SECTION 23 21 11
BOILER PLANT PIPING SYSTEMS

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. All boiler plant piping systems, except plumbing and sanitary, including piping supports. Piping located outside of the boiler plant building is not included except for gas regulator and meter stations.

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

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 22 11 00 FACILITY WATER DISTRIBUTION.

H. Section 22 31 11, WATER SOFTENERS.

I. Section 22 67 19.16, REVERSE OSMOSIS WATER EQUIPMENT.

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

K. Section 23 05 51, NOISE AND VIBRATION CONTROL FOR BOILER PLANT.

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

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

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

O. //Section 23 08 11, DEMONSTRATIONS AND TESTS FOR BOILER PLANT.//

P. Section 23 09 11, INSTRUMENTATION AND CONTROL FOR BOILER PLANT.

Q. Section 23 25 00, HVAC WATER TREATMENT.

R. Section 23 50 11, BOILER PLANT MECHANICAL EQUIPMENT.

S. Section 23 52 33, WATER-TUBE BOILERS.

T. Section 23 52 39, FIRE-TUBE BOILERS.

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 Civil Engineers (ASCE):

25-2006.....Earthquake-Actuated Automatic Gas Shutoff Devices

C. American Society of Mechanical Engineers (ASME):

B16.3-2011.....Malleable Iron Threaded Fittings: Classes 150 and 300

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

B16.22-2013.....Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings

B16.34-2013.....Valves Flanged, Threaded and Welding End

B31.1-20142010.....Power Piping

B31.9-2014.....Building Services Piping

ASME Boiler and Pressure Vessel Code:

BPVC Section I-2015.....Rules for Construction of Power Boilers

BPVC Section VIII-2015..Rules for Construction of Pressure Vessels

BPVC Section IX-2015....Welding, Brazing, and Fusing Qualifications

D. ASTM International (ASTM):

A47/A47M-1999 (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

A105/A105M-2014.....Standard Specification for Carbon Steel Forgings for Piping Applications

A106/A106M-2015.....Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service

A193/A193M-2015a.....Standard Specification for Alloy-Steel and Stainless-Steel Bolting for High Temperature or High-Pressure Service and Other Special Purpose Applications

A194/A194M-2015a.....Standard Specification for Carbon Steel, Alloy Steel, and Stainless-Steel Nuts for Bolts for High Pressure or High-Temperature Service, or Both

A197/A197M-2000 (R2015).Standard Specification for Cupola Malleable Iron

A216/A216M-2014e1.....Standard Specification for Steel Castings, Carbon, Suitable for Fusion Welding, For High-Temperature Service

A234/A234M-2015.....Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service

A269/A269M-2015a.....Standard Specification for Seamless and Welded Austenitic Stainless-Steel Tubing for General Service

A395/A395M-1999 (R2014).Standard Specification for Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures

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

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

E. American Welding Society (AWS):

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

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

F. California Referenced Standards Codes (CRSC):
Title 24 Part 12-2013

G. Manufacturers Standardization Society of the Valve and Fittings Industry (MSS):
SP-45-2003 (R2008).....Bypass and Drain Connections
SP-58-2009.....Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation
SP-80-2013.....Bronze Gate, Globe, Angle and Check Valves
SP-97-2012.....Integrally Reinforced Forged Branch Outlet Fittings – Socket Welding, Threaded, and Buttwelding Ends
SP-127-2014a.....Bracing for Piping Systems: Seismic – Wind – Dynamic Design, Selection, and Application

H. National Fire Protection Association (NFPA):
30-2015.....Flammable and Combustible Liquids Code
31-2016.....Standard for the Installation of Oil-Burning Equipment
54-2015.....National Fuel Gas Code
85-2015.....Boiler and Combustion Systems Hazards Code

I. Pipe Fabrication Institute (PFI):
ES24-2013.....Pipe Bending Methods, Tolerances, Process and Material Requirements

J. Department of Veterans Affairs:
H-18-8-2013.....Seismic Design Handbook

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 11, BOILER PLANT PIPING SYSTEMS”, 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. Piping:

a. ASTM material specification number.

b. Grade, class or type, schedule number.
c. Manufacturer.
d. Intended service.

2. Pipe Fittings, Unions, Flanges:
   a. ASTM material specification number.
   b. ASME standards number.
   c. Catalog cuts.
   d. Pressure and temperature ratings.
   e. Intended service.
3. Valves - Gate, Globe, Check, Plug, Butterfly, Ball:
   a. Catalog cuts showing design and construction.
   b. Pressure and temperature ratings.
   c. Materials of construction.
   d. Accessories.
   e. Intended service.
4. Sight Flow Indicators:
   a. Catalog cuts showing design and construction.
   b. Pressure and temperature ratings.
   c. Materials of construction.
   d. Intended service.
5. Quick - Couple Hose Connectors and Steam Hose:
   a. Catalog cuts showing design and construction.
   b. Pressure and temperature ratings.
   c. Materials of construction.
   d. Type of seal between couplings.
   e. Flexibility of steam hose.
6. Pressure Reducing and Regulating Valves, Back Pressure Relief Valves, Safety Valves, Relief Valves:
   a. Catalog cuts showing design and construction.
   b. Service limitations (type of fluid, maximum pressure and temperatures).
   c. Materials of construction.
   d. Flow capacity at required set pressure or differential pressure.
   e. Predicted sound levels, at operating condition, for steam pressure reducing valves.
7. Strainers:
   a. Catalog cuts showing design and construction.
   b. Pressure and temperature ratings.

c. Materials of construction.

d. Strainer basket or liner mesh size.

e. Pressure loss and flow rate data.

f. Intended service.

8. Emergency Gas Safety Shutoff Valves// and Automatic Earthquake Gas Valves//:

a. Catalog cuts showing design and construction.

b. Maximum pressure rating.

c. Material of construction.

d. Pressure loss and flow rate data.

9. Steam Traps:

a. Catalog cuts showing design and construction.

b. Service limitations (maximum pressures and temperatures).

c. Materials of construction.

d. Flow rates at differential pressures shown on drawings.

e. Orifice size for each trap.

f. Monitoring equipment or attachments

10. Flexible Connectors:

a. Catalog cuts showing design and construction.

b. Pressure and temperature ratings.

c. Materials of construction.

d. Maximum allowable lateral and axial movements.

e. Description of type of movement permitted, intermittent offset or continuous vibration.

f. Intended service.

11. Pipe Support Systems: The contractor shall provide the following with submissions.

a. Credentials of technical personnel who will design the support systems.

b. Description of computer program for pipe support selection indicating its capability and limitations. Provide documentation showing both program verification and validation results. List of projects where it was employed successfully.

SPEC WRITER NOTE: After any revisions or construction deviations, re-run stress analysis to ensure any revisions in support arrangement still result in allowable limits.

c. Input and output data for pipe support selection program for all piping systems with pipe sizes 65 mm (2-1/2 inches) and above.
d. Boiler, feedwater deaerator and header manifold steam nozzle (pipe connection) allowable and actual forces and moments imposed by connecting piping.
e. Hanger load calculation methods and results for piping systems with pipe sizes 50 mm (2 inches) and below.
f. Piping layouts showing location and type of each hanger support and anchors with unique identifiers that can be referenced back to the calculation results.
g. Catalog cuts showing design and construction of each hanger support and anchor and their conformance to MSS standards.
h. Drawings showing arrangement and sizes of all components comprising each spring-type hanger and support assembly.
i. Load rating and movement tables for all spring hangers//, and seismic shock absorbing devices//.
j. Stress analyses on the boiler plant piping systems under all possible load conditions as part of the design. Once all piping is completed another stress analysis is required on the as built systems. Documentation results shall flag locations/components requiring recommended revision/modification to obtain acceptable stress levels.

D. 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.

E. //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.//

F. //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. Entire installation shall comply with ASME B31.1 and appendices and NFPA 54.

B. Boiler External Piping, as defined in the ASME BPVC Section I, is required to be constructed and inspected in conformance with the ASME Code.

C. 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.

D. 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.

E. 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 DELIVERY, STORAGE AND HANDLING

A. All piping shall be stored and kept free of foreign material and shall be internally and externally cleaned of all oil, dirt, rust and foreign material. Deliver and store valves and pipe hangers in sealed shipping containers with labeling in place. Storage must be in dry, protected location.

SPEC WRITER NOTE: Fill blank spaces within this paragraph. Specification is based on high pressure saturated steam, 110 to 1034 kPa (16 to 150 psig), main header pressure in the boiler plant. The entire specification must be revised if

header pressures are significantly lower or higher.

1.7 INFORMATION ON PRESSURE-TEMPERATURE DESIGN OF PIPING SYSTEMS

A. Steam service pressures are selected to provide optimum pressure to the facilities served by the boiler plant. Main steam header pressure shall be controlled at // // kPa (// // psig). Maximum pressure capability of steam systems between boilers and through first pressure reducing valve protected by a safety valve shall be governed by the pressure/temperature relationship of the highest safety valve setting shown for the boilers.

B. Steam distribution systems protected by safety valves following pressure reducing stations or protected by safety valves on the boilers shall be governed by the pressure/temperature relationship developed by the maximum setting of the safety valve on that system.

C. Boiler feedwater systems between boiler feed pumps, economizers (if provided), and boilers are designed for a normal maximum temperature of 138 degrees C (280 degrees F), and emergency temperature of 213 degrees C (415 degrees F) (if economizers are provided and economizer safety relief valve setting is 1896 kPa (275 psig)). Design pressure is the greater of: boiler feed pump shut off head; or 1896 kPa (275 psig) set pressure, plus accumulation, of economizer (if provided) relief valve.

D. Condensate collection and transfer systems to suction of boiler feed pumps are designed for maximum temperatures to 100 degrees C (212 degrees F), and pressures 276 kPa (40 psig). Vacuum return systems shall operate between 0 and 27 kPa (0 and 8-inch Hg) vacuum and equivalent steam saturation temperatures.

SPEC WRITER NOTE: Add pressure information on propane/air system if system is provided.

E. Natural gas fuel systems are designed and materials and equipment are applied to prevent failure under gas pressure of // // kPa (// // psig) entering Government property. LP gas systems for igniters (pilots) are designed for maximum LP tank pressure of 1724 kPa (250 psig).

F. Fuel oil system pressures are determined by the requirements of the burners and fuel trains. No. 2 oil systems are designed for maximum temperatures of 54 degrees C (130 degrees F), and pressures of 1034 kPa (150 psig).

