SECTION 23 22 13
STEAM AND CONDENSATE HEATING PIPING

SPEC WRITER NOTES:
1. Delete between // // if not applicable to project. Also delete any other item or paragraph not applicable in the Section and renumber the paragraphs.
2. References to pressure in this section are gauge pressure unless otherwise noted.

PART 1 - GENERAL

1.1 DESCRIPTION

A. Steam, condensate and vent piping inside buildings.

B. Boiler plant and outside steam distribution piping is covered in specification Section 33 63 00, STEAM ENERGY DISTRIBUTION and Section 23 21 11, BOILER PLANT PIPING SYSTEMS.

C. A complete listing of common acronyms and abbreviations are included in //Section 23 05 10, COMMON WORK RESULTS FOR BOILER PLANT AND STEAM GENERATION// //Section 23 05 11, COMMON WORK RESULTS FOR HVAC//.

1.2 RELATED WORK

A. Section 01 00 00, GENERAL REQUIREMENTS.

B. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

C. Section 01 81 13, SUSTAINABLE CONSTRUCTION REQUIREMENTS.

D. //Section 01 91 00, GENERAL COMMISSIONING REQUIREMENTS.//

E. Section 09 91 00, PAINTING.

F. //Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS.//

G. //Section 23 05 10, COMMON WORK RESULTS FOR BOILER PLANT AND STEAM GENERATION.//

H. //Section 23 05 11, COMMON WORK RESULTS FOR HVAC.//

I. Section 23 05 93, TESTING, ADJUSTING, AND BALANCING FOR HVAC.

J. Section 23 07 11, HVAC AND BOILER PLANT INSULATION.

K. //Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.//

L. Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC.

M. Section 23 22 23, STEAM CONDENSATE PUMPS.

N. Section 23 25 00, HVAC WATER TREATMENT.

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. Where conflicts occur these specifications and the VHA standard will govern.

B. American Society of Mechanical Engineers (ASME):

B1.20.1-2013.....Pipe Threads, General Purpose (Inch)
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
B16.42-2011.....Ductile Iron Pipe Flanges and Flanged Fittings: Classes 150 and 300
B31.1-2014.....Power Piping
B31.9-2014.....Building Services Piping
B40.100-2013.....Pressure Gauges and Gauge Attachments
ASME Boiler and Pressure Vessel Code -
BPVC Section II-2015....Materials
BPVC Section VIII-2015..Rules for Construction of Pressure Vessels, Division 1
BPVC Section IX-2015....Welding, Brazing, and Fusing Qualifications

C. American Society for Testing and Materials (ASTM):

A53/A53M-2012.....Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
A106/A106M-2015.....Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service
A216/A216M-2014e1.....Standard Specification for Steel Castings, Carbon, Suitable for Fusion Welding, for High-Temperature Service
A285/A285M-2012.....Standard Specification for Pressure Vessel Plates, Carbon Steel, Low-and Intermediate-Tensile Strength

A307-2014.....Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60,000 PSI Tensile Strength

A516/A516M-2010 (R2015).Standard Specification for Pressure Vessel Plates, Carbon Steel, for Moderate- and Lower-Temperature Service

A536-1984 (R2014).....Standard Specification for Ductile Iron Castings

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

D. American Welding Society (AWS):

B2.1/B2.1M-2014.....Specification for Welding Procedure and Performance Qualifications

Z49.1-2012.....Safety in Welding and Cutting and Allied Processes

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

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

F. Military Specifications (Mil. Spec.):

MIL-S-901D-1989.....Shock Tests, H.I. (High Impact) Shipboard Machinery, Equipment, and Systems

G. National Board of Boiler and Pressure Vessel Inspectors (NB):

Relieving Capacities of Safety Valves and Relief Valves

H. Tubular Exchanger Manufacturers Association (TEMA):

TEMA Standards-2007.....9th Edition

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 22 13, STEAM AND CONDENSATE HEATING 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.//Submit calculations for variable spring and constant support hangers.//

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. Pipe alignment guides.
8. Expansion joints.
9. Expansion compensators.
10. Flexible ball joints: Catalog sheets, performance charts, schematic drawings, specifications and installation instructions.
11. All specified steam system components.
12. Gauges.
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:
1. Heat Exchangers (Steam-to-Hot Water).
2. Flash tanks.

E. Coordination Drawings: Refer to paragraph, SUBMITTALS of Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

F. As-Built Piping Diagrams: Provide drawing as follows for steam and steam condensate piping and other central plant equipment.
1. One wall-mounted stick file for prints. Mount stick file in the chiller plant or adjacent control room along with control diagram stick file.
2. One set of reproducible drawings.

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.

B. The products and execution of work specified in this section shall conform to the referenced codes and standards as required by the specifications. Local codes and amendments shall be enforced, along with requirements of local utility companies. The most stringent requirements of these specifications, local codes, or utility company requirements shall always apply. Any conflicts shall be brought to the attention of the COR.

C. Welding Qualifications: Before any welding is performed, contractor shall submit a certificate certifying that welders comply with the following requirements:

1. Qualify welding processes and operators for piping according to ASME BPVC Section IX, AWS Z49.1 and AWS B2.1/B2.1M.
2. Comply with provisions in //ASME B31.9// //ASME B31.1//.
3. Certify that each welder and welding operator has passed AWS qualification tests for welding processes involved and that certification is current and recent. Submit documentation to the COR.
4. All welds shall be stamped according to the provisions of the American Welding Society.

D. ASME Compliance: Comply with //ASME B31.9// //ASME B31.1// for materials, products, and installation. Safety valves and pressure vessels shall bear appropriate ASME labels.

1.6 AS-BUILT DOCUMENTATION

SPEC WRITER NOTE: Coordinate O&M Manual requirements with Section 01 00 00, GENERAL REQUIREMENTS. 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, VA approved 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.

SPEC WRITER NOTE: Select and edit one of the bracketed options after the paragraph below to indicate the format in which the contractor must provide record drawing files. Select the hand-marked option only when the designer has been separately contracted to provide the record drawings from the contractor’s mark-ups. Select the BIM option only when a BIM model will be generated, which is typically only performed by the designer on some Design-Bid-Build projects or by the contractor on some Design-Build projects.

