

SECTION 23 50 11
BOILER PLANT MECHANICAL EQUIPMENT

PART 1 - GENERAL

1.1 DESCRIPTION

Boiler feed pumps and other equipment that supports the operation of the boilers.

1.2 RELATED WORK

- A. Section 09 91 00, PAINTING.
- B. Section 23 05 10, COMMON WORK RESULTS FOR BOILER PLANT and STEAM GENERATION.
- C. Section 23 05 51, NOISE and VIBRATION CONTROL FOR BOILER PLANT.
- D. Section 23 07 11, HVAC and BOILER PLANT INSULATION.
- E. Section 23 21 11, BOILER PLANT PIPING SYSTEMS.
- F. Section 23 08 11, DEMONSTRATIONS and TESTS FOR BOILER PLANT.
- G. Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS. Requirements for commissioning, systems readiness checklists, and training
- H. Section 23 09 11, INSTRUMENTATION AND CONTROL FOR BOILER PLANT.

1.3 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.
- B. Boiler Feed Pumps:
 - 1. Drawings with dimensions of assemblies of pumps and drivers.
 - 2. Catalog data and specification sheets on design and construction of pumps, drivers and couplings (flexible-coupled units).
 - 3. Motor efficiency and power factor at full load.
 - 4. Performance curves showing discharge head, required flow plus recirculation, NPSH required, efficiency, driver power, impeller diameter to be furnished. Refer to Drawings for requirements.
 - 5. Pressure and temperature limitations of pump unit and accessories.
 - 6. Size and capacity of recirculation orifice.
 - 7. Data on variable frequency drive units and pressure controllers (if VFD specified).
- C. Compressed Air System:
 - 1. Drawing with dimensions and arrangement of air compressor, motor, air dryer, receiver and all accessories.
 - 2. Catalog data and specification sheets on the design and construction of air receiver, compressor, after-cooler, motor, air dryer, all accessories, condensate traps. Solenoid valves and filters.

3. Performance data on compressors, after coolers, air dryer, relief valves.
- D. Chemical Feed Systems (Pump Type):
1. Drawings with dimensions of entire unit. Include locations and sizes of all pipe connections.
 2. Catalog data and specification sheets on the design and construction of pump, mixer, tank, controls.
 3. Performance data on pump including head, flow, motor power. Refer to schedules on Drawings for requirements.
 4. Pressure and temperature limitations of unit and accessories.
 5. Information on suitability of materials of construction for chemicals to be utilized.
- E. Boiler Chemical Feeder (Shot-Type):
1. Drawing with dimensions and sizes and location of piping connections.
 2. Design and construction.
 3. Pressure and temperature limitations.
- F. Automatic Continuous Blowdown Control System:
1. Drawings with arrangement and dimensions of entire unit. Include locations and sizes of all pipe connections.
 2. Catalog data and specification sheets on design and construction of conductivity sensor, control valves, controller.
 3. Performance data on control valves.
 4. Pressure and temperature limitations of valves and conductivity sensor.

1.4 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. American Society for Testing and Materials (ASTM):
- A53/A53M-07.....Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
- A106/A106M-08.....Standard Specification for Seamless Carbon Steel Pipe for High Temperature Service
- A234/A234M-10.....Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service
- A285/A285M-03(2007).....Standard Specification for Pressure Vessel Plates, Carbon Steel, Low- and Intermediate - Tensile Strength

- A414/A414M-10.....Standard Specification for Steel, Sheet, Carbon, and High-Strength, Low-Alloy for Pressure Vessels
- A515/A515M-03(2007).....Standard Specification for Pressure Vessel Plates, Carbon Steel, for Intermediate- and Higher-temperature Service
- A516/A516M-06.....Standard Specification for Pressure Vessel Plates, Carbon Steel, for Moderate- and Lower-Temperature Service
- C. American Society of Mechanical Engineers (ASME):
- Boiler and Pressure Vessel Code: 2007 Edition with Amendments. Section VIII.....Pressure Vessels, Division I and II. Performance Test Code:
- PTC 12.3-1997.....Performance Test Code for Deaerators
- B16.9-2007.....Factory-Made Wrought Butt Welding Fittings
- B16.34-2009.....Valves, Flanged, Threaded and Welding End
- D. National Board of Boiler and Pressure Vessel Inspectors:
- NB-23-2007.....Inspection Code
- E. American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE):
- ASHRAE Handbook.....2008 HVAC Systems and Equipment
- F. Society for Protective Coatings (SSPC):
- SP 5-2007.....White Metal Blast Cleaning
- F. U.S. Department of Veterans Affairs:
- VHA Boiler Plant Safety Device Testing Manual

