

SECTION 21 0500
COMMON WORK RESULTS FOR FIRE SUPPRESSION

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Pipe, fittings, sleeves, escutcheons, seals, and connections for sprinkler systems.

1.02 RELATED REQUIREMENTS

- A. Section 07 8400 - Firestopping.
- B. Section 09 9113 - Exterior Painting: Preparation and painting of exterior fire protection piping systems.
- C. Section 09 9123 - Interior Painting: Preparation and painting of interior fire protection piping systems.
- D. Section 21 0523 - General-Duty Valves for Water-Based Fire-Suppression Piping.
- E. Section 21 0553 - Identification for Fire Suppression Piping and Equipment: Piping identification.
- F. Section 21 1300 - Fire Suppression Sprinklers: Sprinkler systems design.

1.03 REFERENCE STANDARDS

- A. ASME A112.18.1 - Plumbing Supply Fittings; 2012.
- B. ASME BPVC-IX - Boiler and Pressure Vessel Code, Section IX - Welding, Brazing, and Fusing Qualifications; 2015.
- C. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250; 2010.
- D. ASME B16.3 - Malleable Iron Threaded Fittings: Classes 150 and 300; 2011.
- E. ASME B16.4 - Gray Iron Threaded Fittings: Classes 125 and 250; 2011.
- F. ASME B16.5 - Pipe Flanges and Flanged Fittings NPS 1/2 Through NPS 24 Metric/Inch Standard; 2013.
- G. ASME B16.9 - Factory-Made Wrought Buttwelding Fittings; 2012.
- H. ASME B16.11 - Forged Fittings, Socket-welding and Threaded; 2011.
- I. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings; 2012.
- J. ASME B16.25 - Buttwelding Ends; 2012.
- K. ASME B36.10M - Welded and Seamless Wrought Steel Pipe; 2004.
- L. ASTM A47/A47M - Standard Specification for Ferritic Malleable Iron Castings; 1999 (Reapproved 2014).
- M. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2012.
- N. ASTM A135/A135M - Standard Specification for Electric-Resistance-Welded Steel Pipe; 2009 (Reapproved 2014).
- O. ASTM A234/A234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service; 2015.
- P. ASTM A536 - Standard Specification for Ductile Iron Castings; 1984 (Reapproved 2014).
- Q. ASTM A795/A795M - Standard Specification for Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Fire Protection Use; 2013.
- R. ASTM B75/B75M - Standard Specification for Seamless Copper Tube; 2011.
- S. ASTM B88 - Standard Specification for Seamless Copper Water Tube; 2014.
- T. ASTM B88M - Standard Specification for Seamless Copper Water Tube (Metric); 2013.

- U. ASTM C592 - Standard Specification for Mineral Fiber Blanket Insulation and Blanket-Type Pipe Insulation (Metal-Mesh Covered) (Industrial Type); 2016.
- V. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems; 2013a.
- W. ASTM F438 - Standard Specification for Socket-Type Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 40; 2015.
- X. ASTM F439 - Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80; 2013.
- Y. ASTM F442/F442M - Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe (SDR-PR); 2013.
- Z. ASTM F493 - Standard Specification for Solvent Cements for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe and Fittings; 2014.
- AA. AWS A5.8M/A5.8 - Specification for Filler Metals for Brazing and Braze Welding; 2011-AMD 1.
- AB. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2015 (Errata 2016).
- AC. AWWA C105/A21.5 - Polyethylene Encasement for Ductile-Iron Pipe Systems; 2010.
- AD. AWWA C606 - Grooved and Shouldered Joints; 2015.
- AE. NFPA 13 - Standard for the Installation of Sprinkler Systems; 2016.
- AF. UL (DIR) - Online Certifications Directory; current listings at database.ul.com.

1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturers catalogue information. Indicate valve data and ratings.
- C. Shop Drawings: Indicate pipe materials used, jointing methods, supports, floor and wall penetration seals. Indicate installation, layout, weights, mounting and support details, and piping connections.
- D. Project Record Documents: Record actual locations of components and tag numbering.
- E. Operation and Maintenance Data: Include installation instructions and spare parts lists.
- F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 1. See Section 01 6000 - Product Requirements, for additional provisions.
 2. Extra Valve Stem Packings: Two for each type and size of valve.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.
- B. Installer Qualifications: Company specializing in performing work of the type specified this section.
 1. Minimum three years experience.
- C. Conform to UL and FM requirements.
- D. Valves: Bear FM and UL (DIR) product listing label or marking. Provide manufacturer's name and pressure rating marked on valve body.
- E. Products Requiring Electrical Connection: Listed and classified as suitable for the purpose specified and indicated.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store valves in shipping containers, with labeling in place.
- B. Provide temporary protective coating on cast iron and steel valves.
- C. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

1.07 WARRANTY

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
- B. Correct defective Work within a five year period after Date of Substantial Completion.

PART 2 PRODUCTS

2.01 FIRE PROTECTION SYSTEMS

- A. Sprinkler Systems: Conform to NFPA 13.
- B. Welding Materials and Procedures: Conform to ASME BPVC-IX.

2.02 BURIED PIPING

- A. Steel Pipe: ASTM A53/A53M Schedule 40, ASTM A135/A135M Schedule 10, ASTM A795/A795M Standard Weight, or ASME B36.10M Schedule 40, black, with AWWA C105/A21.5 polyethylene jacket, or double layer, half-lapped polyethylene tape.
 - 1. Steel Fittings: ASME B16.9, wrought steel, butt welded, ASME B16.25, butt weld ends, ASTM A234/A234M, wrought carbon steel or alloy steel, ASME B16.5, steel flanges and fittings, or ASME B16.11, forged steel socket welded and threaded; with double layer, half-lapped polyethylene tape.
 - 2. Cast Iron Fittings: ASME B16.1, flanges and flanged fittings.
 - 3. Joints: Welded in accordance with AWS D1.1/D1.1M.
 - 4. Casing: Closed glass cell insulation.
- B. Copper Tube: ASTM B75/B75M or ASTM B88 (ASTM B88M), O60 or O50 temper.
 - 1. Type: Type K (A).
 - 2. Fittings: ASME B16.18, cast copper alloy, solder joint, pressure type.
 - 3. Joints: AWS A5.8M/A5.8 Classification BCuP-3 or BCuP-4 copper/silver braze.
 - 4. Casing: Closed glass cell insulation.

2.03 ABOVE GROUND PIPING

- A. Steel Pipe: ASTM A795 Schedule 10, ASTM A53 Schedule 40, or ASTM A135/A135M Schedule 10, black.
 - 1. Steel Fittings: ASME B16.5, steel flanges and fittings.
 - 2. Cast Iron Fittings: ASME B16.1, flanges and flanged fittings and ASME B16.4, threaded fittings.
 - 3. Malleable Iron Fittings: ASME B16.3, threaded fittings and ASTM A47/A47M.
 - 4. Mechanical Grooved Couplings: Malleable iron housing clamps to engage and lock, "C" shaped elastomeric sealing gasket, steel bolts, nuts, and washers; galvanized for galvanized pipe.
- B. Copper Tube: ASTM B88 (ASTM B88M), Type K (A), H58 drawn.
 - 1. Fittings: ASME B16.18, cast copper alloy, grooved.
 - 2. Mechanical Grooved Couplings: Ductile iron housing with alkyd enamel paint coating clamps to engage and lock, "C" shaped elastomeric sealing gasket, steel bolts, nuts, and washers.
- C. CPVC Pipe: ASTM F442/F442M, SDR 13.5.
 - 1. Acceptable for light hazard and residential occupancies only.
 - 2. Fittings: ASTM F438 Schedule 40, or ASTM F439 schedule 80, CPVC.
 - 3. Joints: Solvent welded, using ASTM F493 cement.

2.04 PIPE SLEEVES

- A. Vertical Piping:
 - 1. Sleeve Length: 1 inch (25 mm) above finished floor.
 - 2. Provide sealant for watertight joint.
 - 3. Blocked Out Floor Openings: Provide 1-1/2 inch (40 mm) angle set in silicon adhesive around opening.
 - 4. Drilled Penetrations: Provide 1-1/2 inch (40 mm) angle ring or square set in silicone adhesive around penetration.

- B. Plastic, Sheet Metal, or Moisture-Resistant Fiber: Pipe passing through interior walls, partitions, and floors, unless steel or brass sleeves are specified below.
- C. Pipe Passing Through Below Grade Exterior Walls:
 - 1. Zinc coated or cast iron pipe.
 - 2. Provide watertight space with link rubber or modular seal between sleeve and pipe on both pipe ends.
- D. Pipe Passing Through Quarry Tile, Terrazzo, or Ceramic Tile Floors:
 - 1. Brass pipe.
 - 2. Connect sleeve with floor plate.
- E. Pipe Passing Through Concrete Beam Flanges, except where Brass Pipe Sleeves are Specified:
 - 1. Galvanized steel pipe or black iron pipe with asphalt coating.
 - 2. Connect sleeve with floor plate except in mechanical rooms.
- F. Pipe Passing Through Mechanical, Laundry, and Animal Room Floors above Basement:
 - 1. Galvanized steel pipe or black iron pipe with asphalt coating.
 - 2. Connect sleeve with floor plate except in mechanical rooms.
- G. Not required for wall hydrants for fire department connections or in drywall construction.
- H. Penetrations in concrete beam flanges are permitted but are prohibited through ribs or beams without prior approval from the Architect.
- I. Clearances:
 - 1. Provide allowance for insulated piping.
 - 2. Wall, Floor, Floor, Partitions, and Beam Flanges: 1 inch (25 mm) greater than external; pipe diameter.
 - 3. All Rated Openings: Caulked tight with fire stopping material conforming to ASTM E814 in accordance with Section 07 8400 to prevent the spread of fire, smoke, and gases.

2.05 MANUFACTURED SLEEVE-SEAL SYSTEMS

- A. Manufacturers:
 - 1. Advance Products & Systems, Inc: www.apsonline.com.
 - 2. The Metraflex Company: www.metraflex.com.
 - 3. Calpico, Inc: www.calpicoinc.com.
 - 4. GPT Industries: www.gptindustries.com.
 - 5. Substitutions: See Section 01 6000 - Product Requirements.
- B. Modular/Mechanical Seal:
 - 1. Synthetic rubber interlocking links continuously fill annular space between pipe and wall/casing opening.
 - 2. Provide watertight seal between pipe and wall/casing opening.
 - 3. Elastomer element size and material in accordance with manufacturer's recommendations.
 - 4. Glass reinforced plastic pressure end plates.

2.06 ESCUTCHEONS

- A. Manufacturers:
 - 1. Fire Protection Products, Inc: www.fppi.com.com.
 - 2. Tyco Fire Protection Products: www.tyco-fire.com.
 - 3. Viking Group Inc: www.vikinggroupinc.com.
 - 4. Substitutions: See Section 01 6000 - Product Requirements.
- B. Material:
 - 1. Fabricate from nonferrous metal.
 - 2. Chrome-plated.
 - 3. Metals and Finish: Comply with ASME A112.18.1.
- C. Construction:

1. One-piece for mounting on chrome-plated tubing or pipe and one-piece or split-pattern type elsewhere.
2. Internal spring tension devices or setscrews to maintain a fixed position against a surface.

2.07 PIPE HANGERS AND SUPPORTS

- A. Hangers for Pipe Sizes 1/2 to 1-1/2 inch (15 to 40 mm): Malleable iron, adjustable swivel, split ring.
- B. Hangers for Pipe Sizes 2 inches (50 mm) and Over: Carbon steel, adjustable, clevis.
- C. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
- D. Wall Support for Pipe Sizes to 3 inches (80 mm): Cast iron hook.
- E. Wall Support for Pipe Sizes 4 inches (100 mm) and Over: Welded steel bracket and wrought steel clamp.
- F. Vertical Support: Steel riser clamp.
- G. Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
- H. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.

2.08 MECHANICAL COUPLINGS

- A. Manufacturers:
 1. Victaulic Company; FireLock Style 009H: www.victaulic.com.
 2. Substitutions: See Section 01 6000 - Product Requirements.
- B. Rigid Mechanical Couplings for Grooved Joints:
 1. Dimensions and Testing: Comply with AWWA C606.
 2. Minimum Working Pressure: 300 psig (2065 kPa).
 3. Housing Material: Fabricate of ductile iron conforming to ASTM A536.
 4. Housing Coating: Factory applied orange enamel.
 5. Gasket Material: EPDM suitable for operating temperature range from minus 30 degrees F (minus 34 degrees C) to 230 degrees F (110 degrees C).
 6. Bolts and Nuts: Hot dipped galvanized or zinc electroplated steel.

PART 3 EXECUTION

3.01 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Remove scale and foreign material, from inside and outside, before assembly.
- C. Prepare piping connections to equipment with flanges or unions.

3.02 INSTALLATION

- A. Install sprinkler system and service main piping, hangers, and supports in accordance with NFPA 13.
- B. Route piping in orderly manner, plumb and parallel to building structure. Maintain gradient.
- C. Install piping to conserve building space, to not interfere with use of space and other work.
- D. Group piping whenever practical at common elevations.
- E. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- F. Inserts:
 1. Provide inserts for placement in concrete formwork.
 2. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
 3. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches (100 m).
 4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.

5. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut above slab.
- G. Pipe Hangers and Supports:
1. Install hangers to provide minimum 1/2 inch (15 mm) space between finished covering and adjacent work.
 2. Place hangers within 12 inches (300 mm) of each horizontal elbow.
 3. Use hangers with 1-1/2 inch (40 mm) minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
 4. Support vertical piping at every other floor. Support riser piping independently of connected horizontal piping.
 5. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
 6. Provide copper plated hangers and supports for copper piping.
 7. Prime coat exposed steel hangers and supports. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.
 - a. Painting of interior fire suppression systems is specified in Section 09 9123.
 - b. Painting of exterior fire suppression systems is specified in Section 09 9113.
- H. Slope piping and arrange systems to drain at low points. Use eccentric reducers to maintain top of pipe level.
- I. Prepare pipe, fittings, supports, and accessories for finish painting. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.
1. Painting of interior fire suppression systems is specified in Section 09 9123.
 2. Painting of exterior fire suppression systems is specified in Section 09 9113.
- J. Structural Considerations:
1. Do not penetrate building structural members unless indicated.
- K. Provide sleeves when penetrating footings, floors, walls, and partitions and seal pipe and sleeve penetrations to achieve fire resistance equivalent to fire separation required.
1. Underground Piping: Caulk pipe sleeve watertight with lead and oakum or mechanically expandable chloroprene inserts with bitumen sealed metal components.
 2. Aboveground Piping:
 - a. Pack solid using mineral fiber conforming to ASTM C592.
 - b. Fill space with an elastomer caulk to a depth of 0.50 inch (15 mm) where penetrations occur between conditioned and unconditioned spaces.
 3. All Rated Openings: Caulk tight with fire stopping material conforming to ASTM E814 in accordance with Section 07 8400 to prevent the spread of fire, smoke, and gases.
 4. Caulk exterior wall sleeves watertight with lead and oakum or mechanically expandable chloroprene inserts with mastic-sealed components.
- L. Manufactured Sleeve-Seal Systems:
1. Install manufactured sleeve-seal systems in sleeves located in grade slabs and exterior concrete walls at piping entrances into building.
 2. Provide sealing elements of the size, quantity, and type required for the piping and sleeve inner diameter or penetration diameter.
 3. Locate piping in center of sleeve or penetration.
 4. Install field assembled sleeve-seal system components in annular space between sleeve and piping.
 5. Tighten bolting for a water-tight seal.
 6. Install in accordance with manufacturer's recommendations.
- M. Escutcheons:
1. Install and firmly attach escutcheons at piping penetrations into finished spaces.
 2. Provide escutcheons on both sides of partitions separating finished areas through which piping passes.

3. Attach plates at the underside only of suspended ceilings.
 4. Use chrome plated escutcheons in occupied spaces and to conceal openings in construction.
- N. When installing more than one piping system material, ensure system components are compatible and joined to ensure the integrity of the system. Provide necessary joining fittings. Ensure flanges, union, and couplings for servicing are consistently provided.
 - O. Die cut threaded joints with full cut standard taper pipe threads with red lead and linseed oil or other non-toxic joint compound applied to male threads only.

3.03 CLEANING

- A. Upon completion of work, clean all parts of the installation.
- B. Clean equipment, pipes, valves, and fittings of grease, metal cuttings, and sludge that may have accumulated from the installation and testing of the system.

END OF SECTION

SECTION 21 0523

GENERAL-DUTY VALVES FOR WATER-BASED FIRE-SUPPRESSION PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Two-piece ball valves with indicators.
- B. Bronze butterfly valves with indicators.
- C. Iron butterfly valves with indicators.
- D. Check valves.
- E. Bronze OS&Y gate valves.
- F. Iron OS&Y gate valves.
- G. NRS gate valves.
- H. Indicator posts.
- I. Trim and drain valves.

1.02 RELATED REQUIREMENTS

- A. Section 21 0500 - Common Work Results for Fire Suppression: Pipe and fittings.
- B. Section 21 0553 - Identification for Fire Suppression Piping and Equipment.
- C. Section 21 1300 - Fire Suppression Sprinklers.
- D. Section 26 2717 - Equipment Wiring: Electrical characteristics and wiring connections.
- E. Section 28 3100 - Fire Detection and Alarm.
- F. Section 33 1116 - Site Water Utility Distribution Piping.

1.03 ABBREVIATIONS AND ACRONYMS

- A. EPDM: Ethylene-propylene diene monomer.
- B. NRS: Non-rising stem.
- C. OS&Y: Outside screw and yoke.
- D. PTFE: Polytetrafluoroethylene.

1.04 REFERENCE STANDARDS

- A. ASME B1.20.1 - Pipe Threads, General Purpose (Inch); 2013.
- B. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250; 2010.
- C. ASME B31.9 - Building Services Piping; 2014.
- D. ASME BPVC-IX - Boiler and Pressure Vessel Code, Section IX - Welding, Brazing, and Fusing Qualifications; 2015.
- E. AWWA C606 - Grooved and Shouldered Joints; 2015.
- F. FM (AG) - FM Approval Guide; current edition.
- G. NFPA 13 - Standard for the Installation of Sprinkler Systems; 2016.
- H. NFPA 13R - Standard for the Installation of Sprinkler Systems in Low-Rise Residential Occupancies; 2016.
- I. UL (DIR) - Online Certifications Directory; current listings at database.ul.com.
- J. UL 262 - Gate Valves for Fire-Protection Service; Current Edition, Including All Revisions.
- K. UL 312 - Check Valves for Fire-Protection Service; Current Edition, Including All Revisions.
- L. UL 789 - Indicator Posts for Fire-Protection Service; Current Edition, Including All Revisions.
- M. UL 1091 - Standard for Butterfly Valves for Fire-Protection Service; Current Edition, Including All Revisions.

1.05 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on valves including manufacturers catalog information. Submit performance ratings, rough-in details, weights, support requirements, and piping connections.
- C. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.
- D. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, maintenance and repair data, and parts listings.

1.06 QUALITY ASSURANCE

- A. Manufacturer Qualifications:
 - 1. Obtain valves for each valve type from single manufacturer.
 - 2. Company must specialize in manufacturing products specified in this section, with not less than three years of documented experience.
- B. Where listed products are specified, provide products listed, classified, and labeled by FM (AG), UL (DIR), or testing firm acceptable to authorities having jurisdiction as suitable for the purpose indicated.
- C. Welding Materials and Procedures: Conform to ASME BPVC-IX.
- D. Installer Qualifications:
 - 1. Company specializing in performing the work of this section with minimum five years documented experience.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves for shipping as follows:
 - 1. Protect internal parts against rust and corrosion.
 - 2. Protect threads and flange faces.
 - 3. Protect threads, flange faces, and weld ends.
 - 4. Set valves open to minimize exposure of functional surfaces.
- B. Use the following precautions during storage:
 - 1. Maintain valve end protection and protect flanges and specialties from dirt.
 - a. Provide temporary inlet and outlet caps.
 - b. Maintain caps in place until installation.
 - 2. Store valves in shipping containers and maintain in place until installation.
 - a. Store valves indoors and maintain at higher than ambient dew point temperature.
 - b. If outdoor storage is unavoidable, store valves off the ground in watertight enclosures.
- C. Use the following precautions for handling:
 - 1. Use sling to handle large valves, rigged to avoid damage to exposed parts.
 - 2. Do not use operating handles or stems as lifting or rigging points.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

- A. UL Listed: Provide valves listed in UL (DIR) under following headings and bearing UL mark:
 - 1. Main Level: HAMV - Fire Main Equipment.
 - a. Level 1: HCBZ - Indicator Posts, Gate Valve.
 - b. Level 1: HLOT - Valves.
 - c. Level 3: HLUG - Ball Valves, System Control.
 - d. Level 3: HLXS - Butterfly Valves.
 - e. Level 3: HMER - Check Valves.
 - f. Level 3: HMRZ - Gate Valves.
 - 2. Main Level: VDGT - Sprinkler System & Water Spray System Devices.
 - a. Level 1: VQGU - Valves, Trim, and Drain.

- B. FM Global Approved: Provide valves listed in FM (AG) Approval Guide under the following headings:
 - 1. Automated Sprinkler Systems:
 - a. Indicator posts.
 - b. Valves:
 - 1) Gate valves.
 - 2) Single check valves.
 - 3) Miscellaneous valves.
- C. ASME Compliance:
 - 1. ASME B16.1 for flanges on iron valves.
 - 2. ASME B1.20.1 for threads on threaded-end valves.
 - 3. ASME B31.9 for building services piping valves.
- D. Comply with AWWA C606 for grooved-end connections.
- E. Comply with NFPA 13 and NFPA 13R for valves.
- F. Valve Pressure Ratings: Not less than minimum pressure rating indicated or higher as required.
- G. Valve Sizes: Same as upstream piping unless otherwise indicated.
- H. Valve Actuator Types:
 - 1. Worm-gear actuator with handwheel for quarter-turn valves, except trim and drain valves.
 - 2. Handwheel: For other than quarter-turn trim and drain valves.
 - 3. Hand-lever: For quarter-turn trim and drain valves 2 NPS (50 DN) and smaller.

2.02 TWO-PIECE BALL VALVES WITH INDICATORS

- A. Manufacturers:
 - 1. Anvil International, Inc: www.anvilintl.com.
 - 2. Victaulic Company: www.victaulic.com.
 - 3. Substitutions: See Section 01 6000 - Product Requirements.
- B. UL 1091, except with ball instead of disc and FM (AG) standard listing for indicating valves (butterfly or ball type), Class Number 1112.
- C. Description:
 - 1. Minimum Pressure Rating: 175 psig (1200 kPa).
 - 2. Body Design: Two piece.
 - 3. Body Material: Forged brass or bronze.
 - 4. Port Size: Full or standard.
 - 5. Seat: PTFE.
 - 6. Stem: Bronze or stainless steel.
 - 7. Ball: Chrome-plated brass.
 - 8. Actuator: Worm gear or traveling nut.
 - 9. Supervisory Switch: Internal or external.
 - 10. End Connections for Valves 1 NPS (25 DN) through 2 NPS (50 DN): Threaded ends.
 - 11. End Connections for Valves 2-1/2 NPS (65 DN): Grooved ends.

2.03 BRONZE BUTTERFLY VALVES WITH INDICATORS

- A. Manufacturers:
 - 1. Anvil International, Inc: www.anvilintl.com.
 - 2. Fivalco, Inc: www.fivalcoinc.com.
 - 3. Henry Pratt Company: www.henrypratt.com.
 - 4. Kennedy Valve: www.kennedyvalve.com.
 - 5. Milwaukee Valve Company: www.milwaukeevalve.com.
 - 6. Nibco, Inc: www.nibco.com.
 - 7. Shurjoint Piping Products: www.shurjoint.com.
 - 8. Tyco Fire Products: www.tyco-fire.com.

- 9. Victaulic Company: www.victaulic.com
- 10. Substitutions: See Section 01 6000 - Product Requirements.
- B. UL 1091 and FM (AG) standard listing for indicating valves, (butterfly or ball type), Class Number 1112.
- C. Minimum Pressure Rating: 175 psig (1200 kPa).
- D. Body Material: Bronze.
- E. Seat: EPDM.
- F. Stem: Bronze or stainless steel.
- G. Disc: Bronze with EPDM coating.
- H. Actuator: Worm gear or traveling nut.
- I. Supervisory Switch: Internal or external.
- J. End Connections for Valves 1 NPS (25 DN) through 2 NPS (50 DN): Threaded ends.
- K. End Connections for Valves 2-1/2 NPS (65 DN): Grooved ends.

2.04 IRON BUTTERFLY VALVES WITH INDICATORS

- A. Manufacturers:
 - 1. Anvil International, Inc: www.anvilintl.com.
 - 2. Fivalco, Inc: www.fivalcoinc.com.
 - 3. Henry Pratt Company: www.henrypratt.com.
 - 4. Kennedy Valve: www.kennedyvalve.com.
 - 5. Milwaukee Valve Company: www.milwaukeevalve.com.
 - 6. Nibco, Inc: www.nibco.com.
 - 7. Shurjoint Piping Products: www.shurjoint.com.
 - 8. Tyco Fire Products: www.tyco-fire.com.
 - 9. Victaulic Company: www.victaulic.com.
 - 10. Substitutions: See Section 01 6000 - Product Requirements.
- B. UL 1091 and FM (AG) standard listing for indicating valves (butterfly or ball type), Class Number 112.
- C. Minimum Pressure Rating: 175 psig (1200 kPa).
- D. Body Material: Cast or ductile iron with nylon, EPDM, epoxy, or polyamide coating.
- E. Seat: EPDM.
- F. Stem: Stainless steel.
- G. Disc: Ductile iron, nickel plated.
- H. Actuator: Worm gear or traveling nut.
- I. Supervisory Switch: Internal or external.
- J. Body Design: Grooved-end connections.

2.05 CHECK VALVES

- A. Manufacturers:
 - 1. American Cast Iron Pipe Company: www.american-usa.com.
 - 2. Anvil International, Inc: www.anvilintl.com.
 - 3. Clow Valve Company: www.clowvalve.com.
 - 4. Crane Co.; Crane ChemPharma & Energy; Crane Valves: www.cranecpe.com/chem-energy/brand/crane.
 - 5. Crane Co.; Crane ChemPharma & Energy; Jenkins Valves: www.cranecpe.com/chem-energy/brand/jenkins.
 - 6. Crane Co.; Crane ChemPharma & Energy; Stockham Valves: www.cranecp.com/chem-energy/branch/stockham.
 - 7. Fire End & Croker Corporation; Croker Division: www.croker.com.

8. Fire Protection Products, Inc: www.fppi.com.
 9. Fivalco, Inc: www.fivalcoinc.com.
 10. Globe Fire Sprinkler Corporation: www.globesprinkler.com.
 11. Kennedy Valve: www.kennedyvalve.com.
 12. Matco-Norca: www.matco-norca.com.
 13. Metraflex: www.metraflex.com.
 14. Milwaukee Valve Company: www.milwaukeevalve.com.
 15. Mueller Co.: www.muellercompany.com.
 16. Nibco, Inc: www.nibco.com.
 17. Potter Roemer: www.potterroemer.com.
 18. Reliable Automatic Sprinkler Co., Inc: www.reliablesprinkler.com.
 19. Shurjoint Piping Products: www.shurjoint.com.
 20. Tyco Fire Products: www.tyco-fire.com.
 21. United Brass Works, Inc: ubw.com.
 22. Venus Fire Protection Ltd: www.venus-fire.com.
 23. Victaulic Company: www.victaulic.com.
 24. Viking Corporation: www.vikingcorp.com.
 25. Substitutions: See Section 01 6000 - Product Requirements.
- B. UL 312 and FM (AG) standard listing for check valves, Class Number 1045.
 - C. Minimum Pressure Rating: 175 psig (1200 kPa).
 - D. Type: Center guided check valve.
 - E. Body Material: Cast iron, ductile iron.
 - F. Center guided check with elastomeric seal.
 - G. Hinge Spring: Stainless steel.
 - H. End Connections: Flanged, grooved, or threaded.

2.06 BRONZE OS&Y GATE VALVES

- A. Manufacturers:
 1. American Cast Iron Pipe Company: www.american-usa.com.
 2. Clow Valve Company: www.clowvalve.com.
 3. Crane Co.; Crane ChemPharma & Energy; Crane Valves: www.cranecpe.com/chem-energy/brand/crane.
 4. Crane Co.; Crane ChemPharma & Energy; Jenkins Valves: www.cranecpe.com/chem-energy/brand/jenkins.
 5. Crane Co.; Crane ChemPharma & Energy; Stockham Valves: www.cranecp.com/chem-energy/branch/stockham.
 6. Hammond Valve: www.hammondvalve.com.
 7. Milwaukee Valve Company: www.milwaukeevalve.com.
 8. Mueller Co.: www.muellercompany.com.
 9. Nibco, Inc: www.nibco.com.
 10. Shurjoint Piping Products: www.shurjoint.com.
 11. Tyco Fire Products: www.tyco-fire.com.
 12. United Brass Works, Inc: ubw.com.
 13. Watts Water Technologies, Inc.; Watts Division: www.watts.com.
 14. Substitutions: See Section 01 6000 - Product Requirements.
- B. UL 262 and FM (AG) standard listing for fire-service water control valves (OS&Y and NRS-type gate valves).
- C. Minimum Pressure Rating: 175 psig (1200 kPa).
- D. Body and Bonnet Material: Bronze or brass.
- E. Wedge: One-piece bronze or brass.
- F. Wedge Seat: Bronze.

- G. Stem: Bronze or brass.
- H. Packing: Non-asbestos PTFE.
- I. Supervisory Switch: External.
- J. End Connections: Threaded.

2.07 IRON OS&Y GATE VALVES

- A. Manufacturers:
 1. American Cast Iron Pipe Company: www.american-usa.com.
 2. Clow Valve Company: www.clowvalve.com.
 3. Crane Co.; Crane ChemPharma & Energy; Crane Valves: www.cranecpe.com/chem-energy/brand/crane.
 4. Crane Co.; Crane ChemPharma & Energy; Jenkins Valves: www.cranecpe.com/chem-energy/brand/jenkins.
 5. Crane Co.; Crane ChemPharma & Energy; Stockham Valves: www.cranecp.com/chem-energy/branch/stockham.
 6. Hammond Valve: www.hammondvalve.com.
 7. Milwaukee Valve Company: www.milwaukeevalve.com.
 8. Mueller Co.: www.muellercompany.com.
 9. Nibco, Inc: www.nibco.com.
 10. Shurjoint Piping Products: www.shurjoint.com.
 11. Tyco Fire Products: www.tyco-fire.com.
 12. United Brass Works, Inc: ubw.com.
 13. Watts Water Technologies, Inc.; Watts Division: www.watts.com.
 14. Substitutions: See Section 01 6000 - Product Requirements.
- B. UL 262 and FM (AG) standard listing for fire-service water control valves (OS&Y and NRS-type gate valves).
- C. Minimum Pressure Rating: 175 psig (1200 kPa).
- D. Body and Bonnet Material: Cast or ductile iron.
- E. Wedge: Cast or ductile iron, or bronze with elastomeric coating.
- F. Wedge Seat: Cast or ductile iron, or bronze with elastomeric coating.
- G. Stem: Brass or bronze.
- H. Packing: Non-asbestos PTFE.
- I. Supervisory Switch: External.
- J. End Connections: Flanged.

2.08 NRS GATE VALVES

- A. Manufacturers:
 1. American Cast Iron Pipe Company: www.american-usa.com.
 2. Clow Valve Company: www.clowvalve.com.
 3. Crane Co.; Crane ChemPharma & Energy; Stockham Valves: www.cranecp.com/chem-energy/branch/stockham.
 4. Kennedy Valve: www.kennedyvalve.com.
 5. Mueller Co.: www.muellercompany.com.
 6. Nibco, Inc: www.nibco.com.
 7. Tyco Fire Products: www.tyco-fire.com.
 8. Substitutions: See Section 01 6000 - Product Requirements.
- B. UL 262 and FM (AG) standard listing for fire-service water control valves (OS&Y and NRS-type gate valves).
- C. Minimum Pressure Rating: 175 psig (1200 kPa).
- D. Body and Bonnet Material: Cast or ductile iron.

- E. Wedge: Cast or ductile iron with elastomeric coating.
- F. Wedge Seat: Cast or ductile iron, or bronze with elastomeric coating.
- G. Stem: Brass or bronze.
- H. Packing: Non-asbestos PTFE.
- I. Supervisory Switch: External.
- J. End Connections: Flanged.

2.09 INDICATOR POSTS

- A. Manufacturers:
 - 1. American Cast Iron Pipe Company: www.american-usa.com.
 - 2. Clow Valve Company: www.clowvalve.com.
 - 3. Crane Co.; Crane ChemPharma & Energy; Stockham Valves: www.cranecp.com/chem-energy/branch/stockham.
 - 4. Kennedy Valve: www.kennedyvalve.com.
 - 5. Mueller Co.: www.muellercompany.com.
 - 6. Nibco, Inc: www.nibco.com.
 - 7. Tyco Fire Products: www.tyco-fire.com.
 - 8. Substitutions: See Section 01 6000 - Product Requirements.
- B. UL 789 and FM (AG) standard listing for indicator posts.
- C. Type: Wall.
- D. Base Barrel Material: Cast or ductile iron.
- E. Extension Barrel for Adjustable Length Indicator Posts: Cast or ductile iron.
- F. Cap: Cast or ductile iron.
- G. Operation: Handwheel.

2.10 TRIM AND DRAIN VALVES

- A. Ball Valves:
 - 1. Manufacturers:
 - a. Anvil International, Inc: www.anvilintl.com.
 - b. Apollo Valves: www.apollovalves.com.
 - c. Fire End & Croker Corporation; Croker Division: www.croker.com.
 - d. Fire Protection Products, Inc: www.fppi.com.
 - e. Flowserve Corporation: www.flowserve.com.
 - f. Kennedy Valve: www.kennedyvalve.com.
 - g. Kitz Corporation: www.kitz.com.
 - h. Legend Valve: www.legendvalve.com.
 - i. Milwaukee Valve Company: www.milwaukeevalve.com.
 - j. Nibco, Inc: www.nibco.com.
 - k. Potter Roemer: www.potterroemer.com.
 - l. Red-White Valve Corp: www.redwhitevalvecorp.com.
 - m. Tyco Fire Products: www.tyco-fire.com.
 - n. Victaulic Company: www.victaulic.com.
 - o. Watts Water Technologies, Inc.; Watts Division: www.watts.com.
 - p. Substitutions: See Section 01 6000 - Product Requirements.
 - 2. Description:
 - a. Pressure Rating: 175 psig (1200 kPa).
 - b. Body Design: Two piece.
 - c. Body Material: Forged brass or bronze.
 - d. Port Size: Full or standard.
 - e. Seat: PTFE.
 - f. Stem: Bronze or stainless steel.

- g. Ball: Chrome-plated brass.
 - h. Actuator: Hand-lever.
 - i. End Connections for Valves 1 NPS (25 DN) through 2-1/2 NPS (65 DN): Threaded ends.
 - j. End Connections for Valves 1-1/4 NPS (32 DN) and 2-1/2 NPS (65 DN): Grooved ends.
- B. Angle Valves:
- 1. Manufacturers:
 - a. Fire Protection Products, Inc: www.fppi.com.
 - b. United Brass Works, Inc: ubw.com.
 - c. Substitutions: See Section 01 6000 - Product Requirements.
 - 2. Description:
 - a. Pressure Rating: 175 psig (1200 kPa).
 - b. Body Material: Brass or bronze.
 - c. Ends: Threaded.
 - d. Stem: Bronze.
 - e. Disc: Bronze.
 - f. Packing: Asbestos free.
 - g. Handwheel: Malleable iron, bronze, or aluminum.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Remove packing materials.
- B. Examine guides and seats by operating valves from the fully open position to the fully closed position.
- C. Examine valve threads and mating pipe for form and cleanliness.
- D. Examine mating flange faces for conditions that might cause leakage.
 - 1. Check bolting for proper size, length, and material.
 - 2. Verify gasket for size, defects, damage, and suitable material composition for service.
 - 3. Replace all defective valves with new valves.

3.02 INSTALLATION

- A. Comply with specific valve installation requirements and application in the following Sections:
 - 1. Section 21 1200 for application of valves in fire-suppression standpipes.
 - 2. Section 21 1300 for application of valves in wet and dry pipe, fire-suppression sprinkler systems.
 - 3. Section 21 1339 for application of valves in foam-water, fire-suppression sprinkler systems.
 - 4. Section 33 1116 for application of valves in fire-suppression water-service piping outside the building.
- B. Install listed fire protection shutoff valves supervised-open, located to control sources of water supply except from fire department connections.
 - 1. Install permanent identification signs indicating portion of system controlled by each valve.
- C. Install check valve in water supply connections and backflow preventer at potable water supply connections.
- D. Valves with threaded connections to have unions at equipment arranged for easy access, service, maintenance, and equipment removal without system shutdown.
- E. Valves in horizontal piping installed with stem at or above the pipe center.
- F. Position valves to allow full stem movement.

- G. Install valve tags. Comply with Section 21 0553 requirements for valve tags, schedules, and signs on surfaces concealing valves; and the appropriate NFPA standard applying to the piping system in which valves are installed.

END OF SECTION

SECTION 21 0553

IDENTIFICATION FOR FIRE SUPPRESSION PIPING AND EQUIPMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Nameplates.
- B. Tags.
- C. Pipe markers.
- D. Ceiling tacks.

1.02 REFERENCE STANDARDS

- A. ASME A13.1 - Scheme for the Identification of Piping Systems; 2015.
- B. ASTM D709 - Standard Specification for Laminated Thermosetting Materials; 2016.

1.03 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. List: Submit list of wording, symbols, letter size, and color coding for mechanical identification.
- C. Chart and Schedule: Submit valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.
- D. Product Data: Provide manufacturers catalog literature for each product required.
- E. Manufacturer's Installation Instructions: Indicate special procedures, and installation instructions.
- F. Project Record Documents: Record actual locations of tagged valves.

PART 2 PRODUCTS

2.01 IDENTIFICATION APPLICATIONS

- A. Automatic Controls: Tags.
- B. Control Panels: Nameplates.
- C. Instrumentation: Tags.
- D. Major Control Components: Nameplates.
- E. Piping: Pipe markers.
- F. Relays: Tags.
- G. Small-sized Equipment: Tags.
- H. Valves: Nameplates and ceiling tacks where above lay-in ceilings.

2.02 NAMEPLATES

- A. Manufacturers:
 - 1. Brimar Industries, Inc.: www.pipemarker.com.
 - 2. Kolbi Pipe Marker Company.: www.kolbipipemarkers.com.
 - 3. Seton Identification Products, a Tricor Direct Company: www.seton.com.
 - 4. Substitutions: See Section 01 6000 - Product Requirements.
- B. Description: Laminated three-layer plastic with engraved letters.
 - 1. Letter Color: White.
 - 2. Letter Height: 1/4 inch (6 mm).
 - 3. Background Color: Black.
 - 4. Thickness: 1/8 inch (3 mm).
 - 5. Plastic: Conform to ASTM D709.

