SECTION 235316 - DEAERATORS

Revise this Section by deleting and inserting text to meet Project-specific requirements.

This Section uses the term "Architect." Change this term to match that used to identify the design professional as defined in the General and Supplementary Conditions.

Verify that Section titles referenced in this Section are correct for this Project's Specifications; Section titles may have changed.

1. GENERAL
   * + 1. RELATED DOCUMENTS

Retain or delete this article in all Sections of Project Manual.

* + - * 1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
      1. SUMMARY
         1. Section includes packaged, factory-assembled deaerators.
      2. DEFINITIONS

Retain terms that remain after this Section has been edited for a project.

* + - * 1. DDC: Direct digital control.
        2. Feedwater Pump: Pump that moves feedwater from the deaerator to the boiler.
        3. NPSHR: Net-positive suction head required.
        4. Transfer Pump: Pump that moves feedwater from the surge tank to the deaerator.
      1. SUBMITTALS
         1. Submittals for this section are subject to the re-evaluation fee identified in Article 4 of the General Conditions.
         2. Manufacturer's installation instructions shall be provided along with product data.
         3. Submittals shall be provided in the order in which they are specified and tabbed (for combined submittals).
         4. Product Data: For each unit to include the following:

Equipment performance and operating characteristics, such as rated makeup water, feedwater, steam condensate and steam flow rates; working pressure; tank capacities, storage capacity in minutes; temperature and NPSHR; and pump performance curves with selection points clearly indicated.

Furnished specialties and accessories.

Construction details, material descriptions, dimensions and weight of individual components, and profiles and finishes.

Force and moment capacity of each field piping connection.

Dimensioned location of low, high, and normal water level showing operating set point and each alarm set point.

Temperature and pressure rating, size, and materials of construction for trim components including, piping, fittings, flanges, unions, and valves. Provide valve manufacturer Product Data for each valve furnished. For safety valves, include trip and reset settings and flow capacity.

Manufacturer Product Data showing size, scale range, and accuracy of thermometers and pressure gages.

Detailed information of controls including Product Data with technical performance, operating characteristics, and sequence of operation.

Product Data for each motor, including performance, operating characteristics, and materials of construction.

* + - * 1. Shop Drawings:

Include plans, elevations, sections, and mounting and attachment details.

Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

Include diagrams for power, signal, and control wiring. Differentiate between factory and field installation.

Include piping diagrams of factory-furnished piping that indicate size and each piping component.

* + - 1. INFORMATIONAL SUBMITTALS

Retain "Coordination Drawings" Paragraph below for situations where limited space necessitates maximum utilization for efficient installation of different components or if coordination is required for installation of products and materials by separate installers. Coordinate paragraph with other Sections specifying products listed below. Preparation of coordination drawings requires the participation of each trade involved in installations within the limited space.

* + - * 1. Coordination Drawings: Plan and elevation views, drawn to <**Insert scale**> scale, indicating equipment manufacturer's service clearances, structure and base attachment, piping, power, and controls. Each view to show screened background with the following:

Column grids, beams, columns, and concrete equipment bases.

Room layout with walls, floors, and roofs, including each room name and number.

Equipment and products located in vicinity of deaerators and part of final installation including products of other trades, such as lighting, fire suppression systems, and plumbing systems.

Retain "Seismic Qualification Certificates" Paragraph below if required by seismic criteria applicable to Project. Coordinate with Section 230548 "Vibration and Seismic Controls for HVAC." See ASCE/SEI 7 for certification requirements for equipment and components.

* + - * 1. Seismic Qualification Certificates: For deaerators, accessories, and components, from manufacturer.

Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.

Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

* + - * 1. Source quality-control reports.

Retain "Field quality-control reports" Paragraph below if Contractor is responsible for field quality-control testing and inspecting.

* + - * 1. Field quality-control reports.
        2. Startup service reports.
        3. ASME Stamp Certification and Report: Submit "A," "S," or "PP" stamp certificate of authorization, as required by authorities having jurisdiction, and document hydrostatic testing of piping external to deaerator.
      1. CLOSEOUT SUBMITTALS
         1. Operation and Maintenance Data: For deaerators, components, and accessories to include in emergency, operation, and maintenance manuals.
         2. Spare Parts List: Recommended spare parts list with quantity for each.
         3. Touchup Paint Description: Detailed description of paint used in application of finish coat to allow for procurement of a matching paint.
         4. Instructional Videos: Including those that are prerecorded and those that are recorded during training.
      2. MAINTENANCE MATERIAL SUBMITTALS
         1. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

Gaskets: Furnish [**one**] <**Insert number**> replacement gasket(s) for each gasketed opening.

Gage Glass: Furnish [**one**] <**Insert number**> replacement glass(es) for each gage glass.

Pump Mechanical Seal Set: Furnish [**one**] <**Insert number**> replacement mechanical seal set(s) for each unique pump mechanical seal.

<**Insert extra materials**>.

Retain "Tool Kit" Paragraph below to require tool kit.

* + - * 1. Tool Kit:

A tool kit specially designed by deaerator manufacturer for use in servicing deaerator(s) furnished.

Special tools required to service deaerator components not readily available to Owner Director’s Representative service personnel in performing routine maintenance.

Lockable case with hinged cover, marked with large and permanent text to indicate the special purpose of tool kit, such as "Deaerator Tool Kit." Text size shall be at least 1 inch (25 mm) high.

A list of each tool furnished. Permanently attach the list to underside of case cover. Text size shall be at least 0.5 inch (13 mm) high.

* + - * 1. Touchup Paint: [**32 oz. (1 L)**] <**Insert volume**> container of paint used for finish coat. Label outside of container with detailed description of paint to allow for procurement of a matching paint in the future.
      1. DELIVERY, STORAGE, AND HANDLING
         1. Ship deaerators from the factory free of water. Drain water and blow deaerators dry with compressed air if required to remove all water before shipping.
         2. Cover and protect flanges, pipe openings, nozzles, bearings, and couplings from damage during shipping, storage, and handling.
         3. Cover and protect electrical and control devices and open connections.
         4. Comply with manufacturer's written rigging instructions.
         5. Deliver deaerators as factory-assembled units with protective crating and covering.

Retain subparagraph below for projects with special shipping requirements. Export shipping adds cost.

Package deaerator for export shipping in totally enclosed [**bagging**] [**crate**] [**crate with bagging**].

* + - * 1. Protect deaerator components with removable temporary enclosures to prevent damage during shipping, storage, and installation.

1. PRODUCTS

Manufacturers and products listed in SpecAgent and MasterWorks Paragraph Builder are neither recommended nor endorsed by the AIA or Deltek. Before inserting names, verify that manufacturers and products listed there comply with requirements retained or revised in descriptions and are both available and suitable for the intended applications. For definitions of terms and requirements for Contractor's product selection, see Section 016000 "Product Requirements."

* + - 1. MANUFACTURERS

* + - * 1. [Manufacturers:](http://www.specagent.com/Lookup?ulid=12409) Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

[Ambassador Heat Transfer Company](http://www.specagent.com/Lookup?uid=123457138942).