G. Water service pressures are // // kPa (// // psig) maximum. Systems are designed to operate under conditions of maximum available pressure.

H. Drips, drains, blowdown, water sampling, and chemical treatment are designed, and materials and equipment are applied in accordance with the maximum pressure and temperature of the system with which they are associated.

I. Low pressure steam, condensate, vacuum and vents are designed for service pressures and temperatures equivalent to 103 kPa (15 psig) saturated steam.

J. Compressed air systems are designed to accommodate a maximum pressure of 861 kPa (125 psig).

K. Instrumentation and control piping shall be provided for the service and pressure characteristics of the systems to which they are connected.

1.8 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 STEAM PIPING

A. Pipe: Carbon steel, ASTM A53/A53M Grade B or ASTM A106/A106M Grade B, seamless or electric resistance welded (ERW). Schedule 40 for piping //up to 861 kPa (125 psig)// with welded ends. Schedule 80 for piping with threaded ends //and piping over 861 kPa (125 psig) with welded ends//.

B. Joints:

1. Pipe sizes 65 mm (2-1/2 inches) and above: Butt-welded, no other types allowed.
2. Pipe sizes 50 mm (2 inches) and below: Threaded, butt-welded, or socket-welded. Use Schedule 80 pipe and fittings for threaded joints.

C. Fittings:

1. Welded joints: Steel, ASTM A234/A234M, Grade B, ASME B16.9, same schedule as adjoining pipe, all elbows long radius.
2. Threaded joints: Forged steel, ASME B16.ll, 13,790 kPa (2000 psig) class. Use Schedule 80 pipe and fittings for threaded joints.
3. Socket-welded joints: Forged steel, ASME B16.11, 13,790 kPa (2000 psig) class.

D. Unions on Threaded Piping: Forged steel, 13,790 kPa (2000 psig) class or 20,685 kPa (3000 psig) class on piping 50 mm (2 inches) and under.

E. Flanges and Bolts: Forged steel weld neck, ASME B16.5, ASTM A105/A105M, 1034 kPa (150 psig) pressure class, except 2070 kPa (300 psig) class required adjacent to 1724 kPa (250 psig) and 2070 kPa (300 psig) class valves. Bolts shall be high strength steel ASTM A193/A193M, Class 2, Grade B7. Nuts shall be ASTM A194/A194M.

2.2 STEAM CONDENSATE PIPING

A. Includes all gravity, drip return, pumped and vacuum systems. Does not include piping system between boiler feed pumps and boilers.

B. Pipe: Carbon steel, ASTM A53/A53M Grade B or ASTM A106/A106M Grade B, seamless or ERW, Schedule 80.

C. Joints:
   1. Pipe sizes 65 mm (2-l/2 inches) and above: Butt-welded, no other types allowed.
   2. Pipe sizes 50 mm (2 inches) and below: Schedule 80 threaded, butt-welded or socket-welded.

D. Fittings:
   1. Welded joints: Steel, ASTM A234/A234M, Grade B, ASME B16.9, same schedule as adjoining pipe.
   2. Threaded joints: Forged steel, ASME B16.ll, 13,790 kPa (2000 psig class. Use Schedule 80 pipe and fittings for threaded joints.
   3. Socket-welded joints: Forged steel, ASME B16.11, 13,790 kPa (2000 psig) class.

E. Unions on Threaded Piping: For piping 50 mm (2 inches) and under, forged steel, 13,790 kPa (2000 psig) class or 20,685 kPa (3000 psig) class. Use Schedule 80 pipe and fittings for threaded joints.

F. Flanges: Forged steel weld neck, ASTM A105/A105M, ASME B16.5, 1034 kPa (150 psig).

2.3 FUEL PIPING

A. Natural gas, LP gas (propane), fuel oil (No. 2 heated) for main burner and igniter (pilot) fuels, gas vent piping. Comply with ASME B3l.l and NFPA 54.

B. Piping: Carbon steel, ASTM A53/A53M Grade B or ASTM A106/A106M Grade B, seamless or ERW, Schedule 40. Fuel oil piping shall be seamless downstream of burner automatic shutoff valves.

C. Joints:
   1. Pipe sizes 65 mm (2-l/2 inches) and above: Butt-welded, no other types allowed.
   2. Pipe sizes 50 mm (2 inches) and below: Socket-welded or butt-welded.

D. Fittings:
   1. Butt-welded joints: Steel, ASTM A234/A234M, Grade B, ASME B16.9, same schedule as adjoining pipe.
   2. Socket-welded joints: Forged steel, ASME B16.ll, 13,790 kPa (2000 psig class.

E. Unions on piping 50 mm (2 inches) and under: Forged steel, 13,790 kPa (2000 psig) class or 20,685 kPa (3000 psig) class.

F. Flanges: Forged steel weld neck, ASME B16.5, ASTM A105/A105M, 1034 kPa (150 psig).

G. Companion flanges: Flanges and bolting shall conform to ASME B16.5.

H. Burner Piping: Furnished as part of the factory-assembled burners may be manufacturer's standard materials and assembly. Comply with ASME B31.1, for the actual operating conditions.

I. Igniter (Pilot) Piping: Furnished as part of the factory assembled burners may have 2070 kPa (300 psig) ASTM A47/A47M, ASME B16.3 malleable iron threaded fittings in lieu of welded steel. If threaded fittings are provided, piping shall be Schedule 80.

2.4 BOILER FEEDWATER PIPING

A. Piping from boiler feedwater pump discharge to inlet of boilers.

B. Pipe: Carbon steel, ASTM A53/A53M Grade B or ASTM A106/A106M Grade B, seamless or ERW. Piping with threaded joints shall be Schedule 80; welded joints Schedule 40. No joining of different schedule pipe in order to have welded on one end and threaded on the other. In these cases, the length of pipe shall be Schedule 80.

C. Joints:

1. Pipe sizes 65 mm (2-1/2 inches) and above: Butt-welded, no other types are allowed.
2. Pipe sizes 50 mm (two inches) and below: Threaded, butt-welded, or socket-welded.
3. No pipe to pipe joints when the length of the run is less than a full length of pipe.

D. Fittings:

1. Butt-welded Joints: Steel, ASTM A234/A234M, Grade B, ASME B16.9, same schedule as adjoining pipe.
2. Threaded Joints: Forged steel, ASME B16.ll, 13,790 kPa (2000 psig class. Use Schedule 80 pipe and fittings for threaded joints.
3. Socket-welded joints: Forged steel, ASME B16.11, 13,790 kPa (2000 psig) class.

E. Unions: Forged steel, 13,790 kPa (2000 psig) class or 20,685 kPa (3000 psig) class.

F. Flanges and Bolts: Forged steel weld neck, ASME B16.5, ASTM A105/A105M, 2070 kPa (300 psig) pressure class. Bolts shall be High strength ASTM A193/A193M, Class 2, Grade B7. Nuts shall be ASTM A194/A194M.

2.5 BOILER BLOWOFF PIPING

A. From boiler bottom blowoff connection to blowoff tank. Connections between boiler accessories drain valves and blowoff lines.

B. Pipe: Carbon steel, ASTM A106/A106M, Grade B, seamless, Schedule 80.

C. Joints: Butt-welded, no other types are allowed.

D. Fittings: Steel, ASTM A234/A234M, Grade B, ASME B16.9, same schedule as adjoining pipe, all elbows long radius. Tees or crosses are prohibited.

E. Flanges: Forged steel weld neck, ASME B16.5, ASTM A105/A105M, 2070 kPa (300 psig).

F. At no point shall the bottom blow down lines rise above the point of connection to the boiler.

2.6 DRAIN PIPING FROM BOILER ACCESSORIES TO DRAIN VALVE

A. Drain piping from water column, low water cutoffs, gauge glass, water level sensor, remote water level devices (where applied).

B. Pipe: Carbon steel, ASTM A106/A106M, seamless, Schedule 40.

C. Joints: Threaded.

D. Fittings: Forged steel, ASME B16.ll, 13,790 kPa (2000 psig) class.

E. Unions: Forged steel, 13,790 kPa (2000 psig) class or 20,685 kPa (3000 psig) class.

2.7 VENT LINES FROM TANKS AND SAFETY AND RELIEF VALVES

A. Pipe: Carbon steel, ASTM A53/A53M Grade B or A106/A106M Grade B, seamless or ERW, Schedule 40.

B. Joints:

1. Pipe sizes 65 mm (2-l/2 inches) and above: Butt-welded, no other types are allowed.
2. Pipe sizes 50 mm (2 inches) and below: Threaded or butt-welded.

C. Fittings:

1. Welded Joints: Steel, ASTM A234/A234M, Grade B, ASME B16.9, same schedule as adjoining pipe.
2. Threaded Joints: Steel, ASTM A234/A234M, Grade B, ASME B16.9, Schedule 80.

D. Unions: Forged steel, 13,790 kPa (2000 psig) class or 20,685 kPa (3000 psig) class.

E. Flanges: Forged steel weld neck, ASME B16.5, ASTM A105/A105M, 1034 kPa (150 psig).

2.8 COLD WATER PIPING

A. Soft Water: See Section 22 31 11, WATER SOFTENERS.

B. City Water: See Section 22 11 00, FACILITY WATER DISTRIBUTION.

C. All copper pipe shall use only soldered fittings.

2.9 REVERSE OSMOSIS WATER PIPING

A. See Section 22 67 19.16, REVERSE OSMOSIS WATER EQUIPMENT.

B. All reverse osmosis piping in the boiler plant shall be stainless steel with all valves, etc. made of stainless steel. At no point shall the

reverse osmosis water come into direct contact with carbon steel pipe or equipment.

2.10 COMPRESSED AIR PIPING (FUEL OIL ATOMIZING SERVICE)

A. Pipe: Carbon steel, ASTM A53/A53M Grade B or ASTM A106/A106M Grade B, seamless or ERW Schedule 40.

B. Joints: Threaded.

C. Fittings: Forged steel, ASME B16.ll, 13,790 kPa (2000 psig class); or malleable iron ASTM A47/A47M or ASTM A197/A197M, ASME Bl6.3, 1034 kPa (150 psig) class.

D. Unions: Forged steel, 13,790 kPa (2000 psig) class or 20,685 kPa (3000 psig) class; or malleable iron, 1034 kPa (150 psig) class.