PART 2 - PRODUCTS

2.1 CENTRIFUGAL MULTI-STAGE BOILER FEEDWATER PUMPS

- A. Type: Two or more stages, centrifugal diffuser type, direct-coupled, vertical shaft, in-line, base-mounted, motor-driven, arranged as shown.
- B. Service: Design pumps and accessories for continuous service, 116 °C (240 °F) water, with flow rates ranging from maximum scheduled on the drawings (plus manufacturer's recommended recirculation) to 10 percent of maximum (plus manufacturer's recommended recirculation). Pumps shall be suitable for parallel operation without surging or hunting.
- C. Performance: Refer to schedules on drawings. Pump head-flow performance curve shall slope continuously upward to shut-off.
- D. Control - Boiler Feed: Flow rates will be controlled by automatic modulating feedwater valves on each boiler. Pumps shall be started and stopped manually. Pumps shall be constant speed.

- E. Control - Condensate Transfer: Constant speed operation. Flow rate will be controlled by automatic modulating water level control valve on condensate transfer inlet to deaerator.
- F. Construction:
1. Rotating elements shall be designed and balanced to conform to sound and vibration limits specified in Section 23 05 51, NOISE and VIBRATION CONTROL FOR BOILER PLANT.
 2. Mechanical seals shall have sealing face materials of carbon and tungsten or silicon carbide.
 3. Design bearings for two-year minimum life with continuous operation at maximum pump operating load. Bearings and shaft seals shall be water-cooled if recommended by pump manufacturer for the service.
 4. Materials of Construction:
Chambers: Stainless steel
Impellers: Stainless steel
Diffusers: Stainless steel
Shaft: Stainless steel
Suction-Discharge Chamber: Cast iron or stainless steel
- G. Recirculation Orifice: Provide stainless steel recirculation orifice selected by pump manufacturer to protect pump from overheating at shut-off and designed for low noise under the service conditions. Orifices must not exceed sound level limits in Section 23 05 51, NOISE and VIBRATION CONTROL FOR BOILER PLANT.
- H. Spare Parts: Provide complete rotating assembly for each pump size and type suitable for field installation by plant personnel. Assembly shall include impellers, diffusers, chambers, shaft, seals, bearings.
- I. Shaft Couplings: Pump manufacturer's standard. Provide coupling guard.
- J. Electric Motor Drives: High efficiency type, open drip proof. Select motor size so that the motor is not overloaded at any point on the pump head-flow performance curve. Design motor for 40 °C ambient temperature. For efficiency and power factor requirements refer to Section 23 05 11, COMMON WORK RESULTS FOR HVAC and STEAM GENERATION.
- K. Interface with Computer Workstation: Provide devices to signal computer work station that motor is on or off.

2.2 COMPRESSED AIR SYSTEM

- A. Provide complete compressed air system to serve controls and instruments. Compressed air systems shall include compressors, motor drives, receivers, aftercoolers, filters, air dryers and accessories as scheduled, as shown on the drawings and as specified.
- B. Compressors:

