

DIVISION 23 52 33.13

FIRE-TUBE STAINLESS STEEL HEATING BOILERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes fire-tube, condensing, gas-fired, stainless steel, 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. ASME, Section IV
- C. 2006 UMC, Section 1107.6
- D. ANSI/ASHRAE 15-1994, Section 8.13.6
- E. National Fuel Gas Code, ANSI Z223.1/NFPA 54
- F. AHRI
- G. NEC, ANSI/NFPA 70
- H. ASME CSD-1, 2018 (when required)
- I. ISO 9001:2015

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. Units can be tuned onsite to 9 PPM NO_x where required.
- B. Certifications
 - 1. CSA
 - 2. CEC
 - 3. ASME, Section IV, H Stamped and National Board Registered
 - 4. SCAQMD Rule 1146.2 Compliant (Models H7-0856 to H7-2006)
 - 5. CSA Low-Lead Compliant

1.5 WARRANTY

- A. Limited one-year parts warranty
- B. Limited ten-year closed-system heat exchanger warranty
- C. 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; Web site: www.raypak.com
2. Product: XVers™ condensing stainless steel fire-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 96.2% (95.5% for 3006 model) at full fire (up to 99% at part load).
3. 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.
4. The boiler shall have a user setting to select the vent material being installed with the boiler. This setting, along with a flue gas temperature sensor, will dynamically adjust firing rate to provide protection for the vent system selected by the user. The default setting is for PVC vent material, to ensure the maximum protection level is provided as shipped.

B. Heat Exchanger

1. The primary heat exchanger shall be of a single-pass flue gas, vertically oriented fire-tube design with water surrounding the combustion chamber for maximum efficiency.
2. The heat exchanger shall be fully-welded construction utilizing 316L stainless steel for the fire-tubes, tube sheets, combustion chamber, flue collector and pressure vessel shell. The boiler water connections shall be 3-inch flanged, 150-pound, ANSI 304AL stainless steel.
3. The heat exchanger shall be explosion-proof on the water side.
4. The heat exchanger shall be ASME inspected and stamped and National Board registered for 160 PSIG maximum allowable working pressure and 200°F maximum allowable temperature, complete with a Manufacturer's Data Report.
5. _____ PSIG ASME pressure relief valve, piped by the installer to an approved drain (shipped loose for field installation by others).
6. Temperature and pressure gauge factory-mounted.
7. The heat exchanger must have two lifting lugs welded to the top of the vessel to aid in rigging the unit for installation.
8. A built-in flue gas test port must be included as a standard part of the heat exchanger flue collector.

C. Condensate Drain

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

D. Burner

1. The combustion chamber shall be of the sealed-combustion type employing the Raypak high-temperature FeCrAlloy knitted mesh-burner, mounted in a vertical orientation.
2. The burner must be capable of firing 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" WC when supplied with propane gas, so as to maintain service under heavy demand conditions; no exceptions.
3. The burner shall use a fully-sealed, non-sparking combustion air blower to precisely mix and control the flow of 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 control, thereby electronically and precisely adjusting the volume of air and gas supplied for combustion.
- E. Ignition 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 separately from the ignition source. A three-try-for-ignition sequence is standard (single-try optional).
 3. Unit to employ the "Rich-Start" system (patent pending) to ensure reliable ignition under a very broad range of operational conditions.
 4. The igniter will be oriented vertically to extend the life of the igniter.
 5. The ignition control module shall include an LED display that indicates fifteen (15) individual diagnostic flash codes and transmits any faults to the touchscreen display.
 6. An external viewing port shall be provided, permitting visual observation of burner operation.
- F. 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, shut-off cock and plugged pressure tapping to meet the requirements of ANSI Z21.13/CSA 4.9.
 4. A gas sediment trap with flanged connection shall be included as a standard on the gas line connection point to the boiler (shipped loose).

Specifier Note: Item G is optional. Delete if not being specified.

