

SECTION 23 50 11
BOILER PLANT MECHANICAL EQUIPMENT

PART 1 - GENERAL

1.1 DESCRIPTION

Feedwater deaerator, condensate receiver (surge tank) fuel oil pumping and blowdown separator.

1.2 RELATED WORK

- A. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Section 23 05 51, NOISE AND VIBRATION CONTROL FOR BOILER PLANT.
- C. Section 23 07 11, HVAC, PLUMBING, AND BOILER PLANT INSULATION.
- D. Section 23 09 11, INSTRUMENTATION AND CONTROL FOR BOILER PLANT
- E. Section 23 09 11, DEMONSTRATIONS AND TESTS FOR BOILER PLANT

1.3 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Feedwater Deaerator and Accessories:
 - 1. Drawings showing arrangement and overall dimensions of feedwater deaerator. Show locations of tank-mounted devices. Show locations and sizes of pipe connections and access openings. Show design of all shell, head and nozzle welds.
 - 2. Weight of entire assembly empty and flooded.
 - 3. Catalog data, drawings and specification sheets showing design and construction of feedwater deaerator, storage tank, recycle pumps, water flow control valves, safety valve, overflow control, water level and overflow control systems, vent orifice, vacuum breaker, alarm switches and all accessories.
 - 4. Performance data and pressure and temperature limitations of feedwater deaerator, recycle pumps, water flow/level control valve and control system, safety valve, overflow control valve, vent orifice, vacuum breaker, alarm switches and all accessories.
 - 5. Catalog data on oxygen test kit.
 - 6. Oxygen sample and chemical feed probe design.
 - 7. Deaerator inlet pressure requirements - steam and water.
- C. Condensate Receiver (Surge Tank) and Accessories:
 - 1. Drawings showing arrangement and overall dimensions of tank and supports. Show locations and sizes of all pipe connections and access openings.

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2. Weight of entire assembly empty and flooded.
 3. Design and construction (including pressure and temperature limitations) of tank, control valves, water level control system, level alarm switches and all accessories.
 4. Performance data on control valves. Refer to drawings (Schedules) for requirements.
 5. Interior Coating: Material specification, service limitations, instructions for application, experience record under the required service conditions.
- D. Blowoff Separator and Accessories, Flash Tank:
1. Drawing showing outline dimensions, arrangement and weight of tank and accessories. Locations and sizes of all pipe connections and access openings.
 2. Design and construction of tank, supports and accessories.
 3. Design and performance of blowoff tank temperature control valve.
- E. Fuel Oil Pumping Equipment:
1. Drawings with overall dimensions and arrangement of pumps, motors, couplings, bases, drip pans, duplex strainer, relief valves, back-pressure control valve, and supports and all accessories.
 2. Catalog data and specification sheets on the design and construction of pumps, motors, couplings, bases, drip pans, duplex strainer, relief valves, back pressure control valves, all valves and accessories.
 3. Motor efficiency and power factor at full load.
 4. Pressure and temperature limitations of pumps, duplex strainer, relief valves, back pressure control valve and all valves.
 5. ASTM number and pressure rating of pipe and fittings.
 6. Performance data on pumps including discharge head, flow, suction lift and motor power required at viscosity range shown. Refer to drawings for requirements.
 7. Sound level test data on similar pump in similar installation. Refer to Section 23 05 51, NOISE AND VIBRATION CONTROL FOR BOILER PLANT.
 8. Performance data on relief valves and back-pressure control valves.
 9. Controls.

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.