2.11 BOILER WATER SAMPLING, CONTINUOUS BLOWDOWN

A. Pipe: Steel, ASTM A106/A106M Grade B, seamless, Schedule 80.

B. Joints: Threaded.

C. Fittings: Forged steel, ASME B16.ll, 13,790 kPa (2000 psig) class. Fittings between boiler and first stop valve must be forged steel, ASME B16.11, 13,790 kPa (2000 psig) or 20,685 kPa (3000 psig) class.

D. Unions: Malleable iron, 2070 kPa (300 psig) class.

2.12 FEEDWATER SAMPLING AND CHEMICAL FEED PIPING

A. Pipe: Stainless steel tubing, ASTM A269/A269M, Type 316.

B. Fittings: Stainless steel Type 316 welding fittings.

2.13 MISCELLANEOUS PIPING

A. Instrument and Control Piping (Sensing Point to Transmitter, Controller, or Other Instrument): Construction shall be same as specified for main service.

B. Drain Piping (All Drain Piping Discharging to Floor Drain-From Drain Valve to Floor Drain):

1. Pipe: Carbon steel, ASTM A53/A53M Grade B or ASTM A106/A106M Grade B, seamless or ERW, Schedule 40.
2. Fittings and Unions: Forged steel, ASME B16.ll, 13,790 kPa (2000 psig class); or malleable iron, 1034 kPa (150 psig), threaded.

C. Pump Recirculation:

1. Pipe: Carbon steel, ASTM A53/A53M Grade B or ASTM A106/A106M Grade B, seamless or ERW, double extra strong. Schedule 40 permitted on all lines 1500 mm (5 feet) or more from the recirculation orifice.
2. Joints: Threaded.
3. Fittings: Forged steel, ASME B16.ll, 13,790 kPa (2000 psig) class; or malleable iron, ASTM A47/A47M or ASTM A197/A197M, ASME B16.3,

2070 kPa (300 psig) class, except 1034 kPa (150 psig) class permitted on all lines 1500 mm (5 feet) or more from the recirculation orifice.

4. Unions: Forged steel, 13,790 kPa (2000 psig) class or 20,685 kPa (3000 psig) class; or malleable iron, ASTM A47/A47M or ASTM A197/A197M, same pressure class as nearest fittings.

2.14 DIELECTRIC FITTINGS

A. Provide threaded dielectric unions for pipe sizes 50 mm (2 inches) and under. For 65 mm (2-1/2 inches) and above, provide steel flanges electrically isolated at gasket and by sleeves at bolts. Fittings on cold water and soft water lines shall be rated for 690 kPa (100 psig), 27 degrees C (80 degrees F). Fittings on steam condensate lines shall be rated at 520 kPa (75 psig), 121 degrees C (250 degrees F). Fittings on other services shall be rated for the maximum pressure and temperature conditions of the service.

2.15 VALVES; GATE, GLOBE, PLUG, CHECK, BALL, BUTTERFLY, VENT COCKS

A. Valves for particular services are generally specified as Type Numbers. The Type Numbers are defined below. All valves of the same type shall be the products of a single manufacturer. Comply with MSS SP-45, MSS SP-80, and ASME B3l.l. Design valves for the service fluids and conditions. Pressure-temperature ratings listed are minimum requirements. Packing and gaskets shall not contain asbestos.

B. Valve Type Designations:

1. Gate Valves:

a. Type 101: Cast steel body ASTM A216/A216M WCB, rated for 1034 kPa at 260 degrees C (150 psig at 500 degrees F), ll.5 to l3 percent chromium stainless steel flexible wedge and hard faced (stellite) or nickel copper alloy seats, 1034 kPa (150 psig) ASME flanged ends, OS&Y, rising stem, bolted bonnet.

1) Provide factory installed globe-valved warm-up bypass when main valve is 75 mm (3 inch) pipe size or greater and serves steam main longer than 6.1 m (20 feet). Conform to MSS SP-45.

2) Drill and tap bosses for connection of drains if valve is in steam service. Conform to MSS SP-45.

b. Type 102: Cast steel body ASTM A2l6/A216M WCB, Class 300, ll.5 to l3 percent chromium stainless steel flexible wedge and hard faced (stellite) alloy seats, ASME flanged ends, OS&Y, rising stem, and bolted bonnet.

1) Provide factory installed globe-valved bypass when main valve is 75 mm (3 inch) pipe size or greater and serves steam main longer than 6.1 m (20 feet). Conform to MSS SP-45.
2) Drill and tap bosses for connection of drains if valve is in steam service. Conform to MSS SP-45.

c. Type 103: Cast steel body ASTM A2l6/A216M WCB, Class 300, ll.5 to l3 percent chromium stainless steel flexible wedge and hard faced (stellite) alloy seats, ASME flanged ends, OS&Y, rising stem, and bolted bonnet.
1) Provide factory installed globe-valved bypass when main valve is 75 mm (3 inch) pipe size or greater and serves steam main longer than 6.1 m (20 feet). Conform to MSS SP-45.
2) Drill and tap bosses for connection of drains if valve is in steam service. Conform to MSS SP-45.

d. Type 105: Forged steel body ASTM A105/A105M, rated for 2070 kPa at 216 degrees C (300 psig at 420 degrees F) minimum, Class 4138 kPa (600 psig) or Class 5515 kPa (800 psig), hardened stainless steel or stellite wedge and seats, threaded ends, OS&Y, rising stem, bolted bonnet.

2. Globe Valves:
a. Type 201: Cast steel body ASTM A216/A216M WCB, rated for 1034 kPa at 260 degrees C (150 psig at 500 degrees F), 11-1/2 to 13 percent chromium stainless steel or stellite disc and seat, 1034 kPa (150 psig) ASME flanged ends, OS&Y, rising stem, bolted bonnet, renewable seat rings. Drill and tap bosses for connection of drains where shown. Conform to MSS SP-45.
b. Type 205: Forged steel body ASTM A105/A105M, rated for 2070 kPa at 216 degrees C (300 psig at 420 degrees F) minimum, Class 4138 kPa (600 psig) or Class 5515 kPa (800 psig), stainless steel disc, stellite seat, threaded ends, OS&Y, rising stem, bolted bonnet.

3. Plug Valves: Cast steel body ASME B16.5 Class 150, one-fourth turn to open. 861 kPa (125 psig) ASME flanged ends for pipe sizes above 50 mm (2 inches), threaded ends for pipe sizes 50 mm (2 inches) and under. All components designed for service to which applied: natural gas, LP gas (propane), or fuel oil. Furnish lever handle for each valve.

a. Type 301: Two-way valves up through 100 mm (4 inches) pipe size. Eccentric action, non-lubricated plug with resilient seal molded into groove on plug face providing bubble-tight shut off. O-ring stem seal, corrosion-resistant bearings, corrosion-resistant seat coating, seal materials as recommended by valve manufacturer for the service. Valves on natural gas service AGA approved.
b. Type 302: Two-way valves 125 mm (5 inches) pipe size and above, all sizes of three-way valves. Lubricated full-port plug type with lubricant for intended service. Reinforced Teflon stem seal, valve plug floated on Teflon surfaces, lubricant injection system that has sufficient pressure to fully lubricate all sealing surfaces. Provide laminated plastic label attached to each valve stating, “Lubricate with //(Insert appropriate description)// once a year”.

4. Check Valves:
   a. Type 401: Not used.
   b. Type 402: Swing-type, cast steel body ASME B16.34, rated for 1724 kPa (250 psig) saturated steam, 3447 kPa (500 psig) WOG, bronze or bronze-faced disc and seat, 1724 kPa (250 psig) ASME flanged ends, bolted cover, renewable disc and seat.
   c. Type 403: Swing-type, cast steel body ASME B16.34, rated for 861 kPa (l25 psig) saturated steam, 1380 kPa (200 psig) WOG, bronze or bronze-faced disc and seat, 861 kPa (l25 psig) ASME flanged ends, bolted cover, renewable disc and seat.
   d. Type 405: Lift-type, forged steel body ASTM A105/A105M, rated for 2070 kPa at 216 degrees C (300 psig at 420 degrees F) minimum (Class 4138 kPa (600 psig) or 5515 kPa (800 psig)), hardened stainless steel disc, hard faced seat, bolted cover, threaded ends.
   e. Type 406: Swing-type, Type 316 stainless steel body, disc and hanger, rated for 1724 kPa at 182 degrees C (250 psig at 360 degrees F) minimum.
   f. Type 408: Silent spring-loaded wafer type, cast steel ASTM A216/A216M WCB body, rated for 2070 kPa (300 psig) water, 121 degrees C (250 degrees F), stainless steel trim.
5. Ball Valves: Reduced port permitted for bypass (throttling) service; full port required for all other services, one-fourth turn to open.

a. Type 501: Type 316 stainless steel body, ball and stem, rated for 1034 kPa at 185 degrees C (150 psig at 365 degrees F), 4138 kPa at 93 degrees C (600 psig at 200 degrees F); reinforced TFE seat, stem seal and thrust washer; end entry, threaded ends.
b. Type 502: Steel body, rated for 1034 kPa at 185 degrees C (150 psig at 365 degrees F), 1724 kPa at 121 degrees C (250 psig at 250 degrees F), reinforced TFE seat, stem seal and thrust washer; end entry, threaded ends, UL-listed for natural or LP gas shut off service when used on those services.
c. Type 503: Carbon steel body, steam service, rated for 1380 kPa at 200 degrees C (200 psig at 392 degrees F), stainless steel ball and stem, Polyfil seat, live-loaded or adjustable stem seal, threaded ends.
d. Type 504: Carbon steel body, saturated steam service, rated for 1034 kPa (150 psig), stainless steel ball and stem, Polyfil seat, live-loaded stem seal, ASME flanged ends.

6. Butterfly Valves:
a. Type 601: Carbon steel ASTM A216/A216M wafer style, rated for 861 kPa at 121 degrees C (125 psig at 250 degrees F), bronze disc, stainless steel stem, EPDM liner, EPDM stem seal and body seal, neck extending beyond pipe insulation, lever operator.
b. Type 602: Carbon steel body, triple-offset design, lug or flanged type, rated for steam service at 1034 kPa at 260 degrees C (150 psig at 500 degrees F), stainless steel nitrided disc, stainless steel seat, stainless steel shaft, stainless steel/graphite laminated seal ring, neck extending beyond pipe insulation, geared handwheel operator for valves 100 mm (4 inch) pipe size and over, lever operator for valves 75 mm (3 inch) pipe size and under.

