SECTION 235213 - ELECTRIC BOILERS

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. Section includes electric boilers, trim, and accessories for generating [**hot water**] [**and**] [**steam**].

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for boilers.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: For boilers, boiler trim, and accessories.

1. Include plans, elevations, sections, and [**mounting**] [**attachment**] details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal, and control wiring.

C. Delegated-Design Submittal: For each boiler.

1. Design calculations and vibration isolation base details, signed and sealed by a qualified professional engineer.

a. Design Calculations: Calculate requirements for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.

b. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.

1.4 INFORMATIONAL SUBMITTALS

A. Seismic Qualification Certificates: For boilers, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

B. Source quality-control reports.

C. Field quality-control reports.

D. Sample Warranty: For special warranty.

E. Other Informational Submittals:

1. 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 boiler.
2. CSA B51 pressure vessel Canadian Registration Number (CRN).
3. Startup service reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For boilers, components, and accessories to include in emergency, operation, and maintenance manuals.

1.6 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace pressure vessels of boilers that fail in materials or workmanship within specified warranty period.

1. Warranty Period: [**Five**] <**Insert number**> years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

2.2 MANUFACTURED UNITS

A. Description: Factory-fabricated, -assembled, and -tested electric boilers with trim and controls necessary to generate [**hot water**] [**steam**].

B. Pressure Vessel: [**Carbon-steel**] [**Cast-iron**] pressure vessel mounted on structural-steel base.

C. Nozzles: Flanges for [**water inlet and**] [**steam**] outlet and heating element inserts; threaded connections for trim and controls.

D. Insulation: [**One layer**] [**Two layers**] of minimum [**1-inch- (25-mm-)**] [**2-inch- (50-mm-)**] <**Insert thickness**> thick, glass-fiber insulation.

E. Jacket: [**Galvanized**]sheet metal casing with [**baked-enamel**] [**powder-coated**] protective finish and removable panels with snap-in or interlocking closures for access to pressure vessel.

F. Lifting Lugs: Welded to pressure vessel, extending above jacket.

G. Heating Elements: [**Copper**] [**Incoloy**]-sheathed, replaceable electric-resistance element, rated 20-kW maximum, with maximum [**50 W/sq. in. (7.7 W/sq. cm)**] [**75 W/sq. in. (11.5 W/sq. cm)**] <**Insert value**> over heat-transfer length.

H. Mounting Base: For securing boiler to concrete base.

1. Seismic Fabrication Requirements: Fabricate mounting base and attachment to boiler, accessories, and components with reinforcement strong enough to withstand seismic forces defined in Section 230548 "Vibration and Seismic Controls for HVAC" when mounting base is anchored to building structure.

I. 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.

J. ASME Compliance: Fabricate and label boilers to comply with 2013 ASME Boiler and Pressure Vessel Code.

K. NFPA Compliance: Design and fabricate boilers to comply with NFPA 70, Article 424, Paragraphs G and H.

L. UL Compliance: Test boilers for compliance with UL 834. Boilers shall be listed and labeled by a testing agency acceptable to authorities having jurisdiction.

M. CSA Compliance: Test boilers for compliance with CSA B51.

2.3 TRIM FOR HOT-WATER BOILERS

A. Include devices sized to comply with [**ASME B31.1**] [**ASME B31.9**] [**CSA B51**].

B. Aquastat Controllers: Operating auto-reset high limit.

C. Safety Relief Valve: ASME rated.

D. Pressure and Temperature Gage: Minimum 3-1/2-inch- (89-mm-) diameter, combination water-pressure and -temperature gage. Gages shall have operating-pressure and -temperature ranges, so normal operating range is about 50 percent of full range.

E. Boiler Air Vent: [**Automatic**] [**Manual**].

F. Dip-tube in water outlet.

G. Drain Valve: Minimum NPS 3/4 (DN 20) hose-end ball valve sized according to requirements of authorities having jurisdiction.

H. Tankless Heater: Carbon-steel header with copper-tube heat exchanger, mounted in an upper port of pressure vessel and sealed with fiber gasket.

1. Tappings NPS 2 (DN 50) and Smaller: Threaded ends according to ASME B1.20.1 for pipe threads.
2. Tappings NPS 2-1/2 (DN 65) and Larger: Flanged ends according to ASME B16.5 for steel and stainless-steel flanges, and according to ASME B16.24 for copper and copper-alloy flanges.

2.4 TRIM FOR STEAM BOILERS

A. Include devices sized to comply with [**ASME B31.1**] [**ASME B31.9**] [**CSA B51**].

B. Pressure Controllers: Operating auto-reset high limit.

C. Safety Relief Valve:

1. Size and Capacity: As required for equipment according to 2013 ASME Boiler and Pressure Vessel Code.
2. Description: Fully enclosed steel spring with adjustable pressure range and positive shutoff; factory set and sealed.

a. Drip-Pan Elbow: Cast iron and having threaded inlet and outlet, with threads complying with ASME B1.20.1.

D. Pressure Gage: Minimum 3-1/2-inch (89-mm) diameter. Gage shall have normal operating pressure about 50 percent of full range.

