

**SECTION 23 21 13  
HYDRONIC PIPING**

SPEC WRITER NOTES:

1. Use this section only for NCA projects.
2. Delete between // // if not applicable to project. Also delete any other item or paragraph not applicable in the section and renumber the paragraphs.
3. References to pressure in this section are gage pressure unless otherwise noted.
4. The spec writer shall review the Physical Security Design Manual for VA Facilities to determine and include any Life Safety requirements called out.

DESIGNER NOTE: Following is a list of VA Standard Details. Coordinate work with the applicable details. Details can be found

at: <http://www.cfm.va.gov/til/sDetail.asp>

1. SD232113-01 Waterflow Measuring Device Detail
2. SD232113-07 Drain Valve and Air Vent Connections (Hydronic Systems)
3. SD232113-08 Air Handling Unit Drain Trap Detail

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. Water piping to connect HVAC equipment, including the following:
  1. Water source or ground source heat pump condenser water, and drain piping.
  2. Extension of domestic water make-up piping for HVAC systems.
  3. Glycol-water piping.
- B. A complete listing of common acronyms and abbreviations are included in Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

**1.2 RELATED WORK**

SPEC WRITER NOTE: Retain one of two paragraphs below.

- A. //Section 01 00 01, GENERAL REQUIREMENTS (Major NCA Projects).//
- B. //Section 01 00 02, GENERAL REQUIREMENTS (Minor NCA Projects).//
- C. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- D. Section 01 42 19, REFERENCE STANDARDS.
- E. Section 01 81 13, SUSTAINABLE DESIGN REQUIREMENTS.

- F. //Section 01 91 00, GENERAL COMMISSIONING REQUIREMENTS.//  
 SPEC WRITER NOTE: If Section 13 05 41 is included in this project the section shall be obtained from VA Masters.
- G. //Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS: Seismic restraints for piping.//
- H. //Section 22 05 33, HEAT TRACING FOR PLUMBING PIPING: Heat tracing for freeze protection.//
- I. Section 23 05 11, COMMON WORK RESULTS FOR HVAC: General mechanical requirements and items which are common to more than one section of Division 23.
- J. Section 23 05 41, NOISE AND VIBRATION CONTROL FOR HVAC PIPING AND EQUIPMENT.
- K. //Section 23 05 93, TESTING, ADJUSTING, AND BALANCING FOR HVAC: requirements for sound and vibration tests.//
- L. Section 23 07 11, HVAC INSULATION: Piping insulation.
- M. //Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.//
- N. //Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC: Temperature, pressure sensors, and valve operators.//
- O. //Section 23 21 14 GROUND LOOP HEAT PUMP PIPING.//
- P. //Section 23 21 23, HYDRONIC PUMPS: Pumps.//
- Q. Section 23 25 00, HVAC WATER TREATMENT: Water treatment for open and closed systems.

### 1.3 APPLICABLE PUBLICATIONS

SPEC WRITER NOTE: Make material requirements agree with requirements specified in the referenced Applicable Publications. Verify and update the publication list to that which applies to the project, unless the reference applies to all mechanical systems. Publications that apply to all mechanical systems may not be specifically referenced in the body of the specification, but, shall form a part of this specification.

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. American Society of Mechanical Engineers (ASME):  
 ASME Boiler and Pressure Vessel Code -  
 BPVC Section VIII-2015..Rules for Construction of Pressure Vessels

- B1.20.1-2013.....Pipe Threads, General Purpose (Inch)
- B16.3-2011.....Malleable Iron Threaded Fittings: Classes 150  
and 300
- B16.4-2011.....Gray Iron Threaded Fittings Classes 125 and 250
- B16.5-2013.....Pipe Flanges and Flanged Fittings: NPS 1/2  
through NPS 24 Metric/Inch Standard
- B16.9-2012.....Factory-Made Wrought Buttwelding Fittings
- B16.11-2011.....Forged Fittings, Socket-Welding and Threaded
- B16.24-2011.....Cast Copper Alloy Pipe Flanges and Flanged  
Fittings, Class 150, 300, 400, 600, 900, 1500,  
and 2500
- B16.39-2014.....Malleable Iron Threaded Pipe Unions: Classes  
150, 250, and 300
- B16.42-2011.....Ductile Iron Pipe Flanges and Flanged Fittings:  
Classes 150 and 300
- B31.9-2014.....Building Services Piping
- B40.100-2013.....Pressure Gauges and Gauge Attachments
- C. American Society for Testing and Materials (ASTM):
- A47/A47M-99 (R2014).....Standard Specification for Ferritic Malleable  
Iron Castings
- A53/A53M-2012.....Standard Specification for Pipe, Steel, Black  
and Hot-Dipped, Zinc-Coated, Welded and  
Seamless
- A106/A106M-2014.....Standard Specification for Seamless Carbon  
Steel Pipe for High-Temperature Service
- A126-2004 (R2014).....Standard Specification for Gray Iron Castings  
for Valves, Flanges, and Pipe Fittings
- A183-2014.....Standard Specification for Carbon Steel Track  
Bolts and Nuts
- A216/A216M-2014e1.....Standard Specification for Steel Castings,  
Carbon, Suitable for Fusion Welding, for High  
Temperature Service
- A307-2014.....Standard Specification for Carbon Steel Bolts,  
Studs, and Threaded Rod 60,000 PSI Tensile  
Strength
- A536-1984 (R2014).....Standard Specification for Ductile Iron  
Castings

