SECTION 23 2113
HYDRONIC PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Hydronic system requirements.
B. Heating water and glycol piping, buried.
C. Heating water piping, above grade.
D. Heating water and glycol piping, above grade.
E. Chilled water piping, above grade.
F. Condenser water piping, above grade.
G. Radiant heating piping system.
H. Equipment drains and overflows.
I. Pipe hangers and supports.
J. Unions, flanges and mechanical couplings.
K. Valves:
    1. Ball valves.
    2. Butterfly valves.
    3. Check valves.
    4. Pressure independent temperature control valves and balancing valves.
L. Flow controls.

1.02 RELATED REQUIREMENTS

A. Section 07 8400 - Firestopping.
B. Section 08 3100 - Access Doors and Panels.
C. Section 09 9123 - Interior Painting.
D. Section 22 0516 - Expansion Fittings and Loops for Plumbing Piping.
E. Section 22 0548 - Vibration and Seismic Controls for Plumbing Piping and Equipment.
F. Section 22 0719 - Plumbing Piping Insulation.
G. Section 23 0516 - Expansion Fittings and Loops for HVAC Piping.
H. Section 23 0548 - Vibration and Seismic Controls for HVAC.
I. Section 23 0553 - Identification for HVAC Piping and Equipment.
J. Section 23 0719 - HVAC Piping Insulation.
K. Section 23 2114 - Hydronic Specialties.
L. Section 23 2500 - HVAC Water Treatment: Pipe cleaning.

1.03 REFERENCE STANDARDS

A. ANSI/FCI 70-2 - Control Valve Seat Leakage 2013.
B. ASME BPVC-IX - Boiler and Pressure Vessel Code, Section IX - Welding, Brazing, and Fusing Qualifications 2015.
C. ASME B16.3 - Malleable Iron Threaded Fittings: Classes 150 and 300 2011.
D. ASME B16.15 - Cast Copper Alloy Threaded Fittings Classes 125 and 250 2013.
E. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings 2012.
F. ASME B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings 2013.
G. ASME B16.34 - Valves - Flanged, Threaded and Welding End 2013.
H. ASME B31.9 - Building Services Piping 2014.

I. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless 2012.

J. ASTM A106/A106M - Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service 2014.

K. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products 2015.

L. ASTM A183 - Standard Specification for Carbon Steel Track Bolts and Nuts 2003 (Reapproved 2009).

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 A536 - Standard Specification for Ductile Iron Castings 1984 (Reapproved 2014).

O. ASTM B32 - Standard Specification for Solder Metal 2008 (Reapproved 2014).

P. ASTM B88 - Standard Specification for Seamless Copper Water Tube 2014.

Q. ASTM B88M - Standard Specification for Seamless Copper Water Tube (Metric) 2013.

R. ASTM D1785 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120 2015.

S. ASTM D2000 - Standard Classification System for Rubber Products in Automotive Applications 2012.

T. ASTM D2241 - Standard Specification for Poly (Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series) 2015.

U. ASTM D2466 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40 2013.

V. ASTM D2467 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80 2006.

W. ASTM D2855 - Standard Practice for Making Solvent-Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings 1996 (Reapproved 2010).

X. ASTM F708 - Standard Practice for Design and Installation of Rigid Pipe Hangers 1992, with Editorial Revision (2018).

Y. ASTM F1476 - Standard Specification for Performance of Gasketed Mechanical Couplings for Use in Piping Applications 2007 (Reapproved 2013).

Z. AWS A5.8M/A5.8 - Specification for Filler Metals for Brazing and Braze Welding 2011-AMD 1.

AA. AWS D1.1/D1.1M - Structural Welding Code - Steel 2015.

BB. AWWA C105/A21.5 - Polyethylene Encasement for Ductile-Iron Pipe Systems 2010.

CC. AWWA C606 - Grooved and Shouldered Joints 2011.

DD. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation 2009.