- G. HO₂T™ O₂ Trim System
1. Each boiler shall include the HO₂T O₂ trim system.
 2. The system continuously monitors the oxygen level in the flue gas in the vent piping and if the O₂ level deviates from the target setpoint (operating curve), will modulate the fuel gas flow, via the actuator and valve, to bring the O₂ level back to target setpoint.
 3. The O₂ sensor shall be directly mounted to the vent piping with only a single cable disconnect to allow for easy access and maintenance.
 4. In order to keep the flue gas O₂ level on target, the system compensates and adjusts under the following conditions:
 - a. Partially blocked air inlet
 - b. Variation of air inlet temperatures
 - c. Variation of weather low and high pressure systems
 - d. Fluctuations of the fuel heating values
 5. The O₂ trim system controls are available on the VERSA IC[®] touchscreen. The display shows tracking of the target O₂ curve (blue area) or if off target (red). The VERSA IC[®] allows the operator to select from three (3) different operating curves: Optimum (factory setting), More Excess Air, and Less Excess Air.
 6. Error messages will be displayed on the VERSA IC[®] control touchscreen and error lights will illuminate. Current errors are displayed on the Boiler page. All previous errors are displayed in the Boiler History Log.
 7. Self-diagnostics are included in the system including
 - a. System status
 - b. External factor preventing the system from completing control activities
- 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. Low water cut-off with manual reset, mounted and wired
 - d. Blocked vent pressure switch, mounted and wired
 - e. Blocked condensate switch, mounted and wired
 - f. *Adjustable high limit control with manual reset, mounted and wired (OPTIONAL)*
 - g. *Adjustable high limit control with auto reset, mounted and wired (OPTIONAL)*

2. The boiler(s) shall be equipped with the following:
 - a. VERSA IC® modulating temperature controller with 7" capacitive color touchscreen display
 - b. Three adjustable energy-saving pump control relays (boiler, system, indirect DHW)
 - c. Freeze protection
 - d. Five water sensors included (inlet and outlet factory mounted and wired; indirect, temperature to indirect and cascade sensors shipped loose for field installation by others).
 - e. Outdoor air sensor (shipped loose for field installation by others)
 - f. Water flow rate sensor, mounted and wired. Accurate to +/- 1%. (displays flow in GPM and available via BMS data port)
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. Water flow rate sensor shall enable the following:
 - a. The PIM will only allow for ignition as long as the flow meter detects a flow higher than the minimum flow requirement for the unit. If minimum flow is not achieved within 90 seconds, the unit will broadcast a "Flow Error" condition and will hold from ignition until proper flow is observed. When flow error occurs, an alarm will notify the user that the unit did not ignite due to insufficient flow. If sufficient flow is present, user can override the Flow Error and allow ignition up to 80% firing rate with flow override expiring every 24 hours.
 - b. Allow for adjustable cascade flow offset function, where in a cascaded system the master boiler will only allow the next unit in the cascade to operate when flow requirements are met.
 - c. The boiler integrated control provides delta-T protection zones, which include a "Flow Warning zone", which broadcasts an error when delta-T is higher than expected given a flow rate and firing rate. A "Hold Firing Rate Zone", where firing rate is held constant to prevent an increase in delta-T. And a "Min Firing Rate Zone", where the firing rate will drop to its minimum rate to prevent a delta-T fault.
5. 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
 - d. Cascade functions shall include an interstage delay setting with auto-delay option.
6. Firing Mode: Provide electronic modulating control of the gas input to the boiler.
7. Boiler Diagnostics - Provide external visible LED panel displaying the following boiler status/faults:
 - a. Power on – Green
 - b. Call for heat – Amber
 - c. Burner firing – Blue
 - d. Service - Red
8. Provide monitoring of all safeties, internal/external interlocks with fault display by a 7" capacitive color touchscreen display:
 - a. System status
 - b. Condensate blockage
 - c. Manual-reset high limit
 - d. *Auto-reset high limit (OPTIONAL – please specify shipped loose or installed)*
 - e. Low water cut-off
 - f. Blocked vent
 - g. *Low gas pressure switch (OPTIONAL)*
 - h. *High gas pressure switch (OPTIONAL on 0856-2006, standard on models 2506 - 3006)*
 - i. Controller alarm
 - j. Flow switch
 - k. Factory option
 - l. External interlock
 - m. Ignition lock-out
 - n. Blower speed error

