- 4 b. Supply Piping: NPS 1 with flow regulator and stay-open control valve.
- 5 c. Control-Valve Actuator: Pull rod.
- 6 d. Shower Head: plastic.
- 7 e. Mounting: Pedestal.
- 8 4. Eye/Face Wash Unit:
- 9 a. Capacity: Not less than 3 gpm for at least 15 minutes.
- 10 b. Supply Piping: NPS 1/2 with flow regulator and stay-open control valve.
- 11 c. Control-Valve Actuator: Paddle.
- 12 d. Spray-Head Assembly: Two or four receptor-mounted spray heads.
- 13 e. Receptor: Plastic bowl.
- 14 f. Mounting: Attached shower pedestal.

15 2.2 WATER-TEMPERING EQUIPMENT

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

- 17 1. products by one of the following:
- 18 a. Acorn Safety; a Division of Morris Group International.
- 19 b. Bradley Corporation.
- 20 c. Guardian Equipment Co.
- 21 d. Haws Corporation.
- 22 e. Lawler Manufacturing Company, Inc.
- 23 f. Leonard Valve Company.
- 24 g. POWERS; A WATTS Brand.
- 25 2. Description: Factory-fabricated equipment with thermostatic mixing valve.
- 26 a. Thermostatic Mixing Valve: Designed to provide 85 deg F tepid, potable water at
- 27 emergency plumbing fixtures, to maintain temperature at plus or minus 5 deg F
- 28 throughout required 15-minute test period, and in case of unit failure to continue
- 29 cold-water flow, with union connections, controls, metal piping, and corrosion-
- 30 resistant enclosure.
- 31 b. Supply Connections: For hot and cold water.

1 2.3 SOURCE QUALITY CONTROL

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

4 PART 3 - EXECUTION

5 3.1 EXAMINATION

- 6 A. Examine roughing-in for water and waste piping systems to verify actual locations of piping
7 connections before plumbed emergency plumbing fixture installation.

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

9 3.2 EMERGENCY PLUMBING FIXTURE INSTALLATION

- 10 A. Assemble emergency plumbing fixture piping, fittings, control valves, and other components.

- 11 B. Install fixtures level and plumb.

- 12 C. Fasten fixtures to substrate.

- 13 D. Install shutoff valves in water-supply piping to fixtures. Use ball or gate valve if specific type
14 valve is not indicated. Install valves chained or locked in open position if permitted. Install
15 valves in locations where they can easily be reached for operation. Comply with requirements
16 for valves specified in Section 220523.12 "Ball Valves for Plumbing Piping" and
17 Section 220523.15 "Gate Valves for Plumbing Piping."

- 18 1. Exception: Omit shutoff valve on supply to group of plumbing fixtures that includes
19 emergency equipment.

- 20 2. Exception: Omit shutoff valve on supply to emergency equipment if prohibited by
21 authorities having jurisdiction.

- 22 E. Install dielectric fitting in supply piping to emergency equipment if piping and equipment
23 connections are made of different metals. Comply with requirements for dielectric fittings
24 specified in Section 221116 "Domestic Water Piping."

- 25 F. Install thermometers in supply and outlet piping connections to water-tempering equipment.
26 Comply with requirements for thermometers specified in Section 220519 "Meters and Gages
27 for Plumbing Piping."

- 1 G. Install trap and waste piping on drain outlet of emergency equipment receptors that are
2 indicated to be directly connected to drainage system. Comply with requirements for waste
3 piping specified in Section 221316 "Sanitary Waste and Vent Piping."
- 4 H. Install indirect waste piping on drain outlet of emergency equipment receptors that are
5 indicated to be indirectly connected to drainage system. Comply with requirements for waste
6 piping specified in Section 221316 "Sanitary Waste and Vent Piping."
- 7 I. Install escutcheons on piping wall and ceiling penetrations in exposed, finished locations.
8 Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for
9 Plumbing Piping."
- 10 3.3 CONNECTIONS
- 11 A. Connect hot- and cold-water-supply piping to hot- and cold-water, water-tempering
12 equipment. Connect output from water-tempering equipment to emergency plumbing
13 fixtures. Comply with requirements for hot- and cold-water piping specified in Section 221116
14 "Domestic Water Piping."
- 15 B. Directly connect emergency plumbing fixture receptors with trapped drain outlet to sanitary
16 waste and vent piping. Comply with requirements for waste piping specified in Section 221316
17 "Sanitary Waste and Vent Piping."
- 18 C. Indirectly connect emergency plumbing fixture receptors without trapped drain outlet to
19 sanitary waste or storm drainage piping.
- 20 D. Where installing piping adjacent to emergency plumbing fixtures, allow space for service and
21 maintenance of fixtures.
- 22 3.4 IDENTIFICATION
- 23 A. Install equipment nameplates or equipment markers on emergency plumbing fixtures and
24 equipment and equipment signs on water-tempering equipment. Comply with requirements
25 for identification materials specified in Section 220553 "Identification for Plumbing Piping and
26 Equipment."
- 27 3.5 FIELD QUALITY CONTROL
- 28 A. Mechanical-Component Testing: After plumbing connections have been made, test for
29 compliance with requirements. Verify ability to achieve indicated capacities.

- 1 B. Tests and Inspections:
- 2 1. Perform each visual and mechanical inspection.
- 3 2. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest
- 4 until no leaks exist.
- 5 3. Operational Test: After electrical circuitry has been energized, start units to confirm
- 6 proper unit operation.
- 7 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and
- 8 equipment.
- 9 C. Emergency plumbing fixtures and water-tempering equipment will be considered defective if
- 10 they do not pass tests and inspections.
- 11 D. Prepare test and inspection reports.
- 12 3.6 ADJUSTING
- 13 A. Adjust or replace fixture flow regulators for proper flow.
- 14 B. Adjust equipment temperature settings.
- 15 END OF SECTION 224500

1 SECTION 224716 - PRESSURE WATER COOLERS

2 PART 1 - GENERAL

3 1.1 RELATED DOCUMENTS

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

6 1.2 SUMMARY

- 7 A. Section includes pressure water coolers and related components.

8 1.3 ACTION SUBMITTALS

- 9 A. Product Data: For each type of pressure water cooler.

- 10 1. Include construction details, material descriptions, dimensions of individual components
11 and profiles, and finishes.
12 2. Include rated capacities, operating characteristics, electrical characteristics, and
13 furnished specialties and accessories.

- 14 B. Shop Drawings: Include diagrams for power, signal, and control wiring.

15 1.4 CLOSEOUT SUBMITTALS

- 16 A. Maintenance Data: For pressure water coolers to include in maintenance manuals.

17 PART 2 - PRODUCTS

18 2.1 PRESSURE WATER COOLERS

- 19 A. Pressure Water Coolers: Wall mounted.

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

- 22 a. Elkay Manufacturing Co.
23

- 1 b. Halsey Taylor.
- 2 2. Cabinet: Single, all stainless steel.
- 3 3. Bubbler: One, with adjustable stream regulator, located on each cabinet deck.
- 4 4. Control: Push bar.
- 5 5. Bottle Filler.
- 6 6. Drain: Grid with NPS 1-1/4 tailpiece.
- 7 7. Supply: NPS 3/8 with shutoff valve.
- 8 8. Waste Fitting: ASME A112.18.2/CSA B125.2, NPS 1-1/4 brass P-trap.
- 9 9. Cooling System: Electric, with hermetically sealed compressor, cooling coil, air-cooled
10 condensing unit, corrosion-resistant tubing, refrigerant, corrosion-resistant-metal
11 storage tank, and adjustable thermostat.
- 12 a. Electrical Components, Devices, and Accessories: Listed and labeled as defined in
13 NFPA 70, by a qualified testing agency, and marked for intended location and
14 application.
- 15 10. Capacities and Characteristics:
- 16 a. Cooled Water: 8 gph.
- 17 b. Ambient-Air Temperature: 90 deg F.
- 18 c. Inlet-Water Temperature: 80 deg F.
- 19 d. Cooled-Water Temperature: 50 deg F.
- 20 11. Support: ASME A112.6.1M, Type I water-cooler carrier.

21 PART 3 - EXECUTION

22 3.1 EXAMINATION

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

27 3.2 INSTALLATION

- 28 A. Install fixtures level and plumb according to roughing-in drawings. For fixtures indicated for
29 children, install at height required by authorities having jurisdiction.
- 30 B. Install off-the-floor carrier supports, affixed to building substrate, for wall-mounted fixtures.

- 1 C. Install mounting frames, affixed to building construction, and attach recessed, pressure water
2 coolers to mounting frames.
- 3 D. Install water-supply piping with shutoff valve on supply to each fixture to be connected to
4 domestic-water distribution piping. Use ball or gate valve. Install valves in locations where they
5 can be easily reached for operation. Valves are specified in Section 220523.12 "Ball Valves for
6 Plumbing Piping."
- 7 E. Install trap and waste piping on drain outlet of each fixture to be connected to sanitary
8 drainage system.
- 9 F. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations.
10 Use deep-pattern escutcheons where required to conceal protruding fittings.
- 11 G. Seal joints between fixtures and walls using sanitary-type, one-part, mildew-resistant, silicone
12 sealant. Match sealant color to fixture color.
- 13 3.3 CONNECTIONS
- 14 A. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent
15 piping. Use size fittings required to match fixtures.
- 16 B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."
- 17 C. Install ball shutoff valve on water supply to each fixture. Comply with valve requirements
18 specified in Section 220523.12 "Ball Valves for Plumbing Piping."
- 19 D. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste
20 and Vent Piping."
- 21 3.4 ADJUSTING
- 22 A. Adjust fixture flow regulators for proper flow and stream height.
- 23 B. Adjust pressure water-cooler temperature settings.
- 24 3.5 CLEANING
- 25 A. After installing fixture, inspect unit. Remove paint splatters and other spots, dirt, and debris.
26 Repair damaged finish to match original finish.
- 27 B. Clean fixtures, on completion of installation, according to manufacturer's written instructions.
- 28 C. Provide protective covering for installed fixtures.

- 1 D. Do not allow use of fixtures for temporary facilities unless approved in writing by Owner.

- 2 END OF SECTION 224716

DIVISION 23

1 SECTION 230500 - COMMON WORK RESULTS FOR HVAC

2 PART 1 - GENERAL

3 1.1 RELATED DOCUMENTS

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

6 1.2 SUMMARY

- 7 A. This Section includes the following:

- 8 1. Piping materials and installation instructions common to most piping systems.
9 2. Transition fittings.
10 3. Dielectric fittings.
11 4. Mechanical sleeve seals.
12 5. Sleeves.
13 6. Escutcheons.
14 7. Grout.
15 8. HVAC demolition.
16 9. Equipment installation requirements common to equipment sections.
17 10. Painting and finishing.
18 11. Supports and anchorages.

19 1.3 DEFINITIONS

- 20 A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred
21 spaces, pipe and duct chases, unheated spaces immediately below roof, spaces above ceilings,
22 unexcavated spaces, crawlspaces, and tunnels.
- 23 B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied
24 spaces and mechanical equipment rooms.
- 25 C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient
26 temperatures and weather conditions. Examples include rooftop locations.
- 27 D. Concealed, Interior Installations: Concealed from view and protected from physical contact by
28 building occupants. Examples include above ceilings and chases.
- 29 E. Concealed, Exterior Installations: Concealed from view and protected from weather
30 conditions and physical contact by building occupants but subject to outdoor ambient
31 temperatures. Examples include installations within unheated shelters.

1

2 F. The following are industry abbreviations for plastic materials:

- 3 1. CPVC: Chlorinated polyvinyl chloride plastic.
- 4 2. PE: Polyethylene plastic.
- 5 3. PVC: Polyvinyl chloride plastic.

6 G. The following are industry abbreviations for rubber materials:

- 7 1. EPDM: Ethylene-propylene-diene terpolymer rubber.
- 8 2. NBR: Acrylonitrile-butadiene rubber.

9 1.4 SUBMITTALS

10 A. Product Data: For the following:

- 11 1. Transition fittings.
- 12 2. Dielectric fittings.
- 13 3. Mechanical sleeve seals.
- 14 4. Escutcheons.

15 B. Welding certificates.

16 1.5 QUALITY ASSURANCE

17 A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural
18 Welding Code--Steel."

19 B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure
20 Vessel Code: Section IX, "Welding and Brazing Qualifications."

- 21 1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
- 22 2. Certify that each welder has passed AWS qualification tests for welding processes
23 involved and that certification is current.

24 C. Electrical Characteristics for HVAC Equipment: Equipment of different electrical characteristics
25 may be furnished provided such proposed equipment is approved in writing and connecting
26 electrical services, circuit breakers, and conduit sizes are appropriately modified at the cost of
27 the equipment manufacturer. If minimum energy ratings or efficiencies are specified,
28 equipment shall comply with requirements.

29 1.6 DELIVERY, STORAGE, AND HANDLING

- 1 A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping,
2 storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and
3 moisture.

4 1.7 COORDINATION

- 5 A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of
6 construction, to allow for HVAC installations.

- 7 B. Coordinate installation of required supporting devices and set sleeves in poured-in-place
8 concrete and other structural components as they are constructed.

- 9 C. Coordinate requirements for access panels and doors for HVAC items requiring access that are
10 concealed behind finished surfaces. Access panels and doors are specified in Division 08
11 Section "Access Doors and Frames."

12 PART 2 - PRODUCTS

13 2.1 MANUFACTURERS

- 14 A. In other Part 2 articles where subparagraph titles below introduce lists, the following
15 requirements apply for product selection:

- 16 1. Manufacturers: Subject to compliance with requirements, provide products by the
17 manufacturers specified.

18 2.2 PIPE, TUBE, AND FITTINGS

- 19 A. Refer to individual Division 23 piping Sections for pipe, tube, and fitting materials and joining
20 methods.

- 21 B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

22 2.3 JOINING MATERIALS

- 23 A. Refer to individual Division 23 piping Sections for special joining materials not listed below.

- 24 B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system
25 contents.

- 26 1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless
27 thickness or specific material is indicated.

- 1 a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
- 2 b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
- 3 2. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full-face
- 4 or ring type, unless otherwise indicated.
- 5 C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
- 6 D. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to
- 7 ASTM B 813.
- 8 E. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty
- 9 brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping,
- 10 unless otherwise indicated.
- 11 F. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall
- 12 thickness and chemical analysis of steel pipe being welded.
- 13 2.4 DIELECTRIC FITTINGS
- 14 A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-
- 15 joint, plain, or weld-neck end connections that match piping system materials.
- 16 B. Insulating Material: Suitable for system fluid, pressure, and temperature.
- 17 C. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig minimum working pressure
- 18 at 180 deg F.
- 19 1. Manufacturers:
- 20 a. Capitol Manufacturing Co.
- 21 b. Central Plastics Company.
- 22 c. Eclipse, Inc.
- 23 d. Epco Sales, Inc.
- 24 e. Hart Industries, International, Inc.
- 25 f. Watts Industries, Inc.; Water Products Div.
- 26 g. Zurn Industries, Inc.; Wilkins Div.
- 27 D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig
- 28 minimum working pressure as required to suit system pressures.
- 29 1. Manufacturers:
- 30 a. Capitol Manufacturing Co.
- 31 b. Central Plastics Company.
- 32 c. Epco Sales, Inc.

- 1 d. Watts Industries, Inc.; Water Products Div.
- 2 E. Dielectric-Flange Kits: Companion-flange assembly for field assembly. Include flanges, full-
3 face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic
4 washers, and steel backing washers.
- 5 1. Manufacturers:
- 6 a. Advance Products & Systems, Inc.
7 b. Calpico, Inc.
8 c. Central Plastics Company.
9 d. Pipeline Seal and Insulator, Inc.
- 10 2. Separate companion flanges and steel bolts and nuts shall have 150- or 300-psig
11 minimum working pressure where required to suit system pressures.
- 12 F. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic
13 lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.
- 14 1. Manufacturers:
- 15 a. Calpico, Inc.
16 b. Lochinvar Corp.
- 17 G. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining;
18 plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 deg F.
- 19 1. Manufacturers:
- 20 a. Perfection Corp.
21 b. Precision Plumbing Products, Inc.
22 c. Sioux Chief Manufacturing Co., Inc.
23 d. Victaulic Co. of America.
- 24 2.5 MECHANICAL SLEEVE SEALS
- 25 A. Description: Modular sealing element unit, designed for field assembly, to fill annular space
26 between pipe and sleeve.
- 27 1. Manufacturers:
- 28 a. Advance Products & Systems, Inc.
29 b. Calpico, Inc.
30 c. Metraflex Co.
31 d. Pipeline Seal and Insulator, Inc.

- 1 2. Sealing Elements: EPDM or NBR interlocking links shaped to fit surface of pipe. Include
2 type and number required for pipe material and size of pipe.
- 3 3. Pressure Plates: Carbon steel. Include two for each sealing element.
- 4 4. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating or stainless
5 steel of length required to secure pressure plates to sealing elements. Include one for
6 each sealing element.

- 7 2.6 SLEEVES

- 8 A. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded
9 longitudinal joint.
- 10 B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.
- 11 C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain
12 ends and integral waterstop, unless otherwise indicated.
- 13 D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include
14 clamping ring and bolts and nuts for membrane flashing.
- 15 1. Underdeck Clamp: Clamping ring with set screws.

- 16 2.7 ESCUTCHEONS

- 17 A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely
18 fit around pipe, tube, and insulation of insulated piping and an OD that completely covers
19 opening.
- 20 B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated
21 finish.
- 22 C. One-Piece, Cast-Brass Type: With set screw.
- 23 1. Finish: Polished chrome-plated.
- 24 D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.
- 25 1. Finish: Polished chrome-plated.
- 26 E. One-Piece, Stamped-Steel Type: With set screw or spring clips and chrome-plated finish.
- 27 F. Split-Plate, Stamped-Steel Type: With concealed hinge, set screw or spring clips, and chrome-
28 plated finish.
- 29 G. One-Piece, Floor-Plate Type: Cast-iron floor plate.

1 H. Split-Casting, Floor-Plate Type: Cast brass with concealed hinge and set screw.

2 2.8 GROUT

3 A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.

4 1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive,
5 nongaseous, and recommended for interior and exterior applications.

6 2. Design Mix: 5000-psi, 28-day compressive strength.

7 3. Packaging: Premixed and factory packaged.

8

9

10

11

12 PART 3 - EXECUTION

13 3.1 HVAC DEMOLITION

14 A. Refer to Division 01 Section "Cutting and Patching" and Division 02 Section "Selective Structure
15 Demolition" for general demolition requirements and procedures.

16 B. Disconnect, demolish, and remove HVAC systems, equipment, and components indicated to
17 be removed.

18 1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or
19 plug remaining piping with same or compatible piping material.

20 2. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or
21 compatible piping material.

22 3. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug
23 remaining ducts with same or compatible ductwork material.

24 4. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork
25 material.

26 5. Equipment to Be Removed: Disconnect and cap services and remove equipment.

27 6. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove,
28 clean, and store equipment; when appropriate, reinstall, reconnect, and make
29 equipment operational.

30 7. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove
31 equipment and deliver to Owner.

32 C. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable,
33 remove damaged or unserviceable portions and replace with new products of equal capacity
34 and quality.

- 1 3.2 PIPING SYSTEMS - COMMON REQUIREMENTS
- 2 A. Install piping according to the following requirements and Division 23 Sections specifying
3 piping systems.
- 4 B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping
5 systems. Indicated locations and arrangements were used to size pipe and calculate friction
6 loss, expansion, pump sizing, and other design considerations. Install piping as indicated
7 unless deviations to layout are approved on Coordination Drawings.
- 8 C. Install piping in concealed locations, unless otherwise indicated and except in equipment
9 rooms and service areas.
- 10 D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right
11 angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated
12 otherwise.
- 13 E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- 14 F. Install piping to permit valve servicing.
- 15 G. Install piping at indicated slopes.
- 16 H. Install piping free of sags and bends.
- 17 I. Install fittings for changes in direction and branch connections.
- 18 J. Install piping to allow application of insulation.
- 19 K. Select system components with pressure rating equal to or greater than system operating
20 pressure.
- 21 L. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:
- 22 1. New Piping:
- 23 a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
24 b. Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated
25 finish.
26 c. Insulated Piping: One-piece, stamped-steel type with spring clips.
27 d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-
28 brass type with polished chrome-plated finish.
29 e. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, cast-brass type
30 with polished chrome-plated finish.
31 f. Bare Piping in Unfinished Service Spaces: One-piece, stamped-steel type with
32 concealed hinge and set screw or spring clips.
33 g. Bare Piping in Equipment Rooms: One-piece, cast-brass type.

- 1 h. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate
2 type.
- 3 M. Sleeves are not required for core-drilled holes.
- 4 N. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions,
5 and concrete floor and roof slabs.
- 6 1. Cut sleeves to length for mounting flush with both surfaces.
- 7 a. Exception: Extend sleeves installed in floors of mechanical equipment areas or
8 other wet areas 2 inches above finished floor level. Extend cast-iron sleeve
9 fittings below floor slab as required to secure clamping ring if ring is specified.
- 10 2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
- 11 3. Install sleeves that are large enough to provide 1/4-inch annular clear space between
12 sleeve and pipe or pipe insulation. Use the following sleeve materials:
- 13 a. Steel Pipe Sleeves: For pipes smaller than NPS 6.
- 14 b. Steel Sheet Sleeves: For pipes NPS 6 and larger, penetrating gypsum-board
15 partitions.
- 16 c. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing.
17 Secure flashing between clamping flanges. Install section of cast-iron soil pipe to
18 extend sleeve to 2 inches above finished floor level. Refer to Division 07 Section
19 "Sheet Metal Flashing and Trim" for flashing.
- 20 1) Seal space outside of sleeve fittings with grout.
- 21 4. Except for underground wall penetrations, seal annular space between sleeve and pipe
22 or pipe insulation, using joint sealants appropriate for size, depth, and location of joint.
23 Refer to Division 07 Section "Joint Sealants" for materials and installation.
- 24 O. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and
25 mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between
26 pipe and sleeve for installing mechanical sleeve seals.
- 27 1. Install steel pipe for sleeves smaller than 6 inches in diameter.
- 28 2. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.
- 29 3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements
30 required for pipe material and size. Position pipe in center of sleeve. Assemble
31 mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten
32 bolts against pressure plates that cause sealing elements to expand and make
33 watertight seal.
- 34 P. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors
35 at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07
36 Section "Penetration Firestopping" for materials.

- 1 Q. Verify final equipment locations for roughing-in.
- 2 R. Refer to equipment specifications in other Sections of these Specifications for roughing-in
3 requirements.
- 4 3.3 PIPING JOINT CONSTRUCTION
- 5 A. Join pipe and fittings according to the following requirements and Division 23 Sections
6 specifying piping systems.
- 7 B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- 8 C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before
9 assembly.
- 10 D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube
11 end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-
12 free solder alloy complying with ASTM B 32.
- 13 E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube"
14 Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.
- 15 F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut
16 threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore
17 full ID. Join pipe fittings and valves as follows:
- 18 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal
19 threading is specified.
- 20 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or
21 damaged. Do not use pipe sections that have cracked or open welds.
- 22 G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and
23 welding operators according to Part 1 "Quality Assurance" Article.
- 24 H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service
25 application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
- 26 3.4 PIPING CONNECTIONS
- 27 A. Make connections according to the following, unless otherwise indicated:
- 28 1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection
29 to each piece of equipment.
- 30 2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final
31 connection to each piece of equipment.

- 1 3.5 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS
- 2 A. Install equipment to allow maximum possible headroom unless specific mounting heights are
3 not indicated.
- 4 B. Install equipment level and plumb, parallel and perpendicular to other building systems and
5 components in exposed interior spaces, unless otherwise indicated.
- 6 C. Install HVAC equipment to facilitate service, maintenance, and repair or replacement of
7 components. Connect equipment for ease of disconnecting, with minimum interference to
8 other installations. Extend grease fittings to accessible locations.
- 9 D. Install equipment to allow right of way for piping installed at required slope.
- 10 3.6 PAINTING
- 11 A. Painting of HVAC systems, equipment, and components is specified in Division 09 Sections
12 "Interior Painting" and "Exterior Painting."
- 13 B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials
14 and procedures to match original factory finish.
- 15 3.7 ERECTION OF METAL SUPPORTS AND ANCHORAGES
- 16 A. Refer to Division 05 Section "Metal Fabrications" for structural steel.
- 17 B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and
18 elevation to support and anchor HVAC materials and equipment.
- 19 C. Field Welding: Comply with AWS D1.1.
- 20 3.8 ERECTION OF WOOD SUPPORTS AND ANCHORAGES
- 21 A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor
22 HVAC materials and equipment.
- 23 B. Select fastener sizes that will not penetrate members if opposite side will be exposed to view
24 or will receive finish materials. Tighten connections between members. Install fasteners
25 without splitting wood members.
- 26 C. Attach to substrates as required to support applied loads.
- 27 3.9 GROUTING

- 1 A. Mix and install grout for HVAC equipment base bearing surfaces, pump and other equipment
- 2 base plates, and anchors.

- 3 B. Clean surfaces that will come into contact with grout.

- 4 C. Provide forms as required for placement of grout.

- 5 D. Avoid air entrapment during placement of grout.

- 6 E. Place grout, completely filling equipment bases.

- 7 F. Place grout on concrete bases and provide smooth bearing surface for equipment.

- 8 G. Place grout around anchors.

- 9 H. Cure placed grout.

- 10 END OF SECTION 230500

1 SECTION 230513 - COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

2 PART 1 - GENERAL

3 1.1 RELATED DOCUMENTS

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

6 1.2 SUMMARY

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

11 1.3 COORDINATION

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

18 PART 2 - PRODUCTS

19 2.1 GENERAL MOTOR REQUIREMENTS

- 20 A. Comply with NEMA MG 1 unless otherwise indicated.

21 2.2 MOTOR CHARACTERISTICS

- 22 A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet above
23 sea level.

- 1 B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected
2 loads at designated speeds, at installed altitude and environment, with indicated operating
3 sequence, and without exceeding nameplate ratings or considering service factor.
- 4 2.3 POLYPHASE MOTORS
- 5 A. Description: NEMA MG 1, Design B, medium induction motor.
- 6 B. Efficiency: Energy efficient, as defined in NEMA MG 1.
- 7 C. Service Factor: 1.15.
- 8 D. Multispeed Motors: Variable torque.
- 9 1. For motors with 2:1 speed ratio, consequent pole, single winding.
10 2. For motors with other than 2:1 speed ratio, separate winding for each speed.
- 11 E. Multispeed Motors: Separate winding for each speed.
- 12 F. Rotor: Random-wound, squirrel cage.
- 13 G. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust
14 loading.
- 15 H. Temperature Rise: Match insulation rating.
- 16 I. Insulation: Class F.
- 17 J. Code Letter Designation:
- 18 1. Motors 15 HP and Larger: NEMA starting Code F or Code G.
19 2. Motors Smaller than 15 HP: Manufacturer's standard starting characteristic.
- 20 K. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor
21 frame sizes smaller than 324T.
- 22 2.4 POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS
- 23 A. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection
24 requirements for controller with required motor leads. Provide terminals in motor terminal
25 box, suited to control method.

- 1 B. Motors Used with Variable Frequency Controllers: Ratings, characteristics, and features
2 coordinated with and approved by controller manufacturer.
- 3 1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and
4 tested to resist transient spikes, high frequencies, and short time rise pulses produced
5 by pulse-width modulated inverters.
- 6 2. Energy- and Premium-Efficient Motors: Class B temperature rise; Class F insulation.
- 7 3. Inverter-Duty Motors: Class F temperature rise; Class H insulation.
- 8 4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected
9 motors.
- 10 C. Severe-Duty Motors: Comply with IEEE 841, with 1.15 minimum service factor.

11 2.5 SINGLE-PHASE MOTORS

- 12 A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and
13 requirements of specific motor application:
- 14 1. Permanent-split capacitor.
- 15 2. Split phase.
- 16 3. Capacitor start, inductor run.
- 17 4. Capacitor start, capacitor run.
- 18 B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.
- 19 C. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and
20 thrust loading.
- 21 D. Motors 1/20 HP and Smaller: Shaded-pole type.
- 22 E. Thermal Protection: Internal protection to automatically open power supply circuit to motor
23 when winding temperature exceeds a safe value calibrated to temperature rating of motor
24 insulation. Thermal-protection device shall automatically reset when motor temperature
25 returns to normal range.

26 PART 3 - EXECUTION (Not Applicable)

27 END OF SECTION 230513

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1 SECTION 230529 - HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

2 PART 1 - GENERAL

3 1.1 RELATED DOCUMENTS

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

6 1.2 SUMMARY

7 A. Section Includes:

- 8 1. Metal pipe hangers and supports.
9 2. Trapeze pipe hangers.
10 3. Metal framing systems.
11 4. Thermal-hanger shield inserts.
12 5. Fastener systems.
13 6. Pipe stands.
14 7. Equipment supports.

15 B. Related Sections:

- 16 1. Section 233113 "Metal Ducts" for duct hangers and supports.

17 1.3 DEFINITIONS

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

19 1.4 ACTION SUBMITTALS

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

- 21 B. Shop Drawings: Show fabrication and installation details and include calculations for the
22 following; include Product Data for components:

- 23 1. Trapeze pipe hangers.
24 2. Metal framing systems.
25 3. Pipe stands.
26 4. Equipment supports.

1 1.5 INFORMATIONAL SUBMITTALS

2 A. Welding certificates.

3 1.6 QUALITY ASSURANCE

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

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

8 PART 2 - PRODUCTS

9 2.1 METAL PIPE HANGERS AND SUPPORTS

10 A. Carbon-Steel Pipe Hangers and Supports:

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

18 2.2 TRAPEZE PIPE HANGERS

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

22 2.3 METAL FRAMING SYSTEMS

23 A. MFMA Manufacturer Metal Framing Systems:

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

- 26 a. Cooper B-Line, Inc.
27 b. Unistrut Corporation; Tyco International, Ltd.

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

10 2.4 THERMAL-HANGER SHIELD INSERTS

- 11 A. Manufacturers: Subject to compliance with requirements, provide products by one of the
- 12 following:
- 13 1. Pipe Shields, Inc.; a subsidiary of Piping Technology & Products, Inc.
- 14 B. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with 100-psig
- 15 minimum compressive strength and vapor barrier.
- 16 C. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium
- 17 silicate with 100-psig minimum compressive strength.
- 18 D. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
- 19 E. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
- 20 F. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient
- 21 air temperature.

22 2.5 FASTENER SYSTEMS

- 23 A. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated or stainless- steel anchors, for
- 24 use in hardened portland cement concrete; with pull-out, tension, and shear capacities
- 25 appropriate for supported loads and building materials where used.

26 2.6 PIPE STANDS

- 27 A. General Requirements for Pipe Stands: Shop- or field-fabricated assemblies made of
- 28 manufactured corrosion-resistant components to support roof-mounted piping.
- 29 B. Compact Pipe Stand: One-piece plastic unit with integral-rod roller, pipe clamps, or V-shaped
- 30 cradle to support pipe, for roof installation without membrane penetration.

- 1 C. Low-Type, Single-Pipe Stand: One-piece plastic base unit with plastic roller, for roof
2 installation without membrane penetration.
- 3 D. High-Type, Single-Pipe Stand:
- 4 1. Description: Assembly of base, vertical and horizontal members, and pipe support, for
5 roof installation without membrane penetration.
- 6 2. Base: Plastic.
- 7 3. Vertical Members: Two or more cadmium-plated-steel or stainless-steel, continuous-
8 thread rods.
- 9 4. Horizontal Member: Cadmium-plated-steel or stainless-steel rod with plastic or
10 stainless-steel, roller-type pipe support.
- 11 E. High-Type, Multiple-Pipe Stand:
- 12 1. Description: Assembly of bases, vertical and horizontal members, and pipe supports, for
13 roof installation without membrane penetration.
- 14 2. Bases: One or more; plastic.
- 15 3. Vertical Members: Two or more protective-coated-steel channels.
- 16 4. Horizontal Member: Protective-coated-steel channel.
- 17 5. Pipe Supports: Galvanized-steel, clevis-type pipe hangers.
- 18 F. Curb-Mounted-Type Pipe Stands: Shop- or field-fabricated pipe supports made from
19 structural-steel shapes, continuous-thread rods, and rollers, for mounting on permanent
20 stationary roof curb.
- 21 2.7 EQUIPMENT SUPPORTS
- 22 A. Description: Welded, shop- or field-fabricated equipment support made from structural
23 carbon-steel shapes.
- 24 2.8 MISCELLANEOUS MATERIALS
- 25 A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and
26 galvanized.
- 27 B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and
28 nonmetallic grout; suitable for interior and exterior applications.
- 29 1. Properties: Nonstaining, noncorrosive, and nongaseous.
- 30 2. Design Mix: 5000-psi, 28-day compressive strength.

1 PART 3 - EXECUTION

2 3.1 HANGER AND SUPPORT INSTALLATION

3 A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers,
4 supports, clamps, and attachments as required to properly support piping from the building
5 structure.

6 B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for
7 grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze
8 pipe hangers.

9 1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or
10 install intermediate supports for smaller diameter pipes as specified for individual pipe
11 hangers.

12 2. Field fabricate from ASTM A 36/A 36M, carbon-steel shapes selected for loads being
13 supported. Weld steel according to AWS D1.1/D1.1M.

14 C. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support
15 together on field-assembled metal framing systems.

16 D. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.

17 E. Fastener System Installation:

18 1. Install mechanical-expansion anchors in concrete after concrete is placed and
19 completely cured. Install fasteners according to manufacturer's written instructions.

20 F. Pipe Stand Installation:

21 1. Pipe Stand Types except Curb-Mounted Type: Assemble components and mount on
22 smooth roof surface. Do not penetrate roof membrane.

23 2. Curb-Mounted-Type Pipe Stands: Assemble components or fabricate pipe stand and
24 mount on permanent, stationary roof curb. See Section 077200 "Roof Accessories" for
25 curbs.

26 G. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts,
27 washers, and other accessories.

28 H. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

29 I. Install hangers and supports to allow controlled thermal and seismic movement of piping
30 systems, to permit freedom of movement between pipe anchors, and to facilitate action of
31 expansion joints, expansion loops, expansion bends, and similar units.

- 1 J. Install lateral bracing with pipe hangers and supports to prevent swaying.
- 2 K. Install building attachments within concrete slabs or attach to structural steel. Install
3 additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-
4 1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is
5 placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.
- 6 L. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses
7 from movement will not be transmitted to connected equipment.
- 8 M. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed
9 maximum pipe deflections allowed by ASME B31.9 for building services piping.
- 10
- 11
- 12 N. Insulated Piping:
- 13 1. Attach clamps and spacers to piping.
- 14 a. Piping Operating above Ambient Air Temperature: Clamp may project through
15 insulation.
- 16 b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield
17 insert with clamp sized to match OD of insert.
- 18 c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services
19 piping.
- 20 2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is
21 indicated. Fill interior voids with insulation that matches adjoining insulation.
- 22 a. Option: Thermal-hanger shield inserts may be used. Include steel weight-
23 distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
- 24 3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields
25 shall span an arc of 180 degrees.
- 26 a. Option: Thermal-hanger shield inserts may be used. Include steel weight-
27 distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
- 28 4. Shield Dimensions for Pipe: Not less than the following:
- 29 a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
- 30 b. NPS 4: 12 inches long and 0.06 inch thick.
- 31 c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
- 32 d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.

- 1 5. Pipes NPS 8 and Larger: Include wood or reinforced calcium-silicate-insulation inserts of
2 length at least as long as protective shield.
3 6. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

4 3.2 EQUIPMENT SUPPORTS

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

9 3.3 METAL FABRICATIONS

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

23 3.4 ADJUSTING

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

- 1 3.5 PAINTING
- 2 A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately
3 after erecting hangers and supports. Use same materials as used for shop painting. Comply
4 with SSPC-PA 1 requirements for touching up field-painted surfaces.
- 5 1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.
- 6 B. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded
7 areas of shop paint on miscellaneous metal are specified in Division 09 painting sections.
- 8 C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply
9 galvanizing-repair paint to comply with ASTM A 780.
- 10 END OF SECTION 230529

1 SECTION 230553 - IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

2 PART 1 - GENERAL

3 1.1 RELATED DOCUMENTS

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

6 1.2 SUMMARY

- 7 A. Section Includes:

- 8 1. Equipment labels.
9 2. Warning signs and labels.
10 3. Pipe labels.
11 4. Duct labels.
12 5. Stencils.
13 6. Valve tags.
14 7. Warning tags.

15 1.3 ACTION SUBMITTALS

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

23 1.4 COORDINATION

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

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

2 PART 2 - PRODUCTS

3 2.1 EQUIPMENT LABELS

4 A. Metal Labels for Equipment:

- 5 1. Material and Thickness: Brass, 0.032-inch minimum thickness, and having predrilled or
6 stamped holes for attachment hardware.
7 2. Minimum Label Size: Length and width vary for required label content, but not less than
8 2-1/2 by 3/4 inch.
9 3. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24
10 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger
11 lettering for greater viewing distances. Include secondary lettering two-thirds to three-
12 fourths the size of principal lettering.
13 4. Fasteners: Stainless-steel rivets or self-tapping screws.
14 5. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

15 B. Plastic Labels for Equipment:

- 16 1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving,
17 1/16 inch thick, and having predrilled holes for attachment hardware.
18 2. Letter Color: White.
19 3. Background Color: Red.
20 4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
21 5. Minimum Label Size: Length and width vary for required label content, but not less than
22 2-1/2 by 3/4 inch.
23 6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24
24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger
25 lettering for greater viewing distances. Include secondary lettering two-thirds to three-
26 fourths the size of principal lettering.
27 7. Fasteners: Stainless-steel rivets or self-tapping screws.
28 8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

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

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

- 1 2.2 WARNING SIGNS AND LABELS
- 2 A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16
3 inch thick, and having predrilled holes for attachment hardware.
- 4 B. Letter Color: Black.
- 5 C. Background Color: Yellow.
- 6 D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
- 7 E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2
8 by 3/4 inch.
- 9 F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2
10 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater
11 viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal
12 lettering.
- 13 G. Fasteners: Stainless-steel rivets or self-tapping screws.
- 14 H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- 15 I. Label Content: Include caution and warning information, plus emergency notification
16 instructions.
- 17 2.3 PIPE LABELS
- 18 A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering
19 indicating service, and showing flow direction.
- 20 B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of
21 pipe and to attach to pipe without fasteners or adhesive.
- 22 C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
- 23 D. Pipe Label Contents: Include identification of piping service using same designations or
24 abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.
- 25 1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate
26 both directions, or as separate unit on each pipe label to indicate flow direction.
- 27 2. Lettering Size: At least 1-1/2 inches high.

- 1 2.4 STENCILS
- 2 A. Stencils: Prepared with letter sizes according to ASME A13.1 for piping; minimum letter height
3 of 1-1/4 inches for ducts; and minimum letter height of 3/4 inch for access panel and door
4 labels, equipment labels, and similar operational instructions.
- 5 1. Stencil Material: Fiberboard or metal.
- 6 2. Stencil Paint: Exterior, gloss, alkyd enamel black unless otherwise indicated. Paint may
7 be in pressurized spray-can form.
- 8 3. Identification Paint: Exterior, alkyd enamel in colors according to ASME A13.1 unless
9 otherwise indicated.
- 10 2.5 VALVE TAGS
- 11 A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-
12 inch numbers.
- 13 1. Tag Material: Brass, 0.032-inch minimum thickness, and having predrilled or stamped
14 holes for attachment hardware.
- 15 2. Fasteners: Brass wire-link chain.
- 16 B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve
17 number, piping system, system abbreviation (as shown on valve tag), location of valve (room
18 or space), normal-operating position (open, closed, or modulating), and variations for
19 identification. Mark valves for emergency shutoff and similar special uses.
- 20 1. Valve-tag schedule shall be included in operation and maintenance data.
- 21 2.6 WARNING TAGS
- 22 A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card
23 stock with matte finish suitable for writing.
- 24 1. Size: 3 by 5-1/4 inches minimum.
- 25 2. Fasteners: Brass grommet and wire.
- 26 3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT
27 OPERATE."
- 28 4. Color: Yellow background with black lettering.

1 PART 3 - EXECUTION

2 3.1 PREPARATION

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

6 3.2 EQUIPMENT LABEL INSTALLATION

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

9 3.3 PIPE LABEL INSTALLATION

- 10 A. Stenciled Pipe Label Option: Stenciled labels may be provided instead of manufactured pipe
11 labels, at Installer's option. Install stenciled pipe labels on each piping system.

- 12 1. Identification Paint: Use for contrasting background.
13 2. Stencil Paint: Use for pipe marking.

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

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

- 27 C. Pipe Label Color Schedule:

- 28 1. Refrigerant Piping:
29 a. Background Color: White.
30 b. Letter Color: Blue.

- 1 3.4 DUCT LABEL INSTALLATION
- 2 A. Install self-adhesive duct labels with permanent adhesive on air ducts in the following color
3 codes:
- 4 1. Blue: For cold-air supply ducts.
5 2. Yellow: For hot-air supply ducts.
6 3. Green: For exhaust-, outside-, relief-, return-, and mixed-air ducts.
7 4. ASME A13.1 Colors and Designs: For hazardous material exhaust.
- 8 B. Stenciled Duct Label Option: Stenciled labels, showing service and flow direction, may be
9 provided instead of plastic-laminated duct labels, at Installer's option, if lettering larger than 1
10 inch high is needed for proper identification because of distance from normal location of
11 required identification.
- 12 C. Locate labels near points where ducts enter into concealed spaces and at maximum intervals
13 of 50 feet in each space where ducts are exposed or concealed by removable ceiling system.
- 14 3.5 VALVE-TAG INSTALLATION
- 15 A. Install tags on valves and control devices in piping systems, except check valves; valves within
16 factory-fabricated equipment units; shutoff valves; faucets; convenience and lawn-watering
17 hose connections; and HVAC terminal devices and similar roughing-in connections of end-use
18 fixtures and units. List tagged valves in a valve schedule.
- 19 B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and
20 with captions similar to those indicated in the following subparagraphs:
- 21 1. Valve-Tag Size and Shape:
- 22 a. Refrigerant: 1-1/2 inches, round.
23 b. Gas: 1-1/2 inches, round.
- 24 2. Valve-Tag Color:
- 25 a. Refrigerant: Natural.
26 b. Gas: Natural.
- 27 3. Letter Color:
- 28 a. Refrigerant: Black.
29 b. Gas: Black.

- 1 3.6 WARNING-TAG INSTALLATION
- 2 A. Write required message on, and attach warning tags to, equipment and other items where
- 3 required.

- 4 END OF SECTION 230553

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1 SECTION 230593 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

2 PART 1 - GENERAL

3 1.1 RELATED DOCUMENTS

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

6 1.2 SUMMARY

- 7 A. Section Includes:

- 8 1. Balancing Air Systems:
9 a. Constant-volume air systems.

10 1.3 DEFINITIONS

- 11 A. AABC: Associated Air Balance Council.
12 B. NEBB: National Environmental Balancing Bureau.
13 C. TAB: Testing, adjusting, and balancing.
14 D. TABB: Testing, Adjusting, and Balancing Bureau.
15 E. TAB Specialist: An entity engaged to perform TAB Work.

16 1.4 INFORMATIONAL SUBMITTALS

- 17 A. Qualification Data: Within 30 days of Contractor's Notice to Proceed, submit documentation
18 that the TAB contractor and this Project's TAB team members meet the qualifications specified
19 in "Quality Assurance" Article.
20 B. Contract Documents Examination Report: Within 30 days of Contractor's Notice to Proceed,
21 submit the Contract Documents review report as specified in Part 3.
22 C. Strategies and Procedures Plan: Within 60 days of Contractor's Notice to Proceed, submit TAB
23 strategies and step-by-step procedures as specified in "Preparation" Article.

- 1 D. Certified TAB reports.
- 2 E. Sample report forms.
- 3 F. Instrument calibration reports, to include the following:
 - 4 1. Instrument type and make.
 - 5 2. Serial number.
 - 6 3. Application.
 - 7 4. Dates of use.
 - 8 5. Dates of calibration.
- 9 1.5 QUALITY ASSURANCE
- 10 A. TAB Contractor Qualifications: Engage a TAB entity certified by AABC.
 - 11 1. TAB Field Supervisor: Employee of the TAB contractor and certified by AABC.
 - 12 2. TAB Technician: Employee of the TAB contractor and who is certified by AABC as a TAB
 - 13 technician.
- 14 B. TAB Conference: Meet with Construction Manager on approval of the TAB strategies and
- 15 procedures plan to develop a mutual understanding of the details. Require the participation of
- 16 the TAB field supervisor and technicians. Provide seven days' advance notice of scheduled
- 17 meeting time and location.
 - 18 1. Agenda Items:
 - 19 a. The Contract Documents examination report.
 - 20 b. The TAB plan.
 - 21 c. Coordination and cooperation of trades and subcontractors.
 - 22 d. Coordination of documentation and communication flow.
- 23 C. Certify TAB field data reports and perform the following:
 - 24 1. Review field data reports to validate accuracy of data and to prepare certified TAB
 - 25 reports.
 - 26 2. Certify that the TAB team complied with the approved TAB plan and the procedures
 - 27 specified and referenced in this Specification.
- 28 D. TAB Report Forms: Use standard TAB contractor's forms approved by Construction Manager.
- 29 E. Instrumentation Type, Quantity, Accuracy, and Calibration: As described in ASHRAE 111,
- 30 Section 5, "Instrumentation."

1 1.6 PROJECT CONDITIONS

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

5 B. Testing and balancing is to be completed and a report issued at the completion of each phase
6 of construction. Refer to the phasing drawing for additional information. Provide a final
7 comprehensive report at the end of the project.

8 1.7 COORDINATION

9 A. Notice: Provide seven days' advance notice for each test. Include scheduled test dates and
10 times.

11 B. Perform TAB after leakage and pressure tests on air and water distribution systems have been
12 satisfactorily completed.

13 PART 2 - PRODUCTS (Not Applicable)

14 PART 3 - EXECUTION

15 3.1 TAB SPECIALISTS

16 A. Subject to compliance with requirements, engage one of the following:

17 1. Fluid Dynamics, Inc.
18 802 Incentive Drive
19 Fort Wayne, IN 46825
20 (260) 490-8011
21

22 2. ENGINEER APPROVED TAB CONTRACTOR.

23 3.2 EXAMINATION

24 A. Examine the Contract Documents to become familiar with Project requirements and to
25 discover conditions in systems' designs that may preclude proper TAB of systems and
26 equipment.

- 1 B. Examine systems for installed balancing devices, such as test ports, gage cocks, thermometer
2 wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Verify
3 that locations of these balancing devices are accessible.
- 4 C. Examine the approved submittals for HVAC systems and equipment.
- 5 D. Examine design data including HVAC system descriptions, statements of design assumptions
6 for environmental conditions and systems' output, and statements of philosophies and
7 assumptions about HVAC system and equipment controls.
- 8 E. Examine ceiling plenums and underfloor air plenums used for supply, return, or relief air to
9 verify that they meet the leakage class of connected ducts as specified in Section 233113
10 "Metal Ducts" and are properly separated from adjacent areas. Verify that penetrations in
11 plenum walls are sealed and fire-stopped if required.
- 12 F. Examine equipment performance data including fan and pump curves.
- 13 1. Relate performance data to Project conditions and requirements, including system
14 effects that can create undesired or unpredicted conditions that cause reduced
15 capacities in all or part of a system.
- 16 2. Calculate system-effect factors to reduce performance ratings of HVAC equipment when
17 installed under conditions different from the conditions used to rate equipment
18 performance. To calculate system effects for air systems, use tables and charts found in
19 AMCA 201, "Fans and Systems," or in SMACNA's "HVAC Systems - Duct Design."
20 Compare results with the design data and installed conditions.
- 21 G. Examine system and equipment installations and verify that field quality-control testing,
22 cleaning, and adjusting specified in individual Sections have been performed.
- 23 H. Examine test reports specified in individual system and equipment Sections.
- 24 I. Examine HVAC equipment and filters and verify that bearings are greased, belts are aligned
25 and tight, and equipment with functioning controls is ready for operation.
- 26 J. Examine strainers. Verify that startup screens are replaced by permanent screens with
27 indicated perforations.
- 28 K. Examine system pumps to ensure absence of entrained air in the suction piping.
- 29 L. Examine operating safety interlocks and controls on HVAC equipment.
- 30 M. Report deficiencies discovered before and during performance of TAB procedures. Observe
31 and record system reactions to changes in conditions. Record default set points if different
32 from indicated values.

- 1 3.3 PREPARATION
- 2 A. Prepare a TAB plan that includes strategies and step-by-step procedures.
- 3 B. Complete system-readiness checks and prepare reports. Verify the following:
- 4 1. Permanent electrical-power wiring is complete.
- 5 2. Equipment and duct access doors are securely closed.
- 6 3. Balance, smoke, and fire dampers are open.
- 7 4. Isolating and balancing valves are open and control valves are operational.
- 8 5. Ceilings are installed in critical areas where air-pattern adjustments are required and
- 9 access to balancing devices is provided.
- 10 6. Windows and doors can be closed so indicated conditions for system operations can be
- 11 met.
- 12 3.4 GENERAL PROCEDURES FOR TESTING AND BALANCING
- 13 A. Perform testing and balancing procedures on each system according to the procedures
- 14 contained in AABC's "National Standards for Total System Balance" and in this Section.
- 15 B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the
- 16 minimum extent necessary for TAB procedures.
- 17 1. After testing and balancing, patch probe holes in ducts with same material and thickness
- 18 as used to construct ducts.
- 19 2. After testing and balancing, install test ports and duct access doors that comply with
- 20 requirements in Section 233300 "Air Duct Accessories."
- 21 3. Install and join new insulation that matches removed materials. Restore insulation,
- 22 coverings, vapor barrier, and finish according to Section 230713 "Duct Insulation,"
- 23 Section 230716 "HVAC Equipment Insulation," and Section 230719 "HVAC Piping
- 24 Insulation."
- 25 C. Mark equipment and balancing devices, including damper-control positions, valve position
- 26 indicators, fan-speed-control levers, and similar controls and devices, with paint or other
- 27 suitable, permanent identification material to show final settings.
- 28 D. Take and report testing and balancing measurements in inch-pound (IP) units.
- 29 3.5 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS
- 30 A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and
- 31 recommended testing procedures. Crosscheck the summation of required outlet volumes with
- 32 required fan volumes.

- 1 B. Prepare schematic diagrams of systems' "as-built" duct layouts.
- 2 C. Determine the best locations in main and branch ducts for accurate duct-airflow
3 measurements.
- 4 D. Check airflow patterns from the outdoor-air louvers and dampers and the return- and exhaust-
5 air dampers through the supply-fan discharge and mixing dampers.
- 6 E. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
- 7 F. Verify that motor starters are equipped with properly sized thermal protection.
- 8 G. Check dampers for proper position to achieve desired airflow path.
- 9 H. Check for airflow blockages.
- 10 I. Check condensate drains for proper connections and functioning.
- 11 J. Check for proper sealing of air-handling-unit components.
- 12 K. Verify that air duct system is sealed as specified in Section 233113 "Metal Ducts."

- 13 3.6 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS
- 14 A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed
15 by fan manufacturer.
- 16 1. Measure total airflow.
- 17 a. Where sufficient space in ducts is unavailable for Pitot-tube traverse
18 measurements, measure airflow at terminal outlets and inlets and calculate the
19 total airflow.
- 20 2. Measure fan static pressures as follows to determine actual static pressure:
- 21 a. Measure outlet static pressure as far downstream from the fan as practical and
22 upstream from restrictions in ducts such as elbows and transitions.
- 23 b. Measure static pressure directly at the fan outlet or through the flexible
24 connection.
- 25 c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan
26 as possible, upstream from the flexible connection, and downstream from duct
27 restrictions.
- 28 d. Measure inlet static pressure of double-inlet fans through the wall of the plenum
29 that houses the fan.

- 1 3. Measure static pressure across each component that makes up an air-handling unit,
2 rooftop unit, and other air-handling and -treating equipment.
- 3 a. Report the cleanliness status of filters and the time static pressures are
4 measured.
- 5 4. Measure static pressures entering and leaving other devices, such as sound traps, heat-
6 recovery equipment, and air washers, under final balanced conditions.
- 7 5. Do not make fan-speed adjustments that result in motor overload. Consult equipment
8 manufacturers about fan-speed safety factors. Modulate dampers and measure fan-
9 motor amperage to ensure that no overload will occur. Measure amperage in full-
10 cooling, full-heating, economizer, and any other operating mode to determine the
11 maximum required brake horsepower.
- 12
- 13 B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated
14 airflows within specified tolerances.
- 15 1. Measure airflow of submain and branch ducts.
- 16 a. Where sufficient space in submain and branch ducts is unavailable for Pitot-tube
17 traverse measurements, measure airflow at terminal outlets and inlets and
18 calculate the total airflow for that zone.
- 19 2. Measure static pressure at a point downstream from the balancing damper, and adjust
20 volume dampers until the proper static pressure is achieved.
- 21 3. Remeasure each submain and branch duct after all have been adjusted. Continue to
22 adjust submain and branch ducts to indicated airflows within specified tolerances.
- 23 C. Measure air outlets and inlets without making adjustments.
- 24 1. Measure terminal outlets using a direct-reading hood or outlet manufacturer's written
25 instructions and calculating factors.
- 26 D. Adjust air outlets and inlets for each space to indicated airflows within specified tolerances of
27 indicated values. Make adjustments using branch volume dampers rather than extractors and
28 the dampers at air terminals.
- 29 1. Adjust each outlet in same room or space to within specified tolerances of indicated
30 quantities without generating noise levels above the limitations prescribed by the
31 Contract Documents.
- 32 2. Adjust patterns of adjustable outlets for proper distribution without drafts.

1 3.7 PROCEDURES FOR MOTORS

2 A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:

- 3 1. Manufacturer's name, model number, and serial number.
- 4 2. Motor horsepower rating.
- 5 3. Motor rpm.
- 6 4. Efficiency rating.
- 7 5. Nameplate and measured voltage, each phase.
- 8 6. Nameplate and measured amperage, each phase.
- 9 7. Starter thermal-protection-element rating.

10 B. Motors Driven by Variable-Frequency Controllers: Test for proper operation at speeds varying
11 from minimum to maximum. Test the manual bypass of the controller to prove proper
12 operation. Record observations including name of controller manufacturer, model number,
13 serial number, and nameplate data.

14 3.8 PROCEDURES FOR CONDENSING UNITS

- 15 A. Verify proper rotation of fans.
- 16 B. Measure entering- and leaving-air temperatures.
- 17 C. Record compressor data.

18 3.9 TOLERANCES

- 19 A. Set HVAC system's air flow rates and water flow rates within the following tolerances:
- 20 1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus or minus 10 percent.
 - 21 2. Air Outlets and Inlets: Plus or minus 10 percent.
 - 22 3. Heating-Water Flow Rate: Plus or minus 10 percent.
 - 23 4. Cooling-Water Flow Rate: Plus or minus 10 percent.

24 3.10 REPORTING

- 25 A. Initial Construction-Phase Report: Based on examination of the Contract Documents as
26 specified in "Examination" Article, prepare a report on the adequacy of design for systems'
27 balancing devices. Recommend changes and additions to systems' balancing devices to
28 facilitate proper performance measuring and balancing. Recommend changes and additions
29 to HVAC systems and general construction to allow access for performance measuring and
30 balancing devices.

- 1 B. Status Reports: Prepare biweekly progress reports to describe completed procedures,
2 procedures in progress, and scheduled procedures. Include a list of deficiencies and problems
3 found in systems being tested and balanced. Prepare a separate report for each system and
4 each building floor for systems serving multiple floors.
- 5 3.11 FINAL REPORT
- 6 A. General: Prepare a certified written report; tabulate and divide the report into separate
7 sections for tested systems and balanced systems.
- 8 1. Include a certification sheet at the front of the report's binder, signed and sealed by the
9 certified testing and balancing engineer.
- 10 2. Include a list of instruments used for procedures, along with proof of calibration.
- 11 B. Final Report Contents: In addition to certified field-report data, include the following:
- 12 1. Fan curves.
- 13 2. Manufacturers' test data.
- 14 3. Field test reports prepared by system and equipment installers.
- 15 4. Other information relative to equipment performance; do not include Shop Drawings
16 and product data.
- 17 C. General Report Data: In addition to form titles and entries, include the following data:
- 18 1. Title page.
- 19 2. Name and address of the TAB contractor.
- 20 3. Project name.
- 21 4. Project location.
- 22 5. Architect's name and address.
- 23 6. Engineer's name and address.
- 24 7. Contractor's name and address.
- 25 8. Report date.
- 26 9. Signature of TAB supervisor who certifies the report.
- 27 10. Table of Contents with the total number of pages defined for each section of the report.
28 Number each page in the report.
- 29 11. Summary of contents including the following:
- 30 a. Indicated versus final performance.
- 31 b. Notable characteristics of systems.
- 32 c. Description of system operation sequence if it varies from the Contract
33 Documents.
- 34 12. Nomenclature sheets for each item of equipment.
- 35 13. Data for terminal units, including manufacturer's name, type, size, and fittings.
- 36 14. Notes to explain why certain final data in the body of reports vary from indicated values.

- 1 15. Test conditions for fans and pump performance forms including the following:
- 2 a. Settings for outdoor-, return-, and exhaust-air dampers.
- 3 b. Conditions of filters.
- 4 c. Cooling coil, wet- and dry-bulb conditions.
- 5 d. Fan drive settings including settings and percentage of maximum pitch diameter.
- 6 e. Inlet vane settings for variable-air-volume systems.
- 7 f. Settings for supply-air, static-pressure controller.
- 8 g. Other system operating conditions that affect performance.
- 9 D. System Diagrams: Include schematic layouts of air and distribution systems. Present each
- 10 system with single-line diagram and include the following:
- 11 1. Quantities of outdoor, supply, return, and exhaust airflows.
- 12 2. Duct, outlet, and inlet sizes.
- 13 3. Pipe and valve sizes and locations.
- 14 4. Position of balancing devices.
- 15
- 16 E. Air-Handling-Unit Test Reports: For air-handling units with coils, include the following:
- 17 1. Unit Data:
- 18 a. Unit identification.
- 19 b. Location.
- 20 c. Make and type.
- 21 d. Model number and unit size.
- 22 e. Manufacturer's serial number.
- 23 f. Unit arrangement and class.
- 24 g. Discharge arrangement.
- 25 h. Sheave make, size in inches, and bore.
- 26 i. Center-to-center dimensions of sheave, and amount of adjustments in inches.
- 27 j. Number, make, and size of belts.
- 28 k. Number, type, and size of filters.
- 29 2. Motor Data:
- 30 a. Motor make, and frame type and size.
- 31 b. Horsepower and rpm.
- 32 c. Volts, phase, and hertz.
- 33 d. Full-load amperage and service factor.
- 34 e. Sheave make, size in inches, and bore.
- 35 f. Center-to-center dimensions of sheave, and amount of adjustments in inches.
- 36 3. Test Data (Indicated and Actual Values):

- 1 a. Total air flow rate in cfm.
 - 2 b. Total system static pressure in inches wg.
 - 3 c. Fan rpm.
 - 4 d. Discharge static pressure in inches wg.
 - 5 e. Filter static-pressure differential in inches wg.
 - 6 f. Preheat-coil static-pressure differential in inches wg.
 - 7 g. Cooling-coil static-pressure differential in inches wg.
 - 8 h. Heating-coil static-pressure differential in inches wg.
 - 9 i. Outdoor airflow in cfm.
 - 10 j. Return airflow in cfm.
 - 11 k. Outdoor-air damper position.
 - 12 l. Return-air damper position.
 - 13 m. Vortex damper position.
 - 14 n. Refrigerant expansion valve and refrigerant types.
 - 15 o. Refrigerant suction pressure in psig.
 - 16 p. Refrigerant suction temperature in deg F.
- 17 F. Gas-Fired Heat Apparatus Test Reports: In addition to manufacturer's factory startup
18 equipment reports, include the following:
- 19 1. Unit Data:
 - 20 a. System identification.
 - 21 b. Location.
 - 22 c. Make and type.
 - 23 d. Model number and unit size.
 - 24 e. Manufacturer's serial number.
 - 25 f. Fuel type in input data.
 - 26 g. Output capacity in Btu/h.
 - 27 h. Ignition type.
 - 28 i. Burner-control types.
 - 29 j. Motor horsepower and rpm.
 - 30 k. Motor volts, phase, and hertz.
 - 31 l. Motor full-load amperage and service factor.
 - 32 m. Sheave make, size in inches, and bore.
 - 33 n. Center-to-center dimensions of sheave, and amount of adjustments in inches.
 - 34 2. Test Data (Indicated and Actual Values):
 - 35 a. Total air flow rate in cfm.
 - 36 b. Entering-air temperature in deg F.
 - 37 c. Leaving-air temperature in deg F.
 - 38 d. Air temperature differential in deg F.
 - 39 e. Entering-air static pressure in inches wg.
 - 40 f. Leaving-air static pressure in inches wg.

- 1 g. Air static-pressure differential in inches wg.
 - 2 h. Low-fire fuel input in Btu/h.
 - 3 i. High-fire fuel input in Btu/h.
 - 4 j. Manifold pressure in psig.
 - 5 k. High-temperature-limit setting in deg F.
 - 6 l. Operating set point in Btu/h.
 - 7 m. Motor voltage at each connection.
 - 8 n. Motor amperage for each phase.
 - 9 o. Heating value of fuel in Btu/h.
- 10 G. Fan Test Reports: For supply, return, and exhaust fans, include the following:
- 11 1. Fan Data:
- 12 a. System identification.
 - 13 b. Location.
 - 14 c. Make and type.
 - 15 d. Model number and size.
 - 16 e. Manufacturer's serial number.
 - 17 f. Arrangement and class.
 - 18 g. Sheave make, size in inches, and bore.
 - 19 h. Center-to-center dimensions of sheave, and amount of adjustments in inches.
- 20 2. Motor Data:
- 21 a. Motor make, and frame type and size.
 - 22 b. Horsepower and rpm.
 - 23 c. Volts, phase, and hertz.
 - 24 d. Full-load amperage and service factor.
 - 25 e. Sheave make, size in inches, and bore.
 - 26 f. Center-to-center dimensions of sheave, and amount of adjustments in inches.
 - 27 g. Number, make, and size of belts.
- 28 3. Test Data (Indicated and Actual Values):
- 29 a. Total airflow rate in cfm.
 - 30 b. Total system static pressure in inches wg.
 - 31 c. Fan rpm.
 - 32 d. Discharge static pressure in inches wg.
 - 33 e. Suction static pressure in inches wg
- 34 H. Round, Flat-Oval, and Rectangular Duct Traverse Reports: Include a diagram with a grid
35 representing the duct cross-section and record the following:
- 36 1. Report Data:

- 1 a. System and air-handling-unit number.
- 2 b. Location and zone.
- 3 c. Traverse air temperature in deg F.
- 4 d. Duct static pressure in inches wg.
- 5 e. Duct size in inches.
- 6 f. Duct area in sq. ft..
- 7 g. Indicated air flow rate in cfm.
- 8 h. Indicated velocity in fpm.
- 9 i. Actual air flow rate in cfm.
- 10 j. Actual average velocity in fpm.
- 11 k. Barometric pressure in psig.

12 I. Air-Terminal-Device Reports:

13 1. Unit Data:

- 14 a. System and air-handling unit identification.
- 15 b. Location and zone.
- 16 c. Apparatus used for test.
- 17 d. Area served.
- 18 e. Make.
- 19 f. Number from system diagram.
- 20 g. Type and model number.
- 21 h. Size.
- 22 i. Effective area in sq. ft..

23 2. Test Data (Indicated and Actual Values):

- 24 a. Air flow rate in cfm.
- 25 b. Air velocity in fpm.
- 26 c. Preliminary air flow rate as needed in cfm.
- 27 d. Preliminary velocity as needed in fpm.
- 28 e. Final air flow rate in cfm.
- 29 f. Final velocity in fpm.
- 30 g. Space temperature in deg F.

31 J. Instrument Calibration Reports:

32 1. Report Data:

- 33 a. Instrument type and make.
- 34 b. Serial number.
- 35 c. Application.
- 36 d. Dates of use.
- 37 e. Dates of calibration.

- 1 3.12 INSPECTIONS
- 2 A. Initial Inspection:
- 3 1. After testing and balancing are complete, operate each system and randomly check
- 4 measurements to verify that the system is operating according to the final test and
- 5 balance readings documented in the final report.
- 6 2. Check the following for each system:
- 7 a. Measure airflow of at least 10 percent of air outlets.
- 8 b. Measure water flow of at least 5 percent of terminals.
- 9 c. Measure room temperature at each thermostat/temperature sensor. Compare
- 10 the reading to the set point.
- 11 d. Verify that balancing devices are marked with final balance position.
- 12 e. Note deviations from the Contract Documents in the final report.
- 13
- 14
- 15
- 16 B. If TAB Work fails, proceed as follows:
- 17 1. Recheck all measurements and make adjustments. Revise the final report and balancing
- 18 device settings to include all changes; resubmit the final report and request a second
- 19 final inspection.
- 20 2. If the second final inspection also fails, Owner may contract the services of another TAB
- 21 contractor to complete TAB Work according to the Contract Documents and deduct the
- 22 cost of the services from the original TAB contractor's final payment.
- 23 C. Prepare test and inspection reports.
- 24 3.13 ADDITIONAL TESTS
- 25 A. Within 90 days of completing TAB, perform additional TAB to verify that balanced conditions
- 26 are being maintained throughout and to correct unusual conditions.
- 27 B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and
- 28 winter conditions, perform additional TAB during near-peak summer and winter conditions.
- 29 END OF SECTION 230593

1 SECTION 230713 - DUCT INSULATION

2 PART 1 - GENERAL

3 1.1 RELATED DOCUMENTS

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

6 1.2 SUMMARY

- 7 A. Section includes insulating the following duct services:

- 8 1. Indoor, concealed supply, return, and outdoor air.
9 2. Indoor, exposed supply, return, and outdoor air.

