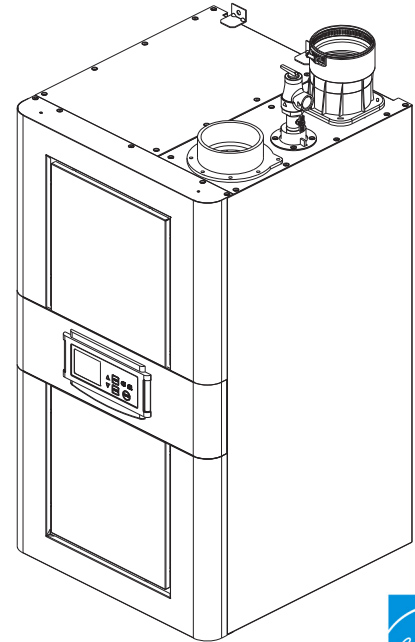


INSTALLATION AND OPERATING INSTRUCTIONS

XPak[®] FT
CONDENSING FIRE TUBE



Models 88AR-398A
Type H



⚠ WARNING: If the information in these instructions are not followed exactly, a fire or explosion may result causing property damage, personal injury or death.

⚠ AVERTISSEMENT: Assurez-vous de bien suivre les instructions données dans cette notice pour réduire au minimum le risque d'incendie ou d'explosion ou pour éviter tout dommage matériel, toute blessure ou la mort.

FOR YOUR SAFETY: Do not store or use gasoline or other flammable vapors and liquids or other combustible materials in the vicinity of this or any other appliance. To do so may result in an explosion or fire.

Ne pas entreposer ni utiliser d'essence ou ni d'autres vapeurs ou liquides inflammables à proximité de cet appareil ou de tout autre appareil.

WHAT TO DO IF YOU SMELL GAS:

CE FAIRE SI VOUS SENTEZ UNE ODEUR DE GAS:

- Do not try to light any appliance.
- Do not touch any electrical switch; do not use any phone in your building.
- Immediately call your gas supplier from a neighbor's phone. Follow the gas supplier's instructions.
- If you cannot reach your gas supplier, call the fire department.

- Ne pas tenter d'allumer d'appareil.
- Ne touchez à aucun interrupteur; ne pas vous servir des téléphones se trouvant dans la bâtiment.
- Appelez immédiatement votre fournisseur de gaz depuis un voisin. Suivre les instructions du fournisseur.
- Si vous ne pouvez rejoindre le fournisseur, appelez le service des incendies.

Installation and service must be performed by a qualified installer, service agency or the gas supplier.

L'installation et l'entretien doivent être assurés par un installateur qualifié ou par le fournisseur de gaz.

Raypak[®]
A Rheem[®] Company

Effective: 04-02-2021
Replaces: 06-15-2018
P/N 241556 Rev. 6

Revision 6 reflects the following changes:

Reformatted and International System of Units (SI) and Celsius extensively added throughout. Warning and Note added to bottom right of page 4. Revised Figure 2 on page 7. "Equipment Room" text revised on page 9. "Clearances Indoor Installations" text revised on page 10. Revised Figure 5 on page 11. Revised Figures 6-10 on pages 11-12. "Direct Vent" text revised on page 14. Figure 12 revised on page 16. Added notes for "See VERSA IC manual" and "cascade configuration" on page 17. Removed Figures 21 & 22 and added note "See VERSA IC manual" "Heating Sensor Installation" revised on page 25. Warning revised in "Gas Supply Connection" on page 21. Figure 16 revised on page 21. Removed "Caution" regarding vent material temperature minimums; replaced with "Note" specifying flue temp limitations on page 27. Replaced with note calling out Figure 24 and caption changed on page 28. "General" text revised on page 27. "Condensate Management" text revised on page 36." Added Figure 25. Table O revised on page 39. Parts List update on page 64. General updates mentioning indoor installations and clarifying "air sensors" where certain "sensor" callouts are detailed. Added two line items to Table P "Cascade Type and Cascade alarm". Added one line item to Table Q "Cascade".

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1. WARNINGS

Pay Attention to These Terms

▲ DANGER	Indicates the presence of immediate hazards which will cause severe personal injury, death or substantial property damage if ignored.
▲ WARNING	Indicates the presence of hazards or unsafe practices which could cause severe personal injury, death or substantial property damage if ignored.
▲ CAUTION	Indicates the presence of hazards or unsafe practices which could cause minor personal injury or product or property damage if ignored.
NOTE	Indicates special instructions on installation, operation, or maintenance which are important but not related to personal injury hazards.

▲ DANGER: Make sure the gas on which the boiler will operate is the same type as that specified on the boiler rating plate.

▲ WARNING: Should overheating occur or the gas supply valve fail to shut, do not turn off or disconnect the electrical supply to the boiler. Instead, shut off the gas supply at a location external to the boiler.

▲ WARNING: Do not use this boiler if any part has been under water. Immediately call a qualified service technician to inspect the boiler and to replace any part of the control system and any gas control which has been under water.

▲ WARNING: To minimize the possibility of improper operation, serious personal injury, fire, or damage to the boiler:

- Always keep the area around the boiler free of combustible materials, gasoline, and other flammable liquids and vapors.
- Boiler should never be covered or have any blockage to the flow of fresh air to the boiler.

▲ WARNING: Vent connectors serving any other appliances shall not be connected into any portion of mechanical draft systems operating under a positive pressure. If an XPak FT® boiler is installed to replace an existing unit, the vent system **MUST** be verified to be of the correct size and of one of the Category IV vent materials identified in this manual. If it is **NOT**, it **MUST** be replaced.

▲ WARNING: Both natural gas and propane have an odorant added to aid in detecting a gas leak. Some people may not physically be able to smell or recognize this odorant. If you are unsure or unfamiliar with the smell of natural gas or propane, ask your local gas supplier. Other conditions, such as “odorant fade,” which causes the odorant to diminish in intensity, can also hide, camouflage, or otherwise make detecting a gas leak by smell more difficult.

▲ WARNING: UL-recognized fuel gas detectors are recommended in all enclosed propane and natural gas applications wherein there is a potential for an explosive mixture of fuel gas to accumulate and their installation should be in accordance with the detector manufacturer’s recommendations and/or local laws, rules, regulations, or customs.

▲ WARNING: This appliance produces condensate from the flue products that is acidic and highly corrosive. Raypak recommends the use of a condensate treatment kit to avoid long-term damage to the drainage system and to meet local code requirements.

▲ WARNING: Risk of electrical shock. More than one disconnect switch may be required to de-energize the equipment before servicing.

▲ WARNING: After testing the PRV on the boiler, isolate boiler from any further components pressure testing on hydronic piping systems. Excessive pressure testing can damage the PRV.

NOTE: RECOMMENDATION - Add air vent valves (preferably auto) to the system water inlet to bleed out extra air.

⚠ CAUTION: This boiler requires forced water circulation when the burner is operating. See minimum and maximum flow rates. Severe damage will occur if the boiler is operated without proper water flow circulation.

NOTE: When the boiler has been filled for the first time or the system has been drained and refilled, it will be necessary to release any air that may have become trapped within the appliance heat exchanger. Open the bleedle valve until all air is purged.

AVERTISSEMENT: N'utilisez pas cette Chaudière si une partie de celle-ci s'est retrouvée sous l'eau. Appelez immédiatement un technicien de service qualifié pour inspecter la Chaudière et pour remplacer toute partie du système de contrôle et toute commande de gaz s'étant retrouvée sous l'eau.

NOTE: Minimum 18 AWG, 105°C, stranded wire must be used for all low voltage (less than 30 Volts) external connections to the unit. Solid conductors should not be used because they can cause excessive tension on contact points. Install conduit as appropriate. All high voltage wires must be the same size (105°C, stranded wire) as the ones on the unit or larger.

⚠ AVERTISSEMENT: En cas de surchauffe ou de non fermeture de la vanne d'alimentation en gaz, n'éteignez ou ne débranchez pas l'alimentation électrique de la chaudière. Coupez plutôt l'alimentation en gaz à l'extérieur de la chaudière.

2. BEFORE INSTALLATION

Raypak strongly recommends that this manual be reviewed thoroughly before installing your XPak FT boiler. Please review the General Safety information before installing the unit. Factory warranty does not apply to units that have been improperly installed or operated. (Refer to the warranty at the back of this manual.) Installation and service must be performed by a qualified installer, service agency or gas supplier. If, after reviewing this manual, you still have questions which this manual does not answer, please contact your local Raypak representative or visit our website at www.raypak.com.

Thank you for purchasing a Raypak product. We hope you will be satisfied with the high quality and durability of our equipment.

Product Receipt

On receipt of your unit it is suggested that you visually check for external damage to the shipping carton. If the carton is damaged, make a note to that effect on the Bill of Lading when signing for the shipment. Next, remove the boiler from the carton. Report any damage to the carrier immediately.

On occasion, items are shipped loose. Be sure that you receive the correct number of packages as indicated on the Bill of Lading.

Claims for shortages and damages must be filed with the carrier by consignee. Permission to return goods must be received from the factory prior to shipping. Goods returned to the factory without an authorized Returned Goods Receipt number will not be accepted. All returned goods are subject to a restocking charge.

When ordering parts, you must specify the model and serial number of the boiler. When ordering under warranty conditions, you must also specify the date of installation.

Purchased parts are subject to replacement only under the manufacturer's warranty. Debits for defective replacement parts will not be accepted. Parts will be replaced in kind only per Raypak's standard warranties.

Model Identification

The model identification number and boiler serial number are found on the rating plate located on the inside upper right panel and also on inlet air decal. The model number has the form H7-198AR or similar depending on the unit size and configuration. The letter in the first group of characters identifies the application (H = Hydronic Heating). The number which follows identifies the firing mode (7 = electronic modulation). The second group of characters identifies the size of the unit (three numbers representing the approximate MBTUH input), and, where applicable, a letter indicating the manufacturing series.

Ratings and Certifications

Standards:

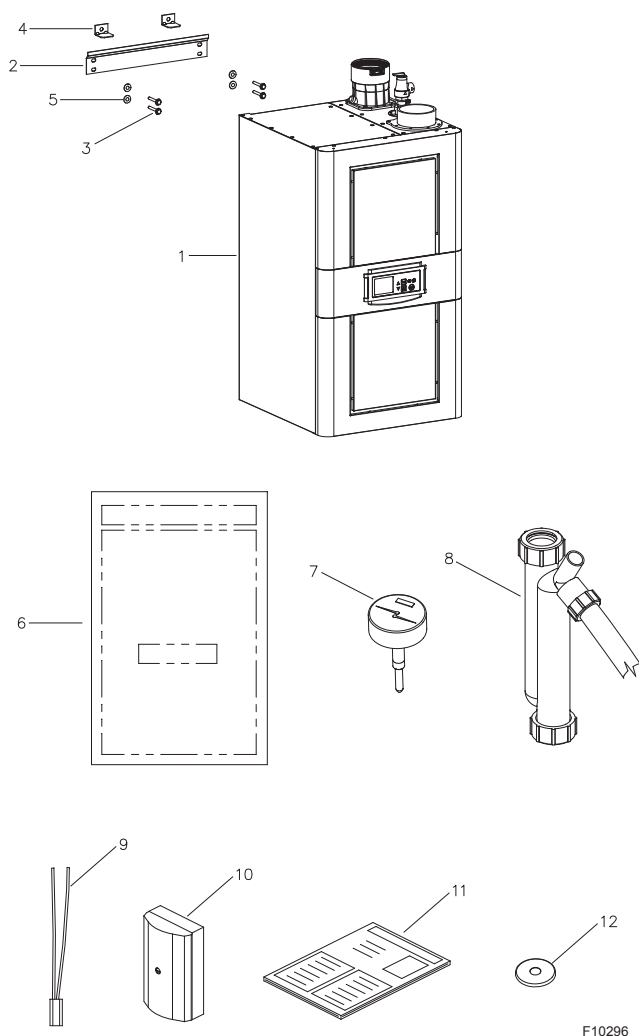
- ANSI Z21.13 · CSA 4.9 - latest edition, Gas-Fired Hot Water Boilers
- SCAQMD Rule 1146.2

All units are National Board registered, and design-certified and tested by the Canadian Standards Association (CSA) for the U.S. and Canada. Each boiler is constructed in accordance with Section IV of the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code and bears the ASME "H" stamp. This boiler also complies with the latest edition of the ASHRAE 90.1 Standard. These units are ONLY approved for indoor installation.

⚠ WARNING: Altering any Raypak pressure vessel by installing replacement heat exchangers or any ASME parts not manufactured and/or approved by Raypak will instantly void the ASME and CSA ratings of the vessel and any damage to the vessel will not be covered under warranty. Altering the ASME or CSA ratings of the vessel also violates national, state, and local approval codes.

Installations at Elevation

Rated inputs are suitable for up to 2,000 ft (610 m) elevation without de-rating. Consult your local representative or the factory for installations at altitudes over 2,000 ft (610 m) above sea level. No hardware changes are required to the boilers for installations up to 10,000 ft (3048 m) (adjustments may be required).



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Figure 1. Boiler Carton Contents

Items Included:

1. (1) XPak FT Boiler
2. (1) Wall Mount Bracket
3. (6) Lag Screws
4. (2) Hold Down Brackets
5. (6) Washers
6. (1) Full-Scale Heater Template
7. (1) T & P Gauge
8. (1) Condensate Trap & Hose
9. (2) System Sensor
10. (1) Outdoor Air Sensor
11. (1) Installation & Operating Instructions Manual
12. (1) Propane Orifice Kit (Models 88AR & 108AR ONLY)

Component Locations

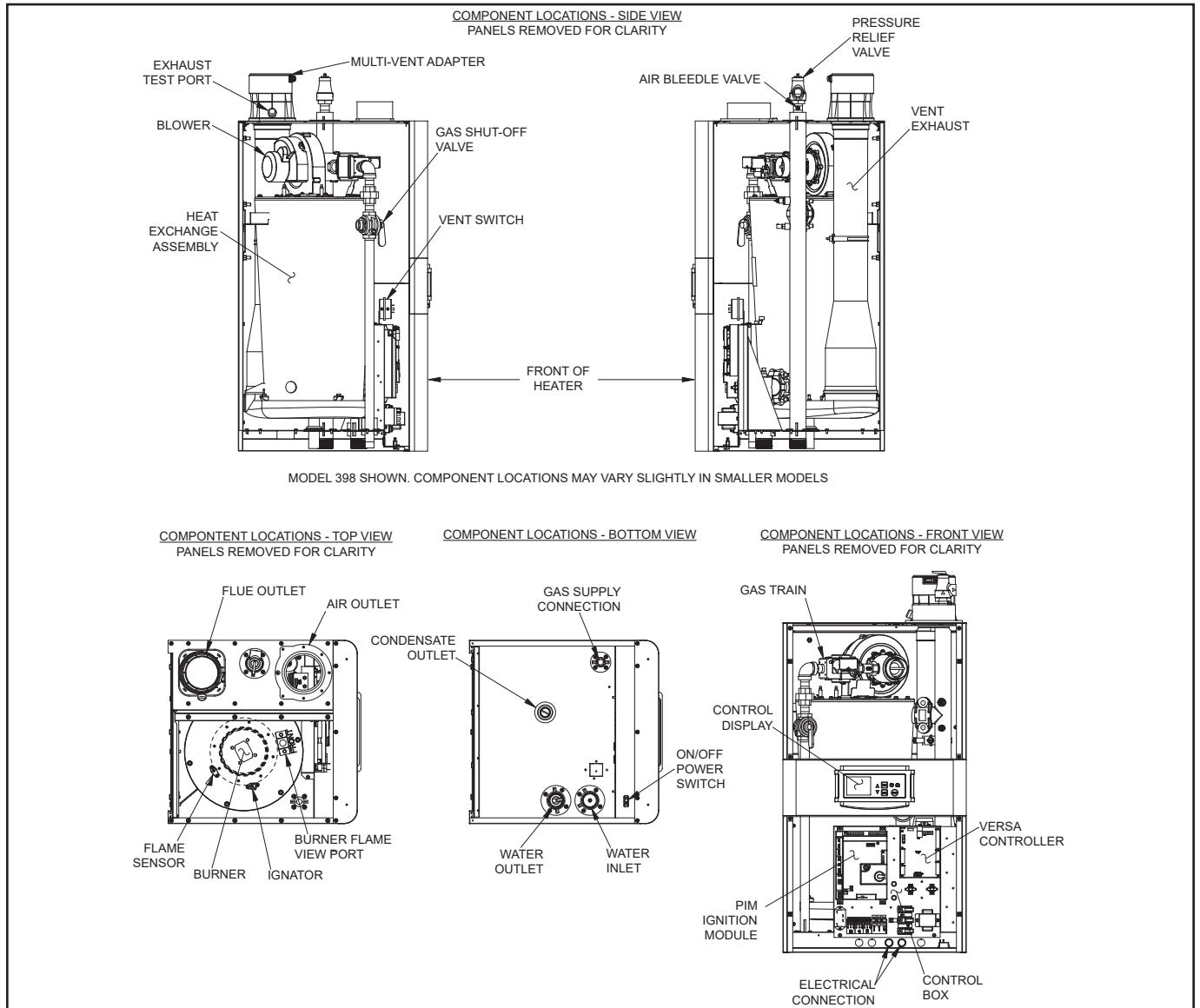


Figure 2. Component Locations

General Information

Model No.	AFUE Rating			Minimum Operating Input (MBTUH)	Water Conn. (NPT)	Gas Conn. (NPT)		Vent Size (Inches)	
	Input (MBTUH)		%			Nat	Pro	Flue	Intake
	Min.	Max.							
88AR	17.0	85	95	12.0	1"	1/2"	1/2"	2"/3"***	2"/3"***
108AR	22.0	110	95	13.0	1"	1/2"	1/2"	3"	3"
198AR	39.8	199	95	28.4	1-1/4"	3/4"	3/4"	3"	3"
278AR	55.0	275	95	36.6	1-1/4"	3/4"	3/4"	3"	3"
398A	39.9	399	96*	39.9	1-1/2"	3/4"	3/4"	3"/4"****	3"/4"****

*Model 398A value is a Thermal Efficiency.

**Model 88AR has a 3" standard vent size, but can be reduced to 2" with a shorter run. For details see page 31.

***Model 398A has a 4" standard vent size, but can be reduced to 3" with a shorter run. For details see page 31.

Table A. Basic Data

3. BOILER DIMENSIONS

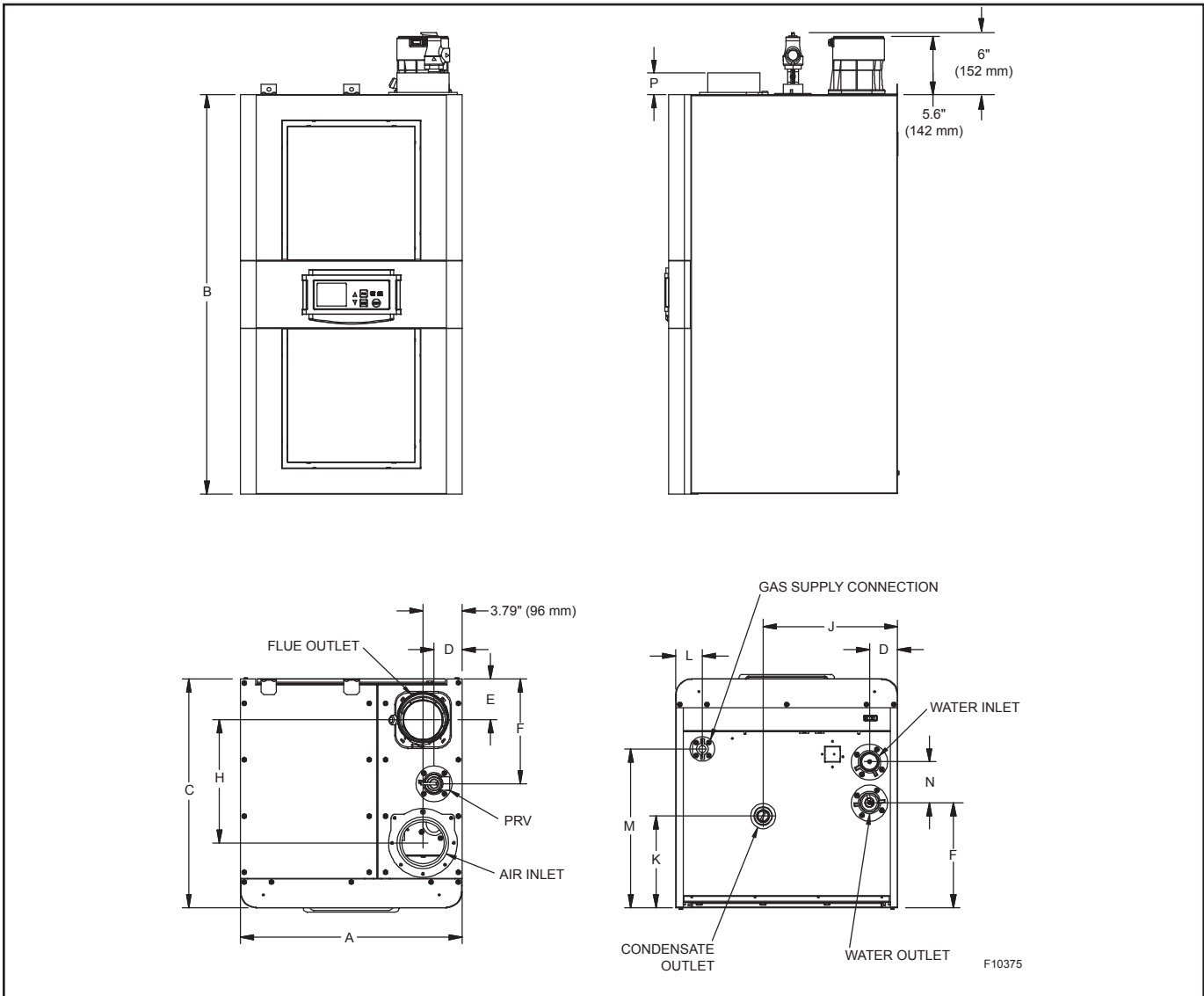


Figure 3. Boiler Dimensions

Model No.	A	B	C	D	E	F	H	J	K	L	M	N	P
	Inches - (mm)												
88AR/ 108AR	16.4 (417)	35.8 (909)	16.5 (419)	2.1 (53)	2.7 (69)	6.3 (160)	7.8 (198)	9.5 (241)	5.5 (140)	1.5 (38)	4.6 (117)	2.8 (71)	2.3 (58)
198AR/ 278AR	18.6 (472)	36.2 (919)	19.4 (493)	2.0 (51)	3.1 (79)	8.2 (208)	10.0 (254)	11.3 (287)	7.1 (180)	1.7 (43)	12.3 (312)	3.6 (91)	2.3 (58)
398A	21.4 (544)	38.6 (980)	22.1 (561)	2.7 (69)	4.0 (102)	10.1 (257)	12.0 (305)	13.0 (330)	8.9 (226)	2.6 (66)	15.3 (389)	4.0 (102)	2.1 (53)

Table B. Basic Data

Model No.	Boiler Water Volume Gallons (liters)
88AR	3.2 (12)
108AR	2.9 (11)
198AR	5.2 (20)
278AR	4.5 (17)
398A	5.9 (22)

Table C. Heater Water Volume

⚠ WARNING: This boiler cannot supply hot water for use by individuals directly. A heat exchanger must be used in conjunction with this boiler to meet DHW needs.

Time/Temperature Relationships in Scalds

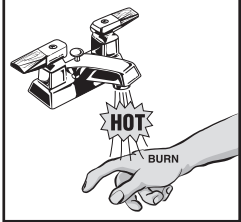
The following chart details the relationship of water temperature and time with regard to scald injury and may be used as a guide in determining the safest water temperature for your applications.

Water Temp.	Time to Produce Serious Burn
120°F (49°C)	More than 5-minutes
125°F (52°C)	1-1/2 to 2-minutes
130°F (54°C)	About 30 seconds
135°F (57°C)	About 10 seconds
140°F (60°C)	Less than 5 seconds
145°F (63°C)	Less than 3 seconds
150°F (66°C)	About 1-1/2 seconds
155°F (68°C)	About 1 second

Table courtesy of The Shrines Burn Institute.

Table D. Time to Produce Serious Burns

⚠ DANGER



Water temperature over 125°F can cause instant severe burns or death from scalds.

Children, disabled, and elderly are at highest risk of being scalded.

See instruction manual before setting temperature at water heater.

Feel water before bathing or showering.

Temperature limiting valves are available, see manual.

4. INSTALLATION

Installation Codes

⚠ CAUTION: This boiler should be located in an area where water leakage will not result in damage to the area adjacent to the appliances or to the structure. When such locations cannot be avoided, it is recommended that a suitable catch pan, adequately drained, be installed under the appliance. The pan must not restrict air flow.

NOTE: Use of this boiler in construction areas where fine particulate matter, such as concrete or dry-wall dust, is present may result in damage to the boiler that is not covered by the warranty. If operated in a construction environment, a clean source of combustion air must be provided directly to the boiler.

Installations must follow these codes:

- Local, state, provincial, and national codes, laws, regulations and ordinances
- National Fuel Gas Code, ANSI Z223.1/NFPA 54 – latest edition (NFGC)
- National Electrical Code, ANSI/NFPA 70 - latest edition (NEC)
- Standard for Controls and Safety Devices for Automatically Fired Boilers, ANSI/ASME CSD-1, (CSD-1) when required
- For Canada only: CAN/CSA B149 Natural Gas and Propane Installation Code and CSA C22.1 C.E.C. Part 1 (C22.1)

Equipment Room

Install CO detectors per local regulations. Boiler requires yearly maintenance, see “Maintenance” on page 56.

Operating Limits of the boiler:

- Max. Boiler Outlet Temperature: 200°F (99°C).
- Max. Operating Pressure: 80 psi (5.5 bar).
- Minimum Inlet Water Temperature: 50°F (10°C).

The hot water distribution system must comply with all applicable codes and regulations. When replacing an existing boiler, it is important to check the condition of the entire hot water distribution system to ensure safe operation.

In addition, the unit shall be installed such that the gas ignition system components are protected from water (dripping, spraying, rain, etc.) during appliance operation or service.

Installation Clearances

The XPakFT boiler must be installed indoors. When installed according to the listed minimum clearances from combustible construction, these boilers can be serviced without removing permanent structural construction around the unit. However, for ease of servicing, we recommend a clearance of at least 24 in (609 mm) in front and 24 in (609 mm) above the top of the boiler. This will allow the unit to be serviced in its installed location without movement or removal of the heater.

Service clearances less than the minimum may require removal of the unit to service either the heat exchanger or the burner components. In either case, the boiler must be installed in a manner that will enable the unit to be serviced without removing any structure around the boiler.

Clearances may be reduced if the surfaces are protected per NFGC Table 10.2.3.

