

INSTALLATION AND OPERATION MANUAL

Raytherm[®] Hot Water Supply Heaters



**Models 0514-4001
Type WH**



▲ 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.

Revision 25 reflects the following changes:

Model Identification section replaced elevation verbiage to: "Only Models 514, 624, 724, 824 are available for elevations up to 10,000 feet. Output ratings for elevations over 2,000 feet should be reduced at a rate of 4% for each 1,000 feet above sea level". Figure 3 added same sentence as above. Figure 4, Figure 5, Figure 6 removed: " Reduce input 4% for each 1,000 ft (305 m) above sea level when installed above 2,000 ft (610 m) elevation".

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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.
CAUTION	CAUTION used without the warning alert symbol indicates a potentially hazardous condition 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: Failure to install the **drafthood** and properly vent the water heater to the outdoors as outlined in the Venting section of this manual can result in unsafe operation of the water heater. To avoid the risk of fire, explosion, or asphyxiation from carbon monoxide, never operate this water heater unless it is properly vented and has an adequate air supply for proper operation. Be sure to inspect the vent system for proper installation at initial start-up; and at least annually thereafter. Refer to the Maintenance section of this manual for more information regarding vent system inspections.

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

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

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

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

▲ WARNING: All venting types must be of the same material or product throughout the entire exhaust installation to ensure proper securing and sealing.

▲ 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: Propane appliances must not be installed below-grade (for example, in a basement) if such installation is prohibited by federal, state and/or local laws, rules and regulations.

▲ WARNING: Both propane and natural gas have an odorant added to help detection. Some people may not physically be able to smell or recognize this odorant. If unsure or unfamiliar about the smell associated with propane or natural gas, ask the gas supplier. Other conditions, such as “Odorant Fade”, which causes the odorant to “fade” or diminish in intensity, can also hide or camouflage a gas leak.

▲ 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: 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: 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/or CSA ratings of the vessel and any damage to the vessel will not be covered under warranty. Altering the ASME and/or CSA ratings of the vessel also violates national, state, and local approval codes.

▲ 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.

▲ 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: This unit contains refractory ceramic fiber (RCF) insulation in the combustion chamber. RCF, as manufactured, does not contain respirable crystalline silica. However, following sustained exposure to very high temperatures (>2192°F), the RCF can transform into crystalline silica (cristabolite). The International Agency for Research on Cancer (IARC) has classified the inhalation of crystalline silica (cristabolite) as carcinogenic to humans.

When removing the burners or heat exchangers, take precautions to avoid creating airborne dust and avoid inhaling airborne fibers. When cleaning spills, use wet sweeping or High Efficiency Particulate Air (HEPA) filtered vacuum to minimize airborne dust. Use feasible engineering controls such as local exhaust ventilation or dust collecting systems to minimize airborne dust. Wear appropriate personal protective equipment including gloves, safety glasses with side shields, and appropriate NIOSH certified respiratory protection, to avoid inhalation of airborne dust and airborne fiber particles.



Vapors from flammable liquids will explode and catch fire causing death or severe burns

Do not use or store flammable products such as gasoline solvents or adhesives in the same room or area near the water heater.

KEEP FLAMMABLE PRODUCTS:

1. Far away from heater,
2. In approved containers,
3. Tightly closed, and
4. Out of children's reach.

Water heater has a main burner and pilot flame.

THE PILOT FLAME:

1. Is on all the time or intermittently (IID).
2. Will ignite flammable vapors.

VAPORS:

1. Cannot be seen,
2. Are heavier than air,
3. Go a long way on the floor,
4. Can be carried from other rooms to the pilot flame by air currents.

INSTALLATION

Do not install the water heater where flammable products will be stored or used unless the main burner and pilot flames are at least 18" (45.7 cm) above the floor. This will reduce, but not eliminate, the risk of vapors being ignited by the main burner or pilot flame.

Read and follow water heater warnings and instructions.

⚠ 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.

⚠ 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 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.

NOTE: Raypak recommends laying out and installing the vent system before installing water piping. This will ensure that the venting system and associated components will fit into the attached space for proper operation.

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 the equipment, visually check for external damage to the carton or the shipping crate. If either is damaged, make a note on the Bill of Lading and report the damage to the Carrier immediately. Remove the heater from the carton or the shipping crate.

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

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.

Raypak recommends that this manual be reviewed thoroughly before installing your Raypak heater. If there are any questions which this manual does not answer, please contact your local Raypak representative.

Claims for shortages and damages must be filed with carrier by consignee. Permission to return goods must be factory authorized and are subject to a stocking charge.

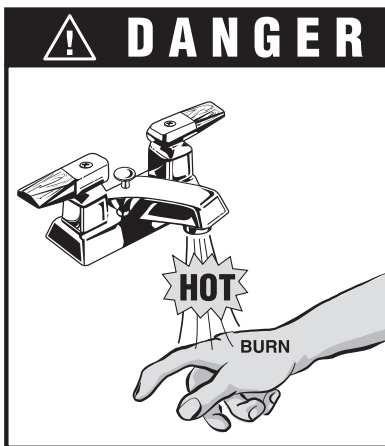
Purchased parts are subject to replacement only under the manufacturer's warranty. Debits for defective replacement parts will not be accepted and will be replaced in kind only per our standard warranties.

General Safety

To meet commercial hot water needs, this heater is equipped with a manual-reset temperature limit that does not allow an outlet temperature over 200°F (93°C). However, water temperatures over 125°F (52°C) can cause instant severe burns or death from scalds.

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 consistent with the application.

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



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.

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.

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

Table A. Time to Produce Serious Burn

Time/Temperature Relationships in Scalds

The temperature of the water in the storage tank heater can be regulated on front dial of the tankstat. For safety regulations, the tankstat is set at its lowest setting before shipment from the factory. See **Figure 1**.

To adjust the water temperature, insert a small straight screwdriver into slotted screw in hole in front of tankstat and turn wheel to desired setting. Thermostat is adjustable up to 190°F (88°C).



Figure 1. Tankstat Adjustment

⚠ DANGER: There is a Hot Water SCALD potential if the tankstat is set too high.

⚠ CAUTION: Hotter water increases the risk of SCALDING!

NOTE: When this heater is supplying general-purpose hot water requirements 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.

Rating and Certification

All models are ASME-Rated and National Board registered. Temperature and pressure [gauge](#) is standard.

All units are CSA-certified for low-lead content (<.25%). Minimum water temp of 105°F (41°C) at the inlet.

Model Identification

The model identification number and the heater serial number are found on the heater data plate. The model number will have the form WH1-0514A or similar depending on the heater model. (WH = Hot Water Supply System, 1 = ON/OFF firing, 0514 = size of heater).

Firing types: 1 = ON/OFF Control
 2 = Modulating Control
 3 = 2-Stage Control

Rated inputs are suitable for up to 2000 ft (610 m) elevation. Only Models 514, 624, 724, 824 are available for elevations up to 10,000 feet. Output ratings for elevations over 2,000 feet should be reduced at a rate of 4% for each 1,000 feet above sea level.

Type WH1 - ON/OFF Controls

Models 0514-4001

Models 0514-1826 are available with rear-mounted pump, factory-mounted and wired.

Type WH2 - Modulating Controls

Models 0514-1826

On models 0182-1826, this design uses mechanical modulating valve(s) over an output range of 110°F-170°F (43°C-77°C). Models 0514-1826 are available with rear-mounted pump, factory-mounted and wired.

Type WH3 - 2-Stage Control

Models 0514-4001

Hot water supply heater with low-high fire for 2-stage control. Models 0514-1826 are available with rear-mounted pump, factory-mounted and wired.

General Specifications

The Raypak water heaters are design-certified and tested under the latest requirements of the American National Standard, ANSI Z21.10.3/CSA 4.3. Each heater has been constructed and pressure-tested in accordance with the requirements of Section IV Part HLW of the American Society of Mechanical Engineers Code, and factory fire-tested. All models are National Board registered.

Temperature and pressure [gauge](#) is standard. Intermittent ignition device is standard on models 0514 and up.

Models 0514-1826 - have 2-pass heat exchangers, 5 tubes first pass, 4 tubes second pass.

Models 2100-4001 - have 2-pass heat exchangers standard, 9 tubes per pass.

Models 0926-4001 - with cast-iron headers allow optional single-pass heat exchangers.

Hot Water Supply Heaters

All Raypak hot water supply heaters are have ASME-certified heat exchangers, with 125 PSI pressure relief valves, and require a minimum water temperature of 105°F (41°C) at the heater inlet. All must be used in conjunction with storage tanks.

Sizes 0514-824 may be installed either indoors or outdoors with appropriate tops. Sizes 926-1758 must be installed outdoors. Sizes 962-1826 are for indoor installation. Sizes 2100-4001 are for indoor installation only.

INSTALLATION

Installation Codes

Installation must be in accordance with local codes, or, in the absence of local codes, with the latest editions of the National Fuel Gas Code (NFGC), ANSI Z223.1/NFPA 54, and the National Electrical Code (NEC), ANSI/NFPA 70. In Canada installations must conform with the current CAN/CSA B149 and the Canadian Electrical Code Part 1 CSA C22.2 No.1.

Where required by the authority having jurisdiction, the installation must conform to American Society of Mechanical Engineers Safety Code for Controls and Safety Devices for Automatically Fired Heaters, [CSD-1](#).

⚠ WARNING: This product must be installed by a licensed plumber or gas fitter when installed within the Commonwealth of Massachusetts.

Installation Base

The heater should be mounted on a level, non-combustible surface. Heater must not be installed on carpeting. The heater can be installed on a combustible surface only when the appropriate listed floor shield base is provided. A listed floor shield base is available for factory installation with the heater on all indoor models. Do NOT use the shipping base crate as an installation base.

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

⚠ WARNING: The heater shall not be located in an area where water sprinklers, or other devices, may cause water to spray through the cabinet louvers and into the heater. This could cause internal rusting or damage electrical components, and void the warranty.

Model No.	Floor Base Part Number
0514	056199
0624	056200
0724	056201
0824	056202
0926*	054597
1083*	054598
1178*	054599
1287*	054600
1414*	054601
1571*	058378
1758*	058379
0962	059233
1125	059234
1223	059235
1336	059236
1468	059237
1631	059238
1826	059239

* Models with factory-installed floor shield as standard.

Table B. Combustible Floor Shield Ordering

Clearance

Installation Clearances

Heater Location	Heater Model No.		
	0514 to 0824	0926 to 1826	2100 to 4001
	in. (mm)		
Back	12 (305)	24 (610)	24 (610)
Right	6 (152)	24 (610)	24 (610)
Left	18 (457)	24 (610)	24 (610)
Vent *	6 (152)	6 (152)	6 (152)
Indoor Top	12 (305)	24 (610)	24 (610)
Outdoor Top	Unobstructed		
Floor	Combustible floor shield is required when heater is installed on a combustible surface. For ordering information see Table B.		
Front	Provide at least 24" (610 mm) for Models 0514-1826 and 48" (130 mm) for Models 2100-4001 in front of unit for removal and servicing of the Controls and Burner Tray. Provide at least 18" (457 mm) on side opposite water connections for delimiting of Heat Exchanger Tubes.		

* Vent includes factory-supplied **drafhood** and does not include field-supplied vent systems above the **drafhood**. On Models 2100-4001 the **drafhood** is built into the heater.

Table C. Minimum Clearances from Combustible Installations

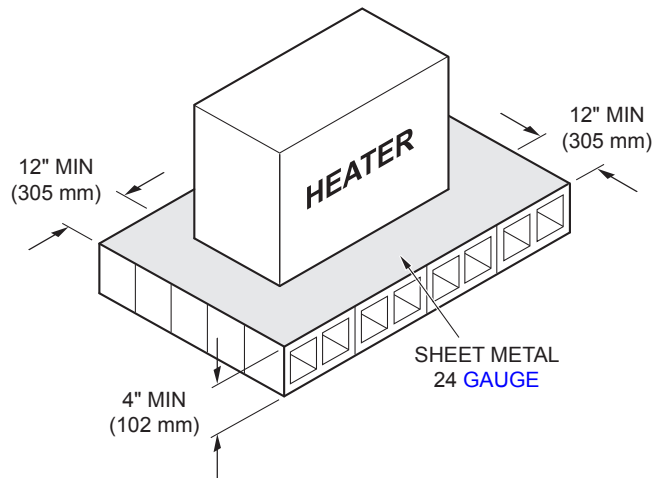


Figure 2. Alternate Method for Providing a Non-Combustible Base

NOTE: The heater shall be installed in a space large in comparison to the size of the heater. Large space is defined as having a volume at least sixteen (16) times the total volume of the heater (NFGC).

NOTE: Clearances to combustible surfaces can be reduced with appropriate protection as shown in Table D.

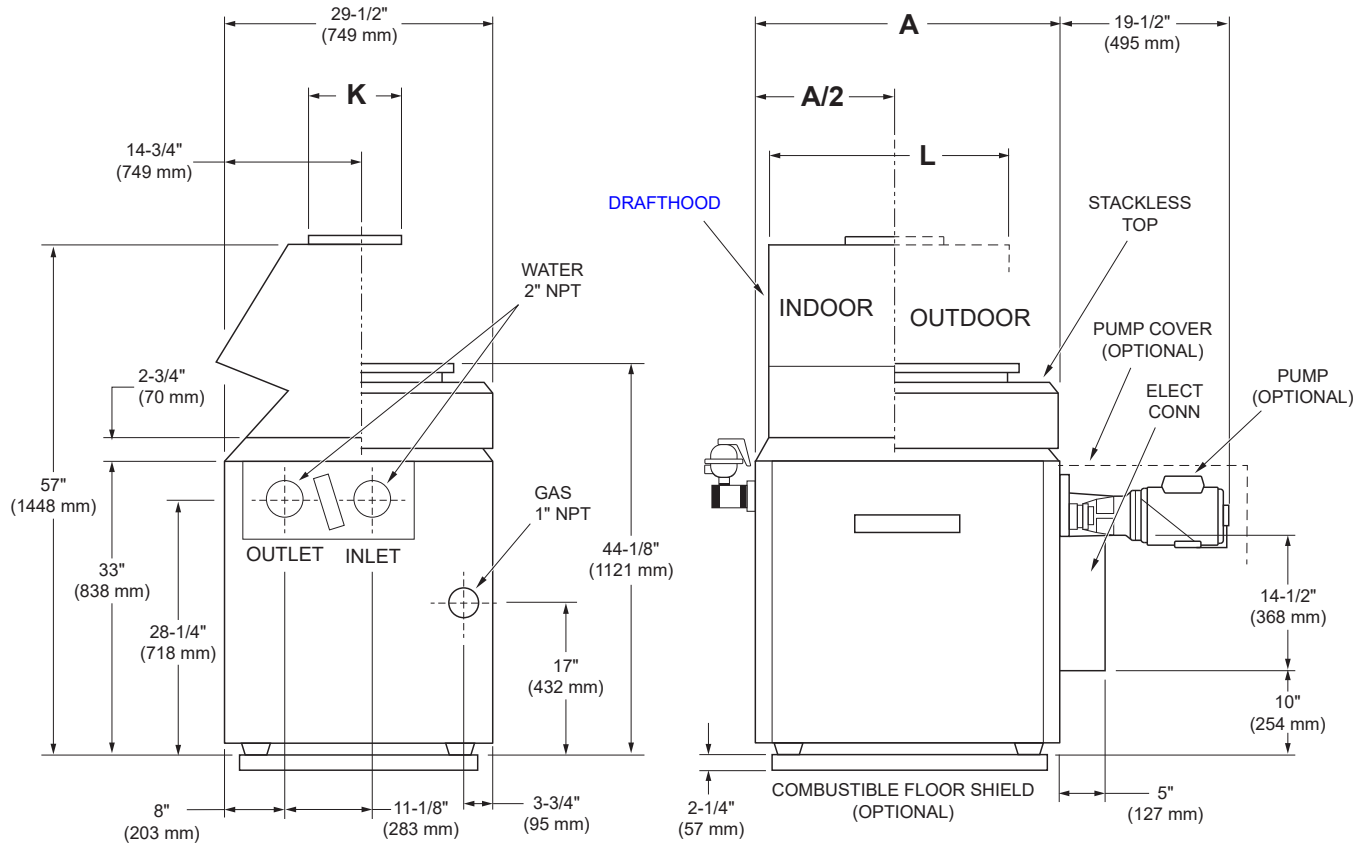
Description	Location	Boiler Model Number		
		0514 to 0824	0926 to 1826	2100 to 4001
a. 3-1/2" (89 mm) thick masonry walls without ventilated air space	Back	9 (229)	16 (406)	16 (406)
	Right	5 (127)	16 (406)	16 (406)
	Left	12 (305)	16 (406)	16 (406)
	Vent	5 (127)	5 (127)	5 (127)
	Indoor Top	36 (914)	24 (610)	24 (610)
	Outdoor Top	Unobstructed		
b. 1/2" (13 mm) insulation board over 1" (25 mm) glass fiber or mineral wool batts	Back	6 (152)	12 (305)	12 (305)
	Right	3 (76)	12 (305)	12 (305)
	Left	9 (229)	12 (305)	12 (305)
	Vent	3 (76)	3 (76)	3 (76)
	Indoor Top	24 (610)	16 (406)	16 (406)
	Outdoor Top	Unobstructed		
c. 0.024 sheet metal over 1" (25 mm) glass fiber or mineral wool batts reinforced with wire on rear face with ventilated air space	Back	4 (102)	8 (203)	8 (203)
	Right	3 (76)	8 (203)	8 (203)
	Left	6 (152)	8 (203)	8 (203)
	Vent	3 (76)	3 (76)	3 (76)
	Indoor Top	18 (457)	12 (305)	12 (305)
	Outdoor Top	Unobstructed		
d. 3-1/2" (89 mm) thick masonry wall with ventilated air space	Back	6 (152)	8 (203)	8 (203)
	Right	6 (152)	8 (203)	8 (203)
	Left	6 (152)	8 (203)	8 (203)
	Vent	6 (152)	6 (152)	6 (152)
	Indoor Top	36 (914)	24 (610)	24 (610)
	Outdoor Top	Unobstructed		
e. 0.024 sheet metal with ventilated air space	Back	4 (102)	8 (203)	8 (203)
	Right	2 (51)	8 (203)	8 (203)
	Left	6 (152)	8 (203)	8 (203)
	Vent	2 (51)	2 (51)	2 (51)
	Indoor Top	18 (457)	12 (305)	12 (305)
	Outdoor Top	Unobstructed		
f. 1/2" (13 mm) thick insulation board with ventilated air space	Back	4 (102)	8 (203)	8 (203)
	Right	3 (76)	8 (203)	8 (203)
	Left	6 (152)	8 (203)	8 (203)
	Vent	3 (76)	3 (76)	3 (76)
	Indoor Top	18 (457)	12 (305)	12 (305)
	Outdoor Top	Unobstructed		
g. 0.024 sheet metal with ventilated air space over 0.024 sheet metal with ventilated air space.	Back	4 (102)	8 (203)	8 (203)
	Right	3 (76)	8 (203)	8 (203)
	Left	6 (152)	8 (203)	8 (203)
	Vent	3 (76)	3 (76)	3 (76)
	Indoor Top	18 (457)	12 (305)	12 (305)
	Outdoor Top	Unobstructed		
h. 1" (25 mm) glass fiber or mineral wool batts sandwiched between two sheets 0.024 sheet metal with ventilated air space	Back	4 (102)	8 (203)	8 (203)
	Right	3 (76)	8 (203)	8 (203)
	Left	6 (152)	8 (203)	8 (203)
	Vent	3 (76)	3 (76)	3 (76)
	Indoor Top	18 (457)	12 (305)	12 (305)
	Outdoor Top	Unobstructed		

