

INSTALLATION & OPERATING INSTRUCTIONS

MVB
Modulating Vertical Boiler



Models 504A-2004A
Types H, WH & P



WARNING: Improper installation, adjustment, alteration, service or maintenance can cause property damage, personal injury, exposure to hazardous materials* or loss of life. Review the information in this manual carefully. *This unit contains materials that have been identified as carcinogenic, or possibly carcinogenic, to humans.

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.

WHAT TO DO IF YOU SMELL 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.

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

This manual should be maintained in legible condition and kept adjacent to the heater or in a safe place for future reference.

Raypak
A Rheem® Company

Rev. 2 reflects the following:

Changes to: Table A on page 6, "Outdoor Installation" on page 9, "Applications and Modes" on page 16, Table J on page 22, "Electrical Power Connections" on page 22, Table K on page 28, "High Limits" on pages 36-37, Wiring Diagram on page 44, "Blower Check" on page 47, Table U on page 47, Filter Maintenance on page 55

Additions: "Motorized Combustion Air Dampers or Louvers" on page 11, "Flushing/Cleaning of System Piping" on page 13, "Extractors, Draft Inducers, and Motorized Flue Dampers" on page 28, Note on page 32, Fig. 47 on page 46.

Deletions: None

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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 heater will operate is the same type as that specified on the heater 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 heater. Instead, shut off the gas supply at a location external to the heater.

WARNING: Do not use this heater if any part has been under water. Immediately call a qualified service technician to inspect the heater 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 heater:

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

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

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

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 - CALIFORNIA PROPOSITION 65: This product contains chemicals known to the State of California to cause cancer, birth defects or other reproductive harm.

CAUTION: Operation of this heater in low temperature systems requires special piping. Harmful internal condensation will occur if the inlet water temperature does not exceed 120°F. Warranty claims will be denied when condensation occurs.

CAUTION: If this heater is to be installed above radiation level, it must be provided with a low water cut-off device at the time of heater installation.

CAUTION: If this heater is to be installed in a negative or positive pressure equipment room, there are special installation requirements. Consult factory for details.

BEFORE INSTALLATION

Raypak strongly recommends that this manual be reviewed thoroughly before installing your MVB heater. Please review the General Safety information before installing the heater. Factory warranty does not apply to heaters 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 heater it is suggested that you visually check for external damage to the shipping crate. If the crate is damaged, make a note to that effect on the Bill of Lading when signing for the shipment. Next, remove the heater from the shipping packaging. 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 heater. 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 heater serial number are found on the heater rating plate located on

the upper rear jacket panel of the heater. The model number will have the form H7-0504A or similar depending on the heater size and configuration. The letter(s) in the first group of characters identifies the application (H = Hydronic Heating, WH = Domestic Hot Water (DHW), and P = Pool heating). The number which follows identifies the firing mode (7 = electronic modulation). The second group of characters identifies the size of the heater (the four 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
- CAN 3.1 - latest edition, Industrial and Commercial Gas-Fired Package Boilers
- ANSI Z21.10.3 · CSA 4.3 - latest edition, Gas Water Heaters
- ANSI Z21.56 · CSA 4.7 - latest edition, Gas-Fired Pool Heaters
- SCAQMD Rule 1146.2
- Low-lead content (<.25%) CSA-certified

All Raypak heaters are National Board Approved, and design-certified and tested by the Canadian Standards Association (CSA) for the U.S. and Canada. Each heater is constructed in accordance with Section IV of the American Society of Mechanical Engineers

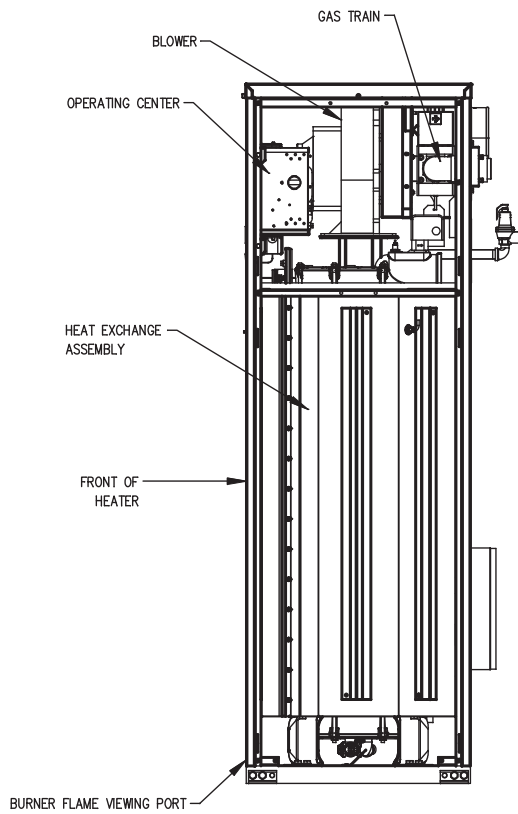
WARNING: Altering any Raypak pressure vessel by installing replacement heat exchangers, tube bundle headers, or any ASME parts not manufactured and/or approved by Raypak will instantly void the ASME and CSA ratings of the vessel. Altering the ASME or CSA ratings of the vessel also violates national, state, and local approval codes.

(ASME) Heater Pressure Vessel Code and bears the ASME stamp. This heater also complies with the latest edition of the ASHRAE 90.1 Standard.

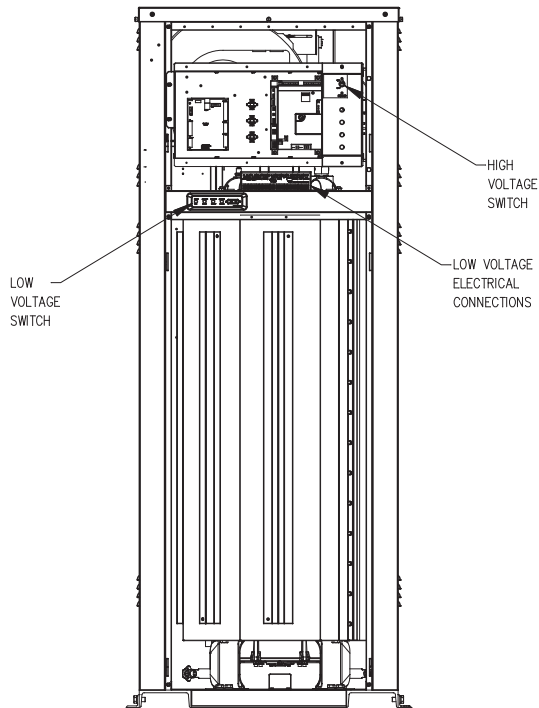
Installations at Elevation

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

Component Locations



Panels omitted for clarity
Fig. 1: Component Locations – Side



Panels omitted for clarity
Fig. 2: Component Locations – Front

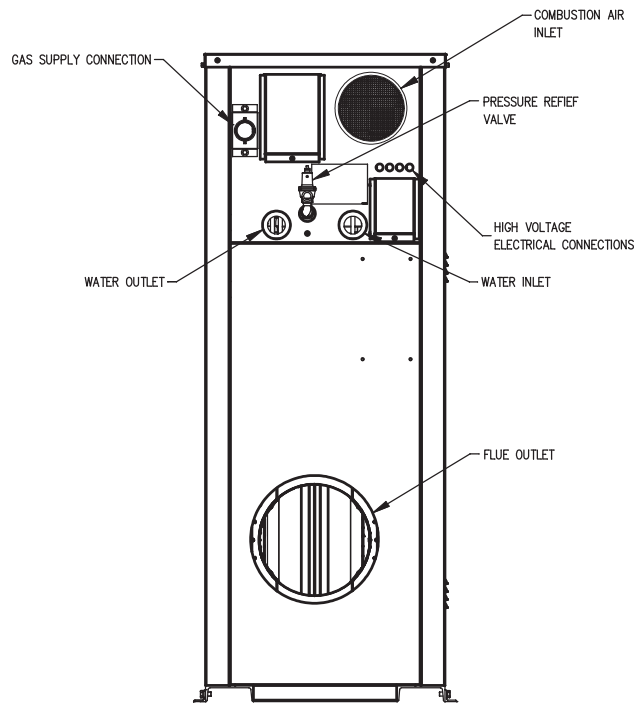
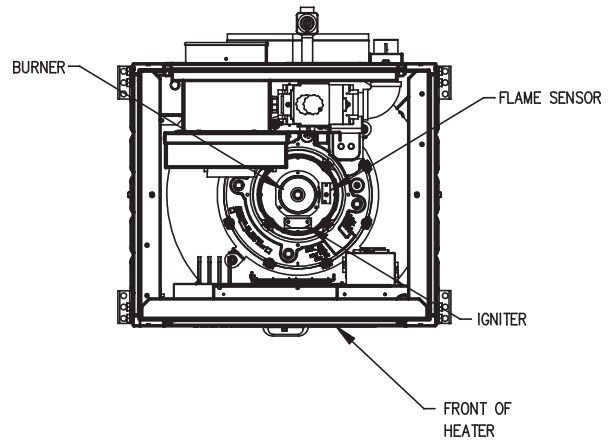


Fig. 3: Component Locations – Rear



Top panel, blower and gas train omitted for clarity
Fig. 4: Component Locations – Top

General Information

Model No.	MBTUH Input*		Water Conn. (NPT)	Gas Conn. (NPT)		Vent Size (in.)	
	Max.*	Min.*		N	P	Flue	Intake
504A	500	300	2	1	1	8	6
754A	750	450	2	1	1	10	6
1104A	1100	660	2-1/2	1-1/4	1	10	6
1504A	1500	900	2-1/2	1-1/4	1	12	8
2004A	1999	1199	2-1/2	2	1	14	8

*H7 units only

Table A: Basic Data

GENERAL SAFETY

To meet commercial hot water use needs, the high limit safety control on this water heater will shut off the main gas valve before the outlet temperature reaches 210°F. However, water temperatures over 125°F can cause instant severe burns or death from scalds. When supplying general purpose hot water, the recommended initial setting for the temperature control is 125°F.

This section applies to Hot Water Supply Boilers and Hot Water Heaters ONLY. For sanitary rinse applications where outlet temperatures of 180°F to 195°F are required, a boiler is recommended since the 210°F limit on water heaters will NOT allow the heater to maintain these desired sanitary rinse temperatures.

Safety and energy conservation are factors to be considered when setting the water temperature on the thermostat. The most energy-efficient operation will result when the temperature setting is the lowest that satisfies the needs of the application.


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.

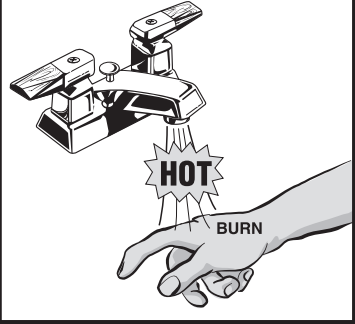
- Feel water before bathing or showering.
- Temperature limiting valves are available.

NOTE: When this water heater is supplying general purpose hot water for use by individuals, a thermostatically controlled mixing valve for reducing point of use water temperature is recommended to reduce the risk of scald injury. Contact a licensed plumber or the local plumbing authority for further information.

Maximum water temperatures occur just after the heater's burner has shut off. To determine the water temperature being delivered, turn on a hot water faucet and place a thermometer in the hot water stream and read the thermometer.

CAUTION: Hotter water increases the risk of scalding! There is a hot water scald potential if the thermostat is set too high.


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.

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	More than 5 minutes
125°F	1-1/2 to 2 minutes
130°F	About 30 seconds
135°F	About 10 seconds
140°F	Less than 5 seconds
145°F	Less than 3 seconds
150°F	About 1-1/2 seconds
155°F	About 1 second

Table courtesy of The Shriners Burn Institute

Table B: Time to Produce Serious Burn

INSTALLATION

Installation Codes

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 Base

The heater should be mounted on a level, structurally sound surface. The heater is approved for installation on a combustible surface but must NEVER be installed on carpeting. Gas-fueled equipment installed in enclosed parking garages must be located at least 18 in. above the floor.

CAUTION: This heater 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.

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

If the heater needs to be secured to the ground, use the hole pattern shown in Fig. 5, following local codes. Additional clearance may be required when using the factory anchor bracket.

Clearances

Indoor Installations

Heater Side	Minimum Clearance from Combustible Surfaces	Minimum Service Clearance
Floor*	0"	0"
Rear	12"	24"
Right Side	1"	1"
Left Side	1"	1"
Top	0"	10"
Front	Open	24"
Vent	1"	1"

*DO NOT install on carpeting.

Table C: Clearances – Indoor Installations

When installed according to the listed minimum clearances from combustible construction, these heaters can still be serviced without removing permanent structural construction around the heater. However, for ease of servicing, a clearance of at least 24 in. in front, 1 in. on the side, at least 24 in. on the rear and 10 in. above the top of the heater is required. This will allow

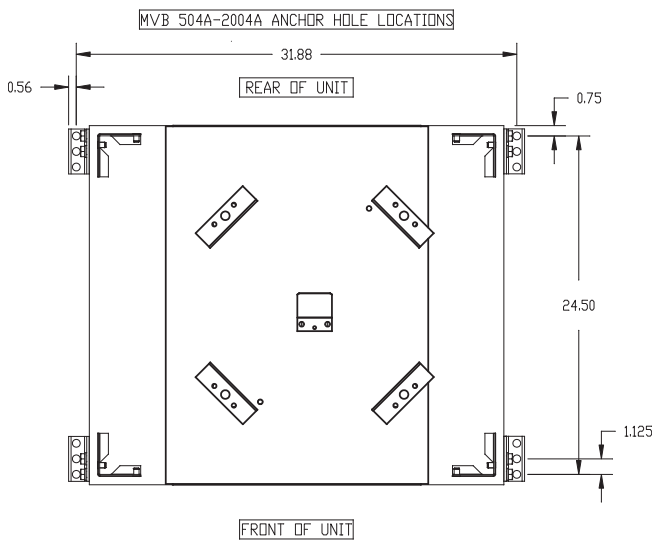


Fig. 5: Anchor Hole Locations

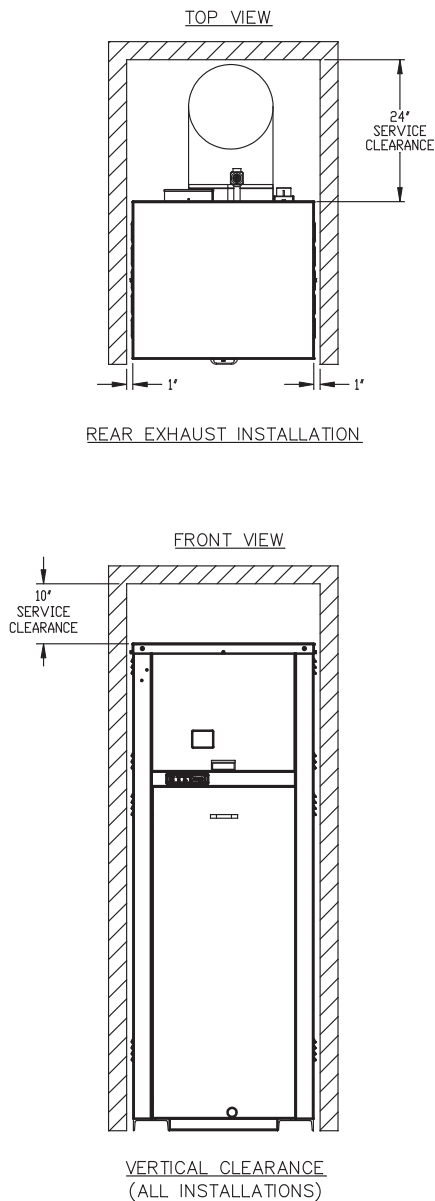


Fig. 6: Minimum Clearances from Combustible Surfaces – Indoor and Outdoor Installations

the heater 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 heater to service either the heat exchanger or the burner components. In either case, the heater must be installed in a manner that will enable the heater to be serviced without removing any structure around the heater.

Outdoor Installations

Outdoor installation **REQUIRES** the use of the combustion air intake elbow. The intake elbow must be ordered when ordering the unit and is shipped loose for field installation. The intake air elbow **MUST** be

installed on the air filter intake at the rear of the unit during installation. The intake elbow **MUST** be oriented with the open end facing downward.

Heaters must not be installed under an overhang unless clearances are in accordance with local installation codes and the requirements of the gas supplier. Three sides must be open in the area under the overhang. Roof water drainage must be diverted away from heaters installed under overhangs.

Heater Side	Min. Clearance from Combustible Surfaces	Minimum Service Clearance
Rear	12"	24"
Front	Open	24"
Right Side	1"	1"
Left Side	1"	1"
Top	Unobstructed	10"
Vent Termination	12"	12"

Table D: Clearances – Outdoor Installations

Combustion and Ventilation Air

NOTE: Use of this heater in construction areas where fine particulate matter, such as concrete or dry-wall dust, is present may result in damage to the heater 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 heater.

