

SECTION 235316

DEAERATORS

PART 1 - GENERAL

1.1 STIPULATIONS

- A. The specifications sections "General Conditions of Contract", "Special Conditions", and "Division 1 – General Requirements" form a part of this section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.3 SUMMARY

- A. This Section includes packaged, factory-assembled deaerators.

1.4 DEFINITIONS

- A. Feedwater Pump: Pump that moves feedwater from the deaerator to the boiler.
- B. NPSH: Net-positive suction head.

1.5 SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated makeup water, feedwater, and steam flow rates; working pressure; tank capacities; storage capacity in minutes; temperature and NPSH required; pump performance curves with selection points clearly indicated; furnished specialties; and accessories.
- B. Shop Drawings: For deaerators, signed and sealed by a qualified professional engineer; include plans, elevations, sections, details, dimensions, weights, loadings, required clearances, and attachments to other work.
 - 1. For installed products indicated to comply with design loads, include structural analysis data.
 - 2. Design Calculations: Calculate requirements for selecting vibration isolators and seismic restraints and for designing deaerator bases.
 - 3. Wiring Diagrams: Power, signal, and control wiring.

- C. Field quality-control test reports.
- D. Operation and Maintenance Data: For deaerators to include in emergency, operation, and maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. ASME Compliance: ASME B31.1, "Power Piping," for systems more than 15 psig. Safety valves and pressure vessels shall bear the appropriate ASME label.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Protect flanges, pipe openings, nozzles, bearings, and couplings from damage during shipping and storage.
- B. Comply with manufacturer's written rigging instructions.
- C. Deliver deaerators as factory-assembled units with protective crating and covering.

1.8 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

1.9 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

- 1. Gaskets: Furnish two replacement gasket(s) for each gasketed opening.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- 1. Skidmore
 - 2. Cleaver Brooks

3. Shipco
4. Bryan Boilers
5. Or equal approved by the Professional.

2.2 MANUFACTURED UNITS

- A. Horizontal, single-compartment deaerator.
- B. Material for Wetted Components: Components in contact with water that has not been deaerated shall be made of Type 316 stainless steel.
- C. Adjustable Spray Valves: Type 316 stainless steel. Arrange spray valves for counterflow of steam and condensate and so corrosive gases being vented do not contact deaerator's head or shell.
- D. Vent Condenser: Stainless steel, with automatic and manual vent valves.
- E. Deaerator and Storage Tank:
 1. Material: Welded carbon steel galvanized after fabrication
 2. Access: Manhole in deaerator and storage tank for access to internal components for inspection and service.
 3. Factory-Applied Insulation and Jacket: Minimum thickness of 2 inches for mineral-fiber pipe and tank insulation. Cover insulation with painted steel jacket.
 4. Factory-Installed Pipe, NPS 2-1/2 and Smaller: ASTM A 53/A 53M, Type S (seamless), Grade B; or ASTM A 106, Type S, Grade B, Schedule 80; with threaded joints and fittings.
 - a. Cast-Iron Threaded Fittings: ASME B16.4, Class 125.
 - b. Malleable-Iron Threaded Fittings: ASME B16.3, Class 150.
 - c. Forged-Steel Fittings: ASME B16.11, Class 3000.
 - d. Malleable-Iron Unions: ASME B16.39, Class 150.
 - e. Forged-Steel Unions: MSS SP-83, Class 3000.
 5. Factory-Installed Pipe, NPS 3 and Larger: ASTM A 53/A 53M, Type E (electric-resistance welded), Grade B; or ASTM A 106, Type S, Grade B, Schedule 80; with welded joints and carbon-steel fittings and flanges.
 - a. Wrought-Steel Fittings: ASME B16.9, wall thickness to match adjoining pipe.
 - b. Wrought Cast- and Forged-Steel Flanges and Flanged Fittings: ASME B16.5, Class 150, including bolts, nuts, and gaskets.
- F. Accessories:
 1. Lifting eyes.
 2. Companion flanges.
 3. Pump suction piping with vortex breaker, isolation valve, strainer, and flexible connector.

4. Pump discharge piping with check valve, isolation valve, and liquid-filled pressure gage graduated in pounds force per square inch
 5. Pump-discharge bypass relief valve.
 6. Makeup Water Assembly:
 - a. Factory-mounted modulating valve with mechanical level control, external float cage, and stainless-steel float.
 7. Steam Pressure-Reducing Valve(s): Steam operated, and sized to reduce boiler outlet pressure to the deaerator design pressure.
 8. Tank Overflow Drain: Sized to relieve full capacity at operating pressure.
 9. Safety Valve(s): ASME labeled and sized to relieve full capacity of pressure-reducing valve.
 10. Vents: Manual and automatic vent valves.
 11. Vacuum breaker.
 12. Meters and Gages:
 - a. Full-height, water-level gage glass and stop valve set.
 - b. Liquid-filled industrial thermometer graduated in Fahrenheit mounted to measure temperature in storage and steam section of tank.
 - c. Pressure gage graduated in pounds force per square inch mounted to measure pressure in steam section of tank.
 13. Provision for chemical injection quill.
 14. Chemical injection quill.
 15. Sampling connection with valve.
 16. Tank drain connection with valve.
 17. Oxygen test kit.
- G. Support Frame: Structural-steel frame for supporting tank and pumps. Weld or bolt to tank.
1. Fabricate support frame with bracing adequate for seismic forces according to authorities having jurisdiction and to allow installation by anchoring deaerators to floor only.
- H. Feedwater Pump: Cast-iron, base-mounted volute; with impeller, renewable bronze case ring, and stainless-steel shaft.
1. Seals: Mechanical, suitable for 250 deg F.
 2. Pump Motor: Vertical or horizontal enclosure, close coupled to pump. Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."
- I. Feedwater Pump Control Panel: Factory mounted and wired and including the following:
1. NEMA 250, Type 1 enclosure.
 2. Single-point, field power connection to disconnect switch.
 - a. Branch power circuit to each motor and to controls.