2.03 TAGS

- A. Manufacturers:

1. Advanced Graphic Engraving, LLC: www.advancedgraphicengraving.com.
 2. Brady Corporation: www.bradycorp.com.
 3. Brimar Industries, Inc.: www.pipemarker.com.
 4. Kolbi Pipe Marker Company: www.kolbipipemarkers.com.
 5. Seton Identification Products, a Tricor Direct Company: www.seton.com.
 6. Substitutions: See Section 01 6000 - Product Requirements.
- B. Plastic Tags: Laminated three-layer plastic with engraved black letters on light contrasting background color. Tag size minimum 1-1/2 inch (40 mm) diameter.
- C. Metal Tags: Brass with stamped letters; tag size minimum 1-1/2 inch (40 mm) diameter with smooth edges.
- D. Valve Tag Chart: Typewritten letter size list in anodized aluminum frame.

2.04 PIPE MARKERS

- A. Manufacturers:
1. Brady Corporation: www.bradycorp.com.
 2. Brimar Industries, Inc.: www.pipemarker.com.
 3. Kolbi Pipe Marker Company.: www.kolbipipemarkers.com.
 4. MIFAB, Inc.: www.mifab.com.
 5. Seton Identification Products, a Tricor Company: www.seton.com.
 6. Substitutions: See Section 01 6000 - Product Requirements.
- B. Color: Conform to ASME A13.1.
- C. Plastic Pipe Markers: Factory fabricated, flexible, semi- rigid plastic, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and identification of fluid being conveyed.
- D. Plastic Tape Pipe Markers: Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings.
- E. Underground Plastic Pipe Markers: Bright colored continuously printed plastic ribbon tape, minimum 6 inches (150 mm) wide by 4 mil (0.10 mm) thick, manufactured for direct burial service.

2.05 CEILING TACKS

- A. Manufacturers:
1. Craftmark: www.craftmarkid.com.
 2. Substitutions: See Section 01 6000 - Product Requirements.
- B. Description: Steel with 3/4 inch (20 mm) diameter color coded head.

PART 3 EXECUTION

3.01 PREPARATION

- A. Degrease and clean surfaces to receive adhesive for identification materials.

3.02 INSTALLATION

- A. Install nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer.
- B. Install tags with corrosion resistant chain.
- C. Install plastic pipe markers in accordance with manufacturer's instructions.
- D. Install plastic tape pipe markers complete around pipe in accordance with manufacturer's instructions.
- E. Install underground plastic pipe markers 6 to 8 inches (150 to 200 mm) below finished grade, directly above buried pipe.
- F. Use tags on piping 3/4 inch (20 mm) diameter and smaller.
1. Identify service, flow direction, and pressure.
 2. Install in clear view and align with axis of piping.

3. Locate identification not to exceed 20 feet (6 m) on straight runs including risers and drops, adjacent to each valve and Tee, at each side of penetration of structure or enclosure, and at each obstruction.
- G. Locate ceiling tacks to locate valves above T-bar type panel ceilings. Locate in corner of panel closest to equipment.

END OF SECTION

SECTION 21 1300
FIRE SUPPRESSION SPRINKLERS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Wet-pipe sprinkler system.
- B. System design, installation, and certification.
- C. Fire department connections.

1.02 RELATED REQUIREMENTS

- A. Section 22 0553 - Identification for Plumbing Piping and Equipment.

1.03 REFERENCE STANDARDS

- A. FM (AG) - FM Approval Guide; current edition.
- B. ICC-ES AC01 - Acceptance Criteria for Expansion Anchors in Masonry Elements; 2015.
- C. ICC-ES AC106 - Acceptance Criteria for Predrilled Fasteners (Screw Anchors) in Masonry Elements; 2012.
- D. ICC-ES AC193 - Acceptance Criteria for Mechanical Anchors in Concrete Elements; 2015.
- E. ICC-ES AC308 - Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Elements; 2015.
- F. NFPA 13 - Standard for the Installation of Sprinkler Systems; 2016.
- G. NFPA 1963 - Standard for Fire Hose Connections; 2014.
- H. UL (DIR) - Online Certifications Directory; current listings at database.ul.com.

1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on sprinklers, valves, and specialties, including manufacturers catalog information. Submit performance ratings, rough-in details, weights, support requirements, and piping connections.
- C. Shop Drawings:
 - 1. Submit preliminary layout of finished ceiling areas indicating only sprinkler locations coordinated with ceiling installation.
 - 2. Indicate hydraulic calculations, detailed pipe layout, hangers and supports, sprinklers, components and accessories. Indicate system controls.
 - 3. Submit shop drawings to Authorities Having Jurisdiction for approval. Submit proof of approval to Architect.
- D. Samples: Submit two of each style of sprinkler specified.
- E. Manufacturer's Certificate: Certify that system has been tested and meets or exceeds specified requirements and code requirements.
- F. Operation and Maintenance Data: Include components of system, servicing requirements, record drawings, inspection data, replacement part numbers and availability, and location and numbers of service depot.
- G. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 01 6000 - Product Requirements, for additional provisions.
 - 2. Extra Sprinklers: Type and size matching those installed, in quantity required by referenced NFPA design and installation standard.
 - 3. Sprinkler Wrenches: For each sprinkler type.
- H. Project Record Documents: Record actual locations of sprinklers and deviations of piping from drawings. Indicate drain and test locations.

1.05 QUALITY ASSURANCE

- A. Maintain one copy of referenced design and installation standard on site.
- B. Conform to FM (AG) requirements.
- C. Designer Qualifications: Design system under direct supervision of a Professional Engineer experienced in design of this type of work and licensed in York, PA.
- D. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.
- E. Installer Qualifications: Company specializing in performing the work of this section with minimum three years experience.
- F. Equipment and Components: Provide products that bear FM (AG) label or marking.
- G. Products Requiring Electrical Connection: Listed and classified by UL (DIR) as suitable for the purpose specified and indicated.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Store products in shipping containers and maintain in place until installation. Provide temporary inlet and outlet caps. Maintain caps in place until installation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Sprinklers, Valves, and Equipment:
 - 1. Globe Fire Sprinkler Corporation: www.globesprinkler.com.
 - 2. Reliable Automatic Sprinkler Co., Inc: www.reliablesprinkler.com.
 - 3. Tyco Fire Protection Products, a Tyco Business: www.tyco-fire.com.
 - 4. Venus Fire Protection Ltd: www.venus-fire.com.
 - 5. Victaulic Company: www.victaulic.com.
 - 6. Viking Corporation: www.vikinggroupinc.com.
 - 7. Substitutions: See Section 01 6000 - Product Requirements.

2.02 SPRINKLER SYSTEM

- A. Sprinkler System: Provide coverage for entire building.
- B. Occupancy: Light hazard; comply with NFPA 13.
- C. Water Supply: Determine volume and pressure from water flow test data.
- D. Provide fire department connections where indicated.
- E. Storage Cabinet for Spare Sprinklers and Tools: Steel, located adjacent to alarm valve.
- F. Pipe Hanger Fasteners: Attach hangers to structure using appropriate fasteners, as follows:
 - 1. Concrete Wedge Expansion Anchors: Complying with ICC-ES AC193.
 - 2. Masonry Wedge Expansion Anchors: Complying with ICC-ES AC01.
 - 3. Concrete Screw Type Anchors: Complying with ICC-ES AC193.
 - 4. Masonry Screw Type Anchors: Complying with ICC-ES AC106.
 - 5. Concrete Adhesive Type Anchors: Complying with ICC-ES AC308.
 - 6. Other Types: As required.

2.03 SPRINKLERS

- A. Suspended Ceiling Type: Semi-recessed pendant type with matching push on escutcheon plate.
 - 1. Response Type: Quick.
 - 2. Coverage Type: Standard.
 - 3. Finish: Brass.
 - 4. Escutcheon Plate Finish: Antique Brass.
 - 5. Fusible Link: Fusible solder link type temperature rated for specific area hazard.
- B. Exposed Area Type: Pendant type with guard.

1. Response Type: Quick.
 2. Coverage Type: Standard.
 3. Finish: Brass.
 4. Fusible Link: Fusible solder link type temperature rated for specific area hazard.
- C. Sidewall Type: Semi-recessed horizontal sidewall type with matching push on escutcheon plate.
1. Response Type: Quick.
 2. Coverage Type: Standard.
 3. Finish: Brass.
 4. Escutcheon Plate Finish: Brass.
 5. Fusible Link: Fusible solder link type temperature rated for specific area hazard.
- D. Storage Sprinklers: Pendant type with guard.
1. Response Type: Standard.
 2. Coverage Type: Standard.
 3. Finish: Chrome plated.
 4. Fusible Link: Fusible solder link type temperature rated for specific area hazard.
- E. Guards: Finish to match sprinkler finish.
- F. Spray Nozzles: Brass with solid cone discharge, 30 degrees of arc with blow-off dust cap.
1. Finish: Brass.

2.04 PIPING SPECIALTIES

- A. Wet Pipe Sprinkler Alarm Valve: Check type valve with divided seat ring, rubber faced clapper to automatically actuate water motor alarm, pressure retard chamber and variable pressure trim with the following additional capabilities and features:
1. Activate electric alarm.
 2. Test and drain valve.
 3. Replaceable internal components without removing valve from installed position.
- B. Backflow Preventer: Reduced pressure principle valve assembly backflow preventer with drain and OS & Y gate valve on each end.
- C. Test Connections:
1. Backflow Preventer Test Connection:
 - a. Provide downstream of the backflow prevention assembly, listed hose valves with 2.5 inch (65 mm) National Standard male hose threads with cap and chain.
 - b. Furnish one valve for each 250 gpm (16 L/s) of system demand or fraction thereof.
 - c. Provide permanent sign reading "Test Valve" in accordance with Section 22 0553.
- D. Water Motor Alarm: Hydraulically operated impeller type alarm with aluminum alloy chrome plated gong and motor housing, nylon bearings, and inlet strainer.
- E. Electric Alarm: Electrically operated chrome plated gong with pressure alarm switch.
- F. Water Flow Switch: Vane type switch for mounting horizontal or vertical, with two contacts; rated 10 amp at 125 volt AC and 2.5 amp at 24 volt DC.
- G. Fire Department Connections:
1. Type: Flush, wall mount made of corrosion resistant metal complying with UL 405.
 - a. Inlets: Two way, 2-1/2 inch (65 DN) swivel fittings, internal threaded. Thread size and inlets according to NFPA 1963 or Authority Having Jurisdiction. Brass caps with gaskets, chains, and lugs.
 - b. Configuration: Horizontal.
 - c. Outlet: Bottom with pipe threads, 4 NPS (100 DN).
 - 1) Location: Back.
 - d. Rated Working Pressure: 175 psi (1200 kPa).
 - e. Finish: Brass or bronze.

- f. Signage: Raised or engraved lettering 1 inch (25.4 mm) minimum indicating system type.
- g. Manufacturers:
 - 1) Elkhart Brass Manufacturing Company, Inc: www.elkhartbrass.com.
 - 2) Fire End & Croker Corporation: www.croker.com.
 - 3) Substitutions: See Section 01 6000 - Product Requirements.

- H. Supervisory Switches:
- I. Water Level Supervisory Switches:
- J. Tank Temperature Supervisory Switches:
- K. Room Temperature Supervisory Switches:

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with referenced NFPA design and installation standard.
- B. Install equipment in accordance with manufacturer's instructions.
- C. Install buried shut-off valves in valve box. Provide post indicator.
- D. Provide approved double check valve assembly at sprinkler system water source connection.
- E. Locate fire department connection with sufficient clearance from walls, obstructions, or adjacent siamese connectors to allow full swing of fire department wrench handle.
- F. Locate outside alarm gong on building wall as indicated.
- G. Place pipe runs to minimize obstruction to other work.
- H. Place piping in concealed spaces above finished ceilings.
- I. Center sprinklers in two directions in ceiling tile and provide piping offsets as required.
- J. Apply masking tape or paper cover to ensure concealed sprinklers, cover plates, and sprinkler escutcheons do not receive field paint finish. Remove after painting. Replace painted sprinklers.
- K. Install and connect to fire pump system in accordance with Section 21 3000.
- L. Flush entire piping system of foreign matter.
- M. Install guards on sprinklers where indicated.
- N. Hydrostatically test entire system.
- O. Require test be witnessed by Fire Marshal.

3.02 INTERFACE WITH OTHER PRODUCTS

- A. Ensure required devices are installed and connected as required to fire alarm system.

END OF SECTION

SECTION 22 0513

COMMON MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. General construction and requirements.
- B. Applications.
- C. Single phase electric motors.

1.02 RELATED REQUIREMENTS

- A. Section 26 2717 - Equipment Wiring: Electrical characteristics and wiring connections.

1.03 REFERENCE STANDARDS

- A. NEMA MG 1 - Motors and Generators; 2014.
- B. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide wiring diagrams with electrical characteristics and connection requirements.
- C. Test Reports: Indicate test results verifying nominal efficiency and power factor for three phase motors larger than 1/2 horsepower.
- D. Manufacturer's Installation Instructions: Indicate setting, mechanical connections, lubrication, and wiring instructions.
- E. Operation Data: Include instructions for safe operating procedures.
- F. Maintenance Data: Include assembly drawings, bearing data including replacement sizes, and lubrication instructions.

1.05 QUALITY ASSURANCE

- A. Conform to NFPA 70.
- B. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Protect motors stored on site from weather and moisture by maintaining factory covers and suitable weather-proof covering. For extended outdoor storage, remove motors from equipment and store separately.

1.07 WARRANTY

- A. See Section 01 7800 - Closeout Submittals for additional warranty requirements.
- B. Provide five year manufacturer warranty for motors larger than 20 horsepower.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Baldor Electric Company/ABB Group: www.baldor.com.
- B. Leeson Electric Corporation: www.leeson.com.
- C. Regal-Beloit Corporation (Century): www.centuryelectricmotor.com.
- D. Substitutions: See Section 01 6000 - Product Requirements.

2.02 GENERAL CONSTRUCTION AND REQUIREMENTS

- A. Electrical Service: Refer to Section 26 2717 for required electrical characteristics.

- B. Nominal Efficiency:
 1. Open Motor with Two Poles: 82.5.
 2. Open Motor with Four Poles: 82.5.
 3. Open Motor with Six poles: 50.0.
 4. Enclosed Motor with Two Poles: 75.5.
 5. Enclosed Motor with Four Poles: 82.5.
 6. Enclosed Motor with Six Poles: 50.0.
- C. Construction:
 1. Open drip-proof type except where specifically noted otherwise.
 2. Design for continuous operation in 104 degrees F (40 degrees C) environment.
 3. Design for temperature rise in accordance with NEMA MG 1 limits for insulation class, service factor, and motor enclosure type.
 4. Motors with frame sizes 254T and larger: Energy efficient type.
- D. Explosion-Proof Motors: UL approved and labelled for hazard classification, with over temperature protection.
- E. Visible Nameplate: Indicating motor horsepower, voltage, phase, cycles, RPM, full load amps, locked rotor amps, frame size, manufacturer's name and model number, service factor, power factor, efficiency.
- F. Wiring Terminations:
 1. Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to NFPA 70, threaded for conduit.
 2. For fractional horsepower motors where connection is made directly, provide threaded conduit connection in end frame.

2.03 APPLICATIONS

- A. Exception: Motors less than 250 watts, for intermittent service may be the equipment manufacturer's standard and need not conform to these specifications.
- B. Single phase motors for oil burners and centrifugal pumps: Split phase type.
- C. Single phase motors for shaft mounted fans or blowers: Permanent split capacitor type.
- D. Single phase motors for pumps and air compressors: Capacitor start type.
- E. Single phase motors for pumps: Capacitor start, capacitor run type.
- F. Motors located in exterior locations and explosion proof environments: Totally enclosed type.
- G. Motors located outdoors: Totally enclosed weatherproof epoxy-sealed type.

2.04 SINGLE PHASE POWER - SPLIT PHASE MOTORS

- A. Starting Torque: Less than 150 percent of full load torque.
- B. Starting Current: Up to seven times full load current.
- C. Breakdown Torque: Approximately 200 percent of full load torque.
- D. Drip-proof Enclosure: Class A (50 degrees C temperature rise) insulation, NEMA Service Factor, prelubricated sleeve or ball bearings.
- E. Enclosed Motors: Class A (50 degrees C temperature rise) insulation, 1.0 Service Factor, prelubricated ball bearings.

2.05 SINGLE PHASE POWER - PERMANENT-SPLIT CAPACITOR MOTORS

- A. Starting Torque: Exceeding one fourth of full load torque.
- B. Starting Current: Up to six times full load current.
- C. Multiple Speed: Through tapped windings.
- D. Open Drip-proof or Enclosed Air Over Enclosure: Class A (50 degrees C temperature rise) insulation, minimum 1.0 Service Factor, prelubricated sleeve or ball bearings, automatic reset overload protector.

2.06 SINGLE PHASE POWER - CAPACITOR START MOTORS

- A. Starting Torque: Three times full load torque.
- B. Starting Current: Less than five times full load current.
- C. Pull-up Torque: Up to 350 percent of full load torque.
- D. Breakdown Torque: Approximately 250 percent of full load torque.
- E. Motors: Capacitor in series with starting winding; provide capacitor-start/capacitor-run motors with two capacitors in parallel with run capacitor remaining in circuit at operating speeds.
- F. Drip-proof Enclosure: Class A (50 degrees C temperature rise) insulation, NEMA Service Factor, prelubricated sleeve bearings.
- G. Enclosed Motors: Class A (50 degrees C temperature rise) insulation, 1.0 Service Factor, prelubricated ball bearings.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install securely on firm foundation. Mount ball bearing motors with shaft in any position.
- C. Check line voltage and phase and ensure agreement with nameplate.

END OF SECTION

SECTION 22 0519
METERS AND GAGES FOR PLUMBING PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Positive displacement meters.
- B. Pressure gages and pressure gage taps.
- C. Thermometers and thermometer wells.

1.02 REFERENCE STANDARDS

- A. ASME B40.100 - Pressure Gauges and Gauge Attachments; 2013.
- B. ASTM E1 - Standard Specification for ASTM Liquid-in-Glass Thermometers; 2014.
- C. ASTM E77 - Standard Test Method for Inspection and Verification of Thermometers; 2014.
- D. AWWA C700 - Cold-Water Meters -- Displacement Type, Metal Alloy Main Case; 2015.
- E. AWWA M6 - Water Meters -- Selection, Installation, Testing, and Maintenance; 2012.
- F. UL 393 - Indicating Pressure Gauges for Fire-Protection Service; Current Edition, Including All Revisions.

1.03 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide list that indicates use, operating range, total range and location for manufactured components.
- C. Project Record Documents: Record actual locations of components and instrumentation.
- D. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 01 6000 - Product Requirements. for additional provisions.
 - 2. Extra Gage Oil for Inclined Manometers: One bottle.
 - 3. Extra Pressure Gages: One of each type and size.

1.04 FIELD CONDITIONS

- A. Do not install instrumentation when areas are under construction, except for required rough-in, taps, supports and test plugs.

PART 2 PRODUCTS

2.01 POSITIVE DISPLACEMENT METERS (LIQUID)

- A. Manufacturers:
 - 1. Dwyer Instruments, Inc: www.dwyer-inst.com.
 - 2. FMC Technologies: www.fmctechnologies.com.
 - 3. Venture Measurement, a Danaher Corporation Company: www.venturemeasurement.com.
 - 4. Substitutions: See Section 01 6000 - Product Requirements.
- B. AWWA C700, positive displacement disc type suitable for fluid with bronze case and cast iron frost-proof, breakaway bottom cap, hermetically sealed register, remote reading.
- C. Meter: Brass body turbine meter with magnetic drive register.
 - 1. Service: Cold water, 122 degrees F (50 degrees C).
 - 2. Service: Hot water, 200 degrees F (93 degrees C).
 - 3. Accuracy: 1-1/2 percent.
 - 4. Maximum Counter Reading: 10 million gallons (liters).
 - 5. Size: 1/2 inch (13 mm).

2.02 PRESSURE GAGES

- A. Manufacturers:
 - 1. Dwyer Instruments, Inc: www.dwyer-inst.com.

2. Moeller Instrument Company, Inc: www.moellerinstrument.com.
 3. Omega Engineering, Inc: www.omega.com.
 4. Substitutions: See Section 01 6000 - Product Requirements.
- B. Pressure Gages: ASME B40.100, UL 393 drawn steel case, phosphor bronze bourdon tube, rotary brass movement, brass socket, with front recalibration adjustment, black scale on white background.
1. Case: Steel with brass bourdon tube.
 2. Size: 4-1/2 inch (115 mm) diameter.
 3. Mid-Scale Accuracy: One percent.
 4. Scale: Psi and kPa.

2.03 STEM TYPE THERMOMETERS

- A. Manufacturers:
1. Dwyer Instruments, Inc: www.dwyer-inst.com.
 2. Omega Engineering, Inc: www.omega.com.
 3. Weksler Glass Thermometer Corp: www.wekslerglass.com.
 4. Substitutions: See Section 01 6000 - Product Requirements.
- B. Thermometers - Fixed Mounting: Red- or blue-appearing non-toxic liquid in glass; ASTM E1; lens front tube, cast aluminum case with enamel finish.
1. Size: 9 inch (225 mm) scale.
 2. Window: Clear Lexan.
 3. Accuracy: 2 percent, per ASTM E77.
 4. Calibration: Degrees F.
- C. Thermometers - Adjustable Angle: Red- or blue-appearing non-toxic liquid in glass; ASTM E1; lens front tube, cast aluminum case with enamel finish, cast aluminum adjustable joint with positive locking device; adjustable 360 degrees in horizontal plane, 180 degrees in vertical plane.
1. Size: 9 inch (225 mm) scale.
 2. Window: Clear Lexan.
 3. Accuracy: 2 percent, per ASTM E77.
 4. Calibration: Degrees F.

2.04 THERMOMETER SUPPORTS

- A. Socket: Brass separable sockets for thermometer stems with or without extensions as required, and with cap and chain.
- B. Flange: 3 inch (75 mm) outside diameter reversible flange, designed to fasten to sheet metal air ducts, with brass perforated stem.

2.05 TEST PLUGS

- A. Test Plug: 1/4 inch (6 mm) or 1/2 inch (13 mm) brass fitting and cap for receiving 1/8 inch (3 mm) outside diameter pressure or temperature probe with neoprene core for temperatures up to 200 degrees F (93 degrees C).
- B. Test Kit: Carrying case, internally padded and fitted containing one 2-1/2 inch (60 mm) diameter pressure gages, one gage adapters with 1/8 inch (3 mm) probes, two 1 inch (25 mm) dial thermometers.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install positive displacement meters with isolating valves on inlet and outlet to AWWA M6. Provide full line size valved bypass with globe valve for liquid service meters.
- C. Provide one pressure gage per pump, installing taps before strainers and on suction and discharge of pump. Pipe to gage.

- D. Install pressure gages with pulsation dampers. Provide gage cock to isolate each gage. Extend nipples and siphons to allow clearance from insulation. Provide siphon on gages in steam systems.
- E. Install thermometers in piping systems in sockets in short couplings. Enlarge pipes smaller than 2-1/2 inch (60 mm) for installation of thermometer sockets. Ensure sockets allow clearance from insulation.
- F. Install thermometer sockets adjacent to controls systems thermostat, transmitter, or sensor sockets. Refer to Section 23 0943. Where thermometers are provided on local panels, duct or pipe mounted thermometers are provided on local panels, duct or pipe mounted thermometers are not required.
- G. Locate duct mounted thermometers minimum 10 feet (3 m) downstream of mixing dampers, coils, or other devices causing air turbulence.
- H. Coil and conceal excess capillary on remote element instruments.
- I. Provide instruments with scale ranges selected according to service with largest appropriate scale.
- J. Install gages and thermometers in locations where they are easily read from normal operating level. Install vertical to 45 degrees off vertical.
- K. Adjust gages and thermometers to final angle, clean windows and lenses, and calibrate to zero.
- L. Locate test plugs adjacent thermometers and thermometer sockets.

3.02 SCHEDULES

- A. Positive Displacement Meters, Location:
 - 1. Domestic cold water.
- B. Pressure Gages, Location and Scale Range:
 - 1. Pumps, 0 to 100 psi (0 to 600 kPa).
 - 2. Backflow preventers, 0 to 100 psi (0 to 600 kPa).
- C. Stem Type Thermometers, Location and Scale Range:
 - 1. Domestic hot water supply and recirculation, 0 to 250 degrees F (0 to 150 Degrees C).

END OF SECTION

SECTION 22 0523
GENERAL-DUTY VALVES FOR PLUMBING PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Applications.
- B. General requirements.
- C. Angle valves.
- D. Ball valves.
- E. Butterfly valves.
- F. Check valves.
- G. Gate valves.
- H. Globe valves.
- I. Plug valves.
- J. Chainwheels.

1.02 RELATED REQUIREMENTS

- A. Section 22 0553 - Identification for Plumbing Piping and Equipment.
- B. Section 22 0719 - Plumbing Piping Insulation.
- C. Section 22 1005 - Plumbing Piping.

1.03 ABBREVIATIONS AND ACRONYMS

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

1.04 REFERENCE STANDARDS

- A. API STD 594 - Check Valves: Flanged, Lug Wafer, and Butt-Welding; 2007 (Errata 2010).
- B. ASME B1.20.1 - Pipe Threads, General Purpose (Inch); 2013.
- C. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250; 2010.
- D. ASME B16.5 - Pipe Flanges and Flanged Fittings NPS 1/2 Through NPS 24 Metric/Inch Standard; 2013.
- E. ASME B16.10 - Face-to-Face and End-to-End Dimensions of Valves; 2009.
- F. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings; 2012.
- G. ASME B16.34 - Valves-Flanged, Threaded, and Welding End; 2013.
- H. ASME B31.9 - Building Services Piping; 2014.
- I. ASME BPVC-IX - Boiler and Pressure Vessel Code, Section IX - Welding, Brazing, and Fusing Qualifications; 2015.
- J. ASTM A48/A48M - Standard Specification for Gray Iron Castings; 2003 (Reapproved 2012).

- K. ASTM A126 - Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings; 2004 (Reapproved 2014).
- L. ASTM A395/A395M - Standard Specification for Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures; 1999 (Reapproved 2014).
- M. ASTM A536 - Standard Specification for Ductile Iron Castings; 1984 (Reapproved 2014).
- N. ASTM B62 - Standard Specification for Composition Bronze or Ounce Metal Castings; 2015.
- O. AWWA C606 - Grooved and Shouldered Joints; 2015.
- P. MSS SP-45 - Bypass and Drain Connections; 2003 (Reaffirmed 2008).
- Q. MSS SP-67 - Butterfly Valves; 2011.
- R. MSS SP-70 - Cast Iron Gate Valves, Flanged and Threaded Ends; 2011.
- S. MSS SP-71 - Cast Iron Swing Check Valves, Flanged and Threaded Ends; 2011.
- T. MSS SP-72 - Ball Valves with Flanged or Butt-Welding Ends for General Service; 2010.
- U. MSS SP-78 - Cast Iron Plug Valves, Flanged and Threaded Ends; 2011.
- V. MSS SP-80 - Bronze Gate, Globe, Angle and Check Valves; 2013.
- W. MSS SP-85 - Cast Iron Globe & Angle Valves, Flanged and Threaded Ends; 2011.
- X. MSS SP-110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends; 2010.
- Y. MSS SP-125 - Gray Iron and Ductile Iron In-Line, Spring-Loaded, Center-Guided Check Valves; 2010.
- Z. NSF 61 - Drinking Water System Components - Health Effects; 2014 (Errata 2015).
- AA. NSF 372 - Drinking Water System Components - Lead Content; 2011.

1.05 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on valves including manufacturers catalog information. Submit performance ratings, rough-in details, weights, support requirements, and piping connections.
- C. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, maintenance and repair data, and parts listings.
- D. Maintenance Materials: Furnish Owner with one wrench for every five plug valves, in each size of square plug valve head.
 - 1. See Section 01 6000 - Product Requirements, for additional provisions.

1.06 QUALITY ASSURANCE

- A. Manufacturer:
 - 1. Obtain valves for each valve type from single manufacturer.
 - 2. Company must specialize in manufacturing products specified in this section, with not less than three years of documented experience.
- B. Welding Materials and Procedures: Conform to ASME (BPVC-IX).

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves for shipping as follows:
 - 1. Minimize exposure of operable surfaces by setting plug and ball valves to open position.
 - 2. Protect valve parts exposed to piped medium against rust and corrosion.
 - 3. Protect valve piping connections such as grooves, weld ends, threads, and flange faces.
 - 4. Adjust globe, gate, and angle valves to the closed position to avoid clattering.
 - 5. Secure check valves in either the closed position or open position.
 - 6. Adjust butterfly valves to closed or partially closed position.
- B. Use the following precautions during storage:
 - 1. Maintain valve end protection and protect flanges and specialties from dirt.

- a. Provide temporary inlet and outlet caps.
- b. Maintain caps in place until installation.
- 2. Store valves in shipping containers and maintain in place until installation.
 - a. Store valves indoors in dry environment.
 - b. Store valves off the ground in watertight enclosures when indoor storage is not an option.

PART 2 PRODUCTS

2.01 APPLICATIONS

- A. Provide the following valves for the applications if not indicated on Drawings:
 - 1. Shutoff: Ball, butterfly, gate or plug.
 - 2. Dead-End: Single-flange butterfly (lug) type.
 - 3. Throttling: Provide globe, angle, ball, or butterfly.
 - 4. Balancing: Ball or globe, brass or bronze, with two readout ports and memory setting indicator.
 - 5. Swing Check (Pump Outlet):
 - a. 2 NPS (50 DN) and Smaller: Bronze swing check valves with bronze or nonmetallic disc.
 - b. 2-1/2 NPS (65 DN) and Larger for Domestic Water: Iron swing check valves with closure control, metal or resilient seat check valves.
 - c. 2-1/2 NPS (65 DN) and Larger for Sanitary Waste and Storm Drainage: Iron swing check valves with lever and weight or spring.
- B. Substitutions of valves with higher CWP classes or SWP ratings for same valve types are permitted when specified CWP ratings or SWP classes are not available.
- C. Required Valve End Connections for Non-Wafer Types:
 - 1. Steel Pipe:
 - a. 2 NPS (50 DN) and Smaller: Threaded ends.
 - b. 2-1/2 NPS (65 DN) to 4 NPS (100 DN): Grooved or flanged ends except where threaded valve-end option is indicated in valve schedules below.
 - c. 5 NPS (125 DN) and Larger: Grooved or flanged ends.
 - d. Grooved-End Copper Tubing and Steel Piping: Grooved.
 - 2. Copper Tube:
 - a. 2 NPS (50 DN) and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.
 - b. 2-1/2 NPS (65 DN) to 4 NPS (100 DN): Grooved or flanged ends except where threaded valve-end option is indicated in valve schedules below.
 - c. 5 NPS (125 DN) and Larger: Grooved or flanged ends.
- D. Domestic, Hot and Cold Water Valves:
 - 1. 2 NPS (50 DN) and Smaller:
 - a. Bronze and Brass: Provide with solder-joint or threaded ends.
 - b. Bronze Angle: Class 125, bronze disc.
 - c. Ball: One piece, full port, brass or bronze with brass trim.
 - d. Bronze Swing Check: Class 125, bronze disc.
 - e. Bronze Gate: Class 125, NRS.
 - f. Bronze Globe: Class 125, bronze disc.
 - 2. 2-1/2 NPS (65 DN) and Larger:
 - a. Iron, 2-1/2 NPS (65 DN) to 4 NPS (100 DN): Provide with threaded or flanged ends.
 - b. Iron Ball: Class 150.
 - c. Iron Single-Flange Butterfly: 200 CWP, EPDM seat, aluminum-bronze disc.
 - d. Iron Grooved-End Butterfly: 175 CWP.
 - e. Iron Swing Check: Class 125, metal seats.
 - f. Iron Swing Check with Closure Control: Class 125, lever and spring.
 - g. Iron Grooved-End Swing Check: 300 CWP.

- h. Iron Center-Guided Check: Class 125, compact-wafer, metal seat.
 - i. Iron Plate-Type Check: Class 125; single plate; metal seat.
 - j. Iron Gate: Class 125, NRS.
 - k. Iron Globe: Class 125.
- E. Sanitary Waste and Storm Drainage Water Valves:
- 1. 2 NPS (50 DN) and Smaller:
 - a. Bronze and Brass: Provide with solder-joint or threaded.
 - b. Bronze Angle: Class 125, bronze disc.
 - c. Ball: One piece, full port, brass or bronze with brass trim.
 - d. Bronze Swing Check: Class 125, bronze disc.
 - e. Bronze Gate: Class 125, NRS.
 - f. Bronze Globe: Class 125, bronze disc.
 - 2. 2-1/2 NPS (65 DN) and Larger:
 - a. Iron, 2-1/2 NPS (65 DN) to 4 NPS (100 DN): Provide with threaded or flanged ends.
 - b. Iron Ball: Class 150.
 - c. Iron Swing Check: Class 125, metal seats.
 - d. Iron Swing Check with Closure Control: Class 125, lever and spring.
 - e. Iron Grooved-End Swing Check: 300 CWP.
 - f. Iron Gate: Class 125, NRS.
 - g. Iron Globe: Class 125.
 - h. Lubricated Plug: Class 125, regular gland.

2.02 GENERAL REQUIREMENTS

- A. Valve Pressure and Temperature Ratings: No less than rating indicated; as required for system pressures and temperatures.
- B. Valve Sizes: Match upstream piping unless otherwise indicated.
- C. Valve Actuator Types:
 - 1. Gear Actuator: Quarter-turn valves 8 NPS (200 DN) and larger.
 - 2. Handwheel: Valves other than quarter-turn types.
 - 3. Hand Lever: Quarter-turn valves 6 NPS (150 DN) and smaller except plug valves.
 - 4. Wrench: Plug valves with square heads.
 - 5. Chainwheel: Device for attachment to valve handwheel, stem, or other actuator, of size and with chain for mounting height, as indicated in the "Valve Installation" Article.
- D. Valves in Insulated Piping: With 2 NPS (50 DN) stem extensions and the following features:
 - 1. Gate Valves: Rising stem.
 - 2. Ball Valves: Extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
 - 3. Butterfly Valves: Extended neck.
 - 4. Memory Stops: Fully adjustable after insulation is installed.
- E. Valve-End Connections:
 - 1. Threaded End Valves: ASME B1.20.1.
 - 2. Flanges on Iron Valves: ASME B16.1 for flanges on iron valves.
 - 3. Pipe Flanges and Flanged Fittings 1/2 NPS (15 DN) through 24 NPS (600 DN): ASME B16.5.
 - 4. Solder Joint Connections: ASME B16.18.
 - 5. Grooved End Connections: AWWA C606.
- F. General ASME Compliance:
 - 1. Ferrous Valve Dimensions and Design Criteria: ASME B16.10 and ASME B16.34.
 - 2. Solder-joint Connections: ASME B16.18.
 - 3. Building Services Piping Valves: ASME B31.9.
- G. Valve Materials for Potable Water: NSF 61 and NSF 372.

- H. Bronze Valves:
 - 1. Fabricate from dezincification resistant material.
 - 2. Copper alloys containing more than 15 percent zinc are not permitted.
- I. Valve Bypass and Drain Connections: MSS SP-45.
- J. Source Limitations: Obtain each valve type from a single manufacturer.

2.03 BRONZE ANGLE VALVES

- A. Class 125: CWP Rating: 200 psig (1380 kPa), and Class 150: CWP Rating: 300 psig (2070 kPa).
 - 1. Comply with MSS SP-80, Type 1.
 - 2. Body: Bronze; ASTM B62, with integral seat and screw in bonnet.
 - 3. Ends: Threaded.
 - 4. Stem: Bronze.
 - 5. Disc: Bronze.
 - 6. Packing: Asbestos free.
 - 7. Handwheel: Bronze or aluminum.

2.04 BRASS BALL VALVES

- A. Two Piece, Full Port and Regular Port with Brass Trim:
 - 1. Comply with MSS SP-110.
 - 2. SWP Rating: 150 psig (1035 kPa).
 - 3. CWP Rating: 600 psig (4140 kPa).
 - 4. Body: Forged brass.
 - 5. Ends: Threaded.
 - 6. Seats: PTFE.
 - 7. Stem: Brass.
 - 8. Ball: Chrome-plated brass.
- B. Three Piece, Full Port with Stainless Steel Trim:
 - 1. Comply with MSS SP-110.
 - 2. SWP Rating: 150 psig (1035 kPa).
 - 3. CWP Rating: 600 psig (4140 kPa).
 - 4. Body: Forged brass.
 - 5. Ends: Threaded.
 - 6. Seats: PTFE or TFE.
 - 7. Stem: Stainless steel.
 - 8. Ball: Stainless steel, vented.

2.05 BRONZE BALL VALVES

- A. Two Piece, Regular Port and Full Port with Bronze Trim:
 - 1. Comply with MSS SP-110.
 - 2. SWP Rating: 150 psig (1035 kPa).
 - 3. CWP Rating: 600 psig (4140 kPa).
 - 4. Body: Bronze.
 - 5. Ends: Threaded.
 - 6. Seats: PTFE or TFE.
 - 7. Stem: Bronze.
 - 8. Ball: Chrome plated brass.
- B. Three Piece, Full Port with Stainless Steel Trim:
 - 1. Comply with MSS SP-110.
 - 2. SWP Rating: 150 psig (1035 kPa).
 - 3. CWP Rating: 600 psig (4140 kPa).
 - 4. Body: Bronze.
 - 5. Ends: Threaded.
 - 6. Seats: PTFE or TFE

7. Stem: Stainless steel.
8. Ball: Stainless steel, vented.

2.06 STAINLESS STEEL BALL VALVES

- A. One-Piece, Regular Port with Stainless-Steel Trim:
 1. Comply with MSS SP-110.
 2. SWP Rating: 150 psig (1035 kPa).
 3. CWP Rating: 800 psig (5515 kPa).
 4. Body: Stainless steel.
 5. Ends: Threaded.
 6. Seats: PTFE.
 7. Stem: Stainless steel.
 8. Ball: Stainless steel.
- B. Two Piece, Large Port with Stainless Steel Trim:
 1. Comply with MSS SP-110.
 2. SWP Rating: 150 psig (1035 kPa).
 3. CWP Rating: 1000 psig (6895 kPa).
 4. Body: Stainless steel.
 5. Seats: PFTE.
 6. Stem: Stainless steel.
 7. Ball: Stainless steel.
- C. Three Piece, Full Port with Stainless Steel Trim:
 1. Comply with MSS SP-110.
 2. SWP Rating: 150 psig (1035 kPa).
 3. CWP Rating: 1000 psig (6895 kPa).
 4. Body: Stainless steel.
 5. Seats: PFTE.
 6. Stem: Stainless steel.
 7. Ball: Stainless steel.
 8. Bolts: Stainless steel.

2.07 IRON BALL VALVES

- A. Class 125, Full Port, Stainless Steel Trim:
 1. Comply with MSS SP-72.
 2. CWP Rating: 200 psig (1380 kPa).
 3. Body: ASTM A536, Grade 65-45-12, ductile iron.
 4. Ends: Flanged.
 5. Seats: PTFE, TFE, or Teflon.
 6. Stem: Stainless steel.
 7. Ball: Stainless steel.
 8. Operator: Lever, with locking handle.

2.08 IRON, SINGLE FLANGE BUTTERFLY VALVES

- A. Lug type: Bi-directional dead-end service without use of downstream flange.
 1. Comply with MSS SP-67, Type I.
 2. CWP Rating: 200 psig (1380 kPa).
 3. Body: ASTM A126, cast iron or ASTM A536, ductile iron.
 4. Stem: One or two-piece stainless steel.
 5. Seat: EPDM.
 6. Disc: Coated ductile iron.