7. Gas Vent Cocks: Type 701, bronze body, tee handle, rated for 207 kPa at 38 degrees C (30 psig at 100 degrees F), ground plug, rated for tight shut-off on fuel gas service.

C. Boiler Valves:
1. Steam Non-Return Stop Check Valves:
a. Type: Straight-way Y-pattern, with dash-pot and piston and tapped drain openings, OS&Y, bolted bonnet, rising stem. Provide angle pattern only if shown on the contract drawings.

b. Construction: Cast steel body ASTM A216/A216M WCB, rated for 2070 kPa (300 psig) saturated steam, stellite faced steel disc, alloy steel seat, 2070 kPa (300 psig) ASME flanged ends.

c. Operation: Valves shall automatically close tightly when boiler steam pressure becomes less than that of the steam header. Valves shall operate without sticking or chattering.

2. Stop Valves for Steam Vents on Boiler Drums and Steam Lead, Steam Pressure Gauge:

a. Installation of steam pressure gauge shut-off valves shall conform to ASME BPVC, Section I.

b. Angle stop valves (water tube boilers), OS&Y, chain operated, cast or forged steel, 1380 kPa (200 psig) steam rating, renewable seat and disc.

c. Gate valves, two inches and under: Type 105.

3. Valves in Drain Lines from Steam Stop Check Valve, Water Column, Gauge Glass, Low Water Cut-offs:

a. Gate valves, two inches and under: Type 105.

b. Check valves, two inches and under: Type 405.

4. Bottom Blowoff Valves:

SPEC WRITER NOTE: Field reports on durability of the valves specified are uniformly excellent. Other makes and types of valves have a mixed service record.

a. Type: Seatless, sliding plunger, 0S&Y, designed for blowoff service. Sliding disc-type or globe-type valves are prohibited.

b. Construction: ASTM A216/A216M WCB cast steel body, rated for 2070 kPa (300 psig) saturated steam, 2070 kPa (300 psig) ANSI flanged ends. Valves shall have handwheel with rotating handle.

c. Conform to ASME B31.1.

D. Steam above 103 kPa (15 psig), all valves in steam pressure reducing stations:

1. Gate valves, 50 mm (2 inches) and under: Type 105.

2. Gate valves, 65 mm (2-1/2 inches) and above: Type 101.

3. Globe valves, 50 mm (2 inches) and under: Type 205.

4. Globe valves, 65 mm (2-1/2 inches) and above: Type 201.

5. Butterfly valves, 75 mm (3 inches) and above: Type 602.

6. Ball valves, 50 mm (2 inches) and under: Type 503.

7. Ball valves, 65 mm (2-1/2 inches) and above: Type 504.

E. Steam 103 kPa (15 psig) and under:

1. Gate Valves, 50 mm (2 inches) and under: Type 105.
2. Gate valves, 65 mm (2-1/2 inches) and above: Type 103.
3. Globe valves, 50 mm (2 inches) and under: Type 205.
4. Globe valves, 65 mm (2-1/2 inches) and above: Type 205.
5. Butterfly valves, 75 mm (3 inches) and above: Type 602.
6. Ball valves, 50 mm (2 inches) and under: Type 503.
7. Ball valves, 65 mm (2-1/2 inches) and above: Type 504.

F. Boiler Feedwater from Pumps to Boilers, Recirculation:

1. Gate valves, 50 mm (2 inches) and under: Type 105.
2. Gate valves, 65 mm (2-1/2 inches) and above: Type 102.
3. Globe valves, 50 mm (2 inches) and under: Type 205.
4. Globe valves, 65 mm (2-l/2 inches) and above: Type 205.
5. Check valves, at boiler feed pump discharge: Type 408.
6. Check valves, at boiler, 50 mm (2 inches) and under: Type 405.
7. Check valves, at boiler, 65 mm (2-1/2 inches) and above: Type 402.

G. Condensate, Condensate Transfer, Boiler Feedwater from Feedwater Deaerator to Boiler Feed Pump Suction, Overflow, Control and Instrument Piping for Condensate Storage Tank and for Feedwater Deaerator:

1. Gate valves, 50 mm (2 inches) and under: Type 105.
2. Gate valves, 65 mm (2-1/2 inches) and above: Type 103.
3. Globe valves, 50 mm (2 inches) and under: Type 205.
4. Globe valves, 65 mm (2-1/2 inches) and above: Type 205.
5. Butterfly valves, 65 mm (2-1/2 inches) and above Type 601.
6. Ball valves, 50 mm (2 inches) and under: Type 502.
7. Ball valves, 65 mm (2-1/2 inches) and above: Type 504.
8. Check valves 50 mm (2 inches) and under: Type 405.
9. Check valves, 65 mm (2-1/2) inches and above: Type 403.
10. Check valves on pump discharge, all sizes: Type 408.

H. Boiler Water Sampling, Continuous Blowdown:

1. Gate Valves, 50 mm (2 inches) and under: Type 105.
2. Globe valves, 50 mm (2 inches) and under: Type 205.
3. Check valves, 50 mm (2 inches) and under: Type 405.
4. Ball valves, 50 mm (2 inches) and under: Type 502.

SPEC WRITER NOTE: If automatic continuous blowdown control systems are specified in Section 23 50 11, BOILER PLANT MECHANICAL EQUIPMENT, the following valve can be deleted from this specification (23 21 11) because it is included in the

automatic blowdown control system in Section 23 50 11, BOILER PLANT MECHANICAL EQUIPMENT.

5. Continuous Blowdown Flow Control Valve: Forged steel angle-type body, rated for 2070 kPa at 288 degrees C (300 psig at 550 degrees F), hardened stainless steel disc and seat, threaded ends, rising stem, union bonnet, graduated micrometer-type dial and pointer showing amount of valve opening. Furnish valve blowdown chart showing flow rate versus valve opening based on 861 kPa (125 psig) boiler drum pressure.

I. Feedwater Sampling:
   1. Ball valves, 50 mm (2 inches) and under: Type 501.
   2. Check valves, 50 mm (2 inches) and under: Type 406.

J. Chemical Feed System:
   1. Ball valves, 50 mm (2 inches) and under: Type 501.
   2. Check valves, 50 mm (2 inches) and under: Type 406.

K. Fuel Oil: Discharge side of pumps. Conform to NFPA 30 and NFPA 3l.
   1. Gate valves, 50 mm (2 inches) and under: Type 105.
   2. Gate Valves, 65 mm (2-l/2 inches) and above: Type 101 or 102.
   3. Globe valves, 50 mm (2 inches) and under: Type 205.
   4. Plug valves, 100 mm (4 inches) and under: Type 301. (Tank isolating valve on return line.)
   5. Check valves, 50 mm (2 inches) and under: Type 405 or 408.
   6. Check valves, 65 mm (2-l/2 inches) and above: Type 402 or 408.
   7. Ball valves, 50 mm (2 inches) and under: Type 502.

L. Fuel Oil: Suction side of pumps and tank fill lines where tank is below fill point. Conform to NFPA 30 and NFPA 3l.
   1. Gate valves, 50 mm (2 inches) and under: Type 105.
   2. Gate valves, 65 mm (2-l/2 inches) and above: Type 103.
   3. Plug valves, 100 mm (4 inches) and under: Type 301.
   4. Check valves, 50 mm (2 inches) and under: Type 405.
   5. Check valves, 65 mm (2-l/2 inches) and above: Type 403.
   6. Ball valves, 50 mm (2 inches) and under: Type 502.

M. Fuel Oil: Tank fill lines where tank is above fill point.
   1. Gate valves, 50 mm (2 inches) and under: Type 105.
   2. Gate valves, 65 mm (2-1/2 inches) and above: Type 103.
   3. Check valves, all sizes: Type 408.

N. Fuel Gas: Main fuel and igniter (pilot) systems.
   1. Plug valves, 100 mm (4 inches) and under: Type 301.
   2. Ball valves, 50 mm (2 inches) and under: Type 502. May be applied where plug valves are shown.
   3. Plug valves, 125 mm (5 inches) and above: Type 302.
   4. Plug valves, three-way, all sizes: Type 302.
   5. Check valves, 50 mm (2 inches) and under: Type 405.
   6. Vent cocks, 15 mm (1/2 inch) and under: Type 701.

O. Compressed Air:
   1. Gate valves, 50 mm (2 inches) and under: Type 105.
   2. Ball valves, 50 mm (2 inches) and under: Type 502.

P. City (Cold) Water: See Section 22 11 00, FACILITY WATER DISTRIBUTION.

Q. Soft Water: See Section 22 31 11, WATER SOFTENERS.

R. Instrumentation and Control Piping: Ball valves, 50 mm (2 inches) and under: Type 502.

S. Non-Boiler Blowdowns, Drains, Flow Sensing Lines:
   1. Gate valves, 50 mm (2 inches) and under: Type 105.
   2. Ball valves, 50 mm (2 inches) and under: Type 503.

2.16 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//.

2.17 SIGHT FLOW INDICATORS

A. Provide, where shown, to allow observation of flow in piping systems.

B. Type: In line, dual portholes on opposite sides, with safety shield, with or without rotor as shown on the drawings. Where provided, rotor shall have minimum of three vanes.

C. Construction: Carbon steel body, tempered borosilicate window, PTFE seals (except Buna-N on oil service), threaded ends on pipe sizes under 65 mm (2-1/2 inches), flanged ends on sizes 65 mm (2-1/2 inches) and above. Pressure and temperature ratings shall be equivalent to requirements for valves on the same pipelines.

D. Safety Shield: Transparent wrap-around overlap covering entire sight flow indicator, designed to protect personnel from failure of indicator. Shield shall fit the indicator tightly and be suitable for 1034 kPa, 150 degrees C (150 psig, 302 degrees F).

2.18 QUICK-COUPLE HOSE CONNECTORS AND STEAM HOSES

A. Provide on all Y-strainer drains and where shown to allow quick connection of length of hose to piping drain or blowoff so that discharge fluid (water or steam) can be conveyed to a drainage system.

B. Type: Straight through, plug and socket, screw type or cam locking connections, all units 20 mm (3/4 inch) pipe size. Integral shut-off devices not required.

