SECTION 235213 - ELECTRIC BOILERS

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 electric boilers, trim, and accessories for generating [**hot water**] [**and**] [**steam**].
			2. 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 type of product.

Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for boilers.

Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

* + - * 1. Sustainable Design Submittals:
				2. Shop Drawings: For boilers, boiler trim, and accessories.

Include plans, elevations, sections, and [**mounting**] [**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.

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 Data: Certificates, for boilers, 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. Sample Warranty: For special warranty.
				3. Other Informational Submittals:

Retain "ASME Stamp Certification and Report" subparagraph below for steam boilers operating at more than 15 psig (104 kPa) or hot-water boilers operating at more than 160 psig (1100 kPa) or 250 deg F (120 deg C).

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.

Retain first subparagraph below for project in Canada.

CSA B51 pressure vessel Canadian Registration Number (CRN).

Startup service reports.

* + - 1. CLOSEOUT SUBMITTALS
				1. Operation and Maintenance Data: For boilers, components, and accessories to include in emergency, operation, and maintenance manuals.
			2. WARRANTY

When warranties are required, verify with Director’s Representative's counsel that warranties stated in this article are not less than remedies available to Director’s Representative under prevailing local laws. Coordinate with Section 016000 "Product Requirements."

* + - * 1. Manufacturer's Warranty: Manufacturer agrees to repair or replace pressure vessels of boilers that fail in materials or workmanship within specified warranty period.

Verify available warranties and warranty periods for units and components.

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

1. PRODUCTS

See Editing Instruction No. 1 in the Evaluations for cautions about named manufacturers and products. For an explanation of options and Contractor's product selection procedures, see Section 016000 "Product Requirements."

* + - 1. MANUFACTURERS

* + - * 1. [Manufacturers:](http://www.specagent.com/Lookup?ulid=6262) Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

[Acme Engineering Products Inc](http://www.specagent.com/Lookup?uid=123457137838).

[Cleaver-Brooks](http://www.specagent.com/Lookup?uid=123457137842).

[Lochinvar, LLC](http://www.specagent.com/Lookup?uid=123457137836).

[Patterson-Kelley](http://www.specagent.com/Lookup?uid=123457137837).

Approved equivalent.

* + - 1. MANUFACTURED UNITS
				1. Description: Factory-fabricated, -assembled, and -tested electric boilers with trim and controls necessary to generate [**hot water**] [**steam**].
				2. Pressure Vessel: [**Carbon-steel**] [**Cast-iron**] pressure vessel mounted on structural-steel base.
				3. Nozzles: Flanges for [**water inlet and**] [**steam**] outlet and heating element inserts; threaded connections for trim and controls.
				4. Insulation: [**One layer**] [**Two layers**] of minimum [**1-inch- (25-mm-)**] [**2-inch- (50-mm-)**] <**Insert thickness**> thick, glass-fiber insulation.
				5. 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.
				6. Lifting Lugs: Welded to pressure vessel, extending above jacket.
				7. 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.
				8. Mounting Base: For securing boiler to concrete base.

Retain "Seismic Fabrication Requirements" Subparagraph below for projects in seismic areas. If retaining, also retain "Seismic Qualification Certificates" Paragraph in "Informational Submittals" Article.

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.

* + - * 1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70 “Standard for Electrical Safety in the Workplace”, by a qualified testing agency, and marked for intended location and application.
				2. ASME Compliance: Fabricate and label boilers to comply with 2013 ASME Boiler and Pressure Vessel Code.
				3. NFPA Compliance: Design and fabricate boilers to comply with NFPA 70 “Standard for Electrical Safety in the Workplace”, Article 424, Paragraphs G and H.
				4. UL Compliance: Test boilers for compliance with UL 834 “Standard for Safety Heating, Water Supply, and Power Boilers – Electric”. Boilers shall be listed and labeled by a testing agency acceptable to authorities having jurisdiction.

Retain "CSA Compliance" Paragraph below for projects in Canada.

* + - * 1. CSA Compliance: Test boilers for compliance with CSA B51 “Boiler, Pressure Vessel, and Pressure Piping Code”.

Retain "Trim for Hot-Water Boilers" or "Trim for Steam Boilers" Article below.

* + - 1. TRIM FOR HOT-WATER BOILERS

In first paragraph below, retain first option if boiler operating pressure exceeds 160 psig (1100 kPa) or boiler temperature exceeds 250 deg F (120 deg C).