1.04 SUBMITTALS

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

B. Welders Certificate: Include welders certification of compliance with ASME BPVC-IX.

C. Product Data:
   1. Include data on pipe materials, pipe fittings, valves, and accessories.
   2. Provide manufacturers catalogue information.
   3. Show grooved joint couplings, fittings, valves, and specialties on drawings and product submittals, specifically identified with the manufacturer's style or series designation.

D. Manufacturer's Installation Instructions: Indicate hanging and support methods, joining procedures.

E. Maintenance Data: Include installation instructions, spare parts lists, exploded assembly views.

F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01 6000 - Product Requirements, for additional provisions.

1.05 QUALITY ASSURANCE

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

B. Installer Qualifications: Company specializing in performing work of the type specified in this section, with minimum 3 years of experience.

C. Provide all grooved joint couplings, fittings, valves, specialties, and grooving tools from a single manufacturer.

D. Welder Qualifications: Certify in accordance with ASME BPVC-IX.
   1. Provide certificate of compliance from authority having jurisdiction, indicating approval of welders.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.

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.

D. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

1.07 FIELD CONDITIONS

A. Do not install underground piping when bedding is wet or frozen.

PART 2 PRODUCTS

2.01 HYDRONIC SYSTEM REQUIREMENTS

A. Comply with ASME B31.9 and applicable federal, state, and local regulations.

B. Piping: Provide piping, fittings, hangers and supports as required, as indicated, and as follows:
   1. Where more than one piping system material is specified, provide joining fittings that are compatible with piping materials and ensure that the integrity of the system is not jeopardized.
   2. Use brass fittings (union, valve, flange or coupling) or other non-conductive connections (final approval by owner) whenever jointing dissimilar metals. A valve shall be placed upstream of any connection involving a union or flange. Dielectric unions shall not be installed and shall be replaced with any of the before mentioned connections if encountered during repair or retrofit work.
   3. Grooved mechanical joints may be used in accessible locations only.
      a. Accessible locations include those exposed on interior of building, in pipe chases, and in mechanical rooms, aboveground outdoors, and as approved by Architect.
      b. Grooved mechanical connections and joints comply with AWWA C606.
         1) Ductile Iron: Comply with ASTM A536, Grade 65-45-12.
         2) Steel: Comply with ASTM A106/A106M, Grade B or ASTM A53/A53M.
      c. Use rigid joints unless otherwise indicated.
      d. Use gaskets of molded synthetic rubber with central cavity, pressure responsive configuration and complying with ASTM D2000, Grade 2CA615A15B44F17Z for circulating medium up to maximum 230 degrees F or Grade M3BA610A15B44Z for circulating medium up to maximum 200 degrees F.
      e. Provide steel coupling nuts and bolts complying with ASTM A183.
   4. Provide pipe hangers and supports in accordance with ASME B31.9 or MSS SP-58 unless indicated otherwise.

C. Pipe-to-Valve and Pipe-to-Equipment Connections: Use flanges, unions, or grooved couplings to allow disconnection of components for servicing; do not use direct welded, soldered, or threaded connections.
   1. Where grooved joints are used in piping, provide grooved valve/equipment connections if available; if not available, provide flanged ends and grooved flange adapters.

D. Valves: Provide valves where indicated:
   1. Provide drain valves where indicated, and if not indicated provide at least at main shut-off, low points of piping, bases of vertical risers, and at equipment. Use 3/4 inch gate valves with cap; pipe to nearest floor drain.
   2. On discharge of condenser water pumps, use spring loaded check valves.
   3. Isolate equipment using butterfly valves with lug end flanges or grooved mechanical couplings. Provide isolation valves at equipment whether shown or not.
   4. For throttling, bypass, or manual flow control services, use globe, ball, or butterfly valves.
   5. For throttling and isolation service in chilled and condenser water systems, use only butterfly valves.
   6. In heating water, chilled water, or condenser water systems, butterfly valves may be used interchangeably with gate and globe valves.
   7. For shut-off and to isolate parts of systems or vertical risers, use gate, ball, or butterfly valves.
   8. For throttling service, use plug cocks. Use non-lubricated plug cocks only when shut-off or isolating valves are also provided.

