

DIVISION 23 52 33.13

WATER-TUBE BOILERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes condensing gas-fired, copper and cupronickel finned-tube hydronic heating boilers

Specifier Note: Use as needed

B. Related Sections

- 1. Building Services Piping – Division 23 21 00
- 2. Breeching, Chimneys, and Stacks (Venting) – Division 23 51 00
- 3. HVAC Instrumentation and Controls – Division 23 09 00
- 4. Electrical – Division 23 09 33

1.2 REFERENCES

- A. ANSI Z21.13/CSA 4.9
- B. ASHRAE 90.1
- C. ASME, Sections IV and VIII
- D. 2006 UMC, Section 1107.6
- E. ANSI/ASHRAE 15-1994, Section 8.13.6
- F. National Fuel Gas Code, ANSI Z223.1/NFPA 54
- G. BTS - 2000
- H. CAN 3.1
- I. ASME CSD-1, 2018 (when required)

1.3 SUBMITTALS

- A. Product data sheet (including dimensions, rated capacities, shipping weights, accessories)
- B. Wiring diagram
- C. Warranty information
- D. Installation and operating instructions

1.4 QUALITY ASSURANCE

- A. Regulatory Requirements
 - 1. ANSI Z21.13/CSA 4.9
 - 2. Local and national air quality regulations for low NO_x (0-20 PPM NO_x emissions) boilers
- B. Certifications
 - 1. CSA - ANSI Z21.13/CSA 4.9
 - 2. ASME H-Stamped and National Board registered – Primary Heat Exchanger
 - 3. ASME U-Stamped and National Board registered – Secondary Stainless Steel Condensing Heat Exchanger
 - 4. CSA-Certified – Low-Lead Compliant
 - 5. CEC

1.5 WARRANTY

- A. Limited one-year parts warranty
- B. Limited ten-year closed-system heat exchanger warranty
- C. Limited ten-year secondary heat exchanger warranty
- D. Limited twenty-five-year thermal shock warranty

PART 2 - PRODUCTS

2.1 MANUFACTURER

A. Raypak, Inc.

1. Contact: 2151 Eastman Ave., Oxnard, CA 93030; Telephone: (805) 278-5300; Fax: (805) 278-5468; Website: www.raypak.com
2. Product: XTherm condensing water-tube hydronic heating boiler(s)

2.2 BOILERS

A. General

1. The boiler(s) shall be fired with _____ gas at a rated input of _____ BTU/hr.
2. The boiler(s) shall be CSA-tested and certified with a minimum thermal efficiency of 96% at full fire (up to 99% at part load).
3. The boiler(s) shall be ASME inspected and stamped and National Board registered for 160 PSIG maximum allowable working pressure and 250°F maximum allowable temperature, complete with a Manufacturer's Data Report.
4. The boiler(s) shall have a floor loading of 70 lbs. /square foot or less.
5. The boiler(s) shall be capable of operating with inlet water temperatures as low as 50°F.
6. The boiler(s) shall have a user setting for percentage of glycol to be used in the piping system and, using a patent-pending algorithm, will automatically and dynamically adjust maximum allowable firing rate, maximum temperature differential, minimum required fluid flow and burner response timing. This feature will provide maximum protection for the heat exchanger and provide for the maximum achievable life of the boiler under varying system conditions. The default setting for this feature is 50% glycol, to ensure the maximum protection level is provided as shipped.

B. Primary Heat Exchanger

1. The primary heat exchanger shall be of a single-bank, vertical multi-pass design and shall completely enclose the combustion chamber for maximum efficiency. The tubes shall be set vertically and shall be rolled into a powder-coated, ASME boiler-quality, carbon steel tube sheet.
2. The primary heat exchanger shall be sealed to 160 PSIG-rated low lead bronze headers with high-temp silicone "O"-rings.
3. The low water volume primary heat exchanger shall be explosion-proof on the waterside.
4. The headers shall be secured to the tube sheet by stud bolts with flange nuts to permit inspection and maintenance without removal of external piping connections. A heavy gauge stainless steel slotted heat exchanger wrap shall ensure proper combustion gas flow across the copper and cupronickel finned tubes.
5. The flue connection, combustion air opening, gas connection, water connections, electrical connections and condensate drain shall be located on the rear.
6. The primary heat exchanger shall have accessible boiler drain valves with hose bibs to drain the water section of the primary heat exchanger.

