SECTION 235313 - BOILER FEEDWATER PUMPS

TIPS:

To view non-printing **Editor's Notes** that provide guidance for editing, click on Masterworks/Single-File Formatting/Toggle/Editor's Notes.

To read **detailed research, technical information about products and materials, and coordination checklists**, click on Masterworks/Supporting Information.

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Feedwater pumps and receivers.
2. Vacuum-type feedwater pumps and receivers.

1.3 DEFINITION

A. NPSH: Net-positive suction head.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacity, temperature and NPSH required, pump performance curves with selection points clearly indicated, and furnished specialties and accessories.

B. Shop Drawings: Include plans, elevations, sections, details, dimensions, weights, loadings, required clearances, method of field assembly, and attachments to other work.

1. Wiring Diagrams: Power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

A. Manufacturer Seismic Qualification Certification: Submit certification that feedwater equipment, accessories, and components will withstand seismic forces defined in Section 230548 "Vibration and Seismic Controls for HVAC." Include the following:

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

    a. The term "withstand" means "the unit will remain in place without separation of internal and external parts during a seismic event."
    b. The term "withstand" means "the unit will remain in place without separation of internal and external parts during a seismic event and the unit will be fully operational after the event."

2. Dimensioned Outline Drawings of Equipment: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which certification is based and their installation requirements.

B. Field quality-control test reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For feedwater equipment to include in emergency, operation, and maintenance manuals.

1.7 QUALITY ASSURANCE

A. Regulatory Requirements: Fabricate and test unit according to ASME PTC 12.1, "Closed Feedwater Heaters."

B. 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.

C. ASME Compliance: [**ASME B31.1, "Power Piping," for systems more than 15 psig (104 kPa)**] [**ASME B31.9, "Building Services Piping," for systems equal to or less than 15 psig (104 kPa)**]. Safety valves and pressure vessels shall bear the appropriate ASME label.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Preparation for Shipping: Clean flanges and exposed-metal surfaces and treat with anticorrosion compound after assembly and testing. Protect flanges, pipe openings, and nozzles with wooden flange covers or with screwed-in plugs.

B. Store units in dry location.

C. Retain protective flange covers and machined-surface protective coatings during storage.

D. Protect bearings and couplings against damage from sand, grit, and other foreign matter.

E. Comply with manufacturer's written rigging instructions.

1.9 COORDINATION

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

PART 2 - PRODUCTS

2.1 FEEDWATER UNITS

A. <Double click here to find, evaluate, and insert list of manufacturers and products.>

B. Description: Factory-assembled and -tested unit consisting of a receiver, [**simplex**] [**duplex**] feedwater pumps, controls, and the following features and accessories:

1. [**Liquid-filled industrial**][**Bimetal dial-type**] thermometer graduated in [**Fahrenheit**] [**Celsius**] [**both Fahrenheit and Celsius**].
2. Level gage glass[**, reflex flat type,**] with stops at top and bottom.
3. Lifting eyes.
4. Companion flanges.
5. Pump, suction and discharge isolation valve, inlet strainer, discharge check valve, and liquid-filled pressure gage.
6. Makeup Water Assembly: [**Float operated with integral valve**] [**Electric level controller and valve**]; with inlet strainer and three-valve bypass.
7. Feedwater Heater: Sparge tube, thermostat, and control valve.
8. Factory-Installed Pipe, NPS 2-1/2 (DN 65) and Smaller: ASTM A 53/A 53M, Type S (seamless), Grade B; or ASTM A 106, Type S, Grade B, Schedule [**40**] [**80**]; with threaded joints and fittings.

    a. Cast-Iron Threaded Fittings: ASME B16.4; Class [**125**] [**250**].
    b. Malleable-Iron Threaded Fittings: ASME B16.3, Class [**150**] [**300**].
    c. Forged-Steel Fittings: ASME B16.11, Class 3000.
    d. Malleable-Iron Unions: ASME B16.39; Class [**150**] [**300**].
    e. Forged-Steel Unions: MSS SP-83, Class 3000.

9. Factory-Installed Pipe, NPS 3 (DN 80) and Larger: ASTM A 53/A 53M, Type E (electric-resistance welded), Grade B; or ASTM A 106, Type S, Grade B, Schedule [**40**] [**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**] [**300**], including bolts, nuts, and gaskets.