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

A53/A53M-05.....Pipe, Steel, Black and Hot-Dipped, Zinc-Coated,
Welded and Seamless

A106/A106M-05.....Seamless Carbon Steel Pipe for High Temperature
Service

A234/A234M-05a.....Piping Fittings of Wrought Carbon Steel and
Alloy Steel for Moderate and High Temperature
Service

A285/A285M-03.....Pressure Vessel Plates, Carbon Steel, Low and
Intermediate-Tensile Strength

A414/A414M-05.....Steel, Sheet, Carbon, for Pressure Vessels

A515/A515M-03.....Pressure Vessel Plates, Carbon Steel, for
Intermediate- and Higher-temperature Service

A516/A516M-05e1.....Pressure Vessel Plates, Carbon Steel, for
Moderate-and Lower-Temperature Service

C. American Society of Mechanical Engineers (ASME):

Boiler and Pressure Vessel Code: 2004 Edition with Amendments.

Section VIII.....Pressure Vessels, Division I and II. Performance
Test Code:

PTC 12.3-1997.....Deaerators

B16.9-2003.....Factory Made Wrought Steel Butt Welding Fittings

B16.34-2004.....Valves, Flanged, Threaded and Welding End

D. National Board of Boiler and Pressure Vessel Inspectors:

NB-23-2004.....Inspection Code

**E. American Society of Heating, Refrigeration and Air-Conditioning
Engineers (ASHRAE):**

ASHRAE Handbook.....2004 HVAC Systems and Equipment

F. Society for Protective Coatings (SSPC):

SP 5-2000(R2004).....White Metal Blast Cleaning

PART 2 - PRODUCTS

2.1 FEEDWATER DEAERATOR AND ACCESSORIES

- A. Pressurized (14-35 kPa) (2-5 psi) unit designed to heat and deaerate boiler feedwater by direct contact with low pressure steam. Spray type deaerating section in a horizontal tank. Provide recycle spray water pumps on spray-type units if necessary to obtain required performance. Provide accessories including vacuum breaker, safety valve, water inlet and overflow controls and control valves, water level indicators and alarms and other devices as specified and shown.

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B. Performance and Operating Characteristics:

1. Oxygen Content of Feedwater Output: 7 parts per billion maximum over turndown range with minimum and normal feedwater input temperatures as listed.
2. Turndown: 20/1.
3. Required Maximum Feedwater Flow Output: 1.9 kg/sec (15,000 lb/hr).
4. No carbon dioxide in feedwater output; maximum steam vent loss 1/2 percent of input steam at maximum load.
5. Feedwater Input Temperature: Minimum temperature is 15 °C (60 °F) and normal range is 60 - 82 °C (140 - 180 °F).
6. Water Pressure Loss Through Spray Valves: 48 kPa (7 psi) maximum.
7. Steam Pressure Loss in Unit: 7 kPa (1 psi) maximum.

C. Feedwater Storage Capacity to the Overflow Line: Sufficient for twenty minutes operation at maximum required feedwater output with no input water, unless shown otherwise on the drawings. Overflow line (elevation) shall be set by feedwater deaerator manufacturer.

D. Construction:

1. Deaerator Pressure Vessels:
 - a. Conform to ASME Boiler and Pressure Vessel Code, Section VIII. Design for saturated steam at 200 kPa (30 psi) with 3 mm (0.125 inch) corrosion allowance.
 - b. Carbon steel, ASTM A285 Grade C or ASTM A516 Grade 70. Weld metal strength shall approximate the strength of the base metal. All welds shall be double-vee type. No single vee welds allowed. Weld undercut not allowed. All welding must be constructed to allow future internal weld inspections, utilizing non-destructive-testing methods.
 - c. Post Weld Heat Treatment (PWHT) to stress-relieve pressure vessel to 620 °C (1150 °F) not to exceed ASME hold-time or temperature.
 - d. Provide 100 percent radiography of all longitudinal and circumferential welded seams. Test nozzle-to-shell welds by wet magnetic-particle method. Hydrostatically test final assembly at 1.5 times design pressure.
 - e. Furnish completed applicable ASME Forms U-1, U-1A or U-2.
2. Spray Valve Assemblies: Spring-loaded, guided stem, stainless steel and Monel, removable. Spring-loaded, guided stem types not required

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on spray-type units that operate with recycle pumps at constant flow rates through the spray valves.

