

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. ANSI 2.17
- C. ASME, Section II, IV, VIII, and IX
- 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. AHRI 1500
- H. NEC, ANSI/NFPA 70
- I. ASME CSD-1, latest edition (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 NOx boilers. Units can be tuned onsite to 9 PPM NOx where required.
- B. Certifications
 - 1. CSA
 - 2. CEC (as applicable)
 - 3. CFC
 - 4. ASME, Section IV, H-Stamped and National Board registered
 - 5. SCAQMD Rule 1146.2 certified – NOx < 20 ppm (Models H7-1007 to H7-2007)
 - 6. BAAQMD Rule 9-7-307.1 certified – NOx < 30 ppm (Models H7-2507 to H7-4007)
 - 7. SJVAPCD Rule 4307 and 4308 propane-certified – NOx < 30 ppm

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; Website: www.raypak.com
2. Product: XVers™ with KOR 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 AHRI certified with a minimum thermal efficiency of 94.5% (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 shall be 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 shall be for PVC vent material, to ensure the maximum protection level is provided as-shipped.
5. The boiler(s) shall operate at elevations up to 5,000 feet without component changes. High elevation models shall be required for elevations from 5,001 feet to 10,000 feet with specific derates.
6. The boiler shall be capable of field-conversion between natural gas and propane without changing components.

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 and flue collector. The pressure vessel shell shall be 304L stainless steel. The boiler water connections shall be 304L stainless steel, 3-inch ANSI/ASME B16.5 150-pound flanges.
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 210°F maximum allowable temperature, complete with a Manufacturer's Data Report.
5. _____ PSIG ASME pressure relief valve mounted on the boiler.
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 trap and drain with float switch, which will shutdown 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 FeCrAloy knitted mesh-burner, mounted in a vertical orientation.
2. The burner must be capable of firing at 100% of rated-input when supplied with a minimum of 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. Combustion Chamber
1. The combustion chamber shall be constructed of 316L stainless steel and fully surround the burner for maximum efficiency
- F. 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.
 5. The platform ignition control module (PIM) shall include an LED display that indicates up to fifteen (15) individual diagnostic flash codes locally and transmits any faults to the touchscreen display when present.
- G. Gas Train
1. The boiler(s) gas valve 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 train 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.
- H. 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 (for indoor installation) 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.
 7. The cabinet base shall include seismic anchor holes.

Specifier Note: The remaining item(s) in this section (2.1) are options. Delete those that are not being specified.

- I. 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)
- J. Motorized Isolation Valve
1. The boiler shall have the option and be capable of controlling a motorized isolation valve to allow the boiler to be isolated from the system plumbing when not firing. The controller shall allow users to set a minimum open isolation valve requirement.

2. Optional Isolation valve shall include:
 - 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
- K. Optional Oxygen Monitoring (HO₂T Track)
 1. Provide oxygen monitoring system to continuously monitor oxygen concentrations in boiler flue gas and allow for manual adjustments for fuel and airflow to maintain optimum level.
 2. Provide system suitable to monitor oxygen concentration in boiler flue gas that can be impacted by changes in ambient temperature, barometric pressure, humidity, and variations in fuel characteristics.
 3. Provide automotive-grade oxygen sensor directly mounted to vent piping for easy access and service.
 - a. Sensor orientation to prevent condensate build up at measurement point
 - b. Continuously heated sensor to prevent humidity buildup and optimize response time at startup and during operation
 - c. Provide sensor with cable disconnect fitting
 4. Provide touchscreen interface with oxygen monitoring system controls to display flue gas oxygen concentration value in colors.
 - a. Blue zone indication, when flue gas oxygen concentration is at optimum level
 - b. Red zone indication, when flue gas oxygen concentration is deviating from optimum level
 5. Display system diagnostics on control touchscreen and through Raymote (if connected).