[Bryan Boilers; Bryan Steam LLC](http://www.specagent.com/Lookup?uid=123457138944).

[Cleaver-Brooks](http://www.specagent.com/Lookup?uid=123457138945).

[Cochrane, Inc](http://www.specagent.com/Lookup?uid=123457138946).

[Ecodyne Limited](http://www.specagent.com/Lookup?uid=123457138949).

[Industrial Steam](http://www.specagent.com/Lookup?uid=123457138951).

Approved equivalent.

* + - 1. PERFORMANCE REQUIREMENTS

Retain this article to define performance requirements that are not indicated elsewhere.

Retain "Seismic Performance" Paragraph below with "Seismic Qualification Certificates" Paragraph in "Informational Submittals" Article for projects requiring seismic design. Delete paragraph if performance requirements are indicated on Drawings. Model building codes and ASCE/SEI 7 establish criteria for buildings subject to earthquake motions. Coordinate requirements with structural engineer.

* + - * 1. Seismic Performance: Deaerator shall withstand the effects of earthquake motions determined according to [**ASCE/SEI 7**] <**Insert requirement**>.

Retain subparagraph below to define the term "withstand" as it applies to this Project. Definition varies with type of building and occupancy and is critical to valid certification. Option is used for essential facilities where equipment must operate immediately after an earthquake.

The term "withstand" means "the deaerator will remain in place without separation of any parts when subjected to the seismic forces specified[**and the deaerator will be fully operational after the seismic event**]."

For life-safety components required to function after an earthquake (such as fire-sprinkler systems, components that contain hazardous content, and storage racks in structures open to the public), the Component Importance Factor is 1.5. For other components, the Component Importance Factor is 1.0 unless the structure is in Seismic Use Group III and component is necessary for continued operation of facility or failure of component could impair continued operation of facility, in which case the Component Importance Factor is 1.5.

Component Importance Factor: [**1.5**] [**1.0**].

See ASCE/SEI 7, Coefficients for Architectural Component Table and Seismic Coefficients for Mechanical and Electrical Components Table for requirements to be inserted in subparagraph below.

<**Insert requirements for Component Amplification Factor and Component Response Modification Factor**>.

Retain "Operation Following Loss of Normal Power" Paragraph below if uninterrupted deaerator operation is required without operator intervention.

* + - * 1. Operation Following Loss of Normal Power:

Equipment, associated factory- and field-installed controls, and associated electrical equipment and power supply connected to backup power system shall automatically return equipment and associated controls to the operating state. This shall occur immediately before loss of normal power without need for manual intervention by an operator when power is restored either through a backup power source or through normal power if restored before backup power is brought on-line.

See Drawings for equipment served by backup power systems.

Provide means and methods required to satisfy requirement even if not explicitly indicated.

Retain "Outdoor Installations" Paragraph below for deaerators installed outdoors.

* + - * 1. Outdoor Installations:

Deaerators shall be suitable for outdoor installation indicated. Provide adequate weather protection to ensure reliable service life over a [**25**] <**Insert value**>-year period with minimal degradation due to exposure to outdoor ambient conditions.

Deaerators equipped to provide safe and stable operation while achieving performance indicated when operating at extreme outdoor temperatures encountered by the installation. Review historical weather database and provide equipment that can operate at extreme outdoor temperatures recorded over past [**30**] <**Insert value**>-year period.

* + - * 1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
        2. ASME Compliance: Fabricate and label deaerators and components to comply with ASME Boiler and Pressure Vessel Code.
      1. MANUFACTURED UNITS

If Project has only one deaerator configuration, retain one of first three paragraphs below. First paragraph is most common; third paragraph is least common. If Project has multiple deaerators with different configurations, delete all three paragraphs and indicate orientation, type, configuration, and surge tank options in a schedule on Drawings. See "Deaerator Configurations" Article in the Evaluations for discussion about packed-column, spray, and tray deaerators. The decision to select a horizontal-style unit or a vertical-style unit is based primarily on the available floor space. Horizontal-style units are more common and less expensive than vertical-style units and are generally used when available floor space is not an issue. Single-compartment deaerators are more common than two-compartment units and deaerators with a separate surge tank. A surge tank is added to provide a buffer to compensate for erratic "slugs" of condensate return. The surge tank can be an integral part of a two-compartment tank or a separate tank that is "piggybacked" and mounted on the same stand with the storage tank. If a continuous and stable flow of condensate is anticipated, a single-compartment tank is usually acceptable and preferred because of its lower initial cost. If not, further investigation is required to determine the need to retain one of the other options indicated. A two-compartment tank consists of a single tank with a partition that isolates fluid flow from one side to the other. One side of the tank is usually designed to the ASME Boiler and Vessel Pressure Code; the other side of the tank, the surge-tank side, is usually atmospheric and not designed to the ASME Boiler and Vessel Pressure Code. Two-compartment tanks tend to be long and require more floor space than other designs.

* + - * 1. [**Horizontal**] [**Vertical**], [**packed-column**] [**spray**] [**tray**], single-compartment deaerator[**, and a separate packaged surge tank with transfer and feedwater pumps and controls to supply feedwater to deaerator**].
        2. [**Horizontal**] [**Vertical**], [**packed-column**] [**spray**] [**tray**], two-compartment deaerator. One compartment for deaeration and one for surge volume, each with its own transfer and feedwater pumps and controls.
        3. [**Horizontal**] [**Vertical**], [**packed-column**] [**spray**] [**tray**], single-compartment deaerator and separate surge tank, both mounted on same factory-fabricated stand with necessary transfer and feedwater pumps and controls.

First option in "Material for Wetted Components" Paragraph below is most common and a standard offering by many manufacturers.

* + - * 1. Material for Wetted Components: Components in contact with water that has not been deaerated shall be made of Type [**304**] [**316**] stainless steel.
        2. 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.
        3. Vent Condenser: Stainless steel, with automatic and manual vent valves.
        4. Deaerator and Storage Tank:

Material: [**Welded carbon steel**] [**Welded carbon steel galvanized after fabrication**] [**Stainless steel**].

Retain first subparagraph below for additional corrosion protection for carbon-steel tanks only.

Additional Corrosion Protection:

Retain one of first two subparagraphs below, or both.

[**0.07-inch (1.8-mm)**] [**0.13-inch (3.3-mm)**] [**0.19-inch (4.8-mm)**] <**Insert dimension**> thickness allowance.

Electrolytic corrosion-inhibitor anode.

Access: Manhole in deaerator and storage tank for access to internal components for inspection and service.

Manhole cover shall be [**davited**] [**or**] [**hinged**].

Factory-Applied Insulation and Jacket:

Minimum thickness of [**2 inches (50 mm)**] <**Insert dimension**> for mineral-fiber pipe and tank insulation.

Cover insulation with preformed and removable sections of [**painted steel**] [**stucco-embossed aluminum**] [**or**] [**stainless-steel**] jacket to uniformly follow the contour of the tank. Jacket nominal thickness is not less than [**0.030 inch (0.8 mm)**] [**0.048 inch (1.2 mm)**] <**Insert dimension**>.

