## SECTION 23 5233
## WATER-TUBE BOILERS

### PART 1 GENERAL

### 1.01 SECTION INCLUDES

A. Packaged water-tube boilers.

B. Boiler accessory equipment.

C. Water pre-treatment equipment.

D. Water treatment.

E. Controls.

F. Electrical power.

G. Venting.

### 1.02 RELATED REQUIREMENTS

A. Section 03 3000 - Cast-in-Place Concrete.

B. Section 08 9100 - Louvers.

C. Section 23 0513 - Common Motor Requirements for HVAC Equipment.

D. Section 23 0548 - Vibration and Seismic Controls for HVAC Piping and Equipment.

E. Section 23 0913 - Instrumentation and Control Devices for HVAC.

F. Section 23 2114 - Hydronic Specialties.

G. Section 23 2123 - Hydronic Pumps.

H. Section 23 2214 - Steam and Condensate Heating Specialties.

I. Section 23 2500 - HVAC Water Treatment.

J. Section 23 5100 - Breechings, Chimneys, and Stacks.

K. Section 26 0519 - Low-Voltage Electrical Power Conductors and Cables.

L. Section 26 0526 - Grounding and Bonding for Electrical Systems

### 1.03 ABBREVIATIONS AND ACRONYMS

A. AGA: American Gas Association.

B. FMG: Factory Mutual Global.

C. IRI: Industrial Risk Insurers.

D. UL: Underwriters Laboratories Inc.

### 1.04 REFERENCE STANDARDS

A. ASHRAE Std 90.1 - Energy Standard for Buildings Except Low-Rise Residential Buildings; 2013, Including All Addenda.

B. ASME B31.1 - Power Piping; 2014.

C. ASME B31.9 - Building Services Piping; 2014.

D. ASME BPVC - Boiler and Pressure Vessel Code; 2015.

E. ASME BPVC-VIII-1 - Boiler and Pressure Vessel Code, Section VIII, Division 1 - Rules for Construction of Pressure Vessels; 2015.

F. ASME CSD-1 - Controls and Safety Devices for Automatically Fired Boilers; 2012.

G. ASTM A106/A106M - Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service; 2014.

H. ASTM A959 - Standard Guide for Specifying Harmonized Standard Grade Compositions for Wrought Stainless Steels; 2011.

I. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2014.

J. NFPA 54 - National Fuel Gas Code; 2015.

K. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

L. UL 726 - Oil-Fired Boiler Assemblies; Current Edition, Including All Revisions.

M. UL 795 - Commercial-Industrial Gas Heating Equipment; Current Edition, Including All Revisions.

### 1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data indicating general assembly, components, controls, safety controls, and wiring diagrams with electrical characteristics and connection requirements, and service connections.

C. Shop Drawings: Vibration isolation and seismic restraint requirements; approved by Architect.

D. Manufacturer's Instructions: Indicate assembly, support details, connection requirements, and include start up instructions.

E. Manufacturer's Inspection Report: Submit authorized boiler inspection prior to shipment.

F. Manufacturer's Field Reports: Indicate that specified performance and efficiency has been met or exceeded; at minimum provide report of the following combustion tests: boiler firing rate, over fire draft, gas flow rate, heat input, burner manifold gas pressure, percent carbon monoxide (CO), percent oxygen (O), percent excess air, flue gas temperature at outlet, ambient temperature, net stack temperature, percent stack loss, percent combustion efficiency, and heat output.

G. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, cleaning procedures, replacement parts list, and maintenance and repair data.

H. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

I. ASME "A" Stamp Certification and Report: Submit "A" stamp certificate of authorization as required by authorities having jurisdiction, and document hydrostatic testing of piping external to boiler.

J. Startup service reports.

### 1.06 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

### 1.07 DELIVERY, STORAGE, AND HANDLING

A. Protect boilers from damage by leaving factory inspection openings and shipping packaging in place until final installation.

## PART 2 PRODUCTS

### 2.01 MANUFACTURERS

A. Bryan Steam Corporation; _____: www.bryanboilers.com.

B. Cleaver-Brooks; _____: www.cleaver-brooks.com.

C. MIURA America Co., Ltd.; LX Series: www.miuraboiler.com/sle.

D. Substitutions: See Section 01 6000 - Product Requirements.

### 2.02 PERFORMANCE REQUIREMENTS

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: Fabricate and label boilers to comply with ASME BPVC.

C. ASHRAE Std 90.1 Compliance: Boilers shall have minimum efficiency according to "Gas and Oil Fired Boilers - Minimum Efficiency Requirements."