Indoor Units

This heater 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 heater, or via direct vent, where combustion air is drawn directly from outside. All installations must comply with the requirements of the NFGC (U.S.) and B149 (Canada), and all local codes.

CAUTION: Combustion air must not be contaminated by corrosive chemical fumes which can cause non-warranted damage to the heater. (See the Appendix.)

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

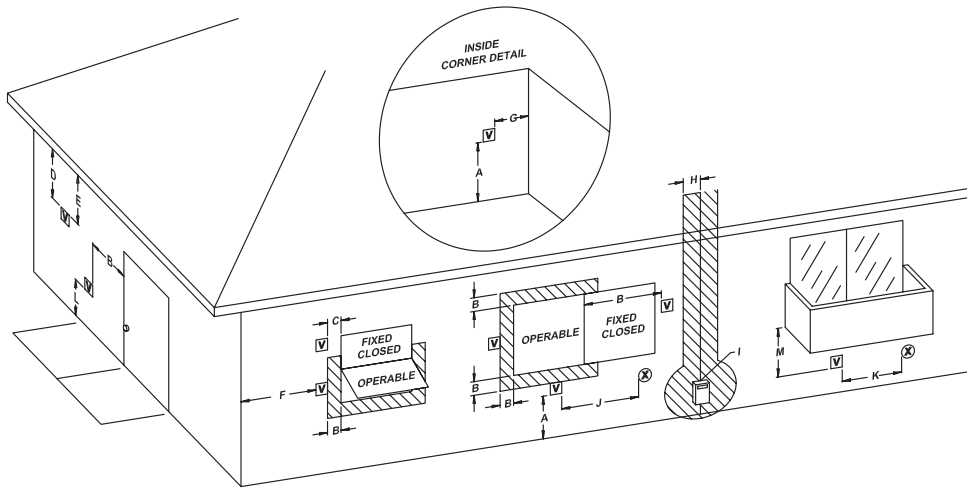


Fig. 7: Minimum Clearances from Vent/Air Inlet Terminations – Indoor and Outdoor Installations

		U.S. Installations¹	Canadian Installations²
A	Clearance above grade, veranda, porch, deck, or balcony	1 ft (30 cm)	1 ft (30 cm)
B	Clearance to window or door that may be opened	4 ft (1.2m) below or to side of opening; 1 foot (30 cm) above opening	3 ft (91 cm)
C	Clearance to permanently closed window	*	*
D	Vertical clearance to ventilated soffit located above the terminal within a horizontal distance of 2 ft (61cm) from the centerline of the terminal	5 ft (1.5m)	*
E	Clearance to unventilated soffit	*	*
F	Clearance to outside corner	*	*
G	Clearance to inside corner	6 ft (1.83m)	*
H	Clearance to each side of center line extended above meter/regulator assembly	*	3 ft (91 cm) within a height 15 ft above the meter/regulator assembly
I	Clearance to service regulator vent outlet	*	6 ft (1.83m)
J	Clearance to non-mechanical air supply inlet to building or the combustion air inlet to any other appliance	4 ft (1.2m) below or to side of opening; 1 ft (30 cm) above opening	3 ft (91 cm)
K	Clearance to mechanical air supply inlet	3 ft (91 cm) above if within 10 ft (3m) horizontally	6 ft (1.83m)
L	Clearance above paved sidewalk or paved driveway located on public property	7 ft (2.13m)	7 ft (2.13m) ^t
M	Clearance under veranda, porch, deck or balcony	*	12 in. (30 cm) ^{TT}

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 Vent terminal shall not terminate directly above sidewalk or paved driveway located between 2 single family dwellings that serves both dwellings

^{TT} 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 ft (30cm)

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

Table E: Vent/Air Inlet Termination Clearances

Air Filter

An air filter is supplied standard with the heater. This filter is shipped loose for field installation. Refer to the Air Filter Kit Installation Instructions (Part No. 241338) for details. (see figure 37 for outdoor installation)

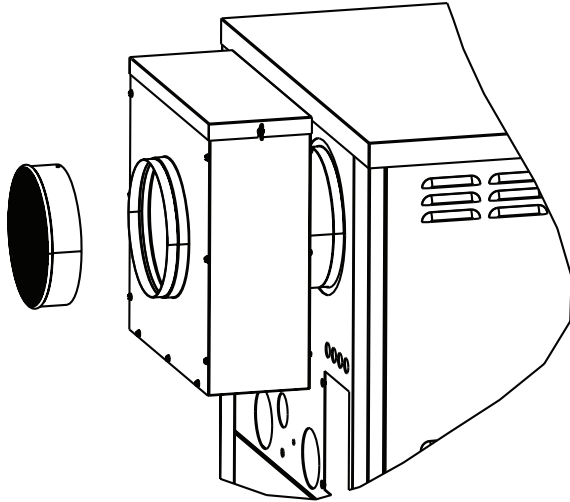


Fig. 8: Air Filter Box

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 Fig. 35 (horizontal) or Fig. 36 (vertical) of this manual (pages 33 and 34, respectively).
2. Ventilation of the space occupied by the heater(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 areas should be at least 1 in.² 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 in.² 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 to prevent the circulation of cold air through the heater during the non-operating hours.

Motorized Combustion Air Dampers or Louvers:

When motorized dampers or louvers are communicating directly with outside combustion air, they must be interlocked with each appliance in the equipment room, to ensure proper operation. See Field Wiring Connection section of this manual for proper wiring instructions, using Fan/Damper dry contacts and external interlock

TruSeal™ Combustion Air

In addition to the 3 previous steps, combustion air may be ducted directly to the heater by using PVC, CPVC or sealed single-wall galvanized ducting. The duct will attach directly to the air collar located on the inline Air Filter Box (shipped loose), using 3-4 sheet metal screws (not supplied) equally positioned around the circumference of the duct. The screen assembly should be removed before attaching any air duct. The screws and duct connection point must be sealed with RTV (not supplied). TruSeal is generally used when damaging contaminants are present in the mechanical room.

All ducting **MUST** be self-supported.

Conventional Combustion Air Supply

CAUTION: Use TruSeal combustion air if damaging airborne contaminants are or may be present in the heater area. See the Appendix of this manual regarding air contamination.

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 in.² 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 in.² (645 cm²). One opening shall commence within 12 in. (305 mm) of the top, and one opening shall commence within 12 in. (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 in.² 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 in.² 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 and back 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 in.² 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.

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

Canadian Installations

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

1. Ventilation of the space occupied by the heater 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 in.² (65 cm²).
2. For heaters 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 in.² per 7,000 BTUH (320 mm² per kW) up to and including 1 million BTUH, plus 1 in.² 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).

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

3. For heaters not using a barometric damper in the vent system, and 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 in.² 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

General

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

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

NOTE: Minimum pipe size for in/out connections is 2 in. NPT for 504A and 754A models and 2-½ in NPT for 1104A–2004A models. Verify proper flow rates and ΔT as instructed in this manual.

Relief Valve Piping

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.

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 heater does not require hydrostatic testing prior to being placed in operation. The heat exchanger has already been factory-tested and is rated for 160 psi operating pressure. However, Raypak does recommend hydrostatic testing of the piping connections to the heater 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. Fill heater with water. 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 any that are found.

Flushing/Cleaning of System Piping

Many of the chemicals used to perform this function will harm the heat exchanger as well as some gaskets and seals within the unit, causing a non-warrantable failure. When required, Raypak recommends the boiler be isolated from the system piping prior to flushing or cleaning with any cleaning agent.

Cold Water Operation

CAUTION: Damage due to internal condensation may occur if the heater inlet water temperature does not exceed 120°F (49°C) within 7 minutes of start-up.

This heater is equipped with a proprietary condensate evaporation system which will evaporate any condensate that may begin to accumulate inside the primary heat exchanger with water temperatures as low as 120°F (49°C).

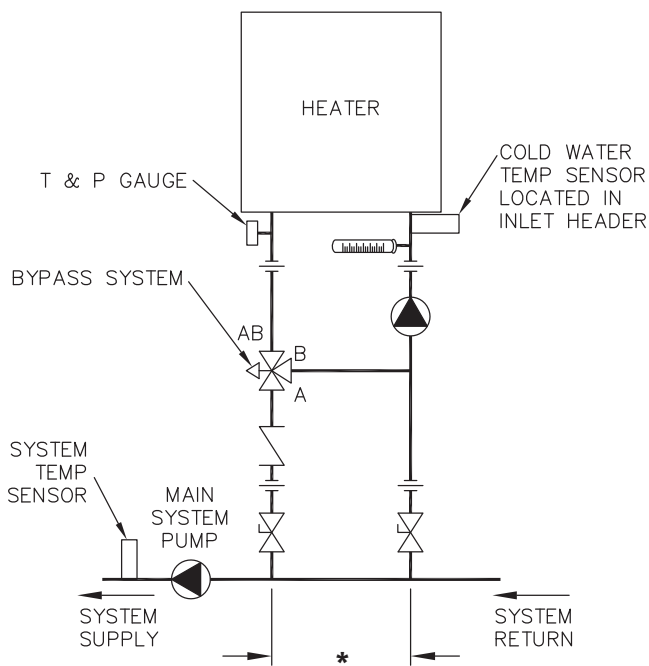
Heaters operated with an inlet temperature of less than 120°F (49°C) MUST have a low-temperature operation system (Figs. 9, 10 and 11) to prevent problems with condensation. Inlet water temperatures below 120°F (49°C) can excessively cool the products of combustion, resulting in collection of condensate in the heat exchanger area beyond the capacity of the condensate evaporation system.

Failure to reach or exceed 120°F (49°C) may damage or cause failure of the heat exchanger, combustion chamber, or other parts within the combustion chamber. It can cause operational problems, bad combustion, sooting, flue gas leakage and reduced service life of the appliance and the vent system. A bypass allows part of the heater discharge water to be mixed with the cooler water returning to the heater

inlet to increase the heater inlet temperature above 120°F (49°C). This precautionary measure should prevent the products of combustion from condensing beyond the ability of the condensate management system employed in this heater in most installations. **Warranty claims will be denied for damage or failures caused by condensation.**

Cold Water Starts

Cold water starts, where the inlet water temperature remains below 120°F (49°C) **must have cold water start protection**. Known protection methods consist of mixing heated outlet water with the inlet water using a bypass to raise the inlet to 120°F (49°C) or higher. Once the system is heated up and has return water temperatures of 120°F (49°C) or higher, the mixing of outlet water with inlet water is no longer needed and the bypass can be shut off. If the bypass is not shut off as the system heats up, the outlet temperature may continue to climb and trip the high limit, thereby shutting down the heater. Thus an automatic valve system, such as a three-way proportional valve to control the bypass, should be used.



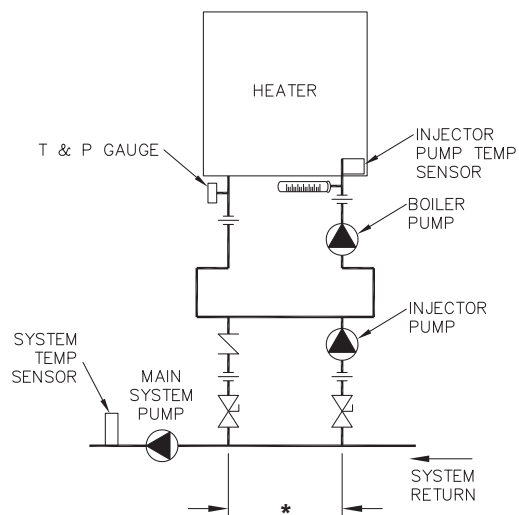
*Maximum 4 times the pipe diameter or 12", whichever is less.

Fig. 9: Cold Water Start

Cold Water Run

Cold water run differs from cold water start in that the system water entering the heater remains below 120°F (49°C) continuously. Typically, this is the case in swimming pool heating and water source heat pump applications, as well as some others. If the system

water is kept in a narrow temperature range of no more than 10°F (5°C), a permanent manual bypass can be employed and manually adjusted to achieve an inlet temperature of 120°F (49°C) or higher as adjusted at the minimum temperature in this narrow temperature range (i.e. Range 75°F to 85°F – adjust bypass with temperature at 75°F (24°C)) so that when temperature is 85°F (29°C), minimum inlet temperature would be 130°F (54°C). An injector pump arrangement may also be utilized to keep the heater loop at or above 120°F (49°C). An injector pump arrangement may be used to keep the heater loop at or above 120°F (49°C). An injector pump approach has the added value of being able to adjust automatically to changes in the system water coming back to the heater.



*Maximum 4 times the pipe diameter or 12", whichever is less.

Fig. 10: Cold Water Run

"H" Bypass

Adjustment of the manual bypass valve is critical to proper operation of the heater. The manual bypass valve should be adjusted to achieve a minimum inlet water temperature of 105°F (40°C) for Pool Heater (P) versions and 120°F (49°C) for Hydronic Heating (H7) or Domestic Hot Water (WH7) versions and a system supply water temperature below 140°F (60°C). When starting with a cold pool, make initial adjustments. Make final adjustments when pool water approaches desired temperature.

For the H-bypass, use the following instructions to set the manual bypass:

1. Turn on pump.
2. Turn on heater and wait until heater goes to full fire.

MVB Model	20° ΔT		30° ΔT		39° ΔT		Min Flow			Max Flow		
	GPM	ΔP (ft WC)	GPM	ΔP (ft WC)	GPM	ΔP (ft WC)	GPM	ΔP (ft WC)	ΔT (°F)	GPM	ΔP (ft WC)	ΔT (°F)
504A	42	2.7	28	1.4	N/A	N/A	25	1.1	34	100	11.3	8
754A	63	6.0	42	2.9	32	1.8	32	1.8	39	100	13.8	13
1104A	92	13.3	62	6.7	47	4.3	47	4.3	39	113	18.6	16
1504A	N/A	N/A	84	13.3	65	8.4	65	8.4	39	113	22.2	22
2004A	N/A	N/A	112	26.9	86	16.7	86	16.7	39	113	27.2	30

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

Table F: Heater Rates of Flow and Pressure Drops

NOTE: Opening the valve will increase the temperature and closing the valve will decrease the temperature.

3. With the heater operating at 100% firing rate, set Valve A (the bypass) to ½ open position, and Valve B to fully open position. See Fig. 16.
4. Adjust Valve A until the inlet water temperature is 105°F (40°C) or 120°F (49°C) depending upon heater type.
5. If this process does not raise the inlet water temperature to 105°F (40°C) for Pool Heater (P) versions and 120°F (49°C) for Hydronic Heating (H7) or Domestic Hot Water (WH7) versions and Valve A is fully open, then slowly throttle Valve B closed to increase the inlet water temperature to the required temperature.

NOTE: For automatic temperature adjustment, a Cold Water Run (CWR) system can be used instead of a manual bypass. See Fig. 10.

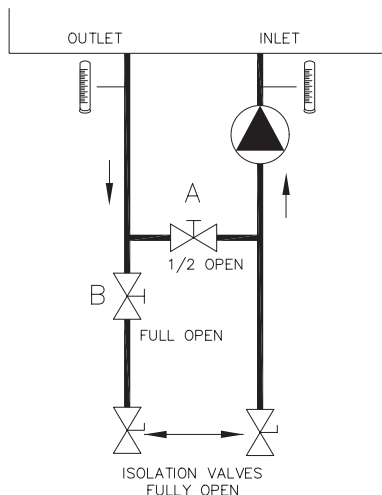


Fig. 11: "H" Bypass Setting

Hydronic Heating

Pump Selection

In order to ensure proper performance of your heater system, you must install a correctly-sized pump. Raypak requires designing for a ΔT within the range of 16°F to 39°F (9°C to 22°C). See Table F 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).

Feedwater Regulator

Raypak recommends that a feedwater regulator be installed and set at 12 psi minimum pressure at the highest point of the system. Install a check valve or back flow device upstream of the regulator, with a manual shut-off valve as required by local codes.

Piping

All high points should be vented. A heater installed above radiation level must be provided with a low water cut-off device (sales order option F-10). This heater, when used in connection with a refrigeration system, must be installed so that the chilled medium is

NOTE: Hot water heating systems all have unique levels of operating diversity that must be accounted for in the system design. The system should always include adequate system flow in excess of the connected boiler flow for proper operation. Where the system flow may drop below the connected boiler flow a buffer/decoupler may be needed. Failure to design for adequate flow (i.e. bypasses, 3 way control valves, flow limiting balance devices, buffer tanks, etc.) will result in boiler short cycling and may reduce boiler life. Always contact your local Raypak representative for system design assistance to avoid these issues.

pipled in parallel with the heater with appropriate valves to pre-vent the chilled medium from entering the heater.

The piping system of a hot water heater connected to heating coils located in air handling units where they may be exposed to circulating refrigerated air, must be equipped with flow control valves or other automatic means to prevent gravity circulation of the heater water during the cooling cycle. It is highly recommended that the piping be insulated.

Air-Separation/Expansion Tank

All heaters should be equipped with a properly sized expansion tank and air separator fitting as shown in Fig. 12.