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

Retain "Aquastat Controllers" Paragraph below if using modulating sequence of elements.

* + - * 1. Aquastat Controllers: Operating auto-reset high limit.
				2. Safety Relief Valve: ASME rated.
				3. 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.
				4. Boiler Air Vent: [**Automatic**] [**Manual**].
				5. Dip-tube in water outlet.
				6. Drain Valve: Minimum NPS 3/4 (DN 20) hose-end ball valve sized according to requirements of authorities having jurisdiction.

Coordinate "Tankless Heater" Paragraph below with other Sections for domestic water heaters. A tankless heater is not available from all manufacturers listed.

* + - * 1. Tankless Heater: Carbon-steel header with copper-tube heat exchanger, mounted in an upper port of pressure vessel and sealed with fiber gasket.

Tappings NPS 2 (DN 50) and Smaller: Threaded ends according to ASME B1.20.1 “Pipe Threads, General Purpose, Inch” for pipe threads.

Tappings NPS 2-1/2 (DN 65) and Larger: Flanged ends according to ASME B16.5 “Pipe Flanges & Flanged Fittings” for steel and stainless-steel flanges, and according to ASME B16.24 “Cast Copper Alloy Pipe Flanges, Flanged Fittings, and Valves: Classes 150, 300, 600, 900, 1500 and 2500” for copper and copper-alloy flanges.

* + - 1. TRIM FOR STEAM BOILERS

In first paragraph below, retain first option if boiler operating pressure exceeds 15 psig (104 kPa).

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

Retain "Pressure Controllers" Paragraph below if using modulating sequence of elements.

* + - * 1. Pressure Controllers: Operating auto-reset high limit.

Retain "Safety Relief Valve" Paragraph below if safety valve is a component of boiler. Coordinate with Section 232216 "Steam and Condensate Heating Piping Specialties."

* + - * 1. Safety Relief Valve:

Size and Capacity: As required for equipment according to 2013 ASME Boiler and Pressure Vessel Code.

Description: Fully enclosed steel spring with adjustable pressure range and positive shutoff; factory set and sealed.

Drip-Pan Elbow: Cast iron and having threaded inlet and outlet, with threads complying with ASME B1.20.1 “Pipe Threads, General Purpose, Inch”.

* + - * 1. Pressure Gage: Minimum 3-1/2-inch (89-mm) diameter. Gage shall have normal operating pressure about 50 percent of full range.
				2. Water Column: Minimum 12-inch (300-mm) glass gage with shutoff cocks.
				3. Drain Valves: Minimum NPS 3/4 (DN 20) or nozzle size with hose-end connection.

In "Blowdown Valves" Paragraph below, retain option if boiler operating pressure exceeds 100 psig (690 kPa).

* + - * 1. 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.**]
				2. 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.

Retain "Stop-Check Valves" Paragraph below for boilers equipped with manhole openings that operate at more than 15 psig (104 kPa) and supply steam to a common steam header with other boilers.

* + - * 1. 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.

Coordinate "Tankless Heater" Paragraph below with other Sections for domestic water heaters. A tankless heater is not available from all manufacturers listed.

* + - * 1. Tankless Heater: Carbon-steel header with copper-tube heat exchanger, mounted in an upper port of pressure vessel and sealed with fiber gasket.

Tappings NPS 2 (DN 50) and Smaller: Threaded ends according to ASME B1.20.1 “Pipe Threads, General Purpose, Inch” for pipe threads.

Tappings NPS 2-1/2 (DN 65) and Larger: Flanged ends according to ASME B16.5 “Pipe Flanges & Flanged Fittings” for steel and stainless-steel flanges, and according to ASME B16.24 “Cast Copper Alloy Pipe Flanges, Flanged Fittings, and Valves: Classes 150, 300, 600, 900, 1500 and 2500” for copper and copper-alloy flanges.

* + - 1. CONTROLS

Retain paragraph below if controls are specified in Section 230923 "Direct Digital Control (DDC) System for HVAC" and Section 230993.11 "Sequence of Operations for HVAC DDC."

* + - * 1. Refer to Section 230923 "Direct Digital Control (DDC) System for HVAC" and Section 230993.11 "Sequence of Operations for HVAC DDC."

Delete paragraph above and retain first two paragraphs below if controls are components of boilers. Coordinate with Section 230993.11 "Sequence of Operations for HVAC DDC."