- 10 B. Related Sections:

- 11 1. Section 230716 "HVAC Equipment Insulation."
12 2. Section 230719 "HVAC Piping Insulation."
13 3. Section 233113 "Metal Ducts" for duct liners.

14 1.3 ACTION SUBMITTALS

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

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

- 18 1. Detail application of protective shields, saddles, and inserts at hangers for each type of
19 insulation and hanger.
20 2. Detail insulation application at elbows, fittings, dampers, specialties and flanges for each
21 type of insulation.
22 3. Detail application of field-applied jackets.
23 4. Detail application at linkages of control devices.

24 1.4 QUALITY ASSURANCE

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

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

3 1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed
4 index of 50 or less.

5 2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed
6 index of 150 or less.

7 1.5 DELIVERY, STORAGE, AND HANDLING

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

10 1.6 COORDINATION

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

13 B. Coordinate clearance requirements with duct Installer for duct insulation application. Before
14 preparing ductwork Shop Drawings, establish and maintain clearance requirements for
15 installation of insulation and field-applied jackets and finishes and for space required for
16 maintenance.

17 1.7 SCHEDULING

18 A. Schedule insulation application after pressure testing systems. Insulation application may
19 begin on segments that have satisfactory test results.

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

22 PART 2 - PRODUCTS

23 2.1 INSULATION MATERIALS

24 A. Comply with requirements in "Duct Insulation Schedule, General," and "Indoor Duct and
25 Plenum Insulation Schedule," articles for where insulating materials shall be applied.

26 B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

27 C. Products that come in contact with stainless steel shall have a leachable chloride content of
28 less than 50 ppm when tested according to ASTM C 871.

- 1 D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable
2 according to ASTM C 795.
- 3 E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing
4 process.
- 5 F. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin.
6 Comply with ASTM C 553, Type II and ASTM C 1290, Type III with factory-applied FSK jacket.
7 Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
- 8 1. Products: Subject to compliance with requirements, provide one of the following:
- 9 a. CertainTeed Corp.; SoftTouch Duct Wrap.
10 b. Johns Manville; Microlite.
11 c. Knauf Insulation; Friendly Feel Duct Wrap.
12 d. Owens Corning; SOFTR All-Service Duct Wrap.
- 13 2.2 ADHESIVES
- 14 A. Materials shall be compatible with insulation materials, jackets, and substrates and for
15 bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.
- 16 B. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
- 17 1. Products: Subject to compliance with requirements, provide one of the following:
- 18 a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller
19 Company; CP-127.Eagle Bridges - Marathon Industries; 225.
20 b. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller
21 Company; 85-03/11-70.Mon-Eco Industries, Inc.; 22-25.
- 22 2. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when
23 calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- 24 3. Adhesive shall comply with the testing and product requirements of the California
25 Department of Health Services' "Standard Practice for the Testing of Volatile Organic
26 Emissions from Various Sources Using Small-Scale Environmental Chambers."
- 27 C. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for
28 bonding insulation jacket lap seams and joints.
- 29 1. Products: Subject to compliance with requirements, provide one of the following:
- 30 a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller
31 Company; CP-82.
32 b. Eagle Bridges - Marathon Industries; 225.

- 1 c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller
2 Company; 85-50.Mon-Eco Industries, Inc.; 22-25.
- 3 2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when
4 calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- 5 D. PVC Jacket Adhesive: Compatible with PVC jacket.
- 6 1. Products: Subject to compliance with requirements, provide one of the following:
- 7 a. Dow Corning Corporation; 739, Dow Silicone.
8 b. Johns Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.
9 c. P.I.C. Plastics, Inc.; Welding Adhesive.
10 d. Speedline Corporation; Polyco VP Adhesive.
- 11 2.3 FACTORY-APPLIED JACKETS
- 12 A. Insulation system schedules indicate factory-applied jackets on various applications. When
13 factory-applied jackets are indicated, comply with the following:
- 14 1. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing;
15 complying with ASTM C 1136, Type II.
- 16 2.4 TAPES
- 17 A. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive;
18 complying with ASTM C 1136.
- 19 1. Products: Subject to compliance with requirements, provide one of the following:
- 20 a. ABI, Ideal Tape Division; 491 AWF FSK.
21 b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
22 c. Compac Corporation; 110 and 111.
23 d. Venture Tape; 1525 CW NT, 1528 CW, and 1528 CW/SQ.
- 24 2. Width: 3 inches.
25 3. Thickness: 6.5 mils.
26 4. Adhesion: 90 ounces force/inch in width.
27 5. Elongation: 2 percent.
28 6. Tensile Strength: 40 lbf/inch in width.
29 7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

- 1 2.5 SECUREMENTS
- 2 A. Bands:
- 3 1. Products: Subject to compliance with requirements, provide one of the following:
- 4 a. ITW Insulation Systems; Gerrard Strapping and Seals.
- 5 b. RPR Products, Inc.; Insul-Mate Strapping, Seals, and Springs.
- 6 2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316; 0.015 inch
- 7 thick, 1/2 inch wide with wing seal or closed seal.
- 8
- 9
- 10 B. Insulation Pins and Hangers:
- 11 1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for
- 12 capacitor-discharge welding, 0.106-inch- diameter shank, length to suit depth of
- 13 insulation indicated.
- 14 a. Products: Subject to compliance with requirements, provide one of the following:
- 15 1) AGM Industries, Inc.; CWP-1.
- 16 2) GEMCO; CD.
- 17 3) Midwest Fasteners, Inc.; CD.
- 18 4) Nelson Stud Welding; TPA, TPC, and TPS.
- 19 2. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully
- 20 annealed for capacitor-discharge welding, 0.106-inch- diameter shank, length to suit
- 21 depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
- 22 a. Products: Subject to compliance with requirements, provide one of the following:
- 23 1) AGM Industries, Inc.; CHP-1.
- 24 2) GEMCO; Cupped Head Weld Pin.
- 25 3) Midwest Fasteners, Inc.; Cupped Head.
- 26 4) Nelson Stud Welding; CHP.
- 27 3. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to
- 28 projecting spindle that is capable of holding insulation, of thickness indicated, securely
- 29 in position indicated when self-locking washer is in place. Comply with the following
- 30 requirements:
- 31 a. Products: Subject to compliance with requirements, provide one of the following:

- 1) AGM Industries, Inc.; Tactoo Perforated Base Insul-Hangers.
 - 2) GEMCO; Perforated Base.
 - 3) Midwest Fasteners, Inc.; Spindle.
- b. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
 - c. Spindle: Copper- or zinc-coated, low-carbon steel, fully annealed, 0.106-inch-diameter shank, length to suit depth of insulation indicated.
 - d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
4. Nonmetal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate fastened to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
 - a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) GEMCO; Nylon Hangers.
 - 2) Midwest Fasteners, Inc.; Nylon Insulation Hangers.
 - C. Staples: Outward-clinching insulation staples, nominal 3/4-inch- wide, stainless steel or Monel.
 - D. Wire: 0.080-inch nickel-copper alloy.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. C & F Wire.

24 PART 3 - EXECUTION

25 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.

- 1 3.2 PREPARATION
- 2 A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will
3 adversely affect insulation application.
- 4 3.3 GENERAL INSTALLATION REQUIREMENTS
- 5 A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces;
6 free of voids throughout the length of ducts and fittings.
- 7 B. Install insulation materials, vapor barriers or retarders, jackets, and thicknesses required for
8 each item of duct system as specified in insulation system schedules.
- 9 C. Install accessories compatible with insulation materials and suitable for the service. Install
10 accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet
11 or dry state.
- 12 D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- 13 E. Install multiple layers of insulation with longitudinal and end seams staggered.
- 14 F. Keep insulation materials dry during application and finishing.
- 15 G. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with
16 adhesive recommended by insulation material manufacturer.
- 17 H. Install insulation with least number of joints practical.
- 18 I. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers,
19 supports, anchors, and other projections with vapor-barrier mastic.
- 20 1. Install insulation continuously through hangers and around anchor attachments.
- 21 2. For insulation application where vapor barriers are indicated, extend insulation on
22 anchor legs from point of attachment to supported item to point of attachment to
23 structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
- 24 3. Install insert materials and install insulation to tightly join the insert. Seal insulation to
25 insulation inserts with adhesive or sealing compound recommended by insulation
26 material manufacturer.
- 27 J. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet
28 and dry film thicknesses.
- 29 K. Install insulation with factory-applied jackets as follows:
- 30 1. Draw jacket tight and smooth.

- 1 2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation
2 jacket. Secure strips with adhesive and outward clinching staples along both edges of
3 strip, spaced 4 inches o.c.
- 4 3. Overlap jacket longitudinal seams at least 1-1/2 inches. Clean and dry surface to receive
5 self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.
- 6 a. For below ambient services, apply vapor-barrier mastic over staples.
- 7 4. Cover joints and seams with tape, according to insulation material manufacturer's
8 written instructions, to maintain vapor seal.
- 9 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and
10 at ends adjacent to duct flanges and fittings.
- 11 L. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its
12 nominal thickness.
- 13 M. Finish installation with systems at operating conditions. Repair joint separations and cracking
14 due to thermal movement.
- 15 N. Repair damaged insulation facings by applying same facing material over damaged areas.
16 Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches
17 similar to butt joints.
- 18 3.4 PENETRATIONS
- 19 A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof
20 penetrations.
- 21 1. Seal penetrations with flashing sealant.
- 22 2. For applications requiring only indoor insulation, terminate insulation above roof
23 surface and seal with joint sealant. For applications requiring indoor and outdoor
24 insulation, install insulation for outdoor applications tightly joined to indoor insulation
25 ends. Seal joint with joint sealant.
- 26 3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of
27 roof flashing.
- 28 4. Seal jacket to roof flashing with flashing sealant.
- 29 B. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated):
30 Install insulation continuously through walls and partitions.
- 31 C. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Terminate insulation at
32 fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper
33 sleeves to match adjacent insulation and overlap duct insulation at least 2 inches.

1 1. Comply with requirements in Section 078413 "Penetration Firestopping" firestopping
2 and fire-resistive joint sealers.

3 D. Insulation Installation at Floor Penetrations:

4 1. Duct: For penetrations through fire-rated assemblies, terminate insulation at fire
5 damper sleeves and externally insulate damper sleeve beyond floor to match adjacent
6 duct insulation. Overlap damper sleeve and duct insulation at least 2 inches.

7 2. Seal penetrations through fire-rated assemblies. Comply with requirements in
8 Section 078413 "Penetration Firestopping."

9 3.5 INSTALLATION OF MINERAL-FIBER INSULATION

10 A. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation
11 pins.

12 1. Apply adhesives according to manufacturer's recommended coverage rates per unit
13 area, for 50 percent coverage of duct and plenum surfaces.

14 2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and
15 transitions.

16 3. Install either capacitor-discharge-weld pins and speed washers or cupped-head,
17 capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of
18 vertical ducts as follows:

19 a. On duct sides with dimensions 18 inches and smaller, place pins along
20 longitudinal centerline of duct. Space 3 inches maximum from insulation end
21 joints, and 16 inches o.c.

22 b. On duct sides with dimensions larger than 18 inches, place pins 16 inches o.c.
23 each way, and 3 inches maximum from insulation joints. Install additional pins to
24 hold insulation tightly against surface at cross bracing.

25 c. Pins may be omitted from top surface of horizontal, rectangular ducts and
26 plenums.

27 d. Do not overcompress insulation during installation.

28 e. Impale insulation over pins and attach speed washers.

29 f. Cut excess portion of pins extending beyond speed washers or bend parallel with
30 insulation surface. Cover exposed pins and washers with tape matching
31 insulation facing.

32 4. For ducts and plenums with surface temperatures below ambient, install a continuous
33 unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with
34 insulation by removing 2 inches from one edge and one end of insulation segment.
35 Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1
36 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive,
37 vapor-barrier mastic, and sealant at joints, seams, and protrusions.

- 1 a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-
2 barrier seal.
- 3 b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot
4 intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped
5 pattern over insulation face, along butt end of insulation, and over the surface.
6 Cover insulation face and surface to be insulated a width equal to two times the
7 insulation thickness, but not less than 3 inches.
- 8 5. Overlap unfaced blankets a minimum of 2 inches on longitudinal seams and end joints.
9 At end joints, secure with steel bands spaced a maximum of 18 inches o.c.
- 10 6. Install insulation on rectangular duct elbows and transitions with a full insulation section
11 for each surface. Install insulation on round and flat-oval duct elbows with individually
12 mitered gores cut to fit the elbow.
- 13
- 14 7. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface
15 with 6-inch- wide strips of same material used to insulate duct. Secure on alternating
16 sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

17 3.6 DUCT INSULATION SCHEDULE, GENERAL

18 A. Plenums and Ducts Requiring Insulation:

- 19 1. Indoor, concealed supply, return, and outdoor air.
- 20 2. Indoor, exposed supply, return, and outdoor air.

21 B. Items Not Insulated:

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

29 3.7 INDOOR DUCT AND PLENUM INSULATION SCHEDULE

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

- 31 1. Mineral-Fiber Blanket: 1 1/2 inches thick and 1.5-lb/cu. ft. nominal density.

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

- 33 1. Mineral-Fiber Blanket: 1 1/2 inches thick and 1.5-lb/cu. ft. nominal density.

- 1 2. Mineral-Fiber Board: 1 1/2 inches thick and 2-lb/cu. ft. nominal density.
- 2 C. Concealed, rectangular, supply-air duct insulation shall be the following:
- 3 1. Mineral-Fiber Blanket: 1 1/2 inches thick and 1.5-lb/cu. ft. nominal density.
- 4 D. Concealed, rectangular, return-air duct insulation shall be one of the following:
- 5 1. Mineral-Fiber Blanket: 1 1/2 inches thick and 1.5-lb/cu. ft. nominal density.
- 6 2. Mineral-Fiber Board: 1 1/2 inches thick and 2-lb/cu. ft. nominal density.
- 7 E. Concealed and exposed, rectangular, outdoor-air duct insulation shall be one of the following:
- 8 1. Mineral-Fiber Blanket: 2 inches thick and 1.5-lb/cu. ft. nominal density.
- 9 2. Mineral-Fiber Board: 2 inches thick and 2-lb/cu. ft. nominal density.
- 10 F. Exposed, round and flat-oval, supply-air duct insulation shall be the following unless otherwise
11 noted:
- 12 1. Mineral-Fiber Blanket: 1 1/2 inches thick and 1.5-lb/cu. ft. nominal density.
- 13 G. Exposed, rectangular, supply-air duct insulation shall be the following unless otherwise noted:
- 14 1. Mineral-Fiber Blanket: 1 1/2 inches thick and 1.5-lb/cu. ft. nominal density.
- 15 H. Exposed, rectangular, return-air duct insulation shall be one of the following unless otherwise
16 noted:
- 17 1. Mineral-Fiber Blanket: 1 1/2 inches thick and 1.5-lb/cu. ft. nominal density.
- 18 2. Mineral-Fiber Board: 1 1/2 inches thick and 2-lb/cu. ft. nominal density.
- 19 END OF SECTION 230713

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1 SECTION 230719 - HVAC PIPING INSULATION

2 PART 1 - GENERAL

3 1.1 RELATED DOCUMENTS

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

6 1.2 SUMMARY

- 7 A. Section includes insulating the following HVAC piping systems:

- 8 1. Condensate drain piping, indoors and outdoors.
9 2. Refrigerant suction and hot-gas piping, indoors and outdoors.

- 10 B. Related Sections:

- 11 1. Section 230713 "Duct Insulation."
12 2. Section 230716 "HVAC Equipment Insulation."

13 1.3 ACTION SUBMITTALS

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

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

- 17 1. Detail application of protective shields, saddles, and inserts at hangers for each type of
18 insulation and hanger.
19 2. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each
20 type of insulation.
21 3. Detail removable insulation at piping specialties.
22 4. Detail application of field-applied jackets.
23 5. Detail application at linkages of control devices.

24 1.4 INFORMATIONAL SUBMITTALS

- 25 A. Qualification Data: For qualified Installer.

- 1 B. Material Test Reports: From a qualified testing agency acceptable to authorities having
2 jurisdiction indicating, interpreting, and certifying test results for compliance of insulation
3 materials, sealers, attachments, cements, and jackets, with requirements indicated. Include
4 dates of tests and test methods employed.
- 5 C. Field quality-control reports.
- 6 1.5 QUALITY ASSURANCE
- 7 A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship
8 program or another craft training program certified by the Department of Labor, Bureau of
9 Apprenticeship and Training.
- 10 B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing
11 identical products according to ASTM E 84, by a testing and inspecting agency acceptable to
12 authorities having jurisdiction. Factory label insulation and jacket materials and adhesive,
13 mastic, tapes, and cement material containers, with appropriate markings of applicable testing
14 agency.
- 15 1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed
16 index of 50 or less.
- 17 2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed
18 index of 150 or less.
- 19 1.6 DELIVERY, STORAGE, AND HANDLING
- 20 A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate
21 ASTM standard designation, type and grade, and maximum use temperature.
- 22 1.7 COORDINATION
- 23 A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in
24 Section 230529 "Hangers and Supports for HVAC Piping and Equipment."
- 25 B. Coordinate clearance requirements with piping Installer for piping insulation application.
26 Before preparing piping Shop Drawings, establish and maintain clearance requirements for
27 installation of insulation and field-applied jackets and finishes and for space required for
28 maintenance.

1 1.8 SCHEDULING

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

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

7 PART 2 - PRODUCTS

8 2.1 INSULATION MATERIALS

9 A. Comply with requirements in "Piping Insulation Schedule, General," "Indoor Piping Insulation
10 Schedule," and "Outdoor, Aboveground Piping Insulation Schedule," articles for where
11 insulating materials shall be applied.

12 B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

13 C. Products that come in contact with stainless steel shall have a leachable chloride content of
14 less than 50 ppm when tested according to ASTM C 871.

15 D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable
16 according to ASTM C 795.

17 E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing
18 process.

19 F. Flexible Elastomeric Insulation: Closed-cell, sponge or expanded rubber materials. Comply
20 with ASTM C 534, Type 1 for tubular materials.

21 1. Products: Subject to compliance with requirements, provide one of the following:

22 a. Aeroflex USA, Inc.; Aerocel.

23 b. Armacell LLC; AP Armaflex.

24 c. K-Flex USA; Insul-Lock, Insul-Tube, and K-FLEX LS.

25 G. Mineral-Fiber, Preformed Pipe Insulation:

26 1. Products: Subject to compliance with requirements, provide one of the following:

27 a. Fibrex Insulations Inc.; Coreplus 1200.

28 b. Johns Manville; Micro-Lok.

29 c. Knauf Insulation; 1000-Degree Pipe Insulation.

- 1 d. Owens Corning; Fiberglas Pipe Insulation.
- 2 2.2 INSULATING CEMENTS
- 3 A. Mineral-Fiber Insulating Cement: Comply with ASTM C 195.
- 4 1. Products: Subject to compliance with requirements, provide one of the following:
- 5 a. Ramco Insulation, Inc.; Super-Stik.
- 6 B. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449.
- 7 1. Products: Subject to compliance with requirements, provide one of the following:
- 8 a. Ramco Insulation, Inc.; Ramcote 1200 and Quik-Cote.
- 9 2.3 ADHESIVES
- 10 A. Materials shall be compatible with insulation materials, jackets, and substrates and for
11 bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.
- 12 B. Flexible Elastomeric Adhesive: Comply with MIL-A-24179A, Type II, Class I.
- 13 1. Products: Subject to compliance with requirements, provide one of the following:
- 14 a. Aeroflex USA, Inc.; Aero seal.
- 15 b. Armacell LLC; Armaflex 520 Adhesive.
- 16 c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller
17 Company; 95-75.
- 18 d. K-Flex USA; R-373 Contact Adhesive.
- 19 C. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
- 20 1. Products: Subject to compliance with requirements, provide one of the following:
- 21 a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller
22 Company; CP-127.
- 23 b. Eagle Bridges - Marathon Industries; 225.
- 24 c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller
25 Company; 85-60/85-70.
- 26 d. Mon-Eco Industries, Inc.; 22-25.
- 27 D. ASJ Adhesive, and FSK and PVDC Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A
28 for bonding insulation jacket lap seams and joints.

- 1 1. Products: Subject to compliance with requirements, provide one of the following:
- 2 a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller
3 Company; CP-82.
- 4 b. Eagle Bridges - Marathon Industries; 225.
- 5 c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller
6 Company; 85-50.
- 7 d. Mon-Eco Industries, Inc.; 22-25.
- 8 E. PVC Jacket Adhesive: Compatible with PVC jacket.
- 9 1. Products: Subject to compliance with requirements, provide one of the following:
- 10 a. Dow Corning Corporation; 739, Dow Silicone.
- 11 b. Johns Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.
- 12 c. P.I.C. Plastics, Inc.; Welding Adhesive.
- 13 d. Speedline Corporation; Polyco VP Adhesive.
- 14 2.4 MASTICS
- 15 A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with
16 MIL-PRF-19565C, Type II.
- 17 1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when
18 calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- 19 B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below-ambient services.
- 20 1. Products: Subject to compliance with requirements, provide one of the following:
- 21 a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller
22 Company; 30-80/30-90.
- 23 b. Vimasco Corporation; 749.
- 24 2. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm at 43-mil dry film
25 thickness.
- 26 3. Service Temperature Range: Minus 20 to plus 180 deg F.
- 27 4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
- 28 5. Color: White.
- 29 C. Vapor-Barrier Mastic: Solvent based; suitable for indoor use on below-ambient services.
- 30 1. Products: Subject to compliance with requirements, provide one of the following:

- 1 a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller
2 Company; CP-30.
- 3 b. Eagle Bridges - Marathon Industries; 501.
- 4 c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller
5 Company; 30-35.
- 6 d. Mon-Eco Industries, Inc.; 55-10.

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

- 11 D. Vapor-Barrier Mastic: Solvent based; suitable for outdoor use on below-ambient services.

- 12 1. Products: Subject to compliance with requirements, provide one of the following:
- 13 a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller
14 Company; Encacel.
- 15 b. Eagle Bridges - Marathon Industries; 570.
- 16 c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller
17 Company; 60-95/60-96.

- 18 2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm at 30-mil dry film thickness.
- 19 3. Service Temperature Range: Minus 50 to plus 220 deg F.
- 20 4. Solids Content: ASTM D 1644, 33 percent by volume and 46 percent by weight.
- 21 5. Color: White.

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

- 24 1. Products: Subject to compliance with requirements, provide one of the following:
- 25 a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller
26 Company; CP-10.
- 27 b. Eagle Bridges - Marathon Industries; 550.
- 28 c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller
29 Company; 46-50.
- 30 d. Mon-Eco Industries, Inc.; 55-50.
- 31 e. Vimasco Corporation; WC-1/WC-5.

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

- 1 2.5 LAGGING ADHESIVES
- 2 A. Description: Comply with MIL-A-3316C, Class I, Grade A and shall be compatible with
3 insulation materials, jackets, and substrates.
- 4 1. For indoor applications, use lagging adhesives that have a VOC content of 50 g/L or less
5 when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- 6 2. Products: Subject to compliance with requirements, provide one of the following:
- 7 a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller
8 Company; CP-50 AHV2.
- 9 b. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller
10 Company; 30-36.
- 11 c. Vimasco Corporation; 713 and 714.
- 12 3. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-
13 resistant lagging cloths over pipe insulation.
- 14 4. Service Temperature Range: 0 to plus 180 deg F.
- 15 5. Color: White.
- 16 2.6 SEALANTS
- 17 A. Joint Sealants:
- 18 1. Materials shall be compatible with insulation materials, jackets, and substrates.
- 19 2. Permanently flexible, elastomeric sealant.
- 20 3. Service Temperature Range: Minus 100 to plus 300 deg F.
- 21 4. Color: White or gray.
- 22 B. FSK and Metal Jacket Flashing Sealants:
- 23 1. Products: Subject to compliance with requirements, provide one of the following:
- 24 a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller
25 Company; CP-76.
- 26 b. Eagle Bridges - Marathon Industries; 405.
- 27 c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller
28 Company; 95-44.
- 29 d. Mon-Eco Industries, Inc.; 44-05.
- 30 2. Materials shall be compatible with insulation materials, jackets, and substrates.
- 31 3. Fire- and water-resistant, flexible, elastomeric sealant.
- 32 4. Service Temperature Range: Minus 40 to plus 250 deg F.
- 33 5. Color: Aluminum.

- 1 C. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:
- 2 1. Products: Subject to compliance with requirements, provide one of the following:
- 3 a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller
4 Company; CP-76.
- 5 2. Materials shall be compatible with insulation materials, jackets, and substrates.
- 6 3. Fire- and water-resistant, flexible, elastomeric sealant.
- 7 4. Service Temperature Range: Minus 40 to plus 250 deg F.
- 8 5. Color: White.
- 9 2.7 FACTORY-APPLIED JACKETS
- 10 A. Insulation system schedules indicate factory-applied jackets on various applications. When
11 factory-applied jackets are indicated, comply with the following:
- 12 1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing;
13 complying with ASTM C 1136, Type I.
- 14 2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a
15 removable protective strip; complying with ASTM C 1136, Type I.
- 16 3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing;
17 complying with ASTM C 1136, Type II.
- 18 4. FSP Jacket: Aluminum-foil, fiberglass-reinforced scrim with polyethylene backing;
19 complying with ASTM C 1136, Type II.
- 20 5. PVDC Jacket for Outdoor Applications: 6-mil- thick, white PVDC biaxially oriented
21 barrier film with a permeance at 0.01 perm when tested according to ASTM E 96/E 96M
22 and with a flame-spread index of 5 and a smoke-developed index of 25 when tested
23 according to ASTM E 84.
- 24 a. Products: Subject to compliance with requirements, provide one of the following:
- 25 1) Dow Chemical Company (The); Saran 540 Vapor Retarder Film and
26 Saran 560 Vapor Retarder Film.
- 27 6. PVDC-SSL Jacket: PVDC jacket with a self-sealing, pressure-sensitive, acrylic-based
28 adhesive covered by a removable protective strip.
- 29 a. Products: Subject to compliance with requirements, provide one of the following:
- 30 1) Dow Chemical Company (The); Saran 540 Vapor Retarder Film and
31 Saran 560 Vapor Retarder Film.

- 1 7. Vinyl Jacket: White vinyl with a permeance of 1.3 perms when tested according to
2 ASTM E 96/E 96M, Procedure A, and complying with NFPA 90A and NFPA 90B.
- 3 2.8 FIELD-APPLIED JACKETS
- 4 A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
- 5 B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.
- 6 C. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784,
7 Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming.
8 Thickness is indicated in field-applied jacket schedules.
- 9 1. Products: Subject to compliance with requirements, provide one of the following:
- 10 a. Johns Manville; Zeston.
- 11 b. P.I.C. Plastics, Inc.; FG Series.
- 12 c. Proto Corporation; LoSmoke.
- 13 d. Speedline Corporation; SmokeSafe.
- 14 2. Adhesive: As recommended by jacket material manufacturer.
- 15 3. Color: Color-code jackets based on system.
- 16 4. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.
- 17 a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges,
18 unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap
19 and supply covers for lavatories.
- 20 D. Metal Jacket:
- 21 1. Products: Subject to compliance with requirements, provide one of the following:
- 22 a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller
23 Company; Metal Jacketing Systems.
- 24 b. ITW Insulation Systems; Aluminum and Stainless Steel Jacketing.
- 25 c. RPR Products, Inc.; Insul-Mate.
- 26 2. Aluminum Jacket: Comply with ASTM B 209, Alloy 3003, 3005, 3105, or 5005,
27 Temper H-14.
- 28 a. Factory cut and rolled to size.
- 29 b. Finish and thickness are indicated in field-applied jacket schedules.
- 30 c. Moisture Barrier for Outdoor Applications: 3-mil- thick, heat-bonded
31 polyethylene and kraft paper or 2.5-mil- thick polysurlyn.
- 32 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.
- 11 E. Self-Adhesive Outdoor Jacket: 60-mil- thick, laminated vapor barrier and waterproofing
12 membrane for installation over insulation located aboveground outdoors; consisting of a
13 rubberized bituminous resin on a crosslaminated polyethylene film covered with white
14 aluminum-foil facing.
- 15 1. Products: Subject to compliance with requirements, provide one of the following:
 - 16 a. Polyguard Products, Inc.; Alumaguard 60.
- 17 F. PVDC Jacket for Indoor Applications: 4-mil- thick, white PVDC biaxially oriented barrier film
18 with a permeance at 0.02 perms when tested according to ASTM E 96/E 96M and with a flame-
19 spread index of 5 and a smoke-developed index of 20 when tested according to ASTM E 84.
- 20 1. Products: Subject to compliance with requirements, provide one of the following:
 - 21 a. Dow Chemical Company (The); Saran 540 Vapor Retarder Film.
- 22
- 23 G. PVDC Jacket for Outdoor Applications: 6-mil- thick, white PVDC biaxially oriented barrier film
24 with a permeance at 0.01 perms when tested according to ASTM E 96/E 96M and with a flame-
25 spread index of 5 and a smoke-developed index of 25 when tested according to ASTM E 84.
- 26 1. Products: Subject to compliance with requirements, provide one of the following:
 - 27 a. Dow Chemical Company (The); Saran 560 Vapor Retarder Film.
- 28 H. PVDC-SSL Jacket: PVDC jacket with a self-sealing, pressure-sensitive, acrylic-based adhesive
29 covered by a removable protective strip.
- 30 1. Products: Subject to compliance with requirements, provide one of the following:
 - 31 a. Dow Chemical Company (The); Saran 540 Vapor Retarder Film and Saran 560
32 Vapor Retarder Film.

- 1 2.9 FIELD-APPLIED FABRIC-REINFORCING MESH
- 2 A. Woven Glass-Fiber Fabric: Approximately 2 oz./sq. yd. with a thread count of 10 strands by 10
3 strands/sq. in. for covering pipe and pipe fittings.
- 4 1. Products: Subject to compliance with requirements, provide one of the following:
- 5 a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller
6 Company; Chil-Glas Number 10.
- 7 B. Woven Polyester Fabric: Approximately 1 oz./sq. yd. with a thread count of 10 strands by 10
8 strands/sq. in., in a Leno weave, for pipe.
- 9 1. Products: Subject to compliance with requirements, provide one of the following:
- 10 a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller
11 Company; Mast-A-Fab.
- 12 b. Vimasco Corporation; Elastafab 894.
- 13 2.10 TAPES
- 14 A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive,
15 complying with ASTM C 1136.
- 16 1. Products: Subject to compliance with requirements, provide one of the following:
- 17 a. ABI, Ideal Tape Division; 428 AWF ASJ.
- 18 b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0836.
- 19 c. Compac Corporation; 104 and 105.
- 20 d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.
- 21 2. Width: 3 inches.
- 22 3. Thickness: 11.5 mils.
- 23 4. Adhesion: 90 ounces force/inch in width.
- 24 5. Elongation: 2 percent.
- 25 6. Tensile Strength: 40 lbf/inch in width.
- 26 7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.
- 27 B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive;
28 complying with ASTM C 1136.
- 29 1. Products: Subject to compliance with requirements, provide one of the following:
- 30 a. ABI, Ideal Tape Division; 491 AWF FSK.
- 31 b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.

- 1 c. Compac Corporation; 110 and 111.
- 2 d. Venture Tape; 1525 CW NT, 1528 CW, and 1528 CW/SQ.
- 3 2. Width: 3 inches.
- 4 3. Thickness: 6.5 mils.
- 5 4. Adhesion: 90 ounces force/inch in width.
- 6 5. Elongation: 2 percent.
- 7 6. Tensile Strength: 40 lbf/inch in width.
- 8 7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.
- 9 C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive;
- 10 suitable for indoor and outdoor applications.
- 11 1. Products: Subject to compliance with requirements, provide one of the following:
- 12 a. ABI, Ideal Tape Division; 370 White PVC tape.
- 13 b. Compac Corporation; 130.
- 14 c. Venture Tape; 1506 CW NS.
- 15 2. Width: 2 inches.
- 16 3. Thickness: 6 mils.
- 17 4. Adhesion: 64 ounces force/inch in width.
- 18 5. Elongation: 500 percent.
- 19 6. Tensile Strength: 18 lbf/inch in width.
- 20 D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
- 21 1. Products: Subject to compliance with requirements, provide one of the following:
- 22 a. ABI, Ideal Tape Division; 488 AWF.
- 23 b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.
- 24 c. Compac Corporation; 120.
- 25 d. Venture Tape; 3520 CW.
- 26 2. Width: 2 inches.
- 27 3. Thickness: 3.7 mils.
- 28 4. Adhesion: 100 ounces force/inch in width.
- 29 5. Elongation: 5 percent.
- 30 6. Tensile Strength: 34 lbf/inch in width.
- 31 E. PVDC Tape for Indoor Applications: White vapor-retarder PVDC tape with acrylic adhesive.
- 32 1. Products: Subject to compliance with requirements, provide one of the following:
- 33 a. Dow Chemical Company (The); Saran 540 Vapor Retarder Tape.

- 1 2. Width: 3 inches.
- 2 3. Film Thickness: 4 mils.
- 3 4. Adhesive Thickness: 1.5 mils.
- 4 5. Elongation at Break: 145 percent.
- 5 6. Tensile Strength: 55 lbf/inch in width.

6 F. PVDC Tape for Outdoor Applications: White vapor-retarder PVDC tape with acrylic adhesive.

- 7 1. Products: Subject to compliance with requirements, provide one of the following:

- 8 a. Dow Chemical Company (The); Saran 560 Vapor Retarder Tape.

- 9 2. Width: 3 inches.
- 10 3. Film Thickness: 6 mils.
- 11 4. Adhesive Thickness: 1.5 mils.
- 12 5. Elongation at Break: 145 percent.
- 13 6. Tensile Strength: 55 lbf/inch in width.

14 2.11 SECUREMENTS

15 A. Bands:

- 16 1. Products: Subject to compliance with requirements, provide one of the following:

- 17 a. ITW Insulation Systems; Gerrard Strapping and Seals.

- 18 b. RPR Products, Inc.; Insul-Mate Strapping, Seals, and Springs.

- 19 2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316; 0.015 inch
20 thick, 1/2 inch wide with wing seal or closed seal.

- 21 3. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch
22 thick, 1/2 inch wide with wing seal or closed seal.

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

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

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

- 28 a. C & F Wire.

1 PART 3 - EXECUTION

2 3.1 EXAMINATION

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

- 5 1. Verify that systems to be insulated have been tested and are free of defects.
6 2. Verify that surfaces to be insulated are clean and dry.
7 3. Proceed with installation only after unsatisfactory conditions have been corrected.

8 3.2 PREPARATION

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

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

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

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

22 3.3 GENERAL INSTALLATION REQUIREMENTS

23 A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces;
24 free of voids throughout the length of piping including fittings, valves, and specialties.

25 B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses
26 required for each item of pipe system as specified in insulation system schedules.

27 C. Install accessories compatible with insulation materials and suitable for the service. Install
28 accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet
29 or dry state.

30 D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

- 1 E. Install multiple layers of insulation with longitudinal and end seams staggered.
- 2 F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- 3 G. Keep insulation materials dry during application and finishing.
- 4 H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with
5 adhesive recommended by insulation material manufacturer.
- 6 I. Install insulation with least number of joints practical.
- 7 J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers,
8 supports, anchors, and other projections with vapor-barrier mastic.
 - 9 1. Install insulation continuously through hangers and around anchor attachments.
 - 10 2. For insulation application where vapor barriers are indicated, extend insulation on
11 anchor legs from point of attachment to supported item to point of attachment to
12 structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
 - 13 3. Install insert materials and install insulation to tightly join the insert. Seal insulation to
14 insulation inserts with adhesive or sealing compound recommended by insulation
15 material manufacturer.
 - 16 4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over
17 jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- 18 K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet
19 and dry film thicknesses.
- 20 L. Install insulation with factory-applied jackets as follows:
 - 21 1. Draw jacket tight and smooth.
 - 22 2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation
23 jacket. Secure strips with adhesive and outward clinching staples along both edges of
24 strip, spaced 4 inches o.c.
 - 25 3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with
26 longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap.
27 Staple laps with outward clinching staples along edge at 2 inches o.c.
 - 28 a. For below-ambient services, apply vapor-barrier mastic over staples.
 - 29 4. Cover joints and seams with tape, according to insulation material manufacturer's
30 written instructions, to maintain vapor seal.
 - 31 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and
32 at ends adjacent to pipe flanges and fittings.
- 33 M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its
34 nominal thickness.

- 1 N. Finish installation with systems at operating conditions. Repair joint separations and cracking
2 due to thermal movement.
- 3 O. Repair damaged insulation facings by applying same facing material over damaged areas.
4 Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches
5 similar to butt joints.
- 6 P. For above-ambient services, do not install insulation to the following:
- 7 1. Vibration-control devices.
8 2. Testing agency labels and stamps.
9 3. Nameplates and data plates.
10 4. Manholes.
11 5. Handholes.
12 6. Cleanouts.
- 13 3.4 PENETRATIONS
- 14 A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof
15 penetrations.
- 16 1. Seal penetrations with flashing sealant.
17 2. For applications requiring only indoor insulation, terminate insulation above roof
18 surface and seal with joint sealant. For applications requiring indoor and outdoor
19 insulation, install insulation for outdoor applications tightly joined to indoor insulation
20 ends. Seal joint with joint sealant.
21 3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of
22 roof flashing.
23 4. Seal jacket to roof flashing with flashing sealant.
- 24 B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush
25 with sleeve seal. Seal terminations with flashing sealant.
- 26 C. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated):
27 Install insulation continuously through walls and partitions.
- 28 D. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation
29 continuously through penetrations of fire-rated walls and partitions.
- 30 1. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping
31 and fire-resistive joint sealers.
- 32 E. Insulation Installation at Floor Penetrations:
- 33 1. Pipe: Install insulation continuously through floor penetrations.

- 1 2. Seal penetrations through fire-rated assemblies. Comply with requirements in
2 Section 078413 "Penetration Firestopping."

3 3.5 GENERAL PIPE INSULATION INSTALLATION

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

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

- 7 1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties
8 with continuous thermal and vapor-retarder integrity unless otherwise indicated.
- 9 2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from
10 same material and density as adjacent pipe insulation. Each piece shall be butted tightly
11 against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular
12 surfaces with insulating cement finished to a smooth, hard, and uniform contour that is
13 uniform with adjoining pipe insulation.
- 14 3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same
15 material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit.
16 Butt each section closely to the next and hold in place with tie wire. Bond pieces with
17 adhesive.
- 18 4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same
19 material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe
20 insulation by not less than two times the thickness of pipe insulation, or one pipe
21 diameter, whichever is thicker. For valves, insulate up to and including the bonnets,
22 valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with
23 insulating cement.
- 24 5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same
25 material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe
26 insulation by not less than two times the thickness of pipe insulation, or one pipe
27 diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating
28 cement. Insulate strainers so strainer basket flange or plug can be easily removed and
29 replaced without damaging the insulation and jacket. Provide a removable reusable
30 insulation cover. For below-ambient services, provide a design that maintains vapor
31 barrier.
- 32 6. Insulate flanges and unions using a section of oversized preformed pipe insulation.
33 Overlap adjoining pipe insulation by not less than two times the thickness of pipe
34 insulation, or one pipe diameter, whichever is thicker.
- 35 7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a
36 mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic
37 for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel
38 the mastic to a smooth and well-shaped contour.
- 39 8. For services not specified to receive a field-applied jacket except for flexible elastomeric
40 and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and

- 1 unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation
2 facing using PVC tape.
- 3 9. Stencil or label the outside insulation jacket of each union with the word "union."
4 Match size and color of pipe labels.
- 5 C. Insulate instrument connections for thermometers, pressure gages, pressure temperature
6 taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes.
7 Shape insulation at these connections by tapering it to and around the connection with
8 insulating cement and finish with finishing cement, mastic, and flashing sealant.
- 9 D. Install removable insulation covers at locations indicated. Installation shall conform to the
10 following:
- 11 1. Make removable flange and union insulation from sectional pipe insulation of same
12 thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe
13 insulation.
- 14 2. When flange and union covers are made from sectional pipe insulation, extend
15 insulation from flanges or union long at least two times the insulation thickness over
16 adjacent pipe insulation on each side of flange or union. Secure flange cover in place
17 with stainless-steel or aluminum bands. Select band material compatible with insulation
18 and jacket.
- 19 3. Construct removable valve insulation covers in same manner as for flanges, except
20 divide the two-part section on the vertical center line of valve body.
- 21 4. When covers are made from block insulation, make two halves, each consisting of
22 mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached
23 insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent
24 pipe insulation on each side of valve. Fill space between flange or union cover and pipe
25 insulation with insulating cement. Finish cover assembly with insulating cement applied
26 in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
- 27 5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces
28 with a metal jacket.
- 29 3.6 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION
- 30 A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to
31 eliminate openings in insulation that allow passage of air to surface being insulated.
- 32 B. Insulation Installation on Pipe Flanges:
- 33 1. Install pipe insulation to outer diameter of pipe flange.
- 34 2. Make width of insulation section same as overall width of flange and bolts, plus twice
35 the thickness of pipe insulation.

- 1 3. Fill voids between inner circumference of flange insulation and outer circumference of
2 adjacent straight pipe segments with cut sections of sheet insulation of same thickness
3 as pipe insulation.
- 4 4. Secure insulation to flanges and seal seams with manufacturer's recommended
5 adhesive to eliminate openings in insulation that allow passage of air to surface being
6 insulated.
- 7 C. Insulation Installation on Pipe Fittings and Elbows:
- 8 1. Install mitered sections of pipe insulation.
- 9 2. Secure insulation materials and seal seams with manufacturer's recommended adhesive
10 to eliminate openings in insulation that allow passage of air to surface being insulated.
- 11 D. Insulation Installation on Valves and Pipe Specialties:
- 12 1. Install preformed valve covers manufactured of same material as pipe insulation when
13 available.
- 14 2. When preformed valve covers are not available, install cut sections of pipe and sheet
15 insulation to valve body. Arrange insulation to permit access to packing and to allow
16 valve operation without disturbing insulation.
- 17 3. Install insulation to flanges as specified for flange insulation application.
- 18 4. Secure insulation to valves and specialties and seal seams with manufacturer's
19 recommended adhesive to eliminate openings in insulation that allow passage of air to
20 surface being insulated.
- 21 3.7 INSTALLATION OF MINERAL-FIBER INSULATION
- 22 A. Insulation Installation on Straight Pipes and Tubes:
- 23 1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten
24 bands without deforming insulation materials.
- 25 2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions
26 with vapor-barrier mastic and joint sealant.
- 27 3. For insulation with factory-applied jackets on above-ambient surfaces, secure laps with
28 outward-clinched staples at 6 inches o.c.
- 29 4. For insulation with factory-applied jackets on below-ambient surfaces, do not staple
30 longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by
31 insulation material manufacturer and seal with vapor-barrier mastic and flashing
32 sealant.
- 33 B. Insulation Installation on Pipe Flanges:
- 34 1. Install preformed pipe insulation to outer diameter of pipe flange.
- 35 2. Make width of insulation section same as overall width of flange and bolts, plus twice
36 the thickness of pipe insulation.

- 1 3. Fill voids between inner circumference of flange insulation and outer circumference of
2 adjacent straight pipe segments with mineral-fiber blanket insulation.
- 3 4. Install jacket material with manufacturer's recommended adhesive, overlap seams at
4 least 1 inch, and seal joints with flashing sealant.

- 5 C. Insulation Installation on Pipe Fittings and Elbows:

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

- 11 D. Insulation Installation on Valves and Pipe Specialties:

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

- 19 3.8 FIELD-APPLIED JACKET INSTALLATION

- 20 A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with
21 factory-applied jackets.

- 22 1. Draw jacket smooth and tight to surface with 2-inch overlap at seams and joints.
- 23 2. Embed glass cloth between two 0.062-inch- thick coats of lagging adhesive.
- 24 3. Completely encapsulate insulation with coating, leaving no exposed insulation.

- 25 B. Where FSK jackets are indicated, install as follows:

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

- 33 C. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end
34 joints; for horizontal applications. Seal with manufacturer's recommended adhesive.

- 1 1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and
2 the finish bead along seam and joint edge.
- 3 D. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end
4 joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof
5 sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12
6 inches o.c. and at end joints.
- 7 E. Where PVDC jackets are indicated, install as follows:
- 8 1. Apply three separate wraps of filament tape per insulation section to secure pipe
9 insulation to pipe prior to installation of PVDC jacket.
- 10 2. Wrap factory-presize jackets around individual pipe insulation sections with one end
11 overlapping the previously installed sheet. Install presize jacket with an approximate
12 overlap at butt joint of 2 inches over the previous section. Adhere lap seal using
13 adhesive or SSL, and then apply 1-1/4 circumferences of appropriate PVDC tape around
14 overlapped butt joint.
- 15 3. Continuous jacket can be spiral-wrapped around a length of pipe insulation. Apply
16 adhesive or PVDC tape at overlapped spiral edge. When electing to use adhesives, refer
17 to manufacturer's written instructions for application of adhesives along this spiral edge
18 to maintain a permanent bond.
- 19 4. Jacket can be wrapped in cigarette fashion along length of roll for insulation systems
20 with an outer circumference of 33-1/2 inches or less. The 33-1/2-inch- circumference
21 limit allows for 2-inch- overlap seal. Using the length of roll allows for longer sections of
22 jacket to be installed at one time. Use adhesive on the lap seal. Visually inspect lap seal
23 for "fishmouthing," and use PVDC tape along lap seal to secure joint.
- 24 5. Repair holes or tears in PVDC jacket by placing PVDC tape over the hole or tear and
25 wrapping a minimum of 1-1/4 circumferences to avoid damage to tape edges.
- 26 3.9 FINISHES
- 27 A. Pipe Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with
28 paint system identified below.
- 29 1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material
30 and finish coat paint. Add fungicidal agent to render fabric mildew proof.
- 31 a. Finish Coat Material: Interior, flat, latex-emulsion size.
- 32 B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of
33 insulation manufacturer's recommended protective coating.
- 34 C. Color: Final color as selected by Architect. Vary first and second coats to allow visual
35 inspection of the completed Work.

- 1 D. Do not field paint aluminum or stainless-steel jackets.
- 2 3.10 PIPING INSULATION SCHEDULE, GENERAL
- 3 A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for
4 each piping system and pipe size range. If more than one material is listed for a piping system,
5 selection from materials listed is Contractor's option.
- 6 B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:
- 7 1. Drainage piping located in crawl spaces.
8 2. Underground piping.
9 3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.
- 10 3.11 INDOOR PIPING INSULATION SCHEDULE
- 11 A. Condensate and Equipment Drain Water below 60 Deg F:
- 12 1. All Pipe Sizes: Insulation shall be the following:
- 13 a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
- 14 B. Refrigerant Suction and Hot-Gas Piping:
- 15 1. All Pipe Sizes: Insulation shall be the following:
- 16 a. Flexible Elastomeric: 1 inch thick.
- 17 3.12 OUTDOOR, ABOVEGROUND PIPING INSULATION SCHEDULE
- 18 A. Refrigerant Suction and Hot-Gas Piping:
- 19 1. All Pipe Sizes: Insulation shall be one of the following:
- 20 a. Flexible Elastomeric: 2 inches thick.
21 b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 2 inches thick.
- 22 3.13 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE
- 23 A. Install jacket over insulation material. For insulation with factory-applied jacket, install the
24 field-applied jacket over the factory-applied jacket.
- 25 B. If more than one material is listed, selection from materials listed is Contractor's option.

- 1 C. Piping, Exposed:
- 2 1. PVC: 30 mils thick.
- 3 2. Aluminum, Smooth with Z-Shaped Locking Seam: 0.024 inch thick.

- 4 END OF SECTION 230719

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1 SECTION 231123 - FACILITY NATURAL-GAS PIPING

2 PART 1 - GENERAL

3 1.1 RELATED DOCUMENTS

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

6 1.2 SUMMARY

- 7 A. Section Includes:

- 8 1. Pipes, tubes, and fittings.
9 2. Piping specialties.
10 3. Piping and tubing joining materials.
11 4. Valves.
12 5. Pressure regulators.
13 6. Concrete bases.

14 1.3 DEFINITIONS

- 15 A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred
16 spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings,
17 unexcavated spaces, crawlspaces, and tunnels.

- 18 B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied
19 spaces and mechanical equipment rooms.

- 20 C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient
21 temperatures and weather conditions. Examples include rooftop locations.

22 1.4 PERFORMANCE REQUIREMENTS

- 23 A. Minimum Operating-Pressure Ratings:

- 24 1. Piping and Valves: 100 psig minimum unless otherwise indicated.

- 1 1.5 ACTION SUBMITTALS
- 2 A. Product Data: For each type of the following:
- 3 1. Piping specialties.
- 4 2. Corrugated, stainless-steel tubing with associated components.
- 5 3. Valves. Include pressure rating, capacity, settings, and electrical connection data of
- 6 selected models.
- 7 4. Pressure regulators. Indicate pressure ratings and capacities.
- 8 5. Dielectric fittings.
- 9 B. Shop Drawings: For facility natural-gas piping layout. Include plans, piping layout and
- 10 elevations, sections, and details for fabrication of pipe anchors, hangers, supports for multiple
- 11 pipes, alignment guides, expansion joints and loops, and attachments of the same to building
- 12 structure. Detail location of anchors, alignment guides, and expansion joints and loops.
- 13 1.6 INFORMATIONAL SUBMITTALS
- 14 A. Welding certificates.
- 15 B. Field quality-control reports.
- 16 1.7 CLOSEOUT SUBMITTALS
- 17 A. Operation and Maintenance Data: For pressure regulators to include in emergency, operation,
- 18 and maintenance manuals.
- 19 1.8 QUALITY ASSURANCE
- 20 A. Steel Support Welding Qualifications: Qualify procedures and personnel according to
- 21 AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- 22 B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and
- 23 Pressure Vessel Code.
- 24 C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by
- 25 a qualified testing agency, and marked for intended location and application.
- 26 1.9 DELIVERY, STORAGE, AND HANDLING
- 27 A. Handling Flammable Liquids: Remove and dispose of liquids from existing natural-gas piping
- 28 according to requirements of authorities having jurisdiction.

1 B. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping,
2 storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and
3 moisture.

4 C. Store and handle pipes and tubes having factory-applied protective coatings to avoid
5 damaging coating, and protect from direct sunlight.

6 1.10 PROJECT CONDITIONS

7 A. Interruption of Existing Natural-Gas Service: Do not interrupt natural-gas service to facilities
8 occupied by Owner or others unless permitted under the following conditions and then only
9 after arranging to provide purging and startup of natural-gas supply according to requirements
10 indicated:

- 11 1. Notify Owner no fewer than two days in advance of proposed interruption of natural-
12 gas service.
13 2. Do not proceed with interruption of natural-gas service without Owner's written
14 permission.

15 1.11 COORDINATION

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

17 B. Coordinate requirements for access panels and doors for valves installed concealed behind
18 finished surfaces. Comply with requirements in Section 083113 "Access Doors and Frames."

19 PART 2 - PRODUCTS

20 2.1 PIPES, TUBES, AND FITTINGS

21 A. Steel Pipe: ASTM A 53/A 53M, black steel, Schedule 40, Type E or S, Grade B.

- 22 1. Malleable-Iron Threaded Fittings: ASME B16.3, Class 150, standard pattern.
23 2. Wrought-Steel Welding Fittings: ASTM A 234/A 234M for butt welding and socket
24 welding.
25 3. Unions: ASME B16.39, Class 150, malleable iron with brass-to-iron seat, ground joint,
26 and threaded ends.
27 4. Forged-Steel Flanges and Flanged Fittings: ASME B16.5, minimum Class 150, including
28 bolts, nuts, and gaskets of the following material group, end connections, and facings:

- 29 a. Material Group: 1.1.
30 b. End Connections: Threaded or butt welding to match pipe.

- 1 c. Lapped Face: Not permitted underground.
- 2 d. Gasket Materials: ASME B16.20, metallic, flat, asbestos free, aluminum o-rings,
3 and spiral-wound metal gaskets.
- 4 e. Bolts and Nuts: ASME B18.2.1, carbon steel aboveground and stainless steel
5 underground.
- 6 5. Mechanical Couplings:
 - 7 a. Manufacturers: Subject to compliance with requirements, provide products by
8 one of the following:
 - 9 1) Dresser Piping Specialties; Division of Dresser, Inc.
 - 10 2) Smith-Blair, Inc.
 - 11 b. Stainless-steel flanges and tube with epoxy finish.
 - 12 c. Buna-nitrile seals.
 - 13 d. Stainless-steel bolts, washers, and nuts.
- 14 B. Annealed-Temper Copper Tube: Comply with ASTM B 88, Type K.
 - 15 1. Copper Fittings: ASME B16.22, wrought copper, and streamlined pattern.
- 16 2.2 PIPING SPECIALTIES
 - 17 A. Appliance Flexible Connectors:
 - 18 1. Indoor, Fixed-Appliance Flexible Connectors: Comply with ANSI Z21.24.
 - 19 2. Indoor, Movable-Appliance Flexible Connectors: Comply with ANSI Z21.69.
 - 20 3. Outdoor, Appliance Flexible Connectors: Comply with ANSI Z21.75.
 - 21 4. Operating-Pressure Rating: 0.5 psig.
 - 22 5. End Fittings: Zinc-coated steel.
 - 23 6. Threaded Ends: Comply with ASME B1.20.1.
 - 24 7. Maximum Length: 72 inches
 - 25 B. Quick-Disconnect Devices: Comply with ANSI Z21.41.
 - 26 1. Copper-alloy convenience outlet and matching plug connector.
 - 27 2. Nitrile seals.
 - 28 3. Hand operated with automatic shutoff when disconnected.
 - 29 4. For indoor or outdoor applications.
 - 30 5. Adjustable, retractable restraining cable.
 - 31 C. Weatherproof Vent Cap: Cast- or malleable-iron increaser fitting with corrosion-resistant wire
32 screen, with free area at least equal to cross-sectional area of connecting pipe and threaded-
33 end connection.

- 1 2.3 JOINING MATERIALS
- 2 A. Joint Compound and Tape: Suitable for natural gas.
- 3 B. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate
4 for wall thickness and chemical analysis of steel pipe being welded.
- 5 C. Brazing Filler Metals: Alloy with melting point greater than 1000 deg F complying with
6 AWS A5.8/A5.8M. Brazing alloys containing more than 0.05 percent phosphorus are
7 prohibited.
- 8
- 9 2.4 MANUAL GAS SHUTOFF VALVES
- 10 A. General Requirements for Metallic Valves, NPS 2 and Smaller: Comply with ASME B16.33.
- 11 1. CWP Rating: 125 psig.
- 12 2. Threaded Ends: Comply with ASME B1.20.1.
- 13 3. Dryseal Threads on Flare Ends: Comply with ASME B1.20.3.
- 14 4. Tamperproof Feature: Locking feature for valves indicated in "Underground Manual Gas
15 Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule"
16 Articles.
- 17 5. Listing: Listed and labeled by an NRTL acceptable to authorities having jurisdiction for
18 valves 1 inch and smaller.
- 19 6. Service Mark: Valves 1-1/4 inches to NPS 2 shall have initials "WOG" permanently
20 marked on valve body.
- 21 B. General Requirements for Metallic Valves, NPS 2-1/2 and Larger: Comply with ASME B16.38.
- 22 1. CWP Rating: 125 psig.
- 23 2. Flanged Ends: Comply with ASME B16.5 for steel flanges.
- 24 3. Tamperproof Feature: Locking feature for valves indicated in "Underground Manual Gas
25 Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule"
26 Articles.
- 27 4. Service Mark: Initials "WOG" shall be permanently marked on valve body.
- 28 C. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim: MSS SP-110.
- 29 1. Manufacturers: Subject to compliance with requirements, provide products by one of
30 the following:
- 31 a. Conbraco Industries, Inc.; Apollo Div.
- 32 2. Body: Bronze, complying with ASTM B 584.

- 1 3. Ball: Chrome-plated bronze.
- 2 4. Stem: Bronze; blowout proof.
- 3 5. Seats: Reinforced TFE; blowout proof.
- 4 6. Packing: Threaded-body packnut design with adjustable-stem packing.
- 5 7. Ends: Threaded, flared, or socket as indicated in "Underground Manual Gas Shutoff
- 6 Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
- 7 8. CWP Rating: 600 psig.
- 8 9. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to
- 9 authorities having jurisdiction.
- 10 10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

- 11 D. Cast-Iron, Nonlubricated Plug Valves: MSS SP-78.

- 12 1. Manufacturers: Subject to compliance with requirements, provide products by one of
- 13 the following:
 - 14 a. McDonald, A. Y. Mfg. Co.
 - 15 b. Mueller Co.; Gas Products Div.
 - 16 c. Xomox Corporation; a Crane company.

- 17 2. Body: Cast iron, complying with ASTM A 126, Class B.
- 18 3. Plug: Bronze or nickel-plated cast iron.
- 19 4. Seat: Coated with thermoplastic.
- 20 5. Stem Seal: Compatible with natural gas.
- 21 6. Ends: Threaded or flanged as indicated in "Underground Manual Gas Shutoff Valve
- 22 Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
- 23 7. Operator: Square head or lug type with tamperproof feature where indicated.
- 24 8. Pressure Class: 125 psig.
- 25 9. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to
- 26 authorities having jurisdiction.
- 27 10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

- 28 2.5 PRESSURE REGULATORS

- 29 A. General Requirements:
 - 30 1. Single stage and suitable for natural gas.
 - 31 2. Steel jacket and corrosion-resistant components.
 - 32 3. Elevation compensator.
 - 33 4. End Connections: Threaded for regulators NPS 2 and smaller; flanged for regulators
 - 34 NPS 2-1/2 and larger.

- 35 B. Line Pressure Regulators: Comply with ANSI Z21.80.

- 1 1. Manufacturers: Subject to compliance with requirements, provide products by one of
2 the following:
 - 3 a. Actaris.
 - 4 b. American Meter Company.
 - 5 c. Eclipse Combustion, Inc.
 - 6 d. Fisher Control Valves and Regulators; Division of Emerson Process Management.
 - 7 e. Invensys.
 - 8 f. Maxitrol Company.
 - 9 g. Richards Industries; Jordan Valve Div.

- 10 2. Body and Diaphragm Case: Cast iron or die-cast aluminum.
- 11 3. Springs: Zinc-plated steel; interchangeable.
- 12 4. Diaphragm Plate: Zinc-plated steel.
- 13 5. Seat Disc: Nitrile rubber resistant to gas impurities, abrasion, and deformation at the
14 valve port.
- 15 6. Orifice: Aluminum; interchangeable.
- 16 7. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.
- 17 8. Single-port, self-contained regulator with orifice no larger than required at maximum
18 pressure inlet, and no pressure sensing piping external to the regulator.
- 19 9. Pressure regulator shall maintain discharge pressure setting downstream, and not
20 exceed 150 percent of design discharge pressure at shutoff.
- 21 10. Overpressure Protection Device: Factory mounted on pressure regulator.
- 22 11. Atmospheric Vent: Factory- or field-installed, stainless-steel screen in opening if not
23 connected to vent piping.
- 24 12. Maximum Inlet Pressure: 5 psig.

- 25 C. Appliance Pressure Regulators: Comply with ANSI Z21.18.
 - 26 1. Manufacturers: Subject to compliance with requirements, provide products by one of
27 the following:
 - 28 a. Canadian Meter Company Inc.
 - 29 b. Eaton Corporation; Controls Div.
 - 30 c. Harper Wyman Co.
 - 31 d. Maxitrol Company.
 - 32 e. SCP, Inc.

 - 33 2. Body and Diaphragm Case: Die-cast aluminum.
 - 34 3. Springs: Zinc-plated steel; interchangeable.
 - 35 4. Diaphragm Plate: Zinc-plated steel.
 - 36 5. Seat Disc: Nitrile rubber.
 - 37 6. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.
 - 38 7. Factory-Applied Finish: Minimum three-layer polyester and polyurethane paint finish.

- 1 8. Regulator may include vent limiting device, instead of vent connection, if approved by
2 authorities having jurisdiction.
- 3 9. Maximum Inlet Pressure: 5 psig.
- 4 2.6 DIELECTRIC FITTINGS
- 5 A. General Requirements: Assembly of copper alloy and ferrous materials with separating
6 nonconductive insulating material. Include end connections compatible with pipes to be
7 joined.
- 8 B. Dielectric Unions:
- 9 1. Manufacturers: Subject to compliance with requirements, provide products by one of
10 the following:
- 11 a. Capitol Manufacturing Company.
12 b. Central Plastics Company.
13 c. Hart Industries International, Inc.
14 d. Jomar International Ltd.
15 e. Matco-Norca, Inc.
16 f. McDonald, A. Y. Mfg. Co.
17 g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
18 h. Wilkins; a Zurn company.
- 19 2. Description:
- 20 a. Standard: ASSE 1079.
21 b. Pressure Rating: 150 psig.
22 c. End Connections: Solder-joint copper alloy and threaded ferrous.
- 23 C. Dielectric Flanges:
- 24 1. Manufacturers: Subject to compliance with requirements, provide products by one of
25 the following:
- 26 a. Capitol Manufacturing Company.
27 b. Central Plastics Company.
28 c. Matco-Norca, Inc.
29 d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
30 e. Wilkins; a Zurn company.
- 31 2. Description:
- 32 a. Standard: ASSE 1079.
33 b. Factory-fabricated, bolted, companion-flange assembly.

- 1 c. Pressure Rating: 150 psig.
2 d. End Connections: Solder-joint copper alloy and threaded ferrous; threaded
3 solder-joint copper alloy and threaded ferrous.
- 4 D. Dielectric-Flange Insulating Kits:
- 5 1. Manufacturers: Subject to compliance with requirements, provide products by one of
6 the following:
- 7 a. Advance Products & Systems, Inc.
8 b. Calpico, Inc.
9 c. Central Plastics Company.
10 d. Pipeline Seal and Insulator, Inc.
- 11 2. Description:
- 12 a. Nonconducting materials for field assembly of companion flanges.
13 b. Pressure Rating: 150 psig.
14 c. Gasket: Neoprene or phenolic.
15 d. Bolt Sleeves: Phenolic or polyethylene.
16 e. Washers: Phenolic with steel backing washers.

17 PART 3 - EXECUTION

18 3.1 EXAMINATION

- 19 A. Examine roughing-in for natural-gas piping system to verify actual locations of piping
20 connections before equipment installation.
- 21 B. Proceed with installation only after unsatisfactory conditions have been corrected.

22 3.2 PREPARATION

- 23 A. Close equipment shutoff valves before turning off natural gas to premises or piping section.
- 24 B. Inspect natural-gas piping according to the International Fuel Gas Code to determine that
25 natural-gas utilization devices are turned off in piping section affected.
- 26 C. Comply with the International Fuel Gas Code requirements for prevention of accidental
27 ignition.

- 1 3.3 OUTDOOR PIPING INSTALLATION
- 2 A. Comply with the International Fuel Gas Code for installation and purging of natural-gas piping.
- 3 3.4 INDOOR PIPING INSTALLATION
- 4 A. Comply with the International Fuel Gas Code for installation and purging of natural-gas piping.
- 5 B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping
6 systems. Indicated locations and arrangements are used to size pipe and calculate friction
7 loss, expansion, and other design considerations. Install piping as indicated unless deviations
8 to layout are approved on Coordination Drawings.
- 9 C. Arrange for pipe spaces, chases, slots, sleeves, and openings in building structure during
10 progress of construction, to allow for mechanical installations.
- 11 D. Install piping in concealed locations unless otherwise indicated and except in equipment
12 rooms and service areas.
- 13 E. Install piping indicated to be exposed and piping in equipment rooms and service areas at right
14 angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated
15 otherwise.
- 16 F. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- 17 G. Locate valves for easy access.
- 18 H. Install natural-gas piping at uniform grade of 2 percent down toward drip and sediment traps.
- 19 I. Install piping free of sags and bends.
- 20 J. Install fittings for changes in direction and branch connections.
- 21 K. Verify final equipment locations for roughing-in.
- 22 L. Comply with requirements in Sections specifying gas-fired appliances and equipment for
23 roughing-in requirements.
- 24 M. Drips and Sediment Traps: Install drips at points where condensate may collect, including
25 service-meter outlets. Locate where accessible to permit cleaning and emptying. Do not
26 install where condensate is subject to freezing.
- 27 1. Construct drips and sediment traps using tee fitting with bottom outlet plugged or
28 capped. Use nipple a minimum length of 3 pipe diameters, but not less than 3 inches

- 1 long and same size as connected pipe. Install with space below bottom of drip to
2 remove plug or cap.
- 3 N. Extend relief vent connections for service regulators, line regulators, and overpressure
4 protection devices to outdoors and terminate with weatherproof vent cap.
- 5 O. Conceal pipe installations in walls, pipe spaces, utility spaces, above ceilings, below grade or
6 floors, and in floor channels unless indicated to be exposed to view.
- 7 P. Concealed Location Installations: Except as specified below, install concealed natural-gas
8 piping and piping installed under the building in containment conduit constructed of steel pipe
9 with welded joints as described in Part 2. Install a vent pipe from containment conduit to
10 outdoors and terminate with weatherproof vent cap.
- 11 1. Above Accessible Ceilings: Natural-gas piping, fittings, valves, and regulators may be
12 installed in accessible spaces without containment conduit.
- 13 2. In Floors: Install natural-gas piping with welded or brazed joints and protective coating
14 in cast-in-place concrete floors. Cover piping to be cast in concrete slabs with minimum
15 of 1-1/2 inches of concrete. Piping may not be in physical contact with other metallic
16 structures such as reinforcing rods or electrically neutral conductors. Do not embed
17 piping in concrete slabs containing quick-set additives or cinder aggregate.
- 18 3. In Floor Channels: Install natural-gas piping in floor channels. Channels must have
19 cover and be open to space above cover for ventilation.
- 20 4. In Walls or Partitions: Protect tubing installed inside partitions or hollow walls from
21 physical damage using steel striker barriers at rigid supports.
- 22 a. Exception: Tubing passing through partitions or walls does not require striker
23 barriers.
- 24 5. Prohibited Locations:
- 25 a. Do not install natural-gas piping in or through circulating air ducts, clothes or
26 trash chutes, chimneys or gas vents (flues), ventilating ducts, or dumbwaiter or
27 elevator shafts.
- 28 b. Do not install natural-gas piping in solid walls or partitions.
- 29 Q. Use eccentric reducer fittings to make reductions in pipe sizes. Install fittings with level side
30 down.
- 31 R. Connect branch piping from top or side of horizontal piping.
- 32 S. Install unions in pipes NPS 2 and smaller, adjacent to each valve, at final connection to each
33 piece of equipment. Unions are not required at flanged connections.
- 34 T. Do not use natural-gas piping as grounding electrode.