Factory-Installed Pipe, NPS 2-1/2 (DN 65) and Smaller: ASTM A53/A53M, Type S (seamless), Grade B; or ASTM A106/A106M, Type S, Grade B, Schedule [**40**] [**80**]; with threaded joints and fittings.

Retain one of first three subparagraphs below.

Cast-Iron Threaded Fittings: ASME B16.4, Class [**125**] [**250**].

Malleable-Iron Threaded Fittings: ASME B16.3, Class [**150**] [**300**].

Forged-Steel Fittings: ASME B16.11, Class 3000.

Retain "Malleable-Iron Unions" or "Forged-Steel Unions" Subparagraph below, or both.

Malleable-Iron Unions: ASME B16.39, Class [**150**] [**300**].

Forged-Steel Unions: MSS SP-83, Class 3000.

Factory-Installed Pipe, NPS 3 (DN 80) and Larger: ASTM A53/A53M, Type E (electric-resistance welded), Grade B; or ASTM A106/A106M, Type S, Grade B, Schedule [**40**] [**80**]; with welded joints and carbon-steel fittings and flanges.

Wrought-Steel Fittings: ASME B16.9, wall thickness to match adjoining pipe.

Wrought Cast- and Forged-Steel Flanges and Flanged Fittings: ASME B16.5, Class [**150**] [**300**], including bolts, nuts, and gaskets.

* + - * 1. Accessories:

Lifting eyes.

Companion flanges.

Pump suction piping with vortex breaker, isolation valve, strainer, and flexible connector.

Pump discharge piping with check valve, isolation valve, and liquid-filled pressure gage graduated in [**pounds force per square inch**] [**kilopascals**] [**both pounds force per square inch and kilopascals**].

Second option in first subparagraph below is common for continuously operating pump to maintain circulation of pumped water during times the modulating valve is throttled closed.

Pump-discharge bypass [**relief valve**] [**orifice plate**] [**relief valve with orifice plate**] sized to provide continuous pump operation with boiler feedwater valve closed.

Makeup Water Assembly:

Retain one of first three subparagraphs below. Coordinate with "Makeup Water Control Sequence" Paragraph in "Controls" Article.

Factory-mounted modulating valve with mechanical level control, external float cage, and stainless-steel float.

[**Factory**] [**Field**]-mounted, electric, [**pilot-operated, solenoid**] [**modulating**] valve with factory-mounted, [**probe-type**]water-level controller.

[**Factory**] [**Field**]-mounted, pneumatic modulating valve with factory-mounted water-level controller.

[**Factory**] [**Field**]-mounted, three-valve bypass and inlet strainer.

Steam option in "Steam Pressure-Reducing Valve(s)" Subparagraph below is most common.

Steam Pressure-Reducing Valve(s): [**Steam**] [**Electric**] [**Pneumatic**] operated[**with three-valve bypass**], and sized to reduce boiler outlet pressure to the deaerator design pressure.

Tank Overflow Drain: Sized to relieve full capacity at operating pressure.

Tank Overflow Drainer: Float-type trap, sized to relieve full capacity at operating pressure, with steel housing and stainless-steel float ball.

Safety Valve(s): ASME labeled and sized to relieve full capacity of pressure-reducing valve. Provide each safety valve with a drip-pan elbow.[**For units installed outdoors, provide each safety valve vent with an exhaust head.**]

Vents: Manual and automatic vent valves.

Automatic air vents shall be thermostatically controlled to provide a fast means of venting when a sudden buildup of gas occurs.

Manual air vents shall have an orifice to provide continuous venting at a rate of up to 0.1 percent of rated deaerator capacity at operating pressure indicated.

Retain first subparagraph below for units installed outdoors.

For units installed outdoors, provide each vent with a drip-pan elbow and exhaust head.

High-temperature condensate diffuser tube.

Vacuum breaker.

Meters and Gages:

Full-height, water-level gage glass[**, reflex flat type,**] with gage rods to protect glass and stop valve set, ball check and shutoff cocks, water-column blowdown valves, and vacuum breaker.

Thermometer:

[**Liquid-filled industrial**] [**Bimetal dial-type**] thermometer graduated in [**Fahrenheit**] [**Celsius**] [**both Fahrenheit and Celsius**] mounted to measure temperature in storage [**and steam**]section of tank.

Graduated scale with a range of approximately [**1.5**] <**Insert value**> times the normal operating temperature.

Any angle position adjustment.

Retain first subparagraph for bimetal dial-type thermometers.

Stainless-steel case with nominal [**5-inch- (125-mm-)**] <**Insert dimension**> diameter face.

Mount thermometer in a Type 316 stainless-steel thermowell.

Pressure Gage:

Pressure gage graduated in [**pounds force per square inch**] [**kilopascals**] [**both pounds force per square inch and kilopascals**] mounted to measure pressure in steam section of tank and pressure at feedwater discharge manifold pipe.

Nominal [**4-inch- (100-mm-)**] <**Insert dimension**> diameter face with graduated scale and siphon with isolation valve. Gage shall have normal operating pressure about [**50**] <**Insert number**> percent of full range and an accuracy of [**0.5**] [**1**] percent.

Retain first subparagraph below for feedwater flow measurement. This measurement is not a standard offering. Consult listed manufacturers for availability.

Flow meter mounted in feedwater discharge manifold pipe and positioned to measure and display flow supplied by deaerator to boilers. Accuracy within [**2**] <**Insert value**> of actual reading when measured across design to minimum flow range.

Meters and gages shall be easily readable by operator standing at grade adjacent to unit. Provide remote reading gages if required to comply with requirement.

Retain one of first two subparagraphs below, or both, which are optional features.

Provision for chemical injection quill.

Chemical injection quill with check valve and isolation valve.

Sample Cooler: Factory [**installed**] [**or**] [**furnished for field installation**], with [**needle**] valve for each connection.[**Constructed of Type 316 stainless steel.**]

Tank drain connection with valve.

Oxygen test kit.

<**Insert accessory**>.

* + - * 1. Support Frame: Structural-steel frame for supporting tank and pumps. Weld or bolt to tank.

Retain first subparagraph below if Project is located in seismic area. If retaining, also retain "Seismic Qualification Certificates" Paragraph in "Informational Submittals" Article.

Fabricate support frame with bracing adequate for seismic forces according to authorities having jurisdiction and to allow installation by anchoring deaerators to floor only.

Minimum height of frame shall be as required by application, but not less than <**Insert height**>.

Turbine pumps are used for on/off control only.

* + - * 1. Feedwater Pump: Cast-iron, [**flange**] [**base**]-mounted volute; with [**bronze**] [**stainless-steel**], [**multistage centrifugal**] [**turbine**] impeller, renewable bronze case ring, and stainless-steel shaft.

Seals: Mechanical, suitable for [**250 deg F (121 deg C)**] <**Insert temperature**>.

Default motor characteristics are specified in Section 230513 "Common Motor Requirements for HVAC Equipment."