B62-2015.....Standard Specification for Composition Bronze  
or Ounce Metal Castings

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

D. American Welding Society (AWS):

B2.1/B2.1M-2014.....Standard Welding Procedure Specification

E. Expansion Joint Manufacturer's Association, Inc. (EJMA):

EJMA.....Expansion Joint Manufacturer's Association  
Standards, 10th Edition

F. Manufacturers Standardization Society (MSS) of the Valve and Fitting  
Industry, Inc.:

SP-67-2011.....Butterfly Valves

SP-70-2011.....Gray Iron Gate Valves, Flanged and Threaded  
Ends

SP-71-2011.....Gray Iron Swing Check Valves, Flanged and  
Threaded Ends

SP-80-2013.....Bronze Gate, Globe, Angle and Check Valves

SP-85-2011.....Gray Iron Globe and Angle Valves, Flanged and  
Threaded Ends

G. National Fire Protection Association (NFPA):

70-2014.....National Electrical Code (NEC)

**1.4 SUBMITTALS**

A. Submittals, including number of required copies, shall be submitted in  
accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND  
SAMPLES.

B. Information and material submitted under this section shall be marked  
"SUBMITTED UNDER SECTION 23 21 13, HYDRONIC PIPING", with applicable  
paragraph identification.

C. Manufacturer's Literature and Data including: Full item description and  
optional features and accessories. Include dimensions, weights,  
materials, applications, standard compliance, model numbers, size, and  
capacity:

1. Pipe and equipment supports.
2. Pipe and tubing, with specification, class or type, and schedule.
3. Pipe fittings, including miscellaneous adapters and special  
fittings.
4. Flanges, gaskets, and bolting.
5. Valves of all types.

6. Strainers.
  7. Flexible connectors for water service.
  8. Pipe alignment guides.
  9. Expansion joints.
  10. Expansion compensators.
  11. All specified hydronic system components.
  12. Gages.
  13. Thermometers and test wells.
  14. //Electric heat tracing systems.//
  15. //Seismic bracing details for piping.//
- D. Manufacturer's certified data report, Form No. U-1, for ASME pressure vessels:

SPEC WRITER NOTE:  
List all certified pressure vessels.

1. Air separators.
  2. Expansion tanks.
- E. Submit prior to welding of steel piping a certificate of welder's certification. Ensure the certificate is current and not more than one year old.
- F. As-Built Piping Diagrams: Provide drawing as follows for water source or ground source heat pump condenser water, and other piping systems and equipment.
1. One wall-mounted stick file with complete set of prints.
  2. One complete set of reproducible drawings.
  3. One complete set of drawings in electronic pdf format.
- G. Complete operating and maintenance manuals including wiring diagrams, technical data sheets, information for ordering replacement parts, and troubleshooting guide:
1. Include complete list indicating all components of the systems.
  2. Include complete diagrams of the internal wiring for each item of equipment.
  3. Diagrams shall have their terminals identified to facilitate installation, operation and maintenance.
- H. //Completed System Readiness Checklist provided by the Commissioning Agent and completed by the contractor, signed by a qualified technician and dated on the date of completion, in accordance with the requirements of Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.//

- I. //Submit training plans and instructor qualifications in accordance with the requirements of Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.//

#### 1.5 QUALITY ASSURANCE

- A. Section 23 05 11, COMMON WORK RESULTS FOR HVAC, which includes welding qualifications.

#### 1.6 AS-BUILT DOCUMENTATION

SPEC WRITER NOTE: Coordinate O&M Manual requirements with Section 01 00 01, GENERAL REQUIREMENTS (Major NCA Projects) or Section 01 00 02, GENERAL REQUIREMENTS (Minor NCA Projects). O&M manuals shall be submitted for content review as part of the close-out documents.