1. Type: Oil-free scroll compressors, belt-driven drive.
2. Performance: Shall be as shown on the drawings. Shall be suitable for continuous service.
3. Construction:
 - a. Unloading: Provide automatic cylinder air pressure unloader to prevent compressor starting under load.
 - b. Inlet Filter: Dry-type with replaceable cartridge.
 - c. Cylinders: Shall be removable from crankcase.
- C. Receivers: Vertical or horizontal cylindrical tanks as shown on the drawings. Construct in accordance with the ASME Boiler and Pressure Vessel Code, Section VIII, with inspection under the rules of the National Board of Boiler and Pressure Vessel Inspectors. Design pressure 1025 kPa (150 psi) minimum.
- D. Compressor and Receiver Accessories:
 1. Automatic Condensate Traps: Provide on lowest point of receiver and on aftercooler if required by type of aftercooler furnished. Size shall be suitable for compressor air delivery.
 2. Safety Valve: Provide on receiver, set pressure lower than receiver design pressure. Capacity of valve at set pressure shall be greater than maximum output of all compressors supplying receiver.
 3. Pressure Gauges: Provide on receiver and as shown. Refer to specification Section 23 09 11, INSTRUMENTATION and CONTROL FOR BOILER PLANT.
 4. Receiver Piping Connections: Shall include air in, air out, safety valve, automatic drain, valved manual drain and valved pressure gauge.
- E. Compressor Controls:
 1. Automatic start-stop control actuated by pressure in receiver. Pressure settings shall be adjustable.
 2. Controls shall operate on 120 volts maximum. Provide "on-off-automatic" control for each compressor.
- F. Electrical Motors and V-Belt Drives: Motors shall be open drip proof designed for 40 °C ambient temperature. Select V-belt drives in accordance with manufacturer's recommendations for frequent start-stop service. Provide belt guard that encloses belts on all sides.
- G. Vibration Isolation: Refer to specification Section 23 21 11, BOILER PLANT PIPING SYSTEMS for isolators required in piping.
- H. Air Dryer: Shall be refrigerant-type with capacity sufficient for all pneumatic controls and instruments in the boiler plant. Cycling type which turns on and off in response to load. Base capacity ratings on 690

kPa (120 psi) inlet pressure; 38 °C (100 °F) air inlet temperature; 38 °C (100 °F) ambient air temperature. Unit shall maintain dewpoint at 2 to 4 °C (35 to 40 °F) at 690 kPa (120 psi) air pressure. Provide unit with "power on" light, automatic water drain trap. Provide reheat of output air by heat exchange with input air to decrease condensation on air pipes. Design unit for 145 psi.

- I. Air Filter: Located in compressed air line between receiver and air dryer, coalescing type, entrained water mist, and dirt from the compressed air. Provide automatic drain valve piped to nearest drain. Size unit for maximum pressure drop of 3.5 kPa (0.5 psi) at normal air flow rate. Design unit for 1025 kPa (150 psi) air pressure. Filter efficiency: 90 percent efficient for particulates less than 10 µ.

J. Spare Parts:

1. Complete set of drive belts.
2. Two filter cartridges for each compressor intake filter.
3. Two filter cartridges for air dryer intake filter.

2.3 BOILER CHEMICAL FEEDERS - SHOT-TYPE

- A. Type: Floor-mounted unit consisting of tank, funnel and piping connections. Sizes and arrangement are shown on the Drawings.
- B. Construction: Construct tank shell with ASTM A53 or A106 seamless pipe or ASTM A53 electric resistance welded pipe, standard weight. Tank heads shall be ASTM A234 standard weight welding caps. Pipe connections shall be 20,600 kPa (3,000 psi) forged steel reinforced fittings designed for connection of threaded pipe. Entire unit shall be a welded assembly constructed in accordance with the ASME Boiler and Pressure Vessel Code, Section VIII, for design conditions of 2050 kPa (300 psi), 138 degrees C (280 degrees F). Stamp tank with Code Symbol showing compliance with Code requirements.

2.4 CHEMICAL FEED SYSTEMS - PUMP TYPE

- A. Type: Factory-assembled packaged units, each consisting of chemical tank, pump, mixer, support base, controls and accessories.
- B. Service: Design units for storing mixture of boiler or deaerator water treatment chemicals, or steam distribution system treatment chemicals, and pumping the chemicals at an adjustable controlled rate into the boilers or deaerator or steam header as shown. Units shall be suitable for boiler and feedwater deaerator water treatment chemicals including: Caustic soda, soda ash, trisodium phosphate, disodium phosphate, sodium metaphosphate, sodium sulfite, amines and various commercially available water and steam line treatment compounds.

- C. Pump: Continuous duty, Teflon diaphragm-type, actuated with seal-less hydraulics, submerged oil bath lubricated power train, 316 stainless steel cartridge type double ball check valves on suction and discharge, totally enclosed standard NEMA frame motor. 316 stainless steel casings designed for 1725 kPa (250 psi) minimum. Check valves shall be removable for cleaning or replacement without disturbing piping. Pump capacity must be adjustable through 100 percent of range by micrometer dial while the pump is running or stopped. Mount pump under tank with cast iron strainer and ball valve on suction pipe and ball valve in discharge pipe.
- D. Mixer: Direct drive, 1750 RPM, mounted on tank with angle adjustment. Totally enclosed motor, stainless steel propeller.
- E. Tank: Polyethylene with hinged cover. 50-gallon capacity. Provide 5 gallon indicating increments molded into side of tank. Steel support frame and mixer bracket.
- F. Controls: NEMA 250, Type 12 panel with stop-start switches, motor protection and pilot lights indicating each motor in operation and "power on." Provide low level pump cut off with indicating light. Provide devices to signal computer work station that pumps are on or off.
- G. Relief Valve: Rated for maximum pump capacity, set at 1200 kPa (175 psi).