Pump Motor: [**Vertical**] [**Horizontal**], [**close**] [**or**] [**flexible**] coupled to pump. Comply with requirements in Section 230513 "Common Motor Requirements for HVAC Equipment" unless more stringent requirements are indicated below:

Efficiency: [**Premium efficient**] <**Insert requirement**>.

Consult manufacturer on availability of "totally enclosed fan cooled" option in "Enclosure" Subparagraph below for pump size and configuration selected. Some pump configurations may exclude the option and necessitate the "totally enclosed" option.

Enclosure: [**Open dripproof**] [**totally enclosed**] [**or**] [**totally enclosed fan cooled**].

Insulation Class: [**F**] [**H**] <**Insert requirement**>.

Service Factor: [**1.15**] <**Insert value**>.

Motors operated through variable-frequency controllers shall be inverter duty rated per NEMA MG-1, Section IV, "Performance Standard Applying to All Machines," Part 31, "Definite-Purpose, Inverter-Fed, Polyphase Motors."

Motor Sizes: Minimum size as indicated and large enough so driven load does not require motor to operate in service factor.

* + - 1. SURGE TANK ASSEMBLY

Retain this article if unit is to be provided with an integral surge tank as part of either a two-compartment design or a separate surge tank that is mounted on the same support fame and stand. Delete this article if a single-compartment unit is intended.

* + - * 1. Description: Factory-assembled and -tested unit consisting of a condensate receiver, transfer pumps, and controls.
        2. Accessories:

Thermometer:

[**Liquid-filled industrial**] [**Bimetal dial-type**] thermometer graduated in [**Fahrenheit**] [**Celsius**] [**both Fahrenheit and Celsius**].

Graduated scale with a range of approximately [**1.5**] <**Insert value**> times the normal operating temperature.

Any angle position adjustment.

Retain first subparagraph for bimetal dial-type thermometers.

Stainless-steel case with nominal [**5-inch- (125-mm-)**] <**Insert dimension**> diameter face.

Mount thermometer in a Type 316 stainless-steel thermowell.

Full-height, water-level gage glass[**, reflex flat type,**] with gage rods to protect glass and stop valve set, ball check and shutoff cocks, water-column blowdown valves, and vacuum breaker.

Lifting eyes.

Companion flanges.

Pump suction piping with vortex breaker, isolation valve, strainer, and flexible connector.

Pump discharge piping with check valve, isolation valve, and liquid-filled pressure gage graduated in [**pounds force per square inch**] [**kilopascals**] [**both pounds force per square inch and kilopascals**]. Gage with nominal [**4-inch- (100-mm-)**] <**Insert dimension**> diameter face, isolation valve, normal operating pressure about [**50**] <**Insert number**> percent of full range, and an accuracy of [**0.5**] [**1**] percent.

Gages shall be easily readable by operator standing at grade adjacent to unit. Provide remote reading gages if required to comply with requirement.

Second option in first subparagraph below is common for continuously operating pump to maintain circulation of pumped water during times the modulating valve is throttled closed.

Pump-discharge bypass [**relief valve**] [**orifice plate**] [**relief valve with orifice plate**] sized to provide continuous pump operation.

<**Insert accessories**>.

* + - * 1. Factory-Installed Pipe, NPS 2-1/2 (DN 65) and Smaller: ASTM A53/A53M, Type S (seamless), Grade B; or ASTM A106/A106M, Type S, Grade B, Schedule [**40**] [**80**]; with threaded joints and fittings.

Retain one of five subparagraphs below to limit Contractor's options. Retain more than one to allow Contractor to choose the most economical fittings and unions.

Cast-Iron Threaded Fittings: ASME B16.4, Class [**125**] [**250**].

Malleable-Iron Threaded Fittings: ASME B16.3, Class [**150**] [**300**].

Forged-Steel Fittings: ASME B16.11, Class 3000.

Malleable-Iron Unions: ASME B16.39, Class [**150**] [**300**].

Forged-Steel Unions: MSS SP-83, Class 3000.

* + - * 1. Factory-Installed Pipe, NPS 3 (DN 80) and Larger: ASTM A53/A53M, Type E (electric-resistance welded), Grade B; or ASTM A106/A106M, Type S, Grade B, Schedule [**40**] [**80**]; with welded joints and carbon-steel fittings and flanges.

Wrought-Steel Fittings: ASME B16.9, wall thickness to match adjoining pipe.

Wrought Cast- and Forged-Steel Flanges and Flanged Fittings: ASME B16.5, Class [**150**] [**300**], including bolts, nuts, and gaskets.

* + - * 1. Tank:

If unit includes a two-compartment tank, revise "Material" and "Additional Corrosion Protection" subparagraphs below to match the requirements in "Deaerator and Storage Tank" Paragraph in "Manufactured Units" Article.

Material: [**Welded carbon steel**] [**Welded carbon steel galvanized after fabrication**] [**Stainless steel**].

Retain first subparagraph below for additional corrosion protection for carbon-steel tanks only.

Additional Corrosion Protection:

Retain one of first two subparagraphs below, or both.

[**0.07-inch (1.8-mm)**] [**0.13-inch (3.3-mm)**] [**0.19-inch (4.8-mm)**] <**Insert dimension**> thickness allowance.

Electrolytic corrosion-inhibitor anode.

Access: Manhole in tank for access to internal components for inspection and service.

Manhole cover shall be [**davited**] [**or**] [**hinged**].

Factory-Applied Insulation and Jacket:

Minimum thickness of [**2 inches (50 mm)**] <**Insert dimension**> for mineral-fiber pipe and tank insulation.

Cover insulation with preformed and removable sections of [**painted steel**] [**stucco-embossed aluminum**] [**stainless-steel**] jacket to uniformly follow the contour of the tank. Jacket nominal thickness is not less than [**0.030 inch (0.8 mm)**] [**0.048 inch (1.2 mm)**] <**Insert dimension**>.

* + - * 1. Support Frame: Structural-steel frame for supporting tank. Weld or bolt to tank.

Retain first subparagraph below if Project is located in seismic area. If retaining, also retain "Seismic Qualification Certificates" Paragraph in "Informational Submittals" Article.

Fabricate support frame with bracing adequate for seismic forces according to authorities having jurisdiction and to allow installation by anchoring deaerators to floor only.

Minimum height of frame shall be as required by application, but not less than <**Insert height**>.

Retain one of two "Transfer Pump" paragraphs below and revise for desired pump construction.

* + - * 1. Transfer Pump: Vertical, flange-mounted, close-coupled, [**single-stage**] [**multistage**], radially split-case centrifugal pump; rated for [**175-psig (1205-kPa)**] <**Insert value**> minimum working pressure and a continuous water temperature of [**225 deg F (107 deg C)**] <**Insert temperature**>; with the following features:

Impeller: [**Bronze**] [**Stainless steel**].

Seals: Mechanical.