* + - * 1. Boiler operating controls shall include the following devices and features:

Control transformer.

Step controller.

Recycling relay returns controller to off position after power failure.

Multistage thermostat.

Control-circuit switch.

Visual indication for each step.

Supply-voltage indicator.

Set-Point Adjust: Set points shall be adjustable.

Retain "Operating Level Control" Subparagraph below for steam boilers.

Operating Level Control: Factory wired and mounted to cycle feedwater pump(s) for makeup water control.

Retain one of three "Sequence of Operation" subparagraphs below for operating control sequences. Retain one of first two subparagraphs for hot-water boilers; second or third, for steam boilers.

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.

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

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**>.

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

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.

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

* + - * 1. Safety Controls: To maintain safe operating conditions, safety controls limit boiler operation.

In "High Cutoff" Subparagraph below, retain third option for hot-water boiler and fourth option for steam boiler.

High Cutoff: [**Manual**] [**Automatic**] reset stops boiler if operating conditions rise above set point or maximum boiler design [**temperature**] [**pressure**].

In "Low-Water Cutoff Switch" Subparagraph below, retain first option for hot-water boilers and second option for steam boilers.

Low-Water Cutoff Switch: [**Electronic**] [**Float and electronic**] probe shall prevent boiler operation on low water. Cutoff switch shall be [**manual**] [**automatic**]-reset type.

Audible Alarm: Factory mounted on control panel with silence switch; shall sound alarm for above conditions.

Retain "Building Management System Interface" Paragraph below if boiler controls interface with building management system.

* + - * 1. Building Management System Interface: Factory install hardware and software to enable building management system to monitor, control, and display boiler status and alarms.

Retain "Hardwired Points" Subparagraph below if interface with building management system is through hardwired points and minimal interface is required.

Hardwired Points:

Monitoring: On/off status, [**common trouble alarm**] [**low-water-level alarm**] <**Insert monitoring**>.

Control: On/off operation, [**hot water supply temperature set-point adjustment**] [**steam pressure adjustment**] <**Insert control**>.

Retain subparagraph below if extensive interface with building management system is required and is beyond that which can be provided by hardwired points. Requirement may exclude some manufacturers listed.

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.

* + - 1. ELECTRICAL POWER
				1. 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.

Field power interface shall be to [**fused disconnect switch**] [**nonfused disconnect switch**] [**circuit breaker**].

Subparagraph below describes an optional, but recommended, safety feature. Revise to suit Project.

Interlock with door to de-energize power with door open.

* + - * 1. Electrical Enclosures: NEMA 250 “Enclosures for Electrical Equipment”, Type [**1**] <**Insert type**> enclosure with hinged door and key-locking handle.
				2. Install factory wiring outside of an enclosure in a [**metal**]raceway.
				3. Comply with NFPA 70 “Standard for Electrical Safety in the Workplace”.

Electrical Circuits: 48 A, maximum.

* + - * 1. Connectors: Mechanical lugs bolted to copper bus bars or distribution blocks with pressure connectors.
				2. Fuses: NEMA FU 1, Class J or K5; 60 A, maximum.
				3. Contactors: Three-pole magnetic contactors, listed for 500,000 cycles at full load.
				4. Factory-wired internal control devices and heating elements.

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

* + - 1. CAPACITIES AND CHARACTERISTICS

Retain "Hot-Water Heating" or "Steam Heating" Paragraph below.

* + - * 1. Hot-Water Heating:

**Design Water-Pressure Rating: [160 psig (1100 kPa)] <Insert pressure rating>.**

**Safety Relief Valve Setting: <Insert psig (kPa)>.**

**Entering-Water Temperature: <Insert deg F (deg C)>.**

**Leaving-Water Temperature: <Insert deg F (deg C)>.**

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

**Design Pressure Drop: <Insert psig (kPa)>.**

* + - * 1. Steam Heating:

**Design Steam-Pressure Rating: [15 psig (104 kPa)] [60 psig (420 kPa)] [125 psig (860 kPa)] <Insert pressure rating>.**

**Safety Relief Valve Setting: <Insert psig (kPa)>.**

**Steam Operating Pressure: <Insert psig (kPa)>.**

**Steam Flow Rate: <Insert lb/h (kg/s)>.**

Retain "Output Capacity" or "Equivalent Direct Radiation" Paragraph below for rating methods.

* + - * 1. Output Capacity: <**Insert MBh (kW)**>.
				2. Equivalent Direct Radiation: <**Insert EDR (W)**>.

