

SECTION 235216 - CONDENSING 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 gas-fired, [**pulse-combustion**] [**fire-tube**] [**water-tube**] [**water-jacketed**] condensing 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, 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 boiler, 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).

1.5 CLOSEOUT SUBMITTALS

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

1.6 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to repair or replace components of boilers that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period for Pulse-Combustion Boilers:
 - a. Heat Exchanger Damaged by Thermal Shock: [10] <Insert number> years from date of Substantial Completion.
 - b. Heat-Exchanger Corrosion: [Prorated] [Nonprorated] for [five] <Insert number> years from date of Substantial Completion.
 - 2. Warranty Period for Fire-Tube Condensing Boilers:
 - a. Leakage and Materials: [10] <Insert number> years from date of Substantial Completion.

- b. Heat Exchanger Damaged by Thermal Stress and Corrosion: **[Prorated]** **[Nonprorated]** for **[five]** **<Insert number>** years from date of Substantial Completion.
- 3. Warranty Period for Water-Tube Condensing Boilers: **[20]** **<Insert number>** years from date of Substantial Completion.
- 4. Warranty Period for Water-Jacketed Condensing Boilers:
 - a. Leakage and Materials: **[Eight]** **<Insert number>** years from date of Substantial Completion.
 - b. Heat Exchanger Damaged by Thermal Stress and Corrosion: **[Prorated]** **[Nonprorated]** for **[five]** **<Insert number>** years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. 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.
- B. ASME Compliance: Fabricate and label boilers to comply with 2010 ASME Boiler and Pressure Vessel Code.
- C. ASHRAE/IES 90.1 Compliance: Boilers shall have minimum efficiency according to "Gas and Oil Fired Boilers - Minimum Efficiency Requirements."
- D. DOE Compliance: Minimum efficiency shall comply with 10 CFR 430, Subpart B, Appendix N.
- E. UL Compliance: Test boilers for compliance with UL 795. Boilers shall be listed and labeled by a testing agency acceptable to authorities having jurisdiction.
- F. CSA Compliance: Test boilers for compliance with CSA B51.
- G. Mounting Base: For securing boiler to concrete base.
 - 1. Seismic Fabrication Requirements: Fabricate mounting base and attachment to boiler pressure vessel, 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.

2.2 PULSE-COMBUSTION, FIRE-TUBE CONDENSING BOILERS

- A. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
- B. Description: Factory-fabricated, -assembled, and -tested, pulse-combustion condensing boiler with heat exchanger sealed pressure tight, built on a steel base, including insulated jacket; flue-

gas vent; combustion-air intake connections; water supply, return, and condensate drain connections; and controls.

- C. Heat Exchanger: [Type 316L, stainless-steel] [Carbon-steel] primary and secondary combustion chamber.
- D. Pressure Vessel: Carbon steel with welded heads and tube connections.
- E. Exhaust Decoupler: Fiberglass composite material in a corrosion-resistant steel box.
- F. Burner: [Natural] [Propane] gas, self-aspirating and self-venting after initial start.
- G. Blower: Centrifugal fan to operate only during start of each burner sequence.
 - 1. Motors: Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
 - a. Motor Sizes: Minimum size as indicated; if not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
- H. Gas Train: Combination gas valve with manual shutoff and pressure regulator.
- I. Ignition: Spark ignition with 100 percent main-valve shutoff with electronic flame supervision.
- J. Casing:
 - 1. Jacket: Sheet metal, with snap-in or interlocking closures.
 - 2. Control Compartment Enclosure: NEMA 250, Type 1A.
 - 3. Finish: [Baked-enamel] [Powder-coated] protective finish.
 - 4. Insulation: Minimum 2-inch- (50-mm-) thick, mineral-fiber insulation surrounding heat exchanger.
 - 5. Draft Hood: [Integral] [External].
 - 6. Combustion-Air Connection: Inlet duct collar and sheet metal closure over burner compartment.
- K. Mufflers: Carbon-steel intake muffler and stainless-steel exhaust.
- L. Condensate Trap: Cast-iron body with stainless-steel internal parts.
- M. Capacities and Characteristics:
- N. Hot-Water Heating:
 - 1. Design Water-Pressure Rating: [15 psig (104 kPa)] [150 psig (1035 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)>.