* + - * 1. Transfer Pump: Horizontal, base-mounted, [**single-stage**] [**multistage**], radially split-case centrifugal pump; rated for [**175-psig (1205-kPa)**] <**Insert value**> minimum working pressure and a continuous water temperature of [**225 deg F (107 deg C)**] <**Insert temperature**>; with the following features:

Impeller: [**Bronze**] [**Stainless steel**].

Coupling: [**Close**] [**Flexible**].

Seals: Mechanical.

* + - * 1. Transfer Pump Motor: Comply with requirements in Section 230513 "Common Motor Requirements for HVAC Equipment" unless more stringent requirements are indicated below:

Default motor characteristics are specified in Section 230513 "Common Motor Requirements for HVAC Equipment."

Efficiency: [**Premium efficient**] <**Insert requirement**>.

Consult manufacturer on availability of "totally enclosed fan cooled" option in "Enclosure" Subparagraph below for pump size and configuration selected. Some pump configurations may exclude the option and necessitate the "totally enclosed" option.

Enclosure: [**Open dripproof**] [**totally enclosed**] [**or**] [**totally enclosed fan cooled**].

Insulation Class: [**F**] [**H**] <**Insert requirement**>.

Service Factor: [**1.15**] <**Insert value**>.

Motors operated through variable-frequency controllers shall be inverter duty rated per NEMA MG-1, Section IV, "Performance Standard Applying to All Machines," Part 31, "Definite-Purpose, Inverter-Fed, Polyphase Motors."

Motor Sizes: Minimum size as indicated and large enough so driven load does not require motor to operate in service factor.

* + - 1. CONTROLS
         1. Factory-installed and -wired controllers, meters, sensors, switches, transformers, transmitters, valves, and other control devices necessary to provide a complete and functioning unit to operate as indicated and connect to field control interfaces indicated.
         2. Operating controls shall include the following devices and features:

Control transformer(s) with fuse protection, as required by manufacturer, to implement requirements indicated. Provide transformer with 25 percent spare capacity.

Set-Point Adjust: Operating and alarm set points shall be field adjustable.

* + - * 1. Control Enclosures:

In first subparagraph below, Type 1 is most common for indoor applications that are not susceptible to moisture, and Type 12 is second most common. Type 4X is used primarily in corrosive environments. Contact manufacturer for availability of option retained.

NEMA 250, Type [**1**] [**4**] [**4X**] [**12**] <**Insert type**>.

Provide enclosure with integral vents, fans, heat, and air conditioner as required to automatically control temperature inside enclosure within safe operating limits of devices installed within the enclosure.

Wiring shall be numbered and color-coded to match wiring diagram. Provide a laminated wiring diagram located inside enclosure.

Mounted on deaerator assembly at a location convenient to operator.

Provide hinged full-size door with key lock. Provide common key for all locks.

Enclosure shall consist of multiple sections divided by a partition with a separate hinged door for each section. One section shall house low-voltage controls; other section shall house line voltage controls.

Enclosure shall house the following:

Control transformers with fuses.

Labeled terminal strips.

[**Controller(s)**] [**Microprocessor-based controller(s)**] to provide control and alarm functions indicated.

Audible indication of safety alarms.

Dry Contacts:

For interface with chemical feed pump controls.

<**Insert additional requirements**>.

Face of enclosure shall provide the following:

Visual indication of operating components and alarms[**with momentary test push button**].

Visual indication of elapsed run time, graduated in hours.

Auto/local capability to allow operator to manual operate unit locally.

Audible alarm silence capability.

Labels for switches, lights, and displays to provide clear indication of service.

Retain subparagraph below for units with surge tank assembly on a separate support frame from deaerator assembly.

For units with surge tank assembly mounted on a separate support frame from deaerator assembly, [**provide a separate**] [**provide a common**] [**manufacturer has option to provide a separate or common**] control panel for deaerator and surge tank assemblies.

* + - * 1. Control Instrument Enclosures: Control instruments and devices that are mounted on the deaerator assembly and cannot be installed inside the control enclosure shall have same or higher level of protection indicated for control enclosures.
        2. Control Cable and Wire:

Control cable and wiring shall be numbered and color-coded to match wiring diagram.

Install cable and wiring located outside of enclosure(s) in a[**metal**] raceway.

Use flexible conduit to make final terminations.

Provide watertight installation for applications exposed to moisture.

Retain "Touch-Screen Local Operator Interface" Paragraph below to provide enhanced local operator interface. Consult listed manufacturers for availability.

* + - * 1. Touch-Screen Local Operator Interface: Provide local operator interface through a nominal [**10-inch (250-mm)**] <**Insert dimension**> touch-screen graphical color display for setup, monitoring, and data acquisition.

Monitoring:

Pump operating status (on/off).

Pump lead/lag status (lead/lag position).

Pump speed for variable-speed pumps (analog value, zero to 100 percent).

Pump operation failure alarm.

Pump starts.

Pump run time.

Feedwater pump manifold pipe discharge flow rate (analog valve).

Feedwater pump manifold pipe discharge pressure (analog valve, gage pressure).

Steam pressure (analog value, gage pressure).

Steam valve open position (analog value, zero to 100 percent).

Tank water level (analog value).

Tank high-water-level alarm (analog value).

Tank low-water-level alarm (analog value).

Tank low-water-level cutoff alarm (digital value).

Makeup water valve open position (analog value, zero to 100 percent).

Tank temperature (analog value).

<**Insert monitoring**>.

Control Setup:

Pump operation (on/off).

Pump lead/lag operation (lead/lag position).

Pump speed for variable-speed pumps (analog value, zero to 100 percent).

Pump manifold pipe discharge pressure set point (analog valve, gage pressure).

Steam pressure set point (analog value, gage pressure).

Steam valve open position override (analog value, zero to 100 percent).

Tank water level set point (analog value).

Tank high-water-level alarm set point (analog value).

Tank low-water-level alarm set point (analog value).

Tank low-water-level cutoff alarm set point (digital value).

Makeup water valve open position override (analog value, zero to 100 percent).

<**Insert control**>.

Retain first paragraph below if deaerator controls interface with building automation or DDC system.

* + - * 1. [**Building Automation**] [**DDC**] System Interface: Factory install hardware and software to enable system to monitor, control, and display deaerator status and alarms.

Retain "Hardwired I/O Points" Subparagraph below if interface with control system is through hardwired points and minimal interface is required. If extensive interface is required, delete below and retain "Communication Interface" Subparagraph, or retain both subparagraphs if requiring both hardwired and communication interface. Contact manufacturer for availability of options retained.

Hardwired I/O Points:

Monitoring: On/off status for each pump[**, failure alarm for each pump**] [**, low-water-level alarm**] [**, high-water-level alarm**] [**, feedwater temperature**] [**, feedwater flow rate**] <**Insert monitoring point**>.

Control: On/off operation, [**on/off operation of each pump,**] [**lead/lag position of each pump,**] [**feedwater supply pressure set-point adjustment,**] [**tank water level set-point adjustment**] <**Insert control point**>.

Retain "Communication Interface" Subparagraph below if extensive interface is required and is beyond that than can be provided by hardwired points. Coordinate communication protocol option retained with control system requirements. Contact manufacturer to confirm communication interface is available.