2.02 HEATING WATER AND GLYCOL PIPING, BURIED

A. Steel Pipe: ASTM A53/A53M, Schedule 40, black, with AWWA C105/A21.5 polyethylene jacket, or double layer, half-lapped polyethylene tape.

B. Steel Pipe Sizes 12 inch and Greater: ASTM A53/A53M, 3/8 inch wall, blackwith AWWA C105/A21.5 polyethylene jacket or double layer half-lapped polyethylene tape.
   1. Fittings: ASTM A234/A234M, wrought steel welding type with double layer, half-lapped polyethylene tape.
   2. Joints: Welded in accordance with AWS D1.1/D1.1M.
   3. Casing: Closed glass cell insulation.

C. Copper Tube: ASTM B88 (ASTM B88M), Type K (A), annealed.
   1. Fittings: ASME B16.22, wrought copper.
   2. Joints: Braze, AWS A5.8M/A5.8 BCuP copper/silver alloy.
   3. Casing: Closed glass cell insulation.

2.03 HEATING WATER AND GLYCOL PIPING, ABOVE GRADE

A. Steel Pipe: ASTM A53/A53M, Schedule 40, black, using one of the following joint types:
   1. Welded Joints: ASTM A234/A234M, wrought steel welding type fittings; AWS D1.1/D1.1M welded.
   2. Grooved Joints: AWWA C606 grooved pipe, fittings of same material, and mechanical couplings.

B. Steel Pipe Sizes 12 Inch and Greater: ASTM A53/A53M, 3/8 inch wall, black, using one of the following joint types:
   1. Welded Joints: ASTM A234/A234M, wrought steel welding type fittings; AWS D1.1/D1.1M welded.
   2. Grooved Joints: AWWA C606 grooved pipe, fittings of same material, and mechanical couplings.

C. Copper Tube: ASTM B88 (ASTM B88M), Type K (A), drawn, using one of the following joint types:
   1. Solder Joints: ASME B16.18 cast brass/bronze or ASME B16.22 solder wrought copper fittings.
      a. Solder: ASTM B32 lead-free solder, HB alloy (95-5 tin-antimony) or tin and silver.
      b. Braze: AWS A5.8M/A5.8 BCuP copper/silver alloy.

2. Grooved Joints: AWWA C606 grooved tube, fittings of same material, and copper-tube-dimension mechanical couplings.
3. Tee Connections: Mechanically extracted collars with notched and dimpled branch tube.
4. Mechanical Press Sealed Fittings: Double pressed type complying with ASME B16.22, utilizing EPDM, nontoxic synthetic rubber sealing elements.
    a. Manufacturers:
        1) Grinnell Products; [_____]: www.grinnell.com/#sle.
        2) Viega LLC; [_____]: www.viega.us/#sle.
        3) Substitutions: See Section 01 6000 - Product Requirements.

2.04 CHILLED WATER PIPING, ABOVE GRADE

A. Steel Pipe: ASTM A53/A53M, Schedule 40, black; using one of the following joint types:
    1. Welded Joints: ASTM A234/A234M, wrought steel welding type fittings; AWS D1.1/D1.1M welded.
    2. Threaded Joints: ASME B16.3, malleable iron fittings.
    3. Grooved Joints: AWWA C606 grooved pipe, fittings of same material, and mechanical couplings.

B. Steel Pipe Sizes 12 Inch and Greater: ASTM A53/A53M, 3/8 inch wall, black; using one of the following joint types:
    1. Welded Joints: ASTM A234/A234M, wrought steel welding type fittings; AWS D1.1/D1.1M welded.
    2. Grooved Joints: AWWA C606 grooved pipe, fittings of same material, and mechanical couplings.