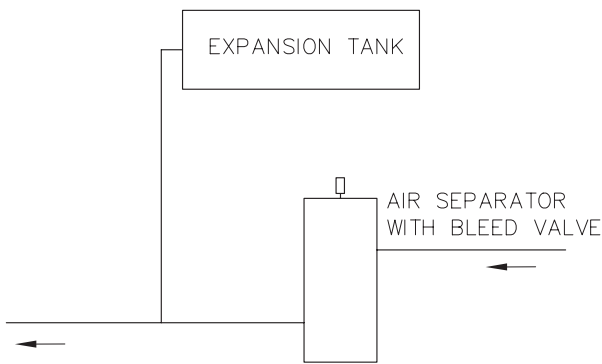


Fig. 12: Air-Separation/Expansion Tank

Three-Way Valves

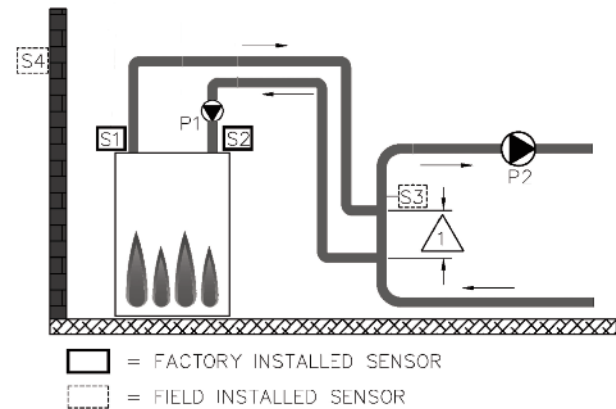
Three-way valves intended to regulate system water temperatures by reducing flow in the boiler should not be used. Raypak heaters are high-recovery, low-mass heaters which are not subject to thermal shock.

Applications & 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.

Type H models of MVB have three modes available to them to address the various applications the units can be applied to. Type WH units will only have the WH configuration available to them for use with potable water applications when directly connected to a hot water storage tank.

For detailed information on the Versa IC™ control system, see Catalog 5000.72. This manual can be found in the document library at www.raypak.com.



MODE 1

△ MAXIMUM DISTANCE NOT TO EXCEED 4 PIPE DIAMETERS OR 12 INCHES, WHICHEVER IS LESS.

Fig. 13: MODE 1 - Single Boiler with Primary/Secondary Piping

Mode 1 (Type H Units Only)

This mode selection is for hydronic heating systems with single or multiple boilers (Maximum 4 boilers) 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 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 and System Pump are delayed “off” as user defined in the **ADJUST** menu.

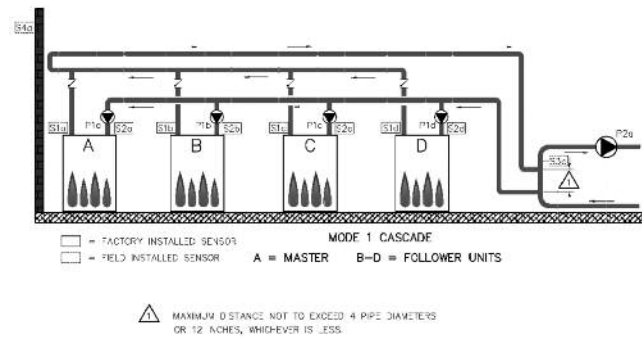


Fig. 14: MODE 1 - Boiler Cascade with Primary/Secondary Piping

NOTE: MODE 1 can also be used for process heating applications in conjunction with a buffer/storage tank when operating temperatures above 160°F are required. Care must be given to ensure water hardness is no more than 15 grains per gallon for scale free operation.

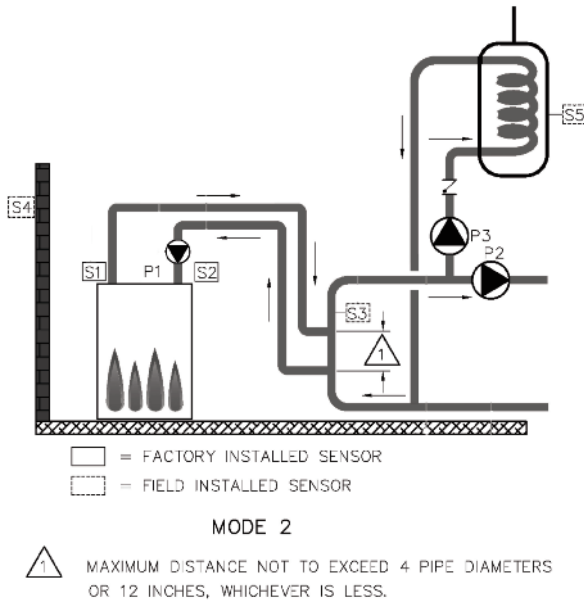


Fig. 15: MODE 2 - Single Boiler with Indirect on System Loop

Mode 2 (Type H Units Only)

This mode selection is for hydronic heating systems with single or multiple boilers (Maximum 4 boilers) 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 (P1) and System Pump (P2) delay “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.

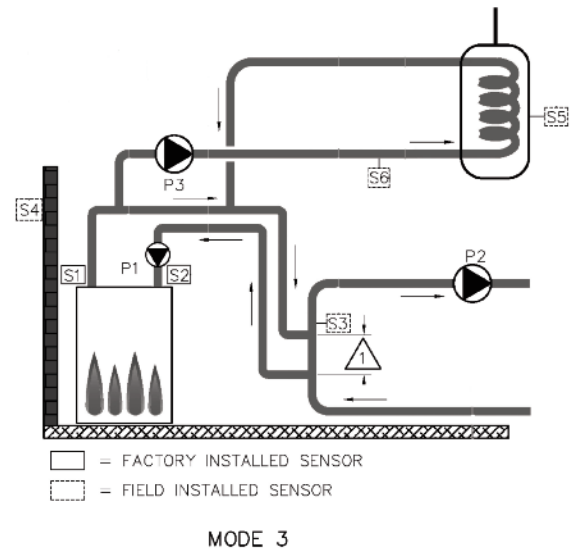


Fig. 16: MODE 3 - Single Boiler with Indirect on Boiler Loop

Mode 3 (Type H Units Only)

This mode selection is for hydronic heating systems with single or multiple boilers (Maximum 4 boilers) 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). 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 (P1) and System Pump (P2) delay “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.

NOTE: A Tank Aquastat can be used in lieu of the Indirect DHW Sensor (S5). See the Versa IC manual for additional details.

Domestic Hot Water

When designing the water piping system for domestic hot water applications, water hardness should be considered. Table G indicates the suggested flow rates for soft, medium and hard water. Water hardness is expressed in grains per gallon.

MVB Model	WATER HARDNESS														
	SOFT*					MEDIUM					HARD*				
	3-4 Grains Per Gallon					5-15 Grains Per Gallon					16-25** Grains Per Gallon				
	ΔT (°F)	GPM	ΔP (ft wc)	MTS (in)	SHL (ft wc)	ΔT (°F)	GPM	ΔP (ft wc)	MTS (in)	SHL (ft wc)	ΔT (°F)	GPM	ΔP (ft wc)	MTS (in)	SHL (ft wc)
504A	17	50	3.6	2	8.3	17	50	3.6	2	8.3	9	95	10.4	2	25.7
754A	26	50	4.0	2	8.7	17	73	7.8	2	17.3	14	90	11.4	2	25.3
1104A	21	85	11.5	2 1/2	16.2	21	85	11.5	2 1/2	16.2	15	116	19.6	2 1/2	27.8
1504A	27	94	18.4	2 1/2	24.0	24	105	22.5	2 1/2	29.3	22	115	26.5	2 1/2	34.6
2004A	29	117	32.6	2 1/2	40.9	29	117.2	32.6	2 1/2	40.9	29	117	32.6	2 1/2	40.9

ΔT = Temperature rise, °F

ΔP = Pressure drop through heat exchanger, ft

SHL = System head loss, ft (based on heater and tank connections of no more than 100 eq. ft. of tubing)

gpm = Gallons per minute, flow rate

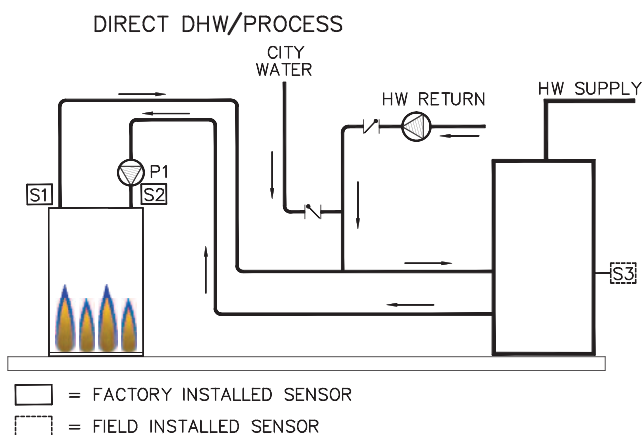
MTS = Minimum tubing size

*Must utilize optional cupro-nickel tubes. If over 25 grains per gallon, a water softener/treatment system must be utilized.

****Caution:** For scale free operation with "Hard Water" (16-25 grains per gallon of total hardness), the operating control must NOT be set higher than 130 F. For higher than 130 F operation, a water softener/treatment system must be utilized.

***Care should be given to prevent over-softening of the water as over-softened water can become aggressive. Cupro-nickel tubes are recommended for water softened below 5 grains per gallon.

Table G: Domestic Water Heater Flow Rate Requirements



**Fig. 17: WH Units - Single Water Heater with Tank
H Units - Single Boiler with Process Tank**

WH – Direct DHW Configuration

When the unit is ordered as a "WH" configuration the only application available to it is direct DHW with single or multiple heaters (Maximum 4 heaters). The tank temperature is controlled by the System sensor (S3). The Boiler Pump (P1) runs during any call for heat. The System Pump (P2) output is active whenever the system is enabled. The Boiler Pump is delayed "off" after the Tank Target temperature is achieved and as user defined in the **ADJUST** menu.

NOTE: If local codes require a vacuum relief valve, acquire one locally and install per valve manufacturer's instructions.

NOTE: WH units will operate to a maximum tank temperature of 160°F. For temperatures required above 160°F an "H" model boiler must be used and great care must be given to ensure water hardness is no more than 15 grains per gallon for scale free operation. MODE 1 should be used and configured for setpoint operation for process heating applications.

Potable Water and Space Heating

CAUTION: When this heater is used for both potable water and space heating, observe the following to ensure proper operation.

1. All piping materials and components connected to the water heater for the space heating application shall be suitable for use with potable water.
2. Toxic chemicals, such as used for boiler treatment, shall not be introduced into the potable water used for space heating.
3. If the heater will be used to supply potable water, it shall not be connected to any heating system or components previously used with a non-potable water heating appliance.
4. When the system requires water for space heating at temperatures higher than 140°F (60°C), a means such as a mixing valve shall be installed to temper the water in order to reduce scald hazard potential.

Automatic Chemical Feeders

All chemicals must be introduced and completely diluted into the water before being circulated through the heater. High chemical concentrations will result when the pump is not running (e.g. overnight).

NOTE: High chemical concentrations from feeders that are out of adjustment will cause rapid corrosion to the heat exchanger. Such damage is not covered under the warranty.

NOTE: Failure of a heat exchanger due to lime scale build-up on the heating surface, low pH or other chemical imbalance is non-warrantable.

CAUTION: Combustion air must not be contaminated by corrosive chemical fumes which can cause unwarrantable damage to the heater.

Pool Heating

When a boiler or water heater is used in a pool heating application, ensure that all the following installation requirements are met.

The MVB must be equipped with an external pump and bypass arrangement. This arrangement blends outlet water with the inlet water to increase the inlet water temperature to a minimum of 105°F (40°C) for Pool Heater (P) versions and 120°F (49°C) for Hydronic Heating (H7) or Domestic Hot Water (WH7) versions, thereby reducing the likelihood of condensation forming on the heat exchanger. The pump also serves to circulate water through the heater from the main system piping.

CAUTION: Power to the heater should be interlocked with the main system pump to make sure the heater does not fire without the main system pump in operation. Improper flow control can damage the heater. Uncontrolled flow (too high) or restricted flow (too low) can seriously damage the heater. Follow these instructions to make sure your heater is properly installed.

To complete the installation of the pool heater, the pool thermostat must be installed in the main return water line, upstream of the heater. This will ensure that the heater will be energized at the right time.

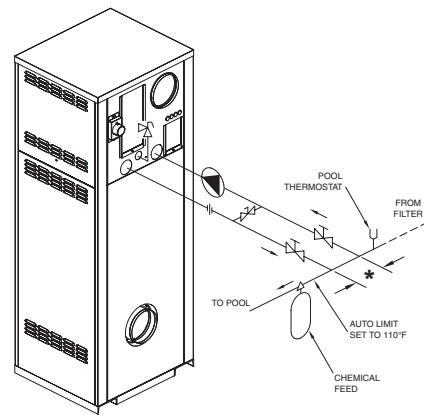


Fig. 18: Single Pool Heater Application

CAUTION: Combustion air must not be contaminated by corrosive chemical fumes which can damage the heater and can cause unwarrantable damage to the heater.

Winterizing Your Heater

Heaters installed outdoors as pool heaters in freezing climate areas should be shut down for the winter. To shut down the heater, turn off manual main gas valve and main gas shut-off. Close isolation valves. Drain the heater using the hose bibs located on the bottom of the heat exchanger.

NOTE: There are 2 separate drains on the MVB that must BOTH be drained to protect the heat exchanger. These are both accessible by removing the lower front door from the heater. Drain any piping of all water that may experience below-freezing temperatures.

Pool/Spa Water Chemistry

CAUTION: Corrosive water can cause unwarrantable damage to the heater.

NOTE: Chemical imbalance can cause severe damage to your heater and associated equipment.

Chemical imbalance can cause severe damage to the pool heater and associated equipment. Maintain the water chemistry according to the chart below. If the mineral content and dissolved solids in the water become too high, scale forms inside the heat exchanger tubes, reducing heater efficiency and damaging the heater. If the pH drops below 7.2, this will cause corrosion of the heat exchanger and severely damage the heater. Heat exchanger damage resulting from chemical imbalance is not covered by the warranty.

Recommended Level(s)	Fiberglass Pools	Fiberglass Spas	Other Pool and Spa Types
Water Temperature	68-88°F (20-31°C)	89-104°F (31-40°C)	68-104°F (20-40°C)
pH	7.3-7.4	7.3-7.4	7.6-7.8
Total Alkalinity (ppm)	120-150	120-150	80-120
Calcium Hardness (ppm)	200-300	150-200	200-400
Salt (ppm)	6000 Maximum	6000 Maximum	6000 Maximum
Free Chlorine (ppm)*	2-3	2-3	2-3
Total Dissolved Solids (ppm)	3000 Maximum	3000 Maximum	3000 Maximum

*Free Chlorine **MUST NOT EXCEED 5 ppm!**

Table H: Pool Water Chemistry

For your health and the protection of your pool equipment, it is essential that your water be chemically balanced. The following levels must be used as a guide for balanced water.

Occasional chemical shock dosing of the pool or spa should not damage the heater providing the water is balanced.

Automatic chemical dosing devices and salt chlorinators are usually more efficient in heater water, unless controlled, they can lead to excessive chlorine level which can damage your heater.

Further advice should be obtained from your pool or spa builder, accredited pool shop, or chemical supplier for the correct levels for your water.

Automatic Chlorinators and Chemical Feeders

All chemicals must be introduced and completely diluted into the pool or spa water before being circulated through the heater. Do not place sanitizing chemicals in the skimmer. High chemical concentrations will result when the pump is not running (e.g. overnight).

Chlorinators must feed downstream of the heater and have an anti-siphoning device to prevent chemical back-up into the heater when the pump is shut off.

NOTE: High chemical concentrates from feeders and chlorinators that are out of adjustment will cause rapid corrosion to the heat exchanger. Such damage is not covered under the warranty.

NOTE: Failure of a heat exchanger due to lime scale build-up on the heating surface, low pH or other chemical imbalance is non-warrantable.

Gas Supply

DANGER: Make sure the gas on which the heater will operate is the same type as specified on the heater's rating plate.

Gas piping **must** have a sediment trap ahead of the heater gas controls, **and** a manual shut-off valve located outside the heater jacket. It is recommended that a union be installed in the gas supply piping adjacent to the heater for servicing. The gas supply pressure to the heater must not exceed 10.5 in. WC for natural gas or 13.0 in. WC for propane gas. A pounds-to-inches regulator must be installed to reduce the gas supply pressure if it is higher than noted above. This regulator should be placed a minimum distance of 10 times the pipe diameter upstream of the heater gas controls. Refer to Table H for maximum pipe lengths.

Gas Supply Connection

CAUTION: The heater 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 heater 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 less than 1/2 psi (3.45 kPa). Relieve test pressure in the gas supply line prior to re-connecting the heater 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 heater 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.

