

Category: High Efficiency Gas Boilers

Type: Condensing

Model: EVO XL

EVO XL Boilers

1.0 General

1.1 Quality Assurance

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. ASME/CRN Compliance: Fabricate and label boilers to comply with ASME/CRN Boiler and Pressure Vessel Code.
- C. ASHRAE/IESNA 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, "Uniform Test Method for Measuring the Energy Consumption of Furnaces and Boilers."
- E. UL/CSA Compliance: Test boilers for compliance with UL 795/CSA 3.4, "Commercial-Industrial Gas Heating Equipment." boilers shall be listed and labeled by a testing agency acceptable to authorities having jurisdiction.

1.2 Coordination

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Installation Manual. With temperature sensing thermistors integral of the mixing chamber, is designed specifically for recirculating hot water systems.

1.3 Warranty

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of boilers that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period for Condensing Boilers: 15 years from date of Substantial Completion on heat exchanger.
 - 2. Warranty Period for Condensing boiler components: 15 months from the Warranty start date for all other components.

2.0 Products

2.1 Condensing Boilers

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
- B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings Hamilton Engineering EVO XL or comparable product by one of the following:
 - 1. <Insert manufacturer's name>
- C. Description: Factory-fabricated, -assembled, and -tested, water-tube condensing boiler with heat exchanger sealed pressure tight; flue-gas vent; combustion-air intake connections; water supply, return, and condensate drain connections; and controls. The boiler shall be LabTest certified and listed under ANSI Z21.13/CSA 4.9 boiler

test standard for the US and Canada. The boiler shall comply with the energy efficiency requirements of the ASHRAE 103 Standard. The boiler shall meet U.S. Environmental Protection Agency and Department of Energy guidelines for "Energy Star" efficiency. The boiler shall have been tested and certified by a third party listed and certified testing agency to have the following:

1. The boiler shall operate at high-fire with a minimum thermal efficiency of 90% when supplied with 160°F entering water.
 2. The boiler shall operate at thermal efficiency of 99.8% when supplied with 54°F entering water.
 3. The boiler shall operate at a combustion efficiency of up to 94.7%
 4. The boiler shall have a rating for Oxides of Nitrogen (NOx) of 30 ppm or less, when corrected to 3% O₂.
 5. The boiler shall have an AFUE rating of 93.7% or greater.
 6. The boiler shall operate at altitudes up to 9000 feet above sea level without additional parts or loss of BTU output.
- D. Heat Exchanger: The heat exchanger shall be constructed of 316L stainless steel and shall bear the ASME "H" stamp for 160 PSI working pressure and shall be National Board listed.
 - E. Combustion Chamber: Shall be sealed and completely enclosed, independent of the outer jacket assembly, so that integrity of the outer jacket does not affect a proper seal. A burner/flame observation port shall be provided. The stainless-steel combustion chamber shall be designed to drain condensation to the bottom of the heat exchanger assembly, keeping the primary combustion chamber free of excess moisture. The boiler shall contain an integral non-return valve in the mixing arm providing for the ability to utilize a common inlet and exhaust vent for up to 8 appliances when coupled together for a common load.
 - F. Burner: The burner shall be a premix design and constructed of high temperature stainless steel to provide a full input burner port loading ratio of 3400 btu/sq. inch or greater. Burner shall be suitable for firing with natural gas or propane.
 - G. Blower: Centrifugal fan with ECM drive to operate during each burner firing sequence, to pre-purge and post-purge the combustion chamber, and to provide up to 8.7:1 modulating firing rates for maximum efficiency.
 - H. Gas Train: Shall be supplied with a negative pressure gas valve providing precise control of the air-gas offset ratio and maximum firing rate. The gas valve outlet shall be coupled to an air gas mixing venturi with a full port gas valve outlet and a free air inlet of no less than 2.5 times greater than the gas valve outlet area.
 - I. Ignition: The ignition system shall be direct-spark ignition with integrated flame sensor and soft start. Hot-surface ignition shall not be accepted.

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J. Condensate Drain: The boiler shall contain an external condensate drain trap that shall allow condensation to drain freely from the heat exchanger assembly, while providing a water trapping height of a minimum of 1.5 times the maximum fan outlet pressure. This trap shall contain an integral neutralizer system. The safety control system shall incorporate a pressure switch or transducer that monitors the condensate drain system for any restriction causing a backup or leakage through trap and shall shut the appliance down and display a fault code to indicate such a condition exists.

K. Casing:

1. Jacket: Sheet metal, with snap-in or interlocking closures.
2. Control Compartment Enclosures: NEMA 250, Type 3.
3. Finish: Powder coated rear, side, and top panels and Molded plastic front cover.
4. Combustion-Air Connections: Inlet and vent duct collars.
5. Mounting base to secure EVO XL.
 - a. The boiler shall be supplied seismic rated and certified upon request.
 - b. 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.