C. Copper Tube: ASTM B88 (ASTM B88M), Type K (A), hard drawn; using one of the following joint types:
    1. Solder Joints: ASME B16.18 cast brass/bronze or ASME B16.22, solder wrought copper fittings.
        a. Solder: ASTM B32 lead-free solder, HB alloy (95-5 tin-antimony) or tin and silver.
    2. Grooved Joints: AWWA C606 grooved tube, fittings of same material, and copper-tube-dimension mechanical couplings.
    3. Tee Connections: Mechanically extracted collars with notched and dimpled branch tube.
    4. Mechanical Press Sealed Fittings: Double pressed type complying with ASME B16.22, utilizing EPDM, nontoxic synthetic rubber sealing elements.
        a. Manufacturers:
            1) Grinnell Products; [_____]: www.grinnell.com/#sle.
            2) Viega LLC; [_____]: www.viega.us/#sle.

D. PVC Pipe: ASTM D1785, Schedule 40, or ASTM D2241, SDR 21 or 26.
    1. Fittings: ASTM D2466 or ASTM D2467, PVC.
    2. Joints: Solvent welded in accordance with ASTM D2855.

2.05 CONDENSER WATER PIPING, ABOVE GRADE

A. Steel Pipe: ASTM A53/A53M, Schedule 40, black.
    1. Welded Joints: ASTM A234/A234M, wrought steel welding type fittings with finish matching piping; AWS D1.1/D1.1M welded.
    2. Threaded Joints: ASME B16.3, malleable iron fittings with finish matching piping.
    3. Grooved Joints: AWWA C606 grooved pipe, fittings of same material, and mechanical couplings.

B. Steel Pipe Sizes 12 Inch and Greater: ASTM A53/A53M, 3/8 inch wall, black; using one of the following joint types:
    1. Welded Joints: ASTM A234/A234M, wrought steel welding type fittings; AWS D1.1/D1.1M welded.
    2. Grooved Joints: AWWA C606 grooved pipe, fittings of same material, and mechanical couplings.

C. Copper Tube: ASTM B88 (ASTM B88M), Type K (A), drawn; using one of the following joint types:
   1. Solder Joints: ASME B16.18 cast brass/bronze or ASME B16.22 solder wrought copper fittings.
      a. Solder: ASTM B32 lead-free solder, HB alloy (95-5 tin-antimony) or tin and silver.
   2. Grooved Joints: AWWA C606 grooved tube, fittings of same material, and copper-tube-dimension mechanical couplings.
   3. Tee Connections: Mechanically extracted collars with notched and dimpled branch tube.
   4. Mechanical Press Sealed Fittings: Double pressed type complying with ASME B16.22, utilizing EPDM, nontoxic synthetic rubber sealing elements.
      a. Manufacturers:
         1) Grinnell Products; [_____]: www.grinnell.com/#sle.
         2) Viega LLC; [_____]: www.viega.us/#sle.

D. PVC Pipe: ASTM D1785, Schedule 40, or ASTM D2241, SDR 21 or 26.
   1. Fittings: ASTM D2466 or ASTM D2467, PVC.
   2. Joints: Solvent welded in accordance with ASTM D2855.

E. PVC Pipe Sizes 8 Inch and Greater: ASTM D1785, Schedule 80, or ASTM D2241, SDR 21 or 26.
   1. Fittings: ASTM D2466 or ASTM D2467, PVC.
   2. Joints: Solvent welded in accordance with ASTM D2855.

2.06 RADIANT HEATING PIPING

A. Copper Tube: ASTM B88 (ASTM B88M), Type K (A) annealed.
   1. Fittings: ASME B16.22, wrought copper.
   2. Joints: Braze, AWS A5.8M/A5.8 BCuP copper/silver alloy.

2.07 EQUIPMENT DRAINS AND OVERFLOWS

A. Steel Pipe: ASTM A53/A53M, Schedule 40 galvanized; using one of the following joint types:
   1. Threaded Joints: Galvanized cast iron, or ASME B16.3 malleable iron fittings.
   2. Grooved Joints: AWWA C606 grooved pipe, fittings of same material, and mechanical couplings.

B. Copper Tube: ASTM B88 (ASTM B88M), Type K (A), drawn; using one of the following joint types:
   1. Solder Joints: ASME B16.18 cast brass/bronze or ASME B16.22 solder wrought copper fittings; ASTM B32 lead-free solder, HB alloy (95-5 tin-antimony) or tin and silver.
   2. Grooved Joints: AWWA C606 grooved pipe, fittings of same material, and mechanical couplings.