2.09 IRON, GROOVED-END BUTTERFLY VALVES

- A. CWP Rating: 175 psig (1200 kPa).
 1. Comply with MSS SP-67, Type I.
 2. Body: Coated ductile iron.

3. Stem: Two-piece stainless steel.
4. Disc: Coated ductile iron.
5. Disc Seal: EPDM.

2.10 BRONZE SWING CHECK VALVES

- A. Class 125: CWP Rating: 200 psig (1380 kPa) and Class 150: CWP Rating: 300 psig (2070 kPa).
 1. Comply with MSS SP-80, Type 3.
 2. Design: Horizontal flow.
 3. Body: Bronze, ASTM B62.
 4. Ends: Threaded as indicated.
 5. Disc: Bronze.

2.11 IRON SWING CHECK VALVES

- A. Class 125:
 1. Comply with MSS SP-71, Type I.
 2. CWP Rating: 200 psig (1380 kPa).
 3. Design: Clear or full waterway.
 4. Body: ASTM A126, gray iron with bolted bonnet.
 5. Ends: Flanged as indicated.
 6. Trim: Composition.
 7. Seat Ring and Disc Holder: Bronze.
 8. Disc: PTFE or TFE.
 9. Gasket: Asbestos free.
- B. Class 250:
 1. Comply with MSS SP-71, Type I.
 2. CWP Rating: 500 psig (3450 kPa).
 3. Design: Clear or full waterway.
 4. Body: ASTM A126, gray iron with bolted bonnet.
 5. Ends: Flanged as indicated.
 6. Trim: Bronze.
 7. Metal Seat.
 8. Gasket: Asbestos free.

2.12 IRON SWING CHECK VALVES WITH CLOSURE CONTROL

- A. Class 125 with Lever and Spring-Closure Control.
 1. Comply with MSS SP-71, Type I.
 2. Description:
 - a. CWP Rating: 200 psig (1380 kPa).
 - b. Design: Clear or full waterway.
 - c. Body: ASTM A126, gray iron with bolted bonnet.
 - d. Ends: Flanged as indicated.
 - e. Trim: Bronze.
 - f. Gasket: Asbestos free.
 - g. Closer Control: Factory installed, exterior lever, and weight.

2.13 IRON GROOVED-END SWING CHECK VALVES

- A. 300 CWP:
 1. CWP Rating: 300 psig (2070 kPa).
 2. Body: ASTM A536, Grade 65-45-12 ductile iron.
 3. Seal: EPDM or Nitrile.
 4. Disc: Ductile iron.
 5. Coating: Black, non-lead paint.

2.14 IRON CENTER-GUIDED CHECK VALVES

- A. Class 125, Compact-Wafer:
 - 1. Comply with MSS SP-125.
 - 2. CWP Rating: 200 psig (1380 kPa).
 - 3. Body: ASTM A126, gray iron.
 - 4. Metal Seat: Bronze.
- B. Class 125, Globe:
 - 1. Comply with MSS SP-125.
 - 2. CWP Rating: 200 psig (1380 kPa).
 - 3. Body: ASTM A126, gray iron.
 - 4. Style: Spring loaded.
 - 5. Ends: Flanged.
 - 6. Metal Seat: Bronze.
- C. Class 150, Compact-Wafer:
 - 1. Comply with MSS SP-125.
 - 2. CWP Rating: 300 psig (2070 kPa).
 - 3. Body: ASTM A395/A395M or ASTM A536, ductile iron.
 - 4. Metal Seat: Bronze.
- D. Class 150, Globe:
 - 1. Comply with MSS SP-125.
 - 2. CWP Rating: 300 psig (2070 kPa).
 - 3. Body: ASTM A395/A395M or ASTM A536, ductile iron.
 - 4. Style: Spring loaded.
 - 5. Ends: Flanged.
 - 6. Metal Seat: Bronze.
- E. Class 250, Compact-Wafer:
 - 1. Comply with MSS SP-125.
 - 2. CWP Rating: 400 psig (2760 kPa).
 - 3. Body: ASTM A126, gray iron.
 - 4. Style: Spring loaded.
 - 5. Metal Seat: Bronze.
- F. Class 250, Globe:
 - 1. Comply with MSS SP-125.
 - 2. 2-1/2 NPS (65 DN) to 12 NPS (300 DN), CWP Rating: 400 psig (2760 kPa).
 - 3. Body Material: ASTM A126, gray iron.
 - 4. Style: Spring loaded.
 - 5. Ends: Flanged.
 - 6. Metal Seat: Bronze.
- G. Class 300, Compact-Wafer:
 - 1. Comply with MSS SP-125.
 - 2. CWP Rating: 500 psig (3450 kPa).
 - 3. Body: ASTM A395/A395M or ASTM A536, ductile iron.
 - 4. Style: Spring loaded.
 - 5. Metal Seat: Bronze.
- H. Class 300, Globe:
 - 1. Comply with MSS SP-125.
 - 2. CWP Rating: 500 psig (3450 kPa).
 - 3. Body: ASTM A395/A395M or ASTM A536, ductile iron.
 - 4. Style: Spring loaded.
 - 5. Ends: Flanged.
 - 6. Metal Seat: Bronze.

2.15 IRON PLATE TYPE CHECK VALVES

- A. Class 125 Single-Plate:
 - 1. Comply with API 594.
 - 2. CWP Rating: 200 psig (1380 kPa).
 - 3. Design: Wafer, spring-loaded plate.
 - 4. Body: ASTM A126, gray iron.
 - 5. Resilient Seat: EPDM or NBR.
- B. Class 125, Dual-Plate:
 - 1. Comply with API 594.
 - 2. CWP Rating: 200 psig (1380 kPa).
 - 3. Design: Wafer, spring-loaded plates.
 - 4. Body: ASTM A126, gray iron.
 - 5. Resilient Seat: EPDM or NBR.
- C. Class 150, Dual-Plate:
 - 1. Comply with API 594.
 - 2. CWP Rating: 300 psig (2070 kPa).
 - 3. Design: Wafer, spring-loaded plates.
 - 4. Body: ASTM A395/A395M or ASTM A536, ductile iron.
 - 5. Resilient Seat: EPDM or NBR.
- D. Class 250, Single-Plate:
 - 1. Comply with API 594.
 - 2. CWP Rating: 400 psig (2760 kPa).
 - 3. Design: Wafer, spring-loaded plate.
 - 4. Body: ASTM A126, gray iron.
 - 5. Resilient Seat: EPDM or NBR.
- E. Class 250, Dual-Plate:
 - 1. Comply with API 594.
 - 2. CWP Rating: 400 psig (2760 kPa).
 - 3. Design: Wafer, spring-loaded plates.
 - 4. Body: ASTM A126, gray iron.
 - 5. Resilient Seat: EPDM or NBR.
- F. Class 300, Dual-Plate:
 - 1. Comply with API 594.
 - 2. CWP Rating: 500 psig (3450 kPa).
 - 3. Design: Wafer, spring-loaded plates.
 - 4. Body: ASTM A395/A395M or ASTM A536, ductile iron.
 - 5. Metal Seat: Bronze.

2.16 BRONZE GATE VALVES

- A. Non-Rising Stem (NRS) or Rising Stem (RS):
 - 1. Comply with MSS SP-80, Type I.
 - 2. Class 125: CWP Rating: 200 psig (1380 kPa), and Class 150: CWP Rating: 300 psig (2070 kPa).
 - 3. Body: ASTM B62, bronze with integral seat and screw-in bonnet.
 - 4. Ends: Threaded or solder joint joint.
 - 5. Stem: Bronze.
 - 6. Disc: Solid wedge; bronze.
 - 7. Packing: Asbestos free.
 - 8. Handwheel: Malleable iron, bronze, or aluminum.

2.17 IRON GATE VALVES

- A. NRS or OS & Y:
 - 1. Comply with MSS SP-70, Type I.

2. Class 125: CWP Rating: 200 psig: (1380 kPa), and Class 250: CWP Rating: 500 psig: (3450 kPa).
3. Body: ASTM A126, gray iron with bolted bonnet.
4. Ends: Flanged.
5. Trim: Bronze.
6. Disc: Solid wedge.
7. Packing and Gasket: Asbestos free.

2.18 BRONZE GLOBE VALVES

- A. Class 125: CWP Rating: 200 psig: (1380 kPa), and Class 150: CWP Rating: 300 psig: (2070 kPa).
 1. Comply with MSS SP-80, Type 1.
 2. Body: ASTM B62, bronze with integral seat and screw-in bonnet.
 3. Ends: Threaded joint.
 4. Stem: Bronze.
 5. Disc: Bronze, PTFE, or TFE.
 6. Packing: Asbestos free.
 7. Handwheel: Malleable Iron.

2.19 IRON GLOBE VALVES

- A. Class 125: CWP Rating: 200 psig: (1380 kPa).
 1. Comply with MSS SP-85, Type I.
 2. Body: Gray iron; ASTM A126, with bolted bonnet.
 3. Ends: Flanged.
 4. Trim: Bronze.
 5. Packing and Gasket: Asbestos free.
 6. Operator: Handwheel or chainwheel.

2.20 LUBRICATED PLUG VALVES

- A. Regular Gland and Cylindrical with Flanged Ends:
 1. Comply with MSS SP-78, Type II.
 2. Class 125: CWP Rating: 200 psig (1380 kPa).
 3. Class 250: CWP Rating: 400 psig (2760 kPa).
 4. Body: ASTM A48/A48M or ASTM A126, cast iron with lubrication sealing system.
 5. Pattern: Regular or short.
 6. Plug: Cast iron or bronze with sealant groove.

2.21 CHAINWHEELS

- A. Description: Valve actuation assembly with sprocket rim, brackets, and chain.
 1. Brackets: Type, number, size, and fasteners required to mount actuator on valve.
 2. Attachment: For connection to ball, butterfly, and plug valve stems.
 3. Sprocket Rim with Chain Guides: Ductile iron. Include zinc coating.
 4. Chain: Hot-dip galvanized steel. Sized to fit sprocket rim.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Discard all packing materials and verify that valve interior, including threads and flanges are completely clean without signs of damage or degradation that could result in leakage.
- B. Verify valve parts to be fully operational in all positions from closed to fully open.
- C. Confirm gasket material to be suitable for the service, to be of correct size, and without defects that could compromise effectiveness.
- D. Should valve is determined to be defective, replace with new valve.

3.02 INSTALLATION

- A. Provide unions or flanges with valves to facilitate equipment removal and maintenance while maintaining system operation and full accessibility for servicing.
- B. Provide separate valve support as required and locate valve with stem at or above center of piping, maintaining unimpeded stem movement.
- C. Where valve support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welds.
- D. Install check valves where necessary to maintain direction of flow as follows:
 - 1. Lift Check: Install with stem plumb and vertical.
 - 2. Swing Check: Install horizontal maintaining hinge pin level.
 - 3. Orient plate-type and center-guided into horizontal or vertical position, between flanges.
- E. Provide chainwheels on operators for valves 4 NPS (100 DN) and larger where located 96 NPS (2400 DN) or more above finished floor, terminating 60 NPS (1520 DN) above finished floor.

END OF SECTION

SECTION 22 0553

IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Nameplates.
- B. Tags.
- C. Pipe markers.
- D. Ceiling tacks.

1.02 RELATED REQUIREMENTS

- A. Section 09 9123 - Interior Painting: Identification painting.
- B. Section 22 6005 - Medical Air, Gas, and Vacuum Systems: Supply of pipe labels for placement under this section.

1.03 REFERENCE STANDARDS

- A. ASME A13.1 - Scheme for the Identification of Piping Systems; 2015.

1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. List: Submit list of wording, symbols, letter size, and color coding for mechanical identification.
- C. Chart and Schedule: Submit valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.
- D. Product Data: Provide manufacturers catalog literature for each product required.
- E. Manufacturer's Installation Instructions: Indicate special procedures, and installation.
- F. Project Record Documents: Record actual locations of tagged valves.

PART 2 PRODUCTS

2.01 IDENTIFICATION APPLICATIONS

- A. Control Panels: Nameplates.
- B. Major Control Components: Nameplates.
- C. Piping: Pipe markers.
- D. Pumps: Nameplates.
- E. Small-sized Equipment: Tags.
- F. Tanks: Nameplates.
- G. Valves: Tags and ceiling tacks where located above lay-in ceiling.
- H. Water Heaters: Nameplates.

2.02 NAMEPLATES

- A. Manufacturers:
 - 1. Brimar Industries, Inc.: www.pipemarker.com.
 - 2. Kolbi Pipe Marker Co.: www.kolbipipemarkers.com.
 - 3. Seton Identification Products: www.seton.com.
 - 4. Substitutions: See Section 01 6000 - Product Requirements.
- B. Description: Laminated three-layer plastic with engraved letters.
 - 1. Letter Color: White.
 - 2. Letter Height: 1/4 inch (6 mm).
 - 3. Background Color: Black.
 - 4. Plastic: Conform to ASTM D709.

2.03 TAGS

- A. Manufacturers:
 - 1. Advanced Graphic Engraving: www.advancedgraphicengraving.com.
 - 2. Brady Corporation: www.bradycorp.com.
 - 3. Brimar Industries, Inc.: www.pipemarker.com.
 - 4. Kolbi Pipe Marker Co.: www.kolbipipemarkers.com.
 - 5. Seton Identification Products: www.seton.com.
 - 6. Substitutions: See Section 01 6000 - Product Requirements.
- B. Plastic Tags: Laminated three-layer plastic with engraved black letters on light contrasting background color. Tag size minimum 1-1/2 inch (40 mm) diameter.
- C. Metal Tags: Brass with stamped letters; tag size minimum 1-1/2 inch (40 mm) diameter with smooth edges.
- D. Valve Tag Chart: Typewritten letter size list in anodized aluminum frame.

2.04 PIPE MARKERS

- A. Manufacturers:
 - 1. Brady Corporation: www.bradycorp.com.
 - 2. Brimar Industries, Inc.: www.pipemarker.com.
 - 3. Kolbi Pipe Marker Co.: www.kolbipipemarkers.com.
 - 4. MIFAB, Inc.: www.mifab.com.
 - 5. Seton Identification Products: www.seton.com.
- B. Comply with ASME A13.1.
- C. Plastic Pipe Markers: Factory fabricated, flexible, semi- rigid plastic, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and identification of fluid being conveyed.
- D. Plastic Tape Pipe Markers: Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings.
- E. Underground Plastic Pipe Markers: Bright colored continuously printed plastic ribbon tape, minimum 6 inches (150 mm) wide by 4 mil (0.10 mm) thick, manufactured for direct burial service.

2.05 CEILING TACKS

- A. Manufacturers:
 - 1. Craftmark: www.craftmarkid.com.
 - 2. Substitutions: See Section 01 6000 - Product Requirements.
- B. Description: Steel with 3/4 inch (20 mm) diameter color coded head.

PART 3 EXECUTION

3.01 PREPARATION

- A. Degrease and clean surfaces to receive adhesive for identification materials.
- B. Prepare surfaces in accordance with Section 09 9123 for stencil painting.

3.02 INSTALLATION

- A. Install plastic nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer.
- B. Install tags with corrosion resistant chain.
- C. Install plastic pipe markers in accordance with manufacturer's instructions.
- D. Install plastic tape pipe markers complete around pipe in accordance with manufacturer's instructions.
- E. Install underground plastic pipe markers 6 to 8 inches (150 to 200 mm) below finished grade, directly above buried pipe.

- F. Use tags on piping 3/4 inch (20 mm) diameter and smaller.
 - 1. Identify service, flow direction, and pressure.
 - 2. Install in clear view and align with axis of piping.
 - 3. Locate identification not to exceed 20 feet (6 m) on straight runs including risers and drops, adjacent to each valve and Tee, at each side of penetration of structure or enclosure, and at each obstruction.
- G. Locate ceiling tacks to locate valves above lay-in panel ceilings. Locate in corner of panel closest to equipment.

END OF SECTION

**SECTION 22 0719
PLUMBING PIPING INSULATION**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Piping insulation.
- B. Jackets and accessories.

1.02 RELATED REQUIREMENTS

- A. Section 07 8400 - Firestopping.
- B. Section 22 1005 - Plumbing Piping: Placement of hangers and hanger inserts.

1.03 REFERENCE STANDARDS

- A. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2014.
- B. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric); 2014.
- C. ASTM C177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus; 2013.
- D. ASTM C534/C534M - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form; 2016.
- E. ASTM C547 - Standard Specification for Mineral Fiber Pipe Insulation; 2015.
- F. ASTM C795 - Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel; 2008 (Reapproved 2013).
- G. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2016.
- H. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials; 2016.
- I. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.
- C. Manufacturer's Instructions: Indicate installation procedures that ensure acceptable workmanship and installation standards will be achieved.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with not less than three years of documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Accept materials on site, labeled with manufacturer's identification, product density, and thickness.

1.07 FIELD CONDITIONS

- A. Maintain ambient conditions required by manufacturers of each product.
- B. Maintain temperature before, during, and after installation for minimum of 24 hours.

PART 2 PRODUCTS

2.01 REGULATORY REQUIREMENTS

- A. Surface Burning Characteristics: Flame spread index/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84 or UL 723.

2.02 GLASS FIBER

- A. Manufacturers:
 - 1. CertainTeed Corporation: www.certainteed.com.
 - 2. Johns Manville Corporation: www.jm.com.
 - 3. Knauf Insulation: www.knaufusa.com.
 - 4. Owens Corning Corporation; Fiberglas Pipe Insulation ASJ: www.ocbuildingspec.com/sle.
 - 5. Owens Corning Corporation; VaporWick Pipe Insulation: www.ocbuildingspec.com/sle.
 - 6. Substitutions: See Section 01 6000 - Product Requirements.
- B. Insulation: ASTM C547 and ASTM C795; rigid molded, noncombustible.
 - 1. 'K' ('Ksi') Value: ASTM C177, 0.24 at 75 degrees F (0.035 at 24 degrees C).
 - 2. Maximum Service Temperature: 850 degrees F (454 degrees C).
 - 3. Maximum Moisture Absorption: 0.2 percent by volume.
- C. Vapor Barrier Jacket: White Kraft paper with glass fiber yarn, bonded to aluminized film; moisture vapor transmission when tested in accordance with ASTM E96/E96M of 0.02 perm-inches (0.029 ng/Pa s m).
- D. Tie Wire: 0.048 inch (1.22 mm) stainless steel with twisted ends on maximum 12 inch (300 mm) centers.
- E. Vapor Barrier Lap Adhesive: Compatible with insulation.

2.03 FLEXIBLE ELASTOMERIC CELLULAR INSULATION

- A. Manufacturer:
 - 1. Aeroflex USA, Inc: www.aeroflexusa.com.
 - 2. Armacell LLC: www.armacell.us.
 - 3. K-Flex USA LLC: www.kflexusa.com.
 - 4. Substitutions: See Section 01 6000 - Product Requirements.
- B. Insulation: Preformed flexible elastomeric cellular rubber insulation complying with ASTM C534/C534M Grade 3; use molded tubular material wherever possible.
 - 1. Minimum Service Temperature: Minus 40 degrees F (Minus 40 degrees C).
 - 2. Maximum Service Temperature: 220 degrees F (104 degrees C).
 - 3. Connection: Waterproof vapor barrier adhesive.
- C. Elastomeric Foam Adhesive: Air dried, contact adhesive, compatible with insulation.

2.04 JACKETS

- A. PVC Plastic.
 - 1. Manufacturers:
 - a. Johns Manville Corporation: www.jm.com.
 - b. Techlite Insulation Systems: www.techlite.net.
 - c. Substitutions: See Section 01 6000 - Product Requirements.
 - 2. Jacket: One piece molded type fitting covers and sheet material, off-white color.
 - a. Minimum Service Temperature: 0 degrees F (Minus 18 degrees C).
 - b. Maximum Service Temperature: 150 degrees F (66 degrees C).
 - c. Moisture Vapor Permeability: 0.002 perm inch (0.0029 ng/Pa s m), maximum, when tested in accordance with ASTM E96/E96M.
 - d. Thickness: 10 mil (0.25 mm).
 - e. Connections: Brush on welding adhesive.
 - 3. Covering Adhesive Mastic: Compatible with insulation.
- B. Aluminum Jacket: ASTM B209 (ASTM B209M) formed aluminum sheet.
 - 1. Thickness: 0.016 inch (0.40 mm) sheet.
 - 2. Finish: Smooth.
 - 3. Joining: Longitudinal slip joints and 2 inch (50 mm) laps.
 - 4. Fittings: 0.016 inch (0.4 mm) thick die shaped fitting covers with factory attached protective liner.

5. Metal Jacket Bands: 3/8 inch (10 mm) wide; 0.015 inch (0.38 mm) thick aluminum.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that piping has been tested before applying insulation materials.
- B. Verify that surfaces are clean and dry, with foreign material removed.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install in accordance with North American Insulation Manufacturers Association (NAIMA) National Insulation Standards.
- C. Exposed Piping: Locate insulation and cover seams in least visible locations.
- D. Insulated pipes conveying fluids below ambient temperature: Insulate entire system including fittings, valves, unions, flanges, strainers, flexible connections, pump bodies, and expansion joints.
- E. Install cellular melamine with factory-applied jackets with a manufacturer-approved adhesive along seams, both straight lap joints and circumferential lap joints.
 1. Install seal over seams with factory-approved room temperature vulcanization (RTV) silicone sealant to ensure a positive vapor barrier seal in outdoor and sanitary washdown environments.
- F. Glass fiber insulated pipes conveying fluids below ambient temperature:
 1. Provide vapor barrier jackets, factory-applied or field-applied. Secure with self-sealing longitudinal laps and butt strips with pressure sensitive adhesive. Secure with outward clinch expanding staples and vapor barrier mastic.
 2. Insulate fittings, joints, and valves with molded insulation of like material and thickness as adjacent pipe. Finish with glass cloth and vapor barrier adhesive or PVC fitting covers.
- G. For hot piping conveying fluids 140 degrees F (60 degrees C) or less, do not insulate flanges and unions at equipment, but bevel and seal ends of insulation.
- H. For hot piping conveying fluids over 140 degrees F (60 degrees C), insulate flanges and unions at equipment.
- I. Glass fiber insulated pipes conveying fluids above ambient temperature:
 1. Provide standard jackets, with or without vapor barrier, factory-applied or field-applied. Secure with self-sealing longitudinal laps and butt strips with pressure sensitive adhesive. Secure with outward clinch expanding staples.
 2. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe. Finish with glass cloth and adhesive or PVC fitting covers.
- J. Inserts and Shields:
 1. Application: Piping 1-1/2 inches (40 mm) diameter or larger.
 2. Shields: Galvanized steel between pipe hangers or pipe hanger rolls and inserts.
 3. Insert Location: Between support shield and piping and under the finish jacket.
 4. Insert Configuration: Minimum 6 inches (150 mm) long, of same thickness and contour as adjoining insulation; may be factory fabricated.
 5. Insert Material: Hydrous calcium silicate insulation or other heavy density insulating material suitable for the planned temperature range.
- K. Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations. Finish at supports, protrusions, and interruptions. At fire separations, refer to Section 07 8400.
- L. Pipe Exposed in Mechanical Equipment Rooms or Finished Spaces (less than 10 feet (3 meters) above finished floor): Finish with PVC jacket and fitting covers.
- M. Exterior Applications: Provide vapor barrier jacket. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe, and finish with glass mesh reinforced

vapor barrier cement. Cover with aluminum jacket with seams located on bottom side of horizontal piping.

- N. Buried Piping: Provide factory fabricated assembly with inner all-purpose service jacket with self-sealing lap, and asphalt impregnated open mesh glass fabric, with one mil (0.025 mm) thick aluminum foil sandwiched between three layers of bituminous compound; outer surface faced with a polyester film.
- O. Heat Traced Piping: Insulate fittings, joints, and valves with insulation of like material, thickness, and finish as adjoining pipe. Size large enough to enclose pipe and heat tracer. Cover with aluminum jacket with seams located on bottom side of horizontal piping.

3.03 SCHEDULES

A. Plumbing Systems:

- 1. Domestic Hot Water Supply and Recirculation:
 - a. Glass Fiber Insulation:
 - 1) Pipe Size Range: less than 1-1/2 inch (38 mm).
 - 2) Thickness: 1 inch (25 mm).
 - b. Glass Fiber Insulation:
 - 1) Pipe Size Range: 1-1/2 inch (38 mm) or greater.
 - 2) Thickness: 1-1/2 inch (38 mm).
 - c. Flexible Elastomeric Cellular Insulation:
 - 1) Pipe Size Range: less than 1-1/2 inch (38 mm).
 - 2) Thickness: 1 inch (25 mm).
 - d. Flexible Elastomeric Cellular Insulation:
 - 1) Pipe Size Range: 1-1/2 inch (38 mm) or greater.
 - 2) Thickness: 1-1/2 inch (38 mm).
- 2. Domestic Cold Water:
 - a. Glass Fiber Insulation:
 - 1) Pipe Size Range: less than 1-1/2 inch (38 mm).
 - 2) Thickness: 1/2 inch (13 mm).
 - b. Glass Fiber Insulation:
 - 1) Pipe Size Range: 1-1/2 inch (38 mm) or greater.
 - 2) Thickness: 1 inch (25 mm).
 - c. Flexible Elastomeric Cellular Insulation:
 - 1) Pipe Size Range: less than 1-1/2 inch (38 mm).
 - 2) Thickness: 1/2 inch (13 mm).
 - d. Flexible Elastomeric Cellular Insulation:
 - 1) Pipe Size Range: 1-1/2 inch (38 mm) or greater.
 - 2) Thickness: 1 inch (25 mm).

END OF SECTION

**SECTION 22 1005
PLUMBING PIPING**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Pipe, pipe fittings, specialties, and connections for piping systems.
 - 1. Sanitary sewer.
 - 2. Sanitary sewer force mains.
 - 3. Domestic water.
 - 4. Flanges, unions, and couplings.
 - 5. Pipe hangers and supports.
 - 6. Valves.
 - 7. Flow controls.
 - 8. Check.
 - 9. Water pressure reducing valves.
 - 10. Relief valves.
 - 11. Strainers.

1.02 RELATED REQUIREMENTS

- A. Section 08 3100 - Access Doors and Panels.
- B. Section 09 9113 - Exterior Painting.
- C. Section 09 9123 - Interior Painting.
- D. Section 22 0553 - Identification for Plumbing Piping and Equipment.
- E. Section 22 0719 - Plumbing Piping Insulation.

1.03 REFERENCE STANDARDS

- A. ASTM D1785 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120; 2015.
- B. ASTM D2241 - Standard Specification for Poly (Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series); 2015.
- C. ASTM D2466 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40; 2015.
- D. ASTM D2564 - Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems; 2012.
- E. ASME B16.39 - Malleable Iron Threaded Pipe Unions Classes 150, 250, and 300; 2014.
- F. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2012.
- G. ASME B16.3 - Malleable Iron Threaded Fittings: Classes 150 and 300; 2011.
- H. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings; 2012.
- I. ASME B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings; 2013.
- J. ASME B31.1 - Power Piping; 2016.
- K. ASME B31.9 - Building Services Piping; 2014.
- L. ASME BPVC-IX - Boiler and Pressure Vessel Code, Section IX - Welding, Brazing, and Fusing Qualifications; 2015.
- M. ASSE 1003 - Performance Requirements for Water Pressure Reducing Valves for Domestic Water Distribution Systems; 2009.
- N. ASTM A47/A47M - Standard Specification for Ferritic Malleable Iron Castings; 1999 (Reapproved 2014).

- O. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2012.
- P. ASTM A74 - Standard Specification for Cast Iron Soil Pipe and Fittings; 2016.
- Q. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2015.
- R. ASTM A234/A234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service; 2015.
- S. ASTM B32 - Standard Specification for Solder Metal; 2008 (Reapproved 2014).
- T. ASTM B42 - Standard Specification for Seamless Copper Pipe, Standard Sizes; 2015a.
- U. ASTM B88 - Standard Specification for Seamless Copper Water Tube; 2014.
- V. ASTM B88M - Standard Specification for Seamless Copper Water Tube (Metric); 2013.
- W. ASTM B813 - Standard Specification for Liquid and Paste Fluxes for Soldering of Copper and Copper Alloy Tube; 2016.
- X. ASTM B828 - Standard Practice for Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings; 2016.
- Y. ASTM C564 - Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings; 2014.
- Z. ASTM D1785 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120; 2015.
- AA. ASTM D2241 - Standard Specification for Poly (Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series); 2015.
- AB. ASTM D2466 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40; 2015.
- AC. ASTM D2564 - Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems; 2012.
- AD. ASTM D2665 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings; 2014.
- AE. ASTM D2846/D2846M - Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Hot- and Cold-Water Distribution Systems; 2014.
- AF. ASTM D2855 - Standard Practice for the Two-Step (Primer & Solvent Cement) Method of Joining Poly (Vinyl Chloride) (PVC) or Chlorinated Poly (Vinyl Chloride) (CPVC) Pipe and Piping Components with Tapered Sockets; 2015.
- AG. ASTM D3034 - Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings; 2015.
- AH. ASTM F437 - Standard Specification for Threaded Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80; 2015.
- AI. ASTM F438 - Standard Specification for Socket-Type Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 40; 2015.
- AJ. ASTM F439 - Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80; 2013.
- AK. ASTM F441/F441M - Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80; 2015.
- AL. ASTM F442/F442M - Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe (SDR-PR); 2013.
- AM. ASTM F493 - Standard Specification for Solvent Cements for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe and Fittings; 2014.
- AN. ASTM F876 - Standard Specification for Crosslinked Polyethylene (PEX) Tubing; 2015a.

- AO. ASTM F877 - Standard Specification for Crosslinked Polyethylene (PEX) Plastic Hot- and Cold-Water Distribution Systems; 2011a.
- AP. AWS A5.8M/A5.8 - Specification for Filler Metals for Brazing and Braze Welding; 2011-AMD 1.
- AQ. AWWA C105/A21.5 - Polyethylene Encasement for Ductile-Iron Pipe Systems; 2010.
- AR. AWWA C111/A21.11 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings; 2012.
- AS. AWWA C151/A21.51 - Ductile-Iron Pipe, Centrifugally Cast; 2009.
- AT. AWWA C550 - Protective Interior Coatings for Valves and Hydrants; 2013.
- AU. AWWA C606 - Grooved and Shouldered Joints; 2015.
- AV. AWWA C651 - Disinfecting Water Mains; 2014.
- AW. CISPI 301 - Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste and Vent Piping Applications; 2009 (Revised 2012).
- AX. CISPI 310 - Specification for Coupling for Use in Connection with Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications; 2011 (Revised 2012).
- AY. ICC-ES AC01 - Acceptance Criteria for Expansion Anchors in Masonry Elements; 2015.
- AZ. ICC-ES AC106 - Acceptance Criteria for Predrilled Fasteners (Screw Anchors) in Masonry Elements; 2012.
- BA. ICC-ES AC193 - Acceptance Criteria for Mechanical Anchors in Concrete Elements; 2015.
- BB. ICC-ES AC308 - Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Elements; 2015.
- BC. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation; 2009.
- BD. MSS SP-67 - Butterfly Valves; 2011.
- BE. MSS SP-110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends; 2010.
- BF. NSF 61 - Drinking Water System Components - Health Effects; 2014 (Errata 2015).
- BG. NSF 372 - Drinking Water System Components - Lead Content; 2011.
- BH. PPI TR-4 - PPI Listing of Hydrostatic Design Basis (HDB), Hydrostatic Design Stress (HDS), Strength Design Basis (SDB), Pressure Design Basis (PDB), and Minimum Required Strength (MRS) Ratings For Thermoplastic Piping Materials or Pipe; 2016.

1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on pipe materials, pipe fittings, valves, and accessories. Provide manufacturers catalog information. Indicate valve data and ratings.
- C. Welder Certificate: Include welders certification of compliance with ASME BPVC-IX.
- D. Shop Drawings: For non-penetrating rooftop supports, submit detailed layout developed for this project, with design calculations for loadings and spacings.
- E. Project Record Documents: Record actual locations of valves.
- F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 01 6000 - Product Requirements, for additional provisions.
 - 2. Valve Repacking Kits: One for each type and size of valve.

1.05 QUALITY ASSURANCE

- A. Perform work in accordance with applicable codes.
- B. Valves: Manufacturer's name and pressure rating marked on valve body.

- C. Welding Materials and Procedures: Conform to ASME BPVC-IX and applicable state labor regulations.
- D. Welder Qualifications: Certified in accordance with ASME BPVC-IX.
- E. Identify pipe with marking including size, ASTM material classification, ASTM specification, potable water certification, water pressure rating.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Provide temporary protective coating on cast iron and steel valves.
- B. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
- C. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

- A. Potable Water Supply Systems: Provide piping, pipe fittings, and solder and flux (if used), that comply with NSF 61 and NSF 372 for maximum lead content; label pipe and fittings.

2.02 SANITARY SEWER PIPING, BURIED WITHIN 5 FEET (1500 MM) OF BUILDING

- A. Cast Iron Pipe: ASTM A74 service weight.
 - 1. Fittings: Cast iron.
 - 2. Joints: Hub-and-spigot, CISPI HSN compression type with ASTM C564 neoprene gaskets or lead and oakum.
- B. Cast Iron Pipe: CISPI 301, hubless.
 - 1. Fittings: Cast iron.
 - 2. Joints: CISPI 310, neoprene gasket and stainless steel clamp and shield assemblies.
- C. PVC Pipe: ASTM D2665 or ASTM D3034.
 - 1. Fittings: PVC.
 - 2. Joints: Solvent welded, with ASTM D2564 solvent cement.

2.03 SANITARY SEWER PIPING, ABOVE GRADE

- A. Cast Iron Pipe: ASTM A74, service weight.
 - 1. Fittings: Cast iron.
 - 2. Joint Seals: ASTM C564 neoprene gaskets, or lead and oakum.
- B. Cast Iron Pipe: CISPI 301, hubless, service weight.
 - 1. Fittings: Cast iron.
 - 2. Joints: CISPI 310, neoprene gaskets and stainless steel clamp-and-shield assemblies.
- C. PVC Pipe: ASTM D2665.
 - 1. Fittings: PVC.
 - 2. Joints: Solvent welded, with ASTM D2564 solvent cement.
 - 3. Not for installation in air plenums.

2.04 SANITARY SEWER FORCE MAINS

- A. Steel Pipe: ASTM A53/A53M Schedule 40, galvanized, using one of the following joint types:
 - 1. Threaded Joints: ASME B16.39 malleable iron pressure fittings.
- B. PVC Pipe: ASTM D1785 Schedule 40, or ASTM D2241 SDR 26 with not less than 150 psi (1034 kPa) pressure rating.
 - 1. Fittings: ASTM D2466, PVC.
 - 2. Joints: Solvent welded, with ASTM D2564 Solvent cement.
 - 3. Not for installation in air plenums.

2.05 DOMESTIC WATER PIPING, BURIED WITHIN 5 FEET (1500 MM) OF BUILDING

- A. Copper Pipe: ASTM B42, hard drawn.

1. Fittings: ASME B16.18, cast copper alloy or ASME B16.22 wrought copper and bronze.
 2. Joints: AWS A5.8M/A5.8, BCuP copper/silver braze.
- B. Ductile Iron Pipe: AWWA C151/A21.51.
1. Fittings: Ductile or gray iron, standard thickness.
 2. Joints: AWWA C111/A21.11, rubber gasket with 3/4 inch (19 mm) diameter rods.

2.06 DOMESTIC WATER PIPING, ABOVE GRADE

- A. Copper Tube: ASTM B88 (ASTM B88M), Type K (A), Drawn (H).
1. Fittings: ASME B16.18, cast copper alloy or ASME B16.22, wrought copper and bronze.
 2. Joints: ASTM B32, alloy Sn95 solder.
 3. Mechanical Press Sealed Fittings: Double pressed type, NSF 61 and NSF 372 approved or certified, utilizing EPDM, non toxic synthetic rubber sealing elements.
 - a. Manufacturers:
 - 1) Grinnell Products, a Tyco Business: www.grinnell.com.
 - 2) Viega LLC: www.viega.com.
 - 3) Substitutions: See Section 01 6000 - Product Requirements.
- B. CPVC Pipe: ASTM D2846/D2846M, ASTM F441/F441M, or ASTM F442/F442M.
1. Fittings: CPVC; ASTM D2846/D2846M, ASTM F437, ASTM F438, or ASTM F439.
 2. Joints: ASTM D2846/D2846M, solvent weld with ASTM F493 solvent cement.
- C. For Pipe 1 inch (25 mm) and smaller: Cross-Linked Polyethylene Pipe: ASTM F876 or ASTM F877.
1. Manufacturers:
 - a. Uponor, Inc.: www.uponorpro.com.
 - b. Viega LLC: www.viega.com.
 - c. Zurn Industries, LLC: www.zurn.com.
 - d. Substitutions: See Section 01 6000 - Product Requirements.
 2. PPI TR-4 Pressure Design Basis:
 - a. 100 psig (689 kPa) at maximum 180 degrees F (82 degrees C).
 3. Fittings: Brass and copper.
 4. Joints: Mechanical compression fittings.

2.07 PROPANE GAS PIPING, BURIED WITHIN 5 FEET (1500 MM) OF BUILDING

- A. Steel Pipe: ASTM A53/A53M Schedule 40 black.
1. Fittings: ASTM A234/A234M, wrought steel welding type.
 2. Joints: ASME B31.1, welded.
 3. Jacket: AWWA C105/A21.5 polyethylene jacket or double layer, half-lapped 10 mil (0.25 mm) polyethylene tape.

2.08 PROPANE GAS PIPING, ABOVE GRADE

- A. Steel Pipe: ASTM A53/A53M Schedule 40 black.
1. Fittings: ASME B16.3, malleable iron, or ASTM A234/A234M, wrought steel welding type.
 2. Joints: NFPA 58, threaded or welded to ASME B31.1.
- B. Gas piping installed on roof shall be painted "safety" yellow.

2.09 FLANGES, UNIONS, AND COUPLINGS

- A. Unions for Pipe Sizes 3 Inches (80 mm) and Under:
1. Ferrous pipe: Class 150 malleable iron threaded unions.
 2. Copper tube and pipe: Class 150 bronze unions with soldered joints.
- B. Flanges for Pipe Size Over 1 Inch (25 mm):
1. Ferrous Pipe: Class 150 malleable iron threaded or forged steel slip-on flanges; preformed neoprene gaskets.
 2. Copper Tube and Pipe: Class 150 slip-on bronze flanges; preformed neoprene gaskets.

- C. Mechanical Couplings for Grooved and Shouldered Joints: Two or more curved housing segments with continuous key to engage pipe groove, circular C-profile gasket, and bolts to secure and compress gasket.
 - 1. Dimensions and Testing: In accordance with AWWA C606.
 - 2. Housing Material: Provide ASTM A47/A47M malleable iron or ductile iron, galvanized.
 - 3. Gasket Material: EPDM suitable for operating temperature range from minus 30 degrees F (minus 34 degrees C) to 230 degrees F (110 degrees C).
 - 4. Bolts and Nuts: Hot dipped galvanized or zinc-electroplated steel.
 - 5. When pipe is field grooved, provide coupling manufacturer's grooving tools.
 - 6. Manufacturers:
 - a. Grinnell Products, a Tyco Business: www.grinnell.com.
 - b. Substitutions: See Section 01 6000 - Product Requirements.
- D. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.