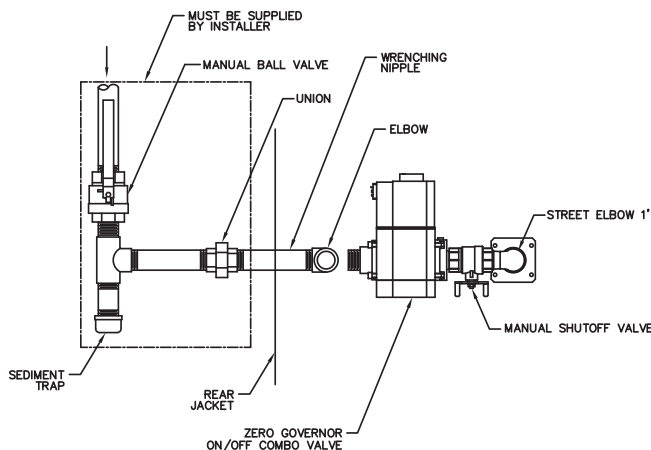


Fig. 19: Gas Supply Connection

CAUTION: Do not use Teflon tape on gas line pipe thread. 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 heater or its accessories. Make sure the gas piping is protected from physical damage and freezing, where required.

Gas Supply Pressure

A minimum of 4.0 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 4.0 in. WC upstream gas pressure under full load and a maximum gas supply pressure setpoint of 13.0 in. WC is required for propane gas. The gas pressure regulator(s) supplied on the heater 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 heater gas controls.

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.

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 heater is nominally preset as noted in Table I.

During normal operation, carbon dioxide should be $9.0\% \pm 0.2\%$ at full fire for natural gas and $10.2\% \pm 0.2\%$ for propane gas. Carbon monoxide should be $<100\text{ppm}$.

Model No.	1 in. NPT		1-1/4 in. NPT		1-1/2 in. NPT		2 in. NPT		2-1/2 in. NPT	
	N	P	N	P	N	P	N	P	N	P
504A	15	35	65	150	130	360				
754A	5	15	65	100	75	180	250			
1104A			35	55	35	90	125	300	300	
1504A			10	15	15	25	60	150	150	275
2004A							35	90	85	210

- Natural Gas – 1,000 BTU/ft³, 0.60 specific gravity at 0.5 in. WC pressure drop
- Propane Gas – 2,500 BTU/ft³, 1.53 specific gravity at 0.6 in. WC pressure drop

Table I: Maximum Equivalent Pipe Length

Model	Manifold Gas Pressure Setting High Fire Values (in. WC)	
	Natural Gas	Propane Gas
504A	-4.1	-4.4
754A	-4.6	-5.8
1104A	-4.6	-7.2
1504A	-7.0	-9.2
2004A	-4.4	-8.1

NOTE: Manifold pressures should be ±0.2 in. WC.

Table J: Manifold Gas Pressure Settings

The MVB 504A-1504A heaters are wired for 120 VAC, 12 amps while the MVB 2004A heaters are wired for 120 VAC, 18 amps. Consult the wiring diagram shipped with the heater. Before starting the heater, check to ensure proper voltage to the heater and pump.

Pumps must use a separate power supply and run the power through the pump contactor, which is located in the rear wiring box. Use appropriately-sized wire as defined by NEC, CSA and/or local codes. All primary wiring should be 125% of minimum rating.

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

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.

All high voltage wiring connections to the MVB heater are made inside the rear wiring box as shown in Fig. 20. Power for indirect DHW pump not exceeding 5 amps should be taken from terminals 4 (Hot), 5 (Com), and 6 (Gnd). Power for system pump not exceeding 5 amps should be taken from terminals 7 (Hot), 8 (Com), and 9 (Gnd). Power for boiler pumps 3/4 HP and smaller should be taken from terminals 1 (Hot), 2 (Com), and 3 (Gnd), and must be routed through the pump contactor; 30A supply is required. Power for pumps larger than 3/4 HP must be a separate circuit wired through the pump contactor. Power to the MVB heater should be connected to terminals 1, 2, and 3 as noted in Fig. 20. All low voltage wiring, including sensors, interlocks, enable/disable, and various options are wired into terminals 1–24 on the front wiring panel as noted in Fig. 25.

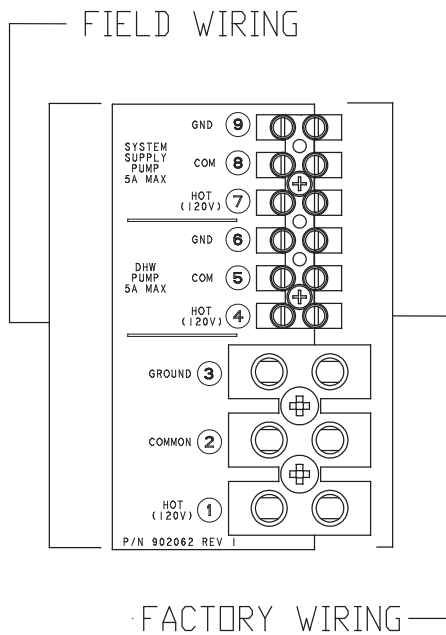


Fig. 20: Wiring Electrical Connections

Field-Connected Controllers

It is strongly recommended that all individually-powered control modules and the heater should be supplied from the same power source.

NOTE: Field-supplied isolation relays should be installed when field-connected controllers are mounted more than 50 equivalent feet (18 AWG) from heater. See wiring diagrams.

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.

Check the Power Source

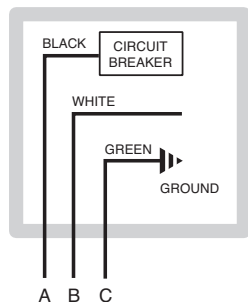


Fig. 21: Wiring Connections

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 Fig. 19.)

Check the power source:

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

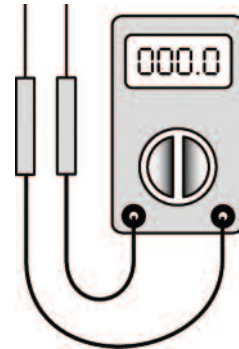


Fig. 22: Multi-meter

Making the Electrical Connections

Refer to Fig. 20-23.

1. Verify that circuit breaker is properly sized by referring to heater rating plate. A dedicated circuit breaker should be provided.
2. NOTE: Current draw noted on rating plate does not include pump current.
3. Turn off all power to the heater. Verify that power has been turned off by testing with a multi-meter prior to working with any electrical connections or components.
4. 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.
5. Provide overload protection and a disconnect means for equipment serviceability as required by local and state code.
6. Install heater controls, thermostats, or building management systems in accordance with the applicable manufacturers' instructions.
7. Conduit should not be used as the earth ground.

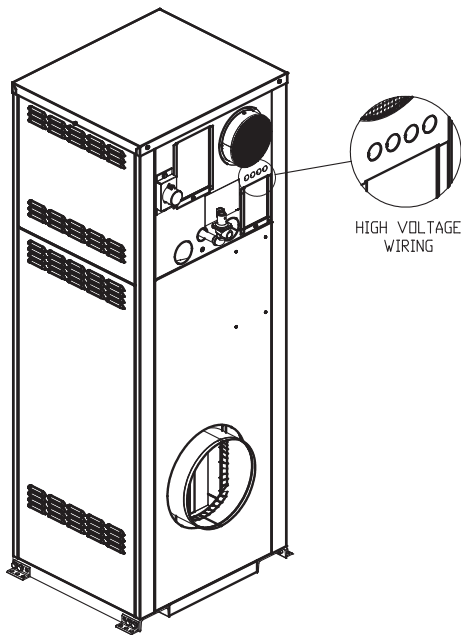


Fig. 23: Wiring Location

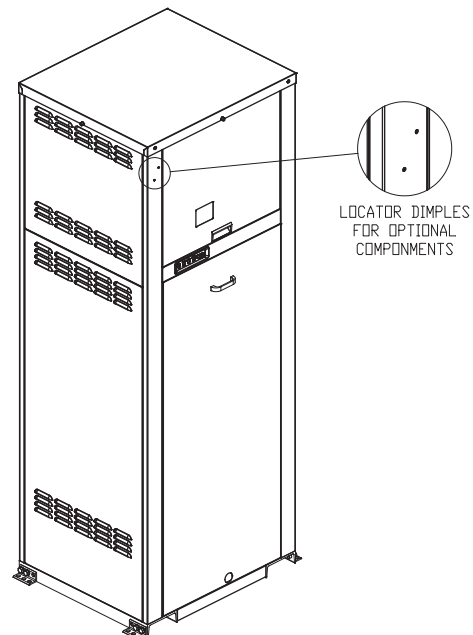


Fig. 24: Locator Dimples for Optional Components

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 Connection

CAUTION: Label all wires prior to disconnection when servicing controls. Wiring errors can cause improper and dangerous operation. Verify proper operation after servicing.

DANGER: SHOCK HAZARD

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

Wiring the Enable/Disable

Connect the Enable/Disable wiring to the field wiring terminal (shown in Fig. 25). Alternately, any dry contact

closure (including a remote thermostat) across these terminals will enable the MVB unit to run. Caution should be used to ensure neither of the terminals becomes connected to ground.

Wiring the Outdoor Sensor

1. There is no connection required if an outdoor sensor is not used in this installation.
2. If using an Outdoor Sensor (option B-32), connect the sensor wires to the terminals marked OUTDOOR SENSOR (see Fig. 25). Caution should be used to ensure neither of these terminals becomes connected to ground.
3. Use a minimum 18 AWG wire for runs of up to 150 feet.
4. Mount the outdoor 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.

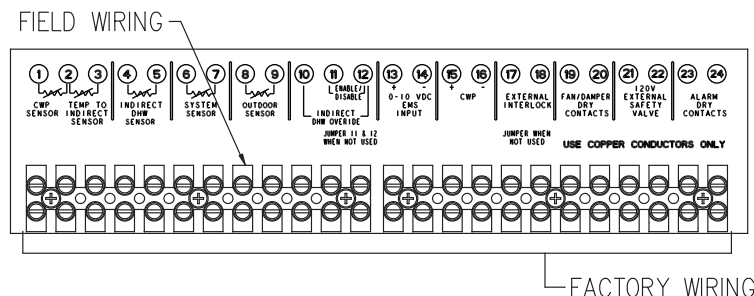


Fig. 25: Low Voltage Field Wiring

Wiring the Indirect Sensor

1. An indirect sensor connection is not 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 as needed. If an optional Indirect DHW sensor is connected, 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 still 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 will also be activated based on the Indirect DHW piping configuration setting. Consult the VERSA IC manual (Cat. 5000.72) for additional configurations.
3. Connect the indirect tank sensor to the terminals marked INDIRECT DHW SENSOR (see wiring diagram). 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 INDIRECT DHW OVERRIDE.

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

Wiring the Optional 0–10 Volt Building Control Signal

1. A signal from an energy management system may be connected to the MVB 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 of a single MVB or a cascade of up to 4 boilers, or the firing rate of a single MVB 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 4-20mA application, refer to the VERSA IC manual (Cat. 5000.72).
4. Connect an Energy Management system or other auxiliary control signal to the terminals marked 0-10V (+ /-) on the field wiring terminals (see Fig. 25). Caution should be used to ensure that the +0-10V connection does not create a short to ground.

Wiring the Cascade System Communication Bus

1. Designate the primary boiler as the master boiler/boiler1 by leaving dip switch 2 on the VERSA in the ON position. All other VERSA controls require dip switch 2 to be toggled OFF, designating them as followers. Follower VERSA boards are ignored by their corresponding PIM™ modules. Use standard 18 AWG wire to connect the master VERSA to the PIM™ on the followers. A total of 3 followers can be connected to the VERSA on the master. For systems requiring more than 4 connected boilers, an external sequencer such as the Raypak Temp Tracker Mod+ Hybrid can be used.
2. It is recommended that the shortest length cable possible be used to reach between the boilers. Do not run unprotected cables across the floor or where they will become wet or damaged. Do not run communication cables parallel with, or close to or against, high voltage (120 volt or greater) wiring. Raypak recommends that the total maximum length of each set of communication bus cables not exceed 200 feet.
3. Connect the FT_BUS wires to the PIM™ by pressing down on the slots with a small screwdriver and then inserting the wires into the holes. See Fig. 26.

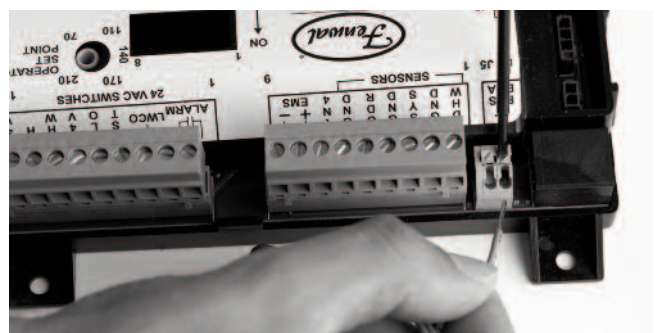


Fig. 26: FT_BUS Wire Connection

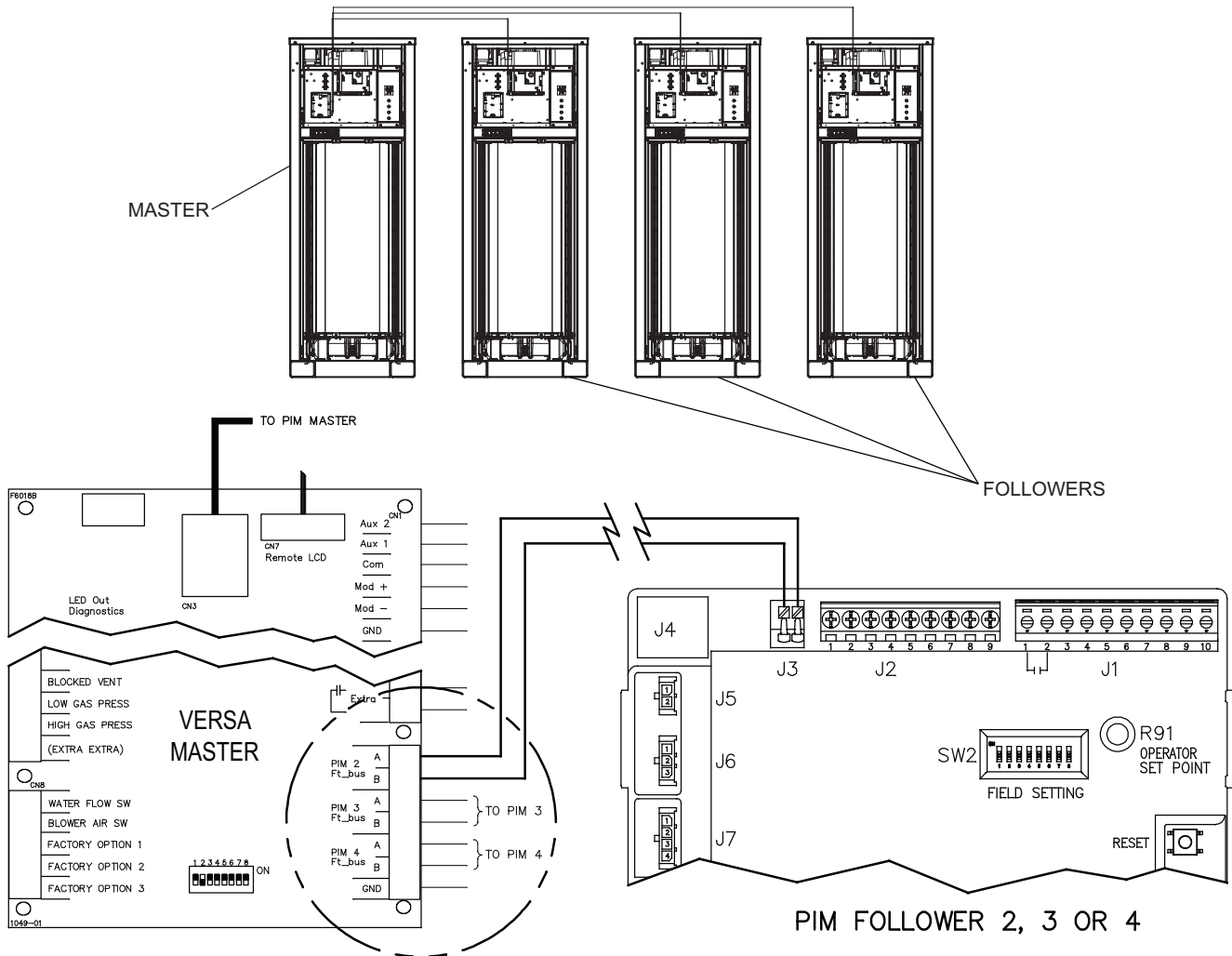


Fig. 27: MVB Cascade System Wiring

Cascade System Pump and Sensor Wiring

1. On the boiler designated as the Master, connect the system pump enable wiring to the terminal block at the rear of the unit. The connections are dry contacts rated for pilot duty only (5A maximum).
2. Connect the boiler pump enable wires to the terminal block at the rear of their unit. The connections are dry contacts rated for pilot duty only (5A maximum).
3. Connect the system supply sensor to terminals 6 and 7 on the field wiring strip located on the Master PIM™ (See Fig. 25).
4. Connect the Outdoor sensor (if used) to terminals 8 and 9 on the field wiring strip located on the Master boiler (See Fig. 25).