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. 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. Provide record drawings as follows:

1. //Red-lined, hand-marked drawings are to be provided, with one paper copy and a scanned PDF version of the hand-marked drawings provided on CD or DVD.//
2. //As-built drawings are to be provided, with a copy of them on AutoCAD version // // provided on CD or DVD. The CAD drawings shall use multiple line layers with a separate individual layer for each system.//

3. //As-built drawings are to be provided, with a copy of them in three-dimensional Building Information Modeling (BIM) software version // // provided on CD or DVD.//

D. The as-built drawings shall indicate the location and type of all lockout/tagout points for all energy sources for all equipment and pumps to include breaker location and numbers, valve tag numbers, etc. Coordinate lockout/tagout procedures and practices with local VA requirements.

E. Certification documentation shall be provided to COR 21 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 provide documentation/certification that all results of tests were within limits specified. Test results shall contain written sequence of test procedure with written test results annotated at each step along with the expected outcome or setpoint. The results shall include all readings, including but not limited to data on device (make, model and performance characteristics), normal pressures, switch ranges, trip points, amp readings, and calibration data to include equipment serial numbers or individual identifications, etc.

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. Steam Piping: Steel, ASTM A53/A53M, Grade B, seamless or ERW; ASTM A106/A106M Grade B, seamless; Schedule 40.

B. Steam Condensate and Pumped Condensate Piping: Steel, ASTM A53/A53M, Grade B, seamless or ERW; or ASTM A106/A106M Grade B, seamless, Schedule 80.

C. Vent Piping: Steel, ASTM A53/A53M, Grade B, seamless or ERW; ASTM A106/A106M Grade B, seamless; Schedule 40, galvanized.

2.3 FITTINGS FOR STEEL PIPE

A. 50 mm (2 inches) and Smaller: Screwed or welded.

1. Cast iron fittings or piping is not acceptable for steam and steam condensate piping. Bushing reduction or use of close nipples is not acceptable.

2. Forged steel, socket welding or threaded: ASME B16.11, 13,790 kPa (2000 psig) class with ASME B1.20.1 threads. Use Schedule 80 pipe and fittings for threaded joints. Lubricant or sealant shall be oil and graphite or other compound approved for the intended service.
3. Unions: Forged steel, 13,790 kPa (2000 psig) class or 20,685 kPa (3000 psig) class on piping 50 mm (2 inches) and under.
4. Steam line drip station and strainer quick-couple blowdown hose connection: Straight through, plug and socket, screw or cam locking type for 15 mm (1/2 inch) ID hose. No integral shut-off is required.

B. 65 mm (2-1/2 inches) and Larger: Welded or flanged joints.
1. Cast iron fittings or piping is not acceptable for steam and steam condensate piping.
2. Butt welding fittings: ASME B16.9 with same wall thickness as connecting piping. Elbows shall be long radius type, unless otherwise noted.
3. Welding flanges and bolting: ASME B16.5:
a. Steam service: Weld neck or slip-on, raised face, with non-asbestos gasket. Non-asbestos gasket shall either be stainless steel spiral wound strip with flexible graphite filler or compressed inorganic fiber with nitrile binder rated for saturated and superheated steam service 400 degrees C (750 degrees F) and 10,342 kPa (1500 psig).
b. Flange bolting: Carbon steel machine bolts or studs and nuts, ASTM A307, Grade B.

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 gauge connections.

2.4 DIELECTRIC FITTINGS

A. Provide where dissimilar metal pipe are joined.
B. 50 mm (2 inches) and Smaller: Threaded dielectric union.
C. 65 mm (2-1/2 inches) and Larger: Flange union with dielectric gasket and bolt sleeves, ASME B16.42.
D. Temperature Rating, 121 degrees C (250 degrees F) for steam condensate and as required for steam service.
E. Contractor’s option: On pipe sizes 50 mm (2 inches) and smaller, screwed end steel gate valves //or dielectric nipples// may be used in lieu of dielectric unions.

2.5 VALVES

A. Asbestos packing is not acceptable.

B. All valves of the same type shall be products of a single manufacturer.

C. Provide chain operators for valves 150 mm (6 inches) and larger when the centerline is located 2.1 m (7 feet) or more above the floor or operating platform.

D. Shut-Off Valves:

1. Gate Valves:

a. 50 mm (2 inches) and smaller: Forged steel body, rated for 1380 kPa (200 psig) saturated steam, 2758 kPa (400 psig) WOG, bronze wedges and Monel or stainless-steel seats, threaded ends, rising stem, and union bonnet.

b. 65 mm (2-1/2 inches) and larger: Flanged, outside screw and yoke.

1) High pressure steam 110 kPa (16 psig) and above system): Cast steel body, ASTM A216/A216M grade WCB, 1035 kPa (150 psig) at 260 degrees C (500 degrees F), 11-1/2 to 13 percent chrome stainless steel solid disc and seats. Provide 25 mm (1 inch) factory installed bypass with globe valve on valves 100 mm (4 inches) and larger.

2) All other services: Forged steel body, Class B, rated for 850 kPa (123 psig) saturated steam, 1380 kPa (200 psig) WOG, bronze or bronze face wedge and seats, 850 kPa (123 psig) ASME flanged ends, OS&Y, rising stem, bolted bonnet, and renewable seat rings.

E. Globe and Angle Valves:

1. Globe Valves:

a. 50 mm (2 inches) and smaller: Forged steel body, rated for 1380 kPa (200 psig) saturated steam, 2758 kPa (400 psig) WOG, hardened stainless steel disc and seat, threaded ends, rising stem, union bonnet, and renewable seat rings.

b. 65 mm (2-1/2 inches) and larger:

1) Globe valves for high pressure steam 110 kPa (16 psig): Cast steel body, ASTM A216/A216M grade WCB, flanged, OS&Y, 1035 kPa (150 psig) at 260 degrees C (500 degrees F), 11-1/2 to 13 percent chrome stainless steel disc and renewable seat rings.

2) All other services: Steel body, rated for 850 kPa (123 psig) saturated steam, 1380 kPa (200 psig) WOG, bronze or bronze-faced disc (Teflon or composition facing permitted) and seat,

850 kPa (123 psig) ASME flanged ends, OS&Y, rising stem, bolted bonnet, and renewable seat rings.