3. All other parts in deaerator section exposed to undeaerated liquids or gases must be constructed of stainless steel, cupro-nickel or equivalent.
4. Provide two 300 mm (12 inches) x 400 mm (16 inches) elliptical manways near the tank centerline and away from the deaeration section or internal piping. Manway locations must allow unrestricted access to tank interior with no interference from internal equipment and piping and with easy access from outside the tank. Second manway is to facilitate the annual internal inspections.
5. Support: Provide steel saddles or legs welded to tank. Coordinate location with structural design of building.
6. Nameplates: Attach to bracket projecting beyond field-applied insulation. Provide all ASME pressure vessel nameplate information as required by the Code along with information identifying the designer and manufacturer of the deaerator.
7. Pipe Connections:
 - a. Threaded for sizes 50 mm (2 inches) and under.
 - b. Flanged, 1025 kPa (150 psi) ASME, for sizes above 50 mm (2 inches).
 - c. Vortex breaker in boiler feedwater pump suction connection.
 - d. Overflow Pipe:
 - 1) Overflow pipe inside tank terminating 150 mm (6 inches) below low level alarm set point. Operation of overflow control system must not allow water level to fall to the level of the overflow pipe inlet.
 - 2) Overflow pipe sizing, based on required maximum feedwater flow output of feedwater deaerator:

Feedwater Flow Rate (kg/sec)	Feedwater Flow Rate (klb/hr)	Overflow Pipe Minimum Size (mm)	Overflow Pipe Minimum Size (in)
0 thru 3.8	0 thru 30	75	3
3.9 thru 7.6	31 thru 60	100	4
7.7 thru 12.6	61 thru 100	150	6

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- E. Steam Safety Valve: Mount on feedwater deaerator pressure vessel. Set pressure 100 kPa (15 psi). Capacity as shown. If not shown, minimum capacity 0.12 kg/sec (900 lb/hr).
- F. Oxygen and Non-Condensable Gas Venting: Straight vertical pipe extending through roof from deaeration section. Provide gate valve in vent pipe, with hole drilled in wedge. Hole size selected by feedwater deaerator manufacturer for normal venting with gate valve closed.
- G. Thermometers and Pressure Gages: Refer to Section 23 09 11, INSTRUMENTATION AND CONTROL FOR BOILER PLANT for construction requirements. Provide thermometers on deaeration section. Provide compound gage with shut-off valve and siphon on deaerator.
- H. Vacuum Breaker: Sized by deaerator manufacturer to protect unit. Bronze swing check valve, rated for 1030 kPa (150 psi), PTFE seat, stainless steel hinge pin.
- I. Water Sample and Chemical Feed Probes: Type 304 or 316 stainless steel, multi-ported, minimum length 300 mm (1 foot), accessible for removal from exterior of tank.
- J. Dissolved Oxygen Test Kit: Provide a colorimetric-comparator type kit, utilizing Rhodazine D methodology, for use during acceptance testing and for future use by the Medical Center. Kit shall include self-filling ampoules, color comparator, oxygen-resistant tubing, sampling devices, sealed glass ampoules containing reagent, carrying case, all equipment necessary for complete test. Range 0-20 parts per billion of dissolved oxygen. Kit shall be Chemetrics Catalog No. K-7511 or equal.
- K. Cleaning and Painting: Remove all foreign material to bare metal. Coat exterior of pressure vessel with rust-preventative primer. Do not coat interior of pressure vessel.
- L. Insulation: Field-applied. Refer to Section 23 07 11, HVAC, PLUMBING, AND BOILER PLANT INSULATION.
- M. Water Level Indicators:
 - 1. Gage Glasses: Red line type, overlapping glasses if multiple glasses are utilized. Provide automatic offset-type gage valves that stop the flow if a glass is broken. Drain cock on lower gage valve. Gage glass protecting rods.
 - 2. Viewable gages shall cover entire diameter of tank.
 - 3. Minimum rating 120 degrees C, 200 kPa (250 degrees F, 30 psi).
- N. Low Level Alarm Switch: Float type unit with hermetically sealed mercury switch. Locate external to tank on a vertical header with valved tank

connections and valved drain. Switch elevation shall be at the tank centerline. Minimum rating 120 degrees C, 200 kPa (250 degrees F, 30 psi). Provide signals to computer workstation specified in Section 23 09 11, INSTRUMENTATION AND CONTROL FOR BOILER PLANT.