- A. Submit manufacturer's literature and data updated to include submittal review comments and any equipment substitutions.
- B. Submit operation and maintenance data updated to include submittal review comments, substitutions and construction revisions shall be //in electronic version on CD or DVD// inserted into a three ring binder. All aspects of system operation and maintenance procedures, including applicable piping isometrics, wiring diagrams of all circuits, a written description of system design, control logic, and sequence of operation shall be included in the operation and maintenance manual. The operations and maintenance manual shall include troubleshooting techniques and procedures for emergency situations. Notes on all special systems or devices shall be included. A List of recommended spare parts (manufacturer, model number, and quantity) shall be furnished. Information explaining any special knowledge or tools the owner will be required to employ shall be inserted into the As-Built documentation.
- C. The installing contractor shall maintain as-built drawings of each completed phase for verification; and, shall provide the complete set at the time of final systems certification testing. As-built drawings are to be provided, and a copy of them in Auto-CAD version //\_\_\_\_// provided on CD or DVD. Should the installing contractor engage the testing company to provide as-built or any portion thereof, it shall not be deemed a conflict of interest or breach of the 'third party testing company' requirement.
- D. Certification documentation shall be provided to COR 10 working days prior to submitting the request for final inspection. The documentation

shall include all test results, the names of individuals performing work for the testing agency on this project, detailed procedures followed for all tests, and certification that all results of tests were within limits specified.

## **PART 2 - PRODUCTS**

### **2.1 PIPE AND EQUIPMENT SUPPORTS, PIPE SLEEVES, AND WALL AND CEILING PLATES**

- A. Provide in accordance with Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

### **2.2 PIPE AND TUBING**

- A. Water Source or Ground Source Heat Pump Condenser Water (aboveground), Glycol-Water, and Vent Piping:
  - 1. Steel: ASTM A53/A53M Grade B, seamless or ERW, Schedule 40.
  - 2. Copper water tube option: ASTM B88, Type K or L, hard drawn.
- B. Cooling Coil Condensate Drain Piping from Unitary Equipment: Copper water tube, ASTM B88, Type L.
- C. Pipe supports, including insulation shields, for aboveground piping: Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

### **2.3 FITTINGS FOR STEEL PIPE**

- A. 65 mm (2-1/2 inches) and Greater: Welded or flanged joints. Mechanical couplings and fittings are optional for water piping only.
  - 1. Butt-welding fittings: ASME B16.9 with same wall thickness as connecting piping. Ensure elbows be of the long radius type, unless otherwise noted.
  - 2. Welding flanges and bolting: ASME B16.5:
    - a. Water service: Weld neck or slip-on, plain face, with 3.2 mm (1/8 inch) thick full face neoprene gasket suitable for 104 degrees C (220 degrees F).
      - 1) Contractor's option: Convuluted, cold formed 150 pound steel flanges, with teflon gaskets, may be used for water service.
    - b. Flange bolting: Carbon steel machine bolts or studs and nuts, ASTM A307, Grade B.
- B. 50 mm (2 inches) and Smaller: Screwed or welded. Mechanical couplings are optional for water piping only.
  - 1. Butt-welding: ASME B16.9 with same wall thickness as connecting piping.
  - 2. Forged steel, socket welding or threaded: ASME B16.11.

3. Screwed: 150 pound malleable iron, ASME B16.3. 125 pound cast iron, ASME B16.4, may be used in lieu of malleable iron. Bushing reduction of a single pipe size, or use of close nipples, is not acceptable.
  4. Unions: ASME B16.39.
  5. Water hose connection adapter: Brass, pipe thread to 20 mm (3/4 inch) garden hose thread, with hose cap nut.
- C. Welded Branch and Tap Connections: Forged steel weldolets, or branchlets and threadolets may be used for branch connections up to one pipe size smaller than the main. Forged steel half-couplings, ASME B16.11 may be used for drain, vent, and gage connections.
- D. Mechanical Pipe Couplings and Fittings: May be used, with cut or roll grooved pipe, in water service up to 110 degrees C (230 degrees F) in lieu of welded, screwed, or flanged connections.
1. Grooved mechanical couplings: Malleable iron, ASTM A47/A47M or ductile iron, ASTM A536, fabricated in two or more parts, securely held together by two or more track-head, square, or oval-neck bolts, ASTM A183.
  2. Gaskets: Rubber product recommended by the coupling manufacturer for the intended service.
  3. Grooved end fittings: Malleable iron, ASTM A47/A47M; ductile iron, ASTM A536; or steel, ASTM A53/A53M or ASTM A106/A106M, designed to accept grooved mechanical couplings. Tap-in type branch connections are acceptable.

#### **2.4 FITTINGS FOR COPPER TUBING**

- A. Solder Joint:
1. Ensure joints are made up in accordance with recommended practices of the materials applied. Apply 95/5 tin and antimony on all copper piping.
  2. Mechanically formed tee connection in water and drain piping: Form mechanically extracted collars in a continuous operation by drilling pilot hole and drawing out tube surface to form collar, having a height of not less than three times the thickness of tube wall. Ensure adjustable collaring device has proper tolerance and complete uniformity of the joint. Notch and dimple joining branch tube in a single process to provide free flow where the branch tube penetrates the fitting.
- B. Bronze Flanges and Flanged Fittings: ASME B16.24.