C. Service: Design for water and steam at 103 kPa (15 psig), 154 degrees C (309 degrees F).

D. Spare Parts: Furnish one socket and one plug.

E. Accessories: Furnish two hoses 6.1 m (20 feet) long, 20 mm (3/4 inch) inside diameter, rated for steam service at 690 kPa, 149 degrees C (100 psig, 300 degrees F). Hose must be sufficiently flexible to be placed in 1200 mm (4 foot) diameter coil. Provide connector on one end of each hose to mate with connectors on drains. Provide hose rack for holding both hoses. Securely mount rack in location selected by COR.

2.19 SAFETY VALVES, RELIEF VALVES, SAFETY RELIEF VALVES AND ACCESSORIES

A. Provide valves and accessories to protect piping systems and pressure vessels from over-pressure. All valves shall comply with ASME BPVC Section I and ASME BPVC Section VIII). Flow capacities shall be certified by National Board of Boiler and Pressure Vessel Inspectors (NB).

B. Boiler and Economizer Service: Refer to Section 23 52 39, FIRE-TUBE BOILERS or Section 23 52 33, WATER-TUBE BOILERS.

SPEC WRITER NOTE: Flow capacities of safety valves located at the outlet of pressure reducing stations shall be sufficient for the maximum capacity of the largest pressure reducing valve, or the wide-open bypass valve, whichever is greater. Refer to National Board Inspection Code, NB-23, “Safety Valves on the Low-Pressure Side of Steam Pressure Reducing Valves”.

C. Steam Service (Pressure Vessels and Piping Systems): Refer to schedules on drawings for set pressures and capacities. Provide lifting levers, stainless steel trim, lapped seats on steel valves.

D. Fuel Oil Service: Refer to Section 23 50 11, BOILER PLANT MECHANICAL EQUIPMENT.

E. Compressed Air Service: Refer to Section 23 50 11, BOILER PLANT MECHANICAL EQUIPMENT.

F. Drip Pan Ells: Cast iron factory-built safety valve discharge fitting with pipe-within-pipe slip-type connection to vertical vent pipe, basin for collecting condensate from vent pipe, drain connections on basin and at base of ell.

2.20 STEAM PRESSURE REDUCING VALVES

A. Type: Single-seated, diaphragm operated, spring-loaded, steam pilot-controlled, normally closed, packless, adjustable set pressure. Pilot shall sense controlled pressure downstream of main valve.

B. Service: Provide controlled reduced pressure to steam piping systems. Design for saturated steam at pressures shown on drawings or equipment requirements.

C. Performance: Pressure control shall be smooth, continuous. Maximum //10// // // percent deviation from set pressure over an //10/1// // / // turndown. Refer to schedules on drawings for flow and pressure requirements. Downstream safety valve shall be sized equal to or exceed the maximum total flow capacity of the pressure reducing station.

D. Construction:

1. Main Valve – Pipe sizes 50 mm (2 inches) and less: Steel body rated for 1724 kPa (250 psig), threaded ends. Globe body valve and seat shall be replaceable, Type 316 stainless steel and include stainless steel stem.

2. Main Valves – Pipe sizes greater than 50 mm (2 Inches): Steel body rated for 1034 kPa (150 psig), ASME flanged ends, or steel body 1724 kPa (250 psig) ASME flanged ends. Globe body valve and seat shall be

replaceable, Type 316 stainless steel and include stainless steel stem.

3. Pilot Valve: Valve plug and seat shall be replaceable, stainless steel or Monel.

E. //Direct Digital Control Valves: May be furnished in lieu of steam operation. All specification requirements for steam operated valves shall 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.//

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

F. Sound Levels: Refer to requirements in Section 23 05 51, NOISE AND VIBRATION CONTROL FOR BOILER PLANT.

2.21 STRAINERS, SIMPLEX BASKET TYPE

A. Provide on condensate lines where shown. Refer to Section 23 50 11, BOILER PLANT MECHANICAL EQUIPMENT, for duplex basket strainers at oil pumps.

B. Type: Simplex cylindrical basket type, clamp cover, closed-bottom, removable basket, drain at bottom with threaded plug.

C. Service: Water at 100 degrees C (212 degrees F), 103 kPa (15 psig) maximum pressure.

D. Construction:

1. Body: Cast steel rated for 861 kPa (125 psig) ASME flanged ends, flow arrows cast on side.
2. Basket: Stainless steel, 3.2 mm (1/8 inch) perforations. Ratio of screen open area to cross section of pipe; four to one minimum.

2.22 STRAINERS, Y-TYPE

A. Provide as shown on steam, water and compressed air piping systems.

B. Type: Open-end removable cylindrical screen. Threaded blow-off connection.

C. Construction:

1. Steam Service 420 to 1034 kPa (61 to 150 psig): 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, for pipe sizes above 50 mm (2 inches). Cast steel rated for saturated steam at 1034 kPa (150 psig) threaded ends, for pipe sizes 50 mm (2 inches) and under.
2. Steam Service 414 kPa (60 psig) and under, water (except boiler feed between feedwater pumps and boilers), compressed air: Cast steel rated for 861 kPa (125 psig) saturated steam, 1200 kPa (175 psig) WOG, with 861 kPa (125 psig) ASME flanged ends, for pipe sizes above 50 mm (2 inches). Cast steel, threaded ends, rated for 861 kPa (125 psig) saturated steam, 1200 kPa (175 psig) WOG, for pipe sizes 50 mm (2 inches) and under.
3. Boiler Feed between Feedwater Pumps and Boilers: Cast steel rated for 1724 kPa at 232 degrees C (250 psig at 450 degrees F) with 2070 kPa (300 psig) ASME flanged ends, or cast steel with 1724 kPa (250 psig) ASME flanged ends, for pipe sizes above 50 mm (2 inches). Cast steel, threaded ends, rated for 1724 kPa at 232 degrees F (250 psig at 450 degrees F) for pipe sizes 50 mm (2 inches) and under.

D. Screen: Monel or stainless steel, free area not less than 2-1/2 times flow area of pipe. For strainers 75 mm (3 inch) pipe size and smaller, diameter of openings shall be 0.8 mm (0.032 inch) or less on steam service, 1.3 mm (0.05 inch) or less on water service, 0.3 mm (0.01 inch) or less on compressed air service. For strainers 100 mm (4 inch) pipe size and greater, diameter of openings shall be 1.3 mm (0.05 inch) on steam service, 3.2 mm (1/8 inch) on water service. Provide 80 mesh stainless steel screen liner on all strainers installed upstream of water meters or control valves.

E. Accessories: Gate or ball valve and quick-couple hose connection on all blowoff connections. These items are specified elsewhere in this section.

2.23 LIQUID PETROLEUM TANKS GAS PRESSURE REGULATORS

A. Type: Single stage or two-stage designed to reduce tank pressure to LPG header pressure 34 kPa (5 psig). Outlet pressure shall be adjustable. Design for LPG (propane) service. Valve shall be weatherproof for outside installation. Valve body shall be designed for 1724 kPa (250 psig). Provide internal relief valve set at 69 kPa (10 psig).

B. Performance: Valve shall provide steady outlet pressure of 34 kPa (5 psig) with flow rate required by igniters (pilots) furnished, with tank pressure variation from 1724 kPa to 138 kPa (250 psig to 20 psig).

SPEC WRITER NOTE: Earthquake sensor may be provided on EGSSO valve in lieu of providing separate earthquake valve. Earthquake valves or EGSSO valves with earthquake sensors are required where seismicity is “Moderate-High” or greater (Refer to VA Handbook H-18-8).

2.24 EMERGENCY GAS SAFETY SHUT-OFF VALVE //WITH EARTHQUAKE SENSOR//

A. Permits remote shut-off of fuel gas flow to boiler plant.

B. Type: Manually opened, electrically held open, automatic closing upon power interruption. Pneumatic operator is prohibited.

C. Performance: Shall shut bubble tight within one second after power interruption. Refer to the drawings for pressure, flow, and valve size requirements.

D. Service: Natural gas and LP gas.

E. Construction: UL listed, FM approved, rated for 861 kPa (125 psig) ASME flanged ends for pipe sizes above 50 mm (2 inches), threaded ends for pipe sizes 50 mm (2 inches) and under. Cast iron, cast steel or bronze body, open and shut indicator. Valves for LP gas service shall be rated at 1724 kPa (250 psig).

F. Control Switch: Mounted //on Boiler Plant Instrumentation Panel// //in Control Room// //at exterior doorways (multiple switches)//. Switch shall also cut the power to the fuel oil pump set. Refer to Section 23 09 11, INSTRUMENTATION AND CONTROL FOR BOILER PLANT. Provide auxiliary switch to //operate annunciator on Boiler Plant Instrumentation Panel// //provide signal to Computer Work Station//.

G. //Earthquake Sensor: Mechanical device which automatically breaks 120-volt electrical circuit to safety shut off valve when earthquake occurs allowing valve to automatically close. UL listed and shall comply with CRSC Title 24 Part 12. Valve shall close within 5 seconds after sensor is subjected to horizontal sinusoidal oscillation having a peak acceleration of 2.94 m/sec^2 (0.3g) and a period of 0.4 seconds. The valve shall not shut off when the sensor is subjected for 5 seconds to horizontal, sinusoidal oscillations having: a peak acceleration of 3.92 m/sec^2 (0.4g) with a period of 0.1 second; a peak acceleration of 0.78 m/sec^2 (0.08g) with a period of 0.4 second; peak acceleration of 0.78

m/sec^2 (0.08g) with a period of 1.0 second. Sensor shall be corrosion-resistant for outside location. Manufacturer: Quake-Defense or equal.//

2.25 //EARTHQUAKE AUTOMATIC GAS SHUT OFF VALVE

A. Automatically stops gas flow to boiler plant when actuated by earth tremor.

B. Type: Single seated, manual reset.

C. Performance: Shall automatically shut bubble tight within five seconds when subjected to a horizontal sinusoidal oscillation having a peak acceleration of 2.94 m/sec^2 (0.3g) and a period of 0.4 seconds. The valve shall not shut-off when subjected for five seconds to horizontal, sinusoidal oscillations having: A peak acceleration of 3.92 m/sec^2 (0.4g) with a period of 0.1 second; a peak acceleration of 0.78 m/sec^2 (0.08g) with a period of 0.4 second or 1.0 second. Refer to drawings for pressure, flow and valve size requirements.

D. Service: Natural gas or LP gas.

E. Construction: 138 kPa (20 psig) minimum rating. Cast iron or aluminum body, rated for 861 kPa (125 psig) ASME flanged ends for pipe sizes above 50 mm (2 inches). Threaded ends for pipe sizes 50 mm (2 inches) and under. Valves for LP gas service shall be rated at 1724 kPa (250 psig).