Communication Interface: [**ASHRAE 135 (BACnet)**] [**(LonTalk)**] [**Modbus**] [**Industry-accepted, open-protocol**] <**Insert type of interface**> communication interface shall enable control system operator to remotely control and monitor deaerator operation from an operator workstation. Control features available, and monitoring points displayed, locally at deaerator control panel shall be available to control system through the interface.

Retain one of first two paragraphs below, or both. Retain only one if Project has one deaerator or multiple deaerators with same control sequence. If more than one deaerator is required with differing control sequences, retain both and indicate control sequence type in a schedule on Drawings. Coordinate with boiler controls. Retain first paragraph for intermittent pump operation; retain second for continuous pump operation and boiler with modulating control valve.

* + - * 1. Feedwater Pump Start-Stop Control Sequence:

Boiler water-level controller starts and stops lead pump to maintain boiler water-level set point.

Lead and lag pumps alternate [**after each start**] [**to equalize run time**].

Lead pump failure [**automatically starts lag pump if lead pump cannot maintain set point**] [**manually starts lag pump**].

Visual indication of pump on[**and off**] status.

Visual indication of pump starts.

Visual indication of pump run time.

Visual indication of pump lead/lag status.

Visual[**and audible**] alarm indication of pump failure.

* + - * 1. Feedwater Pump Continuous Control Sequence:

Pump runs continuously while boiler operates. Electric interlock with boiler control to start lead pump when boiler starts.

Boiler water-level controller modulates feedwater control valve to maintain boiler water-level set point. Valve closes when boiler is off.

Lead and lag pumps alternate [**after each start**] [**to equalize run time**].

Lead pump failure automatically starts lag pump.

Retain one of first two subparagraphs below. Retain first for constant-speed pump applications and second for variable-speed pump applications,

Feedwater pressure controller starts and stops lag pump to maintain feedwater pressure set point.

Feedwater pressure controller controls operating feedwater pump(s) speed and starts and stops lag pump(s) to maintain feedwater pressure set point.

Visual indication of pump on[**and off**] status.

Visual indication of pump starts.

Visual indication of pump run time.

Visual indication of pump lead/lag status.

Visual[**and audible**] alarm indication of pump failure.

Visual indication of feedwater flow rate.

* + - * 1. Makeup Water Control Sequence:

Retain one of first three subparagraphs below.

Electric level controller operates electric control valve to maintain tank water-level set point.

Pneumatic level controller operates pneumatic control valve to maintain tank water-level set point.

Mechanical float operates valve to maintain water-level set point.

Visual[**and audible**] alarm indication of low[**and high**] tank water level.

Low-water level stops pumps.

Visual indication of makeup water flow rate.

Retain one or both paragraphs below for units with surge tank assemblies. Retain first for units with start-stop operating lead pump and second for continuous operating lead pump with water level controlled by a modulating valve. If more than one deaerator is required with differing control sequences, retain both and indicate control sequence type in a schedule on Drawings.

* + - * 1. Transfer Pump Start-Stop Control Sequence: Deaerator water-level controller controls lead pump; alternator switches lead and lag pump(s) [**after each start**] [**to equalize run time**]; failure of lead pump switches to lag pump[**and sounds audible alarm**].
        2. Transfer Pump Continuous-Run Control Sequence: Lead pump runs continuously while deaerator is operating; deaerator water-level controller modulates water-level-control valve; lead and lag pump(s) switch to equalize run time; lag pump operates if lead pump fails[**; pump failure sounds audible alarm**].
      1. ELECTRICAL POWER
         1. Single-Point Field Power Connection: Factory-installed and -wired switches, motor controllers, transformers, and other electrical devices necessary shall provide a single-point field power connection to unit.

Retain first subparagraph below for units with surge tank assembly on a separate support frame from deaerator assembly.

For units with surge tank assembly mounted on a separate support frame from deaerator assembly, [**provide a separate**] [**provide a common**] [**manufacturer has option to provide a separate or common**] field electrical connection for deaerator and surge tank assemblies.

In "Enclosure" Subparagraph below, Type 1 is most common for indoor applications that are not susceptible to moisture, and Type 12 is second most common. Type 4X is used primarily in corrosive environments. Contact manufacturer for availability of option retained.

Enclosure: NEMA 250, Type [**1**] [**4**] [**4X**] [**12**] <**Insert type**>.

Enclosure shall have integral vents, fans, heat, and air conditioner as required to automatically control temperature inside enclosure within safe operating limits of devices installed within the enclosure.

Mounted on deaerator assembly at a location convenient to operator.

Enclosure shall have hinged full-size door with key lock with common key for all locks.

Wiring shall be numbered and color-coded to match wiring diagram. Provide a laminated wiring diagram located inside enclosure.

Install wiring outside of an enclosure in a [**metal**]raceway. Make final connections to motors using flexible conduit. Provide watertight installation for applications exposed to moisture.

Field power interface shall be to [**fused disconnect switch**] [**nonfused disconnect switch**] [**circuit breaker**]. Withstanding rating of disconnecting means shall protect equipment. Coordinate requirements with field electrical power source.

Provide branch power circuit to each motor and to controls[**with a disconnect switch or circuit breaker**].

Provide each motor with NEMA-rated motor controller, hand-off-auto switch, and overcurrent protection. Provide variable-frequency controller [**with manual bypass**]and line reactors for each variable-speed motor indicated.

Alternating control as indicated by control sequence for each pump.

Provide transformer with fuses and power wiring to power a 20-A, 120-V duplex receptacle mounted in each control panel for use in connecting analytical and testing equipment.

* + - 1. FACTORY FINISHES

Retain one of first two paragraphs below for units that do not require special finishes. If retaining first paragraph, specify field-painting requirements in painting Sections. Verify compatibility of factory finishes with field-applied coats.

* + - * 1. Manufacturer's standard prime-coat finish ready for field painting.
        2. Manufacturer's standard paint in standard colors, applied to factory-assembled and -tested unit before shipping.

Retain five paragraphs below for special finish requirements. Contact listed manufacturers to confirm requirements are available.

* + - * 1. General:

Paint deaerator, using manufacturer's standard procedures, except comply with requirements indicated.

Miscellaneous surfaces shall be finished to match continuous surfaces.

Manufacturer shall field touch-up or entirely repaint surface finishes, damaged during shipment, to original condition, using original materials and methods.

Paint shall be suitable for temperatures encountered on painted surfaces.

Requirements indicate minimum quality level. Provide more robust paint system if required to comply with other requirements indicated.

* + - * 1. Preparation:

Follow paint manufacturer's published preparation and application instructions.

When paint manufacturer's recommended preparation requirements differ from those specified, use more stringent requirements.

Structural steel with visible corrosion shall be sandblasted according to SSPC SP-6 or SSPC SP-10 before applying primer and paint.

Before applying a primer and a topcoat, remove oil and grease from surfaces to be coated using clean rags soaked in thinner according to SSPC SP-1.