Derived from National Fuel Gas Code, Table 10.2.3

Table D. Reduction of Clearances to Protected Surfaces (in. / mm)

Specifications and Dimensions

Indoor or Outdoor Installation



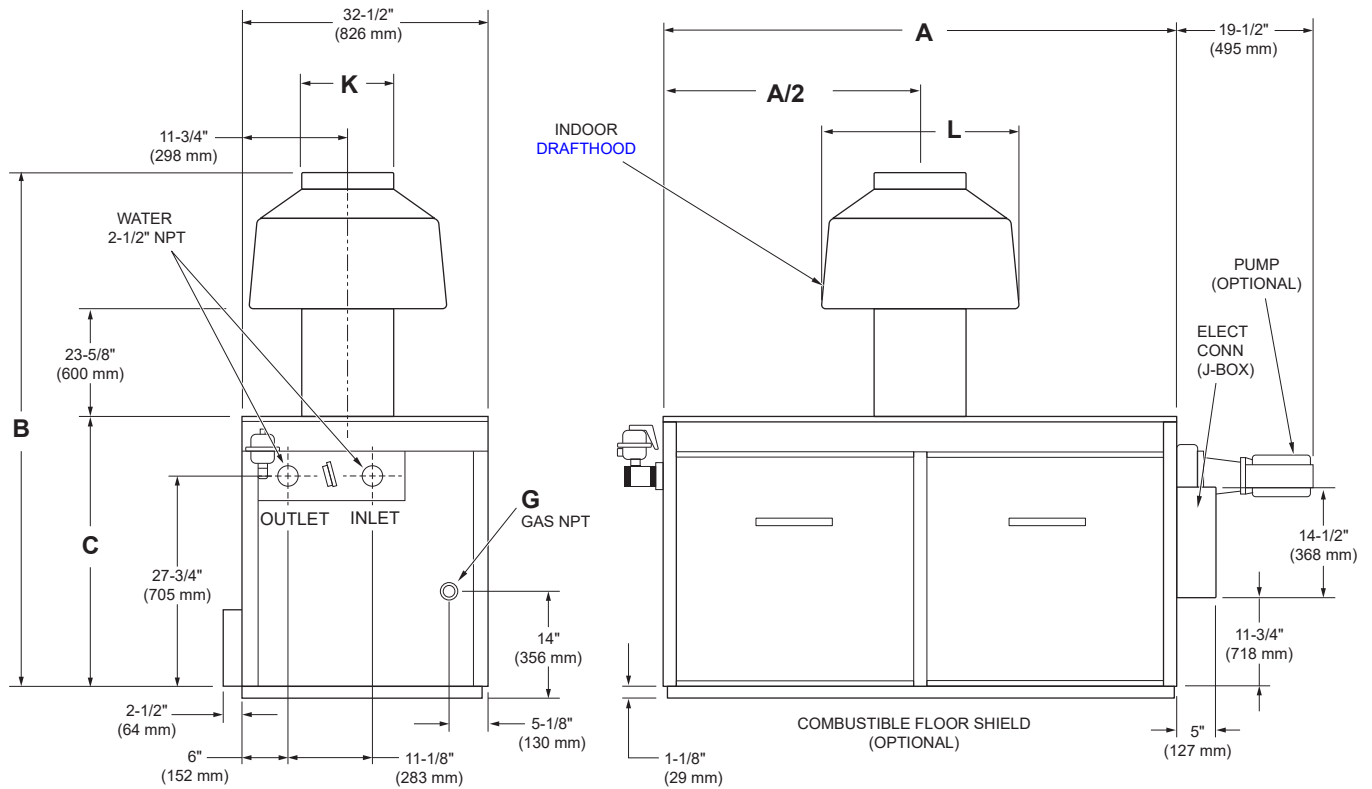
Model	Indoor/Outdoor				Dimensions in. (mm)		
	MBTUH Natural Gas (kW)		MBTUH Propane Gas (kW)		Width A	Flue Diameter K	L
	Input	Output	Input	Output			
WH-0514	512 (150)	419 (123)	481 (141)	394 (116)	32-3/4 (832)	10 (254)	25-3/8 (645)
WH-0624	627 (184)	514 (151)	589 (173)	483 (142)	37-1/2 (953)	12 (305)	29-1/2 (749)
WH-0724	726 (213)	595 (174)	682 (200)	559 (164)	41-5/8 (1057)	12 (305)	34-1/4 (870)
WH-0824	825 (242)	676 (198)	775 (227)	635 (186)	45-3/4 (1156)	14 (356)	38-1/2 (978)

Only Models 514, 624, 724, 824 are available for elevations up to 10,000 feet. Output ratings for elevations over 2,000 feet should be reduced at a rate of 4% for each 1,000 feet above sea level.

* Recovery based on manufacturer's rating.

Figure 3. Heater Specification and Dimensions - Models 0514-0824

Indoor Installation Only



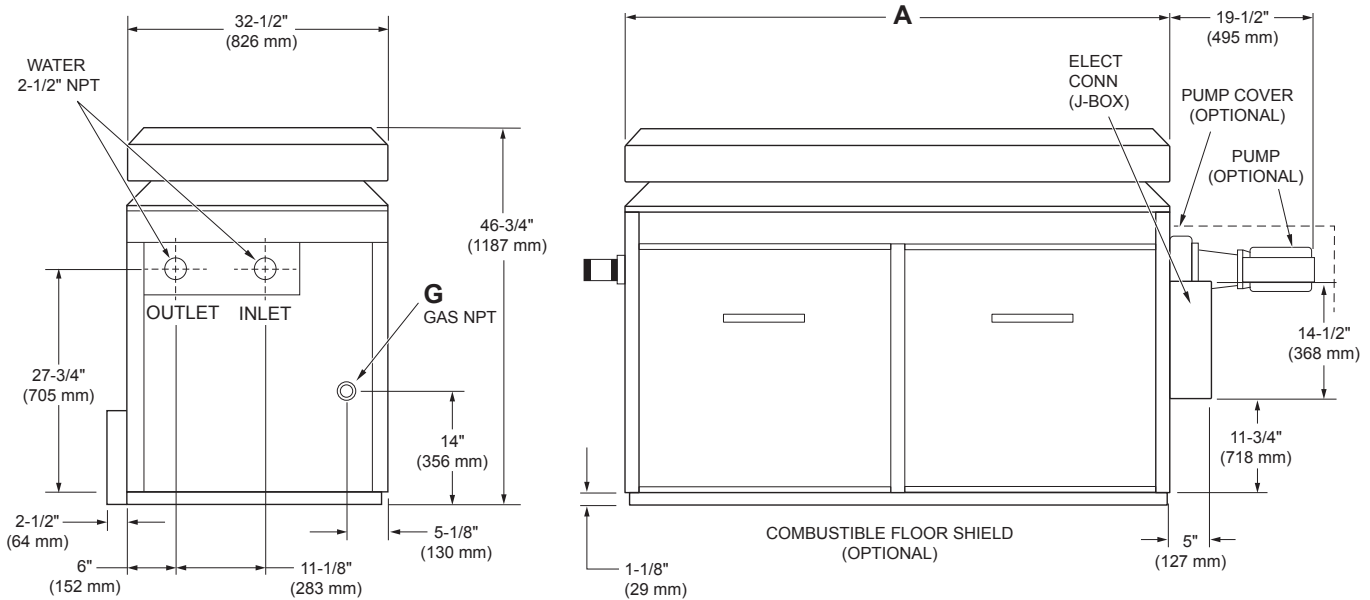
Model	MBTUH Natural Gas (kW)		MBTUH Propane Gas (kW)		Dimensions in. (mm)					
	Input	Output	Input	Output	Width A	Overall Height B	Jacket Height C	Gas Conn. G**	Flue Diameter K	L
WH-0962	962 (282)	789 (231)	885 (259)	726 (213)	52-3/8 (1330)	68-3/4 (1746)	33-1/2 (851)	1 (25)	14 (356)	28 (711)
WH-1125	1125 (330)	922 (270)	1035 (303)	849 (249)	59-1/4 (1616)	74-1/2 (1892)	33-1/2 (851)	1 (25)	16 (406)	32 (813)
WH-1223	1223 (358)	1003 (294)	1125 (330)	923 (270)	63-5/8 (1743)	74-1/2 (1892)	33-1/2 (851)	1-1/4 (32)	16 (406)	32 (813)
WH-1336	1337 (392)	1083 (317)	1230 (360)	1009 (296)	68-5/8 (1743)	76-1/2 (1943)	33-1/2 (851)	1-1/4 (32)	18 (457)	36 (914)
WH-1468	1467 (430)	1203 (353)	1350 (396)	1107 (324)	74-7/8 (1901)	76-1/2 (1943)	33-1/2 (851)	1-1/4 (32)	18 (457)	36 (914)
WH-1631	1630 (478)	1337 (392)	1500 (440)	1230 (360)	82-1/8 (2085)	79-1/2 (2019)	36-1/2 (927)	1-1/4 (32)	18 (457)	36 (914)
WH-1826	1826 (535)	1497 (439)	1680 (492)	1378 (404)	89-3/8 (2270)	81-1/2 (2070)	36-1/2 (927)	1-1/4 (32)	20 (508)	40 (1016)

* Recovery based on manufacturer's rating.

** Varies depending on gastrain options selected

Figure 4. Heater Specification and Dimensions - Models 0962-1826

Outdoor Installation Only



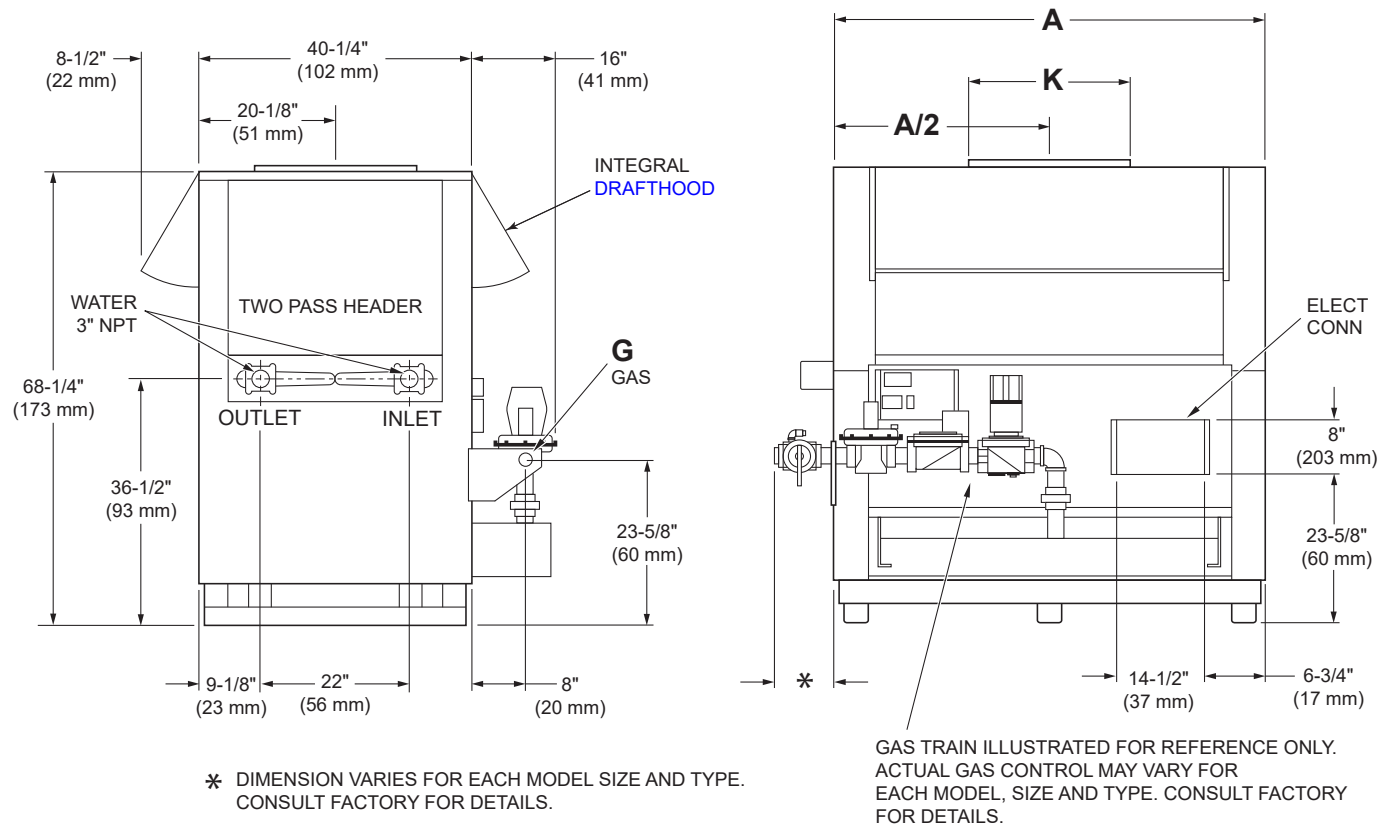
Model	MBTUH Natural Gas (kW)		MBTUH Propane Gas (kW)		Dimensions in. (mm)	
	Input	Output	Input	Output	Width A	Gas Conn. G**
WH-0926	926 (271)	759 (223)	885 (259)	726 (213)	52-3/8 (1330)	1 (25)
WH-1083	1083 (317)	888 (260)	1035 (303)	849 (249)	59-1/4 (1505)	1 (25)
WH-1178	1178 (345)	966 (283)	1125 (330)	923 (270)	63-5/8 (1616)	1-1/4 (32)
WH-1287	1287 (377)	1055 (309)	1230 (360)	1009 (296)	68-5/8 (1743)	1-1/4 (32)
WH-1414	1413 (414)	1159 (340)	1350 (396)	1107 (324)	74-7/8 (1902)	1-1/4 (32)
WH-1571	1570 (460)	1287 (377)	1500 (440)	1230 (360)	82-1/8 (2086)	1-1/4 (32)
WH-1758	1758 (515)	1442 (422)	1680 (492)	1378 (404)	89-3/8 (2270)	1-1/4 (32)

* Recovery based on manufacturer's rating.

** Varies depending on gastrain options selected.

Figure 5. Heater Specification and Dimensions - Models 0926-1758

Indoor Installation Only



Model	MBTUH (kW) Natural & Propane Gas		Dimensions in. (mm)		
	Input	Output	Width A	Gas Conn. G	Flue Diameter K
WH-2100	2100 (615)	1722 (505)	61 (1549)	**	24 (610)
WH-2500	2499 (732)	2049 (601)	70 (1778)	**	26 (660)
WH-3001	3000 (879)	2460 (721)	81-1/4 (2064)	2 (51)	28 (711)
WH-3500	3500 (1026)	2870 (841)	92-1/2 (2349)	2 (51)	30 (762)
WH-4001	4000 (1172)	3280 (961)	103-3/4 (2635)	2 (51)	32 (812)

* Recovery based on manufacturer's rating.

** 1-1/2" or 2" contingent on code requirements

Figure 6. Heater Specification and Dimensions - Models 2100-4001

Outdoor Water Heaters

These heaters are design-certified for outdoor installation. Heaters must not be installed under an overhang within 3' (0.9 m) from the top on the heater. Three (3) sides must be open in the area under the overhang. Roof water drainage must be diverted away from the heaters with the use of gutters.

The point from where the flue products exit the heater must be a minimum of 4' (1.2 m) below, 4' (1.2 m) horizontally from or 12" (305 mm) above any door, window or gravity inlet to a building. The top surface of the heater shall be at least 3' (0.9 m) above any forced air inlet, or intake ducts located within ten 10' (3 m) horizontally.

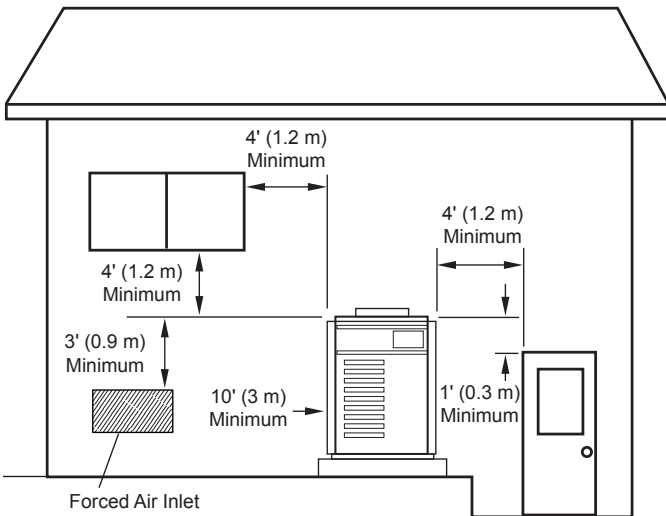


Figure 7. Minimum Distances to Building Openings from Where Flue Products Exit the Heater

High-Wind Conditions

Outdoor Units Only

In areas where high winds are frequent, it may be necessary to locate the heater a minimum of 3' (0.9 m) from high vertical walls, or install a wind break so the heater is not in direct wind current.