F. Approvals: UL listed, State of California Referenced Standards Code for Earthquake Actuated Automatic Gas Shut-off Systems. Complies with ASCE 25.

G. Nitrile rubber, reset stem O-ring seal.

H. Valve position indication, open or closed indicators.//

2.26 STEAM TRAPS

A. Application: Steam line drip points and heat exchangers. Each type furnished by a single manufacturer.

B. Type: Inverted bucket type with thermostatic vent in bucket except closed float-thermostatic on discharge side of pressure reducing stations and on all heat exchangers. Refer to the drawings for trap locations, capacity and size, differential operating pressures, and design pressure.

C. Bodies: Cast steel or stainless steel. Construction shall permit ease of removal and servicing working parts without disturbing connected piping, 4 bolt flanged.

D. Floats: Stainless steel.

E. Valves: Hardened chrome-steel.

F. Mechanism and Thermostatic Elements: Stainless steel mechanisms. Bimetallic strip air vent on inverted bucket traps.

SPEC WRITER NOTES:
1. Select one of the two following paragraphs.
2. Insert details of existing trap monitoring system in the following paragraph.

G. //Trap Performance Monitoring Systems: All traps shall be provided with electronic monitoring devices. These devices shall be compatible with the existing monitoring system so that trap malfunctions will be automatically transmitted to and properly interpreted by the existing monitoring system. Provide all necessary power sources, transmitting and retransmitting devices and batteries to achieve a properly operating system. The existing monitoring system is // //.//

H. //Provision for Future Trap Monitoring System: All traps shall include ports for future installation of monitoring devices. Ports shall be plugged. To facilitate future removal of the plugs, install them with Teflon tape on the threads.//

I. Identification: Label each trap at the factory with an identification number keyed to number that is shown on the drawings. Label shall be a metal tag permanently affixed to the trap.

J. Factory-Packaged Trap Station: As an option for drip points requiring isolating valves, strainer, trap, trap monitoring device or ports for future monitoring device, and valved test ports, provide factory-packaged trap station including these features.

2.27 PRESSURE DRIVEN CONDENSATE PUMP TRAP

A. Unit shall automatically trap and pump condensate from process and heating equipment under all operating conditions including vacuum.

B. Body shall be constructed of carbon steel with all stainless-steel internals. The mechanism shall incorporate //Inconel alloy// //stainless steel// springs.

C. 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.

D. Pumps shall require no electricity for operation.

E. //The pump trap shall include a carbon steel water level gauge with shut off valves.//

F. Check valves at inlet and outlet shall be stainless steel.

G. ASME BPVC Section VIII.

H. //Provide Pump Trap with removable insulation cove //and digital cycle counter//.//

I. Manufacturer standard paint finish //coated in electroless nickel plate//.

2.28 FLEXIBLE CONNECTORS

A. Provide flexible connectors as shown to allow differential movements of pumps and piping systems subject to thermal expansion, to serve as vibration isolators between air compressors and piping systems, and to allow connection of steam or compressed air atomizing media for oil burners on water tube boilers.

B. Units for Water Service:

1. Service: Refer to schematic diagrams for pressure, temperature and movement requirements. If requirements are not shown on the drawings, units shall be designed for maximum system pressure, temperature, axial movement and lateral movement.
2. Construction:
   a. Teflon Bellows Type: Molded Teflon bellows with metal reinforcing rings, flanged ends, bolted limit rods.
   b. Stainless Steel Bellows Type: Multi-ply stainless steel with flanged ends, bolted limit rods.
   c. Flexible Metal Hose Type: Corrugated stainless steel hose wrapped with wire braid sheath. Ends shall be threaded, with union connectors, for pipe sizes 50 mm (2 inches) and below, flanged for pipe sizes 65 mm (2-1/2 inches) and greater.

C. Units for Compressed Air Service Only:

1. Service: Designed for 93 degrees C (200 degrees F), 1034 kPa (150 psig), and 15 mm (1/2 inch) intermittent offset.
2. Construction: Flexible corrugated stainless-steel hose wrapped with wire braid sheath. Provide threaded ends with union connectors.

D. Units for Atomizing Media Service (Steam, Compressed Air) and Steam Safety Valve Drip Pan Ell Drains:

1. Service: Designed for saturated steam at set pressure of boiler safety valves or for set pressure of compressor relief valve, whichever is greater. Hose shall be designed for bend radii to suit location of connection points to burner piping system. Hose shall also be designed for intermittent flexing.

2. Construction: Flexible corrugated stainless-steel hose wrapped with wire braid sheath. Provide threaded ends with union connectors.

2.29 PIPING SUPPORT SYSTEMS

A. Provide an engineered piping support system with all hangers, supports and anchors designed and located by experienced technical pipe support specialists, utilizing piping system design and analysis software. The system design must be completely documented and submitted for review.

B. All pipe hangers and supports, and selection and installation shall comply with MSS SP-58 and MSS SP-127.

C. All pipe hanger and support devices must be in compliance with specified MSS SP-58 type numbers, have published load ratings, and be products of engineered pipe support manufacturers.

D. All pipe stresses and forces and moments on connecting equipment and structures shall be within the allowances of the ASME B31.1, applicable building codes, and equipment manufacturer’s design limits.

E. Piping that expands and contracts horizontally including steam, steam condensate, boiler feed, condensate transfer, shall be supported by roller or sliding type hangers and supports except when long vertical hanger rods permit sufficient horizontal movement with the vertical angles of the rods less than 4 degrees.

F. Piping that expands and contracts vertically including steam, steam condensate, boiler feed, condensate transfer, shall be supported by engineered variable spring and spring cushion hangers. Utilize MSS SP-58 selection requirements and guidelines. Vibration isolator hanger types are prohibited.

SPEC WRITER NOTE: Delete the following paragraph if seismic requirements are not applicable to this project. Seismic requirements apply if seismicity is “Moderate-High” or greater (Refer to VA Handbook H-18-8 for seismicity).

G. //Seismic braces and shock absorbers shall be provided. Comply with MSS SP-127 design requirements and guidelines. Piping shall remain fully connected and supported under the design seismic events. Piping and connected equipment shall not be overstressed beyond code limits during seismic events.//

H. Piping system anchors shall be engineered and located to control movement of piping that is subject to thermal expansion.

I. Prior to construction, submit complete engineering calculation methods and results, descriptions of all devices with MSS numbers, sizes, load capabilities and locations. Submit calculations on all moments and forces at anchors and guides, all hanger loads, all pipe stresses that are within 20 percent of the code allowable or exceed ASME B31.1 code allowable, all pipe movements at supports.

J. Detailed Design Requirements:

1. Piping system design and analysis software shall be current state of the art that performs ASME B31.1 code analyses, and shall be utilized to analyze pipe movement and deflection, pipe stresses, pipe support forces and moments, and for selection of pipe support types and sizes. //Seismic restraint calculations shall utilize the applicable shock spectra for the type of building structure, type of supported system, and the locality. Comply with MSS SP-127.//
2. Each support for piping 65 mm (2-1/2 inches) and above shall be completely engineered to include location, type and size, hot and cold loads and movement. Submit layout drawings showing precise support locations and submit individual drawings for each support assembly showing all components, sizes, loadings.
3. Supports for piping 50 mm (2 inches) and below shall be engineered in general terms with approximate locations, typical support types and sizes, approximate movements. Submit layout drawings showing general locations and support types and sizes.
4. Obtain permissible loadings (forces and moments) for equipment nozzles (pipe connections) from the manufacturer of the boilers, the feedwater deaerator and any other equipment as necessary. Professional structural engineer shall verify capability of building structure to handle piping loads.
5. The project drawings may show locations and types of resilient supports including rollers and springs, and may also show special supports including anchors, guides and braces. Comply with the drawing requirements unless it is determined that piping may be overstressed or supports overloaded. Refer conflicts to the COR.
6. Variable spring hangers conforming the MSS SP-58, Type 51, shall support all piping that expands vertically from thermal effects which may include connected equipment, such as boilers. Spring rates must be selected to avoid excessive load transfer to the connected equipment as the piping expands vertically. Vibration-type spring

isolators are not acceptable. Light duty spring hangers, MSS SP-58, Type 48, may be utilized on loads of 91 kg (200 pounds) or less, and vertical movement of 3.2 mm (1/8 inches) or less. Spring cushion hangers, MSS SP-58, Type 49, may be utilized for vertical movement of 3.2 mm (1/8 inches) or less.

7. Locate supports to permit removal of valves and strainers from pipelines without disturbing supports.
8. If equipment and piping arrangement differs from that shown on the drawings, support locations and types shall be revised at no cost or time to the Government. The Government will also require a complete stress analysis of the system as-built at no additional cost or time to the Government.

K. Hangers and Supports - Products:

1. Factory-built products of a manufacturer specializing in engineered pipe supports. All components must have published load ratings. All spring type supports shall have published spring rates and movement limits. All support assemblies shall include threaded connections that permit vertical position adjustment. Supports shall comply with MSS SP-58 Type Numbers as listed below.
2. Upper Attachments to Building Structure: Types 18, 20, 21, 22, 23, 29, and 30.
3. Roller Supports: Types 41, 43, and 46. Provide vertical adjustment for Type 41 with threaded studs and nuts adjacent to the roller.
4. Variable Spring Hanger Assembly:
   a. Type 51 variable spring, with Type 3 pipe clamp or Type 1 clevis. Type 53 variable spring trapeze may also be used. Locate Type 51 variable spring within 300 mm (1 foot) above pipe attachment. Attach rod to top of variable spring with Type 14 clevis.
   b. Typical features of variable spring hangers include spring rates under 150 lb/in, enclosed spring, load and travel indicator, sizes available with load capabilities ranging from 50 lb to multiples of 10,000 lb.
5. Spring Cushion Hanger Assembly: Double Rod: Type 41 and 49.
6. Light Duty Spring Hanger Assembly: Type 48 light duty spring, with Type 3 pipe clamp or Type 1 clevis. Locate Type 48 light duty spring within 300 mm (1 foot) above pipe attachment.
7. Clevis Hangers: Type 1.
8. Wall Brackets: Type 31, 32, and 33.