Boiler Side	Min. Clearances from Combustible Surfaces in. (mm)	Minimum Service Clearances in. (mm)
Right Side	0 (0)	1 (25)
Left Side	0 (0)	1 (25)
Top	0 (0)	24 (610)
Front	Open	24 (610)
Vent	1 (25)	1 (25)
Bottom	6 (152)	12 (305)

Table E. Clearances

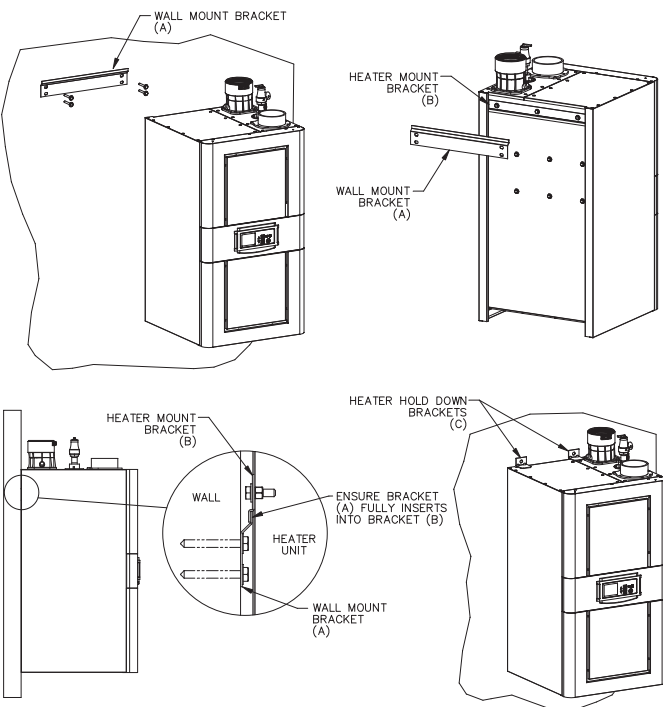
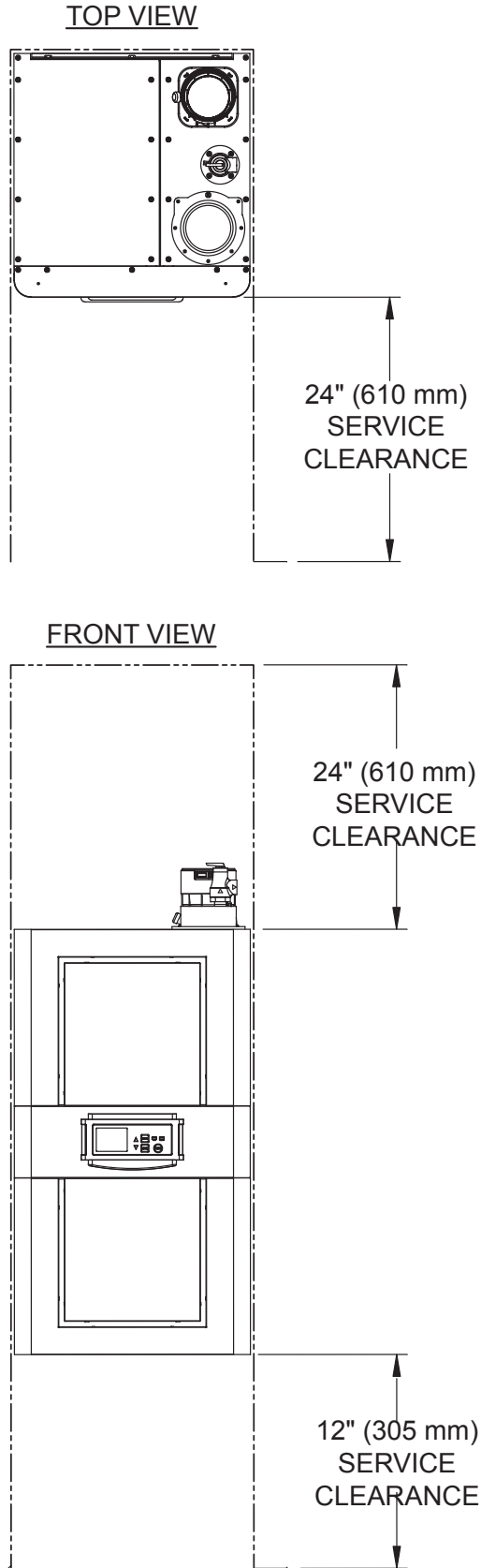


Figure 4. Wall Mount Installation



Venting not shown for clarity. Boiler must be vented per instructions in this manual.

Figure 5. Minimum Clearances from Combustible Surfaces

Combustion and Ventilation Air

CAUTION: Combustion air must not be contaminated by corrosive chemical fumes which can damage the boiler and which will not be covered under warranty.

NOTE: It is recommended that the intake vent be insulated in cold climates to minimize sweating.

This unit must be supplied with sufficient quantities of non-contaminated air to support proper combustion and equipment ventilation. Combustion air can be supplied via conventional means where combustion air is drawn from the area immediately surrounding the boiler (see Figures 6 thru 10, sized per NFGC requirements), or via direct vent, where combustion air is drawn directly from outside (see Figures 26 through 36). All installations must comply with the requirements of the NFGC (U.S.) or B149 (Canada), and all local codes.

Inside Air Contamination

Combustion air can be contaminated by certain vapors in the air which raise the acidity of the condensate. Higher acidity levels attack many materials including stainless steel, which is commonly used in high efficiency systems. The boiler can be supplied with corrosion-resistant, non-metallic intake air vent material. You may, however, choose to use outside combustion air for one or more of these reasons:

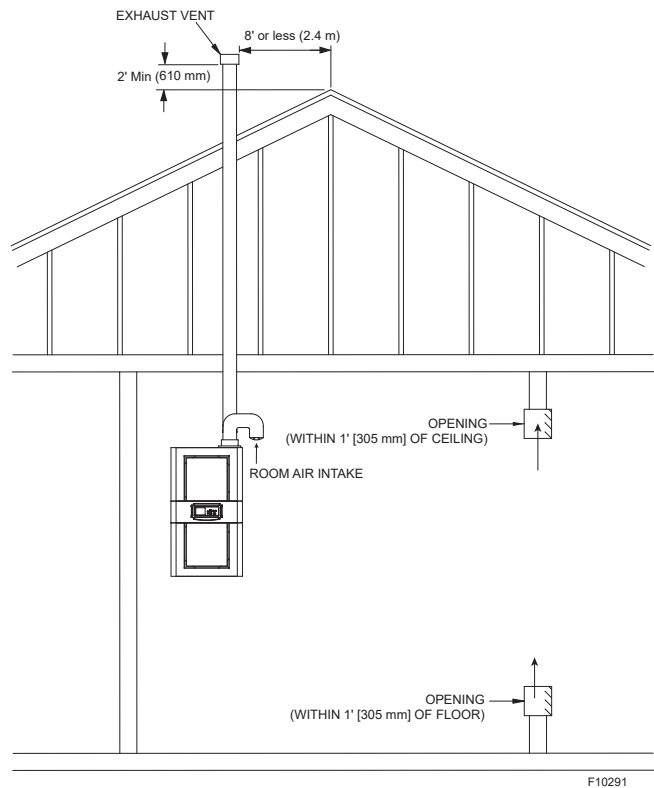


Figure 6. Room Air, 2-Opening Method

1. Installation is in an area containing contaminants listed below which will induce acidic condensation.
2. You want to reduce infiltration into your building through openings around windows and doors.
3. You are using AL29-4C stainless steel vent pipe, which is more corrosion-resistant than standard metallic vent pipe. In extremely contaminated areas, this may also experience deterioration.

Products causing contaminated combustion air:

- spray cans containing chloro/fluorocarbons
- permanent wave solutions
- chlorinated waxes/cleaners
- chlorine-based swimming pool chemicals
- calcium chloride used for thawing
- sodium chloride used for water softening
- refrigerant leaks
- paint or varnish removers
- hydrochloric acid/muriatic acid
- cements and glues
- antistatic fabric softeners used in clothes dryers
- chloride-type bleaches, detergents, and cleaning solvents found in household laundry rooms
- adhesives used to fasten building products
- similar products

Areas where contaminated combustion air commonly exists:

- dry cleaning/laundry areas
- metal fabrication plants
- beauty shops
- refrigeration repair shops
- photo processing plants
- auto body shops
- plastic manufacturing plants
- furniture refinishing areas and establishments
- new building construction
- remodeling areas
- open pit skimmers

Check for areas and products listed above before installing boiler. If found:

- remove products permanently, OR
- install Truseal direct vent.
- see also Figures 26 (page 33) through Figure 36 (page 35).

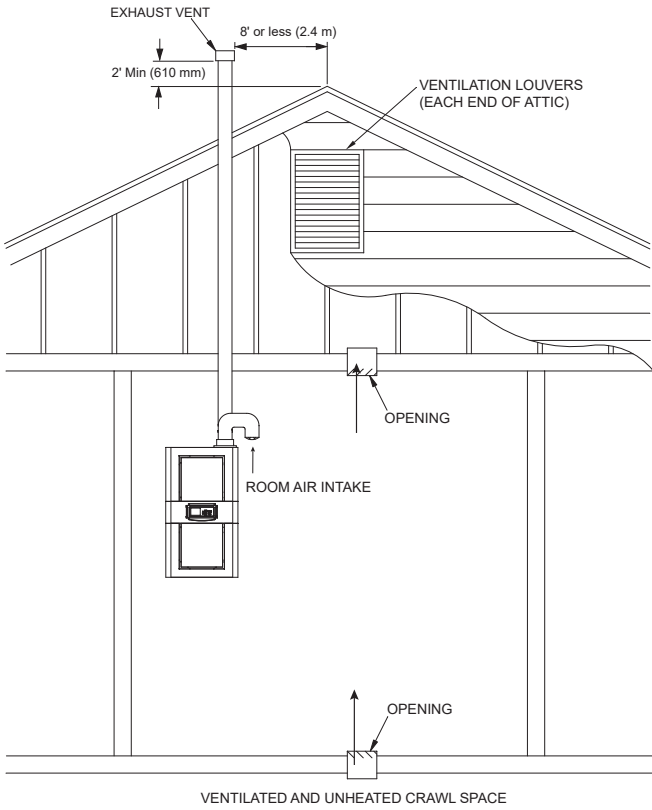


Figure 7. Floor and Ceiling Ducts

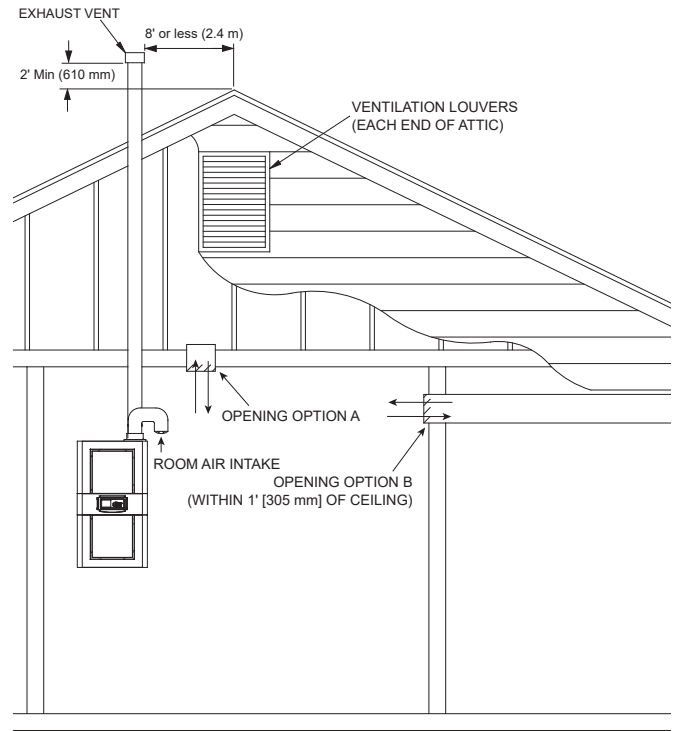


Figure 8. Single Air Duct

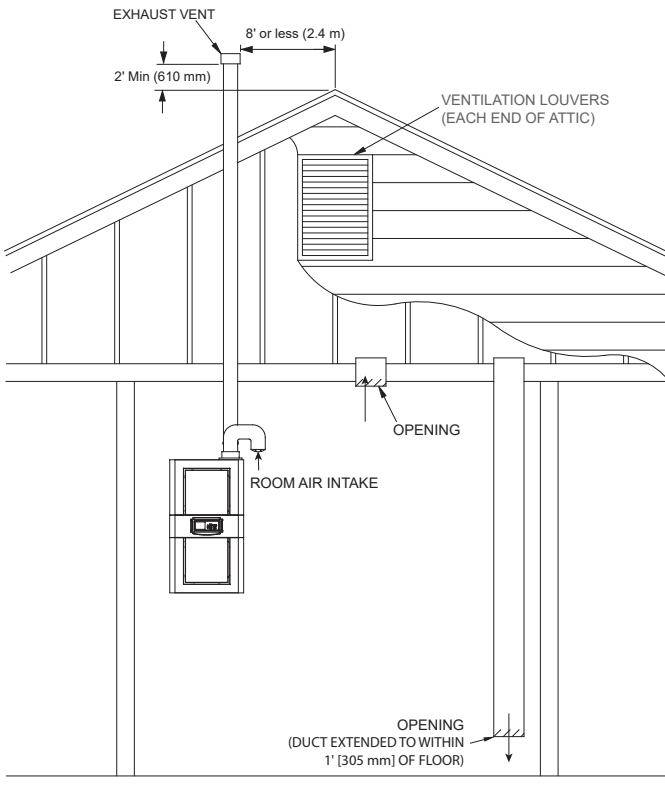


Figure 9. Two Ceiling Air Ducts

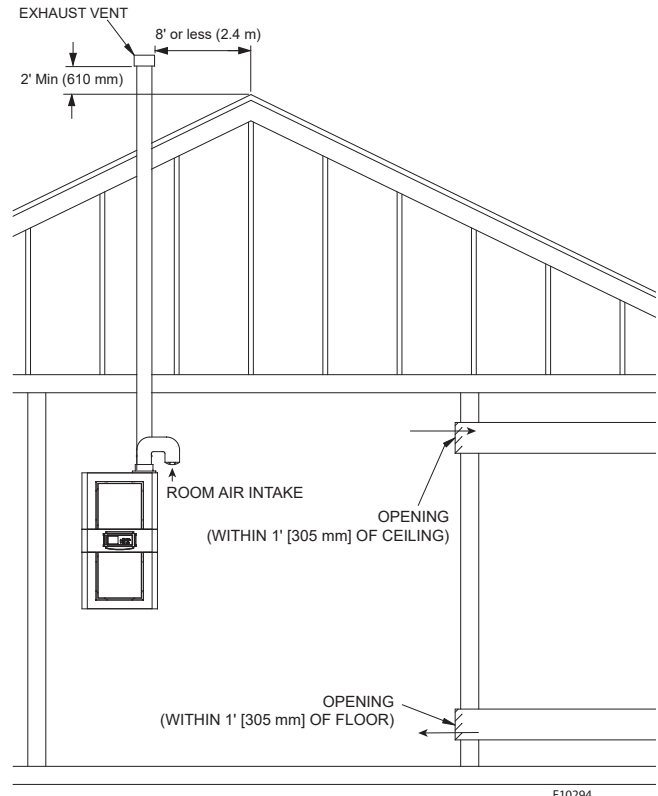


Figure 10. Two Horizontal Air Ducts

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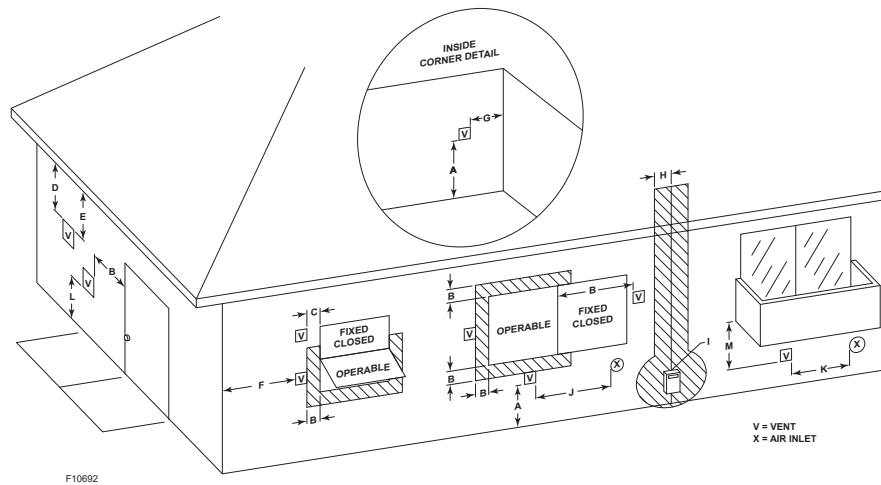


Figure 11. Minimum Clearances from Vent/Air Inlet Terminations – Indoor Installations Only

		U.S. Installations ¹	Canadian Installations ²
A	Clearance above grade, veranda, porch, deck, or balcony	1' (30 cm)	1' (30 cm)
B	Clearance to window or door that may be opened	4' (1.2 m) below or to side of opening	3' (91 cm)
C	Clearance to permanently closed window	*	*
D	Vertical clearance to ventilated soffit located above the terminal within a horizontal distance of 2' (61 cm) from the centerline of the terminal	5' (1.5 m)	*
E	Clearance to unventilated soffit	*	*
F	Clearance to outside corner	*	*
G	Clearance to inside corner	6' (1.83 m)	*
H	Clearance to each side of center line extended above meter/regulator assembly	*	3' (91 cm) within a height 15' above the meter/regulator assembly
I	Clearance to service regulator vent outlet	*	6' (1.83 m)
J	Clearance to non-mechanical air supply inlet to building or the combustion air inlet to any other appliance	4' (1.2 m) below or to side of opening; 1' (30 cm) above opening	3' (91 cm)
K	Clearance to mechanical air supply inlet	3' (91 cm) above if within 10' (3 m) horizontally	6' (1.83 m)
L	Do not terminate above paved sidewalk or paved driveway	Slip hazard due to frozen condensate	Slip hazard due to frozen condensate
M	Clearance under veranda, porch, deck or balcony	*	12" (30 cm) ^t

¹ In accordance with the current ANSI Z223.1/NFPA 54 National Fuel Gas Code.

² In accordance with the current CAN/CSA-B149 Installation Codes.

^t Permitted only if veranda, porch, deck, or balcony is fully open on a minimum of two sides beneath the floor and top of terminal, and underside of veranda, porch, deck or balcony is greater than 1' (30 cm).

* Clearances in accordance with local installation codes and the requirements of the gas supplier.

Table F. Vent/Air Inlet Termination Clearances

Direct Vent

If outside air is drawn through the intake pipe directly to the unit for combustion:

1. Install combustion air direct vent in accordance with Figure 26 (horizontal) on page 33 or Figure 28 on (vertical) on page 33 of this manual.
2. Ventilation of the space occupied by the boiler(s) is recommended and can be provided by an opening(s) for ventilation air at the highest practical point communicating with the outdoors. The total cross-sectional area should be at least 1 in² of free area per 20,000 BTUH (111 mm² per kW) of total input rating of all equipment in the room when the opening is communicating directly with the outdoors or through vertical duct(s). The total cross-sectional area should be at least 1 in² of free area per 10,000 BTUH (222 mm² per kW) of total input rating of all equipment in the room when the opening is communicating with the outdoors through horizontal duct(s). Damage to the equipment due to inadequate ventilation of the space is not a warrantable failure.
3. In cold climates, and to mitigate potential freeze-up, Raypak highly recommends the installation of a motorized sealed damper on the air intake to prevent the circulation of cold air through the boiler during non-operating hours.

Conventional Combustion Air Supply

⚠ WARNING: Do not use the “one permanent opening” method if the equipment room is under negative-pressure conditions.

⚠ CAUTION: All combustion air must be drawn from the air outside of the building; the mechanical equipment room must communicate directly with the outdoors.

⚠ WARNING: Care must be taken to ensure that the equipment room is not under negative pressure conditions.

U.S. Installations

All Air from Inside the Building

The confined space shall be provided with **TWO** permanent openings communicating directly with an additional room(s) of sufficient volume so that the combined volume of all spaces meets the criteria for a room large in comparison (NFGC). The total input of all gas utilization equipment installed in the combined space shall be considered in making this determination. **Each opening** shall have a minimum free area of 1 in² per 1,000 BTUH (2,225 mm² per kW) of the total input rating of all gas utilization equipment in the confined space,

but not less than 100 in² (645 cm²). One opening shall commence within 12 in (51 mm) (305 mm) of the top, and one opening shall commence within 12 in (51 mm) (305 mm) of the bottom of the enclosure. The minimum dimension of air openings shall be not less than 3 in (76 mm) in any direction.

All Air from Outdoors

The confined space shall communicate with the outdoors in accordance with one of the methods below. The minimum dimension of air openings shall not be less than 3 in (76 mm) in any direction. Where ducts are used, they shall be of the same cross-sectional area as the net free area of the openings to which they connect.

1. **Two permanent openings**, one commencing within 12 in (305 mm) of the top, and one commencing within 12 in (305 mm) of the bottom of the enclosure, shall be provided. The openings shall communicate directly, or by ducts, with the outdoors or spaces (crawl or attic) that freely communicate with the outdoors.
 - a. Where directly communicating with the outdoors or where communicating to the outdoors through vertical ducts, each opening shall have a minimum free area of 1 in² per 4,000 BTUH (550 mm² per kW) of total input rating of all equipment in the enclosure.
 - b. Where communicating with the outdoors through horizontal ducts, each opening shall have a minimum free area of 1 in² per 2,000 BTUH (1,100 mm² per kW) of total input rating of all equipment in the enclosure.
2. **One permanent opening**, commencing within 12 in (305 mm) of the top of the enclosure, shall be permitted where the equipment has clearances of at least 1 in (25 mm) from the sides, top and bottom and 6 in (152 mm) from the front of the appliance. The opening shall directly communicate with the outdoors or shall communicate through a vertical or horizontal duct to the outdoors or spaces that freely communicate with the outdoors, and shall have a minimum free area of:
 - a. 1 in² per 3,000 BTUH (740 mm² per kW) of the total input rating of all equipment located in the enclosure, and
 - b. Not less than the sum of the areas of all vent connectors in the confined space.

Canadian Installations

1. Ventilation of the space occupied by the boiler shall be provided by an opening(s) for ventilation air at the highest practical point communicating with the outdoors. The total cross-sectional area of such an opening(s) shall be at least 10% of the area required in 2. and 3. (below), but in no case shall the cross-sectional area be less than 10 in² (65 cm²).

2. For boilers using a barometric damper in the vent system, there shall be a permanent air supply opening(s) having a cross section area of not less than 1 in² per 7,000 BTUH (320 mm² per kW) up to and including 1 million BTUH, plus 1 in² per 14,000 BTUH (160 mm² per kW) in excess of 1 million BTUH. This opening(s) shall be either located at or ducted to a point not more than 18 in (450 mm) nor less than 6 in (152 mm) above the floor level. The duct can also “goose neck” through the roof. The duct is preferred to be straight down and terminated 18 in (450 mm) from the floor, but not near piping. This air supply opening requirement shall be in addition to the air opening for ventilation air required in 1. (above).
3. For heaters when air supply is provided by natural air flow from outdoors for a power burner and there is no draft regulator, draft hood or similar flue gas dilution device installed in the same space, in addition to the opening for ventilation air required in 1., there shall be a permanent air supply opening(s) having a total cross-sectional area of not less than 1 in² for each 30,000 BTUH (74 mm² per kW) of total rated input of the burner(s), and the location of the opening(s) shall not interfere with the intended purpose of the opening(s) for ventilation air referred to in 1. This opening(s) can be ducted to a point not more than 18 in (450 mm) nor less than 6 in (152 mm) above the floor level. The duct can also “goose neck” through the roof. The duct is preferred to be straight down 18 in (450 mm) from the floor, but not near piping.
4. Refer to the B149 Installation Code for additional information.

Water Piping

NOTE: Refer to the **VERSA IC® Applications Guide (241493)** for detailed instructions regarding the various applications supported by the **VERSA IC®** control system.

CAUTION: This boiler requires forced water circulation when the burner is operating. See Table H for minimum and maximum flow rates. The pump must be interlocked with the boiler to prevent heater operation without water circulation.

WARNING: Pressure relief valve discharge piping must be piped near the floor and close to a drain to eliminate the potential of severe burns. Do not pipe to any area where freezing could occur. Refer to local codes.

General

The boiler should be located so that any water leaks will not cause damage to the adjacent area or structures.

Relief Valve Installation and Piping

The boiler is supplied with a Section IV “H” stamped relief valve sized for the full input of the unit. Relief valve discharge piping shall provide no less than the cross-sectional area of the relief valve outlet and must be routed to a safe point of discharge. Installation must comply with all national, state and local codes.

Temperature & Pressure Gauge

The temperature and pressure gauge is shipped loose for field installation and must be installed within 12 inches of the boiler outlet (if possible) in an easily readable location. Installation must comply with ASME Section IV as well as all applicable national, state and local codes.

Hydrostatic Test

Unlike many types of heaters, this boiler does not require hydrostatic testing prior to being placed in operation. The heat exchanger is ASME certified for 80 PSI maximum working pressure. However, Raypak does recommend hydrostatic testing of the piping connections to the unit and the rest of the system prior to operation. This is particularly true for hydronic systems using expensive glycol-based anti-freeze. Raypak recommends conducting the hydrostatic test before connecting gas piping or electrical supply.

Leaks must be repaired at once to prevent damage to the heater. NEVER use petroleum-based stop-leak compounds.

To perform hydrostatic test:

1. Connect fill water supply. With bleed valve open, fill boiler with water. When water flows from bleed valve, shut off water. Close bleed valve. Carefully fill the rest of the system, making sure to eliminate any entrapped air by using high-point vents. Close feed valve. Test at standard operating pressure for at least 24 hours.
2. Make sure constant gauge pressure has been maintained throughout test.
3. Check for leaks. Repair if found.

Hydronic Heating

Pump Selection

In order to ensure proper performance of your boiler system, you must install a correctly-sized pump. Raypak recommends designing for a ΔT within the range of 20°F to 60°F (8°C to 19°C). See Table H for acceptable flow rates for each model (ΔT is the temperature difference between the inlet and outlet water when the heater is firing at full rate).

Boiler Model	Standard Boiler Pump*	
	Pump	HP
H7-88AR	TACO 007	1/25
H7-108AR	TACO 007	1/25
H7-198AR	TACO 010	1/8
H7-278AR	TACO 012	1/8
H7-398A	TACO 012	1/8

* Pump selection based on 30°F (17°C) ΔT with up to 50 eq. ft (15.2 m) of tubing.

Table G. Pump Selections

NOTE: The 50 eq. ft (15.2 m) of tubing typically represents 25 linear feet of tubing and 25 eq. ft (7.6 m) of fittings.

System Sensor Installation

The System Sensor (S3) is required for all selectable modes unless the unit's firing rate will be controlled by an external source, such as Rapak's Temp Tracker MOD+ Hybrid sequencer. Proper placement and method of installation are critical for proper operation of the system. See Figure 12 on page 16. The sensor must be installed in a drywell in conjunction with heat conductive compound as shown in the following images. The drywell must be installed no more than 5 equivalent feet of pipe/tubing downstream of the de-coupler and installed in such a way that ensures the sensor bulb is in the flow path.

