

SECTION 235216 - CONDENSING BOILERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes gas-fired, floor-mounted or wall-hung condensing boilers, trim, and accessories for generating hot water.

- B. Reference and Industry Standards

Enterprise Green Communities Criteria

- 1. Mandatory Requirements: See the current edition of the NYC overlay of EGC reference standard for full specifications.
 - a. NYC New Construction projects must achieve at least 60 optional points, and Substantial and Moderate Rehab projects must also achieve at least 55 optional points.
 - b. Building Performance Standard Criterion 5.1b
 - c. Sizing of Heating and Cooling Equipment 5.6
 - d. Combustion Equipment 7.3
- C. Comply with the current edition of the New York City Energy Conservation Code.
- D. Comply with relevant HPD design guidelines.
- E. Project will elevate new equipment above 2050's SLR-adjusted DFE or above grade if applicable for projects in flood-prone areas.
- F. Floodproof equipment that cannot be elevated for projects in flood-prone areas.
- G. <https://www.nyc.gov/site/hpd/services-and-information/sustainability.page>
- H. <https://www.nyc.gov/site/hpd/services-and-information/blds.page>

1.2 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.
- B. Sample warranty.
 - 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).

1.3 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.
 - a. PRODUCTS

1.4 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 ASME Boiler and Pressure Vessel Code.
- C. ASHRAE/IES 90.1 Compliance: Boilers shall have minimum efficiency in accordance with Table 6.8.1-6 and other requirements in Ch. 6 of ASHRAE/IES 90.1.
- D. ASHRAE 90.2 Compliance: Boilers shall have minimum efficiency in accordance with Ch. 6 of ASHRAE 90.2.
- E. DOE Compliance: Minimum efficiency shall comply with 10 CFR 431, Subpart E, Appendix N or 10 CFR 430, Subpart B, Appendix N.
- F. Mounting Base: For securing boiler to concrete base or For securing boiler to structural wall.

1.5 FLOOR-MOUNTED, FORCED-DRAFT, FIRE-TUBE CONDENSING BOILERS

- A. Description: Factory-fabricated, -assembled, and -tested, fire-tube, forced-draft, 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. Units are to be for water-heating service only.
- B. Primary Heat Exchanger: Corrosion-resistant Type 316 stainless steel [or] aluminum.
- C. Secondary Heat Exchanger: Corrosion-resistant Type 316 stainless steel [or] aluminum.
- D. Combustion Chamber and Flue Pipes: Corrosion-resistant stainless steel or aluminum.
- E. Pressure Vessel: Carbon steel with welded heads and tube connections.
- F. Burner: Natural gas, forced draft.
- G. 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: 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: Direct-spark ignition or silicone carbide hot-surface ignition with 100 percent main-valve shutoff and electronic flame supervision.
- J. 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 Stainless steel 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.
- K. Capacities and Characteristics:
 - 1. Heating Medium: Hot water.
 - 2. Design Water-Pressure Rating:
 - 3. Safety Relief Valve Setting:
 - 4. Entering-Water Temperature:
 - 5. Leaving-Water Temperature: 120 deg F
 - 6.
 - 7. Minimum Efficiency AFUE: 90% percent.
 - 8. Minimum Thermal Efficiency: 90% percent.
 - 9. Electrical Characteristics:
 - a. Volts: 115 V.
 - b. Phase: Single.
 - c. Hertz: 60 Hz.