- 1 U. Install sleeves for piping penetrations of walls, ceilings, and floors.
- 2 3.5 VALVE INSTALLATION
- 3 A. Install manual gas shutoff valve for each gas appliance ahead of corrugated stainless-steel
4 tubing, aluminum, or copper connector.
- 5 B. Install underground valves with valve boxes.
- 6 C. Install regulators and overpressure protection devices with maintenance access space
7 adequate for servicing and testing.
- 8 3.6 PIPING JOINT CONSTRUCTION
- 9 A. Piping 1-1/2 inches and smaller shall have threaded joints.
- 10 B. Piping 2 inches and larger shall have welded joints.
- 11 C. Ream ends of pipes and tubes and remove burrs.
- 12 D. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before
13 assembly.
- 14 E. Threaded Joints:
- 15 1. Thread pipe with tapered pipe threads complying with ASME B1.20.1.
16 2. Cut threads full and clean using sharp dies.
17 3. Ream threaded pipe ends to remove burrs and restore full inside diameter of pipe.
18 4. Apply appropriate tape or thread compound to external pipe threads unless dryseal
19 threading is specified.
20 5. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or
21 damaged. Do not use pipe sections that have cracked or open welds.
- 22 F. Welded Joints:
- 23 1. Construct joints according to AWS D10.12/D10.12M, using qualified processes and
24 welding operators.
25 2. Bevel plain ends of steel pipe.
26 3. Patch factory-applied protective coating as recommended by manufacturer at field
27 welds and where damage to coating occurs during construction.
- 28 G. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube"
29 Chapter.

- 1 H. Flanged Joints: Install gasket material, size, type, and thickness appropriate for natural-gas
2 service. Install gasket concentrically positioned.
- 3 I. Flared Joints: Cut tubing with roll cutting tool. Flare tube end with tool to result in flare
4 dimensions complying with SAE J513. Tighten finger tight, then use wrench. Do not
5 overtighten.
- 6 3.7 HANGER AND SUPPORT INSTALLATION
- 7 A. Comply with requirements for pipe hangers and supports specified in Section 230529 "Hangers
8 and Supports for HVAC Piping and Equipment."
- 9 B. Install hangers for horizontal steel piping with the following maximum spacing and minimum
10 rod sizes:
- 11 1. NPS 1 and Smaller: Maximum span, 96 inches; minimum rod size, 3/8 inch.
12 2. NPS 1-1/4: Maximum span, 108 inches; minimum rod size, 3/8 inch.
13 3. NPS 1-1/2 and NPS 2: Maximum span, 108 inches; minimum rod size, 3/8 inch.
14 4. NPS 2-1/2 to NPS 3-1/2: Maximum span, 10 feet; minimum rod size, 1/2 inch.
15 5. NPS 4 and Larger: Maximum span, 10 feet; minimum rod size, 5/8 inch.
- 16 C. Install hangers for horizontal drawn-temper copper tubing with the following maximum
17 spacing and minimum rod sizes:
- 18 1. NPS 3/8: Maximum span, 48 inches; minimum rod size, 3/8 inch.
19 2. NPS 1/2 and NPS 5/8: Maximum span, 72 inches; minimum rod size, 3/8 inch.
20 3. NPS 3/4 and NPS 7/8: Maximum span, 84 inches; minimum rod size, 3/8 inch.
21 4. NPS 1: Maximum span, 96 inches; minimum rod size, 3/8 inch.
- 22 3.8 CONNECTIONS
- 23 A. Connect to utility's gas main according to utility's procedures and requirements.
- 24 B. Install natural-gas piping electrically continuous, and bonded to gas appliance equipment
25 grounding conductor of the circuit powering the appliance according to NFPA 70.
- 26 C. Install piping adjacent to appliances to allow service and maintenance of appliances.
- 27 D. Connect piping to appliances using manual gas shutoff valves and unions. Install valve within
28 72 inches of each gas-fired appliance and equipment. Install union between valve and
29 appliances or equipment.
- 30 E. Sediment Traps: Install tee fitting with capped nipple in bottom to form drip, as close as
31 practical to inlet of each appliance.

- 1 3.9 LABELING AND IDENTIFYING
- 2 A. Comply with requirements in Section 230553 "Identification for HVAC Piping and Equipment"
3 for piping and valve identification.
- 4 3.10 PAINTING
- 5 A. Comply with requirements in Section 099113 "Exterior Painting" and Section 099123 "Interior
6 Painting" for painting interior and exterior natural-gas piping.
- 7 B. Paint exposed, exterior metal piping, valves, service regulators, and piping specialties, except
8 components, with factory-applied paint or protective coating.
- 9 1. Alkyd System: MPI EXT 5.1D.
- 10 a. Prime Coat: Alkyd anticorrosive metal primer.
- 11 b. Intermediate Coat: Exterior alkyd enamel matching topcoat.
- 12 c. Topcoat: Exterior alkyd enamel (flat).
- 13 d. Color: Gray.
- 14 C. Damage and Touchup: Repair marred and damaged factory-applied finishes with materials
15 and by procedures to match original factory finish.
- 16 3.11 FIELD QUALITY CONTROL
- 17 A. Perform tests and inspections.
- 18 B. Tests and Inspections:
- 19 1. Test, inspect, and purge natural gas according to the International Fuel Gas Code and
20 authorities having jurisdiction.
- 21 C. Natural-gas piping will be considered defective if it does not pass tests and inspections.
- 22 D. Prepare test and inspection reports.
- 23 3.12 OUTDOOR PIPING SCHEDULE
- 24 A. Aboveground natural-gas pipings shall be one of the following:
- 25 1. Steel pipe with malleable-iron fittings and threaded joints.
- 26 2. Steel pipe with wrought-steel fittings and welded joints.
- 27 3. Drawn-temper copper tube with wrought-copper fittings and brazed joints.

- 1 3.13 INDOOR PIPING SCHEDULE FOR SYSTEM PRESSURES LESS THAN 0.5 PSIG
- 2 A. Aboveground, branch piping NPS 1 and smaller shall be one of the following:
- 3 1. Annealed-temper, tin-lined copper tube with flared joints and fittings.
- 4 2. Annealed-temper, copper tube with wrought-copper fittings and brazed flared joints.
- 5 3. Steel pipe with malleable-iron fittings and threaded joints.
- 6 B. Aboveground, distribution piping shall be one of the following:
- 7 1. Steel pipe with malleable-iron fittings and threaded joints.
- 8 2. Steel pipe with wrought-steel fittings and welded joints.
- 9 C. Underground, below building, piping shall be one of the following:
- 10 1. Steel pipe with malleable-iron fittings and threaded joints.
- 11 2. Steel pipe with wrought-steel fittings and welded joints.
- 12 D. Containment Conduit: Steel pipe with wrought-steel fittings and welded joints. Coat pipe and
- 13 fittings with protective coating for steel piping.
- 14 E. Containment Conduit Vent Piping: Steel pipe with malleable-iron fittings and threaded or
- 15 wrought-steel fittings with welded joints. Coat underground pipe and fittings with protective
- 16 coating for steel piping.
- 17 3.14 INDOOR PIPING SCHEDULE FOR SYSTEM PRESSURES MORE THAN 0.5 PSIG AND LESS THAN 5
- 18 PSIG
- 19 A. Aboveground, branch piping NPS 1 and smaller shall be the following:
- 20 1. Steel pipe with malleable-iron fittings and threaded joints.
- 21 B. Aboveground, distribution piping shall be one of the following:
- 22 1. Steel pipe with malleable-iron fittings and threaded joints.
- 23 2. Steel pipe with steel welding fittings and welded joints.
- 24 C. Underground, below building, piping shall be one of the following:
- 25 1. Steel pipe with malleable-iron fittings and threaded joints.
- 26 2. Steel pipe with wrought-steel fittings and welded joints.
- 27 D. Containment Conduit: Steel pipe with wrought-steel fittings and welded joints. Coat
- 28 underground pipe and fittings with protective coating for steel piping.

1 E. Containment Conduit Vent Piping: Steel pipe with malleable-iron fittings and threaded or
2 wrought-steel fittings with welded joints. Coat underground pipe and fittings with protective
3 coating for steel piping.

4 3.15 ABOVEGROUND MANUAL GAS SHUTOFF VALVE SCHEDULE

5 A. Valves for pipe sizes NPS 2 and smaller at service meter shall be the following:

6 1. Two-piece, full-port, bronze ball valves with bronze trim.

7

8 B. Valves for pipe sizes NPS 2-1/2 and larger at service meter shall be one of the following:

9 1. Two-piece, full-port, bronze ball valves with bronze trim.

10 2. Cast-iron, nonlubricated plug valve.

11 C. Distribution piping valves for pipe sizes NPS 2 and smaller shall be the following:

12 1. Two-piece, full-port, bronze ball valves with bronze trim.

13 D. Distribution piping valves for pipe sizes NPS 2-1/2 and larger shall be one of the following:

14 1. Two-piece, full-port, bronze ball valves with bronze trim.

15 2. Cast-iron, nonlubricated plug valve.

16 E. Valves in branch piping for single appliance shall be one of the following:

17 1. Two-piece, full-port, bronze ball valves with bronze trim.

18 2. Bronze plug valve.

19 END OF SECTION 231123

1 SECTION 232300 - REFRIGERANT PIPING

2 PART 1 - GENERAL

3 1.1 RELATED DOCUMENTS

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

6 1.2 SUMMARY

- 7 A. This Section includes refrigerant piping used for air-conditioning applications.

8 1.3 PERFORMANCE REQUIREMENTS

- 9 A. Line Test Pressure for Refrigerant R-134a:

- 10 1. Suction Lines for Air-Conditioning Applications: 115 psig.
11 2. Suction Lines for Heat-Pump Applications: 225 psig.
12 3. Hot-Gas and Liquid Lines: 225 psig.

- 13 B. Line Test Pressure for Refrigerant R-407C:

- 14 1. Suction Lines for Air-Conditioning Applications: 230 psig.
15 2. Suction Lines for Heat-Pump Applications: 380 psig.
16 3. Hot-Gas and Liquid Lines: 380 psig.

- 17 C. Line Test Pressure for Refrigerant R-410A:

- 18 1. Suction Lines for Air-Conditioning Applications: 300 psig.
19 2. Suction Lines for Heat-Pump Applications: 535 psig.
20 3. Hot-Gas and Liquid Lines: 535 psig.

21 1.4 ACTION SUBMITTALS

- 22 A. Product Data: For each type of valve and refrigerant piping specialty indicated. Include
23 pressure drop, based on manufacturer's test data, for the following:

- 24 1. Thermostatic expansion valves.

- 1 2. Solenoid valves.
- 2 3. Hot-gas bypass valves.
- 3 4. Filter dryers.
- 4 5. Strainers.
- 5 6. Pressure-regulating valves.

- 6 B. Shop Drawings: Show layout of refrigerant piping and specialties, including pipe, tube, and
7 fitting sizes, flow capacities, valve arrangements and locations, slopes of horizontal runs, oil
8 traps, double risers, wall and floor penetrations, and equipment connection details. Show
9 interface and spatial relationships between piping and equipment.
 - 10 1. Refrigerant piping indicated on Drawings is schematic only. Size piping and design
11 actual piping layout, including oil traps, double risers, specialties, and pipe and tube
12 sizes to accommodate, as a minimum, equipment provided, elevation difference
13 between compressor and evaporator, and length of piping to ensure proper operation
14 and compliance with warranties of connected equipment.

- 15 1.5 INFORMATIONAL SUBMITTALS
 - 16 A. Welding certificates.
 - 17 B. Field quality-control test reports.

- 18 1.6 CLOSEOUT SUBMITTALS
 - 19 A. Operation and Maintenance Data: For refrigerant valves and piping specialties to include in
20 maintenance manuals.

- 21 1.7 QUALITY ASSURANCE
 - 22 A. Welding: Qualify procedures and personnel according to ASME Boiler and Pressure Vessel
23 Code: Section IX, "Welding and Brazing Qualifications."
 - 24 B. Comply with ASHRAE 15, "Safety Code for Refrigeration Systems."
 - 25 C. Comply with ASME B31.5, "Refrigeration Piping and Heat Transfer Components."

- 26 1.8 PRODUCT STORAGE AND HANDLING
 - 27 A. Store piping in a clean and protected area with end caps in place to ensure that piping interior
28 and exterior are clean when installed.

1 1.9 COORDINATION

- 2 A. Coordinate size and location of roof curbs, equipment supports, and roof penetrations.

3 PART 2 - PRODUCTS

4 2.1 COPPER TUBE AND FITTINGS

- 5 A. Copper Tube: ASTM B 280, Type ACR.

- 6 B. Wrought-Copper Fittings: ASME B16.22.

- 7 C. Wrought-Copper Unions: ASME B16.22.

- 8 D. Solder Filler Metals: ASTM B 32. Use 95-5 tin antimony or alloy HB solder to join copper
9 socket fittings on copper pipe.

- 10 E. Brazing Filler Metals: AWS A5.8.

- 11 F. Flexible Connectors:

- 12 1. Body: Tin-bronze bellows with woven, flexible, tinned-bronze-wire-reinforced
13 protective jacket.
14 2. End Connections: Socket ends.
15 3. Offset Performance: Capable of minimum 3/4-inch misalignment in minimum 7-inch-
16 long assembly.
17 4. Pressure Rating: Factory test at minimum 500 psig.
18 5. Maximum Operating Temperature: 250 deg F.

19 2.2 VALVES AND SPECIALTIES

- 20 A. Diaphragm Packless Valves:

- 21 1. Body and Bonnet: Forged brass or cast bronze; globe design with straight-through or
22 angle pattern.
23 2. Diaphragm: Phosphor bronze and stainless steel with stainless-steel spring.
24 3. Operator: Rising stem and hand wheel.
25 4. Seat: Nylon.
26 5. End Connections: Socket, union, or flanged.
27 6. Working Pressure Rating: 500 psig.
28 7. Maximum Operating Temperature: 275 deg F.

- 1 B. Packed-Angle Valves:
- 2 1. Body and Bonnet: Forged brass or cast bronze.
- 3 2. Packing: Molded stem, back seating, and replaceable under pressure.
- 4 3. Operator: Rising stem.
- 5 4. Seat: Nonrotating, self-aligning polytetrafluoroethylene.
- 6 5. Seal Cap: Forged-brass or valox hex cap.
- 7 6. End Connections: Socket, union, threaded, or flanged.
- 8 7. Working Pressure Rating: 500 psig.
- 9 8. Maximum Operating Temperature: 275 deg F.
- 10 C. Check Valves:
- 11 1. Body: Ductile iron, forged brass, or cast bronze; globe pattern.
- 12 2. Bonnet: Bolted ductile iron, forged brass, or cast bronze; or brass hex plug.
- 13 3. Piston: Removable polytetrafluoroethylene seat.
- 14 4. Closing Spring: Stainless steel.
- 15 5. Manual Opening Stem: Seal cap, plated-steel stem, and graphite seal.
- 16 6. End Connections: Socket, union, threaded, or flanged.
- 17 7. Maximum Opening Pressure: 0.50 psig.
- 18 8. Working Pressure Rating: 500 psig.
- 19 9. Maximum Operating Temperature: 275 deg F.
- 20 D. Service Valves:
- 21 1. Body: Forged brass with brass cap including key end to remove core.
- 22 2. Core: Removable ball-type check valve with stainless-steel spring.
- 23 3. Seat: Polytetrafluoroethylene.
- 24 4. End Connections: Copper spring.
- 25 5. Working Pressure Rating: 500 psig.
- 26 E. Safety Relief Valves: Comply with ASME Boiler and Pressure Vessel Code; listed and labeled by
27 an NRTL.
- 28 1. Body and Bonnet: Ductile iron and steel, with neoprene O-ring seal.
- 29 2. Piston, Closing Spring, and Seat Insert: Stainless steel.
- 30 3. Seat Disc: Polytetrafluoroethylene.
- 31 4. End Connections: Threaded.
- 32 5. Working Pressure Rating: 400 psig.
- 33 6. Maximum Operating Temperature: 240 deg F.
- 34 F. Thermostatic Expansion Valves: Comply with ARI 750.
- 35 1. Body, Bonnet, and Seal Cap: Forged brass or steel.

- 1 2. Diaphragm, Piston, Closing Spring, and Seat Insert: Stainless steel.
- 2 3. Packing and Gaskets: Non-asbestos.
- 3 4. Capillary and Bulb: Copper tubing filled with refrigerant charge.
- 4 5. Suction Temperature: 40 deg F.
- 5 6. Superheat: Adjustable.
- 6 7. Reverse-flow option (for heat-pump applications).
- 7 8. End Connections: Socket, flare, or threaded union.
- 8 9. Working Pressure Rating: 700 psig.

- 9 G. Hot-Gas Bypass Valves: Comply with UL 429; listed and labeled by an NRTL.

- 10 1. Body, Bonnet, and Seal Cap: Ductile iron or steel.
- 11 2. Diaphragm, Piston, Closing Spring, and Seat Insert: Stainless steel.
- 12 3. Packing and Gaskets: Non-asbestos.
- 13 4. Solenoid Tube, Plunger, Closing Spring, and Seat Orifice: Stainless steel.
- 14 5. Seat: Polytetrafluoroethylene.
- 15 6. Equalizer: Internal or External.
- 16 7. Electrical: Molded, watertight coil in NEMA 250 enclosure of type required by location
17 with 1/2-inch conduit adapter, and 24-V ac coil.
- 18 8. End Connections: Socket.
- 19 9. Throttling Range: Maximum 5 psig.
- 20 10. Working Pressure Rating: 500 psig.
- 21 11. Maximum Operating Temperature: 240 deg F.

- 22 H. Straight-Type Strainers:

- 23 1. Body: Welded steel with corrosion-resistant coating.
- 24 2. Screen: 100-mesh stainless steel.
- 25 3. End Connections: Socket or flare.
- 26 4. Working Pressure Rating: 500 psig.
- 27 5. Maximum Operating Temperature: 275 deg F.

- 28 I. Angle-Type Strainers:

- 29 1. Body: Forged brass or cast bronze.
- 30 2. Drain Plug: Brass hex plug.
- 31 3. Screen: 100-mesh monel.
- 32 4. End Connections: Socket or flare.
- 33 5. Working Pressure Rating: 500 psig.
- 34 6. Maximum Operating Temperature: 275 deg F.

- 35 J. Moisture/Liquid Indicators:

- 36 1. Body: Forged brass.

- 1 2. Window: Replaceable, clear, fused glass window with indicating element protected by
- 2 filter screen.
- 3 3. Indicator: Color coded to show moisture content in ppm.
- 4 4. Minimum Moisture Indicator Sensitivity: Indicate moisture above 60 ppm.
- 5 5. End Connections: Socket or flare.
- 6 6. Working Pressure Rating: 500 psig.
- 7 7. Maximum Operating Temperature: 240 deg F.

- 8 K. Replaceable-Core Filter Dryers: Comply with ARI 730.

- 9 1. Body and Cover: Painted-steel shell with ductile-iron cover, stainless-steel screws, and
- 10 neoprene gaskets.
- 11 2. Filter Media: 10 micron, pleated with integral end rings; stainless-steel support.
- 12 3. Desiccant Media: Activated alumina or charcoal.
- 13 4. Designed for reverse flow (for heat-pump applications).
- 14 5. End Connections: Socket.
- 15 6. Access Ports: NPS 1/4 connections at entering and leaving sides for pressure differential
- 16 measurement.
- 17 7. Maximum Pressure Loss: 2 psig.
- 18 8. Working Pressure Rating: 500 psig.
- 19 9. Maximum Operating Temperature: 240 deg F.
- 20

- 21 L. Permanent Filter Dryers: Comply with ARI 730.

- 22 1. Body and Cover: Painted-steel shell.
- 23 2. Filter Media: 10 micron, pleated with integral end rings; stainless-steel support.
- 24 3. Desiccant Media: Activated alumina or charcoal.
- 25 4. Designed for reverse flow (for heat-pump applications).
- 26 5. End Connections: Socket.
- 27 6. Access Ports: NPS 1/4 connections at entering and leaving sides for pressure differential
- 28 measurement.
- 29 7. Maximum Pressure Loss: 2 psig.
- 30 8. Working Pressure Rating: 500 psig.
- 31 9. Maximum Operating Temperature: 240 deg F.

- 32 M. Mufflers:

- 33 1. Body: Welded steel with corrosion-resistant coating.
- 34 2. End Connections: Socket or flare.
- 35 3. Working Pressure Rating: 500 psig.
- 36 4. Maximum Operating Temperature: 275 deg F.

- 37 N. Receivers: Comply with ARI 495.

- 1 1. Comply with ASME Boiler and Pressure Vessel Code; listed and labeled by an NRTL.
- 2 2. Comply with UL 207; listed and labeled by an NRTL.
- 3 3. Body: Welded steel with corrosion-resistant coating.
- 4 4. Tappings: Inlet, outlet, liquid level indicator, and safety relief valve.
- 5 5. End Connections: Socket or threaded.
- 6 6. Working Pressure Rating: 500 psig.
- 7 7. Maximum Operating Temperature: 275 deg F.

8 O. Liquid Accumulators: Comply with ARI 495.

- 9 1. Body: Welded steel with corrosion-resistant coating.
- 10 2. End Connections: Socket or threaded.
- 11 3. Working Pressure Rating: 500 psig.
- 12 4. Maximum Operating Temperature: 275 deg F.

13 2.3 REFRIGERANTS

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

- 16 1. Atofina Chemicals, Inc.
- 17 2. DuPont Company; Fluorochemicals Div.
- 18 3. Honeywell, Inc.; Genetron Refrigerants.
- 19 4. INEOS Fluor Americas LLC.

20 B. ASHRAE 34, R-22: Monochlorodifluoromethane.

21 C. ASHRAE 34, R-134a: Tetrafluoroethane.

22 D. ASHRAE 34, R-407C: Difluoromethane/Pentafluoroethane/1,1,1,2-Tetrafluoroethane.

23 E. ASHRAE 34, R-410A: Pentafluoroethane/Difluoromethane.

24 PART 3 - EXECUTION

25 3.1 PIPING APPLICATIONS FOR REFRIGERANT R-134a

26 A. Suction Lines NPS 1-1/2 and Smaller for Conventional Air-Conditioning Applications: Copper,
27 Type ACR, annealed-temper tubing and wrought-copper fittings with brazed or soldered joints.

28 B. Suction Lines NPS 2 to NPS 4 for Conventional Air-Conditioning Applications: Copper, Type
29 ACR, drawn-temper tubing and wrought-copper fittings with brazed or soldered joints.

- 1 C. Hot-Gas and Liquid Lines, Copper, Type ACR, annealed-temper tubing and wrought-copper
2 fittings with brazed or soldered joints.
- 3 D. Safety-Relief-Valve Discharge Piping: Copper, Type ACR, drawn-temper tubing and wrought-
4 copper fittings with soldered joints.
- 5 3.2 PIPING APPLICATIONS FOR REFRIGERANT R-407C
- 6 A. Suction Lines NPS 1-1/2 and Smaller for Conventional Air-Conditioning Applications: Copper,
7 Type ACR, annealed-temper tubing and wrought-copper fittings with brazed or soldered joints.
- 8 B. Hot-Gas and Liquid Lines, Copper, Type ACR, annealed-temper tubing and wrought-copper
9 fittings with brazed or soldered joints.
- 10 C. Safety-Relief-Valve Discharge Piping: Copper, Type ACR, drawn-temper tubing and wrought-
11 copper fittings with soldered joints.
- 12 3.3 PIPING APPLICATIONS FOR REFRIGERANT R-410A
- 13 A. Suction Lines NPS 1-1/2 and Smaller for Conventional Air-Conditioning Applications: Copper,
14 Type ACR, annealed-temper tubing and wrought-copper fittings with brazed or soldered joints.
- 15 B. Suction Lines NPS 2 to NPS 3-1/2 for Conventional Air-Conditioning Applications: Copper, Type
16 ACR, drawn-temper tubing and wrought-copper fittings with brazed or soldered joints.
- 17 C. Hot-Gas and Liquid Lines: Copper, Type ACR, annealed- or drawn-temper tubing and wrought-
18 copper fittings with brazed or soldered joints.
- 19 D. Safety-Relief-Valve Discharge Piping: Copper, Type ACR, annealed- or drawn-temper tubing
20 and wrought-copper fittings with brazed or soldered joints.
- 21 3.4 VALVE AND SPECIALTY APPLICATIONS
- 22 A. Install diaphragm packless or packed-angle valves in suction and discharge lines of compressor.
- 23 B. Install service valves for gage taps at inlet and outlet of hot-gas bypass valves and strainers if
24 they are not an integral part of valves and strainers.
- 25 C. Install a check valve at the compressor discharge and a liquid accumulator at the compressor
26 suction connection.

- 1 D. Except as otherwise indicated, install diaphragm packless or packed-angle valves on inlet and
2 outlet side of filter dryers.
- 3 E. Install a full-sized, three-valve bypass around filter dryers.
- 4 F. Install solenoid valves upstream from each expansion valve and hot-gas bypass valve. Install
5 solenoid valves in horizontal lines with coil at top.
- 6 G. Install thermostatic expansion valves as close as possible to distributors on evaporators.
- 7 1. Install valve so diaphragm case is warmer than bulb.
8 2. Secure bulb to clean, straight, horizontal section of suction line using two bulb straps.
9 Do not mount bulb in a trap or at bottom of the line.
10 3. If external equalizer lines are required, make connection where it will reflect suction-line
11 pressure at bulb location.
- 12 H. Install safety relief valves where required by ASME Boiler and Pressure Vessel Code. Pipe
13 safety-relief-valve discharge line to outside according to ASHRAE 15.
- 14 I. Install moisture/liquid indicators in liquid line at the inlet of the thermostatic expansion valve
15 or at the inlet of the evaporator coil capillary tube.
- 16 J. Install strainers upstream from and adjacent to the following unless they are furnished as an
17 integral assembly for device being protected:
- 18 1. Solenoid valves.
19 2. Thermostatic expansion valves.
20 3. Hot-gas bypass valves.
21 4. Compressor.
- 22 K. Install filter dryers in liquid line between compressor and thermostatic expansion valve.
- 23 L. Install receivers sized to accommodate pump-down charge.
- 24 M. Install flexible connectors at compressors.

25 3.5 PIPING INSTALLATION

- 26 A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping
27 systems; indicated locations and arrangements were used to size pipe and calculate friction
28 loss, expansion, pump sizing, and other design considerations. Install piping as indicated
29 unless deviations to layout are approved on Shop Drawings.
- 30 B. Install refrigerant piping according to ASHRAE 15.

- 1 C. Install piping in concealed locations unless otherwise indicated and except in equipment
2 rooms and service areas.
- 3 D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right
4 angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated
5 otherwise.
- 6 E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- 7 F. Install piping adjacent to machines to allow service and maintenance.
- 8 G. Install piping free of sags and bends.
- 9 H. Install fittings for changes in direction and branch connections.
- 10 I. Select system components with pressure rating equal to or greater than system operating
11 pressure.
- 12 J. Refer to Section 230900 "Instrumentation and Control for HVAC" and Section 230993
13 "Sequence of Operations for HVAC Controls" for solenoid valve controllers, control wiring, and
14 sequence of operation.
- 15 K. Install piping as short and direct as possible, with a minimum number of joints, elbows, and
16 fittings.
- 17 L. Arrange piping to allow inspection and service of refrigeration equipment. Install valves and
18 specialties in accessible locations to allow for service and inspection. Install access doors or
19 panels as specified in Section 083113 "Access Doors and Frames" if valves or equipment
20 requiring maintenance is concealed behind finished surfaces.
- 21 M. Install refrigerant piping in protective conduit where installed belowground.
- 22 N. Install refrigerant piping in rigid or flexible conduit in locations where exposed to mechanical
23 injury.
- 24 O. Slope refrigerant piping as follows:
- 25 1. Install horizontal hot-gas discharge piping with a uniform slope downward away from
26 compressor.
- 27 2. Install horizontal suction lines with a uniform slope downward to compressor.
- 28 3. Install traps and double risers to entrain oil in vertical runs.
- 29 4. Liquid lines may be installed level.

- 1 P. When brazing or soldering, remove solenoid-valve coils and sight glasses; also remove valve
2 stems, seats, and packing, and accessible internal parts of refrigerant specialties. Do not apply
3 heat near expansion-valve bulb.
- 4 Q. Install piping with adequate clearance between pipe and adjacent walls and hangers or
5 between pipes for insulation installation.
- 6 R. Identify refrigerant piping and valves according to Section 230553 "Identification for HVAC
7 Piping and Equipment."
- 8 S. Install sleeves for piping penetrations of walls, ceilings, and floors.
- 9 T. Install sleeve seals for piping penetrations of concrete walls and slabs.
- 10 U. Install escutcheons for piping penetrations of walls, ceilings, and floors.
- 11 3.6 PIPE JOINT CONSTRUCTION
- 12 A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- 13 B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before
14 assembly.
- 15 C. Fill pipe and fittings with an inert gas (nitrogen or carbon dioxide), during brazing or welding,
16 to prevent scale formation.
- 17 D. Soldered Joints: Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook."
- 18 E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," Chapter "Pipe and
19 Tube."
- 20 1. Use Type BcuP, copper-phosphorus alloy for joining copper socket fittings with copper
21 pipe.
- 22 2. Use Type BAg, cadmium-free silver alloy for joining copper with bronze or steel.
- 23 3.7 HANGERS AND SUPPORTS
- 24 A. Hanger, support, and anchor products are specified in Section 230529 "Hangers and Supports
25 for HVAC Piping and Equipment."
- 26 B. Install the following pipe attachments:
- 27 1. Adjustable steel clevis hangers for individual horizontal runs less than 20 feet long.

- 1 2. Roller hangers and spring hangers for individual horizontal runs 20 feet or longer.
- 2 3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet or longer,
- 3 supported on a trapeze.
- 4 4. Spring hangers to support vertical runs.
- 5 5. Copper-clad hangers and supports for hangers and supports in direct contact with
- 6 copper pipe.

- 7 C. Install hangers for copper tubing with the following maximum spacing and minimum rod sizes:

- 8 1. NPS 1/2: Maximum span, 60 inches; minimum rod size, 1/4 inch.
- 9 2. NPS 5/8: Maximum span, 60 inches; minimum rod size, 1/4 inch.
- 10 3. NPS 1: Maximum span, 72 inches; minimum rod size, 1/4 inch.
- 11 4. NPS 1-1/4: Maximum span, 96 inches; minimum rod size, 3/8 inch.
- 12 5. NPS 1-1/2: Maximum span, 96 inches; minimum rod size, 3/8 inch.
- 13 6. NPS 2: Maximum span, 96 inches; minimum rod size, 3/8 inch.
- 14 7. NPS 2-1/2: Maximum span, 108 inches; minimum rod size, 3/8 inch.

- 15 D. Support multifloor vertical runs at least at each floor.

- 16 3.8 FIELD QUALITY CONTROL

- 17 A. Perform tests and inspections and prepare test reports.

- 18 B. Tests and Inspections:

- 19 1. Comply with ASME B31.5, Chapter VI.
- 20 2. Test refrigerant piping, specialties, and receivers. Isolate compressor, condenser,
- 21 evaporator, and safety devices from test pressure if they are not rated above the test
- 22 pressure.
- 23 3. Test high- and low-pressure side piping of each system separately at not less than the
- 24 pressures indicated in Part 1 "Performance Requirements" Article.

- 25 a. Fill system with nitrogen to the required test pressure.
- 26 b. System shall maintain test pressure at the manifold gage throughout duration of
- 27 test.
- 28 c. Test joints and fittings with electronic leak detector or by brushing a small
- 29 amount of soap and glycerin solution over joints.
- 30 d. Remake leaking joints using new materials, and retest until satisfactory results are
- 31 achieved.

32 3.9 SYSTEM CHARGING

- 33 A. Charge system using the following procedures:

- 1 1. Install core in filter dryers after leak test but before evacuation.
- 2 2. Evacuate entire refrigerant system with a vacuum pump to 500 micrometers. If vacuum
- 3 holds for 12 hours, system is ready for charging.
- 4 3. Break vacuum with refrigerant gas, allowing pressure to build up to 2 psig.
- 5 4. Charge system with a new filter-dryer core in charging line.

6 3.10 ADJUSTING

- 7 A. Adjust thermostatic expansion valve to obtain proper evaporator superheat.
- 8 B. Adjust high- and low-pressure switch settings to avoid short cycling in response to fluctuating
- 9 suction pressure.
- 10 C. Adjust set-point temperature of air-conditioning or chilled-water controllers to the system
- 11 design temperature.
- 12 D. Perform the following adjustments before operating the refrigeration system, according to
- 13 manufacturer's written instructions:
 - 14 1. Open shutoff valves in condenser water circuit.
 - 15 2. Verify that compressor oil level is correct.
 - 16 3. Open compressor suction and discharge valves.
 - 17 4. Open refrigerant valves except bypass valves that are used for other purposes.
 - 18 5. Check open compressor-motor alignment and verify lubrication for motors and
 - 19 bearings.
- 20 E. Replace core of replaceable filter dryer after system has been adjusted and after design flow
- 21 rates and pressures are established.

22 END OF SECTION 232300

23

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1 SECTION 233113 - METAL DUCTS

2 PART 1 - GENERAL

3 1.1 RELATED DOCUMENTS

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

6 1.2 SUMMARY

- 7 A. Section Includes:

- 8 1. Single-wall rectangular ducts and fittings.
9 2. Single-wall round ducts and fittings.
10 3. Sheet metal materials.
11 4. Duct liner.
12 5. Sealants and gaskets.
13 6. Hangers and supports.

- 14 B. Related Sections:

- 15 1. Section 230593 "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and
16 balancing requirements for metal ducts.
17 2. Section 233300 "Air Duct Accessories" for dampers, sound-control devices, duct-
18 mounting access doors and panels, turning vanes, and flexible ducts.

19 1.3 ACTION SUBMITTALS

- 20 A. Product Data: For each type of the following products:

- 21 1. Liners and adhesives.
22 2. Sealants and gaskets.

- 23 B. Shop Drawings:

- 24 1. Fabrication, assembly, and installation, including plans, elevations, sections,
25 components, and attachments to other work.
26 2. Factory- and shop-fabricated ducts and fittings.
27 3. Fittings.

- 1 4. Reinforcement and spacing.
- 2 5. Seam and joint construction.
- 3 6. Penetrations through fire-rated and other partitions.
- 4 7. Equipment installation based on equipment being used on Project.
- 5 8. Locations for duct accessories, including dampers, turning vanes, and access doors and
- 6 panels.
- 7 9. Hangers and supports, including methods for duct and building attachment, and
- 8 vibration isolation.

9 1.4 INFORMATIONAL SUBMITTALS

- 10 A. Welding certificates.
- 11 B. Field quality-control reports.

12 1.5 QUALITY ASSURANCE

- 13 A. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 14 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.
 - 15 2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum," for aluminum supports.
 - 16 3. AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.
- 17 B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and
- 18 Equipment" and Section 7 - "Construction and System Start-up."

19 PART 2 - PRODUCTS

20 2.1 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS

- 21 A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction
- 22 Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise
- 23 indicated.
- 24 B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct
- 25 Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints,"
- 26 for static-pressure class, applicable sealing requirements, materials involved, duct-support
- 27 intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and
- 28 Flexible."

- 1 C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct
2 Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal
3 Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-
4 support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards -
5 Metal and Flexible."
- 6 D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types
7 and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and
8 Flexible," Chapter 4, "Fittings and Other Construction," for static-pressure class, applicable
9 sealing requirements, materials involved, duct-support intervals, and other provisions in
10 SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- 11 2.2 SINGLE-WALL ROUND DUCTS AND FITTINGS
- 12 A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction
13 Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on
14 indicated static-pressure class unless otherwise indicated.
- 15 B. Flat-Oval Ducts: Indicated dimensions are the duct width (major dimension) and diameter of
16 the round sides connecting the flat portions of the duct (minor dimension).
- 17 C. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct
18 Construction Standards - Metal and Flexible," Figure 3-1, "Round Duct Transverse Joints," for
19 static-pressure class, applicable sealing requirements, materials involved, duct-support
20 intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and
21 Flexible."
- 22 1. Transverse Joints in Ducts Larger Than 60 Inches in Diameter: Flanged.
- 23 D. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct
24 Construction Standards - Metal and Flexible," Figure 3-2, "Round Duct Longitudinal Seams," for
25 static-pressure class, applicable sealing requirements, materials involved, duct-support
26 intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and
27 Flexible."
- 28 1. Fabricate round ducts larger than 90 inches in diameter with butt-welded longitudinal
29 seams.
- 30 2. Fabricate flat-oval ducts larger than 72 inches in width (major dimension) with butt-
31 welded longitudinal seams.
- 32 E. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction
33 Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6,
34 "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved,

1 duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards
2 - Metal and Flexible."

3 2.3 SHEET METAL MATERIALS

4 A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards -
5 Metal and Flexible" for acceptable materials, material thicknesses, and duct construction
6 methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam
7 marks, roller marks, stains, discolorations, and other imperfections.

8 B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.

9 1. Galvanized Coating Designation: G60.

10 2. Finishes for Surfaces Exposed to View: Mill phosphatized.

11 C. Reinforcement Shapes and Plates: ASTM A 36/A 36M, steel plates, shapes, and bars; black and
12 galvanized.

13 1. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum
14 ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket
15 materials.

16 D. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch
17 minimum diameter for lengths longer than 36 inches.

18 2.4 DUCT LINER

19 A. Fibrous-Glass Duct Liner: Comply with ASTM C 1071, NFPA 90A, or NFPA 90B; and with
20 NAIMA AH124, "Fibrous Glass Duct Liner Standard."

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

23 a. CertainTeed Corporation; Insulation Group.

24 b. Johns Manville.

25 c. Knauf Insulation.

26 d. Owens Corning.

27 e. Maximum Thermal Conductivity:

28 1) Type I, Flexible: 0.27 Btu x in./h x sq. ft. x deg F at 75 deg F mean
29 temperature.

30 2) Type II, Rigid: 0.23 Btu x in./h x sq. ft. x deg F at 75 deg F mean
31 temperature.

- 1 2. Antimicrobial Erosion-Resistant Coating: Apply to the surface of the liner that will form
2 the interior surface of the duct to act as a moisture repellent and erosion-resistant
3 coating. Antimicrobial compound shall be tested for efficacy by an NRTL and registered
4 by the EPA for use in HVAC systems.
- 5 3. Water-Based Liner Adhesive: Comply with NFPA 90A or NFPA 90B and with ASTM C 916.

- 6 B. Insulation Pins and Washers:
 - 7 1. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully
8 annealed for capacitor-discharge welding, 0.106-inch- diameter shank, length to suit
9 depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
 - 10 2. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- thick
11 galvanized steel; with beveled edge sized as required to hold insulation securely in place
12 but not less than 1-1/2 inches in diameter.

 - 13
 - 14
 - 15
 - 16

- 17 C. Shop Application of Duct Liner: Comply with SMACNA's "HVAC Duct Construction Standards -
18 Metal and Flexible," Figure 7-11, "Flexible Duct Liner Installation."
 - 19 1. Adhere a single layer of indicated thickness of duct liner with at least 90 percent
20 adhesive coverage at liner contact surface area. Attaining indicated thickness with
21 multiple layers of duct liner is prohibited.
 - 22 2. Apply adhesive to transverse edges of liner facing upstream that do not receive metal
23 nosing.
 - 24 3. Butt transverse joints without gaps, and coat joint with adhesive.
 - 25 4. Fold and compress liner in corners of rectangular ducts or cut and fit to ensure butted-
26 edge overlapping.
 - 27 5. Do not apply liner in rectangular ducts with longitudinal joints, except at corners of
28 ducts, unless duct size and dimensions of standard liner make longitudinal joints
29 necessary.
 - 30 6. Apply adhesive coating on longitudinal seams in ducts with air velocity of 2500 fpm.
 - 31 7. Secure liner with mechanical fasteners 4 inches from corners and at intervals not
32 exceeding 12 inches transversely; at 3 inches from transverse joints and at intervals not
33 exceeding 18 inches longitudinally.
 - 34 8. Secure transversely oriented liner edges facing the airstream with metal nosings that
35 have either channel or "Z" profiles or are integrally formed from duct wall. Fabricate
36 edge facings at the following locations:
 - 37 a. Fan discharges.
 - 38 b. Intervals of lined duct preceding unlined duct.

- 1 c. Upstream edges of transverse joints in ducts where air velocities are higher than
2 2500 fpm or where indicated.
- 3 9. Terminate inner ducts with buildouts attached to fire-damper sleeves, dampers, turning
4 vane assemblies, or other devices. Fabricated buildouts (metal hat sections) or other
5 buildout means are optional; when used, secure buildouts to duct walls with bolts,
6 screws, rivets, or welds.
- 7 2.5 SEALANT AND GASKETS
- 8 A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and
9 gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index
10 of 50 when tested according to UL 723; certified by an NRTL.
- 11 B. Two-Part Tape Sealing System:
- 12 1. Tape: Woven cotton fiber impregnated with mineral gypsum and modified
13 acrylic/silicone activator to react exothermically with tape to form hard, durable,
14 airtight seal.
- 15 2. Tape Width: 3 inches.
- 16 3. Sealant: Modified styrene acrylic.
- 17 4. Water resistant.
- 18 5. Mold and mildew resistant.
- 19 6. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
- 20 7. Service: Indoor and outdoor.
- 21 8. Service Temperature: Minus 40 to plus 200 deg F.
- 22 9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless
23 steel, or aluminum.
- 24 C. Water-Based Joint and Seam Sealant:
- 25 1. Application Method: Brush on.
- 26 2. Solids Content: Minimum 65 percent.
- 27 3. Shore A Hardness: Minimum 20.
- 28 4. Water resistant.
- 29 5. Mold and mildew resistant.
- 30 6. VOC: Maximum 75 g/L (less water).
- 31 7. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
- 32 8. Service: Indoor or outdoor.
- 33 9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless
34 steel, or aluminum sheets.
- 35 D. Flanged Joint Sealant: Comply with ASTM C 920.

- 1 1. General: Single-component, acid-curing, silicone, elastomeric.
- 2 2. Type: S.
- 3 3. Grade: NS.
- 4 4. Class: 25.
- 5 5. Use: O.

- 6 E. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

- 7 F. Round Duct Joint O-Ring Seals:

- 8 1. Seal shall provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg and shall be
- 9 2. rated for 10-inch wg static-pressure class, positive or negative.
- 10 2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.
- 11 3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings
- 12 and fitting spigots.

- 13 2.6 HANGERS AND SUPPORTS

- 14 A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.

- 15 B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods
- 16 with threads painted with zinc-chromate primer after installation.

- 17 C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and
- 18 Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum
- 19 Hanger Sizes for Round Duct."

- 20 D. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.

- 21 E. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and
- 22 bolts designed for duct hanger service; with an automatic-locking and clamping device.

- 23 F. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible
- 24 with duct materials.

- 25 G. Trapeze and Riser Supports:

- 26 1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.

- 1 PART 3 - EXECUTION
- 2 3.1 DUCT INSTALLATION
- 3 A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct
4 system. Indicated duct locations, configurations, and arrangements were used to size ducts
5 and calculate friction loss for air-handling equipment sizing and for other design
6 considerations. Install duct systems as indicated unless deviations to layout are approved on
7 Shop Drawings and Coordination Drawings.
- 8 B. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"
9 unless otherwise indicated.
- 10 C. Install round ducts in maximum practical lengths.
- 11 D. Install ducts with fewest possible joints.
- 12 E. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for
13 branch connections.
- 14 F. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and
15 perpendicular to building lines.
- 16 G. Install ducts close to walls, overhead construction, columns, and other structural and
17 permanent enclosure elements of building.
- 18 H. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.
- 19 I. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and
20 enclosures.
- 21 J. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed
22 to view, cover the opening between the partition and duct or duct insulation with sheet metal
23 flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2
24 inches.
- 25 K. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers.
26 Comply with requirements in Section 233300 "Air Duct Accessories" for fire and smoke
27 dampers.
- 28 L. Protect duct interiors from moisture, construction debris and dust, and other foreign
29 materials. Comply with SMACNA's "IAQ Guidelines for Occupied Buildings Under
30 Construction," Appendix G, "Duct Cleanliness for New Construction Guidelines."

- 1 3.2 INSTALLATION OF EXPOSED DUCTWORK
- 2 A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.
- 3 B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use
4 two-part tape sealing system.
- 5 C. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When
6 welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds,
7 and treat the welds to remove discoloration caused by welding.
- 8 D. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings,
9 hangers and supports, duct accessories, and air outlets.
- 10 E. Repair or replace damaged sections and finished work that does not comply with these
11 requirements.
- 12 3.3 DUCT SEALING
- 13 A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct
14 Schedule" Article according to SMACNA's "HVAC Duct Construction Standards - Metal and
15 Flexible."
- 16 B. Seal ducts to the following seal classes according to SMACNA's "HVAC Duct Construction
17 Standards - Metal and Flexible":
- 18 1. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
19 2. Unconditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal
20 Class B.
21 3. Unconditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg: Seal
22 Class A.
23 4. Unconditioned Space, Exhaust Ducts: Seal Class C.
24 5. Unconditioned Space, Return-Air Ducts: Seal Class B.
25 6. Conditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal
26 Class C.
27 7. Conditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg: Seal
28 Class B.
29 8. Conditioned Space, Exhaust Ducts: Seal Class B.
30 9. Conditioned Space, Return-Air Ducts: Seal Class C.

- 1 3.4 HANGER AND SUPPORT INSTALLATION
- 2 A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5,
3 "Hangers and Supports."
- 4 B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel
5 fasteners appropriate for construction materials to which hangers are being attached.
- 6 1. Where practical, install concrete inserts before placing concrete.
7 2. Install powder-actuated concrete fasteners after concrete is placed and completely
8 cured.
9 3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for
10 slabs more than 4 inches thick.
11 4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or
12 for slabs less than 4 inches thick.
- 13 C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and
14 Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum
15 Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports
16 within 24 inches of each elbow and within 48 inches of each branch intersection.
- 17 D. Hangers Exposed to View: Threaded rod and angle or channel supports.
- 18 E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds,
19 bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of
20 16 feet.
- 21 F. Install upper attachments to structures. Select and size upper attachments with pull-out,
22 tension, and shear capacities appropriate for supported loads and building materials where
23 used.
- 24 3.5 CONNECTIONS
- 25 A. Make connections to equipment with flexible connectors complying with Section 233300 "Air
26 Duct Accessories."
- 27 B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch,
28 outlet and inlet, and terminal unit connections.
- 29 3.6 PAINTING
- 30 A. Paint interior of metal ducts that are visible through registers and grilles and that do not have
31 duct liner. Apply one coat of flat, black, latex paint over a compatible galvanized-steel primer.

1 Paint materials and application requirements are specified in Section 099113 "Exterior
2 Painting" and Section 099123 "Interior Painting."

3 3.7 FIELD QUALITY CONTROL

4 A. Perform tests and inspections.

5 B. Leakage Tests:

- 6 1. Comply with SMACNA's "HVAC Air Duct Leakage Test Manual." Submit a test report for
7 each test.
- 8 2. Disassemble, reassemble, and seal segments of systems to accommodate leakage
9 testing and for compliance with test requirements.
- 10 3. Test for leaks before applying external insulation.
- 11 4. Conduct tests at static pressures equal to maximum design pressure of system or
12 section being tested. If static-pressure classes are not indicated, test system at
13 maximum system design pressure. Do not pressurize systems above maximum design
14 operating pressure.
- 15 5. Give seven days' advance notice for testing.

16 C. Duct System Cleanliness Tests:

- 17 1. Visually inspect duct system to ensure that no visible contaminants are present.

18 D. Duct system will be considered defective if it does not pass tests and inspections.

19 E. Prepare test and inspection reports.

20 3.8 START UP

21 A. Air Balance: Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing
22 for HVAC."

23 3.9 DUCT SCHEDULE

24 A. Fabricate ducts with galvanized sheet steel except as otherwise indicated.

25 B. Supply Ducts:

26 1. Ducts Connected to Fan Coil Units and Terminal Units:

27 a. Pressure Class: Positive 2-inch wg.

- 1 2. Ducts Connected to Constant-Volume Air-Handling Units:
- 2 a. Pressure Class: Positive 2-inch wg.
- 3 3. Ducts Connected to Equipment Not Listed Above:
- 4 a. Pressure Class: Positive 2-inch wg.
- 5 C. Return Ducts:
- 6 1. Ducts Connected to Fan Coil Units and Terminal Units:
- 7 a. Pressure Class: Positive or negative 2-inch wg.
- 8 2. Ducts Connected to Air-Handling Units:
- 9 a. Pressure Class: Positive or negative 2-inch wg.
- 10
- 11 3. Ducts Connected to Equipment Not Listed Above:
- 12 a. Pressure Class: Positive or negative 2-inch wg.
- 13 D. Exhaust Ducts:
- 14 1. Ducts Connected to Fans Exhausting (ASHRAE 62.1, Class 1 and 2) Air:
- 15 a. Pressure Class: Negative 2-inch wg.
- 16 2. Ducts Connected to Air-Handling Units:
- 17 a. Pressure Class: Positive or negative 2-inch wg.
- 18 3. Ducts Connected to Equipment Not Listed Above:
- 19 a. Pressure Class: Positive or negative 2-inch wg.
- 20 E. Outdoor-Air (Not Filtered, Heated, or Cooled) Ducts:
- 21 1. Ducts Connected to Fan Coil Units and Terminal Units:
- 22 a. Pressure Class: Positive or negative 2-inch wg.
- 23 2. Ducts Connected to Air-Handling Units:

- 1 a. Pressure Class: Positive or negative 2-inch wg
- 2 3. Ducts Connected to Equipment Not Listed Above:
- 3 a. Pressure Class: Positive or negative 2-inch wg.
- 4 F. Intermediate Reinforcement:
- 5 1. Galvanized-Steel Ducts: Galvanized steel.
- 6 G. Liner: (Where Indicated on Drawings)
- 7 1. Supply Air Ducts: Fibrous glass, Type I, 1 inch thick.
- 8 2. Return Air Ducts: Fibrous glass, Type I, 1 inch thick.
- 9 3. Supply Fan Plenums: Fibrous glass, Type II, 1 inch thick.
- 10 4. Transfer Ducts: Fibrous glass, Type I, 1 inch thick.
- 11
- 12 H. Elbow Configuration:
- 13 1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal
- 14 and Flexible," Figure 4-2, "Rectangular Elbows."
- 15 a. Velocity 1000 fpm or Lower:
- 16 1) Radius Type RE 1 with minimum 0.5 radius-to-diameter ratio.
- 17 2) Mitered Type RE 4 without vanes.
- 18 b. Velocity 1000 to 1500 fpm:
- 19 1) Radius Type RE 1 with minimum 1.0 radius-to-diameter ratio.
- 20 2) Radius Type RE 3 with minimum 0.5 radius-to-diameter ratio and two
- 21 vanes.
- 22 3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct
- 23 Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane
- 24 Runners," and Figure 4-4, "Vane Support in Elbows."
- 25 c. Velocity 1500 fpm or Higher:
- 26 1) Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
- 27 2) Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two
- 28 vanes.
- 29 3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct
- 30 Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane
- 31 Runners," and Figure 4-4, "Vane Support in Elbows."

- 1 2. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal
2 and Flexible," Figure 4-2, "Rectangular Elbows."
- 3 a. Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
4 b. Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
5 c. Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct
6 Construction Standards - Metal and Flexible," Figure 4-3, "Vaness and Vane
7 Runners," and Figure 4-4, "Vane Support in Elbows."
- 8 3. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and
9 Flexible," Figure 3-4, "Round Duct Elbows."
- 10 a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with
11 SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1,
12 "Mitered Elbows." Elbows with less than 90-degree change of direction have
13 proportionately fewer segments.
- 14 1) Velocity 1000 fpm or Lower: 0.5 radius-to-diameter ratio and three
15 segments for 90-degree elbow.
16 2) Velocity 1000 to 1500 fpm: 1.0 radius-to-diameter ratio and four segments
17 for 90-degree elbow.
18 3) Velocity 1500 fpm or Higher: 1.5 radius-to-diameter ratio and five
19 segments for 90-degree elbow.
20 4) Radius-to Diameter Ratio: 1.5.
- 21 b. Round Elbows, 12 Inches and Smaller in Diameter: Stamped or pleated.
22 c. Round Elbows, 14 Inches and Larger in Diameter: Standing seam.
23
- 24 I. Branch Configuration:
- 25 1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal
26 and Flexible," Figure 4-6, "Branch Connection."
- 27 a. Rectangular Main to Rectangular Branch: 45-degree entry.
28 b. Rectangular Main to Round Branch: Spin in.
- 29 2. Round and Flat Oval: Comply with SMACNA's "HVAC Duct Construction Standards -
30 Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical
31 Tees." Saddle taps are permitted in existing duct.
- 32 a. Velocity 1000 fpm or Lower: 90-degree tap.
33 b. Velocity 1000 to 1500 fpm: Conical tap.
34 c. Velocity 1500 fpm or Higher: 45-degree lateral.

1 END OF SECTION 233113

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1 SECTION 233300 - AIR DUCT ACCESSORIES

2 PART 1 - GENERAL

3 1.1 RELATED DOCUMENTS

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

6 1.2 SUMMARY

7 A. Section Includes:

- 8 1. Backdraft dampers.
9 2. Barometric relief dampers.
10 3. Manual volume dampers.
11 4. Fire dampers.
12 5. Flange connectors.
13 6. Turning vanes.
14 7. Duct-mounted access doors.
15 8. Flexible connectors.
16 9. Flexible ducts.
17 10. Duct accessory hardware.

18 B. Related Requirements:

- 19 1. Section 233723 "HVAC Gravity Ventilators" for roof-mounted ventilator caps.

20 1.3 ACTION SUBMITTALS

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

- 22 1. For duct silencers, include pressure drop and dynamic insertion loss data. Include
23 breakout noise calculations for high transmission loss casings.
24

25 B. Shop Drawings: For duct accessories. Include plans, elevations, sections, details and
26 attachments to other work.

- 27 1. Detail duct accessories fabrication and installation in ducts and other construction.
28 Include dimensions, weights, loads, and required clearances; and method of field
29 assembly into duct systems and other construction. Include the following:

- 1 a. Special fittings.
- 2 b. Manual volume damper installations.

3 1.4 INFORMATIONAL SUBMITTALS

- 4 A. Source quality-control reports.

5 1.5 CLOSEOUT SUBMITTALS

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

8 PART 2 - PRODUCTS

9 2.1 ASSEMBLY DESCRIPTION

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

16 2.2 MATERIALS

- 17 A. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
 - 18 1. Galvanized Coating Designation: G60.
 - 19 2. Exposed-Surface Finish: Mill phosphatized.
- 20 B. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on
- 21 galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.
- 22 C. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch
- 23 minimum diameter for lengths longer than 36 inches.

24 2.3 BACKDRAFT DAMPERS

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

- 1 1. Air Balance Inc.; a division of Mestek, Inc.
- 2 2. American Warming and Ventilating; a division of Mestek, Inc.
- 3 3. Cesco Products; a division of Mestek, Inc.
- 4 4. Greenheck Fan Corporation.
- 5 5. Ruskin Company.

- 6 B. Description: Gravity balanced.

- 7 C. Maximum Air Velocity: 2000 fpm.

- 8 D. Maximum System Pressure: 2-inch wg.

- 9 E. Frame: Hat-shaped, 0.05-inch- thick, galvanized sheet steel, with welded corners or
10 mechanically attached and mounting flange.

- 11 F. Blades: Multiple single-piece blades, center pivoted, maximum 6-inch width, 0.025-inch- thick,
12 roll-formed aluminum with sealed edges.

- 13 G. Blade Action: Parallel.

- 14 H. Blade Seals: Extruded vinyl, mechanically locked.

- 15 I. Blade Axles:
 - 16 1. Material: Nonferrous metal.
 - 17 2. Diameter: 0.20 inch.

- 18 J. Tie Bars and Brackets: Aluminum.

- 19 K. Return Spring: Adjustable tension.

- 20 L. Bearings: Steel ball or synthetic pivot bushings.

- 21 M. Accessories:
 - 22 1. Adjustment device to permit setting for varying differential static pressure.
 - 23 2. Counterweights and spring-assist kits for vertical airflow installations.
 - 24 3. Chain pulls.

- 25 2.4 BAROMETRIC RELIEF DAMPERS

- 26 A. Manufacturers: Subject to compliance with requirements, provide products by one of the
27 following:
 - 28 1. Air Balance Inc.; a division of Mestek, Inc.
 - 29 2. American Warming and Ventilating; a division of Mestek, Inc.

- 1 3. Cesco Products; a division of Mestek, Inc.
- 2 4. Greenheck Fan Corporation.
- 3 5. Ruskin Company.

- 4 B. Suitable for horizontal or vertical mounting.

- 5 C. Maximum Air Velocity: 2000 fpm.

- 6 D. Maximum System Pressure: 2-inch wg.

- 7 E. Frame: Hat-shaped, 0.05-inch- thick, galvanized sheet steel, with welded corners or
8 mechanically attached and mounting flange.

- 9 F. Blades:
 - 10 1. Multiple, 0.025-inch- thick, roll-formed aluminum.
 - 11 2. Maximum Width: 6 inches.
 - 12 3. Action: Parallel.
 - 13 4. Balance: Gravity.
 - 14 5. Eccentrically pivoted.

- 15 G. Blade Seals: Vinyl or neoprene.

- 16 H. Blade Axles: Nonferrous metal.

- 17 I. Tie Bars and Brackets:
 - 18 1. Material: Aluminum.
 - 19 2. Rattle free with 90-degree stop.

- 20 J. Return Spring: Adjustable tension.

- 21 K. Bearings: Synthetic.

- 22 L. Accessories:
 - 23 1. Flange on intake.
 - 24 2. Adjustment device to permit setting for varying differential static pressures.

- 25 2.5 MANUAL VOLUME DAMPERS

- 26 A. Standard, Steel, Manual Volume Dampers:
 - 27 1. Manufacturers: Subject to compliance with requirements, provide products by one of
28 the following:
 - 29 a. Air Balance Inc.; a division of Mestek, Inc.

- 1 b. American Warming and Ventilating; a division of Mestek, Inc.
- 2 c. Ruskin Company.
- 3 2. Standard leakage rating, with linkage outside airstream.
- 4 3. Suitable for horizontal or vertical applications.
- 5 4. Frames:
 - 6 a. Frame: Hat-shaped, 0.094-inch- thick, galvanized sheet steel.
 - 7 b. Mitered and welded corners.
 - 8 c. Flanges for attaching to walls and flangeless frames for installing in ducts.
 - 9
- 10 5. Blades:
 - 11 a. Multiple or single blade.
 - 12 b. Parallel- or opposed-blade design.
 - 13 c. Stiffen damper blades for stability.
 - 14 d. Galvanized-steel, 0.064 inch thick.
- 15 6. Blade Axles: Nonferrous metal.
- 16 7. Bearings:
 - 17 a. Oil-impregnated bronze.
 - 18 b. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full
 - 19 length of damper blades and bearings at both ends of operating shaft.
- 20 8. Tie Bars and Brackets: Galvanized steel.
- 21 B. Low-Leakage, Steel, Manual Volume Dampers:
 - 22 1. Manufacturers: Subject to compliance with requirements, provide products by one of
 - 23 the following:
 - 24 a. Air Balance Inc.; a division of Mestek, Inc.
 - 25 b. American Warming and Ventilating; a division of Mestek, Inc.
 - 26 c. Ruskin Company.
 - 27 2. Comply with AMCA 500-D testing for damper rating.
 - 28 3. Low-leakage rating, with linkage outside airstream, and bearing AMCA's Certified
 - 29 Ratings Seal for both air performance and air leakage.
 - 30 4. Suitable for horizontal or vertical applications.
 - 31 5. Frames:
 - 32 a. Hat shaped.
 - 33 b. 0.094-inch- thick, galvanized sheet steel.
 - 34 c. Mitered and welded corners.
 - 35 d. Flanges for attaching to walls and flangeless frames for installing in ducts.

- 1 6. Blades:
- 2 a. Multiple or single blade.
- 3 b. Parallel- or opposed-blade design.
- 4 c. Stiffen damper blades for stability.
- 5 d. Galvanized, roll-formed steel, 0.064 inch thick.
- 6
- 7 7. Blade Axles: Nonferrous metal.
- 8 8. Bearings:
- 9 a. Oil-impregnated bronze.
- 10 b. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full
- 11 length of damper blades and bearings at both ends of operating shaft.
- 12 9. Blade Seals: Vinyl or neoprene.
- 13 10. Jamb Seals: Cambered aluminum.
- 14 11. Tie Bars and Brackets: Aluminum.
- 15 12. Accessories:
- 16 a. Include locking device to hold single-blade dampers in a fixed position without
- 17 vibration.
- 18 C. Jackshaft:
- 19 1. Size: 1-inch diameter.
- 20 2. Material: Galvanized-steel pipe rotating within pipe-bearing assembly mounted on
- 21 supports at each mullion and at each end of multiple-damper assemblies.
- 22 3. Length and Number of Mountings: As required to connect linkage of each damper in
- 23 multiple-damper assembly.
- 24 D. Damper Hardware:
- 25 1. Zinc-plated, die-cast core with dial and handle made of 3/32-inch- thick zinc-plated
- 26 steel, and a 3/4-inch hexagon locking nut.
- 27 2. Include center hole to suit damper operating-rod size.
- 28 3. Include elevated platform for insulated duct mounting.
- 29 2.6 FIRE DAMPERS
- 30 A. Manufacturers: Subject to compliance with requirements, provide products by one of the
- 31 following:
- 32 1. Air Balance Inc.; a division of Mestek, Inc.
- 33 2. Arrow United Industries; a division of Mestek, Inc.
- 34 3. Cesco Products; a division of Mestek, Inc.

- 1 4. Greenheck Fan Corporation.
2 5. Ruskin Company.
- 3 B. Type: Rated and labeled according to UL 555 by an NRTL.
- 4 C. Fire Rating: 1-1/2 and 3 hours.
- 5 D. Frame: Curtain type with blades outside airstream; fabricated with roll-formed, 0.034-inch-
6 thick galvanized steel; with mitered and interlocking corners.
- 7 E. Mounting Sleeve: Factory- or field-installed, galvanized sheet steel.
- 8 1. Minimum Thickness: 0.05 or 0.138 inch thick, as indicated, and of length to suit
9 application.
10 2. Exception: Omit sleeve where damper-frame width permits direct attachment of
11 perimeter mounting angles on each side of wall or floor; thickness of damper frame
12 must comply with sleeve requirements.
- 13 F. Mounting Orientation: Vertical or horizontal as indicated.
- 14 G. Blades: Roll-formed, interlocking, 0.034-inch- thick, galvanized sheet steel. In place of
15 interlocking blades, use full-length, 0.034-inch- thick, galvanized-steel blade connectors.
- 16 H. Horizontal Dampers: Include blade lock and stainless-steel closure spring.
- 17 I. Heat-Responsive Device: Replaceable, 165 deg F rated, fusible links.
- 18 2.7 FLANGE CONNECTORS
- 19 A. Manufacturers: Subject to compliance with requirements, provide products by one of the
20 following:
- 21 1. Ductmate Industries, Inc.
22 2. Nexus PDQ; Division of Shilco Holdings Inc.
23 3. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- 24 B. Description: Roll-formed, factory-fabricated, slide-on transverse flange connectors, gaskets,
25 and components.
- 26 C. Material: Galvanized steel.
- 27 D. Gage and Shape: Match connecting ductwork.