C. Receiver:

1. Material: [**Close-grain cast iron**] [**Welded carbon steel**] [**Welded carbon steel galvanized after fabrication**] [**Stainless steel**].
2. Additional corrosion protection:

a. [**0.07-inch (1.8-mm)**] [**0.13-inch (3.3-mm)**] [**0.19-inch (4.8-mm)**] <**Insert thickness**> thickness allowance.
b. Electrolytic corrosion-inhibitor anode.

3. Finish: [**Primer**] [**Primer under enamel topcoat**] [**Primer under epoxy topcoat**].
4. Factory-Applied Insulation and Jacket: Minimum thickness of [**2 inches (50 mm)**] <**Insert thickness**> for mineral-fiber pipe and tank insulation. Cover insulation with [**painted steel**] [**stucco-embossed aluminum**] [**stainless-steel**] jacket.
5. Mounting Arrangement: [**Recessed below floor**] [**Floor mounted**].
6. Mounting Frame: Structural-steel stand to support receiver and pumps.[**Fabricate stand with bracing adequate for seismic forces according to authorities having jurisdiction and to allow anchoring mounting frame to floor.**]

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

1. Impeller: [**Bronze**] [**Stainless steel**].
2. Seals: Mechanical.
3. Motor: [**Open dripproof**] [**Totally enclosed**] [**Totally enclosed fan-cooled**] enclosure. Comply with requirements in Section 230513 "Common Motor Requirements for HVAC Equipment."

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

1. Impeller: [**Bronze**] [**Stainless steel**].
2. Coupling: [**Close**] [**Flexible**].
3. Seals: Mechanical.
4. Motor: [**Open dripproof**] [**Totally enclosed**] [**Totally enclosed fan-cooled**] enclosure. Comply with requirements in Section 230513 "Common Motor Requirements for HVAC Equipment."

F. Control panel shall be unit mounted and factory wired and include the following:

1. NEMA 250, Type [**1**] [**4**] [**4X**] [**12**] <**Insert type**> enclosure.
2. Single-point field power interface to [**fused disconnect switch**] [**nonfused disconnect switch**] [**circuit breaker**].

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

3. NEMA-rated motor controller for each motor, and include a hand-off-auto switch and overcurrent protection.

a. Alternating controls for duplex units with intermittent operation as indicated by control sequence.

4. Terminal blocks with numbered and color-coded wiring to match wiring diagram.
5. Wiring outside of an enclosure in a [**metal**]raceway. 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. Fused control-circuit transformer.
11. Microprocessor-based controller.

G. Feedwater Simplex-Pump Control Sequence:

1. Boiler water-level controller starts and stops pump to maintain boiler water-level set point.
2. Visual indication of pump on[**and off**] status.
3. Visual[**and audible**] alarm indication of pump failure.

H. Feedwater Duplex-Pump Control Sequence:

1. Boiler water-level controller starts and stops lead pump to maintain boiler water-level set point.
2. Lead and lag pumps alternate [**after each start**] [**to equalize run time**].
3. Lead pump failure, lag pump [**automatically starts if lead pump cannot maintain set point**] [**is started manually**].
4. Visual indication of pump on[**and off**] status.
5. Visual indication of pump lead/lag status.
6. Visual[**and audible**] alarm indication of pump failure.

I. Feedwater Duplex-Pump 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 [**after each start**] [**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.

J. Receiver Makeup Water Control Sequence:

1. Electric level controller operates electric control valve to maintain receiver water-level set point.
2. Mechanical float operates integral valve to maintain water-level set point.
3. Visual[**and audible**] alarm indication of low[**and high**] receiver-water level.

K. 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**] [**, receiver low-water-level alarm**] [**, receiver high-water-level alarm**] [**, feedwater temperature**] <**Insert monitoring**>.