O. Steam Heating:

1. Design Steam-Pressure Rating: [Steam, 60 psig (415 kPa)] [100 psig (690 kPa)] [160 psig (1100 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)>.
5. Minimum Efficiency AFUE: <Insert number> percent.
6. Minimum Thermal Efficiency: <Insert number> percent.
7. Minimum Combustion Efficiency: <Insert number> percent.
8. AGA Input: <Insert MBh (kW)>.
9. Gas Input: <Insert cfm (mL/s)>.
10. AGA Output Capacity: <Insert MBh (kW)>.
11. DOE Output Capacity: <Insert MBh (kW)>.
12. Equivalent Direct Radiation: <Insert EDR (W)>.
13. Blower:
 - a. Motor Horsepower: <Insert number> hp.
 - b. RPM: <Insert number>.
14. Electrical Characteristics:
 - a. Volts: [115] [208] [230] [460] <Insert number> V.
 - b. Phase: [Single] [Three].
 - c. Hertz: [50] [60] <Insert number> Hz.
 - d. Full-Load Amperes: <Insert value> A.
 - e. Minimum Circuit Ampacity: <Insert number> A.
 - f. Maximum Overcurrent Protection: <Insert number> A.

2.3 FORCED-DRAFT, FIRE-TUBE CONDENSING BOILERS

- A. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
- B. Description: Factory-fabricated, -assembled, and -tested, fire-tube condensing boiler with heat exchanger sealed pressure tight, built on a steel base, including insulated jacket; flue-gas vent; combustion-air intake connections; water supply, return, and condensate drain connections; and controls. Water-heating service only.
- C. Heat Exchanger: Nonferrous, corrosion-resistant combustion chamber.
- D. Pressure Vessel: Carbon steel with welded heads and tube connections.
- E. Burner: [Natural] [Propane] gas, forced draft.
- F. Blower: Centrifugal fan to operate during each burner firing sequence and to prepurge and postpurge the combustion chamber.
 1. Motors: Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."

- a. Motor Sizes: Minimum size as indicated; if not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
- G. Gas Train: Combination gas valve with manual shutoff and pressure regulator.
- H. Ignition: Spark ignition with 100 percent main-valve shutoff with electronic flame supervision.
- I. Casing:
 - 1. Jacket: [Sheet metal] [Plastic], with snap-in or interlocking closures.
 - 2. Control Compartment Enclosures: NEMA 250, Type 1A.
 - 3. Finish: [Baked-enamel] [Powder-coated] protective finish.
 - 4. Insulation: Minimum ~~2-inch-~~ (50-mm-) thick, [mineral-fiber] [polyurethane-foam] insulation surrounding the heat exchanger.
 - 5. Combustion-Air Connections: Inlet and vent duct collars.
- J. Capacities and Characteristics:
 - 1. Heating Medium: Hot water.
 - 2. Design Water-Pressure Rating: [160 psig (1100 kPa)] <Insert value>.
 - 3. Safety Relief Valve Setting: <Insert psig (kPa)>.
 - 4. Entering-Water Temperature: <Insert deg F (deg C)>.
 - 5. Leaving-Water Temperature: <Insert deg F (deg C)>.
 - 6. Design Water Flow Rate: <Insert gpm (L/s)>.
 - 7. Minimum Water Flow Rate: <Insert gpm (L/s)>.
 - 8. Design Pressure Drop: <Insert psig (kPa)>.
 - 9. Minimum Efficiency AFUE: <Insert number> percent.
 - 10. Minimum Thermal Efficiency: <Insert number> percent.
 - 11. Minimum Combustion Efficiency: <Insert number> percent.
 - 12. AGA Input: <Insert MBh (kW)>.
 - 13. Gas Input: <Insert cfh (mL/s)>.
 - 14. AGA Output Capacity: <Insert MBh (kW)>.
 - 15. DOE Output Capacity: <Insert MBh (kW)>.
 - 16. Equivalent Direct Radiation: <Insert EDR (W)>.
 - 17. Blower:
 - a. Motor Horsepower: <Insert number> hp.
 - b. RPM: <Insert number>.
 - 18. Electrical Characteristics:
 - a. Volts: [115] [208] [230] [460] <Insert number> V.
 - b. Phase: [Single] [Three].
 - c. Hertz: [50] [60] <Insert number> Hz.
 - d. Full-Load Amperes: <Insert number> A.
 - e. Minimum Circuit Ampacity: <Insert number> A.
 - f. Maximum Overcurrent Protection: <Insert number> A.