9. Pipe Stands: Type 38.
10. Riser Clamps: Type 42.
11. Roller Guides: Type 44. Construct guides to restrain movement perpendicular to the long axis of the piping. All members shall be welded steel.
12. Trapeze Supports: May be used where pipes are close together and parallel. Construct with structural steel channels or angles. Bolt roller supports to steel to support piping subject to horizontal thermal expansion. Attach other piping with U-bolts.
13. Pipe Covering Protection Saddles: Type 39. Provide at all support points on insulated pipe except where Type 3 pipe clamp is provided. Insulation shields are prohibited. Refer to Section 23 07 11, HVAC AND BOILER PLANT INSULATION.
14. Sliding Supports: Type 35. Welded steel attachments to pipe and building structure with Teflon or graphite sliding surfaces bonded to the attachments. Provide steel guides, except at expansion bends, to prevent lateral movement of the pipe.
15. Piping Anchors: Provide engineered designs to accommodate the calculated loads. //All ferrous material shall be painted in accordance with Section 09 91 00, PAINTING.//
16. //Seismic Restraints:
    a. Comply with MSS SP-127.
    b. Bracing: Provide as determined by engineering calculations.
    c. Shock Absorbers: Type 50. Mechanical or hydraulic type rated for shock loads. Pipe attachments shall be Type 3.//

2.30 PIPE AND VALVE FLANGE GASKETS

A. Non-asbestos, designed for the service conditions. On steam service utilize 3.2 mm (1/8 inch) thick Class 300 spiral-wound with Type 304 stainless steel and mica/graphite filler and carbon steel gauge ring.

2.31 THREAD SEALANTS

A. As recommended by the sealant manufacturer for the service. Teflon tape of any type is prohibited on fuel oil systems.

2.32 PIPE SLEEVES

A. Service: For pipes passing through floors, walls, partitions.
B. Construction: Steel pipe, schedule 10 minimum.
C. Sleeve Diameter: Not less than 25 mm (1 inch) larger than the diameter of the enclosed pipe and thermal insulation, vapor barrier, and protective covering for insulated pipe; sleeves for un-insulated pipe

shall be not less than 25 mm (1 inch) larger than the diameter of the enclosed pipe.

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.

3.2 ARRANGEMENT OF PIPING

A. The piping arrangement shown is a design based on currently available equipment. The plans show typical equipment to scale and show practical arrangement. Modification will be necessary during construction, at no additional cost or time to the Government, to adapt the equipment layout and piping plans to the precise equipment purchased by the Contractor. Accessibility for operation and maintenance must be maintained.

B. All piping shall be installed parallel to walls and column centerlines (unless shown otherwise). Fully coordinate work of each trade to provide the designed systems without interference between systems. All piping shall be accurately cut, true, and beveled for welding. Threaded piping shall be accurately cut, reamed and threaded with sharp dies. Copper piping work shall be performed in accordance with best practices requiring accurately cut clean joints and soldering in accordance with the recommended practices for the material and solder employed. Compression type fittings are prohibited.

C. All piping shall be pitched for drainage at a constant slope of 25 mm in 12 m (1 inch in 40 feet). Steam, condensate, trap discharge, drip, drain, air, gas and blowdown piping shall pitch down in direction of flow. Service water, pumped condensate, pumped boiler feedwater, oil, shall pitch up in direction of flow. Provide valved air vents at top of rise and valved drains at low points. Gas piping may be run level as it is presumed to be dry, but dirt pockets shall be provided at base of risers.

D. Valves shall be located and stems oriented to permit proper and easy operation and access to valve bonnet for maintenance of packing, seat and disc. Valve stems shall not be below centerline of pipe. Refer to plans for stem orientation. Where valves are more than 2.1 m (7 feet) above the floor or platform, stems shall be horizontal unless shown otherwise. Gate and globe valves more than 3 m (10 feet) above floor or

platform, shall be accessed using additional permanent work platforms to be provided by contractor. Provide hammer-blow wheel on any valve that cannot be opened or tightly closed by one person. Steam line gate and butterfly type isolation valves 75 mm (3 inch) pipe size and above shall have factory or field-fabricated 20 mm or 25 mm (3/4 inch or 1 inch) globe-valved warm-up bypasses if the steam line length is 6.1 m (20 feet) or longer.

E. Provide union adjacent to all threaded end valves.

F. Bolt wafer-type butterfly valves between pipe flanges.

G. Provide valves as necessary to permit maintenance of a device or sub-system without discontinuing service to other elements of that service or system.

H. Do not install any piping within 600 mm (2 feet) of water tube boiler side or top casings.

3.3 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.

3.4 PIPING JOINTS

A. All butt-welded piping shall be welded at circumferential joints, flanges shall be weld neck type; slip-on flanges, screwed flanges may be applied only with written approval of the COR.

B. Companion flanges at equipment or valves shall match flange construction of equipment or valve. Raised face shall be removed at all companion flanges when attached to flanges equipped for flat face construction.

C. Gaskets and bolting shall be applied in accordance with the recommendations of the gasket manufacturer and bolting standards of ASME B31.1. Strains shall be evenly applied without overstress of bolts. Gaskets shall cover entire area of mating faces of flanges.

D. Screw threads shall be made up with Teflon tape except gas and oil piping joints shall utilize specified joint compound.

E. Solder joints shall be made up in accordance with recommended practices of the materials applied. Apply 95/5 tin and antimony on all copper piping. The COR or their representative reserves the right to reject any soldered joints based on the appearance of excessive heat, solder build up or not evenly distributed around the joint, or excessive flux build up. In which case, the contractor shall remove, clean, and replace joints at no additional cost or time to the Government.

3.5 BRANCH INTERSECTION CONNECTIONS

A. Factory-built reinforced tees and laterals are required.

B. Factory-built integrally-reinforced forged steel branch outlet fittings may be used on reduced size connections upon approval of COR. They must comply with MSS SP-97.

3.6 EXPANSION AND FLEXIBILITY

A. The design includes provision for piping expansion due to pressure, thermal, weight and seismic (where applicable) effects. It is the Contractor's responsibility to avoid reduction in flexibility and increase in stress in piping systems. Major deviation will be shown by submittal for review of scale working drawings and stress calculations for the piping systems. Contractor shall provide any necessary

additional construction and materials to limit stresses to safe values as directed by the COR and at no additional cost or time to the Government.

3.7 PIPE BENDING

A. Pipe bending shall be in accordance with the recommended practices of PFI ES24. Only ASTM A106/A106M seamless pipe may be bent. Sizes below 50 mm (2 inches) may be bent in field; sizes 65 mm (2-1/2 inches) and larger shall have factory-fabricated bends. Minimum radii and tangent lengths for field bent piping are shown in the following table:

Size	Minimum Radius	Minimum Tangent
15 mm (1/2 inch)	65 mm (2-1/2 inches)	40 mm (1-1/2 inches)
20 mm (3/4 inch)	70 mm (2-3/4 inches)	45 mm (1-3/4 inches)
25 mm (1 inch)	125 mm (5 inches)	50 mm (2 inches)
32 mm (1-1/4 inches)	159 mm (6-1/4 inches)	50 mm (2 inches)
40 mm (1-1/2 inches)	191 mm (7-1/2 inches)	65 mm (2-1/2 inches)

3.8 SIZE CHANGES

A. Piping size changes shall be accomplished by use of line reducers, reducing ell, reducing tee. Apply eccentric reduction in all piping requiring continuous drainage; steam, condensate, vacuum, blowdown. Concentric reduction may be applied in run of piping involving pressure water systems except at pump inlets. Use concentric increasers where flow is in direction of increased size. Eccentric reduction, top flat, at all pump connections.

3.9 ADDITIONAL DRIPS AND TRAPS

A. Where additional rises or drops in steam or gas lines are provided, provide additional drip pockets with steam trap assemblies on steam lines and additional dirt pockets on gas lines. All air drops shall have dirt legs and no actuator or other air operated equipment may come off the end of the air line. Airline taps are either from the top of the supplying line if the supply line is horizontal or from the side if the supplying line is vertical. All air operated equipment shall have inline moisture separators or dryers.

3.10 MINOR PIPING

A. Minor piping associated with instrumentation and control is generally not shown. Interconnection of sensors, transducers, control devices, instrumentation panels, combustion control panel, burner control panels is the responsibility of the contractor. Small piping associated with

water cooling, drips, drains and other minor piping may not be shown to avoid confusion in the plan presentation but shall be provided as part of contract work.

3.11 DIELECTRIC CONNECTION

A. Where copper piping is connected to steel piping provide dielectric connections.

3.12 INSTALLATION - BOILER EXTERNAL STEAM PIPING FROM BOILER TO MAIN HEADER

A. From Boiler to Second Stop Valve: Fabricate from boiler nozzle through second stop valve under the rules for boiler external piping of the ASME BPVC Section I. Full compliance will be required, including qualification of welders, Code inspection, and certification with ASME Form P4A. Deliver original of Form P4A properly executed to COR.

B. Construction shall include: non-return stop and check valve at the boiler, welding coupling for 20 mm (3/4 inch) vent, second stop valve, steam flowmeter primary element, welding coupling for IPT calorimeter connection located to provide clear space and access for temporary test calorimeter, and header stop valve. Second stop valve may be deleted if the entire steam line from the non-return valve to the header valve is constructed in accordance with the rules for boiler external piping, ASME BPVC Section I.

C. Companion flange at 2070 kPa (300 psig) valves shall be 2070 kPa (300 psig) weld neck; at 1034 kPa (150 psig) valves shall be 1034 kPa (150 psig) weld neck.

D. Equip header stop valve with factory applied warm-up bypass connected to drilled and tapped bosses in valve body located above and below valve wedge. Connect valved drain to header valve body boss located above valve wedge.

E. Equip steam pipe with 20 mm (3/4 inch) vent, 1380 kPa (200 psig) steel gate valve, as specified.

F. Support and slope boiler steam line to drain; apply variable spring hangers (MSS-SP58, Type 51 or 53).

G. Provide screwed fitting for calorimeter (temporary test instrument) on side of pipe as shown. Allow 600 mm (2 feet) horizontal and vertical clearance for calorimeter.

H. Handwheel and drain valve on non-return stop check valve shall be within easy reach of boiler platform.

I. Disassemble, clean and reassemble entire mechanism of non-return stop check valve after conclusion of boiler testing.

3.13 INSTALLATION - MAIN STEAM HEADER

A. The header shall be the connection point for steam piping from all boilers and for steam distribution piping. The boiler plant steam pressure control transmitter shall be connected to the header.