Treat galvanized-steel surfaces that cannot be procured with a phosphatized finish with a phosphate rinse to ensure proper paint adhesion.

* + - * 1. Primer:

Rust-inhibiting type with a minimum dry film thickness of [**2 mils (0.05 mm)**] <**Insert thickness**>.

Provide multiple passes if required to prevent runs.

Select a primer that is compatible with substrate and with finish coat.

* + - * 1. Finish Coat:

Contact listed manufacturers for availability of paint option retained.

Finish coat shall be [**alkyd enamel**] [**epoxy**] [**polyurethane**] <**Insert type**>.

Use dry film thickness recommended by paint manufacturer, but not less than [**2 mils (0.05 mm)**] <**Insert thickness**>. Provide multiple passes if required to prevent runs.

* + - * 1. Paint the following surfaces with primer and finish coat:

Base and miscellaneous supports that are not hot-dip galvanized.

Carbon steel that is not galvanized.

Exterior surfaces of unit exposed to view.

Piping and trim.

* + - * 1. Do not paint aluminum, galvanized-steel, and stainless-steel surfaces.
      1. CAPACITIES AND CHARACTERISTICS

If Project has more than one type or configuration of deaerator, delete this article and schedule deaerators on Drawings. Retain information below that is common to all units and is not scheduled on Drawings. If retaining article, also retain "Basis-of-Design Product" Paragraph in "Manufacturers" Article and insert manufacturer's name and product name or designation there.

* + - * 1. Nominal Capacity: <**Insert lb/h (kg/h)**>.
        2. Design Feedwater Flow Rate: <**Insert gpm (L/s)**>.
        3. Steam Flow Rate: <**Insert lb/h (kg/h)**>.

If more than one steam condensate source is connected to the deaerator, copy "Steam Condensate Flow Rate" and "Steam Condensate Temperature" paragraphs below and revise for each source.

* + - * 1. Steam Condensate Flow Rate: <**Insert gpm (L/s)**>.
        2. Steam Condensate Temperature: <**Insert deg F (deg C)**>.
        3. Makeup Water Flow Rate: <**Insert gpm (L/s)**>.
        4. Makeup Water Temperature: <**Insert deg F (deg C)**>.
        5. Capacity: Capable of raising temperature of condensate and makeup water to within [**3 deg F (2 deg C)**] <**Insert temperature**> of saturated steam temperature.
        6. Minimum Working Pressure: [**50 psig (345 kPa)**] <**Insert value**>.

Second option in "Operating Pressure Range" Paragraph below is most common.

* + - * 1. Operating Pressure Range: [**Atmospheric**] [**From 2 to 15 psig (14 to 104 kPa)**] <**Insert pressure range**>.

Second option in "Resultant Oxygen Content" Paragraph below is most common and only attainable with second option in "Operating Pressure Range" Paragraph above.

* + - * 1. Resultant Oxygen Content: Not more than [**0.03**] [**0.005**] cc/L through an operating range between [**zero**] [**3**] [**5**] <**Insert number**> and 100 percent of full load.
        2. Storage Tank:

Tank Capacity to Overflow: <**Insert gal. (L)**>.

Storage Time: [**10**] <**Insert number**> minutes.

* + - * 1. Feedwater Pumps:

No. of Pumps: [**Duplex**] <**Insert quantity**>.

Design Flow Rate: <**Insert gpm (L/s)**>.

Minimum Flow Rate: <**Insert gpm (L/s)**>.

NPSHR: <**Insert psig (kPa)**>.

Rated Operating Temperature: <**Insert deg F (deg C)**>.

Head Pressure: <**Insert psig (kPa)**>.

Close-off Pressure: <**Insert psig (kPa)**>.

Horsepower: <**Insert value**>.

Speed: <**Insert rpm**>.

Retain "Surge Tank" and "Transfer Pumps" paragraphs below if packaged deaerator includes a surge tank and transfer pumps.

* + - * 1. Surge Tank:

Tank Capacity to Overflow: <**Insert gal. (L)**>.

Storage Time: <**Insert number**> minutes.

* + - * 1. Transfer Pumps:

No. of Pumps: [**Duplex**] <**Insert quantity**>.

Design Flow Rate: <**Insert gpm (L/s)**>.

Minimum Flow Rate: <**Insert gpm (L/s)**>.

NPSHR: <**Insert psig (kPa)**>.

Rated Operating Temperature: <**Insert deg F (deg C)**>.

Head Pressure: <**Insert psig (kPa)**>.

Close-off Pressure: <**Insert psig (kPa)**>.

Horsepower: <**Insert value**>.

Speed: <**Insert rpm**>.

* + - * 1. Deaerator Assembly Single-Point Power Electrical Characteristics:

Volts: [**208**] [**230**] [**460**] <**Insert value**> V.

Phase: Three.

Hertz: 60.

Full-Load Amperes: <**Insert value**>.

Minimum Circuit Ampacity: <**Insert value**>.

Maximum Overcurrent Protection: <**Insert amperage**>.

Retain "Surge Tank Assembly Single-Point Power Electrical Characteristics" Paragraph below if surge tank assembly is on a separate support frame with separate field power connection.

* + - * 1. Surge Tank Assembly Single-Point Power Electrical Characteristics:

Volts: [**208**] [**230**] [**460**] <**Insert value**> V.

Phase: Three.

Hertz: 60.

Full-Load Amperes: <**Insert value**>.

Minimum Circuit Ampacity: <**Insert value**>.

Maximum Overcurrent Protection: <**Insert amperage**>.

* + - 1. SOURCE QUALITY CONTROL
         1. Fabricate and label deaerator tanks according to ASME Boiler and Pressure Vessel Code: Section VIII, "Pressure Vessels," Division 1.

Retain first option in first paragraph below for systems operating at more than 15 psig (104 kPa); retain second option for systems operating at 15 psig (104 kPa) and less.

* + - * 1. Factory install and test piping that connects pumps to tanks according to [**ASME B31.1, "Power Piping."**] [**ASME B31.9, "Building Services Piping."**].

Retain "Factory Tests" Paragraph below for factory-assembled units. Factory tests are an added cost option and may not be available from some manufacturers. Verify requirement with Director’s Representative.

* + - * 1. Factory Tests: Test performance and submit test results on packaged deaerator units, according to ASME PTC 12.3, before shipping to Project.

Retain "Witness Testing" Paragraph below if Director’s Representative wants to witness source quality-control testing.

* + - * 1. Witness Testing:

Allow Director’s Representative access to witness source quality-control testing.

Notify [**Architect**] [Director’s Representative] [**15**] <**Insert time**> days in advance of testing.

1. EXECUTION
   * + 1. EXAMINATION
          1. Examine conditions for compliance with requirements for installation tolerances and other conditions affecting deaerator performance, maintenance, and operations.

Deaerator locations indicated on Drawings are approximate. Determine exact locations before roughing-in for piping and electrical connections.