Three-Way Valves

Three-way valves intended to regulate system water temperatures by reducing flow in the boiler should not be used.

Applications and Modes

The VERSA IC® Control system is designed for a wide range of applications. The installer/design engineer should refer to the following Modes to determine which best fits the intended application and functionality for the unit being installed.

The XPak FT has three modes available to them to address the various applications the units can be applied to.

For detailed information on the VERSA IC® control system about applications and modes, see manual 241493.

Mode 1

This mode is for hydronic heating systems with single or multiple boilers (Illustration shows 4 boilers for reference only) in primary/secondary piping configuration with or without Outdoor Air Reset (S4). The system temperature is controlled by the System sensor (S3). The Boiler Pump (P1) runs during any call for heat. The System

CAUTION: Be careful when installing the drywell not to over-tighten the well as this can damage the well and may prevent the sensor from fitting properly.

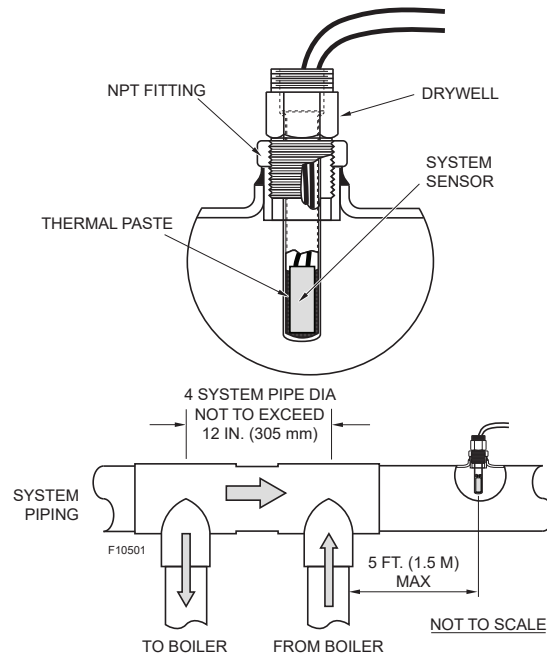


Figure 12. System Sensor Installation

Pump (P2) runs whenever the system is enabled for heating and the outdoor air temperature is lower than the warm weather shut down (WWSD) temperature setting (if utilized). The Boiler Pump is delayed "off" as user defined in the BOILER menu, and System Pump is delayed "off" as user defined in the ADJUST menu. For piping example see Figure 13 on page 18.

Mode 2

This mode is for hydronic heating systems with single or multiple boilers (Illustration shows 4 boilers for reference only) in primary/secondary piping configuration with or without Outdoor Air Reset (S4) with indirect DHW on the system loop (with or without priority). The system temperature is controlled by the System sensor (S3). The Indirect DHW sensor (S5) determines the indirect call/tank setpoint. The system temperature is boosted to Target Max when using the Indirect DHW sensor (S5) during an indirect call for heat. Priority mode toggles off the System Pump (P2) when an indirect call for heat is present. The Boiler Pump (P1) runs during any call for heat. The Indirect DHW Pump (P3) runs during an indirect call for heat with no "off" delay. The Boiler Pump is delayed "off" as user defined in the BOILER menu, and System Pump is delayed "off" as user defined in the ADJUST menu. The System Pump (P2) runs whenever the system is enabled for heating and the outdoor air temperature is lower than the WWSD temperature setting (if utilized) unless an indirect call for heat is present with priority. See Figure 14 on page 19 for piping example.

Mode 3

This mode is for hydronic heating systems with single or multiple boilers (Illustration shows 4 boilers for reference only) in primary/secondary piping configuration with or without Outdoor Air Reset (S4) with indirect DHW on the boiler loop (with priority). The system temperature is controlled by the Supply sensor (S3) whenever the indirect call for heat is not active. The DHW Supply sensor (S5) determines the indirect call/tank setpoint. During an indirect call for heat the boiler firing rate is determined by the water temperature at the Indirect Supply sensor (S6) and the Target Max setting when using the Indirect DHW sensor (S5).

NOTE: In cascade configuration, the system pump and DHW pump (if applicable) outputs from each cascade member must be connected in parallel to activate the system pump and DHW pump during “limp-along” operation, respectively. See VERSA IC Manual (241493) for detailed information.

The Boiler Pump (P1) runs during all heat calls regardless of priority. The Indirect DHW Pump (P3) runs during an indirect call for heat with no “off” delay. The Boiler Pump is delayed “off” as user defined in the BOILER menu, and System Pump is delayed “off” as user defined in the ADJUST menu. The System Pump (P2) runs whenever the system is enabled for heating and the outdoor air temperature is lower than the WWSD temperature setting (if utilized) unless an indirect call for heat is present. See Figure 15 on page 20 for piping example.

System flow must exceed 120% of boiler flow.

⚠ WARNING: All potable water heating with this boiler must be by an indirect heat exchanger. Only non-potable water will go through the boiler.

NOTE: See VERSA IC Manual (241493) for more information on cascade systems.

Water Flow Rates and Pressure Drop

Model No.	MAXIMUM FLOW			30°F (17°C) ΔT		40°F (22°C) ΔT		50°F (27°C) ΔT		MINIMUM FLOW		
	GPM (lpm)	ΔP ft. (m)	ΔT °F (°C)	GPM (lpm)	ΔP ft. (m)	GPM (lpm)	ΔP ft. (m)	GPM (lpm)	ΔP ft. (m)	GPM (lpm)	ΔP ft. (m)	ΔT °F (°C)
H7-88AR	8.1 (31)	5.4 (1.6)	20 (11)	5.4 (20)	3.3 (1)	4.0 (15)	2.3 (0.7)	3.2 (12)	1.8 (.5)	2.7 (10)	1.4 (.4)	60 (33)
H7-108AR	10.5 (40)	7.4 (2.2)	20 (11)	7.0 (26)	4.5 (1.4)	5.2 (20)	3.2 (1)	4.2 (16)	2.4 (.7)	3.5 (13)	2.0 (.6)	60 (33)
H7-198AR	18.9 (72)	11.6 (3.5)	20 (11)	12.6 (48)	6.2 (1.9)	9.5 (36)	4.3 (1.3)	7.6 (29)	3.5 (1)	6.3 (24)	3.0 (.9)	60 (33)
H7-278AR	26.1 (99)	20.3 (6.2)	20 (11)	17.4 (66)	10.1 (3)	13.1 (50)	6.5 (2)	10.5 (40)	4.9 (1.5)	8.7 (33)	4.0 (1.2)	60 (33)
H7-398A	38.3 (145)	14.1 (4.3)	20 (11)	25.5 (97)	7.4 (2.2)	19.2 (73)	5.0 (1.5)	15.3 (58)	4.0 (1.2)	12.8 (48)	3.4 (1)	60 (33)

Notes: Basis for minimum flow is ΔT. Basis for maximum flow is GPM.

Table H. Heater Rates of Flow and Pressure Drops

Mode 1 - Water Plumbing

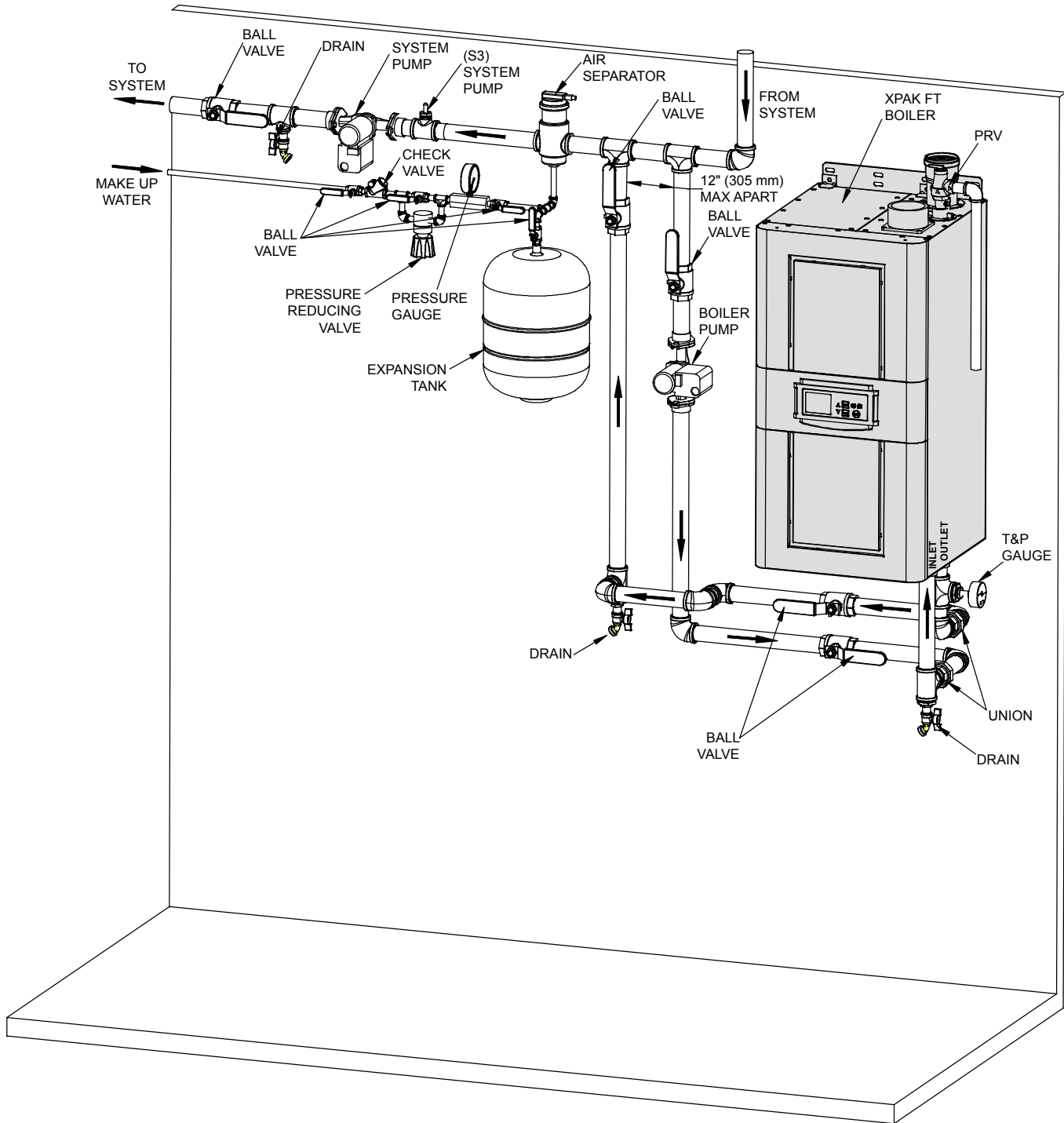


Figure 13. MODE 1 - Single Boiler - Primary/Secondary Piping

Mode 2 - Water Plumbing

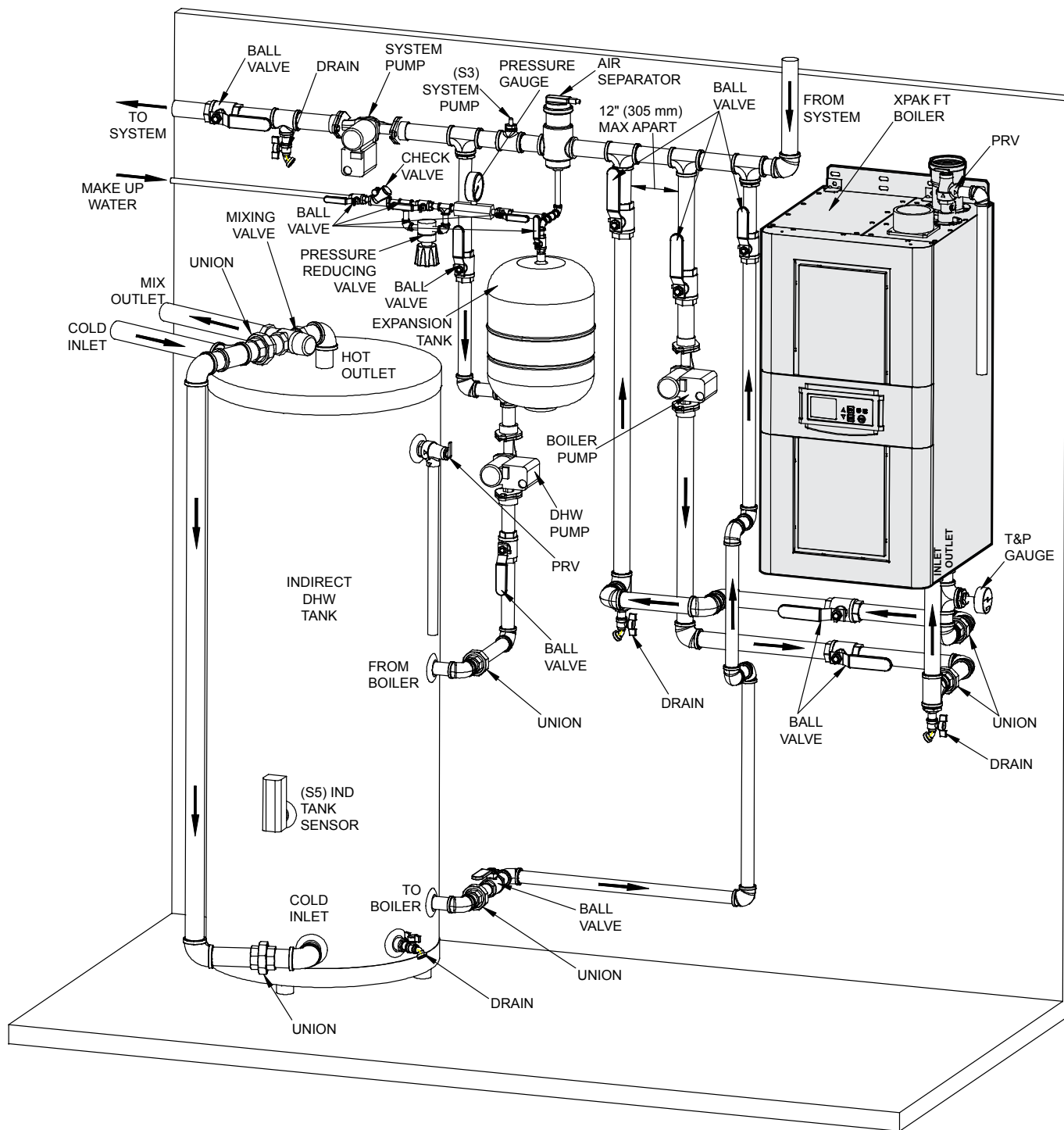


Figure 14. MODE 2 - Single Boiler - Primary/Secondary Piping with Indirect DHW on System Loop

Mode 3 - Water Plumbing

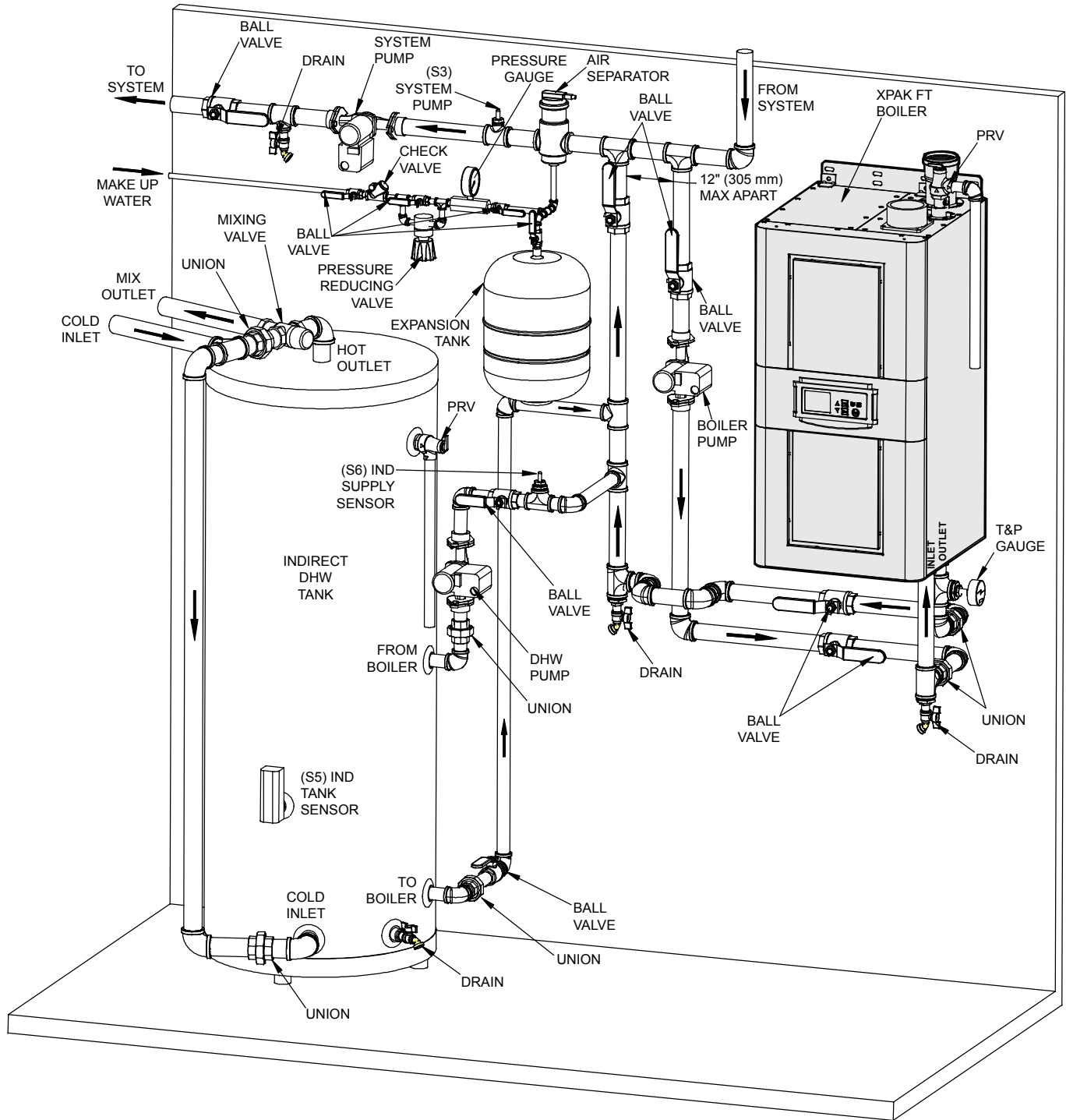


Figure 15. MODE 3 - Single Boiler - Primary/Secondary Piping with Indirect DHW on Boiler Loop

Gas Supply

⚠ DANGER: Make sure the gas on which the unit will operate is the same type as specified on the rating plate.

Gas piping must have a sediment trap ahead of the boiler gas controls, and a manual shut-off valve located outside the boiler jacket. It is recommended that a union be installed in the gas supply piping adjacent to the boiler for servicing. Refer to Table I for maximum pipe lengths.

Gas Supply Connection

⚠ CAUTION: The boiler must be disconnected from the gas supply during any pressure testing of the gas supply system at test pressures in excess of 1/2 PSI (3.45 kPa).

The boiler must be isolated from the gas supply piping system by closing the upstream manual shut-off valve during any pressure testing of the gas supply piping system at test pressures equal to or greater than 1/2 PSI (3.45 kPa). Relieve test pressure in the gas supply line prior to re-connecting the boiler and its manual shut-off valve to the gas supply line. **FAILURE TO FOLLOW THIS PROCEDURE MAY DAMAGE THE GAS VALVE.** Over-pressurized gas valves are not covered by warranty. The boiler and its gas connections shall be leak-tested before placing the appliance in operation. Use soapy water for leak test. DO NOT use an open flame.

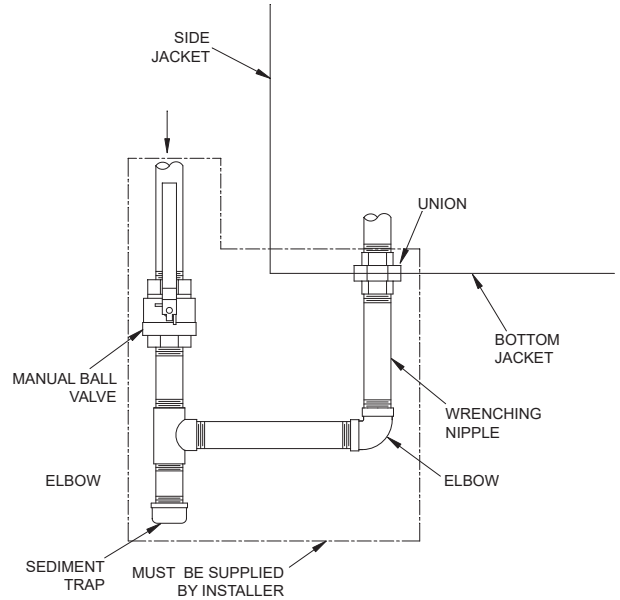


Figure 16. Gas Supply Connection

⚠ CAUTION: Only sealant tape or a pipe compound rated for use with natural and propane gases is recommended. Apply sparingly only on male pipe ends, leaving the two end threads bare.

⚠ CAUTION: Support gas supply piping with hangers, not by the boiler or its accessories. Make sure the gas piping is protected from physical damage and freezing, where required.

Model No.	Input MBTUH	Maximum Equivalent Pipe Length (ft/m)									
		1/2"		3/4"		1"		1-1/4"		1-1/2"	
		Nat	Pro	Nat	Pro	Nat	Pro	Nat	Pro	Nat	Pro
88AR	88	35 (11)	75 (23)	135 (41)	305 (120)	440 (134)	990 (302)				
108AR	110	20 (6)	50 (15)	90 (27)	205 (62)	290 (88)	720 (219)	1045 (319)			
198AR	199		15 (5)	30 (9)	65 (20)	95 (290)	220 (67)	365 (111)	880 (268)	830 (253)	
278AR	275			15 (5)	35 (11)	50 (15)	120 (37)	205 (62)	460 (140)	425 (130)	980 (299)
398A	399				20 (6)	25 (8)	60 (18)	100 (30)	230 (70)	220 (67)	485 (148)

Natural Gas 1000 BTU/FT³ .60 Specific Gravity @ 0.5" WC pressure drop

Propane Gas 2500 BTU/FT³ 1.53 Specific Gravity @ 0.5" WC pressure drop (Grade HD-5)

Table I. Gas Supply Piping

Gas Supply Pressure

A minimum of 4.5 in. WC upstream gas pressure under full load and a maximum gas supply pressure setpoint of 10.5 in. WC under load and no-load conditions for natural gas. A minimum of 8.0 in. WC upstream gas pressure under full load and a maximum gas supply pressure setpoint of 13.5 in. WC is required for propane gas. The gas pressure regulator(s) supplied on the boiler is for low-pressure service. If upstream pressure exceeds 1/2 PSI at any time, an intermediate gas pressure regulator, of the lockup type, must be installed. This regulator should be placed a minimum distance of 10 times the pipe diameter upstream of the boiler gas controls.

When connecting additional gas utilization equipment to the gas piping system, the existing piping must be checked to determine if it has adequate capacity for the combined load. The gas valve pressure regulator on the boiler is nominally preset as noted in Table J.

During normal operation, carbon dioxide should be 8.8 to 10.5% at full fire for natural gas and between 10.2 and 10.8% for propane gas. Carbon monoxide should be <200 ppm.

Model No.	Manifold Pressure (in. WC)	
	Natural Gas	Propane Gas (Minimum Grade HD-5)
	High	High
88AR	-.1" WC	-.1" WC
108AR	-.1" WC	-.1" WC
198AR	-1.0" WC	-0.9" WC
278AR	-2.1" WC	-2.0" WC
398A	-3.4" WC	-3.0" WC

Table J. Manifold Gas Pressure Settings

⚠ CAUTION: For proper operation, no more than a 30% drop in gas supply pressure from no-load to full-load conditions is acceptable. Under no circumstances should the pressure be outside the listed operational range.

Electrical Power Connections

Installations must follow these codes:

- National Electrical Code and any other national, state, provincial or local codes or regulations having jurisdiction.
- Safety wiring must be NEC Class 1.
- Heater must be electrically grounded as required by the NEC.
- In Canada, CSA C22. 1 C.E.C. Part 1.

The XPak FT 88AR-398A boilers are wired for 120 VAC single-phase 60 Hz power. Consult the wiring diagram shipped with the unit. Before starting the boiler, check to ensure proper voltage to the boiler and pump(s).

The expected current draw for the boiler is less than 12 amps. The pump load is additional.

The boiler pump (up to ¼ HP) and the indirect DHW pump (up to ¼ HP) get their power supply directly from the boiler power supply. The system pump relay is rated for pilot duty only. An indirect DHW pump larger than ¼ HP or 5A must use a separate power supply and run the power through an external field-supplied pump contactor. Use appropriately-sized wire as defined by NEC, CSA and/or local codes. All primary wiring should be 125% of minimum rating. The indirect and system pumps outputs are fuse-protected.

If any of the original wire as supplied with the boiler must be replaced, it must be replaced with 105°C wire or its equivalent.

All 120VAC field wiring connections to the XPak FT are made inside the rear wiring box. See Figure 17 on page 23. Low-voltage wiring is connected to the VERSA control board and the Platform Ignition Module (PIM) at the front of the unit. Sensors, enable/disable contacts, (optional) 0-10 VDC control wiring, and cascade connections are wired into the VERSA and PIM field wiring plugs. See the wiring diagram, Figure 45 on page 45.

Check the Power Source

NOTE: Minimum 18 AWG, 105°C, stranded wire must be used for all low voltage (less than 30 volts) external connections to the unit. Solid conductors should not be used because they can cause excessive tension on contact points. Install conduit as appropriate. All high voltage wires must be the same size (105°C, stranded wire) as the ones on the unit or larger.

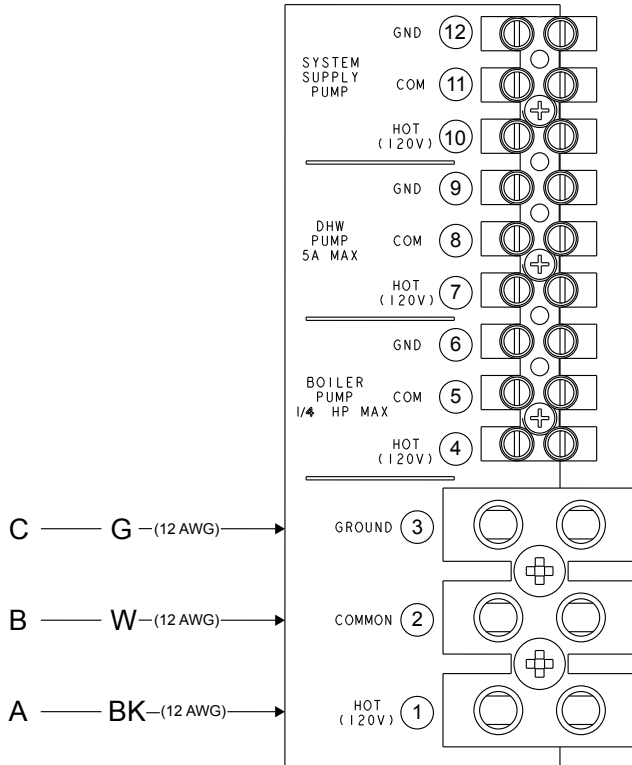


Figure 17. Wiring Connections

⚠ WARNING: Using a multi-meter, check the following voltages at the circuit breaker panel prior to connecting any equipment. Make sure proper polarity is followed and house ground is proven. See Figure 17 on page 23.