- 1 2.8 TURNING VANES
- 2 A. Manufacturers: Subject to compliance with requirements, provide products by one of the
3 following:
- 4 1. Ductmate Industries, Inc.
5 2. Duro Dyne Inc.
6 3. METALAIRE, Inc.
7 4. SEMCO Incorporated.
8 5. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- 9 B. Manufactured Turning Vanes for Metal Ducts: Curved blades of galvanized sheet steel;
10 support with bars perpendicular to blades set; set into vane runners suitable for duct
11 mounting.
- 12 1. Acoustic Turning Vanes: Fabricate airfoil-shaped aluminum extrusions with perforated
13 faces and fibrous-glass fill.
- 14 C. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal
15 and Flexible"; Figures 4-3, "Vanes and Vane Runners," and 4-4, "Vane Support in Elbows."
- 16 D. Vane Construction: Single wall.
- 17 E. Vane Construction: Single wall for ducts up to 48 inches wide and double wall for larger
18 dimensions.
- 19 2.9 DUCT-MOUNTED ACCESS DOORS
- 20 A. Manufacturers: Subject to compliance with requirements, provide products by one of the
21 following:
- 22 1. American Warming and Ventilating; a division of Mestek, Inc.
23 2. Cesco Products; a division of Mestek, Inc.
24 3. Greenheck Fan Corporation.
- 25 B. Duct-Mounted Access Doors: Fabricate access panels according to SMACNA's "HVAC Duct
26 Construction Standards - Metal and Flexible"; Figures 7-2, "Duct Access Doors and Panels," and
27 7-3, "Access Doors - Round Duct."
- 28 1. Door:
- 29 a. Double wall, rectangular.
30 b. Galvanized sheet metal with insulation fill and thickness as indicated for duct
31 pressure class.
32 c. Vision panel.
33 d. Hinges and Latches: 1-by-1-inchbutt or piano hinge and cam latches.

- 1 e. Fabricate doors airtight and suitable for duct pressure class.
- 2 2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.
- 3 3. Number of Hinges and Locks:
- 4 a. Access Doors Less Than 12 Inches Square: No hinges and two sash locks.
- 5 b. Access Doors up to 18 Inches Square: Two hinges and two sash locks.
- 6 c. Access Doors up to 24 by 48 Inches: Three hinges and two compression latches
- 7 with outside and inside handles.
- 8 d. Access Doors Larger Than 24 by 48 Inches: Four hinges and two compression
- 9 latches with outside and inside handles.
- 10 2.10 FLEXIBLE CONNECTORS
- 11 A. Manufacturers: Subject to compliance with requirements, provide products by one of the
- 12 following:
- 13 1. Ductmate Industries, Inc.
- 14 2. Duro Dyne Inc.
- 15 3. Ventfabrics, Inc.
- 16 4. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- 17 B. Materials: Flame-retardant or noncombustible fabrics.
- 18 C. Coatings and Adhesives: Comply with UL 181, Class 1.
- 19 D. Metal-Edged Connectors: Factory fabricated with a fabric strip 3-1/2 inches 5-3/4 inches wide
- 20 attached to two strips of 2-3/4-inch- wide, 0.028-inch- thick, galvanized sheet steel or 0.032-
- 21 inch- thick aluminum sheets. Provide metal compatible with connected ducts.
- 22 E. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.
- 23 1. Minimum Weight: 26 oz./sq. yd..
- 24 2. Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
- 25 3. Service Temperature: Minus 40 to plus 200 deg F.
- 26 2.11 FLEXIBLE DUCTS
- 27 A. Manufacturers: Subject to compliance with requirements, provide products by one of the
- 28 following:
- 29 1. Flexmaster U.S.A., Inc.
- 30 2. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

- 1 B. Insulated, Flexible Duct: UL 181, Class 1, 2-ply vinyl film supported by helically wound, spring-
2 steel wire; fibrous-glass insulation; polyethylene vapor-barrier film.
- 3 1. Pressure Rating: 10-inch wg positive and 1.0-inch wg negative.
4 2. Maximum Air Velocity: 4000 fpm.
5 3. Temperature Range: Minus 10 to plus 160 deg F.
- 6 C. Flexible Duct Connectors:
- 7 1. Clamps: Stainless-steel band with cadmium-plated hex screw to tighten band with a
8 worm-gear action in sizes 3 through 18 inches, to suit duct size.
- 9 2.12 DUCT ACCESSORY HARDWARE
- 10 A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap
11 and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to
12 suit duct-insulation thickness.
- 13 B. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline
14 and grease.
- 15 PART 3 - EXECUTION
- 16 3.1 INSTALLATION
- 17 A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction
18 Standards - Metal and Flexible" for metal ducts.
- 19 B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories
20 in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts,
21 and aluminum accessories in aluminum ducts.
- 22 C. Install backdraft dampers at inlet of exhaust fans or exhaust ducts as close as possible to
23 exhaust fan unless otherwise indicated.
- 24 D. Install volume dampers at points on supply, return, and exhaust systems where branches
25 extend from larger ducts. Where dampers are installed in ducts having duct liner, install
26 dampers with hat channels of same depth as liner, and terminate liner with nosing at hat
27 channel.
- 28 E. Set dampers to fully open position before testing, adjusting, and balancing.
- 29 F. Install test holes at fan inlets and outlets and elsewhere as indicated.

- 1 G. Install fire dampers according to UL listing.
- 2 H. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining
3 accessories and equipment at the following locations:
- 4 1. At outdoor-air intakes and mixed-air plenums.
5 2. At drain pans and seals.
6 3. Adjacent to and close enough to fire or smoke dampers, to reset or reinstall fusible links.
7 Access doors for access to fire or smoke dampers having fusible links shall be pressure
8 relief access doors and shall be outward operation for access doors installed upstream
9 from dampers and inward operation for access doors installed downstream from
10 dampers.
11 4. Control devices requiring inspection.
12 5. Elsewhere as indicated.
- 13 I. Install access doors with swing against duct static pressure.
- 14 J. Access Door Sizes:
- 15 1. One-Hand or Inspection Access: 8 by 5 inches.
16 2. Two-Hand Access: 12 by 6 inches.
17 3. Head and Hand Access: 18 by 10 inches.
18 4. Head and Shoulders Access: 21 by 14 inches.
19 5. Body Access: 25 by 14 inches.
20 6. Body plus Ladder Access: 25 by 17 inches.
- 21 K. Label access doors according to Section 230553 "Identification for HVAC Piping and
22 Equipment" to indicate the purpose of access door.
- 23 L. Install flexible connectors to connect ducts to equipment.
- 24 M. For fans developing static pressures of 5-inch wg and more, cover flexible connectors with
25 loaded vinyl sheet held in place with metal straps.
- 26 N. Connect terminal units to supply ducts with maximum 12-inch lengths of flexible duct. Do not
27 use flexible ducts to change directions.
- 28 O. Connect diffusers to ducts directly or with maximum 60-inch lengths of flexible duct clamped
29 or strapped in place.
- 30 P. Connect flexible ducts to metal ducts with draw bands.
- 31 Q. Install duct test holes where required for testing and balancing purposes.

1 3.2 FIELD QUALITY CONTROL

2 A. Tests and Inspections:

- 3 1. Operate dampers to verify full range of movement.
- 4 2. Inspect locations of access doors and verify that purpose of access door can be
5 performed.
- 6 3. Operate fire dampers to verify full range of movement and verify that proper heat-
7 response device is installed.
- 8 4. Inspect turning vanes for proper and secure installation.

9 END OF SECTION 233300

1 SECTION 233346 - FLEXIBLE DUCTS

2 PART 1 - GENERAL

3 1.1 RELATED DOCUMENTS

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

6 1.2 SUMMARY

- 7 A. Section Includes:

- 8 1. Insulated flexible ducts.

9 1.3 ACTION SUBMITTALS

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

- 11 B. Shop Drawings: For flexible ducts.

- 12 1. Include plans showing locations and mounting and attachment details.

13 1.4 INFORMATIONAL SUBMITTALS

- 14 A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which ceiling-mounted
15 access panels and access doors required for access to duct accessories are shown and
16 coordinated with each other, using input from installers of the items involved.

17 PART 2 - PRODUCTS

18 2.1 ASSEMBLY DESCRIPTION

- 19 A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with
20 NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

- 21 B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for
22 acceptable materials, material thicknesses, and duct construction methods unless otherwise

1 indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains,
2 discolorations, and other imperfections.

3 C. Comply with the Air Diffusion Council's "ADC Flexible Air Duct Test Code FD 72-R1."

4 D. Comply with ASTM E 96/E 96M, "Test Methods for Water Vapor Transmission of Materials."

5 2.2 INSULATED FLEXIBLE DUCTS

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

- 8 1. Flexmaster U.S.A., Inc.
- 9 2. JP Lamborn Co.
- 10 3. McGill AirFlow LLC.
- 11 4. Thermaflex; a Flex-Tek Group company.
- 12 5. Ward Industries; a brand of Hart & Cooley, Inc.

13 B. Insulated, Flexible Duct: UL 181, Class 1, black polymer film supported by helically wound,
14 spring-steel wire; fibrous-glass insulation; polyethylene vapor-barrier film.

- 15 1. Pressure Rating: 4-inch wg positive and 0.5-inch wg negative.
- 16 2. Maximum Air Velocity: 4000 fpm.
- 17 3. Temperature Range: Minus 20 to plus 175 deg F.
- 18 4. Insulation R-Value: Comply with ASHRAE/IES 90.1.

19 C. Insulated, Flexible Duct: UL 181, Class 1, multiple layers of aluminum laminate supported by
20 helically wound, spring-steel wire; fibrous-glass insulation; aluminized vapor-barrier film.

- 21 1. Pressure Rating: 10-inch wg positive and 1.0-inch wg negative.
- 22 2. Maximum Air Velocity: 4000 fpm.
- 23 3. Temperature Range: Minus 20 to plus 210 deg F.
- 24 4. Insulation R-Value: Comply with ASHRAE/IES 90.1.

25 2.3 FLEXIBLE DUCT CONNECTORS

26 A. Clamps: Nylon strap in sizes 3 through 18 inches, to suit duct size.

- 1 PART 3 - EXECUTION
- 2 3.1 INSTALLATION
- 3 A. Install flexible ducts according to applicable details in SMACNA's "HVAC Duct Construction
4 Standards - Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct
5 Construction Standards," for fibrous-glass ducts.
- 6 B. Install in indoor applications only. Flexible ductwork should not be exposed to UV lighting.
- 7 C. Connect diffuser to ducts with maximum 60-inch lengths of flexible duct clamped or strapped
8 in place.
- 9 D. Connect flexible ducts to metal ducts with draw bands,
- 10 E. Install duct test holes where required for testing and balancing purposes.
- 11 F. Installation:
- 12 1. Install ducts fully extended.
- 13 2. Do not bend ducts across sharp corners.
- 14 3. Bends of flexible ducting shall not exceed a minimum of one duct diameter.
- 15 4. Avoid contact with metal fixtures, water lines, pipes, or conduits.
- 16 5. Install flexible ducts in a direct line, without sags, twists, or turns.
- 17 G. Supporting Flexible Ducts:
- 18 1. Suspend flexible ducts with bands 1-1/2 inches wide or wider and spaced a maximum of
19 48 inches apart. Maximum centerline sag between supports shall not exceed 1/2 inch
20 per 12 inches.
- 21 2. Install extra supports at bends placed approximately one duct diameter from center line
22 of the bend.
- 23 3. Ducts may rest on ceiling joists or truss supports. Spacing between supports shall not
24 exceed the maximum spacing per manufacturer's written installation instructions.
- 25 4. Vertically installed ducts shall be stabilized by support straps at a maximum of 72 inches
26 o.c.
- 27 END OF SECTION 233346

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1 SECTION 233411 - FIXED LOUVERS

2 PART 1 - GENERAL

3 1.1 RELATED DOCUMENTS

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

6 1.2 SUMMARY

- 7 A. Section Includes:

- 8 1. Fixed, extruded-aluminum louvers.

9 1.3 DEFINITIONS

- 10 A. Louver Terminology: Definitions of terms for metal louvers contained in AMCA 501 apply to
11 this Section unless otherwise defined in this Section or in referenced standards.
- 12 B. Horizontal Louver: Louver with horizontal blades (i.e., the axes of the blades are horizontal).
- 13 C. Vertical Louver: Louver with vertical blades (i.e., the axes of the blades are vertical).
- 14 D. Drainable-Blade Louver: Louver with blades having gutters that collect water and drain it to
15 channels in jambs and mullions, which carry it to bottom of unit and away from opening.

16 1.4 ACTION SUBMITTALS

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

- 18 1. For louvers specified to bear AMCA seal, include printed catalog pages showing
19 specified models with appropriate AMCA Certified Ratings Seals.

- 20 B. Shop Drawings: For louvers and accessories. Include plans, elevations, sections, details, and
21 attachments to other work. Show frame profiles and blade profiles, angles, and spacing.

- 22 1. Show weep paths, gaskets, flashing, sealant, and other means of preventing water
23 intrusion.

- 24 2. Show mullion profiles and locations.

1 C. Samples: For each type of metal finish required.

2 1.5 QUALITY ASSURANCE

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

4 1. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."

5 1.6 FIELD CONDITIONS

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

8 PART 2 - PRODUCTS

9 2.1 MANUFACTURERS

10 A. Source Limitations: Obtain louvers from single source from a single manufacturer where
11 indicated to be of same type, design, or factory-applied color finish.

12 2.2 FIXED, EXTRUDED-ALUMINUM LOUVERS

13 A. Horizontal, Drainable-Blade Louver:

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

- 16 a. Greenheck Fan Corporation.
- 17 b. NCA Manufacturing, Inc.
- 18 c. Pottorff.
- 19 d. Ruskin Company; Tomkins PLC.

20 2. Frame and Blade Nominal Thickness: Not less than 0.060 inch for blades and 0.080 inch
21 for frames.

22 3. Mullion Type: Exposed.

23 2.3 LOUVER SCREENS

24 A. General: Provide screen at each exterior louver.

25 1. Screen Location for Fixed Louvers: Interior face.

- 1 2. Screening Type: Bird screening.
- 2 B. Secure screen frames to louver frames with machine screws with heads finished to match
3 louver, spaced a maximum of 6 inches from each corner and at 12 inches o.c.
- 4
- 5 C. Louver Screen Frames: Fabricate with mitered corners to louver sizes indicated.
- 6 1. Metal: Same type and form of metal as indicated for louver to which screens are
7 attached. Reinforce extruded-aluminum screen frames at corners with clips.
8 2. Finish: Same finish as louver frames to which louver screens are attached.
9 3. Type: Non-rewirable, U-shaped frames.
- 10 D. Louver Screening for Aluminum Louvers:
11 1. Bird Screening: Flattened, expanded aluminum, 3/4 by 0.050 inch thick.
- 12 2.4 BLANK-OFF PANELS
- 13 A. Insulated, Blank-Off Panels: Laminated panels consisting of an insulating core surfaced on
14 back and front with metal sheets and attached to back of louver.
- 15 1. Thickness: 2 inches.
16 2. Metal Facing Sheets: Aluminum sheet, not less than 0.032-inch nominal thickness.
17 3. Insulating Core: Rigid, glass-fiber-board insulation or extruded-polystyrene foam.
18 4. Seal perimeter joints between panel faces and louver frames with gaskets or sealant.
19 5. Attach blank-off panels with clips.
- 20 2.5 MATERIALS
- 21 A. Aluminum Extrusions: ASTM B 221, Alloy 6063-T5, T-52, or T6.
- 22 B. Aluminum Sheet: ASTM B 209, Alloy 3003 or 5005 with temper as required for forming, or as
23 otherwise recommended by metal producer for required finish.
- 24 C. Fasteners: Use types and sizes to suit unit installation conditions.
- 25 1. Use hex-head or Phillips pan-head screws for exposed fasteners unless otherwise
26 indicated.
27 2. For fastening aluminum, use aluminum or 300 series stainless-steel fasteners.
28 3. For color-finished louvers, use fasteners with heads that match color of louvers.
- 29 D. Postinstalled Fasteners for Concrete and Masonry: Torque-controlled expansion anchors,
30 made from stainless-steel components, with capability to sustain, without failure, a load equal

- 1 to 4 times the loads imposed, for concrete, or 6 times the load imposed for masonry, as
2 determined by testing according to ASTM E 488, conducted by a qualified independent testing
3 agency.
- 4 E. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.
- 5 2.6 FABRICATION
- 6 A. Factory assemble louvers to minimize field splicing and assembly. Disassemble units as
7 necessary for shipping and handling limitations. Clearly mark units for reassembly and
8 coordinated installation.
- 9 B. Vertical Assemblies: Where height of louver units exceeds fabrication and handling
10 limitations, fabricate units to permit field-bolted assembly with close-fitting joints in jambs and
11 mullions, reinforced with splice plates.
- 12 1. Continuous Vertical Assemblies: Fabricate units without interrupting blade-spacing
13 pattern.
- 14 2. Horizontal Mullions: Provide horizontal mullions at joints.
- 15 C. Maintain equal louver blade spacing to produce uniform appearance.
- 16 D. Fabricate frames, including integral sills, to fit in openings of sizes indicated, with allowances
17 made for fabrication and installation tolerances, adjoining material tolerances, and perimeter
18 sealant joints.
- 19 1. Frame Type: Exterior flange unless otherwise indicated.
- 20 E. Include supports, anchorages, and accessories required for complete assembly.
- 21 F. Provide vertical mullions of type and at spacings indicated, but not more than is recommended
22 by manufacturer, or 72 inches o.c., whichever is less.
- 23 1. Exposed Mullions: Where indicated, provide units with exposed mullions of same width
24 and depth as louver frame. Where length of louver exceeds fabrication and handling
25 limitations, provide interlocking split mullions designed to permit expansion and
26 contraction.
- 27 G. Provide subsills made of same material as louvers for recessed louvers.
- 28 H. Join frame members to each other and to fixed louver blades with fillet welds concealed from
29 view unless otherwise indicated or size of louver assembly makes bolted connections between
30 frame members necessary.

- 1 2.7 ALUMINUM FINISHES
- 2 A. Finish louvers after assembly.
- 3 B. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.
- 4 C. Color Anodic Finish: AAMA 611, AA-M12C22A42/A44, Class I, 0.018 mm or thicker.
- 5 1. Color: As selected by Architect from full range of industry colors and color densities.
- 6 D. High-Performance Organic Finish: Two-coat fluoropolymer finish complying with AAMA 2604
7 and containing not less than 50 percent PVDF resin by weight in color coat. Prepare, pretreat,
8 and apply coating to exposed metal surfaces to comply with coating and resin manufacturers'
9 written instructions.
- 10 1. Color and Gloss: As selected by Architect from manufacturer's full range.
- 11 PART 3 - EXECUTION
- 12 3.1 EXAMINATION
- 13 A. Examine substrates and openings, with Installer present, for compliance with requirements for
14 installation tolerances and other conditions affecting performance of the Work.
- 15 B. Proceed with installation only after unsatisfactory conditions have been corrected.
- 16 3.2 PREPARATION
- 17 A. Coordinate setting drawings, diagrams, templates, instructions, and directions for installation
18 of anchorages that are to be embedded in concrete or masonry construction. Coordinate
19 delivery of such items to Project site.
- 20 3.3 INSTALLATION
- 21 A. Locate and place louvers level, plumb, and at indicated alignment with adjacent work.
- 22 B. Use concealed anchorages where possible. Provide brass or lead washers fitted to screws
23 where required to protect metal surfaces and to make a weathertight connection.
- 24 C. Form closely fitted joints with exposed connections accurately located and secured.
- 25 D. Provide perimeter reveals and openings of uniform width for sealants and joint fillers, as
26 indicated.

- 1 E. Protect unpainted galvanized and nonferrous-metal surfaces that are in contact with concrete,
2 masonry, or dissimilar metals from corrosion and galvanic action by applying a heavy coating
3 of bituminous paint or by separating surfaces with waterproof gaskets or nonmetallic flashing.
- 4 F. Install concealed gaskets, flashings, joint fillers, and insulation as louver installation progresses,
5 where weathertight louver joints are required.
- 6 3.4 ADJUSTING AND CLEANING
- 7 A. Clean exposed louver surfaces that are not protected by temporary covering, to remove
8 fingerprints and soil during construction period. Do not let soil accumulate during
9 construction period.
- 10 B. Before final inspection, clean exposed surfaces with water and a mild soap or detergent not
11 harmful to finishes. Thoroughly rinse surfaces and dry.
- 12 C. Restore louvers damaged during installation and construction so no evidence remains of
13 corrective work. If results of restoration are unsuccessful, as determined by Architect, remove
14 damaged units and replace with new units.
- 15 1. Touch up minor abrasions in finishes with air-dried coating that matches color and gloss
16 of, and is compatible with, factory-applied finish coating.

17 END OF SECTION 233411

1 SECTION 233423 - HVAC POWER VENTILATORS

2 PART 1 - GENERAL

3 1.1 RELATED DOCUMENTS

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

6 1.2 SUMMARY

- 7 A. Section Includes:
8 1. Ceiling-mounted ventilators.
9 2. In-line centrifugal fans.
10 3. Propeller fans.

11 1.3 PERFORMANCE REQUIREMENTS

- 12 A. Project Altitude: Base fan-performance ratings on sea level.
13 B. Operating Limits: Classify according to AMCA 99.

14 1.4 ACTION SUBMITTALS

- 15 A. Product Data: For each type of product indicated. Include rated capacities, operating
16 characteristics, and furnished specialties and accessories. Also include the following:
17 1. Certified fan performance curves with system operating conditions indicated.
18 2. Certified fan sound-power ratings.
19 3. Motor ratings and electrical characteristics, plus motor and electrical accessories.
20 4. Material thickness and finishes, including color charts.
21 5. Dampers, including housings, linkages, and operators.
22 6. Roof curbs.
23 7. Fan speed controllers.
24 B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

- 1 1. Detail equipment assemblies and indicate dimensions, weights, loads, required
2 clearances, method of field assembly, components, and location and size of each field
3 connection.
- 4 2. Wiring Diagrams: For power, signal, and control wiring.

5 1.5 INFORMATIONAL SUBMITTALS

- 6 A. Coordination Drawings: Reflected ceiling plans and other details, drawn to scale, on which the
7 following items are shown and coordinated with each other, using input from Installers of the
8 items involved:

- 9 1. Ceiling suspension assembly members.
- 10 2. Size and location of initial access modules for acoustical tile.
- 11 3. Ceiling-mounted items including light fixtures, diffusers, grilles, speakers, sprinklers,
12 access panels, and special moldings.

- 13 B. Field quality-control reports.

14 1.6 CLOSEOUT SUBMITTALS

- 15 A. Operation and Maintenance Data: For power ventilators to include in emergency, operation,
16 and maintenance manuals.

17 1.7 MAINTENANCE MATERIAL SUBMITTALS

- 18 A. Furnish extra materials that match products installed and that are packaged with protective
19 covering for storage and identified with labels describing contents.

- 20 1. Belts: One set(s) for each belt-driven unit.

21 1.8 QUALITY ASSURANCE

- 22 A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by
23 a qualified testing agency, and marked for intended location and application.

- 24 B. AMCA Compliance: Fans shall have AMCA-Certified performance ratings and shall bear the
25 AMCA-Certified Ratings Seal.

- 26 C. UL Standards: Power ventilators shall comply with UL 705. Power ventilators for use for
27 restaurant kitchen exhaust shall also comply with UL 762.

1 1.9 COORDINATION

2 A. Coordinate size and location of structural-steel support members.

3 B. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with
4 actual equipment provided.

5 PART 2 - PRODUCTS

6 2.1 CEILING-MOUNTED VENTILATORS

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

- 9 1. Greenheck Fan Corporation.
10 2. Loren Cook Company.
11 3. PennBarry; division of Air System Components.

12 B. Housing: Steel, lined with acoustical insulation.

13 C. Fan Wheel: Centrifugal wheels directly mounted on motor shaft. Fan shrouds, motor, and fan
14 wheel shall be removable for service.

15 D. Grille: Aluminum, louvered grille with flange on intake and thumbscrew attachment to fan
16 housing.

17 E. Electrical Requirements: Junction box for electrical connection on housing and receptacle for
18 motor plug-in.

19 F. Accessories:

- 20 1. Variable-Speed Controller: Solid-state control to reduce speed from 100 to less than 50
21 percent.
22 2. Time-Delay Switch: Assembly with single-pole rocker switch, timer, and cover plate.
23 3. Ceiling Radiation Damper: Fire-rated assembly with ceramic blanket, stainless-steel
24 springs, and fusible link.
25 4. Filter: Washable aluminum to fit between fan and grille.
26 5. Isolation: Rubber-in-shear vibration isolators.
27 6. Manufacturer's standard roof jack or wall cap, and transition fittings.

1 2.2 IN-LINE CENTRIFUGAL FANS

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

- 4 1. Greenheck Fan Corporation.
- 5 2. Loren Cook Company.
- 6 3. PennBarry; division of Air System Components.

7 B. Housing: Split, spun aluminum with aluminum straightening vanes, inlet and outlet flanges,
8 and support bracket adaptable to floor, side wall, or ceiling mounting.

9 C. Direct-Drive Units: Motor mounted in airstream, factory wired to disconnect switch located on
10 outside of fan housing.

11 D. Belt-Driven Units: Motor mounted on adjustable base, with adjustable sheaves, enclosure
12 around belts within fan housing, and lubricating tubes from fan bearings extended to outside
13 of fan housing.

14 E. Fan Wheels: Aluminum, airfoil blades welded to aluminum hub.

15 F. Accessories:

- 16 1. Variable-Speed Controller: Solid-state control to reduce speed from 100 to less than 50
17 percent.
- 18 2. Volume-Control Damper: Manually operated with quadrant lock, located in fan outlet.
- 19 3. Companion Flanges: For inlet and outlet duct connections.
- 20 4. Fan Guards: 1/2- by 1-inch (13- by 25-mm) mesh of galvanized steel in removable frame.
21 Provide guard for inlet or outlet for units not connected to ductwork.
- 22 5. Motor and Drive Cover (Belt Guard): Epoxy-coated steel.

23 2.3 PROPELLER FANS

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

- 26 1. Greenheck Fan Corporation.
- 27 2. Loren Cook Company.
- 28 3. PennBarry; division of Air System Components.

29 B. Housing: Galvanized-steel sheet with flanged edges and integral orifice ring with baked-enamel
30 finish coat applied after assembly.

- 1 C. Steel Fan Wheels: Formed-steel blades riveted to heavy-gage steel spider bolted to cast-iron
2 hub.
- 3 D. Fan Wheel: Replaceable, aluminum, airfoil blades fastened to cast-aluminum hub; factory set
4 pitch angle of blades.
- 5 E. Fan Drive: Motor mounted in airstream, factory wired to disconnect switch located on outside
6 of fan housing.
- 7 F. Accessories:
- 8 1. Gravity Shutters: Aluminum blades in aluminum frame; interlocked blades with nylon
9 bearings.
- 10 2. Motor-Side Back Guard: Galvanized steel, complying with OSHA specifications,
11 removable for maintenance.
- 12 3. Wall Sleeve: Galvanized steel to match fan and accessory size.
- 13 4. Weathershield Hood: Galvanized steel to match fan and accessory size.
- 14 5. Weathershield Front Guard: Galvanized steel with expanded metal screen.
- 15 6. Variable-Speed Controller: Solid-state control to reduce speed from 100 to less than 50
16 percent.
- 17 7. Disconnect Switch: Nonfusible type, with thermal-overload protection mounted inside
18 fan housing, factory wired through an internal aluminum conduit.

19 2.4 MOTORS

- 20 A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and
21 efficiency requirements for motors specified in Section 230513 "Common Motor Requirements
22 for HVAC Equipment."
- 23 1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load
24 will not require motor to operate in service factor range above 1.0.
- 25 B. Enclosure Type: Totally enclosed, fan cooled.

26 2.5 SOURCE QUALITY CONTROL

- 27 A. Certify sound-power level ratings according to AMCA 301, "Methods for Calculating Fan Sound
28 Ratings from Laboratory Test Data." Factory test fans according to AMCA 300, "Reverberant
29 Room Method for Sound Testing of Fans." Label fans with the AMCA-Certified Ratings Seal.
- 30 B. Certify fan performance ratings, including flow rate, pressure, power, air density, speed of
31 rotation, and efficiency by factory tests according to AMCA 210, "Laboratory Methods of

1 Testing Fans for Aerodynamic Performance Rating." Label fans with the AMCA-Certified
2 Ratings Seal.

3 PART 3 - EXECUTION

4 3.1 INSTALLATION

5 A. Install power ventilators level and plumb.

6 B. Install units with clearances for service and maintenance.

7 C. Label units according to requirements specified in Section 230553 "Identification for HVAC
8 Piping and Equipment."

9 D. Ceiling Units: Suspend units from structure; use steel wire or metal straps.

10 E. Support suspended units from structure using threaded steel rods and spring hangers having a
11 static deflection of 1 inch.

12

13 3.2 CONNECTIONS

14 A. Drawings indicate general arrangement of ducts and duct accessories. Make final duct
15 connections with flexible connectors. Flexible connectors are specified in Section 233300 "Air
16 Duct Accessories."

17 B. Install ducts adjacent to power ventilators to allow service and maintenance.

18 C. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical
19 Systems."

20 D. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and
21 Cables."

22 3.3 FIELD QUALITY CONTROL

23 A. Perform tests and inspections.

24 B. Tests and Inspections:

25 1. Verify that shipping, blocking, and bracing are removed.

- 1 2. Verify that unit is secure on mountings and supporting devices and that connections to
- 2 ducts and electrical components are complete. Verify that proper thermal-overload
- 3 protection is installed in motors, starters, and disconnect switches.
- 4 3. Verify that cleaning and adjusting are complete.
- 5 4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan
- 6 wheel free rotation and smooth bearing operation. Reconnect fan drive system, align
- 7 and adjust belts, and install belt guards.
- 8 5. Adjust belt tension.
- 9 6. Adjust damper linkages for proper damper operation.
- 10 7. Verify lubrication for bearings and other moving parts.
- 11 8. Verify that manual and automatic volume control and fire and smoke dampers in
- 12 connected ductwork systems are in fully open position.
- 13 9. Disable automatic temperature-control operators, energize motor and adjust fan to
- 14 indicated rpm, and measure and record motor voltage and amperage.
- 15 10. Shut unit down and reconnect automatic temperature-control operators.
- 16 11. Remove and replace malfunctioning units and retest as specified above.

- 17 C. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and
- 18 equipment.

- 19 D. Prepare test and inspection reports.

20 3.4 ADJUSTING

- 21 A. Adjust damper linkages for proper damper operation.
- 22 B. Adjust belt tension.
- 23 C. Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC" for
- 24 testing, adjusting, and balancing procedures.
- 25 D. Replace fan and motor pulleys as required to achieve design airflow.
- 26 E. Lubricate bearings.

27 END OF SECTION 233423

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1 SECTION 233439 - HIGH-VOLUME, LOW-SPEED FANS

2 PART 1 - GENERAL

3 1.1 RELATED DOCUMENTS

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

6 1.2 SUMMARY

- 7 A. Section includes high-volume, low-speed fans.

8 1.3 DEFINITIONS

- 9 A. HVLS - High volume, low speed.

10 1.4 ACTION SUBMITTALS

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

- 12 1. Include rated capacities, furnished specialties, and accessories for each fan.
13 2. Certified fan performance curves with system operating conditions indicated.
14 3. Certified fan sound-power ratings.
15 4. Motor ratings and electrical characteristics, plus motor and electrical accessories.
16 5. Material thickness and finishes, including color charts.
17 6. Fan speed controllers.

- 18 B. Shop Drawings:

- 19 1. Include plans, elevations, sections, and mounting details.
20 2. Include details of equipment assemblies. Show dimensions, weights, loads, required
21 clearances, method of field assembly, components, and location and size of each field
22 connection.
23 3. Include diagrams for power, signal, and control wiring.

- 1 1.5 INFORMATIONAL SUBMITTALS
- 2 A. Coordination Drawings: Floor plans and details, drawn to scale and coordinated with each
3 other, using input from installers of the items involved.
- 4
- 5 B. Qualification Data:
- 6 1. For Installer: Certificate from HVLS fan manufacturer certifying that Installer has
7 successfully completed prerequisite training administered by manufacturer for proper
8 installation of systems, including but not limited to, equipment, controls, and
9 accessories indicated and furnished for installation.
- 10 C. Field quality-control reports.
- 11 1.6 CLOSEOUT SUBMITTALS
- 12 A. Operation and Maintenance Data: For HVLS fans to include in emergency, operation, and
13 maintenance manuals.
- 14 1.7 QUALITY ASSURANCE
- 15 A. Manufacturer Qualifications: Provide certification that manufacturer complies with the
16 requirements of the most recent edition of ISO 9001.
- 17 B. Installer Qualifications: An entity that employs installers and supervisors who are trained and
18 approved by HVLS fan manufacturer.
- 19 1. Each employee shall be certified by manufacturer for proper installation of systems,
20 including, but not limited to, equipment, controls, and accessories indicated and
21 furnished for installation.
- 22 2. Installer certification shall be valid and current for duration of Project.
- 23 3. Retain copies of Installer certificates on-site and make available on request.
- 24 4. Installers shall have staffing resources of competent, trained, and experienced full-time
25 employees that are assigned to execute work according to schedule.
- 26 1.8 DELIVERY, STORAGE, AND HANDLING
- 27 A. Deliver and store products in a clean and dry place.

- 1 B. Comply with manufacturer's written rigging and installation instructions for unloading and
2 moving to final installed location.
- 3 C. Handle products carefully to prevent damage, breaking, denting, and scoring. Do not install
4 damaged products.
- 5 D. Protect products from weather, dirt, dust, water, construction debris, and physical damage.
 - 6 1. Retain factory-applied coverings on equipment to protect finishes during construction
7 and remove just prior to operating unit.
 - 8 2. Cover unit openings before installation to prevent dirt and dust from entering inside of
9 units. If required to remove coverings during unit installation, reapply coverings over
10 openings after unit installation and remove just prior to operating unit.
- 11 E. Replace installed products damaged during construction.

12 1.9 WARRANTY

- 13 A. Warranty: Manufacturer and Installer agree to repair or replace components of fans that fail in
14 materials or workmanship within specified warranty period.
 - 15 1. Warranty Period:
 - 16 a. For Motor, Including Controls: Five year(s) from date of Substantial Completion.
 - 17 b. For Parts, Including Blades and Hub: Five year(s) from date of Substantial
18 Completion.
 - 19 c. For Labor: One year(s) from date of Substantial Completion.

20 PART 2 - PRODUCTS

21 2.1 PERFORMANCE REQUIREMENTS

- 22 A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by
23 a qualified testing agency, and marked for intended location and application.
- 24 B. UL Compliance: Listed and labeled to UL 507.
- 25 C. CSA Compliance: Listed and labeled to CSA C22.2, No. 113.
- 26 D. Comply with NFPA 13 requirements for HVLS fans.
- 27 E. AMCA Compliance:

- 1 1. Test HVLS fans according to AMCA 230.
- 2 2. Certify HVLS fan performance according to AMCA 211.

- 3 F. Performance Data: Comply with ANSI 230 test procedure standard, based on five rating points:
4 20-, 40-, 60-, 80-, and 100-percent of maximum speed. Comply with AMCA 211 for publication
5 of performance data.

- 6 2.2 MANUFACTURERS

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

9 1. Big Ass Fans.
10 2. Greenheck Fan Corporation.

- 11 B. Source Limitations: Obtain HVLS fans from single source from single manufacturer.

- 12 2.3 HIGH-VOLUME, LOW-SPEED FANS

- 13 A. Description: Factory-assembled and -tested horizontal, non-ducted fan unit, consisting of
14 large-diameter blade set, direct-drive electric motor, with variable-speed motor controller.

15 1. Provide fan designed to circulate large air volume, vertically, at low velocity.
16 2. Maximum Operating Temperature: 122 deg F.
17 3. Frame:

18 a. Material: Galvanized steel.

19 1) Finish: Anodized.
20 4. Blades: Airfoil type.

21 a. Material: Aluminum.

22 1) Blade Finish: Anodized.

- 23 5. Controls: Provide wall-mounted keypad.

24 a. Provide variable speed motor controller speed control.
- 25 6. Accessories:

26 a. Mounting extension tube.

- 1 PART 3 - EXECUTION
- 2 3.1 EXAMINATION
- 3 A. Examine conditions for compliance with requirements for installation tolerances and other
4 conditions affecting HVLS fan performance, maintenance, and operations.
- 5 1. Fan locations indicated on Drawings are approximate. Determine exact locations before
6 roughing-in for mounting, control, and electrical connections.
- 7 B. Examine roughing-in for mounting location, anchor-bolt sizes, and locations, to verify actual
8 locations for mounting connections before installation of fan.
- 9 C. Examine areas for suitable conditions where fan will be installed.
- 10 D. Proceed with installation only after unsatisfactory conditions have been corrected.
- 11 3.2 INSTALLATION OF HIGH-VOLUME LOW-SPEED FANS
- 12 A. Install fan according to manufacturer's published instructions.
- 13 B. Comply with NECA 1 and NFPA 70.
- 14 C. Comply with NFPA 13 for installation of HVLS fans and maximum allowable fan diameter.
15 Center HVLS fans between four adjacent sprinklers. Minimum vertical clearance from HVLS fan
16 to sprinkler deflector is 3 feet.
- 17 D. Comply with NFPA 72 and interlock HVLS fans to shut down upon receiving an alarm from fire
18 alarm system.
- 19 E. Equipment Mounting:
- 20 1. Anchor fan to building structure with manufacturer's recommended mounting bracket
21 for installed condition.
- 22 2. Consult a licensed professional structural engineer for mounting methods and approval
23 for mounting to the structure. Structure must be able to withstand the torque and
24 forces generated by the fan.
- 25 3. Comply with requirements for hangers and supports specified in Section 230529
26 "Hangers and Supports for HVAC Piping and Equipment."
- 27 F. Install unit to permit access for maintenance.
- 28 G. Install parts and accessories shipped loose.

- 1 3.3 ELECTRICAL CONNECTIONS
- 2 A. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and
3 Cables."
- 4 B. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical
5 Systems."
- 6 C. Install electrical devices furnished by manufacturer, but not factory mounted, according to
7 NFPA 70 and NECA 1.
- 8 D. Install nameplate for each electrical connection, indicating electrical equipment designation
9 and circuit number feeding connection.
- 10 1. Nameplate shall be laminated acrylic or melamine plastic signs, as specified in
11 Section 260553 "Identification for Electrical Systems."
12 2. Nameplate shall be laminated acrylic or melamine plastic signs with a black background
13 and engraved white letters at least 1/2 inch high.
- 14 E. Install power wiring to field-mounted electrical devices, furnished by fan manufacturer, but
15 not factory mounted.
- 16 3.4 CONTROL CONNECTIONS
- 17 A. Connect control wiring to field-mounted control devices.
- 18 B. Connect control wiring according to Section 260523 "Control-Voltage Electrical Power Cables."
- 19 C. Connect control interlock wiring between HVLS fan and other equipment to provide a
20 complete and functioning system.
- 21 D. Connect control wiring between fan unit control interface and control system to provide
22 remote control and monitoring.
- 23 E. Install control devices furnished by manufacturer, but not factory mounted.
- 24 F. Install control wiring to field-mounted control devices, furnished by fan manufacturer, but not
25 factory mounted.
- 26 G. Protect installed units from damage caused by other work.

- 1 3.5 FIELD QUALITY CONTROL
- 2 A. Testing Agency, Owner Engaged: Owner will engage a qualified testing agency to perform tests
3 and inspections.
- 4 B. Testing Agency, Contractor Engaged: Engage a qualified testing agency to perform tests and
5 inspections.
- 6 C. Manufacturer's Field Service: Engage a factory-authorized service representative to test and
7 inspect components, assemblies, and equipment installations, including connections.
- 8 D. Perform the following tests and inspections with the assistance of a factory-authorized service
9 representative:
- 10 1. Fan Operational Test: After electrical circuitry has been energized, start units to confirm
11 proper motor rotation and unit operation.
- 12 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and
13 equipment.
- 14 E. Fan or components will be considered defective if fan or components do not pass tests and
15 inspections.
- 16 F. Prepare and submit test and inspection reports.
- 17 3.6 STARTUP SERVICE
- 18 A. Engage a factory-authorized service representative to perform startup service.
- 19 1. Complete installation and startup checks according to manufacturer's written
20 instructions.
- 21 2. Verify that fan is secure on mountings and supporting devices and that connections to
22 electrical systems are complete. Verify that proper thermal-overload protection is
23 installed in motors, controllers and switches.
- 24 3. Verify proper motor rotation direction and free fan rotation.
- 25 4. Check bearing and gearbox lubrication.
- 26 5. Verify proper fan rotation. Set rotation selector to blow vertically downward during
27 heating season, and vertically upward during cooling season.
- 28 3.7 ADJUSTING
- 29 A. Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC" for
30 air-handling system testing, adjusting, and balancing.

- 1 3.8 CLEANING
- 2 A. Clean equipment externally; remove coatings applied for protection during shipping and
3 storage, foreign material, and oily residue according to manufacturer's written instructions.
4 Following manufacturer's cleaning procedures, and clean with manufacturer-recommended
5 cleaning products.
- 6 3.9 DEMONSTRATION
- 7 A. Engage a factory-authorized service representative to train Owner's maintenance personnel to
8 adjust, operate, and maintain HVLS fans.
- 9 B. Video training sessions and provide electronic copy of video to Owner.
- 10 END OF SECTION 233439

1 SECTION 233713 - DIFFUSERS, REGISTERS, AND GRILLES

2 PART 1 - GENERAL

3 1.1 RELATED DOCUMENTS

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

6 1.2 SUMMARY

7 A. Section Includes:

- 8 1. Rectangular and square ceiling diffusers.
9 2. Fixed face grilles.

10 B. Related Sections:

- 11 1. Section 233300 "Air Duct Accessories" for fire and smoke dampers and volume-control
12 dampers not integral to diffusers, registers, and grilles.

13 1.3 ACTION SUBMITTALS

14 A. Product Data: For each type of product indicated, include the following:

- 15 1. Data Sheet: Indicate materials of construction, finish, and mounting details; and
16 performance data including throw and drop, static-pressure drop, and noise ratings.
17 2. Diffuser, Register, and Grille Schedule: Indicate drawing designation, room location,
18 quantity, model number, size, and accessories furnished.

19 PART 2 - PRODUCTS

20 2.1 CEILING DIFFUSERS

21 A. Square Ceiling Diffusers:

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

- 24 a. NCA Manufacturing, Inc

- 1 b. Pottorff
- 2 c. Price Industries.
- 3 d. Titus.
- 4 e. Tuttle & Bailey.

5 2.2 REGISTERS AND GRILLES

6 A. Fixed Face Grille:

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

- 9 a. NCA Manufacturing, Inc
- 10 b. Pottorff
- 11 c. Price Industries.
- 12 d. Titus.
- 13 e. Tuttle & Bailey.

14 2.3 SOURCE QUALITY CONTROL

15 A. Verification of Performance: Rate diffusers, registers, and grilles according to ASHRAE 70,
16 "Method of Testing for Rating the Performance of Air Outlets and Inlets."

17 PART 3 - EXECUTION

18 3.1 EXAMINATION

19 A. Examine areas where diffusers, registers, and grilles are to be installed for compliance with
20 requirements for installation tolerances and other conditions affecting performance of
21 equipment.

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

23 3.2 INSTALLATION

24 A. Install diffusers, registers, and grilles level and plumb.

25 B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings,
26 and accessories. Air outlet and inlet locations have been indicated to achieve design
27 requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make

1 final locations where indicated, as much as practical. For units installed in lay-in ceiling panels,
2 locate units in the center of panel. Where architectural features or other items conflict with
3 installation, notify Architect for a determination of final location.

4 C. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service
5 and maintenance of dampers, air extractors, and fire dampers.

6 3.3 ADJUSTING

7 A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed,
8 before starting air balancing.

9 END OF SECTION 233713

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1 SECTION 235100 - BREECHINGS, CHIMNEYS, AND STACKS

2 PART 1 - GENERAL

3 1.1 RELATED DOCUMENTS

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

6 1.2 SUMMARY

- 7 A. This Section includes the following:
8 1. Listed double-wall vents.

9 1.3 ACTION SUBMITTALS

- 10 A. Product Data: For the following:

- 11 1. Type B vents.

- 12 B. Shop Drawings: For vents, breechings, chimneys, and stacks. Include plans, elevations,
13 sections, details, and attachments to other work.

- 14 1. Detail equipment assemblies and indicate dimensions, weights, loads, required
15 clearances, methods of field assembly, components, hangers and seismic restraints, and
16 location and size of each field connection.

17 1.4 INFORMATIONAL SUBMITTALS

- 18 A. Welding certificates.

- 19 B. Warranty: Special warranty specified in this Section.

20 1.5 QUALITY ASSURANCE

- 21 A. Source Limitations: Obtain listed system components through one source from a single
22 manufacturer.

1 B. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural
2 Welding Code--Steel," for hangers and supports and AWS D9.1/D9.1M, "Sheet Metal Welding
3 Code," for shop and field welding of joints and seams in vents, breechings, and stacks.

4 C. Certified Sizing Calculations: Manufacturer shall certify venting system sizing calculations.

5 1.6 WARRANTY

6 A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or
7 replace components of venting system that fail in materials or workmanship within specified
8 warranty period. Failures include, but are not limited to, structural failures caused by
9 expansion and contraction.

10 1. Warranty Period: 10 years from date of Substantial Completion.

11 PART 2 - PRODUCTS

12 2.1 LISTED TYPE B AND BW VENTS

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

- 15 1. Heat-Fab, Inc.
- 16 2. Metal-Fab, Inc.
- 17 3. Selkirk Inc.; Selkirk Metalbestos and Air Mate.
- 18 4. Simpson Dura-Vent Co., Inc.; Subsidiary of Simpson Manufacturing Co.

19 B. Description: Double-wall metal vents tested according to UL 441 and rated for 480 deg F
20 continuously for Type B; with neutral or negative flue pressure complying with NFPA 211.

21 C. Construction: Inner shell and outer jacket separated by at least a 1/4-inch airspace.

22 D. Inner Shell: ASTM B 209, Type 1100 aluminum.

23 E. Outer Jacket: Galvanized steel.

24 F. Accessories: Tees, elbows, increasers, draft-hood connectors, terminations, adjustable roof
25 flashings, storm collars, support assemblies, thimbles, firestop spacers, and fasteners;
26 fabricated from similar materials and designs as vent-pipe straight sections; all listed for same
27 assembly.

1 PART 3 - EXECUTION

2 3.1 EXAMINATION

3 A. Examine areas and conditions for compliance with requirements for installation tolerances and
4 other conditions affecting performance of work.

5 1. Proceed with installation only after unsatisfactory conditions have been corrected.

6 3.2 APPLICATION

7 A. Listed Type B Vents: Vents for certified gas appliances.

8 3.3 INSTALLATION OF LISTED VENTS AND CHIMNEYS

9 A. Locate to comply with minimum clearances from combustibles and minimum termination
10 heights according to product listing or NFPA 211, whichever is most stringent.

11 B. Support vents at intervals recommended by manufacturer to support weight of vents and all
12 accessories, without exceeding appliance loading.

13 C. Slope breechings down in direction of appliance, with condensate drain connection at lowest
14 point piped to nearest drain.

15 D. Lap joints in direction of flow.

16 E. Connect base section to foundation using anchor lugs of size and number recommended by
17 manufacturer.

18 F. Join sections with acid-resistant joint cement to provide continuous joint and smooth interior
19 finish.

20 G. Erect stacks plumb to finished tolerance of no more than 1 inch out of plumb from top to
21 bottom.

22 3.4 CLEANING

23 A. After completing system installation, including outlet fittings and devices, inspect exposed
24 finish. Remove burrs, dirt, and construction debris and repair damaged finishes.

25 B. Clean breechings internally, during and after installation, to remove dust and debris. Clean
26 external surfaces to remove welding slag and mill film. Grind welds smooth and apply touchup
27 finish to match factory or shop finish.

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1 C. Provide temporary closures at ends of breechings, chimneys, and stacks that are not
2 completed or connected to equipment.

3 END OF SECTION 235100

1 SECTION 235400 - FURNACES

2 PART 1 - GENERAL

3 1.1 RELATED DOCUMENTS

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

6 1.2 SUMMARY

- 7 A. This Section includes the following:

- 8 1. Gas-fired, condensing furnaces and accessories complete with controls.
9 2. Air filters.
10 3. Refrigeration components.

11 1.3 ACTION SUBMITTALS

- 12 A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and
13 accessories for each of the following:

- 14 1. Furnace.
15 2. Thermostat.
16 3. Air filter.
17 4. Refrigeration components.

18 1.4 INFORMATIONAL SUBMITTALS

- 19 A. Warranty: Special warranty specified in this Section.

20 1.5 CLOSEOUT SUBMITTALS

- 21 A. Operation and Maintenance Data: For each furnace to include in emergency, operation, and
22 maintenance manuals for each of the following:

- 23 1. Furnace and accessories complete with controls.
24 2. Refrigeration components.

- 1 1.6 MAINTENANCE MATERIAL SUBMITTALS
- 2 A. Furnish extra materials described below that match products installed and that are packaged
3 with protective covering for storage and identified with labels describing contents.
- 4 1. Disposable Air Filters: Furnish two complete sets.
- 5 2. Fan Belts: Furnish one set for each furnace fan.
- 6 1.7 QUALITY ASSURANCE
- 7 A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70,
8 Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for
9 intended use.
- 10 B. Comply with NFPA 70.
- 11 1.8 COORDINATION
- 12 A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete,
13 reinforcement, and formwork requirements are specified with concrete.
- 14 B. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items
15 are specified in Section 077200 "Roof Accessories."
- 16 1.9 WARRANTY
- 17 A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or
18 replace the following components of furnaces that fail in materials or workmanship within
19 specified warranty period:
- 20 1. Warranty Period, Commencing on Date of Substantial Completion:
- 21 a. Furnace Heat Exchanger: Lifetime.
- 22 b. Refrigeration Compressors: 10 years Lifetime.
- 23 PART 2 - PRODUCTS
- 24 2.1 GAS-FIRED FURNACES, CONDENSING
- 25 A. Manufacturers: Subject to compliance with requirements, provide products by one of the
26 following:
- 27 1. American Standard.

- 1 2. Trane.
- 2 3. YORK, a Johnson Controls Company.

- 3 B. General Requirements for Gas-Fired, Condensing Furnaces: Factory assembled, piped, wired,
4 and tested; complying with ANSI Z21.47/CSA 2.3, "Gas-Fired Central Furnaces," and with
5 NFPA 54.

- 6 C. Cabinet: Galvanized steel.
 - 7 1. Cabinet interior around heat exchanger shall be factory-installed insulation.
 - 8 2. Lift-out panels shall expose burners and all other items requiring access for
9 maintenance.
 - 10 3. Factory paint external cabinets in manufacturer's standard color.
 - 11 4. Airstream Surfaces: Surfaces in contact with the airstream shall comply with
12 requirements in ASHRAE 62.1.

- 13 D. Fan: Centrifugal, factory balanced, resilient mounted, direct drive.
 - 14 1. Fan Motors: Comply with requirements in Section 230513 "Common Motor
15 Requirements for HVAC Equipment."
 - 16 2. Special Motor Features: Multitapped, multispeed with internal thermal protection and
17 permanent lubrication.

- 18 E. Type of Gas: Natural.

- 19 F. Heat Exchanger:
 - 20 1. Primary: Aluminized steel.
 - 21 2. Secondary: Polyethylene-coated steel.

- 22 G. Burner:
 - 23 1. Gas Valve: 100 percent safety two-stage main gas valve, main shutoff valve, pressure
24 regulator, safety pilot with electronic flame sensor, limit control, transformer, and
25 combination ignition/fan timer control board.
 - 26 2. Ignition: Electric pilot ignition, with hot-surface igniter or electric spark ignition.

- 27 H. Gas-Burner Safety Controls:
 - 28 1. Electronic Flame Sensor: Prevents gas valve from opening until pilot flame is proven;
29 stops gas flow on ignition failure.
 - 30 2. Flame Rollout Switch: Installed on burner box; prevents burner operation.
 - 31 3. Limit Control: Fixed stop at maximum permissible setting; de-energizes burner on
32 excessive bonnet temperature; automatic reset.

- 33 I. Combustion-Air Inducer: Centrifugal fan with thermally protected motor and sleeve bearings
34 prepurges heat exchanger and vents combustion products; pressure switch prevents furnace
35 operation if combustion-air inlet or flue outlet is blocked.

- 1 J. Furnace Controls: Solid-state board integrates ignition, heat, cooling, and fan speeds;
2 adjustable fan-on and fan-off timing; terminals for connection to accessories; diagnostic light
3 with viewport.
- 4 K. Accessories:
- 5 1. Combination Combustion-Air Intake and Vent: PVC plastic fitting to combine
6 combustion-air inlet and vent through outside wall.
 - 7 2. CPVC Plastic Vent Materials.
 - 8 a. CPVC Plastic Pipe: Schedule 40, complying with ASTM F 441/F 441M.
 - 9 b. CPVC Plastic Fittings: Schedule 40, complying with ASTM F 438, socket type.
 - 10 c. CPVC Solvent Cement: ASTM F 493.
 - 11 3. PVC Plastic Vent Materials:
 - 12 a. PVC Plastic Pipe: Schedule 40, complying with ASTM D 1785.
 - 13 b. PVC Plastic Fittings: Schedule 40, complying with ASTM D 2466, socket type.
 - 14 c. PVC Solvent Cement: ASTM D 2564.

15 2.2 THERMOSTATS

- 16 A. Solid-State, Combination Thermostat and Humidistat: Wall-mounting, programmable,
17 microprocessor-based unit with automatic switching from heating to cooling and humidifying
18 to dehumidifying, preferential rate control, seven-day programmability with minimum of four
19 temperature presets per day, and battery backup protection against power failure for program
20 settings.
- 21 B. Control Wiring: Unshielded twisted-pair cabling.
- 22 1. No. 24 AWG, 100 ohm, four pair.
 - 23 2. Cable Jacket Color: Blue.

24 2.3 AIR FILTERS

- 25 A. Disposable Filters: 1-inch- thick fiberglass media with ASHRAE 52.2 MERV rating of 6 or higher,
26 in sheet metal frame.

27 2.4 REFRIGERATION COMPONENTS

- 28 A. General Refrigeration Component Requirements:
- 29 1. Refrigeration compressor, coils, and specialties shall be designed to operate with CFC-
30 free refrigerants.
 - 31 2. Energy Efficiency: Equal to or greater than prescribed by ASHRAE/IES 90.1.
- 32 B. Refrigerant Coil: Copper tubes mechanically expanded into aluminum fins. Comply with
33 ARI 203/110, "Unitary Air-Conditioning and Air-Source Heat Pump Equipment." Match size

- 1 with furnace. Include condensate drain pan with accessible drain outlet complying with
2 ASHRAE 62.1.
- 3 1. Refrigerant Coil Enclosure: Steel, matching furnace and evaporator coil, with access
4 panel and flanges for integral mounting at or on furnace cabinet and galvanized sheet
5 metal drain pan coated with black asphaltic base paint.
- 6 C. Refrigerant Line Kits: Annealed-copper suction and liquid lines factory cleaned, dried,
7 pressurized with nitrogen, sealed, and with suction line insulated. Provide in standard lengths
8 for installation without joints, except at equipment connections.
- 9 D. Refrigerant Piping: Comply with requirements in Section 232300 "Refrigerant Piping."

10 PART 3 - EXECUTION

11 3.1 EXAMINATION

- 12 A. Examine areas and conditions, with Installer present, for compliance with requirements for
13 installation tolerances and other conditions affecting performance of the Work.
- 14 B. Examine factory-installed insulation before furnace installation. Reject units that are wet,
15 moisture damaged, or mold damaged.
- 16 C. Examine roughing-in for gas and refrigerant piping systems to verify actual locations of piping
17 connections before equipment installation.
- 18 D. Proceed with installation only after unsatisfactory conditions have been corrected.

19 3.2 INSTALLATION

- 20 A. Install gas-fired furnaces and associated fuel and vent features and systems according to
21 NFPA 54.
- 22 B. Base-Mounted Units: Secure units to substrate. Provide optional bottom closure base if
23 required by installation conditions.
- 24 C. Controls: Install thermostats and humidistats at mounting height of 60 inches above floor.
- 25 D. Wiring Method: Install control wiring in accessible ceiling spaces and in gypsum board
26 partitions where unenclosed wiring method may be used. Conceal control wiring except in
27 unfinished spaces.

- 1 3.3 CONNECTIONS
- 2 A. Gas piping installation requirements are specified in Division 23 "Facility Natural-Gas Piping."
3 Drawings indicate general arrangement of piping, fittings, and specialties. Connect gas piping
4 with union or flange and appliance connector valve.
- 5 B. Install piping adjacent to equipment to allow service and maintenance.
- 6 C. Vent and Outside-Air Connection, Condensing, Gas-Fired Furnaces: Connect plastic piping vent
7 material to furnace connections and extend outdoors. Terminate vent outdoors with a cap
8 and in an arrangement that will protect against entry of birds, insects, and dirt.
- 9 1. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
10 2. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before
11 assembly.
- 12 3. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and
13 fittings according to the following:
- 14 a. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and
15 solvent cements.
- 16 b. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC
17 socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC
18 pipe and socket fittings according to ASTM D 2855.
- 19 4. Slope pipe vent back to furnace or to outside terminal.
- 20 D. Connect ducts to furnace with flexible connector. Comply with requirements in
21 Section 233300 "Air Duct Accessories."
- 22 E. Connect refrigerant tubing kits to refrigerant coil in furnace and to air-cooled, compressor-
23 condenser unit.
- 24 1. Flared Joints: Use ASME B16.26 fitting and flared ends, following procedures in CDA's
25 "Copper Tube Handbook."
- 26 2. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to
27 tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook,"
28 using lead-free solder alloy complying with ASTM B 32.
- 29 3. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and
30 Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.
- 31 F. Comply with requirements in Section 232300 "Refrigerant Piping" for installation and joint
32 construction of refrigerant piping.
- 33 3.4 FIELD QUALITY CONTROL
- 34 A. Perform the following field tests and inspections and prepare test reports:
35 1. Perform electrical test and visual and mechanical inspection.

- 1 2. Leak Test: After installation, charge systems with refrigerant and oil and test for leaks.
- 2 Repair leaks, replace lost refrigerant and oil, and retest until no leaks exist.
- 3 3. Operational Test: After electrical circuitry has been energized, start units to confirm
- 4 proper operation, product capability, and compliance with requirements.
- 5 4. Verify that fan wheel is rotating in the correct direction and is not vibrating or binding.
- 6 5. Test and adjust controls and safeties. Replace damaged and malfunctioning controls
- 7 and equipment.

- 8 B. Verify that vibration isolation and flexible connections properly dampen vibration transmission
- 9 to structure.

- 10 3.5 STARTUP SERVICE

- 11 A. Complete installation and startup checks according to manufacturer's written instructions and
- 12 perform the following:
- 13 1. Inspect for physical damage to unit casings.
- 14 2. Verify that access doors move freely and are weathertight.
- 15 3. Clean units and inspect for construction debris.
- 16 4. Verify that all bolts and screws are tight.
- 17 5. Adjust vibration isolation and flexible connections.
- 18 6. Verify that controls are connected and operational.

- 19 B. Adjust fan belts to proper alignment and tension.

- 20 C. Start unit according to manufacturer's written instructions and complete manufacturer's
- 21 operational checklist.

- 22 D. Measure and record airflows.

- 23 E. Verify proper operation of capacity control device.

- 24 F. After startup and performance test, lubricate bearings and adjust belt tension.

- 25 3.6 ADJUSTING

- 26 A. Adjust initial temperature and humidity set points.

- 27 B. Set controls, burner, and other adjustments for optimum heating performance and efficiency.
- 28 Adjust heat-distribution features, including shutters, dampers, and relays, to provide optimum
- 29 heating performance and system efficiency.

- 1 3.7 CLEANING
- 2 A. After completing installation, clean furnaces internally according to manufacturer's written
3 instructions.
- 4 B. Install new filters in each furnace within 14 days after Substantial Completion.
- 5 3.8 DEMONSTRATION
- 6 A. Engage a factory-authorized service representative to train Owner's maintenance personnel to
7 adjust, operate, and maintain condensing units. Refer to Section 017900 "Demonstration and
8 Training."
- 9 END OF SECTION 235400

1 SECTION 235523.13 – LOW-INTENSITY, GAS-FIRED, RADIANT HEATERS

2 PART 1 - GENERAL

3 1.1 RELATED DOCUMENTS

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

6 1.2 SUMMARY

- 7 A. Section includes low-intensity, gas-fired, forced-draft radiant heaters.

8 1.3 ACTION SUBMITTALS

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

- 10 1. Include rated capacities, operating characteristics, electrical characteristics, and
11 furnished specialties and accessories.

- 12 B. Shop Drawings:

- 13 1. Include plans, elevations, sections, and mounting details.
14 2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required
15 clearances, method of field assembly, components, and location and size of each field
16 connection.
17 3. Detail fabrication and assembly of high-intensity, gas-fired, radiant heaters, as well as
18 procedures and diagrams.
19 4. Include diagrams for power, signal, and control wiring.

20 1.4 INFORMATIONAL SUBMITTALS

- 21 A. Coordination Drawings: Plans, elevations, and other details, drawn to scale, on which the
22 following items are shown and coordinated with each other, using input from installers of the
23 items involved:

- 24 1. Structural members to which equipment will be attached.
25 2. Gas piping to heater installations
26 3. Thermostats and wiring to heaters.

- 1 4. Heater locations and clearance requirements.
- 2 5. Other suspended ceiling components including the following:
 - 3 a. Lighting fixtures.
 - 4 b. Air outlets and inlets.
 - 5 c. Sprinklers.
- 6 B. Field quality-control reports.
- 7 C. Sample Warranty: For manufacturer's special warranties.
- 8 1.5 CLOSEOUT SUBMITTALS
 - 9 A. Operation and Maintenance Data: For gas-fired, radiant heaters to include in emergency,
10 operation, and maintenance manuals.
- 11 1.6 WARRANTY
 - 12 A. Manufacturer's Special Warranty: Manufacturer agrees to repair or replace components of
13 radiant heaters that fail in materials or workmanship within specified warranty period.
 - 14 1. Warranty Period: All warranty periods listed below are from date of Substantial
15 Completion.
 - 16 a. Burner Assembly: Three years.
 - 17 b. Combustion and Emitter Tubes: Two years.
 - 18 c. Heater Controls: One year(s).
- 19 PART 2 - PRODUCTS
 - 20 2.1 PERFORMANCE REQUIREMENTS
 - 21 A. CSA certified, with CSA Seal and certification number clearly visible on units indicating
22 compliance with ANSI Z83.20/CSA 2.34.
 - 23 B. UL listed and labeled, with UL label clearly visible on units indicating compliance with
24 ANSI Z83.20/CSA 2.34.
 - 25 C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by
26 a qualified testing agency, and marked for intended location and application.

1

2 2.2 FORCED-DRAFT HEATERS

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

- 5 1. Detroit Radiant Products Company.
- 6 2. Roberts-Gordon, LLC.
- 7 3. Sterling Heating, Ventilation & Air-Conditioning Products; a Mestek company.

8 B. Description: Factory-assembled, indoor, overhead-mounted, electrically controlled, low-
9 intensity, infrared radiant heating units using gas combustion. Heater to have all necessary
10 factory-installed wiring and piping required prior to field installation and startup.

11 C. Fuel Type: Design burner for natural gas having characteristics same as those of gas available
12 at Project site.

13 D. Burner Assembly:

- 14 1. Combustion-Air Inlet: Ducted vertical to outdoors through roof with vent caps.
- 15 2. Burner Control Housing: Corrosion-resistant, aluminized steel.

- 16 a. Totally enclosed with steel access cover.
- 17 b. Sight glass for visual inspection of burner.
- 18 c. Finish: Powder-coated finish.

19 3. Burner: Stainless steel.

20 4. Ignition System: Silicon carbide hot-surface igniter with flame rod sensing
21 capabilities and self-diagnostic control module.

22 5. Combustion Blower Fan: Dynamically balanced, direct-driven, forward-curved fan with
23 cast-aluminum-alloy impeller and aluminized-steel housing, with a minimum
24 temperature rating of 450 deg F.

25 6. Motors: General requirements for motors are specified in Section 230513 "Common
26 Motor Requirements for HVAC Equipment."

27 a. Motor: Resilient-mounted, capacitor-start-capacitor-run type with sealed ball
28 bearings; totally enclosed, nonventilated type with internal thermal protection.

29 b. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven
30 load will not require motor to operate in service factor range above 1.0.

31 E. Combustion Chamber: 4-inch- diameter, 16-gage, titanium-coated aluminized-steel tubing
32 with high-emissivity, high-temperature, corrosion-resistant external finish. Chambers shall be
33 equipped with sight glass for burner and pilot flame observation.

- 1 F. Emitter Tube: 4-inch diameter, 16-gage, aluminized-steel tubing with high-emissivity, high-
2 temperature, corrosion-resistant external finish.
- 3 1. Tubing Connections: Interlocking flare joints with stainless-steel draw bolts.
4 2. 180-degree-bend emitter steel tubing with high-emissivity, high-temperature, corrosion-
5 resistant external finish.
6 3. Exhaust Vent Termination: Vertical through roof with vent caps.
- 7 G. Reflector: Polished aluminum, with end caps. Shape to control radiation from tubing for
8 uniform intensity at floor level with 100 percent cutoff above centerline of tubing. Reflectors
9 or entire heater shall accommodate rotational adjustment from horizontal to a minimum 30-
10 degree tilt from vertical.
- 11 H. Accessories:
- 12 1. Reflector Extension Shields: Same material as reflectors, arranged for fixed connection
13 to lower reflector lip and rigid support to provide 100 percent cutoff of direct radiation
14 from tubing at angles greater than 30 degrees from vertical.
15 2. Protective grilles mounted to reflectors to protect emitter tubing.
16 3. Stainless-steel flexible connector with manual valve for gas supply.
17 4. Hanger chain with "S" hooks.
18 5. 3/16-inch- diameter, galvanized-steel wire tubing hangers and reflector supports.
19 6. Rigid mounting kits.
20 7. Clearance warning plaque.
- 21 2.3 CONTROLS AND SAFETIES
- 22 A. Gas Control Valve: Modulating, regulated redundant 24-V ac gas valve that contains pilot
23 solenoid valve, electric gas valve, pilot filter, pressure regulator, pilot shutoff, and manual
24 shutoff all in one body.
- 25 B. Failure Safeguards: 100 percent shutoff of gas flow in the event of flame or power failure.
- 26 C. Prepurge of 45 seconds of air control system prior to burner ignition.
- 27 D. Safety lockout of burner after flame is not reestablished within trial ignition period.
- 28 E. Blocked Vent Safety: Differential pressure switch in burner safety circuit to stop burner
29 operation with high discharge or suction pressure.
- 30 F. Control Panel Interlock: Stops burner if panel is open.
- 31 G. Indicator Lights: "Airflow-on" and "burner-on" indicator lights.

