

INSTALLATION AND OPERATION MANUAL

Raytherm® Heating Boilers

Models 0514-4001 Type H



THIS MANUAL CAN BE VIEWED ELECTRONICALLY
USING YOUR SMART DEVICE. SEE PAGE 39 FOR QR
CODE.



DOE: FOR USE OUTSIDE THE UNITED STATES ONLY.

▲ 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 boiler or in a safe place for future reference.



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Revision 42 reflects the following changes:

Added "DOE" statement to the coverpage. Added QR Code section.

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1. WARNINGS

Pay Attention to These Terms

▲ DANGER	Indicates the presence of immediate hazards which will cause severe personal injury, death or substantial property damage if ignored.
▲ WARNING	Indicates the presence of hazards or unsafe practices which could cause severe personal injury, death or substantial property damage if ignored.
▲ CAUTION	Indicates the presence of hazards or unsafe practices which could cause minor personal injury or product or property damage if ignored.
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: Make sure the gas on which the boiler will operate is the same type as that specified on the boiler rating plate.

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

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

▲ WARNING: 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 [$>2192^{\circ}\text{F}$ (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.

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

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

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

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

▲ CAUTION: Operation of this boiler in low-temperature systems requires special piping. Harmful internal condensation will occur if the inlet water temperature does not exceed 105°F (41°C). Warranty claims will be denied when condensation occurs.

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

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

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

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

⚠ DANGER: Failure to install the drafthood and properly vent the boiler to the outdoors as outlined in the Venting section of this manual can result in unsafe operation of the boiler. To avoid the risk of fire, explosion, or asphyxiation from carbon monoxide, never operate this boiler 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: When servicing or replacing components that are in direct contact with the water, be certain that:

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

⚠ WARNING: 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: 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 Raypak warranty on the vessel. Altering the ASME and/or CSA ratings of the vessel also violates national, state, and local approval codes.

⚠ 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.

2. BEFORE INSTALLATION

Raypak strongly recommends that this manual be reviewed thoroughly before installing your Raytherm boiler. Please review the General Safety information before installing the heater. Factory warranty does not apply to boilers 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 boiler 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 boiler. When ordering under warranty conditions, you must also specify the date of installation.

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.

Rating and Certification

The Raypak hydronic boilers are design-certified and tested under the latest requirements of the American National Standard, ANSI Z21.13. Each boiler has been constructed and pressure tested in accordance with the requirements of Section IV Part H of the American Society of Mechanical Engineers Code, and factory fire-tested.

All models are ASME-Rated and National Board registered. Temperature and pressure gauge is standard. Models 0514-1826 have 2-pass heat exchangers, 5 tubes first pass, 4 tubes second pass. Models 2100-4001 have 2-pass heat exchangers, 9 tubes per pass. Models 0926-4001 with cast-iron headers allow optional single-pass heat exchangers.

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 number of a boiler can be found on the Sales Order and the boiler's rating plate. The example below identifies what the characters of the model number represent. An external on/off controller is required to generate a call-for-heat.

MODEL NUMBER EXAMPLE:

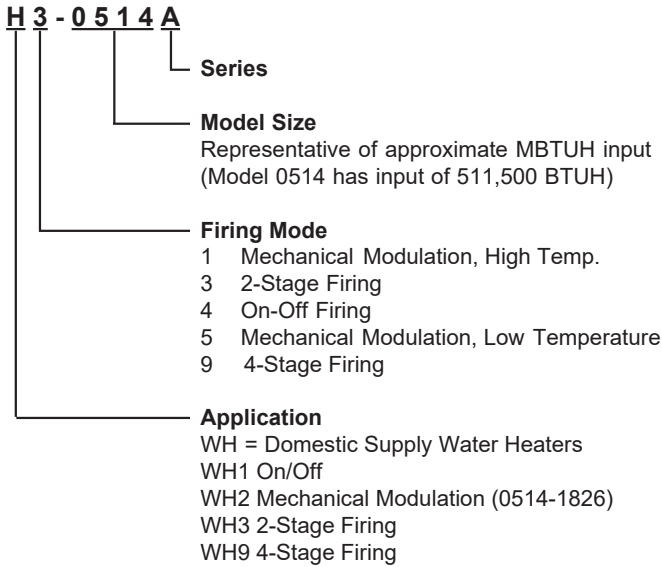


Figure 1. Model Identification Number

3. BOILER TYPES

Type H1 - Mechanical Modulating, High Temp

Models 0514-1826

Central heating boiler with 150°F (66°C) - 210°F (99°C) mechanical modulating gas valve(s). The number of valves varies with the model size. An external on/off controller is required to generate a call-for-heat.

Type H3 - 2-Stage Controls

Models 0514-4001

Central heating boiler with single 2-stage gas valve. An external 2-stage controller is required; multiple options are available.

Type H4 - On-Off Controls

Models 0514-4001

Central heating boiler with on/off firing. An external on/off controller is required; multiple options are available.

Type H5 - Mechanical Modulating, Low Temp

Models 0514-1826

Central heating boiler with 110°F (43°C) - 170°F (77°C) mechanical modulating gas valve(s). The number of valves varies with the model size. An external on/off controller is required to generate a call-for-heat.

Type H9 - 4-Stage

Models 0514-4001

Central heating boiler with 4-stage firing. Controller optional. An external 4-stage controller is required; multiple options are available.

4. INSTALLATION

Installation Codes

The installation must conform with these instructions and the latest editions of the National Fuel Gas Code ANSI Z223.1, the National Electric Code ANSI/NFPA 70 and local codes. In Canada installations must conform with the current CAN/CSA B149 and the Canadian Electrical Code CSA C22.1 C.E.C. Part 1 (C22.1). All boiler installations must conform to ASME boiler code. Hot water pipes must be installed with minimum clearances to combustible material as required by code.

Installation Base

The boiler should be mounted on a level, non-combustible surface. Boiler must not be installed on carpeting. The boiler can be installed on a combustible surface only when a suitable floor shield base is provided. Raypak offers an optional floor shield base which can be factory installed on all indoor models. Do NOT use the shipping crate base as an installation base.

NOTE: The boiler 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.

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

Boiler Model No.	Base Part No.	Boiler Model No.	Base Part No.
0514	056199	1336	059236
0624	056200	1414*	054601
0724	056201	1468	059237
0824	056202	1571*	058378
0926*	054597	1631	059238
0962	059233	1758*	058379
1083*	054598	1826	059239
1125	059234	2100-4001	STD
1178*	054599		
1223	059235		
1287*	054600		

* Models with factory-installed floor shield as standard

Table A. Combustible Floor Shield Ordering Information Clearances

Indoor Installations

Boiler Location	Boiler 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	36 (914)	24 (610)	24 (610)
Outdoor Top			
Floor	Combustible floor shield is required when boiler is installed on a combustible surface. For ordering information see Table A .		
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) on side opposite water connections for delimiting of Heat Exchanger Tubes.		

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

Table B. Minimum Clearances from Combustible Installations

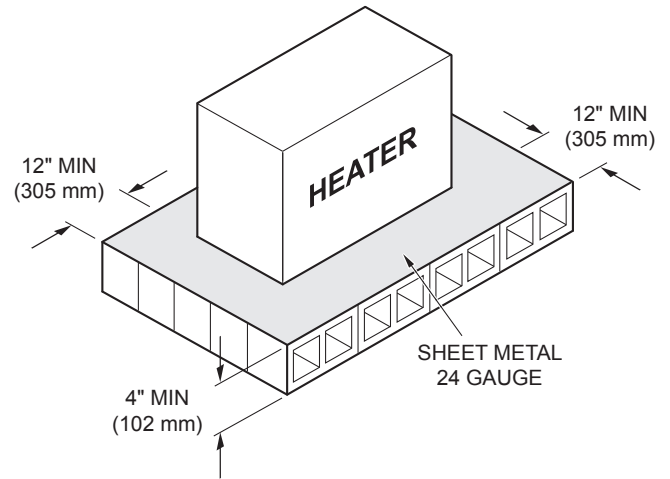


Figure 2. Alternate Method for Providing a Non-Combustible Base

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

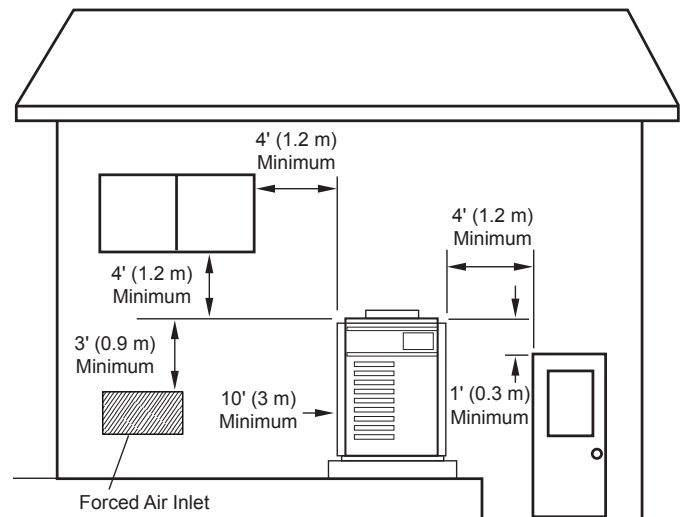


Figure 3. Minimum Distances to Building Openings from Where Flue Products Exit the Boiler

Outdoor Boilers

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

The point from where the flue products exit the boiler 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 boiler shall be at least 3' (0.9 m) above any forced air inlet, or intake ducts located within 8' (2.4 m) horizontally.