C. PVC Pipe: ASTM D1785, Schedule 40, or ASTM D2241, SDR 21 or 26.
   1. Fittings: ASTM D2466 or D2467, PVC.
   2. Joints: Solvent welded in accordance with ASTM D2855.

2.08 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. Hangers for Pipe Sizes 1/2 to 1-1/2 Inch: Malleable iron, adjustable swivel, split ring.
   3. Hangers for Cold Pipe Sizes 2 Inches and Greater: Carbon steel, adjustable, clevis.
   4. Hangers for Hot Pipe Sizes 2 to 4 Inches: Carbon steel, adjustable, clevis.
   5. Hangers for Hot Pipe Sizes 6 Inches and Greater: Adjustable steel yoke, cast iron roll, double hanger.
   6. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
   7. Multiple or Trapeze Hangers for Hot Pipe Sizes 6 Inches and Greater: Steel channels with welded spacers and hanger rods, cast iron roll.
   8. Wall Support for Pipe Sizes to 3 Inches: Cast iron hook.

9. Wall Support for Pipe Sizes 4 Inches and Greater: Welded steel bracket and wrought steel clamp.
10. Wall Support for Hot Pipe Sizes 6 Inches and Greater: Welded steel bracket and wrought steel clamp with adjustable steel yoke and cast iron roll.
11. Vertical Support: Steel riser clamp.
12. Floor Support for Cold Pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
13. Floor Support for Hot Pipe Sizes to 4 Inches: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
14. Floor Support for Hot Pipe Sizes 6 Inches and Greater: Adjustable cast iron roll and stand, steel screws, and concrete pier or steel support.
15. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.
16. Hanger Rods: Mild steel threaded both ends, threaded one end, or continuous threaded.
17. 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.

B. In grooved installations, use rigid couplings with offsetting angle-pattern bolt pads or with wedge shaped grooves in header piping to permit support and hanging in accordance with ASME B31.9.

C. 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:
1. Bases: High density polypropylene.
2. Base Sizes: As required to distribute load sufficiently to prevent indentation of roofing assembly.
3. Steel Components: Stainless steel, or carbon steel hot-dip galvanized after fabrication in accordance with ASTM A123/A123M.
4. Attachment/Support Fixtures: As recommended by manufacturer, same type as indicated for equivalent indoor hangers and supports; corrosion resistant material.
5. Height: Provide minimum clearance of 6 inches under pipe to top of roofing.

2.09 UNIONS, FLANGES, MECHANICAL COUPLINGS, AND DIELECTRIC CONNECTIONS

A. Unions for Pipe less than 2 Inches:
1. Ferrous Piping: 150 psig malleable iron, threaded.
2. Copper Pipe: Bronze, soldered joints. Install so coils can be removed.

B. Flanges for Pipe 2 Inches and Greater:
1. Ferrous Piping: 150 psig forged steel, slip-on.
2. Copper Piping: Bronze.
3. Gaskets: 1/16 inch thick preformed neoprene. 1/8 inch preformed stainledd steel core with non-asbestoscompressible graphite sealing element.
4. Manufacturer:
   a. Garlock; Graphonic 304 Stainless - www.garlock.com
   b. Substitutions: See Section 01 6000 - Product Requirements.

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. Mechanical Couplings: Comply with ASTM F1476.
3. Housing Material: Ductile iron, galvanized complying with ASTM A536.
4. Gasket Material: EPDM suitable for operating temperature range from minus 30 degrees F to 230 degrees F.
5. Bolts and Nuts: Hot dipped galvanized or zinc-electroplated steel.
6. When pipe is field grooved, provide coupling manufacturer's grooving tools.
7. Manufacturers:

a. Grinnell Products; [_____]: www.grinnell.com/#sle.
b. Victaulic Company; [_____]: www.victaulic.com/#sle.
c. Substitutions: See Section 01 6000 - Product Requirements.