- 1 H. Thermostat: Devices and wiring are specified in Section 230900 "Instrumentation and Control
2 for HVAC."

3 PART 3 - EXECUTION

4 3.1 EXAMINATION

- 5 A. Examine structures, substrates, areas and conditions, with Installer present, for compliance
6 with requirements for installation tolerances, required clearances, and other conditions
7 affecting performance of the Work.
- 8 B. Examine roughing-in for fuel-gas piping to verify actual locations of piping connections before
9 equipment installation.
- 10 C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of
11 the Work.
- 12 D. Proceed with installation only after unsatisfactory conditions have been corrected.

13 3.2 INSTALLATION

- 14 A. Equipment Installation: Install gas-fired, radiant heaters and associated gas features and
15 systems according to NFPA 54.
- 16 B. Suspended Units: Suspend from substrate using chain hanger kits and building attachments.
- 17 1. Restrain the unit to resist seismic acceleration. Comply with requirements for seismic-
18 restraint devices specified in Section 230548 "Vibration and Seismic Controls for HVAC."
19 2. Comply with requirements for hangers and supports specified in Section 230529
20 "Hangers and Supports for HVAC Piping and Equipment."
- 21 C. Maintain manufacturers' recommended clearances for combustibles.

22 3.3 CONNECTIONS

- 23 A. Gas Piping: Comply with Section 231123 "Facility Natural-Gas Piping." Connect gas piping to
24 gas train inlet; provide union with enough clearance for burner removal and service.
- 25 1. Gas Connections: Connect gas piping to radiant heaters according to NFPA 54.

- 1 B. Where installing piping adjacent to gas-fired, radiant heaters, allow space for service and
2 maintenance.
- 3 C. Vent Connections: Comply with Section 233113 "Metal Ducts" and with Section 235100
4 "Breechings, Chimneys, and Stacks."
- 5 D. Electrical Connections: Comply with applicable requirements in Section 260519 "Low-Voltage
6 Electrical Power Conductors and Cables."
- 7 1. Install electrical devices furnished with heaters but not specified to be factory mounted.

8 3.4 FIELD QUALITY CONTROL

- 9 A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and
10 inspect components, assemblies, and equipment installations, including connections.
- 11 B. Perform the following tests and inspections with the assistance of a factory-authorized service
12 representative:
- 13 1. Test and adjust controls and safeties. Replace damaged and malfunctioning controls
14 and equipment.
- 15 2. Verify bearing lubrication.
- 16 3. Verify proper motor rotation.
- 17 4. Test Reports: Prepare a written report to record the following:
- 18 a. Test procedures used.
- 19 b. Test results that comply with requirements.
- 20 c. Test results that do not comply with requirements and corrective action taken to
21 achieve compliance with requirements.
- 22 C. Gas-fired, radiant heaters will be considered defective if they do not pass tests and
23 inspections.
- 24 D. Prepare test and inspection reports.

25 3.5 ADJUSTING

- 26 A. Adjust initial-temperature set points.
- 27 B. Adjust burner and other unit components for optimum heating performance and efficiency.

- 1 3.6 DEMONSTRATION
- 2 A. Engage a factory-authorized service representative to train Owner's maintenance personnel to
- 3 adjust, operate, and maintain gas-fired, radiant heaters.

- 4 END OF SECTION 23 55 23.13

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1 SECTION 235533.16 – GAS-FIRED UNIT HEATERS

2 PART 1 - GENERAL

3 1.1 RELATED DOCUMENTS

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

6 1.2 SUMMARY

- 7 A. Section includes gas-fired unit heaters.

8 1.3 ACTION SUBMITTALS

- 9 A. Product Data: For each type of gas-fired unit heater.

10 1. Include rated capacities, operating characteristics, and accessories.

- 11 B. Shop Drawings: For gas-fired unit heaters. Include plans, elevations, sections, and attachment
12 details.

13 1. Include details of equipment assemblies. Indicate dimensions, weights, loads, required
14 clearances, method of field assembly, components, and location and size of each field
15 connection.

16 2. Include diagrams for power, signal, and control wiring.

17 1.4 INFORMATIONAL SUBMITTALS

- 18 A. Coordination Drawings: Plans, elevations, and other details, drawn to scale, on which the
19 following items are shown and coordinated with each other, using input from installers of the
20 items involved:

21 1. Structural members to which equipment will be attached.

22 2. Items penetrating roof and the following:

23 a. Vent and gas piping rough-ins and connections.

- 24 B. Field quality-control reports.

- 1 1.5 CLOSEOUT SUBMITTALS
- 2 A. Operation and Maintenance Data: For gas-fired unit heaters to include in emergency,
3 operation, and maintenance manuals.
- 4 1.6 QUALITY ASSURANCE
- 5 A. ASHRAE/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6 -
6 "Heating, Ventilating, and Air-Conditioning."
- 7 1.7 WARRANTY
- 8 A. Special Warranty: Manufacturer agrees to repair or replace heat exchanger of gas-fired unit
9 heater that fails in materials or workmanship within specified warranty period.
- 10 1. Warranty Period: Two years from date of Substantial Completion.
- 11 PART 2 - PRODUCTS
- 12 2.1 MANUFACTURERS
- 13 A. Manufacturers: Subject to compliance with requirements, provide products by one of the
14 following:
- 15 1. Modine Manufacturing Company.
16 2. REZNOR, a brand of Nortek Global HVAC.
17 3. Sterling HVAC Products; a Mestek company.
- 18 2.2 PERFORMANCE REQUIREMENTS
- 19 A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by
20 a qualified testing agency, and marked for intended location and application.
- 21 2.3 MANUFACTURED UNITS
- 22 A. Description: Factory assembled, piped, and wired, and complying with ANSI Z83.8/CSA 2.6.
- 23 B. Gas Type: Design burner for natural gas having characteristics same as those of gas available at
24 Project site.
- 25 C. Type of Venting: Powered vented.

- 1
- 2 D. Housing: Steel, with integral draft hood and inserts for suspension mounting rods.
- 3 1. External Casings and Cabinets: Baked enamel over corrosion-resistant-treated surface.
- 4 2. Discharge Louvers: Independently adjustable, horizontal blades.
- 5 E. Accessories:
- 6 1. Four-point suspension kit.
- 7 2. Power Venter: Centrifugal aluminized-steel fan, with stainless-steel shaft; 120-V ac
- 8 motor.
- 9 3. Concentric, Terminal Vent Assembly: Combined combustion-air inlet and power-vent
- 10 outlet with wall or roof caps. Include adapter assembly for connection to inlet and
- 11 outlet pipes, and flashing for wall or roof penetration.
- 12 F. Heat Exchanger: Aluminized steel.
- 13 G. Burner Material: Aluminized steel with stainless-steel inserts.
- 14 H. Propeller Unit Fan:
- 15 1. Formed-steel propeller blades riveted to heavy-gage steel spider bolted to cast-iron
- 16 hub, dynamically balanced, and resiliently mounted.
- 17 2. Fan-Blade Guard: Galvanized steel, complying with OSHA specifications, removable for
- 18 maintenance.
- 19 I. Centrifugal Unit Fan:
- 20 1. Steel, centrifugal fan dynamically balanced and resiliently mounted.
- 21 2. Belt-Driven Drive Assembly:
- 22 a. Resiliently mounted to housing, with the following features:
- 23 1) Fan Shaft: Turned, ground, and polished steel; keyed to wheel hub.
- 24 2) Shaft Bearings: Permanently lubricated, permanently sealed, self-aligning
- 25 ball bearings.
- 26 3) Pulleys: Cast-iron, adjustable-pitch motor pulley.
- 27 J. Motors:
- 28 1. Comply with NEMA designation, temperature rating, service factor, and efficiency
- 29 requirements for motors specified in Section 230513 "Common Motor Requirements for
- 30 HVAC Equipment."
- 31 2. Enclosure Materials: Rolled steel.

- 1 3. Efficiency: Premium efficient.
- 2 K. Controls: Regulated redundant gas valve containing pilot solenoid valve, electric gas valve,
3 pilot filter, pressure regulator, pilot shutoff, and manual shutoff all in one body.
- 4 1. Gas Control Valve: Two stage.
- 5 2. Ignition: Electronically controlled electric spark with flame sensor.
- 6 3. Fan Thermal Switch: Operates fan on heat-exchanger temperature.
- 7 4. Vent Flow Verification: Differential pressure switch to verify open vent.
- 8 5. Control transformer.
- 9 6. High Limit: Thermal switch or fuse to stop burner.
- 10 7. Unit-Mounted Thermostat:
 - 11 a. Two stage.
 - 12 b. Fan on-off-automatic switch.
 - 13 c. 24-V ac.
 - 14 d. 50 to 90 deg F (10 to 32 deg C) operating range.
- 15 L. Electrical Connection: Factory wire motors and controls for a single electrical connection.

16 PART 3 - EXECUTION

17 3.1 INSTALLATION

- 18 A. Install and connect gas-fired unit heaters and associated gas and vent features and systems
19 according to NFPA 54, applicable local codes and regulations, and manufacturer's written
20 instructions.

21 3.2 EQUIPMENT MOUNTING

- 22 A. Suspended Units: Suspend from substrate using threaded rods, spring hangers, and building
23 attachments. Secure rods to unit hanger attachments. Adjust hangers so unit is level and
24 plumb.

- 25 B. Substrate-Mounted Units: Provide supports connected to substrate. Secure units to supports.
- 26 1. Threaded Rods, Spring Hangers, and Building Attachments: Comply with requirements in
27 Section 230529 "Hangers and Supports for HVAC Piping and Equipment" and
28 Section 230548 "Vibration and Seismic Controls for HVAC."
 - 29 2. Threaded Rods, Spring Hangers, Building Attachments, and Seismic Restraints: Comply
30 with requirements in Section 230529 "Hangers and Supports for HVAC Piping and
31 Equipment." and Section 230548 "Vibration and Seismic Controls for HVAC."
 - 32 3. Anchor the unit to resist code-required horizontal acceleration.

- 1 3.3 CONNECTIONS
- 2 A. Piping installation requirements are specified in other Sections. Drawings indicate general
3 arrangement of piping, fittings, and specialties.
- 4 B. Where installing piping adjacent to gas-fired unit heater, allow space for service and
5 maintenance.
- 6 C. Gas Piping: Comply with Section 231123 "Facility Natural-Gas Piping." Connect gas piping to
7 gas train inlet; provide union with enough clearance for burner removal and service.
- 8 D. Vent Connections: Comply with Section 235123 "Gas Vents."
- 9 E. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical
10 Systems."
- 11 F. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and
12 Cables."
- 13 3.4 FIELD QUALITY CONTROL
- 14 A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and
15 inspect components, assemblies, and equipment installations, including connections.
- 16 B. Perform the following tests and inspections:
- 17 1. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and
18 equipment.
- 19 2. Verify bearing lubrication.
- 20 3. Verify proper motor rotation.
- 21 4. Test Reports: Prepare a written report to record the following:
- 22 a. Test procedures used.
- 23 b. Test results that comply with requirements.
- 24 c. Test results that do not comply with requirements and corrective action taken to
25 achieve compliance with requirements.
- 26 C. Gas-fired unit heater will be considered defective if it does not pass tests and inspections.
- 27 D. Prepare test and inspection reports.

- 1 3.5 ADJUSTING
- 2 A. Adjust initial temperature and humidity set points.
- 3 B. Adjust burner and other unit components for optimum heating performance and efficiency.
- 4 3.6 DEMONSTRATION
- 5 A. Train Owner's maintenance personnel to adjust, operate, and maintain gas-fired unit heaters.
- 6 END OF SECTION 235533.16

1 SECTION 236313 – AIR-COOLED REFRIGERANT CONDENSERS

2 PART 1 - GENERAL

3 1.1 RELATED DOCUMENTS

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

6 1.2 SUMMARY

- 7 A. Section includes packaged, air-cooled refrigerant condensers for outdoor indoor installation.

8 1.3 ACTION SUBMITTALS

- 9 A. Product Data: For each air-cooled refrigerant condenser. Include rated capacities, operating
10 characteristics, furnished specialties, and accessories. Include equipment dimensions, weights
11 and structural loads, required clearances, method of field assembly, components, and location
12 and size of each field connection.
- 13 B. Shop Drawings: For air-cooled refrigerant condensers. Include plans, elevations, sections,
14 details, and attachments to other work.
- 15 1. Detail equipment assemblies and indicate dimensions, weights, loads, required
16 clearances, method of field assembly, components, and location and size of each field
17 connection.
- 18 2. Wiring Diagrams: For power, signal, and control wiring.

19 1.4 INFORMATIONAL SUBMITTALS

- 20 A. Field quality-control reports.

21 1.5 CLOSEOUT SUBMITTALS

- 22 A. Operation and Maintenance Data: For air-cooled refrigerant condensers to include in
23 emergency, operation, and maintenance manuals.

- 1 1.6 QUALITY ASSURANCE
- 2 A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by
3 a qualified testing agency, and marked for intended location and application.
- 4 B. Fabricate and label refrigeration system according to ASHRAE 15, "Safety Standard for
5 Refrigeration Systems."
- 6 1.7 COORDINATION
- 7 A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete,
8 reinforcement, and formwork requirements are specified in Section 033000 "Cast-in-Place
9 Concrete."
- 10 B. Coordinate location of refrigerant piping and electrical rough-ins.
- 11 PART 2 - PRODUCTS
- 12 2.1 MANUFACTURERS
- 13 A. Manufacturers: Subject to compliance with requirements, provide products by one of the
14 following:
- 15 1. American Standard.
16 2. Trane.
17 3. YORK, a Johnson Controls Company.
- 18 2.2 MANUFACTURED UNITS
- 19 A. Description: Factory assembled and tested; consisting of casing, condenser coils, condenser
20 fans and motors, and unit controls.
- 21 B. Refrigerant: R-410A.
- 22 C. Condenser Coil: Factory tested at 425 psig.
23 1. Tube: Seamless copper.
24 2. Coil Fin: Aluminum.
25 3. Circuit: To match compressors with liquid subcooling coil.

- 1 D. Condenser Fans and Drives: Propeller fans with aluminum or galvanized-steel galvanized-steel
2 fan blades, for vertical air discharge; directly driven with permanently lubricated ball-bearing
3 motors with integral current- and thermal-overload protection.
4 1. Weather-proof motors with rain shield and shaft slinger.
5 2. Extend grease lines to outside of casing.
- 6 E. Operating and Safety Controls: Include condenser fan motor thermal and overload cutouts;
7 115-V control transformer, if required; magnetic contactors for condenser fan motors and a
8 nonfused factory-mounted and -wired disconnect switch for single external electrical power
9 connection.
- 10 F. Casings: Galvanized or zinc-coated steel treated and finished with manufacturer's standard
11 paint coating, designed for outdoor installation with weather protection for components and
12 controls, and with the following:
13 1. Removable panels for access to controls, condenser fans, motors, and drives.
14 2. Plated-steel fan guards.
15 3. Lifting eyes.
- 16 G. Accessories:
17 1. Crankcase heater.
18 2. Cycle Protector: Automatic reset timer to prevent rapid compressor cycling.
19 3. Evaporator Freeze Thermostat: Temperature-actuated switch that steps until
20 evaporator reaches freezing temperature.
21 4. Filter dryer.
22 5. High-Pressure Switch: Automatic reset switch, cycles compressor off on high refrigerant
23 pressure.
24 6. Low Ambient Controller: Cycles condenser fan to permit operation down to 0 deg F.
25 7. Low Pressure Switch: Automatic reset switch cycles compressor off on low refrigerant
26 pressure.
27 8. Precharged and insulated suction and liquid tubing.
28 9. Thermostatic expansion valve.
29 10. Time Delay Relay: Continues operation of evaporator fan after compressor shuts off.

30 2.3 MOTORS

- 31 A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and
32 efficiency requirements for motors specified in Section 230513 "Common Motor Requirements
33 for HVAC Equipment."
34 1. Enclosure Type: Totally enclosed, fan cooled.
35 2. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load
36 will not require motor to operate in service factor range above 1.0.

1 2.4 SOURCE QUALITY CONTROL

2 A. Verification of Performance: Rate air-cooled refrigerant condensers according to ARI 460.

3 B. Testing Requirements: Factory test sound-power-level ratings according to ARI 270.

4 PART 3 - EXECUTION

5 3.1 EXAMINATION

6 A. Examine substrates, areas, and conditions, with Installer present, for compliance with
7 requirements for installation tolerances and other conditions affecting performance of air-
8 cooled refrigerant condensers.

9 B. Examine roughing-in for refrigerant piping systems to verify actual locations of piping
10 connections before equipment installation.

11 C. Examine walls, floors, and roofs for suitable conditions where air-cooled condensers will be
12 installed.

13 D. Proceed with installation only after unsatisfactory conditions have been corrected.

14 3.2 INSTALLATION

15 A. Install units level and plumb, firmly anchored in locations indicated; maintain manufacturer's
16 recommended clearances.

17 B. Maintain manufacturer's recommended clearances for service and maintenance.

18 C. Loose Components: Install electrical components, devices, and accessories that are not
19 factory mounted.

20 3.3 CONNECTIONS

21 A. Piping installation requirements are specified in Section 232113 "Hydronic Piping" and Section
22 232116 Hydronic Piping Specialties." Drawings indicate general arrangement of piping, fittings,
23 and specialties.

24 B. Install piping adjacent to machine to allow service and maintenance.

1 C. Refrigerant Piping: Connect piping to unit with pressure relief, service valve, filter-dryer, and
2 moisture indicator on each refrigerant-circuit liquid line. Refrigerant piping and specialties are
3 specified in Section 232300 "Refrigerant Piping."

4 3.4 FIELD QUALITY CONTROL

5 A. Perform tests and inspections.

6 1. Manufacturer's Field Service: Engage a factory-authorized service representative to
7 inspect, test, and adjust components, assemblies, and equipment installations, including
8 connections, and to assist in testing.

9 B. Tests and Inspections:

10 1. Perform electrical test and visual and mechanical inspection.

11 2. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest
12 until no leaks exist.

13 3. Operational Test: After electrical circuitry has been energized, start units to confirm
14 proper motor rotation and unit operation. Complete manufacturer's starting checklist.

15 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and
16 equipment.

17 5. Verify proper airflow over coils.

18 C. Verify that vibration isolation and flexible connections properly dampen vibration transmission
19 to structure.

20 D. Air-cooled refrigerant condensers will be considered defective if they do not pass tests and
21 inspections.

22 E. Prepare test and inspection reports.

23 3.5 STARTUP SERVICE

24 A. Engage a factory-authorized service representative to perform startup service.

25 1. Complete installation and startup checks according to manufacturer's written
26 instructions and perform the following:

27 a. Inspect for physical damage to unit casing.

28 b. Verify that access doors move freely and are weathertight.

29 c. Clean units and inspect for construction debris.

30 d. Verify that all bolts and screws are tight.

31 e. Adjust vibration isolation and flexible connections.

32 f. Verify that controls are connected and operational.

33 2. Lubricate bearings on fan motors.

34 3. Verify that fan wheel is rotating in the correct direction and is not vibrating or binding.

35 4. Adjust fan belts to proper alignment and tension.

- 1 5. Start unit according to manufacturer's written instructions and complete manufacturer's
- 2 startup checklist.
- 3 6. Measure and record airflow and air temperature rise over coils.
- 4 7. Verify proper operation of capacity control device.
- 5 8. Verify that vibration isolation and flexible connections properly dampen vibration
- 6 transmission to structure.
- 7 9. After startup and performance test, lubricate bearings.

8 3.6 DEMONSTRATION

- 9 A. Engage a factory-authorized service representative to train Owner's maintenance personnel to
- 10 adjust, operate, and maintain air-cooled refrigerant condensers.

11 END OF SECTION 236313

1 SECTION 23 8126 - SPLIT-SYSTEM AIR-CONDITIONERS

2 PART 1 - GENERAL

3 1.1 RELATED DOCUMENTS

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

6 1.2 SUMMARY

- 7 A. Section includes split-system air-conditioning and heat-pump units consisting of separate
8 evaporator-fan and compressor-condenser components.

9 1.3 ACTION SUBMITTALS

- 10 A. Product Data: For each type of product indicated. Include rated capacities, operating
11 characteristics, and furnished specialties and accessories. Include performance data in terms
12 of capacities, outlet velocities, static pressures, sound power characteristics, motor
13 requirements, and electrical characteristics.

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

- 15 1. Detail equipment assemblies and indicate dimensions, weights, loads, required
16 clearances, method of field assembly, components, and location and size of each field
17 connection.
18 2. Wiring Diagrams: For power, signal, and control wiring.

- 19 C. Samples for Initial Selection: For units with factory-applied color finishes.

20 1.4 INFORMATIONAL SUBMITTALS

- 21 A. Field quality-control reports.

- 22 B. Warranty: Sample of special warranty.

23 1.5 CLOSEOUT SUBMITTALS

- 24 A. Operation and Maintenance Data: For split-system air-conditioning units to include in
25 emergency, operation, and maintenance manuals.

- 26 1.6 MAINTENANCE MATERIAL SUBMITTALS
- 27 A. Furnish extra materials that match products installed and that are packaged with protective
28 covering for storage and identified with labels describing contents.
- 29 1. Filters: One set(s) for each air-handling unit.
30 2. Gaskets: One set(s) for each access door.
31 3. Fan Belts: One set(s) for each air-handling unit fan.
- 32 1.7 QUALITY ASSURANCE
- 33 A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by
34 a qualified testing agency, and marked for intended location and application.
- 35 B. ASHRAE Compliance:
- 36 1. Fabricate and label refrigeration system to comply with ASHRAE 15, "Safety Standard for
37 Refrigeration Systems."
38
- 39 C. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1.
- 40 1.8 COORDINATION
- 41 A. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast
42 anchor-bolt inserts into bases. Concrete, reinforcement, and formwork are specified in
43 Section 033000 "Cast-in-Place Concrete."
- 44 B. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with
45 actual equipment provided.
- 46 1.9 WARRANTY
- 47 A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or
48 replace components of split-system air-conditioning units that fail in materials or workmanship
49 within specified warranty period.
- 50 1. Warranty Period:
- 51 a. For Compressor: Five year(s) from date of Substantial Completion.
52 b. For Parts: Five year(s) from date of Substantial Completion.
53 c. For Labor: One year(s) from date of Substantial Completion.

54 PART 2 - PRODUCTS

55 2.1 MANUFACTURERS

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

- 58 1. Samsung HVAC
- 59 2. Daikin AC (Americas), Inc.
- 60 3. LG Electronics.
- 61 4. Mitsubishi Electric & Electronics USA, Inc.

62 2.2 INDOOR UNITS (5 TONS OR LESS)

63 A. Concealed Evaporator-Fan Components:

- 64 1. Chassis: Galvanized steel with flanged edges, removable panels for servicing, and
65 insulation on back of panel.
- 66 2. Insulation: Faced, glass-fiber duct liner.
- 67 3. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and thermal-
68 expansion valve. Comply with ARI 206/110.
- 69 4. Fan: Forward-curved, double-width wheel of galvanized steel; directly connected to
70 motor.
- 71 5. Fan Motors:
 - 72 a. Comply with NEMA designation, temperature rating, service factor, enclosure
73 type, and efficiency requirements specified in Section 230513 "Common Motor
74 Requirements for HVAC Equipment."
 - 75 b. Multitapped, multispeed with internal thermal protection and permanent
76 lubrication.
 - 77 c. Wiring Terminations: Connect motor to chassis wiring with plug connection.
- 78 6. Filters: Permanent, cleanable.

79 2.3 OUTDOOR UNITS (5 TONS OR LESS)

80 A. Air-Cooled, Compressor-Condenser Components:

- 81 1. Casing: Steel, finished with baked enamel in color selected by Architect, with removable
82 panels for access to controls, weep holes for water drainage, and mounting holes in
83 base. Provide brass service valves, fittings, and gage ports on exterior of casing.
- 84 2. Compressor: Hermetically sealed with crankcase heater and mounted on vibration
85 isolation device. Compressor motor shall have thermal- and current-sensitive overload
86 devices, start capacitor, relay, and contactor.

- 87 a. Compressor Type: Scroll.
- 88 b. Two-speed compressor motor with manual-reset high-pressure switch and
- 89 automatic-reset low-pressure switch.
- 90 c. Refrigerant Charge: R-410A.
- 91 d. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and
- 92 liquid subcooler. Comply with ARI 206/110.
- 93 3. Fan: Aluminum-propeller type, directly connected to motor.
- 94 4. Motor: Permanently lubricated, with integral thermal-overload protection.
- 95 5. Low Ambient Kit: Permits operation down to 17 deg F.

96 2.4 ACCESSORIES

- 97 A. Control equipment and sequence of operation are specified in Section 230900
- 98 "Instrumentation and Control for HVAC" and Section 230993 "Sequence and Operations for
- 99 HVAC Controls."
- 100 B. Thermostat: Low voltage with subbase to control compressor and evaporator fan.
- 101 C. Thermostat: Wireless infrared functioning to remotely control compressor and evaporator
- 102 fan, with the following features:
 - 103 1. Compressor time delay.
 - 104 2. 24-hour time control of system stop and start.
 - 105 3. Liquid-crystal display indicating temperature, set-point temperature, time setting,
 - 106 operating mode, and fan speed.
 - 107 4. Fan-speed selection including auto setting.
- 108 D. Automatic-reset timer to prevent rapid cycling of compressor.
- 109 E. Refrigerant Line Kits: Soft-annealed copper suction and liquid lines factory cleaned, dried,
- 110 pressurized, and sealed; factory-insulated suction line with flared fittings at both ends.
- 111 F. Drain Hose: For condensate.

112 PART 3 - EXECUTION

113 3.1 INSTALLATION

- 114 A. Install units level and plumb.
- 115 B. Install evaporator-fan components using manufacturer's standard mounting devices securely
- 116 fastened to building structure.
- 117 C. Equipment Mounting:

- 118 1. Install ground-mounted, compressor-condenser components on cast-in-place concrete
119 equipment base(s). Comply with requirements for equipment bases and foundations.
120 Retain one of two subparagraphs below. Retain first for projects in seismic areas; retain
121 second for projects not in seismic areas. Indicate vibration isolation and seismic-control
122 device type and minimum deflection in supported equipment schedule on Drawings.
- 123 2. Comply with requirements for vibration isolation devices specified in Section 230548.13
124 "Vibration Controls for HVAC."
- 125 D. Install and connect precharged refrigerant tubing to component's quick-connect fittings.
126 Install tubing to allow access to unit.
- 127 3.2 CONNECTIONS
- 128 A. Piping installation requirements are specified in other Sections. Drawings indicate general
129 arrangement of piping, fittings, and specialties.
- 130 B. Where piping is installed adjacent to unit, allow space for service and maintenance of unit.
- 131 3.3 FIELD QUALITY CONTROL
- 132 A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect,
133 test, and adjust components, assemblies, and equipment installations, including connections.
- 134 B. Perform tests and inspections.
- 135 1. Manufacturer's Field Service: Engage a factory-authorized service representative to
136 inspect components, assemblies, and equipment installations, including connections,
137 and to assist in testing.
- 138 C. Tests and Inspections:
- 139 1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest
140 until no leaks exist.
- 141 2. Operational Test: After electrical circuitry has been energized, start units to confirm
142 proper motor rotation and unit operation.
- 143 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls
144 and equipment.
- 145 D. Remove and replace malfunctioning units and retest as specified above.
- 146 E. Prepare test and inspection reports.

147 3.4 STARTUP SERVICE

148 A. Engage a factory-authorized service representative to perform startup service.

149 1. Complete installation and startup checks according to manufacturer's written
150 instructions.

151 3.5 DEMONSTRATION

152 A. Engage a factory-authorized service representative to train Owner's maintenance personnel to
153 adjust, operate, and maintain units.

154 END OF SECTION 23 8126

1 SECTION 238239.19 – WALL AND CEILING HUNG HEATERS

2 PART 1 - GENERAL

3 1.1 RELATED DOCUMENTS

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

6 1.2 SUMMARY

- 7 A. Section includes wall and ceiling heaters with propeller fans and electric-resistance heating
8 coils.

9 1.3 ACTION SUBMITTALS

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

- 11 1. Include rated capacities, operating characteristics, furnished specialties, and
12 accessories.

- 13 B. Shop Drawings:

- 14 1. Include plans, elevations, sections, and details.

- 15 2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required
16 clearances, method of field assembly, components, and location and size of each field
17 connection.

- 18 3. Include details of anchorages and attachments to structure and to supported
19 equipment.

- 20 4. Include equipment schedules to indicate rated capacities, operating characteristics,
21 furnished specialties, and accessories.

- 22 5. Wiring Diagrams: Power, signal, and control wiring.

- 23 C. Samples: For each exposed product and for each color and texture specified.

24 1.4 CLOSEOUT SUBMITTALS

- 25 A. Operation and Maintenance Data: For wall and ceiling unit heaters to include in emergency,
26 operation, and maintenance manuals.

1 PART 2 - PRODUCTS

2 2.1 MANUFACTURERS

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

- 5 1. Berko; Marley Engineered Products.
- 6 2. INDEECO.
- 7 3. Markel Products Company; a subsidiary of TPI Corporation.
- 8 4. Marley Engineered Products.
- 9 5. QMark; Marley Engineered Products.

10 2.2 DESCRIPTION

11 A. Assembly including chassis, electric heating coil, fan, motor, and controls. Comply with
12 UL 2021.

13 B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by
14 a qualified testing agency, and marked for intended location and application.

15 2.3 CABINET

16 A. Front Panel: Stamped-steel louver, with removable panels fastened with tamperproof
17 fasteners.

18 B. Finish: Baked enamel over baked-on primer with manufacturer's standard color selected by
19 Architect, applied to factory-assembled and -tested wall and ceiling heaters before shipping.

20 C. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in
21 ASHRAE 62.1.

22 D. Surface-Mounted Cabinet Enclosure: Steel with finish to match cabinet.

23 2.4 COIL

24 A. Electric-Resistance Heating Coil: Nickel-chromium heating wire, free from expansion noise and
25 60-Hz hum, embedded in magnesium oxide refractory and sealed in corrosion-resistant
26 metallic sheath. Terminate elements in stainless-steel, machine-staked terminals secured with
27 stainless-steel hardware, and limit controls for high-temperature protection. Provide integral
28 circuit breaker for overcurrent protection.

1 2.5 FAN AND MOTOR

2 A. Fan: Aluminum propeller directly connected to motor.

3 B. Motor: Permanently lubricated, multispeed. Comply with requirements in Section 230513
4 "Common Motor Requirements for HVAC Equipment."

5 2.6 CONTROLS

6 A. Controls: Unit-mounted thermostat. Low-voltage relay with transformer kit.

7 B. Electrical Connection: Factory wire motors and controls for a single field connection with
8 disconnect switch.

9 PART 3 - EXECUTION

10 3.1 EXAMINATION

11 A. Examine areas to receive wall and ceiling unit heaters for compliance with requirements for
12 installation tolerances and other conditions affecting performance of the Work.

13 B. Examine roughing-in for electrical connections to verify actual locations before unit-heater
14 installation.

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

16 3.2 INSTALLATION

17 A. Install wall and ceiling unit heaters to comply with NFPA 90A.

18 B. Install wall and ceiling unit heaters level and plumb.

19 C. Install wall-mounted thermostats and switch controls in electrical outlet boxes at heights to
20 match lighting controls. Verify location of thermostats and other exposed control sensors with
21 Drawings and room details before installation.

22 D. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical
23 Systems."

24 E. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and
25 Cables."

1 END OF SECTION 238239.1

DIVISION 26

1 SECTION 260500 – COMMON WORK RESULTS FOR ELECTRICAL

2 PART 1 - GENERAL

3 1.1 RELATED DOCUMENTS

- 4 A. Drawings and general provisions of Contract, including General and Supplementary Conditions
5 and Division 01 Specification Sections, apply to this and the other sections of Division 26.
- 6 B. Refer to civil, architectural, structural, kitchen equipment, and mechanical drawings for
7 coordination of actual dimensions, building construction methods, and additional
8 requirements for Division 26.
- 9 C. If a conflict occurs between drawings and specifications, contractor shall include the most
10 costly means depicted in their bid or bring the conflict to the Architect/Engineer's attention
11 prior to bid.

12 1.2 SUMMARY

- 13 A. This Section includes general administrative and procedural requirements for electrical
14 installations. The following administrative and procedural requirements are included in this
15 Section to expand the requirements specified in Division 01:
- 16 1. Submittals.
17 2. Supporting devices for electrical components.
18 3. Maintenance manuals.
19 4. Concrete equipment bases.
20 5. Electrical installations.
21 6. Owner training sessions.
- 22 B. Related Sections: The following sections contain requirements that relate to this section:
- 23 1. Division 22 and 23 Sections for factory-installed motors, controllers, accessories, and
24 connections.

25 1.3 MATERIAL SUBSTITUTIONS

- 26 A. In addition to the requirements of Division 01, the following definitions, procedures and
27 requirements shall pertain to Division 26 work.
- 28 B. The materials, equipment and specialty items shown on the drawings and/or in these
29 specifications are, in all cases, specified around a list of brand names known and performance

30 proven to the Engineer. Only those manufacturers named on the drawings or in their
31 specifications will be approved for this project.

32 C. Additional Manufacturers: During the bidding period, the Engineer will consider written
33 requests for material substitutions. The Engineer will evaluate the request, and if acceptable,
34 will issue a written Addendum to the Contract Documents. Verbal approval will not be
35 considered binding.

36 D. Approved Equal: The terms “or equal” and “approved equal” are meant to apply only to those
37 manufacturers and brand names listed in these specifications or noted on the drawings. It
38 does not imply “or equal” outside of the limits of the list of manufacturers named for each
39 item.

40 E. The Engineer reserves the sole right for the approval of proposed additional manufacturers,
41 materials, or equipment.

42 F. Requesting approvals: In order to facilitate the evaluation, the Engineer will require the
43 following of each request for approval of material substitution.

44 G. Time: Requests for material substitutions shall be submitted, in writing, at least 14 calendar
45 days prior to bid opening time.

46 H. Product Data: Request shall include manufacturer’s name and address, brochures, catalog
47 literature, performance and test data and reference standards.

48 I. Installation: Provide detailed description of methods of installation as appropriate.

49 J. Benefits: Identify the differences in alternate material or equipment as compared to that
50 specified and indicate the benefits to the project as a result of approving the alternate.

51 K. Samples: Furnish to the Engineer, when requested, samples of proposed material or
52 equipment substitutions. These samples shall remain with the Engineer as long as he deems
53 necessary.

54 L. Costs: All changes required by material substitutions or alternate equipment shall be made at
55 no additional cost to the Owner. All costs incurred by other trades, public utilities or the
56 Owner as a result of the use of such equipment shall be the responsibility of the Contractor.

57 1.4 SUBMITTALS

58 A. General: Follow the procedures specified in Division 01 Section "Submittal Procedures."

59 B. Increase, by the quantity listed below, the number of electrical related shop drawings, product
60 data, and samples submitted, to allow for required distribution plus two copies of each
61 submittal required, which will be retained by the Electrical Consulting Engineer.

- 62 1. Shop Drawings - Initial Submittal: 1 additional blue- or black-line prints.
63 2. Shop Drawings - Final Submittal: 1 additional blue- or black-line prints.
64 3. Product Data: 1 additional copy of each item.
65 4. Samples: 1 addition as set.
- 66 C. Additional copies may be required by individual sections of these Specifications.
- 67 1.5 QUALITY ASSURANCE
- 68 A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70,
69 Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for
70 intended use.
- 71 B. Comply with NFPA 70.
- 72 1.6 COORDINATION
- 73 A. Coordinate chases, slots, inserts, sleeves, and openings with general construction work and
74 arrange in building structure during progress of construction to facilitate the electrical
75 installations that follow.
- 76 B. Sequence, coordinate, and integrate installing electrical materials and equipment for efficient
77 flow of the Work. Coordinate installing large equipment requiring positioning before closing
78 in the building.
- 79 C. Coordinate electrical, telephone, and CATV service connections to components furnished by
80 utility companies and perform all specific duties they require.
- 81 1. Comply with requirements of authorities having jurisdiction and of utility company
82 providing services including any service demolition or build-up charges.
- 83 D. Coordinate location of access panels and doors for electrical items that are concealed by
84 finished surfaces. Access doors and panels are specified in Division 08.
- 85 E. Where electrical identification devices are applied to field-finished surfaces, coordinate
86 installation of identification devices with completion of finished surface.
- 87 F. Where electrical identification markings and devices will be concealed by acoustical ceilings
88 and similar finishes, coordinate installation of these items before ceiling installation.
- 89 1.7 MAINTENANCE MANUALS

- 90 A. Prepare maintenance manuals in accordance with Division 01 Section "Closeout Procedures."
91 In addition to the requirements specified in Division 01, include the following information for
92 equipment items:
- 93 1. Description of function, normal operating characteristics and limitations, performance
94 curves, engineering data and tests, and complete nomenclature and commercial
95 numbers of replacement parts.
 - 96 2. Manufacturer's printed operating procedures to include start-up, break-in, and routine
97 and normal operating instructions; regulation, control, stopping, shutdown, and
98 emergency instructions; and summer and winter operating instructions.
 - 99 3. Maintenance procedures for routine preventative maintenance and troubleshooting;
100 disassembly, repair, and reassembly; aligning and adjusting instructions.
 - 101 4. Servicing instructions and lubrication charts and schedules.
- 102 1.8 DELIVERY, STORAGE, AND HANDLING
- 103 A. Deliver products to the project properly identified with names, model numbers, types, grades,
104 compliance labels, and other information needed for identification.
- 105 1.9 OWNER TRAINING SESSIONS
- 106 A. Comply with the requirements of Division 01 and contractor shall video record all training
107 sessions and provide discs to owner with Operation and Maintenance Manuals.
- 108 PART 2 - PRODUCTS
- 109 2.1 SUPPORTING DEVICES
- 110 A. Material: Cold-formed steel, with corrosion-resistant coating acceptable to authorities having
111 jurisdiction.
 - 112 B. Metal Items for Use Outdoors or in Damp Locations: Hot-dip galvanized or #312 stainless
113 steel.
 - 114 C. Slotted-Steel Channel Supports: Flange edges turned toward web, and 9/16-inch- diameter
115 slotted holes at a maximum of 2 inches o.c., in webs.
 - 116 D. Raceway and Cable Supports: Manufactured clevis hangers, riser clamps, straps, threaded C-
117 clamps with retainers, ceiling trapeze hangers, wall brackets, and spring-steel clamps or click-
118 type hangers.
 - 119 E. Pipe Sleeves: ASTM A 53, Type E, Grade A, Schedule 40, galvanized steel, plain ends.

- 120 F. Cable Supports for Vertical Conduit: Factory-fabricated assembly consisting of threaded body
121 and insulating wedging plug for non-armored electrical cables in riser conduits. Plugs have
122 number and size of conductor gripping holes as required to suit individual risers. Body
123 constructed of malleable-iron casting with hot-dip galvanized finish.
- 124 G. Expansion Anchors: Carbon-steel wedge or sleeve type.
- 125 H. Toggle Bolts: All-steel springhead type.
- 126 I. Powder-Driven Threaded Studs: Heat-treated steel.
- 127 2.2 CONCRETE BASES
- 128 A. Concrete Forms and Reinforcement Materials: As specified in Division 03.
- 129 B. Concrete: 3500-psi, 28-day compressive strength as specified in Division 03.
- 130 2.3 TOUCHUP PAINT
- 131 A. For Equipment: Equipment manufacturer's paint selected to match installed equipment
132 finish.
- 133 B. Galvanized Surfaces: Zinc-rich paint recommended by item manufacturer.
- 134 PART 3 - EXECUTION
- 135 3.1 ELECTRICAL EQUIPMENT INSTALLATION
- 136 A. Headroom Maintenance: If mounting heights or other location criteria are not indicated,
137 arrange and install components and equipment to provide the maximum possible headroom.
- 138 B. Materials and Components: Install level, plumb, and parallel and perpendicular to other
139 building systems and components, unless otherwise indicated.
- 140 C. Equipment: Install to facilitate service, maintenance, and repair or replacement of
141 components. Connect for ease of disconnecting, with minimum interference with other
142 installations.
- 143 D. Right of Way: Give to raceways and piping systems installed at a required slope.
- 144 3.2 ELECTRICAL INSTALLATIONS

- 145 A. General: Sequence, coordinate, and integrate the various elements of electrical systems,
146 materials, and equipment. Comply with the following requirements:
- 147 1. Install temporary electrical power. Lighting and equipment hook-up as required per
148 Division 01.
 - 149 2. Coordinate electrical systems, equipment, and materials installation with other building
150 components.
 - 151 3. Verify all dimensions by field measurements.
 - 152 4. Arrange for chases, slots, and openings in other building components during progress of
153 construction, to allow for electrical installations.
 - 154 5. Coordinate the installation of required supporting devices and sleeves to be set in
155 poured-in-place concrete and other structural components, as they are constructed.
 - 156 6. Sequence, coordinate, and integrate installations of electrical materials and equipment
157 for efficient flow of the Work. Give particular attention to large equipment requiring
158 positioning prior to closing in the building.
 - 159 7. Where mounting heights are not detailed or dimensioned, install systems, materials,
160 and equipment to provide the maximum headroom possible.
 - 161 8. Coordinate connection of electrical systems with exterior underground and overhead
162 utilities and services. Comply with requirements of governing regulations, franchised
163 service companies, and controlling agencies. Provide required connection for each
164 service including all changes.
 - 165 9. Install systems, materials, and equipment to conform with approved submittal data,
166 including coordination drawings, to greatest extent possible. Conform to arrangements
167 indicated by the Contract Documents, recognizing that portions of the Work are shown
168 only in diagrammatic form. Where coordination requirements conflict with individual
169 system requirements, refer conflict to the Architect.
 - 170 10. Install systems, materials, and equipment level and plumb, parallel and perpendicular to
171 other building systems and components, where installed exposed in finished spaces.
 - 172 11. Install electrical equipment to facilitate servicing, maintenance, and repair or
173 replacement of equipment components. As much as practical, connect equipment for
174 ease of disconnecting, with minimum of interference with other installations.
 - 175 12. Install access panel or doors where units are concealed behind finished surfaces. Access
176 panels and doors are specified in Division 08 and Division 26 Section "Common Work
177 Results for Electrical."
 - 178 13. Install systems, materials, and equipment giving right-of-way priority to systems
179 required to be installed at a specified slope.

180 3.3 ELECTRICAL SUPPORTING METHODS

- 181 A. Damp Locations and Outdoors: Hot-dip galvanized materials or non-metallic, U-channel
182 system components.
- 183 B. Dry Locations: Steel materials.
- 184 C. Support Clamps for PVC Raceways: Click-type clamp system.

- 185 D. Conform to manufacturer's recommendations for selecting supports.
- 186 E. Strength of Supports: Adequate to carry all present and future loads, times a safety factor of
187 at least 4; 200-lb- minimum design load.
- 188 F. Mounting Heights:
- 189 1. Mounting heights to bottom of box and above finished floor for the below named items
190 shall be as follows, unless otherwise shown. All other devices' mounting heights shall be
191 as shown on drawings.
- 192 a. Switches - 44"
- 193 b. Receptacles - 16" mounted vertically with ground prong slot at bottom.
- 194 c. Safety switches - 54".
- 195 d. Motor controllers - 54".
- 196 e. Panelboards to top - 72".
- 197 f. Receptacles in mechanical, electrical, janitor and elevator machine rooms - 44"
- 198 g. Telephone terminal boards - 72" to top.
- 199 h. Exterior W.P. convenience - 24" above grade mounted horizontally.
- 200 i. Open-close-stop or ADA push button - 44".
- 201 j. Fire alarm pull station - 44".
- 202 k. Fire alarm horn/strobe or strobe only - 80".
- 203 2. Contractor shall check all equipment and casework layouts with released shop drawings
204 and verify exact mounting heights before rough-in.
- 205 3.4 SUPPORT INSTALLATION
- 206 A. Install support devices to securely and permanently fasten and support electrical components.
- 207 B. Install individual and multiple raceway hangers and riser clamps to support raceways. Provide
208 U-bolts, clamps, attachments, and other hardware necessary for hanger assemblies and for
209 securing hanger rods and conduits.
- 210 C. Support parallel runs of horizontal raceways together on trapeze- or bracket-type hangers.
- 211 D. Size supports for multiple raceway installations so capacity can be increased by a 25 percent
212 minimum in the future.
- 213 E. Support individual horizontal raceways with separate, malleable-iron pipe hangers or clamps.
- 214 F. Install 3/8-inch diameter or larger threaded steel hanger rods, unless otherwise indicated 1/4-
215 inch is acceptable for single conduit runs.
- 216 G. Spring-steel fasteners specifically designed for supporting single conduits or tubing may be
217 used instead of malleable-iron hangers for 1-1/2-inch and smaller raceways serving lighting

- 218 and receptacle branch circuits above suspended ceilings and for fastening raceways to slotted
219 channel and angle supports.
- 220 H. Arrange supports in vertical runs so the weight of raceways and enclosed conductors is carried
221 entirely by raceway supports, with no weight load on raceway terminals.
- 222 I. Simultaneously install vertical conductor supports with conductors.
- 223 J. Separately support cast boxes that are threaded to raceways and used for fixture support.
224 Support sheet-metal boxes directly from the building structure or by bar hangers. If bar
225 hangers are used, attach bar to raceways on opposite sides of the box and support the
226 raceway with an approved fastener not more than 24 inches from the box.
- 227 K. Install metal channel racks for mounting cabinets, panelboards, disconnect switches, control
228 enclosures, pull and junction boxes, transformers, and other devices unless components are
229 mounted directly to structural elements of adequate strength.
- 230 L. Install sleeves for cable and raceway penetrations of concrete slabs and walls unless core-
231 drilled holes are used. Install sleeves for cable and raceway penetrations of masonry and fire-
232 rated gypsum walls and of all other fire-rated floor and wall assemblies. Install sleeves during
233 erection of concrete and masonry walls.
- 234 M. Securely fasten electrical items and their supports to the building structure, unless otherwise
235 indicated. Perform fastening according to the following unless other fastening methods are
236 indicated:
- 237 1. Wood: Fasten with wood screws or screw-type nails.
238 2. Masonry: Toggle bolts on hollow masonry units and expansion bolts on solid masonry
239 units.
240 3. New Concrete: Concrete inserts with machine screws and bolts.
241 4. Existing Concrete: Expansion bolts.
242 5. Instead of expansion bolts, threaded studs driven by a powder charge and provided with
243 lock washers may be used in existing concrete.
244 6. Steel: Welded threaded studs or spring-tension clamps on steel.
- 245 a. Field Welding: Comply with AWS D1.1.
- 246 7. Welding to steel structure may be used only for threaded studs, not for conduits, pipe
247 straps, or other items.
248 8. Light Steel: Sheet-metal screws.
249 9. Fasteners: Select so the load applied to each fastener does not exceed 25 percent of its
250 proof-test load.

251 3.5 FIRESTOPPING

252 A. Apply firestopping to electrical component penetrations of fire-rated floor and wall assemblies
253 to achieve fire-resistance rating of the assembly. Firestopping materials and installation
254 requirements are specified in Division 07.

255 3.6 CONCRETE BASES

256 A. Construct concrete bases of dimensions indicated, but not less than 4 inches larger, in both
257 directions, than supported unit. Follow supported equipment manufacturer's anchorage
258 recommendations and setting templates for anchor-bolt and tie locations, unless otherwise
259 indicated. Use 3000-psi, 28-day compressive-strength concrete and reinforcement as
260 specified in Division 03.

261 3.7 FIELD QUALITY CONTROL

262 A. Inspect installed components for damage and faulty work, including the following:

- 263 1. Supporting devices for electrical components.
- 264 2. Electricity-metering components.
- 265 3. Concrete bases.

266 3.8 REFINISHING AND TOUCHUP PAINTING

267 A. Refinish and touch up paint. Paint materials and application requirements are specified in
268 Division 09.

- 269 1. Clean damaged and disturbed areas and apply primer, intermediate, and finish coats to
270 suit the degree of damage at each location.
- 271 2. Follow paint manufacturer's written instructions for surface preparation and for timing
272 and application of successive coats.
- 273 3. Repair damage to galvanized finishes with zinc-rich paint recommended by
274 manufacturer.
- 275 4. Repair damage to PVC or paint finishes with matching touchup coating recommended
276 by manufacturer.

277 3.9 CLEANING AND PROTECTION

278 A. On completion of installation, including outlets, fittings, and devices, inspect exposed finish.
279 Remove burrs, dirt, paint spots, and construction debris.

280 B. Protect equipment and installations and maintain conditions to ensure that coatings, finishes,
281 and cabinets are without damage or deterioration at time of Substantial Completion.

282
283

284 END OF SECTION 260500

285

1 SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

2 PART 1 - GENERAL

3 1.1 RELATED DOCUMENTS

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

6 1.2 SUMMARY

- 7 A. This Section includes building wires and cables and associated connectors, splices, and
8 terminations for wiring systems rated 600 V and less.

9 1.3 SUBMITTALS

- 10 A. Product Data: For each type of product indicated.
11 B. Field Quality-Control Test Reports: From Contractor.

12 1.4 QUALITY ASSURANCE

- 13 A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70,
14 Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for
15 intended use.
16 B. Comply with NFPA 70.

17 PART 2 - PRODUCTS

18 2.1 MANUFACTURERS

- 19 A. In other Part 2 articles where subparagraph titles below introduce lists, the following
20 requirements apply for product selection:

- 21 1. Manufacturers: Subject to compliance with requirements, provide products by the
22 manufacturers specified.

23 2.2 CONDUCTORS AND CABLES

- 24 A. Manufacturers:
- 25 1. American Insulated Wire Corp.; a Leviton Company.
- 26 2. Colonial.
- 27 3. Encore Wire Limited.
- 28 4. General Cable Corporation.
- 29 5. Republic Wire.
- 30 6. Senator Wire & Cable Company.
- 31 7. Southwire Company.
- 32 B. Refer to Part 3 "Conductor and Insulation Applications" Article for insulation type, cable
33 construction, and ratings.
- 34 C. Conductor Material: Copper complying with NEMA WC 7; solid conductor for No. 12 AWG and
35 smaller, stranded for No. 10 AWG and larger.
- 36 D. Conductor Insulation Types: Type THHN-THWN, XHHW complying with NEMA WC 7.

37 2.3 CONNECTORS AND SPLICES

- 38 A. Manufacturers:
- 39 1. AMP
- 40 2. Burndy
- 41 3. Ideal Industries, Inc.
- 42 4. O-Z/Gedney; EGS Electrical Group LLC.
- 43 5. 3M Company; Electrical Products Division.
- 44 6. Thomas & Betts Corp.
- 45 B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type,
46 and class for application and service indicated.

47 PART 3 - EXECUTION

48 3.1 CONDUCTOR AND INSULATION APPLICATIONS

- 49 A. Service Entrance: Type THHN-THWN, single conductors in raceway, XHHW, single conductors
50 in raceway.
- 51 B. Exposed Feeders: Type THHN-THWN, single conductors in raceway.
- 52 C. Feeders Concealed in Ceilings, Walls, and Partitions: Type THHN-THWN, single conductors in
53 raceway.

- 54 D. Feeders Concealed in Concrete, below Slabs-on-Grade, and in Crawlspace: Type THHN-
55 THWN, single conductors in raceway.
- 56 E. Exposed Branch Circuits, including in Crawlspace: Type THHN-THWN, single conductors in
57 raceway.
- 58 F. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN-THWN, single
59 conductors in raceway.
- 60 G. Branch Circuits Concealed in Concrete and below Slabs-on-Grade: Type THHN-THWN, single
61 conductors in raceway.
- 62 H. Cord Drops and Portable Appliance Connections: Type SO, hard service cord.
- 63 I. Fire Alarm Circuits: Plenum rated Power-limited, fire-protective, signaling circuit cable. Cable
64 shall be installed in raceway in areas with open structure or where ceiling is not accessible.
- 65 J. Class 1 Control Circuits: Type THHN-THWN, in raceway.
- 66 K. Class 2 Control Circuits: Type THHN-THWN, in raceway.

67 3.2 INSTALLATION

- 68 A. Conceal cable conduits in finished walls, ceilings, and floors, unless otherwise indicated.
- 69 B. Use manufacturer-approved pulling compound or lubricant where necessary; compound used
70 must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended
71 maximum pulling tensions and sidewall pressure values.
- 72 C. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that
73 will not damage cables or raceway.
- 74 D. Install exposed cables parallel and perpendicular to surfaces of exposed structural members,
75 and follow surface contours where possible.
- 76 E. Support cables according to Division 26 Section "Common Work Results for Electrical."
- 77 F. Seal around cables penetrating fire-rated elements according to Division 07.
- 78 G. Identify and color-code conductors and cables according to Division 26 Section "Identification
79 for Electrical Systems."

80 3.3 CONNECTIONS

- 81 A. Tighten electrical connectors and terminals according to manufacturer's published torque-
82 tightening values. If manufacturer's torque values are not indicated, use those specified in
83 UL 486A.
- 84 B. Make splices and taps that are compatible with conductor material and that possess
85 equivalent or better mechanical strength and insulation ratings than unspliced conductors.
- 86 C. Wiring at Outlets: Install conductor at each outlet, with at least 12 inches of slack.
- 87 3.4 FIELD QUALITY CONTROL
- 88 A. Testing: Perform the following field quality-control testing:
- 89 1. After installing conductors and cables and before electrical circuitry has been energized,
90 test for compliance with requirements.
- 91 2. Perform each electrical test and visual and mechanical inspection stated in NETA ATS,
92 Section 7.3.1. Certify compliance with test parameters.
- 93 B. Test Reports: Prepare a written report to record the following:
- 94 1. Test procedures used.
- 95 2. Test results that comply with requirements.
- 96 3. Test results that do not comply with requirements and corrective action taken to
97 achieve compliance with requirements.
- 98 END OF SECTION 260519

1 SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

2 PART 1 - GENERAL

3 1.1 RELATED DOCUMENTS

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

6 1.2 SUMMARY

- 7 A. This Section includes grounding of electrical systems and equipment. Grounding
8 requirements specified in this Section may be supplemented by special requirements of
9 systems described in other Sections.

10 1.3 SUBMITTALS

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

- 12 B. Product Data: For the following:

- 13 1. Ground rods.

- 14 C. Field Test Reports: Submit written test reports to include the following:

- 15 1. Test procedures used.
16 2. Test results that comply with requirements.
17 3. Results of failed tests and corrective action taken to achieve test results that comply
18 with requirements.

19 1.4 QUALITY ASSURANCE

- 20 A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70,
21 Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for
22 intended use.

- 23 1. Comply with UL 467.

24 PART 2 - PRODUCTS

25 2.1 MANUFACTURERS

- 26 A. Manufacturers: Subject to compliance with requirements, provide products by one of the
27 following:
- 28 1. Grounding Conductors, Cables, Connectors, and Rods:
- 29 a. Apache Grounding/Erico Inc.
30 b. Copperweld Corp.
31 c. Erico Inc.; Electrical Products Group.
32 d. Framatome Connectors/Burndy Electrical.
33 e. Ideal Industries, Inc.
34 f. ILSCO.
35 g. Kearney/Cooper Power Systems.
36 h. Korns: C. C. Korns Co.; Division of Robroy Industries.
37 i. O-Z/Gedney Co.; a business of the EGS Electrical Group.
38 j. Racor, Inc.; Division of Hubbell.
39 k. Thomas & Betts, Electrical.

40 2.2 GROUNDING CONDUCTORS

- 41 A. For insulated conductors, comply with Division 26 Section "Low-Voltage Electrical Power
42 Conductors and Cables."
- 43 B. Material: Copper.
- 44 C. Equipment Grounding Conductors: Insulated with green-colored insulation.
- 45 D. Grounding Electrode Conductors: Stranded cable.
- 46 E. Underground Conductors: Bare, tinned, stranded, unless otherwise indicated.
- 47 F. Bare Copper Conductors: Comply with the following:
- 48 1. Solid Conductors: ASTM B 3.
49 2. Assembly of Stranded Conductors: ASTM B 8.
50 3. Tinned Conductors: ASTM B 33.
- 51 G. Copper Bonding Conductors: As follows:
- 52 1. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG copper conductor, 1/4 inch in
53 diameter.
54 2. Bonding Conductor: No. 4 stranded copper conductor.
55 3. Bonding Jumper: Bare copper tape, braided bare copper conductors, terminated with
56 copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
57 4. Tinned Bonding Jumper: Tinned-copper tape, braided copper conductors, terminated
58 with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
- 59 H. Grounding Bus: Bare, annealed copper bars of rectangular cross section, with insulators.

60 2.3 CONNECTOR PRODUCTS

61 A. Comply with IEEE 837 and UL 467; listed for use for specific types, sizes, and combinations of
62 conductors and connected items.

63 B. Welded Connectors: Exothermic-welded type, in kit form, and selected per manufacturer's
64 written instructions.

65 2.4 GROUNDING ELECTRODES

66 A. Ground Rods: Copper-clad steel.

67 1. Size: $\frac{3}{4}$ diameter by 120 inches in length.

68 PART 3 - EXECUTION

69 3.1 APPLICATION

70 A. Use only copper conductors for both insulated and bare grounding conductors in direct
71 contact with earth, concrete, masonry, crushed stone, and similar materials.

72 B. In raceways, use insulated equipment grounding conductors.

73 C. Exothermic-Welded Connections: Use for connections to structural steel and for underground
74 connections, except those at test wells.

75 D. Equipment Grounding Conductor Terminations: Use bolted pressure clamps.

76 E. Underground Grounding Conductors: Use copper conductor, No. 2/0 AWG minimum. Bury at
77 least 30 inches below grade.

78 3.2 EQUIPMENT GROUNDING CONDUCTORS

79 A. Comply with NFPA 70, Article 250, for types, sizes, and quantities of equipment grounding
80 conductors, unless specific types, larger sizes, or more conductors than required by NFPA 70
81 are indicated.

82 B. Install equipment grounding conductors in all feeder and branch circuits conduits and
83 raceways.

84 C. Install insulated equipment grounding conductor with circuit conductors for the following
85 items, in addition to those required by NEC:

86 1. Feeders and branch circuits.

87 2. Lighting circuits.

- 88 3. Receptacle circuits.
- 89 4. Single-phase motor and appliance branch circuits.
- 90 5. Three-phase motor and appliance branch circuits.
- 91 6. Flexible raceway runs.
- 92 D. Nonmetallic Raceways: Install an equipment grounding conductor in nonmetallic raceways
- 93 unless they are designated for telephone or data cables.
- 94 3.3 INSTALLATION
- 95 A. Ground Rods: Install at least three rods spaced at least one-rod length from each other and
- 96 located at least the same distance from other grounding electrodes.
- 97 1. Drive ground rods until tops are 2 inches below finished floor or final grade, unless
- 98 otherwise indicated.
- 99 2. Interconnect ground rods with grounding electrode conductors. Use exothermic welds,
- 100 except at test wells and as otherwise indicated. Make connections without exposing
- 101 steel or damaging copper coating.
- 102 B. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise
- 103 indicated. Avoid obstructing access or placing conductors where they may be subjected to
- 104 strain, impact, or damage.
- 105 C. Bonding Straps and Jumpers: Install so vibration by equipment mounted on vibration isolation
- 106 hangers and supports is not transmitted to rigidly mounted equipment. Use exothermic-
- 107 welded connectors for outdoor locations, unless a disconnect-type connection is required;
- 108 then, use a bolted clamp. Bond straps directly to the basic structure taking care not to
- 109 penetrate any adjacent parts. Install straps only in locations accessible for maintenance.
- 110 D. Metal Water Service Pipe: Provide insulated copper grounding conductors, in conduit, from
- 111 building's main service equipment, or grounding bus, to main metal water service entrances to
- 112 building. Connect grounding conductors to main metal water service pipes by grounding
- 113 clamp connectors. Where a dielectric main water fitting is installed, connect grounding
- 114 conductor to street side of fitting. Bond metal grounding conductor conduit or sleeve to
- 115 conductor at each end.
- 116 E. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters.
- 117 Connect to pipe with grounding clamp connectors.
- 118 F. Bond interior metal piping systems and metal air ducts to equipment grounding conductors of
- 119 associated pumps, fans, blowers, electric heaters, and air cleaners. Use braided-type bonding
- 120 straps.
- 121 G. Bond each aboveground portion of gas piping system upstream from equipment shutoff valve.

122 3.4 CONNECTIONS

- 123 A. General: Make connections so galvanic action or electrolysis possibility is minimized. Select
124 connectors, connection hardware, conductors, and connection methods so metals in direct
125 contact will be galvanically compatible.
- 126 1. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make
127 contact points closer to order of galvanic series.
- 128 2. Make connections with clean, bare metal at points of contact.
- 129 3. Coat and seal connections having dissimilar metals with inert material to prevent future
130 penetration of moisture to contact surfaces.
- 131 B. Exothermic-Welded Connections: Comply with manufacturer's written instructions. Welds
132 that are puffed up or that show convex surfaces indicating improper cleaning are not
133 acceptable.
- 134 C. Equipment Grounding Conductor Terminations: For No. 8 AWG and larger, use pressure-type
135 grounding lugs. No. 10 AWG and smaller grounding conductors may be terminated with
136 winged pressure-type connectors.
- 137 D. Noncontact Metal Raceway Terminations: If metallic raceways terminate at metal housings
138 without mechanical and electrical connection to housing, terminate each conduit with a
139 grounding bushing. Connect grounding bushings with a bare grounding conductor to
140 grounding bus or terminal in housing. Bond electrically noncontinuous conduits at entrances
141 and exits with grounding bushings and bare grounding conductors, unless otherwise indicated.
- 142 E. Tighten screws and bolts for grounding and bonding connectors and terminals according to
143 manufacturer's published torque-tightening values. If manufacturer's torque values are not
144 indicated, use those specified in UL 486A.
- 145 F. Compression-Type Connections: Use hydraulic compression tools to provide correct
146 circumferential pressure for compression connectors. Use tools and dies recommended by
147 connector manufacturer. Provide embossing die code or other standard method to make a
148 visible indication that a connector has been adequately compressed on grounding conductor.
- 149 G. Moisture Protection: If insulated grounding conductors are connected to ground rods or
150 grounding buses, insulate entire area of connection and seal against moisture penetration of
151 insulation and cable.

152 3.5 FIELD QUALITY CONTROL

- 153 A. Testing: Perform the following field quality-control testing:
- 154 1. After installing grounding system but before permanent electrical circuitry has been
155 energized, test for compliance with requirements.
- 156 2. Test completed grounding system at each location where a maximum ground-resistance
157 level is specified, at service disconnect enclosure grounding terminal, and at ground test
158

- 159 wells. Measure ground resistance not less than two full days after the last trace of
160 precipitation, and without the soil being moistened by any means other than natural
161 drainage or seepage and without chemical treatment or other artificial means of
162 reducing natural ground resistance. Perform tests, by the fall-of-potential method
163 according to IEEE 81.
- 164 3. Provide drawings locating each ground rod and ground rod assembly and other
165 grounding electrodes, identify each by letter in alphabetical order, and key to the record
166 of tests and observations. Include the number of rods driven and their depth at each
167 location and include observations of weather and other phenomena that may affect test
168 results. Describe measures taken to improve test results.
- 169 a. Equipment Rated 500 kVA and Less: 10 ohms.
170 b. Equipment Rated 500 to 1000 kVA: 5 ohms.
171 c. Equipment Rated More Than 1000 kVA: 3 ohms.
- 172 4. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify
173 Architect promptly and include recommendations to reduce ground resistance.

174 3.6 GRADING AND PLANTING

- 175 A. Restore surface features, including vegetation, at areas disturbed by Work of this Section.
176 Reestablish original grades, unless otherwise indicated. If sod has been removed, replace it as
177 soon as possible after backfilling is completed. Restore areas disturbed by trenching, storing
178 of dirt, cable laying, and other activities to their original condition. Include application of
179 topsoil, fertilizer, lime, seed, sod, sprig, and mulch. Maintain restored surfaces. Restore
180 disturbed paving as indicated.

181 END OF SECTION 260526

1 PART 1 - SECTION 260533 - RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

2 PART 2 - GENERAL

3 2.1 RELATED DOCUMENTS

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

6 2.2 SUMMARY

- 7 A. This Section includes raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.

- 8 B. Related Sections include the following:

- 9 1. Division 26 Section "Common Work Results for Electrical" for supports and anchors.
10 2. Division 26 Section "Wiring Devices" for devices installed in boxes and for floor-box
11 service fittings.

12 2.3 DEFINITIONS

- 13 A. EMT: Electrical metallic tubing.

- 14 B. FMC: Flexible metal conduit.

- 15 C. RGC: Rigid galvanized steel conduit

- 16 D. IMC: Intermediate metal conduit.

- 17 E. LFMC: Liquid-tight flexible metal conduit.

- 18 F. RNC: Rigid nonmetallic conduit.

- 19 G. Type AC, MC, or NM cable are not acceptable wiring methods.