E. Water Column: Minimum 12-inch (300-mm) glass gage with shutoff cocks.

F. Drain Valves: Minimum NPS 3/4 (DN 20) or nozzle size with hose-end connection.

G. Blowdown Valves: Factory-installed bottom and surface, slow-acting blowdown valves same size as boiler nozzle.[**Blowdown valves shall be combination of slow and quick acting, as required by ASME B31.1.**]

H. Stop Valves: Boiler inlets and outlets, except safety relief valves or preheater inlet and outlet, shall be equipped with stop valve in an accessible location as near as practical to boiler nozzle and same size or larger than nozzle. Valves larger than NPS 2 (DN 50) shall have rising stem.

I. 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.

J. Tankless Heater: Carbon-steel header with copper-tube heat exchanger, mounted in an upper port of pressure vessel and sealed with fiber gasket.

1. Tappings NPS 2 (DN 50) and Smaller: Threaded ends according to ASME B1.20.1 for pipe threads.
2. Tappings NPS 2-1/2 (DN 65) and Larger: Flanged ends according to ASME B16.5 for steel and stainless-steel flanges, and according to ASME B16.24 for copper and copper-alloy flanges.

2.5 CONTROLS

A. Refer to Section 230923 "Direct Digital Control (DDC) System for HVAC" and Section 230993.11 "Sequence of Operations for HVAC DDC."

B. Boiler operating controls shall include the following devices and features:

1. Control transformer.
2. Step controller.
3. Recycling relay returns controller to off position after power failure.
4. Multistage thermostat.
5. Control-circuit switch.
6. Visual indication for each step.
7. Supply-voltage indicator.
8. Set-Point Adjust: Set points shall be adjustable.
9. Operating Level Control: Factory wired and mounted to cycle feedwater pump(s) for makeup water control.
10. Sequence of Operation: Electric, factory-fabricated and field-installed panel to control element sequence controller to maintain space temperature in response to thermostat with heat anticipator located in heated space.

    a. Include automatic, alternating-operation sequence for multiple boilers to provide equal runtime for boilers.

11. Sequence of Operation: Electric, factory-fabricated and field-installed panel to control element sequence controller to reset supply-water temperature inversely with outside-air temperature. At [**0 deg F (minus 17 deg C)**] <**Insert temperature**> outside-air temperature, set supply-water temperature at [**200 deg F (93 deg C)**] <**Insert temperature**>; at [**60 deg F (15 deg C)**] <**Insert temperature**> outside-air temperature, set supply-water temperature at [**140 deg F (60 deg C)**] <**Insert temperature**>.

    a. Include automatic, alternating-operation sequence for multiple boilers to provide equal runtime for boilers.

12. Sequence of Operation: Electric, factory-fabricated and field-installed panel to control element sequence controller to maintain a constant steam pressure. Maintain pressure set point plus or minus 10 percent.

a. Include automatic, alternating-operation sequence for multiple boilers to provide equal runtime for boilers.

C. Safety Controls: To maintain safe operating conditions, safety controls limit boiler operation.

1. High Cutoff: [**Manual**] [**Automatic**] reset stops boiler if operating conditions rise above set point or maximum boiler design [**temperature**] [**pressure**].
2. Low-Water Cutoff Switch: [**Electronic**] [**Float and electronic**] probe shall prevent boiler operation on low water. Cutoff switch shall be [**manual**] [**automatic**]-reset type.
3. Audible Alarm: Factory mounted on control panel with silence switch; shall sound alarm for above conditions.

D. Building Management System Interface: Factory install hardware and software to enable building management system to monitor, control, and display boiler status and alarms.

1. Hardwired Points:

a. Monitoring: On/off status, [**common trouble alarm**] [**low-water-level alarm**] <**Insert monitoring**>.
b. Control: On/off operation, [**hot water supply temperature set-point adjustment**] [**steam pressure adjustment**] <**Insert control**>.

2. A communication interface with building management system shall enable building management system operator to remotely control and monitor the boiler from an operator workstation. Control features available and monitoring points displayed locally at boiler control panel shall be available through building management system.

2.6 ELECTRICAL POWER

A. Single-Point Field Power Connection: Factory-installed and -wired switches, transformers, and electrical devices necessary shall provide a single-point field power connection to boiler.

1. Field power interface shall be to [**fused disconnect switch**] [**nonfused disconnect switch**] [**circuit breaker**].
2. Interlock with door to de-energize power with door open.