Description	Location	Boiler Size		
		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 C. Reduction of Clearances to Protected Surfaces (in./mm)

High-Wind Conditions

Outdoor Units Only

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

Combustion and Ventilation Air

Indoor Units Only

The boiler 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.

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

- a. All air from inside the building:
Each opening shall have a minimum net free square inches as noted in **Table D**.
- 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 E**.

Model No.	Square Inches (cm)	Model No.	Square Inches (cm)
0514	512 (3302)	1631	1630 (10514)
0624	627 (4044)	1826	1826 (11778)
0724	726 (4683)	2100	2100 (13545)
0824	825 (5321)	2500	2499 (16119)
0962	962 (6205)	3001	3000 (19350)
1125	1125 (7256)	3500	3500 (22575)
1223	1223 (7888)	4001	4000 (25800)
1336	1337 (8624)		
1468	1467 (9462)		

Table D. Minimum Net Free Air from Inside Building

Model	Square Inches (cm)	Model	Square Inches (cm)
0514	128 (826)	1631	408 (2632)
0624	157 (1013)	1826	457 (2948)
0724	182 (1174)	2100	525 (3386)
0824	207 (1335)	2500	625 (4031)
0962	241 (1554)	3001	750 (4838)
1125	282 (1819)	3500	875 (5644)
1223	306 (1974)	4001	1000 (6450)
1336	335 (2161)		
1468	367 (2367)		

Table E. 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.

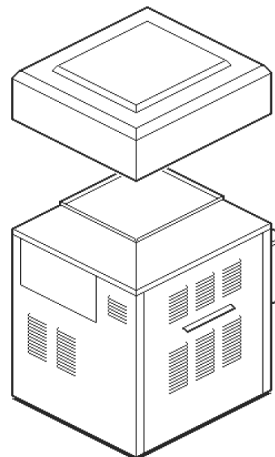


Figure 4. Outdoor Top Installation for Models 0514–0824

2. Tighten the four (4) screws until they come in contact with the unit jacket top then evenly tighten all four (4) screws to secure to unit. See **Figure 5**.

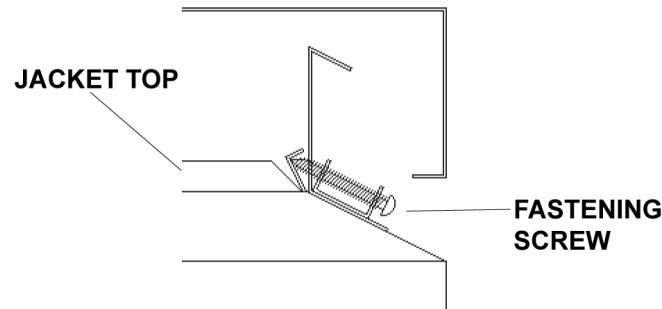


Figure 5. Outdoor Top Installation for Models 0514–0824

Models 0926-1758

Boilers are shipped with outdoor vent terminal factory installed.

Indoor Installations

Models 0514-0824

Locate and assemble as shown in **Figure 6**. Secure with screws supplied in the carton's envelope.

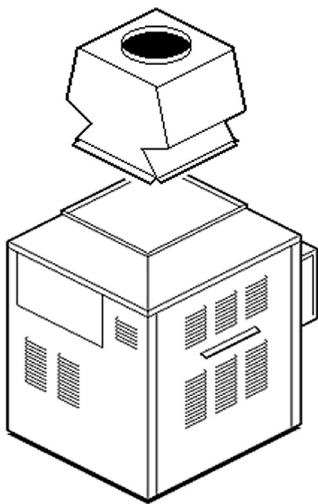


Figure 6. Draft hood Installation for Models 0514–0824

Models 0962-1826

Locate and assemble as shown in **Figure 7**. Secure with screws supplied in the carton's envelope.

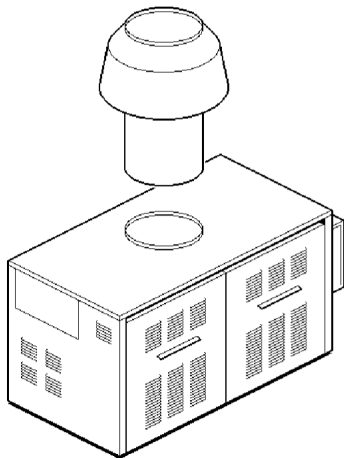


Figure 7. Draft hood Installation for Models 0962–1826

Models 2100-4001

These models have built-in draft hoods. For proper operation, the draft hood outlet must be connected to the venting system.

Vent Piping

⚠ WARNING: Indoor boilers require a draft hood 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 draft hood outlet is recommended, however, when the total vent height is at least 10' (3 m) (draft hood relief opening to vent terminal), the vent pipe size may be reduced as specified in Chapter 10 of the latest edition of the National Fuel Gas Code (NFGC), ANSI Z223.1.

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

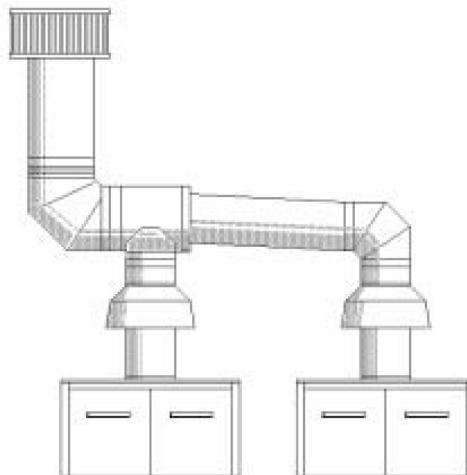


Figure 8. Common Venting Configuration

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' (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' (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.

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, ANSI Z223.1.

The discharge opening must be a minimum of 2' (0.6 m) vertically from the roof surface and at least 2' (0.6 m) higher than any part of the building within 8' (2.4 m) for vents smaller than 12" (305 mm) diameter. For 12" (305 mm) diameter vents and larger, the termination must be 2' (0.6 m) higher than any part of the building within 10' (3 m). See **Figure 9**.

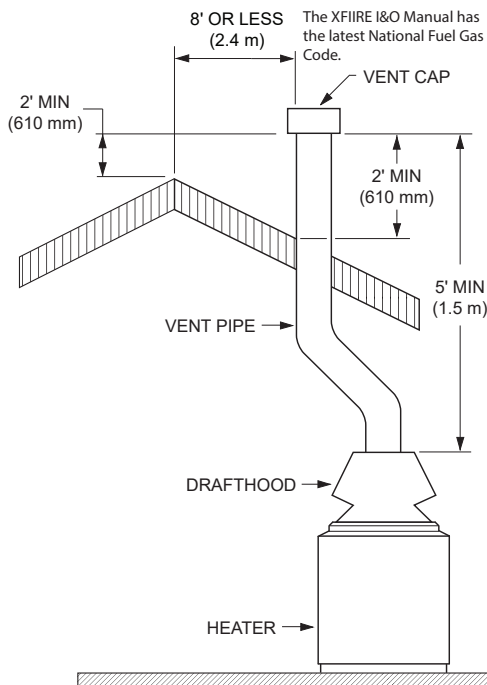


Figure 9. Venting Clearances

Vent stack shall be at least 5' (1.5 m) in vertical height above the draft hood outlet. The vent cap location shall have a minimum clearance of 8' (2.4 m) horizontally from, and in no case above or below, unless a 8' (2.4 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 the boiler draft hood. Support must be provided in compliance with applicable codes. The boiler top and draft hood 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.

Maintain draft of -0.01 - 0.08" WC.

Manifolds that connect more than one boiler 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.

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

- a. Seal any unused openings in the common venting system.
- b. Visually inspect the venting system for proper size and horizontal pitch and make sure there is no blockage or restriction, leakage, corrosion and other deficiencies which could cause an unsafe condition.
- c. 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 draft hood 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 boiler gas controls, and a manual shutoff valve located outside the heater jacket (See **Figure 10.**). All gas piping should be tested after installation in accordance with local codes.