Check the power source:

- AC = 108 VAC Minimum, 132 VAC MAX
- AB = 108 VAC Minimum, 132 VAC MAX
- BC = <1 VAC Maximum

Making the Electrical Connections

Refer to Figure 17 through Figure 22.

1. Verify that circuit breaker is properly sized by referring to the boiler's rating plate. A dedicated circuit breaker should be provided and sized for the boiler and all pumps powered through it.

NOTE: Current draw noted on rating plate does not include pump current.

2. Turn off all power to the boiler. Verify that power has been turned off by testing with a multi-meter prior to working with any electrical connections or components at the J-box inside the unit.
3. Observe proper wire colors while making electrical connections. Many electronic controls are polarity sensitive. Components damaged by improper electrical installation are not covered by warranty.
4. Provide overload protection and a disconnect means for equipment serviceability as required by local and state code.
5. Install boiler controls, thermostats, or building management systems in accordance with the applicable manufacturers' instructions.
6. Conduit must not be used as the earth ground.

NOTE: A grounding electrode conductor shall be used to connect the equipment grounding conductors, the equipment enclosures, and the grounded service conductor to the grounding electrode.

Field Wiring Connections

⚠ DANGER: SHOCK HAZARD!

Make sure electrical power to the boiler is disconnected to avoid potential serious injury or damage to components.

⚠ CAUTION: Wiring errors can cause improper and dangerous operation. See the wiring diagram in this manual. Verify proper operation after servicing.

Wiring the Thermostat

Connect the Enable/Disable terminals to the PIM. See Figure 19. Alternately, any dry contact closure (including a remote thermostat) across these terminals will enable the XPak FT unit to run. Caution should be used to ensure neither of the terminals becomes connected to ground.

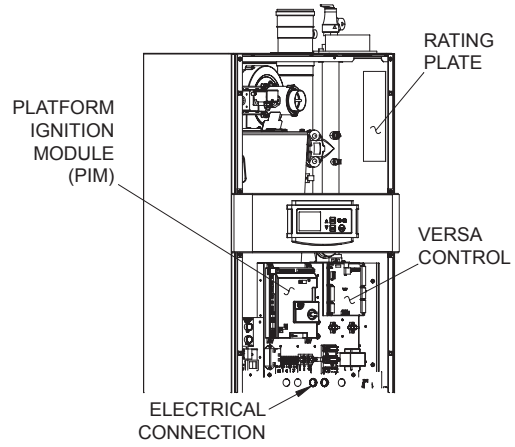


Figure 18. Electrical Wiring

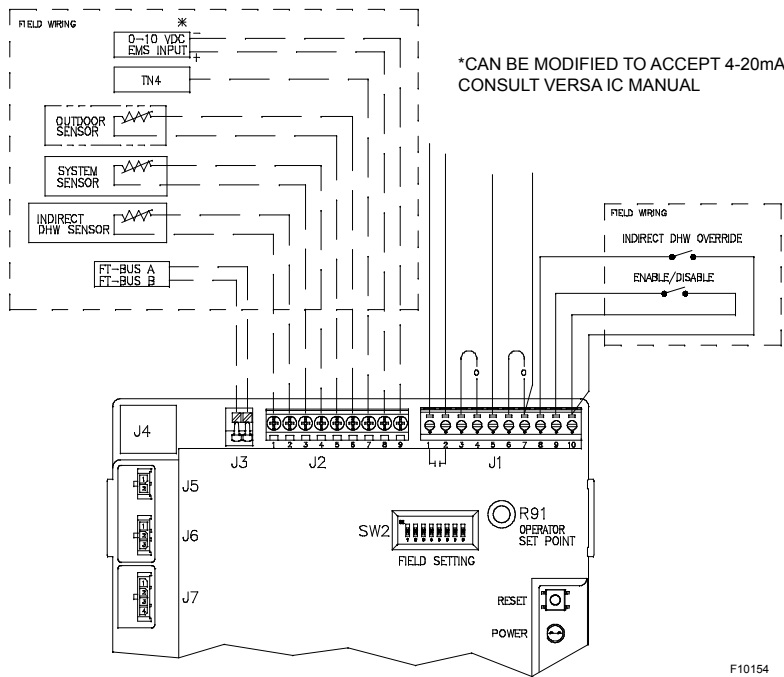


Figure 19. XPak FT Single Boiler Control

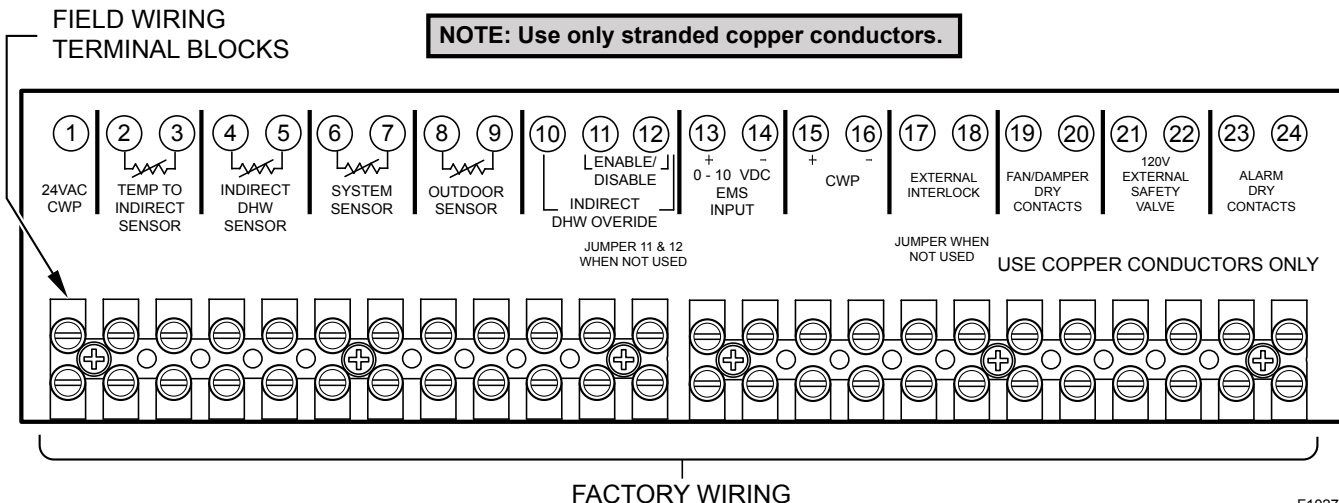


Figure 20. Low Voltage Field Wiring

Heating Sensor Installation

1. Only use the System sensor provided with the unit.
2. The sensor wires can be extended up to 500' using a non-shielded 2-conductor cable.
3. Do not run sensor wires in conduit with line voltage wiring.
4. Install a 3/8" ID 1/2 NPT immersion well. See Figure 12 on page 16.
5. If installing the system sensor on the supply, insert the sensor in a well with heat paste no more than 5' feet past the boiler loop outlet on the common supply header but before any major takeoffs. The sensor must be located where it sees the output of all the boiler stages. If a boiler is piped so that the sensor does not see its output, the VERSA IC[®] will not sequence the boilers correctly.

NOTE: If the System Sensor (S3) can not sense the correct water temperature, the VERSA IC[®] will not provide comfortable heat levels.

▲WARNING: Use only the System and Outdoor Air sensors included with the control.

Wiring the Outdoor Air Sensor (S4)

1. There is no connection required if an outdoor air sensor is not used in this installation.
2. If using an Outdoor Air Sensor, connect the sensor wires to the terminals marked OUTDOOR SENSOR. See Figure 20 on page 24. Caution should be used to ensure neither of these terminals becomes connected to ground.

NOTE: Alternately, a thermostat contact closure can be used in lieu of the sensor for indirect operation. Connect the thermostat to the terminals marked IND REMOTE THERMOSTAT.

▲CAUTION: Sensor and control wiring must NOT be run in conduit or chases with line voltage.

3. Use a minimum 18 AWG wire for runs of up to 150 feet.
4. Mount the outdoor air sensor on an exterior surface of the building, preferably on the north side in an area that will not be affected by direct sunlight and that will be exposed to varying weather conditions.

Wiring the Indirect Sensor (S5)

1. There is no indirect sensor connection required if an indirect water heater is not used in the installation.
2. When the Indirect DHW call for heat is active, the PIM communicates this to the VERSA. The VERSA calculates the optimal operation and sends the firing rate and pump output requests to the PIM so it can activate the Indirect DHW pump and Boiler pump if needed. If an optional Indirect DHW sensor is connected to J2-1 and J2-2 the PIM will pass this signal to the VERSA. This allows the VERSA to optimize the Indirect DHW demand to maintain the Indirect DHW setpoint. The Indirect DHW thermostat switch closure is not required when using the Indirect DHW sensor. If a VERSA is not present the PIM shall activate the Indirect DHW pump whenever the Indirect DHW call is active. The Boiler pump may also be activated based on the Indirect DHW piping configuration setting.
3. Connect the indirect tank sensor to the terminals marked INDIRECT DHW SENSOR. See wiring diagram Figure 45 on page 45. Caution should be used to ensure neither of these terminals becomes connected to ground.

Wiring the Optional 0–10 Volt Building Control Signal

1. A signal from an energy management system may be connected to the XPak FT boiler. This signal should be a 0-10 volt positive DC signal, and an energy management system can be used to control either the setpoint temperature or the firing rate of the XPak FT boiler.
2. To enable this remote control function, set dip switch 5 to the UP position on the PIM. Dip switch 5 Toggles between an EMS (UP) signal or a demand signal from the VERSA (DOWN). Dip switch 2 on the PIM toggles between a Direct Drive (UP) input and a Target Temperature (DOWN) setpoint.
3. For a 4-20 mA application, refer to the VERSA IC[®] manual (241493).
4. Connect an Energy Management system or other auxiliary control signal to the terminals marked 0-10V (+ /-) on the PIM. See Figure 19 on page 24. Caution should be used to ensure that the +0-10V connection does not create a short to ground.

Wiring the Cascade System Communication Bus

Refer to VERSA IC Manual (241493) for details on Cascade wiring and communication setup.

Cascade System Pump and Sensor Wiring

1. On the boiler designated as the Master, connect the system pump wiring to the terminal block at the rear of the unit. Connect to terminals 10, 11, and 12. See Figure 21 on page 26. The output is rated for pilot duty only (2A maximum).
2. Connect the boiler pump wires to the terminal block at the rear of their unit. Connect to terminals 4, 5, and 6. See Figure 21 on page 26.
3. Connect the system supply sensor to terminals 3 and 4 on the J2 connector located on the Master PIM. See Figure 19 on page 24 .
4. Connect the Outdoor air sensor (if used) to terminals 5 and 6 on the J2 connector located on the Master PIM. See Figure 19 on page 24.
5. Connect the Enable/Disable wiring to terminals 9 and 10 on the J1 connector located on the Master PIM. See Figure 19 on page 24. This connection must be provided through dry contacts closure.

NOTE: This dry contacts closure can come from a room thermostat or a remote relay. No power of any kind should be applied to either of these terminals.

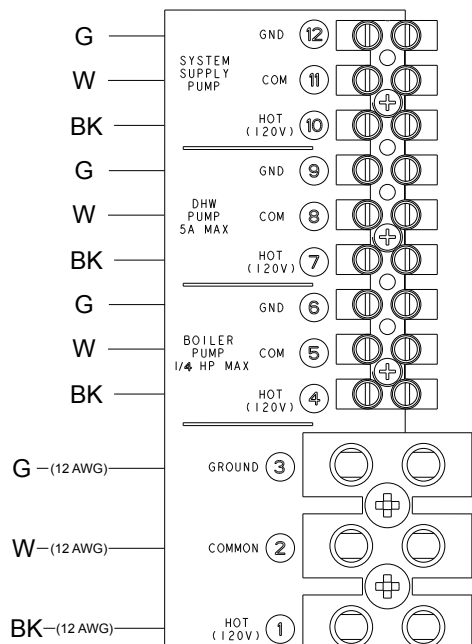


Figure 21. XPak FT Cascade Master Pumps

Cascade Follower Pump and Sensor Wiring

1. Once the primary boiler has been identified, additional boilers will be designated as follower boilers. Ensure DIP switch 2 on each follower VERSA is set to the OFF/Down position. See Figure 22 on page 26.

2. For each follower boiler, connect the boiler pump wires to the terminal block at the rear of each unit. Connect to terminals 4, 5, and 6. See Figure 21 on page 26 .

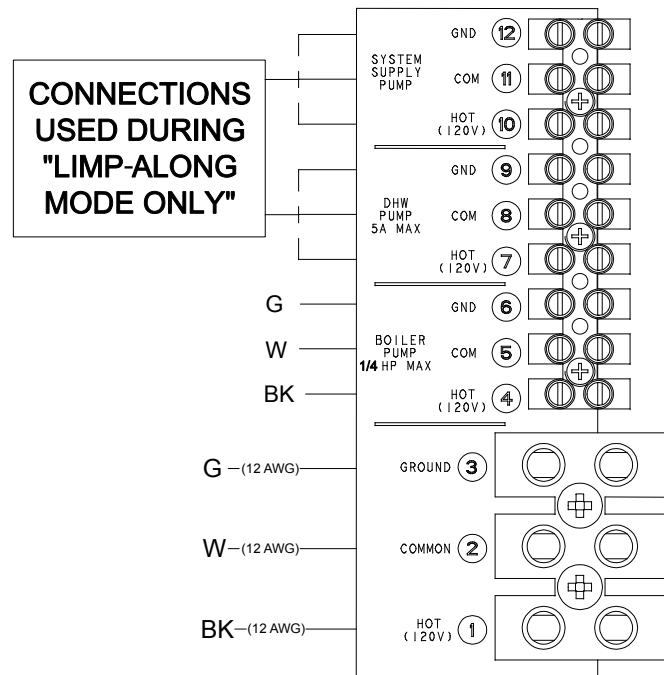


Figure 22. VERSA Follower

Modbus BMS Communication

The VERSA IC[®] control is equipped as standard with a communications port for connectivity to building automation via Modbus protocol. Refer to the VERSA IC[®] manual (241493) for further information. See ProtoNode Manual (241515) for setup and wiring diagram.

Alarm Connection

The Alarm Contacts are 3A rated dry contacts on a normally-open relay that close during fault or lockout conditions, and the maximum voltage across the contacts is 30 VAC or 30 VDC. Connections are made at the supplied alarm contacts (spade terminals).

In a cascade system, in the event of an alarm condition at one or more units, all alarm contacts within the cascade will be closed. This feature can be enabled or disabled, refer to VERSA IC Manual (241493) for further details on "Cascade Alarm".

Venting

CAUTION: Proper installation of flue venting is critical for the safe and efficient operation of the boiler.

General

Appliance Categories

Heaters are divided into four categories based on the pressure produced in the exhaust and the likelihood of condensate production in the vent.

Category I – A heater which operates with a non-positive vent static pressure and with a vent gas temperature that avoids excessive condensate production in the vent.

Category II – A heater which operates with a non-positive vent static pressure and with a vent gas temperature that may cause excessive condensate production in the vent.

Category III – A heater which operates with a positive vent pressure and with a vent gas temperature that avoids excessive condensate production in the vent.

Category IV – A heater which operates with a positive vent pressure and with a vent gas temperature that may cause excessive condensate production in the vent.

See Table M for appliance category requirements.

NOTE: For additional information on appliance categorization, see the ANSI Z21.13 Standard and the NFGC (U.S.), or B149 (Canada), or applicable provisions of local building codes.

WARNING: Contact the manufacturer of the vent material if there is any question about the appliance categorization and suitability of a vent material for application on a Category IV vent system. Using improper venting materials can result in personal injury, death or property damage.

Use only PVC or CPVC vent material (in Canada, ULC-S636 approved plastic material must be used) or special gas vent pipes listed for use with Category IV gas burning heaters, such as the AL29-4C stainless steel vents offered by Heat Fab Inc. (800-772-0739), Protech System, Inc. (800-766-3473), Z-Flex (800-654-5600) or American Metal Product (800-423-4270). Pipe joints must be positively sealed. Follow the vent manufacturer's installation instructions carefully.

In a system with PVC vent, condensate must not re-enter the unit. Use an offset section and condensate drain.

DuraVent® and Centrotherm® polypropylene vent materials are also approved to be used on XPak FT products.

Duravent polypropylene connect directly to the multi-vent connector. Centrotherm polypropylene requires the D-107 adaptor.

Vent installation shall be in accordance with Part 7,

Venting of Equipment, of the NFGC, ANSI Z223.1/ NFPA 54, Section 7, Venting Systems and Air Supply for Appliances, of the B149 Code, or applicable provisions of the local building codes.

WARNING: Do not use foam core or cellular core PVC/CPVC pipe for venting.

WARNING: DO NOT insulate PVC or CPVC vent pipe.

CAUTION: When using stainless steel vent in a climate where freezing may occur, a double wall vent pipe must be used.

NOTE: The following are the flue temperature limitations for various vent materials:

PVC: (149°F/65°C),

CPVC: (194°F/90°C),

PPS: (Polypropylene) (230°F/110°C)

WARNING: Condensate is acidic and highly corrosive. The drain line must not be allowed to freeze. Take appropriate measures.

Support of Vent Stack

The weight of the vent stack or chimney must not rest on the heater vent connection. Support must be provided in compliance with applicable codes. The vent should also be installed to maintain proper clearances from combustible materials. Use insulated vent pipe spacers where the vent passes through combustible roofs and walls.

The Multi-vent connector is capable of using stainless steel (SST), Polypropylene or PVC/CPVC pipe. Before installing vent pipe, verify which o-ring gasket will be used and dispose of the other two.

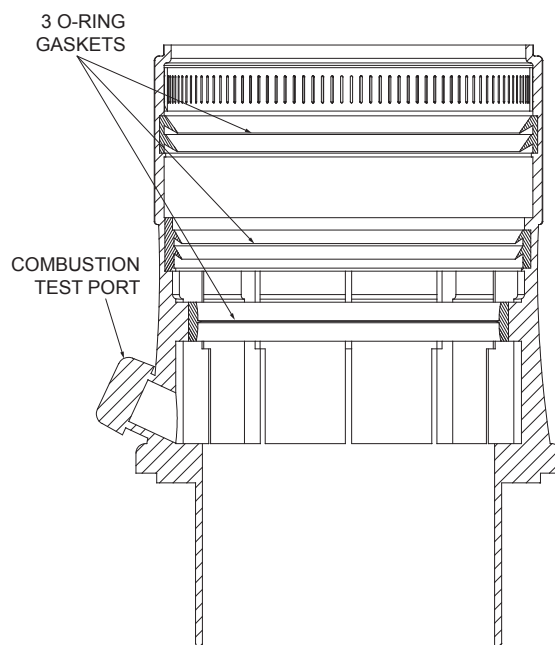


Figure 23. 3 in 1 Multi-Vent Connector

Combustion Air Supply	Exhaust Configuration	Heater Venting Category	Certified Vent Materials	Combustion Air Inlet Material
From Inside Building (Non-Direct Venting)	Vertical Venting	IV	(Canada Only: ULC-S636 PVC and CPVC) Stainless Steel, AL29-4C, Sch 40 PVC or CPVC Polypropylene*	
	Horizontal Through-the-Wall Venting			
From Outside Building (Direct Venting)	Vertical Venting			Galvanized Steel, PVC, ABS, CPVC
	Horizontal Through-the-Wall Venting			

* Only Duravent® and Centrotherm® polypropylene is approved for the XPak FT product.

Table K. Venting Category Requirements

Vent Terminal Location

NOTE: During winter months check the vent cap and make sure no blockage occurs from build-up of snow or ice.

1. Condensate can freeze on the vent cap. Frozen condensate on the vent cap can result in a blocked flue condition.
2. Give special attention to the location of the vent termination to avoid possibility of property damage or personal injury.
3. Gases may form a white vapor plume in winter. The plume could obstruct a window view if the termination is installed near windows.
4. The bottom of the vent terminal and the air intake shall be located at least 12 in (305 mm) above grade, including normal snow line.
5. Single-wall Category IV metal vent pipe shall not be used outdoors in cold climates for venting gas-fired equipment without insulation.
6. Through-the-wall vents for Category IV appliances shall not terminate over public walkways or over an area where condensate or vapor could create a nuisance or hazard or could be detrimental to the operation of regulators, relief valves, or other equipment.
7. Locate and guard vent termination to prevent accidental contact by people or pets.
8. DO NOT terminate vent in window well, stairwell, alcove, courtyard or other recessed area.
9. DO NOT terminate above any door, window, or gravity air intake. Condensate can freeze, causing ice formations.
10. Locate or guard vent to prevent condensate from damaging exterior finishes. Use a 300-series stainless steel backing plate against brick or masonry surfaces.

- DO NOT extend exposed vent pipe outside of building beyond the minimum distance required for the vent termination. Condensate could freeze and block vent pipe.

U.S. Installations

Refer to the latest edition of the National Fuel Gas Code.

⚠ WARNING: The Commonwealth of Massachusetts requires that sidewall-vented heaters, installed in every dwelling, building or structure used in whole or in part for residential purposes, be installed using special provisions as outlined on page 62 of this manual.

Vent termination requirements are as follows:

- Vent must terminate at least 4 ft (1.2 m) below or 4 ft (1.2 m) horizontally from any door, window or gravity air inlet to the building. DO NOT terminate above any door, window, or gravity air intake. Condensate can freeze, causing ice formations.
- The vent must not be less than 7 ft (2.1 m) above grade when located adjacent to public walkways.
- Terminate vent at least 1 ft (915 mm) above any forced air inlet located within 10 ft (3 m).
- Vent must terminate at least 4 ft (1.2 m) horizontally, and in no case above or below unless 4 ft (1.2 m) horizontal distance is maintained, from electric meters, gas.
- Terminate vent at least 6 ft (1.8 m) away from adjacent walls.

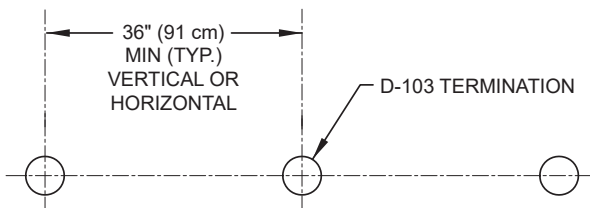


Figure 24. D-103 Sidewall Vent Cap Configuration

- DO NOT terminate vent closer than 5 ft (1.5 m) below roof overhang.
- The vent terminal requires a 12 in (305 mm) vent terminal clearance from the wall.
- Terminate vent at least 1 ft (305 mm) above grade, including normal snow line.
- Multiple direct vent installations require a 4 ft (1.2 m) clearance between the ends of vent caps located on the same horizontal plane.

Installations in Canada

Refer to latest edition of the B149 Installation Code.

A vent shall not terminate:

- Directly above a paved sidewalk or driveway which is located between two single-family dwellings and serves both dwellings.

- Less than 7 ft (2.13 m) above a paved sidewalk or paved driveway located on public property.
- Within 6 ft (1.8 m) of a mechanical air supply inlet to any building.
- Above a meter/regulator assembly within 3 ft (0.9 m) horizontally of the vertical centerline of the regulator.
- Within 6 ft (1.8 m) of any gas service regulator vent outlet.
- Less than 1 ft (305 mm) above grade level.
- Within 3 ft (0.9 m) of a window or door which can be opened in any building, any non-mechanical air supply inlet to any building or the combustion air inlet of any other appliance.
- Underneath a veranda, porch or deck, unless the veranda, porch or deck is fully open on a minimum of two sides beneath the floor, and the distance between the top of the vent termination and the underside of the veranda, porch or deck is greater than 1 ft (305 mm).

NOTE: Ensure adequate clearances to allow annual inspection of the venting system.

⚠ CAUTION: This venting system requires the installation of a condensate drain in the vent piping per the vent manufacturer's instructions. Failure to install a condensate drain in the venting system will cause damage to the boiler which will not be covered under warranty. Condensate is acidic and highly corrosive. The drain line must not be allowed to freeze. Take appropriate measures.

Model No.	Certified Vent Material	Vent and Intake Air Vent Size in. (mm)	Total Vent Length		Combustion Air Intake Pipe Material	Air Inlet Max. Length ¹ ft (m)	
			Min Height if Vertical ft. (m)	Max Length, Vertical or Horizontal ft. (m)			
88AR	(Canada Only: ULC-S636 PVC and CPVC) Stainless Steel, AL29-4C, ANSI/ASTM D1785 Sch 40 PVC, ANSI/ASTM F441 Sch 40 CPVC Polypropylene ²	2 (51) ³	5 (0.9)	50 (15.2)	Galvanized Steel, PVC, ABS, CPVC	50 (15.2)	
108AR		3 (76)		100 (30.5)		100 (30.5)	
198AR				3 (76) ⁴		60 (18.3)	60 (18.3)
278AR						100 (30.5)	100 (30.5)
398A		4 (102)		100 (30.5)		100 (30.5)	

¹ Maximum number of elbows are limited as every elbow's equivalent length is subtracted from maximum equivalent length.

² Only Duravent® and Centrotherm® polypropylene is approved for the XPak FT product.

³ Std flue collar is 3"

⁴ Std flue collar is 4"

Table L. Category IV Vent

Model No.	Size in. (mm)	Approved Intakes	Approved Plastic Terminals	Approved SS Terminals
88AR	3 (76)	PVC 90° Elbow Sch 40 Galvanized 90° Elbow, SS 90° Elbow, ABS 90° Elbow	3" PVC/CPVC Elbow Sch 40*, Duravent Polypropylene	FasNSeal® FSTT 3
108AR				
198AR				
278AR				
398A	4 (102)		4" PVC/CPVC Tee Sch 40*, Duravent Polypropylene	FasNSeal® FSTT 4

*Must be ULC-S636 materials in Canada.

Table M. Horizontal Vent and Air Intake Terminals

Venting Installation Tips

Support piping:

Horizontal runs—At least every 5 ft (1.5 m)

Vertical runs—Use braces

Under or near elbows

Venting Configurations

For heaters connected to gas vents or chimneys, vent installations shall be in accordance with the NFGC (U.S.), or B149 (Canada), or applicable provisions of local building codes.

Vertical Venting (Category IV)

Installation

The maximum and minimum venting length for this Category IV appliance shall be determined per the NFGC (U.S.) or B149 (Canada).

The minimum flue pipe diameter for conventional venting is: 3" for Models 88AR (2" optional), 108AR, 198AR and 278AR, and 4" for Models 398A (3" optional).

The connection from the appliance vent to the stack must be as direct as possible and shall be the same diameter as the vent outlet. The horizontal breaching of a vent must have an upward slope of not less than 1/4 inch per linear foot (21 mm per meter) from the heater to the vent terminal. The horizontal portions of the vent shall also be supported for the design and weight of the material employed to maintain clearances and to prevent physical damage or separation of joints.