2.4 WATER-TUBE CONDENSING BOILERS

- A. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
- B. Description: Factory-fabricated, -assembled, and -tested, copper-finned, water-tube condensing boiler with heat exchanger sealed pressure tight, built on a steel base, including insulated jacket; flue-gas vent; combustion-air intake connections; water supply, return, and condensate drain connections; and controls. Water-heating service only.
- C. Heat Exchanger: Finned-copper primary and stainless-steel secondary heat exchangers.
- D. Combustion Chamber: Stainless steel, sealed.
- E. Burner: **[Natural]** **[Propane]** gas, forced draft drawing from gas premixing valve.
- F. Blower: Centrifugal fan to operate during each burner firing sequence and to prepurge and postpurge the combustion chamber.
1. Motors: Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
- a. Motor Sizes: Minimum size as indicated; if not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
- G. Gas Train: Combination gas valve with manual shutoff and pressure regulator.
- H. Ignition: Silicone carbide hot-surface ignition that includes flame safety supervision and 100 percent main-valve shutoff.
- I. Integral Circulator: Cast-iron body and stainless-steel impeller sized for minimum flow required in heat exchanger.
- J. Casing:
1. Jacket: Sheet metal, with snap-in or interlocking closures.
2. Control Compartment Enclosures: NEMA 250, Type 1A.
3. Finish: Textured epoxy.
4. Insulation: Minimum **[1-inch- (25-mm-)]** **[2-inch- (50-mm-)]** thick, mineral-fiber insulation surrounding the heat exchanger.
5. Combustion-Air Connections: Inlet and vent duct collars.
- K. Capacities and Characteristics:
1. Heating Medium: Hot water.
2. Design Water-Pressure Rating: **[160 psig (1100 kPa)]** **<Insert value>**.
3. Safety Relief Valve Setting: **<Insert psig (kPa)>**.
4. Entering-Water Temperature: **<Insert deg F (deg C)>**.
5. Leaving-Water Temperature: **<Insert deg F (deg C)>**.
6. Design Water Flow Rate: **<Insert gpm (L/s)>**.
7. Minimum Water Flow Rate: **<Insert gpm (L/s)>**.

8. Design Pressure Drop: <Insert **psig (kPa)**>.
9. Minimum Efficiency AFUE: <Insert **number**> percent.
10. Minimum Thermal Efficiency: <Insert **number**> percent.
11. Minimum Combustion Efficiency: <Insert **number**> percent.
12. AGA Input: <Insert **MBh (kW)**>.
13. Gas Input: <Insert **cfh (mL/s)**>.
14. AGA Output Capacity: <Insert **MBh (kW)**>.
15. DOE Output Capacity: <Insert **MBh (kW)**>.
16. Blower:
 - a. Motor Horsepower: <Insert **number**> hp.
 - b. RPM: <Insert **number**>.
17. Electrical Characteristics:
 - a. Volts: [115] [208] [230] [460] <Insert **number**> V.
 - b. Phase: [Single] [Three].
 - c. Hertz: [50] [60] <Insert **number**> Hz.
 - d. Full-Load Amperes: <Insert **number**> A.
 - e. Minimum Circuit Ampacity: <Insert **number**> A.
 - f. Maximum Overcurrent Protection: <Insert **number**> A.

2.5 WATER-JACKETED CONDENSING BOILERS

- A. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
- B. Description: Factory-fabricated, -assembled, and -tested, water-jacketed condensing boiler with heat exchanger sealed pressure tight, built on a steel base, including insulated jacket; flue-gas vent; water supply, return, and condensate drain connections; and controls. Water-heating service only.
- C. Heat Exchanger: Stainless-steel primary and secondary combustion chamber.
- D. Pressure Vessel: Carbon steel with welded heads and tube connections where not in contact with combustion or flue gases.
- E. Burner: [Natural] [Propane] gas, forced draft; swing-open front and burner observation port.
- F. Blower: Centrifugal fan, forced draft. Include prepurge and postpurge of the combustion chamber.
 1. Motors: Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
 - a. Motor Sizes: Minimum size as indicated; if not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
- G. Gas Train: Combination gas valve with manual shutoff and pressure regulator. Include 100 percent safety shutoff with electronic flame supervision.