B. Electrical Enclosures: NEMA 250, Type [**1**] <**Insert type**> enclosure with hinged door and key-locking handle.

C. Install factory wiring outside of an enclosure in a [**metal**]raceway.

D. Comply with NFPA 70.

1. Electrical Circuits: 48 A, maximum.

E. Connectors: Mechanical lugs bolted to copper bus bars or distribution blocks with pressure connectors.

F. Fuses: NEMA FU 1, Class J or K5; 60 A, maximum.

G. Contactors: Three-pole magnetic contactors, listed for 500,000 cycles at full load.

H. Factory-wired internal control devices and heating elements.

1. Wiring shall be numbered and color coded to match wiring diagram.

2.7 CAPACITIES AND CHARACTERISTICS

A. Hot-Water Heating:

1. Design Water-Pressure Rating: [**160 psig (1100 kPa)**] <**Insert pressure rating**>.
2. Safety Relief Valve Setting: <**Insert psig (kPa)**>.
3. Entering-Water Temperature: <**Insert deg F (deg C)**>.
4. Leaving-Water Temperature: <**Insert deg F (deg C)**>.
5. Design Water Flow Rate: <**Insert gpm (L/s)**>.
6. Design Pressure Drop: <**Insert psig (kPa)**>.

B. Steam Heating:

1. Design Steam-Pressure Rating: [**15 psig (104 kPa)**] [**60 psig (420 kPa)**] [**125 psig (860 kPa)**] <**Insert pressure rating**>.
2. Safety Relief Valve Setting: <**Insert psig (kPa)**>.
3. Steam Operating Pressure: <**Insert psig (kPa)**>.
4. Steam Flow Rate: <**Insert lb/h (kg/s)**>.

C. Output Capacity: <**Insert MBh (kW)**>.

D. Equivalent Direct Radiation: <**Insert EDR (W)**>.

E. Tankless Water Heater:

1. Design Water Flow: <**Insert gpm (L/s)**>.
2. Design Pressure Drop: <**Insert psig (kPa)**>.
3. Entering-Water Temperature: <**Insert deg F (deg C)**>.
4. Leaving-Water Temperature: <**Insert deg F (deg C)**>.

F. Electrical Characteristics:

1. Kilowatts: <**Insert number**> kW.
2. Volts: [**208**] [**480**] <**Insert number**> V.
3. Phase: Three.
4. Hertz: [**50**] [**60**] <**Insert number**> Hz.
5. Full-Load Amperes: <**Insert number**> A.
6. Minimum Circuit Ampacity: <**Insert number**> A.
7. Maximum Overcurrent Protection: <**Insert number**> A.

2.8 SOURCE QUALITY CONTROL

A. Test and inspect factory-assembled boilers, before shipping, according to [**2013 ASME Boiler and Pressure Vessel Code**] [**CSA B51**].

B. Hydrostatic Test: Factory test assembled boiler, including hydrostatic test.

C. Allow Owner access to source quality-control testing of boilers. Notify Architect 14 days in advance of testing.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for concrete equipment bases, anchor-bolt sizes and locations, and piping and electrical connections to verify actual locations, sizes, and other conditions affecting performance of the Work.

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

B. Examine mechanical spaces, including required space for element removal, for suitable conditions where boilers will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 BOILER INSTALLATION

A. Equipment Mounting:

1. Install boilers 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-restraint 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 electrical devices furnished with boiler but not specified to be factory mounted.

3.3 CONNECTIONS

A. Piping installation requirements are specified in [**Section 232113 "Hydronic Piping"**] [**and**] [**Section 232213 "Steam and Condensate Heating Piping."**]. Drawings indicate general arrangement of piping, fittings, and specialties.

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

C. Connect hot-water piping to supply- and return-boiler tappings, with shutoff valve and union or flange at each connection.

D. Connect steam and condensate piping to supply-, return-, and blowdown-boiler tappings, with shutoff valve and union or flange at each connection.

E. Install piping from safety relief valves to nearest floor drain.

F. Install piping from safety relief valves to drip-pan elbow and to nearest floor drain.

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

3.4 FIELD QUALITY CONTROL

A. Testing Agency: [**Owner will engage**] [**Engage**] a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

C. Perform the following tests and inspections[**with the assistance of a factory-authorized service representative**]:

1. Perform installation and startup checks according to manufacturer's written instructions.
2. Leak Test: Hydrostatic test. Repair leaks and retest until no leaks exist.
3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

    a. Check and adjust initial operating set points and high- and low-limit safety set points of water level and [**water temperature**] [**steam pressure**].
    b. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

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

E. Performance Tests:

1. Engage a factory-authorized service representative to inspect component assemblies and equipment installations, including connections, and to conduct performance testing.
2. Boilers shall comply with performance requirements indicated, as determined by field performance tests. Adjust, modify, or replace equipment in order to comply.
3. Perform field performance tests to determine the capacity of boilers.
4. Repeat tests until results comply with requirements indicated.
5. Provide analysis equipment required to determine performance.
6. Provide temporary equipment and system modifications necessary to dissipate the heat produced during tests if building systems are inadequate.
7. Notify Architect in advance of test dates.
8. Document test results in a report and submit to Architect.

F. Boiler will be considered defective if it does not pass tests and inspections.

G. Prepare test and inspection reports.

3.5 ADJUSTING

A. Occupancy Adjustments: When requested within [**12 months**] <**Insert time period**> of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied

conditions. Provide up to [**two**] <**Insert number**> visits to Project during other-than-normal occupancy hours for this purpose.

3.6 DEMONSTRATION

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

END OF SECTION 235213