C. Condensing Secondary Heat Exchanger

1. The condensing secondary heat exchanger shall be a single-bank, multi-pass design constructed of stainless steel and bear the ASME U stamp.
2. The secondary heat exchanger shall have accessible boiler drain valves with hose bibs to drain the water section of the heat exchanger.

D. Condensate Drain

1. The boiler(s) will feature a condensate drain switch, which will shut down the boiler(s) if the condensate drain is blocked.

E. Burners

1. The combustion chamber shall be of the sealed-combustion type employing the Raypak high-temperature FeCrAlloy radially fired knit burner, mounted in a vertical orientation.

2. The burner must be capable of firing at both a complete blue flame with maximum gas and air input as well as firing infrared when gas and air are reduced. The burner must be capable of firing at 100% of rated input when supplied with 4.0" WC of inlet natural gas pressure, or 8.0" when supplied with propane gas, so as to maintain service under heavy demand conditions; no exceptions.
 3. The burner shall use a combustion air blower to precisely control the fuel/air mixture for maximum efficiency throughout the entire range of modulation. The combustion air blower shall operate for a pre-purge period before burner ignition and a post-purge period after burner operation to clear the combustion chamber.
 4. The blower shall infinitely vary its output in response to a Pulse Width Modulation (PWM) signal, supplied directly from the VERSA IC[®] modulating temperature controller, thereby electronically and precisely adjusting the volume of air and gas supplied for combustion. Minimum fire shall be as low as 9% of rated input (natural gas or propane gas).
- F. Ignition Control System
1. The boiler(s) shall be equipped with a 100% safety shutdown.
 2. The ignition shall be proven Hot Surface Ignition (HSI) type with full flame rectification by remote sensing separate from the ignition source, with a three-try-for-ignition sequence (single-try optional), to ensure consistent operation.
 3. The igniter will be located to the side of the heat exchanger to protect the device from condensation during start-up.
 4. The ignition control module shall include an LED that indicates fifteen (15) individual diagnostic flash codes and transmits any fault codes to the touchscreen display.
 5. An external viewing port shall be provided, permitting visual observation of burner operation.
- G. Gas Train
1. The boiler(s) shall have a firing/leak test valve and pressure test valve as required by CSD-1.
 2. The boiler(s) shall have dual-seated main gas valve.
 3. Gas control trains shall have a redundant safety shut-off feature, main gas regulation, shutoff cock and plugged pressure tapping to meet the requirements of ANSI Z21.13/CSA 4.9.
 4. High gas pressure safety switch.
- H. Boiler Control
1. The following safety controls shall be provided:
 - a. High limit control with manual-reset, mounted and wired
 - b. Flow switch, mounted and wired
 - c. _____ PSIG ASME pressure relief valve, piped by the installer to an approved drain
 - d. Temperature and pressure gauge (shipped loose)
 2. The boiler(s) shall be equipped with the following:
 - a. VERSA IC[®] modulating temperature controller with 7" capacitive color touchscreen display
 - b. Two adjustable energy-saving pump control relays (system, indirect DHW)
 - c. Freeze protection
 - d. Six (6) sensors included (inlet and outlet factory-mounted and wired; system, outdoor air, indirect DHW, indirect supply shipped loose for field installation by others).
 3. The boiler(s) shall allow for 0-10 VDC input connection for remote building DDC system control of system temperature or firing rate.
 4. The boiler(s) shall have built-in "Cascade" function for up to eight (8) units of same or different BTUH inputs without utilizing an external controller or sequencer.
 - a. The Cascade function shall include selectable modes for parallel modulation and sequential modulation with lead boiler rotation and lead-lag operation
 - b. System shall be capable of leader redundancy and lead rotation every forty-eight (48) hours
 - c. Cascade function shall allow users to enable or disable alarm sharing across cascaded appliances when an alarm condition occurs
- I. Firing Mode: Provide electronic modulating control of the gas input to the boiler.
- J. Boiler Diagnostics
1. Provide external LED panel displaying the following boiler status/faults:

- a. Power on – Green
- b. Call for heat – Amber
- c. Burner firing – Blue
- d. Service – Red
- e. Provide monitoring of all safeties, internal/external interlocks with fault display by a 7" capacitive color touchscreen display
- f. System status
- g. Condensate blockage
- h. Manual-reset high limit
- i. Blocked vent
- j. High gas pressure switch
- k. Controller alarm
- l. Flow switch
- m. Factory option
- n. External interlock
- o. Ignition lock-out
- p. Sensor failure
- q. Inlet sensor (open or short)
- r. Outlet sensor (open or short)
- s. System (cascade) sensor (open or short)
- t. Air sensor (open or short)
- u. Temperature to indirect sensor (open or short)
- v. Indirect DHW tank sensor (open or short)
- w. Cold water protection sensor (open or short)
- x. ID card fault
- y. Internal control fault
- z. Cascade communication error

Specifier Note: The remaining items in this section are options. Delete those that are not being specified.

- aa. Auto-reset high limit (optional)
 - bb. Low water cut-off (optional)
 - cc. Low gas pressure switch (optional)
2. Provide ignition module indicating the following flash codes by LED signal and displayed on the 7" Touch Screen display:
- a. 1 flash – low air pressure
 - b. 2 flashes – flame in the combustion chamber w/o CFH
 - c. 3 flashes – ignition lock-out (flame failure)
 - d. 4 flashes – low hot surface igniter current
 - e. 5 flashes – low 24VAC
 - f. 6 flashes – vent temperature
 - g. 7 flashes – hi-limit
 - h. 8 flashes – sensor fault
 - i. 9 flashes – low gas pressure
 - j. 10 flashes – water pressure
 - k. 11 flashes – blower speed fault
 - l. 12 flashes – low water cut-off
 - m. 13 flashes – hi-temperature ΔT
 - n. 14 flashes – FT-BUS communications
 - o. 15 flashes – general safety limit
- K. Combustion Chamber: The combustion chamber wrapper shall be insulated to reduce standby radiation losses, reducing jacket losses and increasing unit efficiency.
- L. Cabinet
- 1. The corrosion-resistant galvanized-steel jackets shall be finished with a baked-on epoxy powder coat, suitable for outdoor installation, applied prior to assembly for complete coverage, and shall incorporate louvers in the outer panels to divert air past heated surfaces.
 - 2. The boiler(s), if located on a combustible floor, shall not require a separate combustible floor base.

3. The boiler(s) shall connect both the combustion air and flue products through the back of the unit.
 4. The boiler shall have as standard an internal combustion air filter rated to MERV 8 (>95% arrestance).
- M. Boiler Pump – The boiler(s) shall be equipped with a factory-packaged pump system.
- N. Cold Water Protection System
1. The boiler(s) shall be configured with an automatic cold water protection proportional bypass system that ensures the boiler primary heat exchanger will experience inlet temperatures in excess of 120°F in less than 7 minutes to avoid damaging condensation.
 2. The cold-water protection system shall be configured with a variable-flow injection system that is controlled by the VERSA IC® control system that diverts the correct amount of heated outlet water directly into the boiler loop to maintain the required minimum inlet temperature. The VERSA IC® control temperature sensor shall be located in the inlet header of the boiler.