**2.5 DIELECTRIC FITTINGS**

- A. Provide where copper tubing and ferrous metal pipe are joined.
- B. 50 mm (2 inches) and Smaller: Threaded dielectric union, ASME B16.39.
- C. 65 mm (2-1/2 inches) and Greater: Flange union with dielectric gasket and bolt sleeves, ASME B16.42. Ensure dielectric gasket material is compatible with hydronic medium.
- D. Temperature Rating, 99 degrees C (210 degrees F).

**2.6 SCREWED JOINTS**

- A. Pipe Thread: ASME B1.20.1.
- B. Lubricant or Sealant: Oil and graphite, or other compound approved for the intended service.

**2.7 VALVES**

- A. Asbestos packing is prohibited.
- B. Ensure all valves of the same type are products of a single manufacturer. Provide gate and globe valves, with packing that can be replaced with the valve under full working pressure.
- C. Provide chain operators for valves 100 mm (4 inches) and greater, when the centerline is located 2400 mm (8 feet) or more above the floor or operating platform.
- D. Gate Valves:
  - 1. 50 mm (2 inches) and smaller: MSS SP-80, Bronze, 1035 kPa (150 psig), wedge disc, rising stem, union bonnet.
  - 2. 65 mm (2-1/2 inches) and greater: Flanged, outside screw and yoke, MSS SP-70, iron body, bronze mounted, 861 kPa (125 psig) wedge disc.
- E. Globe, Angle and Swing Check Valves:
  - 1. 50 mm (2 inches) and smaller: MSS SP-80, bronze, 1035 kPa (150 psig), globe and angle valves. Ensure valves are union bonnet with metal plug type disc.
  - 2. 65 mm (2-1/2 inches) and greater: 861 kPa (125 psig), flanged, iron body, bronze trim, MSS SP-85 for globe valves and MSS SP-71 for check valves.
- F. Non-Slam or Silent Check Valve: Spring loaded double disc swing check, or internally guided flat disc lift check for bubble tight shut-off. Check valves incorporating a balancing feature may be used.
  - 1. Body: Cast iron, ASTM A126, Class B, or steel, ASTM A216/A216M, Class WCB, or ductile iron, ASTM A536, flanged, grooved, or wafer type.

2. Seat, disc and spring: 18-8 stainless steel, or bronze, ASTM B62.  
Seats may be elastomer material.
- G. Butterfly Valves: May be used in lieu of gate valves in water service except for direct buried pipe. Provide stem extension to allow 50 mm (2 inches) of pipe insulation without interfering with valve operation.
1. MSS SP-67, flange lug type (for end of line service) or grooved end, rated 1200 kPa (175 psig) working pressure at 93 degrees C (199 degrees F).
    - a. Body: Cast iron, ASTM A126, Class B. Malleable iron, ASTM A47/A47M electro-plated, or ductile iron, ASTM A536, Grade 65-45-12 electro-plated.
    - b. Trim: Bronze, aluminum bronze, or 300 series stainless steel disc, bronze bearings, 316 stainless steel shaft, and manufacturer's recommended resilient seat. Ensure resilient seat are field replaceable, and fully line the body to completely isolate the body from the product. A phosphate coated steel shaft or stem is acceptable, if the stem is completely isolated from the product.
    - c. Actuators: Field interchangeable. Ensure valves for balancing service have adjustable memory stop to limit open position.
      - 1) Valves 150 mm (6 inches) and smaller: Lever actuator with minimum of seven locking positions, except where chain wheel is required.
- H. Ball Valves: Brass or bronze body with chrome-plated ball with full port and Teflon seat at //2758 kPa (400 psig)// //4138 kPa (600 psig)// working pressure rating, screwed or solder connections. Provide stem extension to allow operation without interfering with pipe insulation.
- I. Water Flow Balancing Valves: For flow regulation and shut-off. Ensure valves are line size rather than reduced to control valve size and be one of the following types:
1. Butterfly valve as specified herein with memory stop.
  2. Eccentric plug valve: Iron body, bronze, or nickel-plated iron plug, bronze bearings, adjustable memory stop, operating lever, rated 861 kPa (125 psig) and 121 degrees C (250 degrees F).
- J. Circuit Setter Valve: A dual purpose flow balancing valve and adjustable flow meter, with bronze or cast iron body, calibrated position pointer, valved pressure taps or quick disconnects with integral check valves, and preformed polyurethane insulating enclosure.

Provide a readout kit including flow meter, readout probes, hoses, flow charts or calculator, and carrying case.