Combustion and Ventilation Air

Indoor Units Only

The heater must have both combustion and ventilation air. Minimum requirements for net free air supply openings are 12" (305 mm) max from ceiling for ventilation and 12" (305 mm) max from the floor for combustion air as outlined in Z223.1 - latest edition or the current CAN/CSA B149, as well as any local codes that may have jurisdiction.

- a. All air from inside the building

Each opening shall have a minimum net free square inches as noted in **Table E**.

- b. All air from outside the building:

When air is supplied directly from outside of building, each opening shall have a minimum net free square inches as noted in **Table F**.

CAUTION: Combustion air must not be contaminated by corrosive chemical fumes which can damage the heater. Measures must be taken to prevent the entry of corrosive chemical fumes to the combustion and ventilation air supply. Such chemicals include, but are not limited to, chlorinated and/or fluorinated hydrocarbons such as found in refrigerants, aerosol propellants, dry-cleaning fluids, degreasers, and paint removers. Other harmful elements may come from bleaches, air fresheners, or mastics. Vapors from these types of products can form corrosive acid compounds when burned in a gas flame. The resulting acidic condensate can damage or substantially reduce the life of the heater. It may become necessary to provide outside air directly to the heater in order to avoid this problem.

Model	Square Inches (cm)	Model No.	Square Inches (cm)
0514	512 (3302)	2100	2100 (13545)
0624	627 (4044)	2500	2499 (16119)
0724	726 (4683)	3001	3000 (19350)
0824	825 (5321)	3500	3500 (22575)
0962	962 (6205)	4001	4000 (25800)
1125	1125 (7256)		

Table E. Minimum Net Free Air from Inside Building

Model	Square Inches (cm)	Model	Square Inches (cm)
0514	128 (826)	2100	525 (3386)
0624	157 (1013)	2500	625 (4031)
0724	182 (1174)	3001	750 (4838)
0824	207 (1335)	3500	875 (5644)
0962	241 (1554)	4001	4000 (25800)
1125	282 (1819)		

Table F. Minimum Net Free Air from Outside Building

Outdoor Installations

Models 0514-0824

1. Lower outdoor top onto unit. Position top so it is centered on unit from side to side and front to rear.

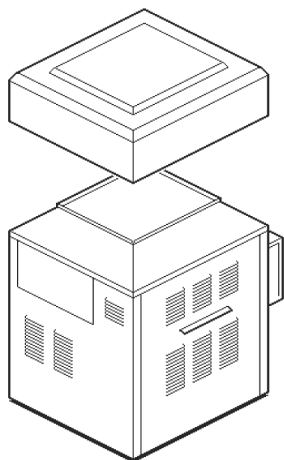


Figure 8. Outdoor Top Installation for Models 0514-0824

2. Tighten the (4) screws until they come in contact with the unit jacket top, then evenly tighten all (4) screws to secure to unit. See Figure 9.

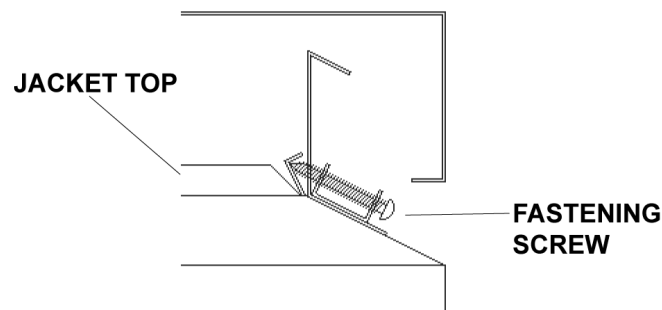


Figure 9. Outdoor Top Installation for Models 0514-0824

Models 0926-1758

Heaters are shipped with an outdoor vent terminal, factory installed.

Indoor Installations

▲ WARNING: Do not use the “one permanent opening” method if the equipment room is under negative-pressure conditions or the equipment is common vented with other gas-fired appliances.

▲ WARNING: These heaters must not be connected into any portion of mechanical draft systems operating under positive pressure. To do so may cause the flue products to be discharged into the living space causing serious health injury.

Models 0514-0824

Locate and assemble as shown in Figure 10. Secure with screws supplied in envelope in carton.

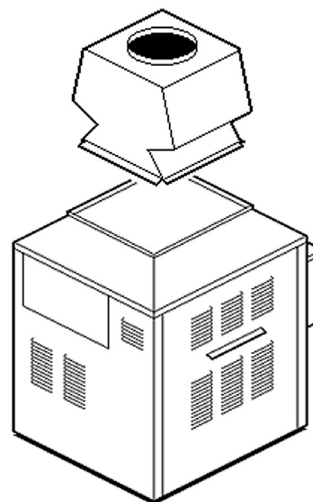


Figure 10. Drafthood Installation for Models 0514-0824

Models 0962-1826

Locate and assemble as shown in Figure 11. Secure with screws supplied in envelope in carton.

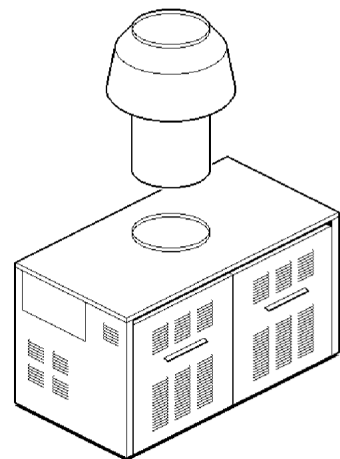


Figure 11. Drafthood Installation for Models 0962-1826

Models 2100-4001

These models have built-in drafthoods. For proper operation, the drafthood outlet must be connected to the venting system.

Vent Piping

⚠ WARNING: Indoor heaters require a **drafthood** that must be connected to a vent pipe and properly vented to the outside. Failure to follow this procedure can cause fire or fatal carbon monoxide poisoning.

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.

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

Vent piping the same size or larger than the **drafthood** outlet is recommended, however, when the total vent height is at least 10 ft (3 m) (**drafthood** relief opening to vent terminal), the vent pipe size may be reduced as specified in Chapter 13 of the latest edition of the National Fuel Gas Code (NFGC).

These units are certified for operation with Cat. I vents (natural draft conditions). Refer to the standard vent tables in the NFGC.

As much as possible, avoid long horizontal runs of vent pipe and too many elbows. If installation requires horizontal non-vertical runs, the vent pipe must have a minimum of 1/4 inch per foot rise and should be supported at not more than 5 ft (1.5 m) intervals. Plumbers tape, criss-crossed, will serve to space both horizontal and vertical piping.

Gas vents supported only by the flashing and extending above the roof more than 5 ft (1.5 m) should be securely guyed or braced to withstand snow and wind loads.

Raypak recommends the use of insulated vent pipe spacers through the roof and walls.

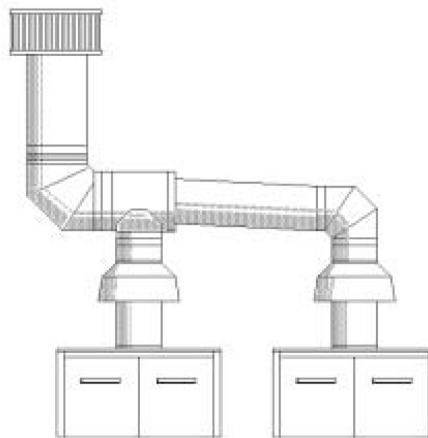


Figure 12. Common Venting

For protection against rain or blockage by snow, the vent pipe must terminate with a vent cap which complies with the local codes or, in the absence of such codes, to the latest edition of the National Fuel Gas Code define in page 7.

The discharge opening must be a minimum of 2 ft (0.6 m) vertically from the roof surface and at least 2 ft (0.6 m) higher than any part of the building within 8 ft (2.4 m) for vents smaller than 12" (305 mm) diameter. For 12" (305 mm) diameter vents and larger, the termination must be 2 ft (0.6 m) higher than any part of the building within 10 ft (3 m). See **Figure 13**.

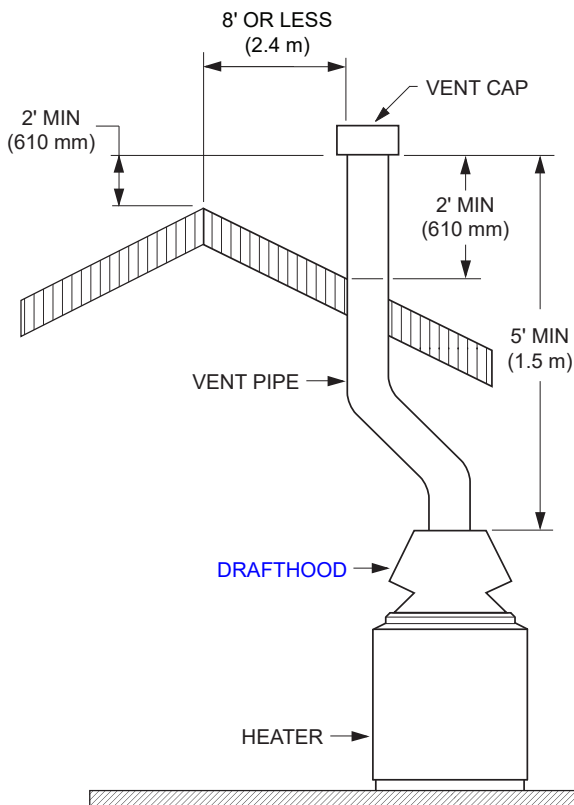


Figure 13. Venting Clearances

Vent stack shall be at least 5' (1.5 m) in vertical height above the **drafthood** outlet. The vent cap location shall have a minimum clearance of 4' (1.2 m) horizontally from, and in no case above or below, unless a 4' (1.2 m) horizontal distance is maintained, from electric meters, gas meters regulators and relief equipment.

The weight of the vent stack or chimney must not rest on heater **drafthood**. Support must be provided in compliance with applicable codes. The heater top and **drafthood** must be readily removable for maintenance and inspection. Vent pipe should be adequately supported to maintain proper clearances from combustible construction.

Type "B" double-wall or equivalent vent pipe is recommended. However, single-wall metal vent pipe may be used as specified in the latest edition of the NFGC.

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 be less than the area of the largest outlet.

Maintain draft of -0.01 to -0.08" WC.

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

- a. Seal any unused openings in the common venting system.
- b. Visually inspect the venting system for proper size and horizontal pitch and make sure there is no blockage or restriction, leakage, corrosion and other deficiencies which could cause an unsafe condition.
- c. As much as possible, 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 venting system. Turn on any exhaust fans, such as range hoods and bathroom exhausts, so they will operate at maximum speed. Do not operate a summer exhaust fan. Close fireplace dampers.
- d. Place in operation the appliance being inspected. Follow the lighting instructions. Adjust thermostat so appliance will operate continuously.
- e. Test for spillage at the **drafthood** relief opening after 5 minutes of main burner operation. Use the flame of a match or candle, or smoke from a cigarette, cigar or pipe.
- f. 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 any other gas burning appliance to their previous conditions of use.

- g. Any improper operation of the common venting system should be corrected so that the installation conforms with the latest edition of the NFGC. 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 Chapter 13 of the NFGC.

For special venting applications that require reduced vent sizes, or through-the-wall venting, the Type D Induced Draft Assembly can be used. Consult the factory or your local Raypak representative.

Gas Supply Connections

Gas piping must have a sediment trap ahead of the heater gas controls, and a manual shutoff valve located outside the heater jacket. All gas piping should be tested after installation in accordance with local codes. See **Table G** for maximum allowable length of the gas line to the heater.

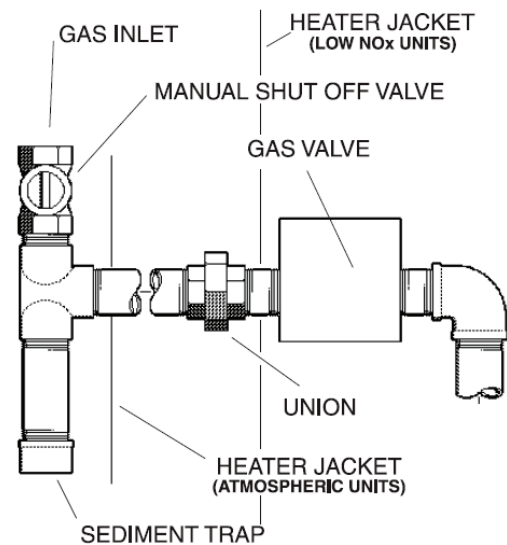


Figure 14. Sediment Trap

A minimum of 7.0" W.C. upstream gas pressure under full load and a maximum gas supply pressure setpoint of 10.5" W.C. under load and no-load conditions for natural gas. A minimum of 12.0" W.C. upstream gas pressure under full load and a maximum gas supply pressure of 13.5" W.C. is required for propane gas. If upstream pressure exceeds 1/2 psi at any time, an intermediate gas pressure regulator, of the lockup type, must be installed.

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

⚠ CAUTION: The heater and its manual shutoff valve must be disconnected from the gas supply during any pressure testing of that system at test pressures in excess of 1/2 PSIG. Dissipate test pressure in the gas supply line before reconnecting the heater and its manual shutoff valve to gas supply line. **FAILURE TO FOLLOW THIS PROCEDURE MAY DAMAGE THE GAS VALVE. OVER-PRESSURED 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 open flame.

⚠ 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.

Domestic Hot Water Supply Heaters

Table H provides data for selecting in-line pumps for use in a Uni-Temp 80 system for a single heater and tank according to the following:

- Flow rates are based on water hardness as measured in grains per gallon.

Soft: 3-4 grains per gallon.

Medium: 5-15 grains per gallon.

Hard: 16-25 grains per gallon.

- Pressure drop values (ΔP and SHL) and minimum pipe sizes are for two-pass heaters.
- Pump sizing based on heater and tank being placed 5 feet apart. The max allowable equivalent length of pipe, valves and fittings in the system is as follows:

0514-0824: 2" NPT = 75 ft (23 m)

0926-1826: 2-1/2" NPT = 80 ft (24 m)

2100-4001: 3" NPT = 85 ft (26 m)

Additional pipe fittings will increase the system head loss and may require a different pump.

- Select a pump based on the water hardness, flow, and system head loss.
- If heater is more than two stories above the tank, consult the factory.

NOTE: GPM flow rates are limited by the maximum acceptable velocity through the heat exchanger tubes. Heater models 0514 through 1826 may be provided with a rear-mounted pump. This must be specified at time of order.

MINIMUM INPUT ADJUSTMENT: WH models have minimum input ratings as specified on their individual rating plates. Minimum input controllers have been preset at the factory. Consult with factory representatives if a minimum input problem should occur.

Gas Pressure Regulator

The manifold gas pressure regulator is preset nominally at 4" W.C. for natural gas, and 11" W.C. for propane. Between the gas valve and the burners is a 1/8" pipe plug. The pressure at this point, taken with a manometer, should be about 3.7" W.C. for natural gas and 10.5" W.C. for propane. If an adjustment is needed, turn adjustment screw clockwise to increase pressure, or counter-clockwise to decrease pressure.

Venting of Diaphragm Gas Components

Gas train components that have diaphragms in their construction are supplied with a bleed line connection that must be connected to the outside atmosphere as required by the National Fuel Gas Code. Under NO circumstances shall bleed lines terminate in the gas utilization equipment flue or exhaust system. Care should be used to prevent obstruction to the bleed lines, as blocked lines could prevent gas valves or other devices from operating.

All regulators on a Raypak gastrain must remain in an upright vertical position for proper operation.

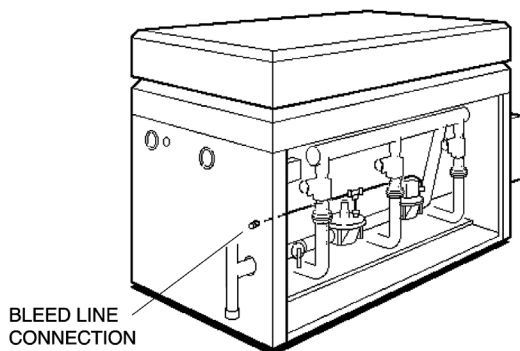


Figure 15. Bleed Line Connection Location

Model No.																
	3/4" NPT		1" NPT		1-1/4" NPT		1-1/2" NPT		2" NPT		2-1/2" NPT		3" NPT		4" NPT	
	NAT	PRO	NAT	PRO	NAT	PRO	NAT	PRO	NAT	PRO	NAT	PRO	NAT	PRO	NAT	PRO
0514		10 (3)	15 (5)	35 (11)	65 (20)	150 (46)	130 (40)	360 (110)	500 (152)							
0624			10 (3)	25 (8)	45 (14)	100 (30)	95 (29)	250 (76)	340 (104)							
0724				20 (6)	35 (11)	80 (24)	75 (23)	180 (55)	260 (79)	600 (183)						
0824				15 (5)	25 (8)	60 (18)	55 (17)	130 (40)	185 (56)	480 (146)	500 (152)					
0926/0962				15 (5)	20 (6)	45 (14)	45 (14)	110 (34)	150 (46)	360 (110)	400 (122)					
1083/1125				10 (3)	15 (5)	35 (11)	35 (11)	80 (24)	120 (37)	300 (91)	300 (91)					
1178/1223						25 (8)	25 (8)	60 (18)	85 (26)	220 (67)	200 (61)					
1287/1336						25 (8)	20 (6)	55 (17)	75 (23)	180 (55)	170 (52)	325 (99)	560 (171)			
1414/1468						20 (6)	15 (5)	45 (14)	65 (20)	150 (46)	165 (50)	300 (91)	500 (152)			
1571/1631						15 (5)	15 (5)	35 (11)	50 (15)	120 (37)	125 (38)	250 (76)	400 (122)			
1758/1826						15 (5)	10 (3)	30 (9)	40 (12)	100 (30)	100 (30)	225 (69)	340 (104)			
2100						10 (3)	10 (3)	25 (8)	30 (9)	80 (24)	75 (23)	175 (53)	260 (79)			
2500								15 (5)	20 (6)	55 (17)	55 (17)	135 (41)	160 (49)	400 (122)	600 (183)	
3001								10 (3)	15 (5)	35 (11)	40 (12)	85 (26)	120 (37)	250 (76)	500 (152)	
3500									10 (3)	30 (9)	30 (9)	45 (14)	80 (24)	200 (61)	400 (122)	600 (183)
4001									5 (2)	20 (6)	25 (8)	35 (11)	65 (20)	160 (49)	300 (91)	400 (122)

A minimum of 7" WC and a maximum of 10.5" WC upstream pressure under load, and no-load conditions must be provided for natural gas, or a minimum of 11" WC and a maximum of 13" for propane.