D. Dielectric Connections:
1. Waterways:
a. Water impervious insulation barrier capable of limiting galvanic current to 1 percent of short circuit current in a corresponding bimetallic joint.
b. Dry insulation barrier able to withstand 600 volt breakdown test.
c. Construct of galvanized steel with threaded end connections to match connecting piping.
d. Suitable for the required operating pressures and temperatures.
2. Flanges:
a. Dielectric flanges with same pressure ratings as standard flanges.
b. Water impervious insulation barrier capable of limiting galvanic current to 1 percent of short circuit current in a corresponding bimetallic joint.
c. Dry insulation barrier able to withstand 600 volt breakdown test.
d. Construct of galvanized steel with threaded end connections to match connecting piping.
e. Suitable for the required operating pressures and temperatures.

2.10 BALL VALVES

A. Manufacturers:
1. Grinnell Products; [_____]: www.grinnell.com/#sle.
2. Victaulic Company; [_____]: www.victaulic.com/#sle.
3. Substitutions: See Section 01 6000 - Product Requirements.

B. Up To and Including 2 Inches:
1. Bronze one piece body, chrome plated brass ball, teflon seats and stuffing box ring, lever handle with balancing stops, solder ends with union.

C. Over 2 Inches:
1. Ductile iron body, chrome plated stainless steel ball, teflon, Virgin TFE, or [_____] seat and stuffing box seals, lever handle, gear operated, or [_____], flanged ends, rated to 800 psi.

2.11 BUTTERFLY VALVES

A. Manufacturers:
1. Grinnell Products; [_____]: www.grinnell.com/#sle.
2. Victaulic Company; [_____]: www.victaulic.com/#sle.
3. Substitutions: See Section 01 6000 - Product Requirements.

B. Body: Cast or ductile iron with resilient replaceable EPDM seat, wafer, lug, grooved, or [_____] ends, extended neck.

C. Disc: Construct of aluminum bronze, chrome plated ductile iron, stainless steel, ductile iron with EPDM encapsulation, Buna-N encapsulation, or [_____].

D. Stem: Stainless steel with stem offset from the centerline to provide full 360 degree circumferential setting.

E. Operator: 10 position lever handle.

2.12 SWING CHECK VALVES

A. Manufacturers:
1. Grinnell Products, a Tyco Business: www.grinnell.com.
2. Shurjoint Piping Products, Inc., a Tyco Business: www.shurjoint.com.
3. Hammond Valve: www.hammondvalve.com.
4. Milwaukee Valve Company: www.milwaukeevalve.com.
5. Nibco, Inc: www.nibco.com.
6. Victaulic Company: www.victaulic.com.

7. Substitutions: See Section 01 6000 - Product Requirements.

B. Up To and Including 2 Inches:
1. Bronze body, bronze trim, bronze rotating swing disc, with composition disc, solder ends.

C. Over 2 Inches:
1. Iron body, bronze trim, stainless steel, bronze, or bronze faced rotating swing disc, renewable disc and seat, flanged or grooved ends.

2.13 SPRING LOADED CHECK VALVES

A. Manufacturers:
1. Crane Co.: www.craneco.com.
2. Victaulic Company; [_____]: www.victaulic.com/#sle.
3. Substitutions: See Section 01 6000 - Product Requirements.

B. Iron body, bronze trim, split plate, hinged with stainless steel spring, resilient seal bonded to body, wafer or threaded lug ends.

2.14 PRESSURE INDEPENDENT TEMPERATURE CONTROL VALVES AND BALANCING VALVES

A. Manufacturers:
1. Danfoss; AB-QM Valve: www.danfoss.com/#sle.
2. Substitutions: See Section 01 6000 - Product Requirements.