- o. Low 24VAC
- p. Sensor failure
 - 1. Inlet sensor (open or short)
 - 2. Outlet sensor (open or short)
 - 3. System (cascade) sensor (open or short)
 - 4. Air sensor (open or short)
 - 5. Temperature to indirect sensor (open or short)
 - 6. Indirect DHW tank sensor (open or short)
 - 7. Water flow rate sensor
 - 8. Vent temperature sensor
 - 9. Internal control fault
 - 10. ID card fault
 - 11. Cascade communication error

I. Combustion Chamber

- 1. The combustion chamber shall be constructed of 316L stainless steel and fully surround the burner for maximum efficiency.

J. 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 the heated surfaces.
- 2. The boiler top shall be fabricated from reinforced, UV-stable polymer rated for outdoor use.
- 3. The boiler(s), if located on a combustible surface, shall not require a separate combustible floor base.
- 4. The boiler(s) shall connect the combustion air through the top of the cabinet and flue products through the back of the unit.
- 5. The boiler shall have as standard an internal, high-capacity combustion air filter rated to MERV 8 (equal to or greater than 95% arrestance).
- 6. The formed structural steel base shall include properly-sized openings for forklift from either side or a pallet jack from the front or rear of the unit.

Specifier Note: The remaining item(s) in this section are options. Delete those that are not being specified.

- K. The capacitive touchscreen display shall include a digital document viewer.

L. Boiler Pump

- 1. The boiler(s) shall have the option of a fixed or variable-speed boiler pump controlled by the VERSA IC® integral control system. (shipped loose for field installation by others)
 - a. Fixed speed pump to be installed in the boiler connected piping and interlocked with the boiler mounted VERSA IC® control system via the “Boiler” pilot-duty pump relay located in the rear wiring box on the back of the unit. Pump will be operated only during a call for heat from the system and only when there is a call for the unit’s burner to operate to provide for maximum operating efficiency of the overall system. Pump is maintained in the idle position when the associated unit’s burner is not operating.
 - b. Variable-speed pump to be installed in the boiler connected piping and interlocked with the boiler-mounted VERSA IC® control system via the “Boiler” pilot duty pump relay and variable-speed boiler pump output located in the rear wiring box on the back of the unit. Pump will be operated only during a call for heat from the system and only when there is a call for the unit’s burner to operate. Boiler pump speed and flow will work in concert with the connected boilers firing rate to provide for maximum operating efficiency of the overall system. Pump is maintained in the idle position when the associated unit’s burner is not operating.

M. Motorized Isolation Valve

- 1. The boiler shall have the option of a 3-inch motorized isolation valve to allow the boiler to be isolated from the system plumbing when not firing, in a cascade system.
 - a. Cast iron with Nylon coated ductile iron disc, 416 stainless steel stem, EPDM seats
 - b. Normally-open, powered closed
 - c. 2-way spring return

N. Cold Water Protection System

1. The boiler shall be field configured with a factory-provided, cold-water protection, automatic proportional bypass system that ensures the heat exchanger of the boiler will experience inlet temperatures in excess of 40°F in less than 7 minutes to avoid damaging condensation formation in the burner chamber.