Retain "Tankless Water Heater" Paragraph below if boiler is equipped with tankless water heater.

* + - * 1. Tankless Water Heater:

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

Design Pressure Drop: <**Insert psig (kPa)**>.

Entering-Water Temperature: <**Insert deg F (deg C)**>.

Leaving-Water Temperature: <**Insert deg F (deg C)**>.

* + - * 1. Electrical Characteristics:

Kilowatts: <**Insert number**> kW.

Volts: [**208**] [**480**] <**Insert number**> V.

Phase: Three.

Hertz: [**50**] [**60**] <**Insert number**> Hz.

Full-Load Amperes: <**Insert number**> A.

Minimum Circuit Ampacity: <**Insert number**> A.

Maximum Overcurrent Protection: <**Insert number**> A.

* + - 1. SOURCE QUALITY CONTROL

Retain first option in first paragraph below for projects in the United States; retain second option for projects in Canada.

* + - * 1. Test and inspect factory-assembled boilers, before shipping, according to [**2013 ASME Boiler and Pressure Vessel Code**] [**CSA B51**].
				2. Hydrostatic Test: Factory test assembled boiler, including hydrostatic test.

Retain paragraph below if Director’s Representative wants to witness source quality-control testing.

* + - * 1. Allow Director’s Representative access to source quality-control testing of boilers. Notify Director’s Representative 14 days in advance of testing.
1. EXECUTION
	* + 1. EXAMINATION
				1. 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.

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

* + - * 1. Examine mechanical spaces, including required space for element removal, for suitable conditions where boilers will be installed.
				2. Proceed with installation only after unsatisfactory conditions have been corrected.
			1. BOILER INSTALLATION
				1. Equipment Mounting:

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-restraint device type and minimum deflection in supported equipment schedule on Drawings.

Comply with requirements for vibration isolation and seismic-restraint 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 electrical devices furnished with boiler but not specified to be factory mounted.
			1. CONNECTIONS

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

* + - * 1. 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.
				2. Install piping adjacent to boiler to allow service and maintenance.

Retain first paragraph below for hot-water boilers.

* + - * 1. Connect hot-water piping to supply- and return-boiler tappings, with shutoff valve and union or flange at each connection.

Retain first paragraph below for steam boilers.

* + - * 1. Connect steam and condensate piping to supply-, return-, and blowdown-boiler tappings, with shutoff valve and union or flange at each connection.

Retain one of first two paragraphs below. Retain first for hot-water boilers and second for steam boilers. Delete both if safety valves are specified in Section 232116 "Hydronic Piping Specialties" or Section 232216 "Steam and Condensate Heating Piping Specialties."

* + - * 1. Install piping from safety relief valves to nearest floor drain.
				2. Install piping from safety relief valves to drip-pan elbow and to nearest floor drain.
				3. 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.
			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.

* + - * 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 014216**]:

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

Leak Test: Hydrostatic test. Repair leaks and retest until no leaks exist.

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

Check and adjust initial operating set points and high- and low-limit safety set points of water level and [**water temperature**] [**steam pressure**].

Set field-adjustable switches and circuit-breaker trip ranges as indicated.

* + - * 1. Remove and replace malfunctioning units and retest as specified above.

Retain "Performance Tests" paragraph below if performance tests are required. Performance verification based on field tests is not typically required because of the associated cost. Consult Director’s Representative.

* + - * 1. Performance Tests:

Engage a Company Service Advisor to inspect component assemblies and equipment installations, including connections, and to conduct performance testing.

Boilers shall comply with performance requirements indicated, as determined by field performance tests. Adjust, modify, or replace equipment in order to comply.

Perform field performance tests to determine the capacity of boilers.

Repeat tests until results comply with requirements indicated.

Provide analysis equipment required to determine performance.

Provide temporary equipment and system modifications necessary to dissipate the heat produced during tests if building systems are inadequate.

Notify Director’s Representative in advance of test dates.

Document test results in a report and submit to Director’s Representative.

* + - * 1. Boiler will be considered defective if it does not pass tests and inspections.
				2. Prepare test and inspection reports.
			1. ADJUSTING
				1. 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.
			2. DEMONSTRATION
				1. [**Engage a Company Field Advisor per OGS Spec Section 014216 to train**] [**Train**] Facility's maintenance personnel to adjust, operate, and maintain boilers.

END OF SECTION 235213