20 2.4 SUBMITTALS

- 21 A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover
22 enclosures, and cabinets.

23 2.5 QUALITY ASSURANCE

- 24 A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70,
25 Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for
26 intended use.
- 27 B. Comply with NFPA 70.
- 28 C. Comply with the latest edition of NECA's Standard of Installation.

29 2.6 COORDINATION

- 30 A. Coordinate layout and installation of raceways, boxes, enclosures, cabinets, and suspension
31 system with other construction that penetrates ceilings or is supported by them, including light
32 fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

33 PART 3 - PRODUCTS

34 3.1 MANUFACTURERS

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

39 3.2 METAL CONDUIT

- 40 A. Manufacturers:
- 41 1. AFC Cable Systems, Inc.
- 42 2. Alflex Inc.
- 43 3. Anamet Electrical, Inc.; Anaconda Metal Hose.
- 44 4. Electri-Flex Co.
- 45 5. Grinnell Co./Tyco International; Allied Tube and Conduit Div.
- 46 6. LTV Steel Tubular Products Company.
- 47 7. Manhattan/CDT/Cole-Flex.
- 48 8. O-Z Gedney; Unit of General Signal.
- 49 9. Wheatland Tube Co.
- 50 B. RGC: ANSI C80.1.
- 51 C. IMC: ANSI C80.6.
- 52 D. EMT and Fittings: ANSI C80.3.
- 53 1. Fittings: Set-screw type of steel construction. Die-cast is unacceptable. Connectors
54 shall be manufactured with insulated throat.

- 55 E. FMC: Zinc-coated steel.
- 56 F. LFMC: Flexible steel conduit with PVC jacket.
- 57 G. Fittings: NEMA FB 1; compatible with conduit and tubing materials and of steel construction
58 with insulated throat. Die-cast is unacceptable.
- 59 3.3 NONMETALLIC CONDUIT
- 60 A. Manufacturers:
- 61 1. American International.
- 62 2. Anamet Electrical, Inc.; Anaconda Metal Hose.
- 63 3. Arnco Corp.
- 64 4. Cantex Inc.
- 65 5. Certainteed Corp.; Pipe & Plastics Group.
- 66 6. Condux International.
- 67 7. ElecSYS, Inc.
- 68 8. Electri-Flex Co.
- 69 9. Lamson & Sessions; Carlon Electrical Products.
- 70 10. Manhattan/CDT/Cole-Flex.
- 71 11. RACO; Division of Hubbell, Inc.
- 72 12. Spiralduct, Inc./AFC Cable Systems, Inc.
- 73 13. Thomas & Betts Corporation.
- 74 B. RNC: NEMA TC 2, Schedule 40 and Schedule 80 PVC.
- 75 C. RNC Fittings: NEMA TC 3; match to conduit or tubing type and material.
- 76 3.4 METAL WIREWAYS
- 77 A. Manufacturers:
- 78 1. EM Weigmann & Company, Inc.
- 79 2. Hammond Manufacturing Co.
- 80 3. Hoffman.
- 81 4. Square D.
- 82 B. Material and Construction: Sheet metal sized and shaped as indicated, NEMA 1.
- 83 C. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters, hold-
84 down straps, end caps, and other fittings to match and mate with wireways as required for
85 complete system.
- 86 D. Select features, unless otherwise indicated, as required to complete wiring system and to
87 comply with NFPA 70.

- 88 E. Wireway Covers: Hinged type.
- 89 F. Finish: Manufacturer's standard enamel finish.
- 90 3.5 BOXES, ENCLOSURES, AND CABINETS
- 91 A. Manufacturers:
- 92 1. Cooper Crouse-Hinds; Div. of Cooper Industries, Inc.
- 93 2. Emerson/General Signal; Appleton Electric Company.
- 94 3. Hoffman.
- 95 4. Hubbell, Inc.; Killark Electric Manufacturing Co.
- 96 5. O-Z/Gedney; Unit of General Signal.
- 97 6. RACO; Division of Hubbell, Inc.
- 98 7. Robroy Industries, Inc.; Enclosure Division.
- 99 8. Thomas & Betts Corporation.
- 100 9. Walker Systems, Inc.; Wiremold Company (The).
- 101 10. Woodhead, Daniel Company; Woodhead Industries, Inc. Subsidiary.
- 102 B. Sheet Metal Outlet and Device Boxes: NEMA OS 1.
- 103 C. Cast-Metal Outlet and Device Boxes: NEMA FB 1, Type FD, with gasketed cover.
- 104 D. Floor Boxes: Cast metal, fully adjustable, rectangular.
- 105 E. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- 106 F. Cast-Metal Pull and Junction Boxes: NEMA FB 1, cast aluminum with gasketed cover.
- 107 G. Hinged-Cover Enclosures: NEMA 250, Type 1, with continuous hinge cover and flush latch.
- 108 1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
- 109 H. Cabinets: NEMA 250, Type 1, galvanized steel box with removable interior panel and
110 removable front, finished inside and out with manufacturer's standard enamel. Hinged door in
111 front cover with flush latch and concealed hinge. Key latch to match panelboards. Include
112 metal barriers to separate wiring of different systems and voltage and include accessory feet
113 where required for freestanding equipment.
- 114 3.6 FACTORY FINISHES
- 115 A. Finish: For raceway, enclosure, or cabinet components, provide manufacturer's standard paint
116 applied to factory-assembled surface raceways, enclosures, and cabinets before shipping.
- 117 PART 4 - EXECUTION
- 118 3.1 EXAMINATION

- 119 A. Examine surfaces to receive raceways, boxes, enclosures, and cabinets for compliance with installation tolerances and other conditions affecting performance of raceway installation. Do not
120 proceed with installation until unsatisfactory conditions have been corrected.
121
- 122 3.2 RACEWAY APPLICATIONS
- 123 A. Outdoors: Use the following wiring methods:
- 124 1. Exposed: RGC or IMC.
125 2. Concealed: RGC or IMC.
126 3. Underground, Single Run: RNC.
127 4. Underground, Grouped: RNC.
128 5. Underground: Conduit underground and located under driveways and paved areas shall
129 be Schedule 40 PVC encased in concrete to form a 3" wall around conduit or group of
130 conduits or RGC painted with a heavy continuous coat of asphalt varnish. Conduit located
131 outside the building area and under grassy areas or sidewalks shall be Schedule
132 40 PVC direct buried or RGC painted with a heavy continuous coat of asphalt varnish.
133 All PVC conduit shall have RGC elbows. Minimum depth shall be 30".
134 6. Connection to vibrating equipment (including transformers and hydraulic, pneumatic,
135 electric solenoid, motor-driven equipment, and all mechanical equipment): LFMC.
136 7. Boxes and Enclosures: NEMA 250, Type 3R or Type 4.
- 137 B. Indoors: Use the following wiring methods:
- 138 1. Exposed: EMT.
139 2. Concealed: EMT.
140 3. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic,
141 Electric Solenoid, or Motor-Driven Equipment): FMC; except in wet or damp locations,
142 use LFMC.
143 4. Damp or Wet Locations: Rigid steel conduit.
144 5. Boxes and Enclosures: NEMA 250, Type 1, except as follows:
145 a. Damp or Wet Locations: NEMA 250, Type 4, stainless steel.
146 b. Damp or Wet Locations: NEMA 250, Type 4, nonmetallic.
147 6. All exposed or concealed panel feeder and other conduits that are 2-1/2" or larger
148 shall be RGC or IMC.
- 149 3.3 INSTALLATION
- 150 A. Install raceways, boxes, enclosures, and cabinets as indicated, according to manufacturer's written
151 instructions.
152 B. Minimum Raceway Size: 3/4-inch trade size.
153 C. Conceal conduit and EMT, unless otherwise indicated, within finished walls, ceilings, and floors.
154 D. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes.
155 Install horizontal raceway runs above water and steam piping.
156 E. Install raceways level and square and at proper elevations. Provide adequate headroom.
157 F. Complete raceway installation before starting conductor installation.
158 G. Support raceways as specified in Division 26 Section "Common Work Results for Electrical."
159 H. Use temporary closures to prevent foreign matter from entering raceways.
160 I. Protect stub-ups from damage where conduits rise through floor slabs. Arrange so curved portion
161 of bends is not visible above the finished slab.
162 J. Make bends and offsets so ID is not reduced. Keep legs of bends in the same plane and straight
163 legs of offsets parallel, unless otherwise indicated.

- 164 K. Use raceway fittings compatible with raceways and suitable for use and location. For intermedi-
165 ate steel conduit, use threaded rigid steel conduit fittings, unless otherwise indicated.
- 166 L. Run concealed raceways, with a minimum of bends, in the shortest practical distance considering
167 the type of building construction and obstructions, unless otherwise indicated.
- 168 M. Raceways Beneath Slabs: Install below slab not within concrete pour.
- 169 1. Transition from RNC to RGC, or IMC before rising above floor.
- 170 N. Install exposed raceways parallel to or at right angles to nearby surfaces or structural members,
171 and follow the surface contours as much as practical.
- 172 1. Run parallel or banked raceways together, on common supports where practical.
- 173 2. Make bends in parallel or banked runs from same centerline to make bends parallel.
174 Use factory elbows only where elbows can be installed parallel; otherwise, provide
175 field bends for parallel raceways.
- 176
- 177 O. Join raceways with fittings designed and approved for the purpose and make joints tight.
- 178 1. Make raceway terminations tight. Use bonding bushings or wedges at connections sub-
179 ject to vibration. Use bonding jumpers where joints cannot be made tight.
- 180 2. Use insulating bushings to protect conductors at RGC and IMC terminations. EMT con-
181 nectors shall have insulated throat..
- 182 P. Tighten set screws of threadless fittings with suitable tools.
- 183 Q. Terminations: Where raceways are terminated with locknuts and bushings, align raceways to en-
184 ter squarely and install locknuts with dished part against the box. Where terminations are not
185 secure with 1 locknut, use 2 locknuts: 1 inside and 1 outside the box.
- 186 R. Where raceways are terminated with threaded hubs, screw raceways or fittings tightly into the
187 hub so the end bears against the wire protection shoulder. Where chase nipples are used, align
188 raceways so the coupling is square to the box and tighten the chase nipple so no threads are ex-
189 posed.
- 190 S. Install pull wires in empty raceways. Use No. 14 AWG zinc-coated steel or monofilament plastic
191 line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of the
192 pull wire.
- 193 T. Install raceway sealing fittings according to manufacturer's written instructions. Locate fittings at
194 suitable, approved, and accessible locations and fill them with UL-listed sealing compound. For
195 concealed raceways, install each fitting in a flush steel box with a blank cover plate having a fin-
196 ish similar to that of adjacent plates or surfaces. Install raceway sealing fittings at the following
197 points:
- 198 1. Where otherwise required by NFPA 70.
- 199 U. Stub-up Connections: Extend conduits through concrete floor for connection to freestanding
200 equipment. Install with an adjustable top or coupling threaded inside for plugs set flush with the
201 finished floor. Extend conductors to equipment with rigid steel conduit; FMC may be used 6
202 inches above the floor. Install screwdriver-operated, threaded flush plugs flush with floor for fu-
203 ture equipment connections.
- 204 V. Flexible Connections: Use maximum of 6 feet (maximum) of flexible conduit for recessed and
205 semirecessed lighting fixtures; 3 feet (maximum) for equipment subject to vibration, noise
206 transmission, or movement; and for all motors. Use liquidtight flexible conduit in wet or damp
207 locations. Install separate ground conductor across flexible connections.
- 208 3.4 PROTECTION

- 209 A. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and
210 installer that ensure coatings, finishes, and cabinets are without damage or deterioration at the
211 time of Substantial Completion.
- 212 1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufactur-
213 er.
 - 214 2. Repair damage to PVC or paint finishes with matching touchup coating recommended
215 by manufacturer.
- 216 3.5 CLEANING
- 217 A. On completion of installation, including outlet fittings and devices, inspect exposed finish. Re-
218 move burrs, dirt, and construction debris and repair damaged finish, including chips, scratches,
219 and abrasions.

220 END OF SECTION 260533

221

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1 SECTION 260553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

2 PART 1 - GENERAL

3 1.1 RELATED DOCUMENTS

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

6 1.2 SUMMARY

- 7 A. This Section includes electrical identification materials and devices required to comply with
8 ANSI C2, NFPA 70, OSHA standards, and authorities having jurisdiction.

9 1.3 SUBMITTALS

- 10 A. Product Data: For each electrical identification product indicated.
- 11 B. Schedule of Nomenclature: An index of electrical equipment and system components used in
12 identification signs and labels.

13 1.4 QUALITY ASSURANCE

- 14 A. Comply with ANSI A13.1 and NFPA 70 for color-coding.
- 15 B. Room designations shall be coordinated with Owner.

16 PART 2 - PRODUCTS

17 2.1 RACEWAY AND CABLE LABELS

- 18 A. Comply with ANSI A13.1, Table 3, for minimum size of letters for legend and for minimum
19 length of color field for each raceway and cable size.

- 20 1. Color: Black letters on orange field.
- 21 2. Legend: Indicates voltage and service.

- 22 B. Adhesive Labels: Preprinted, flexible, self-adhesive vinyl with legend overlaminated with a
23 clear, weather- and chemical-resistant coating.

- 24 C. Colored Adhesive Tape: Self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 inches
25 wide.
- 26 D. Underground-Line Warning Tape: Permanent, bright-colored, continuous-printed, vinyl tape.
- 27 1. Not less than 6 inches wide by 4 mils thick.
28 2. Compounded for permanent direct-burial service.
29 3. Embedded continuous metallic strip or core.
30 4. Printed legend indicating type of underground line.
- 31 E. Tape Markers: Vinyl or vinyl-cloth, self-adhesive, wraparound type with preprinted numbers
32 and letters.
- 33 F. Aluminum, Wraparound Marker Bands: Bands cut from 0.014-inch-thick aluminum sheet,
34 with stamped or embossed legend, and fitted with slots or ears for permanently securing
35 around wire or cable jacket or around groups of conductors.
- 36 G. Plasticized Card-Stock Tags: Vinyl cloth with preprinted and field-printed legends. Orange
37 background, unless otherwise indicated, with eyelet for fastener.
- 38 2.2 NAMEPLATES AND SIGNS
- 39 A. Safety Signs: Comply with 29 CFR, Chapter XVII, Part 1910.145.
- 40 B. Engraved Plastic Nameplates and Signs: Engraving stock, melamine plastic laminate, minimum
41 1/16 inch thick for signs up to 20 sq. in. and 1/8 inch thick for larger sizes.
- 42 1. Engraved legend with black letters on white face.
43 2. Punched or drilled for mechanical fasteners.
- 44 C. Baked-Enamel Signs for Interior Use: Preprinted aluminum signs, punched or drilled for
45 fasteners, with colors, legend, and size required for the application. 1/4-inch grommets in
46 corners for mounting.
- 47 D. Exterior, Metal-Backed, Butyrate Signs: Weather-resistant, non-fading, preprinted, cellulose-
48 acetate butyrate signs with 0.0396-inch stainless-steel backing; and with colors, legend, and
49 size required for the application. 1/4-inch grommets in corners for mounting.
- 50 E. Fasteners for Nameplates and Signs: Self-tapping, blunt end, stainless-steel screws or
51 No. 10/32, stainless-steel machine screws with nuts and flat and lock washers.
- 52 2.3 MISCELLANEOUS IDENTIFICATION PRODUCTS
- 53 A. Cable Ties: Fungus-inert, self-extinguishing, one-piece, self-locking, Type 6/6 nylon cable ties.

- 54 1. Minimum Width: 3/16 inch.
- 55 2. Tensile Strength: 50 lb minimum.
- 56 3. Color: According to color-coding.

- 57 B. Paint: Formulated for the type of surface and intended use.

58 PART 3 - EXECUTION

59 3.1 INSTALLATION

- 60 A. Identification Materials and Devices: Install at locations for most convenient viewing without
61 interference with operation and maintenance of equipment.

- 62 B. Sequence of Work: If identification is applied to surfaces that require finish, install
63 identification after completing finish work.

- 64 C. Color Banding Raceways and Exposed Cables: Band exposed and accessible raceways of the
65 systems listed below:
 - 66 1. Bands: Pre-tensioned, wraparound plastic sleeves; colored adhesive tape; or a
67 combination of both. Make each color band 2 inches wide, completely encircling
68 conduit, and place adjacent bands of two-color markings in contact, side by side.
 - 69 2. Band Locations: At changes in direction, at penetrations of walls and floors, at 50-foot
70 maximum intervals in straight runs, and at 25-foot maximum intervals in congested
71 areas.
 - 72 3. Apply the following colors to the systems listed below:
 - 73 a. Fire Alarm System: Red.
 - 74 b. Fire-Suppression Supervisory and Control System: Red and yellow.
 - 75 c. Combined Fire Alarm and Security System: Red and blue.
 - 76 d. Security System: Blue and yellow.
 - 77 e. Mechanical and Electrical Supervisory System: Green and blue.
 - 78 f. Telecommunication System: Green and yellow.

- 79 D. Circuit Identification Labels on Boxes: Install externally.
 - 80 1. Labeling Legend: Permanent, waterproof listing of panel and circuit number or
81 equivalent.

- 82 E. Paths of Underground Electrical Lines: During trench backfilling, for exterior underground
83 power, control, signal, and communication lines, install continuous underground plastic line
84 marker located directly above line at 6 to 8 inches below finished grade. Where width of
85 multiple lines installed in a common trench or concrete envelope does not exceed 16 inches
86 overall, use a single line marker.

- 87 F. Color-Coding of Secondary Phase Conductors: Use the following colors for service, feeder, and
88 branch-circuit phase conductors:
- 89 1. 208/120-V Conductors:
- 90 a. Phase A: Black.
91 b. Phase B: Red.
92 c. Phase C: Blue.
93
- 94 2. 480/277-V Conductors:
- 95 a. Phase A: Brown.
96 b. Phase B: Orange.
97 c. Phase C: Yellow.
- 98 3. Factory apply color the entire length of conductors.
- 99 G. Apply identification to conductors as follows:
- 100 1. Conductors to Be Extended in the Future: Indicate source and circuit numbers.
101 2. Multiple Power or Lighting Circuits in the Same Enclosure: Identify each conductor with
102 source, voltage, circuit number, and phase. Use color-coding to identify circuits' voltage
103 and phase.
104 3. Multiple Control and Communication Circuits in the Same Enclosure: Identify each
105 conductor by its system and circuit designation. Use a consistent system of tags, color-
106 coding, or cable marking tape.
- 107 H. Apply warning, caution, and instruction signs as follows:
- 108 1. Emergency Operation: Install engraved laminated signs with white legend on red
109 background with minimum 3/8-inch-high lettering for emergency instructions on power
110 transfer, load shedding, and other emergency operations.
- 111 I. Equipment Identification Labels: Engraved plastic laminate. Install on each unit of equipment,
112 including central or master unit of each system. This includes power, lighting, communication,
113 signal, and alarm systems, unless units are specified with their own self-explanatory
114 identification. Unless otherwise indicated, provide a single line of text with 1/2-inch-high
115 lettering on 1-1/2-inch-high label; where two lines of text are required, use labels 2 inches
116 high. Use white lettering on black field. Apply labels for each unit of the following categories
117 of equipment using mechanical fasteners:
- 118 1. Access doors and panels for concealed electrical items.
119 2. Panelboards.
120 3. Distribution panelboards on each circuit breaker.
121 4. Electrical switchboards on each circuit breaker.

- 122 5. Motor-control centers on each compartment.
- 123 6. Disconnect switches.
- 124 7. Enclosed circuit breakers.
- 125 8. Motor starters.
- 126 9. Push-button stations.
- 127 10. Contactors.
- 128 11. Transformers.

129 END OF SECTION 260553

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1 SECTION 260923 - LIGHTING CONTROL DEVICES

2 PART 1 - GENERAL

3 1.1 RELATED DOCUMENTS

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

6 1.2 SUMMARY

- 7 A. This Section includes the following lighting control devices:

- 8 1. Outdoor photoelectric switches.
9 2. Multipole contactors.
10 3. Indoor occupancy sensors.

- 11 B. Related Sections include the following:

- 12 1. Division 26 Section "Wiring Devices" for wall-box dimmers and manual light switches.

13 1.3 SUBMITTALS

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

- 15 B. Field quality-control test reports.

- 16 C. Operation and Maintenance Data: For each type of product to include in emergency,
17 operation, and maintenance manuals.

18 1.4 QUALITY ASSURANCE

- 19 A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70,
20 Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for
21 intended use.

22 1.5 EXTRA MATERIALS

- 23 A. Provide additional labor and materials not indicated on plans for four of each type of indoor
24 occupancy sensors for owner/engineer placement during construction for a complete and
25 functional system.

26 PART 2 - PRODUCTS

27 2.1 MANUFACTURERS

28 A. In other Part 2 articles where titles below introduce lists, the following requirements apply to
29 product selection:

- 30 1. Manufacturers: Subject to compliance with requirements, provide products by one of
31 the manufacturers specified.

32 2.2 GENERAL LIGHTING CONTROL DEVICE REQUIREMENTS

33 A. Line-Voltage Surge Protection: An integral part of the devices for 120- and 277-V solid-state
34 equipment. For devices without integral line-voltage surge protection, field-mounting surge
35 protection shall comply with IEEE C62.41 and with UL 1449.

36 2.3 OUTDOOR PHOTOELECTRIC SWITCHES

37 A. Manufacturers:

- 38 1. Intermatic, Inc.
39 2. Paragon Electric Co.
40 3. Tork

41 B. Description: Solid state, with SPST dry contacts rated for 1800-VA tungsten or 1000-VA
42 inductive, to operate connected relay, contactor coils, microprocessor input, and complying
43 with UL 773A.

- 44 1. Light-Level Monitoring Range: 1 to 15 fc, with an adjustment for turn-on and turn-off
45 levels within that range, and a directional lens in front of photocell to prevent fixed light
46 sources from causing turn-off.
47 2. Time Delay: 15-second minimum, to prevent false operation.

48 2.4 MULTIPOLE CONTACTORS

49 A. Manufacturers:

- 50 1. Cutler-Hammer.
51 2. General Electric.
52 3. Siemens.
53 4. Square D.

54 B. Description: Electrically operated and electrically held, complying with NEMA ICS 2 and
55 UL 508.

- 56 1. Current Rating for Switching: Refer to Drawings.
57 2. Control-Coil Voltage: Match control power source.
58 3. Manual Control: Unit mounted HOA for exterior lighting contactors.

59 2.5 CONDUCTORS AND CABLES

60 A. Power Wiring to Supply Side of Remote-Control Power Sources: Not smaller than No. 12
61 AWG, complying with Division 26 Section "Low-Voltage Electrical Power Conductors and
62 Cables."

63 2.6 INDOOR OCCUPANCY SENSORS

64 A. Manufacturers:

- 65 1. Hubbell Lighting Inc.
66 2. N-Lite.
67 3. Watt Stopper (The).
68 4. Eaton

70 B. General Description: Wall- or ceiling-mounting, solid-state units with a separate relay unit.

- 71 1. Operation: Unless otherwise indicated, turn lights on when covered area is occupied
72 and off when unoccupied; with a time delay for turning lights off, adjustable over a
73 minimum range of 1 to 15 minutes.
74 2. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A.
75 Sensor shall be powered from the relay unit.
76 3. Relay Unit: Dry contacts rated for 20-A ballast load at 120- and 277-V ac, for 13-A
77 tungsten at 120-V ac, and for 1 hp at 120-V ac. Power supply to sensor shall be 24-V dc,
78 150-mA, Class 2 power source as defined by NFPA 70.
79 4. Mounting:
80 a. Sensor: Suitable for mounting in any position on a standard outlet box.
81 b. Relay: Externally mounted though a 1/2-inch knockout in a standard electrical
82 enclosure.
83 c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged
84 door.
85 5. Indicator: LED, to show when motion is being detected during testing and normal
86 operation of the sensor.
87 6. Bypass Switch: Override the on function in case of sensor failure.

- 88 7. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc; keeps lighting off when
89 selected lighting level is present.
- 90 C. PIR Type: Ceiling mounting; detect occupancy by sensing a combination of heat and
91 movement in area of coverage.
- 92 1. Detector Sensitivity: Detect occurrences of 6-inch minimum movement of any portion
93 of a human body that presents a target of at least 36 sq. in.
- 94 2. Detection Coverage (Room): Detect occupancy anywhere in a circular area of 1000 sq.
95 ft. when mounted on a 96-inch-high ceiling.
- 96 3. Detection Coverage (Corridor): Detect occupancy within 90 feet when mounted on a
97 10-foot-high ceiling.
- 98 D. Ultrasonic Type: Ceiling mounting; detect occupancy by sensing a change in pattern of
99 reflected ultrasonic energy in area of coverage.
- 100 1. Detector Sensitivity: Detect a person of average size and weight moving at least 12
101 inches in either a horizontal or a vertical manner at an approximate speed of 12
102 inches/s.
- 103 2. Detection Coverage (Small Room): Detect occupancy anywhere within a circular area of
104 600 sq. ft. when mounted on a 96-inch-high ceiling.
- 105 3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular
106 area of 1000 sq. ft. when mounted on an 8-foot-high ceiling.
- 107 4. Detection Coverage (Large Room): Detect occupancy anywhere within a circular area of
108 2000 sq. ft. when mounted on a 96-inch-high ceiling.
- 109 5. Detection Coverage (Corridor): Detect occupancy anywhere within 90 feet when
110 mounted on a 10-foot-high ceiling in a corridor not wider than 14 feet.
- 111 E. Dual-Technology Type: Ceiling mounting; detect occupancy by using a combination of PIR and
112 ultrasonic detection methods in area of coverage. Particular technology or combination of
113 technologies that controls on and off functions shall be selectable in the field by operating
114 controls on unit.
- 115 1. Sensitivity Adjustment: Separate for each sensing technology.
- 116 2. Detector Sensitivity: Detect occurrences of 6-inch minimum movement of any portion
117 of a human body that presents a target of at least 36 sq. in., and detect a person of
118 average size and weight moving at least 12 inches in either a horizontal or a vertical
119 manner at an approximate speed of 12 inches/s.
- 120 3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular
121 area of 1000 sq. ft. when mounted on a 96-inch-high ceiling.

122 PART 3 - EXECUTION

123 3.1 SENSOR INSTALLATION

- 124 A. Install and aim sensors in locations to achieve at least 90 percent coverage of areas indicated.
125 Do not exceed coverage limits specified in manufacturer's written instructions.
- 126 3.2 WIRING INSTALLATION
- 127 A. Wiring Method: Comply with Division 26 Section "Low-Voltage Electrical Power Conductors
128 and Cables." Minimum conduit size shall be 3/4-inch.
- 129 B. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points. Separate
130 power-limited and nonpower-limited conductors according to conductor manufacturer's
131 written instructions.
- 132 C. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in
133 junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.
- 134 D. Tighten electrical connectors and terminals according to manufacturer's published torque-
135 tightening values. If manufacturer's torque values are not indicated, use those specified in
136 UL 486A.
- 137 3.3 IDENTIFICATION
- 138 A. Identify components and power and control wiring according to Division 26 Section
139 "Identification for Electrical Systems."
- 140 B. Label time switches and contactors with a unique designation.
- 141 3.4 FIELD QUALITY CONTROL
- 142 A. Perform the following field tests and inspections and prepare test reports:
- 143 1. After installing time switches and sensors, and after electrical circuitry has been
144 energized, adjust and test for compliance with requirements.
- 145 2. Operational Test: Verify actuation of each sensor and adjust time delays.
- 146 B. Remove and replace lighting control devices where test results indicate that they do not
147 comply with specified requirements.
- 148 C. Additional testing and inspecting, at Contractor's expense, will be performed to determine
149 compliance of replaced or additional work with specified requirements.
- 150 3.5 ADJUSTING

- 151 A. Occupancy Adjustments: When requested within 12 months of date of Substantial
152 Completion, provide on-site assistance in adjusting sensors to suit actual occupied conditions.
153 Provide up to two visits to site outside normal occupancy hours for this purpose.

154 END OF SECTION 260923

155

156

1 SECTION 262416 - PANELBOARDS

2 PART 1 - GENERAL

3 1.1 RELATED DOCUMENTS

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

6 1.2 SUMMARY

- 7 A. This Section includes load centers and panelboards, overcurrent protective devices, and
8 associated auxiliary equipment rated 600 V and less for the following types:

- 9 1. Lighting and appliance branch-circuit panelboards.
10 2. Distribution panelboards.

- 11 B. Related Sections include the following:

- 12 1. Division 26 Section "Fuses."

13 1.3 DEFINITIONS

- 14 A. EMI: Electromagnetic interference.

- 15 B. GFCI: Ground-fault circuit interrupter.

- 16 C. RFI: Radio-frequency interference.

- 17 D. RMS: Root mean square.

- 18 E. SPDT: Single pole, double throw.

- 19 F. TVSS: Transient voltage surge suppression.

20 1.4 SUBMITTALS

- 21 A. Product Data: For each type of panelboard, overcurrent protective device, TVSS device,
22 accessory, and component indicated. Include dimensions and manufacturers' technical data
23 on features, performance, electrical characteristics, ratings, and finishes.

- 24 B. Shop Drawings: For each panelboard and related equipment.

- 25 1. Dimensioned plans, elevations, sections, and details. Show tabulations of installed
26 devices, equipment features, and ratings. Include the following:
- 27 a. Enclosure types and details for types other than NEMA 250, Type 1.
28 b. Bus configuration, current, and voltage ratings.
29 c. Short-circuit current rating of panelboards and overcurrent protective devices.
30 d. UL listing for series rating of installed devices.
31 e. Features, characteristics, ratings, and factory settings of individual overcurrent
32 protective devices and auxiliary components.
- 33 2. Wiring Diagrams: Diagram power, signal, and control wiring and differentiate between
34 manufacturer-installed and field-installed wiring.
- 35 C. Field Test Reports: Submit written test reports and include the following:
- 36 1. Test procedures used.
37 2. Test results that comply with requirements.
38 3. Results of failed tests and corrective action taken to achieve test results that comply
39 with requirements.
- 40 D. Panelboard Schedules: For installation in panelboards. Submit final versions after load
41 balancing.
- 42 E. Maintenance Data: For panelboards and components to include in maintenance manuals
43 specified in Division 01. In addition to requirements specified in Division 01, include the
44 following:
- 45 1. Manufacturer's written instructions for testing and adjusting overcurrent protective
46 devices.
47 2. Time-current curves, including selectable ranges for each type of overcurrent protective
48 device.
- 49 1.5 QUALITY ASSURANCE
- 50 A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70,
51 Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for
52 intended use.
- 53 B. Comply with NEMA PB 1.
- 54 C. Comply with NFPA 70.
- 55 1.6 COORDINATION

- 56 A. Coordinate layout and installation of panelboards and components with other construction
57 that penetrates walls or is supported by them, including electrical and other types of
58 equipment, raceways, piping, and encumbrances to workspace clearance requirements.
- 59 1.7 EXTRA MATERIALS
- 60 A. Keys: Four spares of each panelboard cabinet lock.
- 61 PART 2 - PRODUCTS
- 62 2.1 MANUFACTURERS
- 63 A. Manufacturers:
- 64 1. Eaton Electric Inc.; Cutler Hammer Products.
65 2. Siemens.
66 3. Square D; a brand of Schneider Electric.
- 67 2.2 FABRICATION AND FEATURES
- 68 A. Enclosures: Flush- and surface-mounted cabinets. NEMA PB 1, Type 1, to meet
69 environmental conditions at installed location.
- 70 1. Outdoor Locations: NEMA 250, Type 3R.
71 2. Kitchen Areas: NEMA 250, Type 4X, stainless steel.
72 3. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.
73 4. Hazardous Areas Indicated on Drawings: NEMA 250, Type 7C.
- 74 B. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged
75 trim cover.
- 76 C. Finish: Manufacturer's standard enamel finish over corrosion-resistant treatment or primer
77 coat.
- 78 D. Directory Card: With transparent protective cover, mounted inside metal frame, inside
79 panelboard door.
- 80 E. Bus: Hard-drawn copper, 98 percent conductivity.
- 81 F. Main and Neutral Lugs: Mechanical type suitable for use with conductor material.
- 82 G. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment ground
83 conductors; bonded to box.

- 84 H. Service Equipment Label: UL labeled for use as service equipment for panelboards with main
85 service disconnect switches.
- 86 I. Future Devices: Mounting brackets, bus connections, and necessary appurtenances required
87 for future installation of devices.
- 88 J. Isolated Equipment Ground Bus: Adequate for branch-circuit equipment ground conductors;
89 insulated from box.
- 90 K. Feed-through Lugs: Mechanical type suitable for use with conductor material. Locate at
91 opposite end of bus from incoming lugs or main device.
- 92 L. Tubs shall require field cut or punched knock-outs. Manufacturer's concentric knock-outs are
93 not acceptable.
- 94 2.3 PANELBOARD SHORT-CIRCUIT RATING
- 95 A. UL label indicating series-connected rating with integral or remote upstream devices. Include
96 size and type of upstream device allowable, branch devices allowable, and UL series-
97 connected short-circuit rating.
- 98 2.4 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS
- 99 A. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without
100 disturbing adjacent units.
- 101 B. Doors: Hinged front cover with standard door within hinged cover; secured with flush latch
102 with tumbler lock; keyed alike.
- 103 2.5 DISTRIBUTION PANELBOARDS
- 104 A. Doors: Hinged front cover with standard door within cover, except omit in fused-switch
105 panelboards; secured with vault type latch with tumbler lock; keyed alike.
- 106 B. Main Overcurrent Protective Devices: Circuit breaker.
- 107 C. Branch overcurrent protective devices shall be one of the following:
- 108 1. For Circuit-Breaker Frame Sizes 125 A and Smaller: Bolt-on circuit breakers.
109 2. For Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers; plug-in
110 circuit breakers where individual positive-locking device requires mechanical release for
111 removal.
112 3. Fused switches.

- 113 2.6 TVSS PANELBOARDS
- 114 A. Doors: Hinged front cover with standard door within hinged cover; secured with flush latch
115 with tumbler lock; keyed alike.
- 116 B. Main Overcurrent Devices: Thermal-magnetic circuit breaker.
- 117 C. Branch Overcurrent Protective Devices: Bolt-on circuit breakers.
- 118 D. Bus: Copper phase and neutral buses; 200 percent capacity neutral bus when called for.
- 119 E. TVSS Device: IEEE C62.41, integrally mounted, plug-in-style, solid-state, parallel-connected,
120 sine-wave tracking suppression and filtering modules.
- 121 1. Direct bus termination to panelboard bus by panelboard manufacturer, where tandem
122 panel tubs are called for, direct bus termination shall be ahead of feed-through lugs.
123 2. Peak single impulse surge current rating: 100 kA per phase.
- 124 a. Line to Neutral: 50 kA.
125 b. Line to Ground: 50 kA.
126 c. Neutral to Ground: 50 kA.
- 127 3. Protection modes shall be as follows:
- 128 a. Line to neutral.
129 b. Line to ground.
130 c. Neutral to ground.
- 131 4. EMI/RFI Noise Attenuation Using 50-ohm Insertion Loss Test: 55 dB at 100 kHz
132 complying with UL 1283.
- 133 5. UL 1449 Second Edition clamping levels shall not exceed 400V, line to neutral, line to
134 ground, and neutral to ground on 120/208V systems and 800V, line to neutral, line to
135 ground, and neutral to ground on 277/480V systems.
- 136 6. Withstand Capabilities: 3000 Category C surges with less than 5 percent change in
137 clamping voltage.
138
- 139 7. Accessories shall include the following:
- 140 a. Form-C contacts, one normally open and one normally closed, for remote
141 monitoring of system operation. Contacts to reverse position on failure of any
142 surge diversion module.
- 143 b. Audible alarm activated on failure of any surge diversion module with alarm
144 silence as well as push-to-test switch.
- 145 c. Six-digit transient-counter set to total transient surges that deviate from the sine-
146 wave envelope by more than 125 V.

147 d. Red and green solid state indicating lights with front cover printed labels to
148 indicate line status. The absence of green light and presence of a red light shall
149 indicate a reduction in the unit's surge protection and service is required.

150 2.7 OVERCURRENT PROTECTIVE DEVICES

151 A. Molded-Case Circuit Breaker: NEMA AB 1, with interrupting capacity to meet available fault
152 currents.

153 1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level
154 overloads, and instantaneous magnetic trip element for short circuits. Adjustable
155 magnetic trip setting for circuit-breaker frame sizes 250 A and larger.

156 2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-
157 mounted, field-adjustable trip setting.

158 3. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings
159 less than NEMA FU 1, RK-5.

160 4. Integrally Fused Circuit Breakers: Thermal-magnetic trip element with integral limiter-
161 style fuse listed for use with circuit breaker; trip activation on fuse opening or on
162 opening of fuse compartment door.

163 5. GFCI Circuit Breakers: Single- and two-pole configurations with 5-mA trip sensitivity.

164 B. Molded-Case Circuit-Breaker Features and Accessories. Standard frame sizes, trip ratings, and
165 number of poles.

166 1. Lugs: Mechanical style, suitable for number, size, trip ratings, and material of
167 conductors.

168 2. Application Listing: Appropriate for application; Type SWD for switching fluorescent
169 lighting loads; Type HACR for heating, air-conditioning, and refrigerating equipment.

170 3. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup
171 and time-delay settings, push-to-test feature, and ground-fault indicator.

172 4. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 75 percent of
173 rated voltage.

174 C. Fused Switch: NEMA KS 1, Type HD; clips to accommodate specified fuses; lockable handle.

175 2.8 ACCESSORY COMPONENTS AND FEATURES

176 A. Accessory Set: Tools and miscellaneous items required for overcurrent protective device test,
177 inspection, maintenance, and operation.

178 PART 3 - EXECUTION

179 3.1 INSTALLATION

- 180 A. Install panelboards and accessories according to NEMA PB 1.1.
- 181 B. Mounting Heights: Top of trim 72 inches above finished floor, unless otherwise indicated.
- 182 C. Mounting: Plumb and rigid without distortion of box. Mount recessed panelboards with
183 fronts uniformly flush with wall finish.
- 184 D. Circuit Directory: Create a directory to indicate installed circuit loads after balancing panel-
185 board loads. Obtain approval before installing. Use a computer or typewriter to create direc-
186 tory; handwritten directories are not acceptable.
- 187 E. Install filler plates in unused spaces.
- 188 F. Provision for Future Circuits at Flush Panelboards: Stub six 1-inch empty conduits from panel-
189 board into accessible ceiling space or space designated to be ceiling space in the future.
- 190 G. Wiring in Panelboard Gutters: Arrange conductors into groups and bundle and wrap with wire
191 ties after completing load balancing.
- 192 3.2 IDENTIFICATION
- 193 A. Identify field-installed conductors, interconnecting wiring, and components; provide warning
194 signs as specified in Division 26 Section "Identification for Electrical Systems."
- 195 B. Panelboard Nameplates: Label each panelboard with engraved metal or laminated-plastic
196 nameplate mounted with corrosion-resistant screws.
- 197 3.3 CONNECTIONS
- 198 A. Install equipment grounding connections for panelboards with ground continuity to main
199 electrical ground bus.
- 200 B. Tighten electrical connectors and terminals according to manufacturer's published torque-
201 tightening values. If manufacturer's torque values are not indicated, use those specified in
202 UL 486A.
- 203 3.4 FIELD QUALITY CONTROL
- 204 A. Prepare for acceptance tests as follows:
- 205 1. Test insulation resistance for each panelboard bus, component, connecting supply,
206 feeder, and control circuit.
- 207 2. Test continuity of each circuit.

- 208 B. Testing: After installing panelboards and after electrical circuitry has been energized,
209 demonstrate product capability and compliance with requirements.
- 210 1. Procedures: Perform each visual and mechanical inspection and electrical test indicated
211 in NETA ATS, Section 7.5 for switches and Section 7.6 for molded-case circuit breakers.
212 Certify compliance with test parameters.
- 213 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate
214 compliance; otherwise, replace with new units and retest.
- 215 C. Balancing Loads: After Substantial Completion, but not more than 60 days after Final
216 Acceptance, measure load balancing and make circuit changes as follows:
- 217 1. Measure as directed during period of normal system loading.
- 218 2. Perform load-balancing circuit changes outside normal occupancy/working schedule of
219 the facility and at time directed. Avoid disrupting critical 24-hour services such as fax
220 machines and on-line data-processing, computing, transmitting, and receiving
221 equipment.
- 222 3. After circuit changes, recheck loads during normal load period. Record all load readings
223 before and after changes and submit test records.
- 224 4. Tolerance: Difference exceeding 20 percent between phase loads, within a panelboard,
225 is not acceptable. Rebalance and recheck as necessary to meet this minimum
226 requirement.
- 227 3.5 ADJUSTING
- 228 A. Set field-adjustable switches and circuit-breaker trip ranges.
- 229 3.6 CLEANING
- 230 A. On completion of installation, inspect interior and exterior of panelboards. Remove paint
231 splatters and other spots. Vacuum dirt and debris; do not use compressed air to assist in
232 cleaning. Repair exposed surfaces to match original finish.
- 233 END OF SECTION 262416
- 234

1 SECTION 262726 - WIRING DEVICES

2 PART 1 - GENERAL

3 1.1 RELATED DOCUMENTS

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

6 1.2 SUMMARY

- 7 A. This Section includes the following:

- 8 1. Single and duplex receptacles, ground-fault circuit interrupters, integral surge
9 suppression units, and isolated-ground receptacles.
10 2. Single- and double-pole snap switches and dimmer switches.
11 3. Device wall plates.

12 1.3 DEFINITIONS

- 13 A. EMI: Electromagnetic interference.
14 B. GFCI: Ground-fault circuit interrupter.
15 C. PVC: Polyvinyl chloride.
16 D. RFI: Radio-frequency interference.
17 E. TVSS: Transient voltage surge suppressor.

18 1.4 SUBMITTALS

- 19 A. Product Data: For each type of product indicated.
20 B. Shop Drawings: List of legends and description of materials and process used for premarking
21 wall plates.
22 C. Field quality-control test reports.

23 1.5 QUALITY ASSURANCE

- 24 A. Source Limitations: Obtain each type of wiring device through one source from a single
25 manufacturer.
- 26 B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70,
27 Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for
28 intended use.
- 29 C. Comply with NFPA 70.
- 30 1.6 COORDINATION
- 31 A. Receptacles for Owner-Furnished Equipment: Match plug configurations.
- 32 1. Cord and Plug Sets: Match equipment requirements.
- 33 PART 2 - PRODUCTS
- 34 2.1 MANUFACTURERS
- 35 A. Manufacturers: Subject to compliance with requirements, provide products by one of the
36 following:
- 37 1. Wiring Devices:
- 38 a. Hubbell Incorporated; Wiring Device-Kellems.
39 b. Pass & Seymour/Legrand; Wiring Devices Div.
40 c. Cooper Wiring Devices.
41 d. Leviton Manufacturing.
- 42 2.2 RECEPTACLES
- 43 A. Straight-Blade-Type Receptacles: Comply with NEMA WD 1, NEMA WD 6, DSCC W-C-596G,
44 and UL 498.
- 45 B. Straight-Blade and Locking Receptacles: Industrial specification grade with finder face
46 configuration 5-20R.
- 47 C. GFCI Receptacles: Straight blade, non-feed-through type, industrial specification grade, with
48 integral NEMA WD 6, Configuration 5-20R duplex receptacle; complying with UL 498 and
49 UL 943. Design units for installation in a 2-3/4-inch-deep outlet box without an adapter.
- 50 2.3 PENDANT CORD/CONNECTOR DEVICES

- 51 A. Description: Matching, locking-type plug and receptacle body connector, NEMA WD 6,
52 Configurations L5-20P and L5-20R, Heavy-Duty grade.
- 53 1. Body: Nylon with screw-open cable-gripping jaws and provision for attaching external
54 cable grip.
- 55 2. External Cable Grip: Woven wire-mesh type made of high-strength galvanized-steel
56 wire strand, matched to cable diameter, and with attachment provision designed for
57 corresponding connector.
- 58 2.4 CORD AND PLUG SETS
- 59 A. Description: Match voltage and current ratings and number of conductors to requirements of
60 equipment being connected.
- 61 1. Cord: Rubber-insulated, stranded-copper conductors, with Type SOW-A jacket; with
62 green-insulated grounding conductor and equipment-rating ampacity plus a minimum
63 of 30 percent.
- 64 2. Plug: Nylon body and integral cable-clamping jaws. Match cord and receptacle type for
65 connection.
- 66 2.5 SWITCHES
- 67 A. Single- and Double-Pole Switches: Comply with DSCC W-C-896F and UL 20.
- 68 B. Snap Switches: Industrial specification grade, quiet type.
- 69 1. Switch: 20A, 120/277-V ac.
- 70 C. Dimmer Switches: Modular, full-wave, solid-state units with integral, quiet on/off switches
71 and audible frequency and EMI/RFI filters.
- 72 1. Control: Continuously adjustable slider or as specified on Drawings; with single-pole or
73 three-way switching to suit connections.
- 74 2. Incandescent Lamp Dimmers: Modular, 120 V, 60 Hz with continuously adjustable
75 rotary knob, toggle switch, or slider; single pole with soft tap or other quiet switch;
76 EMI/RFI filter to eliminate interference; and 5-inch wire connecting leads.
- 77 2.6 WALL PLATES
- 78 A. Single and combination types to match corresponding wiring devices.
- 79 1. Plate-Securing Screws: Metal with head color to match plate finish.
- 80 2. Material for Finished Spaces: 0.035-inch-thick, satin-finished stainless steel.

81 3. Material for Wet Locations: Cast aluminum with spring-loaded lift cover, and listed and
82 labeled as an "in-use" cover for "wet locations."

83 2.7 FINISHES

84 A. Color: By Architect.

85 PART 3 - EXECUTION

86 3.1 INSTALLATION

87 A. Install devices and assemblies level, plumb, and square with building lines.

88 B. Install wall dimmers to achieve indicated rating after derating for ganging according to
89 manufacturer's written instructions.

90 C. Install unshared neutral conductors on line and load side of dimmers according to
91 manufacturers' written instructions.

92 D. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension
93 vertical, and with grounding terminal of receptacles on bottom. Group adjacent switches
94 under single, multigang wall plates.

95 E. Remove wall plates and protect devices and assemblies during painting.

96 F. Adjust locations of floor service outlets and service poles to suit arrangement of partitions and
97 furnishings.

98 3.2 IDENTIFICATION

99 A. Comply with Division 26 Section "Identification for Electrical Systems."

100 1. At each wiring device, identify panelboard and circuit number from which served. Use
101 hot, stamped or engraved machine printing with black-filled lettering on face of plate or
102 indelible ink on back of face plate.

103 3.3 CONNECTIONS

104 A. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical
105 Systems."

- 106 B. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and
107 Cables."
- 108 C. Tighten electrical connectors and terminals according to manufacturer's published torque-
109 tightening values. If manufacturer's torque values are not indicated, use those specified in
110 UL 486A.
- 111 3.4 FIELD QUALITY CONTROL
- 112 A. Perform the following field tests and inspections and prepare test reports:
- 113 1. After installing wiring devices and after electrical circuitry has been energized, test for
114 proper polarity, ground continuity, and compliance with requirements.
- 115 2. Test GFCI operation with both local and remote fault simulations according to
116 manufacturer's written instructions.
- 117 B. Remove malfunctioning units, replace with new units, and retest as specified above.
- 118 END OF SECTION 262726
119
- 120

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1 SECTION 262813 - FUSES

2 PART 1 - GENERAL

3 1.1 RELATED DOCUMENTS

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

6 1.2 SUMMARY

- 7 A. This Section includes cartridge fuses, rated 600 V and less, for use in switches, panelboards,
8 switchboards, controllers, and motor-control centers; and spare fuse cabinets.

9 1.3 SUBMITTALS

- 10 A. Product Data: Include dimensions and manufacturer's technical data on features,
11 performance, electrical characteristics, and ratings for each fuse type indicated.

- 12 B. Product Data: Include the following for each fuse type indicated:

- 13 1. Dimensions and manufacturer's technical data on features, performance, electrical
14 characteristics, and ratings.
15 2. Let-through current curves for fuses with current-limiting characteristics.
16 3. Time-current curves, coordination charts and tables, and related data.
17 4. Fuse size for elevator feeders and elevator disconnect switches.

- 18 C. Ambient Temperature Adjustment Information. If ratings of fuses have been adjusted to
19 accommodate ambient temperatures, provide list of fuses adjusted.

- 20 1. For each adjusted fuse, include location of fuse, original fuse rating, local ambient
21 temperature, and adjusted fuse rating.
22 2. Provide manufacturer's technical data on which ambient temperature adjustment
23 calculations are based.

- 24 D. Maintenance Data: For tripping devices to include in maintenance manuals specified in
25 Division 01.

26 1.4 QUALITY ASSURANCE

- 27 A. Source Limitations: Provide fuses from a single manufacturer.

- 28 B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70,
29 Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for
30 intended use.
- 31 C. Comply with NEMA FU 1.
- 32 D. Comply with NFPA 70.
- 33 1.5 PROJECT CONDITIONS
- 34 A. Where ambient temperature to which fuses are directly exposed is less than 40 deg F or more
35 than 100 deg F, apply manufacturer's ambient temperature adjustment factors to fuse ratings.
- 36 1.6 COORDINATION
- 37 A. Coordinate fuse ratings with HVAC and refrigeration equipment nameplate limitations of
38 maximum fuse size.
- 39 1.7 EXTRA MATERIALS
- 40 A. Furnish extra materials described below that match products installed and that are packaged
41 in original cartons or containers and identified with labels describing contents.
- 42 1. Fuses: Quantity equal to 10 percent of each fuse type and size, but not fewer than 3 of
43 each type and size.
- 44 PART 2 - PRODUCTS
- 45 2.1 MANUFACTURERS
- 46 A. Manufacturers: Subject to compliance with requirements, provide products by one of the
47 following:
- 48 1. Cooper Industries, Inc.; Bussmann Div.
49 2. Ferraz Shawmut.
50 3. Tracor, Inc.; Littelfuse, Inc. Subsidiary.
- 51 2.2 CARTRIDGE FUSES
- 52 A. Characteristics: NEMA FU 1, non-renewable cartridge fuse; class and current rating indicated;
53 voltage rating consistent with circuit voltage.

54 PART 3 - EXECUTION

55 3.1 EXAMINATION

56 A. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes
57 and with characteristics appropriate for each piece of equipment.

58 B. Evaluate ambient temperatures to determine if fuse rating adjustment factors must be
59 applied to fuse ratings.

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

61 3.2 FUSE APPLICATIONS

62 A. Main Service: Class L, time delay.

63 B. Main Feeders: Class L, time delay or Class RK1, time delay.

64 C. Motor Branch Circuits: Class RK5, time delay.

65 D. Other Branch Circuits: Class RK1, time delay.

66 3.3 INSTALLATION

67 A. Install fuses in fusible devices. Arrange fuses so rating information is readable without
68 removing fuse.

69 3.4 IDENTIFICATION

70 A. Install labels indicating fuse replacement information on inside door of each fused switch.

71 END OF SECTION 262813

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1 SECTION 262816 – ENCLOSED SWITCHES AND CIRCUIT BREAKERS

2 PART 1 - GENERAL

3 1.1 RELATED DOCUMENTS

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

6 1.2 SUMMARY

- 7 A. This Section includes individually mounted enclosed switches and circuit breakers used for the
8 following:

- 9 1. Service disconnecting means.
10 2. Feeder and branch-circuit protection.
11 3. Motor and equipment disconnecting means.

- 12 B. Related Sections include the following:

- 13 1. Division 26 Section "Wiring Devices" for attachment plugs, receptacles, and toggle
14 switches used for disconnecting means.
15 2. Division 26 Section "Fuses" for fusible devices.

16 1.3 DEFINITIONS

- 17 A. GFCI: Ground-fault circuit interrupter.

- 18 B. RMS: Root mean square.

- 19 C. SPDT: Single pole, double throw.

20 1.4 SUBMITTALS

- 21 A. Product Data: For each type of switch, circuit breaker, accessory, and component indicated.
22 Include dimensions and manufacturers' technical data on features, performance, electrical
23 characteristics, ratings, and finishes.

- 24 B. Shop Drawings: For each switch and circuit breaker.

- 25 1. Dimensioned plans, elevations, sections, and details, including required clearances and
26 service space around equipment. Show tabulations of installed devices, equipment
27 features, and ratings. Include the following:

- 28 a. Enclosure types and details for types other than NEMA 250, Type 1.
- 29 b. Current and voltage ratings.
- 30 c. Short-circuit current rating.
- 31 d. UL listing for series rating of installed devices.
- 32 e. Features, characteristics, ratings, and factory settings of individual overcurrent
- 33 protective devices and auxiliary components.
- 34 2. Wiring Diagrams: Power, signal, and control wiring. Differentiate between
- 35 manufacturer-installed and field-installed wiring.
- 36 C. Field Test Reports: Submit written test reports and include the following:
- 37 1. Test procedures used.
- 38 2. Test results that comply with requirements.
- 39 3. Results of failed tests and corrective action taken to achieve test results that comply
- 40 with requirements.
- 41 D. Maintenance Data: For enclosed switches and circuit breakers and for components to include
- 42 in maintenance manuals specified in Division 01. In addition to requirements specified in
- 43 Division 01 Section "Closeout Procedures," include the following:
- 44 1. Routine maintenance requirements for components.
- 45 2. Manufacturer's written instructions for testing and adjusting switches and circuit
- 46 breakers.
- 47 3. Time-current curves, including selectable ranges for each type of circuit breaker.
- 48 1.5 QUALITY ASSURANCE
- 49 A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70,
- 50 Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for
- 51 intended use.
- 52 B. Comply with NEMA AB 1 and NEMA KS 1.
- 53 C. Comply with NFPA 70.
- 54 D. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed
- 55 switches and circuit breakers, including clearances between enclosures, and adjacent surfaces
- 56 and other items. Comply with indicated maximum dimensions.
- 57 1.6 COORDINATION
- 58 A. Coordinate layout and installation of switches, circuit breakers, and components with other
- 59 construction, including conduit, piping, equipment, and adjacent surfaces. Maintain required
- 60 workspace clearances and required clearances for equipment access doors and panels.

61 PART 2 - PRODUCTS

62 2.1 MANUFACTURERS

63 A. Manufacturers:

- 64 1. Eaton Electric Inc.; Cutler Hammer Products.
- 65 2. General Electric Company; GE Consumer & Industrial.
- 66 3. Square D; a brand of Schneider Electric.

67 2.2 ENCLOSED SWITCHES

68 A. Enclosed, Non-Fusible Switch: NEMA KS 1, Type HD heavy-duty, with lockable handle.

69 B. Enclosed, Fusible Switch, 800 A and Smaller: NEMA KS 1, Type HD, with clips to accommodate
70 specified fuses, lockable handle with two padlocks, and interlocked with cover in closed
71 position.

72 2.3 ENCLOSED CIRCUIT BREAKERS

73 A. Molded-Case Circuit Breaker: NEMA AB 1, with interrupting capacity to meet available fault
74 currents.

75 1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level
76 overloads, and instantaneous magnetic trip element for short circuits. Adjustable
77 magnetic trip setting for circuit-breaker frame sizes 250 A and larger.

78 2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-
79 mounted, field-adjustable trip setting.

80 3. Electronic Trip Unit Circuit Breakers: RMS sensing; field-replaceable rating plug; with
81 the following field-adjustable settings:

- 82 a. Instantaneous trip.
- 83 b. Long- and short-time pickup levels.
- 84 c. Long- and short-time time adjustments.
- 85 d. Ground-fault pickup level, time delay, and I^2t response.

86 4. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings
87 less than NEMA FU 1, RK-5.

88 5. GFCI Circuit Breakers: Single- and two-pole configurations with 30-mA trip sensitivity.

89 6. Molded-Case Switch: Molded-case circuit breaker without trip units.

90 B. Molded-Case Circuit-Breaker Features and Accessories: Standard frame sizes, trip ratings, and
91 number of poles.

- 92 1. Lugs: Mechanical style suitable for number, size, trip ratings, and material of
93 conductors.
- 94 2. Application Listing: Appropriate for application; Type SWD for switching fluorescent
95 lighting loads; Type HACR for heating, air-conditioning, and refrigerating equipment.
- 96 3. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup
97 and time-delay settings, push-to-test feature, and ground-fault indicator.
- 98 4. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 55 percent of
99 rated voltage.
- 100 5. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage with field-
101 adjustable 0.1- to 0.6-second time delay.

102 2.4 ENCLOSURES

- 103 A. NEMA AB 1 and NEMA KS 1 to meet environmental conditions of installed location.

- 104 1. Outdoor Locations: NEMA 250, Type 3R or 4X stainless steel as indicated.
- 105 2. Kitchen Areas: NEMA 250, Type 4X, stainless steel.
- 106 3. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.
- 107 4. Hazardous Areas Indicated on Drawings: NEMA 250, Type 7C.

108 2.5 FACTORY FINISHES

- 109 A. Finish: Manufacturer's standard paint applied to factory-assembled and -tested enclosures
110 before shipping.

111 PART 3 - EXECUTION

112 3.1 EXAMINATION

- 113 A. Examine elements and surfaces to receive enclosed switches and circuit breakers for
114 compliance with installation tolerances and other conditions affecting performance.

- 115 1. Proceed with installation only after unsatisfactory conditions have been corrected.

116 3.2 INSTALLATION

- 117 A. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and
118 temporary blocking of moving parts from enclosures and components.

119 3.3 IDENTIFICATION

120 A. Identify field-installed conductors, interconnecting wiring, and components; provide warning
121 signs as specified in Division 26 Section "Identification for Electrical Systems."

122 B. Enclosure Nameplates: Label each enclosure with engraved metal or laminated-plastic
123 nameplate mounted with corrosion-resistant screws.

124 3.4 CONNECTIONS

125 A. Install equipment grounding connections for switches and circuit breakers with ground
126 continuity to main electrical ground bus.

127 B. Install power wiring. Install wiring between switches and circuit breakers, and control and
128 indication devices.

129 C. Tighten electrical connectors and terminals according to manufacturer's published torque-
130 tightening values. If manufacturer's torque values are not indicated, use those specified in
131 UL 486A.

132 3.5 FIELD QUALITY CONTROL

133 A. Prepare for acceptance tests as follows:

134 1. Test insulation resistance for each enclosed switch, circuit breaker, component, and
135 control circuit.

136 2. Test continuity of each line- and load-side circuit.

137 3.6 ADJUSTING

138 A. Set field-adjustable switches and circuit-breaker trip ranges.

139 3.7 CLEANING

140 A. On completion of installation, inspect interior and exterior of enclosures. Remove paint
141 splatters and other spots. Vacuum dirt and debris; do not use compressed air to assist in
142 cleaning. Repair exposed surfaces to match original finish.

143 END OF SECTION 262816

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1 SECTION 265100 - INTERIOR LIGHTING

2 PART 1 - GENERAL

3 1.1 RELATED DOCUMENTS

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

6 1.2 SUMMARY

- 7 A. This Section includes the following:

- 8 1. Interior lighting fixtures with lamps and ballasts.
9 2. Lighting fixtures mounted on exterior building surfaces.
10 3. Emergency lighting units.
11 4. Exit signs.

- 12 B. Related Sections include the following:

- 13 1. Division 26 Section "Wiring Devices" for manual wall-box dimmers for incandescent
14 lamps.
15 2. Division 26 Section "Lighting Control Devices" for automatic control of lighting,
16 including time switches, photoelectric relays, occupancy sensors, and multipole
17 lighting relays and contactors.

18 1.3 DEFINITIONS

- 19 A. BF: Ballast factor. Ratio of light output of a given lamp(s) operated by the subject ballast to
20 the light output of the same lamp(s) when operated on an ANSI reference circuit.

- 21 B. CRI: Color rendering index.

- 22 C. CU: Coefficient of utilization.

- 23 D. LER: Luminaire efficiency rating, which is calculated according to NEMA LE 5. This value can
24 be estimated from photometric data using the following formula:

- 25 1. LER is equal to the product of total rated lamp lumens times BF times luminaire
26 efficiency, divided by input watts.

- 27 E. RCR: Room cavity ratio.

- 28 1.4 SUBMITTALS
- 29 A. Product Data: For each type of lighting fixture scheduled, arranged in order of fixture
30 designation. Include data on features, accessories, finishes, and the following:
- 31 1. Physical description of fixture, including dimensions and verification of indicated
32 parameters.
- 33 2. Emergency lighting unit battery and charger.
- 34 3. Fluorescent and high-intensity-discharge ballasts.
- 35 4. Sound Performance Data: For air-handling fixtures. Indicate sound power level and
36 sound transmission class in test reports certified according to standards specified in
37 Division 23 Section "Diffusers, Registers and Grilles."
- 38 5. Lamps.
- 39 B. Shop Drawings: Show details of nonstandard or custom fixtures. Indicate dimensions,
40 weights, methods of field assembly, components, features, and accessories.
- 41 C. Wiring Diagrams: Power, signal, and control wiring.
- 42 D. Product Certificates: For each type of ballast for dimmer-controlled fixtures, signed by
43 product manufacturer.
- 44 E. Source quality-control test reports.
- 45 F. Field quality-control test reports.
- 46 G. Operation and Maintenance Data: For lighting equipment and fixtures to include in
47 emergency, operation, and maintenance manuals. In addition to items specified in Division 1
48 Section "Closeout Procedures," include the following:
- 49 1. Catalog data for each fixture. Include the diffuser, ballast, and lamps installed in that
50 fixture.
- 51 H. Warranties: Special warranties specified in this Section.
- 52 1.5 QUALITY ASSURANCE
- 53 A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70,
54 Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for
55 intended use.
- 56 B. Comply with NFPA 70.
- 57 C. FMG Compliance: Fixtures for hazardous locations shall be listed and labeled for indicated
58 class and division of hazard by FMG.

59 D. NFPA 101 Compliance: Comply with visibility and luminance requirements for exit signs.

60 1.6 COORDINATION

61 A. Coordinate layout and installation of lighting fixtures and suspension system with other
62 construction that penetrates ceilings or is supported by them, including HVAC equipment, fire-
63 suppression system, and partition assemblies.

64 1.7 WARRANTY

65 A. Special Warranty for Emergency Lighting Unit Batteries: Manufacturer's standard form in
66 which manufacturer of battery-powered emergency lighting unit agrees to repair or replace
67 components of rechargeable batteries that fail in materials or workmanship within specified
68 warranty period.

69 1. Warranty Period: 10 years from date of Substantial Completion. Full warranty shall
70 apply for first year, and prorated warranty for the remaining nine years.

71 B. Electrical contractor shall provide material and labor as required for the complete installation
72 of 2 additional exit signs to be located by the Architect/Engineer during construction.

73 PART 2 - PRODUCTS

74 2.1 MANUFACTURERS

75 A. In other Part 2 articles where titles below introduce lists, the following requirements apply to
76 product selection:

77 1. Products: Subject to compliance with requirements, products that may be
78 incorporated into the Work include, but are not limited to, products specified. Refer
79 to Luminaire Schedule on Drawings.

80 2.2 FIXTURES AND COMPONENTS, GENERAL

81 A. Recessed Fixtures: Comply with NEMA LE 4 for ceiling compatibility for recessed fixtures.

82 B. Metal Parts: Free of burrs and sharp corners and edges.

83 C. Sheet Metal Components: Steel, unless otherwise indicated. Form and support to prevent
84 warping and sagging.

85 D. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under
86 operating conditions, and designed to permit relamping without use of tools. Designed to
87 prevent doors, frames, lenses, diffusers, and other components from falling accidentally
88 during relamping and when secured in operating position.

89 E. Reflecting surfaces shall have minimum reflectance as follows, unless otherwise indicated:

- 90 1. White Surfaces: 85 percent.
- 91 2. Specular Surfaces: 83 percent.
- 92 3. Diffusing Specular Surfaces: 75 percent.
- 93 4. Laminated Silver Metallized Film: 90 percent.
- 94

95 F. Plastic Diffusers, Covers, and Globes:

96 1. Acrylic Lighting Diffusers: 100 percent virgin acrylic plastic. High resistance to
97 yellowing and other changes due to aging, exposure to heat, and UV radiation.

98 a. Lens Thickness: At least 0.156 inch minimum unless different thickness is
99 scheduled.

100 b. UV stabilized.

101 2. Glass: Annealed crystal glass, unless otherwise indicated.

102 2.3 LED DRIVERS

103 A. Manufacturers:

- 104 1. Philips Lumileds Lighting.
- 105 2. Nichia.
- 106 3. Cree.
- 107 4. Osram Opto Semiconductors.

108 B. Description: Include the following features, unless otherwise indicated:

109 1. Designed for type and quantity of lamps indicated at full light output except for
110 emergency lamps powered by in-fixture battery-packs.