Pressure drops from the no-load condition to the full-load condition must be no more than 30% for proper operation.

Table G. Maximum Equivalent Pipe Length (ft./m)

Model No.	2-PASS HEAT EXCHANGER							1-PASS HEAT EXCHANGER						
	MAX			MIN			HDR CONN	MAX			MIN			HDR CONN
	GPM (lpm)	ΔT °F	ΔP ft.	GPM (lpm)	ΔT °F	ΔP ft.		GPM (lpm)	ΔT °F	ΔP ft.	GPM (lpm)	ΔT °F	ΔP ft.	
0514	90 (341)	9	9.0	40 (152)	21	1.8	2"							
0624	90 (341)	12	9.5	40 (152)	26	1.9	2"							
0724	90 (341)	13	10.0	40 (152)	30	2.0	2"							
0824	90 (341)	15	10.5	40 (152)	34	2.1	2"							
0926	90 (341)	17	11.0	40 (152)	38	2.2	2-1/2"	200 (758)	8	9.7	90 (341)	17	2.1	3"
0962	90 (341)	18	11.0	40 (152)	40	2.2	2-1/2"	200 (758)	8	9.7	90 (341)	18	2.1	3"
1083	90 (341)	20	12.0	45 (170)	40	3.1	2-1/2"	200 (758)	9	10.3	90 (341)	20	2.3	3"
1125	90 (341)	21	12.0	47 (178)	40	3.3	2-1/2"	200 (758)	9	10.3	90 (341)	20	2.3	3"
1178	90 (341)	22	12.5	49 (186)	40	3.8	2-1/2"	200 (758)	10	11	90 (341)	21	2.4	3"
1223	90 (341)	22	12.5	51 (193)	40	4.0	2-1/2"	200 (758)	10	11	90 (341)	22	2.4	3"
1287	90 (341)	24	13.2	53 (201)	40	4.5	2-1/2"	200 (758)	11	11.7	90 (341)	23	2.5	3"
1336	90 (341)	24	13.2	55 (208)	40	4.9	2-1/2"	200 (758)	11	11.7	90 (341)	24	2.5	3"
1414	90 (341)	26	14.0	58 (220)	40	5.8	2-1/2"	200 (758)	12	12.2	90 (341)	26	2.7	3"
1468	90 (341)	27	14.0	61 (231)	40	6.4	2-1/2"	200 (758)	12	12.2	90 (341)	27	2.7	3"
1571	90 (341)	29	14.5	65 (246)	40	7.5	2-1/2"	200 (758)	13	13	90 (341)	29	2.8	3"
1631	90 (341)	30	14.5	68 (258)	40	8.3	2-1/2"	200 (758)	13	13	90 (341)	30	2.8	3"
1758	90 (341)	32	15.4	73 (277)	40	10.0	2-1/2"	200 (758)	14	14.7	90 (341)	32	3.0	3"
1826	90 (341)	34	15.4	76 (288)	40	10.8	2-1/2"	200 (758)	15	14.7	90 (341)	33	3.0	3"
2100	200 (758)	17	14.8	90 (341)	39	3.2	3"	400 (1515)	9	18	180 (682)	19	4.0	4"
2500	200 (758)	21	15.8	103 (390)	40	4.4	3"	400 (1515)	10	18.8	180 (682)	23	4.1	4"
3001	200 (758)	25	16.7	124 (470)	40	6.7	3"	400 (1515)	12	19.5	180 (682)	27	4.3	4"
3500	200 (758)	29	17.5	145 (549)	40	9.5	3"	400 (1515)	14	20.5	180 (682)	32	4.5	4"
4001	200 (758)	33	18.7	166 (629)	40	13.0	3"	400 (1515)	16	21.5	180 (682)	36	4.7	4"

GPM Flow rates limited by maximum acceptable velocity through heat exchanger tubes. May be increased by 10% for closed-loop heating systems.

Table H. Maximum and Minimum Flow Rates

Model		WATER HARDNESS														
		SOFT 3-4 Grains Per Gallon					MEDIUM 5-15 Grains Per Gallon					HARD 16-25 Grains Per Gallon*				
Indoor	Outdoor	ΔT °F	GPM (lpm)	ΔP ft.	MPS	SHL	ΔT °F	GPM (lpm)	ΔP ft.	MPS	SHL	ΔT °F	GPM (lpm)	ΔP ft.	MPS	SHL
0514	0514	20	42 (159)	2.0	2"	4.8	16	52 (197)	3.0	2"	7.1	9	90 (341)	9.0	2"	19.1
0624	0624	25	41 (155)	2.0	2"	4.7	19	54 (204)	3.4	2"	7.9	11	90 (341)	9.5	2"	20.9
0724	0724	29	41 (155)	2.1	2"	4.9	20	60 (227)	4.4	2"	9.8	13	90 (341)	10.0	2"	21.4
0824	0824	30	45 (170)	2.6	2"	5.9	20	68 (257)	6.0	2"	12.8	15	90 (341)	10.5	2"	21.9
0962	0926	30	53 (201)	3.8	2-1/2"	5.3	20	79 (299)	8.5	2-1/2"	11.5	18	90 (341)	11.0	2-1/2"	15.2
1125	1083	30	61 (231)	5.5	2-1/2"	7.5	20	90 (341)	12.0	2-1/2"	16.2	20	90 (341)	12.0	2-1/2"	16.2
1223	1178	30	67 (254)	7.0	2-1/2"	9.3	22	90 (341)	12.5	2-1/2"	16.7	22	90 (341)	12.5	2-1/2"	16.7
1336	1287	30	73 (276)	8.7	2-1/2"	11.5	24	90 (341)	13.3	2-1/2"	17.5	24	90 (341)	13.3	2-1/2"	17.5
1468	1414	30	80 (303)	11	2-1/2"	14.4	27	90 (341)	14.0	2-1/2"	18.2	27	90 (341)	14.0	2-1/2"	18.2
1631	1571	30	90 (341)	14.8	2-1/2"	19.0	30	90 (341)	14.8	2-1/2"	19.0	30	90 (341)	14.8	2-1/2"	19.0
1826	1758	33	90 (341)	15.4	2-1/2"	19.6	33	90 (341)	15.4	2-1/2"	19.6	33	90 (341)	15.8	2-1/2"	19.6
2100		30	115 (435)	5.0	3"	7.9	20	172 (651)	11.0	3"	17.2	17	200 (757)	14.8	3"	22.9
2500		30	137 (519)	7.5	3"	11.4	20	200 (757)	15.8	3"	23.9	20	200 (757)	15.8	3"	23.9
3001		30	164 (621)	11.2	3"	17.0	25	200 (757)	16.7	3"	24.8	25	200 (757)	16.7	3"	24.8
3500		30	191 (723)	16.2	3"	23.7	29	200 (757)	17.5	3"	25.6	29	200 (757)	17.5	3"	25.6
4001		33	200 (757)	18.7	3"	26.8	33	200 (757)	18.7	3"	26.8	33	200 (757)	18.7	3"	26.8

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

ΔT = Temperature Rise, Degree F@GPM FLOW GPM = Gallons per Minute Flow ΔP = Pressure Drop, Foot thru Heat Exchanger

MPS = Minimum Pipe Size, NPT

SHL = System Head Loss

Table I. General Specifications Uni-Temp 80 Hot Water Supply Systems

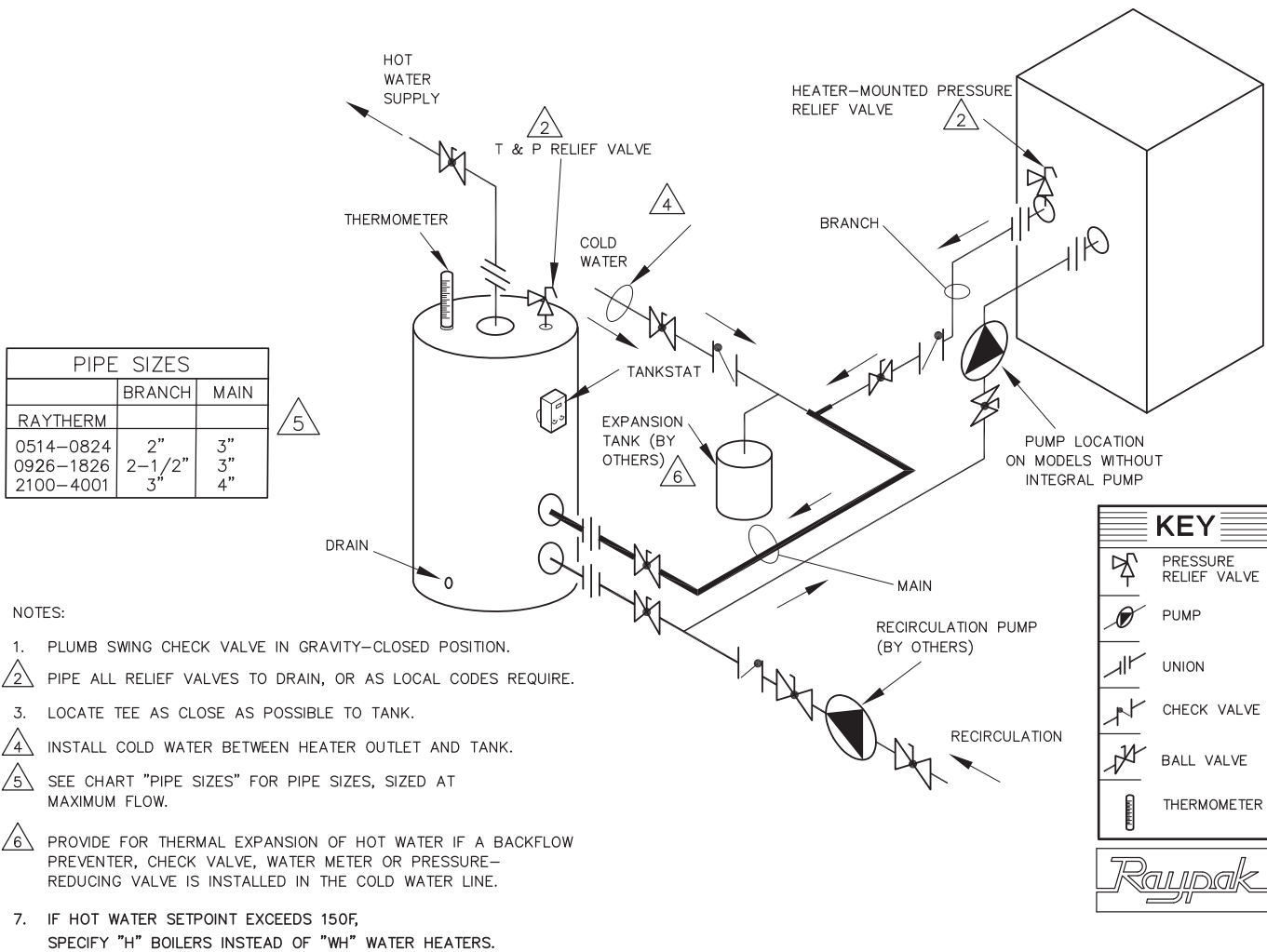


Figure 16. Type WH - Unitemp 80 System Piping Diagram

CONTROLS

Relief Valve

A new combination temperature and pressure (T&P) relief valve, complying with the Standard for Relief Valves and Automatic Gas Shutoff Devices for Hot Water Supply Systems, ANSI Z21.22, must be installed in the opening provided on top of the storage tank at the time of installation. No valve is to be placed between the relief valve and the storage tank. The pressure rating of the relief valve must not exceed the 160 PSIG maximum working pressure indicated on the water heater rating plate. The BTUH relief capacity of the relief valve must not be less than the BTUH input of the heater.

Connect the outlet of the relief valve to a suitable open drain. The discharge line must pitch downward from the valve to allow complete draining (by gravity) of the relief valve and discharge line. The discharge line should be no smaller than the outlet of the valve. The end of the discharge line should not be threaded or concealed, and should be protected from freezing. No valve of any type, restriction or reducer coupling, should be installed in the discharge line. Local codes shall govern installation of the relief valve.

Pump Time Delay

The Time Delay Relay board allows the operator to set a variable time (3 to 10 minutes) for the pump to run after the heater shuts off. See **Figure 17**. The time is factory-set at 7 minutes and it can be re-adjusted in the field. Max load 3/4 HP.

In a conventional system, when the tankstat is satisfied, the main gas valve closes, but the pump continues operating. With the time delay relay, the heater pump is programmed to continue running for an optimum period of time in order to absorb the residual heat from the combustion chamber and use it in the system. The pump then shuts off until the next call for heat is received from the tankstat.

NOTE: Pump will come on when power is first applied to heater.

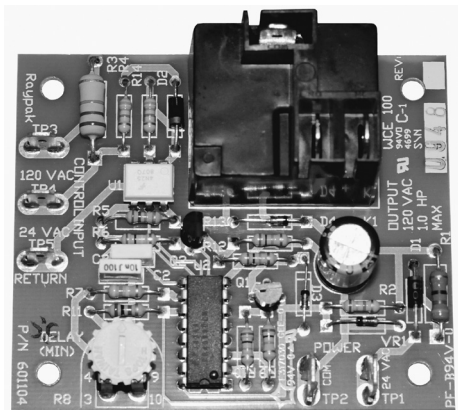


Figure 17. Economaster Time Delay Relay (TDR)

Electronic Ignition

The intermittent ignition device (IID) conserves energy by automatically extinguishing the pilot when the desired temperature is reached. When additional heat is needed, the pilot re-ignites electrically, eliminating the fuel costs of maintaining a constant pilot. To ensure safe operation, the gas valve cannot open until the pilot relights and is confirmed on each firing cycle.

Model	Gas	Without Lockout	With Lockout
0514-1826	Nat	Optional	Standard
0514-1826	Pro		Standard
2100-4001	Nat	Optional	Standard
2100-4001	Pro		Standard

Table J. Electronic Ignition

Operating Controls

All WH units require a control device (tankstat) that senses the temperature of the water in the storage tank. See **Figure 25** through **Figure 27**.

WH1 models fire on-off and require closure across the TH contacts by a tankstat.

WH2 units use one or more mechanical modulating firing valves. After the heater ignites, the valve(s) will throttle the heater input to adjust the firing rate to match the required load. This reduces fuel consumption, as compared to an on-off cycling heater. The valve has a remote capillary bulb immersed in a well at the header outlet, to provide temp data for the valve. This is a purely mechanical system; no outside control package will affect the setting of the valve(s).

Sizes 0724-1336 use 2 modulation valves. See **Figure 19**. Sizes 1414-1826 use 3 modulation valves. See **Figure 27**.

These valves can be staged to give greater flexibility of control. Standard factory setting is at position 5. Consult the dial setting tag attached to the control for your desired heater outlet temperature. See Figure 18.

Robertshaw modulating valve dial setting chart STANDARD FACTORY SETTINGS	
Dial Position	Temperature °F (°C)
LO	110 (43)
1	117 (47)
2	124 (51)
3	130 (54)
4	137 (58)
5	143 (62)
6	150 (66)
7	156 (69)
8	163 (73)
HI	170 (77)

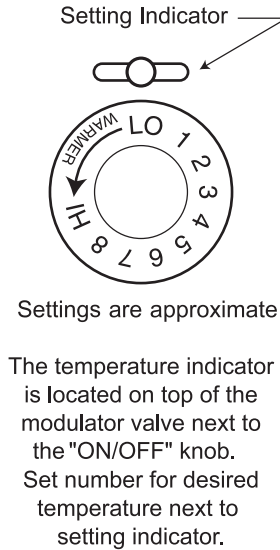


Figure 18. Dial Setting Tag (WH2 only)

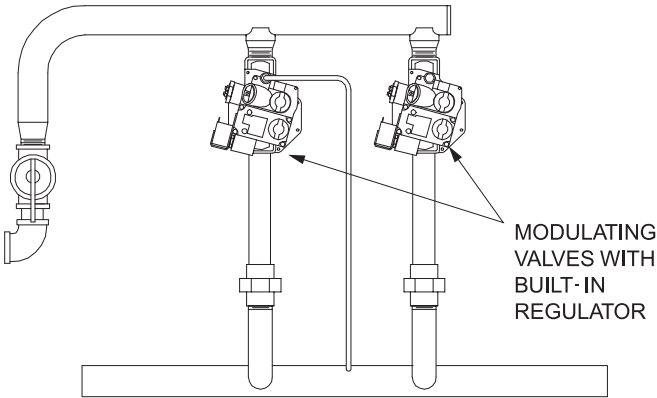


Figure 19. WH2 0724-1336 Gastrain

WH2 models in sizes 2100-4001 use motorized modulation; closure across the STG contacts activates the heater. The firing valve modulates in response to a 0-135 ohm signal received from an external controlling tankstat. See Figure 20.

WH3 models operate in response to a 2-stage tankstat mounted in the storage tank. See Figure 26. When stage 1 of the tankstat activates, it closes across the TH contacts to fire the unit on low fire. When stage 2 of the tankstat activates, it energizes stage 2 of the heater.

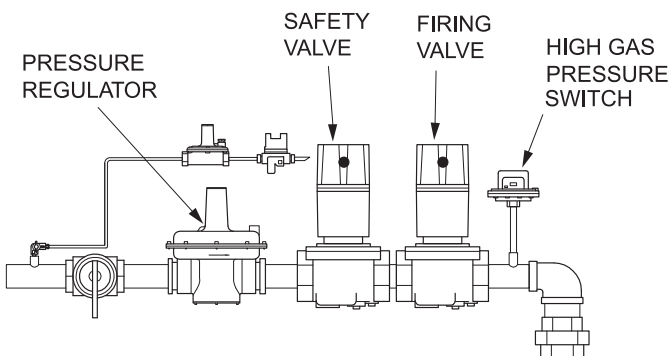


Figure 20. WH2-3001 Motorized Valve Gastrain

Limit Controls

High Limit

The heater is equipped with a manual-reset High Limit, set at 200°F (93°C). See Figure 21. An optional auto-reset high limit (sales option I-1) may also be present, to be set approximately 20°F above the expected outlet temperature.