1.6 WALL-HUNG, FORCED-DRAFT, FIRE-TUBE CONDENSING BOILERS

- A. Description: Factory-fabricated, -assembled, and -tested, fire-tube, forced-draft, 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. Units are to be for water-heating service only.
- B. Heat Exchanger: Corrosion-resistant Type 316 stainless steel.
- C. Fire Tubes: Corrosion-resistant Type 316 stainless steel or aluminum core.
- D. Combustion Chamber and Flue Pipes: Corrosion-resistant stainless steel or aluminum.
- E. Burner: Natural 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: 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: Direct-spark ignition or silicone carbide hot-surface ignition with 100 percent main-valve shutoff and electronic flame supervision.
 - I. Integral Circulator: Cast-iron body and stainless steel impeller sized for minimum flow required in heat exchanger.
 - J. Casing:
 1. Jacket: Sheet metal or Plastic, with snap-in or interlocking closures.
 2. Control Compartment Enclosures: NEMA 250, Type 1A.
 3. Finish: Baked-enamel or Powder-coated or Stainless steel protective finish.
 4. Insulation: Minimum ~~2-inch~~ (50-mm-) thick, mineral-fiber or polyurethane-foam 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:
 3. Safety Relief Valve Setting:
 4. Entering-Water Temperature:
 5. Leaving-Water Temperature: 120 deg F
 6. Minimum Efficiency AFUE: 90% percent.
 7. Minimum Thermal Efficiency: 90% percent.
 8. Electrical Characteristics:
 - a. Volts: 115 V.
 - b. Phase: Single.
 - c. Hertz: 60 Hz.
- 1.7 FLOOR-MOUNTED, WATER-TUBE CONDENSING BOILERS
- A.
 - B. Description: Factory-fabricated, -assembled, and -tested, water-tube, forced-draft, 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. Units are to be for water-heating service only.
 - C. Heat Exchanger: Stainless steel primary and secondary heat exchangers.

- D. Combustion Chamber: Stainless steel, sealed.
- E. Burner: Natural 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: 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: Direct-spark ignition or silicone carbide hot-surface ignition with 100 percent main-valve shutoff and electronic flame supervision.
- 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: Baked-enamel or Powder-coated or Stainless steel protective finish.
 - 4. Insulation: Minimum ~~1-inch-~~ (25-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:
 - 3. Safety Relief Valve Setting:
 - 4. Entering-Water Temperature:
 - 5. Leaving-Water Temperature: 120 deg F
 - 6. Fuel: Natural gas.
 - 7. Minimum Efficiency AFUE: 90% percent.
 - 8. Minimum Thermal Efficiency: 90% percent.
 - 9. Electrical Characteristics:
 - a. Volts: 115 V.
 - b. Phase: Single.
 - c. Hertz: 60 Hz.

1.8 WALL HUNG, WATER-TUBE CONDENSING BOILERS

- A. Description: Factory-fabricated, -assembled, and -tested, water-tube, forced-draft, 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.
- B. Heat Exchanger: Stainless steel primary and secondary heat exchangers.
- C. Combustion Chamber: Stainless steel, sealed.
- D. Burner: Natural gas, forced draft drawing from gas-premixing valve.
- E. 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: Large enough so driven load will not require motor to operate in service factor range above 1.0.
- F. Gas Train: Combination gas valve with manual shutoff and pressure regulator.
- G. Ignition: Direct-spark ignition or silicone carbide hot-surface ignition with 100 percent main-valve shutoff and electronic flame supervision.
- H. Integral Circulator: Cast-iron body and stainless steel impeller sized for minimum flow required in heat exchanger.
- I. Casing:
 - 1. Jacket: Sheet metal, with snap-in or interlocking closures.
 - 2. Control Compartment Enclosures: NEMA 250, Type 1A.
 - 3. Finish: Baked-enamel or Powder-coated or Stainless steel protective finish.
 - 4. Insulation: Minimum ~~1-inch~~ (25-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:
 - 3. Safety Relief Valve Setting:
 - 4. Entering-Water Temperature:
 - 5. Leaving-Water Temperature: 120 deg F
 - 6. Fuel: Natural gas.
 - 7. Minimum Efficiency AFUE: 90% percent.
 - 8. Minimum Thermal Efficiency: 90% percent.
 - 9. Electrical Characteristics:

- a. Volts: 115 V.
- b. Phase: Single.
- c. Hertz: 60 Hz.

1.9 TRIM - FOR HOT-WATER BOILERS

- A. Include devices sized to comply with ASME B31.1 ASME B31.9.
- B. Aquastat Controllers: Operating, firing rate, and high limit with automatic reset.
- C. Safety Relief Valve: ASME rated.
- D. Pressure and Temperature Gauge: Minimum **3-1/2-inch-** (**89-mm-**) diameter, combination water-pressure and -temperature gauge. Gauges shall have operating-pressure and -temperature ranges, so normal operating range is about 50 percent of full range.
- E. High and low gas-pressure switches.
- F. Alarm bell with silence switch.
- G. Boiler Air Vent: Automatic.
- H. Drain Valve: Minimum **NPS 3/4** (**DN 20**) hose-end gate valve.
- I. 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.