B. Control Valves: Factory-fabricated pressure independent with internal differential pressure regulator (DPRV) which automatically adjusts to normal changes in system pressure and provides 100 percent control valve authority at all positions of the valve.
1. Maintain proportional and linear flow coil characteristics.
2. PICV to accurately control the flow from 0 to 100 percent full rated flow with an operating pressure differential range of 3 to 60 psig.
3. Provide ANSI/FCI 70-2 Class 4 shut-off on all sizes and field serviceable.
4. Provide control valve to incorporate control, balancing and flow limiting. Hydronic system pressure independent control valve bodies to comply with ASME B16.34 or ASME B16.15 pressure and temperature class ratings based on the design operating temperature and 150 percent of the system design operating pressure and have the following characteristics:
   a. 2 NPS and Smaller: Class 150 bronze or brass body with union connections, stainless steel trim trim, stainless steel rising stem, stainless steel disc or ball, and screwed ends with backseating capacity repackable under pressure.
   b. 2-1/2 NPS and Larger: Class 125 iron or ductile iron body, stainless steel trim, stainless steel rising stem, stainless steel disc or ball, flanged ends with backseating capacity repackable under pressure.
   c. Pressure Control Seat: Brass construction with vulcanized EPDM.
   d. Sizing: Line-size.
   e. Fittings and Components: All fittings and components to meet ANSI standards and be compatible with readily available components. 8 inch valves and above to be provided with proper companion flanges.
   f. Close-Off (Differential) Pressure Rating: Combination of actuator, DPRV action, and trim to provide a minimum close-off pressure rating of 150 percent of total system (pump) head. Provide actuator from the same manufacturer as the pressure independent control valve.

C. Electronic Actuators: Direct-mounted, self-calibrating type designed for minimum 60,000 full-stroke cycles at rated force.

D. Provide actuator with visible position indication. Fail positions on power failure to include in-place, open or closed as indicated in the controls specifications.
1. Valves: Sized for maximum circuit flow rate and nominally, line-sized.
2. Overload Protection: Electronic overload or digital rotation-sensing circuitry.
3. Fail-Safe Operation: Mechanical, spring-return mechanism or capacitance return.
4. Power Requirements (Two-Position Spring Return): 24 VAC.

5. Power Requirements (Modulating): Maximum 10 VA at 24 VAC or 8 watts at 24 VDC.
6. Proportional Signal: 0 to 10 VDC or 2 to 10 VDC or 4 to 20 mA, and 2 to 10 VDC position feedback signal.
7. Provide plenum-rated actuators for service above ceilings to possess UL listings and approvals.
8. Temperature Rating: 40 to 104 degrees F.

2.15 FLOW CONTROLS

A. Manufacturers:
1. Griswold Controls; [_____]: www.griswoldcontrols.com/#sle.
2. ITT Bell & Gossett; [_____]: www.bellgossett.com/#sle.
3. Substitutions: See Section 01 6000 - Product Requirements.

B. Construction: Class 125, Brass or bronze body with union on inlet and outlet, temperature and pressure test plug on inlet and outlet, blowdown/backflush drain.

C. Calibration: Control flow within 10 percent of selected rating, over operating pressure range of 10 times minimum pressure required for control, minimum pressure 2 psi.

PART 3 EXECUTION

3.01 PREPARATION

A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.

B. Prepare pipe for grooved mechanical joints as required by coupling manufacturer.

C. Remove scale and dirt on inside and outside before assembly.

D. Prepare piping connections to equipment using jointing system specified.

E. Keep open ends of pipe free from scale and dirt. Protect open ends with temporary plugs or caps.

F. After completion, fill, clean, and treat systems. Refer to Section 23 2500 for additional requirements.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. PVC Pipe: Make solvent-welded joints in accordance with ASTM D2855.

C. Route piping in orderly manner, parallel to building structure, and maintain gradient.

D. Install piping to conserve building space and to avoid interfere with use of space.

E. Group piping whenever practical at common elevations.

F. Sleeve pipe passing through partitions, walls and floors.

G. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified [_____].

H. Slope piping and arrange to drain at low points.

I. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment. Refer to Section 22 0516.

J. Grooved Joints:
1. Install in accordance with the manufacturer's latest published installation instructions.
2. Gaskets to be suitable for the intended service, molded, and produced by the coupling manufacturer.

K. 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.

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.