2. Angle Valves:
   a. 50 mm (2 inches) and smaller: Cast steel 1035 kPa (150 psig), union bonnet with metal plug type disc.
   b. 65 mm (2-1/2 inches) and larger:
      1) Angle valves for high pressure steam 110 kPa (16 psig): Cast steel body, ASTM A216/A216M grade WCB, flanged, OS&Y, 1035 kPa (150 psig) at 260 degrees C (500 degrees F), 11-1/2 to 13 percent chrome stainless steel disc and renewable seat rings.
      2) All other services: 861 kPa (125 psig), flanged, cast steel body, and bronze trim.

F. Swing Check Valves:
   1. 50 mm (2 inches) and smaller: Cast steel, 1035 kPa (150 psig), 45-degree swing disc.
   2. 65 mm (2-1/2 inches) and Larger:
      a. Check valves for high pressure steam 110 kPa (16 psig) and above system: Cast steel body, ASTM A216/A216M grade WCB, flanged, OS&Y, 1035 kPa (150 psig) at 260 degrees C (500 degrees F), 11-1/2 to 13 percent chrome stainless steel disc and renewable seat rings.
      b. All other services: 861 kPa (125 psig), flanged, cast steel body, and bronze trim.

G. Manual Radiator/Convector Valves: Brass, packless, with position indicator.

2.6 STRAINERS

A. Basket or Y Type. Tee type is acceptable for gravity flow and pumped steam condensate service.

B. High Pressure Steam: Rated 1035 kPa (150 psig) saturated steam.
   1. 50 mm (2 inches) and smaller: Cast steel, rated for saturated steam at 1034 kPa (150 psig) threaded ends.
   2. 65 mm (2-1/2 inches) and larger: Cast steel rated for 1034 kPa (150 psig) saturated steam with 1034 kPa (150 psig) ASME flanged ends or forged steel with 1724 kPa (250 psig) ASME flanged ends.

C. All Other Services: Rated 861 kPa (125 psig) saturated steam.
   1. 50 mm (2 inches) and smaller: Cast steel body.
   2. 65 mm (2-1/2 inches) and larger: Flanged, cast steel body.

D. 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. 75 mm (3 inches) and smaller: 20 mesh for steam and 1.1 mm (0.045 inch) diameter perforations for liquids.
   2. 100 mm (4 inches) and larger: 1.1 mm (0.045) inch diameter perforations for steam and 3.2 mm (1/8 inch) diameter perforations for liquids.

2.7 PIPE ALIGNMENT

A. Guides: Provide factory-built guides along the pipe line to permit axial movement only and to restrain lateral and angular movement. Guides must be 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.

SPEC WRITER NOTE: Pipe loops are preferred. Provide pipe loops where possible.

2.8 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. Minimum Service Requirements:
   1. Pressure Containment:
      a. Steam Service 35-200 kPa (5-29 psig): Rated 345 kPa (50 psig) at 148 degrees C (298 degrees F).
      b. Steam Service 214-850 kPa (31-123 psig): Rated 1035 kPa (150 psig) at 186 degrees C (366 degrees F).
      c. Steam Service 869-1035 kPa (126-150 psig): Rated 1380 kPa (200 psig) at 194 degrees C (381 degrees F).
      d. Condensate Service: Rated 690 kPa (100 psig) at 154 degrees C (309 degrees F).
   2. Number of Full Reverse Cycles without failure: Minimum 1000.
   3. Movement: As shown on drawings plus recommended safety factor of manufacturer.

C. Manufacturing Quality Assurance: Conform to Expansion Joints Manufacturers Association Standards.

D. 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. Design shall conform to standards of EJMA and ASME B31.1.
   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.

E. 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 B31.1.
   6. Threaded connection at bottom, 25 mm (1 inch) minimum, for drain or drip point.
   7. Integral external cover and internal sleeve.

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.

2.9 FLEXIBLE BALL JOINTS

A. Design and Fabrication: One-piece component construction, fabricated from steel with welded ends, designed for a working steam pressure of 1725 kPa (250 psig) and a temperature of 232 degrees C (450 degrees F). Each joint shall provide for 360 degrees rotation in addition to a minimum angular flexible movement of 30 degrees for sizes 6 mm (1/4 inch) to 150 mm (6 inch) inclusive, and 15 degrees for sizes 65 mm (2-1/2 inches) to 762 mm (30 inches). Joints through 355 mm (14 inches) shall have forged pressure retaining members; while size 406 mm (16 inches) through 762 mm (30 inches) shall be of one-piece construction.

B. Material:
   1. Cast or forged steel pressure containing parts and bolting in accordance with ASME BPVC Section II or ASME B31.1. Retainer may be

ductile iron ASTM A536, Grade 65-45-12, or ASME BPVC Section II SA 515, Grade 70.

2. Gaskets: Steam pressure molded composition design for a temperature range of from minus 10 degrees C (50 degrees F) to plus 274 degrees C (525 degrees F).

C. Certificates: Submit qualifications of ball joints in accordance with the following test data:

1. Low pressure leakage test: 41 kPa (6 psig) saturated steam for 60 days.
2. Flex cycling: 800 Flex cycles at 3447 kPa (500 psig) saturated steam.
3. Thermal cycling: 100 saturated steam pressure cycles from atmospheric pressure to operating pressure and back to atmospheric pressure.
4. Environmental shock tests: Forward certificate from a recognized test laboratory, that ball joints of the type submitted has passed shock testing in accordance with Mil. Spec MIL-S-901.
5. Vibration: 170 hours on each of three mutually perpendicular axes at 25 to 125 Hz; 1.3 mm to 2.5 mm (0.05 inch to 0.10 inch) double amplitude on a single ball joint and 3 ball joint off set.

2.10 STEAM SYSTEM COMPONENTS

A. Heat Exchanger (Steam to Hot Water): Shell and tube type, U-bend removable tube bundle, steam in shell, water in tubes, equipped with support cradles.