D. UL Compliance: UL 726 and UL 795.

E. Boilers shall be listed and labeled by a testing agency acceptable to Authority Having Jurisdiction.

F. Boiler Efficiency (Fuel to Steam): 85 percent at 70 degrees farenheit feed water temperature, 70 psig steam.

G. Outer casing temperature not to exceed 120 degrees farenheit at maximum boiler capacity.

**2.03 PACKAGED WATER-TUBE BOILERS**

A. Factory-fabricated, steam, water-tube boiler on a skid mounted steel base including insulation, jacketing, venting, supply and return connections, and controls.

B. Pressure Vessel: Vertical steel tubes and drums.
   1. Accessible head plates at both ends.
   2. Inspection openings or couplings in headers.
   3. Drain tappings, both drums, for surface and mud removal.
   4. Steam separator.
   5. Limit tube configurations to two.
   6. Accessible inspection ports in drum, mud legs, and tube manifolds.
   7. Membrane water-wall design.

C. Combustion Chamber:
   1. Poured Refractory: 2 1/2 inch, 2700 deg F minimum.
      a. Lap joints 2 inch thick.
   2. Fiber-blanket joint seals on side walls.
   3. Observation ports in front and back.

D. Casing:
   1. Insulation Surrounding Pressure Vessel and Combustion Chamber:
      a. Refractory Thickness: 2 inch.
      b. Insulating Board Thickness: 1 inch.
      c. Galvanized-steel membrane.
      d. Mineral-fiber Insulation: 2 inch.
   2. Flue Connection: Aluminized steel.
   3. Jacketing Material: Stainless steel, with screw-fastened closures.
      a. Finish: Baked-enamel.
   4. Steel mounting base.
   5. Control Compartment Enclosure: NEMA 250, Type 1A.

E. Burner, Forced-Draft: Natural gas.
   1. Welded, stainless-steel, multiport.
   2. Blower: Direct drive integral to burner. Adjustable, air-fuel ratio damper.
      a. Motors: Comply with requirements specified in Section 23 0513. Motor sized so as to operate in service factor range above 1.0 when operating.
   3. Gas Train: Control devices to have full-modulation control. Sequencing complying with AGA for gas.
   4. Pilot: Intermittent-electric-spark ignition with observation port.
      a. Main-valve and pilot-safety shutoff.
      b. Electronic supervision of burner flame.

F. Barometric Damper: Galvanized-steel assembly with flue-gas thermometer.

G. Trim for Hot Water:
   1. Comply with ASME B31.1.
   2. Comply with ASME B31.9.
   3. Aquastat Controllers: Operating, firing rate, and high limit.

4. Safety Relief Valve: ASME rated.
5. Pressure and Temperature Gage: Minimum 3 1/2 inch diameter,
6. Air Vent: Automatic.
7. Drain: 3/4 NPS gate valve.

H. Trim for Steam:
1. Devices to comply with ASME B31.1.
2. Devices to comply with ASME B31.9.
3. Pressure Controllers: Operating, firing rate, and high limit with manual reset and back up.
4. Safety Relief Valve:
5. Water Column: 12 inch glass gage with shutoffs.
6. Drain Valves: 3/4 NPS or hose-ends.
7. Blowdown Valves: Slow-acting.
8. Stop Valves: Boiler inlets and outlets, except safety relief valves or pre-heater inlet and outlet. Rising stems on valves larger than 2 NPS.
9. Stop-Check Valves: Factory-installed, stop-check valve and stop valve at boiler outlet with free-blow drain valve factory installed between the two valves and visible when operating stop-check valve.

## 2.04 BOILER ACCESSORY EQUIPMENT

A. Heat Recovery:
1. Economizer: Gas to liquid heat exchanger, utilizing flue gasses to preheat boiler feed water.
a. Factory installed on boiler.
b. Floor mounted and attached directly to boiler flue gas outlet.
c. ASME BPVC-VIII-1 pressure vessel with insulated outer casing.
1) Gas-tight, inner seal welded steel casing.
d. Drainable and capable of emergency dry operation.

B. Blowdown Equipment:
1. Blowdown Separator:
a. Comply with ASME BPVC-VIII-1.
b. Construction:
1) After cooler with automatic temperature control valve.
2) Temperature gage.
3) Cooling water inlet strainer.
4) Pressure gage with stop valve.
c. Maximum Allowable Working Pressure: 90 psig at 400 degrees F.
d. Hydrostatic Test Pressure: 117 psig.