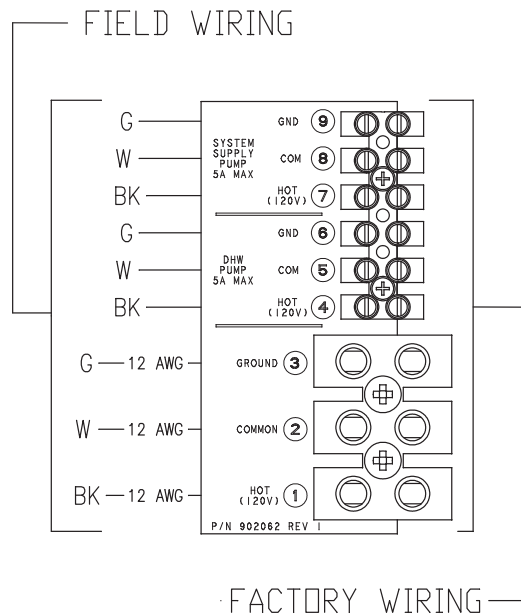


Fig. 28: MVB Cascade Master Pumps

- Connect the Enable/Disable wiring to terminals 11 and 12 on the field wiring strip located on the Master boiler (See Fig. 25). 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.

Cascade Follower Pump and Sensor Wiring

- 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.
- For each follower boiler, connect the boiler pump wires to the pump contactor at the rear of each unit.
- The System and DHW pump outputs are not used in the Cascade Follower configuration.

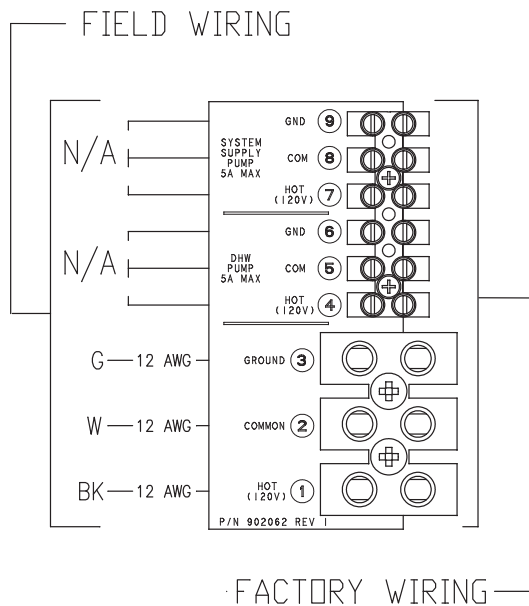


Fig. 29: VERSA Follower

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 (5000.72) for further information.

Alarm Connection

An alarm annunciator or light may be connected to the alarm contacts on the field wiring terminals. 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. See the Field Wiring as shown in Fig. 25.

In a cascade system, the alarm output of the master boiler will be active if either the master boiler or follower(s) have a lockout condition. The alarm output of the follower boilers will only energize if a lockout condition occurs on that specific boiler.

Venting

General

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

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 K for appliance category requirements.

Combustion Air Supply	Exhaust Configuration	Heater Venting Category	Certified Materials	Combustion Air Inlet Material
From Inside Building (Non-Direct Venting)	Vertical Venting	I	B-Vent Equivalent	
	Horizontal Through-the-Wall Venting	III	Stainless Steel	
From Outside Building (Direct Venting)	Vertical Venting	I	B-Vent Equivalent	Galvanized Steel PVC ABS CPVC
	Horizontal Through-the-Wall Venting	III	Stainless Steel	

Table K: Venting Category Requirements

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

CAUTION: Condensate drains for the vent piping are required for installations of the MVB. Follow vent manufacturer instructions for installation and location of condensate drains in the vent. Condensate drain must be primed with water to prevent gas flue leak and must be routed to an appropriate container for neutralization before disposal, as required by local 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 I or III vent system. Using improper venting materials can result in personal injury, death or property damage.

CAUTION: Vent piping is hot. Raypak recommends the use of double wall or insulated wall pipe to prevent personal injury.

NOTE: Ensure that clearances are maintained per Tables C and D.

Extractors, Draft Inducers, and Motorized Flue Dampers

When extractors or inducers are used in the venting system, they must be interlocked with each connected appliance, to ensure proper operation. If individual motorized dampers are used, they must be interlocked to their respective appliance. See Field Wiring Connection section of this manual for proper wiring instructions, using Fan/Damper dry contacts and external interlock.

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.

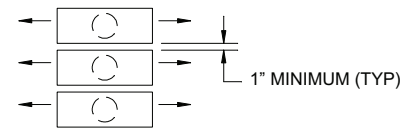
Vent Terminal Location

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

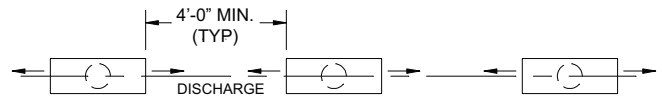
1. Condensate can freeze on the vent cap. Frozen condensate on the vent cap can result in a blocked flue condition.
2. Give special attention to the location of the vent termination to avoid possibility of property damage or personal injury.
3. Gases may form a white vapor plume in winter. The plume could obstruct a window view if the termination is installed near windows.
4. Prevailing winds, in combination with below-freezing temperatures, can cause freezing of condensate and water/ice build-up on buildings, plants or roofs.
5. The bottom of the vent terminal and the air intake shall be located at least 12 in. above grade, including normal snow line.

6. Uninsulated single-wall metal vent pipe shall not be used for venting this appliance without insulation.
7. Through-the-wall vents for Category I and III 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.
8. Locate and guard vent termination to prevent accidental contact by people or pets.
9. DO NOT terminate vent in window well, stairwell, alcove, courtyard or other recessed area.
10. DO NOT terminate above any door, window, or gravity air intake. Condensate can freeze, causing ice formations.
11. Locate or guard vent to prevent condensate from damaging exterior finishes. Use a rust-resistant sheet metal backing plate against brick or masonry surfaces.
12. 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.

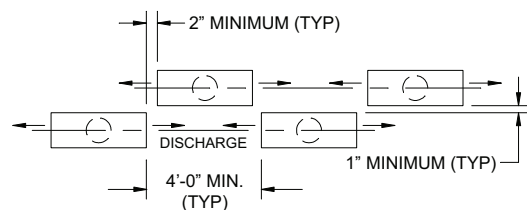
6. DO NOT terminate vent closer than 5 ft below roof overhang.
7. The vent terminal requires a 12 in. vent terminal clearance from the wall.
8. Terminate vent at least 1 ft above grade, including normal snow line.
9. Multiple direct vent installations require a 4 ft clearance between the ends of vent caps located on the same horizontal plane.



VENT CAPS STACKED VERTICALLY
FLUE GASES MOVING IN PARALLEL



VENT CAPS ALL AT SAME ELEVATION
FLUE GASES MOVING TOWARD EACH OTHER



VENT CAPS AT STAGGERED ELEVATIONS
FLUE GASES MOVING TOWARD EACH OTHER

U.S. Installations

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

Vent termination requirements are as follows:

1. Vent must terminate at least 4 ft below, 4 ft horizontally from or 1 ft above any door, window or gravity air inlet to the building.
2. The vent must not be less than 7 ft above grade when located adjacent to public walkways.
3. Terminate vent at least 3 ft above any forced air inlet located within 10 ft.
4. Vent must terminate at least 4 ft horizontally, and in no case above or below unless 4 ft horizontal distance is maintained, from electric meters, gas meters, regulators, and relief equipment.
5. Terminate vent at least 6 ft away from adjacent walls.

Fig. 30: Vent Cap Configurations

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 57 of this manual.

Canadian Installations

Refer to latest edition of the B149 Installation Code.

A vent shall not terminate:

1. Directly above a paved sidewalk or driveway which is located between two single-family dwellings and serves both dwellings.
2. Less than 7 ft (2.13 m) above a paved sidewalk or paved driveway located on public property.
3. Within 6 ft (1.8 m) of a mechanical air supply inlet to any building.
4. Above a meter/regulator assembly within 3 ft (915 mm) horizontally of the vertical centre-line of the regulator.
5. Within 6 ft (1.8 m) of any gas service regulator vent outlet.
6. Less than 1 ft (305 mm) above grade level.
7. Within 3 ft (915 mm) 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.
8. Underneath a verandah, porch or deck, unless the verandah, 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 verandah, porch or deck is greater than 1 ft (305 mm).

Venting Installation Tips

Support piping:

- horizontal runs—at least every 5 ft (1.5m)
- vertical runs—use braces
- under or near elbows

Venting Configurations

WARNING: Examine the venting system at least once a year. Check all joints and vent pipe connections for tightness, corrosion or deterioration.

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 I)

Installation

Natural draft venting uses the natural buoyancy of the heated flue products to create a thermal driving head that expels the exhaust gases from the flue. The negative draft must be within the range of $-.01$ to $-.08$ in. WC as measured 12 in. above the appliance flue outlet to ensure proper operation. Vent material must be listed by a nationally recognized test agency.

The venting for Category I appliances shall be determined per the NFGC (U.S.) or B149 (Canada).

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 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.

Termination

NOTE: A vent adapter (field-supplied) may be required to connect the Category I vent to the heater.

The vent terminal should be vertical and should terminate outside the building at least 2 ft above the highest point of the roof that is within 8 ft for models 504 to 1504 and within 10 ft for model 2004. The vent cap should have a minimum clearance of 4 ft horizontally from and in no case above or below (unless a 4 ft 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). Gas vents supported only by flashing and extended above the roof more than 5 ft should be securely guyed or braced to withstand snow and wind loads.

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

Model No.	Certified Vent Material	Vent Size (in.)	Vertical Vent Height ¹ (ft)		Combustion Air Intake Pipe Material	Air Inlet Max. Length* (ft)		
			Min.	Max.		6" Ø	8" Ø	10" Ø
504A	Category I (Type B Equivalent)	8	5	25	Galvanized Steel, PVC, ABS, CPVC	45	100**	
754A		10						
1104A		10						
1504A		12				45	85**	
2004A		14						

¹ Vent lengths are based on a lateral length of 2 ft. Refer to the latest edition of the NFGC for further details. When vertical height exceeds 25 ft, consult factory prior to installation.

* Subtract 10 ft per elbow. Max. 4 elbows.

** Adapters supplied by others.

Table L: Category I Vertical Venting

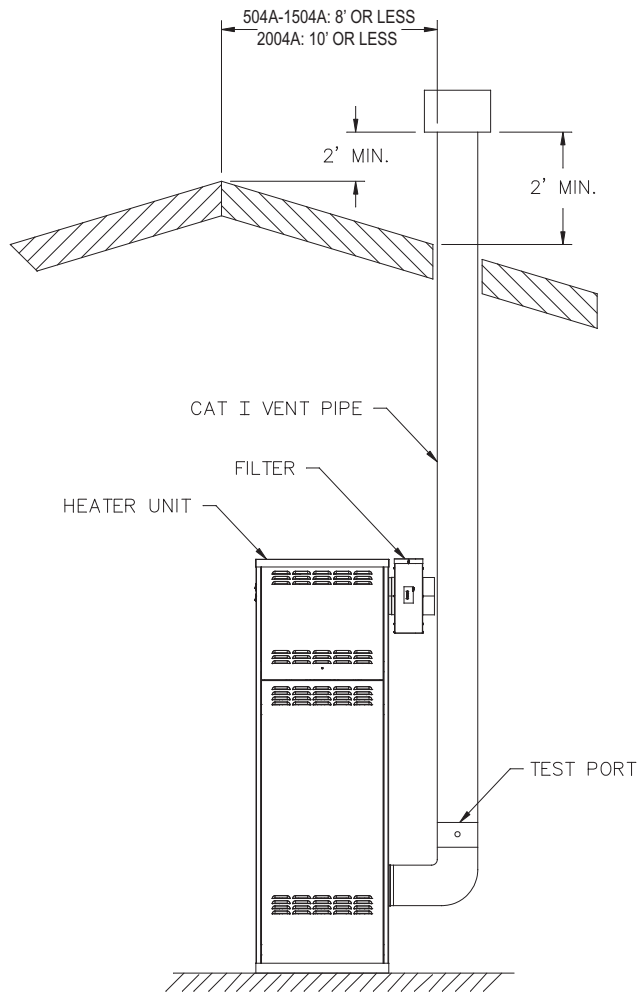


Fig. 31: Vertical Venting

Common Venting

Manifolds that connect more than one heater to a common chimney must be sized to handle the combined load. Consult available guides for proper sizing of the manifold and the chimney. At no time should the area of the common vent be less than the area of the largest heater exhaust outlet.

Common venting systems may be too large once an existing unit is removed. At the time of removal of an existing appliance, **the following steps must 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.

WARNING: Vent connectors serving appliances vented by natural draft shall not be connected into any portion of mechanical draft systems operating under a positive pressure.

CAUTION: Vent connectors for natural draft venting systems must be Type B or better.

1. Seal any unused opening in the common venting system.
2. Visually inspect the venting system for proper size and horizontal pitch and verify there is no blockage, restriction, leakage, corrosion or other unsafe condition.

3. Insofar as is practical, close all building doors and windows and all doors between the space in which the appliances remaining connected to the common venting system are located and other spaces of the building. Turn on clothes dryers and any appliance not connected to the common vent system. Turn on any exhaust fans, such as range hoods and bathroom exhausts, at maximum speed. Do not operate summer exhaust fan. Close fireplace dampers.
4. Place in operation the appliances being inspected. Follow the manufacturer's instructions for lighting each appliance. Adjust thermostat so appliance will operate continuously.
5. Check the pressure at a pressure tap located 12 in. above the bottom joint of the first vertical vent pipe. Pressure should be anywhere between -0.01 and -0.08 in. WC.
6. After it has been determined that each appliance remaining connected to the common venting system properly vents when tested as outlined above, return doors, windows, exhaust fans, fireplace dampers and other gas burning appliances to their previous conditions of use.

7. Any improper operation of the common venting system should be corrected so that the installation conforms with the NFGC (U.S.) or B149 (Canada). When re-sizing any portion of the common venting system, the common venting system should be re-sized to approach the minimum size as determined using the appropriate tables in Appendix G in the NFGC (U.S.) or B149 (Canada).

Engineered Vent Systems

Table M provides boiler discharge vent volumes of flue products at full fire for the calculation of appropriate vent sizing for common venting.

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 MVB heater is installed to replace an existing heater, the vent system **MUST** be verified to be of the correct size and Category. If it is **NOT**, it **MUST** be replaced.

NOTE: For extractor sizing, typical CO₂ levels are 9.0% for natural gas and 10.2% for LP gas and flue temperature of 350° F. measured at test port 12" above the flue collar.

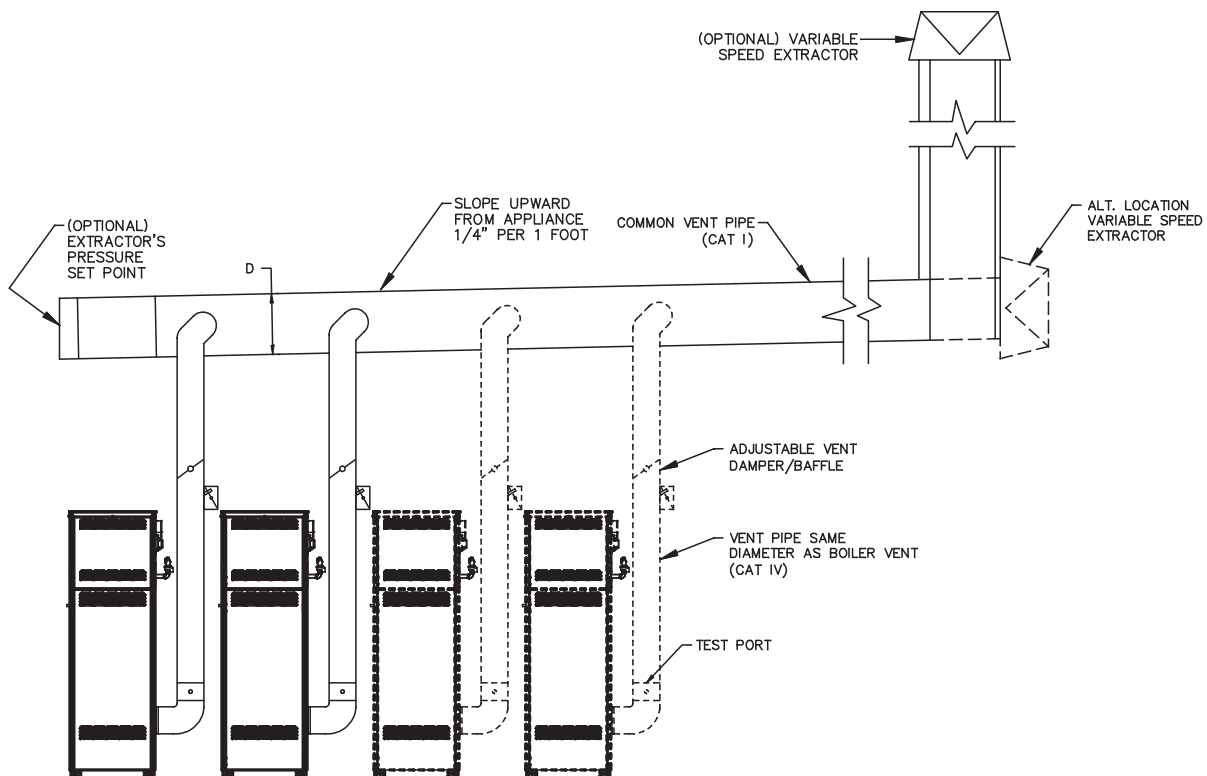


Fig. 32: Typical Common Venting

Model No.	Vent Size (in.)	Volume of Flue Products (CFM)
504A	8	170
754A	10	260
1104A	10	380
1504A	12	510
2004A	14	680

NOTE: Data for 100% firing rate.