- K. Automatic Balancing Control Valves: Factory calibrated to maintain constant flow (plus or minus five percent) over system pressure fluctuations of at least 10 times the minimum required for control. Provide standard pressure taps and four sets of capacity charts. Ensure valves are line size and be one of the following designs:
1. Gray iron ASTM A126 or brass body rated 1200 kPa (175 psig) at 93 degrees C (199 degrees F), with stainless steel piston and spring.
  2. Brass or ferrous body designed for 2070 kPa (300 psig) service at 121 degrees C (250 degrees F), with corrosion resistant, tamper proof, and self-cleaning piston/spring assembly that is easily removable for inspection or replacement.
  3. The following are acceptable: Combination assemblies containing ball type shut-off valves, unions, flow regulators, strainers with blowdown valves, and pressure temperature ports.

## **2.8 STRAINERS**

### A. Y Type:

1. Screens: Bronze, monel metal or 18-8 stainless steel, free area not less than 2-1/2 times pipe area, with perforations as follows: 1.1 mm (0.045 inch) diameter perforations.
2. 100 mm (4 inches) and greater: 3.2 mm (3/8 inch) diameter perforations.

### B. Suction Diffusers: Specified in Section 23 21 23, HYDRONIC PUMPS.

## **2.9 FLEXIBLE CONNECTORS FOR WATER SERVICE**

### A. Flanged Spool Connector:

1. Single arch or multiple arch type. Ensure tube and cover are constructed of chlorobutyl elastomer with full faced integral flanges to provide a tight seal without gaskets. Ensure connectors are internally reinforced with high strength synthetic fibers impregnated with rubber or synthetic compounds as recommended by connector manufacturer, and steel reinforcing rings.
2. Ensure working pressures and temperatures are as follows:
  - a. Connector sizes 50 mm to 100 mm (2 inches to 4 inches), 1137 kPa (165 psig) at 121 degrees C (250 degrees F).
  - b. Connector sizes 125 mm to 300 mm (5 inches to 12 inches), 965 kPa (140 psig) at 121 degrees C (250 degrees F).
3. Provide ductile iron retaining rings and control units.

- B. Mechanical Pipe Couplings: See other fittings specified under paragraph FITTINGS FOR STEEL PIPE.

## 2.10 EXPANSION JOINTS

- A. Factory built devices, inserted in the pipe lines, designed to absorb axial cyclical pipe movement which results from thermal expansion and contraction. This includes factory-built or field-fabricated guides located along the pipe lines to restrain lateral pipe motion and direct the axial pipe movement into the expansion joints.
- B. Manufacturing Quality Assurance: Conform to Expansion Joints Manufacturers Association (EJMA) standards.
- C. Bellows - Internally Pressurized Type:
1. Multiple corrugations of Type 304 or Type A240-321 stainless steel.
  2. Internal stainless steel sleeve entire length of bellows.
  3. External cast iron equalizing rings for services exceeding 345 kPa (50 psig).
  4. Welded ends.
  5. Ensure design conforms to the standards of EJMA and ASME B31.9.
  6. External tie rods designed to withstand pressure thrust force upon anchor failure if one or both anchors for the joint are at change in direction of pipeline.
  7. Integral external cover.
- D. Bellows - Externally Pressurized Type:
1. Multiple corrugations of Type 304 stainless steel.
  2. Internal and external guide integral with joint.
  3. Design for external pressurization of bellows to eliminate squirm.
  4. Welded ends.
  5. Conform to the standards of EJMA and ASME B31.9.
  6. Threaded connection at bottom, 25 mm (1 inch) minimum, for drain or drip point.
  7. Integral external cover and internal sleeve.
- E. Expansion Compensators:
1. Corrugated bellows, externally pressurized, stainless steel or bronze.
  2. Internal guides and anti-torque devices.
  3. Threaded ends.
  4. External shroud.
  5. Conform to the standards of EJMA.

- F. Expansion Joint Identification: Provide stamped brass or stainless steel nameplate on each expansion joint listing the manufacturer, the allowable movement, flow direction, design pressure and temperature, date of manufacture, and identifying the expansion joint by the identification number on the contract drawings.
- G. Guides: Provide factory-built guides along the pipe line to permit axial movement only and to restrain lateral and angular movement. Ensure guides are designed to withstand a minimum of 15 percent of the axial force which will be imposed on the expansion joints and anchors. Field-built guides may be used if detailed on the contract drawings.