C. Feedwater Deaerator:
1. Vertical Tray Type:
a. Comply with ASME BPVC-VIII-1.
b. Construction:
1) Completely packaged with pumps and control panel.
2) Maximum Allowable Working Pressure: 50 psig.
3) Standard 10 minutes deaerated water storage.
4) 304L Stainless Steel: All internal surfaces in contact with water that is not deaerated.
5) 2-stage deaeration.
6) Internal direct contact vent condenser for minimum steam loss.

## 2.05 WATER TREATMENT

A. Corrosion Inhibitors:
1. Silicate Based Corrosion Inhibitor:
a. Properties:
1) Appearance: Clear or slightly light yellow liquid.

2) One Percent pH: 11.7.
3) Specific Gravity: 1.25.
4) Flash Point: None.
5) Odor: None.

b. Provides pH boosting, scale protection, and corrosion inhibition for once-through boiler internals.
c. Environmentally friendly.

B. Chemical Pump:
1. Electronic metering pump.
2. Control: Manual speed control (adjustable to 360 strokes per minute) and manually adjustable strike length.
3. Control Module:

**2.06 CONTROLS: AS SPECIFIED IN SECTION 23 0913.**

**2.07 ELECTRICAL POWER**

A. Controllers, Electrical Devices, and Wiring: Electrical devices and connections are specified in electrical Sections.

B. Single-Point Field Power Connection: Factory installed switches, controllers, transformers, and other devices will have a single-point field connection.
1. Enclosure: NEMA 250, Type 1.
2. Wiring: Numbered and color-coded matching wiring diagram.
3. Factory wiring exterior of an enclosure to be in a metal raceway.
4. Field power interface shall be to lugs.
5. Branch power circuit to each motor and controls with disconnect switch or circuit breaker.
6. Overcurrent Protection: Each motor.

**2.08 VENTING**

A. Complete system, ASTM A959, Type 29-4C stainless steel, pipe, vent terminal, thimble, indoor plate, vent adapter, condensate trap, and sealant. Refer to Section 23 5100.

B. Combustion-Air Intake: Stainless steel, pipe, vent terminal with screen, inlet air coupling, and sealant. Refer to Section 08 9100.

**2.09 CAPACITIES AND CHARACTERISTICS**

A. Heating Medium: _____.

B. Design Pressure Rating for Hot Water: 60 psig.
1. Entering Temperature: ___ deg F.
2. Leaving Temperature: ___ deg F.
3. Design Flow Rate: ___ gpm.
4. Design Pressure Drop: ___ psig.

C. Input Rating for Gas:
1. AGA Input: ____ MBh.
2. I=B=R Input: _____ MBh.
3. Gas Input: _____ cfh.

**2.10 SOURCE QUALITY CONTROL**

A. See Section 01 4000 - Quality Requirements, for additional requirements.

B. Test and inspect factory-assembled boilers, before shipping, according to ASME BPVC.

C. Burner and Hydrostatic Test: Factory adjust burner to eliminate excess oxygen, carbon dioxide, oxides of nitrogen emissions, and carbon monoxide in flue gas and to achieve combustion efficiency; perform hydrostatic test.

## PART 3 EXECUTION

### 3.01 EXAMINATION

A. Examine concrete equipment bases, locations, connection sizes, and any conditions affecting performance, maintenance, and operations.

B. Determine exact boiler and equipment locations before establishing piping and electrical connections.

C. Be sure spaces and conditions where boilers will be installed are suitable and to code according to Authority Having Jurisdiction.

D. Proceed with installation after correction of unsatisfactory conditions.

### 3.02 INSTALLATION

A. Install boilers on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified in Section 03 3000.

B. Gas-Fired Boilers: Install according to NFPA 54.

### 3.03 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Piping installation must not impede service and maintenance of boiler.

C. Gas-train to gas piping with union. Piping to be same or larger than gas-train connection.

D. Hot-water to supply and return tappings with shutoff valve with union or flange connections. Install piping from safety relief valves to nearest floor drain.

E. Steam and condensate piping to supply, return, and blowdown tappings with shutoff valve and union or flange connections. Install piping from safety valves to drip-pan elbow and to nearest floor drain.

F. Equipment drain connection to nearest floor drain. Pipe size same as connection. Provide isolation valve.

G. Connect breeching boiler outlet. Comply with Section 23 5100.

H. Install flue-gas recirculation duct from vent to burner. Comply with Section 23 5100.

I. Ground equipment according to Section 26 0526.

J. Connect wiring according to Section 26 0519.

### 3.04 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for additional requirements.

### 3.05 CLOSEOUT ACTIVITIES

A. See Section 01 7800 - Closeout Submittals, for closeout submittals.

B. See Section 01 7900 - Demonstration and Training, for additional requirements.

**END OF SECTION 23 5233**