Table M: Typical Volume of Flue Products

Horizontal Through-the-Wall Direct Venting (Category III)

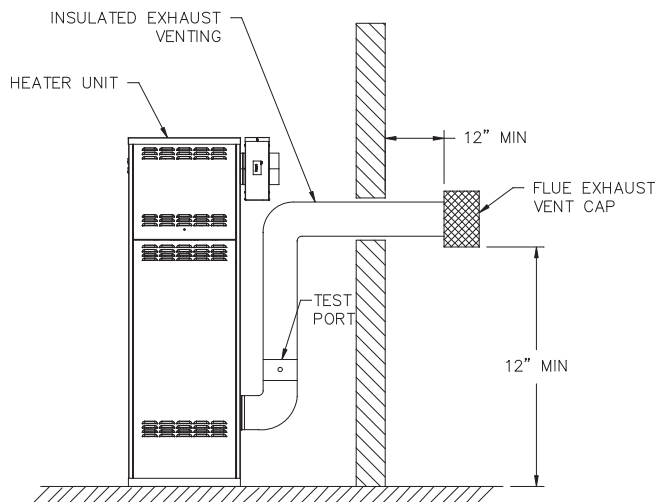


Fig. 33: Horizontal Through-the-Wall Venting

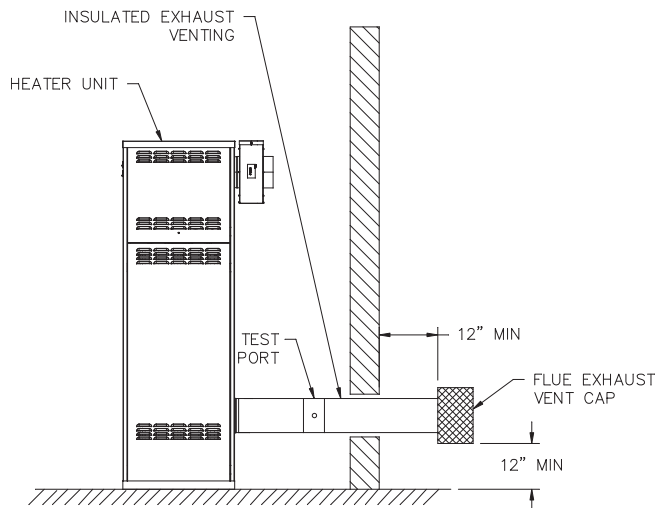


Fig. 34: Alt. Horizontal Through-the-Wall Venting

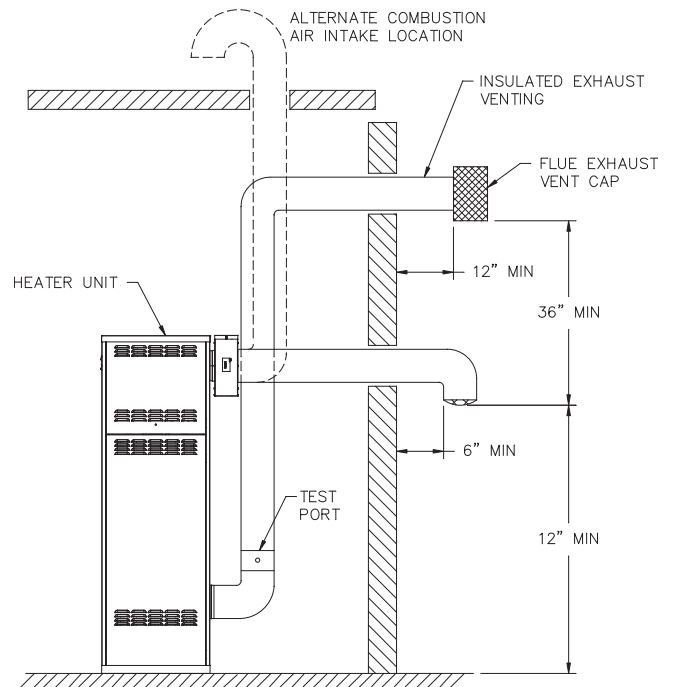


Fig. 35: Horizontal Through-the-Wall Direct Venting

Installation

These installations utilize the heater-mounted blower to vent the combustion products to the outdoors. Combustion air is taken from inside the room and the vent is installed horizontally through the wall to the outdoors. Adequate combustion and 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 flue system should not exceed 75 equivalent ft in length. If horizontal run exceeds 75 equivalent ft, an appropriately sized variable-speed extractor must be used. Each elbow used is equal to 10 ft of straight pipe. This will allow installation in one of the four following arrangements:

- 75' of straight flue pipe
- 65' of straight flue pipe and one elbow
- 55' of straight flue pipe and two elbows
- 45' of straight flue pipe and three elbows

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

When installing multiple sidewall vent terminations, follow guidelines in fig. 30.

Model No.	Certified Vent Material	Vent Size (in.)	Maximum Horizontal Vent Length (ft)**	Combustion Air Intake Pipe Material	Air Inlet Max. Length** (ft)		
					6" Ø	8" Ø	10" Ø
504A	Category III	8	75	Galvanized Steel, PVC, ABS, CPVC	45	100 ^t	
754A		10					
1104A		10					
1504A		12			45	85 ^t	
2004A		14					

** Subtract 10 ft per elbow. Max. 4 elbows.

^t Adapters supplied by others.

Table N: Category III Horizontal Vent & Horizontal Direct Vent

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 a condensate drain located in proximity to the heater 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 double wall or insulated through the length of the horizontal run.

Termination

The flue direct vent cap **MUST** be mounted on the exterior of the building. The direct vent cap cannot be installed in a well or below grade. The direct vent cap must be installed at least 1 ft above ground level and above normal snow levels. **The Raypak-approved stainless steel flue direct vent cap must be used (sales order option D-15).** The vent terminal must be located **NO CLOSER** than 12" off the wall.

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

Direct Vent—Vertical

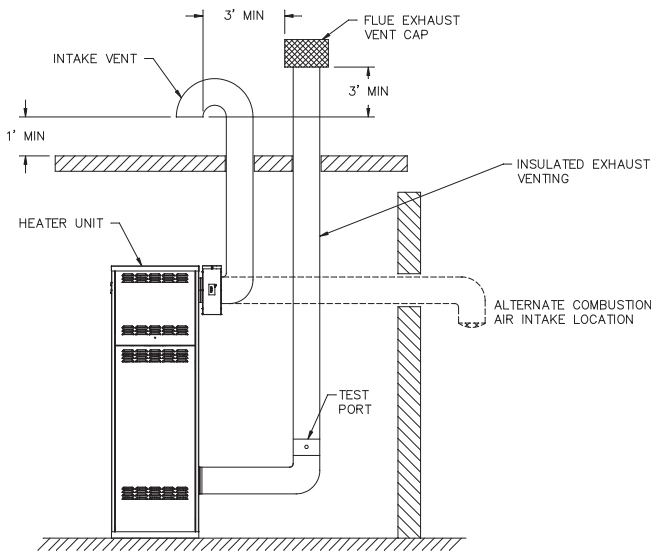


Fig. 36: Direct Vent - Vertical

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 Tables L and N. Each elbow used is equal to 10 ft of straight pipe. This will allow installation in any arrangement that does not exceed the lengths shown in Tables L and N.

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.

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 slight upward slope of not more than 1/4 inch per foot of horizontal run to the vent terminal.
2. The entire vent must be double wall or insulated through its length.

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 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 heater due to the recirculation of flue products. Multiple vent caps installed in the same horizontal plane must have a 4 ft 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.

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

CAUTION: A listed vent cap terminal adequately sized, must be used to evacuate the flue products from the building.

Outdoor Installation

Units installed outdoors must be vented with listed Category I (Type B double-wall or equivalent) vent material per the following instructions and installed with the factory-supplied outdoor vent kit. A special vent cap and air intake elbow are provided in accordance with CSA requirements. These must be installed directly on the vent pipe as illustrated in Fig. 36.

Care must be taken when locating the heater outdoors, because the flue gases discharged from the vent cap can condense as they leave the cap. Improper location can result in damage to adjacent structures or building finish. For maximum efficiency and safety, the following precautions must be observed:

1. Outdoor models must be installed outdoors and must use the outdoor vent cap and air intake elbow available from the manufacturer (sales order option D-11).
2. Periodically check venting system. The heater's venting areas must never be obstructed in any way and minimum clearances must be observed to prevent restriction of combustion and ventilation air. Keep area clear and free of combustible and flammable materials.
3. Do not locate adjacent to any window, door, walkway, or gravity air intake. The vent must be located a minimum of 4 ft horizontally from such areas.
4. Install above grade level and above normal snow levels.
5. Vent terminal must be at least 3 ft above any forced air inlet located within 10 ft.

NOTE: The vent cap and air intake elbow must be furnished by the heater manufacturer in accordance with its listing (sales order option D-11).

Freeze Protection

To enable freeze protection, dip switch position 7 (on the PIM™) must be turned on (UP position). This is the default position.

If the water temperature drops below 45°F on the Outlet or Inlet sensors, the Boiler pump is enabled. The pump is turned off when both the Inlet and Outlet temperatures rise above 50°F.

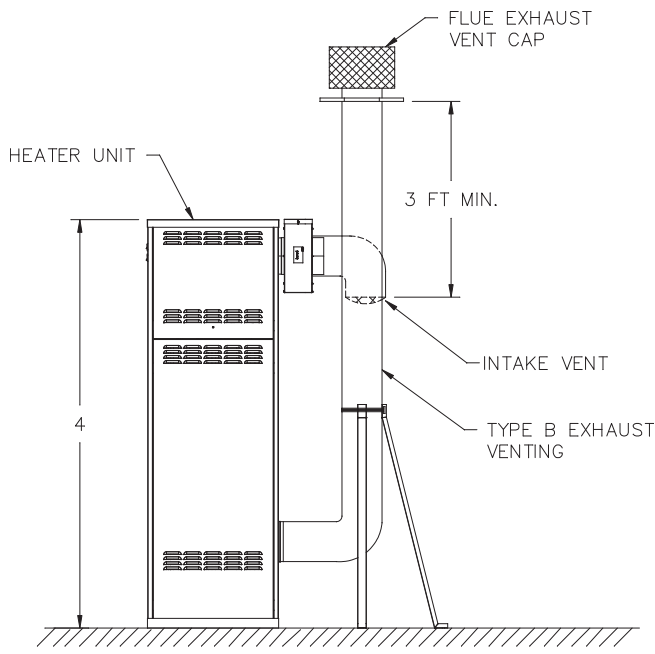


Fig. 37: Outdoor Venting

If either the Outlet or Inlet temperature drops below 38°F, the VERSA starts the burner at the minimum firing rate. The burner cycle will terminate when both the Inlet and Outlet temperatures rise above 42°F.

Controls

WARNING: Installation, adjustment and service of heater 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, heater malfunction, property damage, personal injury, or death.

WARNING: Turn off the power to the heater before installation, adjustment or service of any heater controls. Failure to do so may result in board damage, heater 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.

Ignition Control Functions

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 standard ignition module will lock-out after failing to light 3 times during a call for heat. To reset the lock-out, press and release the **RESET** button located on the user interface. The control will automatically reset after 1 hour. When in lock-out the control will run the blower through a post-purge cycle.

The single-try ignition module (part of the CSD-1 option) will attempt to light only one time before lock-out occurs. To reset the lock-out, press and release the **RESET** button located on the user interface.

Turning off the power to the heater WILL NOT reset the single-try ignition module.

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

High Limit—Manual Reset

This heater is equipped with a fixed setting manual reset high limit temperature device as standard. It may also have an additional optional adjustable manual reset high temperature device.

The optional adjustable manual reset high limit is located inside the cabinet on the upper left corner post. Access the limit by hinging the control box open to view and make adjustments.

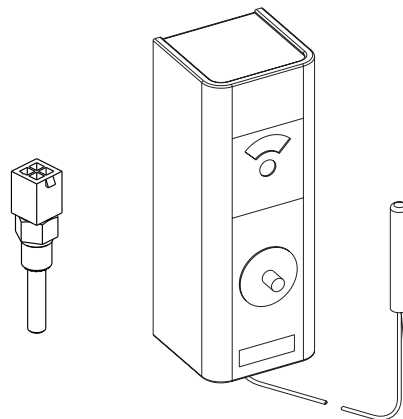


Fig. 38: High Limit (Manual Reset)

Standard

The fixed setting manual reset high limit is built into the PIM™, it utilizes a dual element sensor located on the outlet (see Fig. 38). To reset a high limit lock-out, press and release the RESET button located on the user interface.

High Limit—Auto Reset (Optional)

This heater may be equipped with an optional adjustable auto reset high limit temperature device.

The optional adjustable auto reset high limit is located inside the cabinet on the upper left corner post. Access the limit by hinging the control box open to view and make adjustments. Adjust the setting to approx. 20°F (10°C) above desired outlet temperature.

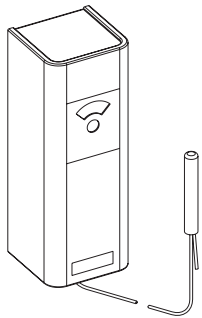


Fig. 39: Adjustable High Limit (Auto Reset)

Flow Switch

This standard, dual-purpose control, mounted and wired in series with the main gas valve, shuts off heater in case of pump failure or low water flow.

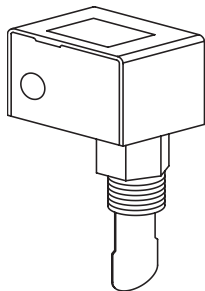


Fig. 40: Flow Switch

Low Water Cut-Off (Optional)

The optional 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.

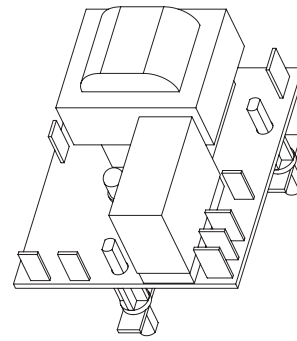


Fig. 41: Low Water Cut-Off

High & Low Gas Pressure Switches (Optional)

The optional low gas pressure switch mounts upstream of the gas valve (on the inlet flange to the gas valve) and is accessible through the removable access panels on the side or front of the heater 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 heater if gas supply drops below the factory setting of 3.0 in. WC for natural gas or propane gas.

The optional high gas pressure switch connection mounts down-stream of the gas valve. Special ports are located on the backside of the gas valve and accessible from the front of the heater (to reset the gas pressure switch) or through the removable access panels on the rear of the heater (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.

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 as shown in Fig. 42 to reset a tripped pressure switch. The LED will go out when the switch is reset.

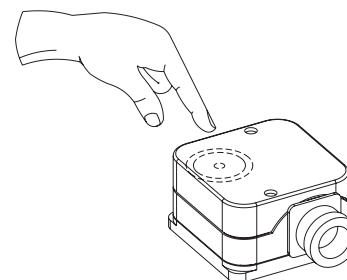


Fig. 42: High/Low Gas Pressure Switch

Blocked Vent Switch

This heater is equipped with a blocked vent pressure switch to prevent the operation of the heater when too much of the vent is blocked. This switch is located on the right side of the heater near the right rear corner.

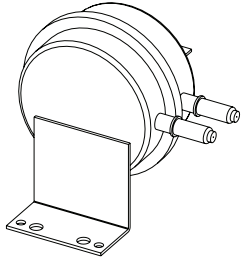


Fig. 43: Blocked Vent Switch

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. Refer to Fig. 44 for display and key locations.