- H. Ignition: Electric-spark ignition with 100 percent main-valve shutoff with electronic flame supervision.
- I. Casing:
 - 1. Jacket: Sheet metal, with snap-in or interlocking closures.
 - 2. Control Compartment Enclosures: NEMA 250, Type 1A.
 - 3. Finish: Powder-coated protective finish.
 - 4. Insulation: Minimum ~~4-inch-~~ (100-mm-) thick, mineral-fiber insulation surrounding the heat exchanger.
 - 5. Combustion-Air Connections: Inlet and vent duct collars.
- J. Capacities and Characteristics:
 - 1. Heating Medium: Hot water.
 - 2. Design Water-Pressure Rating: [30 psig (207 kPa)] <Insert value>.
 - 3. Safety Relief Valve Setting: <Insert psig (kPa)>.
 - 4. Maximum Design Temperature: 210 deg F (99 deg C).
 - 5. Entering-Water Temperature: <Insert deg F (deg C)>.
 - 6. Leaving-Water Temperature: <Insert deg F (deg C)>.
 - 7. Design Water Flow Rate: <Insert gpm (L/s)>.
 - 8. Design Pressure Drop: <Insert psig (kPa)>.
 - 9. Minimum Efficiency AFUE: <Insert number> percent.
 - 10. Minimum Thermal Efficiency: <Insert number> percent.
 - 11. Minimum Combustion Efficiency: <Insert number> percent.
 - 12. AGA Input: <Insert MBh (kW)>.
 - 13. Gas Input: <Insert cfh (mL/s)>.
 - 14. AGA Output Capacity: <Insert MBh (kW)>.
 - 15. DOE Output Capacity: <Insert MBh (kW)>.
 - 16. Equivalent Direct Radiation: <Insert EDR (W)>.
 - 17. Blower:
 - a. Motor Horsepower: <Insert number> hp.
 - b. RPM: <Insert number>.
 - 18. Electrical Characteristics:
 - a. Volts: [115] [208] [230] [460] <Insert number> V.
 - b. Phase: [Single] [Three].
 - c. Hertz: [50] [60] <Insert number> Hz.
 - d. Full-Load Amperes: <Insert number> A.
 - e. Minimum Circuit Ampacity: <Insert number> A.
 - f. Maximum Overcurrent Protection: <Insert number> A.

2.6 TRIM

- A. Include devices sized to comply with [ASME B31.1] [ASME B31.9].
- B. Aquastat Controllers: Operating[, firing rate,] and 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. Drain Valve: Minimum NPS 3/4 (DN 20) hose-end gate valve.
- G. Circulation Pump: Nonoverloading, in-line pump with split-capacitor motor having thermal-overload protection and lubricated bearings; designed to operate at specified boiler pressures and temperatures.

2.7 TRIM

- A. Include devices sized to comply with [ASME B31.1] [ASME B31.9].
- B. Pressure Controllers: Operating[, firing rate,] and high limit.
- C. Safety Relief Valve:
 - 1. Size and Capacity: As required for equipment according to 2010 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.