#### **2.11 HYDRONIC SYSTEM COMPONENTS**

- A. Air Purger: Cast iron or fabricated steel, 861 kPa (125 psig) water working pressure, for in-line installation.
- B. Tangential Air Separator: ASME BPVC Section VIII construction for 861 kPa (125 psig) working pressure, flanged tangential inlet and outlet connection, internal perforated stainless steel air collector tube designed to direct released air into expansion tank, bottom blowdown connection. Provide Form No. U-1. If scheduled on the drawings, provide a removable stainless steel strainer element having 5 mm (3/16 inch) perforations and free area of not less than five times the cross-sectional area of connecting piping.
- C. Diaphragm Type Pre-Pressurized Expansion Tank: ASME BPVC Section VIII construction for 861 kPa (125 psig) working pressure, welded steel shell, rust-proof coated, with a flexible elastomeric diaphragm suitable for a maximum operating temperature of 115 degrees C (240 degrees F). Provide Form No. U-1. Ensure tank is equipped with system connection, drain connection, standard air fill valve, and be factory pre-charged to a minimum of 83 kPa (12 psig).
- D. Pressure Reducing Valve (Water): Diaphragm or bellows operated, spring loaded type, with minimum adjustable range of 28 kPa (4 psig) above and below set point. Bronze, brass, or iron body and bronze, brass or stainless steel trim, rated 861 kPa (125 psig) working pressure at 107 degrees C (225 degrees F).
- E. Pressure Relief Valve: Bronze or iron body and bronze or stainless steel trim, with testing lever. Comply with ASME BPVC Section VIII and bear ASME stamp.

SPEC WRITER NOTE: Show automatic air vents on drawings. Automatic air vent should be used only on air separators and

similar applications in mechanical rooms. When used, pipe outlet to floor drain to prevent damage from leaks.

- F. Automatic Air Vent Valves (where shown): Cast iron or semi-steel body, 1035 kPa (150 psig) working pressure, stainless steel float, valve, valve seat and mechanism, minimum 15 mm (1/2 inch) water connection, and 6 mm (1/4 inch) air outlet. Pipe the air outlet to drain.

#### **2.12 POT CHEMICAL FEEDERS**

- A. See section 23 25 00, HVAC WATER TREATMENT, paragraph CHEMICAL TREATMENT FOR CLOSED LOOP SYSTEMS.

#### **2.13 GAGES, PRESSURE AND COMPOUND**

- A. ASME B40.100, Accuracy Grade 1A, (pressure, vacuum, or compound for air, oil, or water), initial mid-scale accuracy 1 percent of scale (Qualify grade), metal or phenolic case, 115 mm (4-1/2 inches) in diameter, 6 mm (1/4 inch) NPT bottom connection, white dial with black graduations and pointer, clear glass or acrylic plastic window, suitable for board mounting. Provide red "set hand" to indicate normal working pressure.
- B. Provide brass lever handle union cock. Provide brass/bronze pressure snubber for gages in water service.
- C. Range of Gages: Provide range equal to at least 130 percent of normal operating range.
1. For condenser water suction (compound): Minus 100 kPa (29.5 inches Hg) to plus 690 kPa (100 psig).

#### **2.14 PRESSURE/TEMPERATURE TEST PROVISIONS**

- A. Pete's Plug: 6 mm (1/4 inch) MPT by 75 mm (3 inches) long, brass body and cap, with retained safety cap, nordel self-closing valve cores, permanently installed in piping where shown, or in lieu of pressure gage test connections shown on the drawings.

#### **2.15 THERMOMETERS**

- A. Mercury or organic liquid filled type, red or blue column, clear plastic window, with 150 mm (6 inch) brass stem, straight, fixed or adjustable angle as required for each in reading.
- B. Case: Chrome plated brass or aluminum with enamel finish.
- C. Scale: Not less than 225 mm (9 inches), range as described below, 2 degree graduations.
- D. Separable Socket (Well): Brass, extension neck type to clear pipe insulation.

- E. Scale ranges may be slightly greater than shown to meet manufacturer's standard.

## 2.16 FIRESTOPPING MATERIAL

- A. Refer to Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

SPEC WRITER NOTE: Verify that the extent of freeze protection for outdoor condenser water is clearly described and that electrical drawings show power supply to heat tracing.

## 2.17 //ELECTRICAL HEAT TRACING FOR FREEZE PROTECTION

- A. Ensure systems meet the requirements of NFPA 70.
- B. Provide tracing for outdoor HVAC piping that does not contain glycol.
- C. Heating Cable: Flexible, parallel circuit construction consisting of a continuous self-limiting resistance, conductive inner core material between 2 parallel copper bus wires, designed for cut-to-length at the job site, and for wrapping around valves and complex fittings. Ensure self-regulation prevents overheating and burnouts even where the cable overlaps itself.
  1. Provide end seals at ends of circuits. Wire at the ends of the circuits are not to be tied together.
  2. Provide sufficient cable, as recommended by the manufacturer, to keep the pipe surface at 2.2 degrees C (36 degrees F) minimum during winter outdoor design temperature, but not less than 4 watts per foot of pipe. For heat traced 75 mm (3 inch) pipe and smaller, ensure insulation be not less than 25 mm (1 inch) thick. Refer to Section 23 07 11, HVAC INSULATION for recommended minimum thicknesses.
- D. Electrical Heating Tracing Accessories:
  1. Power supply connection fitting and stainless steel mounting brackets. Provide stainless steel worm gear clamp to fasten bracket to pipe.
  2. Use 15 mm (1/2 inch) wide fiberglass reinforced pressure sensitive cloth tape to fasten cable to pipe at 300 mm (12 inch) intervals.
  3. Pipe surface temperature control thermostat: Cast aluminum, NEMA 4 (watertight) enclosure, 15 mm (1/2 inch) NPT conduit hub, SPST switch rated 20 amps at 480 volts AC, with capillary and copper bulb sensor. Set thermostat to maintain pipe surface temperature at not less than 1 degrees C (34 degrees F).