A minimum of 6.0" W.C. (7.0" W.C. for models 0514-0824) 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.

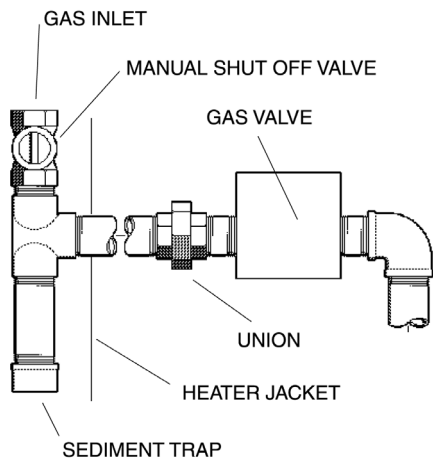


Figure 10. Gas Piping Plumbing

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 boiler 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 boiler and its manual shut-off 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 boiler 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.

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.

For boilers with mechanical modulation gas valves (Type H1 and H5) or two-stage gas valves (Type H3), the gas pressure regulator is preset and sealed, and not field adjustable. Pressure tap is provided on the outlet side of the gas valve for measurement of gas pressure in the manifold.

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

Venting of Diaphragm Gas Components

Gas valves that are equipped with a gas bleed must be vented to the outdoors as required by the National Fuel Gas Code. Under NO circumstances shall bleed lines terminate in the gas utilization equipment flue or exhaust system.

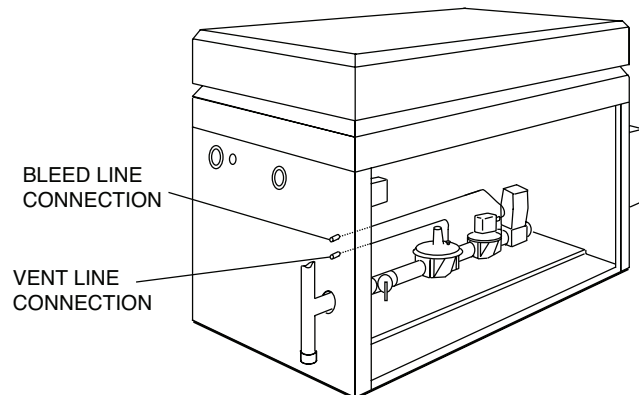


Figure 11. Bleed Line Connection Location

General

Boiler should be located so that any water leaks will not cause damage to any adjacent areas or structures. See piping diagrams (**Figures 12 & 13**) for proper water connections for the type of boiler and system.

Pump Selection

In order to ensure proper hydraulics in your hydronic heating system, adequate pump size must be selected. Raypak recommends that the pump be sized for 20°F (11°C) Delta-T (ΔT) whenever possible. (ΔT is the temperature difference between the inlet and outlet water when the boiler is firing at full rate). For some boilers, the ΔT is more than 20°F (11°C) [22°F (12°C) - 33°F (18°C)] at the recommended flow rates.

Feedwater Regulator

Raypak recommends that a feedwater regulator be installed and set at 12 PSIG minimum pressure. Install a check valve or back flow device upstream of the regulator, with a manual shut-off valve. Leave the valve open.

Piping - Heating Boilers

Raypak recommends that all high points be vented and that purge valves and a bypass valve be installed. A boiler installed above radiation level must be provided with a low-water cut-off device. The boiler, when used in conjunction with a refrigeration system, must be installed so that the chilled medium is piped in parallel with the boiler with

appropriate valves to prevent the chilled medium from entering the boiler.

Raypak strongly recommends the use of primary/secondary piping for all H boilers, as shown in the following piping diagrams. System flow must exceed the flow through the boiler at all firing rates.

Hot water heating systems all have unique levels of operating diversity that must be accounted for in the system design. The system should always include adequate system flow in excess of the connected boiler flow for proper operation. Where the system flow may drop below the connected boiler flow a buffer/decoupler may be needed. Failure to design for adequate flow (i.e. bypasses,

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)

Natural gas - 1,000 btu/ft³, 0.60 specific gravity at 0.5" W.C. pressure drop

Propane gas - 2,500 btu/ft³, 1.53 specific gravity at 0.6" W.C. pressure drop

Lengths based on Sched 40 BIP - for other materials consult local codes

Table F. Gas Supply Piping Length (ft./m)

3-way control valves, flow limiting balance devices, buffer tanks, etc.) will result in boiler short-cycling and may reduce boiler life. Always contact your local Raypak representative for system design assistance to avoid these issues.

Maintain a minimum water temperature of 105°F (41°C) at the inlet to avoid condensation.

Temperature and Pressure Gauge

The temperature and pressure gauge is standard equipment on all hydronic heating and hot water supply boilers. All temperature and pressure gauges are factory mounted in the inlet/outlet header.

Recommended Purge Manifolds for Typical Hydronic System Hookups

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

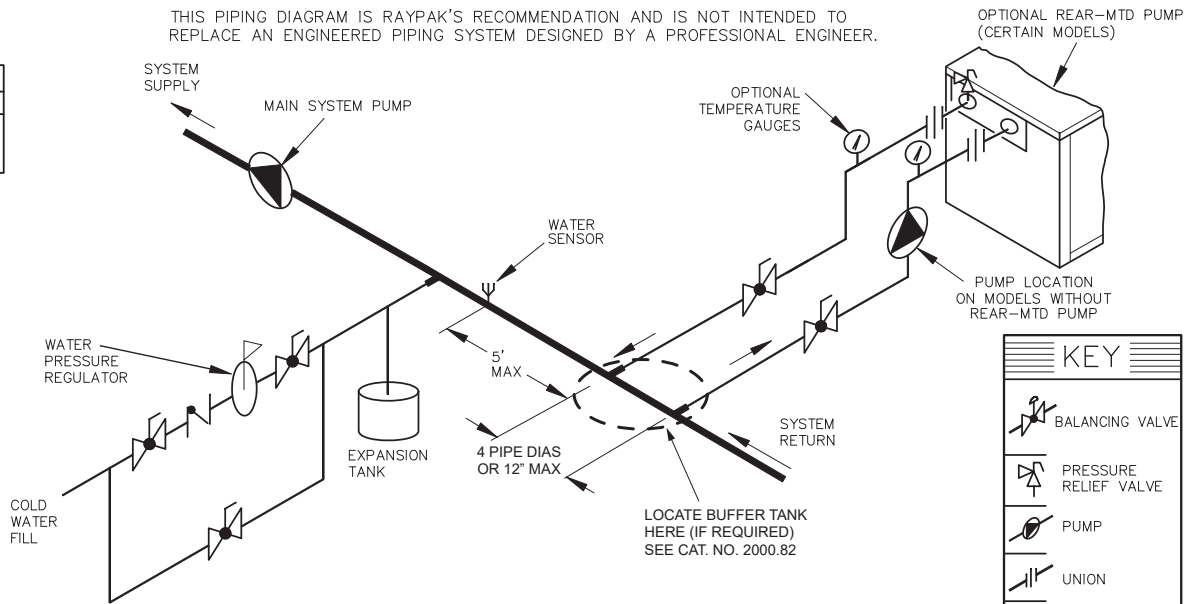
Model No.	2-PASS HEAT EXCHANGER							1-PASS HEAT EXCHANGER						
	MAX			MIN			HDR CONN.	MAX			MIN			HDR CONN.
	GPM (lpm)	ΔT	ΔP FT.	GPM (lpm)	ΔT	ΔP FT.		GPM (lpm)	ΔT	ΔP FT.	GPM (lpm)	ΔT	ΔP FT.	
0514	90 (341)	9	9.0	40 (152)	21	1.8	2"							
0624	90 (341)	12	9.5	40 (152)	26	1.9	2"							
0724	90 (341)	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 heating systems.

Table G. Maximum and Minimum Flow Rates

THIS PIPING DIAGRAM IS RAYPAK'S RECOMMENDATION AND IS NOT INTENDED TO REPLACE AN ENGINEERED PIPING SYSTEM DESIGNED BY A PROFESSIONAL ENGINEER.