1. Maximum tube velocity: 2.3 m/s (7.5 f/s).
2. Tube fouling factor: TEMA Standards, but not less than 0.00018 m^2K/W (0.001 ft^2hrF/Btu).
3. Materials:
   a. Shell: Steel.
   b. Tube sheet and tube supports: Steel or brass.
   c. Tubes: 20 mm (3/4 inch) OD copper.
   d. Head or bonnet: Steel.
4. Construction: In accordance with ASME Pressure Vessel Code for 861 kPa (125 psig) working pressure for shell and tubes. Provide manufacturer's certified data report, Form No. U-1.

B. Optional Heat Transfer Package: In lieu of field erected individual components, the Contractor may provide a factory or shop assembled

package of heat exchangers, pumps, and other components, pre-piped and pre-wired and supported on a welded steel frame or skid.

C. Steam Pressure Reducing Valves in PRV Stations:

1. Type: Single-seated, diaphragm operated, spring-loaded, external or internal steam pilot-controlled, normally closed, adjustable set pressure. Pilot shall sense controlled pressure downstream of main valve.
2. Service: Provide controlled reduced pressure to steam piping systems.
3. Pressure control shall be smooth and continuous with maximum drop of //10// // // percent deviation from set pressure. Maximum flow capacity of each valve shall not exceed capacity of downstream safety valve(s).
4. Main valve and pilot valve shall have replaceable valve plug and seat of stainless steel, Monel, or similar durable material.
   a. Pressure rating for high pressure steam: Not less than 1035 kPa (150 psig) saturated steam.
   b. Connections: Flanged for valves 65 mm (2-1/2 inches) and larger; flanged or threaded ends for smaller valves.

SPEC WRITER: Evaluate the need to provide acoustical measures for maintaining the specified noise levels in the adjoining spaces. Append here specifications for sound reduction accessories such as acoustic plates or blankets, silencers or noise diffusers as required. Indicate location on drawings.

5. Select pressure reducing valves to develop less than 85 db(A) at 1.5 m (5 feet) elevation above adjacent floor, and 1.5 m (5 feet) distance in any direction. Inlet and outlet piping for steam pressure reducing valves shall be Schedule 80 minimum for required distance to achieve required levels or sound attenuators shall be applied.
6. //Direct-Digital Control PRV Valves: May be furnished in lieu of steam operated valves. All specification requirements for steam operated valves apply. In the event of signal failure, //valves shall be normally closed// //failsafe device accessory in the actuator to stroke valve to predetermined position indicated//. Install per manufacturer’s recommendation.//

D. Safety Valves and Accessories: Comply with ASME BPVC Section VIII. Capacities shall be certified by National Board of Boiler and Pressure Vessel Inspectors, maximum accumulation 10 percent. Provide lifting lever. Provide drip pan elbow where shown. Valve shall have stainless steel seats and trim.

E. Steam PRV for Individual Equipment: Cast steel body, screwed or flanged ends, rated 861 kPa (125 psig), or 20 percent above the working pressure, whichever is greater. Single-seated, diaphragm operated, spring loaded, adjustable range, all parts renewable.

F. Flash Tanks: Horizontal or vertical vortex type, constructed of copper bearing steel, ASTM A516/A516M or ASTM A285/A285M, for a steam working pressure of 861 kPa (125 psig) to comply with ASME Code for Unfired Pressure Vessels and stamped with "U" symbol. Perforated pipe inside tank shall be ASTM A53/A53M Grade B, seamless or ERW, or ASTM A106/A106M Grade B seamless, Schedule 80. Corrosion allowance of 1.6 mm (1/16 inch) may be provided in lieu of the copper bearing requirement. Provide data Form No. U-1.

G. Steam Trap: Each type of trap shall be the product of a single manufacturer. Provide trap sets at all low points and at 61 m (200 feet) intervals on the horizontal main lines.

   1. Floats and linkages shall provide sufficient force to open trap valve over full operating pressure range available to the system. Unless otherwise indicated on the drawings, traps shall be sized for capacities indicated at minimum pressure drop as follows:
      a. For equipment with modulating control valve: 1.7 kPa (1/4 psig), based on a condensate leg of 300 mm (12 inches) at the trap inlet and gravity flow to the receiver.
      b. For main line drip trap sets and other trap sets at steam pressure: Up to 70 percent of design differential pressure. Condensate may be lifted to the return line.
   2. Trap bodies: Steel, constructed to permit ease of removal and servicing working parts without disturbing connecting piping. The use of 4 bolt raised face flange is required. The use of unions is unacceptable for steam trap maintenance. For systems without relief valve traps shall be rated for the pressure upstream of the steam supplying the system.
   3. Balanced pressure thermostatic elements: Phosphor bronze, stainless steel or Monel metal.

4. Valves and seats: Suitable hardened corrosion resistant alloy.
5. Mechanism: Brass, stainless steel or corrosion resistant alloy.
6. Floats: Stainless steel.
7. Inverted bucket traps: Provide bi-metallic thermostatic element for rapid release of non-condensables.

SPEC WRITER NOTE: In situations where ordinary traps may not meet the varying range of equipment performance (such as possibility of stall conditions), consider the use of pressure powered pump traps.

H. Pressure Driven Condensate Pump Trap:
1. Unit shall automatically trap and pump condensate from process and heating equipment under all operating conditions including vacuum.
2. Body shall be constructed of cast iron with all stainless-steel internals. The mechanism shall incorporate //Inconel alloy// //stainless steel// springs.
3. Motive Force: The pump trap shall utilize steam, compressed air, or inert gas to remove condensate from the receiving vessel. If two types of motive forces are used (e.g., primary and back-up force) the two systems shall never be permanently interconnected.
4. Pumps shall require no electricity for operation.
5. //The pump trap shall include a bronze water level gauge with shut off valves.//
6. Check valves at inlet and outlet shall be //steel// //stainless steel//.
7. ASME BPVC Section VIII.
8. //Provide pump trap with removable insulation cove //and digital cycle counter//.//
9. //Manufacturer standard paint finish //coated in electroless nickel plate//.//

I. Thermostatic Air Vent (Steam): Steel body, balanced pressure bellows, stainless steel (renewable) valve and seat, rated 861 kPa (125 psig) working pressure, 20 mm (3/4 inch) screwed connections. Air vents shall be balanced pressure type that responds to steam pressure-temperature curve and vents air at any pressure.