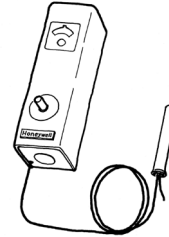


Figure 21. High Limit (Manual Shown)

Flow Switch

This dual-purpose safety device shuts off the heater in case of pump failure or low-water condition. See Figure 22. It is standard on all models, mounted and wired upstream of the ignition module.

NOTE: The flow switch is a safety device and not a control. Do not operate the heater with flow rates less than the minimums stated in this manual.

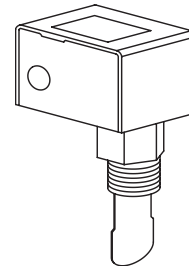


Figure 22. Flow Switch

100% Pilot Safety

All models with standard IID ignition employ electronic devices which close the main gas valve within 8/10 of a second whenever the pilot flame is interrupted. Pilot flame is automatically lit when the device is powered, after the safety circuit confirms safe conditions. The main valve is only energized after the pilot is proven to be lit.

Most models uses a version which locks out after a trial-for-ignition expires without a confirmed pilot signal. 90-sec trial-for-ignition is standard; a version with 15-sec lockout is available. A version without lockout is also available for some models.

Low-Water Cut-Off (Optional)

The low-water cut-off automatically shuts down burner whenever water level drops below probe. See **Figure 23**. A 5-second (max) time delay prevents premature lockout due to temporary conditions such as power failure or air pockets. Flush float-type devices at beginning of each heating season.

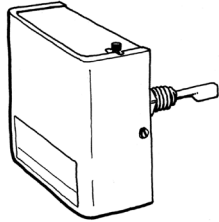


Figure 23. Low-Water Cut-Off

High-Gas and Low-Gas Pressure Switches (Optional)

These optional safety devices sense either high-gas or low-gas pressures and automatically shut down the heater if abnormal pressures exist. See Figure 18. If present, the low gas pressure switch is located upstream of the regulator. It opens if the inlet gas pressure drops below 5" WC (Nat) or 10" WC (Pro). If present, the high gas pressure switch is located downstream of the firing valve. It opens if the manifold gas pressure rises above 5.0" WC (natural gas) or 11.5" WC (propane). These safety devices can emit small amounts of fuel gas, and must be vented to a safe discharge location outdoors, in accordance with local code requirements.

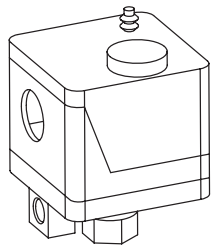


Figure 24. Gas Pressure Switch

Electrical Connections

⚠ WARNING: Turn off the power to the heater before installation, adjustment or service of the heater controls. Failure to do so may result in heater malfunction, property damage, personal injury, or death.

⚠ CAUTION: When servicing controls, label all wires prior to disconnection. Wiring errors can cause improper and dangerous operation. Verify proper operation after servicing.

The heater is normally wired for 120 Volts. The voltage is indicated on the tie-in leads. Consult the wiring diagram shipped with the heater in the instruction packet. The "TH" leads are for the remote tank control connection. 24 Volts are supplied to this connection through the heater transformer. DO NOT attach line voltage to the "TH" leads. Before starting heater check to ensure proper voltage and proper power connections to heater and pump. Heater must be electrically grounded in accordance with National Electrical Code ANSI/NFPA No 70.

NOTES:

8. Field install ground wire to inside of junction box.
9. If any of the original wire supplied with the heater must be replaced, it must be replaced with 105°C wire or its equivalent.

Model	With Pump	Without Pump
0514-0824	Less than 10 amps @ 120 VAC	Less than 4 amps @ 120V
0926-1826		
2100-4001	11 amps @ 230V, 22 amps @ 110V	Less than 8 amps

Options selected for the unit may affect total power draw.

Table K. Electrical Rating

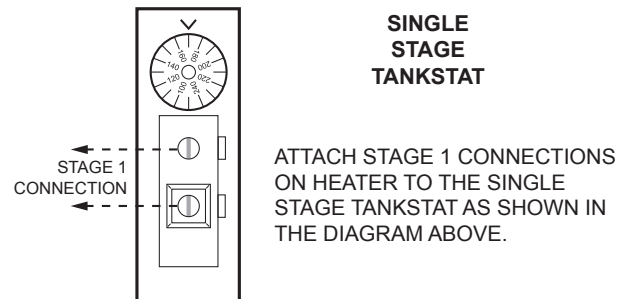
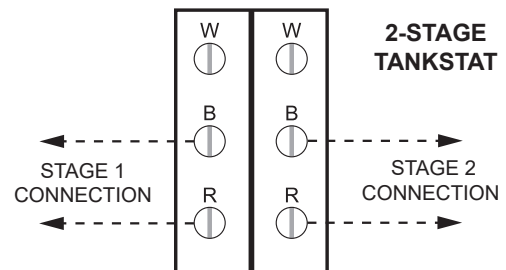


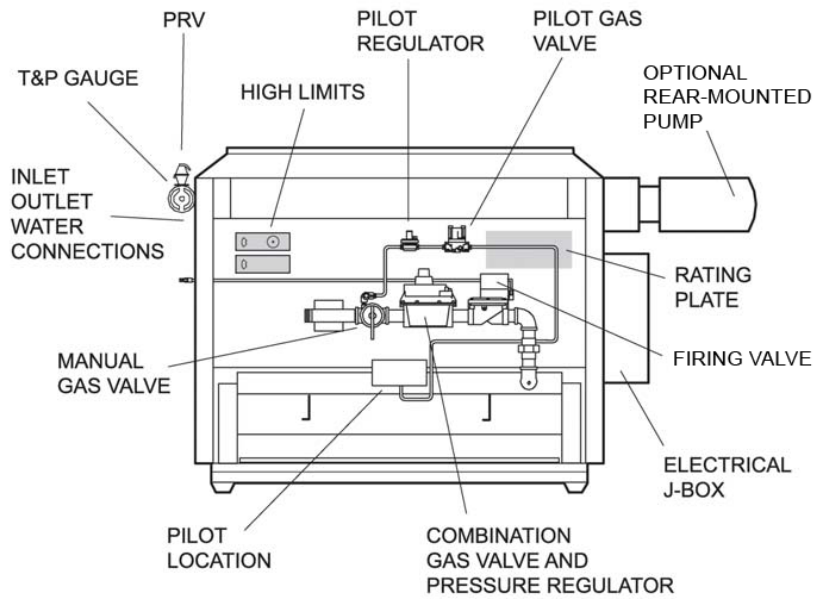
Figure 25. Single-Stage Tankstat



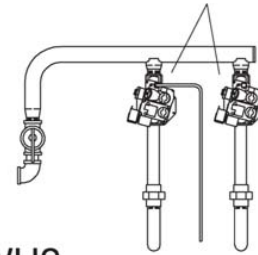
ATTACH STAGE 1 CONNECTIONS ON HEATER TO STAGE 1 CONNECTION ON TANKSTAT. ATTACH STAGE 2 CONNECTIONS OF HEATER 1, OR STAGE 1 CONNECTION OF HEATER 2 TO STAGE 2 CONNECTION ON TANKSTAT AS SHOWN IN THE DIAGRAM.

Figure 26. 2-Stage Tankstat (2 On/Off Units)

WH1 - 0824

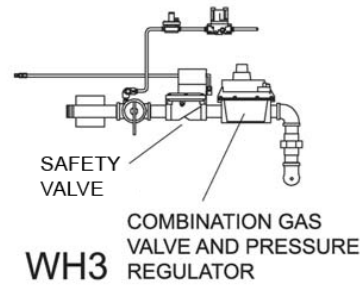


MECHANICAL MODULATION VALVES WITH BUILT-IN GAS PRESSURE REGULATOR



WH2

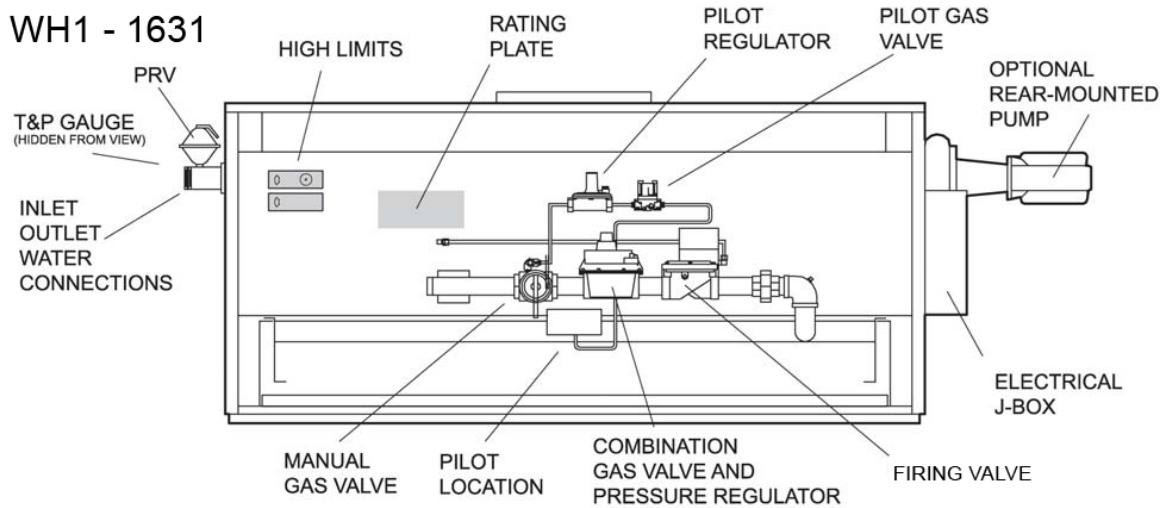
Sizes 0724-1336



WH3

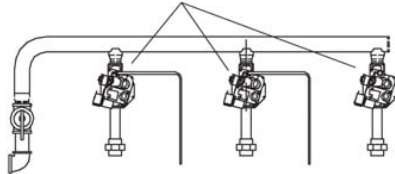
AGA DESIGN GAS TRAIN SHOWN. CODE REQUIREMENTS FOR SPECIFIC JURISDICTIONS MAY NECESSITATE CHANGES.

WH1 - 1631



WH2

MECHANICAL MODULATION VALVES WITH BUILT-IN GAS PRESSURE REGULATOR



Sizes 1414-1826 Shown

WH3

COMBINATION GAS VALVE AND PRESSURE REGULATOR

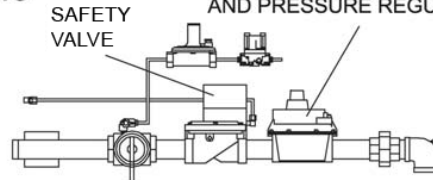
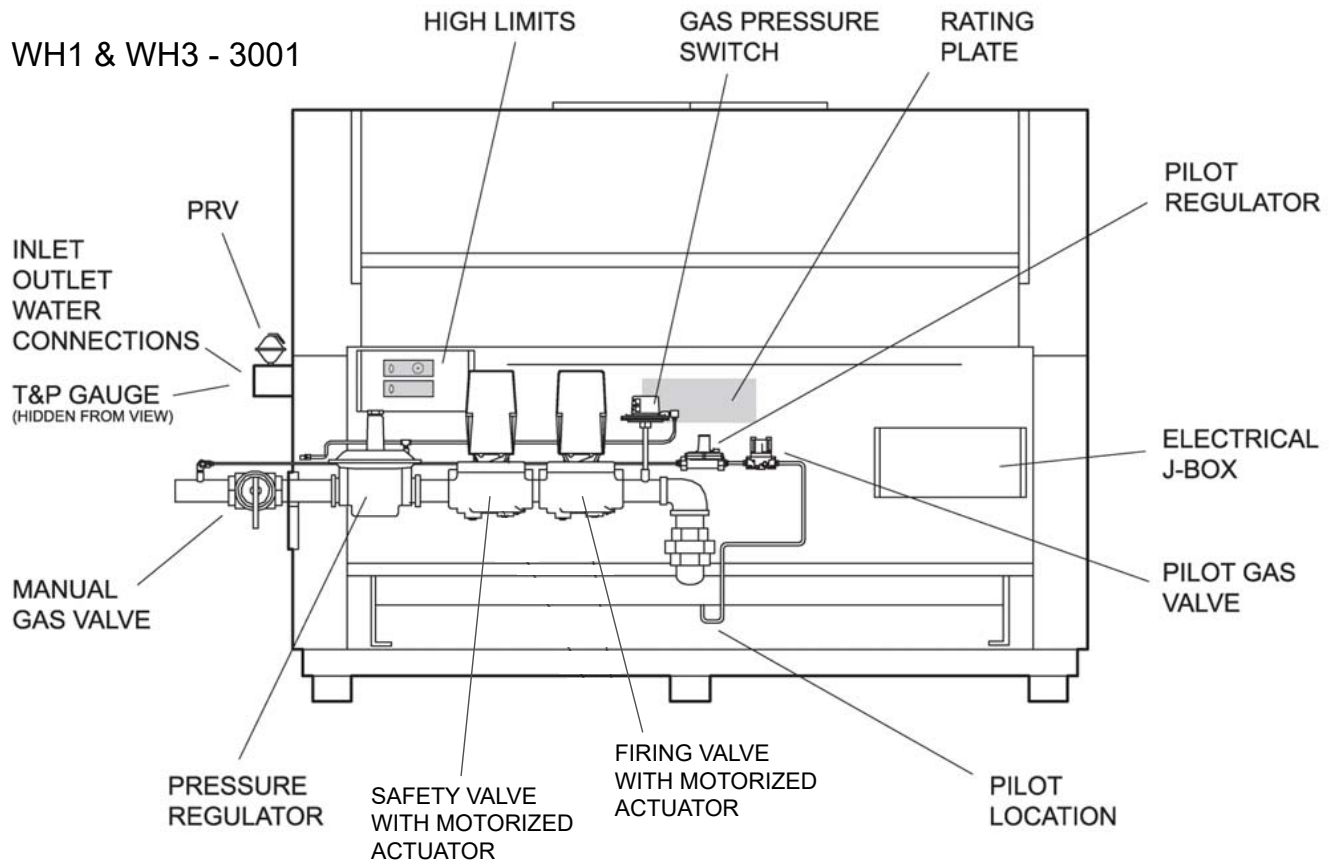


Figure 27. Location of Controls - Type WH1-WH3 Models 0824-1631



FOR MODELS 3001-4001, THE ONLY DIFFERENCE BETWEEN FIRING MODES IS THE ACTUATOR FOR THE SECOND VALVE.

STANDARD GAS TRAIN SHOWN. CODE REQUIREMENTS FOR SPECIFIC JURISDICTIONS MAY NECESSITATE CHANGES.

Figure 28. Location of Controls - Type WH1 & WH3 Models 3001

START-UP PROCEDURES

Before Start-Up

Safe lighting and other performance criteria were met with the gas manifold and control assembly provided on the heater when the heater underwent tests specified in the latest edition of the ANSI Z21.10.3/CSA 4.3 Standard.

General

Before lighting up a new installation, water should be flowing through the heater. Water pressure regulator should be set to minimum 25 PSI.

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

⚠ CAUTION: Propane gas is heavier than air and sinks to the ground. Exercise extreme care in lighting heater in confined areas.

Initial Start-Up

Pump and Motor

Many pumps are now direct-drive. They have no coupler or bearing assembly. These pumps do not require lubrication. Others require SAE-30 non-detergent oil to lubricate both the motor and the bearing assembly. Check pump motor for type before adding oil.

Clean dust and lint from pump and motor. Check pump coupler and tighten if necessary.

Flush system before putting into operation to ensure that foreign material does not damage pump seals.

⚠ CAUTION: Pump must be off to check oil in bearing assembly. Do not run pump without water in system.

For Models With Automatic Gas Valves

10. Close all gas valves. Turn off electric power supply. Wait five (5) minutes.
11. Open manual pilot valve. Turn on electric power. Pilot is automatically lighted.
12. Open main gas valve.
13. Set temperature controls to desired temperature.

TO SHUT DOWN

Close all manual gas valves. Turn off electric power.

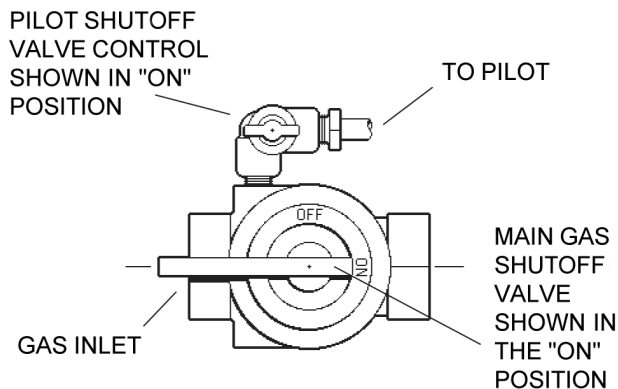


Figure 29. Shutoff Valve

Intermittent Pilot System Checkout Procedure (S8600)

After Start-Up

14. Turn on power to the ignition systems and turn gas supply off.
15. Check ignition module as follows:
 - a. Set the tankstat to call for heat.
 - b. Watch for continuous spark at the pilot burner.
 - c. Time the spark operation. Time must be within the lockout timing period (15 or 90 seconds).
 - d. Turn tankstat down to end call for heat and wait 60 seconds on lockout models before beginning step 3.
16. Turn on gas supply.
17. Set tankstat to call for heat.
18. Systems should start as follows:
 - a. Once safeties clear, the pump will start. The spark will turn on and pilot gas valve will open at once. Pilot burner should ignite after gas reaches the pilot burner.

- b. Spark ignition should cut-off when pilot flame is established.
- c. Main gas valve should open and main burner should ignite after gas reaches the burner port.

INSPECTION PROCEDURES

Burners

Clean main burners and air louvers free of dust, lint and debris. Keep heater area clear and free from combustibles and flammable liquids. Do not obstruct the flow of combustion and ventilation air. Make visual check of burner and pilot flame. Yellow flame indicates clogging of air openings. Lifting or blowing flame indicates excessively high gas pressure. Low flame indicates low gas pressure.