PIPE SIZES	
RAYTHERM BOILER	
0514-0824	2"
0926-1826	2-1/2"
2100-4001	3"



NOTES:

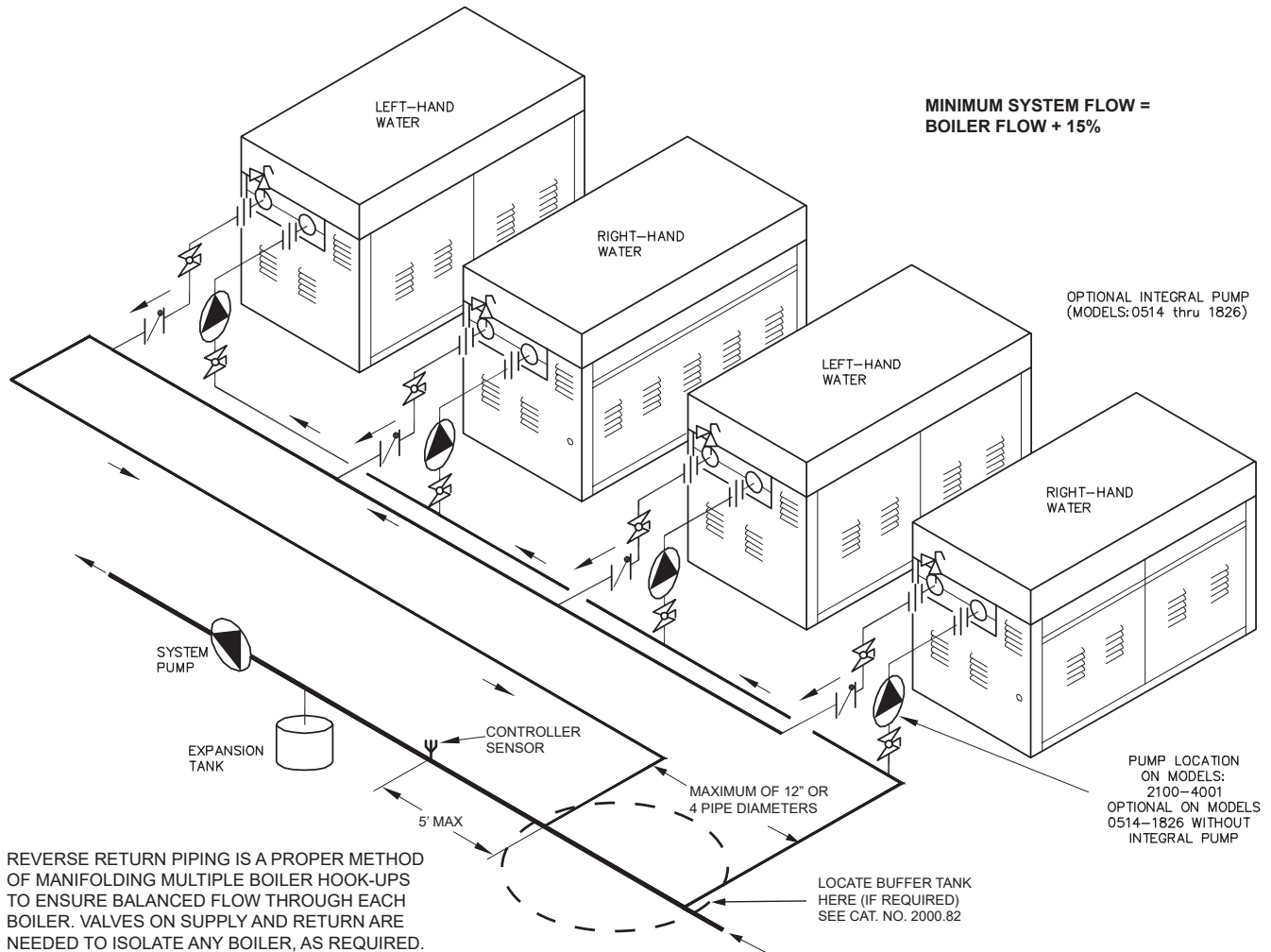
1. PIPE ALL RELIEF VALVES TO DRAIN, OR AS LOCAL CODES REQUIRE.
2. PLUMB SWING CHECK VALVE IN GRAVITY-CLOSED POSITION.

3. SEE TABLE FOR PIPE SIZES, CALCULATED AT MAXIMUM FLOW IF LOWER FLOW RATES THAT ARE ACCEPTABLE FOR THE UNIT ARE USED, SMALLER PIPE SIZES MAY BE USED.

**MINIMUM SYSTEM FLOW =
BOILER FLOW + 15%**

**NOTE: EXPANSION TANKS (SUPPLIED BY OTHERS)
SHOULD BE INSTALLED PER MANUFACTURER'S INSTRUCTIONS.**

Figure 12. Single Boiler Primary/Secondary Piping - Models 0514-4001



REVERSE RETURN PIPING IS A PROPER METHOD OF MANIFOLDING MULTIPLE BOILER HOOK-UPS TO ENSURE BALANCED FLOW THROUGH EACH BOILER. VALVES ON SUPPLY AND RETURN ARE NEEDED TO ISOLATE ANY BOILER, AS REQUIRED.

**MINIMUM SYSTEM FLOW =
BOILER FLOW + 15%**

OPTIONAL INTEGRAL PUMP
(MODELS: 0514 thru 1826)

PUMP LOCATION
ON MODELS:
2100-4001
OPTIONAL ON MODELS
0514-1826 WITHOUT
INTEGRAL PUMP

LOCATE BUFFER TANK
HERE (IF REQUIRED)
SEE CAT. NO. 2000.82

Figure 13. Multiple-Boiler - Reverse Return Hook-Up - Models 0514-4001

5. CONTROLS

Economaster Controls

The Economaster II is an electronic device that allows the operator to set the desired time for the pump to run after the boiler shuts off. The time is factory-set at 7-minutes and it can be re-adjusted in the field anywhere from 3 to 10-minutes.

In a conventional system, when the aquastat is satisfied, the main gas valve closes, but the pump continues operating. With the energy-conserving Economaster II the boiler 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 aquastat.

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

Electronic Ignition

The electronic intermittent ignition (IID) device 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 proven.

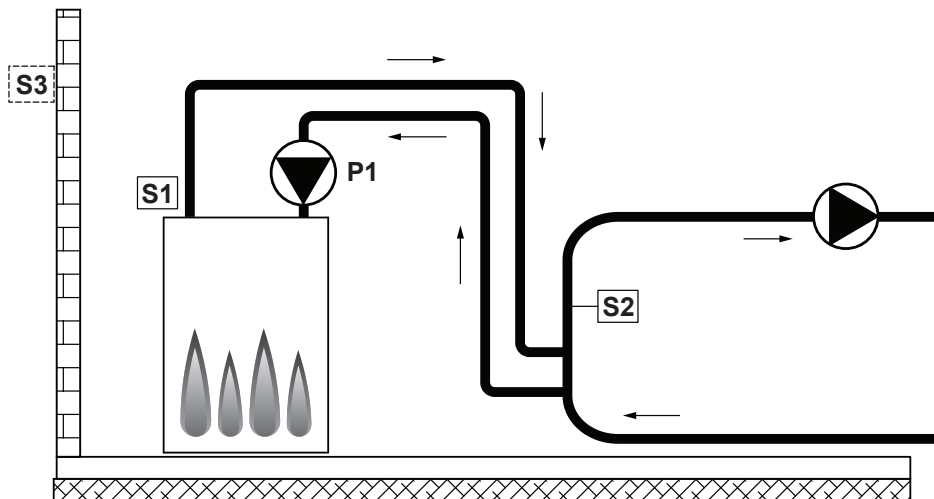


Figure 14. Hydronic with Outdoor Air Reset

All units regardless of fuel type are equipped with a 90-second trial for pilot ignition - lockout ignition module as standard.

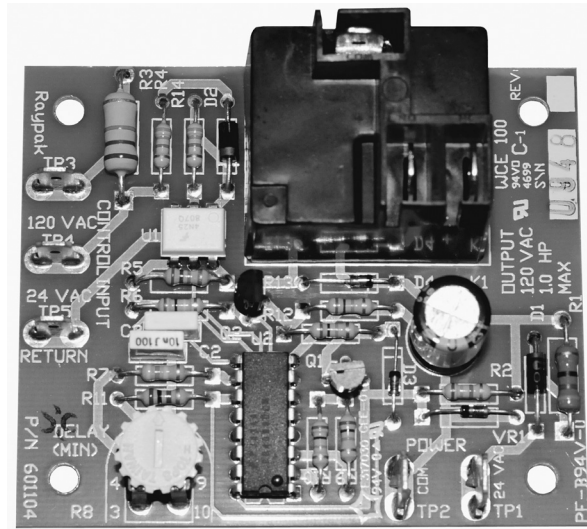


Figure 15. Economaster II Pump Delay

Hydronic with Outdoor Air Reset

For hydronic operation with outdoor air reset, the System Supply Sensor (S2) is used as the operating sensor. Boiler Outlet Sensor (S1) is used for boiler outlet maximum limiting. The Outdoor Air Sensor (S3) is used to determine how the reset algorithm will respond. Boiler Pump (P1) is controlled by the boiler and is cycled off using a fixed 5-minute purge delay after burner operation has ceased.