2.10 PIPE HANGERS AND SUPPORTS

- A. Provide hangers and supports that comply with MSS SP-58.
 - 1. If type of hanger or support for a particular situation is not indicated, select appropriate type using MSS SP-58 recommendations.
 - 2. Overhead Supports: Individual steel rod hangers attached to structure or to trapeze hangers.
 - a. Cold and Hot Pipe Sizes 6 Inches (150 mm) and Over: Double hangers.
 - 3. Trapeze Hangers: Welded steel channel frames attached to structure.
 - 4. Vertical Pipe Support: Steel riser clamp.
 - 5. Floor Supports: Concrete pier or steel pedestal with floor flange; fixture attachment.
 - 6. Rooftop Supports for Low-Slope Roofs: Steel pedestals with bases that rest on top of roofing membrane, not requiring any attachment to the roof structure and not penetrating the roofing assembly, with support fixtures as specified; and as follows:
 - a. Bases: High density polypropylene.
 - b. Base Sizes: As required to distribute load sufficiently to prevent indentation of roofing assembly.
 - c. Steel Components: Stainless steel, or carbon steel hot-dip galvanized after fabrication in accordance with ASTM A123/A123M.
 - d. Attachment/Support Fixtures: As recommended by manufacturer, same type as indicated for equivalent indoor hangers and supports; corrosion resistant material.
 - e. Height: Provide minimum clearance of 6 inches (150 mm) under pipe to top of roofing.
 - f. Manufacturers:
 - 1) PHP Systems/Design: www.phpsd.com.
 - 2) Substitutions: See Section 01 6000 - Product Requirements.
- B. Plumbing Piping - Drain, Waste, and Vent:
 - 1. Hangers for Pipe Sizes 1/2 Inch (15 mm) to 1-1/2 Inches (40 mm): Malleable iron, adjustable swivel, split ring.
 - 2. Hangers for Pipe Sizes 2 Inches (50 mm) and Over: Carbon steel, adjustable, clevis.
 - 3. Wall Support for Pipe Sizes to 3 Inches (80 mm): Cast iron hook.
 - 4. Wall Support for Pipe Sizes 4 Inches (100 mm) and Over: Welded steel bracket and wrought steel clamp.
 - 5. Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
 - 6. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.
- C. Plumbing Piping - Water:
 - 1. Hangers for Pipe Sizes 1/2 Inch (15 mm) to 1-1/2 Inches (40 mm): Malleable iron, adjustable swivel, split ring.
 - 2. Hangers for Cold Pipe Sizes 2 Inches (50 mm) and Over: Carbon steel, adjustable, clevis.

3. Hangers for Hot Pipe Sizes 2 Inches (50 mm) to 4 Inches (100 mm): Carbon steel, adjustable, clevis.
 4. Hangers for Hot Pipe Sizes 6 Inches (150 mm) and Over: Adjustable steel yoke, cast iron pipe roll, double hanger.
 5. Wall Support for Pipe Sizes to 3 Inches (80 mm): Cast iron hook.
 6. Wall Support for Pipe Sizes 4 Inches (100 mm) and Over: Welded steel bracket and wrought steel clamp.
 7. Wall Support for Hot Pipe Sizes 6 Inches (150 mm) and Over: Welded steel bracket and wrought steel clamp with adjustable steel yoke and cast iron pipe roll.
 8. Floor Support for Cold Pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
 9. Floor Support for Hot Pipe Sizes to 4 Inches (100 mm): Cast iron adjustable pipe saddle, locknut, nipple, floor flange, and concrete pier or steel support.
 10. Floor Support for Hot Pipe Sizes 6 Inches (150 mm) and Over: Adjustable cast iron pipe roll and stand, steel screws, and concrete pier or steel support.
 11. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.
- D. Hanger Fasteners: Attach hangers to structure using appropriate fasteners, as follows:
1. Concrete Wedge Expansion Anchors: Complying with ICC-ES AC193.
 2. Masonry Wedge Expansion Anchors: Complying with ICC-ES AC01.
 3. Concrete Screw Type Anchors: Complying with ICC-ES AC193.
 4. Masonry Screw Type Anchors: Complying with ICC-ES AC106.
 5. Concrete Adhesive Type Anchors: Complying with ICC-ES AC308.
 6. Other Types: As required.
 7. Manufacturers:
 - a. Powers Fasteners, Inc: www.powers.com.
 - b. Substitutions: See Section 01 6000 - Product Requirements.

2.11 BALL VALVES

- A. Manufacturers:
1. Grinnell Products, a Tyco Business: www.grinnell.com.
 2. Nibco, Inc: www.nibco.com.
 3. Uponor, Inc: www.uponorpro.com.
 4. Substitutions: See Section 01 6000 - Product Requirements.
- B. Construction, 4 Inches (100 mm) and Smaller: MSS SP-110, Class 150, 400 psi (2760 kPa) CWP, bronze or ductile iron body, 304 stainless steel or chrome plated brass ball, regular port, teflon seats and stuffing box ring, blow-out proof stem, lever handle with balancing stops, solder, threaded, or grooved ends with union.

2.12 BUTTERFLY VALVES

- A. Manufacturers:
1. Crane Company: www.cranecpe.com.
 2. Grinnell Products, a Tyco Business; B302: www.grinnell.com.
 3. Substitutions: See Section 01 6000 - Product Requirements.
- B. Construction 1-1/2 Inches (40 mm) and Larger: MSS SP-67, 200 psi (1380 kPa) CWP, cast or ductile iron body, nickel-plated ductile iron disc, resilient replaceable EPDM seat, wafer ends, extended neck, 10 position lever handle.
- C. Provide gear operators for valves 8 inches (150 mm) and larger, and chain-wheel operators for valves mounted over 8 feet (2400 mm) above floor.

2.13 WATER PRESSURE REDUCING VALVES:

- A. Manufacturers:
1. Amtrol Inc: www.amtrol.com.
 2. Cla-Val Company: www.cla-val.com.
 3. Watts Regulator Company: www.wattsregulator.com.

4. Substitutions: See Section 01 6000 - Product Requirements.
- B. Up to 2 Inches (50 mm):
 1. ASSE 1003, bronze body, stainless steel, and thermoplastic internal parts, fabric reinforced diaphragm, strainer, threaded single union ends.
- C. Over 2 Inches (50 mm):
 1. ASSE 1003, cast iron body with interior lining complying with AWWA C550, bronze fitted, elastomeric diaphragm and seat disc, flanged.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that excavations are to required grade, dry, and not over-excavated.

3.02 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Remove scale and dirt, on inside and outside, before assembly.
- C. Prepare piping connections to equipment with flanges or unions.

3.03 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Provide non-conducting dielectric connections wherever jointing dissimilar metals.
- C. Route piping in orderly manner and maintain gradient. Route parallel and perpendicular to walls.
- D. Install piping to maintain headroom, conserve space, and not interfere with use of space.
- E. Group piping whenever practical at common elevations.
- F. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment. Refer to Section 22 0516.
- G. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings.
 1. Refer to Section 22 0719.
- H. Provide access where valves and fittings are not exposed.
 1. Coordinate size and location of access doors with Section 08 3100.
- I. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.
- J. Provide support for utility meters in accordance with requirements of utility companies.
- K. Prepare exposed, unfinished pipe, fittings, supports, and accessories ready for finish painting.
- L. Install bell and spigot pipe with bell end upstream.
- M. Install valves with stems upright or horizontal, not inverted. Refer to Section 22 0523.
- N. Install water piping to ASME B31.9.
- O. Copper Pipe and Tube: Make soldered joints in accordance with ASTM B828, using specified solder, and flux meeting ASTM B813; in potable water systems use flux also complying with NSF 61 and NSF 372.
- P. PVC Pipe: Make solvent-welded joints in accordance with ASTM D2855.
- Q. Sleeve pipes passing through partitions, walls and floors.
- R. Inserts:
 1. Provide inserts for placement in concrete formwork.
 2. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
 3. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches (100 mm).

4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
 5. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut above slab.
- S. Pipe Hangers and Supports:
1. Install in accordance with ASME B31.9.
 2. Support horizontal piping as scheduled.
 3. Install hangers to provide minimum 1/2 inch (15 mm) space between finished covering and adjacent work.
 4. Place hangers within 12 inches (300 mm) of each horizontal elbow.
 5. Use hangers with 1-1/2 inch (40 mm) minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
 6. Support vertical piping at every other floor. Support riser piping independently of connected horizontal piping.
 7. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
 8. Provide copper plated hangers and supports for copper piping.
 9. Prime coat exposed steel hangers and supports. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.
 - a. Painting of interior plumbing systems and components is specified in Section 09 9123.
 - b. Painting of exterior plumbing systems and components is specified in Section 09 9113.
 10. Provide hangers adjacent to motor driven equipment with vibration isolation; refer to Section 22 0548.
 11. Support cast iron drainage piping at every joint.

3.04 APPLICATION

- A. Use grooved mechanical couplings and fasteners only in accessible locations.
- B. Install unions downstream of valves and at equipment or apparatus connections.
- C. Install brass male adapters each side of valves in copper piped system. Solder adapters to pipe.
- D. Install gate valves for shut-off and to isolate equipment, part of systems, or vertical risers.
- E. Install globe valves for throttling, bypass, or manual flow control services.
- F. Provide lug end butterfly valves adjacent to equipment when provided to isolate equipment.
- G. Provide spring loaded check valves on discharge of water pumps.
- H. Provide flow controls in water recirculating systems where indicated.

3.05 TOLERANCES

- A. Drainage Piping: Establish invert elevations within 1/2 inch (10 mm) vertically of location indicated and slope to drain at minimum of 1/4 inch per foot (1:50) slope.
- B. Water Piping: Slope at minimum of 1/32 inch per foot (1:400) and arrange to drain at low points.

3.06 DISINFECTION OF DOMESTIC WATER PIPING SYSTEM

- A. Prior to starting work, verify system is complete, flushed and clean.
- B. Ensure acidity (pH) of water to be treated is between 7.4 and 7.6 by adding alkali (caustic soda or soda ash) or acid (hydrochloric).
- C. Inject disinfectant, free chlorine in liquid, powder, tablet or gas form, throughout system to obtain 50 to 80 mg/L residual.
- D. Bleed water from outlets to ensure distribution and test for disinfectant residual at minimum 15 percent of outlets.
- E. Maintain disinfectant in system for 24 hours.

- F. If final disinfectant residual tests less than 25 mg/L, repeat treatment.
- G. Flush disinfectant from system until residual equal to that of incoming water or 1.0 mg/L.
- H. Take samples no sooner than 24 hours after flushing, from 10 percent of outlets and from water entry, and analyze in accordance with AWWA C651.

3.07 SERVICE CONNECTIONS

- A. Provide new sanitary sewer services. Before commencing work check invert elevations required for sewer connections, confirm inverts and ensure that these can be properly connected with slope for drainage and cover to avoid freezing.
- B. Provide new water service complete with approved reduced pressure backflow preventer and water meter with by-pass valves, pressure reducing valve, and sand strainer.
 - 1. Provide sleeve in wall for service main and support at wall with reinforced concrete bridge. Calk enlarged sleeve and make watertight with pliable material. Anchor service main inside to concrete wall.
 - 2. Provide 18 gage, 0.0478 inch (1.21 mm) galvanized sheet metal sleeve around service main to 6 inch (150 mm) above floor and 6 feet (1800 mm) minimum below grade. Size for minimum of 2 inches (50 mm) of loose batt insulation stuffing.

3.08 SCHEDULES

- A. Pipe Hanger Spacing:
 - 1. Metal Piping:
 - a. Pipe Size: 1/2 inches (15 mm) to 1-1/4 inches (32 mm):
 - 1) Maximum Hanger Spacing: 6.5 ft (2 m).
 - 2) Hanger Rod Diameter: 3/8 inches (9 mm).
 - b. Pipe Size: 1-1/2 inches (40 mm) to 2 inches (50 mm):
 - 1) Maximum Hanger Spacing: 10 ft (3 m).
 - 2) Hanger Rod Diameter: 3/8 inch (9 mm).
 - c. Pipe Size: 2-1/2 inches (65 mm) to 3 inches (75 mm):
 - 1) Maximum Hanger Spacing: 10 ft (3 m).
 - 2) Hanger Rod Diameter: 1/2 inch (13 mm).
 - d. Pipe Size: 4 inches (100 mm) to 6 inches (150 mm):
 - 1) Maximum Hanger Spacing: 10 ft (3 m).
 - 2) Hanger Rod Diameter: 5/8 inch (15 mm).
 - e. Pipe Size: 8 inches (200 mm) to 12 inches (300 mm):
 - 1) Maximum hanger spacing: 14 ft (4.25 m).
 - 2) Hanger Rod Diameter: 7/8 inch (22 mm).
 - f. Pipe Size: 14 inches and Over (350 mm and Over):
 - 1) Maximum Hanger Spacing: 20 ft (6 m).
 - 2) Hanger Rod Diameter: 1 inch (25 mm).
 - 2. Plastic Piping:
 - a. All Sizes:
 - 1) Maximum Hanger Spacing: 6 ft (1.8 m).
 - 2) Hanger Rod Diameter: 3/8 inch (9 mm).

END OF SECTION

SECTION 22 1006
PLUMBING PIPING SPECIALTIES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Drains.
- B. Cleanouts.
- C. Hydrants.
- D. Backflow preventers.
- E. Double check valve assemblies.
- F. Mixing valves.

1.02 RELATED REQUIREMENTS

- A. Section 22 1005 - Plumbing Piping.
- B. Section 22 3000 - Plumbing Equipment.
- C. Section 22 4000 - Plumbing Fixtures.

1.03 REFERENCE STANDARDS

- A. ASME A112.6.3 - Floor and Trench Drains; 2001 (R2007).
- B. ASSE 1012 - Backflow Preventer with Intermediate Atmospheric Vent; 2009.
- C. ASSE 1013 - Reduced Pressure Principle Backflow Preventers and Reduced Pressure Principle Fire Protection Backflow Preventers; 2011.
- D. ASSE 1019 - Performance Requirements for Wall Hydrant with Backflow Protection and Freeze Resistance; 2011.
- E. NSF 61 - Drinking Water System Components - Health Effects; 2014 (Errata 2015).
- F. NSF 372 - Drinking Water System Components - Lead Content; 2011.

1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide component sizes, rough-in requirements, service sizes, and finishes.
- C. Shop Drawings: Indicate dimensions, weights, and placement of openings and holes.
- D. Certificates: Certify that grease interceptors meet or exceed specified requirements.
- E. Manufacturer's Instructions: Indicate Manufacturer's Installation Instructions: Indicate assembly and support requirements.
- F. Operation Data: Indicate frequency of treatment required for interceptors.
- G. Maintenance Data: Include installation instructions, spare parts lists, exploded assembly views.
- H. Project Record Documents: Record actual locations of equipment, cleanouts, backflow preventers, water hammer arrestors.
- I. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 01 6000 - Product Requirements, for additional provisions.
 - 2. Extra Loose Keys for Outside Hose Bibbs: One.
 - 3. Extra Hose End Vacuum Breakers for Hose Bibbs: One.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with not less than three years documented experience.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

- A. Specialties in Potable Water Supply Systems: Provide products that comply with NSF 61 and NSF 372 for maximum lead content.

2.02 DRAINS

- A. Manufacturers:
 - 1. Jay R. Smith Manufacturing Company: www.jayrsmith.com.
 - 2. Josam Company: www.josam.com.
 - 3. LATICRETE International, Inc.; LATICRETE® HYDRO BAN® Linear Drain: www.laticrete.com.
 - 4. LATICRETE International, Inc.; LATICRETE® HYDRO BAN® Bonding Flange Drain: www.laticrete.com.
 - 5. Noble Company; FreeStyle Linear Drain: www.noblecompany.com.
 - 6. Zurn Industries, LLC: www.zurn.com.
 - 7. Substitutions: See Section 01 6000 - Product Requirements.
- B. Floor Drain (FD):
 - 1. ASME A112.6.3; lacquered cast iron or stainless steel, two piece body with double drainage flange, weep holes, reversible clamping collar, and round, adjustable nickel-bronze strainer.

2.03 CLEANOUTS

- A. Manufacturers:
 - 1. Jay R. Smith Manufacturing Company: www.jayrsmith.com.
 - 2. Josam Company: www.josam.com.
 - 3. Zurn Industries, LLC: www.zurn.com.
 - 4. Substitutions: See Section 01 6000 - Product Requirements.
- B. Cleanouts at Exterior Surfaced Areas:
 - 1. Round cast nickel bronze access frame and non-skid cover.
- C. Cleanouts at Exterior Unsurfaced Areas:
 - 1. Line type with lacquered cast iron body and round epoxy coated gasketed cover.
- D. Cleanouts at Interior Finished Floor Areas:
 - 1. Lacquered cast iron body with anchor flange, reversible clamping collar, threaded top assembly, and round gasketed scored cover in service areas and round gasketed depressed cover to accept floor finish in finished floor areas.
- E. Cleanouts at Interior Finished Wall Areas:
 - 1. Line type with lacquered cast iron body and round epoxy coated gasketed cover, and round stainless steel access cover secured with machine screw.
- F. Cleanouts at Interior Unfinished Accessible Areas: Calked or threaded type. Provide bolted stack cleanouts on vertical rainwater leaders.

2.04 HYDRANTS

- A. Manufacturers:
 - 1. Arrowhead Brass & Plumbing, LLC: www.arrowheadbrass.com.
 - 2. Jay R. Smith Manufacturing Company: www.jayrsmith.com.
 - 3. Zurn Industries, LLC: www.zurn.com.
 - 4. Substitutions: See Section 01 6000 - Product Requirements.
- B. Wall Hydrants:
 - 1. ASSE 1019; freeze resistant, self-draining type with chrome plated wall plate hose thread spout, handwheel, and integral vacuum breaker.

2.05 BACKFLOW PREVENTERS

- A. Manufacturers:

1. Conbraco Industries, Inc: www.apollovalves.com.
2. Watts Regulator Company, a part of Watts Water Technologies: www.wattsregulator.com.
3. Zurn Industries, LLC: www.zurn.com.
4. Substitutions: See Section 01 6000 - Product Requirements.

B. Reduced Pressure Backflow Preventers:

1. ASSE 1013; bronze body with bronze internal parts and stainless steel springs; two independently operating, spring loaded check valves; diaphragm type differential pressure relief valve located between check valves; third check valve that opens under back pressure in case of diaphragm failure; non-threaded vent outlet; assembled with two gate valves, strainer, and four test cocks.

2.06 DOUBLE CHECK VALVE ASSEMBLIES

A. Manufacturers:

1. Conbraco Industries, Inc: www.apollovalves.com.
2. Watts Regulator Company, a part of Watts Water Technologies: www.wattsregulator.com.
3. Zurn Industries, LLC: www.zurn.com.
4. Substitutions: See Section 01 6000 - Product Requirements.

B. Double Check Valve Assemblies:

1. ASSE 1012; Bronze body with corrosion resistant internal parts and stainless steel springs; two independently operating check valves with intermediate atmospheric vent.

2.07 MIXING VALVES

A. Thermostatic Mixing Valves:

1. Manufacturers:
 - a. ESBE: www.esbe.se/en.
 - b. Honeywell International Inc: yourhome.honeywell.com.
 - c. Leonard Valve Company: www.leonardvalve.com.
 - d. Watts Water Technologies Inc: www.watts.com.
 - e. Substitutions: See Section 01 6000 - Product Requirements.
2. Valve: Chrome plated cast brass body, stainless steel or copper alloy bellows, integral temperature adjustment.
3. Accessories:
 - a. Check valve on inlets.
 - b. Volume control shut-off valve on outlet.
 - c. Stem thermometer on outlet.
 - d. Strainer stop checks on inlets.
4. Cabinet: 16 gage, 0.0598 inch (1.52 mm) prime coated steel, for recessed mounting with keyed lock.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Extend cleanouts to finished floor or wall surface. Lubricate threaded cleanout plugs with mixture of graphite and linseed oil. Ensure clearance at cleanout for rodding of drainage system.
- C. Encase exterior cleanouts in concrete flush with grade.
- D. Install floor cleanouts at elevation to accommodate finished floor.
- E. Install approved portable water protection devices on plumbing lines where contamination of domestic water may occur; on boiler feed water lines, janitor rooms, fire sprinkler systems, premise isolation, irrigation systems, flush valves, interior and exterior hose bibbs.
- F. Pipe relief from backflow preventer to nearest drain.

- G. Install water hammer arrestors complete with accessible isolation valve on hot and cold water supply piping to lavatory sinks or washing machine outlets.

END OF SECTION

**SECTION 22 3000
PLUMBING EQUIPMENT**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Water heaters.
- B. Compression tanks.
- C. Pumps.
 - 1. Circulators.
 - 2. Sump pumps.

1.02 RELATED REQUIREMENTS

- A. Section 26 2717 - Equipment Wiring: Electrical characteristics and wiring connections.

1.03 REFERENCE STANDARDS

- A. ANSI Z21.10.1 - Gas Water Heaters - Volume I - Storage Water Heaters with Input Ratings of 75,000 Btu per Hour or Less; 2014.
- B. ANSI Z21.10.3 - Gas-Fired Water Heaters - Volume III - Storage Water Heaters with Input Ratings Above 75,000 Btu per Hour, Circulating and Instantaneous; 2016.
- C. ASME BPVC-VIII-1 - Boiler and Pressure Vessel Code, Section VIII, Division 1 - Rules for Construction of Pressure Vessels; 2015.
- D. NFPA 31 - Standard for the Installation of Oil Burning Equipment; 2016.
- E. UL 174 - Standard for Household Electric Storage Tank Water Heaters; Current Edition, Including All Revisions.
- F. UL 1453 - Standard for Electric Booster and Commercial Storage Tank Water Heaters; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Sequencing: Ensure that utility connections are achieved in an orderly and expeditious manner.

1.05 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittals procedures.
- B. Product Data:
 - 1. Provide dimension drawings of water heaters indicating components and connections to other equipment and piping.
 - 2. Indicate pump type, capacity, power requirements.
 - 3. Provide certified pump curves showing pump performance characteristics with pump and system operating point plotted. Include NPSH curve when applicable.
 - 4. Provide electrical characteristics and connection requirements.
- C. Shop Drawings:
 - 1. Indicate heat exchanger dimensions, size of tappings, and performance data.
 - 2. Indicate dimensions of tanks, tank lining methods, anchors, attachments, lifting points, tappings, and drains.
- D. Project Record Documents: Record actual locations of components.
- E. Operation and Maintenance Data: Include operation, maintenance, and inspection data, replacement part numbers and availability, and service depot location and telephone number.
- F. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.
- G. Project Record Documents: Record actual locations of components.
- H. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

1. See Section 01 6000 - Product Requirements, for additional provisions.
2. Extra Pump Seals: One of each type and size.
3. Extra Water Softener Salt: 50 pounds (22.7 kg).

1.06 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.
- B. Identification: Provide pumps with manufacturer's name, model number, and rating/capacity identified by permanently attached label.
- C. Performance: Ensure pumps operate at specified system fluid temperatures without vapor binding and cavitation, are non-overloading in parallel or individual operation, operate within 25 percent of midpoint of published maximum efficiency curve.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Provide temporary inlet and outlet caps. Maintain caps in place until installation.

1.08 WARRANTY

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
- B. Provide five year manufacturer warranty for domestic water heaters.

PART 2 PRODUCTS

2.01 WATER HEATER MANUFACTURERS

- A. A.O. Smith Water Products Co: www.hotwater.com.
- B. Bock Water Heaters, Inc: www.bockwaterheaters.com.
- C. Rheem Manufacturing Company: www.rheem.com.
- D. Substitutions: See Section 01 6000 - Product Requirements.

2.02 CERTIFICATIONS

- A. Water Heaters: NSF approved.
- B. Gas Water Heaters: Certified by CSA International to ANSI Z21.10.1 or ANSI Z21.10.3, as applicable, in addition to requirements specified elsewhere.
- C. Electric Water Heaters: UL listed and labeled to UL 174 or UL 1453.
- D. Oil-Fired Water Heaters: To NFPA 31.
- E. Pressure Vessels for Heat Exchangers: ASME labeled, to ASME BPVC-VIII-1.
- F. Water Tanks: ASME labeled, to ASME BPVC-VIII-1.
- G. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.

2.03 RESIDENTIAL ELECTRIC WATER HEATERS

- A. Type: Automatic, electric, vertical storage.
- B. Tank: Glass lined welded steel, thermally insulated with one inch (25 mm) thick glass fiber; encased in corrosion-resistant steel jacket; baked-on enamel finish.
- C. Controls: Automatic water thermostat with externally adjustable temperature range from 120 to 170 degrees F (49 to 77 degrees C), flanged or screw-in nichrome elements, enclosed controls and electrical junction box and operating light. Wire double element units so elements do not operate simultaneously.
- D. Accessories: Provide:
 1. Water Connections: Brass.
 2. Dip Tube: Brass.
 3. Drain Valve.
 4. Anode: Magnesium
 5. Temperature and Pressure Relief Valve: ASME labelled.

2.04 DIAPHRAGM-TYPE COMPRESSION TANKS

- A. Manufacturers:
 - 1. Amtrol Inc: www.amtrol.com.
 - 2. ITT Bell & Gossett: www.bellgossett.com.
 - 3. Taco, Inc: www.taco-hvac.com.
 - 4. Substitutions: See Section 01 6000 - Product Requirements.
- B. Construction: Welded steel, tested and stamped in accordance with ASME BPVC-VIII-1; supplied with National Board Form U-1, rated for working pressure of 125 psig (860 kPa), with flexible EPDM diaphragm sealed into tank, and steel legs or saddles.
- C. Accessories: Pressure gage and air-charging fitting, tank drain; precharge to 12 psig (80 kPa).

2.05 IN-LINE CIRCULATOR PUMPS

- A. Manufacturers:
 - 1. Armstrong Pumps Inc: www.armstrongpumps.com.
 - 2. ITT Bell & Gossett: www.bellgossett.com.
 - 3. SIHI Group: www.sterlingsihi.com.
 - 4. Substitutions: See Section 01 6000 - Product Requirements.
- B. Casing: Bronze, rated for 125 psig (860 kPa) working pressure, with stainless steel rotor assembly.
- C. Impeller: Bronze.
- D. Shaft: Alloy steel with integral thrust collar and two oil lubricated bronze sleeve bearings.
- E. Seal: Carbon rotating against a stationary ceramic seat.
- F. Drive: Flexible coupling.

2.06 SUBMERSIBLE SUMP PUMPS

- A. Manufacturers:
 - 1. Armstrong Pumps Inc: www.armstrongpumps.com.
 - 2. Goulds Pumps: www.goulds.com.
 - 3. Zoeller Pump Company: www.zoeller.com.
 - 4. Substitutions: See Section 01 6000 - Product Requirements.
- B. Type: Completely submersible, vertical, centrifugal.
- C. Casing: Cast iron pump body and oil filled motor chamber.
- D. Impeller: Cast iron; open non-clog, stainless steel shaft.
- E. Bearings: Ball bearings.
- F. Sump: Fiberglass basin with steel cover plate.
- G. Accessories: Oil resistant 6 foot (2 m) cord and plug with three-prong connector for connection to electric wiring system including grounding connector.
- H. Servicing: Slide-away coupling consisting of discharge elbow secure to sump floor, movable bracket, guide pipe system, lifting chain and chain hooks.
- I. Controls: Integral diaphragm type level controls with separate liquid level control high level alarm.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install plumbing equipment in accordance with manufacturer's instructions, as required by code, and complying with conditions of certification, if any.
- B. Coordinate with plumbing piping and related fuel piping work to achieve operating system.
- C. Domestic Water Storage Tanks:
 - 1. Provide steel pipe support, independent of building structural framing members.
 - 2. Clean and flush prior to delivery to site. Seal until pipe connections are made.

D. Pumps:

1. Ensure shaft length allows sump pumps to be located minimum 24 inches (600 mm) below lowest invert into sump pit and minimum 6 inches (150 mm) clearance from bottom of sump pit.
2. Provide air cock and drain connection on horizontal pump casings.
3. Provide line sized isolating valve and strainer on suction and line sized soft seated check valve and balancing valve on discharge.
4. Decrease from line size with long radius reducing elbows or reducers. Support piping adjacent to pump such that no weight is carried on pump casings. Provide supports under elbows on pump suction and discharge line sizes 4 inches (100 mm) and over.
5. Ensure pumps operate at specified system fluid temperatures without vapor binding and cavitation, are non-overloading in parallel or individual operation, and operate within 25 percent of midpoint of published maximum efficiency curve.
6. Align and verify alignment of base mounted pumps prior to start-up
7. Provide electrical interlocking from cooling condensate pump safety switch to associated HVAC unit(s) furnished under other Sections.

END OF SECTION

**SECTION 22 4000
PLUMBING FIXTURES**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Water closets.
- B. Urinals.
- C. Lavatories.
- D. Sinks.
- E. Service sinks.
- F. Electric water coolers.
- G. Showers.
- H. Eye and face wash fountains.

1.02 RELATED REQUIREMENTS

- A. Section 22 1005 - Plumbing Piping.
- B. Section 22 1006 - Plumbing Piping Specialties.
- C. Section 22 3000 - Plumbing Equipment.

1.03 REFERENCE STANDARDS

- A. ANSI Z124.1.2 - American National Standard for Plastic Bathtub and Shower Units; 2005.
- B. ANSI Z358.1 - American National Standard for Emergency Eyewash and Shower Equipment; 2014.
- C. ASHRAE Std 18 - Methods of Testing for Rating Drinking-Water Coolers with Self-Contained Mechanical Refrigeration; 2008.
- D. ASME A112.6.1M - Supports for Off-the-Floor Plumbing Fixtures for Public Use; 1997 (Reaffirmed 2002).
- E. ASME A112.18.1 - Plumbing Supply Fittings; 2012.
- F. ASME A112.19.2 - Ceramic Plumbing Fixtures; 2013.
- G. ASME A112.19.3 - Stainless Steel Plumbing Fixtures; 2008 (R2013).
- H. NSF 61 - Drinking Water System Components - Health Effects; 2014 (Errata 2015).
- I. NSF 372 - Drinking Water System Components - Lead Content; 2011.

1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide catalog illustrations of fixtures, sizes, rough-in dimensions, utility sizes, trim, and finishes.
- C. Manufacturer's Instructions: Indicate installation methods and procedures.
- D. Maintenance Data: Include fixture trim exploded view and replacement parts lists.
- E. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.
- F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 01 6000 - Product Requirements, for additional provisions.
 - 2. Extra Faucet Washers: One set of each type and size.
 - 3. Extra Lavatory Supply Fittings: One set of each type and size.
 - 4. Extra Shower Heads: One of each type and size.
 - 5. Extra Toilet Seats: One of each type and size.
 - 6. Flush Valve Service Kits: One for each type and size.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.

1.06 REGULATORY REQUIREMENTS

- A. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Protect installed fixtures from damage by securing areas and by leaving factory packaging in place to protect fixtures and prevent use.

1.08 WARRANTY

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
- B. Provide five year manufacturer warranty for electric water cooler.

PART 2 PRODUCTS

2.01 GENERAL

- A. Potable Water Systems: Provide plumbing fittings and faucets that comply with NSF 61 and NSF 372 for maximum lead content; label pipe and fittings.

2.02 TANK TYPE WATER CLOSET WC-1A

- A. Tank Type Water Closet Manufacturers:
 - 1. American Standard, Inc: www.americanstandard-us.com.
 - 2. Gerber Plumbing Fixtures LLC: www.gerberonline.com.
 - 3. Kohler Company: www.kohler.com.
 - 4. Zurn Industries, Inc: www.zurn.com.
 - 5. Substitutions: See Section 01 6000 - Product Requirements.
- B. Bowl: ASME A112.19.2; floor mounted, siphon jet, vitreous china, 18 inches (450 mm) high, close-coupled closet combination with elongated rim, insulated vitreous china closet tank with fittings and lever flushing valve, bolt caps, vandalproof cover locking device.
 - 1. Water Consumption: Maximum 1.6 gallons (6 liters) per flush.
- C. Seat Manufacturers:
 - 1. American Standard, Inc: www.americanstandard-us.com.
 - 2. Bemis Manufacturing Company: www.bemismfg.com.
 - 3. Church Seat Company: www.churchseats.com.
 - 4. Olsonite: www.olsonite.com.
 - 5. Substitutions: See Section 01 6000 - Product Requirements.
- D. Seat: Solid white plastic, open front, extended back, less cover, complete with self-sustaining hinge.
- E. Handle Height: 44 inches (1117 mm) or less.
- F. Water Closet Carrier:
 - 1. Manufacturers:
 - a. JOSAM Company: www.josam.com.
 - b. Zurn Industries, Inc: www.zurn.com.
 - c. Substitutions: See Section 01 6000 - Product Requirements.
 - 2. ASME A112.6.1M; adjustable cast iron frame, integral drain hub and vent, adjustable spud, lugs for floor and wall attachment, threaded fixture studs with nuts and washers.

2.03 TANK TYPE WATER CLOSET WC-1

- A. Tank Type Water Closet Manufacturers:
 - 1. American Standard, Inc: www.americanstandard-us.com.
 - 2. Gerber Plumbing Fixtures LLC: www.gerberonline.com.
 - 3. Kohler Company: www.kohler.com.

4. Zurn Industries, Inc: www.zurn.com.
 5. Substitutions: See Section 01 6000 - Product Requirements.
- B. Bowl: ASME A112.19.2; floor mounted, siphon jet, vitreous china, 16.5 inches (420 mm) high, close-coupled closet combination with elongated rim, insulated vitreous china closet tank with fittings and lever flushing valve, bolt caps, vandalproof cover locking device.
1. Water Consumption: Maximum 1.6 gallons (6 liters) per flush.
- C. Seat Manufacturers:
1. American Standard, Inc: www.americanstandard-us.com.
 2. Bemis Manufacturing Company: www.bemismfg.com.
 3. Church Seat Company: www.churchseats.com.
 4. Olsonite: www.olsonite.com.
 5. Substitutions: See Section 01 6000 - Product Requirements.
- D. Seat: Solid white plastic, open front, extended back, less cover, complete with self-sustaining hinge.
- E. Handle Height: 44 inches (1117 mm) or less.
- F. Water Closet Carrier:
1. Manufacturers:
 - a. JOSAM Company: www.josam.com.
 - b. Zurn Industries, Inc: www.zurn.com.
 - c. Substitutions: See Section 01 6000 - Product Requirements.
 2. ASME A112.6.1M; adjustable cast iron frame, integral drain hub and vent, adjustable spud, lugs for floor and wall attachment, threaded fixture studs with nuts and washers.

2.04 WALL HUNG URINALS

- A. Wall Hung Urinal Manufacturers:
1. American Standard, Inc: www.americanstandard-us.com.
 2. Gerber Plumbing Fixtures LLC: www.gerberonline.com.
 3. Kohler Company: www.kohler.com.
 4. Zurn Industries, Inc; EcoVantage Z5798 High-Efficiency Urinal System: www.zurn.com.
 5. Substitutions: See Section 01 6000 - Product Requirements.
- B. Urinals: Vitreous china, ASME A112.19.2, wall hung with side shields and concealed carrier.
1. Flush Volume: 1.0 gallons (3.7 liters), maximum.
 2. Flush Style: Siphon jet.
 3. Flush Valve: Exposed (top spud).
 4. Flush Operation: Manual, oscillating handle.
 5. Trap: Integral.
 6. Removable stainless steel strainer.
- C. Flush Valves: ASME A112.18.1, diaphragm type, complete with vacuum breaker stops and accessories.
1. Exposed Type: Chrome plated, escutcheon, integral screwdriver stop.
 2. Manufacturers:
 - a. American Standard, Inc: www.americanstandard-us.com.
 - b. Delaney Products: www.delaneyvalve.com.
 - c. Sloan Valve Company: www.sloanvalve.com.
 - d. Zurn Industries, Inc: www.zurn.com.
 - e. Substitutions: See Section 01 6000 - Product Requirements.
- D. Carriers:
1. Manufacturers:
 - a. JOSAM Company: www.josam.com.
 - b. Zurn Industries, Inc: www.zurn.com.
 - c. Substitutions: See Section 01 6000 - Product Requirements.

2. ASME A112.6.1M; cast iron and steel frame with tubular legs, lugs for floor and wall attachment, threaded fixture studs for fixture hanger, bearing studs.

2.05 LAVATORIES

- A. Lavatory Manufacturers:
 1. American Standard, Inc: www.americanstandard-us.com.
 2. Gerber Plumbing Fixtures LLC: www.gerberonline.com.
 3. Kohler Company: www.kohler.com.
 4. Zurn Industries, Inc: www.zurn.com.
 5. Substitutions: See Section 01 6000 - Product Requirements.
- B. Vitreous China Wall Hung Basin: ASME A112.19.2; vitreous china wall hung lavatory, 20 by 18.25 inch (508 by 464 mm) minimum, with 4 inch (100 mm) high back, rectangular basin with splash lip, front overflow, and soap depression.
 1. Drilling Centers: 4 inch (100 mm).
- C. Supply Faucet Manufacturers:
 1. American Standard, Inc: www.americanstandard-us.com.
 2. Kohler Company: www.kohler.com.
 3. Zurn Industries, Inc: www.zurn.com.
 4. Substitutions: See Section 01 6000 - Product Requirements.
- D. Supply Faucet: ASME A112.18.1; chrome plated combination supply fitting with pop-up waste, water economy aerator with maximum flow of 2.2 gallons per minute (8.3 liters per minute), indexed handles.
- E. Accessories:
 1. Chrome plated 17 gage, 0.0538 inch (1.37 mm) brass P-trap with clean-out plug and arm with escutcheon.
 2. Rigid supplies.

2.06 SINKS

- A. Sink Manufacturers:
 1. American Standard, Inc: www.americanstandard-us.com.
 2. Kohler Company: www.kohler.com.
 3. Substitutions: See Section 01 6000 - Product Requirements.
- B. Single Compartment Bowl: ASME A112.19.3; 25.25 by 22 by 9 inch (641 by 559 by 229 mm) outside dimensions 20 gage, 0.0359 inch (0.91 mm) thick, Type 302 stainless steel, self rimming and undercoated, with ledge back drilled for trim.
 1. Drain: 3-1/2 inch (90 mm) crumb cup and tailpiece.
- C. Double Compartment Bowl: ASME A112.19.3; 33.375 by 22 by 9 inch (848 by 559 by 229 mm) outside dimensions 20 gage, 0.0359 inch (0.91 mm) thick, Type 302 stainless steel, self rimming and undercoated, with ledge back drilled for trim.
 1. Drain: 3-1/2 inch (90 mm) crumb cup and tailpiece.

2.07 SHOWERS

- A. Shower Manufacturers:
 1. American Standard, Inc: www.americanstandard-us.com.
 2. Aqua Glass Corporation: www.aquaglass.com.
 3. Jacuzzi: www.jacuzzi.com.
 4. Kohler Company: www.kohler.com.
 5. Aker by Maax: www.akerbymaxx.com.
 6. Substitutions: See Section 01 6000 - Product Requirements.
- B. Cabinet: ANSI Z124.1.2, 39 by 39 by 79 inches (991 by 991 by 2007 mm) with integral receptor, soap dish, integral seat, removable chrome plated strainer, tail piece, white color.

- C. Trim: ASME A112.18.1; concealed shower supply with pressure balanced mixing valves, integral service stops, bent shower arm with adjustable spray ball joint shower head with maximum flow, and escutcheon.
- D. Shower Head:
 1. ASME A112.18.1; chrome plated vandal-proof institutional head with integral wall bracket, built-in 2.5 gpm (0.16 L/s) flow control.