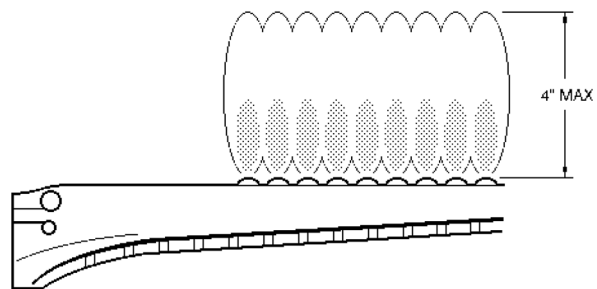


Figure 30. Typical Main Burner Flame

Controls

Check all controls to see that they are operational. To check electronic safety (IID models), turn off main burner. Observe pilot burner when shutting off pilot gas. Ignition spark should go on. Main gas valve will also drop out.

High Limit Switch - to check high limit switch, turn dial setting down to a point slightly below the temperature of the water leaving the heater. The reset button should snap out and the burner should shut off. Reset dial to 200°F (93°C) and push the reset button. Burner should light.





LIGHTING INSTRUCTIONS FOR HEATERS WITH ELECTRONIC IGNITION (IID) FOR MODELS WITH MANUAL GAS VALVES



FOR YOUR SAFETY READ BEFORE OPERATING

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

- A. This appliance is equipped with an ignition device which automatically lights the pilot. Do not try to light the pilot by hand.
- B. BEFORE OPERATING smell all around the appliance area for gas. Be sure to smell next to the floor because some gas is heavier than air and will settle on the floor.
- WHAT TO DO IF YOU SMELL GAS**
- * Do not try to light any appliance.
 - * Do not touch any electric switch.
 - * Do not use any phone in your building.
 - * Immediately call your gas supplier from your neighbor's phone. Follow the gas supplier's instructions.
- * If you cannot reach your gas supplier, call the fire department.
- C. Use only your hand to push in or turn the gas control knob. Never use tools. If the knob will not push in or turn by hand, do not try to repair it. Call a qualified service technician. Force or attempted repair may result in a fire or explosion.
- D. Do not use this appliance if any part has been under water. Immediately call a qualified service technician to inspect the appliance and to replace any part of the control system and any gas control which has been under water.

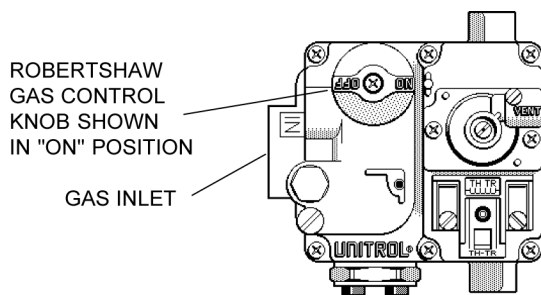
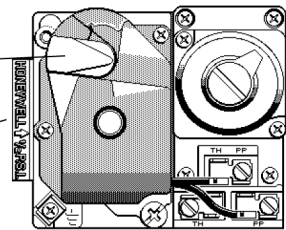
OPERATING INSTRUCTIONS

1. STOP! Read the safety information above.
2. Set the thermostat on the lowest setting.
3. Turn off all electric power to the appliance.
4. This appliance is equipped with an ignition device which automatically lights the pilot. Do not try to light the pilot by hand.
5. Remove heater door panel.
6. **For Robertshaw gas valve:** Turn gas control knob clockwise  to "OFF".
For Honeywell Gas Valve: Turn gas control knob clockwise  to "OFF". Make sure knob rests against stop.
For Honeywell Gas Valve: (Model 400 only) Push in gas control knob slightly and turn clockwise  to "OFF". Knob cannot be turned "OFF" unless knob is pushed in slightly. Do not force.
7. Wait five (5) minutes to clear out any gas. Then smell for gas, including near the floor. If you smell gas, STOP! Follow "B" in the safety information previously stated. If you do not smell gas, go to the next step.
8. **For Robertshaw Gas Valve:** Turn gas control knob counter-clockwise  to "ON".

For Honeywell Gas Valve: Turn gas control knob counter-clockwise  from "OFF" until it stops. Push in gas control knob and continue rotating counter-clockwise  to "ON" position. Make sure knob rests against stop.



HONEYWELL
GAS CONTROL
KNOB SHOWN
IN "ON" POSITION

GAS INLET



9. Replace heater door panel.
10. Turn on all electric power to the appliance.
11. Set thermostat to desired setting.
12. If the appliance will not operate, follow the instructions "To Turn Off Gas To Appliance" and call your service technician or gas supplier.

TO TURN OFF GAS TO APPLIANCE

1. Set the thermostat to the lowest setting.
2. Turn off all the electric power to the appliance if service is to be performed.
3. Remove door panel.
4. **For Robertshaw Gas Valve:** Turn gas control knob clockwise  to "OFF".
5. **For Honeywell Gas Valve:** Turn gas control knob clockwise  to "OFF". Make sure knob rests against stop.
5. Replace heater door panel.

Inspection Procedures

Inspect on the first and third month after initial startup and then on an annual basis. If problems are found, refer to the Troubleshooting sections of this manual for additional directions.

19. Remove top of heater and inspect heat exchanger for soot and examine venting system.
20. Remove rear header and inspect for scale deposits.
21. *Inspect pilot and main burner flame and firing rate.
22. *Inspect and operate all controls and gas valve.
23. *Visually inspect system for water leaks.
 - a. *Oil pump motor and bearing assembly, if oil cups are provided.
 - b. *Disconnect pump from header and check condition of pump impeller. Check condition of bearing by attempting to move impeller from side to side. Replace any parts showing wear.
 - c. *Check pump coupler for wear and vibration.
24. Check flow switch paddle.
25. Clean room air intake openings to ensure adequate flow of combustion and ventilation air.

▲ CAUTION: Combustion air must not be contaminated by corrosive chemical fumes which can damage the heater and void the warranty.

26. Keep heater area clear and free from combustible materials, gasoline, and other flammable vapors and liquids.

***Should be checked monthly.** (Takes approximately 15 minutes).

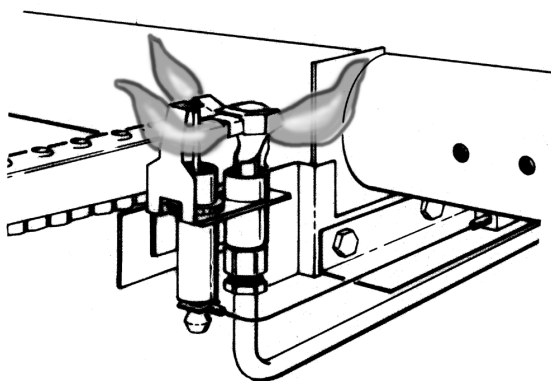
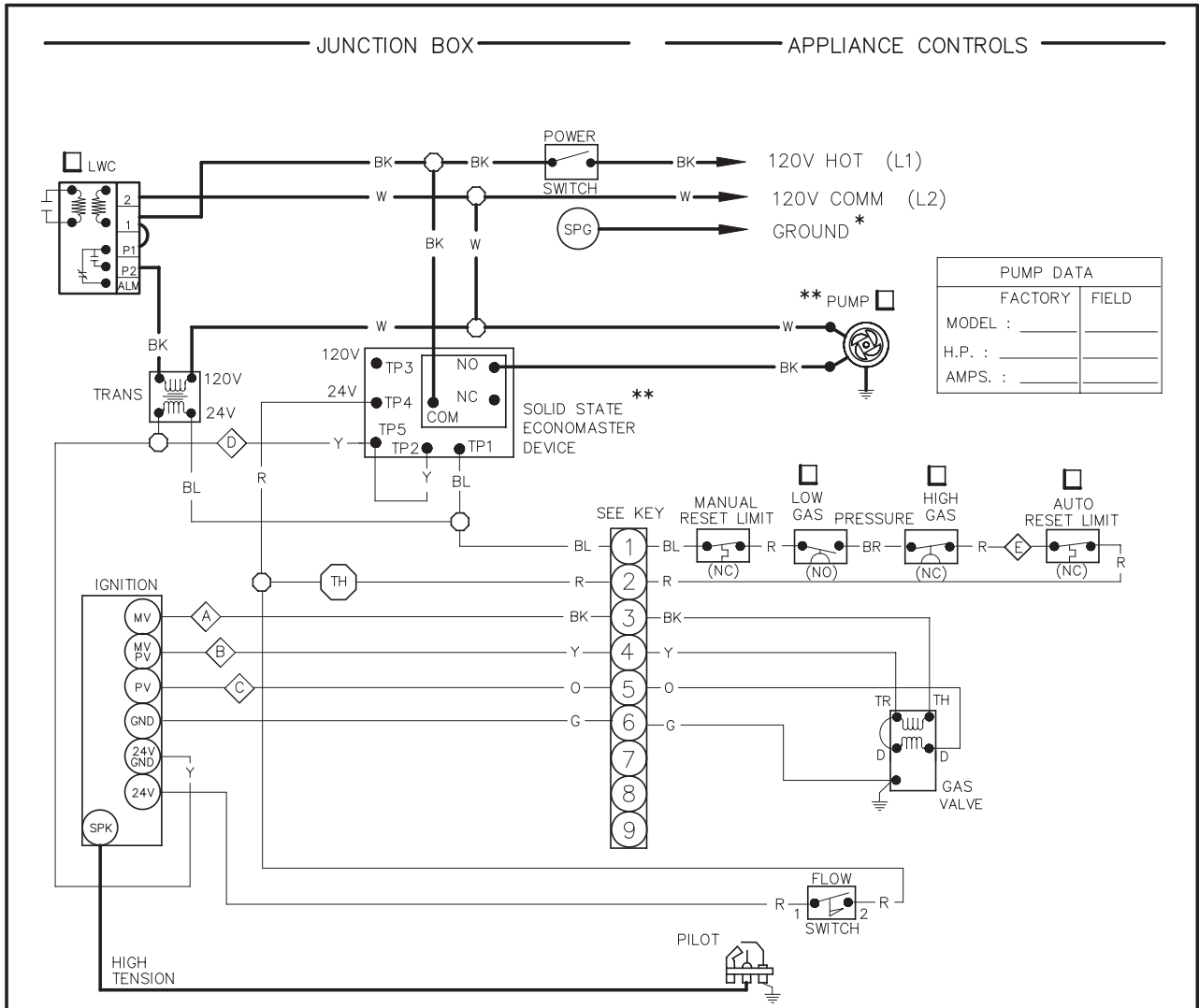


Figure 31. Pilot Burner Flame—IID

WIRING DIAGRAMS

Type WH1 Models 0514-0724



PUMP DATA	
FACTORY	FIELD
MODEL :	
H.P. :	
AMPS. :	

NOTES: * USE GROUND CONNECTION PROVIDED. FAILURE TO PROVIDE PROPER GROUND MAY RESULT IN LOCK-OUT ALL GROUND ± TERMINATE AT SPG.

****** PUMP USED MUST BE RATED 10 AMPS MAX OR 3/4 HP MAX. PUMP DELAY ADJUSTABLE BETWEEN 3 AND 10 MINUTES.

⬡ — ⬢ CONNECTIONS FOR OPTIONAL E-4 ALARM PANEL.

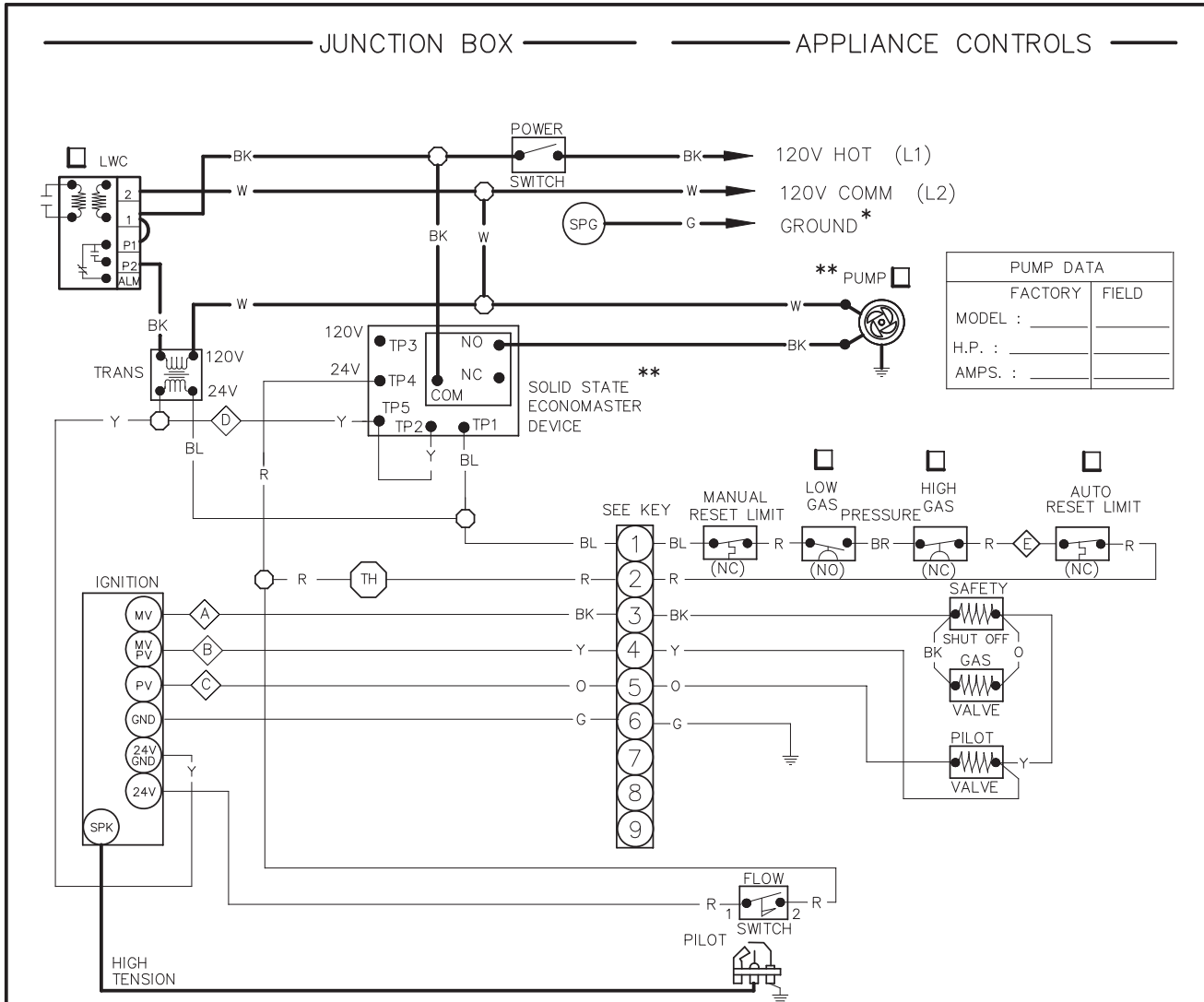
☑ CHECK CONTROLS PROVIDED (WIRED AS SHOWN) REPLACE WIRING WITH 105°C WIRE ONLY

APPROVED BY:	
CHECKED BY:	
ORIG E.O. 2214	
07/08/87	
CHG E.O. 5223	
4/23/14	

WIRING DIAGRAM IID ECONOMASTER FIRING MODE — ON/OFF	
BOILER INPUTS: 512,000 THRU 726,000 BTUH	
BOILER SIZE: 514-724	BOILER TYPE: H4/W1

KEY										
—	24V 105°C									
—	120V 105°C									
○	WIRE NUT									
⊕	GROUND									
BK	BLACK									
BR	BROWN									
R	RED									
O	ORANGE									
Y	YELLOW									
G	GREEN									
BL	BLUE									
V	VIOLET									
W	WHITE									
PLUG (ACTUAL)										
<table border="1"> <tr> <td>3</td> <td>2</td> <td>1</td> </tr> <tr> <td>6</td> <td>5</td> <td>4</td> </tr> <tr> <td>9</td> <td>8</td> <td>7</td> </tr> </table>		3	2	1	6	5	4	9	8	7
3	2	1								
6	5	4								
9	8	7								
FRONT VIEW										
152194	9									

Type WH1 Models 0824-1826



PUMP DATA	
FACTORY	FIELD
MODEL :	
H.P. :	
AMPS. :	

- SEE KEY
- 1
 - 2
 - 3
 - 4
 - 5
 - 6
 - 7
 - 8
 - 9

KEY										
—	24V 105°C									
—	120V 105°C									
○	WIRE NUT									
⊕	GROUND									
BK	BLACK									
BR	BROWN									
R	RED									
O	ORANGE									
Y	YELLOW									
G	GREEN									
BL	BLUE									
V	VIOLET									
W	WHITE									
PLUG (ACTUAL)										
<table border="1"> <tr> <td>3</td> <td>2</td> <td>1</td> </tr> <tr> <td>6</td> <td>5</td> <td>4</td> </tr> <tr> <td>9</td> <td>8</td> <td>7</td> </tr> </table>		3	2	1	6	5	4	9	8	7
3	2	1								
6	5	4								
9	8	7								
FRONT VIEW										

NOTES: * USE GROUND CONNECTION PROVIDED. FAILURE TO PROVIDE PROPER GROUND MAY RESULT IN LOCK-OUT ALL GROUND ⊥ TERMINATE AT ⊕.