* + - * 1. Examine roughing-in for concrete equipment bases, anchor-bolt sizes and locations, and piping to verify actual locations of piping connections before installation of deaerators.
        2. Examine areas for suitable conditions where deaerators will be installed.
        3. Proceed with installation only after unsatisfactory conditions have been corrected.
      1. INSTALLATION
         1. Coordinate size and location of bases. Cast anchor-bolt inserts into concrete bases. Concrete, reinforcement, and formwork requirements are specified with concrete.
         2. Equipment Mounting:

Retain first subparagraph below to require equipment to be installed on cast-in-place concrete equipment bases.

Install deaerators on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified in Section 033000 "Cast-in-Place Concrete."

Retain one of two subparagraphs below. Retain first for projects in seismic areas; retain second for projects not in seismic areas. Indicate vibration isolation and seismic-control device type and minimum deflection in supported equipment schedule on Drawings.

Comply with requirements for vibration isolation and seismic-control devices specified in Section 230548 "Vibration and Seismic Controls for HVAC."

Comply with requirements for vibration isolation devices specified in Section 230548.13 "Vibration Controls for HVAC."

* + - * 1. Install deaerators to permit access for service and maintenance.
        2. Where installing piping adjacent to machine, allow space for service and maintenance.
        3. Support piping independent of equipment.
        4. Install base-mounted pumps on concrete base with grouted base frame.
        5. Install all parts and materials not factory installed.
        6. Assemble and install deaerators trim, components, and accessories that are not factory installed.
        7. Install control and electrical devices furnished with deaerators that are not factory mounted.
        8. Install control and power wiring to field-mounted control and electrical devices furnished with deaerators that are not factory installed.
        9. Perform cleaning procedures according to manufacturer's written instructions after completion of hydrostatic testing and before performing other field tests. Following cleaning procedures, deaerator shall be washed and flushed until water leaving deaerator is clear.
        10. Protect deaerators from corrosion.

Before filling with water, protect by dry storage method recommended by manufacturer.

After filled with water, protect by wet storage method recommended by manufacturer.

* + - * 1. Chemical Treatment: Quality of water in deaerators shall be maintained by a professional water treatment organization that shall provide on-site supervision to maintain the required water quality during periods of storage, operating, standby, and test conditions. See applicable water treatment Section, <**Insert Section number and title**>, for additional requirements.
      1. PIPING CONNECTIONS

Coordinate piping installations and specialty arrangements with Drawings and with requirements specified in piping systems. If Drawings are explicit enough, these requirements may be reduced or omitted.

* + - * 1. Steam and condensate piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
        2. Connect steam and condensate piping to tank tappings with shutoff valves and unions or flanges at each connection.
        3. Connect condensate drains, pump-discharge piping, vents, overflow drains, makeup water, steam supply, and cooling water piping.

Extend overflow drains to [**floor**] [**or**] [**sanitary**] drains.

Extend vent piping to outside and terminate with manufacturer-approved cap furnished with deaerator.

Install piping from safety valves and drip-pan elbows. Extend piping from safety valves and terminate to vent outdoors. Extend piping from drip-pan elbow drain to nearest [**floor**] [**or**] [**sanitary**] drain.

Install piping from equipment drain connection to nearest [**floor**] [**or**] [**sanitary**] drain. Piping shall be at least full size of connection. Provide an isolation valve if required.

* + - * 1. Hot equipment drains connected to sanitary drainage system shall be cooled before discharging into the system if required to comply with more stringent of governing code requirements and requirements indicated.

Provide a temperature-controlled, non-potable, domestic cold water source to cool hot equipment drains to deliver a discharge temperature of <**Insert temperature**>.

Retain first paragraph below for deaerators requiring a direct connection to chemical treatment system.

* + - * 1. Connect chemical treatment piping to each deaerator chemical treatment connection with check valve and isolation valve.
        2. Where installing piping adjacent to deaerators, allow space for service and maintenance.
      1. ELECTRICAL POWER CONNECTIONS
         1. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
         2. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
      2. CONTROLS CONNECTIONS
         1. Install control and electrical power wiring to field-mounted control devices.
         2. Connect control wiring between deaerators and other equipment to interlock operation as required to provide a complete and functioning system.

Retain paragraph below to connect deaerators to DDC system for remote monitoring and control.

* + - * 1. Connect control wiring between deaerator control interface and [**DDC system**] <**Insert system description**> for remote monitoring and control of deaerators. Comply with requirements in [**Section 230923 "Direct Digital Control (DDC) System for HVAC."**] <**Insert Section number and title.**>
      1. FIELD QUALITY CONTROL

Retain "Testing Agency," "Manufacturer's Field Service," and "Perform the following tests and inspections" paragraphs below to identify who shall perform tests and inspections. If retaining second option in "Testing Agency" Paragraph or if retaining "Manufacturer's Field Service" or "Perform the following tests and inspections" Paragraph, retain "Field quality-control reports" Paragraph in "Informational Submittals" Article.

Retain "Manufacturer's Field Service" Paragraph below to require a factory-authorized service representative to perform tests and inspections.

* + - * 1. Manufacturer's Field Service: Engage a Company Field Advisor per OGS Spec Section 014216 to test and inspect components, assemblies, and equipment installations, including connections.

Retain "Perform the following tests and inspections" Paragraph below to require Contractor to perform tests and inspections.

* + - * 1. Perform the following tests and inspections[**with the assistance of a Company Field Advisor per OGS Spec section 014216factory-authorized service representative**]:

Inspect field-assembled components and equipment installation, including piping and electrical connections, for compliance with requirements.

Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

Verify bearing lubrication.

Verify proper motor rotation.

Test Reports: Prepare a written report to record the following:

Test procedures used.

Test results that comply with requirements.

Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

See Section 014000 "Quality Requirements" for retesting and reinspecting requirements and Section 017300 "Execution" for requirements for correcting the Work.

* + - * 1. Deaerator will be considered defective if it does not pass tests and inspections.
        2. Prepare test and inspection reports.
      1. STARTUP SERVICE
         1. [**Engage a Company Field Advisor per OGS Spec Section 014216 to perform**] [**Perform**] startup service.

Complete installation and startup checks according to manufacturer's written instructions.

Set makeup water-level controls.

Set operating controls.

Verify safety controls.

Verify lubrication.

Verify proper motor rotation.

Start pumps according to manufacturer's written instructions.

<**Insert startup steps if any**>.

* + - * 1. Report: Prepare a written report to record the following:

Procedures used.

Initial findings.

Final results.

Corrective action taken to achieve compliance with requirements indicated.

Date of testing.

Name and contact information for person performing testing.

* + - 1. ADJUSTING AND CLEANING
         1. Adjust initial temperature and pressure set points.
         2. Set field-adjustable switches and circuit-breaker trip ranges.
         3. Clean strainers.
      2. DEMONSTRATION
         1. [**Engage a Company Field Advisor per OGS Spec Section 014216 to train**] [**Train**] Facility’s Director’s Representative's maintenance personnel to adjust, operate, and maintain deaerators.

Retain paragraph below for video training session.

* + - * 1. Video training sessions, and provide electronic copy of video to Director’s Representative.

END OF SECTION 235316