2.08 ELECTRIC WATER COOLERS

- A. Electric Water Cooler Manufacturers:
 1. Elkay Manufacturing Company: www.elkay.com.
 2. Haws Corporation: www.hawsc.com.
 3. Oasis, a Lynn Tilton Company: www.oasiscoolers.com
 4. Substitutions: See Section 01 6000 - Product Requirements.
- B. Water Cooler: Electric, mechanically refrigerated; surface handicapped mounted; stainless steel top, vinyl on steel body, elevated anti-squirt bubbler with stream guard, automatic stream regulator, push button, mounting bracket; integral air cooled condenser and stainless steel grille.
 1. Capacity: 8 gallons per hour (30.3 liters per hour) of 50 degrees F (10 degrees C) water with inlet at 80 degrees F (27 degrees C) and room temperature of 90 degrees F (32 degrees C), when tested in accordance with ASHRAE Std 18.
 2. Electrical: 115 V, 60 Hertz compressor, 6 foot (2 m) cord and plug for connection to electric wiring system including grounding connector.

2.09 SERVICE SINKS

- A. Service Sink Manufacturers:
 1. American Standard, Inc: www.americanstandard-us.com.
 2. Commercial Enameling Company: www.cecosinks.com.
 3. Elkay Manufacturing Company: www.elkay.com.
 4. Gerber Plumbing Fixtures LLC: www.gerberonline.com.
 5. Just Manufacturing Company: www.justmfg.com.
 6. Zurn Industries, Inc: www.zurn.com.
 7. Fiat Products: www.fiatproducts.com.
 8. Substitutions: See Section 01 6000 - Product Requirements.
- B. Bowl: 24 by 24 by 10 inch (600 by 600 by 250 mm) high white molded stone, floor mounted, with one inch (25 mm) wide shoulders, vinyl bumper guard, stainless steel strainer.
- C. Trim: ASME A112.18.1 exposed wall type supply with cross handles, spout wall brace, vacuum breaker, hose end spout, strainers, eccentric adjustable inlets, integral screwdriver stops with covering caps and adjustable threaded wall flanges.
- D. Accessories:
 1. 5 feet (1.5 m) of 1/2 inch (13 mm) diameter plain end reinforced plastic hose.
 2. Hose clamp hanger.
 3. Mop hanger.

2.10 EMERGENCY EYE AND FACE WASH

- A. Emergency Wash Manufacturers:
 1. Haws Corporation: www.hawsc.com.
 2. Therm-Omega-Tech, Inc: www.thermomegatech.com.
 3. Gaurdian Equipment: www.gesafety.com.
 4. Substitutions: See Section 01 6000 - Product Requirements.
- B. Emergency Wash: ANSI Z358.1; wall-mounted, self-cleaning, non-clogging eye and face wash with quick opening, full-flow valves, stainless steel eye and face wash receptor, twin eye wash heads and face spray ring, stainless steel dust cover, copper alloy control valve and fittings.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that walls and floor finishes are prepared and ready for installation of fixtures.
- B. Verify that electric power is available and of the correct characteristics.
- C. Confirm that millwork is constructed with adequate provision for the installation of counter top lavatories and sinks.

3.02 PREPARATION

- A. Rough-in fixture piping connections in accordance with minimum sizes indicated in fixture rough-in schedule for particular fixtures.

3.03 INSTALLATION

- A. Install each fixture with trap, easily removable for servicing and cleaning.
- B. Provide chrome plated rigid or flexible supplies to fixtures with loose key stops, reducers, and escutcheons.
- C. Install components level and plumb.
- D. Install and secure fixtures in place with wall supports and bolts.
- E. Solidly attach water closets to floor with lag screws. Lead flashing is not intended hold fixture in place.

3.04 INTERFACE WITH WORK OF OTHER SECTIONS

- A. Review millwork shop drawings. Confirm location and size of fixtures and openings before rough-in and installation.

3.05 ADJUSTING

- A. Adjust stops or valves for intended water flow rate to fixtures without splashing, noise, or overflow.

3.06 CLEANING

- A. Clean plumbing fixtures and equipment.
- B. See Section 01 7419 - Construction Waste Management and Disposal, for additional requirements.

3.07 PROTECTION

- A. Protect installed products from damage due to subsequent construction operations.
- B. Repair or replace damaged products before Date of Substantial Completion.

END OF SECTION

SECTION 23 0513

COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. General construction and requirements.
- B. Applications.
- C. Single phase electric motors.

1.02 RELATED REQUIREMENTS

- A. Section 26 2717 - Equipment Wiring: Electrical characteristics and wiring connections.

1.03 REFERENCE STANDARDS

- A. NEMA MG 1 - Motors and Generators; 2014.
- B. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide wiring diagrams with electrical characteristics and connection requirements.
- C. Test Reports: Indicate test results verifying nominal efficiency and power factor for three phase motors larger than 1/2 horsepower.
- D. Manufacturer's Installation Instructions: Indicate setting, mechanical connections, lubrication, and wiring instructions.
- E. Operation Data: Include instructions for safe operating procedures.
- F. Maintenance Data: Include assembly drawings, bearing data including replacement sizes, and lubrication instructions.

1.05 QUALITY ASSURANCE

- A. Conform to NFPA 70.
- B. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Protect motors stored on site from weather and moisture by maintaining factory covers and suitable weather-proof covering. For extended outdoor storage, remove motors from equipment and store separately.

1.07 WARRANTY

- A. See Section 01 7800 - Closeout Submittals for additional warranty requirements.
- B. Provide five year manufacturer warranty for motors larger than 20 horsepower.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Baldor Electric Company/ABB Group: www.baldor.com.
- B. Leeson Electric Corporation: www.leeson.com.
- C. Regal-Beloit Corporation (Century): www.centuryelectricmotor.com.
- D. Substitutions: See Section 01 6000 - Product Requirements.

2.02 GENERAL CONSTRUCTION AND REQUIREMENTS

- A. Electrical Service: Refer to Section 26 2717 for required electrical characteristics.

- B. Nominal Efficiency:
 1. Open Motor with Two Poles: 82.5.
 2. Open Motor with Four Poles: 82.5.
 3. Open Motor with Six Poles: 50.0.
 4. Enclosed Motor with Two Poles: 75.5.
 5. Enclosed Motor with Four Poles: 82.5.
 6. Enclosed Motor with Six Poles: 50.0.
- C. Construction:
 1. Open drip-proof type except where specifically noted otherwise.
 2. Design for continuous operation in 104 degrees F (40 degrees C) environment.
 3. Design for temperature rise in accordance with NEMA MG 1 limits for insulation class, service factor, and motor enclosure type.
 4. Motors with frame sizes 254T and larger: Energy efficient type.
- D. Explosion-Proof Motors: UL approved and labelled for hazard classification, with over temperature protection.
- E. Visible Nameplate: Indicating motor horsepower, voltage, phase, cycles, RPM, full load amps, locked rotor amps, frame size, manufacturer's name and model number, service factor, power factor, efficiency.
- F. Wiring Terminations:
 1. Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to NFPA 70, threaded for conduit.
 2. For fractional horsepower motors where connection is made directly, provide threaded conduit connection in end frame.

2.03 APPLICATIONS

- A. Exception: Motors less than 250 watts, for intermittent service may be the equipment manufacturer's standard and need not conform to these specifications.
- B. Single phase motors for shaft mounted fans, oil burners, and centrifugal pumps: Split phase type.
- C. Single phase motors for shaft mounted fans or blowers: Permanent split capacitor type.
- D. Single phase motors for fans, pumps, blowers, and air compressors: Capacitor start type.
- E. Single phase motors for fans, blowers, and pumps: Capacitor start, capacitor run type.
- F. Motors located in exterior locations, wet air streams downstream of sprayed coil dehumidifiers, draw through cooling towers, air cooled condensers, humidifiers, direct drive axial fans, roll filters, explosion proof environments, and dust collection systems: Totally enclosed type.
- G. Motors located in outdoors, in wet air streams downstream of sprayed coil dehumidifiers, in draw through cooling towers, and in humidifiers: Totally enclosed weatherproof epoxy-treated type.
- H. Motors located outdoors and in draw through cooling towers: Totally enclosed weatherproof epoxy-sealed type.

2.04 SINGLE PHASE POWER - SPLIT PHASE MOTORS

- A. Starting Torque: Less than 150 percent of full load torque.
- B. Starting Current: Up to seven times full load current.
- C. Breakdown Torque: Approximately 200 percent of full load torque.
- D. Drip-proof Enclosure: Class A (50 degrees C temperature rise) insulation, NEMA Service Factor, prelubricated sleeve or ball bearings.
- E. Enclosed Motors: Class A (50 degrees C temperature rise) insulation, 1.0 Service Factor, prelubricated ball bearings.

2.05 SINGLE PHASE POWER - PERMANENT-SPLIT CAPACITOR MOTORS

- A. Starting Torque: Exceeding one fourth of full load torque.
- B. Starting Current: Up to six times full load current.
- C. Multiple Speed: Through tapped windings.
- D. Open Drip-proof or Enclosed Air Over Enclosure: Class A (50 degrees C temperature rise) insulation, minimum 1.0 Service Factor, prelubricated sleeve or ball bearings, automatic reset overload protector.

2.06 SINGLE PHASE POWER - CAPACITOR START MOTORS

- A. Starting Torque: Three times full load torque.
- B. Starting Current: Less than five times full load current.
- C. Pull-up Torque: Up to 350 percent of full load torque.
- D. Breakdown Torque: Approximately 250 percent of full load torque.
- E. Motors: Capacitor in series with starting winding; provide capacitor-start/capacitor-run motors with two capacitors in parallel with run capacitor remaining in circuit at operating speeds.
- F. Drip-proof Enclosure: Class A (50 degrees C temperature rise) insulation, NEMA Service Factor, prelubricated sleeve bearings.
- G. Enclosed Motors: Class A (50 degrees C temperature rise) insulation, 1.0 Service Factor, prelubricated ball bearings.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install securely on firm foundation. Mount ball bearing motors with shaft in any position.
- C. Check line voltage and phase and ensure agreement with nameplate.

END OF SECTION

SECTION 23 0553
IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Tags.
- B. Stencils.
- C. Pipe markers.
- D. Ceiling tacks.

1.02 RELATED REQUIREMENTS

- A. Section 09 9123 - Interior Painting: Identification painting.

1.03 REFERENCE STANDARDS

- A. ASME A13.1 - Scheme for the Identification of Piping Systems; 2015.
- B. ASTM D709 - Standard Specification for Laminated Thermosetting Materials; 2016.

1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.
- B. List: Submit list of wording, symbols, letter size, and color coding for mechanical identification.
- C. Chart and Schedule: Submit valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.
- D. Product Data: Provide manufacturers catalog literature for each product required.
- E. Manufacturer's Installation Instructions: Indicate special procedures, and installation.
- F. Project Record Documents: Record actual locations of tagged valves.

PART 2 PRODUCTS

2.01 IDENTIFICATION APPLICATIONS

- A. Air Handling Units: Nameplates.
- B. Automatic Controls: Tags. Key to control schematic.
- C. Control Panels: Nameplates.
- D. Dampers: Ceiling tacks, where located above lay-in ceiling.
- E. Ductwork: Stencilled painting.
- F. Instrumentation: Tags.
- G. Piping: Pipe markers.
- H. Small-sized Equipment: Tags.
- I. Thermostats: Nameplates.

2.02 NAMEPLATES

- A. Manufacturers:
 - 1. Advanced Graphic Engraving, LLC: www.advancedgraphicengraving.com.
 - 2. Brimar Industries, Inc: www.pipemarker.com.
 - 3. Kolbi Pipe Marker Co: www.kolbipipemarkers.com.
 - 4. Seton Identification Products, a Tricor Direct Company: www.seton.com.
- B. Letter Color: White.
- C. Letter Height: 1/4 inch (6 mm).
- D. Background Color: Black.
- E. Plastic: Conform to ASTM D709.

2.03 TAGS

- A. Manufacturers:
 - 1. Advanced Graphic Engraving: www.advancedgraphicengraving.com.
 - 2. Brady Corporation: www.bradycorp.com.
 - 3. Brimar Industries, Inc: www.pipemarker.com.
 - 4. Kolbi Pipe Marker Co: www.kolbipipemarkers.com.
 - 5. Seton Identification Products, a Tricor Company: www.seton.com.
- B. Plastic Tags: Laminated three-layer plastic with engraved black letters on light contrasting background color. Tag size minimum 1-1/2 inch (40 mm) diameter.
- C. Metal Tags: Brass with stamped letters; tag size minimum 1-1/2 inch (40 mm) diameter with smooth edges.

2.04 STENCILS

- A. Stencils: With clean cut symbols and letters of following size:
 - 1. 3/4 to 1-1/4 inch (20-30 mm) Outside Diameter of Insulation or Pipe: 8 inch (200 mm) long color field, 1/2 inch (15 mm) high letters.
 - 2. 1-1/2 to 2 inch (40-50 mm) Outside Diameter of Insulation or Pipe: 8 inch (200 mm) long color field, 3/4 inch (20 mm) high letters.
 - 3. 2-1/2 to 6 inch (65-150 mm) Outside Diameter of Insulation or Pipe: 12 inch (300 mm) long color field, 1-1/4 inch (30 mm) high letters.
 - 4. 8 to 10 inch (200-250 mm) Outside Diameter of Insulation or Pipe: 24 inch (600 mm) long color field, 2-1/2 inch (65 mm) high letters.
 - 5. Over 10 inch (250 mm) Outside Diameter of Insulation or Pipe: 32 inch (800 mm) long color field, 3-1/2 inch (90 mm) high letters.
 - 6. Ductwork and Equipment: 2-1/2 inch (65 mm) high letters.
- B. Stencil Paint: As specified in Section 09 9123, semi-gloss enamel, colors conforming to ASME A13.1.

2.05 PIPE MARKERS

- A. Manufacturers:
 - 1. Brady Corporation: www.bradycorp.com.
 - 2. Brimar Industries, Inc: www.pipemarker.com.
 - 3. Kolbi Pipe Marker Co: www.kolbipipemarkers.com.
 - 4. MIFAB, Inc: www.mifab.com.
 - 5. Seton Identification Products, a Tricor Company: www.seton.com.
- B. Color: Conform to ASME A13.1.
- C. Plastic Pipe Markers: Factory fabricated, flexible, semi-rigid plastic, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and identification of fluid being conveyed.
- D. Plastic Tape Pipe Markers: Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings.

2.06 CEILING TACKS

- A. Manufacturers:
 - 1. Craftmark: www.craftmarkid.com.
- B. Description: Steel with 3/4 inch (20 mm) diameter color coded head.

PART 3 EXECUTION

3.01 PREPARATION

- A. Degrease and clean surfaces to receive adhesive for identification materials.
- B. Prepare surfaces in accordance with Section 09 9123 for stencil painting.

3.02 INSTALLATION

- A. Install nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer.
- B. Install tags with corrosion resistant chain.
- C. Apply stencil painting in accordance with Section 09 9123.
- D. Install plastic pipe markers in accordance with manufacturer's instructions.
- E. Install plastic tape pipe markers complete around pipe in accordance with manufacturer's instructions.
- F. Use tags on piping 3/4 inch (20 mm) diameter and smaller.
 - 1. Identify service, flow direction, and pressure.
 - 2. Install in clear view and align with axis of piping.
 - 3. Locate identification not to exceed 20 feet (6 m) on straight runs including risers and drops, adjacent to each valve and Tee, at each side of penetration of structure or enclosure, and at each obstruction.
- G. Install ductwork with stencilled painting. Identify with air handling unit identification number and area served. Locate identification at air handling unit, at each side of penetration of structure or enclosure, and at each obstruction.
- H. Locate ceiling tacks to locate valves or dampers above lay-in panel ceilings. Locate in corner of panel closest to equipment.

END OF SECTION

SECTION 23 0593
TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Testing, adjustment, and balancing of air systems.
- B. Measurement of final operating condition of HVAC systems.

1.02 RELATED REQUIREMENTS

- A. Section 01 4000 - Quality Requirements: Employment of testing agency and payment for services.

1.03 REFERENCE STANDARDS

- A. AABC MN-1 - AABC National Standards for Total System Balance; 2002.
- B. ASHRAE Std 111 - Measurement, Testing, Adjusting, and Balancing of Building HVAC Systems; 2008.
- C. NEBB (TAB) - Procedural Standards for Testing Adjusting and Balancing of Environmental Systems; 2015, Eighth Edition.
- D. SMACNA (TAB) - HVAC Systems Testing, Adjusting and Balancing; 2002.

1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Installer Qualifications: Submit name of adjusting and balancing agency and TAB supervisor for approval within 30 days after award of Contract.
- C. Final Report: Indicate deficiencies in systems that would prevent proper testing, adjusting, and balancing of systems and equipment to achieve specified performance.
 - 1. Submit under provisions of Section 01 4000.
 - 2. Submit to the the Construction Manager within two weeks after completion of testing, adjusting, and balancing.
 - 3. Revise TAB plan to reflect actual procedures and submit as part of final report.
 - 4. Submit draft copies of report for review prior to final acceptance of Project. Provide final copies for Architect and for inclusion in operating and maintenance manuals.
 - 5. Provide reports in soft cover, letter size, 3-ring binder manuals, complete with index page and indexing tabs, with cover identification at front and side. Include set of reduced drawings with air outlets and equipment identified to correspond with data sheets, and indicating thermostat locations.
 - 6. Include actual instrument list, with manufacturer name, serial number, and date of calibration.
 - 7. Form of Test Reports: Where the TAB standard being followed recommends a report format use that; otherwise, follow ASHRAE Std 111.
 - 8. Units of Measure: Report data in both I-P (inch-pound) and SI (metric) units.
- D. Project Record Documents: Record actual locations of flow measuring stations and balancing valves and rough setting.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 GENERAL REQUIREMENTS

- A. Perform total system balance in accordance with one of the following:
 - 1. AABC MN-1, AABC National Standards for Total System Balance.
 - 2. NEBB Procedural Standards for Testing Adjusting Balancing of Environmental Systems.
 - 3. SMACNA (TAB).
 - 4. Maintain at least one copy of the standard to be used at project site at all times.

- B. Begin work after completion of systems to be tested, adjusted, or balanced and complete work prior to Substantial Completion of the project.
- C. Where HVAC systems and/or components interface with life safety systems, including fire and smoke detection, alarm, and control, coordinate scheduling and testing and inspection procedures with the authorities having jurisdiction.
- D. TAB Agency Qualifications:
 - 1. Company specializing in the testing, adjusting, and balancing of systems specified in this section.
 - 2. Having minimum of three years documented experience.
 - 3. Certified by one of the following:
 - a. AABC, Associated Air Balance Council: www.aabchq.com; upon completion submit AABC National Performance Guaranty.
 - b. NEBB, National Environmental Balancing Bureau: www.nebb.org.
 - c. TABB, The Testing, Adjusting, and Balancing Bureau of National Energy Management Institute: www.tabbcertified.org.
- E. TAB Supervisor and Technician Qualifications: Certified by same organization as TAB agency.

3.02 EXAMINATION

- A. Verify that systems are complete and operable before commencing work. Ensure the following conditions:
 - 1. Systems are started and operating in a safe and normal condition.
 - 2. Temperature control systems are installed complete and operable.
 - 3. Proper thermal overload protection is in place for electrical equipment.
 - 4. Final filters are clean and in place. If required, install temporary media in addition to final filters.
 - 5. Duct systems are clean of debris.
 - 6. Fans are rotating correctly.
 - 7. Fire and volume dampers are in place and open.
 - 8. Air coil fins are cleaned and combed.
 - 9. Access doors are closed and duct end caps are in place.
 - 10. Air outlets are installed and connected.
 - 11. Duct system leakage is minimized.
- B. Submit field reports. Report defects and deficiencies that will or could prevent proper system balance.
- C. Beginning of work means acceptance of existing conditions.

3.03 PREPARATION

- A. Provide instruments required for testing, adjusting, and balancing operations. Make instruments available to Architect to facilitate spot checks during testing.
- B. Provide additional balancing devices as required.

3.04 ADJUSTMENT TOLERANCES

- A. Air Handling Systems: Adjust to within plus or minus 10 percent of design for supply systems and plus or minus 10 percent of design for return and exhaust systems.
- B. Air Outlets and Inlets: Adjust total to within plus 10 percent and minus 10 percent of design to space. Adjust outlets and inlets in space to within plus or minus 10 percent of design.

3.05 RECORDING AND ADJUSTING

- A. Field Logs: Maintain written logs including:
 - 1. Running log of events and issues.
 - 2. Discrepancies, deficient or uncompleted work by others.
 - 3. Contract interpretation requests.
 - 4. Lists of completed tests.

- B. Ensure recorded data represents actual measured or observed conditions.
- C. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.
- D. Mark on the drawings the locations where traverse and other critical measurements were taken and cross reference the location in the final report.
- E. After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.
- F. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.
- G. At final inspection, recheck random selections of data recorded in report. Recheck points or areas as selected and witnessed by the Owner.
- H. Check and adjust systems approximately six months after final acceptance and submit report.

3.06 AIR SYSTEM PROCEDURE

- A. Adjust air handling and distribution systems to provide required or design supply, return, and exhaust air quantities at site altitude.
- B. Make air quantity measurements in ducts by Pitot tube traverse of entire cross sectional area of duct.
- C. Measure air quantities at air inlets and outlets.
- D. Adjust distribution system to obtain uniform space temperatures free from objectionable drafts and noise.
- E. Use volume control devices to regulate air quantities only to extend that adjustments do not create objectionable air motion or sound levels. Effect volume control by duct internal devices such as dampers and splitters.
- F. Vary total system air quantities by adjustment of fan speeds. Provide drive changes required. Vary branch air quantities by damper regulation.
- G. Provide system schematic with required and actual air quantities recorded at each outlet or inlet.
- H. Measure static air pressure conditions on air supply units, including filter and coil pressure drops, and total pressure across the fan. Make allowances for 50 percent loading of filters.
- I. Adjust outside air automatic dampers, outside air, return air, and exhaust dampers for design conditions.
- J. Measure temperature conditions across outside air, return air, and exhaust dampers to check leakage.
- K. Where modulating dampers are provided, take measurements and balance at extreme conditions. Balance variable volume systems at maximum air flow rate, full cooling, and at minimum air flow rate, full heating.
- L. Measure building static pressure and adjust supply, return, and exhaust air systems to provide required relationship between each to maintain approximately 0.05 inches (12.5 Pa) positive static pressure near the building entries.

3.07 SCOPE

- A. Test, adjust, and balance the following:
 - 1. Direct Fired Furnaces.
 - 2. Air Handling Units.
 - 3. Fans.
 - 4. Air Inlets and Outlets.

3.08 MINIMUM DATA TO BE REPORTED

- A. Air Moving Equipment:
 - 1. Location.

2. Manufacturer.
 3. Model number.
 4. Serial number.
 5. Arrangement/Class/Discharge.
 6. Air flow, specified and actual.
 7. Return air flow, specified and actual.
 8. Outside air flow, specified and actual.
 9. Total static pressure (total external), specified and actual.
 10. Inlet pressure.
 11. Discharge pressure.
 12. Sheave Make/Size/Bore.
 13. Number of Belts/Make/Size.
 14. Fan RPM.
- B. Exhaust Fans:
1. Location.
 2. Manufacturer.
 3. Model number.
 4. Serial number.
 5. Air flow, specified and actual.
 6. Total static pressure (total external), specified and actual.
 7. Inlet pressure.
 8. Discharge pressure.
 9. Sheave Make/Size/Bore.
 10. Number of Belts/Make/Size.
 11. Fan RPM.
- C. Air Distribution Tests:
1. Room number/location.
 2. Design velocity.
 3. Design air flow.
 4. Test (final) velocity.
 5. Test (final) air flow.
 6. Percent of design air flow.

END OF SECTION

**SECTION 23 0713
DUCT INSULATION**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Duct insulation.
- B. Duct liner.
- C. Insulation jackets.

1.02 RELATED REQUIREMENTS

- A. Section 09 9113 - Exterior Painting: Painting insulation jackets.
- B. Section 09 9123 - Interior Painting: Painting insulation jackets.
- C. Section 23 0553 - Identification for HVAC Piping and Equipment.
- D. Section 23 3100 - HVAC Ducts and Casings: Glass fiber ducts.

1.03 REFERENCE STANDARDS

- A. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2014.
- B. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric); 2014.
- C. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus; 2015.
- D. ASTM C534/C534M - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form; 2016.
- E. ASTM C553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications; 2013.
- F. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation; 2014.
- G. ASTM C916 - Standard Specification for Adhesives for Duct Thermal Insulation; 2014.
- H. ASTM C1071 - Standard Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material); 2012.
- I. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2016.
- J. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials; 2016.
- K. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi; 2015.
- L. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible; 2005 (Rev. 2009).
- M. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.
- C. Manufacturer's Instructions: Indicate installation procedures necessary to ensure acceptable workmanship and that installation standards will be achieved.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products of the type specified in this section with not less than three years of experience.

- B. Applicator Qualifications: Company specializing in performing the type of work specified in this section, with minimum three years of experience.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Accept materials on site in original factory packaging, labelled with manufacturer's identification, including product density and thickness.
- B. Protect insulation from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original wrapping.

1.07 FIELD CONDITIONS

- A. Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics, and insulation cements.
- B. Maintain temperature during and after installation for minimum period of 24 hours.

PART 2 PRODUCTS

2.01 REGULATORY REQUIREMENTS

- A. Surface Burning Characteristics: Flame spread index/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84 or UL 723.

2.02 GLASS FIBER, FLEXIBLE

- A. Manufacturer:
 - 1. Knauf Insulation: www.knaufinsulation.com.
 - 2. Johns Manville: www.jm.com.
 - 3. Owens Corning Corporation: www.ocbuildingspec.com.
 - 4. CertainTeed Corporation: www.certainteed.com.
 - 5. Substitutions: See Section 01 6000 - Product Requirements.
- B. Insulation: ASTM C553; flexible, noncombustible blanket.
 - 1. 'K' ('Ksi') value: 0.36 at 75 degrees F (0.052 at 24 degrees C), when tested in accordance with ASTM C518.
 - 2. Maximum Service Temperature: 1200 degrees F (649 degrees C).
 - 3. Maximum Water Vapor Absorption: 5.0 percent by weight.
- C. Vapor Barrier Jacket:
 - 1. Kraft paper with glass fiber yarn and bonded to aluminized film.
 - 2. Moisture Vapor Permeability: 0.02 perm inch (0.029 ng/Pa s m), when tested in accordance with ASTM E96/E96M.
 - 3. Secure with pressure sensitive tape.
- D. Vapor Barrier Tape:
 - 1. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film, with pressure sensitive rubber based adhesive.
- E. Outdoor Vapor Barrier Mastic:
- F. Tie Wire: Annealed steel, 16 gage, 0.0508 inch diameter (1.29 mm diameter).

2.03 GLASS FIBER, RIGID

- A. Manufacturer:
 - 1. Knauf Insulation: www.knaufinsulation.com.
 - 2. Johns Manville: www.jm.com.
 - 3. Owens Corning Corporation; 700 Series FIBERGLAS Insulation: www.ocbuildingspec.com/sle.
 - 4. CertainTeed Corporation: www.certainteed.com.
 - 5. Substitutions: See Section 01 6000 - Product Requirements.
- B. Insulation: ASTM C612; rigid, noncombustible blanket.
 - 1. 'K' ('Ksi') Value: 0.24 at 75 degrees F (0.036 at 24 degrees C), when tested in accordance with ASTM C518.

2. Maximum Service Temperature: 450 degrees F (232 degrees C).
 3. Maximum Water Vapor Absorption: 5.0 percent.
 4. Maximum Density: 8.0 lb/cu ft (128 kg/cu m).
- C. Vapor Barrier Jacket:
1. Kraft paper with glass fiber yarn and bonded to aluminized film.
 2. Moisture Vapor Permeability: 0.02 perm inch (0.029 ng/Pa s m), when tested in accordance with ASTM E96/E96M.
 3. Secure with pressure sensitive tape.
- D. Vapor Barrier Tape:
1. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film, with pressure sensitive rubber based adhesive.
- E. Indoor Vapor Barrier Finish:
1. Cloth: Untreated; 9 oz/sq yd (305 g/sq m) weight, glass fabric.
 2. Vinyl emulsion type acrylic, compatible with insulation, black color.

2.04 FLEXIBLE ELASTOMERIC CELLULAR INSULATION

- A. Manufacturer:
1. Aeroflex USA, Inc: www.aeroflexusa.com.
 2. Armacell LLC: www.armacell.us.
 3. K-Flex USA LLC: www.kflexusa.com.
 4. Substitutions: See Section 01 6000 - Product Requirements.
- B. Insulation: Preformed flexible elastomeric cellular rubber insulation complying with ASTM C534/C534M Grade 3, in sheet form.
1. Minimum Service Temperature: Minus 40 degrees F (Minus 40 degrees C).
 2. Maximum Service Temperature: 220 degrees F (104 degrees C).
 3. Connection: Waterproof vapor barrier adhesive.
- C. Elastomeric Foam Adhesive: Air dried, contact adhesive, compatible with insulation.

2.05 JACKETS

- A. Canvas Jacket: UL listed 6 oz/sq yd (220 g/sq m) plain weave cotton fabric treated with dilute fire retardant lagging adhesive.
1. Lagging Adhesive:
 - a. Compatible with insulation.
- B. Aluminum Jacket: ASTM B209 (ASTM B209M).
1. Thickness: 0.016 inch (0.40 mm) sheet.
 2. Finish: Smooth.
 3. Joining: Longitudinal slip joints and 2 inch (50 mm) laps.
 4. Fittings: 0.016 inch (0.4 mm) thick die shaped fitting covers with factory attached protective liner.
 5. Metal Jacket Bands: 3/8 inch (10 mm) wide; 0.015 inch (0.38 mm) thick aluminum.
 6. Metal Jacket Bands: 3/8 inch (10 mm) wide; 0.010 inch (0.25 mm) thick stainless steel.

2.06 DUCT LINER

- A. Manufacturers:
1. Knauf Insulation: www.knaufinsulation.com.
 2. Johns Manville: www.jm.com.
 3. Owens Corning Corporation: www.ocbuildingspec.com.
 4. CertainTeed Corporation: www.certainteed.com.
 5. Substitutions: See Section 01 6000 - Product Requirements.
- B. Insulation: Non-corrosive, incombustible glass fiber complying with ASTM C1071; flexible blanket, rigid board, and preformed round liner board; impregnated surface and edges coated with poly vinyl acetate polymer, acrylic polymer, or black composite.
1. Fungal Resistance: No growth when tested according to ASTM G21.

2. Apparent Thermal Conductivity: Maximum of 0.31 at 75 degrees F (0.045 at 24 degrees C).
 3. Service Temperature: Up to 250 degrees F (121 degrees C).
 4. Rated Velocity on Coated Air Side for Air Erosion: 5,000 fpm (25.4 m/s), minimum.
 5. Minimum Noise Reduction Coefficients:
 - a. 1/2 inch (13 mm) Thickness: 0.30.
 - b. 1 inch (25 mm) Thickness: 0.45.
 - c. 1-1/2 inches (40 mm) Thickness: 0.60.
 - d. 2 inch (50 mm) Thickness: 0.70.
- C. Adhesive: Waterproof, fire-retardant type, ASTM C916.
- D. Liner Fasteners: Galvanized steel, self-adhesive pad with integral head.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that ducts have been tested before applying insulation materials.
- B. Verify that surfaces are clean, foreign material removed, and dry.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install in accordance with NAIMA National Insulation Standards.
- C. Insulated ducts conveying air below ambient temperature:
 1. Provide insulation with vapor barrier jackets.
 2. Finish with tape and vapor barrier jacket.
 3. Continue insulation through walls, sleeves, hangers, and other duct penetrations.
 4. Insulate entire system including fittings, joints, flanges, fire dampers, flexible connections, and expansion joints.
- D. Insulated ducts conveying air above ambient temperature:
 1. Provide with or without standard vapor barrier jacket.
 2. Insulate fittings and joints. Where service access is required, bevel and seal ends of insulation.
- E. Ducts Exposed in Mechanical Equipment Rooms or Finished Spaces: Finish with canvas jacket sized for finish painting.
- F. Exterior Applications: Provide insulation with vapor barrier jacket. Cover with with calked aluminum jacket with seams located on bottom side of horizontal duct section.
- G. External Duct Insulation Application:
 1. Secure insulation with vapor barrier with wires and seal jacket joints with vapor barrier adhesive or tape to match jacket.
 2. Secure insulation without vapor barrier with staples, tape, or wires.
 3. Install without sag on underside of duct. Use adhesive or mechanical fasteners where necessary to prevent sagging. Lift duct off trapeze hangers and insert spacers.
 4. Seal vapor barrier penetrations by mechanical fasteners with vapor barrier adhesive.
 5. Stop and point insulation around access doors and damper operators to allow operation without disturbing wrapping.
- H. Duct and Plenum Liner Application:
 1. Adhere insulation with adhesive for 90 percent coverage.
 2. Secure insulation with mechanical liner fasteners. Refer to SMACNA (DCS) for spacing.
 3. Seal and smooth joints. Seal and coat transverse joints.
 4. Seal liner surface penetrations with adhesive.
 5. Duct dimensions indicated are net inside dimensions required for air flow. Increase duct size to allow for insulation thickness.

3.03 SCHEDULES

- A. Indoor Exposed Outside Air Intake Ducts:
 - Rigid Glass Fiber Duct Insulation: 2 inches (51 mm) thick.
 - Flexible Glass Fiber Duct Liner Insulation: 2 inches (51 mm) thick.
 - Rigid Glass Fiber Duct Liner Insulation: 2 inches (51 mm) thick.
- B. Indoor Concealed Outside Air Intake Ducts:
 - Flexible Glass Fiber Duct Insulation: 2 inches (51 mm) thick.
 - Flexible Glass Fiber Duct Liner Insulation: 2 inches (51 mm) thick.
 - Rigid Glass Fiber Duct Liner Insulation: 2 inches (51 mm) thick.
- C. Indoor Exposed Supply Ducts:
 - Rigid Glass Fiber Duct Insulation: 1 inches (25 mm) thick.
 - Flexible Glass Fiber Duct Liner Insulation: 1 inches (25 mm) thick.
 - Rigid Glass Fiber Duct Liner Insulation: 1 inches (25 mm) thick.
- D. Indoor Concealed Supply Ducts:
 - Flexible Glass Fiber Duct Insulation: 1-1/2 inches (38 mm) thick.
 - Flexible Glass Fiber Duct Liner Insulation: 1 inches (25 mm) thick.
 - Rigid Glass Fiber Duct Liner Insulation: 1 inches (25 mm) thick.
- E. Indoor Return and Transfer Ducts:
 - Flexible Glass Fiber Duct Liner Insulation: 1 inches (25 mm) thick.
 - Rigid Glass Fiber Duct Liner Insulation: 1 inches (25 mm) thick.
- F. Indoor Supply and Return Ducts in Unconditioned Spaces:
 - Flexible Glass Fiber Duct Insulation: 2 inches (51 mm) thick.
 - Flexible Glass Fiber Duct Liner Insulation: 2 inches (51 mm) thick.
 - Rigid Glass Fiber Duct Liner Insulation: 2 inches (51 mm) thick.
- G. Supply and Return Ducts Exposed to Outdoors:
 - Flexible Elastomeric Cellular Insulation: 2 inches (51 mm) thick with 60 mil adhered rubber (EPDM) or aluminum jacket.

END OF SECTION

SECTION 23 0719
HVAC PIPING INSULATION

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Piping insulation.
- B. Jackets and accessories.

1.02 RELATED REQUIREMENTS

- A. Section 07 8400 - Firestopping.
- B. Section 23 2300 - Refrigerant Piping: Placement of inserts.

1.03 REFERENCE STANDARDS

- A. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2014.
- B. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric); 2014.
- C. ASTM C177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus; 2013.
- D. ASTM C195 - Standard Specification for Mineral Fiber Thermal Insulating Cement; 2007 (Reapproved 2013).
- E. ASTM C449 - Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement; 2007 (Reapproved 2013).
- F. ASTM C534/C534M - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form; 2016.
- G. ASTM C547 - Standard Specification for Mineral Fiber Pipe Insulation; 2015.
- H. ASTM C795 - Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel; 2008 (Reapproved 2013).
- I. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2016.
- J. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials; 2016.
- K. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.
- C. Manufacturer's Instructions: Indicate installation procedures that ensure acceptable workmanship and installation standards will be achieved.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with not less than three years of documented experience.
- B. Applicator Qualifications: Company specializing in performing the type of work specified in this section with minimum three years of experience.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Accept materials on site, labeled with manufacturer's identification, product density, and thickness.

1.07 FIELD CONDITIONS

- A. Maintain ambient conditions required by manufacturers of each product.

- B. Maintain temperature before, during, and after installation for minimum of 24 hours.

PART 2 PRODUCTS

2.01 REGULATORY REQUIREMENTS

- A. Surface Burning Characteristics: Flame spread index/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84 or UL 723.

2.02 GLASS FIBER

- A. Manufacturers:
 - 1. CertainTeed Corporation: www.certainteed.com.
 - 2. Johns Manville Corporation: www.jm.com.
 - 3. Knauf Insulation: www.knaufinsulation.com.
 - 4. Owens Corning Corporation; Fiberglas Pipe Insulation ASJ: www.ocbuildingspec.com/sle.
 - 5. Owens Corning Corporation; VaporWick Pipe Insulation: www.ocbuildingspec.com/sle.
 - 6. Substitutions: See Section 01 6000 - Product Requirements.
- B. Insulation: ASTM C547; rigid molded, noncombustible.
 - 1. 'K' ('Ksi') Value: ASTM C177, 0.24 at 75 degrees F (0.035 at 24 degrees C).
 - 2. Maximum Service Temperature: 850 degrees F (454 degrees C).
 - 3. Maximum Moisture Absorption: 0.2 percent by volume.
- C. Insulation: ASTM C547 and ASTM C795; rigid molded, noncombustible, with wicking material to transport condensed water to the outside of the system for evaporation to the atmosphere.
 - 1. 'K' ('Ksi') Value: ASTM C177, 0.23 at 75 degrees F (0.034 at 24 degrees C).
 - 2. Maximum Service Temperature: 220 degrees F (104 degrees C).
 - 3. Maximum Moisture Absorption: 0.2 percent by volume.
- D. Vapor Barrier Jacket: White kraft paper with glass fiber yarn, bonded to aluminized film; moisture vapor transmission when tested in accordance with ASTM E96/E96M of 0.02 perm-inches (0.029 ng/Pa s m).
- E. Tie Wire: 0.048 inch (1.22 mm) stainless steel with twisted ends on maximum 12 inch (300 mm) centers.
- F. Vapor Barrier Lap Adhesive: Compatible with insulation.
- G. Insulating Cement/Mastic: ASTM C195; hydraulic setting on mineral wool.
- H. Fibrous Glass Fabric:
 - 1. Cloth: Untreated; 9 oz/sq yd (305 g/sq m) weight.
 - 2. Blanket: 1.0 lb/cu ft (16 kg/cu m) density.
 - 3. Weave: 5 by 5.
- I. Indoor Vapor Barrier Finish:
 - 1. Cloth: Untreated; 9 oz/sq yd (305 g/sq m) weight.
 - 2. Vinyl emulsion type acrylic, compatible with insulation, black color.
- J. Outdoor Vapor Barrier Mastic: Vinyl emulsion type acrylic or mastic, compatible with insulation, black color.
- K. Outdoor Breather Mastic: Vinyl emulsion type acrylic or mastic, compatible with insulation, black color.
- L. Insulating Cement: ASTM C449.