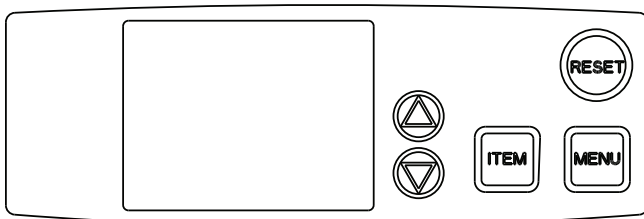


Fig. 44: User Interface

For detailed descriptions of the various screens, consult the VERSA IC Control I&O Manual (Catalog #5000.72).

Adjusting the MVB Setpoint

To adjust the setpoint on the MVB:

Use the **MENU** key to scroll to the **SETUP/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, Maximum is the PIM™ value, and the default is 180°F for H models and 125°F for WH models.

View Menu

The **VIEW** menu is the default menu. 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.

Menu - Initial Adjustment

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

Refer to the VERSA IC Control I&O Manual (Catalog #5000.72) for detailed setup instructions.

Item	Application	Description
OUTDOOR	H MODE 1,2,3	Outdoor air temperature
Boil Target	H MODE 1,2,3	Current target temperature
SUPPLY	H MODE 1,2,3	Current system supply temperature
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
DHW SUPPLY	H MODE 2,3	Current indirect DHW supply temperature
TANK DHW	WH	Current tank temperature
BOILER STATUS	All	IDLE, PREP, IGN, MOD RATE %, POST, SOFT

Table O: View Menu

Item	Application	Range	Description	Default
BOILER 1	All	ON <> OFF	Enable or Disable the operation of boilers. 4 boiler range, 1 is enabled by default	ON
TARGET	H MODE 1,2,3	RSET <> SETP	RSET = Outdoor Reset, SETP =Setpoint	SETP
TANK SETP	WH	OFF, 50°F to 150°F	Tank set point temperature	125°F
TANK DIFF	WH	2°F to 10°F	Tank Differential temperature	3
MODE	H MODE 1,2,3	1,2,3	Piping and application configuration.	1
SETPOINT	H MODE 1,2,3	50°F to PIM™ value*	Boiler target temperature while a heat demand is present for setpoint operation	180°F
OUT START	H MODE 1,2,3	35°F to 85°F	Outdoor starting temperature - outdoor reset	70°F
OUT DESIGN	H MODE 1,2,3	-60°F to 45°F	Outdoor design temperature - outdoor reset	10°F
Boil START	H MODE 1,2,3	35°F to 150°F	Starting boiler target temperature when the outdoor temperature is at outdoor start outdoor reset	70°F
Boil DESIGN	H MODE 1,2,3	70°F to 200°F	Design boiler target temperature when the outdoor temperature is at outdoor design outdoor reset	180°F
Boil MASS	All	1<>2<>3	Thermal mass of the boiler	1
TARGET MAX	H MODE 1,2,3	100°F to PIM™ value*	Maximum target system temperature	220°F
TARGET MIN	H MODE 1,2,3	OFF, 50°F to 190°F	Minimum target system temperature	50°F
TARGET DIFF	H MODE 1,2,3	2°F to 42°F	Differential for target system temperature	10°F
DHW SENSOR	H MODE 1,2,3	OFF <> ON	Selects whether a DHW sensor is used for indirect DHW tank	OFF
DHW DIFF	H MODE 2,3	2°F to 10°F	Differential for the target indirect DHW tank temperature	6°F
IND SUPPLY	H MODE 2,3	OFF, 50°F to PIM™ value*	Target boiler temperature for the DHW heat exchanger during indirect DHW operation	180°F
DHW PRIORITY	H MODE 2	OFF <> ON	Selects whether or not Indirect DHW priority is active during indirect DHW operation	OFF
PRI OVR	H MODE 2,3	Au, 0:10hr to 2:00hr	Sets the length of the indirect DHW priority override time	1:00hr
BOIL PURGE	All	0:20min to 10:00min	Sets the length of the boiler pump post purge	20 seconds
SYS PURGE	All	OFF, 0:20min to 20:00min	Sets the length of the system pump post purge	20 seconds
WWSD	H MODE 1,2,3	40°F to 100°F	The system warm weather shutdown temperature outdoor reset	70°F
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	OFF
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

Table P: Setup/Adjust Menu

Boiler Menu

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

Item	Application	Description
IGNITION	All	Current State of Ignition
LIMIT TEMP	All	Current Limit Temperature
AUX TEMP	H MODE 3	Current Auxiliary Temperature
EMS Vdc	All	Current EMS signal in Volts DC
FIRE RATE	All	PIM™ firing rate
SPEED X1000 BLOWER	All	Blower speed, Revolutions/Minute
HIGH LIMIT	All	High Limit Setting *
H L OFFSET	All	High Limit Offset *
OPERATOR	All	Operator Limit Potentiometer (PIM™) setting
AUTO DIFF	H MODE 1,2,3	Current auto differential
PUMP PREPt	All	Duration of pump prepurge
BLOW PREPt	All	Duration of blower prepurge
BLOW PREPr	All	Blower % during prepurge
BLOW POSTt	All	Duration of blower postpurge
BLOW POSTr	All	Blower % during postpurge
MIN RATE	All	Minimum modulation rate % during operation *
START RATE	All	Start modulation rate % during ignition *
MAX RATE	All	Maximum modulation rate % during operation *
FLAME CUR	All	Flame current in micro-amps
IGN TYPE	All	PIM™ board type
MASS	All	Thermal mass of the boiler
ID CARD	All	Identifies OEM identity card
PIM™ ID	All	Identifies OEM PIM™ PCB
SW ID	All	PIM™ software identification number

Table Q: Boiler Menu

* Fixed values based on ID card

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	H 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.
OUTDOOR HI	H MODE 1,2,3	Records the highest outdoor temperature. Press UP/DOWN for 1 sec to clear.
OUTDOOR LO	H 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	H MODE 1,2,3	Records the highest Indirect supply temperature. Press UP/DOWN for 1 sec to clear.
IND LO	H MODE 1,2,3	Records the lowest Indirect supply temperature. Press UP/DOWN for 1 sec to clear.
DHW HI	WH	Records the highest DHW temperature. Press UP/DOWN for 1 sec to clear.
DHW LO	WH	Records the lowest DHW temperature. Press UP/DOWN for 1 sec to clear.

Table R: Monitor Menu

Toolbox Menu

The Toolbox Menu logs all error codes from the BTCII 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 Page 47 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 VERSA IC Manual for details.)
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 <i>lookup logged error</i>	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 water temperature (Boil START) at 70°F outdoor air (OUT START), and 180°F water temperature (Boil DESIGN) at 10°F 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 buildings 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

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

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.

Outdoor Start (OUT START)

The OUT START temperature is the outdoor air 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.

Outdoor Design (OUT DESIGN)

The OUT DESIGN is the outdoor air temperature that is the typical coldest annual temperature where the building is located. This temperature is used when completing heat loss calculations for the building.

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 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.

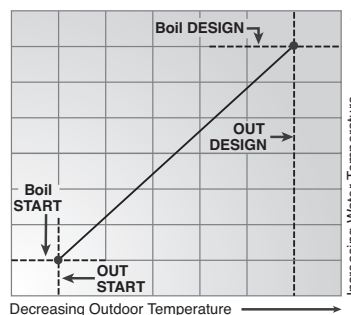


Fig. 45: Reset Ratio

Reset Ratio

The controller uses the following four settings to calculate the Reset Ratio (RR):

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

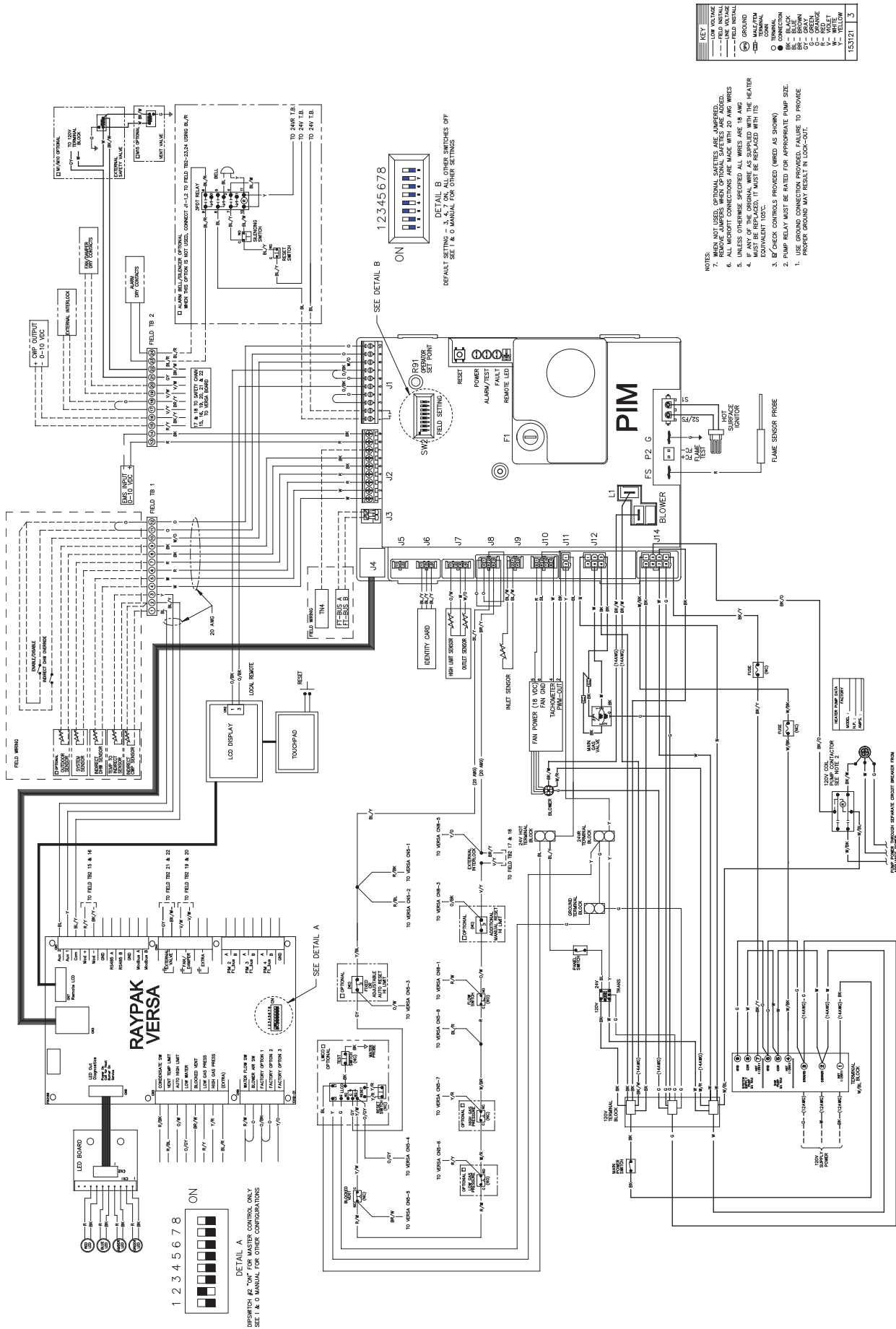
For example, when using the default values, the RR is:

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

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

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

WIRING DIAGRAM - Models 504A-2004A



KEY	
---	FIELD WIRE
○	TERMINAL
⊕	GROUND
⊖	GROUND
⊕	MALE/FEM CONN.
○	TERMINAL
○	BLACK
○	BRN
○	BROWN
○	GRN
○	GREEN
○	RED
○	RED/WH
○	WHT
○	YELLOW

- NOTES:
1. WHEN NOT USED, OPENING TERMINALS ARE UNWIRED.
 2. ALL WIRE CONNECTIONS ARE MADE WITH 20 AWG WIRES UNLESS OTHERWISE SPECIFIED.
 3. ALL WIRE CONNECTIONS ARE MADE WITH 20 AWG WIRES UNLESS OTHERWISE SPECIFIED.
 4. MUST BE EQUIPPED WITH THE HEATER EQUIVALENT IN ACC. TO THE EQUIPMENT IN ACC.
 5. MUST BE EQUIPPED WITH THE HEATER EQUIVALENT IN ACC. TO THE EQUIPMENT IN ACC.
 6. PUMP RELAY MUST BE RATED FOR APPROPRIATE PUMP SIZE.
 7. USE GROUND CONNECTION PROVIDED. FAILURE TO PROVIDE PROPER GROUND MAY RESULT IN LOCK-OUT.

START-UP

NOTE: The following steps must be performed by a factory-trained technician.

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.

Air Purge (Domestic Hot Water/Pool Heaters)

Purge all air from system before heater operation. This can be normally accomplished by opening a downstream valve.

CAUTION: An air vent valve should be installed at the highest point in the system for proper operation. If water piping is located higher than the header, an air vent valve should be located at the highest point in the installed system.

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

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

This appliance has a hot surface 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 turn the gas control valve handle. Never use tools. If the handle 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 heater 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 heater.

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
- (1) Amp probe

(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)

Attach Manometers to Measure Pressures

1. Turn off main gas valve.
2. Attach (1) 12" scale manometer to an upstream bleedle valve on the gas supply pipe to the heater (Measure point "A" in Fig. 46).
3. Attach (1) 24" scale manometer to the manifold pressure tap located on the shutoff valve downstream of the firing valve (Measure point "D" in Fig. 46).
4. Attach (1) 12" scale manometer on the fan suction pressure hose. Pull black cap from air pressure tee as shown in Fig. 47 and connect the manometer. NOTE: Retain caps for reinstallation later.

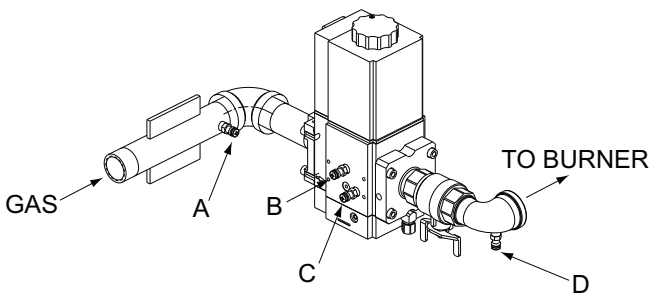


Fig. 46: Gas Pressure Measurement Locations

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 4.0 in. WC, recommended supply is 7.0 in. WC, minimum supply pressure for propane gas is 4.0 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, upstream of the heater.

Start-Up

NOTE: The values in Tables T and V represent the conditions when the heater is at full firing rate at sea level.

NOTE: Pressure and combustion data are provided with the heater.

1. Turn power on.
2. Turn on the heater, wait approximately 15 seconds after the blower starts, the igniter should start to glow (observable through the observation port located at the front, below the gas valve). Look into the sight glass located just below the gas valve near the front of the unit to check igniter operation. Gas valve should open in 45-60 seconds.
3. The heater ignites at 30% to 50% of full rate (as indicated on the LCD display of the temperature controller located behind the front panel).
4. If the burner fails to light on the first trial, it will try for ignition up to three times before going into lock-out with the standard ignition module. If the heater is equipped with the optional single-try ignition module, it will go into lockout.
5. Wait until the controller indicates 100% on the firing rate display screen (approximately 30 seconds).

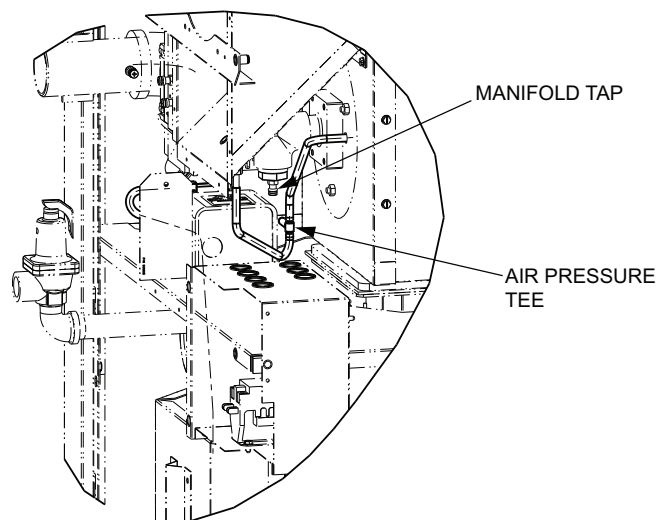


Fig. 47: Air Pressure Tee

Blower Check

1. Check blower suction using the manometer attached to the air pressure tee, with the heater firing at 100% input. The reading should be as noted in Table T for both natural and propane gas.
2. When firing at 100%, the desired heater combustion CO₂ is 9.0% ± 0.5% for natural gas and 10.2% ± 0.5% for propane with CO less than 100 ppm. If this combustion cannot be achieved with the blower suction within the tolerances specified in Table T, contact the factory.