2.3 BOILER OPERATING CONTROLS

A. Raymote™ Connectivity

1. The VERSA IC® shall include the Raymote connectivity feature to allow remote access to boiler or water heater data, and to provide maintenance reminders and error notifications on iOS and Android devices or by website access.
 2. The Raymote system allows for registering of multiple devices at various locations and multiple devices in a single cascade installation. The system also allows separate Groups to be established with various levels of access and control permission to be set by the equipment owner. The Groups feature will also allow for quick and efficient troubleshooting service by Raypak's Service Team.
 3. Raymote will provide reminders and alerts via iOS or Android notification, text, or email. All notification features are user-set.
 4. The Raymote App and website will allow remote monitoring of the following:
 - a. Outlet and inlet temperature monitoring
 - b. Vent temperature
 - c. Flow (if equipped)
 - d. Blower speed
 - e. Modulation percentage
 - f. Flame current
 - g. Run time
 - h. Boiler Status
 - i. Cycles
 - j. Historical data
 5. The Raymote App and website will allow remote control/adjustment of the following:
 - a. Temperature setpoint
 - b. Temperature differential
 - c. Outdoor Reset settings
 - d. Indirect setpoint
 - e. Indirect differential
 - f. Custom notification
 - g. Full historical data reports will be available for review on the Raymote website.
 6. One (1) year of Raymote service is included with boiler/water heater purchase.
- B. The system sensor shall be shipped loose for field installation by installing contractor. Inlet/Outlet sensors are factory-installed.
- C. The control shall have the ability to provide cascade control of up to eight (8) boilers as a single system via 2-wire communication.
- D. Each boiler shall be equipped with Modbus communications compatibility with up to 146 points of data available.

Specifier Note: The remaining items in this section are options. Delete those that are not being specified.

- a. B-85 Gateway – BACnet MS/IP, BACnet IP, N2 Metasys or Modbus ICP
- b. B-86 Gateway – LonWorks

2.4 DIRECT VENT

- A. The boiler(s) shall meet safety standards for direct vent equipment as noted by the Uniform Mechanical Code, section 1107.6, and ASHRAE 15-1994, section 8.13.6.
- B. Boiler shall be capable of combined combustion air duct and vent lengths not to exceed 200 equivalent feet.

2.5 SOURCE QUALITY CONTROL

- A. The boiler(s) shall be completely assembled, wired, and fire-tested prior to shipment from the factory.
- B. The boiler(s) shall be furnished with the sales order, ASME Manufacturer's Data Report(s), inspection sheet, wiring diagram, rating plate and Installation and Operating Manual.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Must comply with:
 - 1. Local, state, provincial, and national codes, laws, regulations and ordinances
 - 2. National Fuel Gas Code, ANSI Z223.1/NFPA 54 – latest edition
 - 3. National Electrical Code, ANSI/NFPA 70 – latest edition
 - 4. Standard for Controls and Safety Devices for Automatically-Fired Boilers, ANSI/ASME CSD-1, when required
 - 5. Canada only: CAN/CGA B149 Installation Code and CSA C22.1 CEC Part I
 - 6. Manufacturer's installation instructions, including required service clearances and venting guidelines
- B. Manufacturer's representative to verify proper and complete installation.

3.2 START-UP

- A. Shall be performed by Raypak factory-trained personnel.
- B. Test during operation and adjust if necessary:
 - 1. Safeties
 - 2. Operating controls
 - 3. Static and full load gas supply pressure
 - 4. Gas manifold and blower air pressure
 - 5. Amp draw of blower
 - 6. Combustion analysis
- C. Submit copy of start-up report to Architect and Engineer.

3.3 TRAINING

- A. Provide factory-authorized service representative to train maintenance personnel on procedures and schedules related to start-up, shut-down, troubleshooting, servicing, and preventive maintenance.
- B. Schedule training at least seven days in advance.

END OF SECTION