4. Signs: Manufacturer's standard (NEC Code), stamped "ELECTRIC TRACED" located on the insulation jacket at 3048 mm (10 feet) intervals along the pipe on alternating sides.//

### **PART 3 - EXECUTION**

#### **3.1 GENERAL**

- A. If an installation is unsatisfactory to the COR, the Contractor shall correct the installation at no additional cost or time to the Government.
- B. The drawings show the general arrangement of pipe and equipment but do not show all required fittings and offsets that may be necessary to connect pipes to equipment, coils, hydronic radiators, etc., and that may be needed in order to coordinate with other trades. Provide all necessary fittings, offsets, and pipe runs based on field measurements at no additional cost to the Government. Coordinate with other trades for space available and relative location of HVAC equipment and accessories. Ensure pipe location on the drawings are altered where necessary to avoid interferences and clearance difficulties.
- C. Store materials to avoid excessive exposure to weather or foreign materials. Keep inside of piping relatively clean during installation and protect open ends when work is not in progress.
- D. Support piping securely. Refer to PART 3, Section 23 05 11, COMMON WORK RESULTS FOR HVAC.
- E. Install piping generally parallel to walls and column center lines, unless shown otherwise on the drawings. Space piping, including insulation, to provide 25 mm (1 inch) minimum clearance between adjacent piping or other surface. Unless shown otherwise, slope drain piping down in the direction of flow not less than 25 mm (1 inch) in 12 m (40 feet). Provide eccentric reducers to keep bottom of sloped piping flat.
- F. Locate and orient valves to permit proper operation and access for maintenance of packing, seat, and disc. Generally locate valve stems in overhead piping in horizontal position. Provide a union adjacent to one end of all threaded end valves. Control valves usually require reducers to connect to pipe sizes shown on the drawing. Install butterfly valves with the valve open as recommended by the manufacturer to prevent binding of the disc in the seat.
- G. Offset equipment connections to allow valving off for maintenance and repair with minimal removal of piping. Provide flexibility in equipment



connections and branch line take-offs with 3-elbow swing joints where noted on the drawings.

- H. Tee water piping runouts or branches into the side of mains or other branches. Avoid bull-head tees, which are two return lines entering opposite ends of a tee and exiting out the common side.
- I. Provide manual air vent at all piping system high points and drain valves at all low points.
- J. Connect piping to equipment as shown on the drawings. Install components furnished by others such as:
  - 1. Water treatment pot feeders.
  - 2. Flow elements (orifice unions), control valve bodies, flow switches, pressure taps with valve, and wells for sensors.
- K. Thermometer Wells: In pipes 65 mm (2-1/2 inches) and smaller increase the pipe size to provide free area equal to the upstream pipe area.
- L. Firestopping: Fill openings around uninsulated piping penetrating floors or fire walls, with firestop material. For firestopping insulated piping refer to Section 23 07 11, HVAC INSULATION.
- M. Where copper piping is connected to steel piping, provide dielectric connections.

### 3.2 PIPE JOINTS

- A. Welded: Ensure beveling, spacing, and other details conform to ASME B31.9 and AWS B2.1/B2.1M. See Welder's qualification requirements under "Quality Assurance" in Section 23 05 11, COMMON WORK RESULTS FOR HVAC.
- B. Screwed: Ensure threads conform to ASME B1.20.1; apply joint compound to male threads only and joints made up so no more than three threads show. Coat exposed threads on steel pipe with joint compound, or red lead paint for corrosion protection.
- C. Mechanical Joint: //Do not use mechanical joints for piping inside walls or areas where service access is inaccessible.// Ensure pipe grooving is in accordance with joint manufacturer's specifications. Lubricate gasket exterior including lips, pipe ends, and housing interiors to prevent pinching the gasket during installation. Ensure lubricant is as recommended by coupling manufacturer.
- D. 125 Pound Cast Iron Flange (Plain Face): Ensure mating flange has raised face, if any, removed to avoid overstressing the cast iron flange.
- E. Solvent Welded Joints: As recommended by the manufacturer.