Hydronic with Outdoor Air Reset and Indirect DHW

For hydronic operation with outdoor air reset and Indirect DHW, the System Supply Sensor (S2) is used as the operating sensor. Boiler Outlet Sensor (S1) is used for boiler outlet maximum limiting. Contact closure from an aquastat located on an indirect DHW tank will cause the controller to operate to a boost temperature to satisfy the indirect call-for-heat. Once the aquastat opens the controller will return to normal operation.

The indirect pump is operated by an external relay (by others). The Boiler Pump (P1) is controlled by the boiler and is cycled off using a 5-minute fixed purge delay after burner operation has ceased.

The DIP switch settings are as follows:

- DIP 1 ON (ON/OFF) – OFF (2-STAGE)
- DIP 2 ON (OUTDOOR RESET)
- DIP 3 ON (WWSD 70°F) (21°C)
- DIP 4 ON (190°F BOIL MAX) (88°C)
- DIP 5 ON (HYDRONIC)

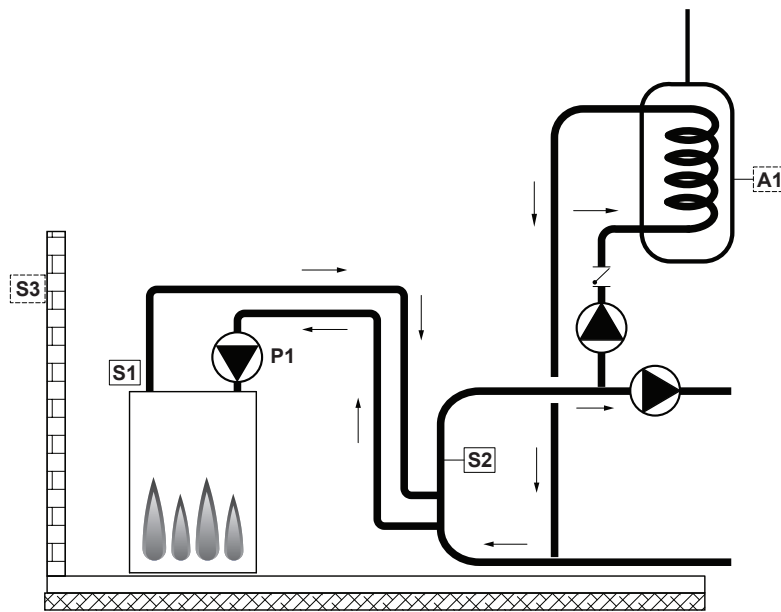


Figure 16. Hydronic with Outdoor Air Reset and Indirect DHW

Item	Feature	Setting/Description	Default
Dial	Operating Temperature	Reset Ratio 0.4 to 3.6 / Setpoint Target 120°F (49°C) to 200°F (93°C)	Reset Ratio 0.4 to 3.6
DIP #1	Firing Mode	Single Stage (On) / Two Stage (Off)	Single Stage (On)
DIP #2	Configuration	Outdoor Reset (On) / Setpoint (Off)	Outdoor Reset (On)
DIP #3	Warm Weather Shut Down	Active 70°F (21°C) (On) / Inactive (Off)	Active 70°F (21°C) (On)
DIP #4	Boiler Max Outlet Setting	Boiler Maximum (dependent on DIP #5) - Default: On o if DIP #5 set to Hydronic (On): 210°F (99°C) (Off) / 190°F (88°C) (On) o if DIP #5 set to Direct DHW (Off): 180°F (82°C) (Off) / 160°F (71°C) (On)	190°F (88°C) (On)
DIP #5	Space Heating or Direct Domestic Hot Water	Direct DHW (Off) / Hydronic (On) - Default: Hydronic (On) <i>Note: if DIP #5 is set to Direct DHW (Off), the operation is based on Setpoint regardless of DIP #2 setting</i>	Hydronic (On)

Table H. Outdoor Air Reset Temperature Controller Settings

Ratio	Water Temperature									
	3.6:1	120°F (49°C)	156°F (69°C)	192°F (89°C)						
3.2:1	120°F (49°C)	152°F (67°C)	184°F (84°C)	216°F (102°C)						
2.8:1	120°F (49°C)	148°F (64°C)	176°F (80°C)	204°F (96°C)						
2.4:1	120°F (49°C)	144°F (62°C)	168°F (76°C)	192°F (89°C)	216°F (102°C)					
2.0:1	120°F (49°C)	140°F (60°C)	160°F (71°C)	180°F (82°C)	200°F (93°C)	220°F (104°C)				
1.6:1	120°F (49°C)	136°F (58°C)	152°F (67°C)	168°F (76°C)	184°F (84°C)	200°F (93°C)	216°F (102°C)			
1.2:1	120°F (49°C)	132°F (56°C)	144°F (62°C)	156°F (69°C)	168°F (76°C)	180°F (82°C)	192°F (89°C)	204°F (96°C)	216°F (102°C)	
.8:1	120°F (49°C)	128°F (53°C)	136°F (58°C)	144°F (62°C)	152°F (67°C)	160°F (71°C)	168°F (76°C)	176°F (80°C)	184°F (84°C)	192°F (89°C)
.4:1	120°F (49°C)	124°F (51°C)	128°F (53°C)	132°F (56°C)	136°F (58°C)	140°F (60°C)	144°F (62°C)	148°F (64°C)	152°F (67°C)	156°F (69°C)
	70°F (21°C)	60°F (16°C)	50°F (10°C)	40°F (4°C)	30°F (-1°C)	20°F (-7°C)	10°F (-12°C)	0	-10°F (-23°C)	-20°F (-29°C)
	Outdoor Air Temperature									

Table I. Reset Ratio

Direct Domestic Hot Water

In this configuration the controller will operate to maintain a set temperature in the storage tank. The differential is fixed at 5°F below target. The System Supply Sensor (S2) is used as the operating sensor. Boiler Outlet Sensor (S1) is used for boiler outlet maximum limiting. Boiler Pump (P1) is controlled by the boiler and is cycled off using a 5-minute fixed purge delay after burner operation has ceased.

The DIP switch settings are as follows:

- DIP 1 ON (ON/OFF) – OFF (2-STAGE)
- DIP 2 OFF (SETPOINT)
- DIP 3 OFF (WWSD INACTIVE)
- DIP 4 ON (160°F BOIL MAX) (71°C)
- DIP 5 OFF (DIRECT DHW)

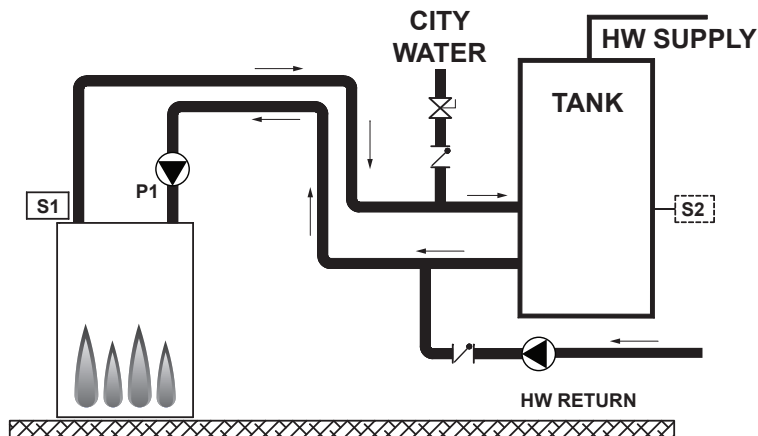


Figure 17. Direct Domestic Hot Water

Operating Controls

Modes H1 and H5 - Mechanical Modulation

Available on sizes 0514-1826

Models with mechanical modulating controls have one or more Robertshaw (Invensys) Unitrol 7000 Series hydraulic snap-on thermostatic combination gas valves. These dual-seat combination valves have the pressure regulator and 24 volt operator built-in.

The hydraulic actuator will throttle the boiler input to adjust the firing rate and meet the required load. This, in effect, prevents costly fuel consumption, as compared to an on/off cycling boiler. The valve has a remote capillary bulb immersed in a well, at the header outlet, to maintain a constant outlet water temperature. When multiple valves are furnished, they 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 temperature. See **Figure 18**.

NOTE: No external control of the valve position is possible.

