

Typical Specification
3VO Spec-03

Typical Specification for EVO Models 750,000 – 4,000,000 Btu/Hr

The **Boilers** shall be a 3VO Model H3H-1000 or equivalent having a maximum input rating of 1,000,000 Btu/Hr, an output of 915,069 Btu/Hr and shall be operated on Natural Gas. The **Boilers** shall be capable of full modulation with a turn down ratio of up to 7 to 1.

The **Boilers** shall bear the ASME “H” stamp, for 125 PSI working pressure and shall be National Board listed. **Heating Boilers** (H3H) shall ship with a 50 PSI pressure relief valve. The combination of straight bare and low fin tube, completely 316L stainless steel heat exchanger shall be designed with a 2.5° slope from front to rear, and have a minimum of 6 passes of water flow, with a variable flow ratio of at least 3:1. The combustion chamber shall have a minimum of 5 passes, and shall be designed to gravity drain condensation to the bottom rear of the heat exchanger assembly, keeping the primary combustion area free of excess moisture. The heads of the heat exchanger shall be removable and all tubes shall be accessible individually on both the inside and outside for cleaning, service or replacement. The complete heat exchanger assembly shall carry a fifteen year limited warranty for a **Heating Boiler** (H3H).

The **Boilers** shall be certified and listed under the latest edition of the harmonized ANSI Z21.13, CSA 4.9 boiler test standard for the US and Canada. The **Boilers** shall comply with the energy efficiency requirements of the latest edition of the ASHRAE 103 Standard. The **Boilers** shall have been tested and certified by a third party listed and certified testing agency to have the following:

- The **Boilers** shall operate at thermal efficiency of 98% when supplied with 54°F entering water.
- The **Boilers** shall operate at a combustion efficiency of up to 94.7%
- The **Boilers** shall have a rating for Oxides of Nitrogen (NOx) of 18 ppm or less, when corrected to 3% Oz.
- The **Boilers** shall have an AFUE rating of 92% or greater.
- The **Boilers** shall operate at altitudes up to 9000 feet above sea level without additional parts or loss of BTU output.

The **Boilers** shall connect to condensate drain trap and neutralizer 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 clean out that allows complete access and cleaning of the condensate trap assembly without opening the appliance or shutting it down. The safety control system shall incorporate a pressure switch that monitors the condensate drain system for any restriction causing a back up and shall shut the appliance down and display a fault code to indicate such an condition exists.

The **Boilers** shall be constructed with a combustion chamber that shall be sealed and completely enclosed with removable panels, 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 burners shall be a premix design and constructed of high temperature stainless steel to provide a full input burner port loading ratio of 1050 btu/sq. in or greater. The **Boilers** shall be supplied with a gas valve providing precise control of the air-gas offset ratio and maximum firing rate and be equipped with a variable speed, ECM motor blower system, to provide up to 7:1 modulating firing rates for maximum efficiency. The negative pressure gas valve outlet shall be coupled to an air gas mixing venturi. The **Boilers** shall operate in a safe condition with gas supply pressures as low as 4 inches of water column.

1.1 Standard internal boiler controls for predictive maintenance

A. Boiler controls shall feature a standard, factory installed 3.5" x 5" screen display and input and be equipped with and operate by the following standard features:

1. Set point of all connected load sensors (up to 3) and system type
2. Pressure sensors to monitor the following critical operations; gas pressure, water pressure into and leaving the heat exchanger, fan pressure, combustion chamber pressure and condensate drain pressure.
3. Temperature sensors to monitor: inlet and outlet water, adjustable manual reset high limit, leaving flue gas, storage tank, building recirculation (DHW), common piping loop (heating), and outdoor temperatures.
4. Creation of, and internal memory stored, trend-lines to monitor changing operating conditions and normal system fouling. This process begins with an Initialization (INI) process at system commissioning, and occurs on a regular basis automatically thereafter.
5. Trend-line data shall be used to automatically adjust appliance operation to prolong time required between maintenance procedures, and to provide messages related to service procedures that will be required, in advance of their immediate need.
6. Use of lowest water temperature possible control algorithms; all connected loads shall be evaluated using temperature gradient data. The lowest possible water temperature shall be used to satisfy the external connected load, providing the highest possible operating efficiency by maintaining the lowest return water temperature to the boiler. Gradient settings are programmable and utilize an offset (droop) from design set-point.
7. Variable Speed Boiler Pump Control: Boiler may be programmed to send a PWM (Pulse Width Modulation) or optionally a 0 – 10VDC or 4 – 20ma output signal to an ECM or VFD boiler pump to maintain a designed temperature rise across the heat exchanger. The boiler shall be able to operate in this mode with a minimum temperature rise of 10 degrees F and a maximum temperature rise of 50 degrees. Project specific temperature rise shall be 40.
8. Password Security: Boiler shall have a different password security codes for the User, the Installer, and factory service to access various adjustable parameters.
9. Pump exercise: appliance shall energize any pump it controls for an adjustable time period if the associated pump has been off for a time period of 24 hours.
10. Aeration cycle: appliance shall operate the appliance pump at initial start up, and anytime the required minimum water pressure threshold has been broken to assist in aeration of the heat exchanger. Times and pressures are programmable.
11. Ramp delay: appliance may be programmed to limit the firing rate based on limit steps and time intervals.
12. Boost function: **Boilers** may be enabled by the installer to automatically increase the set point a set (by installer) number of degrees if operation at the setpoint has been continuously active for a set period of time (also adjustable by installer). This boosted set-point will remain active until the current space heating demand ends.
13. PC port connection: Boiler shall have a PC port allowing the connection of PC appliance software.
14. Time clock: appliance shall have an internal time clock with the ability to time and date stamp lock-out codes and maintain records of runtime.