**3.3 EXPANSION JOINTS (BELLOWS AND SLIP TYPE)**

- A. Anchors and Guides: Provide type, quantity, and spacing as recommended by manufacturer of expansion joint and as shown. Ensure a professional engineer verifies in writing that anchors and guides are properly designed for forces and moments which will be imposed.
- B. Cold Set: Provide setting of joint travel at installation as recommended by the manufacturer for the ambient temperature during the installation.
- C. Preparation for Service: Remove all apparatus provided to restrain joint during shipping or installation. Ensure representative of manufacturer visits the site and verifies that installation is proper.
- D. Access: Ensure expansion joints are located in a readily accessible space. Locate joints to permit access without removing piping or other devices. Allow clear space to permit replacement of joints and to permit access for inspection of all surfaces and for adding packing.

**3.4 //SEISMIC BRACING ABOVEGROUND PIPING**

- A. Provide in accordance with Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS.//

**3.5 LEAK TESTING ABOVEGROUND PIPING**

- A. Inspect all joints and connections for leaks and workmanship and make corrections as necessary, to the satisfaction of the COR. Tests may be either of those below, or a combination, as approved by the COR.
- B. An operating test at design pressure, and for hot systems, design maximum temperature.
- C. A hydrostatic test at 1.5 times design pressure. For water systems, the design maximum pressure would usually be the static head, or expansion tank maximum pressure, plus pump head. Factory tested equipment (convertors, exchangers, coils, etc.) need not be field tested. Isolate equipment where necessary to avoid excessive pressure on mechanical seals and safety devices.

**3.6 FLUSHING AND CLEANING PIPING SYSTEMS**

- A. Water Piping: Clean systems as recommended by the suppliers of chemicals specified in Section 23 25 00, HVAC WATER TREATMENT.
  - 1. Initial flushing: Remove loose dirt, mill scale, metal chips, weld beads, rust, and like deleterious substances without damage to any system component. Provide temporary piping or hose to bypass coils, control valves, exchangers, and other factory cleaned equipment unless acceptable means of protection are provided and subsequent

- inspection of hide-out areas takes place. Isolate or protect clean system components, including pumps and pressure vessels, and remove any component which may be damaged. Open all valves, drains, vents, and strainers at all system levels. Remove plugs, caps, spool pieces, and components to facilitate early debris discharge from system. Sectionalize system to obtain debris carrying velocity of 1.8 m/s (5.9 f/s). Connect dead-end supply and return headers as necessary. Flush bottoms of risers. Install temporary strainers where necessary to protect down-stream equipment. Supply and remove flushing water and drainage by various type hose, temporary and permanent piping and Contractor's booster pumps. Flush until clean as approved by the COR.
2. Cleaning: Using products supplied in Section 23 25 00, HVAC WATER TREATMENT, circulate systems at normal temperature to remove adherent organic soil, hydrocarbons, flux, pipe mill varnish, pipe joint compounds, iron oxide, and like deleterious substances not removed by flushing, without chemical or mechanical damage to any system component. Removal of tightly adherent mill scale is not required. Keep isolated equipment which is "clean" and where dead-end debris accumulation cannot occur. Sectionalize system if possible, to circulate at velocities not less than 1.8 m/s (5.9 f/s). Circulate each section for not less than four hours. Blow-down all strainers, or remove and clean as frequently as necessary. Drain and prepare for final flushing.
  3. Final Flushing: Return systems to conditions required by initial flushing after all cleaning solution has been displaced by clean make-up. Flush all dead ends and isolated clean equipment. Gently operate all valves to dislodge any debris in valve body by throttling velocity. Flush for not less than one hour.

### **3.7 WATER TREATMENT**

- A. Install water treatment equipment and provide water treatment system piping.
- B. Close and fill system as soon as possible after final flushing to minimize corrosion.
- C. Charge systems with chemicals specified in Section 23 25 00, HVAC WATER TREATMENT.
- D. Utilize this activity, by arrangement with the COR, for instructing VA operating personnel.

**3.8 //ELECTRIC HEAT TRACING**

- A. Install tracing as recommended by the manufacturer.
- B. Coordinate electrical connections.//

**3.9 STARTUP AND TESTING**

- A. Make tests as recommended by product manufacturer and listed standards and under actual or simulated operating conditions and prove full compliance with design and specified requirements. Tests of the various items of equipment shall be performed simultaneously with the system of which each item is an integral part.
- B. Adjust red set hand on pressure gages to normal working pressure.
- C. When any defects are detected, correct defects and repeat test at no additional cost or time to the Government.
- D. //The Commissioning Agent will observe startup and contractor testing of selected equipment. Coordinate the startup and contractor testing schedules with the COR and Commissioning Agent. Provide a minimum notice of 10 working days prior to startup and testing.//

**3.10 //COMMISSIONING**

- A. Provide commissioning documentation in accordance with the requirements of Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.
- B. Components provided under this section of the specification will be tested as part of a larger system.//

**3.11 DEMONSTRATION AND TRAINING**

- A. Provide services of manufacturer's technical representative for //four// // // hour//s// to instruct each VA personnel responsible in the operation and maintenance of units.
- B. //Submit training plans and instructor qualifications in accordance with the requirements of Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.//

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