111 2.4 EXIT SIGNS

112 A. General: Comply with UL 924; for sign colors and lettering size, comply with authorities
113 having jurisdiction.

114 B. Internally Lighted Signs:

- 115 1. Lamps for AC Operation: Light-emitting diodes, 70,000 hours minimum of rated lamp
116 life.
- 117 2.5 EMERGENCY LIGHTING UNITS
- 118 A. General: Self-contained units complying with UL 924.
- 119 1. Battery: Sealed, maintenance-free, lead-acid type with minimum 10-year nominal life
120 and special warranty.
- 121 2. Charger: Fully automatic, solid-state type with sealed transfer relay.
- 122 3. Operation: Relay automatically turns lamp on when power supply circuit voltage
123 drops to 80 percent of nominal voltage or below. Lamp automatically disconnects
124 from battery when voltage approaches deep-discharge level. When normal voltage is
125 restored, relay disconnects lamps from battery, and battery is automatically recharged
126 and floated on charger.
- 127 4. Wire Guard: Where indicated, heavy-chrome-plated wire guard protects lamp heads
128 or fixtures.
- 129 5. Integral Time-Delay Relay: Holds unit on for fixed interval when power is restored
130 after an outage; time delay permits high-intensity-discharge lamps to restrike and
131 develop adequate output.
- 132 2.6 FIXTURE SUPPORT COMPONENTS
- 133 A. Comply with Division 26 Section "Common Work Results for Electrical" for channel- and angle-
134 iron supports and nonmetallic channel and angle supports.
- 135 B. Single-Stem Hangers: 1/2-inch steel tubing with swivel ball fittings and ceiling canopy. Finish
136 same as fixture.
- 137 C. Twin-Stem Hangers: Two, 1/2-inch steel tubes with single canopy designed to mount a single
138 fixture. Finish same as fixture.
- 139 D. Wires: ASTM A 641/A 641M, Class 3, soft temper, zinc-coated, 12 gage.
- 140 E. Rod Hangers: 1/4 inch-minimum diameter, cadmium-plated, threaded steel rod.
- 141 F. Hook Hangers: Integrated assembly matched to fixture and line voltage and equipped with
142 threaded attachment, cord, and locking-type plug.
- 143 G. Aircraft Cable Support: Use cable, anchorages, and intermediate supports recommended by
144 fixture manufacturer.
- 145 2.7 FINISHES

- 146 A. Fixtures: Manufacturers' standard, unless otherwise indicated.
- 147 1. Paint Finish: Applied over corrosion-resistant treatment or primer, free of defects.
- 148 2. Metallic Finish: Corrosion resistant.
- 149 2.8 SOURCE QUALITY CONTROL
- 150 A. Factory test fixtures with ballasts and lamps; certify results for electrical ratings and
- 151 photometric data.
- 152 PART 3 - EXECUTION
- 153 3.1 INSTALLATION
- 154 A. Fixtures: Set level, plumb, and square with ceilings and walls. Install lamps in each fixture.
- 155 B. Support for Fixtures in or on Grid-Type Suspended Ceilings: Use grid for support.
- 156 1. Install a minimum of two ceiling support system rods, wires, or chains for each fixture.
- 157 Locate not more than 6 inches from fixture corners. Locate at opposite corners
- 158 fastened to structural steel.
- 159 2. Support Clips: Fasten to fixtures and to ceiling grid members at or near each fixture
- 160 corner with clips that are UL listed for the application.
- 161 3. Fixtures of Sizes Less Than Ceiling Grid: Install as indicated on reflected ceiling plans
- 162 or center in acoustical panel, and support fixtures independently with at least two
- 163 3/4-inch metal channels spanning and secured to ceiling tees.
- 164 C. Suspended Fixture Support: As follows:
- 165 1. Pendants and Rods: Where longer than 48 inches, brace to limit swinging.
- 166 2. Stem-Mounted, Single-Unit Fixtures: Suspend with twin-stem hangers.
- 167 3. Continuous Rows: Suspend from cable.
- 168 D. Adjust aimable fixtures to provide required light intensities.
- 169 3.2 CONNECTIONS
- 170 A. Tighten electrical connectors and terminals according to manufacturer's published torque-
- 171 tightening values. If manufacturer's torque values are not indicated, use those specified in
- 172 UL 486A.
- 173 3.3 FIELD QUALITY CONTROL

- 174 A. Inspect each installed fixture for damage. Replace damaged fixtures and components.
- 175 B. Verify normal operation of each fixture after installation.
- 176 C. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify
177 normal transfer to battery power source and retransfer to normal.
- 178 D. Prepare a written report of tests, inspections, observations, and verifications indicating and
179 interpreting results. If adjustments are made to lighting system, retest to demonstrate
180 compliance with standards.
- 181 E. Corroded Fixtures: During warranty period, replace fixtures that show any signs of corrosion.
- 182 3.4 CLEANING
- 183 A. Clean fixtures internally and externally after installation just prior to substantial completion.
184 Use methods and materials recommended by manufacturer.
- 185 END OF SECTION 265100

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1 SECTION 265600 – EXTERIOR LIGHTING

2 PART 1 - GENERAL

3 1.1 RELATED DOCUMENTS

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

6 1.2 SUMMARY

- 7 A. This Section includes the following:

- 8 1. Exterior luminaires with lamps and ballasts.
9 2. Luminaire-mounted photoelectric relays.
10 3. Poles and accessories.

- 11 B. Related Sections include the following:

- 12 1. Division 26 Section "Interior Lighting" for exterior luminaires normally mounted on
13 exterior surfaces of buildings.

14 1.3 DEFINITIONS

- 15 A. CRI: Color-rendering index.

- 16 B. HID: High-intensity discharge.

- 17 C. Luminaire: Complete lighting fixture, including ballast housing if provided.

- 18 D. Pole: Luminaire support structure, including tower used for large area illumination.

- 19 E. Standard: Same definition as "Pole" above.

20 1.4 STRUCTURAL ANALYSIS CRITERIA FOR POLE SELECTION

- 21 A. Dead Load: Weight of luminaire and its horizontal and vertical supports, lowering devices, and
22 supporting structure, applied as stated in AASHTO LTS-4.

- 23 B. Live Load: Single load of 500 lbf, distributed as stated in AASHTO LTS-4.

- 24 C. Ice Load: Load of 3 lbf/sq. ft., applied as stated in AASHTO LTS-4.

- 25 D. Wind Load: Pressure of wind on pole and luminaire, calculated and applied as stated in
26 AASHTO LTS-4.
- 27 1. Wind speed for calculating wind load for poles is 100 mph.
- 28 E. Poles 20-feet and taller shall have vibration dampers.
- 29 1.5 SUBMITTALS
- 30 A. Product Data: For each luminaire, pole, and support component, arranged in order of lighting
31 unit designation. Include data on features, accessories, finishes, and the following:
- 32 1. Physical description of luminaire, including materials, dimensions, effective projected
33 area, and verification of indicated parameters.
- 34 2. Details of attaching luminaires and accessories.
- 35 3. Details of installation and construction.
- 36 4. Luminaire materials.
- 37 5. Photometric data based on laboratory tests of each luminaire type, complete with
38 indicated lamps, ballasts, and accessories.
- 39 a. Photometric data shall be certified by manufacturer's laboratory with a current
40 accreditation under the National Voluntary Laboratory Accreditation Program for
41 Energy Efficient Lighting Products.
- 42 6. Ballasts, including energy-efficiency data.
- 43 7. Lamps, including life, output, and energy-efficiency data.
- 44 8. Materials, dimensions, and finishes of poles.
- 45 9. Means of attaching luminaires to supports, and indication that attachment is suitable
46 for components involved.
- 47 10. Anchor bolts for poles.
- 48 B. Shop Drawings:
- 49 1. Anchor-bolt templates keyed to specific poles and certified by manufacturer.
- 50 2. Wiring Diagrams: Power and control wiring.
- 51 C. Pole and Support Component Certificates: Signed by manufacturers of poles, certifying that
52 products are designed for indicated load requirements in AASHTO LTS-4 and that load imposed
53 by luminaire has been included in design.
- 54 D. Qualification Data: For agencies providing photometric data for lighting fixtures.
- 55 E. Field quality-control test reports.
- 56 F. Operation and Maintenance Data: For luminaires and poles to include in emergency,
57 operation, and maintenance manuals.

- 58 G. Warranty: Special warranty specified in this Section.
- 59 1.6 QUALITY ASSURANCE
- 60 A. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by manufacturers'
61 laboratories that are accredited under the National Volunteer Laboratory Accreditation
62 Program for Energy Efficient Lighting Products.
- 63 B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70,
64 Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for
65 intended use.
- 66 C. Comply with IEEE C2, "National Electrical Safety Code."
- 67 D. Comply with NFPA 70.
- 68 1.7 DELIVERY, STORAGE, AND HANDLING
- 69 A. Package aluminum poles for shipping according to ASTM B 660.
- 70 B. Store poles on decay-resistant-treated skids at least 12 inches above grade and vegetation.
71 Support poles to prevent distortion and arrange to provide free air circulation.
- 72 C. Retain factory-applied pole wrappings on metal poles until right before pole installation. For
73 poles with non-metallic finishes, handle with web fabric straps.
- 74 1.8 WARRANTY
- 75 A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or
76 replace products that fail in materials or workmanship; that corrode; or that fade, stain,
77 perforate, erode, or chalk due to effects of weather or solar radiation within specified
78 warranty period. Manufacturer may exclude lightning damage, hail damage, vandalism, abuse,
79 or unauthorized repairs or alterations from special warranty coverage.
- 80 1. Warranty Period for Luminaires: Five years from date of Substantial Completion.
- 81 2. Warranty Period for Metal Corrosion: Five years from date of Substantial Completion.
- 82 3. Warranty Period for Color Retention: Five years from date of Substantial Completion.
- 83 4. Warranty Period for Lamps: Replace lamps and fuses that fail within 12 months from
84 date of Substantial Completion; furnish replacement lamps and fuses that fail within the
85 second 12 months from date of Substantial Completion.
- 86 5. Warranty Period for Poles: Repair or replace lighting poles and standards that fail in
87 finish, materials, and workmanship within special warranty period.

88 PART 2 - PRODUCTS

89 2.1 MANUFACTURERS

90 A. Manufacturers: Subject to compliance with requirements, provide products by one of the
91 manufacturers specified.

92 1. Light Fixtures: Refer to Luminaire Schedule on the Drawings.

93 2. Ballasts:

94 a. Advance.

95 b. Osram/Sylvania.

96

97 3. Lamps:

98 a. General Electric.

99 b. Osram/Sylvania.

100 2.2 LUMINAIRES, GENERAL REQUIREMENTS

101 A. Luminaires shall comply with UL 1598 and be listed and labeled for installation in wet locations
102 by an NRTL acceptable to authorities having jurisdiction.

103 B. Comply with IESNA RP-8 for parameters of lateral light distribution patterns indicated for
104 luminaires.

105 C. Metal Parts: Free of burrs and sharp corners and edges.

106 D. Sheet Metal Components: Corrosion-resistant aluminum, unless otherwise indicated. Form
107 and support to prevent warping and sagging.

108 E. Housings: Rigidly formed, weather- and light-tight enclosures that will not warp, sag, or
109 deform in use. Provide filter/breather for enclosed luminaires.

110 F. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under
111 operating conditions, and designed to permit re-lamping without use of tools. Designed to
112 prevent doors, frames, lenses, diffusers, and other components from falling accidentally during
113 re-lamping and when secured in operating position. Doors shall be removable for cleaning or
114 replacing lenses. Designed to disconnect ballast when door opens.

115 G. Exposed Hardware Material: Stainless steel.

116 H. Plastic Parts: High resistance to yellowing and other changes due to aging, exposure to heat,
117 and UV radiation.

- 118 I. Light Shields: Metal baffles, factory installed and field adjustable, arranged to block light
119 distribution to indicated portion of normally illuminated area or field.
- 120 J. Reflecting surfaces shall have minimum reflectance as follows, unless otherwise indicated:
- 121 1. White Surfaces: 85 percent.
122 2. Specular Surfaces: 83 percent.
123 3. Diffusing Specular Surfaces: 75 percent.
- 124 K. Lenses and Refractors Gaskets: Use heat- and aging-resistant resilient gaskets to seal and
125 cushion lenses and refractors in luminaire doors.
- 126 L. Luminaire Finish: Manufacturer's standard paint applied to factory-assembled and -tested
127 luminaire before shipping. Match finish process and color of pole or support materials.
- 128 1. Color: Match Architect's custom color with ANSI number provided.
- 129 M. Factory-Applied Finish for Aluminum luminaires: Comply with NAAMM's "Metal Finishes
130 Manual for Architectural and Metal Products" for recommendations for applying and
131 designating finishes.
- 132 1. Class I, Color Anodic Finish: AA-M32C22A42/A44 (Mechanical Finish: medium satin;
133 Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, integrally
134 colored or electrolytically deposited color coating 0.018 mm or thicker) complying with
135 AAMA 611.
- 136 a. Color: Match Architect's custom color with ANSI number provided.
- 137 2.3 LED DRIVERS
- 138 A. Refer to Section 26 51 00 "Interior Lighting" for requirements.
- 139 2.4 POLES AND SUPPORT COMPONENTS, GENERAL REQUIREMENTS
- 140 A. Structural Characteristics: Comply with AASHTO LTS-4.
- 141 1. Wind-Load Strength of Poles: Adequate at indicated heights above grade without
142 failure, permanent deflection, or whipping in steady winds of speed indicated in Part 1
143 "Structural Analysis Criteria for Pole Selection" Article, with a gust factor of 1.3.
- 144 2. Strength Analysis: For each pole, multiply the actual equivalent projected area of
145 luminaires and all components by a factor of 1.25 to obtain the equivalent projected
146 area to be used in pole selection strength analysis.
- 147 3. Minimum Wall Thickness: Pole height of 12-feet to 20-feet, .188 inch; 21-feet to 40-
148 feet, .250 inch.

- 149 4. Pole Size: In addition to EPA calculation requirements, all poles 20-feet in length and
150 above shall be the same diameter with the same size base plate and anchor bolt
151 pattern.
- 152 B. Luminaire Attachment Provisions: Comply with luminaire manufacturers' mounting
153 requirements. Use stainless-steel fasteners and mounting bolts, unless otherwise indicated.
- 154 C. Mountings, Fasteners, and Appurtenances: Corrosion-resistant items compatible with support
155 components.
- 156 1. Materials: Shall not cause galvanic action at contact points.
157 2. Anchor Bolts, Leveling Nuts, Bolt Caps, and Washers: Hot-dip galvanized after
158 fabrication, unless stainless-steel items are indicated.
159 3. Anchor-Bolt Template: Steel.
- 160 D. Concrete Pole Foundations: Cast in place, with anchor bolts to match pole-base flange.
161 Concrete, reinforcement, and formwork are specified in Division 03.
- 162 2.5 ALUMINUM POLES
- 163 A. Poles: Seamless, extruded structural tube complying with ASTM B 429, Alloy 6063-T6 with
164 access handhole in pole wall.
- 165 B. Poles: ASTM B 209, 5052-H34 marine sheet alloy with access handhole in pole wall.
- 166 1. Shape: As noted in Luminaire Schedule on the Drawings.
167 2. Mounting Provisions: Butt flange for bolted mounting on foundation or breakaway
168 support.
- 169 C. Pole-Top Tenons: Fabricated to support luminaire or luminaires and brackets indicated, and
170 securely fastened to pole top.
- 171 D. Grounding and Bonding Lugs: Two welded 1/2-inch threaded lugs, complying with
172 requirements in Division 26 Section "Grounding and Bonding for Electrical Systems," listed for
173 attaching grounding and bonding conductors of type and size listed in that Section, and
174 accessible through handhole.
- 175 E. Brackets for Luminaires: Detachable, with pole and adapter fittings of cast aluminum.
176 Adapter fitting welded to pole and bracket, then bolted together with stainless-steel bolts.
- 177 1. Tapered oval cross section, with straight tubular end section to accommodate luminaire.
178 2. Finish: Same as pole and luminaire.
- 179 F. Prime-Coat Finish: Manufacturer's standard prime-coat finish ready for field painting.
- 180 G. Aluminum Finish: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal
181 Products" for recommendations for applying and designating finishes.

- 182 1. Class I, Color Anodic Finish: AA-M32C22A42/A44 (Mechanical Finish: medium satin;
183 Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, integrally
184 colored or electrolytically deposited color coating 0.018 mm or thicker) complying with
185 AAMA 611.
- 186 a. Color: Match Architect's custom color with ANSI number provided.
- 187 2.6 POLE ACCESSORIES
- 188 A. Base Covers: Manufacturers' standard aluminum units, arranged to cover pole's mounting
189 bolts and nuts. Finish same as pole.
- 190 PART 3 - EXECUTION
- 191 3.1 LUMINAIRE INSTALLATION
- 192 A. Install lamps in each luminaire.
- 193 B. Fasten luminaire to indicated structural supports.
- 194 1. Use fastening methods and materials selected to resist seismic forces defined for the
195 application and approved by manufacturer.
- 196 C. Adjust luminaires that require field adjustment or aiming. Include adjustment of photoelectric
197 device to prevent false operation of relay by artificial light sources.
- 198 3.2 POLE INSTALLATION
- 199 A. Align pole foundations and poles for optimum directional alignment of luminaires and their
200 mounting provisions on the pole.
- 201 B. Clearances: Maintain the following minimum horizontal distances of poles from surface and
202 underground features, unless otherwise indicated on Drawings:
- 203 1. Fire Hydrants and Storm Drainage Piping: 5 feet.
204 2. Water, Gas, Electric, Communication, and Sewer Lines: 10 feet.
205 3. Trees: 15 feet.
206 4. Pavement or Curbs: 3 feet.
- 207 C. Concrete Pole Foundations: Set anchor bolts according to anchor-bolt templates furnished by
208 pole manufacturer. Concrete materials, installation, and finishing requirements are specified
209 in Division 03.

- 210 D. Foundation-Mounted Poles: Mount pole with leveling nuts, and tighten top nuts to torque
211 level recommended by pole manufacturer.
- 212 1. Use anchor bolts and nuts selected to resist seismic forces defined for the application
213 and approved by manufacturer.
- 214 2. Grout void between pole base and foundation. Use non-shrink or expanding concrete
215 grout firmly packed to fill space.
- 216 3. Install base covers, unless otherwise indicated.
- 217 4. Use a short piece of 3/8-inch- diameter polypropelene gray pipe to make a drain hole
218 through grout. Arrange to drain condensation from interior of pole.
- 219 E. Poles and Pole Foundations Set in Concrete Paved Areas: Install poles with minimum of 2-
220 inch- wide, unpaved gap between the pole or pole foundation and the edge of adjacent
221 concrete slab. Fill unpaved ring with pea gravel to a level 1 inch below top of concrete slab.
- 222 F. Raise and set poles using web fabric slings (not chain or cable).
- 223 3.3 BOLLARD LUMINAIRE INSTALLATION
- 224 A. Align units for optimum directional alignment of light distribution.
- 225 B. Install on concrete base with top 6 inches above finished grade or 1-inch above finished
226 surface at bollard location. Cast conduit into base, and shape base to match shape of bollard
227 base. Finish by troweling and rubbing smooth. Concrete materials, installation, and finishing
228 are specified in Division 03.
- 229 3.4 INSTALLATION OF INDIVIDUAL GROUND-MOUNTING LUMINAIRES
- 230 A. Install on concrete base with top 6 inches above finished grade or surface at luminaire
231 location. Cast conduit into base, and finish by troweling and rubbing smooth. Concrete
232 materials, installation, and finishing are specified in Division 03.
- 233 3.5 CORROSION PREVENTION
- 234 A. Aluminum: Do not use in contact with earth or concrete. When in direct contact with a
235 dissimilar metal, protect aluminum by insulating fittings or treatment.
- 236 B. Steel Conduits: Comply with Division 26 Section "Raceway and Boxes for Electrical Systems."
237 In concrete foundations, apply two coats of asphaltic varnish.
- 238 3.6 GROUNDING
- 239 A. Ground metal poles and support structures according to Division 26 Section "Grounding and
240 Bonding for Electrical Systems."

- 241 1. Install grounding electrode for each pole, unless otherwise indicated.
- 242 2. Install grounding conductor pigtail in the base for connecting luminaire to grounding
- 243 system.

244 3.7 FIELD QUALITY CONTROL

- 245 A. Inspect each installed fixture for damage. Replace damaged fixtures and components.
- 246 B. Illumination Observations: Verify normal operation of lighting units after installing luminaires
- 247 and energizing circuits with normal power source.
- 248 1. Verify operation of photoelectric controls.

249 3.8 DEMONSTRATION

- 250 A. Engage a factory-authorized service representative to train Owner's maintenance personnel to
- 251 adjust, operate, and maintain luminaire lowering devices.

252 END OF SECTION 265600

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254

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DIVISION 28

1 SECTION 283111 - FIRE ALARM SYSTEM

2 PART 1 - GENERAL

3 1.1 RELATED DOCUMENTS

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

6 1.2 SUMMARY

7 A. This Section includes fire alarm systems.

8 1.3 DEFINITIONS

9 A. FACP: Fire alarm control panel.

10 B. LED: Light-emitting diode.

11 C. NICET: National Institute for Certification in Engineering Technologies.

12 D. Definitions in NFPA 72 apply to fire alarm terms used in this Section.

13 1.4 SYSTEM DESCRIPTION

14 A. Noncoded, analog-addressable system; automatic sensitivity control of certain smoke
15 detectors; and multiplexed signal transmission dedicated to fire alarm service only.

16 1.5 PERFORMANCE REQUIREMENTS

17 A. Comply with NFPA 72.

18 1. Factory Mutual (FM)

19 a. FM AG Approval Guide.

20 2. National Fire Protection Association (NFPA)

21 a. NFPA 13 Standard For The Installation of Sprinkler Systems.

- 22 b. NFPA 13A Recommended Practice for The Inspection, Testing And Maintenance of
23 Sprinkler Systems.
- 24 c. NFPA 70 National Electrical Code.
- 25 d. NFPA 72 Standard for The Installation, Maintenance and Use of Protective Signaling
26 Systems.
- 27 e. NFPA 72E Standard on Automatic Fire Detectors.
- 28 f. NFPA 72G Guide for The Installation, Maintenance and Use of Notification
29 Appliances.
- 30 g. NFPA 72H Guide for Testing Procedure for Local, Auxiliary, Remote Station and
31 Proprietary Protective Signaling Systems.
- 32 h. NFPA 90A Standard for The Installation of Air Conditioning and Ventilating Systems.
- 33 i. NFPA 101 Life Safety Code.
- 34 3. Underwriters' Laboratories, Inc. (UL)
- 35 a. Appropriate UL standards.
- 36 4. State and local building codes as adopted by the authority having jurisdiction.
- 37 5. Dept. of Justice rules for Building Accessibility by The Handicapped.
- 38 B. Premises protection includes occupancy K1.
- 39 C. Fire alarm signal initiation shall be by one or more of the following devices:
- 40 1. Manual pull stations.
- 41 2. Heat detectors.
- 42 3. Smoke detectors.
- 43 4. Verified automatic alarm operation of smoke detectors.
- 44 5. Automatic sprinkler system water flow.
- 45 D. Fire alarm signal shall initiate the following actions:
- 46 1. Alarm notification appliances shall operate continuously.
- 47 2. Identify alarm at the FACP and remote annunciators.
- 48 3. Transmit an alarm signal to the remote alarm receiving station.
- 49 4. Switch heating, ventilating, and air-conditioning equipment controls to fire alarm mode.
- 50 5. Close smoke dampers in air ducts of system serving zone where alarm was initiated.
- 51 6. Record events in the system memory.
- 52 7. Record events by the system printer.
- 53 E. Supervisory signal initiation shall be by one or more of the following devices or actions:
- 54 1. Operation of a fire-protection system valve tamper.
- 55 F. System trouble signal initiation shall be by one or more of the following devices or actions:

- 56 1. Open circuits, shorts and grounds of wiring for initiating device, signaling line, and
57 notification-appliance circuits.
- 58 2. Opening, tampering, or removal of alarm-initiating and supervisory signal-initiating
59 devices.
- 60 3. Loss of primary power at the FACP.
- 61 4. Ground or a single break in FACP internal circuits.
- 62 5. Abnormal ac voltage at the FACP.
- 63 6. A break in standby battery circuitry.
- 64 7. Failure of battery charging.
- 65 8. Abnormal position of any switch at the FACP or annunciator.
- 66 G. System Trouble and Supervisory Signal Actions: Ring trouble bell and annunciate at the
67 FACP and remote annunciators. Record the event on system printer.
- 68 1.6 SUBMITTALS
- 69 A. Product Data: For each type of product indicated.
- 70 B. Shop Drawings:
- 71 1. Shop Drawings shall be prepared by persons with the following qualifications:
- 72 a. Trained and certified by manufacturer in fire alarm system design.
- 73 b. Fire alarm certified by NICET, minimum Level III.
- 74 2. System Operation Description: Detailed description for this project, including method of
75 operation and supervision of each type of circuit and sequence of operations for
76 manually and automatically initiated system inputs and outputs. Manufacturer's
77 standard descriptions for generic systems are not acceptable.
- 78 3. Device Address List: Coordinate with final system programming.
- 79 4. System riser diagram with device addresses, conduit sizes, and cable and wire types and
80 sizes.
- 81 5. Wiring Diagrams: Power, signal, and control wiring. Include diagrams for equipment
82 and for system with all terminals and interconnections identified. Show wiring color
83 code.
- 84 6. Batteries: Size calculations.
- 85 7. Duct Smoke Detectors: Performance parameters and installation details for each
86 detector, verifying that each detector is listed for the complete range of air velocity,
87 temperature, and humidity possible when air-handling system is operating.
- 88 8. Ductwork Coordination Drawings: Plans, sections, and elevations of ducts, drawn to
89 scale and coordinating the installation of duct smoke detectors and access to them.
90 Show critical dimensions that relate to placement and support of sampling tubes, the
91 detector housing, and remote status and alarm indicators. Locate detectors according
92 to manufacturer's written recommendations.

- 93 9. Floor Plans: Indicate final outlet locations showing address of each addressable device.
94 Show size and route of cable.
- 95 C. Qualification Data: For installer.
- 96 D. Field quality-control test reports.
- 97 E. Operation and Maintenance Data: For fire alarm system to include in emergency, operation,
98 and maintenance manuals. Comply with NFPA 72, Appendix A, recommendations for Owner's
99 manual. Include abbreviated operating instructions for mounting at the FACP.
- 100 F. Submittals to Authorities Having Jurisdiction: In addition to distribution requirements for
101 submittals specified in Division 01 Section "Submittals," make an identical submittal to
102 authorities having jurisdiction. To facilitate review, include copies of annotated contract
103 drawings as needed to depict component locations. Resubmit if required to make
104 clarifications or revisions to obtain approval. On receipt of comments from authorities having
105 jurisdiction, submit them to Architect for review.
- 106 G. Documentation:
- 107 1. Record of Completion Documents: Provide the "Permanent Records" according to
108 NFPA 72 to Owner, Architect, and authorities having jurisdiction. Format of the written
109 sequence of operation shall be the optional input/output matrix.
- 110 a. Hard copies on paper to Owner, Architect, and authorities having jurisdiction.
111 b. Electronic media may be provided to Architect and authorities having jurisdiction.
- 112 1.7 QUALITY ASSURANCE
- 113 A. Installer Qualifications: Personnel certified by NICET as Fire Alarm Level III.
- 114 B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70,
115 Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for
116 intended use.
- 117 C. Warranty: Warranty all materials, installation and workmanship for five years from date of
118 substantial completion.
- 119 1.8 MAINTENANCE
- 120 A. The factory trained and authorized engineered systems distributor who designed and installed
121 this system shall provide a separate maintenance contract for a period of three years from the
122 date of system commissioning including all required state, NFPA inspections, testings, and
123 filings.

124 PART 2 - PRODUCTS

125 2.1 MANUFACTURERS

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

128 1. FACP, Equipment and Devices:

129 a. Edwards Systems Technology Inc. (EST-3). Existing FACP.

130 2. Wire and Cable:

131 a. Comtran Corporation.

132 b. Helix/HiTemp Cables, Inc.; a Draka USA Company.

133 c. Rockbestos-Suprenant Cable Corporation; a Marmon Group Company.

134 d. West Penn Wire/CDT; a division of Cable Design Technologies.

135 e. Belden.

136 2.2 FACP

137 A. General Description:

138 1. Modular, power-limited design with electronic modules, UL 864 listed.

139 2. Addressable initiation devices that communicate device identity and status.

140 a. Smoke sensors shall additionally communicate sensitivity setting and allow for
141 adjustment of sensitivity at the FACP.

142 b. Temperature sensors shall additionally test for and communicate the sensitivity
143 range of the device.

144 3. Addressable control circuits for operation of mechanical equipment.

145 4. Include the following additional devices with complete installation and commissioning
146 to be placed by the engineer during construction:

147 a. Four smoke detectors or heat detectors.

148 b. Two duct mounted smoke detectors.

149 c. Two manual pull stations.

150 d. Two horn/strobe units.

151 e. Two strobe only units.

152 B. Alphanumeric Display and System Controls: Arranged for interface between human operator
153 at the FACP and addressable system components including annunciation and supervision.

- 154 Display alarm, supervisory, and component status messages and the programming and control
155 menu.
- 156 1. Annunciator and Display: Liquid-crystal type, one line(s) of 80 characters, minimum.
157 2. Keypad: Arranged to permit entry and execution of programming, display, and control
158 commands; and to indicate control commands to be entered into the system for control
159 of smoke-detector sensitivity and other parameters.
- 160 C. Circuits:
- 161 1. Signaling Line Circuits: NFPA 72, Class A, Style 6.
- 162 a. System Layout: Each signaling line circuit shall be loaded to no more than 80% of
163 its capacity.
- 164 2. Notification-Appliance Circuits: NFPA 72, Class B, Style Z.
165 3. Actuation of alarm notification appliances, annunciation, elevator recall, and actuation
166 of suppression systems shall occur within 10 seconds after the activation of an initiating
167 device.
168 4. Electrical monitoring for the integrity of wiring external to the FACP for mechanical
169 equipment shutdown and magnetic door-holding circuits is not required, provided a
170 break in the circuit will cause doors to close and mechanical equipment to shut down.
- 171 D. Smoke-Alarm Verification:
- 172 1. Initiate audible and visible indication of an "alarm verification" signal at the FACP.
173 2. Activate a listed and approved "alarm verification" sequence at the FACP and the
174 detector.
175 3. Sound general alarm if the alarm is verified.
176 4. Cancel FACP indication and system reset if the alarm is not verified.
- 177 E. Notification-Appliance Circuit: Operation shall sound in a temporal pattern, complying with
178 ANSI S3.41.
- 179 F. Power Supply for Supervision Equipment: Supply for audible and visual equipment for
180 supervision of the ac power shall be from a dedicated dc power supply, and power for the dc
181 component shall be from the ac supply.
- 182 G. Alarm Silencing, Trouble, and Supervisory Alarm Reset: Manual reset at the FACP and remote
183 annunciators, after initiating devices are restored to normal.
- 184 1. Silencing-switch operation halts alarm operation of notification appliances and activates
185 an "alarm silence" light. Display of identity of the alarm zone or device is retained.
186 2. Subsequent alarm signals from other devices or zones reactivate notification appliances
187 until silencing switch is operated again.

- 188 3. When alarm-initiating devices return to normal and system reset switch is operated,
189 notification appliances operate again until alarm silence switch is reset.
- 190 H. Walk Test: A test mode to allow one person to test alarm and supervisory features of
191 initiating devices. Enabling of this mode shall require the entry of a password. The FACP and
192 annunciators shall display a test indication while the test is underway. If testing ceases while
193 in walk-test mode, after a preset delay, the system shall automatically return to normal.
- 194 I. Remote Smoke-Detector Sensitivity Adjustment: Controls shall select specific addressable
195 smoke detectors for adjustment, display their current status and sensitivity settings, and
196 control of changes in those settings. Allow controls to be used to program repetitive, time-
197 scheduled, and automated changes in sensitivity of specific detector groups. Record
198 sensitivity adjustments and sensitivity-adjustment schedule changes in system memory, and
199 make a print-out of the final adjusted values on the system printer.
- 200 J. Transmission to Remote Alarm Receiving Station: Automatically transmit alarm, trouble, and
201 supervisory signals to a remote alarm station through a digital alarm communicator
202 transmitter and telephone lines.
- 203 K. Primary Power: 24-V dc obtained from 120-V ac service and a power-supply module.
204 Initiating devices, notification appliances, signaling lines, trouble signal, supervisory and digital
205 alarm communicator transmitter shall be powered by the 24-V dc source.
- 206 1. The alarm current draw of the entire fire alarm system shall not exceed 80 percent of
207 the power-supply module rating.
- 208 L. Secondary Power: 24-V dc supply system with batteries and automatic battery charger and an
209 automatic transfer switch.
- 210 1. Batteries: Sealed lead-acid.
211 2. Battery and Charger Capacity: Comply with NFPA 72.
- 212 M. Surge Protection:
- 213 1. Install surge protection on normal ac power for the FACP, NAC panel and its accessories.
214 Refer to manufacturer's recommendation on TVSS requirement.
215 2. Install surge protectors recommended by FACP manufacturer. Install on all system
216 wiring external to the building housing the FACP.
- 217 N. Instructions: Computer printout or typewritten instruction card mounted behind a plastic or
218 glass cover in a stainless-steel or aluminum frame. Include interpretation and describe
219 appropriate response for displays and signals. Briefly describe the functional operation of the
220 system under normal, alarm, and trouble conditions.

221 2.3 MANUAL FIRE ALARM BOXES

222 A. Description: UL 38 listed; finished in red with molded, raised-letter operating instructions in
223 contrasting color. Station shall show visible indication of operation. Mounted on recessed
224 outlet box; if indicated as surface mounted, provide manufacturer's surface back box.

- 225 1. Double-action mechanism requiring two actions to initiate an alarm, breaking-glass or
226 plastic-rod or pull-lever type. With integral addressable module, arranged to
227 communicate manual-station status (normal, alarm, or trouble) to the FACP.
228 2. Station Reset: Key- or wrench-operated switch.

229 2.4 SYSTEM SMOKE DETECTORS

230 A. General Description:

- 231 1. UL 268 listed, operating at 24-V dc, nominal.
232 2. Integral Addressable Module: Arranged to communicate detector status (normal,
233 alarm, or trouble) to the FACP.
234 3. Multipurpose type, containing the following:
- 235 a. Integral Addressable Module: Arranged to communicate detector status (normal,
236 alarm, or trouble) to the FACP.
237 b. Heat sensor, combination rate-of-rise and fixed temperature.
- 238 4. Plug-in Arrangement: Detector and associated electronic components shall be mounted
239 in a plug-in module that connects to a fixed base. Provide terminals in the fixed base for
240 connection of building wiring.
241 5. Self-Restoring: Detectors do not require resetting or readjustment after actuation to
242 restore them to normal operation.
243 6. Integral Visual-Indicating Light: LED type. Indicating detector has operated and power-
244 on status.
245 7. Remote Control: Unless otherwise indicated, detectors shall be analog-addressable
246 type, individually monitored at the FACP for calibration, sensitivity, and alarm condition,
247 and individually adjustable for sensitivity from the FACP.
- 248 a. Rate-of-rise temperature characteristic shall be selectable at the FACP for 15 or 20
249 deg F per minute.
250 b. Fixed-temperature sensing shall be independent of rate-of-rise sensing and shall
251 be settable at the FACP to operate at 135 or 155 deg F.
252 c. Provide multiple levels of detection sensitivity for each sensor.

253 B. Photoelectric Smoke Detectors:

- 254 1. Sensor: LED or infrared light source with matching silicon-cell receiver.

- 255 2. Detector Sensitivity: Between 2.5 and 3.5 percent/foot smoke obscuration when tested
256 according to UL 268A.
- 257 C. Duct Smoke Detectors:
- 258 1. Photoelectric Smoke Detectors:
- 259 a. Sensor: LED or infrared light source with matching silicon-cell receiver.
260 b. Detector Sensitivity: Between 2.5 and 3.5 percent/foot smoke obscuration when
261 tested according to UL 268A.
- 262 2. UL 268A listed, operating at 24-V dc, nominal.
- 263 3. Integral Addressable Module: Arranged to communicate detector status (normal,
264 alarm, or trouble) to the FACP.
265
- 266 4. Plug-in Arrangement: Detector and associated electronic components shall be mounted
267 in a plug-in module that connects to a fixed base. The fixed base shall be designed for
268 mounting directly to the air duct. Provide terminals in the fixed base for connection to
269 building wiring.
- 270 a. Weatherproof Duct Housing Enclosure: UL listed for use with the supplied
271 detector. The enclosure shall comply with NEMA 250 requirements for Type 4X.
- 272 5. Self-Restoring: Detectors shall not require resetting or readjustment after actuation to
273 restore them to normal operation.
- 274 6. Integral Visual-Indicating Light: LED type. Indicating detector has operated and power-
275 on status.
- 276 7. Remote Control: Unless otherwise indicated, detectors shall be analog-addressable
277 type, individually monitored at the FACP for calibration, sensitivity, and alarm condition,
278 and individually adjustable for sensitivity from the FACP.
- 279 8. Each sensor shall have multiple levels of detection sensitivity.
- 280 9. Sampling Tubes: Design and dimensions as recommended by manufacturer for the
281 specific duct size, air velocity, and installation conditions where applied.
- 282 10. Relay Fan Shutdown: Rated to interrupt fan motor-control circuit.
- 283 D. Contractor to supply and install smoke detector trim rings for all smoke detectors installed in
284 lay-in ceilings.
- 285 2.5 HEAT DETECTORS
- 286 A. General: UL 521 listed.
- 287 B. Heat Detector, Combination Type: Actuated by either a fixed temperature of 135 deg F or
288 rate-of-rise of temperature that exceeds 15 deg F per minute, unless otherwise indicated.

- 289 1. Mounting: Plug-in base, interchangeable with smoke-detector bases.
290 2. Integral Addressable Module: Arranged to communicate detector status (normal,
291 alarm, or trouble) to the FACP.
- 292 2.6 NOTIFICATION APPLIANCES
- 293 A. Description: Equipped for mounting as indicated and with screw terminals for system
294 connections.
- 295 1. Combination Devices: Factory-integrated audible and visible devices in a single-
296 mounting assembly.
- 297 B. Bells: Electric-vibrating, 24-V dc, under-dome type; with provision for housing the operating
298 mechanism behind the bell. Bells shall produce a sound-pressure level of 94 dBA, measured
299 10 feet from the bell. 10-inch size, unless otherwise indicated. Bells are weatherproof where
300 indicated.
- 301 C. Chimes, Low-Level Output: Vibrating type, 75-dBA minimum rated output.
- 302 D. Chimes, High-Level Output: Vibrating type, 81-dBA minimum rated output.
- 303 E. Horns: Electric-vibrating-polarized type, 24-V dc; with provision for housing the operating
304 mechanism behind a grille. Horns shall produce a sound-pressure level of 90 dBA, measured
305 10 feet from the horn.
- 306 F. Visible Alarm Devices: Xenon strobe lights listed under UL 1971, with clear or nominal white
307 polycarbonate lens mounted on an aluminum faceplate. The word "FIRE" is engraved in
308 minimum 1-inch-high letters on the lens.
- 309 1. Rated Light Output: As noted on drawings.
310 2. Strobe Leads: Factory connected to screw terminals.
- 311 2.7 MAGNETIC DOOR HOLDERS
- 312 A. Description: Units shall be listed to UL 228. Units are equipped for wall or floor mounting as
313 indicated and are complete with matching door plate. Unit shall operate from a local 120VAC
314 source and develop a minimum of 25 lbs. holding force.
- 315 2.8 REMOTE ANNUNCIATOR
- 316 A. Description: Duplicate annunciator functions of the FACP for alarm, supervisory, and trouble
317 indications. Also duplicate manual switching functions of the FACP, including acknowledging,
318 silencing, resetting, and testing.

- 319 1. Mounting: Flush cabinet, NEMA 250, Class 1.
- 320 B. Display Type and Functional Performance: Alphanumeric display same as the FACP. Controls
321 with associated LEDs permit acknowledging, silencing, resetting, and testing functions for
322 alarm, supervisory, and trouble signals identical to those in the FACP.
- 323 2.9 ADDRESSABLE INTERFACE DEVICE
- 324 A. Description: Microelectronic monitor module listed for use in providing a system address for
325 listed alarm-initiating devices for wired applications with normally open contacts.
- 326 B. Integral Relay: Capable of providing a direct signal to the elevator controller to initiate
327 elevator recall.
- 328 2.10 DIGITAL ALARM COMMUNICATOR TRANSMITTER
- 329 A. Listed and labeled according to UL 632.
- 330 B. Functional Performance: Unit receives an alarm, supervisory, or trouble signal from the FACP,
331 and automatically captures one or two telephone lines and dials a preset number for a remote
332 central station. When contact is made with the central station(s), the signal is transmitted.
333 The unit supervises up to two telephone lines. Where supervising 2 lines, if service on either
334 line is interrupted for longer than 45 seconds, the unit initiates a local trouble signal and
335 transmits a signal indicating loss of telephone line to the remote alarm receiving station over
336 the remaining line. When telephone service is restored, unit automatically reports that event
337 to the central station. If service is lost on both telephone lines, the local trouble signal is
338 initiated.
- 339 C. Secondary Power: Integral rechargeable battery and automatic charger. Battery capacity is
340 adequate to comply with NFPA 72 requirements.
- 341 D. Self-Test: Conducted automatically every 24 hours with report transmitted to central station.
- 342 2.11 WIRE AND CABLE (CLASS A)
- 343 A. Wire and cable for fire alarm systems shall be plenum rated and UL listed and labeled as
344 complying with NFPA 70, Article 760.
- 345 B. Signaling Line Circuits: Twisted, shielded pair, size as recommended by system manufacturer.
- 346 1. Circuit Integrity Cable: Twisted shielded pair, NFPA 70 Article 760, Classification CI, for
347 power-limited fire alarm signal service. UL listed as Type FPL, and complying with
348 requirements in UL 1424 and in UL 2196 for a 2-hour rating.

- 349 C. Non-Power-Limited Circuits: Solid-copper conductors with 600-V rated, 75 deg C, color-coded
350 insulation.
- 351 1. Low-Voltage Circuits: No. 16 AWG, minimum.
352 2. Line-Voltage Circuits: No. 12 AWG, minimum.
- 353 PART 3 - EXECUTION
- 354 3.1 EQUIPMENT INSTALLATION
- 355 A. HVAC: Locate detectors not closer than 3 feet from air-supply diffuser or return-air opening.
- 356 B. Duct Smoke Detectors: Comply with NFPA 72 and NFPA 90A. Install sampling tubes so they
357 extend the full width of the duct.
- 358 C. Remote Status and Alarm Indicators: Install near each smoke detector and each sprinkler
359 water-flow switch and valve-tamper switch that is not readily visible from normal viewing
360 position.
- 361 D. Audible Alarm-Indicating Devices: Install not less than 6 inches below the ceiling. Install bells
362 and
- 363 E. Device Location-Indicating Lights: Locate in public space near the device they monitor.
- 364 F. FACP: Surface mount with tops of cabinets not more than 72 inches above the finished floor.
- 365 G. Annunciator: Install with top of panel not more than 68 inches above the finished floor.
- 366 3.2 WIRING INSTALLATION
- 367 A. Install wiring according to the following:
- 368 1. NECA 1.
369 2. TIA/EIA 568-A.
370 3. NFPA 70.
- 371 B. Fire alarm cabling shall be installed in conduit in areas where ceiling is not accessible or areas
372 that have open structure (no ceiling).
- 373 C. Wiring Method:
- 374 1. Cables and raceways used for fire alarm circuits, and equipment control wiring
375 associated with the fire alarm system, may not contain any other wire or cable.

- 376 2. Fire-Rated Cables: Use of 2-hour fire-rated fire alarm cables, NFPA 70 Types MI and CI,
377 is not permitted.
- 378 3. Signaling Line Circuits: Power-limited fire alarm cables may be installed in the same
379 cable or raceway as signaling line circuits.
- 380 D. Wiring Within Enclosures: Separate power-limited and non-power-limited conductors as
381 recommended by manufacturer. Install conductors parallel with or at right angles to sides and
382 back of the enclosure. Bundle, lace, and train conductors to terminal points with no excess.
383 Connect conductors that are terminated, spliced, or interrupted in any enclosure associated
384 with the fire alarm system to terminal blocks. Mark each terminal according to the system's
385 wiring diagrams. Make all connections with approved crimp-on terminal spade lugs, pressure-
386 type terminal blocks, or plug connectors.
- 387 E. Cable Taps: Use numbered terminal strips in junction, pull, and outlet boxes, cabinets, or
388 equipment enclosures where circuit connections are made.
- 389 F. Color-Coding: Color-code fire alarm conductors differently from the normal building power
390 wiring. Use one color-code for alarm circuit wiring and a different color-code for supervisory
391 circuits. Color-code audible alarm-indicating circuits differently from alarm-initiating circuits.
392 Use different colors for visible alarm-indicating devices. Paint fire alarm system junction
393 boxes and covers red.
- 394 G. All raceway installed in unfinished areas shall be red in color.
- 395 3.3 IDENTIFICATION
- 396 A. Identify system components, wiring, cabling, and terminals according to Division 26 Section
397 "Identification for Electrical Systems."
- 398 B. Install instructions frame in a location visible from the FACP.
- 399 3.4 GROUNDING
- 400 A. Ground the FACP and associated circuits; comply with IEEE 1100 and NFPA 70. Install a
401 ground wire from main service ground to the FACP.
- 402 3.5 FIELD QUALITY CONTROL
- 403 A. Manufacturer's Field Service: Engage a factory-authorized service representative to
404 inspect, test, and adjust field-assembled components and equipment installation, including
405 connections, and to assist in field testing. Report results in writing.

- 406 B. Testing Agency: Engage a qualified testing and inspecting agency to perform the following
407 field tests and inspections and prepare test reports:
- 408 C. Before requesting final approval of the installation, submit a written statement using the form
409 for Record of Completion shown in NFPA 72.
- 410 D. Perform each electrical test and visual and mechanical inspection listed in NFPA 72. Certify
411 compliance with test parameters. All tests shall be conducted under the direct supervision of
412 a NICET technician certified under the fire alarm systems program at Level III.
- 413 1. Detectors that are outside their marked sensitivity range shall be replaced.
- 414 E. Test and Inspection Records: Prepare according to NFPA 72, including demonstration of
415 sequences of operation by using the matrix-style form in Appendix A in NFPA 70.
- 416 3.6 ADJUSTING
- 417 A. Occupancy Adjustments: When requested within 12 months of date of Substantial
418 completion, provide on-site assistance in adjusting system to suit actual occupied conditions.
419 Provide up to two visits to Project outside normal occupancy hours for this purpose.
- 420 B. Follow-Up Tests and Inspections: After date of substantial completion, test the fire alarm
421 system complying with testing and visual inspection requirements in NFPA 72. Perform tests
422 and inspections listed for three monthly, and one quarterly, periods.
- 423 3.7 DEMONSTRATION
- 424 A. Engage a factory-authorized service representative to train Owner's maintenance personnel to
425 adjust, operate, and maintain the fire alarm system, appliances, and devices. Provide 4 hours
426 total.
- 427 END OF SECTION 283111
428
- 429

DIVISION 31

SECTION 31 00 00 – CONTROL OF SITE WORK

PART 1 - GENERAL

1.1 WORK INCLUDES:

- A. All division 31, 32, and 33 specification sections.
- B. Permitting.

1.2 VERIFY EXISTING CONDITIONS:

- A. Contractor shall study the site survey, site demolition drawing, and have the Utility Locator Service mark existing underground utilities prior to construction operations. The Contractor shall locate private utilities. If existing conditions are different than reflected in the site drawings, notify the Owner's Agent for further instruction, and do not proceed with operations until written direction is given. Do not disconnect any utilities until approved by both the property and utility Owner.

1.3 OPERATION OF ADJACENT FACILITIES:

- A. Contractor shall maintain operation of adjacent facilities, including pedestrian and vehicular traffic circulation on neighboring properties and roadways. Any required closures shall be coordinated and approved by all adjacent property Owners in writing, including authorities of jurisdiction, prior to commencing construction operations. Provide an alternate route that meets the Americans With Disabilities Act (ADA) requirements.

1.4 PROTECT EXISTING STRUCTURES AND UTILITIES:

- A. Protect and maintain the provided benchmarks and survey control points from disturbance during construction. Replacement of any control that is disturbed by construction activities shall be by a Registered Land Surveyor at the Contractor's expense.
- B. Contractor to repair damaged field tile as a result of construction operations.

- C. Locate and clearly flag trees and plantings that are identified to remain or to be relocated. Place construction fencing around trees and plantings to remain at the dripline to protect the root system.
- D. Contractor shall restore any items damaged by construction operations including but not limited to: sidewalks, driveways, roadways, lawns, utilities, walls, and building structures, at no additional expense to the Owner.
- E. All construction traffic on roadways and driveways shall be limited to legal weights and measures.

1.5 EROSION CONTROL:

- A. Any erosion of soils or dust generated from construction activities shall be controlled in a manner that will not adversely impact the adjacent properties and roadways. See the erosion control specification for further requirements.
- B. Prevent surface water and ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation. Install a dewatering system to keep subgrades dry and convey ground water away from excavations. Maintain until dewatering is no longer required.
- C. Stockpile soil materials to be re-used in an area designated by the Owner. Grade all piles to provide positive drainage of storm water. Provide temporary seeding according to the site drawings to stabilize sloped surfaces from erosion. Excess satisfactory and all unsatisfactory soil material shall be removed off site and legally disposed of.
- D. All disturbed areas shall be fine graded and broadcast seeded. Slopes greater than 4:1 shall have erosion control fabric placed as part of the seeding and restoration process.

1.6 PERMITTING:

- A. Contractor shall review and understand any conditions or special provisions of the Improvement Location Permit with the City Planning Office. The contractor is responsible for all requirements of the permit.
- B. Contractor shall comply with any conditions or special provisions of the Rule 5 permit through the Indiana Department of Environmental Management.

- C. Contractor shall be responsible to pay all permit fees, connection fees, testing fees, and inspection fees required to perform work.

1.7 RECORD DRAWINGS:

- A. Record Drawings: Contractor shall provide a set of record drawings (certified by a Land Surveyor in the State of Indiana) to the owner. Include size, material, depth of cover, location, and elevation of all improvements within the contract documents. Include details of underground structures and connections. Identify any items that deviate from the contract documents including but not limited to: underground utilities, finish grades, substitutions if approved, detail modification, etc.

END OF SECTION 31 00 00

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SECTION 31 10 00 - SITE DEMOLITION

PART 1 - GENERAL

1.1 WORK INCLUDES:

- A. Clearing and grubbing existing ground surface.
- B. Stripping topsoil as required.
- C. Demolition of underground utilities.
- D. Protection of existing structures.
- E. Demolition of site structures not classified as a building.

1.2 REFERENCE STANDARDS AND SPECIFICATIONS:

- A. Site Earthwork specification for excavation, backfill, and compaction requirements.
- B. Control of Site Work Specification.

1.3 RECORD OF EXISTING CONDITIONS:

- A. Provide photographs or videotape to sufficiently detail the existing condition of trees, plantings, adjoining construction, existing roadways, and existing structures that are indicated to remain.

1.4 CONTROL OF WORK:

- A. The Contractor shall record all utilities encountered during the clearing and demolition operations. Any additional expense related to uncovering and locating un-marked utility services, or buried drain tile known by the contractor prior to the completion of work, will be the contractor's expense.

1.5 TREE PROTECTION:

- A. Protect trees identified to remain from damage during construction. Damaged trees will be repaired or replaced as determined by the Owner's arborist at the Contractor's expense.

- B. Provide and install a temporary construction fence around trees and plantings identified to remain. Do not store materials, construction equipment or drive vehicles within the barricaded area. Remove the temporary fence when construction is complete.

1.6 PROTECTION OF EXISTING STRUCTURES AND UTILITIES:

- A. Protect existing utilities and building structures not identified to be removed from damage during construction. Damaged utilities will be repaired or replaced at the Contractor's expense.

PART 2 - REMOVALS

2.1 TOPSOIL STRIPPING AND RESREADING:

- A. Remove sod and grass before stripping topsoil. Strip topsoil as required within the disturbed area as identified on the site plans. Excess and unsuitable topsoil, including trash, debris, weeds, roots, and other waste materials shall be removed from site and properly disposed of.
- B. Stockpile topsoil materials in the designated spoil area. Provide temporary seeding to stabilize the slope, and provide erosion control measures to minimize sedimentation onto adjacent properties and water ways. All stockpiles shall be graded to drain.
- C. Re-spread topsoil in lawn areas to finished grade as shown on the site plans.

2.2 CLEARING AND GRUBBING:

- A. Remove trees, shrubs, grass, stumps, roots, and other vegetation as identified on the site demolition plan.
- B. Fill depressions caused by clearing and grubbing operations with standard fill material according to the earthwork specification, unless further excavation or earthwork is indicated to establish proposed subgrade elevations. Provide temporary drainage for any areas that may trap storm runoff prior to completing excavation operations.

2.3 STORM DRAINAGE SYSTEM

- A. Piping removal: Excavate and completely remove piping as identified on the plans. All removed utilities under parking areas or building foundations and slabs shall be backfilled with #53/#73 crushed limestone.
- B. Pipe abandonment: Existing sewer piping that will not interfere with proposed improvements as shown on the drawings may be abandoned in place by completely filling with flowable concrete fill. Any existing piping that lies within the influence of proposed building foundations, including floor slabs, must be removed.
- C. Structure removal: Excavate and remove structure, close open ends of remaining piping, and backfill to subgrade elevations. See the earthwork specification for filling requirements.

2.4 PAVEMENT REMOVAL:

- A. Remove concrete slabs, paving, curbs, gutters, and aggregate base as indicated. Saw-cut the existing pavement indicated to remain full depth before removal operations to provide a clean line of separation.

2.5 HAZARDOUS MATERIALS:

- A. Although no hazardous materials are suspected within the project boundary, the Contractor shall immediately report any suspected hazardous materials encountered during demolition operations to the Owner's Agent. Hazardous waste removal and disposal will be performed by a licensed contractor to do the work outside the scope of this section.

2.6 DISPOSAL:

- A. All cleared materials shall become the Contractor's property, except for materials indicated to be salvaged for the Owner. Store and protect all salvaged items in the area identified by the Owner's Agent. Remove surplus soil material, unsuitable topsoil, obstructions, demolished materials, and waste materials, including trash and debris, and legally dispose of them off the Owner's property.

END OF SECTION 31 10 00

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SECTION 31 20 00 - SITE EARTHWORK

PART 1 - GENERAL

1.1 WORK INCLUDES:

- A. Site earthwork as shown on the Site Plans within the project limits.
- B. Detention basin earthwork.
- C. Excavation and Backfill for site utilities.

1.2 REFERENCE STANDARDS AND SPECIFICATIONS:

- A. Terms and conditions of construction as required by the Contractor's permit with the controlling agency. When conditions of the permit conflict with proposed work, the contractor shall notify the Engineer for correction prior to installation. Any non-compliant work performed by the Contractor shall be at the Contractor's expense.
- B. Site Demolition specification for removals and topsoil stripping.
- C. Control of Site Work Specification.

1.3 UNKNOWN CONDITIONS (change to contract):

- A. Rock: Material 1 cy and larger that exceeds a standard penetration resistance of 100 blows/2 inches. Notify the Owner's Agent if any rock is encountered. Removal of material will be considered a change to the contract. Work shall not commence until instructed by the Owner's Agent.
- B. Unsuitable subgrade: Notify the Owner's Agent if any unsuitable subgrade is encountered. Stabilization of subgrade material above and beyond as stated in part two of this section, will be considered a change to the contract beyond the work covered in this specification. Work shall not commence until instructed by the Owner's Agent.

1.4 TESTING:

- A. Owner will engage a qualified independent geotechnical engineering testing agency to perform field quality-control testing. See Part II of this specification for testing requirements.

1.5 FINISH GRADING:

- A. Final grades shall direct storm water to all collection points and meet the intent of the storm water management plan as identified in the site drawings. Establish grades to within required tolerances. Fill any settled areas as required to meet the specifications within the one-year warranty period. Final grade is defined as the elevation of the final surface, including any mulching material in landscaping beds, applied rubberized surfaces, etc.

1.6 EARTHWORK BALANCE:

- A. No guarantee is made that the site grading plan provides a balanced site condition. The contractor shall import or export soil materials from site as required to meet the conditions of the construction documents.

1.7 PROTECTION OF EXPOSED GRADE:

- A. Protect exposed layers against freezing temperatures, frost, rain, accumulated water, and construction activities, including any open excavations and utility trenches. Reconstruction of damaged layers will be corrected by the contractor according to this specification at no additional cost to the Owner, including areas previously approved by the Geotechnical Engineer.

PART 2 - INSTALLATION

2.1 PREPARATION OF SUBGRADE:

- A. Soil surface immediately below proposed fills (after stripping topsoil) and bottom of proposed excavations (in cut areas).
- B. See the site demolition specification for site clearing requirements.
- C. Notify Geotechnical Engineer when excavations have reached the required subgrade elevations for approval prior to continuing with backfill and fill operations. The

contractor shall proof roll the existing subgrade that is not wet or saturated with heavy pneumatic-tired equipment of not less than 10 ton rated weight and identify any soft pockets or areas of excessive yielding. The contractor shall re-work the existing subgrade material to the depth and moisture content as recommended in the soil report. The subgrade will not be approved until both minimum compaction, and optimum moisture content is achieved.

2.2 SUBGRADE STABILIZATION (change to contract):

- A. Any stabilization measures must be authorized by the owner and approved by the Geotechnical Engineer prior to operations or all work shall be at the contractor's risk. No payment will be made for unauthorized work.
- B. If the Geotechnical Engineer determines that unsatisfactory soils are present, continue the excavation and replace with compacted backfill or fill material as directed and after the Owner approves. Additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work. Any stabilization measures must be authorized by the owner and approved by the geotechnical engineer prior to operations or all work shall be at the contractor's risk. No payment will be made for unauthorized work.

2.3 BACKFILL AND FILL:

- A. Soil materials used to fill an excavation or raise existing grades.
- B. Subgrade Backfill and Fill: Do not place backfill or fill material on surfaces that are muddy, frozen, wet, or contain frost or ice. Place backfill and fill materials in layers not more than 8 inches in loose depth for material compacted by heavy compaction equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers.
- C. Foundation and Slab Backfill and Fill: Do not place backfill or fill material on surfaces that are muddy, frozen, wet, or contain frost or ice. Place backfill and fill materials in layers not more than 6 inches in loose depth for material compacted by heavy compaction equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers.
- D. The Geotechnical Engineer shall test each lift for compliance with the specifications prior to continuing with backfill and fill operations. Each fill and backfill layer will not be approved until both minimum compaction, and optimum moisture content is achieved.

- E. Moisture content: Each fill and backfill layer shall be within 2% of the materials optimum moisture content.
- F. Standard Fill Material: ASTM D 2487 soil classification groups GW, GP, GM, SW, SP, and SM, CL, or a combination of these group symbols; free of rock or gravel larger than 3 inches in any dimension, debris, waste, frozen materials, vegetation, and trash.
- G. Unsuitable Soils: ASTM D 2487 soil classification groups GC, SC, ML, MH, CH, OL, OH, and PT, or a combination of these group symbols, and standard fill material not maintained within 2 percent of optimum moisture content at time of compaction.
- H. Engineered Fill: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 90 percent passing a 1-1/2-inch sieve and not more than 12 percent passing a No. 200 sieve.
- I. Topsoil: Natural or cultivated surface-soil layer containing organic matter and sand, silt, and clay particles; friable, pervious, and black or a darker shade of brown, gray, or red than underlying subsoil; reasonably free of subsoil, clay lumps, gravel, and other objects more than 2 inches in diameter; and free of weeds, roots, and other deleterious materials.

2.4 PAVEMENTS AND SITE SLABS ON GRADE:

- A. Subgrade: scarify and compact the top 12 inches of existing subgrade, and each following lift of fill or base material to 95 percent of maximum dry unit weight according to ASTM D 1557 (modified proctor). Establish grades to within 1" of proposed.
- B. Fill Material: Place and compact each lift with standard fill material to the bottom of the aggregate base layer.
- C. Aggregate Base: See site drawings for material.
- D. Frequency of testing: Coordinate with the Geotechnical Engineer to perform a minimum of one test per 500 sf.

2.5 WALKWAYS:

- A. Subgrade: scarify and compact the top 12 inches of existing subgrade, and each following lift of fill or base material to 95 percent of maximum dry unit weight according to ASTM D 1557 (modified proctor). Establish grades to within 1" of proposed.

- B. Fill Material: Place and compact each lift with standard fill material to the bottom of the aggregate base layer.
- C. Aggregate Base: See site drawings for material.
- D. Frequency of testing: Coordinate with the Geotechnical Engineer to perform a minimum of one test per 50 lf.

2.6 DETENTION FACILITIES:

- A. Subgrade: scarify and compact the top 12 inches of existing subgrade, and each following lift of fill or base material to 90 percent of maximum dry unit weight according to ASTM D 1557 (modified proctor). Establish grades to within 1" of proposed.
- B. Fill Material: Place and compact each lift with standard fill material to final grade elevation. Unsuitable soil materials may be used as fill material in the bottom of the basin when approved by the Geotechnical Engineer. The bottom of the basin may be over-excavated for standard fill materials and replaced with unsuitable materials when approved by the Geotechnical Engineer.
- C. Flow line treatment: See site drawings
- D. Slope treatment: See site drawings.
- E. Frequency of testing: Coordinate with the Geotechnical Engineer to perform a minimum of one test per 1000 sf.
- F. Final Grade: Establish grades to within 1" of proposed.

2.7 BUILDING STRUCTURES:

- A. Buildings, floor slabs, foundations, retaining walls, tanks, or other stationary features.
- B. Subgrade: scarify and compact the top 12 inches of existing subgrade, and each following lift of fill or base material to 98 percent of maximum dry unit weight according to ASTM D 1557 (modified proctor). Establish grades to within 1" of proposed.
- C. Subgrade Fill Material: Place and compact each lift with standard fill material, unless noted otherwise on drawings, to subgrade elevations directly beneath the bottom of the aggregate base layer.

- D. Foundation Wall Backfill: Engineered Fill material unless noted otherwise on the building construction drawings.
- E. Floor Slab Aggregate Base: See building plans for material.
- F. Fill unauthorized excavation under structures by extending bottom elevation of concrete foundation or footing to excavation bottom, without altering top elevation. Lean concrete fill may be used when approved by Engineer.
- G. Frequency of testing: Coordinate with the Geotechnical Engineer to perform a minimum of one test per 500 sf of building slab, one test per 50 lf of foundations, one test per column footing.

2.8 LAWN:

- A. Subgrade: scarify and compact the top 12 inches of existing subgrade, and each following lift of fill or base material to 90 percent of maximum dry unit weight according to ASTM D 1557 (modified proctor). Establish grades to within 1" of proposed.
- B. Fill Material: Place and compact each lift with standard fill material to the bottom of the topsoil layer. Unsuitable soil materials may be used as fill when approved by the Geotechnical Engineer and the Landscape Architect.
- C. Frequency of testing: Coordinate with the Geotechnical Engineer to perform a minimum of one test per 1000 sf.
- D. Final Grade: Establish grades to within 1" of proposed.
- E. Contractor shall repair any settled areas to meet project specifications within the warranty period.
- F. 6" of topsoil shall be used in lawn areas.

2.9 UTILITY TRENCH EXCAVATION AND BACKFILL:

- A. Notify Geotechnical Engineer when excavations have reached the required bottom of trench elevation prior to continuing with backfill and fill operations. If the Geotechnical Engineer determines that unsatisfactory soils are present, the Engineer will instruct the contractor on corrective measures. Additional work required to correct and stabilize the existing subgrade will be paid for according to Contract provisions for changes in the Work.

- B. Fill material required to re-establish the trench bottom due to over-excavation of the utility trench will be bedding material and placed by the contractor at no additional cost to the Owner.
- C. Place and shape the pipe bedding material as shown on the site drawings to provide continuous support for the conduit. Place and compact the initial backfill to a height of 12 inches over the utility pipe. Carefully compact backfill material under the pipe haunches and bring up evenly on both sides.
- D. Backfill material: See site drawings.
- E. Frequency of testing: Coordinate with the Geotechnical Engineer to perform a minimum of one test per 100 lf per lift.

2.10 DRAINAGE STRUCTURE EXCAVATION AND BACKFILL:

- A. Notify Geotechnical Engineer when excavations have reached the required the bottom of trench elevation prior to continuing with backfill and fill operations. If the Geotechnical Engineer determines that unsatisfactory soils are present, the Engineer will instruct the contractor on corrective measures. Additional work required to correct and stabilized the existing subgrade will be paid for according to Contract provisions for changes in the Work.
- B. Fill material required to re-establish the bottom of excavation due to over-excavation of the utility trench will be bedding material and placed by the contractor at no additional cost to the Owner.
- C. Place and compact a 6" minimum depth foundation of Class I or Class II special fill material according to ASTM D2321. After placement of structure and connection of sewer piping, continue special fill to a minimum of 12" above sewer piping in lawn areas, and to subgrade elevation in paved areas or within the influence of building foundations or site slabs on grade.
- D. Frequency of testing: Coordinate with the Geotechnical Engineer to perform a minimum of one test per structure.

END OF SECTION 31 20 00

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SECTION 31 30 00 – SOIL EROSION AND SEDIMENT CONTROL

PART 1 - GENERAL

1.1 SUMMARY:

- A. This section includes conducting earthwork and earth disturbing activities in a manner to protect Waters of the State of Indiana, storm drains, and adjacent properties from soil erosion.

1.2 DEFINITIONS:

- A. "Waters of the State" includes the Great Lakes and their connecting waters, lakes, ponds and streams which may or may not be serving as a County drain as defined by the drain code; or any other body of water that has definite banks, a bed and visible evidence of a continued flow or continued occurrence of water or wetlands.

1.3 REFERENCE STANDARDS AND SPECIFICATIONS:

- A. Indiana Storm Water Quality Manual, Indiana Department of Environmental Management.
- B. Control of Site Work Specification.
- C. Site Earthwork Specification.
- D. Lawns and Grasses Specification.

1.4 PERFORMANCE REQUIREMENTS:

- A. Implement the soil erosion and sedimentation control plan including required maintenance during construction and final removal as directed in the plans, and as needed per site conditions and as required by site inspections by the Wayne County Soil and Water Conservation District and designated agents.
- B. Control runoff, soil erosion, and sedimentation. No sediment should leave the project site.