The vent terminal should be vertical and should terminate outside the building at least 1 ft (610 mm) above the highest point of the roof that is within 8 ft (2.4 m). The vent cap should have a minimum clearance of 4 ft (1.2 m) horizontally from and in no case above or below (unless a 4 ft (1.2 m) horizontal distance is maintained) electric meters, gas meters, regulators and relief equipment.

The distance of the vent terminal from adjacent public walkways, adjacent buildings, open windows and building openings must be consistent with the NFGC (U.S.) or B149 (Canada). Vents supported only by flashing and extending above the roof more than 5 ft (1.5 m) should be securely guyed or braced to withstand snow and wind loads.

Common Venting

The NFGC does not address sizing guidelines for the common venting of multiple Category IV heaters. This is covered in the NFGC under “Engineered Vent Systems”. Table O provides volumes of flue products at full fire for the calculation of appropriate vent and extractor sizing for common venting.

CAUTION: A listed vent cap terminal suitable for connection to the Cat IV vent materials, adequately sized, must be used to evacuate the flue products from the boilers.

WARNING: An extractor is required when multiple heaters are vented through a common vent pipe. The extractor must operate when one or more units are firing.

WARNING: Vent connectors serving any other appliances shall not be connected into any portion of mechanical draft systems operating under a positive pressure. If an XPak FT boiler is installed to replace an existing boiler, the vent system MUST be verified to be of the correct size and of Category IV AL29-4C vent material, approved PVC/CPVC construction, or DuraVent® polypropylene (in Canada, ULC-S636 approved plastic materials must be used). If it is NOT, it MUST be replaced.

NOTE: For extractor sizing, typical CO₂ levels are 9.0% for natural gas and 10.5% for propane gas and flue temperatures of less than 180°F (82°C).

At the time of removal of an existing boiler, the following steps shall be followed with each appliance remaining connected to the common venting system placed in operation, while the other appliances remaining connected to the common venting system are not in operation:

- a. Seal any unused openings in the common venting system.
- b. Visually inspect the venting system for proper size and horizontal pitch and make sure there is no blockage or restriction, leakage, corrosion and other deficiencies which could cause an unsafe condition.
- c. Place in operation the appliance being inspected. Follow the lighting instructions. Adjust thermostat so appliance will operate continuously.

NOTE: Vent and intake piping must be supported so that the weight of the venting is not transferred to the unit. Horizontal runs of vent and intake piping must be supported to prevent sagging.

NOTE: While a drain connection is required in the vent of all XPak FT installations, the drain can be accomplished in several different ways. The figures in this manual show the drain in a vent tee, however, this can also be accomplished using an inline collector for condensing stacks or an inline vertical or horizontal collector available from several of the listed vent manufacturers.

WARNING: Condensate is acidic and highly corrosive.

Installation

CAUTION: This venting system requires the installation of a condensate drain in the vent piping per the vent manufacturer’s instructions. Failure to install a condensate drain in the venting system will cause damage to the boiler which will not be covered under warranty. The drain line must not be allowed to freeze. Take appropriate measures.

WARNING: No substitutions of flue pipe or vent cap material are allowed. Such substitutions would jeopardize the safety and health of inhabitants.

These installations utilize the heater-mounted blower to draw combustion air and to vent the combustion products to the outdoors. The combustion air intake and the vent are installed horizontally through the wall to the outdoors. Adequate ventilation air must be supplied to the equipment room in accordance with the NFGC (U.S.) or B149 (Canada).

The total length of the horizontal through-the-wall direct vent system should not exceed 200 equivalent ft (61.0 m) in length. If combined vent/intake run exceeds 200 equivalent ft (61.0 m), an appropriately-sized variable-speed extractor must be used. Each elbow used is equal to 10 ft (3 m) of straight pipe with a maximum of 4 elbows each on the air intake and vent.

The vent cap is not considered in the overall length of the venting system.

The vent must be installed to prevent flue gas leakage. Care must be taken during assembly to ensure that all joints are sealed properly and are airtight. The vent must be installed to prevent the potential accumulation of condensate in the vent pipes. It is required that:

1. The vent must be installed with condensate drains as directed by the vent manufacturer.
2. The vent must be installed with a slight upward slope of not less than 1/4 inch per foot of horizontal run to the vent terminal.
3. The vent must be offset and condensate from the vent drained away from the unit to prevent damage per Figure 25.

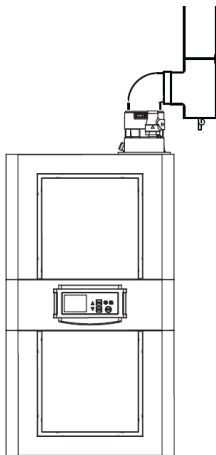


Figure 25. Offset Venting Setup

Termination

The vent cap MUST be mounted on the exterior of the building. The vent cap cannot be installed in a well or below grade.

The vent cap must be installed at least 1 ft (305 mm) above ground level and above normal snow levels. Only Raypak-approved vent caps may be used. The vent terminal must be located NO CLOSER than 12 in (305 mm) off the wall.

Direct Vent—Horizontal Installation

These installations utilize the heater-mounted blower to draw combustion air from outdoors and vent combustion products to the outdoors.

The total length of air supply pipe cannot exceed the distances listed in Table M. Each elbow used is equal to 10 ft (3 m) of straight pipe. This will allow installation in any arrangement that does not exceed the lengths shown in Table M.

The vent cap is not considered in the overall length of the venting system.

Care must be taken during assembly that all joints are sealed properly and are airtight.

The vent must be installed to prevent the potential accumulation of condensate in the vent pipes. It is required that:

1. The vent must be installed with a condensate drain as directed by the vent manufacturer.
2. The vent must be installed with a slight upward slope of not more than 1/4 inch per foot of horizontal run to the vent terminal.

CAUTION: This venting system requires the installation of a condensate drain in the vent piping per the vent manufacturer's instructions. Failure to install a condensate drain in the venting system will cause damage which will not be covered under warranty. Note that the condensate is acidic and highly corrosive.

Termination

The vent cap MUST be installed on the exterior of the building. The vent cap cannot be installed in a well or below grade. The vent cap must be installed at least 1 ft (305 mm) above ground level and above normal snow levels.

The vent cap MUST NOT be installed with any combustion air inlet directly above a vent cap. This vertical spacing would allow the flue products from the vent cap to be pulled into the combustion air intake installed above.

This type of installation can cause non-warrantable problems with components and poor operation of the boiler due to the recirculation of flue products. Multiple vent caps installed in the same horizontal plane must have a 4 ft (1.2 m) clearance from the side of one vent cap to the side of the adjacent vent cap(s).

Combustion air supplied from outdoors must be free of particulate and chemical contaminants. To avoid a blocked flue condition, keep the vent cap clear of snow, ice, leaves, debris, etc.

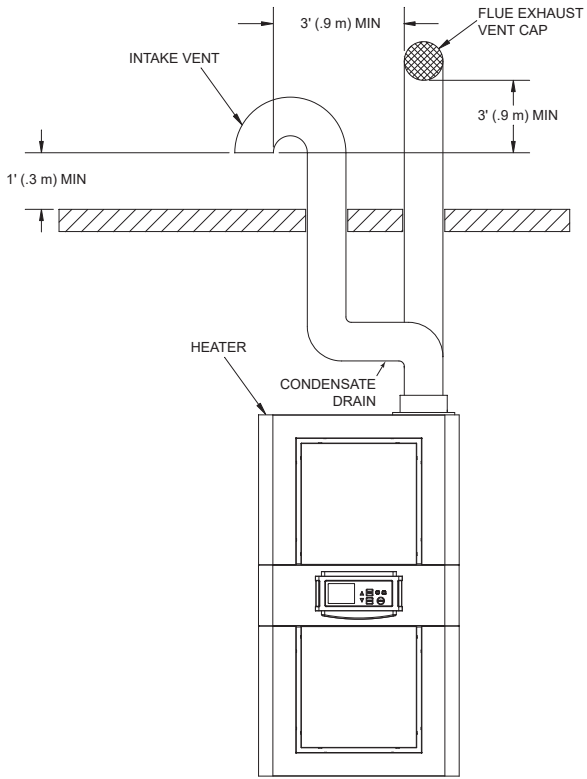


Figure 29. Direct Vent - Vertical

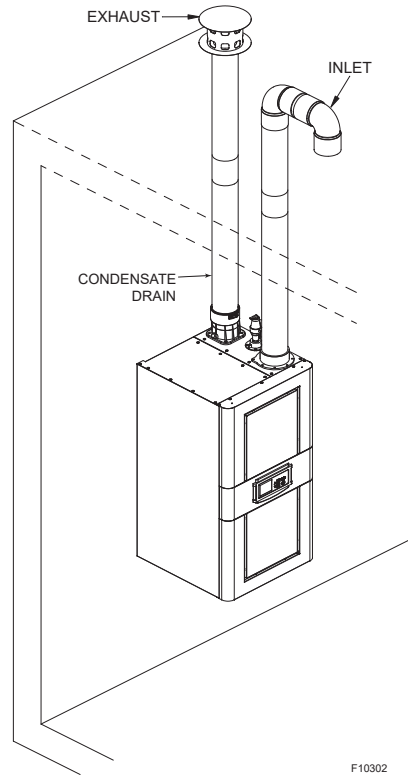


Figure 30. Vertical Venting w/ Stainless Termination Cap

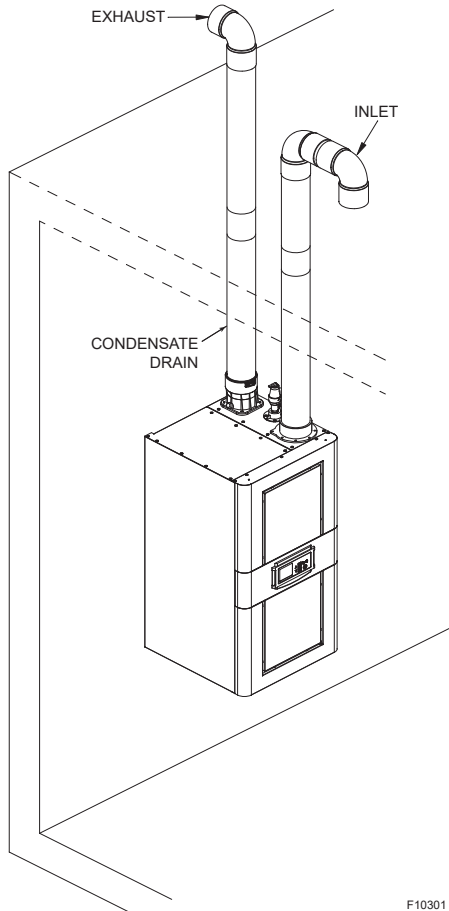


Figure 31. Direct Venting w/ Elbow Terminations

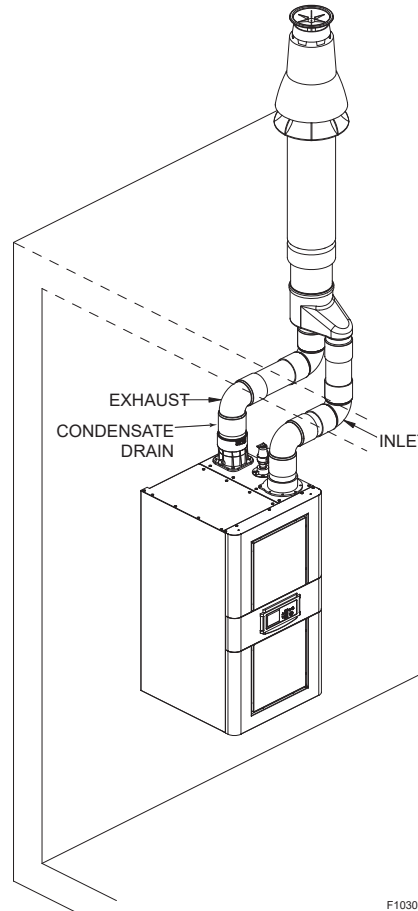


Figure 32. Vertical Concentric Venting

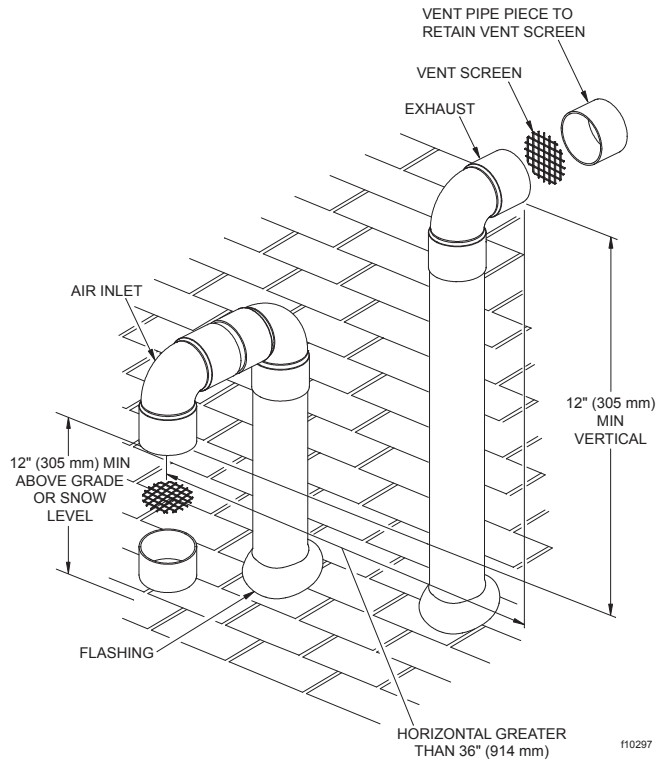


Figure 33. Vertical - Elbow Vent Termination

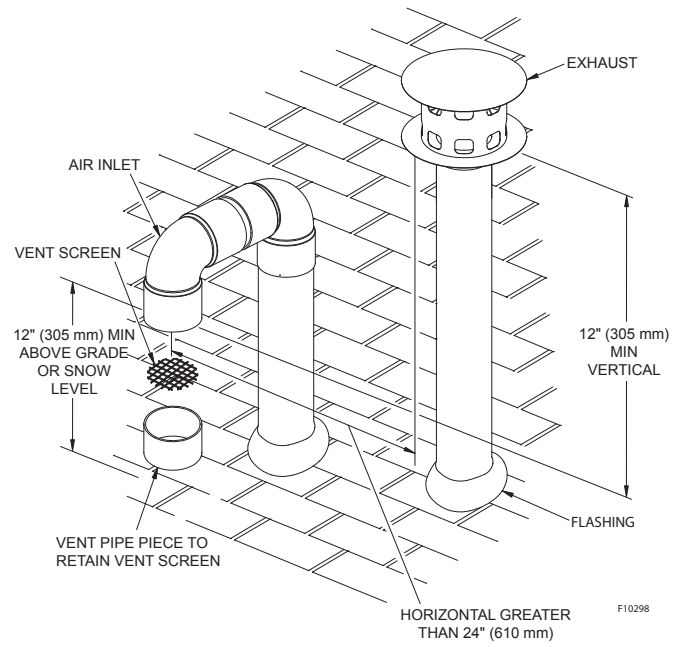


Figure 34. Vertical - Stainless Termination Cap

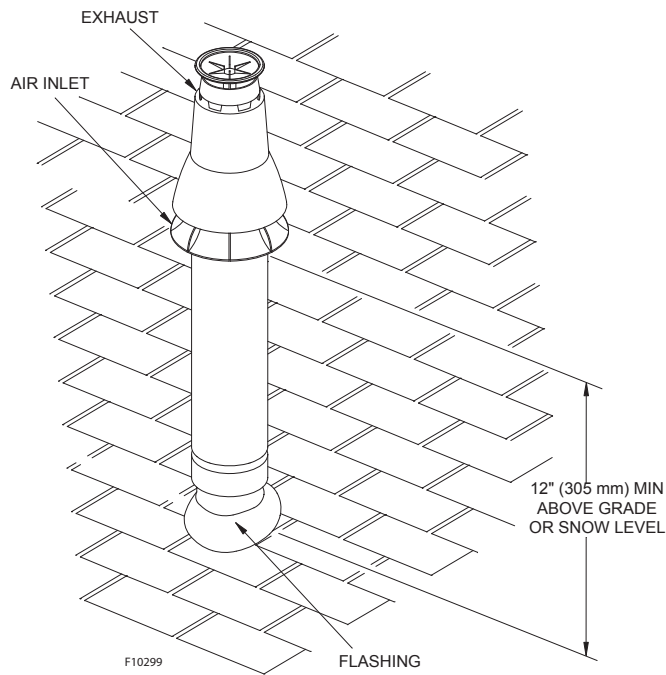


Figure 35. Vertical - Concentric Vent Termination

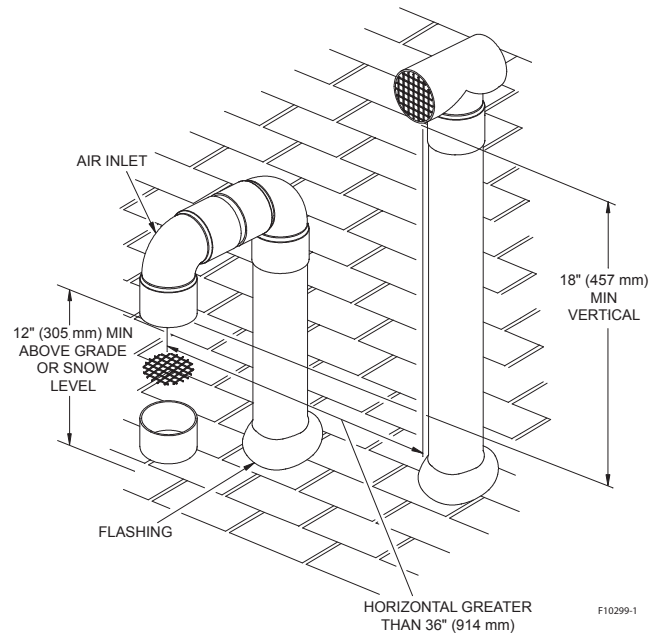


Figure 36. Vertical - Stainless Tee Termination

Condensate Management

The condensate must be drained properly to protect the appliance and drainage system. The condensate from the boiler is acidic. Its pH is between 3.2 and 4.5. Raypak recommends treating the condensate with a Condensate Treatment kit (sales option Z-12). The treatment kit is connected to the drain system and contains an alkali medium to raise the pH level of the condensate. The kit may be added to avoid long-term damage to the drainage system and to meet local code requirements. The pH level of the effluent entering a sanitary drain must be 5.0 or higher.

Vent pipe condensate drains are also required for installation of the XPak FT. Follow vent manufacturer instructions for location of condensate drains in the vent. The vent condensate should also be routed through a treatment kit, as required by local code requirements.

The treatment kit must be sized to the condensate generated by the appliance and the vent.

The condensate drain line must not be allowed to freeze. Take appropriate measures.

Expected max condensate volume:

Model No.	GPH (lph)
88AR	0.9 (3.8)
108AR	1.1 (4.2)
198AR	2.0 (7.6)
278AR	2.8 (10.6)
398A	4.0 (15.1)

Table N. Condensate Volume

CAUTION: In general, the condensate piping from the appliance must have a downward slope of 1/4" per horizontal foot. Condensate drain traps must be primed with water to prevent gas flue leaks. Treatment kits should be checked at least once per year, to ensure that the pH of the effluent is 5.0 or higher, and the chips should be replenished as necessary. When replacing the chips, they should be no smaller than 3/4" to avoid blockage in the condensate piping. Figure 37 on page 36 is a visual guide only. Follow the manufacturer's instructions for the installation of the treatment kit and condensate drains.

WARNING: Installation, adjustment and service of controls, including timing of various operating functions, must be performed by a qualified installer, service agency or the gas supplier. Failure to do so may result in control damage, malfunction, property damage, personal injury, or death.

CAUTION: This appliance has provisions to be connected to more than one supply source. To reduce the risk of electric shock, disconnect all such connections before servicing.

CAUTION: Risk of electric shock: More than one disconnect switch may be required to de-energize the equipment before servicing.

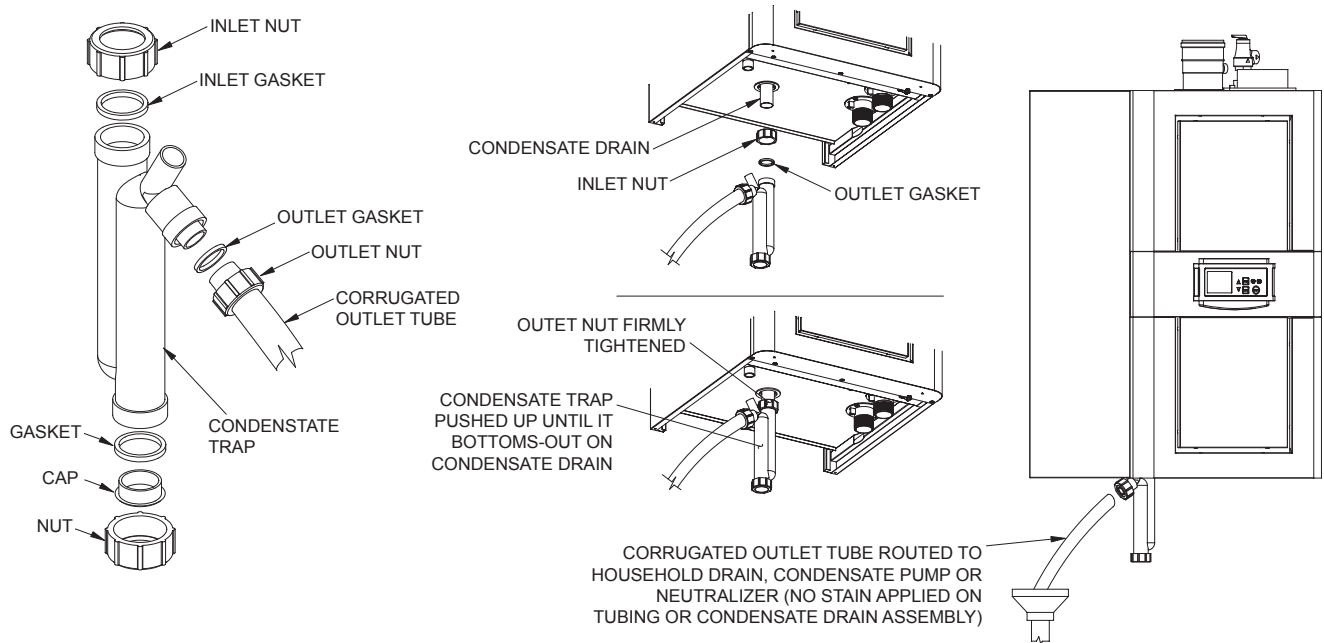


Figure 37. Visual Guide for Condensate Piping

Controls

Ignition Control Functions

NOTE: Ignition modules are common for all model sizes. However, model-specific operating parameters are defined by their respective ID cards.

When there is a call for heat, and all safeties are closed, then the combustion air blower starts to purge air from the combustion chamber. After the pre-purge, the igniter is energized. The ignition module will lockout after failing to light 3 times during a call for heat. To reset the lockout, press and release the RESET button located on the user interface. The control will automatically reset after 1 hour. When in lockout the control will run the blower through a post-purge cycle.

High Limit — Manual-Reset

The heater is equipped with a fixed-setting manual-reset high limit temperature device as standard, set at 200°F, and it may have an additional optional adjustable manual reset high temperature device.

Standard

The fixed-setting manual-reset high limit is built into the PIM, and utilizes a dual element sensor located on the outlet. To reset a high limit lock-out, press and release the RESET button located on the user interface.

Optional

The optional adjustable-setting manual-reset high limit is located behind the front panel. To reset a high limit lockout, press the reset button on the adjustable manual reset limit as well as the reset button located on the user interface.

Flue Temperature Limit

The heater is equipped with a fixed-setting manual-reset high limit temperature device on the vent, for use with non-metallic vent material. The high temperature limit is located inside the unit near the vent adapter. The VERSA monitors the limit and displays any fault associated with the limit on the user interface. To reset the limit, access it and press down on the red button.

The unit is provided with a limit rated for PVC vent material. A higher-rated limit is provided when using DuraVent® polypropylene venting. The limit is removed when using Category IV stainless steel venting.

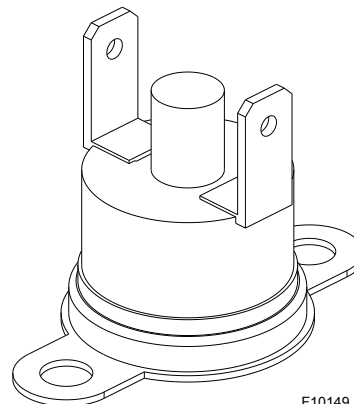


Figure 38. Flue Temperature Limit

Test/Reset

Low Water Cut-Off (Model 398A Only)

The standard low water cut-off automatically shuts down the burner whenever water level drops below the level of the sensing probe. A 5-second time delay prevents premature lockout due to temporary conditions such as power fluctuations or air pockets. Manual reset is required to restore operation.

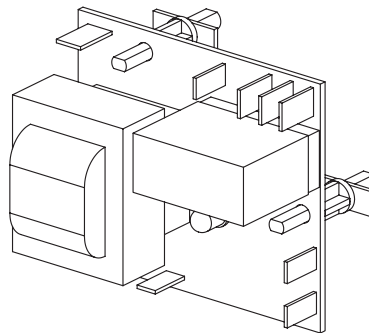


Figure 39. Low Water Cut-Off

All-In-One Low Water Cut-Off (Models 88AR-278AR)

The standard low water cut-off automatically shuts down the burner whenever water level drops below the level of the sensing probe.

This device will automatically reset once the correct water level is restored. The VERSA control will continue to maintain lockout for 15-minutes (soft lockout). During that time, press 'RESET' to restart the unit.

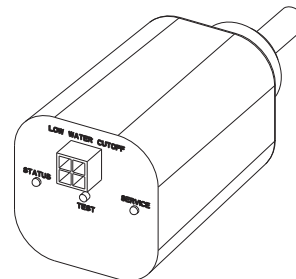


Figure 40. Low Water Cut-Off

High & Low Gas Pressure Switches (Field Add-On)

The low gas pressure switch connection mounts upstream of the gas valve (on the inlet flange to the gas valve) and is accessible through the removable access panels on the front of the boiler to reset the gas pressure switch, as necessary. It is used to ensure that sufficient gas pressure is present for proper valve/regulator performance. The low gas pressure switch automatically shuts down the boiler if the gas supply pressure drops below the factory setting of 3.0 in. WC for natural gas or propane gas.

The high gas pressure switch connection mounts downstream of the gas valve. Special ports are located on the backside of the gas valve and are accessible from the front or top of the boiler (to reset the gas pressure switch), as necessary. If the gas pressure regulator in the valve fails, the high gas pressure switch automatically shuts down the burner.

The High gas pressure switch shuts down the boiler if the gas supply pressure rises above the factory setting of 3.0" WC for either natural or propane gas.

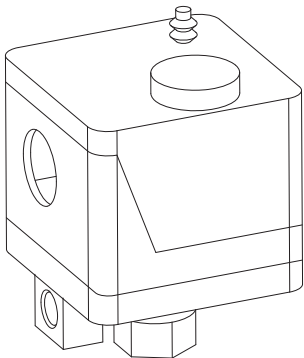


Figure 41. High/Low Gas Pressure Switch

Operation of either the High or Low Gas Pressure Switch will turn on an LED inside the switch housing. Push the top of the plastic switch housing to reset a tripped pressure switch. See Figure 41. The LED will go out when the switch is reset.