2.03 FLEXIBLE ELASTOMERIC CELLULAR INSULATION

- A. Manufacturer:
 - 1. Aeroflex USA, Inc: www.aeroflexusa.com.
 - 2. Armacell LLC: www.armacell.us.
 - 3. K-Flex USA LLC: www.kflexusa.com.
 - 4. Substitutions: See Section 01 6000 - Product Requirements.

- B. Insulation: Preformed flexible elastomeric cellular rubber insulation complying with ASTM C534/C534M Grade 3; use molded tubular material wherever possible.
 - 1. Minimum Service Temperature: Minus 40 degrees F (Minus 40 degrees C).
 - 2. Maximum Service Temperature: 220 degrees F (104 degrees C).
 - 3. Connection: Waterproof vapor barrier adhesive.
- C. Elastomeric Foam Adhesive: Air dried, contact adhesive, compatible with insulation.

2.04 JACKETS

- A. PVC Plastic.
 - 1. Manufacturers:
 - a. Johns Manville Corporation: www.jm.com.
 - b. Substitutions: See Section 01 6000 - Product Requirements.
 - 2. Jacket: One piece molded type fitting covers and sheet material, off-white color.
 - a. Minimum Service Temperature: 0 degrees F (minus 18 degrees C).
 - b. Maximum Service Temperature: 150 degrees F (66 degrees C).
 - c. Moisture Vapor Permeability: 0.002 perm inch (0.0029 ng/Pa s m), maximum, when tested in accordance with ASTM E96/E96M.
 - d. Thickness: 10 mil (0.25 mm).
 - e. Connections: Brush on welding adhesive.
 - 3. Covering Adhesive Mastic: Compatible with insulation.
- B. Aluminum Jacket: ASTM B209 (ASTM B209M) formed aluminum sheet.
 - 1. Thickness: 0.016 inch (0.40 mm) sheet.
 - 2. Finish: Smooth.
 - 3. Joining: Longitudinal slip joints and 2 inch (50 mm) laps.
 - 4. Fittings: 0.016 inch (0.4 mm) thick die shaped fitting covers with factory attached protective liner.
 - 5. Metal Jacket Bands: 3/8 inch (10 mm) wide; 0.010 inch (0.25 mm) thick stainless steel.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that piping has been tested before applying insulation materials.
- B. Verify that surfaces are clean and dry, with foreign material removed.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install in accordance with NAIMA National Insulation Standards.
- C. Exposed Piping: Locate insulation and cover seams in least visible locations.
- D. Insulated pipes conveying fluids below ambient temperature; insulate entire system including fittings, valves, unions, flanges, strainers, flexible connections, pump bodies, and expansion joints.
- E. Glass fiber insulated pipes conveying fluids below ambient temperature:
 - 1. Provide vapor barrier jackets, factory-applied or field-applied; secure with self-sealing longitudinal laps and butt strips with pressure sensitive adhesive. Secure with outward clinch expanding staples and vapor barrier mastic.
 - 2. Insulate fittings, joints, and valves with molded insulation of like material and thickness as adjacent pipe. Finish with glass cloth and vapor barrier adhesive or PVC fitting covers.
- F. For hot piping conveying fluids 140 degrees F (60 degrees C) or less, do not insulate flanges and unions at equipment, but bevel and seal ends of insulation.
- G. For hot piping conveying fluids over 140 degrees F (60 degrees C), insulate flanges and unions at equipment.
- H. Glass fiber insulated pipes conveying fluids above ambient temperature.

1. Provide standard jackets, with or without vapor barrier, factory-applied or field-applied. Secure with self-sealing longitudinal laps and butt strips with pressure sensitive adhesive. Secure with outward clinch expanding staples.
 2. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe. Finish with glass cloth and adhesive or PVC fitting covers.
- I. Inserts and Shields:
1. Application: Piping 1-1/2 inches (40 mm) diameter or larger.
 2. Shields: Galvanized steel between pipe hangers or pipe hanger rolls and inserts.
 3. Insert location: Between support shield and piping and under the finish jacket.
 4. Insert Configuration: Minimum 6 inches (150 mm) long, of same thickness and contour as adjoining insulation; may be factory fabricated.
 5. Insert Material: Hydrous calcium silicate insulation or other heavy density insulating material suitable for the planned temperature range.
- J. Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations. Finish at supports, protrusions, and interruptions. At fire separations, refer to Section 07 8400.
- K. Pipe Exposed in Mechanical Equipment Rooms or Finished Spaces (less than 10 feet (3 meters) above finished floor): Finish with PVC jacket and fitting covers.
- L. Exterior Applications: Provide vapor barrier jacket. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe, and finish with glass mesh reinforced vapor barrier cement. Cover with aluminum jacket with seams located on bottom side of horizontal piping. Provide two coats of UV resistant finish for flexible elastomeric cellular insulation without jacketing.

3.03 SCHEDULE

- A. Cooling Systems:
1. Condensate Drains from Cooling Coils:
 - Flexible Elastomeric Cellular Insulation: 3/4 inch (19 mm) thick.
 - Glass Fiber Insulation: 1 inches (25 mm) thick.
 2. Refrigerant Suction and Hot Gas:
 - Flexible Elastomeric Cellular Insulation: 1 inch (25 mm) thick.

END OF SECTION

**SECTION 23 0913
INSTRUMENTATION AND CONTROL DEVICES FOR HVAC**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Thermostats.
- B. Automatic dampers.
- C. Damper operators.
- D. Time clocks.

1.02 RELATED REQUIREMENTS

- A. Section 23 0993 - Sequence of Operations for HVAC Controls.
- B. Section 23 3300 - Air Duct Accessories: Installation of automatic dampers.
- C. Section 26 2717 - Equipment Wiring: Electrical characteristics and wiring connections.
- D. Section 26 2726 - Wiring Devices: Elevation of exposed components.

1.03 REFERENCE STANDARDS

- A. AMCA 500-D - Laboratory Methods of Testing Dampers for Rating; 2012.
- B. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2014.
- C. NEMA DC 3 - Residential Controls - Electrical Wall-Mounted Room Thermostats; 2013.
- D. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2015.
- E. UL 94 - Tests for Flammability of Plastic Materials for Parts in Devices and Appliances; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Sequencing: Ensure that utility connections are achieved in an orderly and expeditious manner.

1.05 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide description and engineering data for each control system component. Include sizing as requested. Provide data for each system component and software module.
- C. Shop Drawings: Indicate complete operating data, system drawings, wiring diagrams, and written detailed operational description of sequences. Submit schedule of valves indicating size, flow, and pressure drop for each valve. For automatic dampers indicate arrangement, velocities, and static pressure drops for each system.
- D. Manufacturer's Instructions: Provide for all manufactured components.
- E. Operation and Maintenance Data: Include inspection period, cleaning methods, recommended cleaning materials, and calibration tolerances.
- F. Project Record Documents: Record actual locations of control components, including panels, thermostats, and sensors. Accurately record actual location of control components, including panels, thermostats, and sensors.
 - 1. Revise shop drawings to reflect actual installation and operating sequences.
- G. Warranty: Submit manufacturers warranty and ensure forms have been filled out in Owner's name and registered with manufacturer.
- H. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 01 6000 - Product Requirements, for additional provisions.
 - 2. Extra Thermostats and Other Exposed Sensors: One of each type.

1.06 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.
- B. Installer Qualifications: Company specializing in performing the work of this section with minimum three years experience approved by manufacturer.
- C. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.

1.07 WARRANTY

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
- B. Correct defective Work within a five year period after Substantial Completion.
- C. Provide five year manufacturer's warranty for control air compressors.

PART 2 PRODUCTS

2.01 EQUIPMENT - GENERAL

- A. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.

2.02 CONTROL PANELS

- A. Unitized cabinet type for each system under automatic control with relays and controls mounted in cabinet and temperature indicators, pressure gauges, pilot lights, push buttons and switches flush on cabinet panel face.
- B. NEMA 250, general purpose utility enclosures with enamelled finished face panel.
- C. Provide common keying for all panels.

2.03 DAMPERS

- A. Performance: Test in accordance with AMCA 500-D.
- B. Frames: Galvanized steel, welded or riveted with corner reinforcement, minimum 12 gage, 0.1046 inch (2.66 mm).
- C. Blades: Galvanized steel, maximum blade size 8 inches (200 mm) wide, 48 inches (1200 mm) long, minimum 22 gage, 0.0299 inch (0.76 mm), attached to minimum 1/2 inch (13 mm) shafts with set screws.
- D. Blade Seals: Synthetic elastomeric inflatable mechanically attached, field replaceable.
- E. Jamb Seals: Spring stainless steel.
- F. Shaft Bearings: Oil impregnated sintered bronze.
- G. Linkage Bearings: Oil impregnated sintered bronze.
- H. Leakage: Less than one percent based on approach velocity of 2000 ft/min (10 m/sec) and 4 inches wg (1.0 kPa).
- I. Maximum Pressure Differential: 6 inches wg (1.5 kPa).
- J. Temperature Limits: -40 to 200 degrees F (-40 to 93 degrees C).

2.04 DAMPER OPERATORS

- A. General: Provide smooth proportional control with sufficient power for air velocities 20 percent greater than maximum design velocity and to provide tight seal against maximum system pressures. Provide spring return for two position control and for fail safe operation.
 - 1. Provide sufficient number of operators to achieve unrestricted movement throughout damper range.
 - 2. Provide one operator for maximum 36 sq ft (3.24 sq m) damper section.
- B. Pilot Positioners: Starting point adjustable from 2 to 12 psig (15 to 83 kPa) and operating span adjustable from 5 to 13 psig (35 to 90 kPa).
- C. Electric Operators:

1. Spring return, adjustable stroke motor having oil immersed gear train, with auxiliary end switch.
- D. Inlet Vane Operators:
1. High pressure with pilot positioners and sufficient force to move vanes when fan is started with vanes in closed position. Return vane operator to closed position on fan shutdown.

2.05 INPUT/OUTPUT SENSORS

- A. Temperature Sensors:
1. Use thermistor or RTD type temperature sensing elements with characteristics resistant to moisture, vibration, and other conditions consistent with the application without affecting accuracy and life expectancy.
 2. Construct RTD of nickel or platinum with base resistance of 1000 ohms at 70 degrees F (26 degrees C).
 3. 100 ohm platinum RTD is acceptable if used with project DDC controllers.
 4. Temperature sensing device must be compatible with project DDC controllers.
 5. Performance Characteristics:
 - a. RTD:
 - 1) Room Sensor Accuracy: Plus/minus 0.50 degrees F (0.28 degrees C) minimum.
 - 2) Duct Averaging Accuracy: Plus/minus 0.50 degrees F (0.28 degrees C) minimum.
 - 3) Chilled Water Accuracy: Plus/minus 0.50 degrees F (0.28 degrees C) minimum.
 - 4) All Other Accuracy: Plus/minus 0.75 degrees F (0.42 degrees C) minimum.
 - 5) Range: Minus 40 degrees F (Minus 40 degrees C) through 220 degrees F (104.4 degrees C) minimum.
 - b. Thermistor:
 - 1) Accuracy (All): Plus/minus 0.36 degrees F (0.20 degrees C) minimum.
 - 2) Range: Minus 25 degrees F (Minus 13 degrees C) through 122 degrees F (50 degrees C) minimum.
 - 3) Heat Dissipation Constant: 2.7 mW per degree C.
 - c. Temperature Transmitter:
 - 1) Accuracy: 0.10 degree F (0.06 degrees C) minimum or plus/minus 0.20 percent of span.
 - 2) Output: 4 - 20 mA.
 - d. Sensing Range:
 - 1) Provide limited range sensors if required to sense the range expected for a respective point.
 - 2) Use RTD type sensors for extended ranges beyond minus 30 degrees F (minus 34.4 degrees C) to 230 degrees F (114.4 degrees C).
 - 3) Use temperature transmitters in conjunction with RTD's when RTD's are incompatible with DDC controller direct temperature input.
 - e. Wire Resistance:
 - 1) Use appropriate wire size to limit temperature offset due to wire resistance to 1.0 degree F (0.56 degrees C) or use temperature transmitter when offset is greater than 1.0 degree F (0.56 degrees C) due to wire resistance.
 - 2) Compensate for wire resistance in software input definition when feature is available in the DDC controller.
 - f. Room Sensors: Locking cover matching the pneumatic thermostats used.
 - g. Outside Air Sensors: Watertight inlet fitting shielded from direct rays of the sun.
 - h. Immersion Temperature Sensors: A sensor encased in a corrosion-resistant probe with an indoor junction box service entry body.
 - i. Ceiling and Recessed Mount Temperature Sensors: Ceiling-mounted sensor in a low-profile housing.
 - j. Room Security Sensors: Stainless steel cover plate with insulated back and security screws.

- k. Room Temperature Sensors:
 - 1) Construct for surface or wall box mounting.
 - 2) Provide the following:
 - (a) Setpoint reset slide switch with an adjustable temperature range.
 - (b) Individual heating/cooling setpoint slide switches.
 - (c) Momentary override request push button for activation of after-hours operation.
 - (d) Analog thermometer.
 - l. Room Temperature Sensors with Integral Digital Display:
 - 1) Construct for surface or wall box.
 - 2) Provide a four button keypad with the following capabilities:
 - (a) Indication of space and outdoor temperatures.
 - (b) Setpoint adjustment to accommodate room setpoint, DDC Input/Output Points List, and Sequence of Operation.
 - (c) Display and control fan operation status.
 - (d) Manual occupancy override and indication of occupancy status.
 - (e) Controller mode status.
 - (f) Password enabled setpoint and override modes.
 - m. Temperature Averaging Elements:
 - 1) Use on duct sensors for ductwork 10 sq ft (0.93 sq m) or larger.
 - 2) Use averaging elements where prone to stratification with sensor length 8 ft (2.5 m), or 16 ft (5 m).
 - 3) Provide for all mixed air and heating coil discharge sensors regardless of duct size.
 - n. Insertion Elements:
 - 1) Use in ducts not affected by temperature stratification or smaller than 11 sq inches (1 sq m).
 - 2) Provide dry type, insertion elements for liquids, installed in immersion wells, with minimum insertion length of 2.5 inches (60 mm).
- B. Equipment Operation (Current) Sensors:
- 1. Status Inputs for Fans: Differential pressure switch with adjustable range of 0 to 5 inches wg (0 to 1250 Pa).
 - 2. Status Inputs for Pumps: Differential pressure switch piped across pump with adjustable pressure differential range of 8 to 60 psi (50 to 400 kPa).
 - 3. Status Inputs for Electric Motors: Current sensing relay with current transformers, adjustable and set to 175 percent of rated motor current.
- C. Digital to Pneumatic Transducers:
- 1. Convert plus or minus 12 vdc pulse width modulation outputs to 0 to 20 psi (0 to 138 kPa).
- D. Damper Position Indication: Potentiometer mounted in enclosure with adjustable crank arm assembly connected to damper to transmit 0 - 100 percent damper travel.
- E. Nitrogen Dioxide Sensors, for Single-Gang Electrical Box Mounting:
- 1. General:
 - a. Provide gas platform, wired to the building controller, with replaceable sensor.
 - b. Input Power: Class 2; 15 - 30 VDC, plus/minus 20 percent, 50/60 Hz.
 - c. Relay Ratings: 1A/30VAC/DC, normally open.
 - d. Operating Temperature Range: Minus 4 degrees F (Minus 20 degrees C) to 122 degrees F (50 degrees C).
 - e. Operating Humidity Range: 0 - 90 percent RH non-condensing.
 - f. Terminal Block Wire Size: 30 - 12 AWG.
 - g. Terminal Block Torque: 0.37 - 0.44 inch-lbf (0.5 - 0.6 N-m).
 - h. Protection Class: IP20.
 - 2. Sensor:
 - a. Sensor Type: Electrochemical.

- b. Measurement Range: 0 to 15 ppm.
 - c. Accuracy: Plus/minus 5 percent of range at 25 degrees F (minus 3.9 degrees C).
 - d. Resolution: 0.1 ppm.
 - e. Sensor Warranty: 2 years from manufacture date.
 - f. Low Setpoint Value: 1 ppm (fixed).
 - g. High Setpoint Value: 180 ppm (fixed).
 - h. Operating Temperature Range: Minus 4 degrees F (Minus 20 degrees C) to 122 degrees F (50 degrees C).
 - i. Operating Humidity Range: 0 to 90 percent RH non-condensing.
- F. Carbon Monoxide Sensors, for Single-Gang Electrical Box Mounting:
- 1. General:
 - a. Provide gas platform, wired to the building controller, with replaceable sensor.
 - b. Input Power: Class 2; 15 - 30 VDC/24 VAC plus/minus 20 percent, 50/60 Hz.
 - c. Relay Ratings: 1A/30VAC/DC, normally open.
 - d. Operating Temperature Range: Minus 4 degrees F (Minus 20 degrees C) to 122 degrees F (50 degrees C).
 - e. Operating Humidity Range: 0 - 90 percent RH non-condensing.
 - f. Terminal Block Wire Size: 30 - 12 AWG.
 - g. Terminal Block Torque: 0.37 - 0.44 inch-lbf (0.5 - 0.6 N-m).
 - h. Protection Class: IP20.
 - 2. Sensor:
 - a. Sensor Type: Electrochemical.
 - b. Measurement Range: 0 to 200 ppm.
 - c. Accuracy: Plus/minus 5 percent of range.
 - d. Resolution: 1 ppm.
 - e. Sensor Warranty: 2 years from manufacture date.
 - f. Low Setpoint Value: 25 ppm or 50 ppm switch selectable.
 - g. High Setpoint Value: 180 ppm (fixed).
 - h. Operating Temperature Range: Minus 4 degrees F (Minus 20 degrees C) to 122 degrees F (50 degrees C).
 - i. Operating Humidity Range: 0 to 90 percent RH non-condensing.
- G. Carbon Dioxide Sensors, Wall:
- 1. General: Provide non-dispersive infrared (NDIR), diffusion sampling CO2 sensors with integral transducers and linear output.
 - a. Linear, CO2 Concentration Range Display: 0 to 2000 / 5000 ppm, programmable.
 - b. Accuracy: Plus/minus 30 ppm or plus/minus 2 percent of measured value, measured at NTP.
 - c. Repeatability: Plus/minus 20 ppm or plus/minus 2 percent of measured value.
 - d. Response Time: Less than 60 seconds for 90 percent step change.
 - e. Output:
 - 1) Analog: 4-20 mA.
 - 2) Communication Protocol: Modbus or BACnet.
 - (a) Connection: 2-wire, RS-485.
 - (b) Data Rate: 9600 bps.
 - (c) Parity: None.
 - 3) Wireless: Wi-Fi network.
 - 2. Air Temperature: Range of 32 to 122 degrees F (0 to 50 degrees C).
 - 3. Relative Humidity: Range of 0 to 95 percent (non-condensing).
 - 4. Power Input: Class 2; 12 to 30VDC or 24VAC 50/60 Hz; 100mA max.
 - 5. Calibration Characteristics:
 - a. Automatically compensating algorithm for sensor drift due to sensor degradation.
 - b. Maximum Drift: 2 percent.
 - c. User calibratable with a minimum calibration interval of 5 years.

6. Construction:
 - a. Sensor Chamber: Non-corrosive material for neutral effect on carbon dioxide sample.
 - b. Provide duct mounted sensors with duct probe designed to protect sensing element from dust accumulation and mechanical damage.
 - c. Housing: High impact plastic, UL 94 VO.
7. Optional Equipment
 - a. Temperature Sensor:
 - 1) Solid state, integrated circuit; Accuracy: Plus/minus 1 degree F (0.5 degrees C); Resolution: 0.2 degrees F (0.1 degrees C); Output Range: 50 to 95 degrees F (10 to 35 degrees C).

2.06 THERMOSTATS

- A. Electric Room Thermostats:
 1. Type: NEMA DC 3, 24 volts, with setback/setup temperature control.
 2. Service: Cooling only.
 3. Covers: Locking with set point adjustment, with thermometer.
- B. Line Voltage Thermostats:
 1. Integral manual On/Off/Auto selector switch, single or two pole as required.
 2. Dead band: Maximum 2 degrees F (one degree C).
 3. Cover: Locking with set point adjustment, with thermometer.
 4. Rating: Motor load.
- C. Room Thermostat Accessories:
 1. Thermostat Covers: Brushed aluminum.
 2. Insulating Bases: For thermostats located on exterior walls.
 3. Thermostat Guards: Metal mounted on separate base.
 4. Adjusting Key: As required for device.
 5. Aspirating Boxes: Where indicated for thermostats requiring flush installation.
- D. Outdoor Reset Thermostat:
 1. Remote bulb or bimetal rod and tube type, proportioning action with adjustable throttling range, adjustable setpoint.
 2. Scale range: -10 to 70 degrees F (2 to 35 degrees C).
- E. Immersion Thermostat:
 1. Remote bulb or bimetallic rod and tube type, proportional action with adjustable setpoint and adjustable throttling range.
- F. Airstream Thermostats:
 1. Remote bulb or bimetallic rod and tube type, proportional action with adjustable setpoint in middle of range and adjustable throttling range.
 2. Averaging service remote bulb element: 7.5 feet (2.3 m).
- G. Electric Low Limit Duct Thermostat:
 1. Snap acting, single pole, single throw, manual reset switch that trips if temperature sensed across any 12 inches (300 mm) of bulb length is equal to or below setpoint,
 2. Bulb length: Minimum 20 feet (6 m).
 3. Provide one thermostat for every 20 sq ft (1.86 sq m) of coil surface.
- H. Electric High Limit Duct Thermostat:
 1. Snap acting, single pole, single throw, manual reset switch that trips if temperature sensed across any 12 inches (300 mm) of bulb length is equal to or above setpoint,
 2. Bulb length: Minimum 20 feet (6 m).
 3. Provide one thermostat for every 20 sq ft (1.86 sq m) of coil surface.
- I. Fire Thermostats:
 1. UL labeled, factory set in accordance with NFPA 90A.
 2. Normally closed contacts, manual reset.

- J. Heating/Cooling Valve Top Thermostats:
 - 1. Proportional acting for proportional flow, molded rubber diaphragm, remote bulb liquid filled element, direct and reverse acting at differential pressure to 25 psig (172 kPa), cast housing with position indicator and adjusting knob.

2.07 TIME CLOCKS

- A. Solid state programmable time control with minimum of two and maximum of eight separate programs, 24 hour battery carry over, duty cycling and 7 day programming.

2.08 TRANSDUCERS

- A. Electropneumatic:
 - 1. General: Provide electropneumatic pressure transducer utilizing micro-controlled poppet valve technology for pressure sensing in multiple applications.
 - a. Input Power: Class 2; 24 VAC/DC nominal, 30 VAC max; 150 mA max.
 - b. Control Input: Class 2; 4-20 mA/0-5 V/0-10 VDC, jumper-selectable.
 - c. Input Impedance: 4-20 mA, 250 ohms; 0-5 V/0-10 VDC; jumper selectable.
 - d. Manual Override: Jumper-selectable mode, digital pushbutton adjust.
 - e. Alarm Contact: 100 mA@30 VAC/DC (Pressure loss, manual mode, jumper selectable).
 - f. Accuracy: 1 percent.
 - g. Compensated Temperature Range: 25 degrees F (minus 4 degrees C) to 140 degrees F (65 degrees C).
 - h. Temperature Coefficient: Plus/minus 0.118 percent per degree F (0.05 percent per degree C).
 - i. Operating Environment: 10 - 90 percent RH noncondensing.
 - j. Air Capacity:
 - 1) 523 cubic inches per minute (8570 cubic meters per minute) @ 45 psi (310.3 kPa).
 - 2) 333 cubic inches per minute (5456 cubic meters per minute) @ 20 psi (137.9 kPa).
 - k. Supply Pressure: 45 psi (310 kPa).
 - l. Control Range: 0 - 20 psi (0 - 138 kPa), or 3 - 15 psi (20.7 - 103.4 kPa).
 - m. Pressure Differential: 0.1 psi (0.69 kPa) (supply to branch).
 - n. Pressure Indication: Electronic, 3-1/2 digit LCD.
 - o. Minimum Tubing Length: 15 ft (4.6 m).
 - p. Port Connection: 1/8 inch (3.18 mm) poly tubing.
 - q. Media Connection:
 - 1) Clean, dry air, or inert gas.
 - 2) Use with oxygen service is prohibited.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify that systems are ready to receive work.
- C. Beginning of installation means installer accepts existing conditions.
- D. Sequence work to ensure installation of components is complementary to installation of similar components in other systems.
- E. Coordinate installation of system components with installation of mechanical systems equipment such as air handling units and air terminal units.
- F. Ensure installation of components is complementary to installation of similar components.
- G. Coordinate installation of system components with installation of mechanical systems equipment such as air handling units and air terminal units.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Mechanically attached tubing to supporting surfaces. Sleeve through concrete surfaces in minimum one inch (25 mm) sleeves, extended 6 inches (150 mm) above floors and one inch (25 mm) below bottom surface of slabs.
- C. Check and verify location of thermostats with plans and room details before installation. Locate 60 inches (1500 mm) above floor. Align with lighting switches and humidistats. Refer to Section 26 2726.
- D. Mount freeze protection thermostats using flanges and element holders.
- E. Mount outdoor reset thermostats and outdoor sensors indoors, with sensing elements outdoors with sun shield.
- F. Provide separable sockets for liquids and flanges for air bulb elements.
- G. Provide thermostats in aspirating boxes in front entrances.
- H. Provide guards on thermostats in entrances.
- I. Provide valves with position indicators and with pilot positioners where sequenced with other controls.
- J. Provide separate steam valves for each bank of coils. Provide two valves in parallel where steam load exceeds 1500 lb/hr (0.10 kg/s) with 1/3 - 2/3 load capacities sequenced with smaller valve opening first.
- K. Provide mixing dampers of opposed blade construction arranged to mix streams. Provide pilot positioners on mixed air damper motors. Provide separate minimum outside air damper section adjacent to return air dampers with separate damper motor.
- L. Provide isolation (two position) dampers of parallel blade construction.
- M. Provide pilot positioners on pneumatic damper operators sequenced with other controls.
- N. Install damper motors on outside of duct in warm areas. Do not install motors in locations at outdoor temperatures.
- O. Mount control panels adjacent to associated equipment on vibration free walls or free standing angle iron supports. One cabinet may accommodate more than one system in same equipment room. Provide engraved plastic nameplates for instruments and controls inside cabinet and engraved plastic nameplates on cabinet face.
- P. Install "hand/off/auto" selector switches to override automatic interlock controls when switch is in "hand" position.
- Q. Provide conduit and electrical wiring in accordance with Section 26 2717. Electrical material and installation shall be in accordance with appropriate requirements of Division 26.

3.03 MAINTENANCE

- A. See Section 01 7000 - Execution and Closeout Requirements, for additional requirements relating to maintenance service.
- B. Provide service and maintenance of control system for one year from Date of Substantial Completion.
- C. Provide complete service of controls systems, including call backs, and submit written report of each service call.

END OF SECTION

SECTION 23 0993

SEQUENCE OF OPERATIONS FOR HVAC CONTROLS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. This section defines the manner and method by which controls function. Requirements for each type of control system operation are specified. Equipment, devices, and system components required for control systems are specified in other sections.
- B. Sequence of operation for:
 - 1. Furnaces.
 - 2. Garage exhaust fans.
 - 3. Heat removal fans.
 - 4. Lab hood fans.
 - 5. Odor control fans.
 - 6. Toilet exhaust fans.
 - 7. Transfer fans.
 - 8. Unit heaters.

1.02 RELATED REQUIREMENTS

- A. Section 23 0913 - Instrumentation and Control Devices for HVAC.

1.03 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.
- B. Sequence of Operation Documentation: Submit written sequence of operation for entire HVAC system and each piece of equipment.
 - 1. Preface: 1 or 2 paragraph overview narrative of the system describing its purpose, components and function.
 - 2. Include at least the following sequences:
 - a. Normal operating mode.
 - b. Unoccupied mode.
 - 3. Include initial and recommended values for all adjustable settings, setpoints and parameters that are typically set or adjusted by operating staff; and any other control settings or fixed values, delays, etc. that will be useful during testing and operating the equipment.
 - 4. For packaged controlled equipment, include manufacturer's furnished sequence of operation amplified as required to describe the relationship between the packaged controls and the control system, indicating which points are adjustable control points and which points are only monitored.
 - 5. Include schedules, if known.
- C. Control System Diagrams: Submit graphic schematic of the control system showing each control component and each component controlled, monitored, or enabled.
 - 1. Label with settings, adjustable range of control and limits.
 - 2. Include flow diagrams for each control system, graphically depicting control logic.
 - 3. Include the system and component layout of all equipment that the control system monitors, enables or controls, even if the equipment is primarily controlled by packaged or integral controls.
 - 4. Include draft copies of graphic displays indicating mechanical system components, control system components, and controlled function status and value.
 - 5. Include all monitoring, control and virtual points specified in elsewhere.
 - 6. Include a key to all abbreviations.
- D. Points List: Submit list of all control points indicating at least the following for each point.
 - 1. Name of controlled system.
 - 2. Point abbreviation.

3. Point description; such as dry bulb temperature, airflow, etc.
 4. Display unit.
 5. Control point or setpoint (Yes / No); i.e. a point that controls equipment and can have its setpoint changed.
 6. Monitoring point (Yes / No); i.e. a point that does not control or contribute to the control of equipment but is used for operation, maintenance, or performance verification.
 7. Intermediate point (Yes / No); i.e. a point whose value is used to make a calculation which then controls equipment, such as space temperatures that are averaged to a virtual point to control reset.
 8. Calculated point (Yes / No); i.e. a "virtual" point generated from calculations of other point values.
- E. Project Record Documents: Record actual locations of components and setpoints of controls, including changes to sequences made after submission of shop drawings.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 FURNACES

- A. Occupied cycle (based on thermostat program): Open the outside air damper for occupied minimum airflow and operate the supply fan continuously. On a rise in space temperature above the cooling set-point of 75 degrees F (24 degrees C), energize the compressor(s) in stages to satisfy the thermostat. On a fall in space temperature below the heating set-point of 70 degrees F (21 degrees C), operate the gas burner to satisfy the thermostat.
- B. Unoccupied cycle (based on thermostat program): Close the outside air damper. On a fall in space temperature below the heating setback temperature of 60 degrees F (16 degrees C), start the supply fan and operate the gas burner to satisfy the thermostat.

3.02 GARAGE EXHAUST FAN EF-1

- A. On detection of CO or NO₂ above setpoint open intake damper and start exhaust fan.

3.03 HEAT REMOVAL FAN EF-10

- A. On room temperatures above 95 degrees F (35 degrees C) open intake damper and start exhaust fan.

3.04 LAB EXHAUST FAN EF-4

- A. Interlock fan with wall switch. Wiring by electrical contractor.

3.05 ODOR CONTROL EXHAUST FANS EF-11, 12

- A. Interlock fan with wall switch. Wiring by electrical contractor.

3.06 TOILET EXHAUST FANS EF-2, 7, 8, 9

- A. Interlock fan with light switch. Wiring by electrical contractor.

3.07 TOILET EXHAUST FANS EF-3, 5, 6

- A. Interlock fan with programmable thermostat auxiliary contacts to operate continuously during the occupied cycle.

3.08 TRANSFER FAN TF-1

- A. On room temperatures above 95 degrees F (35 degrees C) open intake damper and start exhaust fan.

3.09 UNIT HEATERS

- A. Integral thermostat continues fan operation until element temperature falls below 100 degrees F (38 degrees C).

END OF SECTION

**SECTION 23 2300
REFRIGERANT PIPING**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Piping.
- B. Refrigerant.
- C. Moisture and liquid indicators.
- D. Valves.
- E. Strainers.
- F. Check valves.
- G. Pressure regulators.
- H. Pressure relief valves.
- I. Filter-driers.
- J. Solenoid valves.
- K. Expansion valves.
- L. Receivers.
- M. Flexible connections.

1.02 RELATED REQUIREMENTS

- A. Section 08 3100 - Access Doors and Panels.
- B. Section 09 9123 - Interior Painting.
- C. Section 23 0719 - HVAC Piping Insulation.
- D. Section 26 2717 - Equipment Wiring: Electrical characteristics and wiring connections.

1.03 REFERENCE STANDARDS

- A. AHRI 495 - Performance Rating of Refrigerant Liquid Receivers; 2005.
- B. AHRI 750 - Standard for Thermostatic Refrigerant Expansion Valves; 2007.
- C. AHRI 760 - Standard for Performance Rating of Solenoid Valves for Use With Volatile Refrigerants; 2007.
- D. ASHRAE Std 15 - Safety Standard for Refrigeration Systems; 2013.
- E. ASME BPVC-VIII-1 - Boiler and Pressure Vessel Code, Section VIII, Division 1 - Rules for Construction of Pressure Vessels; 2015.
- F. ASME BPVC-IX - Boiler and Pressure Vessel Code, Section IX - Welding, Brazing, and Fusing Qualifications; 2015.
- G. ASME B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings; 2013.
- H. ASME B16.26 - Cast Copper Alloy Fittings for Flared Copper Tubes; 2013.
- I. ASME B31.5 - Refrigeration Piping and Heat Transfer Components; 2013.
- J. ASME B31.9 - Building Services Piping; 2014.
- K. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2012.
- L. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2015.
- M. ASTM A234/A234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service; 2015.
- N. ASTM B88 - Standard Specification for Seamless Copper Water Tube; 2014.

- O. ASTM B88M - Standard Specification for Seamless Copper Water Tube (Metric); 2013.
- P. ASTM B280 - Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service; 2016.
- Q. AWS A5.8M/A5.8 - Specification for Filler Metals for Brazing and Braze Welding; 2011-AMD 1.
- R. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2015 (Errata 2016).
- S. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation; 2009.
- T. UL 429 - Electrically Operated Valves; Current Edition, Including All Revisions.

1.04 SYSTEM DESCRIPTION

- A. Where more than one piping system material is specified ensure system components are compatible and joined to ensure the integrity of the system is not jeopardized. Provide necessary joining fittings. Ensure flanges, union, and couplings for servicing are consistently provided.
- B. Provide pipe hangers and supports in accordance with ASME B31.5 unless indicated otherwise.
- C. Liquid Indicators:
 - 1. Use line size liquid indicators in main liquid line leaving condenser.
 - 2. If receiver is provided, install in liquid line leaving receiver.
 - 3. Use line size on leaving side of liquid solenoid valves.
- D. Valves:
 - 1. Use service valves on suction and discharge of compressors.
 - 2. Use gage taps at compressor inlet and outlet.
 - 3. Use gage taps at hot gas bypass regulators, inlet and outlet.
 - 4. Use check valves on compressor discharge.
 - 5. Use check valves on condenser liquid lines on multiple condenser systems.
- E. Refrigerant Charging (Packed Angle) Valve: Use in liquid line between receiver shut-off valve and expansion valve.
- F. Strainers:
 - 1. Use line size strainer upstream of each automatic valve.
 - 2. Where multiple expansion valves with integral strainers are used, use single main liquid line strainer.
 - 3. On steel piping systems, use strainer in suction line.
 - 4. Use shut-off valve on each side of strainer.
- G. Pressure Relief Valves: Use on ASME receivers and pipe to outdoors.
- H. Filter-Driers:
 - 1. Use a filter-drier immediately ahead of liquid-line controls, such as thermostatic expansion valves, solenoid valves, and moisture indicators.
- I. Solenoid Valves:
 - 1. Use in liquid line of systems operating with single pump-out or pump-down compressor control.
 - 2. Use in liquid line of single or multiple evaporator systems.
 - 3. Use in oil bleeder lines from flooded evaporators to stop flow of oil and refrigerant into the suction line when system shuts down.
- J. Receivers:
 - 1. Use on systems with long piping runs.
- K. Flexible Connectors: Utilize at or near compressors where piping configuration does not absorb vibration.

1.05 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

- B. Product Data: Provide general assembly of specialties, including manufacturers catalogue information. Provide manufacturers catalog data including load capacity.
- C. Shop Drawings: Indicate schematic layout of system, including equipment, critical dimensions, and sizes.
- D. Design Data: Submit design data indicating pipe sizing. Indicate load carrying capacity of trapeze, multiple pipe, and riser support hangers.
- E. Manufacturer's Installation Instructions: Indicate support, connection requirements, and isolation for servicing.
- F. Submit welders certification of compliance with ASME BPVC-IX.
- G. Project Record Documents: Record exact locations of equipment and refrigeration accessories on record drawings.
- H. Maintenance Data: Include instructions for changing cartridges, assembly views, spare parts lists.
- I. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 01 6000 - Product Requirements, for additional provisions.
 - 2. Extra Filter-Dryer Cartridges: One of each type and size.
 - 3. Refrigeration Oil Test Kits: One, each containing everything required to conduct one test.

1.06 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in performing the type of work specified in this section, with minimum three years of experience.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store piping and specialties in shipping containers with labeling in place.
- B. Protect piping and specialties from entry of contaminating material by leaving end caps and plugs in place until installation.
- C. Dehydrate and charge components such as piping and receivers, seal prior to shipment, until connected into system.

PART 2 PRODUCTS

2.01 REGULATORY REQUIREMENTS

- A. Conform to ASME B31.9 for installation of piping system.
- B. Welding Materials and Procedures: Conform to ASME BPVC-IX and applicable state labor regulations.
- C. Welders Certification: In accordance with ASME BPVC-IX.
- D. Products Requiring Electrical Connection: Listed and classified by UL, as suitable for the purpose indicated.

2.02 PIPING

- A. Copper Tube: ASTM B280, H58 hard drawn or O60 soft annealed.
 - 1. Fittings: ASME B16.22 wrought copper.
 - 2. Joints: Braze, AWS A5.8M/A5.8 BCuP silver/phosphorus/copper alloy.
- B. Copper Tube to 7/8 inch (22 mm) OD: ASTM B88 (ASTM B88M), Type K (A), annealed.
 - 1. Fittings: ASME B16.26 cast copper.
 - 2. Joints: Flared.
- C. Steel Pipe: ASTM A53/A53M, Schedule 40, black.
 - 1. Fittings: ASTM A234/A234M, wrought steel welding type.
 - 2. Joints: Welded in accordance with AWS D1.1/D1.1M.
- D. Steel Pipe Sizes 12 Inch (300 mm) and Over: ASTM A53/A53M, 0.375 inch (10 mm) wall, black.
 - 1. Fittings: ASTM A234/A234M, wrought steel welding type.