2.3 BOILER OPERATING CONTROLS

A. 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 (*OPTIONAL*)
 - 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. Cabinet temperature limit switch
 - g. *Adjustable high limit control with manual-reset, mounted and wired (OPTIONAL)*
 - h. *Adjustable high limit control with auto-reset, mounted and wired (OPTIONAL)*
2. The boiler(s) shall be equipped with the VERSA IC[®] modulating temperature controller with 7" capacitive color touchscreen display and platform ignition control module (PIM).
3. The boiler(s) shall be equipped with three (3) adjustable energy-saving pump control relays (boiler, system, indirect DHW).
4. The boiler(s) shall have at least five water temperature sensors included (inlet and outlet factory mounted and wired; system sensor, indirect domestic hot water sensor, indirect supply sensor shipped loose for field-installation by others).
5. The boiler(s) shall include an outdoor air sensor (shipped loose for field-installation by others).
6. The boiler(s) shall allow for 0-10 VDC input connection for building control signal which can be used to control setpoint temperature of single boiler and cascade configuration or firing rate. Each boiler shall have an alarm contact for connection to the central EMS system.
7. 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-86 Gateway – LonWorks shipped loose/installed (optional – please specify shipped loose or installed).*
8. The boiler(s) shall be equipped with a water flow meter, mounted and wired, displaying flow in GPM and available via BMS data port, shall enable the following Dynamic Protection™ features:

- 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.
9. 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.
 10. Firing Mode: Provide electronic modulating control of the gas input to the boiler.
 11. Boiler Diagnostics – The front panel Raypak logo shall be illuminated to provide external display of the following boiler status/faults:
 - a. Solid White: Power On
 - b. Pulsing Blue: Call-for-heat
 - c. Solid Blue: Burner On
 - d. Pulsing White: Post-Purge (gas purge)
 - e. Pulsing Red: Error
 12. 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 1007-2007, standard on models 2507 - 4007)*
 - i. Controller alarm
 - j. Flow switch (OPTIONAL)
 - k. External interlock
 - l. Ignition lock-out
 - m. Blower speed error
 - n. Low 24VAC
 - o. 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

13. The capacitive touchscreen display shall include a digital document viewer.
14. The VERSA IC® control system shall be capable of multiple modes of operation:
 - a. Mode 1 = Hydronic, without indirect domestic hot water
 - b. Mode 2 = Hydronic, with indirect domestic hot water plumbed into system-loop-piping
 - c. Mode 3 = Hydronic, with indirect domestic hot water plumbed into boiler-loop-plumbing (Primary/Secondary Piping Only)
15. The VERSA IC® control system shall be capable of controlling up to three (3) connected pumps:
 - a. Boiler pump (Fixed- or Variable-Speed)
 1. Fixed-speed pump (offered by manufacturer or field-supplied) to be installed in the boiler connected piping and interlocked with the 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.
 2. Variable-speed pump (offered by manufacturer or field-supplied) 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 0-20mA 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. Variable-speed 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.
 - b. System pump
 - c. Indirect DHW pump
16. The VERSA IC® control system shall include freeze-protection capability where if the water temperature drops below 45°F (7°C) the boiler pump or isolation valve will enable. The boiler pump will turn off (or isolation valve close) when both inlet and outlet temperatures rise above 50°F (10°C). If either the Outlet or Inlet temperature drops below 38°F (3°C), the burner will fire at the minimum firing-rate. The burner cycle will terminate when both the Inlet and Outlet temperatures rise above 42°F (6°C).

B. 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. The Raymote App and website will allow export of historical data for boiler system performance analysis and monitoring.

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 1007-2007	Standard on Models 2507-4007 <i>(Optional on Models 1007-2007)</i>	Optional (all models)
Voltage (VAC)	120	240	208/240 and 480/600*
Phase	Single	Single or Three	Single or Three
Frequency (Hz)	60	60	60
Full-load current (Amps)	-	-	-

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

2.5 VENTING AND COMBUSTION AIR

- A. Standard vent connection shall be Duravent FasNSeal®.
- B. The exhaust vent must be UL-listed for use with Category II and IV appliances and compatible with operating temperatures up to 230°F (110°C), 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 powered by KOR boiler when installed using the factory-approved vent adapter.
- C. The minimum exhaust vent duct size for each boiler is 6" diameter for sizes 1007, 8" diameter for sizes 1257-2007, 10" for sizes 2507 – 3007 and 12" for sizes 3507-4007.
- D. 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.
- E. *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 (65°C) or CPVC when the temperature does not exceed 170°F (77°C).*
 2. *Centrotherm Innoflue® (sales option D-33) that allows for the use of polypropylene vent material.*
- F. 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