- C. Prevent wind erosion. No visible emissions (dust) should leave the project site.
- D. Comply with the Indiana Storm Water Quality Manual, Indiana Department of Environmental Management.

1.5 CONTROL OF WORK:

- A. The contractor shall record all utilities encountered during the clearing and operations. Any additional expense related to uncovering and locating un-marked utility services, or buried drain tile known by the contractor prior to the completion of work, will be the contractor's expense.
- B. Landfill Records: Indicate receipt and acceptance of hazardous wastes by a landfill facility licensed to accept hazardous wastes.
- C. Use of explosives is not permitted.

1.6 HAZARDOUS MATERIALS AND POTENTIAL POLLUTANTS:

- A. The contractor must report any and all spill and leaks, regardless of size to the owner or owner's representative.
- B. The owner or owner's representative is ultimately responsible for documenting all spill or leaks.
- C. Any fuel storage locations or fueling locations placed by the contractor shall be protected in the event that a spill occurs. The contractor shall place these locations in such a way, that if a spill does occur, the fuel will not go to a storm inlet.
- D. Any toxic or hazardous material stored outside a building shall be secondarily contained.
- E. The contractor shall also be responsible for monitoring all construction equipment on the site for leaking fuel or fluids.
- F. If a piece of equipment has a fuel or fluid leak, the contractor must not allow that piece of equipment to operate on the construction site until the leaking problem is fixed.
- G. The contractor shall have an emergency spill contingency plan in the event of a spill occurring.

- H. A spill of 5 gallons and above, or local spill quantity minimums, which ever is less, must be reported to the local hazardous materials team and the Indiana Department of Environmental Management (IDEM), Office of Emergency Response at (317) 233-spil (7745).
- I. Part of the contractor's emergency spill plan should include having the number for the local hazardous materials team so that action can be taken immediately after a spill occurs to contain and clean the contaminated area.
- J. A spill of any size that is not contained and cleaned up immediately is in violation of federal and state laws and the contractor and owner can be held liable.
- K. The owner and contractor should be aware of any hazardous materials that will be on site and have a plan of how to handle the materials safely to prevent any spills.
- L. Contractor should also be prepared with a planned response of how to handle any spills of hazardous materials.
- M. Spills shall be cleaned up using acceptable methods according to the type of material spilled and the surface the spill occurred on. The spill may require the removal and proper disposal of contaminated soils or mitigation by a licensed hazardous material contractor depending on the nature of the spill.
- N. In all cases cleanup standards must adhere to local, state and federal requirements.
- O. All spills that occur near an inlet to the storm water conveyance system must have "curbing" implemented immediately. "Curbing" is the use of a barrier of absorbent material which prevents the spill from entering the storm water conveyance system.
- P. The contractor shall compile a list and have material safety data sheets (MSDS) of all potentially hazardous materials used during construction and be aware of how to contain, control, and proper site clean-up of spills and leaks, put out any fires fueled by spills and leaks and of the recommended safety procedures for maintaining public and employee safety during a spill, leak, fire or explosion.
- Q. The list of potential pollutants may include but are not limited to: fuel, oil, grease, paint, solvents, trash, construction material liquids and solids.

PART 2 - EXECUTION

2.1 GENERAL:

- A. Contractor to notify IDEM Rule 5 Coordinator, Eric Roberts at eroberts@idem.IN.gov or 1-800-451-6027, and the Raquel Baker at the Wayne County Soil and Water Conservation District, (765) 966-0191 ext. 3, 48 hours (2 business days) prior to land disturbing activities of actual start date of land disturbing activities.
- B. The project owner/contractor must post near the entrance or near the project field office and be accessible to the public such that it does not create trespass concerns:
 1. A copy of the completed Notice of Intent (NOI) letter with permit number. The permit number can be found on the Notice of Sufficiency letter from IDEM.
 2. Contact information (address, phone, and email) of the project site owner or designated contact person. The NOI contains this information.
 3. Location of the construction plan if one is not stored on-site.
- C. Where the following events result in the need for additional or modified soil erosion and sedimentation control installations to meet the objective of the referenced procedures, provide remedial installations on a timely basis.
- D. Install temporary erosion and sedimentation control measures prior to or upon commencement to earthwork activities.
- E. Utilize a sweeping machine to remove sediment tracked onto adjacent property pavement and public roadways daily or as needed as dictated by site conditions.
- F. Maintain erosion and sedimentation control on a daily basis until the contract has been completed and accepted.
- G. Correct non-conforming soil erosion and sedimentation control work on a timely basis within 24 hours, if Waters of the State are being impacted, or within 5 days if not impacting the Waters of the State.
- H. Complete permanent soil erosion control measures for all slopes, channels, ditches, or any disturbed land area within 5 calendar days after final earth change has been completed. Maintain temporary control measures until permanent soil erosion control measures are in place and area is stabilized.

2.2 CLEAN UP AND NOTICE OF TERMINATION:

- A. Remove temporary erosion control measures after permanent soil erosion measures are in place and the area is stabilized, unless ordered by the owner's representative, federal, state, county, or local authority. Care shall be taken during removal to prevent soil erosion and sedimentation from leaving the site, entering the storm water system or the Waters of the State. Contractor shall notify the Wayne County Soil and Water Conservation District for final site inspection and verification of completion. Upon verification of completion the contractor shall notify Engineering Resources to submit a Notice of Termination (NOT) to IDEM online and send a copy of the NOT to the Wayne County Soil and Water Conservation District as required by the Erosion Control Permit.

PART 3 - MONITORING AND MAINTENANCE

3.1 GENERAL TEMPORARY EROSION CONTROL DEVICES AND PROCEDURES MONITORING AND MAINTENANCE:

- A. All erosion and sediment control devices must be inspected once weekly, unless stated otherwise, and after any ½" storm event by a trained erosion control person. The owner/contractor must keep an inspection log of the erosion control devices, on-site, and must be able to supply this log for inspection by an officer of the Indiana Department of Environmental Management (IDEM), and local storm water control staff or designated agent, within 48-hours of the inspector's request. All contractors involved in earth disturbing activities are responsible for inspections and keeping this log. A designated person from the construction company disturbing the earth shall be responsible of maintaining the log. If multiple contractors are involved, the contractors may elect to designate one person to perform this task for all companies. Items that are to be included in this log are:
 - 1. Project name or description
 - 2. Date, time and weather conditions
 - 3. Rain gauge reading
 - 4. Reason for inspection
 - 5. Observations

6. Corrective actions taken or needed
 7. Signature and printed name of person conducting the erosion control inspection
- B. Sediment build-up on or around any erosion control devices must be removed and returned to its place of origin. All devices must be kept in good working order throughout the duration of the construction project.
- C. The temporary erosion and sediment control devices may be removed after construction has ended and the site has been stabilized with vegetation and pavement.
- 3.2 TEMPORARY EROSION CONTROL DEVICES AND PROCEDURE MONITORING AND MAINTENANCE:
- A. Temporary Construction Ingress / Egress Pad – Sites 2 Acres or Larger
1. Inspect entrance pad and sediment disposal area daily, after heavy usage and storm events.
 2. Reshape as needed for drainage and runoff control.
 3. Top-dress with clean stone as needed.
 4. Immediately remove mud and sediment tracked or washed onto public roads by brushing or sweeping.
 5. Repair any broken adjacent pavement immediately.
- B. Topsoil Salvage and Utilization
1. Inspect daily.
 2. Check for damage to perimeter barrier, repair immediately.
 3. Check for erosion or damage to newly spread topsoil; repair immediately and re-vegetate.

C. Temporary Seeding

1. Inspect weekly, and after ½" storm events, until stand is successfully established.
2. Check for erosion or movement of mulch and repair immediately.
3. Monitor for erosion damage and adequate cover (80 percent density); fill any gullies, reseed, fertilize, and apply mulch where necessary.
4. If nitrogen deficiency is apparent, top-dress fall seeded wheat or rye seeding with 50 pounds per acre of nitrogen in February or March.
5. Inspect for trash and foreign objects and remove items.
6. Mow lawn areas according to growing seasons and lawn conditions.
7. Inspect and monitor moisture content of soil and in conditions of low moisture, apply water to the point of saturation.

D. Permanent Seeding

1. Inspect weekly, and after ½" storm events, until stand is successfully established.
2. Check for erosion or movement of mulch and repair immediately.
3. Monitor for erosion damage and adequate cover (90 percent density); fill any gullies, reseed, fertilize, and apply mulch where necessary.
4. Inspect for trash and foreign objects and remove items.
5. Mow lawn areas according to growing seasons and lawn conditions.
6. Inspect and monitor moisture content of soil and in conditions of low moisture, apply water to the point of saturation.

E. Mulching

1. Inspect weekly and following each ½" storm event for mulch movement or erosion.
2. Check for erosion or movement of mulch, repair damaged areas, reseed, apply new mulch and anchor the mulch in place.
3. Continue inspections until vegetation is firmly established.

4. If erosion is severe or reoccurring, use erosion control blankets or other more substantial stabilization methods to protect the area.
- F. Erosion Control Blanket (12-month Photodegradable, 3:1 to 2:1 Slopes)
1. Inspect weekly and after each ½" storm events for erosion or displacement of the blanket.
 2. If erosion is found, pull back the blanket in that area, add soil and tamp, re-seed / mulch, re-lay and staple the blanket.
 3. After vegetative establishment, check the area periodically and repair as needed.
- G. Turf Reinforcement Mat
1. Inspect weekly and following each ½" storm event.
 2. Check for erosion or displacement / exposure of the mat.
 3. If a specific area shows erosion, add soil and re-stabilize.
- H. Vegetated Swale
1. Inspect weekly and following each ½" rain event.
 2. Check channel outlet and road crossings for blockage, sediment, bank instability, and piping or scour holes; remove and blockage, and make repairs immediately.
 3. Remove significant sediment and debris from channel to maintain design cross section and channel grade and to prevent spot erosion.
- I. Energy Dissipater (Outlet Rock Chute)
1. Inspect weekly and following each ½" rain event
 2. When stones have displaced, remove debris and replace stones ensuring placement at finished grade.
 3. Check for erosion or scouring at the sides of the apron and add and/or reposition stone immediately using the proper size of stone. Do not place additional stone above finished grade.
 4. Check for piping or undercutting, repair immediately.

- J. Geotextile Fabric Drop Inlet Protection
 - 1. Inspect daily.
 - 2. Replace or repair any fabric tears and decomposition, and any broken fabric supports immediately.
 - 3. Remove deposited sediment when it reaches half the height of the fabric barrier or is causing the fabric to bulge.
 - 4. Avoid undermining the fabric barrier during clean out.
 - 5. Remove fabric barrier and sediment after contributing drainage area is stabilized.

- K. Trash Rack Inlet Protection
 - 1. Inspect weekly and following each ½" storm event.
 - 2. Inspect galvanized rack for broken bars and welds to metal plate, corrosion of bars and plate, and connection of rack to concrete. Repair immediately.
 - 3. Check, remove and properly dispose of any sediment and debris from inside of structure and atop of rack that may enter inlet pipe.
 - 4. Check inlet pipe for sediment and debris, remove and dispose of properly.
 - 5. Inspect surrounding Rip-Rap Donut Inlet Protection and surrounding soil for erosion and stone displacement. Repair as necessary (See Rip-Rap Donut Inlet Protection below).

- L. Rip-Rap Donut Inlet Protection
 - 1. Inspect daily.
 - 2. Remove sediment when it reaches half the height of the barrier.
 - 3. Repair stone displacement.

M. FlexStorm™ Inlet Sediment Filter

1. Inspect weekly and after ½" storm events for sediment and debris. Remove sediment (not by flushing) when the containment area becomes more than half full of sediment.
2. Remove any caked-on silt from the sediment bag and reverse flush the bag.
3. Inspect bag clamping band and suspension hangers. Replace bag if the geotextile is torn or punctured to ½" diameter or greater on the lower half of the bag. Replace clamping band and suspension hangers if damaged or corroded.
4. Remove all accumulated sediment and debris from vicinity of the unit after each storm event.
5. Deposit the sediment where it will not enter the storm drains.

N. End Section Inlet Protection

1. Inspect weekly and following each ½" rain event.
2. Remove sediment when it accumulates half of the design volume (marked by stake).
3. Check the dam and abutments for erosion, piping, or rock displacement, and repair immediately.
4. Replace stone on the upstream face of the dam if the basin does not drain between storms.
5. Add INDOT no. 5 gravel on the upstream face if the basin drains too rapidly (i.e., within 6 hrs).
6. Once the contributing drainage area has been permanently stabilized, remove water and sediment from the basin. Remove the dam, disposing of the rock off site. Smooth the site to blend with the surrounding area. Stabilize the grade with vegetation.

O. Dry Detention Basin

1. Inspect weekly and following each ½" storm event.
2. Check for health of vegetation and signs of erosion on basin embankment and repair immediately.
3. Check for animal burrows and remove and repair embankment.
4. Check for woody vegetation on embankment and remove.
5. Check vertical/horizontal alignment of top of dam as per construction design documents.
6. Check low flow swales for obstructions; clear and dispose of obstruction in accordance to local, state and federal standards.
7. Check for sediment and or trash; remove sediment and remove trash.
8. Condition of Outfall(s) into basin
9. Check for rip-rap swale failures and displaced stone. Repair by replacing, and or reconfiguring displaced or missing stone.
10. Check for evidence of slope erosion or scouring. Add additional stone or erosion control blanket/TRM and re-vegetate.
11. Check storm water drainpipes for damage with no evidence of non-storm water discharges. Repair pipe if damaged and locate and repair source of non-storm water discharge immediately.

P. Silt Fence

1. Inspect weekly and following each ½" storm event.
2. Replace or repair any fabric tears and decomposition, and any broken fabric supports immediately.
3. Remove deposited sediment when it reaches half the height of the fence at its lowest point or is causing the fabric to bulge
4. Avoid undermining the fence during clean out.
5. Remove fence and sediment after contributing drainage area is stabilized, grade the site to blend with the surrounding area and stabilize.

Q. Dust Control

1. Inspect daily.
2. Repeat treatments as needed when using temporary dust control methods.
3. Commercial products should be used in accordance with the recommendations of the manufacturer.

R. Concrete Washout

1. Inspect daily and after each storm event.
2. Inspect the integrity of the overall structure including, where applicable, the containment system.
3. Inspect the system for leaks, spills, and tracking of soil by equipment.
4. Inspect the polyethylene lining for failure, including tears and punctures.
5. Once concrete wastes harden, remove and dispose of the material.
6. Excess concrete should be removed when the washout system reaches 50 percent of the design capacity. Use of the system should be discontinued until appropriate measures can be initiated to clean the structure.
7. Prefabricated systems should also utilize this criterion, unless the manufacturer has alternate specifications.
8. Upon removal of solids, inspect the structure. Repair the structure as needed or construct a new system.
9. Dispose of all concrete in a legal manner. Haul the material to an approved construction/demolition landfill site. Recycling of material is encouraged. The availability of recycling should be checked locally.
10. The plastic liner should be replaced after every cleaning; the removal of material will usually damage the lining.
11. The concrete washout system should be repaired or enlarged as necessary to maintain capacity for concrete waste.

12. Concrete washout systems are designed to promote evaporation. However, if the liquids do not evaporate and the system is near capacity it may be necessary to vacuum or remove the liquids and dispose of them in an acceptable method. Disposal may be allowed at the local sanitary sewer authority provided their National Pollutant Discharge Elimination System permits allow for acceptance of this material. Another option would be to utilize a secondary containment system or basin for further dewatering.
13. Prefabricated units are often pumped and the company supplying the unit provides this service.
14. Inspect construction activities on a regular basis to ensure suppliers, contractors, and others are utilizing designated washout areas. If concrete is being disposed of improperly, identify the violators and take appropriate action.
15. When concrete washout systems are no longer required, the concrete washout systems shall be closed. Dispose of all hardened concrete and other materials used to construct the system.
16. Holes, depressions, and other land disturbances associated with the system should be backfilled, graded and stabilized.

S. Surface Roughening

1. Inspect daily.
2. Periodically check seeded and/or mulched slopes for rills and gullies.
3. Fill eroded areas to slightly above the original grade, then re-seed and/or mulch and anchor it in place as soon as possible.

END OF SECTION 31 30 00

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DIVISION 32

SECTION 32 12 16 – BITUMINOUS CONCRETE PAVEMENT

PART 1 - GENERAL

1.1 WORK INCLUDES:

- A. Asphalt paving for parking lots.
- B. Asphalt paving for driveways.

1.2 REFERENCE STANDARDS AND SPECIFICATIONS:

- A. Site Earthwork specification for subgrade and aggregate base requirements.
- B. Terms and conditions of construction as required by the Contractor's permit with the controlling agency. When conditions of the permit conflict with proposed work, the contractor shall notify the Engineer for correction prior to installation. Any non-compliant work performed by the Contractor shall be at the Contractor's expense.
- C. State Department of Transportation for pavement design mix specification as defined on the site drawings.
- D. INDOT Standard Specifications Section 402, latest edition.
- E. Asphalt Paving Publication AI MS-22, "Construction of Hot Mix Asphalt Pavements."
- F. Control of Site Work Specification.

1.3 DELIVERABLES:

- A. Contractor must provide proof of certification by either the State Department of Transportation or controlling municipality for paving work.
- B. Record Drawings: Include size, material, depth of cover, location, and elevation of all improvements within the contract documents. Include details of underground structures and connections.
- C. Material certificates for the pavement design mix.
- D. Tack coat material.

- E. Passing test reports.

1.4 CONTROL OF WORK:

- A. Schedule tests and inspections with the Owner's Geotechnical Engineer and as required under the conditions of the permit. The finished paving will not be accepted or considered complete until all improvements pass the testing requirements of these specifications and the permitting authority.
- B. Comply with INDOT Standard Specifications latest edition, Section 402 for paving work.
- C. Comply with Asphalt Institute (AI) MS-22 "Construction of Hot Mix Asphalt Pavements".

PART 2 - PRODUCTS

2.1 AGGREGATE BASE:

- A. See the site drawings for material requirements. See the Earthwork Specification for subgrade compaction and installation requirements.

2.2 TACK COAT:

- A. Emulsified asphalt according to ASTM D 977.
- B. Minimum surface temperature of 60 deg F
- C. Apply uniformly to all exposed existing asphalt surfaces at point of contact with new paving at a rate of 0.10 gallons per square yard.

2.3 ASPHALT BASE COURSE:

- A. See the site drawings for the Department of Transportation design mix.
- B. Do not place asphalt until the surface temperature is a minimum of 40 deg F and rising at time of placement.
- C. Do not apply asphalt materials if the aggregate base shows signs of yielding or the subgrade is wet or excessively damp.

- D. Spread mix at minimum temperature of 250 deg F at a thickness according to the recommendations of the State Department of Transportation.
- E. Complete breakdown rolling and examine surface immediately after roller passes. Correct as required to comply with this section.
- F. Compaction shall conform to INDOT Standard Specifications latest edition, Section 402.15. Provide the minimum number of rollers and coverage. Begin compaction immediately after the mixture has been spread and finished. Rollers shall not cause undue displacement, cracking, or shoving.
- G. In areas inaccessible to rollers, compact hot-mix paving with hot, tampers or vibratory-plate compactors in accordance with INDOT Standard Specifications latest edition, Section 408.03(d).
- H. Compact each course to within a tolerance of 1/2 inch in lifts not exceeding 2" total thickness. Surface smoothness as determined by using a 10-foot straightedge applied transversely or longitudinally to paved areas shall be within a tolerance of 1/4 inch.
- I. Complete finish rolling while the pavement is still warm.
- J. After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened.
- K. Frequency of testing: Coordinate with the Owner's Geotechnical Engineer to collect one sample of hot-mix asphalt material per lift to determine design mix properties.

2.4 ASPHALT SURFACE COURSE:

- A. See the site drawings for the Department of Transportation design mix.
- B. Do not place asphalt until tack coat has fully cured, and the surface temperature is a minimum of 60 deg F and rising at time of placement.
- C. Spread mix at minimum temperature of 250 deg F at a thickness according to the recommendations of the State Department of Transportation.
- D. Complete breakdown rolling and examine surface immediately after roller passes. Correct as required to comply with this section.
- E. Compaction shall conform to INDOT Standard Specifications latest edition, Section 402.15. Provide the minimum number of rollers and coverage. Begin compaction

immediately after the mixture has been spread and finished. Rollers shall not cause undue displacement, cracking, or shoving.

- F. In areas inaccessible to rollers, compact hot-mix paving with hot, tampers or vibratory-plate compactors in accordance with INDOT Standard Specifications latest edition, Section 408.03(d).
- G. Compact each course to within a tolerance of 1/4 inch in lifts not exceeding 2" total thickness. Surface smoothness as determined by using a 10-foot straightedge applied transversely or longitudinally to paved areas shall be within a tolerance of 1/8 inch.
- H. Complete finish rolling while the pavement is still warm.
- I. After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened
- J. Frequency of testing: Coordinate with the Owner's Geotechnical Engineer to collect one sample of hot-mix asphalt material per lift to determine design mix properties.

2.5 PAVEMENT MARKING PAINT:

- A. Do not place pavement markings unless the surface temperature is between 50 deg F and 95 deg F.
- B. Pavement-Marking Paint shall be waterborne latex complying with FS TT-P-1952 with a minimum thickness of 15 mils. Apply on clean surface.

2.6 JOINTS:

- A. Tack coat all exposed joint surfaces. Offset and install joints as described in AI MS-22, "Construction of Hot Mix Asphalt Pavements."

END OF SECTION 32 12 16

SECTION 32 13 13 – PORTLAND CEMENT CONCRETE PAVEMENT

PART 1 - GENERAL

1.1 WORK INCLUDES:

- A. Concrete paving for site slabs on grade.
- B. Concrete paving for sidewalks.
- C. Sealants for construction joints.
- D. Sealants for expansion joints.

1.2 REFERENCE STANDARDS AND SPECIFICATIONS:

- A. Site Earthwork specification for subgrade and aggregate base requirements.
- B. Terms and conditions of construction as required by the Contractor's permit with the controlling agency. When conditions of the permit conflict with proposed work, the contractor shall notify the Engineer for correction prior to installation. Any non-compliant work performed by the Contractor shall be at the Contractor's expense.
- C. ACI Publications: Comply with ACI 301, "Specification for Structural Concrete," unless modified by the requirements of the Contract Documents.
- D. CRSI's "Manual of Standard Practice"
- E. CRSI's "Placing Reinforcing Bars"
- F. Control of Site Work specification.

1.3 DELIVERABLES:

- A. Record Drawings: Include size, material, depth of cover, location, and elevation of all improvements within the contract documents. Include details of underground structures and connections.
- B. Material certificates for the pavement design mix according to ACI 211.1 and ACI 301.
- C. Passing test reports.

- D. Manufacturer Qualifications: Manufacturer of ready-mixed concrete products complying with ASTM C 94 requirements for production facilities and equipment.
- E. Submittal for hot applied joint sealant.
- F. Submittal for cold applied joint sealant.

1.4 CONTROL OF WORK:

- A. Schedule tests and inspections with the Owner's Geotechnical Engineer and as required under the conditions of the permit. The finished paving will not be accepted or considered complete until all improvements pass the testing requirements of these specifications and the permitting authority.

PART 2 - PRODUCTS

2.1 AGGREGATE BASE:

- A. See the site drawings for material requirements. See the Earthwork Specification for subgrade compaction and installation requirements.

2.2 CONCRETE MATERIALS:

- A. Provide ready mixed concrete according to ASTM C 94 with the following properties: 4000 psi at 28 day compressive strength, 0.45 maximum water to cement ratio, and a 4" maximum slump limit. Provide admixtures to establish an air content of 4.5 to 7.5% according to ASTM C 260
- B. Portland Cement: ASTM C 150, Type I or II. Aggregate: ASTM C 33, uniformly graded, from a single source.
- C. Water: ASTM C 94
- D. Provide a medium textured broom finish on all surfaces unless noted otherwise on the plans.
- E. Allowable Water-Reducing Admixture according to ASTM C 494, Type A
- F. General: Admixtures certified by manufacturer to contain not more than 0.1 percent water-soluble chloride ions by mass of cement and to be compatible with other admixtures

- G. Bonding Agent: ASTM C 1059, Type II, non-redispersible, acrylic emulsion or styrene butadiene.

2.3 CONSTRUCTION JOINTS:

- A. Place joints at the end of concrete pouring operations if more than 30 minutes has elapsed.
- B. Provide joint filler strips according to ASTM D 1751 or ASTM D 1752 and type SL Silicone Sealant complying with ASTM D 5893 for Type SL. Install per the manufacturer's recommendations and according to ASTM C 1193.
- C. Continue reinforcing steel through the construction joint and lap bars of a sufficient development length to assure a good bond with future concrete placement.

2.4 EXPANSION JOINTS:

- A. Place joints at the interface between new concrete pavement and: concrete curbs, site structures, building stoops, and at maximum intervals of 50 feet.
- B. Provide joint filler strips according to ASTM D 1751 or ASTM D 1752 and type SL Silicone Sealant complying with ASTM D 5893 for Type SL. Install per the manufacturer's recommendations and according to ASTM C 1193.
- C. Do not continue reinforcing steel through the expansion joint.

2.5 CONTRACTION JOINTS:

- A. Sawcut or hand tool contraction joints in the locations identified on the site drawings. The minimum depth of all joints shall be 25% of the total pavement thickness. Tooled joints shall be a minimum of 1/8" wide, with 1/4" radii. Sawcut joints shall be a minimum of 1/8". Joint sealants are not required at contraction joint locations.

2.6 CURING MATERIALS:

- A. Provide curing materials after initial placement of concrete. Acceptable methods include: Polyethylene sheeting according to ASTM C 171, burlap cloth according to AASHTO M 182, Class 2, and clear solvent according to ASTM C 309, Type 1, Class B.

2.7 CONCRETE PLACEMENT:

- A. Proof-roll prepared subbase surface to check for unstable areas and verify need for additional compaction.
- B. Remove snow, ice, or frost from subbase surface and reinforcement before placing concrete. Do not place concrete on frozen surfaces. Do not place concrete when the surface temperature is below 40 deg F.
- C. Install clean forms and apply a release agent prior to concrete placement. Use flexible forms for radii that are less than 100'. Allow forms to set for a minimum of 24 hrs after concrete placement before removal.
- D. Moisten subbase to provide a uniform dampened condition at the time concrete is placed. Do not place concrete around manholes or other structures until they are at the required finish elevation and alignment.
- E. Comply with requirements and with recommendations in ACI 304R for measuring, mixing, transporting, and placing concrete.
- F. Do not add water to concrete during delivery, at Project site, or during placement.
- G. Consolidate concrete by mechanical vibrating equipment supplemented by hand-spading, rodding, or tamping. Use equipment and procedures to consolidate concrete according to recommendations in ACI 309R.
- H. Cold-Weather Placement: Comply with ACI 306 R. When air temperature has fallen to or is expected to fall below 40 deg F, uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F and not more than 80 deg F at point of placement. Do not use frozen materials or materials containing ice or snow. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators, unless otherwise specified and approved in mix designs.
- I. Hot-Weather Placement: Place concrete according to recommendations in ACI 305R. Cool ingredients before mixing to maintain concrete temperature at time of placement below 90 deg F.
- J. Tolerance: Gap below 10-foot long, unleveled straightedge not to exceed 1/8 inch. Comply with tolerances of ACI 117 and as follows: Thickness: Plus 3/8 inch, minus 1/4 inch. Elevation: 1/4 inch.

2.8 TESTING:

- A. Reports of compressive-strength tests shall include: concrete type and class, location of concrete batch in pavement, design compressive strength at 28 days, concrete mix proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
- B. Additional Tests: Testing agency shall make additional tests of the concrete when test results indicate slump, air entrainment, concrete strengths, or other requirements have not been met, as directed by Architect. Testing agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42, or by other methods as directed.
- C. Frequency of testing: Coordinate with the Geotechnical Engineer to perform a minimum of one test per load delivered to the site.

END OF SECTION 32 13 13

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SECTION 32 31 13 – CHAIN-LINK FENCES AND GATES

PART 1 - GENERAL

1.1 SUMMARY:

- A. This Section includes industrial/commercial chain link fence and gates specifications:
 - 1. Galvanized steel coated chain link fabric
 - 2. Zinc 5% Aluminum alloy coated steel chain link fabric
 - 3. Galvanized steel framework and fittings
 - 4. Gates: cantilever slide
 - 5. Installation

- B. Related Sections
 - 1. 01 33 13 Certificates
 - 2. 01 33 23 Shop Drawings, product data
 - 3. 01 43 13 Manufacturers Qualifications
 - 4. 01 43 23 Installer Qualifications
 - 5. 01 45 00 Quality Control
 - 6. 01 65 00 Product Delivery Requirements
 - 7. 01 66 00 Product Storage and Handling Requirements
 - 8. 03 30 53 Miscellaneous Cast in Place Concrete
 - 9. 25 50 00 Integrated Automation [pertinent to gate operator access control]
 - 10. 26 01 02 Electrical distribution [relating gate operators]
 - 11. 31 22 19 Finish grading

1.2 SUBMITTALS:

- A. Product Data: For each product indicated.

- B. Shop Drawings: Show locations, components, materials, dimensions, sizes, weights, finishes of components, installation and operational clearances, gate swings, and details of post anchorage and attachment and bracing.

1.3 REFERENCE STANDARDS AND SPECIFICATIONS:

- A. ASTM A392 Specification for Zinc-Coated Steel Chain-Link Fence Fabric

- B. ASTM A491 Specification for Aluminum-Coated Steel Chain-Link Fabric

- C. ASTM A780 Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
 - D. ASTM A817 Specification for Metallic-Coated Steel Wire for Chain-Link Fence Fabric and Marcellled Tension Wire
 - E. ASTM A824 Specification for Metallic-Coated Steel Marcellled Tension Wire for Use With Chain-Link
 - F. ASTM F552 Standard Terminology Relating to Chain-Link Fencing
 - G. ASTM F567 Standard Practice for Installation of Chain-Link Fence
 - H. ASTM F626 Specification for Fence Fittings
 - I. ASTM F1043 Specification for Strength and Protective Coatings of Steel Industrial Chain-Link Fence Framework
 - J. ASTM F1083 Specification for Pipe, Steel, Hot-Dipped Zinc-Coated (Galvanized) Welded, for Fence Structures
 - K. ASTM F1184 Specification for Industrial and Commercial Slide Gates
 - L. ASTM F1345 Specification for Zinc 5% Aluminum-Mischmetal Alloy-Coated Steel Chain-Link Fence Fabric
 - M. ASTM F2200 Specification for Automated Vehicular Gate Construction
 - N. UL325 Automatic Operators: Door, Drapery, Gate, Louver and Window
- 1.4 DELIVERY, STORAGE AND HANDLING:
- A. Delivery: Deliver products to site per the requirements of Section 01 65 00.
 - B. Storage: Store and protect products off the ground when required.

PART 2 - PRODUCTS

2.1 STANDARD CHAIN-LINK FABRIC:

- A. Steel Chain-Link Fence Fabric: Comply with Chain-Link Fence Manufacturers Institute's "Product Manual"

1. Mesh and Wire Size: 2-inch mesh, 0.120-inch diameter.
 2. Zinc-Coated Steel Fabric: ASTM A392, with zinc coating applied to steel wire mesh fabric after weaving with Class 1 – 1.2 oz./ft² minimum coating weight.
- B. Fabric Salvage: Knuckled at both selvages. Standard fabric salvage for 2-inch mesh, 72-inches high and higher is knuckle finish at one end and twist at the other.

2.2 FENCE FRAMEWORK

- A. Round steel pipe and rail: Schedule 40 standard weight pipe, in accordance with ASTM F1083. ASTM F1043, Material Design Group 1A, external and internal coating Type A consisting of not less than 1.8 oz./ft² hot dip galvanized zinc; and line, end, corner, pull posts, top, brace, bottom, and intermediate rails as required for Light Industrial Fence.
- B. Post Brace Rails: Match top rail for coating and strength and stiffness requirements. Provide brace rail with truss rod assembly for each gate, end, and pull post. Provide two brace rails extending in opposing directions, each with truss rod assembly, for each corner post and for pull posts. Provide rail ends and clamps for attaching rails to posts.
- C. Top Rails: With "s" wedged-end or fabricated for expansion-type coupling.
- D. Intermediate Rails: Match top rail for coating and strength and stiffness requirements.
- E. Bottom Rails: Match top rail for coating and strength and stiffness requirements.
- F. Corner, end, and gate posts shall be middle braced and trussed. Bottom rail shall be supplied for all fencing. Line post size for 4' and 6' high fencing shall be 2.5" in diameter minimum.

2.3 TENSION WIRE

- A. Metallic-Coated Steel Tension Wire: 7 gauge (0.177-inch diameter), marcelled tension wire complying with ASTM A824 at locations indicated. Color: Black in compliance with ASTM F934.

2.4 FITTINGS

- A. General: Provide fittings for a complete fence installation, including special fittings for corners. Comply with ASTM F626.
- B. Tension and Brace Bands: Galvanized pressed steel complying with ASTM F626, minimum steel thickness of 12 gauge (0.105 in.) (2.67mm), minimum width of ¾ in.

(19mm) and minimum zinc coating of 1.20 oz/ft² (366g/m²). Secure bands with 5/16 in. (7.94mm) galvanized steel carriage bolts.

- C. Terminal Post Caps, Line Post Loop Tops, Rail and Brace Ends, Boulevard Clamps, and Rail Sleeves: In compliance to ASTM F626, pressed steel galvanized after fabrication having a minimum zinc coating of 1.20 oz/ft² (366g/m²).
- D. Truss Rod Assembly: In compliance with ASTM F626, 3/8 in. (9.53 mm) diameter steel truss rod with a pressed steel tightener, minimum zinc coating of 1.20 oz/ft² (366g/m²), assembly capable of withstanding a tension of 2,000 lbs. (970 kg).
- E. Tension Bars: In compliance with ASTM F626. Galvanized steel one-piece length 2 in. (50 mm) less than the fabric height. Minimum zinc coating of 1.20 oz/ft² (366g/m²). Bars for 2 in. (50 mm) and 1 ¾ in. (44 mm) mesh shall have a minimum cross section of 3/16 in. (4.8 mm) by ¾ in. (19 mm).

2.5 TIE WIRE AND HOG RINGS

- A. Tie wire and hog rings: Galvanized minimum zinc coating of 1.20 oz/ft² (366g/m²), 9 gauge (0.148 in) (3.76 mm) steel wire in compliance with ASTM F626.

2.6 HORIZONTAL SLIDE GATES

- A. Type I – Overhead Slide Gates: In compliance with ASTM F1184 Type I. Gate framing to be od welded construction, minimum 1.900 in. in O.D. (48.3 mm) galvanized pipe members, ASTM F1083 schedule 40 pipe. Framing member to be spaced no more than 8 ft. (2440 mm) apart horizontally and vertically. Welded joints are to be protected by applying zinc-rich paint in accordance with ASTM Practice A780. Positive locking hatch, pressed steel, galvanized after fabrication.
 - 1. Galvanized steel drop bars to be provided with double gates.
 - 2. Match gate fabric to the size weight and color to that of the fence fabric.
 - 3. Manufacturer's standard overhead beam/structure, track, rollers and accessories designed to support the load of the gate panel taking into consideration wind load and possible icing. The support beam structure to be galvanized or receive proper corrosion protection.
 - 4. Gateposts in compliance with ASTM F1083 Schedule 40 galvanized steel pipe. Post size for gate openings up to and including 10 ft. (3.05 m) shall be 2.75 in. O.D. (73 mm). Openings greater than 10 ft. (3.05 m) up to 24 ft. (7.3 m) 4.00 in.

O.D. (101.6 mm). Openings greater than 24 ft. (7.3 m) up to 40 ft. (12.2 m) double 4.00 in. O.D. (101.6 mm) posts.

2.7 CAST-IN-PLACE CONCRETE

A. General: Comply with ACI 301 for cast-in-place concrete; materials consisting of portland cement complying with ASTM C 150, aggregates complying with ASTM C 33, and potable water.

1. Concrete Mixes: Normal-weight concrete with not less than 3000-psi compressive strength (28 days), 3-inch slump, and 1-inch maximum size aggregate.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Install chain-link fencing to comply with ASTM F 567 and more stringent requirements indicated. Do not begin installation before final grading is completed, unless otherwise permitted by Engineer.

B. Post Excavation: Drill or hand-excavate holes for posts to diameters and spacing indicated, in firm, undisturbed or compacted soil.

C. Post Setting: Hand-excavate holes for post foundations in firm, undisturbed or compacted soil.

1. Concrete Footings: Place concrete around posts and vibrate or tamp for consolidation. Verify that posts are set plumb, aligned, and at correct height and spacing, and hold in position during placement and finishing operations until concrete is sufficiently cured. Set the following post types in concrete footings and protect portion of posts aboveground from concrete splatter:

a. Terminal.

b. Line; Using mechanical devices to set line posts per ASTM F 567 is not permitted.

c. Gate.

D. Terminal Posts: Locate terminal end, corner, and gate posts per ASTM F 567 and terminal pull posts at changes in horizontal or vertical alignment.

- E. Line Posts: Space line posts uniformly at 10 feet on center.
- F. Intermediate Rails: Install in one piece at post-height center span, spanning between posts, using fittings, special offset fittings, and accessories.
- G. Bottom Rails: Install, spanning between posts, using fittings and accessories.
- H. Chain-Link Fabric: Apply fabric to outside of enclosing framework.
- I. Tie Wires: Attach wire to chain-link fabric per ASTM F 626. Tie fabric to line posts at maximum interval of 12 inches on center and to braces at maximum interval of 24 inches on center.
- J. Horizontal Slide Gates: Installation varies by design and manufacturer, install according to manufacturer's instructions and in accordance with ASTM F567. Gates shall be plumb in the closed position, installed to slide with an initial pull force no greater than 40 lbs. (18.14 kg). Roller guards and guide posts must be installed on Type I external roller cantilever slide gate in compliance with ASTM F1184. Ground clearance shall be 3 in. (76 mm), grade permitting. Electronically operated gates must be manufactured and installed with ASTM F2200 and UL 325.

3.2 ELECTRICAL GROUNDING

- A. Grounding of the fence and gates is not the responsibility of the fence contractor and not included in the fencing scope of work for this contract. Grounding, when required, shall be specified and included in Contract Section 33 79 00 Site Grounding. A licensed electrical contractor shall install grounding when required.

3.3 CLEAN UP

- A. The area of the fence line shall be left neat and free of any debris caused by the installation of the fence.

END OF SECTION 32 31 13

SECTION 32 92 00 – LAWNS AND GRASSES

PART 1 - GENERAL

1.1 WORK INCLUDES:

- A. This section includes seeding.

1.2 REFERENCE STANDARDS AND SPECIFICATIONS:

- A. Site Earthwork specification.
- B. Control of Site Work Specification.

1.3 SUBMITTALS:

- A. Proposed Seed Species Mixture.
- B. Proposed Fertilizer information.

PART 2 - PRODUCTS

2.1 SEED

- A. Seed Species: State-certified seed of grass species, as follows:

- 1. Full Sun/Partial Shade:

- a. 50% Perennial Ryegrass (2 Varieties)
 - b. 50% Kentucky Bluegrass (3 Varieties)

- 1) Sow seed at a rate of 260 lbs/acre. Contractor shall submit grass seed varieties to the Engineer/Architect for approval before planting begins.

2. Temporary / Dormant Seeding

a.	Wheat or Rye	150 lbs./acre	9/15	-	10/30
b.	Spring Oats	100 lbs./acre	3/1	-	4/15
c.	Annual Ryegrass	40 lbs./acre	3/1	-	5/1
d.	" "	" "	8/1	-	9/1
e.	German Millet	40 lbs./acre	5/1	-	6/1
f.	Sudangrass	35 lbs./acre	5/1	-	7/30

- 1) Contractor shall submit grass seed varieties to the Engineer/Architect for approval before planting begins.

2.2 FERTILIZER

- A. The commercial fertilizer shall consist of a fast- and slow-release nitrogen originated from natural organic sources. The composition of the fertilizer shall be nitrogen 10%, phosphoric acid 10%, and soluble potash 10%.

PART 3 - EXECUTION

3.1 LAWN PREPARATION:

- A. After topsoil has been re-spread to the depth as specified on the Site Grading Plan, remove from the site all stones 1" in diameter or greater, as well as sticks, weeds, debris and roots.
- B. Commercial fertilizer shall be applied to the sub-grade as recommended by the manufacturer.
- C. After fertilizer has been applied, loosen the subgrade a minimum of 4" in depth.
- D. Begin fine grading, but only fine grade areas that can be seeded in the immediate future.
- E. If areas to be seeded are dry, water area completely, but do not overwater and create muddy soil. Once the surface has dried then seeding can begin.

- F. Keep the site weed free by tilling or applying herbicide.

3.2 CONVENTIONAL SEEDING:

- A. Planting season: April 1st to May 31st and August 15th to October 15th.
- B. For dates outside the planting season the disturbed soil must be dormant seeded and mulched or stabilized with mulch.
- C. Only seed areas that can be mulched in one day.
- D. Seeding shall take place in two sowings with the 2nd sowing being perpendicular to the first.
- E. Seeding shall not occur if the ground is too dry, if it has just rained, and/or if windy conditions are present.
- F. Place seed, and rake into the top 1/8 inch of topsoil. After raking, water area lightly with a fine spray.
- G. Mulch with 100% wheat straw, or hydromulch, which is free of weeds. Apply straw at a rate of 2 tons per acre. Straw should be mechanically crimped into the soil.

3.3 HYDROSEEDING

- A. Planting season: April 1st to May 31st and August 15th to October 15th.
- B. Hydroseeding: Mix specified seed, fertilizer, and fiber mulch in water, using equipment specifically designed for hydroseed application. Continue mixing until uniformly blended into homogeneous slurry suitable for hydraulic application.
- C. Mix slurry with asphalt-emulsion tackifier.
- D. Apply slurry uniformly to all areas to be seeded in a one-step process. Apply slurry application at a rate of 7-pounds per 1,000 square feet, but not less than the rate required to obtain specified seed-sowing rate so that the seed comes into direct contact with topsoil.
- E. Fertilizer shall be applied as specified at a rate of 2½ to 4 pounds per square foot.

3.4 MAINTENANCE:

- A. As soon as seeding has been finished, maintenance shall begin. Maintenance shall continue until satisfactory lawn has been established, and a minimum of 60 days from substantial completion.
- B. A satisfactory lawn shall be one where over 90% of an area measuring 10sq.ft. has a healthy stand of grass, free of weeds, and has no bare spots larger than 5 inches in diameter.
- C. Maintenance will include mowing and watering if any is required. Watering shall include the use of tanker trucks as necessary.
- D. Contractor is responsible for obtaining and applying the appropriate herbicide to the lawn area, as to not harm the lawn, if there are weeds in the seeded / lawn area.
- E. Begin mowing as soon as established lawn is tall enough to cut, but do not cut more than 1/3 of the grass blade at one time.
- F. Protect seeded areas with warning signs during the maintenance period.

END OF SECTION 32 92 00

DIVISION 33

SECTION 33 05 00 - SITE UTILITY PIPING

PART 1 - GENERAL

1.1 WORK INCLUDES:

- A. Underground utility piping as identified on the site plans.
- B. Sanitary sewer piping materials.
- C. Storm sewer piping materials.
- D. Water Main piping materials.
- E. Materials shall be neatly stored on site. Excavated material shall be neatly stockpiled if not immediately removed from the site. Streets, driveways, and sidewalks shall be kept clear and open.

1.2 REFERENCE STANDARDS AND SPECIFICATIONS:

- A. Storm Drainage System Specification.
- B. Sanitary Sewer System Specification.
- C. Water Distribution System Specification.
- D. Site Earthwork Specification.
- E. Site Landscaping.

PART 2 - SEWER PIPING – See site drawings for allowable pipe materials.

2.1 FLEXIBLE GRAVITY SEWER PIPE:

- A. Install piping per the flexible pipe utility trench detail on the site drawings for bedding and backfill requirements.
 - 1. ASTM D 3034-97 SDR-35 PVC 15" and smaller.
 - a. Provide slip-on joints with rubber gasket or mechanical joints.

- b. Join pipe with gaskets according to ASTM F 477 for elastomeric seals.
- c. Install according to ASTM D 2321.
- 2. ASTM F 667 High Density Polyethylene (HDPE) for pipe larger than 10"
 - a. Join pipe with gaskets according to ASTM F 477 elastomeric seals.
 - b. Install according to ASTM D 2321.

2.2 RIGID GRAVITY SEWER PIPE:

- A. Install piping per the rigid pipe utility trench detail on the site drawings for bedding and backfill requirements.
 - 1. ASTM C 76, Class III, Wall B, Reinforced Concrete Pipe
 - a. Slip-on joints with rubber compression gasket or mechanical joints
 - b. Round Pipe and Fittings: ASTM C 443, rubber gaskets.

2.3 SUBDRAINAGE PIPING

- A. ASTM F 405 Corrugated, perforated Polyethylene Pipe and fittings with coupled joints.
- B. Join PE pipe and fittings with couplings for soiltight joints according to AASHTO's "Standard Specifications for Highway Bridges," Division II, Section 26.4.2.4, "Joint Properties"; or according to ASTM D 2321 and the Corrugated Pipe Associations "Recommendation Installation Practices for Corrugated Polyethylene Pipe and Fittings".

PART 3 - WATER DISTRIBUTION AND FORCE MAIN PIPING – See site drawings for allowable pipe materials.

3.1 PVC PIPE AND FITTINGS

- A. AWWA pressure class 150 C900 PVC, SDR 18 with push on joints according to ASTM D 3139 and socket fittings. The material shall conform to ASTM D 1784, Class 12454-B.

- B. Gasketed Joints: Use joining materials according to AWWA C900. Construct joints with elastomeric seals and lubricant according to ASTM D 2774 and ASTM D 3139 and pipe manufacturer's written instructions.
- C. Install according to AWWA M23 and ASTM F 645.
- D. Pressure and leak test plastic piping according to AWWA C605-94.
- E. Provide testing only after all restraints have hardened.

3.2 CAST IRON SOIL PIPE

- A. ASTM A 74 Cast Iron Soil Pipe
 - 1. Round Pipe and Fittings: ASTM C 564, rubber gaskets.

3.3 COPPER PIPE AND FITTINGS:

- A. Soft copper tube Type K with wrought-copper fittings conforming with ASTM B 88.
- B. Install according to CDA's "Copper Tube Handbook."
- C. Cast copper fittings according to ASME B16.18 or wrought copper fittings according to ASME A5.8 with BCuP silver braze.
- D. Provide compression joints

3.4 PE PIPING:

- A. ASTM D3035 / F714 pressure class 45, 60, 80, 100, 130, 145 and 160 pipe with fittings according to AWWA C901 / C906. Materials to be in accordance with ASTM D3350.
- B. Install according to ASTM D 2774 and ASTM F 645.
- C. All HDPE for water line piping shall have a blue stripe installed by the manufacturer during the pipe forming process. All HDPE for force main piping shall have a green stripe installed by the manufacturer during the pipe forming process. The pipe in either case shall have multiple stripes so as to be viewed from any angle along the pipe.
- D. HDPE shall be SDR 11 when the product is to be installed by the directional drill method.

- E. HDPE OD shall be ductile iron pipe size (DIPS) unless specified otherwise.
- F. TESTING IN THE TRENCH (procedure taken from PPI Technical Report TR-31 by the Plastic Pipe Institute)
 1. Fill the pipeline with water after it has been laid; bleed off any trapped air. Subject the lowest element in the system to a test pressure that is 1.5 times the design pressure, and check for any leakage. When, in the opinion of the engineer, local conditions require that the trenches be backfilled immediately after the pipe has been laid, apply the pressure test after backfilling has been completed but not sooner than a time which will allow sufficient curing of any concrete that may have been used.
 2. The test procedures consist of two steps; the initial expansion and the test phase. When test pressure is applied to a water filled pipe, the pipe expands. During the initial expansion of the pipe under test, sufficient make-up water must be added to the system hourly intervals for 3 hours to maintain the test pressure. After 4 hours, initial expansion should be complete and the actual test can start.
 3. When the test is to begin, the pipe is full of water and is subjected to a constant pressure of 1.5 times the system design pressure. The test phase should not exceed 3 hours, after which time any water deficiency must be replaced and measured. Add and measure the amount of make-up water required to return to the test pressure and compare this to the maximum allowance in the table below.
 4. Under no circumstances shall the total time under test exceed 8 hours at 1.5 times the system pressure rating. If the test is not complete within this time limit (due to leakage, equipment failure, etc.), the test section shall be permitted to “relax” for 8 hours prior to the next test sequence.
 5. Air testing is not recommended. Additional safety precautions may be required.

ALLOWANCE FOR EXPANSION UNDER TEST PRESSURE							
NOMINAL PIPE SIZE	U.S. GALS/100 FT. OF PIPE			NOMINAL PIPE SIZE	U.S. GALS/100 FT. OF PIPE		
	1 HOUR	2 HOURS	3 HOURS		1 HOUR	2 HOURS	3 HOURS
2"	0.08	0.12	0.15	20"	2.80	5.50	8.00
3"	0.10	0.15	0.25	22"	3.50	7.00	10.50
4"	0.13	0.25	0.40	24"	4.50	8.90	13.30
5"	0.21	0.41	0.63	28"	5.50	11.10	16.80
6"	0.30	0.60	0.90	30"	6.20	12.60	19.10
8"	0.50	1.00	1.50	32"	7.00	14.30	21.50
10"	0.75	1.30	2.10	36"	9.00	18.00	27.00
12"	1.10	2.30	3.40	42"	12.00	24.00	36.00
14"	1.40	2.80	4.20	48"	15.00	27.00	43.00
16"	1.70	3.30	5.00	54"	18.00	30.00	50.00
18"	2.20	4.30	6.50	-	-	-	-

END OF SECTION 33 05 00

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SECTION 33 11 16 – SITE WATER DISTRIBUTION

PART 1 - GENERAL

1.1 WORK INCLUDES:

- A. Domestic water and fire protection facilities as shown on the Site Plans.

1.2 REFERENCE STANDARDS AND SPECIFICATIONS:

- A. The Indiana Department of Environmental Management rules and regulations.
- B. Comply with requirements of utility company supplying water. Include tapping of water mains and backflow prevention.
- C. Terms and conditions of construction as required by the Contractor's permit with the controlling agency. When conditions of the permit conflict with proposed work, the contractor shall notify the Engineer for correction prior to installation. Any non-compliant work performed by the Contractor shall be at the Contractor's expense.
- D. Site Earthwork specification for excavation and backfill requirements.
- E. Comply with ASTM F 645 for selection, design, and installation of thermoplastic water piping.
- F. NFPA Compliance: Comply with NFPA 24 for materials, installations, tests, flushing, and valve and hydrant supervision for fire-service-main piping for fire suppression.
- G. Control of Site Work Specification.

1.3 DELIVERABLES:

- A. Product Data for the following: piping, fittings, valves and accessories, water meters and accessories, fire hydrants, post indicator valves and accessories.
- B. Record Drawings: Contractor shall provide a marked-up set of drawings to the owner. Include size, material, depth of cover, location, and elevation of all improvements within the contract documents. Include details of underground structures and connections. Identify any items that deviate from the contract documents including but not limited to: underground utilities, finish grades, substitutions if approved, detail modification, etc.

- C. Progress Reports: Soil conditions encountered, work completed, etc.
- D. Passing test reports for the entire water distribution system.

1.4 CONTROL OF WORK:

- A. Clean any debris that may accumulate within the water distribution system as a result of construction operations, including new and existing water piping and structures. Flush piping as required to purge the piping system.
- B. Cap the end of exposed piping during installation to minimize infiltration of material into the piping system.
- C. Inspect the distribution system and replace defective piping and structures using new materials, and repeat inspections until defects are within allowances specified. Re-inspect and repeat procedure until results meet specifications.
- D. Do not enclose, cover, or put the water distribution system into service before final inspection and approval by the local utility owner.
- E. Schedule tests and inspections with the utility owner as required under the conditions of the permit, and this section. The water distribution system will not be accepted or considered complete until all improvements pass the testing requirements of the local utility owner and a copy of all passing tests are provided to the Owner's Agent.
- F. Protect piping from damage. Do not store PVC piping and fittings in direct sunlight.

PART 2 - PRODUCTS

2.1 WATER DISTRIBUTION PIPING:

- A. See site plans for allowable pipe materials.
- B. Install piping from the water service connection point to 5' outside the face of building. Connect to the building water system of sizes and in locations indicated. Site contractor shall be responsible for making the final connection to the building system, including any drop piping and fittings required to match invert elevations.
- C. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for using lubricants and other installation requirements. Maintain a swab in line, and pull past each joint as it is completed.

- D. Use proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.
- E. Bury piping with depth of cover over top at least 60 inches.
- F. Protect stored piping, fittings, and specialties from moisture and dirt, and elevate above grade.

2.2 VALVES:

- A. Resilient-Seated gate valve, ductile-iron body, bonnet and gate; resilient seats, bronze stem and stem nut, with mechanical joints and conforming to AWWA C509. Provide interior coating according to AWWA C550. All valves and fittings shall have a minimum working pressure of 200 psig. Install valve nut extension if valve is installed deeper than 60" cover.

2.3 VALVE BOXES:

- A. Comply with AWWA M44 for cast-iron valve boxes. Include top section, adjustable extension of length required for depth of burial of valve, plug with lettering "WATER," bottom section with base of size to fit over valve, and approximately 5-inch- diameter barrel. Install valve box and valve nut extensions if valve is installed deeper than 60" cover.

2.4 ANCHORAGE INSTALLATION

- A. Install underground piping with restrained joints at horizontal and vertical changes in direction. Use restrained-joint piping, thrust blocks, anchors, tie-rods and clamps, and other supports. For water lines 12" and smaller, restrain joints and fittings in accordance with the manufacturer's recommended restraint lengths or the controlling municipality specifications, whichever is more restrictive. Submit calculations for required restraint length to Engineer for water lines larger than 12".
- B. Install anchorages for tees, plugs and caps, bends, crosses, valves, and hydrant branches.
- C. Provide anchorage for PVC Water-Service Piping according to AWWA M23.
- D. Apply full coat of asphalt or other acceptable corrosion-resistant material to surfaces of installed ferrous anchorage devices.

2.5 INDICATOR POSTS:

- A. Use UL/FM, nonrising-stem gate valves for installation with indicator posts, and provide electronic monitoring switch on post indicator. Coordinate work with building fire protection drawings

2.6 WATER METERS:

- A. Contractor shall pay all required fees, and Install according to the Utility Owner's requirements.

2.7 HYDRANT ASSEMBLY:

- A. AWWA C502 and as required by the Water Utility Owner. Each assembly to include a separate gate valve in supply pipe according to AWWA M17. Provide anchorage with restrained joints or thrust blocks, and support in upright position.

2.8 IDENTIFICATION

- A. Install continuous underground detectable warning tape for all plastic pipe during backfilling of trench for underground water-service piping. Locate below finished grade, directly over piping. In addition, attach a continuous green sheathed solid conductor copper/copper clad steel wire line (minimum #12 AWG) directly to the plastic pipe.
- B. Connect any break in the conductor line before construction with an electrical clamp, or solder, and coat the connection with a rubber or plastic insulator to maintain the integrity of the connection from corrosion. Clamp connections must be made of brass or copper and of the butt end type with wires secured by compression. Soldered connections must be made by tight spiral winding of each wire around the other with a finished length minimum of 3 inches overlap.
- C. Test conductors for continuity. Conductors shall be installed to ground level at each hydrant and valve box.

2.9 LIVE TAP 3" AND LARGER:

- A. Tap existing water main according to requirements of water utility company and according to MSS SP-60. Provide gate valve and valve box as shown on the site drawings.

PART 3 - TESTING AND DISINFECTION

3.1 CLEANING:

- A. Clean and disinfect all public and private water distribution piping according to the Utility Owner requirements, and according to AWWA C651-99. Provide temporary testing connections as required by the permitting authority and to effectively complete disinfection requirements.
- B. Fill the distribution system with a water and chlorine solution containing at least 50 ppm of chlorine. isolate and allow to stand for 24 hours.
- C. Drain system or part of system of previous solution and refill with water/chlorine solution containing at least 200 ppm of chlorine; isolate and allow to stand as required.
- D. After standing time, flush system with clean, potable water until no chlorine remains in water coming from system.
- E. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedure if biological examination shows evidence of contamination.
- F. Prepare reports of purging and disinfecting activities.

3.2 WATER DISTRIBUTION TESTING:

- A. Provide testing as required by the Indiana Department of Environmental Management, Indiana State Department of Health, and water utility Owner. In the absence of published standards, see site utility piping section for specific testing requirements.

END OF SECTION 33 11 16

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SECTION 33 31 14 - SANITARY SEWER SYSTEM

PART 1 - GENERAL

1.1 WORK INCLUDES:

- A. Sanitary sewerage as shown on the Site Plans.

1.2 REFERENCE STANDARDS AND SPECIFICATIONS:

- A. The Indiana Department of Environmental Management rules and regulations.
- B. The Utility Owner Standards and Specifications.
- C. Terms and conditions of construction as required by the Contractor's permit with the controlling agency. When conditions of the permit conflict with proposed work, the contractor shall notify the Engineer for correction prior to installation. Any non-compliant work performed by the Contractor shall be at the Contractor's expense.
- D. Site Earthwork specification for excavation and backfill requirements.
- E. Cast in Place Concrete specification for structural channels and benching.
- F. Control of Site Work Specification.

1.3 DELIVERABLES:

- A. Submittals for: piping, fittings, precast manholes, casting frames and covers.
- B. Record Drawings: Include size, material, depth of cover, location, and elevation of all improvements within the contract documents. Include details of underground structures and connections.

1.4 CONTROL OF WORK:

- A. Clean any debris that may accumulate within the sanitary sewer system as a result of construction operations, including new and existing sewer piping and structures. Flush piping as required to purge the piping system.
- B. Cap the end of exposed piping during installation to minimize infiltration of material into the piping system.

- C. Inspect interior of piping to determine whether line displacement or other damage has occurred throughout the construction process. Inspect after approximately 24 inches of backfill is in place, and again at completion of Project.
- D. Replace defective piping and structures using new materials, and repeat inspections until defects are within allowances specified. Re-inspect and repeat procedure until results meet specifications.
- E. Do not enclose, cover, or put the sanitary sewer into service before final inspection and approval by the local utility owner.
- F. Schedule tests and inspections with the utility owner as required under the conditions of the permit, and this section. The sanitary sewer system will not be accepted or considered complete until all improvements pass the testing requirements of the local utility owner and a copy of all passing tests are provided to the Owner's Agent.
- G. Protect piping from damage. Do not store PVC piping and fittings in direct sunlight.

PART 2 - PRODUCTS

- 2.1 GRAVITY PIPE: See the site utility piping specification for material specifications, and the site drawings for allowable pipe materials.
 - A. Install piping from the sewer outlet point to 5' outside the face of building according to the site drawings. The site contractor shall be responsible for making the final connection to the building sewer, including any drop piping required to match invert elevations.
 - B. Use jointing materials and methods defined in the site utility piping specification.
- 2.2 FORCE MAIN PIPE:
 - A. See the site utility piping specification for material specifications, and the site drawings for allowable pipe materials.
 - B. Install force-main piping with restrained joints at horizontal and vertical changes in direction, and maintain a minimum of 60 inches cover over the piping. Restrain joints at horizontal and vertical changes in direction. Use cast in place concrete supports and anchors or corrosion resistant rods and clamps.

2.3 PRECAST DRAINAGE STRUCTURES:

- A. All structures shall be precast concrete according to ASTM C 478. Provide preformed flexible joint sealant per ASTM C 990 or rubber gasket joints per ASTM C 443 and ASTM C 891.
- B. Grade Rings: Set structure depth to include two 6" thick reinforced concrete rings that are compatible with the specified castings.
- C. Steps: Include steps that are placed in alignment with the access hole opening, and extend from the bottom of the structure to the top of the structure. Place each step at 12" intervals and provide a slip resistant surface on each step.
- D. Provide resilient boot according to ASTM C 923 to connect the sewer piping to the precast drainage structure.
- E. Concrete for Channels and Benches: Portland cement design mix, 3000 psi minimum, with 0.45 maximum water-cementitious materials ratio.
- F. See Site Earthwork specification for backfill requirements.

2.4 CLEANOUTS:

- A. Install piping so cleanouts open in direction of flow in sewer pipe. Set cleanout frames and covers as shown on the site drawings.

2.5 TAP CONNECTIONS:

- A. Connect to existing sewer main according to the conditions of the sewer tapping permit.

PART 3 - INSTALLATION

3.1 GRAVITY PIPE TESTING:

- A. Test to be performed 30 days after installation.
- B. Flexible piping shall allow passage of a cylinder that is no smaller than 95% of the pipe inside diameter.
- C. Any piping that is damaged shall be removed and re-installed before approval.

- D. Air test plastic pipe according to ASTM F1417-92: "Standard Test Method for Installation Acceptance of plastic gravity sewer lines using Low-Pressure Air".
- E. Test PVC Piping according to AWWA M23, "Testing and Maintenance" Chapter.

3.2 FORCE MAIN PIPE TESTING:

- A. The maximum allowable infiltration per the hydrostatic test shall be a maximum of 50 gallons per inch of nominal pipe size per mile of pipe, during a 24-hour period. Perform test after thrust blocks, supports, and anchors have hardened. Test at pressure not less than one and one-half times maximum system operating pressure, but not less than 150 psig.
- B. Pressure and leak test ductile-iron piping according to AWWA C600-93.
- C. Pressure and leak test plastic piping according to AWWA C605-94.

3.3 MANHOLE STRUCTURE TESTING:

- A. Perform vacuum test on all manholes according to ASTM C1244-93 "Standard Test Method for Concrete Sewer Manholes by the Negative Air Pressure Test".

END OF SECTION 33 31 14

SECTION 33 41 00 - STORM DRAINAGE SYSTEM

PART 1 - GENERAL

1.1 WORK INCLUDES:

- A. Storm drainage as shown on the Site Plans.
- B. Subdrainage.

1.2 REFERENCE STANDARDS AND SPECIFICATIONS:

- A. Local storm water review agency standards and specifications.
- B. Terms and conditions of construction as required by the Contractor's permit with the controlling agency. When conditions of the permit conflict with proposed work, the contractor shall notify the Engineer for correction prior to installation. Any non-compliant work performed by the Contractor shall be at the Contractor's expense.
- C. Site Earthwork specification for excavation and backfill requirements.
- D. Control of Site Work Specification.

1.3 DELIVERABLES:

- A. Product Data for the following: piping, fittings, cleanouts, precast concrete manholes, and casting frames and covers.
- B. Record Drawings: Include size, material, depth of cover, location, and elevation of all improvements within the contract documents. Include details of underground structures and connections.
- C. Progress Reports: Soil conditions encountered, work completed, etc.
- D. Passing test reports for the entire storm sewer system.
- E. Geotextile fabric data for subdrainage.

1.4 CONTROL OF WORK:

- A. Clean any debris that may accumulate within the storm drainage system as a result of construction operations, including new and existing water piping and structures. Flush piping as required to purge the piping system.
- B. Cap the end of exposed piping during installation to minimize infiltration of material into the piping system.
- C. Inspect interior of piping to determine whether line displacement or other damage has occurred throughout the construction process. Inspect after approximately 24 inches of backfill is in place, and again at completion of Project.
- D. Replace defective piping and structures using new materials, and repeat inspections until defects are within allowances specified. Re-inspect and repeat procedure until results meet specifications.
- E. Do not enclose, cover, or put the storm sewer into service before final inspection and approval by the local utility owner.
- F. Schedule tests and inspections with the utility owner as required under the conditions of the permit, and this section. The storm drainage system will not be accepted or considered complete until all improvements pass the testing requirements of the local utility owner and a copy of all passing tests are provided to the Owner's Agent.
- G. Protect piping from damage. Do not store PVC piping and fittings in direct sunlight.

PART 2 - PRODUCTS

2.1 GRAVITY PIPE:

- A. See the site utility piping specification for material specifications, and the site drawings for allowable pipe materials.
- B. Install piping from the sewer outlet point to 5' outside the face of building according to the site drawings. The site contractor shall be responsible for making the final connection to the building sewer, including any drop piping required to match invert elevations.
- C. Use jointing materials and methods defined in the site utility piping specification.

2.2 SUBDRAINAGE:

- A. See the site drawings for allowable pipe materials and the utility piping specification for jointing methods.
- B. Lay perforated pipe with perforations down.
- C. Drainage fabric: Polypropylene nonwoven geotextile filter that will allow a hydraulic flow rate of 110 gallon per minute per square foot when tested according to ASTM D 4491.

2.3 PIPE END TREATMENTS

- A. Place and shape 12" of soil to cap pipe bedding material at ends of exposed pipe.

2.4 PRECAST DRAINAGE STRUCTURES:

- A. All structures shall be precast concrete according to ASTM C 478. Provide preformed flexible joint sealants per ASTM C 990 or rubber gasket joints per ASTM C 443 and ASTM C 891.
- B. Grade Rings: Set structure depth to include two 6" thick reinforced concrete rings that are compatible with the specified castings.
- C. Steps: Include steps that are placed in alignment with the access hole opening, and extend from the bottom of the structure to the top of the structure. Place each step at 12" intervals and provide a slip resistant surface on each step.
- D. Concrete for Channels and Benches: Portland cement design mix, 3000 psi minimum, with 0.45 maximum water-cementitious materials ratio.
- E. See Site Earthwork specification for backfill requirements.

2.5 CLEANOUTS:

- A. Install piping so cleanouts open in direction of flow in sewer pipe. Set cleanout frames and covers as shown on drawings.

2.6 TAP CONNECTIONS:

- A. Connect to existing sewer main according to the conditions of the sewer tapping permit.

END OF SECTION 33 41 00