O. High Level Alarm and Overflow Control:

1. A differential pressure type level transmitter providing monitoring and level alarms, separate from the low level alarm switch function. Overflow control float (trap) shall automatically open when the water level rises approximately 100 mm (4 inches) above the high water alarm level. Provide low level, high level and overflow signals to computer workstation specified in Section 23 09 11, INSTRUMENTATION AND CONTROL FOR BOILER PLANT.
2. Transmitter shall have "Smart" HART protocol programmable electronics, sealed diaphragms, direct sensing electronics, no mechanical force or torque transfer devices, external span and zero adjustment. Controller shall have proportional plus reset control, adjustable proportional band, reset rate and level set points. Provide manual-automatic control station on main instrument panel. Control station shall indicate actual water level, normal and emergency level set points and valve positions. The water level controller shall be the same make and model as the combustion controls.

P. Emergency Make-Up Fill: A flanged 3" diameter nozzle shall be provided as a provision for emergency manual fill of the deaerator.

2.2 CONDENSATE RECEIVER AND ACCESSORIES (SURGE TANK)

- A. Horizontal cylindrical welded steel tank, including accessory equipment, suitable for rigging into the available space. Comply with overall dimensions and arrangement of the tank and accessories shown on contract drawings. Accessories include make-up water controls and control valves, thermometer, water level gage, and other devices as specified.
- B. Service: Receiving and storing steam condensate and make-up water. Vent the tank to the atmosphere. Contents of tank may vary in temperature from 4 °C to 100 °C (40 °F to 212 °F).
- C. Construction:
 1. Construct tank and appurtenances in accordance with ASME Boiler and Pressure Vessel Code, Section VIII. Tank shall have cylindrical shell and dished heads.

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2. Material of construction shall be carbon steel ASTM A285, A414, A515, or A516.
 3. Design tank for 170 kPa (25 psi) working pressure with a minimum material thickness of 10 mm (3/8 inch). Thickness of head material at any point shall not vary more than 10 percent from the nominal thickness.
 4. Tank joints shall be double-welded butt joints or single-welded butt joints with backing strips.
 5. Provide 300 mm by 400 mm (12 inches by 16 inches) elliptical manway located as shown.
 6. Provide nozzles for piping connections located as shown. Nozzles shall have threaded pipe connections for pipe sizes 50 mm (2 inches) and under, flanged connections for pipe sizes over 50 mm (2 inches). Flanged nozzles shall have 1025 kPa (150 psi) ASME flanges. Tank opening for pump suction pipes shall include vortex spoilers.
 7. Furnish completed ASME Form U-1 or U-1A MANUFACTURERS' DATA REPORT FOR PRESSURE VESSELS. Hydrostatically test tank at 1-1/2 times the design pressure.
 8. Horizontal tank shall be supported by steel saddles, supplied by the tank manufacturer. Coordinate location with structural design of building. Design saddles to support tank (full of water), accessories, and portions of connecting piping to first hanger.
 9. Affix tank nameplate to bracket that projects beyond the field-applied tank insulation. Nameplate shall include ASME stamp and data to show compliance with design, construction and inspection requirements of the Code, and tank manufacturer information.
- D. Provide overflow pipe inside tank with siphon breaker as shown.
- E. Overflow and vent pipe sizing (minimums):

Boiler Plant Capacity* (kg/sec)	Boiler Plant Capacity* (klb/hr)	Overflow Pipe Size (mm)	Overflow Pipe Size (in)	Vent Pipe Size (mm)	Vent Pipe Size (in)
0 - 3.8	0 - 30	75	3	60	4
3.9 - 8.3	31 - 70	100	4	75	4

*"Boiler Plant Capacity" refers to one boiler on standby and all other boilers at high fire.