These safety devices can emit small amounts of fuel gas, and must be piped to a safe discharge location outdoors, per local code requirements.

Blocked Vent Switch

The heater is equipped with a blocked vent pressure switch to prevent the operation of the boiler when a significant amount of air flow is blocked at the vent. The switch is located at the left rear of the unit.

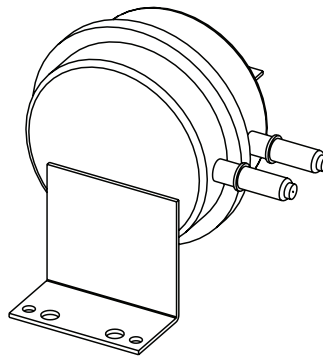


Figure 42. Blocked Vent Switch

User Interface

The user interface consists of several Menu options. Press the MENU button to scroll through the different menus in the interface. Press the ITEM button to scroll through available items within a selected menu. And, the UP and DOWN buttons allow for setting changes to items in the ADJUST menu. See Figure 43 for display and key locations.

For detailed descriptions of the various screens, consult the VERSA IC® Control manual (241493).

Adjusting the XPak FT Setpoint

To adjust the setpoint on the XPak FT:

Use the MENU key to scroll to the ADJUST menu, then use the ITEM key to scroll to the SETPOINT item. Adjust the Setpoint using the UP and DOWN arrow keys. Minimum is 50°F (50°C), Maximum is 192°F (89°C), and the default is 180°F (82°C) for H models.

View Menu

The VIEW menu is the default menu. See Table O. It displays sensor temperatures, the modulation rate of the blower, heater cascade status, pump operation and CFH information. Some of the items displayed are mode-specific and are only observable when its corresponding mode is active.

Setup Menu

To change settings use the MENU key to scroll to the ADJUST menu. The ADJUST menu allows the installer to make adjustments to items shown in Table P.

Refer to the VERSA IC® Control manual (241493) for detailed setup instructions.



Figure 43. User Interface

Item	Application	Description
OUTDOOR	MODE 1, 2, 3	Outdoor air temperature, available when TARGET = RSET in ADJUST menu.
Target	MODE 1, 2, 3	Current target temperature, available when TARGET = SETP in ADJUST menu (D0efault), (EMS /MODB)
SUPPLY	MODE 1, 2, 3	Current system supply temperature
IND SUPPLY	MODE 3	Current temperature being supplied to the indirect system
Boil OUTLET	All	Current boiler outlet temperature
Boil INLET	All	Current boiler inlet temperature
Boil ΔT	All	Current temperature difference between boiler outlet and boiler inlet Max ΔT 60°F (33°C)
DHW SUPPLY	MODE 2, 3	Current indirect DHW supply temperature
BOILER STATUS	All	IDLE, PREP, IGN, MOD RATE %, POST, SOFT

Table O. View Menu

Item	Application	Range	Description	Default	User
TARGET	MODE 1, 2, 3	RSET <> SETP	RSET = Outdoor Reset, SETP =Setpoint	SETP	
MODE	MODE 1, 2, 3	1, 2, 3	Piping and application configuration.	1	
SETPOINT	MODE 1, 2, 3	50°F to 192°F (10°C to 89°C)	Boiler target temperature while a heat demand is present for setpoint operation	180°F (82°C)	
OUT START	MODE 1, 2, 3	35°F to 85°F (2°C to 29°C)	Outdoor starting temperature - outdoor reset	70°F (21°C)	
OUT DESIGN	MODE 1, 2, 3	-60°F to 45°F (-51°C to 7°C)	Outdoor design temperature - outdoor reset	10°F (-12°C)	
Boil START	MODE 1, 2, 3	35°F to 150°F (2°C to 66°C)	Starting boiler target temperature when the outdoor temperature is at outdoor start outdoor reset	70°F (21°C)	
Boil DESIGN	MODE 1, 2, 3	70°F to 200°F (21°C to 93°C)	Design boiler target temperature when the outdoor temperature is at outdoor design outdoor reset	180°F (82°C)	
TARGET MAX	MODE 1, 2, 3	100°F to 192°F (38°C to 89°C)	Maximum target system temperature	192°F (89°C)	
TARGET MIN	MODE 1, 2, 3	OFF, 50°F to 190°F (10°C to 88°C)	Minimum target system temperature	50°F (10°C)	
TARGET DIFF	MODE 1, 2, 3	2°F to 42°F (1°C to 6°C)	Differential for target system temperature	10°F (6°C)	
IND SENSOR	MODE 1, 2, 3	OFF <> ON	Selects whether a DHW sensor is used for indirect DHW tank	OFF	
IND SETP	MODE 2, 3	OFF, 50°F to 180°F (10°C to 82°C)	Target Indirect DHW Temperature (IND Sensor = ON, to enable this setting)	140°F (60°C)	
CASCADE TYPE	CASCADE MASTER ONLY	SEQ<>PAR	Cascade operation type: Sequential or Parallel.	SEQ	
CASCADE ALARM	CASCADE MASTER ONLY	OFF <> ON	Alarm all units in cascade if any unit presents an alarm.	ON	
DHW DIFF	MODE 2, 3	2°F to 10°F (1°C to 6°C)	Differential for the target indirect DHW tank temperature, Requires IND Sensor = ON	6°F (3°C)	
IND SUPPLY	MODE 2, 3	OFF, 50°F (10°C) to PIM value*	Target boiler temperature for the DHW heat exchanger during indirect DHW operation, requires IND Sensor = OFF	180°F (82°C)	
DHW PRIORITY	MODE 2	OFF <> ON	Selects whether or not Indirect DHW priority is active during indirect DHW operation	OFF	
PRI OVR	MODE 2, 3	Au, 0:10hr to 2:00hr	Sets the length of the indirect DHW priority override time	1:00 hour	
SYS PURGE	All	OFF, 0:20min to 20:00min	Sets the length of the system pump post purge	20 seconds	
MIX TYPE	All	(VALVE <> PUMP <> PLNT)	Selects the type of control depending on pipe configuration for CWP	VALVE	
MIX TARGET	All	50°F TO 140°F (10°C to 60°C)	Inlet Target Temperature	120°F	
MIX LOCK	All	ON <> OFF	The equipment will trigger a warning when "MIX Target" is not reached within 7-minutes. MIX LOCK = ON Alarm and lockout, MIX LOCK = OFF Alarm only	OFF	
MIX TRIM	All	-5 to 5	This adjustment is for various types and sizes of units as well as various actuator motor speeds and types supplied by Raypak	0	
MIX SPEED	All	FAST <> MED <> SLOW	This setting defines speed of response.	MED	
MIX INV	All	ON <> OFF	This option is related to the use of spring return actuators with a proportional valve	OFF	
WWSD	MODE 1, 2, 3	40°F to 100°F (4°C to 38°C)	The system warm weather shutdown temperature outdoor reset, requires TARGET = RSET	70°F (21°C)	
UNITS	All	deg F <> deg C	Show units using icons in display	deg F	
MODBUS	All	OFF <> MNTR <> TEMP <> RATE	ModBus Operating Mode: Off, Monitor, Temp Control, Rate Control	MNTR	
ADDRESS	All	1 to 247	ModBus slave address	1	
DATA TYPE	All	RTU <> ASCII	Modbus data type	RTU	
BAUD RATE	All	2400<>9600<>19K2<>57K6<>115K		19K2	
PARITY	All	NONE <> EVEN <> ODD		EVEN	

* Fixed values based on the ID card.

Table P. Adjust Menu

Boiler View Menu

The Boiler View displays various items regarding ignition, temperature monitoring, and modulation rates. As well as software and hardware information.

Item	Application	Description	User
BOILER 1	ALL	Enables Boiler for operation	
BOILER 2	CASCADE	Enables Boiler for cascade operation	
BOILER 3	CASCADE	Enables Boiler for cascade operation	
BOILER 4	CASCADE	Enables Boiler for cascade operation	
IGNITION	ALL	<p>IDLE=no CFH PREP=pre-purge or inter-purge between trials for ignition IGN=trial for ignition BURN=burner operating POST=post purge HARD=a hard lockout fault has occurred requiring manual reset (Ignition Lockout or manual high limit) and SOFT=a soft lockout fault has occurred which interrupts the heating cycle (any safety other than ignition or manual high limit).</p> <p>The CFH will resume after the soft lockout fault has been corrected and a 15 min. waiting period has expired.</p>	
CASCADE	TN-BUS CASCADE FOLLOWER	Set Cascade ID for TN-bus follower, see VERSA IC Manual (241493)	
LIMIT TEMP	ALL	Current Outlet -Limit temperature	
EMS Vdc	ALL	Current EMS signal in Volts DC	
FIRE RATE	ALL	PIM	
SPEEDX 1000	ALL	Blower speed in revolutions per minute (rpm) x 1000	
OUTLET MAX	Mode 1, 2, 3	Defines Max Outlet temperature offset above Target Setpoint (Press and hold up and down arrows for 3 seconds to enable adjustment), see VERSA IC [®] Manual (241493).	
OPERATOR	ALL	Operator Potentiometer setting on PIM	
DIFF	ALL	Current auto differential – Fixed by PIM	
Pump Post	ALL	Sets the length of the boiler pump purge	
FLAME CUR	ALL	Flame current in micro-amps (µA)	
MASS	ALL	Thermal mass recovery, see VERSA IC [®] Manual (241493)	
IDENTITY	ALL	Identifies the unit as boiler, water heater or pool heater	
IGN TYPE	ALL	PIM Board type	
ID CARD	ALL	Identifies Raypak Identity Card	
ERROR CODE	ALL	Current Error Code	

Table Q. Boiler View Menu

Monitor Menu

The Monitor Menu records and displays critical Boiler information, such as, Cycle times, Run times, and Maximum/Minimum temperature readings depending on the setup.

Item	Application	Description
RUN TIME Burner 1	All	Burner run time (hours). Press UP/DOWN for 1 sec to clear.
Cycles Burner	All	Number of burner cycles. Press UP/DOWN for 1 sec to clear.
RUN TIME Boiler pump	All	Boiler pump run time (hours). Press UP/DOWN for 1 sec to clear.
RUN TIME System pump	All	System pump run time (hours). Press UP/DOWN for 1 sec to clear.
RUN TIME DHW pump	MODE 2, 3	DHW pump run time (hours). Press UP/DOWN for 1 sec to clear.
OUTLET HI	All	Records the highest boiler outlet temperature. Press UP/DOWN for 1 sec to clear.
OUTLET LO	All	Records the lowest boiler outlet temperature. Press UP/DOWN for 1 sec to clear.
INLET HI	All	Records the highest boiler inlet temperature. Press UP/DOWN for 1 sec to clear.
INLET LO	All	Records the lowest boiler outlet temperature. Press UP/DOWN for 1 sec to clear.
DELTA T	All	Captures the highest Delta T Temperature recorded Press UP & DOWN buttons for 3 sec to clear this entry
OUTDOOR HI	MODE 1, 2, 3	Records the highest outdoor temperature. Press UP/DOWN for 1 sec to clear.
OUTDOOR LO	MODE 1, 2, 3	Records the lowest outdoor temperature. Press UP/DOWN for 1 sec to clear.
SYSTEM HI	All	Records the highest supply temperature. Press UP/DOWN for 1 sec to clear.
SYSTEM LO	All	Records the lowest supply temperature. Press UP/DOWN for 1 sec to clear.
IND HI	MODE 1, 2, 3	Records the highest Indirect supply temperature. Press UP/DOWN for 1 sec to clear.
IND LO	MODE 1, 2, 3	Records the lowest Indirect supply temperature. Press UP/DOWN for 1 sec to clear.

Table R. Monitor Menu

Toolbox Menu

The Toolbox Menu logs all error codes from the VERSA and PIM, as well as other functions. Up to 15 error codes can be logged for a maximum of 24 days.

Item	Description
Lookup Active Error	Look up and display the active error info.
USER TEST	Select ON to start the function. The setting returns to default after the test is run. See "User Test" on page 50 for details.
MAX HEAT	Select ON to start the function. The setting will time out to OFF after 24 hours or can be set to OFF again by the user. See see VERSA IC [®] manual (241493).
P/N 104901	Software number of the Raypak VERSA
DEFAULTS	Resets to factory settings. Press UP and DOWN for 1 second to show CLR and load factory defaults to all settings. This will also clear all history.
HISTORY lookup logged error	Displayed when an error code is present. 1 indicates the most recent error code. Press UP and DOWN for 1 second to clear the error logs.

Table S. Toolbox Menu

Outdoor Reset Concept

The Temperature controller can change the System Set Point based on outdoor temperature (Outdoor Reset). The temperature controller varies the temperature of the circulating heating water in response to changes in the outdoor temperature. The heating water temperature is controlled through the modulation and/or sequencing of the cascade.

The Temperature controller can also control the system circulating pump with an adjustable Outdoor Cutoff. When the outdoor temperature is above the Outdoor Cutoff, the pump is turned off and no heating water is circulated through the system. When the outdoor temperature drops below the Outdoor Cutoff, the system pump relay is activated and the heating water circulates through the system. The temperature of the heating water is controlled by the Reset Ratio, Water Offset, and changes with the outdoor temperature.

Reset Ratio/Outdoor Reset

When a building is being heated, heat escapes through the walls, doors, and windows to the colder outside air. The colder the outside temperature, the more heat escapes. If you can input heat into the building at the same rate that it is lost out of the building, then the building temperatures will remain constant. The Reset Ratio is an adjustment that lets you achieve this equilibrium between heat input and heat loss.

The starting point for most systems is the 1.00 (OD):1.00 (SYS) (Outdoor Temperature: Heating Water Temperature) ratio. This means that for every degree the outdoor temperature drops, the temperature of the heating water will increase one degree. With the VERSA, both ends of the slope are adjustable. It is factory-set at 70°F (21°C) water temperature (Boil START) at 70°F (21°C) outdoor air (OUT START), and 180°F (82°C) water temperature (Boil DESIGN) at 10°F (-12°C) outdoor air (OUT DESIGN).

Each building has different heat loss characteristics. A very well insulated building will not lose much heat to the outside air, and may need a Reset Ratio of 2.00 (OD):1.00 (SYS) (Outdoor: Water). This means the outdoor temperature would have to drop 2 degrees to increase the water temperature 1 degree. On the other hand, a poorly insulated building may need a Reset Ratio of 1.00 (OD):2.00 (SYS). This means that for each degree the outdoor temperature dropped the water temperature will increase 2 degrees. The VERSA control Reset Ratio allows for full customization to match any building's heat loss characteristics.

A heating curve that relies not only on Outdoor temperature but also on the type of radiation will improve heat comfort. The user can fine-tune these adjustments based on the specific building need.

Reset Ratio Settings

The controller uses the four following settings to determine the reset ratio:

1. Boiler Start (**Boil START**). The Boil START temperature is the theoretical boiler supply water temperature that the heating system requires when the outdoor air temperature equals the OUT START temperature setting. The Boil START is typically set to the desired building temperature.
2. Outdoor Start (**OUT START**). The OUT START temperature is the outdoor temperature at which the control provides the Boil START water temperature to the system. The OUT START is typically set to the desired building temperature.
3. Outdoor Design (**OUT DESIGN**). The OUT DESIGN is the outdoor temperature that is typical coldest annual temperature where the building is located. This temperature is used when completing heat loss calculation for the building.
4. Boiler Design (**Boil DESIGN**). The Boil DESIGN temperature is the water temperature required to heat the boiler zones when the outdoor air is as cold as the OUT DESIGN temperature.

Warm Weather Shut Down (WWSD)

When the outdoor air temperature rises above the WWSD setting, the control turns on the WWSD segment in the display. When the control is in the Warm Weather Shut Down, the Dem 1 segment is displayed if there is a heat demand. However, the control does not operate the boiler to satisfy this demand. The control continues to respond to DHW demands.

Reset Ratio

The controller uses the following four settings to calculate the Reset Ratio (RR). For example, when using the default values, the RR is:

$$\text{RESET RATIO} = \frac{(\text{OUTDOOR START} - \text{OUTDOOR DESIGN})}{(\text{BOILER DESIGN} - \text{BOILER START})}$$

$$\text{RR} = (70 - 10) / (180 - 70) = 0.55$$

Therefore, the RR is 0.55:1 (Outdoor : Water).

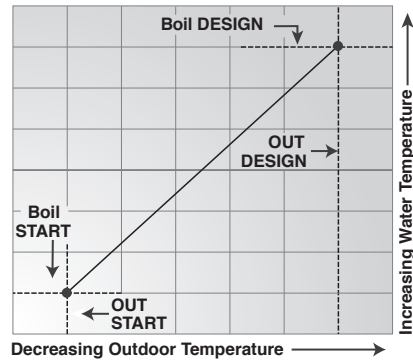


Figure 44. Reset Ratio

NOTE: The wiring diagrams in this manual show all standard options. Refer to the large wiring diagram provided with your boiler for options installed on your specific unit(s).

Converting Natural To Propane Gas

These instructions are intended for boilers manufactured for Natural Gas. The instructions must be followed by a trained qualified technician or manufacturing representative.

All Models

1. Turn power OFF to the boiler.
2. Remove screws holding top panel in place (located above boiler).
3. Turn Supply Gas OFF and/or turn the Manual Valve to the OFF position. See Figure 46.

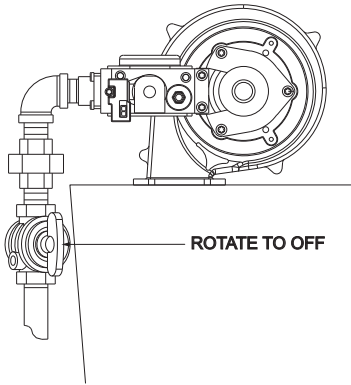


Figure 46. Shut-Off Valve & Venturi Location 88AR thru 108AR

4. Disconnect Gas Valve power harness.
5. Loosen union above Manual Valve.

For Models 88AR & 108AR, additional steps (orifice supplied)

1. Remove the two Allen screws holding the Gas Valve to the Venturi/Blower assembly. See Figure 47.

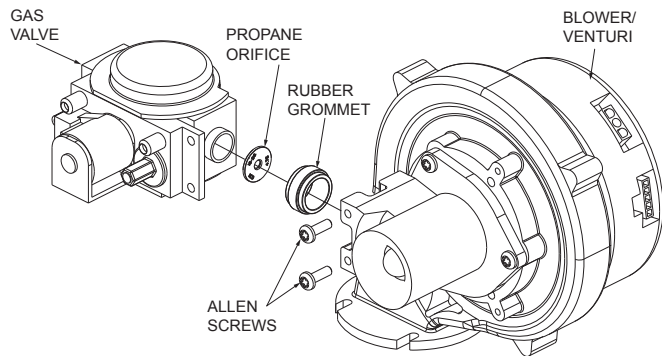


Figure 47. Gas Train Assembly 88AR thru 108AR

2. Remove the Gas Valve assembly. This will reveal the rubber grommet between the Gas Valve and Venturi assembly.
3. Remove the rubber grommet.
4. Insert the Propane orifice inside this grommet. There is a thin slot allocated for the orifice to slip into. See Figure 48.

5. Re-install grommet in between Venturi and Valve assembly.
6. Re-install Allen screws to secure Gas Valve assembly.
7. Tighten union to secure supply line to Gas valve.
8. Turn manual valve back on.
9. See "Gas Valve Adjustment" before running boiler.

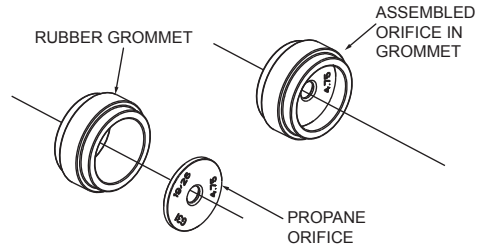


Figure 48. Rubber Seal & Propane Orifice

NOTE: For Propane to Natural Gas conversion, No orifice is needed for Natural Gas (Models 88AR & 108AR ONLY).

For Models 198AR thru 398A, additional steps:

1. Loosen the Venturi Union from the Manifold Nipple. See Figure 49.

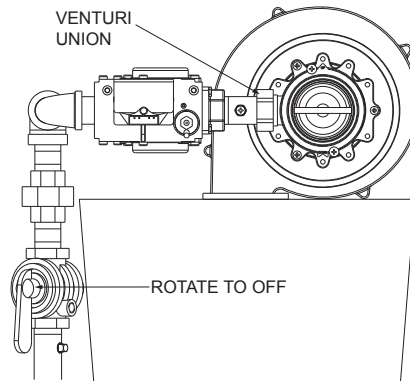


Figure 49. Shut-off Valve & Venturi Location 198AR thru 398A

2. Remove the Gas Valve assembly and set aside.
3. Remove the (3) screws holding the Natural Gas Venturi to the Blower. See Figure 50.

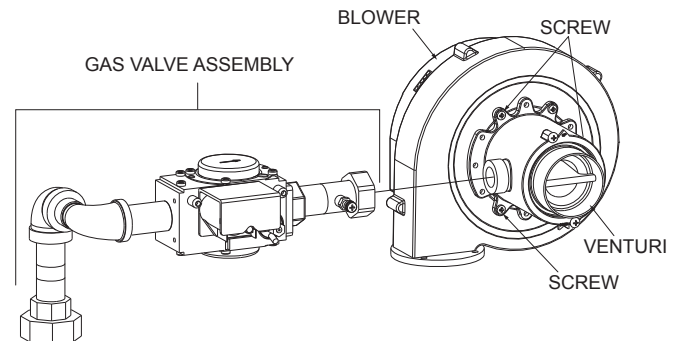


Figure 50. Gas Train Assembly 198AR thru 398A

4. Replace the Natural Gas Venturi with the Propane Venturi. See Figure 51.

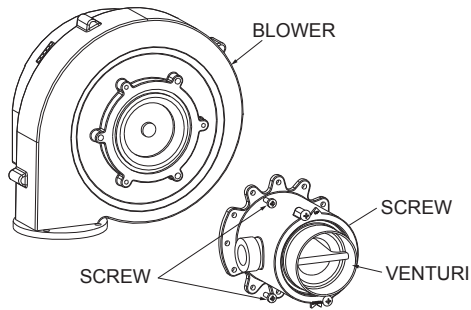


Figure 51. Propane Venturi

5. Re-install (3) screws to secure the Propane Venturi to Blower.
6. Re-install Gas Valve assembly to Venturi by securing the union between them.
7. Tighten union to secure supply line to gas valve.
8. Turn manual valve back on.
9. See “Gas Valve Adjustment” before running boiler.

NOTE: The same procedure is required when converting Propane to Natural Gas on Models 198AR thru 398A.

Gas Valve Adjustment

A Gas Valve adjustment is required to attain optimal performance from the boiler when replacing one or converting gas. These instructions must be followed by a trained qualified technician or manufacturing representative.

CAUTION: Adjust the proper throttle on Hi Fire and/or Offset on LO Fire. Adjustment of the LO fire offset while the heater is running on Hi Fire may cause the valve to work improperly and vice-versa.

Valve adjustment throttle locations are indicated on Figure 52.

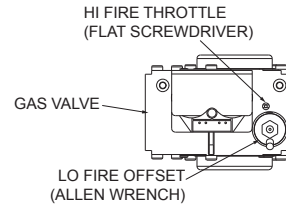


Figure 52. Setting Hi Fire Throttle / LO Fire Offset

Setting Hi Fire Throttle:

1. Turn the needle down (clockwise) until the needle bottoms out.
2. Follow Table T below for the number of 360° counter-clockwise turns needed for each model and Gas Type.
3. Once adjustment is made, turn heater on.
4. Adjust 0-10 VDC SIGNAL to 10 VDC.
5. Wait until “FIRE RATE” reaches 100%.

Adjust Hi Fire Throttle to get within the combustion range required. See Figure 52.

Setting LO Fire Offset (while heater is running on LO Fire):

1. Adjust 0-10 VDC signal to 1 VDC.
2. Wait until Blower RPM reaches 1300 RPM.
3. Using an Allen wrench turn the Offset slightly clockwise to increase CO₂ values. See Figure 52.
4. Adjust 0-10 VDC signal back to 10 VDC.
5. Verify combustion is still within range given in Table T. Adjust if necessary.

GAS VALVE & COMBUSTION SETTINGS - NATURAL GAS											
Model	HI Fire					LO Fire					
	Turns	Manifold	CO ₂ (%)			CO (ppm)	CO ₂ (%)			CO (ppm)	
			MIN	NOMINAL	MAX	MAX	MIN	NOMINAL	MAX		
88AR	3-1/2	-0.1 ± 0.05"WC	8.8	9.4	10.5	200	8.5	9.1	10.8	Less than 100	
108AR	3-1/2										
198AR	4-1/2	-2.0 ± 0.1"WC									
278AR	5-3/4	-2.1 ± 0.1"WC									
398A	5	-3.4 ± 0.2"WC									
GAS VALVE & COMBUSTION SETTINGS - PROPANE GAS (GRADE HD-5)											
Model	HI Fire					LO Fire					
	Turns	Manifold	CO ₂ (%)			CO (ppm)	CO ₂ (%)			CO (ppm)	
			MIN	NOMINAL	MAX	MAX	MIN	NOMINAL	MAX		
88AR	3-1/2	-0.1 ± 0.05"WC	10.2	10.5	10.8	200	9.9	10.2	10.5	Less than 100	
108AR	3-1/2										
198AR	4										-1.4 ± 0.1"WC
278AR	4-1/4										-2.0 ± 0.1"WC
398A	4										-3.0 ± 0.2"WC

Table T. Gas Valve Settings

6. START-UP

⚠ WARNING: If you do not follow these instructions exactly, a fire or explosion may result causing property damage, personal injury or loss of life.

Pre Start-up

Filling System (Heating Boilers)

Fill system with water. Purge all air from the system. Lower system pressure. Open valves for normal system operation, and fill system through feed pressure. Manually open air vent on the compression tank until water appears, then close vent.

Venting System Inspection

1. Check all vent pipe connections and flue pipe material.
2. Make sure vent terminations are installed per code and are clear of all debris or blockage.

For Your Safety

This appliance has a direct spark igniter. It is equipped with an ignition device which automatically lights the burners. Do not try to light the burners by hand.

BEFORE OPERATING, smell all around the appliance area for gas. Be sure to smell near the floor because some gas is heavier than air and will settle on the floor.

WHAT TO DO IF YOU SMELL GAS:

- Do not try to light any appliance.
- Do not touch any electrical switch; do not use any telephone in your building.
- Immediately call your gas supplier from a neighbor's telephone. Follow the gas supplier's instructions.
- If you cannot reach your gas supplier, call the fire department.
- Use only your hand to close the gas supply shutoff valve inside the boiler. Never use tools. If the knob will not turn by hand, do not try to repair it, call a qualified service technician. Forced or attempted repair may result in a fire or explosion.
- Do not use this appliance if any part has been under water. Immediately call a qualified service technician to inspect the appliance and to replace any part of the control system and any gas control which has been under water.
- Check around unit for debris and remove combustible products, i.e. gasoline, etc.