SPEC WRITER NOTES:
1. Humidifiers should be located in the Air Handling Unit and where mandated by the design.

2. Bracketed options are manufacturer specific. Make sure the selected options are available for the basis-of-design humidifier by reviewing manufacturer’s data.

J. Steam Humidifiers:

1. Fabrication requirements:
   a. Tank: Stainless steel.
   b. Enclosed cabinet, coated steel construction and air gap between cabinet and insulated tank.
   c. Steam outlet on top of tank configured to connect to hose, pipe, or flange connection.
   d. //Tubular copper heat exchanger and header with nickel coating.// //Stainless steel evaporator tank with flat surfaces.//
2. Mounting: //Humidifier shall be mounted on trapeze hangers with threaded steel rods, hardware, and predrilled angle irons.// //Humidifier shall be mounted on painted legs.//
3. Water requirements: The humidifier shall be capable of generating steam from tap, softened, or DI/RO water.
4. Drain: //An electric operated drain valve shall be mounted on the humidifier assembly to allow tank to drain automatically at the end of a humidification season.// //Positive drainage/blow-down using a drain pump, drawing water from the bottom of the tank, maximizing mineral evacuation.//
5. Steam trap and strainer: Humidifier shall include a float/thermostatic steam trap and steam supply line strainer.
6. //DI/RO water: //Humidifier shall have a stainless-steel float operated fill valve.// //Humidifier shall have a stainless-steel float operated fill valve with an electric solenoid to prevent tank from filling when the tank drains automatically at the end of a humidification.// //Humidifier shall have a field-wired low water float switch to provide water level indication for building management systems.// //
7. //Outdoor enclosure system:
   a. Factory assembled and tested with the humidifier installed to provide complete weather protection and to operate within -40 to 50 degrees C (-40 to 122 degrees F) temperature limits.
   b. Humidifier and outdoor enclosure shall be shipped as one unit.

c. Frame construction: 125 mm (5 inch), 12-gauge, G-90 galvanized steel formed frame, suitably reinforced and braced to permit loading, shipping, unloading and rigging to the unit destination without damage to external or internal components. The base frame shall be corrosion resistant without painting or further coating.

d. Housing construction: 16-gauge, G-90 galvanized steel panels fabricated into self-framing, double standing seam-type construction. All joints shall be caulked weather tight with a silicone sealant. All interior surfaces shall be insulated with 25 mm (1 inch), 10.8 kg per square meter (2.2 pounds per square foot) rigid, noncombustible glass fiber insulation. No exposed insulation shall be permitted on the top-wearing surface of the floor of the unit. The floor shall be insulated from underneath. The floor shall have a drain connection.

e. Access door construction: Access door shall provide access to all internal components, constructed of 16-gauge, G-90 galvanized steel with a gasket around the full perimeter of the doorframe, with heavy-duty stainless-steel hinges, and latches.

f. Ventilation fans: Wired to a thermostat to ventilate the control cabinet and the enclosure.

g. //Heaters: Thermostatically-controlled to ensure proper operation during cold weather.//

h. //Roof curb: Manufactured of 16-gauge galvanized steel and provided with necessary hardware for bolt-together assembly. The curb shall be a minimum of 355 mm (14 inch) high. A 50 mm (2 inch) by 15 mm (1/2 inch) closed cell curb gasket with adhesive on one side shall be supplied with the hardware.//

i. //Internal steam vapor plumbing: The outdoor enclosure shall have piping to discharge steam through the base of the unit.// //

8. Controls: Control subpanel shall be factory-attached to humidifier with all wiring between subpanel and humidifier completed at factory. A wiring diagram shall be included. The controller shall be microprocessor based and shall have the following features or functions:

a. //Web interface shall have same functionality as the unit keypad/display and shall allow multiple remotely located users to simultaneously view system operation and/or change system parameters. Web interface shall have password-protected secure

access and shall be compatible with standard Internet browsers. Web interface shall connect directly to a personal computer or through a system network via Ethernet cable and shall be interoperable with any communication network.//

b. Redundant low water safety control.

c. Fully modulating (0 to 100 percent) control of humidifier outputs.

d. Water level control: Automatic refill, low water cutoff, field adjustable skimmer bleed off functions and automatic drain-down of humidifier.

e. //Temperature sensor: A factory mounted sensor, with a temperature range of -40 to 121 degrees C (-40 to 250 degrees F) mounted on the humidifier to enable the following functions:
   1) Maintain the evaporating chamber water temperature above freezing.
   2) Maintain a user-defined preset evaporating chamber water temperature.
   3) Allow rapid warm-up of water in evaporating chamber after a call for humidity, providing 100% operation until steam production occurs.//

f. USB port on the control board for software updates, data backups, and data restoration.//

g. //Up-time optimizer function to keep humidifier(s) operating through conditions such as fill, drain, or run-time faults, as long as safety conditions are met, minimizing production down-time.//

h. //Real-time clock to allow time-stamped alarm/message tracking, and scheduled events.//

i. //Factory commissioning of humidifier and control board, including system configuration as-ordered, factory unit testing, and operation with water before shipping.//

j. //Unit-mounted keypad/display operable within a temperature range of 0 to 70 degrees C (32 to 158 degrees F), and provides backlighting for viewing in low light.//

k. //Alarms, unit configuration, and usage timer values shall remain in nonvolatile memory indefinitely during a power outage.//

l. //The controls shall monitor, control, and/or adjust the following parameters:

1) Relative humidity (RH) set point, actual conditions in the space (from humidity transmitter), RH offset.
2) Dew point set point, actual conditions in the space (from dew point transmitter), dew point offset.
3) Relative humidity (RH) duct high limit set point (switch) and actual conditions.
4) Relative humidity (RH) duct high limit set point, actual conditions (from transmitter), high limit span, and high limit offset.
5) Total system demand in % of humidifier capacity.
6) Total system output in kg/hr (lb/hr).
7) Drain/flush duration, allowed days, and frequency based on usage.
8) End-of-season drain status (on standard water systems and if ordered as a DI water option) and hours humidifier is idle before end of season draining occurs.
9) Window glass surface temperature //in percent RH offset application using separate sensor// with programmable offset.
10) Air temperature or other auxiliary temperature monitoring with programmable offset //using separate sensor//.
11) System alarms and system messages, current and previous.
12) Adjustable water skim duration.//

m. //Programmable outputs for remote signaling of alarms and/or messages, device activation (such as a fan), or for signaling tank heating and/or steam production.//

n. //System diagnostics that include:
1) Test outputs function to verify component operation.
2) Test humidifier function by simulating demand to validate performance.
3) Data collection of RH, air temperature, water use, energy use, alarms, and service messages for viewing from the keypad/display or Web interface.
4) Service notification scheduling.
5) Password-protected system parameters.
6) Keypad/display or Web interface displays in English.
7) Numerical units displayed in inch-pound or SI units.//