- F. Cleaning and Painting: Remove all foreign material to bare metal from interior and exterior of tank. In preparation for interior coating,

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sandblast interior to white metal in accordance with SSPC-SP5. Coat exterior of tank with rust-resisting primer.

- G. Interior Coating: Coat entire interior surface, including nozzles, with water-resistant epoxy polymerized with amine adduct-type curing agent. Coating shall be suitable for continuous service at 100 °C (212 °F) immersed in demineralized water and exposed to steam vapor. Surface preparation, application of coating, number of coats, and curing shall comply with printed instructions of coating manufacturer. Ingredients of coating shall comply with U.S. Food and Drug Regulations as listed under Title 21, Chapter 1, 175.300. Coating shall be smooth, even thickness, with no voids. Holiday test at low voltage with wet sponge method and repair all holidays. Coating shall be "Plasguard 7156" (Plasite Protective Coating Corp., Green Bay, WI) or equal.
- H. Insulation: Field apply insulation as specified in Section 23 07 11, HVAC, PLUMBING, AND BOILER PLANT INSULATION.
- I. Water Level Indicators:
1. Gage Glasses: Red line type, overlapping glasses if multiple glasses are utilized. Provide automatic offset-type gage valves that stop the flow if a glass is broken. Drain cock on lower gage valve. Gage glass protecting rods.
 2. Viewable gages shall cover entire diameter of tank.
 3. Minimum rating 120 degrees C, 200 kPa (250 degrees F, 30 psi).
- J. High and Low Level Alarm Switches:
1. Low Level Alarm Switch: Integral unit consisting of float, float housing, hermetically sealed mercury switch. Locate external to tank on a vertical header with valved tank connections and valved drain. Switch elevation shall be 150 mm (6 inches) below the soft water make up level.
 2. High Level Alarm Switch: Integral unit consisting of conductivity probes, probe housing. Float type not acceptable. Locate external to tank on a vertical header, along with the low level switch, with valved tank connections and valved drain. High level alarm indication shall occur 100 mm (4 inches) below the overflow level. Probes shall be AC, not DC, stainless steel with virgin Teflon insulation.
 3. Provide signals to computer workstation specified in Section 23 09 11, INSTRUMENTATION AND CONTROL FOR BOILER PLANT.

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4. All devices exposed to tank service conditions, including sensing devices and transmitters shall be rated for 120 degrees C, 200 kPa (250 degrees F, 30 psi) minimum.

K. Automatic Water Level Controls:

1. Separate pneumatic-type modulating water inlet flow control valves for normal soft water make-up and for emergency city water makeup. Actuated by electronic controller with input signals from water level transmitter. Manual/auto control capability.
2. Performance: Maintain a minimum water level, plus or minus 25 mm (1 inch), in the tank by controlling the flow of soft water to the tank. Soft water makeup shall be activated if water level falls to 30% of tank diameter plus 300 mm (12 inches). If water level falls to 30% of tank diameter, automatically operate the emergency city water makeup valve to bring the water level up 150 mm (6 inches).
3. Water Level Transmitter: "Smart" HART protocol programmable electronics, sealed diaphragms, direct sensing electronics, no mechanical force or torque transfer devices, external span and zero adjustment.
4. Controller: Proportional plus reset control, adjustable proportional band, reset rate and level set points. Provide manual-automatic control station on main instrument panel. Control station shall indicate actual water level, soft water and emergency city water level set points and valve positions. Provide same indicating and control features on computer workstation specified in Section 23 09 11, INSTRUMENTATION AND CONTROL FOR BOILER PLANT. The water level controller and transmitter shall be the same makes and models as furnished for the combustion controls.
5. Water Flow Control Valves:
 - a. Pneumatically-actuated, globe style.
 - b. Bronze or cast iron bodies, threaded ends for pipe sizes 50 mm (2 inches) and under rated at 1700 kPa (250 psi), ASME flanged ends for pipe sizes over 50 mm (2 inches) rated at 850 kPa (125 psi) or 1025 kPa (150 psi).
 - c. Replaceable Type 316 stainless steel plugs and seats. RTFE seal for bubble-tight shut off. Linear flow characteristics.
 - d. Flow pressure loss 35 kPa (5 psi) maximum at maximum flow rating. Unless otherwise shown, maximum flow rate shall be equivalent to