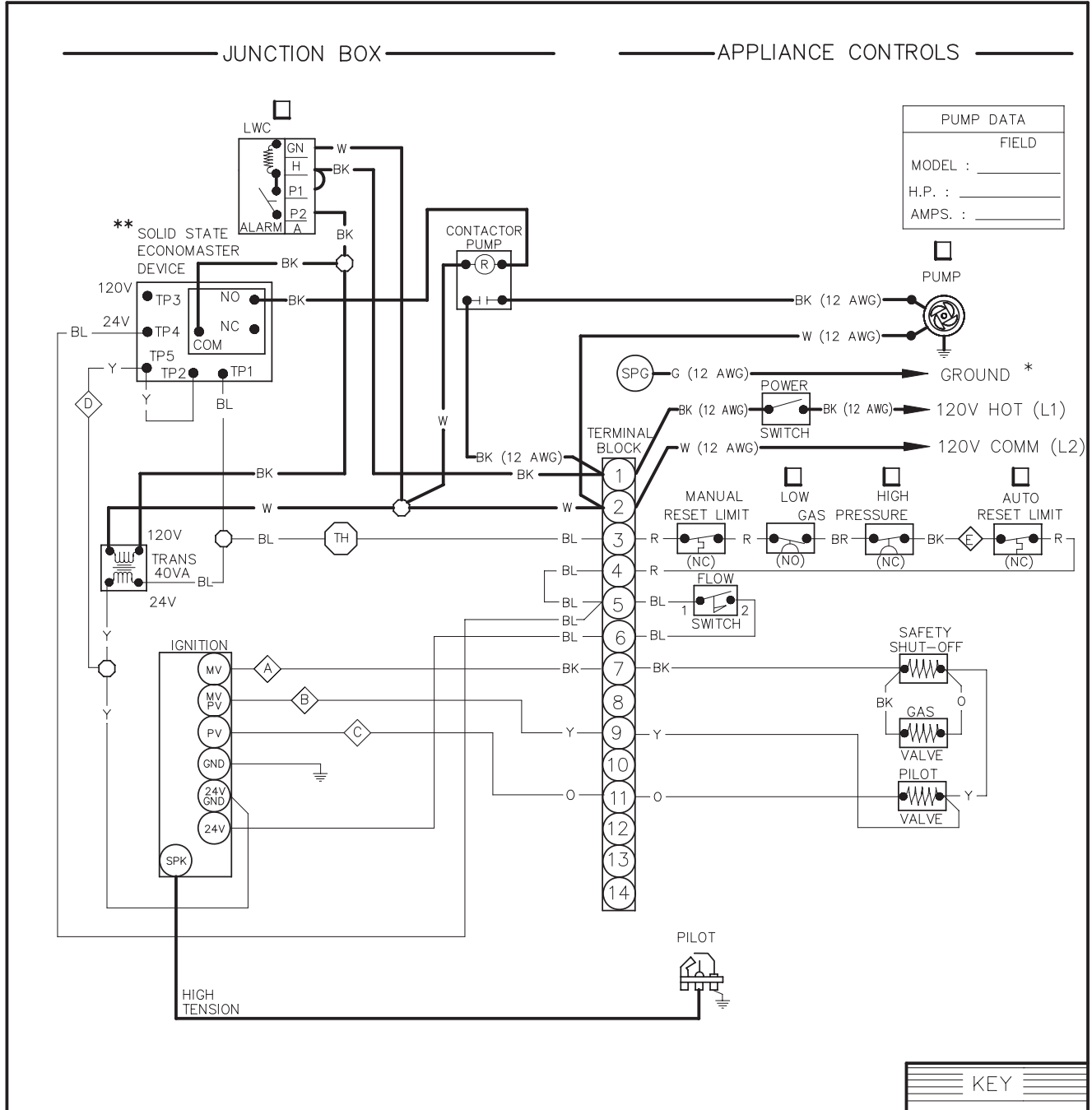
** PUMP USED MUST BE RATED 10 AMPS MAX OR 3/4 HP MAX. PUMP DELAY ADJUSTABLE BETWEEN 3 AND 10 MINUTES.
 ⬡ — ⬢ CONNECTIONS FOR OPTIONAL E-4 ALARM PANEL.
 ✓ CHECK CONTROLS PROVIDED (WIRED AS SHOWN) REPLACE WIRING WITH 105°C WIRE ONLY

APPROVED BY:
CHECKED BY:
ORIG E.O. 2397
07/08/88
CHG E.O. 5764
06/28/17
Raypak

WIRING DIAGRAM IID/ECONOMASTER FIRING MODE — ON/OFF	
BOILER INPUTS:	825,000 THRU 1,826,000 BTUH
BOILER SIZE:	824-1826
BOILER TYPE:	H4/W1

152170	8
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Type WH1 Models 2100-2500



NOTES: * USE GROUND CONNECTION PROVIDED. FAILURE TO PROVIDE PROPER GROUND MAY RESULT IN LOCK-OUT ALL GROUND \pm TERMINATE AT SPG .

** PUMP DELAY ADJUSTABLE BETWEEN 3 AND 10 MINUTES.
 A - E CONNECTIONS FOR OPTIONAL E-4 ALARM PANEL.
 CHECK CONTROLS PROVIDED (WIRED AS SHOWN)
 REPLACE WIRING WITH 105°C WIRE ONLY

CHECKED BY:	
APPROVED BY:	
ORIG E.O. 1947	
07/05/84	
CHG E.O. 5407	
10/12/15	
Raupak	

WIRING DIAGRAM IID ECONOMASTER FIRING MODE - ON/OFF

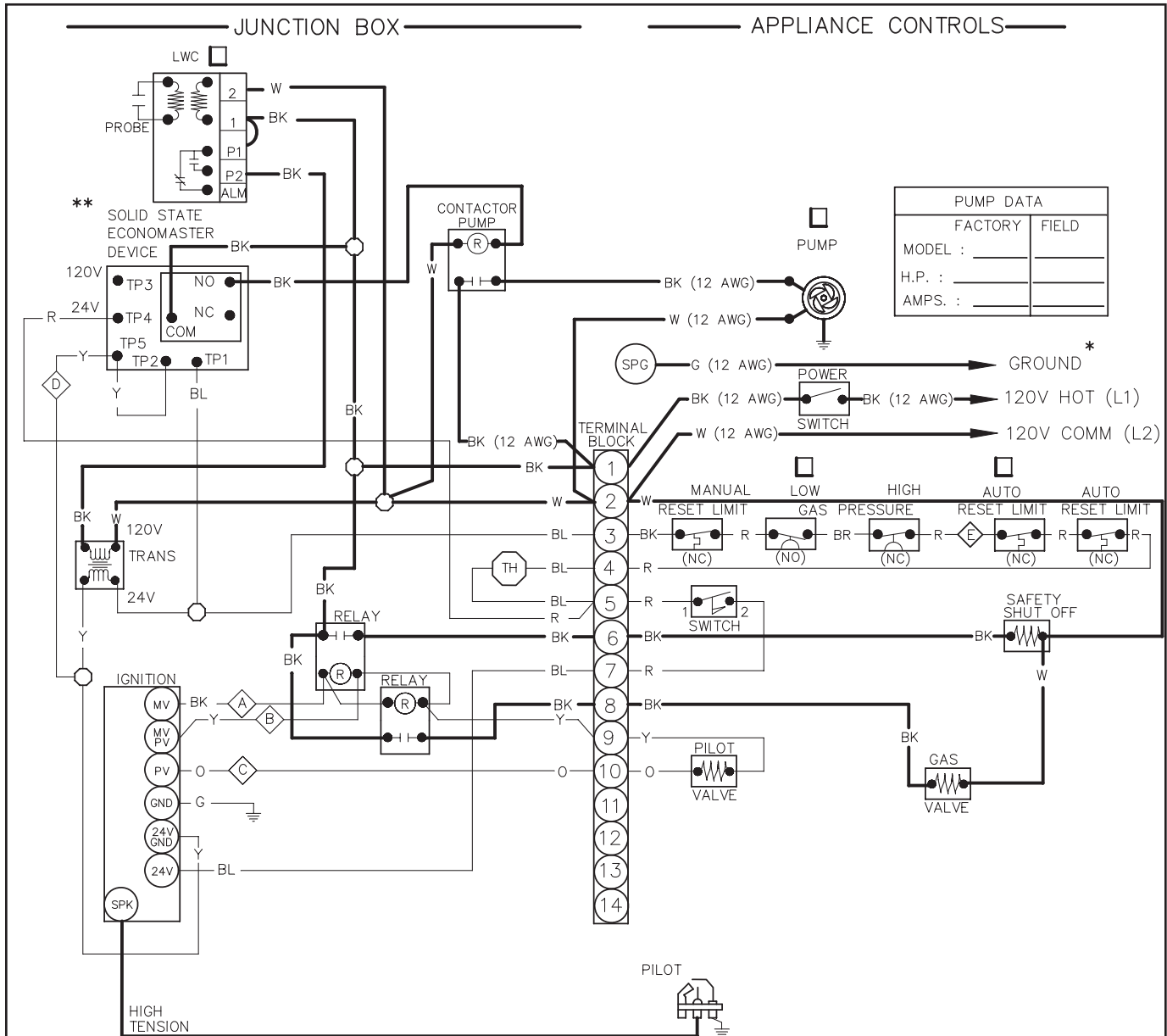
BOILER INPUTS: 2,100,000 THRU 2,499,000 BTUH

BOILER SIZE: **2100-2500** BOILER TYPE: **H4/W1**

KEY	
—	24V 105°C
—	120V 105°C
○	WIRE NUT
⊕	GROUND
BK	BLACK
BR	BROWN
R	RED
O	ORANGE
Y	YELLOW
G	GREEN
BL	BLUE
V	VIOLET
W	WHITE

151998 | **11**

Type WH1 Models 3001-4001



NOTES: * USE GROUND CONNECTION PROVIDED. FAILURE TO PROVIDE PROPER GROUND MAY RESULT IN LOCK-OUT ALL GROUND \pm TERMINATE AT SPG .

** PUMP DELAY ADJUSTABLE BETWEEN 3 AND 10 MINUTES.

\triangle - \diamond CONNECTIONS FOR OPTIONAL E-4 ALARM PANEL.

CHECK CONTROLS PROVIDED (WIRED AS SHOWN)
REPLACE WIRING WITH 105°C WIRE ONLY

KEY	
	24V 105°C
	120V 105°C
	WIRE NUT
	GROUND
	BK - BLACK
	BR - BROWN
	R - RED
	O - ORANGE
	Y - YELLOW
	G - GREEN
	BL - BLUE
	V - VIOLET
	W - WHITE

CHECKED BY:	
APPROVED BY:	
ORIG E.O. 1947	
07/05/84	
CHG E.O. 5407	
07/30/15	
Raupak	

WIRING DIAGRAM IID ECONOMASTER FIRING MODE - ON/OFF

BOILER INPUTS: 3,000,000 THRU 4,000,000 BTUH

SIZE: **3001-4001**

TYPE: **H4/W1**

151994 14

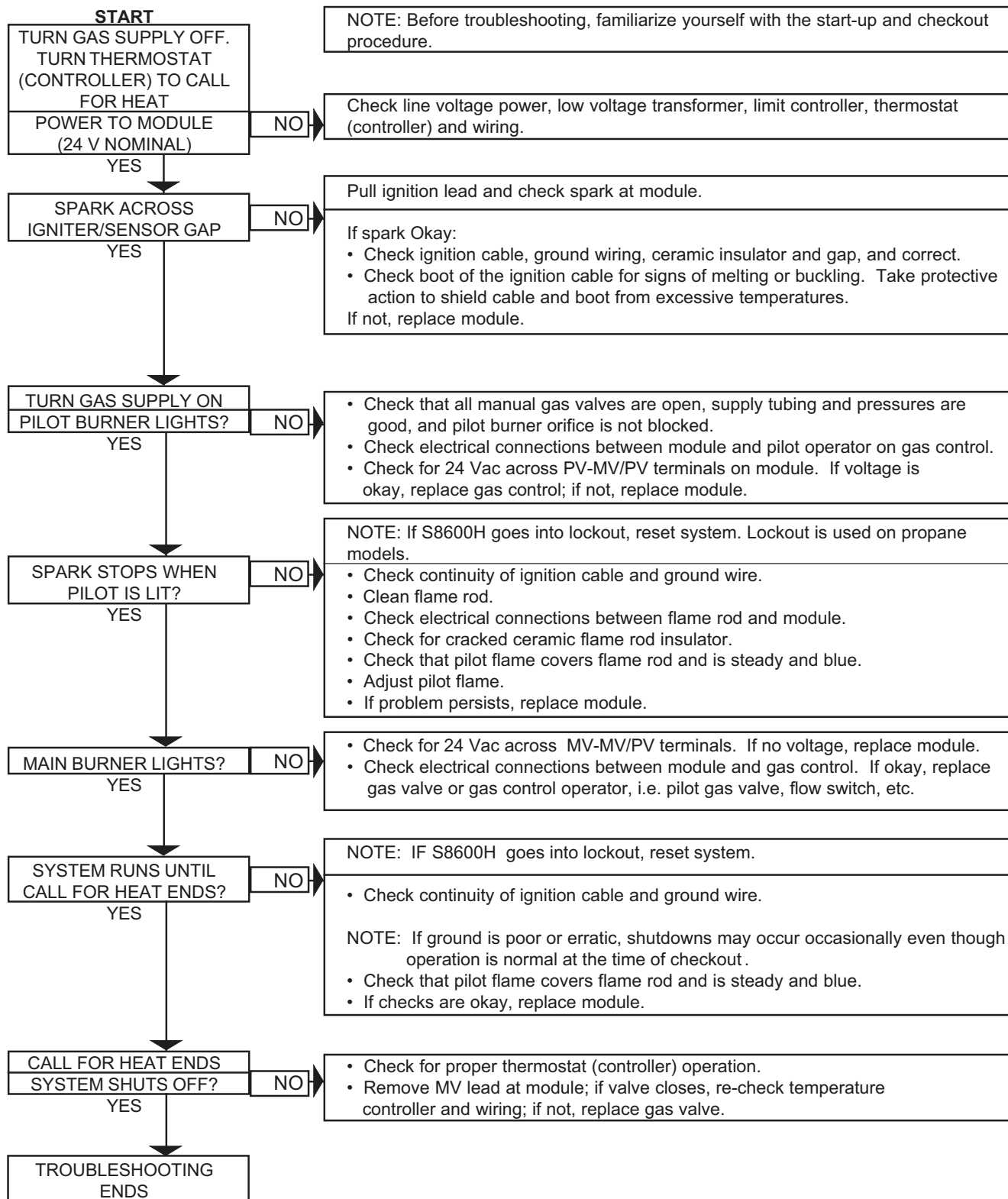
TROUBLESHOOTING

Electronic Ignition IID

Intermittent Pilot System Honeywell S860

⚠ WARNING—HIGH VOLTAGE: For qualified technicians ONLY.

NOTE: Some heaters may be equipped with an ignition module that shuts off pilot gas if pilot fails to light. To reset, interrupt power to heater.



Mechanical

▲ IMPORTANT NOTICE: These instructions are intended for the use of qualified personnel who are specifically trained and experienced in the installation of this type of heating equipment and related system components. Installation and service personnel may be required by some states to be licensed. Persons not qualified shall not attempt to install this equipment nor attempt repairs according to these instructions.

Problem	Possible Cause	Corrective Action
When heater is turned on nothing happens	No power to the heater	Check the circuit breaker, outdoor controller, etc., upstream of heater
	Bad transformer.....	If power to Leads L1 and L2 of transformer, but no power on 24V side, replace
	Inoperative thermostat.....	Jumper thermostat. Replace with new if heater fires. DO NOT leave thermostat jumpered
	Inoperative toggle switch.....	If power to toggle switch, but not through switch, replace
	Inoperative relay.....	If power to relay, but not operating, replace
Thermostat in "ON" position causes relay and pump to operate, but heater does not fire	Main gas valve is closed.....	Open valve
	Plugged bleed line on gas valve or gas pressure regulator	Loosen bleed line and clean
	Broken pump coupler	Replace coupler. Inspect bearing assembly, and if frozen, lubricate or replace
	Shutdown by low water cut-off, caused by air.....	Bleed air from system
	Gas valve defective	Check for power to gas valve. If valve has power but will not open, check vent tube for blockage. If clear, replace valve
Continuous shut down of manual reset high limit	Temperature setting too low	Reset high limit to higher temperature
	Low water flow.....	Check all pumps
	Interrupted pump operation	Check pump oil if necessary
	Modulating control set too high.....	Reset modulator to a lower setting
	Mechanical modulating control.....	Check and replace if necessary
Sooting CAUTION Soot may be combustible. Wet down and exercise caution when cleaning	Air starvation.....	Refer to installation instructions regarding combustion air requirements
	Condensation	Set bypass valve to prevent heater inlet temperature from dropping below 105°F (41°C)
	Toxic fumes which cause a chemical reaction with copper tubes or destroy combustion	Remove all sources of fumes, such as freon, chloride, or isolate the heater
	Improper venting.....	Follow recommended vent installation instructions
Continuous shut down of low water cut-off or flow switch	Insufficient flow	Check pumps and piping
	Low water due to leaking.....	Inspect for leakage and repair
	Air in system	Inspect for leakage and repair. Install an automatic air vent
	Line strainer dirty.....	Clean
	Lime in heat exchanger	Ream tubes
Low Flame	Gas supply.....	Debris in gas line (pipe dope, rocks, etc.). Gas line too small Improperly sized gas meter Gas regulator adjustment
	Insects or debris clogging burners.....	Clean burners
	Burner intake ports low gas pressure.....	Adjust gas pressure
	Venting or combustion air.....	Refer to installation instructions regarding combustion air requirement
Outer jacket very hot (blistered paint)	Broken refractory.....	Replace refractory panels
Combustion fan not running (If applicable)	Fan Relay	Replace fan relay
	Fan	Loose wire connection. Failed Fan motor

Pumps

Failure To Pump

27. Pump not properly primed.
28. Wrong direction of rotation.
29. Speed too low.
30. Total head too high.

Reduced Capacity And/Or Head

1. Air pockets or leaks in suction line.
2. Clogged impeller.
3. Foot valve strainer too small or clogged.
4. Excessive suction lift - over 15' (4.5 m).
5. Insufficient positive suction head (for hot water).
6. Total head more than that for which pump is intended.
7. Excessively worn impeller and wearing rings.

Rapid Wear Of Coupling

1. Misalignment or a bent shaft.
2. Sagging motor mounts (over-oiling).

Pump Loses Prime

1. Air leaks in suction line.
2. Excessive amount of air in water.
3. Water seal in stuffing box not functioning.
4. Excessive suction lift and pump operating too near shut-off point.

Overloaded Driving Unit

1. Head much lower than that for which pump is designed.
2. Speed too high or higher than that contemplated.

Mechanical Troubles and Noise

1. Misalignment.
2. Excessive suction lift or vapor binding (hot water).
3. Bent shaft and/or damaged bearings.
4. Suction and discharge piping not properly supported and anchored.

MAINTENANCE

Service

Tube Cleaning Procedure

Establish a regular inspection schedule, the frequency depending on the local water condition and severity of service. Do not let the tubes clog up solidly. Clean out deposits over 1/16" (2 mm) in thickness.

The heater may be cleaned from the side opposite the water connections as shown, without breaking pipe connections. It is preferable, however, to remove both headers for better visibility through the tubes and to be sure the residue does not get into the system.