9. Other humidifier control features:

a. //Interoperability using LonTalk.// //Interoperability using BACnet MS/TP.//
b. //Multiple humidifier tank control. Control system shall be programmed and configured at the factory to control multiple humidifier tanks. Controller functions shall include all functions listed above including the following:
   1) The controller shall control up to //10// //16// humidifiers.
   2) The controller shall have automatic run-time balancing by assigning duty to all humidifier tanks in the multi-tank group such that each humidifier accrues approximately the same hours of duty, thereby ensuring equal wear across all humidifiers in the multi-tank group.
   3) One humidifier tank shall be capable of being controlled as a redundant tank.
   4) One control keypad/display shall be included with each multi-tank group.//
c. //Water level control for DI/RO water: System shall provide for continuous control of water level and will accommodate the use of deionized or reverse osmosis water with resistance up to 18 M-ohm/cm. System shall include:
   1) Water level sensing unit comprised of a float operated stainless steel valve for water makeup.
   2) Low water cutoff float switch.
   3) Operation within inlet water supply pressure range of 170 to 550 kPa (25 to 80 psig).//
d. //Access panel interlock switch: The control subpanel shall have an interlock control switch with manual override to remove control voltage when access panel is opened.//
e. //Removable keypad/display: Provide a keypad/display with cable for remote use.//
f. //Control input accessory://
   1) //Cold snap offset transmitter: A window surface temperature transmitter, operating temperature range -29 to 71 degrees C (-20 to 160 degrees F), shall be provided for field installation. Transmitter shall supply its signal (4 to 20 mA) to the microprocessor control system, which shall lower the indoor RH set point to a level 5 percent or more below the dew point temperature during a cold spell, thus preventing window

condensation. The indoor RH shall be automatically returned to the normal setting when the glass temperature rises.//

2) //Airflow proving switch, pressure type: Airflow proving switch shall be diaphragm-operated with pitot tube for field installation. Switch shall have an adjustable control point range of 12.5 to 2988 Pa (0.05 to 12 inch WG) Operating temperature range -40 to 82 degrees C (-40 to 180 degrees F). Compatible with 24, 120, and 240 VAC.//

3) //Airflow proving switch, sail type: Airflow proving switch shall be a sail operated electric switch for field installation. Switch makes at 1.3 m/s (250 feet per minute), breaks at 0.4 m/s (75 feet per minute). Maximum operating temperature for sail: 77 degrees C (170 degrees F). Maximum operating temperature for switch: 52 degrees C (125 degrees F).//

10. Distribution Manifold: Stainless steel, composed of dispersion pipe and surrounding steam jacket, manifold shall span the width of duct or air handler, and shall be multiple manifold type under any of the following conditions:

a. Duct section height exceeds 900 mm (36 inches).

b. Duct air velocity exceeds 5.1 m/s (1000 feet per minute).

c. If within 900 mm (3 feet) upstream of fan, damper or pre-filter.

d. If within 3 m (10 feet) upstream of after-filter.

SPEC WRITER NOTE: Coordinate water quality requirements with manufacturer and local water quality conditions and provide additional equipment as recommended. If humidifier is powered by gas or electric, specify in the appropriate specification section.

K. Unfired, Clean, Steam to Steam Generator (for sterilization purposes):

1. Provide a packaged factory assembled, pre-piped unfired steam generator consisting of stainless steel shell, stainless steel tube coil, stainless steel steam piping, valves and controls All stainless-steel piping shall be type //304// //316// factory-fabricated and provided as a part of the complete package. Any make-up water to these units shall be less than 1 ppm hardness. A dual tower water softener with brine tank and automatic regeneration shall be provided, if necessary.

2. Shell: Stainless steel ASME code construction with flanged piping connections, 1035 kPa (150 psig) maximum working steam pressure.
3. Tubes: Stainless Steel tubes suitable for 1035 kPa (150 psig) working pressure.
4. Design: Heated fluid in shell and heating fluid (higher pressure steam) in tubes.
5. Each steam generator shall be furnished with the following accessories:
   a. Resilient insulation.
   b. Pilot operated modulating control valve with pressure controller.
   c. Control pilot to maintain constant steam output.
   d. Pressure relief valve.
   e. Vessel and tube side pressure gauges.
   f. Liquid level controller with brass feed water solenoid valve, in check valve and strainer.
   g. Over-pressure limit system with auto-reset.
   h. Factory packaging.
   i. Dual F&T condensate traps.
   j. Manual blow down valve.
   k. //Time based// //TDS based// automatic blow down of cooled water 38 degrees C (100 degrees F) or less.
   l. Low water cut-off and high-pressure cut-off.
   m. Fully wired control box.
   n. Automatic drain solenoid valve.
6. Provide solid state control module with LED backlit LCD display and LED pilot lights to indicate on-off, high pressure, low pressure, low water and water feed. Control module shall allow the local adjustment of pressure limits on display screen. Control module shall have alarm light and alarm horn with built in alarm silence relay. Control module shall be supplied with dry contact closure outputs to indicate to building automation controls (BAC) the occurrence of power on, high pressure, low pressure, low water and water feed. The control module shall allow the BAC to turn the unfired steam generator on or off through a remote relay suitable for 24 VAC, 1 amp. The control module shall allow the BAC to remotely monitor the operating pressure. Control module shall be supplied with an on-off switch and shall be mounted in a NEMA 4 panel. All solenoids and limits shall be 24 VAC.