50% make-up rate with plant at maximum load (2 boilers at high fire).

- e. Diaphragm-type actuator, sized for 550 kPa (80 psi) air supply, fail closed spring pack, elastomers suitable for 120 degrees C (250 degrees F) continuous service.
- f. Electropneumatic positioner with 4 - 20 ma DC control input. Mounted integral with actuator. "Smart" digital positioner with capability to self-calibrate. Maintenance diagnostic data retained in memory. Design for 120 degrees C (250 degrees F) continuous service.
- g. Compressed Air Supply: Provide filter-regulator rated for flow of 150 percent of control valve requirement. Filter shall be two-stage coalescing color change type in transparent housing with automatic drain. Regulator shall be diaphragm operated, 15 percent maximum proportional band, composition diaphragm and seats.

2.3 BOILER AND ACCESSORIES

- A. Type: Cylindrical welded steel tank mounted vertically. Tank shall include accessory equipment and shall be suitable for rigging into the available space. Overall dimensions and arrangement of the tank and accessories shall conform to the drawings.
- B. Service: Suitable for receiving, venting, storing, cooling and discharging into the drain the effluent from the boilers resulting from the intermittent operation of the boiler bottom blowoffs, boiler accessory drains, and the use of continuous blowdowns.
- C. Construction:
 - 1. Construct tank and appurtenances in accordance with ASME Boiler and Pressure Vessel Code, Section VIII. Tank shall have cylindrical shell and dished heads.
 - 2. Material of construction shall be carbon steel ASTM A285, A414, A515 or A516.
 - 3. Design tank for 275 kPa (40 psi) working pressure; the minimum material thickness shall be 10 mm (3/8-inch). Thickness of head material at any point shall not vary more than 10 percent from the nominal thickness.
 - 4. All tank joints shall be double-welded butt joints or single-welded butt joints with backing strips.
 - 5. Provide 300 mm by 400 mm (12 inches by 16 inches) elliptical manhole located at the vertical centerline of the tank.

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6. Provide 10 mm (3/8-inch) thick carbon steel wear plate welded to interior of tank adjacent to tangential blowoff inlet as shown.
 7. Provide nozzles for piping connections and provide tangential blowoff inlet. Tangential pipe for blowoff inlet shall be Schedule 80, ASTM A53 or A106, seamless steel pipe with beveled end for field-welding of blowoff from boilers. All other nozzles shall have threaded pipe connections for pipe sizes 50 mm (2 inches) and under, 1025 kPa (150 psi) ASME flanged connections for pipe sizes over 50 mm (2 inches).
 8. Furnish completed ASME Form U-1 or U-1A MANUFACTURERS' DATA REPORT FOR PRESSURE VESSELS. Hydrostatically test tank at 1.5 times the design pressure.
 9. Tank nameplate shall be affixed to bracket which projects beyond the tank insulation that will be applied in the field. Apply ASME data stamp to nameplate to show compliance with design, construction and inspection requirements of the Code.
 10. Support tank by steel legs welded to shell of tank. Design legs to support tank (full of water), accessories, and portions of connecting piping to first hanger.
- D. Cleaning and Painting: Remove all dirt, heavy rust, mill scale, oil, welding debris from interior and exterior of tank. Prime exterior of tank with rust-resisting paint.
- E. Insulation: Field apply insulation as specified in Section 23 07 11, HVAC, PLUMBING, AND BOILER PLANT INSULATION.
- F. Accessories:
1. Water Outlet Temperature Control Valve:
 - a. Type: Self-contained, reverse-acting thermal bulb-operated water flow control valve.
 - b. Performance: Control valve shall operate automatically to control blowoff tank water outlet temperature to 60 °C (140 °F) maximum by regulating the flow of cold water which mixes with the blowoff water and reduces the temperature of the blow-off water. Provide valve designed for modulating and tight shut-off service. Valve flow rates and pressure drops shall be as shown. Temperature control range shall be adjustable, 38 to 77 °C (100 to 170 °F) minimum.
 - c. Service: Provide valve designed to control the flow of city water with temperature 4 to 27 °C (40 to 80 °F), and pressure up to 690