B. Steam header shall be assembly of tees, pipe sections, and weld neck flanges.

C. Factory-fabricated forged steel integrally reinforced branch outlet welding fittings, standard weight, ASTM A105/A105M Grade 2, may be applied in lieu of tees for all branch outlets less than the full size of the header. Comply with fitting manufacturer's recommendations and requirements of ASME B31.1 and MSS SP-97.

D. Provide header supports and anchor as shown; apply insulation saddles for insulation thickness as required in Section 23 07 11, HVAC AND BOILER PLANT INSULATION.

E. Weld neck flange bolt position shall conform to required valve, stem, and bypass orientation as shown.

F. Header construction as specified includes the entire header and branches to first valve.

G. Anchor and guide header to resist thermal and weight forces and also seismic forces where required.

H. All valves must be accessible without the use of ladders or chain-wheels.

3.14 INSTALLATION - BOILER BOTTOM BLOWOFF PIPING

A. Fabricate with long swiping radius ells, Y-form laterals. Tees and crosses are prohibited.

3.15 INSTALLATION - EXHAUST HEAD MOUNTED ABOVE ROOF

A. Provide drain line from connection on exhaust head to roof drain. Provide pipe size same as drain connection size.

3.16 INSTALLATION – SIGHT FLOW INDICATORS

A. Locate to permit view from floor or platform.

3.17 INSTALLATION - PRESSURE AND TEMPERATURE REGULATORS, CONTROL VALVES, SAFETY SHUT-OFF VALVES

A. Provide sufficient clearance on all sides of valve to permit replacement of working parts without removing valve from pipeline.

B. Maintain access.

3.18 INSTALLATION - EMERGENCY GAS SAFETY SHUT-OFF VALVES //AND EARTHQUAKE VALVES//

A. Locate so that valve position indicator is visible from nearest walkway.

B. Provide control wiring and wiring to annunciator on instrumentation panel and to computer workstation (if provided).

C. Maintain access to the valve so that it can be easily maintained or reset.

3.19 INSTALLATION - FLEXIBLE CONNECTORS

A. Install units for water and compressed air service in a straight run of pipe. Units for atomizing media service may be installed with bends if necessary. Designer of atomizing media piping must coordinate hose connection points with allowable bend radius of hose.

SPEC WRITER NOTE: Trapped moisture at safety and relief valve piping will cause corrosion where they collect. Designer to provide means of eliminating this corrosion such as choice of corrosion resistant pipe materials or by allowing moisture to drain.

3.20 INSTALLATION - SAFETY VALVES, RELIEF VALVES AND SAFETY-RELIEF VALVES

A. Orient valves so that lifting levers are accessible from nearest walkway or access platform. Valves must be removable without requiring disassembling of vents, except where otherwise specifically provided.

B. Provide a drip pan elbow at discharge of each steam or economizer valve with slip joint in vent discharge line, arranged to prevent vent line from imposing any force on valve and to prevent any moisture accumulation in valve. Connected drip pan ell drains to drain piping to floor drain. Provide flexible connector on drain line, adjacent to drip pan ell.

C. Support vent line from above. Each steam valve must have separate vent line to atmosphere unless shown otherwise.

1. Vent lines shall have no more than a total of 180 degrees of directional changes and any one change is limited to 45 degrees to limit back pressure. The COR may reject any vent based on back pressure and blow by during testing.

2. Use stainless steel Schedule 40 piping for horizontal sections of vent piping. Use dielectric unions or flange gaskets at each dissimilar material vent joint.

D. Relief valves in steam piping shall have a manual valve downstream of the relief valve to allow for testing of the valve in place without risk of over pressurizing downstream equipment.

3.21 INSTALLATION – Y-TYPE STRAINERS ON STEAM SERVICE

A. Install with basket level with the steam pipe so that condensate is not trapped in the strainer.

3.22 INSTALLATION - QUICK COUPLE HOSE CONNECTORS

A. Install male plugs on each piping drain. Connect socket to one end of steam hose.

3.23 INSTALLATION - VIBRATION ISOLATORS IN PIPING

A. Install on all air lines and water supply lines to air compressors.

B. Also install on pump connections as shown.

3.24 INSTALLATION - PIPE SLEEVES

A. Accurately locate and securely fasten sleeves to forms before concrete is poured; install in walls or partitions during the construction of the walls.

B. Sleeve ends shall be flush with finished faces of walls and partitions.

C. Pipe sleeves passing through floors shall project 25 mm (1 inch) minimum above the finished floor surface and the bottom of the sleeve shall be flush with the underside of the floor slab.

3.25 INSTALLATION – PIPE SUPPORT SYSTEMS

A. Coordinate support locations with building structure prior to erection of piping. Also refer to approved shop drawings of equipment and approved piping layout and hanger layout drawings when locating hangers. Arrangement of supports shall facilitate operating, servicing and removal of valves, strainers, and piping specialties. Hanger parts must be marked at the factory with a numbering system keyed to hanger layout drawings. Layout drawings must be available at the site.

B. Upper attachments to Building Structure:

1. New Reinforced Concrete Construction: Concrete inserts.
2. Existing Reinforced Concrete Construction: Upper attachment welded or clamped to steel clip angles (or other construction shown on the drawings) which are expansion-bolted to the concrete. Expansion bolting shall be located so that loads place bolts in shear.
3. Steel Deck and Structural Framing: Upper attachments welded or clamped to structural steel members.

C. Expansion Fasteners and Power Set Fasteners: In existing concrete floor, ceiling and wall construction, expansion fasteners may be used

for hanger loads up to 1/3 the manufacturer's rated strength of the expansion fastener. Power set fasteners may be used for loads up to 1/4 of rated load. When greater hanger loads are encountered, additional fasteners may be used and interconnected with steel members combining to support the hanger.

D. Special Supports:
   1. Secure horizontal pipes where necessary to prevent vibration or excess sway.
   2. Where hangers cannot be adequately secured as specified, (for example, support for flow metering sensing lines, control piping) special provisions shall be made for hanging and supporting pipe as directed by the COR.
   3. Pipe supports, hangers, clamps or anchors shall not be attached to equipment unless specifically permitted by the specifications for that equipment or unless COR gives written permission. Attachments to boiler casings are prohibited.

E. Spring Hangers: Locate spring units within one foot of the pipe, breeching or stack attachment except in locations where spring assemblies interfere with pipe insulation. Adjust springs to loads calculated by hanger manufacturer.

F. //Seismic Braces and Restraints: Provide is accordance with Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS. Do not insulate piping within one foot of device until device has been inspected by COR.//

3.26 CLEANING OF PIPING AFTER INSTALLATION

A. Flush all piping sufficiently to remove all dirt and debris. Fill piping completely. Velocity shall be equivalent to that experienced during normal plant operation at maximum loads. During flushing, all control valves, steam traps and pumps must be disconnected from the system. After cleaning is complete, remove, clean and replace all strainer baskets and elements. Reconnect all equipment. Provide safe points of discharge for debris blown from pipes. Flushing of the systems shall be witnessed by the COR or their representative. Provide documentation of system flow rates to flushing flow rates and for how long was the flow maintained.

3.27 TESTING

A. Testing of piping components is not required prior to installation. Valves and fittings shall be capable of withstanding hydrostatic shell

test equal to twice the primary design service pressure except as modified by specifications on fittings, ASME B16.5. This test capability is a statement of quality of material. Tests of individual items of pipe, fittings or equipment will be required only on instruction of COR and at Government cost, except where required by the specifications for specific equipment such as the boilers.

B. After erection, all piping systems shall be capable of withstanding a hydrostatic test pressure of 1.5 times design pressure, as stipulated in ASME B31.1. Hydrostatic tests will be required only on boiler external steam piping, utilizing water as the test medium. Hydrostatic tests will be required on other piping when operating tests described are unsatisfactory, or when inspection of welds shows poor workmanship and is subject to question by the COR. When hydrostatic tests show leaks, the COR will require necessary welding repairs, in accordance with ASME B31.1, at the Contractor's cost.

C. Perform operating test as follows:

1. All steam piping prior to insulation shall be subjected to steam at final operating pressure. Inspect all joints for leaks and workmanship. Corrections shall be made as specified. If insulation is installed prior to these tests the contractor shall be required to remove and reinstall insulation after the test has been completed at no additional cost or time to the Government.
2. Test main gas piping and LP gas piping at 2 times their respective design pressure up to a maximum of 103 kPa (15 psig), with compressed air for 2 hours with pressure source disconnected and with decay in pressure not to exceed //5// // // percent. Corrections to the readings are permissible to compensate for significant ambient temperature changes during the test period. Test joints with soap solution, check thoroughly for leaks.
3. Test boiler feedwater, condensate, vacuum and service water systems under service conditions and prove tight.
4. Test oil and compressed air systems under service conditions at pressure equal to highest setting of safety and relief valves in the individual systems.
5. Make corrections and retests to establish systems that have no leaks. Replace or recut any defective fittings or defective threads. Soldered material shall be thoroughly cleaned prior to resoldering. Back welding of threads is prohibited.

D. Hydrostatically test boiler external steam piping from boiler to header in approved manner with water at same time boiler is hydrostatically tested under the supervision of COR. Prior to hydrostatic test, remove all valves not rated for hydrostatic test pressure. Replace valves after tests are satisfactorily completed. Hydrostatic test pressure shall be 1.5 times design pressure and performed in accordance with ASME BPVC Section I.

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

F. 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.

G. Generally, insulation work should not be performed prior to testing of piping. Contractor may, at own option and hazard, insulate piping prior to test, but any damaged insulation shall be replaced with new quality as specified for original installation at Contractor's cost and time.

H. Safety, Safety-Relief, Relief Valves: After installation, test under pressure in presence of COR. Test operation, including set pressure, flow, and blowdown in accordance with ASME BPVC. Install relief valve set at pressure no more than 1/3 higher than test pressure and replace safety valves of the appropriate pressure. Reset pressure setpoint of all relief valves to the appropriate pressures and replace safety valves after all tests have been completed. Contractor to provide written report of the reset with date and time stamp for each relief valve and replacement of the safety valves. Any deficiencies must be corrected and retest performed. Refer to Section 23 52 39, FIRE-TUBE BOILERS or Section 23 52 33, WATER-TUBE BOILERS for boiler safety valve test requirements.

3.28 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.//

3.29 //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.//

3.30 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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