L. Capacities and Characteristics:

1. Condensate Receiver:

a. Volume: <**Insert gal. (L).**>
b. Diameter: <**Insert inches (mm).**>
c. Length: <**Insert inches (mm).**>
d. Height to Condensate Inlet: <**Insert inches (mm).**>
e. Condensate Return Minimum Inlet Size: <**Insert NPS (DN).**>
f. Makeup Water Minimum Inlet Size: <**Insert NPS (DN).**>
g. Sparge-Tube Steam Supply: <**Insert lb/h (kW).**>

2. Feedwater Pumps:

a. No. of Pumps: [**Simplex**] [**Duplex**] <**Insert number**>.
b. Flow Rate: <**Insert gpm (L/s).**>
c. NPSH Required: <**Insert psig (kPa).**>
d. Rated Operating Temperature: <**Insert deg F (deg C).**>
e. Head Pressure: <**Insert psig (kPa).**>
f. Horsepower: <**Insert horsepower.**>
g. Speed: <**Insert value**> RPM.
h. Volts: [**115**] [**208**] [**230**] [**460**] <**Insert value**> V.
i. Phase: [**Single**] [**Three**].
j. Hertz: 60.

2.2 FEEDWATER UNIT WITH VACUUM PRODUCER

A. <Double click here to find, evaluate, and insert list of manufacturers and products.>

B. Description: Receiver mounted, consisting of multijet vacuum producer, centrifugal pump and motor assembly mounted on separation chamber, and automatic pressure and water temperature controls. Include the following accessories:

1. [**Liquid-filled industrial**] [**Bimetal dial-type**] thermometer graduated in [**Fahrenheit**] [**Celsius**] [**both Fahrenheit and Celsius**].
2. Vacuum Gage: Dial-type register in inches of mercury (kPa).
3. Level Gage Glass: Stops top and bottom.
4. Air-suction check valve.
5. Lifting eyes.
6. Companion flanges.
7. Low-water cutoff switch.
8. Cooling-Water Control: Aquastat, inlet strainer, and electric valve.
9. Air vent.
10. Overflow drain from vacuum-producer receiver.

11. Factory-Installed Pipe, NPS 2-1/2 (DN 65) and Smaller: ASTM A 53/A 53M, Type S (seamless), Grade B; or ASTM A 106, Type S, Grade B, Schedule [**40**] [**80**]; with threaded joints and fittings.

    a. Cast-Iron Threaded Fittings: ASME B16.4; Class [**125**] [**250**].
    b. Malleable-Iron Threaded Fittings: ASME B16.3, Class [**150**] [**300**].
    c. Forged-Steel Fittings: ASME B16.11, Class 3000.
    d. Malleable-Iron Unions: ASME B16.39; Class [**150**] [**300**].
    e. Forged-Steel Unions: MSS SP-83, Class 3000.

12. Factory-Installed Pipe, NPS 3 (DN 80) and Larger: ASTM A 53/A 53M, Type E (electric-resistance welded), Grade B; or ASTM A 106, Type S, Grade B, Schedule [**40**] [**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**] [**300**], including bolts, nuts, and gaskets.

C. Vacuum-Producer Reservoir and Vacuum Receiver:

1. Material: [**Close-grain cast iron**] [**Welded carbon steel**] [**Welded carbon steel galvanized after fabrication**] [**Stainless steel**].
2. Additional corrosion protection:

    a. [**0.07-inch (1.8-mm)**] [**0.13-inch (3.3-mm)**] [**0.19-inch (4.8-mm)**] <**Insert thickness**> thickness allowance.
    b. Electrolytic corrosion-inhibitor anode.

3. Finish: [**Primer**] [**Primer under enamel topcoat**] [**Primer under epoxy topcoat**].
4. Factory-Applied Insulation and Jacket: Minimum thickness of [**2 inches (50 mm)**] <**Insert thickness**> for mineral-fiber pipe and tank insulation. Cover insulation with [**painted steel**] [**stucco-embossed aluminum**] [**stainless-steel**] jacket.
5. Mounting Arrangement: [**Recessed below floor**] [**Floor mounted**].
6. Mounting Frame: Structural-steel stand to support receiver and pumps.[**Fabricate stand with bracing adequate for seismic forces according to authorities having jurisdiction and to allow anchoring mounting frame to floor.**]

D. Vertical Vacuum-Producer Pump: Flange-mounted, close-coupled, single-stage, radially split-case-design centrifugal pump; rated for [**175-psig (1205-kPa)**] <**Insert pressure**> minimum working pressure and a continuous water temperature of at least [**225 deg F (107 deg C)**] <**Insert temperature**>; with the following features:

1. Impeller: Bronze.
2. Shaft: Stainless steel.
3. Seals: Mechanical.
4. Motor: [**Open dripproof**] [**Totally enclosed**] [**Totally enclosed fan-cooled**] enclosure. Comply with requirements in Section 230513 "Common Motor Requirements for HVAC Equipment."