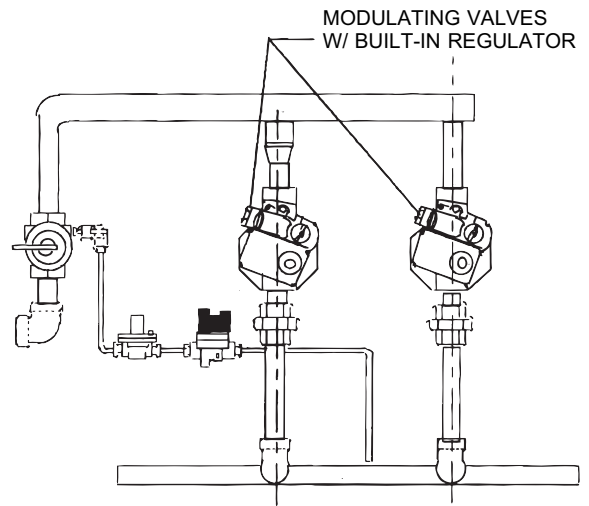


Figure 19. Mechanical Modulating Valve Location (sizes 0724-1336 shown)

INVENSYS MODULATING VALVE DIAL SETTING	
DIAL POSITION	TEMP. IN DEGREES F
POS. LO	110°
POS. 1	117°
POS. 2	124°
POS. 3	130°
POS. 4	137°
POS. 5	143°
POS. 6	150°
POS. 7	156°
POS. 8	163°
POS. HI	170°

P/N

LOW TEMP RANGE
H5

INVENSYS MODULATING VALVE DIAL SETTING	
DIAL POSITION	TEMP. IN DEGREES F
POS. LO	150°
POS. 1	157°
POS. 2	164°
POS. 3	170°
POS. 4	177°
POS. 5	183°
POS. 6	190°
POS. 7	196°
POS. 8	203°
POS. HI	210°

P/N

HIGH TEMP RANGE
H1

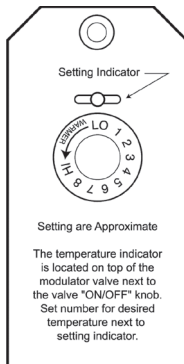


Figure 18. Sample Dial Setting Tags

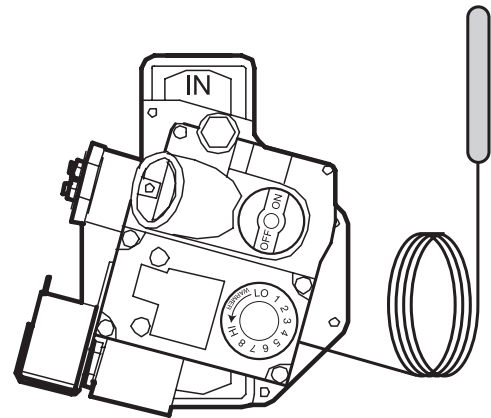


Figure 20. Mechanical Modulating Valve

Mode H3 - 2-Stage Firing

The boiler will fire at low-fire when there is closure across the stage 1 contacts. Thereafter, it will fire at high-fire when there is closure across the stage 2 contacts. Numerous staged controllers are available.

Mode H4 - On/Off Firing

The boiler will fire at full-fire when there is closure across the TH contacts. Numerous mechanical staged controllers are available, as well as digital controllers offering additional features. See **Figure 21**.

A typical wiring diagram for a mid-size H4 unit is shown on page 26. This basic layout applies to most other firing modes as well.

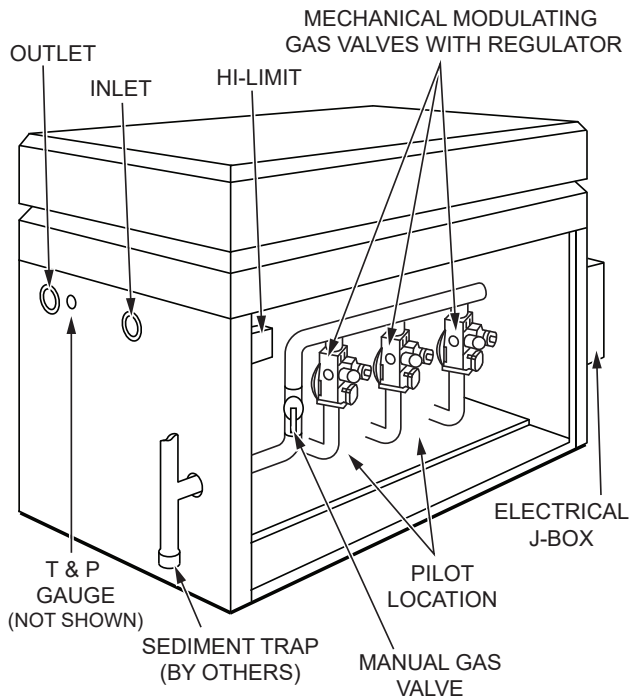


Figure 21. General Location of Controls (H1/H5 1414-1826 shown)

Mode H9 - 4-Stage Firing

The boiler will fire at lowest setting when there is closure across the stage 1 contacts. Thereafter, it will fire at increasing rates when there is closure across the contacts for additional stages. Loss of closure across stage 1 will shut down the entire boiler immediately. Numerous digital controllers are available.

WH Modes

Controller connections for heating boilers used in domestic hot water service are shown in **Figure 22** and **Figure 23**.

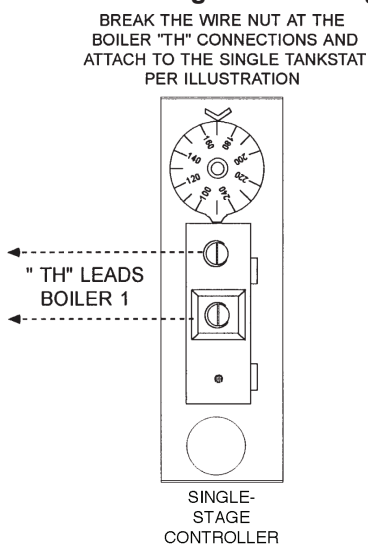


Figure 22. Single-Stage Controller

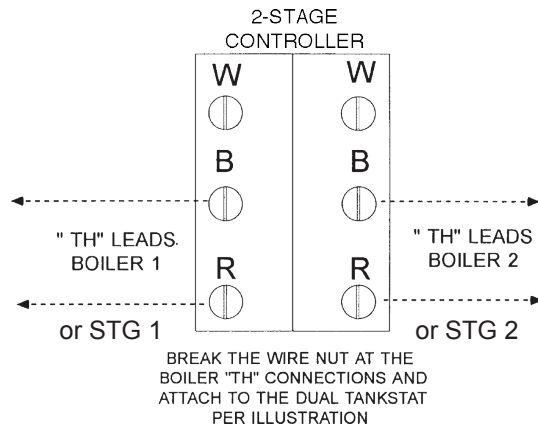


Figure 23. 2-Stage Controller

Limit Controls

Manual-Reset High Limit

All models are equipped with a manual-reset high limit. Set the manual limit to its maximum setpoint.

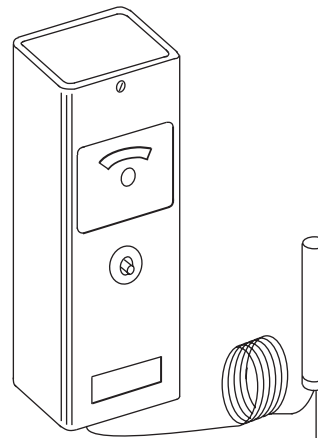


Figure 24. Manual-Reset High Limit

Auto-Reset High Limit

Set the auto limit(s) to 30°F (17°C) - 40°F (22°C) above the desired operating temperature and 15°F (8°C) below the Manual High Limit setting.

Flow Switch

This dual purpose control shuts off the boiler in the case of a pump failure or low water condition. It is mounted and wired in series to the main gas valve. Standard on all models.

NOTE: Flow switch will not operate if flow is less than 12 gpm (45 lpm).

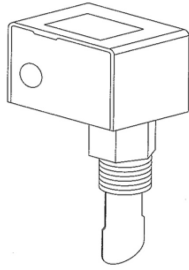


Figure 25. Flow Switch

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

These switches sense either high-gas or low-gas pressures and automatically shut down burners if abnormal pressures exist. The high gas pressure switch opens if the manifold pressure rises above 5.0" WC. The low gas pressure switch opens if the inlet gas pressure drops below 5.0" WC.

NOTE: The High Gas Pressure Switch is standard on Models 3001-4001.

100% Pilot Safety Ignition Module

All standard boiler models employ electronic devices which incorporate Intermittent Ignition Device logic. They 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. Unit performs its own safety check and opens the main valve only after the pilot is proven to be lit.

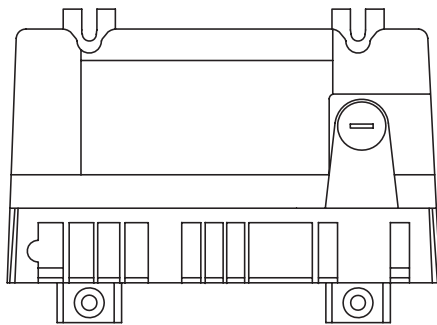


Figure 26. IID Ignition Module

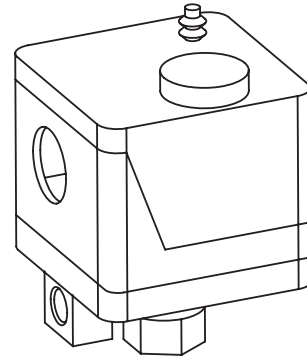


Figure 28. Gas Pressure Switch

Low Water Cut-Off (Optional)

The probe-type low-water cut-off (sales option F-9) automatically shuts down the burner whenever water level drops below the probe for more than 2-seconds. A 3-second time delay prevents premature lockout due to temporary conditions such as power failure or air pockets.