Pre Start-up Check

1. Verify the boiler is filled with water.
2. Check system piping for leaks. If found, repair immediately.
3. Vent air from system. Air in system can interfere with water circulation.
4. Purge air from gas line to boiler.

Initial Start-up

Required tools

- (1) 12-0-12 (24" scale) U-tube manometer
- (2) 6-0-6 (12" scale) U-tube manometer
- Screwdrivers (assorted sizes and shapes)
- (1) Crescent wrench (8" or 10")
- (1) Multi-meter

(Metric Allen wrenches will be required for servicing the gas valve, but not during start-up.)

NOTE: Digital manometers are not recommended.

Preparation

⚠ WARNING: Do not turn on gas at this time.

Check Power Supply

With multi-meter at incoming power, check voltage between:

- Hot - Common (≈ 120 VAC)
- Hot - Ground (≈ 120 VAC)
- Common - Ground (< 1 VAC)

⚠ WARNING: If Common - Ground is > 1 VAC, STOP: Contact electrician to correct ground failure. Failure to do this may burn out 120V-24V transformer, or may cause other safety control damage or failure.

NOTE: While attaching manometers, any cap or bleedle valves removed should be retained for re-installation later.

Attach Manometers to Measure Pressures

1. Turn off main gas shutoff valve.
2. Attach a 24" scale manometer to the supply pressure test port on the gas valve to the heater. See Figure 53.
3. Attach a 12" scale manometer to the offset pressure testport for Models 88AR-108AR. For Models 198AR-398A attach manometer to manifold pressure tap. See Figure 53.

Check Gas Supply Pressure

1. Slowly turn on main gas shut-off valve.
2. Read the gas supply pressure from the manometer; minimum supply pressure for natural gas is 4.5 in. WC, recommended supply is 7.0 in. WC, minimum supply pressure for propane gas is 8.0 in. WC, recommended supply is 11.0 in. WC (dynamic readings, full fire input).
3. If the gas pressure is greater than 14.0 in. WC, turn off the main gas shut-off valve.

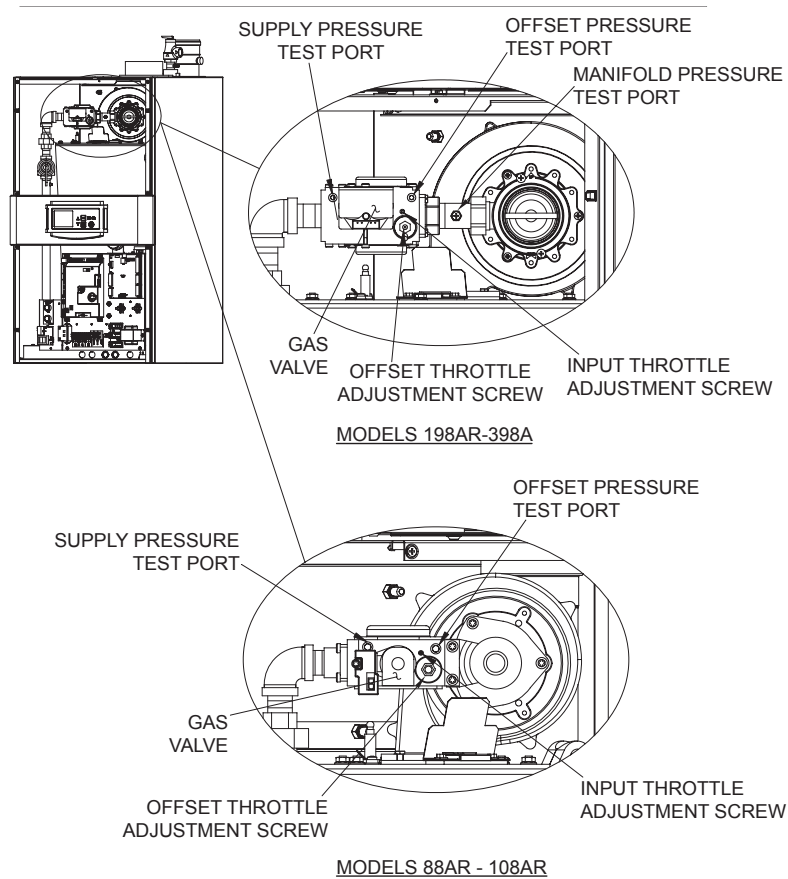


Figure 53. Gas Pressure Measurement Locations

Start-Up

1. Turn power on.
2. Turn on the boiler, approximately 45 seconds after the blower starts, the igniter should start to spark.
3. The boiler ignites at 3000 RPM (as indicated on the LCD display of the user interface).
4. This boiler is equipped with a three-try ignition module, it will try for ignition up to three times before going into lockout.
5. Wait until the controller indicates a percentage on the firing rate display screen. This may take several minutes.

Manifold Check

1. Check manifold gas pressure at the manifold pressure tap. This pressure should read per the values in Table T.
2. Valves should be within the specified ranges given on Table T.

User Test

NOTE: If USER TEST will be performed with Cold Water Protection enabled (VERSA DIP 3 = ON) you must allow valve or VS pump test sequence to complete uninterrupted or a fault condition may occur.

- Set DIP #1 on the VERSA IC[®] control to “ON”. Set USER TEST = ON in the ‘ToolBox’ Menu to start the user test function.
- USER TEST is displayed in the Title Field.
- UP keystrokes are used to advance through the user test.
- The Boil MIN/MAX steps for burner operation are only run for enabled boilers.
- Local Heat/DHW/EMS demands must be present for burner operation.
- On the first press of the Up button, the test step is held and “HOLD” is flashed at 1Hz.
- On the second press of the Up button, the test step is incremented.
- If boiler outlet temperature reaches the PIM Hi-Limit, the boiler will be ramped down to keep the temperature in a safe range.

- Press of the Up button from Boiler Max will End the User Test function.
- When CWP is enabled (VERSA dip #3) VALV will become available during USER TEST.

Number Field	Output Action
SYS	System Pump relay turns on.
DHW	DHW Pump relay turns on.
PMP 1	System and Boiler Pump relays turn on.
CWP	CWP Proportional Output
Boil 1	Ignite Boiler Burner.
Min 1	Hold Boiler at Min Fire.
Max 1	Ramp Boiler to Max Fire and hold.

Table U. User Test Fields

Safety Inspection

1. Check all thermostats and high limit settings.
2. During the following safety checks leave manometers hooked up, check and record.
3. If other gas-fired appliances in the room are on the same gas main, check all pressures on the XPak FT with all other equipment running.
4. Check thermostats for ON-OFF operation.
5. Check high limits for ON-OFF operation.
6. While in operation, check flow switch operation (if equipped).
7. Check the low gas pressure switch (if provided). (For proper adjustment, use the attached manometers, if available, to set pressure. The scales on the switch are approximate only.) Low gas pressure switch (if provided) must be set at 3.0 in. WC for natural gas and propane gas.
8. Make sure that the high gas pressure switch (optional) is set to 3.0 in. WC for both natural gas and propane gas.

Finishing

1. Record all data on the "Start-up Checklist" located at the back of this manual.
2. Disconnect the manometers and reconnect the cap on the air intake and reinsert or close the sealing screws into the bleedle valves.
3. Start-up is complete and the boiler should be operating properly.

Follow-Up

Safety checks must be recorded as performed. Turn boiler on. After main burner ignition:

1. Cycle unit several times and re-check readings.
2. Remove all manometers and replace caps and screws.
3. Check for gas leaks.

Post Start-Up Check

1. Verify that the boiler and heat distribution units or storage tank are filled with water.
2. Confirm that the manual air vent was opened during the venting procedure.
3. Verify that air has been purged from the system.
4. Verify that air has been purged from the gas piping, and that the piping has been checked for leaks.
5. Confirm that the proper start-up procedures were followed.
6. Inspect burner to verify flame.
7. Test safety controls: If boiler is equipped with a low water cut-off or additional safety controls, test for operation as outlined by manufacturer. Burner should be operating and should go off when controls are tested. When safety devices are restored, burners should re-ignite after pre-purge time delay.
8. Check to see that the high limit control is set above the design temperature requirements of the system. For multiple zones: Check to make sure the flow is adjusted as required in each zone.
9. Check that the boiler is cycled with the thermostat. Raise the setting on the thermostat to the highest setting and verify that the boiler goes through the normal start-up cycle. Reduce to the lowest setting and verify that the boiler goes off.
10. Observe several operating cycles for proper operation.
11. Set the boiler thermostat to desired temperature.
12. Review all instructions shipped with this boiler with owner or maintenance person, return to envelope and give to owner or place the instructions inside front panel on boiler.

Lighting Instructions

OPERATING INSTRUCTIONS AND SHUT-OFF PROCEDURES ELECTRONIC IGNITION DIGITAL MODELS (AUTOMATICALLY-LIGHTED PILOT)

FOR YOUR SAFETY READ BEFORE LIGHTING

- A. This appliance is equipped with an ignition device which automatically lights the pilot. Do not try to light the pilot by hand.
- B. BEFORE OPERATING, smell all around the appliance area for gas. Be sure to smell near the floor because some gas is heavier than air and will settle on the floor.

WHAT TO DO IF YOU SMELL GAS:

- *Do not try to light any appliance.
- *Do not touch any electric switch; do not use any phone in your building.
- *Immediately call your gas supplier from a neighbor's phone. Follow the gas supplier's instructions.

*If you cannot reach your gas supplier, call the fire department.

- C. Use only your hand to push in or turn the gas control knob. Never use tools. If the knob will not push in or turn by hand, do not try to repair it. Call a qualified service technician. Force or attempted repair may result in a fire or explosion.
- D. Do not use this appliance if any part has been under water. Immediately call a qualified service technician to inspect the appliance and to replace any part of the control system and any gas control which has been under water.

LIGHTING INSTRUCTIONS

1. **STOP!** Read the safety information above.
2. Turn off all electrical power to the appliance.
3. This appliance is equipped with an ignition device which automatically lights the pilot. Do not try to light the pilot by hand.
4. Turn gas control knob clockwise ↻ to "OFF".
5. Wait 5-minutes to clear out any gas. If you then smell gas, **STOP!** Follow "B" in the safety information above. If you don't smell gas, go to the next step.
6. Turn gas control knob counter-clockwise ↺ to "ON."
7. Turn on all electrical power to the appliance.

8. If the appliance will not operate, follow the instructions "To Turn Off Gas To Appliance" and call your service technician or gas supplier.

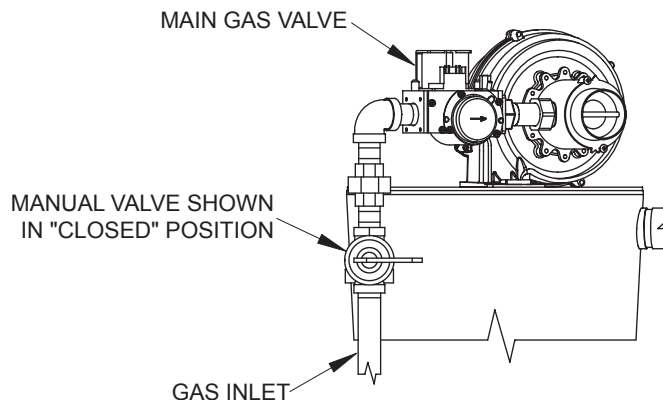


Figure 54. Lighting Instructions

TO TURN OFF GAS TO APPLIANCE

1. Turn off all the electrical power to the appliance if service is to be performed.
2. Turn gas control knob clockwise ↻ to "OFF".

7. TROUBLESHOOTING

⚠ DANGER: When servicing or replacing components that are in direct contact with the water, be certain that:

- There is no pressure in the boiler. (Pull the release on the relief valve. Do not depend on the pressure gauge reading).
- The boiler water is not hot.
- The electrical power is off.

⚠ WARNING: When servicing or replacing any components of this unit be certain that:

- The gas is off.
- All electrical power is disconnected.

⚠ WARNING: Do not use this appliance if any part has been under water. Improper or dangerous operation may result. Contact a qualified service technician to inspect the boiler and to repair or replace any part of the boiler that has been under water prior to placing the boiler back in operation.

⚠ CAUTION: Wiring errors can cause improper and dangerous operation. Verify proper operation after servicing. See wiring diagram.

⚠ CAUTION: If overheating occurs or the gas supply fails to shut off, do not turn off electrical power to the circulating pump. This may aggravate the problem and increase the likelihood of boiler damage. Instead, shut off the gas supply to the boiler at the gas service valve.

XPak FT Error Codes

If any of the sensors detect an abnormal condition or an internal component fails during the operation of the XPak FT, the display may show an error code. This code may either be the result of a temporary condition in which case the display will revert to its normal readout when the condition is corrected, or it may be the result of a condition that the controller has evaluated as not safe to restart the unit. In this case, the unit control will be locked out, requiring the maintenance person to manually reset the control by pressing and releasing the RESET key.

Heater Errors

When an error condition occurs, the controller will display an error code on the display module. These error codes and several suggested corrective actions are included in the XPak FT Fault Text section on the following page.

Heater Faults

When a fault condition occurs, the controller will flash a red light on the PIM and display the error code on the user interface. The alarm output will also be activated. Most fault conditions will also cause the boiler pump to run in an attempt to cool the unit.

Note the error code, either through the flash code on the PIM and/or from the Toolbox menu on the user interface, and reference the explanation of the fault along with troubleshooting steps in the XPak FT fault text section.

Press and release the RESET key to clear the fault on the user interface and resume operation. Be sure to observe the operation of the unit for a period of time to ensure correct operation and no re occurrence of fault code(s).

Sensor Resistance Values

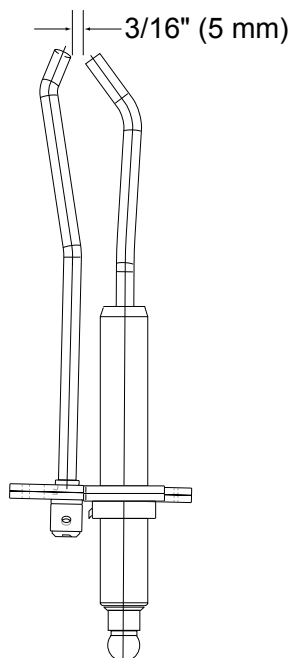
Water Sensor / Outdoor Air Sensor	
Water Temperature °F (°C)	Resistance (ohms)
32 (0)	32550
41 (5)	25340
50 (10)	19870
59 (15)	15700
68 (20)	12490
77 (25)	10000
86 (30)	8059
95 (35)	6535
104 (40)	5330
113 (45)	4372
122 (50)	3605
131 (55)	2989
140 (60)	2490
149 (65)	2084
158 (70)	1753
167 (75)	1481
176 (80)	1256
185 (85)	1070
194 (90)	915
203 (95)	786
212 (100)	667

Table V. Sensor Resistance Values

XPak FT Fault Text

Error Display

If there is an active error, then it is displayed as the first item in the Toolbox Menu and it is the default display for the control until the error is resolved.



NOTE: If receiving a NO FLAME, check the gap spacing between points on the electrode by holding two quarters together and sliding them through the gap. There should be no resistance.

Figure 55. Direct Spark Igniter

Error Item	Description and Troubleshooting
OUTLET SEN	Check the outlet water sensor and its wiring.
LIMIT SEN	Check the high limit sensor and its wiring.
INLET SEN	Check the inlet sensor and its wiring.
GAS PRESS	Check PIM wiring.
IGNITION	Reset control, push and release RESET button
LIMIT TRIP	Boiler temperature tripped the high limit.
FLAME	False flame detected. Shut off gas supply, recycle power.
ID CARD	Identity card, check ID card and wiring.
IGN CTRL	Internal control fault. Reset power, replace control.
DELTA T	Temperature difference between the inlet and outlet exceeded the setpoint. Check water flow.
LOW 24VAC	Low 24 VAC power. Check power supply wiring and transformer.
BLOW SPEED	Blower speed out of range. Check blower wiring and blower.

Table W. Error Display

LED Error Code Listing

Active errors detected are indicated by LED lights on the PIM.

LED Code	Error Mode	Recommended Troubleshooting
Off	Normal Operation	
Red LED steady ON, Green Power LED OFF	ID Card Fault	Check that the proper ID card is securely connected. Perform a power and system restart.
Steady ON	Internal Control Failure	Perform a power and system reset. If fault remains, replace PIM.
1 flash		
2 flashes	False Flame Error	Check for proper gas valve closure. Clean burner and electrodes.
3 flashes	Ignition Lockout Fault	Check the gas supply. See table for more information.
4 flashes		
5 flashes	Low Voltage Fault	Check the 24 VAC input voltage. The voltage must be above 18.0 VAC.
6 flashes		
7 flashes	Hi-Limit Fault	Check for proper water flow. Check hi-limit and outlet sensor.
8 flashes	Sensor Fault	See VERSA for fault identification. Check sensor wiring.
9 flashes		
10 flashes		
11 flashes	Blower Speed Fault	Verify tachometer signal and connection on J5.
12 flashes		
13 flashes	Hi-Temperature Delta Fault	Check pump operation. Confirm proper water flow across heat exchanger.
14 flashes	Ft-Bus Communications Fault	Verify VERSA is connected and operating. Check the cable between the VERSA and PIM.
15 flashes	Safety Circuit Open	Confirm all safeties are functioning normally. Check continuity at the PIM at J8 plug, pins 5 and 6.

Table X. PIM LED Error Codes

8. MAINTENANCE

Suggested Minimum Maintenance Schedule

Regular service by a qualified service agency and maintenance must be performed to ensure maximum operating efficiency.

Maintenance as outlined below may be performed by the owner.

Daily

1. Check that the area where the boiler is installed is free from combustible materials, gasoline, and other flammable vapors and liquids.
2. Check for and remove any obstruction to the flow of combustion or ventilation air to boiler.

Monthly

1. Check for piping leaks around pumps, mixing valves, relief valves, and other fittings. If found, repair at once. DO NOT use petroleum-based stop-leak compounds.
2. Visually inspect burner flame.
3. Visually inspect venting system for proper function, deterioration or leakage.
4. Visually inspect for proper operation of the condensate drains in the venting, and the internal condensate trap. Clean trap as necessary. If leaks are observed, repair at once.
5. Check air vents for leakage.

Yearly (Beginning Of Each Heating Season)

Schedule annual service call by qualified service agency.

1. Visually check top of vent for soot. Call service person to clean. Some sediment at bottom of vent is normal.
2. Visually inspect venting system for proper function, deterioration or leakage. Ensure that condensate drain is inspected and ensure that condensate is being directed to appropriate condensate management system or drain, as required by local codes.
3. Check that area is free from combustible materials, gasoline, and other flammable vapors and liquids.
4. Check for and remove any obstruction to the flow of combustion or ventilation air to boiler.
5. Follow pre-start-up check in the Start-up section.
6. Visually inspect burner flame. It should be light blue at full input. Remove and visually inspect direct spark igniter and sensor for damage, cracking or debris build-up.

7. Check operation of safety devices. Refer to manufacturers' instructions.
8. Follow oil-lubricating instructions on pump (if required). Over-oiling will damage pump. Water-lubricated circulators do not need oiling.
9. To avoid potential of severe burn, DO NOT REST HANDS ON OR GRASP PIPES. Use a light touch; return piping will heat up quickly.
10. Check blower and blower motor.
11. Check for piping leaks around pumps, relief valves and other fittings. Repair, if found. DO NOT use petroleum-based stop-leak.

Periodically

1. Check relief valve. Refer to manufacturer's instructions on valve.
2. Test low water cut-off (if equipped). Refer to manufacturer's instructions.

Preventive Maintenance Schedule

The following procedures are recommended and are good practice for all XPak FT installations.

Daily

1. Check gauges, monitors and indicators.
2. Check instrument and equipment settings. See "Post Start-Up Check" on page 51.
3. Check burner flame. You should see light blue flame at full input rate.

Monthly

1. Check flue, vent, stack, or dampers.
2. Test high and low gas pressure interlocks (if equipped). See "Safety Inspection" on page 51.

Semi-Annually

1. Recalibrate all indicating and recording gauges.
2. Check flame failure detection system components.
3. Check firing rate control by checking the manifold pressure. See "Manifold Check" on page 50.
4. Check piping and wiring of all interlocks and shut-off valves.

Annually

1. Test flame failure detection system.
2. Test high limit and operating temperature. See "Post Start-Up Check" on page 51.
3. Check flame sensor.
4. Gas valve combustion readings see Table T.

5. Check valve coil for 60-cycle hum or buzz. Check for leaks at all valve fittings using a soapy water solution (while unit is operating). Test other operating parts of all safety shut-off and control valves and increase or decrease settings (depending on the type of control) until the safety circuit opens. Reset to original setting after each device is tested.
6. Perform leakage test on gas valves, if required by local codes.
7. Inspect and clean burner using shop air.
8. Clean the combustion chamber coil, using the procedure on the following page.

As Required

1. Recondition or replace low water cut-off device (if equipped).
2. Check drip leg and gas strainers.
3. Check flame failure detection system. See “Post Start-Up Check” on page 51. Verify high and low fire flame signal, compare to start-up data.
4. Check igniter. Clean and verify spark gap. See Figure 55 on page 54.
5. Check fan speed and manifold pressure. See “Blower Check” and “Manifold Check”.)
6. Test safety/safety relief valves in accordance with ASME Heater and Pressure Vessel Code Section IV.

Combustion Chamber Cleaning Instructions

⚠ WARNING: The combustion chamber insulation in this product contains ceramic fiber material. Ceramic fibers can be converted to cristobalite in very high temperature applications. The International Agency for Research on Cancer (IARC) has concluded that “Crystalline silica inhaled in the form of quartz or cristobalite from occupational sources is carcinogenic to humans (Group 1).

- **Avoid breathing dust and contact with skin and eyes.**
- **Use NIOSH certified dust respirator (N95). This type of respirator is based on the OSHA requirements for cristobalite at the time this document was written. Other types of respirators may be needed depending on the job site conditions. Current NIOSH recommendations can be found on the NIOSH website at <http://www.cdc.gov/niosh/homepage.html>.**
- **NIOSH approved respirators, manufacturers, and phone numbers are also listed on this website.**
- **Wear long-sleeved, loose fitting clothing, gloves, and eye protection.**
- **Apply enough water to the combustion chamber lining to prevent dust.**
- **Wash potentially contaminated clothes separately from other clothing. Rinse clothes washer thoroughly.**

NIOSH stated First Aid:

- **Eye: Irrigate immediately**
- **Breathing: Fresh air.**

Before beginning this procedure, you must have on hand the following items:

- a nylon, stainless steel or brass brush (not steel)
- “Rydlyme” (recommended for best results) or “CLR”
- Gloves, eye protection

1. Shut down the XPak FT boiler by using the following steps:
 - a. Close the gas valve, shut down the unit and wait for the unit to be cool to the touch.
 - b. Disconnect the condensate piping from the outside connection, (not from the XPak FT boiler side), so the flow from condensate reservoir can be observed.
 - c. Disconnect electrical connections from the gas valve, spark electrode and flame rectification probe and combustion blower.
 - d. Disconnect the gas line by loosening union above the shut-off valve.
 - e. Disconnect the wiring connected to the combustion blower motor.
 - f. Remove the 10mm nuts from the burner plate assembly.
 - g. Remove the valve/blower/burner assembly with refractory from the heat exchanger.
2. Using a spray bottle filled with the recommended product "RYDLYME" or "CLR", spray liberally on the heat exchanger, making sure the solution penetrates and funnels down through the condensate system. If the condensate system is blocked, let the chemical penetrate for at least 15-minutes or until it drains.
3. Use the nylon, stainless steel or brass brush (do not use steel) to scrub heat exchanger to remove any buildup, then vacuum the debris from the heat exchanger.
4. Spray the heat exchanger with clear water, making sure to confine the spray to the area being cleaned. Flush the combustion chamber with fresh water until clear water runs from the condensate drain. At this point, the XPak FT should be ready to be re-assembled.
 - a. Inspect gaskets.
 - b. Re-install the burner assembly.

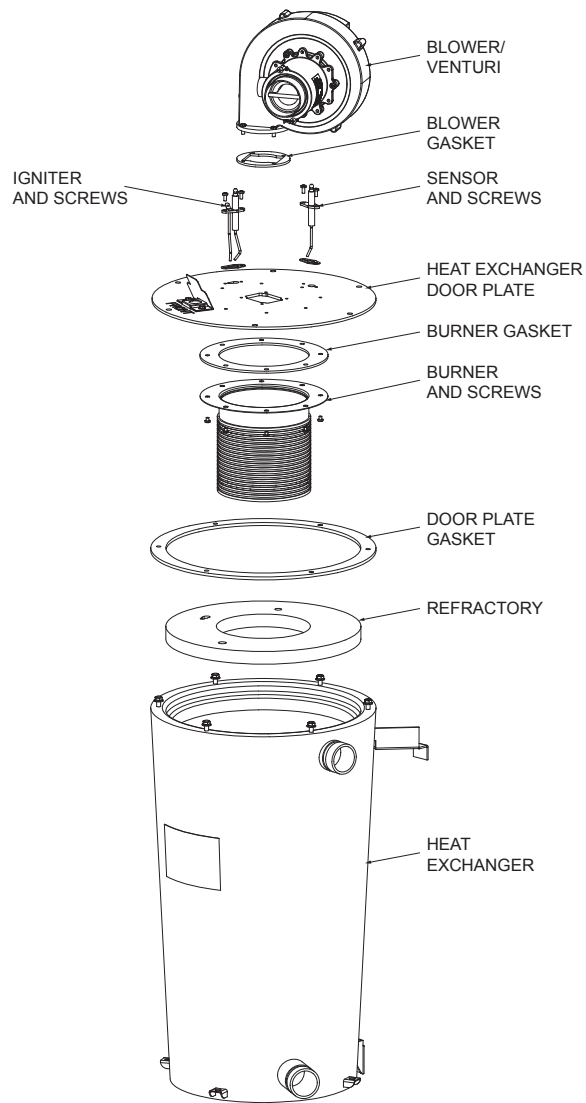


Figure 56. Heat Exchanger Components Removal

9. IMPORTANT INSTRUCTIONS FOR THE COMMONWEALTH OF MASSACHUSETTS

The Commonwealth of Massachusetts requires compliance with regulation 248 CMR 4.00 and 5.00 for installation of through – the – wall vented gas appliances as follows:

(a) For all side wall horizontally vented gas fueled equipment installed in every dwelling, building or structure used in whole or in part for residential purposes, including those owned or operated by the Commonwealth and where the side wall exhaust vent termination is less than seven (7) feet above finished grade in the area of the venting, including but not limited to decks and porches, the following requirements shall be satisfied:

1. **INSTALLATION OF CARBON MONOXIDE DETECTORS.** At the time of installation of the side wall horizontal vented gas fueled equipment, the installing plumber or gasfitter shall observe that a hard wired carbon monoxide detector with an alarm and battery back-up is installed on the floor level where the gas equipment is to be installed. In addition, the installing plumber or gasfitter shall observe that a battery operated or hard wired carbon monoxide detector with an alarm is installed on each additional level of the dwelling, building or structure served by the side wall horizontal vented gas fueled equipment. It shall be the responsibility of the property owner to secure the services of qualified licensed professionals for the installation of hard wired carbon monoxide detectors

a. In the event that the side wall horizontally vented gas fueled equipment is installed in a crawl space or an attic, the hard wired carbon monoxide detector with alarm and battery back-up may be installed on the next adjacent floor level.

b. In the event that the requirements of this subdivision can not be met at the time of completion of installation, the owner shall have a period of thirty (30) days to comply with the above requirements; provided, however, that during said thirty (30) day period, a battery operated carbon monoxide detector with an alarm shall be installed.