2. Joints: Welded in accordance with AWS D1.1/D1.1M.
- E. Pipe Supports and Anchors:
1. Provide hangers and supports that comply with MSS SP-58.
 - a. If type of hanger or support for a particular situation is not indicated, select appropriate type using MSS SP-58 recommendations.
 2. Hangers for Pipe Sizes 1/2 to 1-1/2 Inch (13 to 38 mm): Malleable iron adjustable swivel, split ring.
 3. Hangers for Pipe Sizes 2 Inches (50 mm) and Over: Carbon steel, adjustable, clevis.
 4. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
 5. Wall Support for Pipe Sizes to 3 Inches (75 mm): Cast iron hook.
 6. Wall Support for Pipe Sizes 4 Inches (100 mm) and Over: Welded steel bracket and wrought steel clamp.
 7. Vertical Support: Steel riser clamp.
 8. Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
 9. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.
 10. Hanger Rods: Mild steel threaded both ends, threaded one end, or continuous threaded.
 11. Inserts: Malleable iron case of galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.
 12. Rooftop Supports for Low-Slope Roofs: Steel pedestals with bases that rest on top of roofing membrane, not requiring any attachment to the roof structure and not penetrating the roofing assembly, with support fixtures as specified; and as follows:
 - a. Bases: High density, UV tolerant, polypropylene or reinforced PVC.
 - b. Base Sizes: As required to distribute load sufficiently to prevent indentation of roofing assembly.
 - c. Steel Components: Stainless steel, or carbon steel hot-dip galvanized after fabrication in accordance with ASTM A123/A123M.
 - d. Attachment/Support Fixtures: As recommended by manufacturer, same type as indicated for equivalent indoor hangers and supports; corrosion resistant material.
 - e. Height: Provide minimum clearance of 6 inches (150 mm) under pipe to top of roofing.
 - f. Manufacturers:
 - 1) PHP Systems/Design: www.phpsd.com.
 - 2) Portals Plus; Pedestal Plus: www.portalsplus.com.
 - 3) Substitutions: See Section 01 6000 - Product Requirements.

2.03 REFRIGERANT

- A. Refrigerant: Use only refrigerants that have ozone depletion potential (ODP) of zero and global warming potential (GWP) of less than 50.

2.04 MOISTURE AND LIQUID INDICATORS

- A. Manufacturers:
1. Henry Technologies: www.henrytech.com.
 2. Parker Hannifin/Refrigeration and Air Conditioning: www.parker.com.
 3. Sporlan, a Division of Parker Hannifin: www.parker.com.
 4. Substitutions: See Section 01 6000 - Product Requirements.
- B. Indicators: Single port type, UL listed, with copper or brass body, flared or solder ends, sight glass, color coded paper moisture indicator with removable element cartridge and plastic cap; for maximum temperature of 200 degrees F (93 degrees C) and maximum working pressure of 500 psi (3450 kPa).

2.05 VALVES

- A. Manufacturers:
1. Hansen Technologies Corporation: www.hantech.com.

2. Henry Technologies: www.henrytech.com.
 3. Flomatic Valves: www.flomatic.com.
 4. Substitutions: See Section 01 6000 - Product Requirements.
- B. Diaphragm Packless Valves:
1. UL listed, globe or angle pattern, forged brass body and bonnet, phosphor bronze and stainless steel diaphragms, rising stem and handwheel, stainless steel spring, nylon seat disc, solder or flared ends, with positive backseating; for maximum working pressure of 500 psi (3450 kPa) and maximum temperature of 275 degrees F (135 degrees C).
- C. Packed Angle Valves:
1. Forged brass or nickel plated forged steel, forged brass seal caps with copper gasket, rising stem and seat with backseating, molded stem packing, solder or flared ends; for maximum working pressure of 500 psi (3450 kPa) and maximum temperature of 275 degrees F (135 degrees C).
- D. Ball Valves:
1. Two piece bolted forged brass body with teflon ball seals and copper tube extensions, brass bonnet and seal cap, chrome plated ball, stem with neoprene ring stem seals; for maximum working pressure of 500 psi (3450 kPa) and maximum temperature of 300 degrees F (149 degrees C).
- E. Service Valves:
1. Forged brass body with copper stubs, brass caps, removable valve core, integral ball check valve, flared or solder ends, for maximum pressure of 500 psi (3450 kPa).

2.06 STRAINERS

- A. Manufacturers:
1. Hansen Technologies Corporation: www.hantech.com.
 2. Parker Hannifin/Refrigeration and Air Conditioning: www.parker.com.
 3. Sporlan, a Division of Parker Hannifin: www.parker.com.
 4. Substitutions: See Section 01 6000 - Product Requirements.
- B. Straight Line or Angle Line Type:
1. Brass or steel shell, steel cap and flange, and replaceable cartridge, with screen of stainless steel wire or monel reinforced with brass; for maximum working pressure of 430 psi (2960 kPa).

2.07 CHECK VALVES

- A. Manufacturers:
1. Hansen Technologies Corporation: www.hantech.com.
 2. Parker Hannifin/Refrigeration and Air Conditioning: www.parker.com.
 3. Sporlan, a Division of Parker Hannifin: www.parker.com.
 4. Substitutions: See Section 01 6000 - Product Requirements.
- B. Globe Type:
1. Cast bronze or forged brass body, forged brass cap with neoprene seal, brass guide and disc holder, phosphor-bronze or stainless steel spring, teflon seat disc; for maximum temperature of 300 degrees F (149 degrees C) and maximum working pressure of 425 psi (2930 kPa).
- C. Straight Through Type:
1. Brass body and disc, phosphor-bronze or stainless steel spring, neoprene seat; for maximum working pressure of 500 psi (3450 kPa) and maximum temperature of 200 degrees F (93 degrees C).

2.08 PRESSURE REGULATORS

- A. Manufacturers:
1. Hansen Technologies Corporation: www.hantech.com.
 2. Parker Hannifin/Refrigeration and Air Conditioning: www.parker.com.

3. Sporlan, a Division of Parker Hannifin: www.parker.com.
 4. Substitutions: See Section 01 6000 - Product Requirements.
- B. Brass body, stainless steel diaphragm, direct acting, adjustable over 0 to 80 psi (0 to 550 kPa) range, for maximum working pressure of 450 psi (3100 kPa).

2.09 PRESSURE RELIEF VALVES

- A. Manufacturers:
1. Hansen Technologies Corporation: www.hantech.com.
 2. Henry Technologies: www.henrytech.com.
 3. Sherwood Valve/Harsco Corporation: www.sherwoodvalve.com.
 4. Substitutions: See Section 01 6000 - Product Requirements.
- B. Straight Through or Angle Type: Brass body and disc, neoprene seat, factory sealed and stamped with ASME UV and National Board Certification NB, selected to ASHRAE Std 15, with standard setting of 235 psi (1620 kPa).

2.10 FILTER-DRIERS

- A. Manufacturers:
1. Flow Controls Division of Emerson Electric: www.emersonflowcontrols.com.
 2. Parker Hannifin/Refrigeration and Air Conditioning: www.parker.com.
 3. Sporlan, a Division of Parker Hannifin: www.parker.com.
 4. Substitutions: See Section 01 6000 - Product Requirements.
- B. Cores: Molded or loose-fill molecular sieve desiccant compatible with refrigerant, activated alumina, activated charcoal, and filtration to 40 microns, with secondary filtration to 20 microns; of construction that will not pass into refrigerant lines.
- C. Construction: UL listed.
1. Replaceable Core Type: Steel shell with removable cap.
 2. Sealed Type: Copper shell.
 3. Connections: As specified for applicable pipe type.

2.11 SOLENOID VALVES

- A. Manufacturers:
1. Flow Controls Division of Emerson Electric: www.emersonflowcontrols.com.
 2. Parker Hannifin/Refrigeration and Air Conditioning: www.parker.com.
 3. Sporlan, a Division of Parker Hannifin: www.parker.com.
 4. Substitutions: See Section 01 6000 - Product Requirements.
- B. Valve: AHRI 760 I-P, pilot operated, copper, brass or steel body and internal parts, synthetic seat, stainless steel stem and plunger assembly (permitting manual operation in case of coil failure), integral strainer, with flared, solder, or threaded ends; for maximum working pressure of 500 psi (3450 kPa).
- C. Coil Assembly: UL 429, UL listed, replaceable with molded electromagnetic coil, moisture and fungus proof, with surge protector and color coded lead wires, integral junction box with pilot light.

2.12 EXPANSION VALVES

- A. Manufacturers:
1. Flow Controls Division of Emerson Electric: www.emersonflowcontrols.com.
 2. Parker Hannifin/Refrigeration and Air Conditioning: www.parker.com.
 3. Sporlan, a Division of Parker Hannifin: www.parker.com.
 4. Substitutions: See Section 01 6000 - Product Requirements.
- B. Angle or Straight Through Type: AHRI 750; design suitable for refrigerant, brass body, internal or external equalizer, bleed hole, adjustable superheat setting, replaceable inlet strainer, with non-replaceable capillary tube and remote sensing bulb and remote bulb well.

- C. Selection: Evaluate refrigerant pressure drop through system to determine available pressure drop across valve. Select valve for maximum load at design operating pressure and minimum 10 degrees F (6 degrees C) superheat. Select to avoid being undersized at full load and excessively oversized at part load.

2.13 ELECTRONIC EXPANSION VALVES

- A. Manufacturers:
 - 1. Flomatic Valves: www.flomatic.com.
 - 2. Parker Hannifin/Refrigeration and Air Conditioning: www.parker.com.
 - 3. Sporlan, a Division of Parker Hannifin: www.parker.com.
 - 4. Substitutions: See Section 01 6000 - Product Requirements.
- B. Valve:
 - 1. Brass body with flared or solder connection, needle valve with floating needle and machined seat, stepper motor drive.
- C. Evaporation Control System:
 - 1. Electronic microprocessor based unit in enclosed case, proportional integral control with adaptive superheat, maximum operating pressure function, preselection allowance for electrical defrost and hot gas bypass.
- D. Refrigeration System Control: Electronic microprocessor based unit in enclosed case, with proportional integral control of valve, on/off thermostat, air temperature alarm (high and low), solenoid valve control, liquid injection adaptive superheat control, maximum operating pressure function, night setback thermostat, timer for defrost control.

2.14 RECEIVERS

- A. Manufacturers:
 - 1. Henry Technologies: www.henrytech.com.
 - 2. Parker Hannifin/Refrigeration and Air Conditioning: www.parker.com.
 - 3. Sherwood Valve/Harsco Corporation: www.sherwoodvalve.com.
 - 4. Substitutions: See Section 01 6000 - Product Requirements.
- B. Internal Diameter 6 inch (150 mm) and Smaller:
 - 1. AHRI 495, UL listed, steel, brazed; 400 psi (2760 kPa) maximum pressure rating, with tappings for inlet, outlet, and pressure relief valve.
- C. Internal Diameter Over 6 inch (150 mm):
 - 1. AHRI 495, welded steel, tested and stamped in accordance with ASME BPVC-VIII-1; 400 psi (2760 kPa) with tappings for liquid inlet and outlet valves, pressure relief valve, and magnetic liquid level indicator.

2.15 FLEXIBLE CONNECTORS

- A. Manufacturers:
 - 1. Circuit Hydraulics, Ltd: www.circuit-hydraulics.co.uk.
 - 2. Flexicraft Industries: www.flexicraft.com.
 - 3. Penflex: www.penflex.com.
 - 4. Substitutions: See Section 01 6000 - Product Requirements.
- B. Corrugated stainless steel hose with single layer of stainless steel exterior braiding, minimum 9 inches (230 mm) long with copper tube ends; for maximum working pressure of 500 psi (3450 kPa).

PART 3 EXECUTION

3.01 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Remove scale and dirt on inside and outside before assembly.
- C. Prepare piping connections to equipment with flanges or unions.

3.02 INSTALLATION

- A. Install refrigeration specialties in accordance with manufacturer's instructions.
- B. Route piping in orderly manner, with plumbing parallel to building structure, and maintain gradient.
- C. Install piping to conserve building space and avoid interference with use of space.
- D. Group piping whenever practical at common elevations and locations. Slope piping one percent in direction of oil return.
- E. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- F. Inserts:
 - 1. Provide inserts for placement in concrete formwork.
 - 2. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
 - 3. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches (100 mm).
 - 4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
 - 5. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut above slab.
- G. Pipe Hangers and Supports:
 - 1. Install in accordance with ASME B31.5.
 - 2. Support horizontal piping as scheduled.
 - 3. Install hangers to provide minimum 1/2 inch (13 mm) space between finished covering and adjacent work.
 - 4. Place hangers within 12 inches (300 mm) of each horizontal elbow.
- H. Arrange piping to return oil to compressor. Provide traps and loops in piping, and provide double risers as required. Slope horizontal piping 0.40 percent in direction of flow.
- I. Provide clearance for installation of insulation and access to valves and fittings.
- J. Provide access to concealed valves and fittings. Coordinate size and location of access doors with Section 08 3100.
- K. Flood piping system with nitrogen when brazing.
- L. Where pipe support members are welded to structural building frame, brush clean, and apply one coat of zinc rich primer to welding.
- M. Prepare unfinished pipe, fittings, supports, and accessories ready for finish painting. Refer to Section 09 9123.
- N. Insulate piping and equipment; refer to Section and Section 23 0716.
- O. Follow ASHRAE Std 15 procedures for charging and purging of systems and for disposal of refrigerant.
- P. Provide replaceable cartridge filter-driers, with isolation valves and valved bypass.
- Q. Locate expansion valve sensing bulb immediately downstream of evaporator on suction line.
- R. Provide external equalizer piping on expansion valves with refrigerant distributor connected to evaporator.
- S. Install flexible connectors at right angles to axial movement of compressor, parallel to crankshaft.
- T. Fully charge completed system with refrigerant after testing.
- U. Provide electrical connection to solenoid valves. Refer to Section 26 2717.

3.03 FIELD QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements, for additional requirements.

- B. Test refrigeration system in accordance with ASME B31.5.
- C. Pressure test system with dry nitrogen to 200 psi (1380 kPa). Perform final tests at 27 inches (92 kPa) vacuum and 200 psi (1380 kPa) using halide torch. Test to no leakage.

3.04 SCHEDULES

- A. Hanger Spacing for Copper Tubing.
 - 1. 1/2 inch (13 mm), 5/8 inch (16 mm), and 7/8 inch (22 mm) OD: Maximum span, 5 feet (1500 mm); minimum rod size, 1/4 inch (6.3 mm).
 - 2. 1-1/8 inch (29 mm) OD: Maximum span, 6 feet (1800 mm); minimum rod size, 1/4 inch (6.3 mm).
 - 3. 1-3/8 inch (35 mm) OD: Maximum span, 7 feet (2100 mm); minimum rod size, 3/8 inch (9.5 mm).
 - 4. 1-5/8 inch (41 mm) OD: Maximum span, 8 feet (2400 mm); minimum rod size, 3/8 inch (9.5 mm).
 - 5. 2-1/8 inch (54 mm) OD: Maximum span, 8 feet (2400 mm); minimum rod size, 3/8 inch (9.5 mm).
 - 6. 2-5/8 inch (67 mm) OD: Maximum span, 9 feet (2700 mm); minimum rod size, 3/8 inch (9.5 mm).
 - 7. 3-1/8 inch (79 mm) OD: Maximum span, 10 feet (3.0 m); minimum rod size, 3/8 inch (9.5 mm).
 - 8. 3-5/8 inch (92 mm) OD: Maximum span, 11 feet (3.4 m); minimum rod size, 1/2 inch (12.7 mm).
 - 9. 4-1/8 inch (92 mm) OD: Maximum span, 12 feet (3.6 m); minimum rod size, 1/2 inch (12.7 mm).
- B. Hanger Spacing for Steel Piping.
 - 1. 1/2 inch (15 mm), 3/4 inch (20 mm), and 1 inch (25 mm): Maximum span, 7 feet (2100 mm); minimum rod size, 1/4 inch (6.3 mm).
 - 2. 1-1/4 inches (32 mm): Maximum span, 8 feet (2400 mm); minimum rod size, 3/8 inch (9.5 mm).
 - 3. 1-1/2 inches (40 mm): Maximum span, 9 feet (2700 mm); minimum rod size, 3/8 inch (9.5 mm).
 - 4. 2 inches (50 mm): Maximum span, 10 feet (3.0 m); minimum rod size, 3/8 inch (9.5 mm).
 - 5. 2-1/2 inches (65 mm): Maximum span, 11 feet (3.4 m); minimum rod size, 3/8 inch (9.5 mm).
 - 6. 3 inches (80 mm): Maximum span, 12 feet (3.6 m); minimum rod size, 3/8 inch (9.5 mm).
 - 7. 4 inches (100 mm): Maximum span, 14 feet (4.3 m); minimum rod size, 1/2 inch (12.7 mm).

END OF SECTION

SECTION 23 3100
HVAC DUCTS AND CASINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Metal ductwork.

1.02 RELATED REQUIREMENTS

- A. Section 23 0593 - Testing, Adjusting, and Balancing for HVAC.
- B. Section 23 0713 - Duct Insulation: External insulation and duct liner.
- C. Section 23 3300 - Air Duct Accessories.
- D. Section 23 3700 - Air Outlets and Inlets.

1.03 REFERENCE STANDARDS

- A. ASHRAE (FUND) - ASHRAE Handbook - Fundamentals; 2013.
- B. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2014.
- C. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2015.
- D. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2016.
- E. ICC-ES AC01 - Acceptance Criteria for Expansion Anchors in Masonry Elements; 2015.
- F. ICC-ES AC106 - Acceptance Criteria for Predrilled Fasteners (Screw Anchors) in Masonry Elements; 2012.
- G. ICC-ES AC193 - Acceptance Criteria for Mechanical Anchors in Concrete Elements; 2015.
- H. ICC-ES AC308 - Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Elements; 2015.
- I. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2015.
- J. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible; 2005 (Rev. 2009).

1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Project Record Documents: Record actual locations of ducts and duct fittings. Record changes in fitting location and type. Show additional fittings used.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience, and approved by manufacturer.
- B. Installer Qualifications: Company specializing in performing the type of work specified in this section, with minimum three years of documented experience.

1.06 FIELD CONDITIONS

- A. Do not install duct sealants when temperatures are less than those recommended by sealant manufacturers.
- B. Maintain temperatures within acceptable range during and after installation of duct sealants.

PART 2 PRODUCTS

2.01 DUCT ASSEMBLIES

- A. Regulatory Requirements: Construct ductwork to NFPA 90A standards.
- B. Ducts: Galvanized steel, unless otherwise indicated.

- C. Low Pressure Supply (Heating Systems): 1/2 inch w.g. (125 Pa) pressure class, galvanized steel.
- D. Low Pressure Supply (System with Cooling Coils): 1/2 inch w.g. (125 Pa) pressure class, galvanized steel.
- E. Return and Relief: 1/2 inch w.g. (125 Pa) pressure class, galvanized steel.
- F. General Exhaust: 1/2 inch w.g. (125 Pa) pressure class, galvanized steel.
- G. Outside Air Intake: 1/2 inch w.g. (125 Pa) pressure class, galvanized steel.
- H. Transfer Air and Sound Boots: 1/2 inch w.g. (125 Pa) pressure class, fibrous glass.

2.02 MATERIALS

- A. Galvanized Steel for Ducts: Hot-dipped galvanized steel sheet, ASTM A653/A653M FS Type B, with G60/Z180 coating.
- B. Joint Sealers and Sealants: Non-hardening, water resistant, mildew and mold resistant.
 - 1. Type: Heavy mastic or liquid used alone or with tape, suitable for joint configuration and compatible with substrates, and recommended by manufacturer for pressure class of ducts.
 - 2. Surface Burning Characteristics: Flame spread index of zero and smoke developed index of zero, when tested in accordance with ASTM E84.
- C. Hanger Rod: ASTM A36/A36M; steel, galvanized; threaded both ends, threaded one end, or continuously threaded.
- D. Hanger Fasteners: Attach hangers to structure using appropriate fasteners, as follows:
 - 1. Concrete Wedge Expansion Anchors: Complying with ICC-ES AC193.
 - 2. Masonry Wedge Expansion Anchors: Complying with ICC-ES AC01.
 - 3. Concrete Screw Type Anchors: Complying with ICC-ES AC193.
 - 4. Masonry Screw Type Anchors: Complying with ICC-ES AC106.
 - 5. Concrete Adhesive Type Anchors: Complying with ICC-ES AC308.
 - 6. Other Types: As required.

2.03 DUCTWORK FABRICATION

- A. Fabricate and support in accordance with SMACNA (DCS) and as indicated.
- B. No variation of duct configuration or size permitted except by written permission. Size round duct installed in place of rectangular ducts in accordance with ASHRAE (FUND) Handbook - Fundamentals.
- C. Provide duct material, gages, reinforcing, and sealing for operating pressures indicated.
- D. Construct T's, bends, and elbows with radius of not less than 1-1/2 times width of duct on centerline. Where not possible and where rectangular elbows must be used, provide air foil turning vanes of perforated metal with glass fiber insulation.
- E. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream.
- F. Fabricate continuously welded round and oval duct fittings in accordance with SMACNA (DCS).
- G. Where ducts are connected to exterior wall louvers and duct outlet is smaller than louver frame, provide blank-out panels sealing louver area around duct. Use same material as duct, painted black on exterior side; seal to louver frame and duct.

2.04 MANUFACTURED DUCTWORK AND FITTINGS

- A. Flexible Ducts: Two ply vinyl film supported by helically wound spring steel wire.
 - 1. Insulation: Fiberglass insulation with polyethylene vapor barrier film.
 - 2. Pressure Rating: 10 inches WG (2.50 kPa) positive and 1.0 inches WG (250 Pa) negative.
 - 3. Maximum Velocity: 4000 fpm (20.3 m/sec).

4. Temperature Range: Minus 10 degrees F to 160 degrees F (Minus 23 degrees C to 71 degrees C).
5. Manufacturers:
 - a. Hart & Cooley, Inc: www.hartandcooley.com.
 - b. Substitutions: See Section 01 6000 - Product Requirements.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install, support, and seal ducts in accordance with SMACNA (DCS).
- B. Install in accordance with manufacturer's instructions.
- C. During construction provide temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering ductwork system.
- D. Flexible Ducts: Connect to metal ducts with adhesive.
- E. Duct sizes indicated are inside clear dimensions. For lined ducts, maintain sizes inside lining.
- F. Provide openings in ductwork where required to accommodate thermometers and controllers. Provide pilot tube openings where required for testing of systems, complete with metal can with spring device or screw to ensure against air leakage. Where openings are provided in insulated ductwork, install insulation material inside a metal ring.
- G. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.
- H. Use crimp joints with or without bead for joining round duct sizes 8 inch (200 mm) and smaller with crimp in direction of air flow.
- I. Use double nuts and lock washers on threaded rod supports.
- J. Connect diffusers or light troffer boots to low pressure ducts directly or with 8 feet (2.4 m) maximum length of flexible duct held in place with strap or clamp.
- K. At exterior wall louvers, seal duct to louver frame and install blank-out panels.

END OF SECTION

SECTION 23 3300
AIR DUCT ACCESSORIES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Backdraft dampers - metal.
- B. Combination fire and smoke dampers.
- C. Duct access doors.
- D. Duct test holes.
- E. Fire dampers.
- F. Flexible duct connections.
- G. Smoke dampers.
- H. Volume control dampers.

1.02 RELATED REQUIREMENTS

- A. Section 23 3100 - HVAC Ducts and Casings.

1.03 REFERENCE STANDARDS

- A. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2015.
- B. NFPA 92 - Standard for Smoke Control Systems; 2015.
- C. NFPA 96 - Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations; 2014.
- D. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible; 2005 (Rev. 2009).
- E. UL 555 - Standard for Fire Dampers; Current Edition, Including All Revisions.
- F. UL 555S - Standard for Smoke Dampers; Current Edition, Including All Revisions.

1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Project Record Drawings: Record actual locations of access doors, test holes, and dampers.
- C. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 01 6000 - Product Requirements, for additional provisions.
 - 2. Extra Fusible Links: One of each type and size.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.
- B. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Protect dampers from damage to operating linkages and blades.

PART 2 PRODUCTS

2.01 BACKDRAFT DAMPERS - METAL

- A. Manufacturers:
 - 1. Louvers & Dampers, Inc: www.louvers-dampers.com.
 - 2. Nailor Industries Inc: www.nailor.com.
 - 3. Ruskin Company: www.ruskin.com.
 - 4. Substitutions: See Section 01 6000 - Product Requirements.
- B. Gravity Backdraft Dampers, Size 18 by 18 inches (450 by 450 mm) or Smaller, Furnished with Air Moving Equipment: Air moving equipment manufacturer's standard construction.

- C. Multi-Blade, Parallel Action Gravity Balanced Backdraft Dampers: Galvanized steel, with center pivoted blades of maximum 6 inch (150 mm) width, with felt or flexible vinyl sealed edges, linked together in rattle-free manner with 90 degree stop, steel ball bearings, and plated steel pivot pin; adjustment device to permit setting for varying differential static pressure.

2.02 COMBINATION FIRE AND SMOKE DAMPERS

- A. Manufacturers:
 - 1. Lloyd Industries, Inc.: www.firedamper.com.
 - 2. Louvers & Dampers, Inc: www.louvers-dampers.com.
 - 3. Nailor Industries Inc: www.nailor.com.
 - 4. Ruskin Company: www.ruskin.com.
 - 5. Substitutions: See Section 01 6000 - Product Requirements.
- B. Fabricate in accordance with NFPA 90A, UL 555, UL 555S, and as indicated.
- C. Provide factory sleeve and collar for each damper.
- D. Multiple Blade Dampers: Fabricate with 16 gage, 0.0598 inch (1.52 mm) galvanized steel frame and blades, oil-impregnated bronze or stainless steel sleeve bearings and plated steel axles, stainless steel jamb seals, 1/8 by 1/2 inch (3.2 by 12.7 mm) plated steel concealed linkage, stainless steel closure spring, blade stops, and lock, and 1/2 inch (12.7 mm) actuator shaft.
- E. Operators: UL listed and labelled spring return electric type suitable for 120 volts, single phase, 60 Hz. Provide end switches to indicate damper position. Locate damper operator on interior of duct and link to damper operating shaft.
- F. Electro Thermal Link: Fusible link melting at 165 degrees F (74 degrees C); 120 volts, single phase, 60 Hz; UL listed and labeled.

2.03 DUCT ACCESS DOORS

- A. Manufacturers:
 - 1. Acudor Products Inc: www.acudor.com.
 - 2. Elgen Manufacturing: www.elgenmfg.com.
 - 3. Lloyd Industries, Inc.: www.firedamper.com.
 - 4. Nailor Industries Inc: www.nailor.com.
 - 5. Ruskin Company: www.ruskin.com.
 - 6. SEMCO Incorporated: www.semcohv.com.
 - 7. Ward Industries: www.wardind.com.
 - 8. Substitutions: See Section 01 6000 - Product Requirements.
- B. Fabricate in accordance with SMACNA (DCS) and as indicated.
- C. Access doors with sheet metal screw fasteners are not acceptable.

2.04 DUCT TEST HOLES

- A. Temporary Test Holes: Cut or drill in ducts as required. Cap with neat patches, neoprene plugs, threaded plugs, or threaded or twist-on metal caps.
- B. Permanent Test Holes: Factory fabricated, air tight flanged fittings with screw cap. Provide extended neck fittings to clear insulation.
 - 1. Manufacturers:
 - a. Carlisle HVAC Products; Dynair Test Port with Red Cap with O-Ring Seal: www.carlislehv.com/sle.
 - b. Substitutions: See Section 01 6000 - Product Requirements.

2.05 FIRE DAMPERS

- A. Manufacturers:
 - 1. Lloyd Industries, Inc.: www.firedamper.com.
 - 2. Louvers & Dampers, Inc: www.louvers-dampers.com.
 - 3. Nailor Industries Inc: www.nailor.com.

4. Ruskin Company: www.ruskin.com.
 5. Ward Industries: www.wardind.com.
 6. Substitutions: See Section 01 6000 - Product Requirements.
- B. Fabricate in accordance with NFPA 90A and UL 555, and as indicated.
 - C. Ceiling Dampers: Galvanized steel, 22 gage, 0.0299 inch (0.76 mm) frame and 16 gage, 0.0598 inch (1.52 mm) flap, two layers 0.125 inch (3.2 mm) ceramic fiber on top side and one layer on bottom side for round flaps, with locking clip.
 - D. Horizontal Dampers: Galvanized steel, 22 gage, 0.0299 inch (0.76 mm) frame, stainless steel closure spring, and lightweight, heat retardant non-asbestos fabric blanket.
 - E. Curtain Type Dampers: Galvanized steel with interlocking blades. Provide stainless steel closure springs and latches for horizontal installations. Configure with blades out of air stream except for 1.0 inch (250 Pa) pressure class ducts up to 12 inches (300 mm) in height.
 - F. Multiple Blade Dampers: 16 gage, 0.0598 inch (1.52 mm) galvanized steel frame and blades, oil-impregnated bronze or stainless steel sleeve bearings and plated steel axles, 1/8 by 1/2 inch (3.2 by 12.7 mm) plated steel concealed linkage, stainless steel closure spring, blade stops, and lock.

2.06 FLEXIBLE DUCT CONNECTIONS

- A. Manufacturers:
 1. Carlisle HVAC Products; Dynair Connector Plus G90 Steel Offset Seam Neoprene Fabric: www.carlislehvac.com/sle.
 2. Elgen Manufacturing: www.elgenmfg.com.
 3. Substitutions: See Section 01 6000 - Product Requirements.
- B. Fabricate in accordance with SMACNA (DCS) and as indicated.
- C. Flexible Duct Connections: Fabric crimped into metal edging strip.
 1. Fabric: UL listed fire-retardant neoprene coated woven glass fiber fabric to NFPA 90A, minimum density 30 oz per sq yd (1.0 kg/sq m).
 - a. Net Fabric Width: Approximately 2 inches (50 mm) wide.
 2. Metal: 3 inches (75 mm) wide, 24 gage, 0.0239 inch (0.61 mm) thick galvanized steel.
- D. Leaded Vinyl Sheet: Minimum 0.55 inch (14 mm) thick, 0.87 lbs per sq ft (4.2 kg/sq m), 10 dB attenuation in 10 to 10,000 Hz range.
- E. Maximum Installed Length: 14 inch (356 mm).

2.07 SMOKE DAMPERS

- A. Manufacturers:
 1. Louvers & Dampers, Inc: www.louvers-dampers.com.
 2. Nailor Industries Inc: www.nailor.com.
 3. Ruskin Company: www.ruskin.com.
 4. Substitutions: See Section 01 6000 - Product Requirements.
- B. Fabricate in accordance with NFPA 90A and UL 555S, and as indicated.
- C. Dampers: UL Class 1 airfoil blade type smoke damper, normally open automatically operated by pneumatic actuator.
- D. Electro Thermal Link: Fusible link melting at 165 degrees F (74 degrees C); 120 volts, single phase, 60 Hz; UL listed and labeled.

2.08 VOLUME CONTROL DAMPERS

- A. Manufacturers:
 1. Louvers & Dampers, Inc: www.louvers-dampers.com.
 2. Nailor Industries Inc: www.nailor.com.
 3. Ruskin Company: www.ruskin.com.
 4. Substitutions: See Section 01 6000 - Product Requirements.
- B. Fabricate in accordance with SMACNA (DCS) and as indicated.

- C. Single Blade Dampers: Fabricate for duct sizes up to 6 by 30 inch (150 by 760 mm).
 - 1. Blade: 24 gage, 0.0239 inch (0.61 mm), minimum.
- D. Multi-Blade Damper: Fabricate of opposed blade pattern with maximum blade sizes 8 by 72 inch (200 by 1825 mm). Assemble center and edge crimped blades in prime coated or galvanized channel frame with suitable hardware.
 - 1. Blade: 18 gage, 0.0478 inch (1.21 mm), minimum.
- E. Quadrants:
 - 1. Provide locking, indicating quadrant regulators on single and multi-blade dampers.
 - 2. On insulated ducts mount quadrant regulators on stand-off mounting brackets, bases, or adapters.
 - 3. Where rod lengths exceed 30 inches (750 mm) provide regulator at both ends.
 - 4. Manufacturers:
 - a. Carlisle HVAC Products; Dynair Double Shear Rattle Free Quadrants 1/2 inch: www.carlislehvac.com/sle.
 - b. Substitutions: See Section 01 6000 - Product Requirements.

PART 3 EXECUTION

3.01 PREPARATION

- A. Verify that electric power is available and of the correct characteristics.

3.02 INSTALLATION

- A. Install accessories in accordance with manufacturer's instructions, NFPA 90A, and follow SMACNA (DCS). Refer to Section 23 3100 for duct construction and pressure class.
- B. Provide backdraft dampers on exhaust fans or exhaust ducts nearest to outside and where indicated.
- C. Provide duct access doors for inspection and cleaning before and after filters, coils, fans, automatic dampers, at fire dampers, combination fire and smoke dampers, and elsewhere as indicated. Provide for cleaning kitchen exhaust ducts in accordance with NFPA 96. Provide minimum 8 by 8 inch (200 by 200 mm) size for hand access, size for shoulder access, and as indicated. Provide 4 by 4 inch (100 by 100 mm) for balancing dampers only. Review locations prior to fabrication.
- D. Provide duct test holes where indicated and required for testing and balancing purposes.
- E. Provide fire dampers, combination fire and smoke dampers, and smoke dampers at locations indicated, where ducts and outlets pass through fire rated components, and where required by Authorities Having Jurisdiction. Install with required perimeter mounting angles, sleeves, breakaway duct connections, corrosion resistant springs, bearings, bushings and hinges.
- F. Install smoke dampers and combination smoke and fire dampers in accordance with NFPA 92.
- G. Demonstrate re-setting of fire dampers to Owner's representative.
- H. At fans and motorized equipment associated with ducts, provide flexible duct connections immediately adjacent to the equipment.
- I. At equipment supported by vibration isolators, provide flexible duct connections immediately adjacent to the equipment.
 - 1. Refer to Section 23 0548.
- J. Provide balancing dampers at points on supply, return, and exhaust systems where branches are taken from larger ducts as required for air balancing. Install minimum 2 duct widths from duct take-off.
- K. Provide balancing dampers on high velocity systems where indicated. Refer to Section 23 3600 - Air Terminal Units.
- L. Provide balancing dampers on duct take-off to diffusers, grilles, and registers, regardless of whether dampers are specified as part of the diffuser, grille, or register assembly.

END OF SECTION

**SECTION 23 3413
AXIAL HVAC FANS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Propeller fans.
- B. Motors and drives.
- C. Accessories.

1.02 RELATED REQUIREMENTS

- A. Section 23 0513 - Common Motor Requirements for HVAC Equipment.
- B. Section 23 0913 - Instrumentation and Control Devices for HVAC.
- C. Section 23 3300 - Air Duct Accessories: Backdraft dampers.
- D. Section 26 2717 - Equipment Wiring: Electrical characteristics and wiring connections.

1.03 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on axial fans and accessories including fan curves with specified operating point clearly plotted, power, RPM, sound power levels for both fan inlet and outlet at rated capacity, and electrical characteristics and connection requirements.
- C. Shop Drawings: Indicate assembly of axial fans and accessories including fan curves with specified operating point clearly plotted, sound power levels for both fan inlet and outlet at rated capacity, and electrical characteristics and connection requirements.
- D. Manufacturer's Instructions: Indicate installation instructions.
- E. Maintenance Data: Include instructions for lubrication, motor and drive replacement, spare parts list, and wiring diagrams.
- F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 01 6000 - Product Requirements, for additional provisions.
 - 2. Extra Fan Belts: One set for each individual fan.

1.04 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.
- B. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Protect motors, shafts, and bearings from weather and construction dust.

1.06 FIELD CONDITIONS

- A. Permanent fans may be used for ventilation during construction only after ductwork is clean, filters are in place, bearings have been lubricated, and fan has been test run under observation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. ACME Engineering and Manufacturing Corporation: www.acmefan.com.
- B. Loren Cook Company: www.lorencook.com.
- C. PennBarry: www.pennbarry.com.
- D. Greenheck: www.greenheck.com.
- E. Substitutions: See Section 01 6000 - Product Requirements.

2.02 PROPELLER FANS

- A. Impeller: Shaped steel or steel reinforced aluminum blade with heavy hubs, statically and dynamically balanced, keyed and locked to shaft, directly connected to motor or provided with V-belt drive.
- B. Frame: One piece, square steel with die formed venturi orifice, mounting flanges and supports, with baked enamel finish.
- C. Accessories:
 - 1. Backdraft Damper: Multiple blade with offset hinge pin, blades linked.
 - 2. Safety Screens: Expanded galvanized metal over inlet, motor, drive; to comply with OSHA regulations.
 - 3. Hood: Weathershield, to exclude rain and snow.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install with resilient mountings and with flexible electrical leads; refer to Section 23 0548.
- C. Install flexible connections specified in Section 23 3300 between axial fan inlet and discharge ductwork. Ensure metal bands of connectors are parallel with minimum one inch (25 mm) flex between ductwork and axial fan while running.
- D. Install fan restraining snubbers; refer to Section 23 0548. Adjust snubbers to prevent tension in flexible connectors when fan is operating.
- E. Provide fixed sheaves required for final air balance.
- F. Provide safety screen where inlet or outlet is exposed.
- G. Provide backdraft dampers on discharge of exhaust fans and as indicated.
- H. Provide access to adjustable blade axial fan wheels for varying blade angle setting. Adjust blades for varying range of volume and pressure.
- I. Provide floor mounted axial fans with reinforced legs. Provide ceiling suspended units with support brackets bolted to casing flange.

END OF SECTION

**SECTION 23 3423
POWER VENTILATORS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Roof exhausters.
- B. Roof ventilators.
- C. Cabinet exhaust fans.
- D. Ceiling exhaust fans.

1.02 RELATED REQUIREMENTS

- A. Section 23 0513 - Common Motor Requirements for HVAC Equipment.
- B. Section 23 3300 - Air Duct Accessories: Backdraft dampers.
- C. Section 26 2717 - Equipment Wiring: Electrical characteristics and wiring connections.

1.03 REFERENCE STANDARDS

- A. AMCA (DIR) - (Directory of) Products Licensed Under AMCA International Certified Ratings Program; <http://www.amca.org/certified/search/company.aspx>.
- B. AMCA 99 - Standards Handbook; 2010.
- C. AMCA 204 - Balance Quality and Vibration Levels for Fans; 2005.
- D. AMCA 210 - Laboratory Methods of Testing Fans for Certified Aerodynamic Performance Rating; 2007.
- E. AMCA 300 - Reverberant Room Method for Sound Testing of Fans; 2014.
- F. AMCA 301 - Methods for Calculating Fan Sound Ratings from Laboratory Test Data; 2014.
- G. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2014.
- H. NFPA 96 - Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations; 2014.
- I. UL 705 - Power Ventilators; Current Edition, Including All Revisions.
- J. UL 762 - Outline of Investigation for Power Roof Ventilators for Restaurant Exhaust Appliances; Current Edition, Including All Revisions.

1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on fans and accessories including fan curves with specified operating point clearly plotted, power, RPM, sound power levels at rated capacity, and electrical characteristics and connection requirements.
- C. Manufacturer's Instructions: Indicate installation instructions.
- D. Maintenance Data: Include instructions for lubrication, motor and drive replacement, spare parts list, and wiring diagrams.
- E. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 01 6000 - Product Requirements, for additional provisions.
 - 2. Extra Fan Belts: One set for each individual fan.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.

1.06 FIELD CONDITIONS

- A. Permanent ventilators may be used for ventilation during construction only after ductwork is clean, filters are in place, bearings have been lubricated, and fan has been test run under observation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Greenheck: www.greenheck.com.
- B. Loren Cook Company: www.lorencook.com.
- C. PennBarry: www.pennbarry.com.
- D. Substitutions: See Section 01 6000 - Product Requirements.