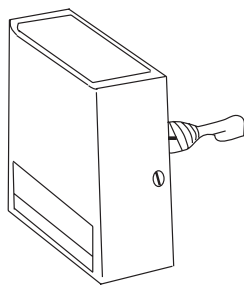


Figure 27. Low-Water Cut-Off

6. START-UP

Electrical Connections

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

⚠ DANGER - SHOCK HAZARD: Make sure electrical power to the heater is disconnected to avoid potential serious injury or damage to components.

This boiler is normally wired for 120 Volts. The voltage is indicated on the tie-in leads. Consult the wiring diagram shipped with the boiler in the instruction packet. The “TH” leads are for the remote tank control connection. 24 Volts are supplied to this connection through the boiler transformer.

DO NOT attach line voltage to the “TH” leads. Before starting the boiler, check to ensure proper voltage to boiler and pump.

The boiler must be electrically grounded in accordance with National Electrical Code ANSI/NFPA No 70, or with CSA C22.1 C.E.C. Part 1 in Canada.

NOTES:

1. Field install ground to inside of junction box.
2. If any of the original wire as supplied with the boiler must be replaced, it must be replaced with 105°C wire or its equivalent.

Pre Start-Up

Safe lighting and other performance criteria were met with the gas manifold and control assembly provided on the boiler when the boiler underwent tests specified in the latest edition of ANSI Z21.13 Standard.

General

Before lighting up a new installation, water should be flowing through the boiler. Regulator should be set to minimum 12 PSI.

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

Filling System

Heating Boilers

Fill system with water. Purge all air from the system using purge valve sequence. After system is purged of air, lower system pressure. Open valves for normal system operation. Fill system through feed pressure.

Manually open air vent on the compression tank until water appears, then close vent.

Ethylene Glycol Systems

Heating Boilers

Fill through filler opening on the top on the Air-X Tank to solution desired. Always maintain solution level in sight glass.

NOTE: Raypak recommends the use of Ethylene Glycol solution only.

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 attempting to 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

Lighting Instructions

1. Close all gas valves. Turn off electrical power supply. Wait 5-minutes.
2. Open manual pilot valve. Turn on electrical power. Pilot is automatically lighted.

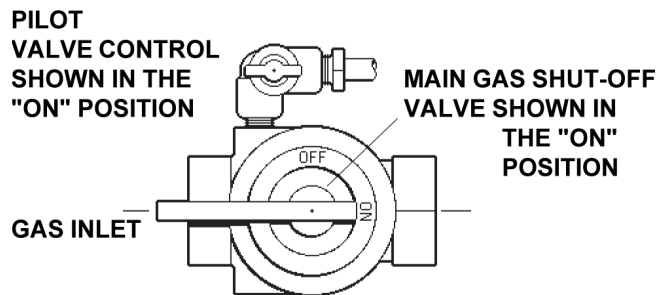


Figure 29. Shut Off Valve

3. Open main gas valve.
4. Set temperature controls to desired temperature.

To Shut Down

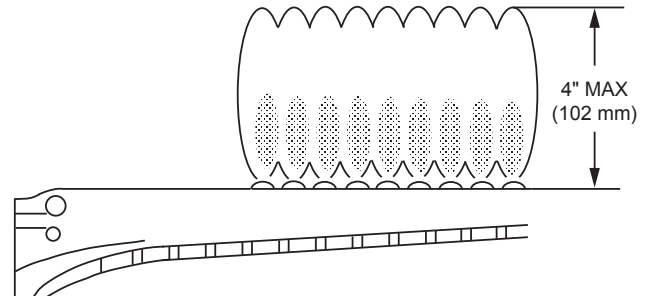
Close all manual gas valves. Turn off electrical power.

After Start-Up

Intermittent Pilot System IID

1. Turn on power to the ignition systems and turn gas supply off.
2. Check ignition module as follows:
 - a. Set the thermostat or controller above room temperature 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 thermostat down to end call-for-heat and wait 60-seconds on lockout models before beginning Step 3.

3. Turn on gas supply.
4. Set thermostat or controller above room temperature to call-for-heat.
5. Systems should start as follows:
 - a. 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.



Modulating burner flame varies in height from approximately 1/4" (6 mm) at low fire to approximately 4" (102 mm) at high fire.

Figure 30. Typical Main Burner Flame

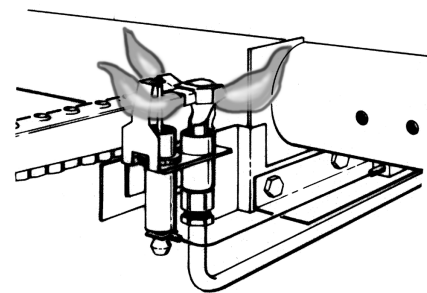


Figure 31. Pilot Burner Flame (IID Units)

Inspections

Burners

Clean main burners and air louvers of dust, lint and debris. Keep boiler 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 high gas pressure. Low flame indicates low gas pressure.

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.

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 30°F (17°C) to 40°F (22°C) above desired operating temperature, and push reset button. Burner should light.

Suggested Inspection Schedule

The boiler should be inspected on the first and third months after initial start-up and then on an annual basis. If problems are found, refer to Troubleshooting Guide on page 31 for additional directions.

1. Remove top of heater and inspect heat exchanger for soot and examine venting system.
2. Remove rear header and inspect for scale deposits, and/or accelerated erosion.
3. * Inspect pilot and main burner flame and firing rate.
4. * Inspect and operate all controls and gas valve.
5. * 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.
6. Check flow switch paddle.
7. Clean room air intake openings to ensure adequate flow of combustion and ventilation air.
8. Keep boiler area clear and free from combustible materials, gasoline, and other flammable vapors and liquids.

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

LIGHTING INSTRUCTIONS FOR BOILERS WITH ELECTRONIC IGNITION (IID)
For Models with Manual Gas Valves

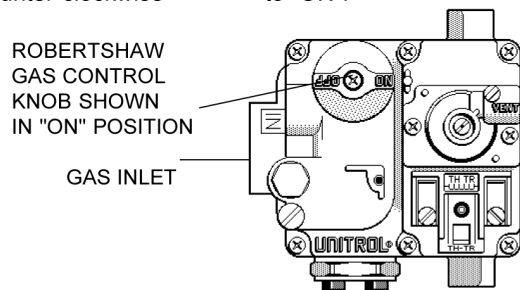
FOR YOUR SAFETY READ BEFORE OPERATING

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

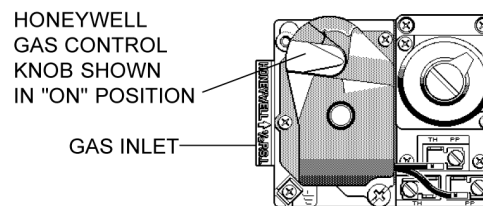
- A. This appliance is equipped with an ignition device which automatically lights the pilot. Do not try to light the pilot by hand.
- B. BEFORE OPERATING smell all around the appliance area for gas. Be sure to smell next to the floor because some gas is heavier than air and will settle on the floor.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

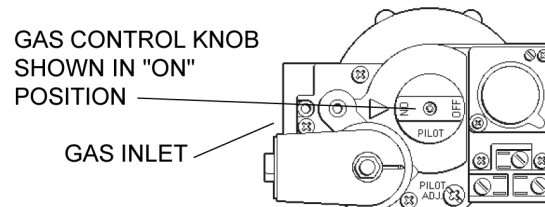
1. STOP! Read the safety information above.
2. Set the thermostat on the lowest setting.
3. Turn off all electrical power to the appliance.
4. This appliance is equipped with an ignition device which automatically lights the pilot. Do not try to light the pilot by hand.
5. Remove boiler door panel.
6. **For Robertshaw gas valve:** Turn gas control knob clockwise to "OFF".
For Honeywell gas valve (all models except 40#): Turn gas control knob clockwise to "OFF". Make sure knob rest against stop.
For Honeywell gas valve (Models 40# only): Push in gas control knob slightly and turn clockwise to "OFF". Knob cannot be turned to "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 above. 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.



For Honeywell gas valve (Models 40# only): Turn gas control knob counter-clockwise to "ON".