2.5 AUTOMATIC CONTINUOUS BOILER BLOWDOWN CONTROL SYSTEM

- A. Type: One factory-assembled system per boiler to automatically sense boiler water conductivity and operate automatic electric-powered blowdown valve to maintain desired total dissolved solids content in boiler water. Micrometer-type adjustable manual blowdown valve piped to bypass the automatic blowdown valve and conductivity sensor.
- B. Service: Design valves, sensors and piping for steam and water at 1035 kPa (150 psi), 186 °C (366 °F) minimum. Controller shall be suitable for 50 °C (120 °F) ambient and resist splashing water. Design automatic and manual blowdown valves for maximum blowdown flow rate equivalent to two percent of boiler steam output. System shall automatically maintain boiler water total dissolved solids at any set point between 1000 ppm and 4000 ppm.
- C. Operation: Programmable timer cycles to intermittently operate the blowdown valve to obtain conductivity samples, and to maintain the valve open for a time period until the conductivity of the boiler water reaches the set point. Provide an automatic temperature compensating circuit.

- D. Controller: Shall be microprocessor-based sealed unit mounted at the boiler.
1. Indicators on Panel Front: One-half inch high digital display showing conductivity and indicating normal or out-of-range conditions. Valve status indicators.
 2. Membrane Keypad on Panel Front: Allows manual operation of the blowdown valve, setting of conductivity set points and alarm set points, setting of timers, calibration data input.
- E. Automatic Valve Construction: Carbon steel body, Type 316 stainless steel ball and stem, TFE coated stainless steel body seal. Electric actuator with NEMA-1 enclosure. Rated for 1025 kPa (150 psi) minimum saturated steam.
- F. Manual Valve Construction: Bronze or forged steel angle-type body, hardened stainless steel disc and seat, threaded ends, rising stem, union bonnet, graduated micrometer-type dial and pointer showing amount of valve opening. Rated for 1025 kPa (150 psi) minimum saturated steam. Furnish valve blowdown chart showing flow rate versus valve opening based on 125 psi boiler pressure.
- G. Provide gate valves and unions at inlet of conductivity sensor and outlet of automatic control valve so that these items can be removed from the system while maintaining the manual control valve in service. Comply with Section 23 21 11, BOILER PLANT PIPING SYSTEMS.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Boiler Feed Pumps:
1. For base-mounted horizontal-shaft pumps, connect base drain to 20 mm (3/4-inch) pipe. Extend pipe to nearest open sight or floor drain.
 2. Align pumps and drivers at the factory. At job site, a millwright shall level, shim, bolt, and grout the base plates or base frames onto the concrete pads, and shall also check the alignments of flexible-coupled pumps and drivers and make corrections necessary. Check alignment when both pump and driver are at normal operating temperature.
 3. Where packaged deaerator-feed pump unit is required, boiler feed pump base plates shall be welded or bolted to deaerator support frame.
 4. If water-cooled bearings or quenched or flushed or water-cooled stuffing boxes are provided on pumps, contractor shall install on each pump valved 15 mm (1/2-inch) piping connections to cold water supply, and 15 mm (1/2-inch) drains to nearest open sight drain. Provide unions at all connections to pumps.

- C. Automatic Continuous Boiler Blowdown Control System: Locate controller on floor-supported angle at four feet above the floor at the boiler adjacent to the continuous blowdown valves. Keypad and indicator must face aisle.

3.2 COMMISSIONING

- A. Provide commissioning documentation in accordance with the requirements of Section 23 08 00 - COMMISSIONING OF HVAC SYSTEMS for all inspection, start up, and contractor testing required above and required by the System Readiness Checklist provided by the Commissioning Agent.
- B. Components provided under this section of the specification will be tested as part of a larger system. Refer to Section 23 08 00 - COMMISSIONING OF HVAC SYSTEMS and related sections for contractor responsibilities for system commissioning.

3.5 DEMONSTRATION AND TRAINING

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

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