L. Pipe Hangers and Supports:
1. Install in accordance with ASME B31.9, ASTM F708, or MSS SP-58.
2. Support horizontal piping as scheduled.
3. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.
4. Place hangers within 12 inches of each horizontal elbow.
5. Use hangers with 1-1/2 inch 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. Refer to Section 09 9123. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.

M. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings. Refer to Section 22 0719.

N. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings. Refer to Section 23 0719.

O. Provide access where valves and fittings are not exposed. Coordinate size and location of access doors with Section 08 3100.

P. Use eccentric reducers to maintain top of pipe level.

Q. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welds.

R. Prepare unfinished pipe, fittings, supports, and accessories, ready for finish painting. Refer to Section 09 9123.

S. Install valves with stems upright or horizontal, not inverted.

T. Install takeoffs on top of the pipe being connected to.

3.03 SCHEDULES

A. Hanger Spacing for Copper Tubing.
1. 1/2 inch and 3/4 inch: Maximum span, 5 feet; minimum rod size, 1/4 inch.
2. 1 inch: Maximum span, 6 feet; minimum rod size, 1/4 inch.
3. 1-1/2 inch and 2 inch: Maximum span, 8 feet; minimum rod size, 3/8 inch.
4. 2-1/2 inch: Maximum span, 9 feet; minimum rod size, 3/8 inch.
5. 3 inch: Maximum span, 10 feet; minimum rod size, 3/8 inch.
6. 4 inch: Maximum span, 12 feet; minimum rod size, 1/2 inch.

B. Hanger Spacing for Steel Piping.
1. 1/2 inch, 3/4 inch, and 1 inch: Maximum span, 7 feet; minimum rod size, 1/4 inch.
2. 1-1/4 inches: Maximum span, 8 feet; minimum rod size, 3/8 inch.
3. 1-1/2 inches: Maximum span, 9 feet; minimum rod size, 3/8 inch.
4. 2 inches: Maximum span, 10 feet; minimum rod size, 3/8 inch.
5. 2-1/2 inches: Maximum span, 11 feet; minimum rod size, 3/8 inch.
6. 3 inches: Maximum span, 12 feet; minimum rod size, 3/8 inch.
7. 4 inches: Maximum span, 14 feet; minimum rod size, 1/2 inch.
8. 6 inches: Maximum span, 17 feet; minimum rod size, 1/2 inch.
9. 8 inches: Maximum span, 19 feet; minimum rod size, 5/8 inch.
10. 10 inches: Maximum span, 20 feet; minimum rod size, 3/4 inch.

11. 12 inches: Maximum span, 23 feet; minimum rod size, 7/8 inch.
12. 14 inches: Maximum span, 25 feet; minimum rod size, 1 inch.
13. 16 inches: Maximum span, 27 feet; minimum rod size, 1 inch.

C. Hanger Spacing for Plastic Piping.
1. 1/2 inch: Maximum span, 42 inches; minimum rod size, 1/4 inch.
2. 3/4 inch: Maximum span, 45 inches; minimum rod size, 1/4 inch.
3. 1 inch: Maximum span, 51 inches; minimum rod size, 1/4 inch.
4. 1-1/4 inches: Maximum span, 57 inches; minimum rod size, 3/8 inch.
5. 1-1/2 inches: Maximum span, 63 inches; minimum rod size, 3/8 inch.
6. 2 inches: Maximum span, 69 inches; minimum rod size, 3/8 inch.
7. 3 inches: Maximum span, 7 feet; minimum rod size, 3/8 inch.
8. 4 inches: Maximum span, 8 feet; minimum rod size, 1/2 inch.
9. 6 inches: Maximum span, 10 feet; minimum rod size, 1/2 inch.
10. 8 inches: Maximum span, 11 feet; minimum rod size, 5/8 inch.
11. 10 inches: Maximum span, 13 feet; minimum rod size, 3/4 inch.
12. 12 inches: Maximum span, 14 feet; minimum rod size, 7/8 inch.
13. 14 inches: Maximum span, 15 feet; minimum rod size, 1 inch.
14. 16 inches: Maximum span, 16 feet; minimum rod size, 1 inch.

END OF SECTION