L. Steam Gun Set: Furnish for ready coupling to building steam and cold water and designed for rinsing equipment (such as carts and racks) with hot or cold water, cleaning such articles with detergent-laden hot water or steam, or alternately sanitizing the articles with only live steam.
   1. Gun: Fit gun for finger-tip release of steam. Design so siphoning action will automatically mix detergent with gun effluent. Equip gun with hardwood front and rear handgrips. Include a 24 mm (15/16 inch) diameter, double tube butyl hose reinforced with braid and designed for 1035 kPa (150 psig) pressure. Hose shall be 3.6 m (12 feet) long.
   2. Detergent Tank: Furnish 9.5 L (2-1/2 gallon) polyethylene or fiberglass storage tank and fit for wall mounting. Also provide 15 mm (1/2 inch) diameter neoprene double wall detergent hose of the same length as steam hose. Fit hose-to-tank connection with strainer. Fit other end of hose with valve to regulate amount of detergent to be mixed with steam.
   3. Steam/Water Selector: Furnish manifold for wall mounting; design manifold to deliver only steam or water, or steam and water mix to gun. Construct mounting panel of stainless steel. Valves and piping located in panel shall be brass.
   4. Accessories: Provide one pair of protective gloves and three 50 mm (2 inch) diameter brushes, one nylon and two stainless-steel.

M. Steam Hose and Accessories: Hose shall be sufficiently flexible to be placed in a 1.2 m (4 feet) diameter coil.
   1. Furnish and install in the mechanical room housing each PRV station a 7.6 m (25 feet) length of 15 mm (1/2 inch) ID steam hose, rated 861 kPa (125 psig) and a hose rack. In one end of the hose install a quick-couple device, suitable for steam service, to match corresponding devices in the PRV blowdown connections.
   2. Hose storage rack: Wall-mounted, steel, iron or aluminum, semi-circular shape, with capacity to store 7.6 m (25 feet) of 15 mm (1/2 inch) ID steam hose.

SPEC WRITER NOTE: Provide flow meters as shown in the design and coordinate the metering requirements with any on-going metering projects at the VA facility.

N. //Steam Flow Meter/Recorder: Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC.//

SPEC WRITER NOTE: Steam exhaust head is used on steam turbines. Delete this item if not applicable.

O. Steam Exhaust Head: Cast iron, fitted with baffle plates, to trap and drain condensed water.

2.11 GAUGES, PRESSURE AND COMPOUND

A. ASME B40.100, Accuracy Grade 1A, (pressure, vacuum, or compound), 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 steel, lever handle union cock. Provide steel or stainless-steel pressure snubber for gauges in water service. Provide steel pigtail syphon for steam gauges.

SPEC WRITER NOTE: Verify with facility personnel the preference for English or metric gauge measurement units and edit accordingly.

C. Pressure gauge ranges shall be selected such that the normal operating pressure for each gauge is displayed near the midpoint of each gauge’s range. Gauges with ranges selected such that the normal pressure is displayed at less than 30 percent or more than 70 percent of the gauge’s range are prohibited. The units of pressure shall be //kPa// //psig//.

2.12 PRESSURE/TEMPERATURE TEST PROVISIONS

A. Provide one each of the following test items to the COR:

1. 6 mm (1/4 inch) FPT by 3.2 mm (1/8 inch) diameter stainless steel pressure gauge adapter probe for extra-long test plug. Pressure/temperature plug is an example.
2. 90 mm (3-1/2 inch) diameter, one percent accuracy, compound gauge, 762 mm (30 inches) Hg to 690 kPa (100 psig) range.
3. 0 to 104 degrees C (32 to 220 degrees F) pocket thermometer one-half degree accuracy, 25 mm (1 inch) dial, 125 mm (5 inch) long stainless-steel stem, plastic case.

2.13 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 steam, condensate, and pumped condensate piping

is clearly described and that electrical drawings show power supply to heat tracing.

2.14 //ELECTRICAL HEAT TRACING SYSTEMS

A. Systems shall meet requirements of NFPA 70.

B. Provide tracing for outdoor piping subject to freezing temperatures below 3.3 degrees C (38 degrees F) as follows:

1. //Steam piping exposed to weather.//
2. //Steam condensate exposed to weather.//
3. //Pumped condensate piping exposed to weather.//

C. Heat tracing shall be provided to the extent shown on the drawings (Floor Plans and Elevations). Heat tracing shall extend below grade to below the defined frost line.

D. Heating Cable: Flexible, parallel circuit construction consisting of a continuous self-limiting resistance, conductive inner core material between two parallel copper bus wires, designed for cut-to-length at the job site and for wrapping around valves and complex fittings. Self-regulation shall prevent overheating and burnouts even where the cable overlaps itself.

1. Provide end seals at ends of circuits. Wires 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 the following:
   a. 75 mm (3 inch) pipe and smaller with 25 mm (1 inch) thick insulation: 4 watts per foot of pipe.
   b. 100 mm (4 inch) pipe and larger 40 mm (1-1/2 inch) thick insulation: 8 watts per feet of pipe.

SPEC WRITER NOTE: Coordinate the need for emergency power with project drawings (electric discipline).

E. 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. 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 3 m (10 feet) intervals along the pipe on alternating sides.//

PART 3 - EXECUTION

SPEC WRITER NOTE: Motors for condensate pumps are not designed to be submerged in water. Designer shall preclude any possibility of submergence or subjected to flooding by selecting suitable locations for condensate pumps or location to be drainable. Require trapped condensate return stations at every low point in piping.

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, fan-coils, coils, radiators, etc., and to coordinate with other trades. Provide all necessary fittings, offsets and pipe runs based on field measurements and at no additional cost or time to the Government. Coordinate with other trades for space available and relative location of HVAC equipment and accessories to be connected on ceiling grid. Pipe location on the drawings shall be altered by contractor 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. Install convertors and other heat exchangers at height sufficient to provide gravity flow of condensate to the flash tank and condensate pump.

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 and another surface. Unless shown otherwise, slope steam, condensate and 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.

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. Connect piping to equipment as shown on the drawings. Install components furnished by others such as flow elements (orifice unions), control valve bodies, flow switches, pressure taps with valve, and wells for sensors.