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. Each boiler shall have the ability to receive a 0-10 VDC signal from the Central Energy Management and Direct Digital Control System (EMCS) to vary the setpoint or control firing rate. Each boiler shall have an alarm contact for connection to the central EMCS system.
- C. Each boiler shall be equipped with Modbus communications compatibility with up to 146 points of data available.
 - a. *B-85 Gateway – BACnet MS/TP, BACnet IP, N2 Metasys or Modbus TCP shipped loose/installed (optional – please specify shipped loose or installed)*
 - b. *B-86 Gateway – LonWorks shipped loose/installed (optional – please specify shipped loose or installed)*
- D. The boiler(s) shall feature the integrated VERSA IC® modulating digital controller, mounted and wired.
 1. Mode 1 = Hydronic, without indirect domestic hot water
 2. Mode 2 = Hydronic, with indirect domestic hot water plumbed into system loop piping
 3. Mode 3 = Hydronic, with indirect domestic hot water plumbed into boiler loop plumbing (Primary/Secondary Piping Only)
- E. System cascade sensor and optional air temperature sensor shall be shipped loose for field installation by installing contractor. Inlet, outlet, flue gas, and water flow rate sensors are factory-installed.

- F. VERSA IC® control system is capable of controlling up to three (3) connected pumps.
 1. Boiler pump (Fixed- or Variable-Speed)
 2. System pump
 3. Indirect DHW pump

2.4 ELECTRICAL POWER

- A. Controllers, electrical devices and wiring: Electrical devices and connections are specified in Division 26 sections.
- B. Single-Point Field Power Connection: Factory-installed and factory-wired switches, motor controllers, transformers, and other electrical devices shall provide single-point field power connection to the boiler.
- C. Electrical characteristics:

	Models 0856–1506	Standard on Models 1756–3006 <i>Optional on Models 0856-1506</i>	Optional (all models)
Voltage (VAC)	120	208/240/277	480/600*
Phase	Single	Single or Three	Three
Frequency (Hz)	60	60	60
Full-load current (Amps)	<12	<18	<12

*Factory-wired for 480VAC 3-phase 60Hz. 600VAC is field-wired only.

2.5 VENTING

- A. The exhaust vent must be UL-listed for use with Category II and IV appliances and compatible with operating temperatures up to 230°F, condensing flue gas service. UL-listed vents of Centrotherm® Polypropylene and Category IV stainless steel must be used with boilers. PVC ANSI/ASTM D1785 schedule 40, ANSI/ASTM F441 schedule 40 CPVC solid-core pipe may also be used to vent the XVers boiler when installed using the factory-supplied vent adapter.
- B. The minimum exhaust vent duct size for each boiler is 6” diameter for sizes 0856 – 1006, 8” diameter for sizes 1256 – 2006 and 10” for sizes 2506 – 3006.
- C. Combustion-Air Intake: Boilers shall be capable of drawing combustion air from the outdoors via a metal or PVC duct connected between the boiler and the outdoors.
- D. The minimum sealed-combustion air duct size for each boiler shall be eight-inch diameter.
- E. Common vent and common combustion air must be an available option for boiler installation. Consult manufacturer for common vent and combustion air sizing. Follow guidelines specified in the manufacturers’ venting guides.
- F. Standard vent connection shall be Duravent FasNSeal®.
- G. Vent adapter (OPTIONAL - select either item 1 or 2 below if utilizing)
 1. PVC/CPVC (sales option D-108) that allows for the use of PVC vent material when the boiler return water temperature does not exceed 150°F or CPVC when the temperature does not exceed 170°F.
 2. Centrotherm Innoflue® (sales option D-33) that allows for the use of polypropylene vent material.
 3. The boiler-mounted VERSA IC® control shall include a feature allowing for the user to select the vent material during setup, which will automatically adjust unit operation to not exceed a maximum safe flue exhaust temperature.

2.6 DIRECT VENT

- A. The boiler(s) shall meet safety standards for direct vent equipment as noted by the 2006 Uniform Mechanical Code, section 1107.6, and ASHRAE 15-1994, section 8.13.6.

2.7 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 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/CSA 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 suction pressure
 - 5. Amp draw of blower
 - 6. Combustion analysis
- C. Submit copy of start-up report to Architect and Engineer.
- D. Register the product at <http://warranty.raypak.com>.

3.3 TRAINING

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

END OF SECTION