L. Characteristics and Capacities:

1. Heating Medium: Hot water.
2. Design Water Pressure Rating: 160 psig.
3. Safety Relief Valve Setting: 50 psig.
4. Entering-Water Temperature: see Schedule.
5. Leaving-Water Temperature: see Schedule.
6. Design Water Flow Rate: per boiler manufacturer requirements
7. Minimum Water Flow Rate: per boiler manufacturer requirements
8. Design Pressure Drop: per boiler manufacturer requirements
9. Minimum Efficiency AFUE: 93.7 percent
10. Minimum Thermal Efficiency: 90 percent at high-fire with 160°F incoming water and 20°F delta T.
11. Minimum Combustion Efficiency: up to 94.7 percent.
12. Boiler Input: see Schedule.
13. Boiler Output Capacity: see Schedule.
14. Gas Pressure: 4" to 14" water column.

volume of neutralizing agent to provide for 2000 hours of operation in a fully condensing application. The neutralizing agent shall be ½" – ¾" common limestone aggregate.

2.3 Controls

A. The boiler shall utilize integrated control circuit and components. The control system shall have an LCD display with self-diagnostic microprocessor controls for boiler set-up, boiler status, and boiler diagnostics. All components shall be easily accessed and serviceable from the front of the jacket without removing any additional panels. The boiler controls shall be equipped with the following:

1. Dual High Limit sensor (fixed and adjustable).
2. Exhaust temperature sensor.
3. Gas inlet pressure transducer.
4. Flue back pressure/ condensate back up protection.
5. Water flow protection (flow switch or transducer).
6. Built-in freeze protection.

B. The boiler shall be equipped with an outdoor air reset function that shall automatically operate when a 10,000-Ohm sensor is attached to the provided terminal strip.

C. The boiler shall automatically sense when an external 10,000-ohm sensor has been attached to the terminal strip and it shall become the primary sensor for temperature control.

D. The boiler controls shall include a cascading control feature able to control up to 8 boilers in parallel using (1 or more) system sensor and factory supplied interconnecting wiring from Master/Lead controller to Member/Lag boilers, allowing for continuously adjusting the reaction to load changes in precise BTU increments.

1. No steps; increase or decrease in BTU by more than 1% at a time shall be allowed.
2. Only the number of boilers required to meet set point are to be brought on.
3. Boilers are to be shut down in same sequence they are brought on line.
4. Determination and assignment of Lead boiler in light off and shut down sequence shall occur at 1 hour of burner on time intervals, to allow for no more than 1 hour in burn time difference per unit in the Cascade at any time.
5. Smart PID Control system, shall "learn" with each burn cycle as to how quickly or slowly set point was met and how precisely it was held. In subsequent burn cycles it shall automatically adjust its reaction rates (time, modulation range and rate of BTU change per second) to hold a closer difference to set point.

E. Optional Building Automation System Interface: Factory install hardware and software to enable building automation system to monitor, control, and display all points displayed on the local display(s).

1. Hardwired Points:
 - a. Monitoring:
 1. Inlet/Outlet temperature
 2. Exhaust Temperature
 3. Gas Inlet Pressure
 4. Run Status
 5. Numerous other points, see Schedule

2.2 Trim

- A. Safety Relief Valve: ASME rated and sized as required.
- B. Boiler Air Vent: Automatic or Manual.
- C. Drain Valve: Minimum ¾ NPT Female
- D. Circulation Pump: Non-overloading pumps with motor having lubricated bearings; designed to operate at specified boiler pressures and temperatures; sized for boiler required flow rates.
- E. Condensate Neutralizer: Each condensing boiler system shall be supplied with condensate neutralizer. The neutralizer shall be factory engineered and sized for the boiler condensate capacity with adequate soak-time to bring the condensate to a pH of 7 and with sufficient

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2. An optional communication interface, see Schedule if required, for 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.

2.4 Electrical Power

- A. 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.
- B. Multiple boilers shall be provided with a pre-wired power supply to boilers and boilers pumps with an individual service disconnect for each boiler for a single-point field electrical connection.
 1. Electrical Characteristics:
 - a. Volts: 208-240 V.
 - b. Phase: Single/Split
 - c. Hertz: 60.
 - d. Full-Load Amperes: see Schedule.
 - e. Minimum Circuit Ampacity: see Schedule.
 - f. Maximum Overcurrent Protection: see Schedule.