E. Horizontal Vacuum-Producer Pump: Base-mounted, single-stage, radially split-case-design centrifugal pump; rated for [**175-psig (1205-kPa)**] <**Insert pressure**> minimum working

pressure and a continuous water temperature of at least [**225 deg F (107 deg C)**] <**Insert temperature**>; with the following features:

1. Impeller: Bronze.
2. Shaft: Stainless steel.
3. Coupling: [**Close**] [**Flexible**].
4. Seals: Mechanical.
5. Motor: [**Open dripproof**] [**Totally enclosed**] [**Totally enclosed fan-cooled**] enclosure. Comply with requirements in Section 230513 "Common Motor Requirements for HVAC Equipment."

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

1. Impeller: [**Bronze**] [**Stainless steel**].
2. Seals: Mechanical.
3. Motor: [**Open dripproof**] [**Totally enclosed**] [**Totally enclosed fan-cooled**] enclosure. Comply with requirements in Section 230513 "Common Motor Requirements for HVAC Equipment."

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

1. Impeller: [**Bronze**] [**Stainless steel**].
2. Coupling: [**Close**] [**Flexible**].
3. Seals: Mechanical.
4. Motor: [**Open dripproof**] [**Totally enclosed**] [**Totally enclosed fan-cooled**] enclosure. Comply with requirements in Section 230513 "Common Motor Requirements for HVAC Equipment."

H. Control panel shall be unit mounted and factory wired and include the following:

1. Vacuum Switches for Simplex Vacuum-Producer Pumps: Include pressure adjustment, and test push button. Factory set to operate pump between 3 and 6 inches of mercury (10.1 and 20.2 kPa).
2. Vacuum Switches for Duplex Vacuum-Producer Pumps: Include pressure adjustment, and test push button. Factory set so one pump operates for 3 to 5 inches of mercury (10.1 to 16.9 kPa) and both pumps operate for 4 to 6 inches of mercury (13.5 to 20.2 kPa).
3. NEMA 250, Type [**1**] [**4**] [**4X**] [**12**] <**Insert type**> enclosure.
4. Single-point field power interface to [**fused disconnect switch**] [**nonfused disconnect switch**] [**circuit breaker**].
    a. Branch power circuit to each motor and to controls[**with a disconnect switch or circuit breaker**].
5. NEMA-rated motor controller for each motor and include a hand-off-auto switch and overcurrent protection.

a. Alternating control for units with intermittent operation as indicated by control sequence.

6. Terminal blocks with numbered and color-coded wiring to match wiring diagram.
7. Wiring outside of an enclosure in a [**metal**]raceway. Make connections to motor with liquidtight conduit.
8. Removable control mounting plate.
9. Visual indication of status and alarm[**with momentary test push button**].
10. Audible alarm and silence switch.
11. Visual indication of elapsed run time, graduated in hours.
12. Fused control-circuit transformer.

I. Vacuum-Producer Control Sequence:

1. Cycle pumps to maintain vacuum-pressure set point.
2. Visual indication of pump on[**and off**] status.
3. Visual[**and audible**] alarm indication of pump failure.

J. Feedwater Simplex-Pump Control Sequence:

1. Boiler water-level controller starts and stops pump to maintain boiler water-level set point.
2. Visual indication of pump on[**and off**] status.
3. Visual[**and audible**] alarm indication of pump failure.

K. Feedwater Duplex-Pump Control Sequence:

1. Boiler water-level controller starts and stops lead pump to maintain boiler water-level set point.
2. Lead and lag pumps alternate [**after each start**] [**to equalize run time**].
3. Lead pump failure, lag pump [**automatically starts if lead pump cannot maintain set point**] [**is started manually**].
4. Visual indication of pump on[**and off**] status.
5. Visual indication of pump lead/lag status.
6. Visual[**and audible**] alarm indication of pump failure.