2.02 POWER VENTILATORS - GENERAL

- A. Static and Dynamically Balanced: AMCA 204 - Balance Quality and Vibration Levels for Fans.
- B. Performance Ratings: Determined in accordance with AMCA 210 and bearing the AMCA Certified Rating Seal.
- C. Sound Ratings: AMCA 301, tested to AMCA 300 and bearing AMCA Certified Sound Rating Seal.
- D. Fabrication: Conform to AMCA 99.
- E. UL Compliance: UL listed and labeled, designed, manufactured, and tested in accordance with UL 705.
- F. Electrical Components: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.
- G. Enclosed Safety Switches: Conform to NEMA 250.
- H. Kitchen Hood Exhaust Fans: Comply with requirements of NFPA 96 and UL 762.

2.03 ROOF EXHAUSTERS

- A. Fan Unit: V-belt or direct driven as indicated, with spun aluminum housing; resilient mounted motor; 1/2 inch (13 mm) mesh, 0.62 inch (1.6 mm) thick aluminum wire birdscreen; square base to suit roof curb with continuous curb gaskets.
- B. Roof Curb: 12 inch (300 mm) high self-flashing of galvanized steel with continuously welded seams, built-in cant strips.
- C. Disconnect Switch: Factory wired, non-fusible, in housing for thermal overload protected motor and wall mounted multiple speed switch.
- D. Backdraft Damper: Gravity actuated, aluminum multiple blade construction, felt edged with offset hinge pin, nylon bearings, blades linked, and line voltage motor drive, power open, spring return.
- E. Sheaves: Cast iron or steel, dynamically balanced, bored to fit shafts and keyed; variable and adjustable pitch motor sheave selected so required rpm is obtained with sheaves set at mid-position; fan shaft with self-aligning pre-lubricated ball bearings.

2.04 CABINET AND CEILING EXHAUST FANS

- A. Centrifugal Fan Unit: V-belt or direct driven with galvanized steel housing lined with acoustic insulation, resilient mounted motor, gravity backdraft damper in discharge.
- B. Disconnect Switch: Cord and plug in housing for thermal overload protected motor and wall mounted switch.
- C. Grille: Molded white plastic.
- D. Sheaves: Cast iron or steel, dynamically balanced, bored to fit shafts and keyed; variable and adjustable pitch motor sheaves selected so required rpm is obtained with sheaves set at mid-position; fan shaft with self-aligning pre-lubricated ball bearings.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Secure roof exhausters with cadmium plated steel lag screws to roof curb.
- C. Extend ducts to roof exhausters into roof curb. Counterflash duct to roof opening.
- D. Hung Cabinet Fans:
 - 1. Install fans with resilient mountings and flexible electrical leads. Refer to Section 23 0548.
 - 2. Install flexible connections specified in Section 23 3300 between fan and ductwork. Ensure metal bands of connectors are parallel with minimum one inch (25 mm) flex between ductwork and fan while running.
- E. Provide sheaves required for final air balance.
- F. Install backdraft dampers on inlet to roof and wall exhausters.
- G. Provide backdraft dampers on outlet from cabinet and ceiling exhauster fans and as indicated.

END OF SECTION

SECTION 23 3700
AIR OUTLETS AND INLETS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Diffusers.
- B. Registers/grilles.
- C. Louvers.
- D. Gravity ventilators.

1.02 RELATED REQUIREMENTS

- A. Section 09 9123 - Interior Painting: Painting of ducts visible behind outlets and inlets.

1.03 REFERENCE STANDARDS

- A. AMCA 500-L - Laboratory Methods of Testing Louvers for Rating; 2012.
- B. AMCA 511 - Certified Ratings Program for Air Control Devices; 2010.
- C. AMCA 550 - Test Method for High Velocity Wind Driven Rain Resistant Louvers; 2015.
- D. ASHRAE Std 70 - Method of Testing the Performance of Air Outlets and Inlets; 2006 (R2011).
- E. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2014.
- F. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2013.

1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide data for equipment required for this project. Review outlets and inlets as to size, finish, and type of mounting prior to submission. Submit schedule of outlets and inlets showing type, size, location, application, and noise level.
- C. Project Record Documents: Record actual locations of air outlets and inlets.

1.05 QUALITY ASSURANCE

- A. Test and rate air outlet and inlet performance in accordance with ASHRAE Std 70.
- B. Test and rate louver performance in accordance with AMCA 500-L.

1.06 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. American Louver Company; ALC Grilles and Registers: www.americanlouver.com.
- B. Carnes, a division of Carnes Company Inc.: www.carnes.com.
- C. Hart & Cooley, Inc.: www.hartandcooley.com.
- D. Krueger: www.krueger-hvac.com.
- E. Price Industries: www.price-hvac.com.
- F. Titus: www.titus-hvac.com.
- G. Tuttle and Bailey: www.tuttleandbailey.com/sle.
- H. Ruskin: www.ruskin.com.
- I. Substitutions: See Section 01 6000 - Product Requirements.

2.02 RECTANGULAR CEILING DIFFUSERS

- A. Type: Provide square, stamped, multi-core diffuser to discharge air in one way, two way, three way, and four way pattern.
- B. Connections: Round.
- C. Frame: Provide inverted T-bar type. In plaster ceilings, provide plaster frame and ceiling frame.
- D. Fabrication: Steel with baked enamel finish.
- E. Color: White.
- F. Accessories: Provide radial opposed blade volume control damper; removable core with damper adjustable from diffuser face.

2.03 CEILING SUPPLY REGISTERS/GRILLES

- A. Type: Streamlined and individually adjustable curved blades to discharge air along face of grille, one-way deflection.
- B. Frame: 1-1/4 inch (32 mm) margin with countersunk screw mounting and gasket.
- C. Construction: Made of aluminum extrusions with factory enamel finish.
- D. Color: White.
- E. Damper: Integral, gang-operated, opposed blade type with removable key operator, operable from face.

2.04 CEILING EXHAUST AND RETURN REGISTERS/GRILLES

- A. Type: Streamlined blades, 3/4 inch (19 mm) minimum depth, 3/4 inch (19 mm) maximum spacing, with blades set at 45 degrees, vertical face.
- B. Frame: 1-1/4 inch (32 mm) margin with countersunk screw mounting.
- C. Fabrication: Steel with 20 gage, 0.0359 inch (0.91 mm) minimum frames and 22 gage, 0.0299 inch (0.76 mm) minimum blades, steel and aluminum with 20 gage, 0.0359 inch (0.91 mm) minimum frame, or aluminum extrusions, with factory baked enamel finish.
- D. Color: White.
- E. Damper: Integral, gang-operated, opposed blade type with removable key operator, operable from face where not individually connected to exhaust fans.
- F. Gymnasiums: Provide front pivoted or welded in place blades, securely fastened to be immobile.

2.05 WALL SUPPLY REGISTERS/GRILLES

- A. Type: Streamlined and individually adjustable blades, 3/4 inch (19 mm) minimum depth, 3/4 inch (19 mm) maximum spacing with spring or other device to set blades, vertical face, single deflection.
- B. Frame: 1-1/4 inch (32 mm) margin with countersunk screw mounting and gasket.
- C. Fabrication: Steel with 20 gage, 0.0359 inch (0.91 mm) minimum frames and 22 gage, 0.0299 inch (0.76 mm) minimum blades, steel and aluminum with 20 gage, 0.0359 inch (0.91 mm) minimum frame, or aluminum extrusions, with factory baked enamel finish.
- D. Color: White.
- E. Damper: Integral, gang-operated opposed blade type with removable key operator, operable from face.
- F. Gymnasiums: Provide front pivoted or welded in place blades, securely fastened to be immobile.

2.06 WALL EXHAUST AND RETURN REGISTERS/GRILLES

- A. Type: Streamlined blades, 3/4 inch (19 mm) minimum depth, 3/4 inch (19 mm) maximum spacing, with spring or other device to set blades, vertical face.

- B. Frame: 1-1/4 inch (32 mm) margin with countersunk screw mounting.
- C. Fabrication: Steel frames and blades, with factory baked enamel finish.
- D. Color: White.
- E. Damper: Integral, gang-operated, opposed blade type with removable key operator, operable from face.
- F. Gymnasiums: Provide front pivoted or welded in place blades, securely fastened to be immobile.

2.07 LOUVERS

- A. Type: 4 inch (100 mm) deep with blades on 37.5 degree slope with drainable head, heavy channel frame, 1/2 inch (13 mm) square mesh screen over exhaust and 1/2 inch (13 mm) square mesh screen over intake.
- B. Fabrication: 12 gage, 0.081 inch (2.06 mm) thick extruded aluminum, welded assembly, with mill finish.
- C. Color: To be selected by Architect from manufacturer's standard range.
- D. Mounting: Furnish with interior flat flange for installation.

2.08 GRAVITY VENTILATORS

- A. Hood Intake Gravity Ventilator:
 - 1. Manufacturers:
 - a. American Coolair Corporation: www.coolair.com.
 - b. Greenheck Fan Corporation: www.greenheck.com.
 - c. Loren Cook Company: www.lorencook.com.
 - d. Substitutions: See Section 01 6000 - Product Requirements.
 - 2. General:
 - a. Low silhouette for intake applications with natural gravity or negative pressure system(s).
 - b. Performance ratings and factory testing to be in accordance with AMCA 511 and AMCA 550.
 - c. Equipment to bear permanently affixed manufacturer's nameplate listing model and serial number.
 - 3. Hood and Base:
 - a. Material: Aluminum.
 - b. Hood Construction: Precision formed, arched panels with interlocking seams.
 - c. Vertical End Panels: Fully locked into hood end panels.
 - d. Curb Cap: Pre-punched mounting holes for installation.
 - 4. Birdscreen:
 - a. Fabricate in accordance with ASTM B221 (ASTM B221M).
 - b. Construction: 1/2 inch (12.7 mm) Galvanized mesh.
 - c. Horizontally mounted across hood intake area.
 - 5. Hood Support: Galvanized steel construction and fastened so hood can be removed completely from the base or hinged open.
 - 6. Options/Accessories:
 - a. Roof Curbs:
 - 1) Flat Roofs:
 - (a) Welded, straight side curb with flashing flange and wood nailer.
 - (b) Tabbed and riveted curb with 45 degree cant and wood nailer.
 - (c) Welded curb with 45 degree cant and wood nailer.
 - 2) Pitched Roofs: Welded, straight side curb with flashing flange and wood nailer.
 - 3) Material: Aluminum.
 - 4) Insulation Thickness: 1 inch (25.4 mm).
 - b. Provide extended base minimum 7 inch (177.8 mm) extension to base height making overall base 12 inches (304.8 mm) in height to prevent snow or moisture intake.

- c. Curb Seal: Rubber seal between fan and roof curb.
- d. Dampers:
 - 1) Type: Motorized.
 - 2) Factory designed to prevent outside air from entering back into building when fan is off.
 - 3) Balanced for minimal resistance to flow.
 - 4) Galvanized frames with pre-punched mounting holes.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Check location of outlets and inlets and make necessary adjustments in position to conform with architectural features, symmetry, and lighting arrangement.
- C. Install diffusers to ductwork with air tight connection.
- D. Provide balancing dampers on duct take-off to diffusers, and grilles and registers, despite whether dampers are specified as part of the diffuser, or grille and register assembly.
- E. Paint ductwork visible behind air outlets and inlets matte black. Refer to Section 09 9123.

END OF SECTION

SECTION 23 5100
BREECHINGS, CHIMNEYS, AND STACKS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Type B double wall gas vents.

1.02 RELATED REQUIREMENTS

- A. Section 07 8400 - Firestopping.

1.03 REFERENCE STANDARDS

- A. ANSI Z21.66 - American National Standard for Automatic Damper Devices for Use with Gas-Fired Appliances; 2015.
- B. NFPA 31 - Standard for the Installation of Oil Burning Equipment; 2016.
- C. NFPA 54 - National Fuel Gas Code; 2015.
- D. NFPA 211 - Guide for Smoke and Heat Venting; 2016.
- E. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible; 2005 (Rev. 2009).
- F. UL 441 - Standard for Gas Vents; Current Edition, Including All Revisions.

1.04 DEFINITIONS

- A. Breeching: Vent Connector.
- B. Chimney: Primarily vertical shaft enclosing at least one vent for conducting flue gases outdoors.
- C. Vent: That portion of a venting system designed to convey flue gases directly outdoors from a vent connector or from an appliance when a vent connector is not used.
- D. Vent Connector: That part of a venting system that conducts the flue gases from the flue collar of an appliance to a chimney or vent, and may include a draft control device.

1.05 DESIGN REQUIREMENTS

- A. Factory built vents and chimneys used for venting natural draft appliances shall comply with NFPA 211 and be UL listed and labeled.

1.06 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data indicating factory built chimneys, including dimensional details of components and flue caps, dimensions and weights, electrical characteristics and connection requirements.
- C. Shop Drawings: Indicate general construction, dimensions, weights, support and layout of breechings. Submit layout drawings indicating plan view and elevations where factory built units are used.
- D. Manufacturer's Instructions: Include installation instructions, and indicate assembly, support details, and connection requirements.

1.07 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.
- B. Installer Qualifications: Company specializing in performing the type of work specified in this section with minimum three years documented experience.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. AMPCO by Hart & Cooley, Inc; Model VSI: www.ampcostacks.com.

- B. Metal-Fab, Inc: www.mtlfab.com.
- C. Selkirk Corporation; Model PS: www.selkirkcommercial.com.
- D. Substitutions: See Section 01 6000 - Product Requirements.

2.02 BREECHINGS, CHIMNEYS, AND STACKS - GENERAL REQUIREMENTS

- A. Regulatory Requirements:
 - 1. Conform to applicable code for installation of natural gas burning appliances and equipment.
 - 2. Conform to NFPA 31 for installation of oil burning appliances and equipment.
 - 3. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

2.03 TYPE B DOUBLE WALL GAS VENTS

- A. Fabrication: Inner pipe of sheet aluminum, and outer pipe of galvanized sheet steel, tested in compliance with UL 441.
- B. Electrically Actuated Vent Dampers: Same size as draft hood collar, constructed of stainless steel or galvanized steel, with corrosion-resistant components, in compliance with ANSI Z21.66.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install in accordance with NFPA 54.
- C. Install breechings with minimum of joints. Align accurately at connections, with internal surfaces smooth.
- D. Support breechings from building structure, rigidly with suitable ties, braces, hangers and anchors to hold to shape and prevent buckling. Support vertical breechings, chimneys, and stacks at 12 foot (4 m) spacing, to adjacent structural surfaces, or at floor penetrations. Refer to SMACNA (DCS) for equivalent duct support configuration and size.
- E. Install concrete inserts for support of breechings, chimneys, and stacks in coordination with formwork.
- F. Pitch breechings with positive slope up from fuel-fired equipment to chimney or stack.
- G. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 07 8400.
- H. For Type B double wall gas vents, maintain UL listed minimum clearances from combustibles. Assemble pipe and accessories as required for complete installation.
- I. Clean breechings, chimneys, and stacks during installation, removing dust and debris.
- J. At appliances, provide slip joints permitting removal of appliances without removal or dismantling of breechings, breeching insulation, chimneys, or stacks.
- K. Provide maximum 2 feet (maximum 600 mm) of breeching to connect appliance to chimney. Provide Type B chimney continuously from appliances.

3.02 SCHEDULES

- A. Breechings, Chimneys and Stacks.
 - 1. Furnace: Galvanized breeching, Type B chimney.

END OF SECTION

SECTION 23 5400
FURNACES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Forced air furnaces.
- B. Controls.

1.02 RELATED REQUIREMENTS

- A. Section 23 0513 - Common Motor Requirements for HVAC Equipment: Additional requirements for fan motors.
- B. Section 23 0713 - Duct Insulation: Duct liner.
- C. Section 23 0913 - Instrumentation and Control Devices for HVAC: Thermostats, humidistats, time clocks.
- D. Section 23 3100 - HVAC Ducts and Casings.
- E. Section 23 5100 - Breechings, Chimneys, and Stacks: Flue or stack.

1.03 REFERENCE STANDARDS

- A. ANSI Z21.47 - American National Standard for Gas-Fired Central Furnaces; 2012.
- B. NFPA 54 - National Fuel Gas Code; 2015.
- C. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2015.
- D. NFPA 211 - Guide for Smoke and Heat Venting; 2016.

1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide rated capacities, weights, accessories, electrical nameplate data, and wiring diagrams.
- C. Shop Drawings: Indicate assembly, required clearances, and location and size of field connections.
- D. Manufacturer's Instructions: Indicate rigging, assembly, and installation instructions.
- E. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, installation instructions, maintenance and repair data, and parts listing.
- F. Warranty: Submit manufacturers warranty and ensure forms have been filled out in Owner's name and registered with manufacturer.
- G. Project Record Documents: Record actual locations of components and connections.
- H. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 01 6000 - Product Requirements, for additional provisions.
 - 2. Extra Filters: One for each furnace.
 - 3. Extra Pilot Thermocouples: One.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.
- B. Installer Qualifications: Company specializing in performing the work of this section with minimum three years of experience and approved by manufacturer.

1.06 REGULATORY REQUIREMENTS

- A. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

1.07 WARRANTY

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
- B. Provide three year manufacturers warranty for solid state ignition modules.
- C. Provide five year manufacturers warranty for heat exchangers.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Carrier Corporation, a brand of United Technologies Corporation Building & Industrial Systems: www.carrier.com.
- B. Trane Inc, a subsidiary of Ingersoll Rand: www.trane.com.
- C. York International Corporation / Johnson Controls: www.york.com.
- D. Substitutions: See Section 01 6000 - Product Requirements.

2.02 GAS FIRED FURNACES

- A. Units: Self-contained, packaged, factory assembled, pre-wired unit consisting of cabinet, supply fan, heating element, controls, air filter, humidifier, and accessories; wired for single power connection with control transformer.
 - 1. Safety certified by CSA in accordance with ANSI Z21.47.
 - 2. Venting System: Direct.
 - 3. Combustion: Sealed.
 - 4. Air Flow Configuration: Upflow.
 - 5. Heating: Propane gas fired.
 - 6. Accessories:
 - a. Condensate drain.
 - b. Concentric roof termination kit.
 - c. Concentric wall termination kit.
- B. Cabinet: Steel with baked enamel finish, easily removed and secured access doors with safety interlock switches, glass fiber insulation with reflective liner. If not certified for combustible flooring, please provide additional steel base.
- C. Primary Heat Exchanger:
 - 1. Material: Hot-rolled steel.
 - 2. Shape: Tubular type.
- D. Gas Burner:
 - 1. Atmospheric type with adjustable combustion air supply.
 - 2. Gas valve, two stage provides 100 percent safety gas shut-off; 24 volt combining pressure regulation, safety pilot, manual set (On-Off), pilot filtration, automatic electric valve.
 - 3. Electronic pilot ignition, with electric spark igniter.
 - 4. Combustion air damper with synchronous spring return damper motor.
 - 5. Non-corrosive combustion air blower with permanently lubricated motor.
- E. Gas Burner Safety Controls:
 - 1. Thermocouple sensor: Prevents opening of gas valve until pilot flame is proven and stops gas flow on ignition failure.
 - 2. Flame rollout switch: Installed on burner box and prevents operation.
 - 3. Vent safety shutoff sensor: Temperature sensor installed on draft hood and prevents operation, manual reset.
 - 4. Limit Control: Fixed stop at maximum permissible setting, de-energizes burner on excessive bonnet temperature, automatic resets.
- F. Supply Fan: Centrifugal type rubber mounted with direct drive with adjustable variable pitch motor pulley.
- G. Motor:
 - 1. 1750 rpm single-speed, permanently lubricated, hinge mounted.

2. Refer to Section 23 0513.
- H. Air Filters: 1 inch (25 mm) thick urethane, washable type arranged for easy replacement.
- I. Operating Controls:
 1. Room Thermostat: Cycles burner to maintain room temperature setting.
 2. Supply Fan Control: Energize from bonnet temperature independent of burner controls, with adjustable timed off delay and fixed timed on delay, with manual switch for continuous fan operation. Provide continuous low speed fan operation.

2.03 THERMOSTATS

- A. Manufacturers:
 1. Carrier Corporation: www.carrier.com.
 2. Trane Inc: www.trane.com.
 3. York International Corporation / Johnson Controls: www.york.com.
 4. Substitutions: See Section 01 6000 - Product Requirements.
- B. Room Thermostat: Low voltage, electric solid state microcomputer based room thermostat with remote sensor:
 1. System selector switch (heat-off) and fan control switch (auto-on).
 2. Preferential rate control to minimize overshoot and deviation from setpoint.
 3. Set-up for four separate temperatures per day.
 4. Instant override of setpoint for continuous or timed period from one hour to 31 days.
 5. Short cycle protection.
 6. Programming based on weekdays, Saturday and Sunday.
 7. Selection features including degree F or degree C display, 12 or 24 hour clock, keyboard disable, remote sensor, fan on-auto.
 8. Battery replacement without program loss.
 9. Thermostat Display:
 - a. Actual room temperature.
 - b. System Mode Indication: heating, cooling, fan auto, off, and on, auto or on, off.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that substrates are ready for installation of units and openings are as indicated on shop drawings.
- B. Verify that proper power supply is available and located correctly.
- C. Verify that proper fuel supply is available for connection.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions and requirements of authorities having jurisdiction.
- B. Install in accordance with NFPA 90A.
- C. Install gas fired furnaces in accordance with NFPA 54.
- D. Provide vent connections in accordance with NFPA 211.

END OF SECTION

SECTION 23 6213

PACKAGED AIR-COOLED REFRIGERANT COMPRESSOR AND CONDENSER UNITS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Condensing unit package.
- B. Charge of refrigerant and oil.
- C. Controls and control connections.
- D. Refrigerant piping connections.
- E. Motor starters.
- F. Electrical power connections.

1.02 RELATED REQUIREMENTS

- A. Section 03 3000 - Cast-in-Place Concrete: Concrete bases.
- B. Section 23 0513 - Common Motor Requirements for HVAC Equipment.
- C. Section 23 0993 - Sequence of Operations for HVAC Controls.
- D. Section 23 2300 - Refrigerant Piping.
- E. Section 23 5400 - Furnaces.
- F. Section 26 2717 - Equipment Wiring: Electrical characteristics and wiring connections.

1.03 REFERENCE STANDARDS

- A. AHRI 210/240 - Standard for Performance Rating of Unitary Air-Conditioning and Air-Source Heat Pump Equipment; 2008, Including All Addenda.
- B. ASHRAE Std 15 - Safety Standard for Refrigeration Systems; 2013.
- C. ASHRAE Std 23.1 - Methods of Testing for Rating the Performance of Positive Displacement Refrigerant Compressors and Condensing Units that Operate at Subcritical Temperatures of the Refrigerant; 2010.
- D. ASHRAE Std 90.1 I-P - Energy Standard for Buildings Except Low-Rise Residential Buildings; 2013, Including All Amendments and Errata.
- E. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2014.

1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide rated capacities, weights specialties and accessories, electrical nameplate data, and wiring diagrams. Include equipment served by condensing units in submittal, or submit at same time, to ensure capacities are complementary.
- C. Shop Drawings: Indicate components, assembly, dimensions, weights and loadings, required clearances, and location and size of field connections. Include schematic layouts showing condensing units, cooling coils, refrigerant piping, and accessories required for complete system.
- D. Manufacturer's Instructions: Submit manufacturer's complete installation instructions.
- E. Operation and Maintenance Data: Include start-up instructions, maintenance instructions, parts lists, controls, and accessories.
- F. Warranty: Submit manufacturer's warranty and ensure forms have been filled out in Owner's name and registered with manufacturer.
- G. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 01 6000 - Product Requirements, for additional provisions.
 - 2. Extra Lubricating Oil: One complete change.

1.05 QUALITY ASSURANCE

- A. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Comply with manufacturer's installation instructions for rigging, unloading, and transporting units.

1.07 WARRANTY

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
- B. Provide a five year warranty to include coverage for refrigerant compressors.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Carrier, a part of UTC Building and Industrial Systems, a unit of United Technologies Corp: www.carrier.com.
- B. Trane, a brand of Ingersoll Rand: www.trane.com.
- C. York International Corporation/Johnson Controls, Inc: www.york.com.
- D. Substitutions: See Section 01 6000 - Product Requirements.

2.02 MANUFACTURED UNITS

- A. Units: Self-contained, packaged, factory assembled and pre-wired units suitable for outdoor use consisting of cabinet, compressors, condensing coil and fans, integral sub-cooling coil, controls, liquid receiver, wind deflector, and screens.
- B. Construction and Ratings: In accordance with AHRI 210/240. Test in accordance with ASHRAE Std 23.1.
- C. Performance Ratings: Energy Efficiency Rating (EER) and Coefficient of Performance (COP) not less than prescribed by ASHRAE Std 90.1 I-P.

2.03 CASING

- A. House components in welded steel frame with galvanized steel panels with weather resistant, baked enamel finish.
- B. Mount starters, disconnects, and controls in weatherproof panel provided with full opening access doors. Provide mechanical interlock to disconnect power when door is opened.
- C. Provide removable access doors or panels with quick fasteners and piano hinges.

2.04 CONDENSER COILS

- A. Coils: Aluminum fins mechanically bonded to seamless copper tubing. Provide sub-cooling circuits. Air test under water to 425 psig (2900 kPa), and vacuum dehydrate. Seal with holding charge of nitrogen.
- B. Coil Guard: Expanded metal with lint screens.

2.05 FANS AND MOTORS

- A. Vertical discharge direct driven propeller type condenser fans with fan guard on discharge. Equip with roller or ball bearings with grease fittings extended to outside of casing.
- B. Weatherproof motors suitable for outdoor use, single phase permanent split capacitor or 3 phase, with permanent lubricated ball bearings and built in current and thermal overload protection. Refer to Section 23 0513.

2.06 COMPRESSORS

- A. Compressor: Semi-hermetic reciprocating type.
- B. Mounting: Statically and dynamically balance rotating parts and mount on spring vibration isolators.

- C. Lubrication System: Reversible, positive displacement oil pump with oil charging valve, oil level sight glass, and magnetic plug or strainer.
- D. Motor: Constant speed 1800 rpm suction gas cooled with electronic sensor and winding over temperature protection, designed for across-the-line starting. Furnish with starter.
- E. Capacity Reduction Equipment: Suction valve unloaders, with lifting mechanism operated by electrically actuated solenoid valve, with unloaded compressor start; controlled from suction pressure.
- F. Sump Oil Heater: Evaporates refrigerant returning to sump during shut down. Energize heater continuously when compressor is not operating.

2.07 REFRIGERANT CIRCUIT

- A. Provide each unit with one refrigerant circuit, factory supplied and piped. Refer to Section 23 2300.
- B. For each refrigerant circuit, provide:
 1. Filter dryer replaceable core type.
 2. Liquid line sight glass and moisture indicator.
 3. Thermal expansion valve for maximum operating pressure.
 4. Insulated suction line.
 5. Suction and liquid line service valves and gage ports.
 6. Liquid line solenoid valve.
 7. Charging valve.
 8. Discharge line check valve.
 9. Compressor discharge service valve.
 10. Condenser pressure relief valve.
- C. For heat pump units, provide reversing valve, suction line accumulator, discharge muffler, flow control check valve, and solid-state defrost control utilizing thermistors.

2.08 CONTROLS

- A. On unit, mount weatherproof steel control panel, NEMA 250, containing power and control wiring, molded case disconnect switch, factory wired with single point power connection.
 1. Factory mount disconnect switch on unit under provisions of Section 26 2717.
- B. For each compressor, provide across-the-line starter, non-recycling compressor overload, starter relay, and control power transformer or terminal for controls power. Provide manual reset current overload protection. For each condenser fan, provide across-the-line starter with starter relay.
- C. Provide safety controls arranged so any one will shut down machine:
 1. High discharge pressure switch (manual reset) for each compressor.
 2. Low suction pressure switch (automatic reset) for each compressor.
 3. Oil Pressure switch (manual reset).
- D. Provide the following operating controls:
 1. Refer to Section 23 0993.
 2. Thermostat located in room cycles compressors activates cylinder unloaders.
 3. One minute off timer prevents compressor from short cycling.
 4. Periodic pump-out timer to pump down on high evaporator refrigerant pressure.
 5. Low ambient temperature controls.
 6. Hot gas bypass sized for minimum compressor loading on one compressor only, bypasses hot refrigerant gas to evaporator.
 7. Lead-lag switch to alternate compressor operation.
 8. Low ambient thermostat to lock out compressor at low ambient temperatures.
- E. Provide controls to permit operation down to 0 degrees F (minus 18 degrees C) ambient temperature.
 1. Thermostat to cycle fan motors in response to outdoor ambient temperature.

2. Head pressure switch to cycle fan motors in response to refrigerant condensing pressure.
 3. Solid state control to vary speed of one condenser fan motor in response to refrigerant condensing pressure.
 4. Electronic control consisting of mixing damper assembly, controlled to maintain constant refrigerant condensing pressure.
- F. Gages: Prepped for suction and discharge refrigerant pressures and oil pressure for each compressor.
- G. For multiple units, provide remote mounted sequence panel to allow operation with lead-lag switching and time delay timer.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's installation instructions.
- B. Complete structural, mechanical, and electrical connections in accordance with manufacturer's installation instructions.
- C. Provide for connection to electrical service. Refer to Section 26 2717.
- D. Install units on concrete base as indicated. Refer to Section 03 3000.
- E. Provide connection to refrigeration piping system and evaporators. Refer to Section 23 2300. Comply with ASHRAE Std 15.

3.02 SYSTEM STARTUP

- A. Supply initial charge of refrigerant and oil for each refrigeration system. Replace losses of oil or refrigerant prior to end of correction period.
- B. Charge system with refrigerant and test entire system for leaks after completion of installation. Repair leaks, put system into operation, and test equipment performance.
- C. Shut-down system if initial start-up and testing takes place in winter and machines are to remain inoperative. Repeat start-up and testing operation at beginning of first cooling season.
- D. Provide cooling season start-up, and winter season shut-down for first year of operation.

END OF SECTION

SECTION 23 8113
PACKAGED TERMINAL AIR-CONDITIONERS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Air conditioning units.
- B. Cabinet.
- C. Evaporator fan.
- D. Compressor.
- E. Evaporator coil.
- F. Condenser.
- G. Air filters.
- H. Controls.

1.02 RELATED REQUIREMENTS

- A. Section 23 2300 - Refrigerant Piping.

1.03 REFERENCE STANDARDS

- A. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2015.

1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data for manufactured products and assemblies. Indicate water, drain, thermostatic valves, and electrical rough-in connections with electrical characteristics and connection requirements.
- C. Manufacturer's Instructions: Indicate assembly, support details, connection requirements, and include start-up instructions.
- D. Warranty: Submit manufacturer's warranty and ensure forms have been filled out in Owner's name and registered with manufacturer.
- E. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 01 6000 - Product Requirements, for additional provisions.
 - 2. Extra Filters: One set for each unit.
 - 3. Extra Fan Belts: One set for each unit.

1.05 QUALITY ASSURANCE

- A. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

1.06 WARRANTY

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
- B. Provide a five year warranty to include coverage for refrigeration compressors.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Daikin Industries Co, Ltd: www.daikin.com.
- B. Friedrich Air Conditioning Co: www.friedrich.com.
- C. Trane Inc: www.trane.com.
- D. Mitsubishi: www.mehvac.com.
- E. Substitutions: See Section 01 6000 - Product Requirements.

2.02 AIR CONDITIONING UNITS

- A. Description: Packaged, self-contained, factory assembled, prewired unit, consisting of cabinet, compressor, condensing coil, evaporator fan, evaporator coil, discharge plenum, outside air connection, heating coil, air filters, and controls; fully charged with refrigerant and filled with oil.
- B. Assembly: Up flow air delivery, in draw-through configuration as indicated.

2.03 CABINET

- A. Frame and Panels: Galvanized steel with baked enamel finish, easily removed access doors or panels with quick fasteners.
- B. Insulation: Minimum 1/2 inch (13 mm) thick acoustic duct liner for lining cabinet interior.
- C. Drain Pan: Galvanized steel with corrosion-resistant coating.

2.04 EVAPORATOR FAN

- A. Fan: V-Belt driven, with permanently lubricated bearings, double width, double inlet, forward curved centrifugal fan, statically and dynamically balanced, resiliently mounted.
- B. V-Belt Drive: Cast iron or steel sheaves, dynamically balanced, bored to fit shafts and keyed. Variable and adjustable pitch motor sheave selected so required rpm is obtained with sheaves set at mid-position as recommended by manufacturer or minimum 1.5 times nameplate rating of the motor.

2.05 COMPRESSOR

- A. Hermetically sealed, 3600 rpm maximum, resiliently mounted with positive lubrication and internal motor protection.

2.06 EVAPORATOR COIL

- A. Direct expansion coiling coil of seamless copper or aluminum tubes expanded into aluminum fins.
- B. Refrigeration circuit with externally equalized thermal expansion valve, filter-drier, and charging valves.

2.07 CONDENSER

- A. Co-Axial: Copper tube in copper tube or shell and tube with finned copper tubes in steel shell with water temperature actuated water regulating valve.
- B. Terminate suction and liquid refrigerant piping with service valves within unit.
- C. Fan: Double width, double inlet, forward curved centrifugal fan, statically and dynamically balanced, with permanently lubricated bearings.
- D. V-Belt Drive: Cast iron or steel sheaves, dynamically balanced, bored to fit shafts and keyed. Variable and adjustable pitch motor sheave selected so required rpm is obtained with sheaves set at mid-position as recommended by manufacturer or minimum 1.5 times nameplate rating of the motor.

2.08 AIR FILTERS

- A. Easily removed 2 inch (50 mm) thick disposable glass fiber panel filters.

2.09 CONTROLS

- A. Factory wired controls shall include contactor, high and low pressure cutouts, internal winding thermostat for compressor, control circuit transformer, non-cycling reset relay.
- B. Provide thermostat to cycle cooling, mounted within unit with 'fan-off-cool' switch allowing continuous fan operation, or cycling fan on call for cooling.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install in accordance with requirements of NFPA 90A.

- C. Provide shut-off valves in condenser water inlet and outlet piping.
- D. Pipe refrigerant from unit to condenser; refer to section 23 2300.
- E. Pipe condensate from drain pan to nearest floor drain.

END OF SECTION

SECTION 23 8200
CONVECTION HEATING AND COOLING UNITS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Electric unit heaters.

1.02 RELATED REQUIREMENTS

- A. Section 23 0513 - Common Motor Requirements for HVAC Equipment.
- B. Section 23 0993 - Sequence of Operations for HVAC Controls.
- C. Section 26 2717 - Equipment Wiring: Electrical characteristics and wiring connections. Installation of room thermostats. Electrical supply to units.

1.03 REFERENCE STANDARDS

- A. AHRI 410 - Forced-Circulation Air-Cooling and Air-Heating Coils; 2001 (R2011).

1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide typical catalog of information including arrangements.
- C. Shop Drawings:
 - 1. Indicate cross sections of cabinets, grilles, bracing and reinforcing, and typical elevations.
 - 2. Indicate air coil and frame configurations, dimensions, materials, rows, connections, and rough-in dimensions.
 - 3. Submit schedules of equipment and enclosures typically indicating length and number of pieces of element and enclosure, corner pieces, end caps, cap strips, access doors, pilaster covers, and comparison of specified heat required to actual heat output provided.
 - 4. Indicate mechanical and electrical service locations and requirements.
- D. Certificates: Certify that coils are tested and rated in accordance with AHRI 410.
- E. Manufacturer's Instructions: Indicate installation instructions and recommendations.
- F. Project Record Documents: Record actual locations of components and locations of access doors in radiation cabinets required for access or valving.
- G. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, installation instructions, maintenance and repair data, and parts listings.
- H. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 01 6000 - Product Requirements, for additional provisions.
 - 2. Extra Filters: One set of each type and size.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.
- B. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

1.06 WARRANTY

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

PART 2 PRODUCTS

2.01 ELECTRIC UNIT HEATERS

- A. Manufacturers:
 - 1. INDEECO (Industrial Engineering and Equipment Company): www.indeeco.com.
 - 2. Modine Manufacturing Company: www.modineHVAC.com.
 - 3. Trane, a brand of Ingersoll Rand: www.trane.com.
 - 4. Substitutions: See Section 01 6000 - Product Requirements.

- B. Provide products listed, classified, and labeled by Underwriters Laboratories Inc. (UL), Intertek (ETL), or testing firm acceptable to Authority Having Jurisdiction as suitable for the purpose indicated.
- C. Assembly: Suitable for mounting from ceiling or structure above with built-in controls, thermal safety cut-out, and electric terminal box.
- D. Acceptable Heating Element Assemblies:
 - 1. Horizontal Projection Units:
 - a. Steel fins copper brazed to steel sheath and epoxy sealed for moisture resistance.
 - b. Nickel chromium resistance wire surrounded with magnesium oxide and sheathed in steel, spiral-finned tubes.
 - c. High-mass, all steel tubular type, copper brazed, centrally located and installed in fixed element banks.
 - 2. Vertical Projection Units:
 - a. Finned tubular.
 - b. Nickel chromium resistance wire surrounded with magnesium oxide and sheathed in steel, spiral-finned tubes.
 - c. High-mass, all steel tubular type, copper brazed, centrally located and installed in fixed element banks.
- E. Housing:
 - 1. Horizontal Projection Units:
 - a. Construction materials to consist of heavy gage steel with galvanized, polyester powder coat, or high gloss baked enamel finish.
 - b. Provide with threaded holes for threaded rod suspension.
 - c. Provisions for access to internal components for maintenance, adjustments, and repair.
 - 2. Vertical Projection Units:
 - a. Construction materials to consist of heavy gage steel with polyester powder coat or high gloss baked enamel.
 - b. Provide with mounting support brackets or provisions for mounting from ceiling or structure above.
 - c. Provisions for access to internal components for maintenance, adjustments, and repair.
- F. Air Inlets and Outlets:
 - 1. Inlets: Provide stamped louvers or protective grilles with fan blade guard.
 - 2. Outlets: Provide diffuser cones, directional louvers, or radial diffusers.
- G. Fan: Factory balanced, direct drive, axial type with fan guard.
- H. Motor: Totally enclosed, thermally protected, and provided with permanently lubricated bearings.
- I. Controls:
 - 1. Disconnect.
 - 2. 24-volt relay.
 - 3. Control transformer.
 - 4. 120-volt control.
 - 5. Fan override to purge residual heat when de-energized.
 - 6. Terminal block for remote control.
 - 7. Fan speed switch.
 - 8. Built-in thermostat.
 - 9. Summer-winter switch.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that surfaces are suitable for installation.

- B. Verify that field measurements are as shown on the drawings.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's recommendations.
- B. Install equipment exposed to finished areas after walls and ceilings are finished and painted.
- C. Do not damage equipment or finishes.
- D. Unit Heaters:
 - 1. Hang from building structure, with pipe hangers anchored to building, not from piping or electrical conduit.
 - 2. Mount as high as possible to maintain greatest headroom unless otherwise indicated.
- E. Units with Electric Heating Elements:
 - 1. Install as indicated including electrical devices furnished by manufacturer but not factory installed.
 - 2. Install wiring in accordance with the manufacturer's wiring diagram submittal and Section 26 2717.

3.03 CLEANING

- A. See Section 01 7419 - Construction Waste Management and Disposal, for additional requirements.
- B. After construction and painting is completed, clean exposed surfaces of units.
- C. Vacuum clean coils and inside of units.
- D. Touch-up marred or scratched surfaces of factory-finished cabinets using finish materials furnished by the manufacturer.
- E. Install new filters.

3.04 PROTECTION

- A. Provide finished cabinet units with protective covers during the balance of construction.

END OF SECTION