J. 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 AND BOILER PLANT INSULATION.

K. Pipe vents to the exterior. Where a combined vent is provided, the cross-sectional area of the combined vent shall be equal to sum of individual vent areas. Slope vent piping 25 mm (1 inch) in 12 m (40 feet) 0.25 percent in direction of flow. Provide a drip pan elbow on relief valve outlets if the vent rises to prevent backpressure. Terminate vent minimum 300 mm (12 inches) above the roof or through the wall minimum 2.4 m (8 feet) above grade with down turned elbow.

3.2 WELDING

A. The contractor is entirely responsible for the quality of the welding and shall:

1. Conduct tests of the welding procedures used on the project, verify the suitability of the procedures used, verify that the welds made will meet the required tests, and also verify that the welding

operators have the ability to make sound welds under standard conditions.

2. Perform all welding operations required for construction and installation of the piping systems.

B. Qualification of Welders: Rules of procedure for qualification of all welders and general requirements for fusion welding shall conform with the applicable portions of ASME B31.1, AWS B2.1/B2.1M, AWS Z49.1, and also as outlined below.

C. Examining Welder: Examine each welder at job site, in the presence of the COR, to determine the ability of the welder to meet the qualifications required. Test welders for piping for all positions, including welds with the axis horizontal (not rolled) and with the axis vertical. Each welder shall be allowed to weld only in the position in which he has qualified and shall be required to identify his welds with his specific code marking signifying his name and number assigned.

D. Examination Results: Provide the COR with a list of names and corresponding code markings. Retest welders who fail to meet the prescribed welding qualifications. Disqualify welders, who fail the second test, for work on the project.

E. Beveling: Field bevels and shop bevels shall be done by mechanical means or by flame cutting. Where beveling is done by flame cutting, surfaces shall be thoroughly cleaned of scale and oxidation just prior to welding. Conform to specified standards.

F. Alignment: Provide approved welding method for joints on all pipes greater than 50 mm (2 inches) to assure proper alignment, complete weld penetration, and prevention of weld spatter reaching the interior of the pipe.

G. Erection: Piping shall not be split, bent, flattened, or otherwise damaged before, during, or after installation. If the pipe temperature falls to 0 degrees C (32 degrees F) or lower, the pipe shall be heated to approximately 38 degrees C (100 degrees F) for a distance of 300 mm (1 foot) on each side of the weld before welding, and the weld shall be finished before the pipe cools to 0 degrees C (32 degrees F).

H. Non-Destructive Examination of Piping Welds:

1. Perform radiographic examination of 50 percent of the first 10 welds made and 10 percent of all additional welds made. The COR reserves the right to identify individual welds for which the radiographic examination must be performed. All welds will be visually inspected

by the COR. The VA reserves the right to require testing on additional welds up to 100 percent if more than 25 percent of the examined welds fail the inspection.

2. An approved independent testing firm regularly engaged in radiographic testing shall perform the radiographic examination of pipe joint welds. All radiographs shall be reviewed and interpreted by an ASNT Certified Level III radiographer, employed by the testing firm, who shall sign the reading report.
3. Comply with ASME B31.1. Furnish a set of films showing each weld inspected, a reading report evaluating the quality of each weld, and a location plan showing the physical location where each weld is to be found in the completed project. The COR and the commissioning agent shall be given a copy of all reports to be maintained as part of the project records and shall review all inspection records.

I. Defective Welds: Replace and reinspect defective welds. Repairing defective welds by adding weld material over the defect or by peening are prohibited. Welders responsible for defective welds must be requalified prior to resuming work on the project.

J. Electrodes: Electrodes shall be stored in a dry heated area, and be kept free of moisture and dampness during the fabrication operations. Discard electrodes that have lost part of their coating.

3.3 PIPE JOINTS

A. Welded: Beveling, spacing and other details shall conform to ASME B31.1 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: Threads shall conform to ASME B1.20.1; joint compound shall be applied 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. 125 Pound Cast Steel Flange (Plain Face): Mating flange shall have raised face, if any, removed to avoid overstressing the cast steel flange.

3.4 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. A professional engineer shall verify 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. Representative of manufacturer shall visit the site and verify that installation is proper.

D. Access: Expansion joints must be located in 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 to devices for inspection of all surfaces and for adding packing.

SPEC WRITER NOTE: Where condensate needs to be lifted to elevated heights or there is existing backpressure, evaluate if a pressure driven condensate pump trap or electric condensate pump would be necessary.

3.5 STEAM TRAP PIPING

A. Install to permit gravity flow to the trap. Provide gravity flow (avoid lifting condensate) from the trap where modulating control valves are used. Support traps weighing over 11 kg (24 pounds) independently of connecting piping.

3.6 //SEISMIC BRACING

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

3.7 LEAK TESTING

A. Inspect all joints and connections for leaks and workmanship and make corrections as necessary, to the satisfaction of the COR in accordance with the specified requirements. Testing shall be performed in accordance with the specification requirements.

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. Avoid excessive pressure on mechanical seals and safety devices.

D. Prepare and submit test and inspection reports to the COR within 5 working days of test completion and prior to covering the pipe.

E. All tests shall be witnessed by the COR, their representative, or the Commissioning Agent and be documented by each section tested, date tested, and list or personnel present.

3.8 FLUSHING AND CLEANING PIPING SYSTEMS

A. Steam, Condensate and Vent Piping: The piping system shall be flushed clean prior to equipment connection. Cleaning includes pulling all strainer screens and cleaning all scale/dirt legs during startup operation. Contractor shall be responsible for damage caused by inadequately cleaned/flushed systems.

3.9 //ELECTRIC HEAT TRACING

A. Install tracing as recommended by the manufacturer.

B. Coordinate electrical connections.//

3.10 STARTUP AND TESTING

A. Perform 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. When any defects are detected, correct defects and repeat test at no additional cost or time to the Government.

C. //The Commissioning Agent will observe startup and contractor testing of selected equipment. Coordinate the startup and contractor testing schedules with COR and Commissioning Agent. Provide a minimum notice of 10 working days prior to startup and testing.//

D. Adjust red set hand on pressure gauges to normal working pressure.

3.11 //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.//

3.12 DEMONSTRATION AND TRAINING

A. Provide services of manufacturer’s technical representative for //4// // // hour//s// to instruct each VA personnel responsible in operation and maintenance of the system.

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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