2.8 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. Set-Point Adjust: Set points shall be adjustable.
 3. Operating Pressure Control: Factory wired and mounted to cycle burner.
 4. Low-Water Cutoff and Pump Control: Cycle feedwater pump(s) for makeup water control.
 5. Sequence of Operation: Electric, factory-fabricated and field-installed panel to control burner firing rate to maintain space temperature in response to thermostat with heat anticipator located in heated space.
 - a. Include automatic, alternating-firing sequence for multiple boilers to ensure maximum system efficiency throughout the load range and to provide equal runtime for boilers.
 6. Sequence of Operation: Electric, factory-fabricated and field-installed panel to control burner firing rate 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-firing sequence for multiple boilers to ensure maximum system efficiency throughout the load range and to provide equal runtime for boilers.
 7. Sequence of Operation: Electric, factory-fabricated and field-installed panel to control burner firing rate to maintain a constant steam pressure. Maintain pressure set point plus or minus 10 percent.
 - a. Include automatic, alternating-firing sequence for multiple boilers to ensure maximum system efficiency throughout the load range and to provide equal runtime for boilers.
- C. Burner Operating Controls: To maintain safe operating conditions, burner safety controls limit burner operation.
1. High Cutoff: [Manual] [Automatic] reset stops burner if operating conditions rise above maximum boiler design [temperature] [pressure].
 2. Low-Water Cutoff Switch: [Electronic] [Float and electronic] probe shall prevent burner operation on low water. Cutoff switch shall be [manual] [automatic]-reset type.
 3. Blocked Inlet Safety Switch: Manual-reset pressure switch field mounted on boiler combustion-air inlet.
 4. Audible Alarm: Factory mounted on control panel with silence switch; shall sound alarm for above conditions.

- D. Building Automation System Interface: Factory install hardware and software to enable building automation 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 automation system shall enable building automation 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 automation system.

2.9 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 and -wired switches, motor controllers, transformers, and other electrical devices necessary shall provide a single-point field power connection to boiler.
1. House in NEMA 250, Type [1] <Insert type> enclosure.
 2. Wiring shall be numbered and color coded to match wiring diagram.
 3. Install factory wiring outside of an enclosure in a [metal] raceway.
 4. Field power interface shall be to [wire lugs] [fused disconnect switch] [nonfused disconnect switch] [circuit breaker].
 5. Provide branch power circuit to each motor and to controls[with a disconnect switch or circuit breaker].
 6. Provide each motor with overcurrent protection.

2.10 VENTING KITS

- A. Kit: Complete system, ASTM A 959, Type 29-4C stainless steel, pipe, vent terminal, thimble, indoor plate, vent adapter, condensate trap and dilution tank, and sealant.
- B. Combustion-Air Intake: Complete system, stainless steel, pipe, vent terminal with screen, inlet air coupling, and sealant.

2.11 SOURCE QUALITY CONTROL

- A. 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.
- B. Test and inspect factory-assembled boilers, before shipping, according to 2010 ASME Boiler and Pressure Vessel Code.

- 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 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 gas-fired boilers according to NFPA 54.
- C. Assemble and install boiler trim.
- D. Install electrical devices furnished with boiler but not specified to be factory mounted.
- E. Install control wiring to field-mounted electrical devices.

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 boiler to allow service and maintenance.
- C. 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.

- D. Connect piping to boilers, except safety relief valve connections, with flexible connectors of materials suitable for service. Flexible connectors and their installation are specified in Section 232116 "Hydronic Piping Specialties."
- E. Connect gas piping to boiler gas-train inlet with union. Piping shall be at least full size of gas-train connection. Provide a reducer if required.
- F. Connect hot-water piping to supply- and return-boiler tapings with shutoff valve and union or flange at each connection.
- G. Connect steam and condensate piping to supply-, return-, and blowdown-boiler tapings with shutoff valve and union or flange at each connection.
- H. Install piping from safety relief valves to nearest floor drain.
- I. Install piping from safety valves to drip-pan elbow and to nearest floor drain.
- J. Boiler Venting:
 - 1. Install flue venting kit and combustion-air intake.
 - 2. Connect full size to boiler connections.[**Comply with requirements in Section 235123 "Gas Vents."**]
- K. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
- L. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

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. Operational Test: Start units to confirm proper motor rotation and unit operation. Adjust air-fuel ratio and combustion.
 - 4. 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 fuel supply, water level, and **[water temperature]** **[steam pressure]**.
 - b. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

- D. Boiler will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.
- F. Occupancy Adjustments: When requested within [12 months of date of Substantial Completion] <Insert time period>, 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.
- G. 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 to comply.
 - 3. Perform field performance tests to determine capacity and efficiency of boilers.
 - a. Test for full capacity.
 - b. Test for boiler efficiency at [low fire 20, 40, 60, 80, 100, 80, 60, 40, and 20] <Insert range> percent of full capacity. Determine efficiency at each test point.
 - 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 [24] <Insert number> hours minimum in advance of test dates.
 - 8. Document test results in a report and submit to Architect.

3.5 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 235216