1.10 CONTROLS

- A. Boiler operating controls shall include the following devices and features:
 - 1. Control transformer.
 - 2. Set-Point Adjust: All set points shall be adjustable.
 - 3. Electric, factory-fabricated and field-installed panel to modulate burner and 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.
 - 4. 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**) outside-air temperature, set supply-water temperature at **140 deg F** (**60 deg C**); at **60 deg F** (**15 deg C**) outside-air temperature, set supply-water temperature at **90 deg F** (**32 deg C**).

- 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.
- B. Burner Operating Controls: To maintain safe operating conditions, burner safety controls limit burner operation.
 - 1. High Cutoff: Automatic reset stops burner if operating conditions rise above maximum boiler design temperature.
 - 2. Low-Water Cutoff Switch: Electronic probe shall prevent burner operation on low water. Cutoff switch shall be [automatic]-reset type.
 - 3. Blocked Inlet Safety Switch: Manual-reset pressure switch factory mounted on boiler combustion-air inlet.
 - 4. Audible Alarm: Factory mounted on control panel with silence switch; shall sound alarm for above conditions.
- C. 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.
 - b. Control: On/off operation, hot-water-supply temperature set-point adjustment.

1.11 ELECTRICAL POWER

- A. Controllers, Electrical Devices, and Wiring: Electrical devices and connections are shown on Drawings and 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 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. Provide branch power circuit to each motor and to controls with a disconnect switch or circuit breaker.
 - 5. Provide each motor with overcurrent protection.

1.12 VENTING KITS

- A. Kit: Complete system, ASTM A959, 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.

1.13 CONDENSATE-NEUTRALIZATION UNITS

- A.
- B. Description: Factory-fabricated and -assembled condensate-neutralizing capsule or tank assembly of corrosion-resistant plastic material with threaded or flanged inlet and outlet pipe connections. Device functions to prevent acidic condensate from damaging drain system. It is to be piped to receive acidic condensate discharged from condensing boiler and neutralize it by chemical reaction with replaceable neutralizing agent. Neutralized condensate is then piped to suitable drain.
- C. Capsule Tank features:
 - 1. All corrosion-resistant material.
 - 2. Suitable for use on all natural gas and propane boilers.
 - 3. Includes initial charge of neutralizing agent.
 - 4. Neutralizing agent to be easily replaceable when exhausted.
 - 5. Inlet and outlet pipe connections.
- D. Capsule Configuration:
 - 1. Low-profile design for applications where boiler condensate drain is close to the floor.
 - 2. Easily removed and opened for neutralizing agent replacement.
 - 3. Multiple units may be used for larger capacity.
- E. Tank Configuration:
 - 1. Utilized where boiler is elevated or where tank is installed in a pit with tank top flush with floor.
 - 2. Top easily removed for neutralizing agent replacement.
 - 3. Internal baffles to channel flow for complete neutralization.
 - 4. Integral bypass to prevent condensate backflow into appliance.
 - 5. Multiple units may be used for larger capacity.

1.14 SOURCE QUALITY CONTROL

- A. UL Compliance: Test gas-fired boilers having input of more than 400,000 Btu/h (117 kW) for compliance with UL 795. Boilers shall be listed and labeled by a testing agency acceptable to authorities having jurisdiction.
- B. UL Compliance, Gas-Fired: Test gas-fired boilers for compliance with UL 2764. Boilers shall be listed and labeled by a testing agency acceptable to authorities having jurisdiction.
- C. CSA Compliance: Test boilers for compliance with ANSI Z21.13-2017/CSA 4.9.
- D. Performance Testing: Test and label boilers for efficiency to comply with AHRI 1500.
- E. 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.

- F. Test and inspect factory-assembled boilers, before shipping, in accordance with 2017 ASME Boiler and Pressure Vessel Code. Factory test boilers for safety and functionality; fill boiler with water, and fire throughout firing range, to prove operation of all safety components.
- G. Allow Owner access to source quality-control testing of boilers. Notify Architect 14 days in advance of testing.