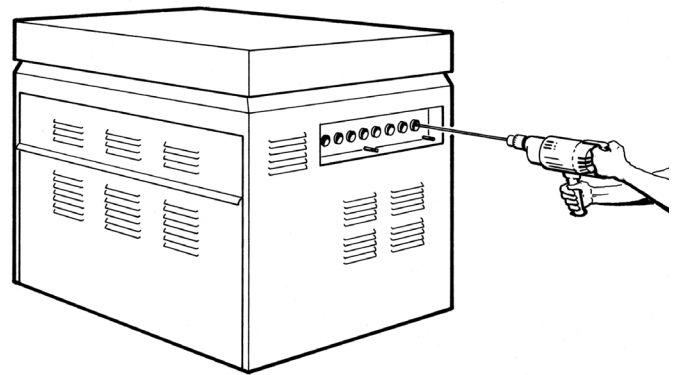


Figure 32. Tube Cleaning Procedure

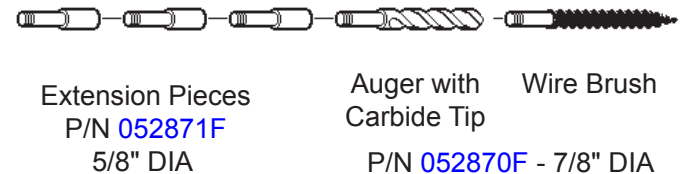


Figure 33. Raypak Tube Cleaning Kit

Note that you do not remove the top pan or the heat exchanger generally. After reaming with the auger, mount the wire brush and clean out the debris remaining in the tubes. Another method is to remove the heat exchanger, ream tubes and immerse heat exchanger in noninhibited de-scale solvent.

Burner Tray Removal

1. Shut off power and gas supply to the heater. Disconnect union(s) and pilot tubing, then loosen and remove burner hold-down screws.
2. Disconnect wires at gas valve and slide burner tray out.

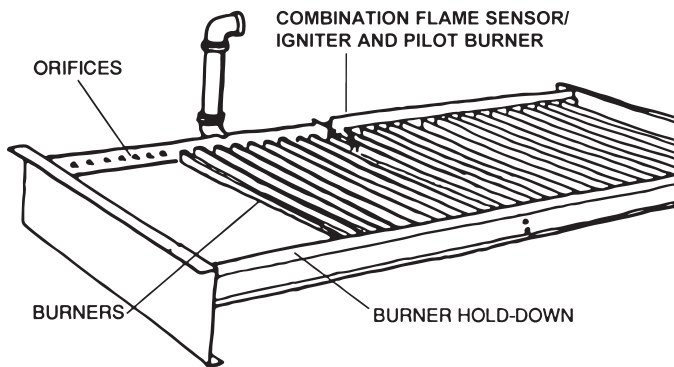


Figure 34. Typical Burner Tray

Gas Valve Removal

1. Shut off gas supply to the heater. Remove gas piping to gas valve inlet.
2. Disconnect wires, pilot tubing and bleed line, if required.
3. Turn vertical gas pipe from manifold slightly and unscrew gas valve.
4. Reverse above procedure to re-install.

WH3 Gas Valve Adjustment, Robertshaw (Invensys) 7000 Series

1. Turn the heater off.
2. Remove the 3/8" nut or the #10 Torx screw.
3. Lift solenoid valve up, keeping the wires connected to the solenoid valve.
4. If only low fire adjustment is needed, go to Step 9.

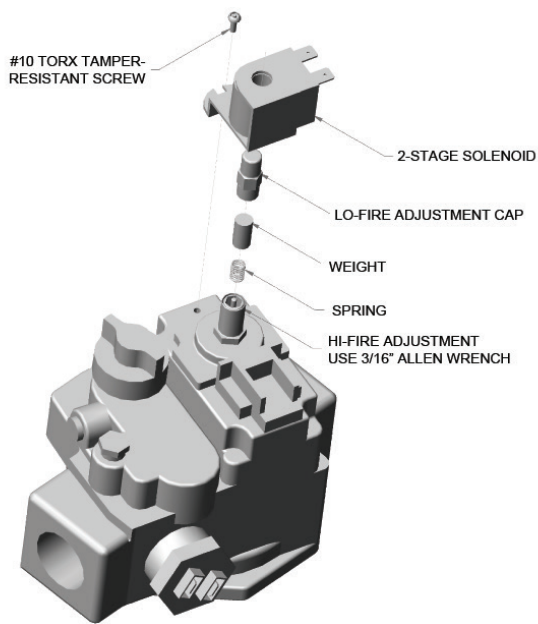


Figure 35. 2-Stage Gas Valve Adjustment (Invensys)

1. Use a 3/8" wrench and remove the aluminum cap located under the solenoid valve. Count number of turns when removing the cap. Be careful not to drop the cylinder (weight) or the small spring that is under the cap. See **Figure 35**.
2. Remove the spring and store in a safe place.
3. Use an Allen wrench, turn the screw clockwise to increase or counterclockwise to decrease high fire manifold pressure.
4. Install the spring, weight and aluminum cap. Tighten the cap using same number of turns as was used in removing the cap. See **Figure 35**.
5. For low fire adjustment, tighten the aluminum cap to increase and loosen to decrease low fire manifold pressure.
6. Install 2-stage solenoid valve and turn heater on, check manifold pressures.
7. Repeat steps 3 to 10 until correct manifold pressures are obtained.
8. Secure 2-stage solenoid valve by tightening the 3/8" nut or #10 Torx screw.

Main Burner and Orifice Removal

1. Remove screws and burner hold-down bracket.
2. Lift burners from slotted spacer and slide from orifices. Clean with a wire brush.
3. Clean orifice(s) as necessary.

NOTE: If the heat exchanger is sooted badly, the burner hold-down bracket and spacer can become distorted from direct flame impingement. This necessitates replacement of these parts.

Pilot Removal and Cleaning

1. Disconnect pilot tubing at pilot and sensor/igniter wire. Remove screws holding pilot bracket to burner tray.
2. Remove pilot and bracket, clean pilot of debris, small bugs, etc., with wire or small brush.
3. Replace pilot, pilot tubing, sensor ignition wires and check for leaks.

High Limit or Tankstat Removal

1. Turn off electrical power.
2. Remove front inspection panel.
3. Remove wires to high limit and loosen screws holding high limit to cabinet.
4. Remove wedge clip holding sensing bulb in control well.
5. Remove high limit and install a new one.
6. Check control operation before leaving job.

Heat Exchanger Removal

1. Shut water, gas and electricity off, close valves and relieve pressure, remove relief valve. Remove side inspection panels.
2. Remove top holding screws.
3. Remove draft diverter, lift and remove top and flue collector on stack type models. Remove inspection panels.
4. Loosen bolts and disconnect flange nuts on in/out header, loosen union(s) at gas pipe, and slide heater away from piping until studs clear the heater.
5. Remove heat exchanger corner brackets.
6. Remove combustion chamber clips at the four corners of the heat exchanger.
7. Lift heat exchanger straight up using caution not to damage refractory.

Heat Exchanger Re-Assembly

1. Heat exchanger water header O-rings should be replaced with new ones.
2. Install in/out and return water headers and install header retainer nuts and torque nuts evenly.
3. Install the four (4) corner clips between tube sheets and refractory. Replace "V" baffles.
4. Install thermostat sensing bulbs in header wells and replace bulb retaining clips.
5. Install inlet and return pipes in water headers using pipe thread sealant.
6. Install water pressure relief valve, flow switch, and low water cut-off devices if so equipped.

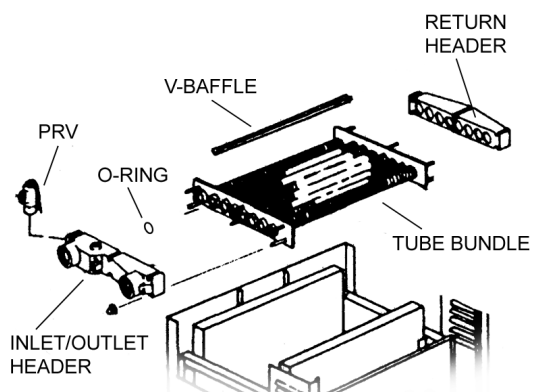


Figure 36. Typical Heat Exchanger Configuration

7. Open water supply and return shut off valves. Fill heater and water piping system with water. Check heater and piping system for leaks at full line pressure. Run system circulating pump for a minimum of 1/2 hour with heater off.

8. Shut down entire system and vent all radiation units and high points in system piping. Check all strainers for debris. Expansion tank water level should be at the 1/4 mark and the balance of the tank filled with air.
9. Install flue collector, jacket top and inspection panels. Install top holding screws. Install draft diverter and vent piping if so equipped.
10. If gas piping was disconnected, reconnect gas piping system and check for leakage using a soapy solution.
11. Check for correct water pressure and water level in the system. Make sure that system pump operates immediately on the call for heat. The system is ready for operation.
12. Within two (2) days of start-up, recheck all air vents and expansion tank levels.

Combustion Chamber Removal

To remove combustion chamber you must first remove the heat exchanger. Unbolt metal combustion chamber retainer from top and remove combustion chamber panels individually.

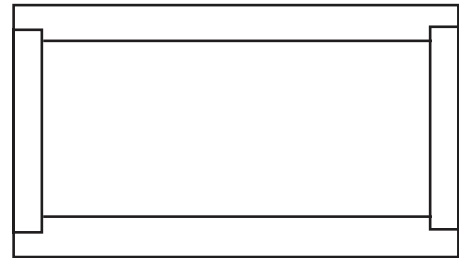


Figure 37. Refractory Panels - Top View

▲ WARNING: This unit contains refractory ceramic fiber (RCF) insulation in the combustion chamber. RCF, as manufactured, does not contain respirable crystalline silica. However, following sustained exposure to very high temperatures (>2192°F [1200°C]), the RCF can transform into crystalline silica (cristabolite). The International Agency for Research on Cancer (IARC) has classified the inhalation of crystalline silica (cristabolite) as carcinogenic to humans.

When removing the burners or heat exchangers, take precautions to avoid creating airborne dust and avoid inhaling airborne fibers. When cleaning spills, use wet sweeping or High Efficiency Particulate Air (HEPA) filtered vacuum to minimize airborne dust. Use feasible engineering controls such as local exhaust ventilation or dust collecting systems to minimize airborne dust. Wear appropriate personal protective equipment including gloves, safety glasses with side shields, and appropriate NIOSH certified respiratory protection, to avoid inhalation of airborne dust and airborne fiber particles.

Control Well Replacement

Remove top, sensing bulb and clip. Collapse well tube at the opening with a chisel, push through into header and remove the well through header. Insert a new well and roll into place. If a roller is not available, solder the well in place with silver solder.

Tube Replacement Procedure

⚠ 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/or CSA ratings of the vessel and any resulting damage will not be covered under warranty. Altering the ASME and/or CSA ratings of the vessel also violates national, state, and local approval codes.

1. Remove heat exchanger from heater following instructions outlined under HEAT EXCHANGER REMOVAL above.
2. Remove in/out and return headers. Remove "V" baffle from damaged tube.
3. Remove damaged tube by cutting with a hack saw or shearing with a chisel adjacent to each tube sheet.
4. Collapse stub ends in tube sheets using a chisel or screwdriver. DO NOT cut into tube sheet or mar surface in tube hole in any way.
5. Insert replacement tube by inserting the end with the most fins removed in the opening of one tube sheet. Slide tube until the opposite end clears the other tube sheet and fit the tube into the hole.
6. Insert the tube roller into tube opening up to stop, making certain that 1/8" of tube projects beyond the tube sheet.
7. Attach drill to tube roller, holding it straight and level.
8. Reverse drill motor and withdraw tube roller. If necessary wrench out by hand.

NOTE: Use a 3/8" heavy duty, reversible, electric drill or larger. Proceed to expand tube until tool starts to grab. Approximately 1/2" to 1" of the tool shank will be visible.

9. DO NOT apply excessive torque during rolling operation and avoid thinning any wall of the tube beyond 0.015".
10. Use same procedure on opposite end.
11. Apply line pressure test. Re-roll if necessary.
12. Reinstall as outlined under HEAT EXCHANGER RE-ASSEMBLY.

Cleaning Flue Gas Passageways

Soot will clog areas behind fins and cause eventual tube failure. Any sign of soot at base of burners or around outer jacket indicates a need for cleaning.

1. Lift off **draffhood** and flue collector by removing bolts and screws.
2. Remove "V" baffles from heat exchanger.
3. Remove burner tray.
4. Take garden hose and wash heat exchanger, making sure soot is removed from between fins. (Avoid excessive water against refractory).
5. Reassemble; when heater is fired, some steam will form from wet refractory. This is normal.
6. Correct reason for soot formation.

NOTE: In extreme cases it may be necessary to remove the heat exchanger completely for cleaning. The simplest method is high-pressure cleaning at a local car wash. DO NOT WIRE BRUSH!

⚠ CAUTION: Soot is combustible, so exercise extreme care.

REPLACEMENT PARTS

See separate parts sheet in instruction envelope.

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

Any part returned for replacement under standard company warranties must be properly tagged with Raypak return parts tag, completely filled in with the heater serial number, model number, etc., and shipped to Raypak freight prepaid. If determined defective by Raypak and within warranty, the part will be returned in kind or equal substitution, freight collect. Credit will not be issued.

RAYPAK, INC.
2151 Eastman Avenue,
Oxnard, CA 93030

WARRANTY

LIMITED WARRANTY RAYTHERM TYPE WH Models: 0514-4001

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 defects in materials and workmanship under normal use and service for the specified warranty periods and subject to the conditions set forth in this Limited Warranty. Labor charges and other costs for parts removal or reinstallation, shipping and transportation are not covered by this Limited Warranty, but are the owner's responsibility.

EFFECTIVE DATE

The Effective Date of this Limited Warranty is the date of original installation if properly documented; if you are not able to provide documentary proof of the date of original installation, the Effective Date will be the date of manufacture plus 30 days.

HEAT EXCHANGER WARRANTY PERIODS

Domestic Hot Water

Five (5) years from Effective Date. Includes copper heat exchanger with bronze or cast iron waterways.

Ten (10) years from Effective Date. Includes only cupronickel heat exchanger with bronze or cast iron waterways.

Thermal Shock Limited Warranty

Twenty five (25) years from Effective Date 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).

ANY OTHER PART MANUFACTURED BY RAYPAK

One (1) year from Effective Date.

THIS LIMITED WARRANTY WILL BE VOID IF THE HEATER RATING PLATE IS ALTERED OR REMOVED.

ADDITIONAL WARRANTY EXCLUSIONS

This Limited Warranty does **NOT** cover units moved from their original installation location or conditions including failures or malfunctions resulting from:

1. Failure to properly install, operate or maintain the heater in accordance with our printed instructions provided;
2. Abuse, misuse, 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. Chemical contamination of combustion air.

REPAIR OR REPLACEMENT

At its option, Raypak will repair or replace a defective part(s) in accordance with the terms of this Limited Warranty, if it fails in normal use and service during its specified warranty period. The failed part must first be returned to Raypak if requested, with transportation charges prepaid, and all applicable warranty conditions found satisfied. The repair or replacement part will be warranted for only the unexpired portion of the original Limited 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.

HOW TO MAKE A WARRANTY CLAIM

You should immediately notify the original installer, supplying the model number 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 please 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 repair or replacement of any part.

EXCLUSIVE WARRANTY LIMITATION OF LIABILITY

The Limited Warranty is the only warranty for this product and its component parts given by Raypak. No one is authorized to make any other warranties on Raypak's behalf. **ANY IMPLIED WARRANTIES, INCLUDING MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE, SHALL NOT EXTEND BEYOND THE APPLICABLE WARRANTY PERIODS SPECIFIED IN THIS LIMITED WARRANTY. RAYPAK'S SOLE LIABILITY WITH RESPECT TO ANY DEFECT SHALL BE AS SET FORTH IN THIS LIMITED WARRANTY. IT IS AGREED THAT RAYPAK SHALL HAVE NO LIABILITY WHETHER UNDER THIS LIMITED WARRANTY OR IN CONTRACT, TORT OR NEGLIGENCE OR OTHERWISE FOR CLAIMS FOR SPECIAL, INCIDENTAL OR CONSEQUENTIAL DAMAGES (INCLUDING NO LIABILITY FOR DAMAGE FROM WATER LEAKAGE) WHICH ARE EXPRESSLY EXCLUDED, NOTWITHSTANDING ANY FAILURE OF ESSENTIAL PURPOSE OF ANY LIMITED REMEDY.** 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, AND YOU MAY ALSO HAVE OTHER RIGHTS WHICH VARY FROM STATE TO STATE

We suggest you immediately record the model and serial number and date of original installation and retain this Limited Warranty Certificate along with your original proof of purchase and date of installation/start-up in the event warranty service is needed.

DO NOT RETURN THIS DOCUMENT TO RAYPAK. KEEP IT WITH YOUR HEATER OR BUSINESS RECORDS.

Name of Owner	Name of Installer
Owners Address	Telephone Number of Installer
Date of Installation	Installation Site
Model Number	Serial Number

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

START-UP CHECKLIST FOR RAYPAK ATMOSPHERIC PRODUCTS

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

GAS SUPPLY DATA

Gas Meter Size _____ CFH
 Gas Line Size _____ In. NPT
 Length of Gas Line _____
 Low Gas Pressure Setting _____ In. WC
 High Gas Pressure Setting _____ In. WC
 Gas Valve Type _____

CLEARANCES

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

ELECTRICAL

Voltage Supply/Control _____
 Auto High Limit Setting _____
 Manual Reset High Limit _____
 Ignition Control: S8600 _____ Other _____
 Is unit grounded ___ Yes ___ No
 Temp Control Setting _____ Deg

VISUAL INSPECTION OF COMPONENTS

Wiring Harness _____
 Pilot Assembly _____
 Burner/s _____
 Refractory _____
 Remote (if applicable) _____

WATER SUPPLY

Flow Rate in GPM or Delta T _____ If Avail
 Pump Economaster setting _____ Min
 Low Water Cutoff _____ Test
 Number of Tanks and Size _____
 Pressure Switch _____
 Plumbing Size _____ Inches
 Pump Size: _____ Pump HP: _____

VENTING

Vent Size: _____ Stack Height: _____
 Vent Category: _____
 Vent Material: _____
 Vent Termination Type: _____
 Combustion Air Openings: _____ Sq. In.

Model Number: _____ Serial Number: _____

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 _____

Signature of Startup Technician _____

NOTES