2. **APPROVED CARBON MONOXIDE DETECTORS.** Each carbon monoxide detector as required in accordance with the above provisions shall comply with NFPA 720 and be ANSI/UL 2034 listed and IAS certified.

3. **SIGNAGE.** A metal or plastic identification plate shall be permanently mounted to the exterior of the building at a minimum height of eight (8) feet above grade directly in line with the exhaust vent terminal for the horizontally vented gas fueled heating appliance or equipment. The sign shall read, in print size no less than one-half (1/2) inch in size, "GAS VENT DIRECTLY BELOW. KEEP CLEAR OF ALL OBSTRUCTIONS".

4. **INSPECTION.** The state or local gas inspector of the side wall horizontally vented gas fueled equipment shall not approve the installation unless, upon inspection, the inspector observes carbon monoxide detectors and signage installed in accordance with the provisions of 248 CMR 5.08(2)(a)1 through 4.

(b) **EXEMPTIONS:** The following equipment is exempt from 248 CMR 5.08(2)(a)1 through 4:

1. The equipment listed in Chapter 10 entitled "Equipment Not Required To Be Vented" in the most current edition of NFPA 54 as adopted by the Board; and

2. Product Approved side wall horizontally vented gas fueled equipment installed in a room or structure separate from the dwelling, building or structure used in whole or in part for residential purposes.

(c) **MANUFACTURER REQUIREMENTS - GAS EQUIPMENT VENTING SYSTEM PROVIDED.** When the manufacturer of Product Approved side wall horizontally vented gas equipment provides a venting system design or venting system components with the equipment, the instructions provided by the manufacturer for installation of the equipment and the venting system shall include:

1. Detailed instructions for the installation of the venting system design or the venting system components; and

2. A complete parts list for the venting system design or venting system.

(d) **MANUFACTURER REQUIREMENTS - GAS EQUIPMENT VENTING SYSTEM NOT PROVIDED.** When the manufacturer of a Product Approved side wall horizontally vented gas fueled equipment does not provide the parts for venting the flue gases, but identifies "special venting systems", the following requirements shall be satisfied by the manufacturer:

1. The referenced "special venting system" instructions shall be included with the appliance or equipment installation instructions; and

2. The "special venting systems" shall be Product Approved by the Board, and the instructions for that system shall include a parts list and detailed installation instructions.

(e) A copy of all installation instructions for all Product Approved side wall horizontally vented gas fueled equipment, all venting instructions, all parts lists for venting instructions, and/or all venting design instructions shall remain with the appliance or equipment at the completion of the installation.

10. LIMITED PARTS WARRANTY

XPak FT® – TYPE H MODELS 88AR-398A

SCOPE

Raypak, Inc. ("Raypak") warrants to the original owner that all parts of this heater which are actually manufactured by Raypak will be free from failure under normal use and service for the specified warranty periods and subject to the conditions set forth in this Warranty. Labor charges and other costs for parts removal or reinstallation, shipping and transportation are not covered by this Warranty but are the owner's responsibility.

HEAT EXCHANGER WARRANTY

Space Heating (Closed Loop System)

Ten (10) year limited warranty from date of heater installation. This warranty applies only to boilers utilized in closed loop heating systems and hot water supply boilers that have been properly installed based upon manufacturer's installation instructions.

Year of Claim	0-5	6	7	8	9
Percentage to be paid by purchaser	0 %	20%	40%	60%	80%

Thermal Shock Warranty

Twenty (20) years from date of heater installation against "Thermal Shock" (excluded, however, if caused by heater operation at large changes exceeding 150°F (66°C) between the water temperature at intake and heater temperature, or operating at heater temperatures exceeding 215°F (102°C)).

ANY OTHER PART MANUFACTURED BY RAYPAK

One (1) year warranty from date of heater installation, or eighteen (18) months from date of factory shipment based on Raypak's records, whichever comes first.

SATISFACTORY PROOF OF INSTALLATION DATE, SUCH AS INSTALLER INVOICE, IS REQUIRED. THIS WARRANTY WILL BE VOID IF THE HEATER RATING PLATE IS ALTERED OR REMOVED.

ADDITIONAL WARRANTY EXCLUSIONS

This warranty does not cover failures or malfunctions resulting from:

1. Failure to properly install, operate or maintain the heater in accordance with our printed instructions provided;
2. Abuse, alteration, accident, fire, flood and the like;
3. Sediment or lime build-up, freezing, or other conditions causing inadequate water circulation;
4. High velocity flow exceeding heater design rates;
5. Failure of connected system devices, such as pump or controller;
6. Use of non-factory authorized accessories or other components in conjunction with the heater system;
7. Failing to eliminate air from, or replenish water in, the connected water system;
8. Chemical contamination of combustion air or use of chemical additives to water.

PARTS REPLACEMENT

Under this Warranty, Raypak will furnish a replacement for any failed part. The failed part must first be returned to Raypak if requested, with transportation charges prepaid, and all applicable warranty conditions found satisfied. The replacement part will be warranted for only the unexpired portion of the original warranty. Raypak makes no warranty whatsoever on parts not manufactured by it, but Raypak will apply any such warranty as may be provided to it by the parts manufacturer.

TO MAKE WARRANTY CLAIM

Promptly notify the original installer, supplying the model and serial numbers of the unit, date of installation and description of the problem. The installer must then notify his Raypak distributor for instructions regarding the claim. If either is not available, contact Service Manager, Raypak, Inc., 2151 Eastman Avenue, Oxnard, CA 93030 or call (805) 278-5300. In all cases proper authorization must first be received from Raypak before replacement of any part.

EXCLUSIVE WARRANTY - LIMITATION OF LIABILITY

This is the only warranty given by Raypak. No one is authorized to make any other warranties on Raypak's behalf. THIS WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. RAYPAK'S SOLE LIABILITY AND THE SOLE REMEDY AGAINST RAYPAK WITH RESPECT TO DEFECTIVE PARTS SHALL BE AS PROVIDED IN THIS WARRANTY. IT IS AGREED THAT RAYPAK SHALL HAVE NO LIABILITY, WHETHER UNDER THIS WARRANTY, OR IN CONTRACT, TORT, NEGLIGENCE OR OTHERWISE, FOR ANY SPECIAL, CONSEQUENTIAL, OR INCIDENTAL DAMAGE, INCLUDING DAMAGE FROM WATER LEAKAGE. Some states do not allow limitations on how long an implied warranty lasts, or for the exclusion of incidental or consequential damages. So the above limitation or exclusion may not apply to you.

This Limited Warranty gives you specific legal rights. You may also have other rights which may vary from state to state. We suggest that you complete the information below and retain this certificate in the event warranty service is needed. Reasonable proof of the effective date of the warranty (date of installation) must be presented; otherwise, the effective date will be based on the date of manufacture plus thirty (30) days.

Original Owner

Model Number

Serial Number

Mailing Address

Date of Installation

City

State

Zip Code

Installation Site

Daytime Telephone Number

Contractor/Installer

RAYPAK, INC • 2151 Eastman Avenue • Oxnard, CA 93030-9786 • (805) 278-5300 • Fax (800) 872-9725 • www.raypak.com

11. START-UP CHECKLIST

START-UP CHECKLIST FOR THE XPAK FT®

This start-up checklist is to be completely filled out by the service technician starting up the Raypak Boiler or Heater for the first time. All information may be used for warranty purposes and to ensure that the installation is correct. Additionally this form will be used to record all equipment operation functions and required settings.

GAS SUPPLY DATA

Regulator Model & Size _____ / _____ CFH
 Gas Line Size (in room) _____ In. NPT
 Length of Gas Line _____ Eq Ft
 Low Gas Pressure Setting _____ In. WC
 High Gas Pressure Setting _____ In. WC
 Gas Shut-Off Valve Type _____
 (Ball, Lube cock)
 Sediment Trap _____ Y/N
 Port _____ Std _____ Full

VISUAL INSPECTION OF COMPONENTS

Verify inspection was done and condition of components are in good working order with a "yes"

Wiring Harness _____ Y/N
 Burner/s (flame) _____ Y/N
 Refractory (visual) _____ Y/N
 Remote flame sense _____ Y/N

VENTING

Vent Size: _____ Stack Height: _____
 Category: _____ sketch vent on reverse side ***
 Vent Material: _____
 Vent Termination Type: _____
 Combustion Air Openings: Low _____ in²
 Ventilation air High _____ in²

EMISSIONS SETTINGS AND TEST INFORMATION

	High	Low
Air Intake Pressure	_____	_____
Supply Gas Pressure	_____	_____
Verify stable pressure static & dynamic condition		
Manifold Gas Pressure	_____	_____

In. WC

CLEARANCES

Front Clearance _____ In.
 Right Side Clearance _____ In.
 Left Side Clearance _____ In.
 Rear Clearance _____ In.
 Overhead Clearance _____ In.

ELECTRICAL

Voltage Supply (VAC) No Load _____ Load _____
 Voltage -24 VAC _____ VAC
 Voltage Com to Ground _____ VAC
 Auto High Limit Setting _____ deg F
 Manual Reset High Limit Setting _____ deg F
 Operating Control Setting _____ deg F

Sketch plumbing on reverse side

WATER SUPPLY

Flow Rate in GPM or Delta T _____ If Avail
 Measure flow rate at full fire
 Pump Off Delay setting _____ Minutes
 Low Water Cutoff _____ Test
 Number of Tanks and Size Qty _____ Gallons
 Plumbing Size _____
 Pump Size: _____ (boiler) Pump HP: _____
 Impeller trim _____ Pump Model _____
 Louvers _____ Screens _____

Nominal Factory Recommended Settings

See manual or card tag
 See manual or card tag
 See manual or card tag

The following measurements must be obtained with a Combustion Analyzer.

NOX	_____	PPM	Less than 20 PPM (If required by Certifying Agency)
CO	_____	PPM	Less than 150 PPM
CO2	_____	%	See manual

Model Number: _____

Serial Number: _____

*** Note: draw venting with details, such as extractors, barometric dampers, blast dampers or draft inducers

Site Altitude Above Sea Level _____ Ft.

Job Name _____

Address _____

Physical Location of Boiler: Boiler Room _____; Ground Level _____; Below Grade _____

Mechanical Contractor / Installer _____

Date and Time of Start-up _____ Print Name and Signature of Start-up Technician _____

Information must be faxed to: (805) 278-5496 in order to ensure warranty consideration Attn: Service Manager

12. REPLACEMENT PARTS

NOTE: To supply you with the correct part, it is important that you supply the heater model number, serial number and type of gas when applicable.

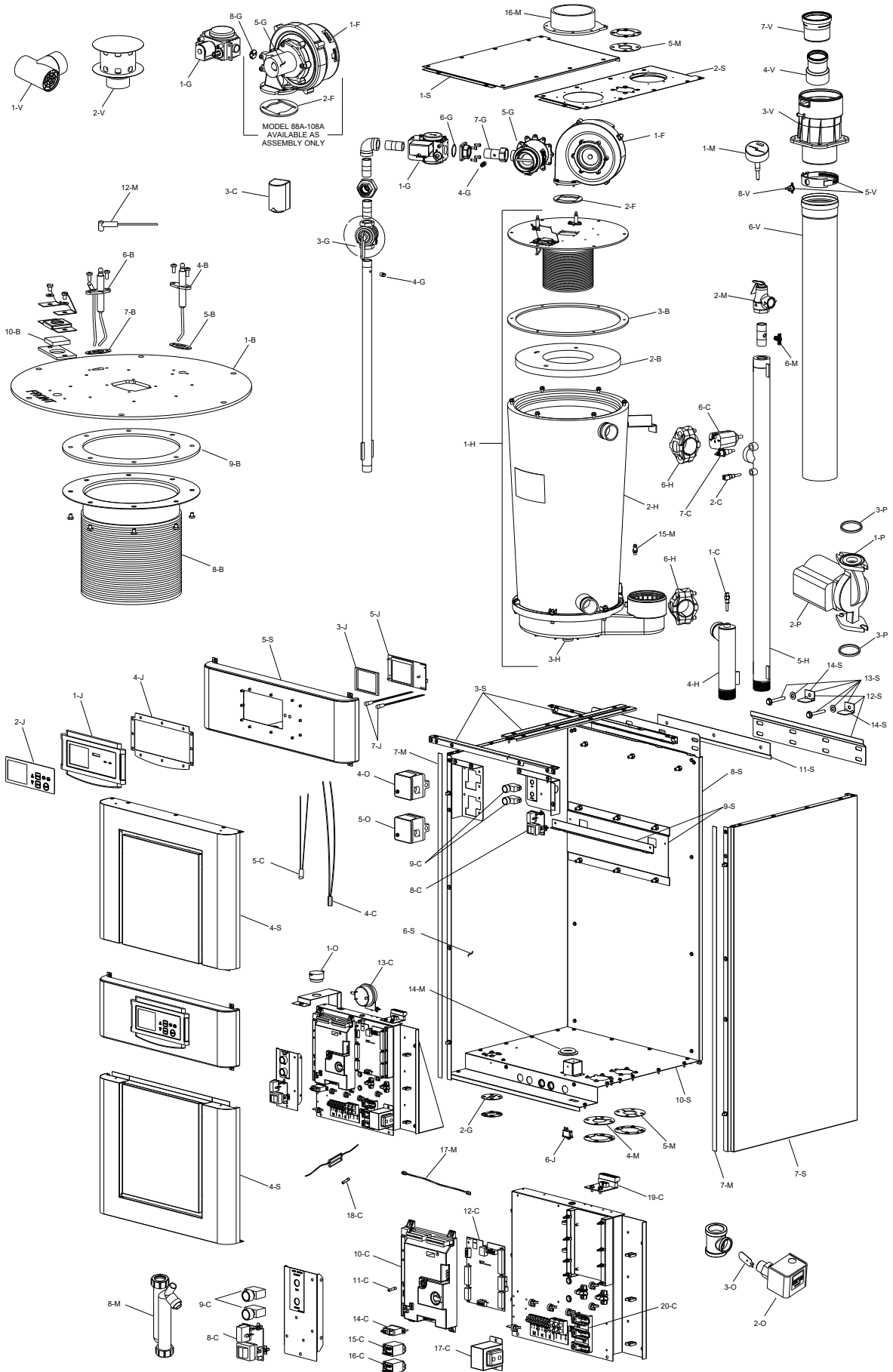
Any part returned for replacement under standard company warranties must be properly tagged with a return parts tag, completely filled in with the heater serial number, model number, etc., and shipped to the Company freight prepaid.

If determined defective by the Company and within warranty, a like part or equal substitution will be returned, freight collect. Credit will not be issued.

MANUFACTURER:

**2151 Eastman Avenue
Oxnard, CA 93030**

13. ILLUSTRATED PARTS LIST



CALL OUT	DESCRIPTION	88AR	108AR	198AR	278AR	398A
B	BURNER ASSEMBLY					
1-B	Combustion Chamber Top	015207F	015207F	015208F	015269F	015209F
2-B	Refractory Combustion Chamber Top	015169F	015169F	015170F	015170F	015171F
3-B	Seal Gasket	015172F	015172F	015173F	015173F	015174F
4-B	Flame Sensor Probe	013163F	013163F	013163F	013163F	013163F
5-B	Flame Sensor Gasket	013168F	013168F	013168F	013168F	013168F
6-B	Igniter	013166F	013166F	013166F	013166F	013166F
7-B	Igniter Gasket	013168F	013168F	013168F	013168F	013168F
8-B	Burner	015175F	015175F	015176F	015176F	015177F
9-B	Burner Seal Gasket	015210F	015210F	015211F	015211F	015212F
10-B	Window Combustion Chamber	006947F	006947F	006947F	006947F	006947F
C	CONTROLS					
1-C	Inlet Sensor (2 Wire)	013175F	013175F	013175F	013175F	013175F
2-C	Outlet/Limit Sensor (4 Wire)	013932F	013932F	013932F	013932F	013932F
3-C	Sensor Outdoor Air B-32	010786F	010786F	010786F	010786F	010786F
4-C	Sensor Water 10K	010787F	010787F	010787F	010787F	010787F
5-C	Sensor Water (Temp-Tracker) B-36 thru B-38	012187F	012187F	012187F	012187F	012187F
6-C	Low Water Cut-Off	015178F	015178F	015178F	015178F	N/A
7-C	Remote Sensor LWCO (Optional on Models 88AR-278AR)	013238F	013238F	013238F	013238F	013238F
8-C	Control PC Board LWCO (Optional on Models 88AR-278AR)	015999F	015999F	015999F	015999F	015999F
9-C	Test / Reset Switch LWCO (Optional on Models 88AR-278AR)	016001F	016001F	016001F	016001F	016001F
10-C	PIM (Platform Ignition Module) Multi Try	013933F	013933F	013933F	013933F	013933F
	PIM (Platform Ignition Module) Single Try CSD-1	013934F	013934F	013934F	013934F	013934F
11-C	Fuse 5 Amp (Fast Acting)	013971F	013971F	013971F	013971F	013971F
12-C	PC Board VERSA IC	013935F	013935F	013935F	013935F	013935F
13-C	Blocked Vent Pressure Switch	011862F	011862F	011862F	011862F	011862F
14-C	Pump Relay 120VAC	012126F	012126F	012126F	012126F	012126F
15-C	Relay #1 24VAC	011720F	011720F	011720F	011720F	011720F
16-C	Relay #2 120VAC	013243F	013243F	013243F	013243F	013243F
17-C	Transformer 50 VA	006533F	006533F	006533F	006533F	006533F
18-C	Fuse 5 Amp (Pump) (Slow Blow)	013972F	013972F	013972F	013972F	013972F
19-C	PC Board Adapter Status Lights Wiring	014712F	014712F	014712F	014712F	014712F
20-C	Power Terminal Block	008523F	008523F	008523F	008523F	008523F
J	CONTROLS (Up Front)					
1-J	Control Bezel	015179F	015179F	015179F	015179F	015179F
2-J	Switch/Decal Membrane	015180F	015180F	015180F	015180F	015180F
3-J	Gasket LCD Window Gasket	013938F	013938F	013938F	013938F	013938F
4-J	Bezel Gasket	015181F	015181F	015181F	015181F	015181F
5-J	LCD Display PC Board	013939F	013939F	013939F	013939F	013939F
6-J	On/Off Switch	009493F	009493F	009493F	009493F	009493F
7-J	Indicator Lamp LED	015213F	015213F	015213F	015213F	015213F
F	FAN					
1-F	Blower Combustion Air	015214F	015215F	015182F	015183F	015183F
2-F	Blower Gasket	015184F	015184F	015184F	015184F	015184F
G	GAS TRAIN					
1-G	Gas Valve 24V Sea Level	015434F	015434F	013942F	013942F	013942F
2-G	Gas Seal Gasket	015216F	015216F	015217F	015217F	015217F
3-G	Manual "A" On/Off Valve	006543F	006543F	007421F	007421F	007421F
4-G	Bleedle Valve 1/8 MPT	N/A	N/A	007423F	007423F	007423F
5-G	Venturi					
	Natural Gas	015214F	015215F	015414F	015415F	015416F
	Propane Gas	015214F	015215F	015417F	015418F	015419F
6-G	Adapter O Ring	N/A	N/A	014089F	014089F	014089F
7-G	Adapter Gas Line 3/4" NPT (Includes Gasket)	N/A	N/A	015218F	015218F	015218F
8-G	Orifice Natural Gas	N/A	N/A	N/A	N/A	N/A
	Orifice Propane Gas	015420F	015420F	N/A	N/A	N/A
H	HEAT TRANSFER					
1-H	Heat Engine (Complete with Burner and Sensors)					
	Units manufactured prior to 03/01/18	017162F	017163F	017164F	017165F	017033F
	Units manufactured from 03/01/18	017162F	017163F	017164F	017165F	017027F
2-H	Chamber Assy					
	Units manufactured prior to 03/01/18	017166F	017167F	017168F	017169F	017034F
	Units manufactured from 03/01/18	017166F	017167F	017168F	017169F	017028F
3-H	Condensate Tray					
	Units manufactured prior to 03/01/18	017166F	017167F	017168F	017169F	017034F
	Units manufactured from 03/01/18	017166F	017167F	017168F	017169F	017028F
4-H	Plumbing Assy Inlet	015185F	015185F	015186F	015186F	015187F
5-H	Plumbing Assy Outlet	015188F	015188F	015189F	015189F	015190F
6-H	Pipe Coupling Grooved Joint	015232F	015232F	015233F	015233F	015234F

CALL OUT	DESCRIPTION	88AR	108AR	198AR	278AR	398A
M	MISCELLANEOUS COMPONENTS					
1-M	T & P Gauge	007205F	007205F	007205F	007205F	007205F
2-M	PRV 30 PSI	007470F	007470F	007470F	007470F	007470F
	PRV 45 PSI	007220F	007220F	007220F	007220F	007220F
	PRV 60 PSI	007222F	007222F	007222F	007222F	007222F
3-M	Clear Silicone Sealant 10 oz	015421F	015421F	015421F	015421F	015421F
4-M	Inlet Water Seal Gasket	015192F	015192F	015193F	015193F	015194F
5-M	Outlet Water Seal Gasket	015195F	015195F	015196F	015196F	015197F
6-M	Air Bleed Fitting	013793F	013793F	013793F	013793F	013793F
7-M	Cabinet Seal Gasket (10 Ft)	015235F	015235F	015235F	015235F	015235F
8-M	Condensate Trap	015198F	015198F	015198F	015198F	015198F
9-M	Condensate Neutralizer (Not Shown)	013141	013141	013141	015199	015199
10-M	Touch-up Paint					
	Cool Dark Gray	750256	750256	750256	750256	750256
	Warm Dark Gray	750258	750258	750258	750258	750258
11-M	Wire Harness Cabinet (Not Shown)	015422F	015422F	015423F	015423F	015424F
12-M	Spark Cable High Tension Harness	015200F	015200F	015200F	015200F	015200F
13-M	Gas Valve Harness	015425F	015425F	015499F	015499F	015499F
17-M	Versa IC Communication Cable	015556F	015556F	015556F	015556F	015556F
14-M	Condensate Discharge Grommet	010778F	010778F	010778F	010778F	010778F
15-M	Barbed Sample Connector	013433F	013433F	013433F	013433F	013433F
16-M	Intake Air Adapter	015202F	015202F	015202F	015202F	015203F
18-M	Heater Template (Not Shown)	016171F	016171F	016172F	016172F	016173F
O	OPTIONS					
1-O	Alarm Buzzer 24V	005640F	005640F	005640F	005640F	005640F
2-O	Flow Switch	007142F	007142F	007142F	007142F	007142F
3-O	Flow Switch Paddle (Taco)	010026F	010026F	010026F	010026F	010026F
4-O	Switch Low Gas Pressure (Optional)	N/A	N/A	007187F	007187F	007187F
5-O	Switch High Gas Pressure (Optional)	N/A	N/A	007188F	007188F	007188F
P	PUMPS*					
1-P	Pump Inline CIBF (Non-Ferrous)	004251F	004251F	015426F	015427F	015427F
	Pump Inline SS	015428F	015428F	015429F	012912F	012912F
2-P	Pump Cartridge	951116F	951116F	951154F	016480F	016480F
3-P	Pump Flange Gasket	015201F	015201F	015201F	008747F	008747F
S	SHEET METAL					
1-S	Jacket Top Side Left	015236F	015236F	015237F	015237F	015238F
2-S	Jacket Top Side Right					
	Units manufactured prior to 03/01/18	015239F	015239F	015240F	015240F	015241F
	Units manufactured from 03/01/18	015239F	015239F	015240F	015240F	017042F
3-S	Upper Cabinet Supports	015242F	015242F	015243F	015243F	015244F
4-S	Door Panel (Upper & Lower)	015245F	015245F	015246F	015246F	015247F
5-S	Control Bezel Mtg Panel	015248F	015248F	015249F	015249F	015250F
6-S	Jacket Side Panel Left	015251F	015251F	015252F	015252F	015253F
7-S	Jacket Side Panel Right	015254F	015254F	015255F	015255F	015256F
8-S	Jacket Rear Panel	015257F	015257F	015258F	015258F	015259F
9-S	Combustion Chamber Mounting Bracket	015260F	015260F	015261F	015261F	015262F
10-S	Base Panel	015263F	015263F	015264F	015264F	015265F
11-S	Boiler Hanging Bracket	015266F	015266F	015267F	015267F	015268F
12-S	Wall Hanging Bracket	015437F	015437F	015437F	015437F	015438F
13-S	Mounting Bracket, Screws, and Washers	016170F	016170F	016170F	016170F	016170F
14-S	Wall Mounting Bracket	016174F	016174F	016174F	016174F	016175F
V	VENTING					
1-V	Outdoor Vent Termination Tee (Stainless Steel)					
	3" Venting	015360	015360	015360	015360	015360
	4" Venting	N/A	N/A	N/A	N/A	015361
2-V	Vent Termination Cap Horizontal or Vertical Rain Cap (Stainless Steel)					
	3" Venting	015329	015329	015329	015329	015329
	4" Venting	N/A	N/A	N/A	N/A	015330
3-V	Flue Exhaust Universal Adapter (Standard)	015435F	015435F	015435F	015435F	015436F
4-V	Flue Exhaust Reducer for Polypropylene Venting					
	3" Venting to 2" Venting Duravent	15368	N/A	N/A	N/A	N/A
	4" Venting to 3" Venting Duravent	N/A	N/A	N/A	N/A	015369
	3" Venting to 2" Venting Centrotherm	016265	N/A	N/A	N/A	N/A
	4" Venting to 3" Venting Centrotherm	N/A	N/A	N/A	N/A	016266
5-V	Vent Limit Switch Assy Manual Reset for CPVC/PVC, 162F	013429F	013429F	013429F	013429F	013429F
	Vent Limit Switch Assy Manual Reset for Polypropylene Venting	017043F	017043F	017043F	017043F	017043F
6-V	Flue Exhaust Connection Pipe					
	Units manufactured prior to 03/01/18	015431F	015431F	015432F	015432F	015433F
	Units manufactured from 03/01/18	015431F	015431F	015432F	015432F	017029F
7-V	Flue Exhaust Adapter Appliance to Centrotherm Polypro Venting 180F					
	2" Venting	016262	N/A	N/A	N/A	N/A
	3" Venting	016263	016263	016263	016263	016263
	4" Venting	N/A	N/A	N/A	N/A	016264
8-V	Vent Limit Switch Manual Reset for Polypropylene, 180F	014043F	014043F	014043F	014043F	014043F

* For individual pump parts see separate pump parts IPL 9300.100

CONVERSION KITS**

Nat. to Pro.	015420F	015420F	015401	015402	015403
Pro. to Nat.	N/A	N/A	015404	015405	015406

**Gas Conversions are to be done only by a qualified agency.
For gas conversions, consult the factory.

NOTES



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