PART 2 - EXECUTION

2.1 BOILER INSTALLATION

- A. Equipment Mounting:
 - 1. Install floor-mounted 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."
 - 2. Install wall-hung boilers where indicated on Drawings using suitable hangers. Comply with manufacturer's mounting instructions.
- 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.

2.2 PIPING CONNECTIONS

- A. Comply with requirements for hydronic piping specified in Section 232113 "Hydronic Piping."
- B. 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."
- C. Drawings indicate general arrangement of piping, fittings, and specialties.
- D. When installing piping adjacent to boiler, allow space for service and maintenance of condensing boilers. Arrange piping for easy removal of condensing boilers.
- E. Install condensate drain piping to condensate-neutralization unit and from neutralization unit to nearest floor drain. Piping shall be at least full size of connection. Install piping with a minimum of 2 percent downward slope in direction of flow.
- F. Install condensate piping from equipment drain connection to nearest floor drain. Piping shall be at least full size of connection. Install piping with a minimum of 2 percent downward slope in direction of flow.

- G. 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.
- H. Connect hot-water piping to supply- and return-boiler tapings with shutoff valve, and union or flange at each connection.
- I. Install piping from safety relief valves to nearest floor drain.

2.3 DUCT CONNECTIONS

A. Boiler Venting:

- 1. Install flue-venting kit and combustion-air intake.
- 2. Comply with all boiler manufacturer's installation instructions.
- 3. Field fabricate and install boiler vent and combustion-air intake.
- 4. Utilize vent and intake duct material, size, and configuration as indicated in boiler manufacturer's instructions and to comply with UL 1738.
- 5. Comply with all boiler manufacturer's installation instructions.
- 6. Connect boiler vent full size to boiler connections.
- 7. Comply with requirements in Section 235123 "Gas Vents."
- 8. Comply with all boiler manufacturer's installation instructions.

2.4 ELECTRICAL CONNECTIONS

- A. Connect wiring in accordance with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- B. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
- C. Install electrical devices furnished by manufacturer, but not factory mounted, according to NFPA 70 and NECA 1.
- D. Install nameplate for each electrical connection, indicating electrical equipment designation and circuit number feeding connection.
 - 1. Nameplate shall be laminated acrylic or melamine plastic signs, as specified in Section 260553 "Identification for Electrical Systems."
 - 2. Nameplate shall be laminated acrylic or melamine plastic signs with a black background and engraved white letters at least **1/2 inch (13 mm)** <Insert size> high.

2.5 CONTROL CONNECTIONS

- A. Install control and electrical power wiring to field-mounted control devices.
- B. Connect control wiring in accordance with Section 260523 "Control-Voltage Electrical Power Cables."

- C. Install nameplate for each control connection, indicating field control panel designation and I/O control designation feeding connection.
 - 1. Nameplate shall be laminated acrylic or melamine plastic signs, as specified in Section 260553 "Identification for Electrical Systems."
 - 2. Nameplate shall be laminated acrylic or melamine plastic signs with a black background and engraved white letters at least 1/2 inch (13 mm) <Insert size> high.

2.6 FIELD QUALITY CONTROL

- A. Testing Agency, Owner: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Testing Agency, Contractor: Engage a qualified testing agency to perform tests and inspections.
- C. Perform tests and inspections with the assistance of a factory-authorized service representative:
- D. Tests and Inspections:
 - 1. Perform installation and startup checks in accordance with 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.
 - b. Set field-adjustable switches and circuit-breaker trip ranges as indicated.
- E. Boiler will be considered defective if it does not pass tests and inspections.
- F. Prepare test and inspection reports.
- G. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to [two] visits to Project during other-than-normal occupancy hours for this purpose.

2.7 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain boilers. Instructor shall be factory trained and certified.
 - 1. Provide not less than two hours of training.
 - 2. Train personnel in operation and maintenance and to obtain maximum efficiency in plant operation.
 - 3. Provide instructional videos showing general operation and maintenance that are coordinated with operation and maintenance manuals.
 - 4. Obtain Owner sign-off that training is complete.

5. Owner training shall be held at Project site.

END OF SECTION 235216