kPa (100 psi). Thermal bulb will be inserted in blowoff tank outlet pipe and will be subjected to water temperatures up to 100 °C (212 °F).

- d. Construction: Cast iron or bronze valve body designed for 850 kPa (125 psi) minimum WOG. Design of valve shall permit access to internal valve parts. Thermal bulb shall be separable socket type with well.

2.4 FUEL OIL PUMPING EQUIPMENT (BURNER FUEL)

A. Pump and Motors:

1. Type: Constant displacement, rotary, three-screw-type, horizontal shaft, flexible-coupled, motor-driven, base-mounted, arranged as shown.
2. Service: Pumps, motors and accessories shall be designed for continuous fuel oil service as shown on the drawings.
3. Performance: Refer to schedules on the drawings. Vendor shall submit complete data to certify that pumps offered will perform in accordance with requirements for suction lift, discharge pressure, sound level limitations and flow rate at viscosity range shown.
4. Pump Construction:
 - a. Pump Casing: Cast iron or steel designed for 1025 kPa (150 psi) minimum. Casing shall have removable bolted sections to allow access to internal parts.
 - b. Power Rotor: Alloy steel.
 - c. Idler Rotors: Pearlitic gray iron.
 - d. Shaft Seals and Bearing: Provide mechanical seals and ball bearings as recommended by pump manufacturer for the service.
 - e. Internal Relief Valves: Shall not be provided.
5. Electric Motor Drives: High efficiency, open drip proof. Select motor sizes so that motors are not overloaded under all operating conditions. Motors shall be designed 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.
6. Mounting - Pumps and Motors: Mount on steel or cast iron base plates. Align pumps and motors at the factory.
7. Shaft Couplings: All metal, grid-type, flexible design that permits parallel, angular, and axial misalignment. Coupling shall be sufficiently flexible to reduce transmission of shock loads

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- significantly. Coupling size selection shall be based on manufacturer's recommendation for service. Provide coupling guard bolted to base plate.
8. Sound and Vibration: Each combination of pump and driver shall conform to sound and vibration limits specified in Section 23 05 51, NOISE AND VIBRATION CONTROL FOR BOILER PLANT.
9. Manufacturers: Imo Pump or equal.
- B. Duplex Strainers: Provide duplex, basket-type cast iron strainers designed to allow one basket to be removed for cleaning while the other is in service. Strainer shall include diverter valve with handle that will select the strainer to be in use. Operation of the diverter valve shall not stop the flow of fluid. Basket covers shall be clamp-type. Ratio of free straining area to area of strainer pipe size shall be at least 4 to 1. Strainer baskets shall be brass or stainless steel. Provide 60 mesh basket liners for No. 2 fuel oil. Strainers on suction side of pumps shall be 345 kPa (50 psi), 93 °C (200 °F) minimum design; discharge side 1375 kPa (200 psi), 93 °C (200 °F) minimum.
- C. Pressure Relief Valves (Overpressure Protection): Provide at discharge of each oil pump. Size valves to relieve the maximum pumping capability of each oil pump furnished, 965 kPa (140 psi) set pressure of the relief valves plus 25 percent accumulation. Pressure settings shall be adjustable. Valves shall have solid ungrooved plug and shall close bubble-tight.
- D. Back Pressure Control Valve (Pump Pressure Control): Valve shall operate to maintain an essentially constant pump discharge pressure as required by the burners furnished, with a set pressure as scheduled on the drawings. Pressure rise shall not exceed five percent of set pressure. Flow range shall exceed the flow of the largest oil pump in the set. Set pressure shall be adjustable plus or minus 20 percent of set pressure. Valve shall have stainless steel disc and seat, bronze body. Valve disc and seat shall be renewable. Valve shall be designed for fuel oil service as shown on the drawings.
- E. Gate Valves, Globe Valves, Pipe, Pipe Fittings, Pressure Gages, Thermometers, Miscellaneous Piping Specialties: Refer to Section 23 21 11, BOILER PLANT PIPING SYSTEMS, and Section 23 09 11, INSTRUMENTATION AND CONTROL FOR BOILER PLANT.