2.5 Plumbing Kits

- A. The Boiler shall be provided with pre-piped manifolds for single point supply and return connections per one of the following:
 1. The manifolds shall be welded steel with finish paint. At all points where steel and copper joints exist, dielectric unions shall be installed. Each boiler pump assembly shall have flanged 1/4-turn full port brass ball valves for isolation. Each boiler return piping assembly shall incorporate an integral check valve to eliminate any unwanted residual flow through off boilers. All fittings shall be rated for design pressure applications. All piping shall be air tested to a minimum of 100 PSI and checked to be free of leaks at the factory; all ball valves will be cycled during this pressure test to insure their integrity. Piping is sized for maximum flow rate.
 - a. Per the schedule, the pre-piped manifolds may be provided with a mounted and piped, welded steel hydronic system separator. The separator shall provide for a maximum connector flow rate of 3.0 feet per second and an internal water flow rate of 0.5 feet per second. Integral to this separator, there shall be stainless steel screens to provide separation of solids contained in the return heating water and separation and elimination of system air. The separator shall include ports for temperature sensors on the inlet and outlet connections, an air vent on the top, a drain connection on the bottom, a gauge connection on the side, and fill-valve/expansion tank connections also on the side. All ports shall be factory labeled. All pipe materials are ASTM A53 Design Certified, and fittings are ASTM A234 Design Certified. The finished separator assembly shall be factory tested to 150% of design working pressure and shall be finished with a base primer and finish acrylic topcoat of gloss black. The separator shall include:
 1. A mounted system temperature control 10k thermistor with thermowell on the system supply port.
 2. A temperature and pressure gauge on the side port.
 3. System fast fill/pressure reducing valve, and a 1/4 turn FPT ball valve connection for the system expansion tank on the side port.

4. A mounted 3/4" full port 1/4 turn drain valve with hose connection and cap on the bottom port.
5. A 3/4" automatic air vent on the top port.
6. Optional Supply and return connections for an indirect DHW zone.

- B. The Boiler shall have a common gas manifold constructed of welded or threaded black steel pipe and shall contain a drip leg at the single point gas connection. The common gas manifold shall have 1/4 turn gas-rated shutoff valve. The entire gas piping system shall be factory engineered and installed prior to shipment. Piping shall be constructed in such a fashion as to allow it to remain in its finished position during shipping. All piping shall be air tested to a minimum of 30 PSI and checked to be free of leaks; all ball valves will be cycled during this pressure test to ensure their integrity. Piping is sized for maximum flow rate.

2.6 Venting Kits

- A. The Boiler shall have Optional common vent manifolds constructed of AL 29-4C stainless steel rated to minimum of 5" w.c. positive pressure and shall contain the appropriate pitch for condensate to drain. The common vent manifolds shall each contain (2) condensate drain fittings that shall be routed through a condensate trap containing a removable clean-out cap and then on to the Factory supplied Condensate Neutralizer. There shall be no more than two vent pieces per boiler in addition to the required condensate drain fittings for the entire common vent manifold. Common vent manifolds shall carry the UL 795 approval, each system shall have up to (8) boilers with (1) combustion air manifold and (1) exhaust vent manifold. Systems utilizing individual boiler vent/air piping shall not be allowed.

2.7 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 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.

3.0 Execution

3.1 Examination

- A. Before boiler installation, 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 boiler performance, maintenance, and operations.
 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. Boilers must be installed level and anchored to floor or wall as required.
- B. Install gas-fired boilers according to NFPA 54.
- C. Assemble and install boiler trim.

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- 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 condensate neutralizer drain connection to nearest floor drain. Piping shall be at least full size of connection. Provide an isolation valve if required.
- D. Connect gas piping to boiler gas-train inlet with union/ flange. Piping shall be at least full size of gas train connection. Provide a reducer if required.
- E. Connect supply- and return-boiler piping.
- F. Connect cold-water supply to make up valve/ fast fill valve assembly.
- G. Install piping from safety relief valves to nearest floor drain.
- H. Boiler Venting:
 - 1. Install flue venting kit and combustion-air intake kit (OPTIONAL KIT).
 - 2. Flue venting and combustion air intake must be installed in accordance with NFPA 54 and all manufacturer's installation instructions.
 - 3. The flue shall be CPVC, Poly Pro, or AL29-4C sealed, category IV vent material. The air inlet pipe may be PVC, CPVC, ABS or AL29-4C sealed pipe.
 - 4. Connect full size to boiler connections (unless otherwise specified during design). [Comply with requirements in Section 235100 "Breechings, Chimneys, and Stacks."]
- I. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
- J. 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.
 - b. Set field-adjustable switches and circuit breaker trip ranges as indicated.
- D. Remove and replace malfunctioning units and retest as specified above.
- 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 not adequate.
 - 7. Notify Architect 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. **[Video training sessions.]** Refer to Section 017900 "Demonstration and Training."