L. Feedwater Duplex-Pump 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 [**after each start**] [**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.

M. Makeup Water Control Sequence:

1. Electric level controller operates electric control valve to maintain water temperature set point.
2. Visual[**and audible**] alarm indication of low[**and high**] water level.

N. 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**] [**, receiver low-water-level alarm**] [**, receiver high-water-level alarm**] [**, feedwater temperature**] <**Insert monitoring**>.

O. Capacities and Characteristics:

1. Vacuum-Producer Reservoir:

a. Volume: <**Insert gal. (L).**>
b. Diameter: <**Insert inches (mm).**>
c. Length: <**Insert inches (mm).**>
d. Cooling Makeup Water Supply: <**Insert NPS (DN).**>
e. Overflow Drain: <**Insert NPS (DN).**>

2. Vacuum-Producer Pumps:

a. No. of Pumps: [**Simplex**] [**Duplex**] <**Insert number**>.
b. Air Capacity: <**Insert cfm (L/s).**>
c. Head Pressure: <**Insert inches of mercury (kPa).**>
d. Horsepower: <**Insert horsepower.**>
e. Speed: <**Insert value**> RPM.
f. Volts: [**115**] [**208**] [**230**] [**460**] <**Insert value**> V.
g. Phase: [**Single**] [**Three**].
h. Hertz: 60.

3. Vacuum Receiver:

a. Volume: <**Insert gal. (L).**>
b. Diameter: <**Insert inches (mm).**>
c. Length: <**Insert inches (mm).**>
d. Height to Condensate Inlet: <**Insert inches (mm).**>
e. Condensate Return Minimum Inlet Size: <**Insert NPS (DN).**>

4. Feedwater Pumps:

a. No. of Pumps: [**Simplex**] [**Duplex**] <**Insert number**>.
b. Flow Rate: <**Insert gpm (L/s).**>
c. NPSH Required: <**Insert psig (kPa).**>
d. Rated Operating Temperature: <**Insert deg F (deg C).**>
e. Head Pressure: <**Insert psig (kPa).**>
f. Horsepower: <**Insert horsepower.**>
g. Speed: <**Insert value**> RPM.
h. Volts: [**115**] [**208**] [**230**] [**460**] <**Insert value**> V.
i. Phase: [**Single**] [**Three**].

j. Hertz: 60.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Before feedwater unit 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 feedwater unit performance, maintenance, and operations.

1. Final feedwater unit 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. Equipment Mounting:

1. Install feedwater units on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified in [**Section 033000 "Cast-in-Place Concrete."**] [**Section 033053 "Miscellaneous Cast-in-Place Concrete."**]
2. Comply with requirements for vibration isolation and seismic control devices specified in Section 230548 "Vibration and Seismic Controls for HVAC."
3. Comply with requirements for vibration isolation devices specified in Section 230548.13 "Vibration Controls for HVAC."

B. Install unit to permit access for maintenance.

C. Support piping independent of pumps.

D. Install base-mounted pumps on concrete bases with grouted base frames.

E. Install parts and accessories shipped loose.

3.3 CONNECTIONS

A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to machine to allow service and maintenance.

C. Connect makeup water piping and cooling-water piping with reduced-pressure backflow preventers.

D. Install overflow drain piping to nearest floor drain.

E. Install vents and extend to outdoors; terminate with elbow turned down and an insect screen.

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, equipment installation, and piping and electrical connections for compliance with manufacturer's written instructions.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
3. Check bearing lubrication.
4. Verify proper motor rotation.
5. Start up service.
6. Report results in writing.

D. Remove and replace malfunctioning units and retest as specified above.

3.5 ADJUSTING

A. Adjust boiler water-level controls to properly stage unit.

B. Set field-adjustable, makeup water and cooling-water controls.

3.6 CLEANING

A. Clean equipment internally; remove coatings applied for protection during shipping and storage, foreign material, and oily residue according to manufacturer's written instructions.

B. Clean strainers.

3.7 DEMONSTRATION

A. [**Engage a factory-authorized service representative to train**] [**Train**] Owner's maintenance personnel to adjust, operate, and maintain feedwater units. Refer to Section 017900 "Demonstration and Training."

END OF SECTION 235313