- F. Arrangement (Pump Set): Pumps, motors, valves, oil heaters, piping and accessories shall be furnished as a factory-built unit. All items of equipment shall be mounted on a steel drip pan base with an area sufficient to extend beyond the limits of all equipment, constructed of 3 mm (1/8-inch) steel with 50 mm (2 inch) high vertical sides. Provide threaded 13 mm (1/2-inch) plugged opening for draining. Arrange valves and piping on rigid steel supports welded to the base. All items of equipment shall be readily accessible for operation and maintenance. Pump set shall be suitable for the space available for rigging and placement. When oil heaters are required, they shall be part of the pump set and located for easy access.
- G. Spare Parts: Complete mechanical seal for one oil pump. Complete set of casing gaskets for one oil pump. Back pressure control valve, complete.
- H. Motor Controls: Provide devices to signal computer workstation that motors are on or off.

2.5 CENTRIFUGAL MULTI-STAGE BOILER FEEDWATER PUMPS/CONDENSATE TRANSFER 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.

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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 manufacturers 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.
- L. Manufacturers: Aurora 390 Series, G & L (Goulds) Series SSV, Grundfos Series C.

PART - 3 EXECUTION

3.1 INSTALLATION

- A. Feedwater Deaerator, Condensate Receiver and Blowoff Tank.

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1. Coordinate location with structural requirements of the building.
 2. Location shall permit access to and removal of all internal and external features without removing other items of equipment or piping.
 3. Bolt to building as recommended by manufacturer or as shown. Comply with seismic requirements in Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS. Arrange anchorage to allow thermal expansion of unit.
 4. Clean interior of equipment before placing in service.
 5. Deaerator vent pipes must extend vertically through roof. Horizontal runs not permitted.
- B. Fuel Oil Pumping Equipment: Locate equipment to permit access to all valves and controls, and to permit removal and cleaning of all equipment.
- C. Continuous Boiler Blowdown Equipment: Locate equipment to permit access to all valves and controls, and to permit removal and cleaning of equipment.

3.2 TESTING AND BALANCING FEEDWATER DEAERATOR WITH CONDENSATE RECEIVER AND ACCESSORIES:

- A. Demonstrate the ability of the deaerator to perform as specified in regard to oxygen removal and outlet temperature, over the required output flow range and input temperature range of unit. Test performance at 5 percent and 100 percent of capacity, and at two intermediate points to be selected by the COTR. Repeat test two times at each load point.
- B. Determine temperatures and pressures by calibrated thermometers and pressure gages.
- C. Utilize the specified colorimetric comparator type dissolved oxygen test kit. After completion of tests, clean the test kit apparatus, replace all ampoules used and parts missing or broken, and deliver the kit to the COTR.
- D. Various impurities in feed water can interfere with the colorimetric test. When impurities are present, the Contractor shall be prepared to test for dissolved oxygen using the titration test as described in ASME PTC 12.3. COTR may permit other test methods.
- E. This test shall be performed in conjunction with any boiler tests that are specified.
- F. Prior to requesting final tests, pretest unit using method specified for final test. Submit test data for review.

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