Manifold Check

1. Check manifold gas pressure at the gas valve outlet pressure tap (connection "D" in Fig. 43). This pressure should read per the values in Table U for natural and propane gas.
2. If the pressure reading differs by more than ± 0.2 in. WC, **STOP – Call the factory for directions on what to do next!**

Model	Air Pressure Setting (in. WC)		Setting Tolerance
	Nat. Gas	Propane	
504A	-4.1	-4.3	± 0.2 in. WC
754A	-4.1	-4.3	± 0.2 in. WC
1104A	-4.1	-4.3	± 0.2 in. WC
1504A	-4.1	-4.3	± 0.2 in. WC
2004A	-4.1	-4.3	± 0.2 in. WC

Table T: MVB Air Pressure Settings

Model	Manifold Gas Pressure Setting High Fire Values (in. WC)	
	Natural Gas	Propane Gas
504A	-4.1	-4.4
754A	-4.6	-5.8
1104A	-4.6	-7.2
1504A	-7.0	-9.2
2004A	-4.4	-8.1

Table U: MVB Manifold Pressure Settings

CAUTION: Special manifold and air settings may be required.

User Test

Set DIP switch #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.

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.
Boil 1	Ignite Boiler Burner.
Min 1	Hold Boiler at Min Fire.
Max 1	Ramp Boiler to Max Fire and hold.

Table V: User Test Fields

- 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.

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 MVB 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.
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 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 fan pressure tee and reinsert the sealing screws into the bleedle valves.
3. Start-up is complete and the heater should be operating properly.

Follow-Up

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

1. Check manometer for proper readings.
2. Cycle heater several times and re-check readings.
3. Remove all manometers and replace caps and screws.
4. Check for gas leaks one more time.

Leak Test Procedure: Dual-Seat Gas Valve

Proper leak testing requires three pressure test points in the gas train. Remove the upper front panel and swing the front J-box out of the way to access the gas valve for this test. Refer to Fig. 48.

Test point A is a bleedle valve located upstream of the combination gas valve on the supply manifold.

Test point B is a bleedle valve located between the two automatic gas valve seats.

Test point C is a bleedle valve located downstream of both automatic gas valve seats and upstream of the manual valve.

These tests are to be conducted with the electrical power to the heater turned OFF.

1. Manually close the downstream leak test valve.
2. Open the bleedle valve at test point A and connect a manometer to it. Verify that there is gas pressure and that it is within the proper range (NOTE: must not exceed 14.0 in. WC).
3. Open test point B and connect a rubber tube to it. Connect the other end of the tube to a manometer and look for a build-up of pressure. Increasing pressure indicates a leaking gas valve which must be replaced.
4. Next, close the upstream manual gas valve (field supplied) and remove the manometers from the bleedle valves in test point A and test point B. Connect a rubber tube from the test point A bleedle valve to the test point B bleedle valve and open the upstream manual gas valve. Make sure that test point A & B bleedle valves have been opened so as to allow gas to flow. This will bring gas pressure to the second valve seat.
5. Open the bleedle valve at test point C and connect a second rubber tube to it. Connect the other end of the tube to a manometer and look for a build-up of pressure. Increasing pressure indicates a leaking gas valve which must be replaced.
6. Remove rubber tube and manometers. Close each bleedle valve as the tubes are removed.
7. After no leakage has been verified at all valve seats and test valve, open downstream leak test valve and restore electrical power to the heater.

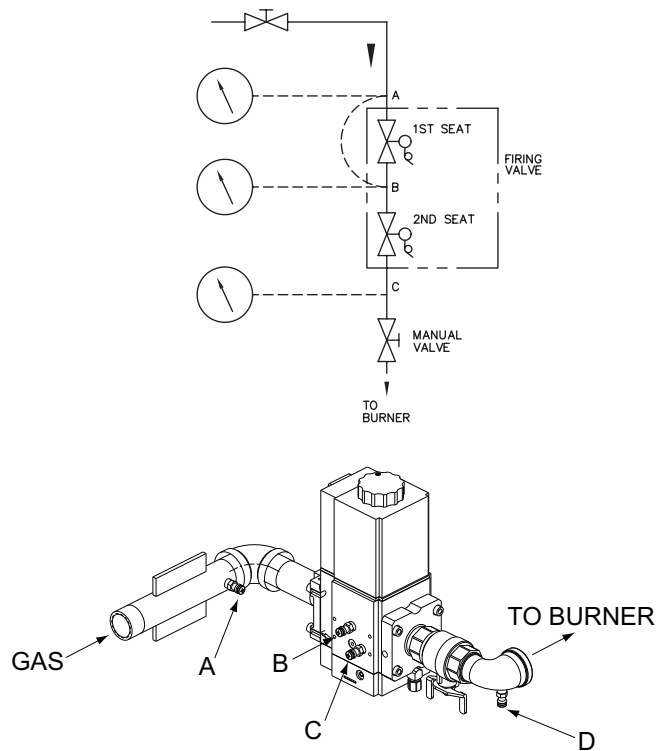


Fig. 48: Leak Test Procedure

Post Start-Up Check

Check off steps as completed:

1. Verify that the heater and heat distribution units or storage tank are filled with water.
2. Confirm that the caps on the automatic air vent valves were opened two full turns 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 heater 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. To test the fixed manual reset high limit built into the PIM™, first set dip switch #8 on the PIM™ to the ON position. This will activate a Commission Test Mode which will turn on the amber Alarm/Test LED on the PIM™. The fixed high limit setting is temporarily overridden to match the setpoint potentiometer position on the PIM™. The high limit can now be adjusted by the potentiometer to assist in commission testing and verification of high limit functionality. The VERSA IC will allow one-time operation of the limit and then must be returned to normal operation by turning dip switch #8 back to the OFF position. Power to the unit must then be cycled off, then on to return to normal operation.
9. Test ignition system safety device:
 - a. Close manual gas valve. Turn power on.
 - b. Close Enable/Disable circuit to call for heat.
 - c. The burner should attempt three trials for ignition for the standard model and then lock out. Single try ignition modules will try only once and then lock out.
 - d. Open manual gas valve. Reset the ignition control by pressing for one second and then releasing the reset button on either the user interface or at the PIM™ to clear the ignition fault.
10. To restart system, follow lighting instructions in the Operation section.
11. 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.
12. Check that the heater is cycled with the thermostat. Raise the setting on the thermostat to the highest setting and verify that the heater goes through the normal start-up cycle. Reduce to the lowest setting and verify that the heater goes off.
13. Observe several operating cycles for proper operation.
14. Set the heater thermostat to desired temperature.
15. Review all instructions shipped with this heater with owner or maintenance person, return to envelope and give to owner or place the instructions inside front panel on heater.

OPERATION

Lighting Instructions

1. Before operation, make sure you have read all of the safety information in this manual.
2. Remove upper front panel.
3. Set the thermostat to the lowest setting.
4. Turn off all electrical power to the appliance.
5. This appliance is equipped with an ignition device which automatically lights the burner. Do not try to light the burner by hand.
6. Turn on main manual gas valve field installed near gas inlet connection on back of heater.
7. Wait 5 minutes to clear out any gas. Then smell for gas, especially near the floor. If you then smell gas, STOP! Follow the steps in the safety information on the front cover of this manual. If you do not smell gas, go to next step.
8. Turn on all electrical power to the appliance.
9. Set thermostat to desired setting. The appliance will operate. The igniter will glow after the pre-purge time delay (15 seconds). After igniter reaches temperature (30 seconds) the main valve should open. System will try for ignition up to three times (one time on optional single-try ignition module). If flame is not sensed, lockout will commence.
10. If the appliance will not operate, follow the instructions "To Turn Off Gas To Appliance," and call your service technician or gas supplier.
11. Replace upper front panel.
12. If heater fails to start, verify the following:
 - a. There are no loose connections or that the service switch is off.
 - b. High temperature limit switch (optional) is set above water temperature or manual reset high limit is not tripped.
 - c. Enable/Disable circuit is closed.

- d. Gas is on at the meter and the heater.
- e. Incoming dynamic gas pressure to the gas valve is NOT less than 4.0 in. WC for natural gas or propane gas.

To Turn Off Gas To Appliance

1. Shut off manual gas valve field installed near gas inlet connection on back of heater.
2. Remove upper front panel.
3. Adjust setpoint to lowest setting.
4. Turn off all electrical power to the appliance if service is to be performed.
5. Replace access panel.

TROUBLESHOOTING

MVB Error Codes

If any of the sensors detect an abnormal condition or an internal component fails during the operation of the MVB, the display may show the error. 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 MVB Fault Text section on the following page.

Heater Faults

1. 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.

2. 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 MVB fault text section.
3. 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 reoccurrence of fault code(s).

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.

MVB 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.

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 set point. 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	N/A	N/A
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	N/A	N/A
5 flashes	Low Voltage Fault	Check the 24 VAC input voltage. The voltage must be above 18.0 VAC.
6 flashes	N/A	N/A
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	N/A	N/A
10 flashes	N/A	N/A
11 flashes	N/A	N/A
12 flashes	N/A	N/A
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 J8, pins 5 and 6 at the PIM™.

Table X: PIM™ LED Error Codes

Sensor Resistance Values

Water Sensor / Outdoor Sensor	
Water Temperature (°F)	Resistance (ohms)
32	32550
41	25340
50	19870
59	15700
68	12490
77	10000
86	8059
95	6535
104	5330
113	4372
122	3605
131	2989
140	2490
149	2084
158	1753
167	1481
176	1256
185	1070
194	915
203	786
212	667

Table Y: Approximate Sensor Resistance Values

MAINTENANCE

Suggested Minimum Maintenance Schedule

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

Daily and monthly maintenance as outlined below may be performed by onsite maintenance staff.

Daily

1. Check that the area where the heater 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 heater.

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 drain in the venting. If leaks are observed repair at once.
5. Check air vents for leakage.

Yearly (Beginning Of Each Heating Season)

Schedule annual service 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 air filter and replace as necessary.
 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 hot surface 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 MVB installations.

Daily

1. Check gauges, monitors and indicators.
2. Check instrument and equipment settings. (See "Post Start-Up Check" on page 49.)
3. Check burner flame. (Should see light blue flame at full input rate).

Weekly

For low-pressure heaters, test low-water cut-off device. (With heater in pre-purge, depress the low water cut-off test button. Appliance should shut-off and ignition fault light should come on. Depress reset button on front of heater control panel to reset).

Monthly

1. Check flue, vent, stack, or outlet dampers.
2. Test blower air pressure. (See "Blower Check" on page 46.)
3. Test high and low gas pressure interlocks (if equipped). (See "Safety Inspection" on page 48.)

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 47.)
4. Check piping and wiring of all interlocks and shut-off valves.
5. Check air filter and replace as necessary.

Annually

1. Test flame failure detection system and pilot turn-down.
2. Test high limit and operating temperature. (See "Post Start-Up Check," page 49.)
3. Check flame sensor.
4. Conduct a combustion test at full fire. Carbon dioxide should be 9.0% at full fire for natural gas, and 10.2% for propane gas. Carbon monoxide should be < 150 ppm.
5. Check valve coil for 60 cycle hum or buzz. Check for leaks at all valve fittings using a soapy water solution (while heater 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. (See Fig. 48.)
7. Inspect and clean burner using shop air.

As Required

1. Recondition or replace low water cut-off device (if equipped).
2. Check sediment trap and gas strainers.
3. Check flame failure detection system. (See "Post Start-Up Check," page 49.)
4. Check igniter. (Resistance reading should be 40-75 ohms at 77°F.)
5. Check flame signal strength. (Flame signal should be greater than 1 **microampere** as measured at the 2 pins on the bottom of the PIM™).
6. Check firing rate control by checking the manifold pressure. (See "Manifold Check" on page 47.)
7. Test safety/safety relief valves in accordance with ASME Heater and Pressure Vessel Code Section IV.

Filter Maintenance

NOTE: Use Raypak replacement filters, kit number 012553F (12"X12") for models 504A-1104A and kit number 012552F (16"X16") for models 1504A-2004A.

- Inspect quarterly.
- Replace when tracking pressure exceeds -0.5 in. WC at 100% fan speed.

Filter Replacement

1. Remove the filter box cover by loosening and removing the two wing nuts holding it in place.

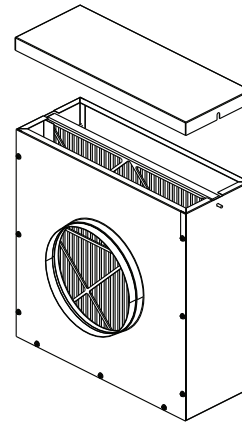


Fig. 49: Remove the Air Filter Box Cover

2. Remove the filter by lifting it straight up and out of the slot in the filter box.

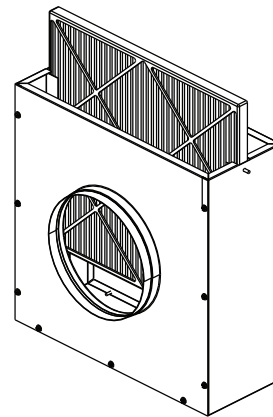


Fig. 50: Remove the Air Filter

3. Reverse steps 1 and 2 to install the new filter. Use Raypak replacement filters, kit number 012553F (12"X12") for models 503A-1104A and kit number 012552F (16"X16") for models 1504A-2004A.

APPENDIX

Inside Air Contamination

All heaters experience some condensation during start-up. The condensate from flue gas is acidic. 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 heater 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:

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.

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 heater. If found:

- remove products permanently, OR
- install TruSeal direct vent.

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.

GAS PRESSURE SUPERVISION

The Commonwealth of Massachusetts requires listed high and low gas pressure switches (manual reset) for any model with a maximum firing input greater than 1,000,000 Btu/Hr in accordance with 248 CMR 7.04(11)(d).

A gas pressure regulator (field supplied) is required in the gas train ahead of the heater, for heaters having input rates greater than 1,000,000 Btu/Hr, in accordance with 248 CMR 7.04 Figure 3B requirements.

START-UP CHECKLIST FOR FAN-ASSISTED RAYPAK PRODUCTS

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
 Covers in place for outdoor _____ 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

(AT FULL FIRE)

Blower Pressure Setting _____ In. WC
 Supply Gas Pressure _____ In. WC
 Verify stable pressure static & dynamic condition
 Pilot Gas Pressure _____ In. WC
 Manifold Gas Pressure _____ In. WC

The following measurements must be obtained with a Combustion Analyzer.

Free Oxygen _____ %
 CO _____ PPM
 CO2 _____ %

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

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
 Hot Surface Igniter _____ Ohms
 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 Economaster 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
 See manual or card tag

Job Name _____

Address _____

Physical Location of Boiler: Indoors _____; Outdoors _____; Ground Level _____; Roof _____; 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) 278-5471 in order to ensure warranty consideration Attn: Service Manager



**LIMITED PARTS WARRANTY
MVB – TYPES H, WH
MODELS 504A-2004A**

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

Domestic Hot Water

Five (5) years from date of heater installation. Includes copper heat exchanger with bronze waterways.

Ten (10) years from date of heater installation. Includes only cupro-nickel heat exchanger with bronze waterways.

Space Heating (Closed Loop System)

Ten (10) years from date of heater installation. Includes both cupro-nickel and copper heat exchanger with bronze or cast iron water-ways.

Thermal Shock Warranty

Twenty-five (25) years from date of heater installation against "Thermal Shock" (excluded, however, if caused by heater operation at large changes exceeding 150°F between the water temperature at intake and heater temperature, or operating at heater temperatures exceeding 230°F).

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 systems 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. Misuse or neglect, including but not limited to freeze-ups, operating the heater with cabinet door off, having flow restrictions or obstructions between the heater outlet and pool/spa or not maintaining proper chemical balance (pH level must be between 7.2 and 7.8 and total alkalinity between 100 and 150 PPM. Total Dissolved Solids (TDS) must be no greater than 2500 PPM).

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 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 rate of manufacture plus thirty (30) days.

Original Owner

Mailing Address

City State Zip Code

Daytime Telephone Number

Model Number

Serial Number

Date of Installation

Installation Site

Contractor/Installer



**LIMITED PARTS WARRANTY
MVB – TYPE P
MODELS 504A–2004A**

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

Five (5) years from date of heater installation. Includes cupo-nickel heat exchanger with bronze waterways.

Thermal Shock Warranty

Twenty-five (25) years from date of heater installation against “Thermal Shock” (excluded, however, if caused by heater operation at large changes exceeding 150°F between the water temperature at intake and heater temperature, or operating at heater temperatures exceeding 230°F).

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 systems devices, such as pump or controller;
6. Use of non-factory authorized accessories or other components in conjunction with the heater system;
7. Chemical contamination of combustion air or use of chemical additives to water.
8. Misuse or neglect, including but not limited to freeze-ups, operating the heater with cabinet door off, having flow restrictions or obstructions between the heater outlet and pool/spa or not maintaining proper chemical balance (pH level must be between 7.2 and 7.8 and total alkalinity between 100 and 150 PPM. Total Dissolved Solids (TDS) must be no greater than 2500 PPM).

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 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 rate of manufacture plus thirty (30) days.

Original Owner

Model Number

Mailing Address

Serial Number

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



www.raypak.com

Raypak, Inc., 2151 Eastman Avenue, Oxnard, CA 93030 (805) 278-5300 Fax (805) 278-5468
Litho in U.S.A.