3. NEMA-rated motor controller, hand-off-auto switch, and overcurrent protection for each motor.
 - a. Alternating control as indicated by control sequence for each pump.
4. Terminal blocks with numbered and color-coded wiring to match wiring diagram.
5. Metal raceway for factory-installed wiring outside of enclosures. Make connections to motor with liquidtight conduit.
6. Removable control mounting plate.
7. Visual indication of status and alarm with momentary test push button.
8. Audible alarm and silence switch.
9. Visual indication of elapsed run time, graduated in hours.
10. Fusible, control-circuit transformer.
11. Microprocessor-based controller.

J. Feedwater Pump Continuous Control Sequence:

1. Pump runs continuously while boiler operates. Electric interlock with boiler control starts lead pump when boiler starts.
2. Boiler water-level controller modulates feedwater control valve to maintain boiler water-level set point. Valve closes when boiler is off.
3. Lead and lag pumps alternate to equalize run time.
4. Lead pump failure automatically starts lag pump.
5. Feedwater pressure controller starts and stops lag pump to maintain feedwater pressure set point.
6. Visual indication of pump on and off status.
7. Visual indication of pump lead/lag status.
8. Visual and audible alarm indication of pump failure.

K. Makeup Water Control Sequence:

1. Electric level controller operates electric control valve to maintain tank water-level set point.
2. Visual and audible alarm indication of low and high tank water level.

L. Building Management System Interface: Factory install hardware to enable building management system to monitor and display points.

1. Hardwired Monitoring Points: On/off status for each pump, failure alarm for each pump, low-water level alarm, high-water level alarm, feedwater temperature.

2.3 FACTORY FINISHES

- A. Manufacturer's standard prime-coat finish ready for field painting.
- B. Manufacturer's standard paint in standard colors, applied to factory-assembled and -tested unit before shipping.
- C. Do not paint aluminum, galvanized-steel, and stainless-steel surfaces.

2.4 SOURCE QUALITY CONTROL

- A. Fabricate and label deaerator tanks according to ASME Boiler and Pressure Vessel Code: Section VIII, "Pressure Vessels," Division 1.
- B. Factory install and test piping that connects pumps to tanks according to ASME B31.1, "Power Piping."
- C. Factory test performance and certify test results on packaged deaerator units, according to ASME PTC 12.3, before shipping to Project.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Before deaerator installation, examine roughing-in for concrete equipment bases, anchor-bolt sizes and locations, and piping and electrical connections to verify actual locations, sizes, and other conditions affecting performance, maintenance, and operations.
 - 1. Final deaerator locations indicated on Drawings are approximate. Determine exact locations before roughing-in for piping and electrical connections.
 - 2. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install deaerators level on concrete base. Concrete base is specified in Division 23 Section "Common Work Results for HVAC," and concrete materials and installation requirements are specified in Division 03.
- B. Vibration Isolation: Elastomeric isolator pads or mounts with a minimum static deflection of 0.25 inch. Vibration isolation devices and installation requirements are specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."
- C. Install deaerators to permit access for service and maintenance.
- D. Support piping independent of pumps.
- E. Install base-mounted pumps on concrete base with grouted base frame.
- F. Install all parts and materials not factory installed.
- G. Extend overflow drains to floor drains.
- H. Extend vent piping to outside and terminate with manufacturer-approved cap furnished with deaerator.

- I. Install piping adjacent to machine to allow service and maintenance.

3.3 CONNECTIONS

- A. Steam and condensate piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect steam and condensate piping to tank tapplings with shutoff valves and unions or flanges at each connection.
- C. Connect condensate drains, pump-discharge piping, vents, overflow drains, makeup water, steam supply, and cooling water piping.

3.4 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections. Report results in writing.
- B. Perform tests and inspections and prepare test reports.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- C. Tests and Inspections:
 - 1. Inspect field-assembled components and equipment installation, including piping and electrical connections, for compliance with requirements.
 - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
 - 3. Verify bearing lubrication.
 - 4. Verify proper motor rotation.
 - 5. Test Reports: Prepare a written report to record the following:
 - a. Test procedures used.
 - b. Test results that comply with requirements.
 - c. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.
- D. Remove and replace malfunctioning equipment and retest as specified above.

3.5 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
- B. Complete installation and startup checks according to manufacturer's written instructions and do the following:

1. Set deaerator makeup water-level controls.
2. Verify bearing lubrication.
3. Verify proper motor rotation.
4. Start pumps according to manufacturer's written instructions.

3.6 ADJUSTING AND CLEANING

- A. Adjust initial temperature and pressure set points.
- B. Set field-adjustable switches and circuit-breaker trip ranges.
- C. Clean strainers.

3.7 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain deaerators. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 235316