15. Service reminder: Appliance shall display a scrolling text service notification based upon deviation from essential sensor values from initial start up. If the **optional** external communication is added, notification type and to whom, are adjustable by the installer.
 16. Multi pump control: Appliance shall have the ability to control the appliance pump, system pump, re-circulation pump for domestic, indirect hot water, indirect pool, indirect spa and the indirect domestic hot water pumps depending on system configuration selected.
 17. Anti-cycling control: Appliance shall have the ability to set a time delay after a heating demand is satisfied allowing the boiler to block a new call for heat. The boiler will display an anti-cycling blocking on the screen until the time has elapsed or the water temperature drops below the anti-cycling differential parameter.
 18. Freeze protection: Appliance shall turn on the boiler and system pumps when the appliance water temperature falls below 40 degrees. When the appliance water temperature falls below 37 degrees the appliance will automatically turn on. Appliance and pumps will turn off when the appliance water temperature rises above 50 degrees.
 19. Isolation valve control: Appliance shall have the ability to control a 2-way motorized control valve. Boiler shall also be able to force a fixed number of valves to always be energized regardless of the number of boilers that are firing.
 20. BMS integration with 0-10V DC input: The Control shall allow an option to Enable and control set point temperature or control firing rate by sending the boiler a 0-10V input signal.
 21. Data logging: Appliance shall have non-volatile data logging memory including last 10 lockouts, hours running and ignition attempts and can be viewed on boiler screen.
- B. Burner Operating Controls: To maintain safe operating conditions, burner safety controls limit burner operation. If limits are reached, they are to be manually reset on the control interface..
1. High Temperature Limits: Adjustable automatic and manual reset
 2. High and Low Water Pressure
 3. High and Low Gas Pressure - manual reset at limits
 4. Blocked Drain
 5. Low air
 6. High vent resistance
 7. Audible Alarm: terminal connection for external alarm
 8. Optional Low Water Cut Off – both automatic and manual reset available
- C. The **Boiler** system shall have an **optional** built in Cascade controller to sequence and rotate lead boiler to ensure equal runtime while maintaining equal modulation of up to 8 units of same or different BTU/hr inputs without utilization of an additional external controller. The factory mounted, wired and configured, cascade controller shall include:
1. Master-less operation; no one appliance is the dedicated Master, and no appliance is dependent on another in the Cascade to fire. Requires separate power supply to Cascade Control.
 2. Efficiency optimization: The Control module shall always operate appliances at the lowest firing rate possible; all cascaded appliances shall always operate at the same firing rate when on.

3. Front end loading: a single appliance may be dedicated as the “pony boiler” and always be first on and last off.
 4. Rotation of lead appliance, lead-lag: The Control module shall change the lead appliance, and all appliances firing priority to insure even wear, once every 24 hours.
 5. When the entire Cascade is at 100% of capacity, a relay is closed providing the ability to turn on an additional heat source (additional Cascade, lower efficiency appliances etc.).
- D. **Building Automation System (BMS) Interface:** Internal communication buss is via Modbus, allowing directly connected building automation systems of the same protocol to monitor, control, and display boiler status and alarms. All other protocols are connected via an **optional** factory mounted and configured processor (BACnet/IP, BACnet MS/TP, LonWorks, KNX, Metasys N2, SNMP, XML, etc.).
- Any BMS system may control the on-off and the boiler or Cascade primary set-point using a 0 – 10 VDC input without any additional hardware or interface being required.
- E. **Dashboard Service package:** factory mounted, wired and configured, private, secure cellular connection (with included remote mount antenna) for data collection, remote cloud and onboard historical storage and two-way communication with installed systems. With this service a Dashboard will be created for each specific job that the End User or Service contractor will be able to monitor boiler status and make changes to the system. Management of data and notifications can be done at End User, Service Contractor, Distributor and Factory levels with various password levels.

The manufacturer shall verify proper operation of the burners, all controls and the heat exchanger, and set the combustion characteristics and test efficiency by connection to water and venting for a factory fire test prior to shipping. This quality control and efficiency document shall be available for every individual appliance on request.

The **Boilers** shall be installed and vented with a:

- A. **Direct Vent** system with vertical roof top termination of both the vent and combustion air. The flue shall be PVC, CPVC, Polypropylene, or AL29-4C sealed vent material terminating at the rooftop with the manufacturers specified termination. A separate pipe shall supply combustion air directly to the boiler from the outside. The air inlet pipe may be PVC, CPVC, Polypropylene, ABS, or AL29-4C sealed pipe. The air inlet must terminate on the rooftop with the manufacturers specified air inlet termination. The boiler's total combined exhaust and intake venting length shall not exceed ____ equivalent feet. (See tables in manual.) ***Foam Core pipe is not an approved material for exhaust pipe.***

Maximum unit dimensions shall be: Length _____ inches, Width _____ inches and Height _____ inches.

Maximum unit weight shall be _____ pounds.