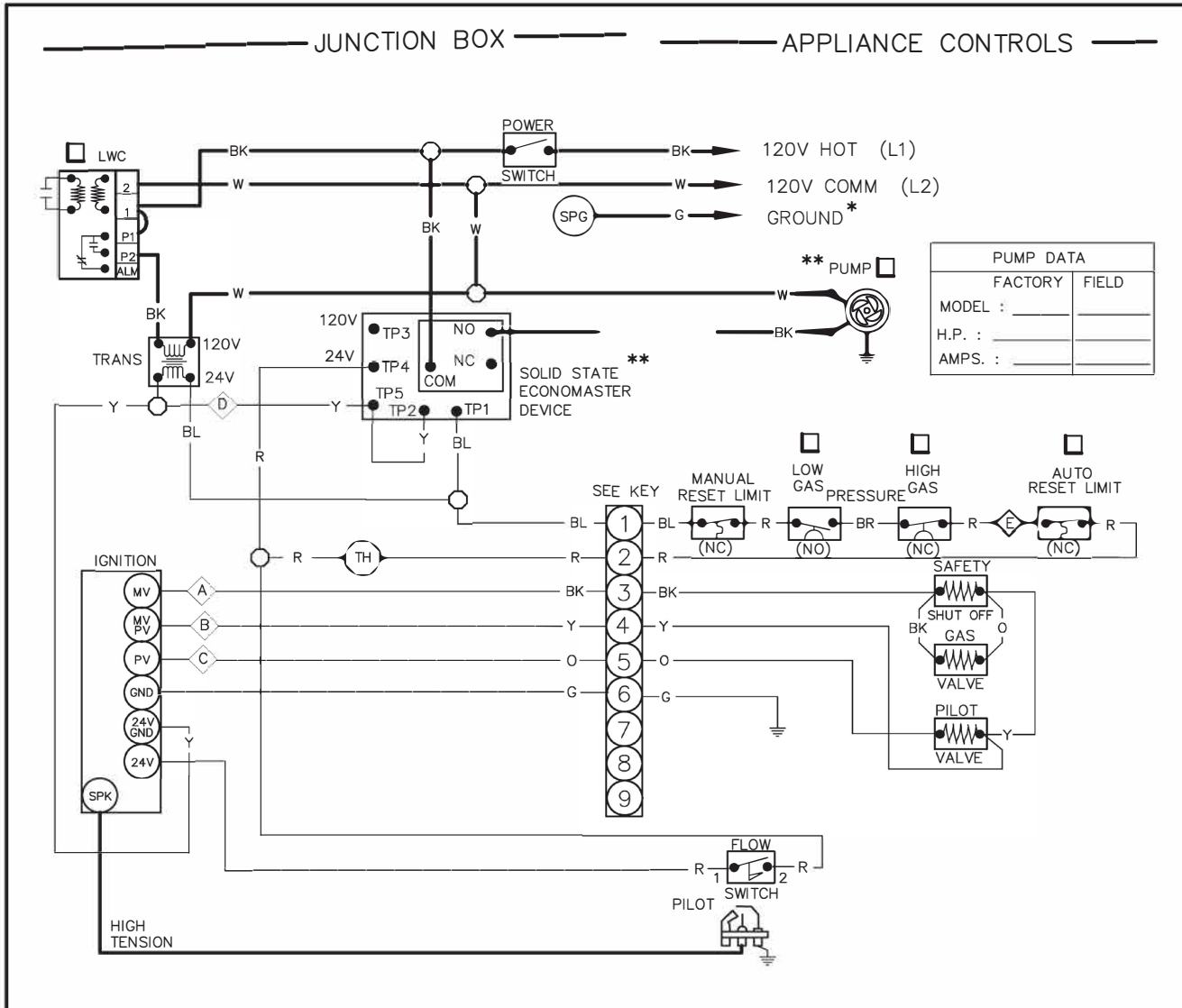
9. Replace boiler door panel.
10. Turn on all electrical power to the appliance.
11. Set thermostat to desired setting.
12. If the appliance will not operate, follow the instructions "To Turn Off Gas To Appliance" and call your service technician or gas supplier.

TO TURN OFF GAS TO APPLIANCE

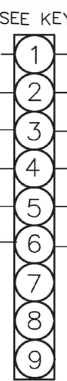
1. Set the thermostat to the lowest setting.
2. Turn off all the electrical power to the appliance if service is to be performed.
3. Remove door panel.
4. **For Robertshaw gas valve:** Turn gas control knob clockwise to "OFF".
For Honeywell gas valve (all models except 40#): Turn gas control knob clockwise to "OFF". Make sure knob rests against stop.
For Honeywell gas valve (Models 40# only): Push in gas control knob slightly and turn clockwise to "OFF".
5. Replace heater door panel.

7. WIRING DIAGRAM

Typical On-Off (H4) Intermittent Ignition Control Wiring



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



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)	
FRONT VIEW	

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

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

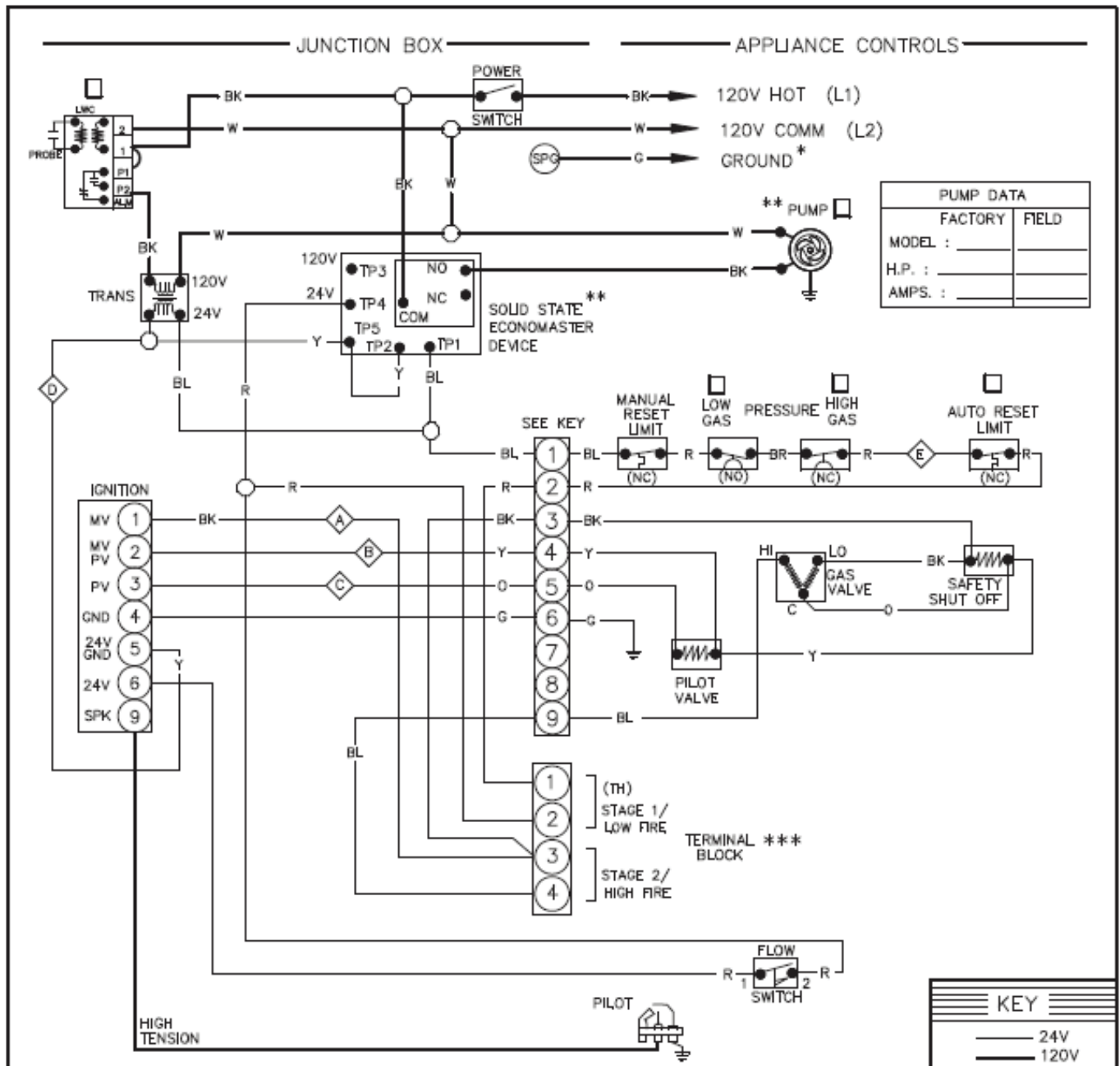
⬠ — ⬠ CONNECTIONS FOR OPTIONAL E-4 ALARM PANEL.

☑ 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	
Raupak	

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

152170	8
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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 \perp TERMINATE AT \oplus .

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

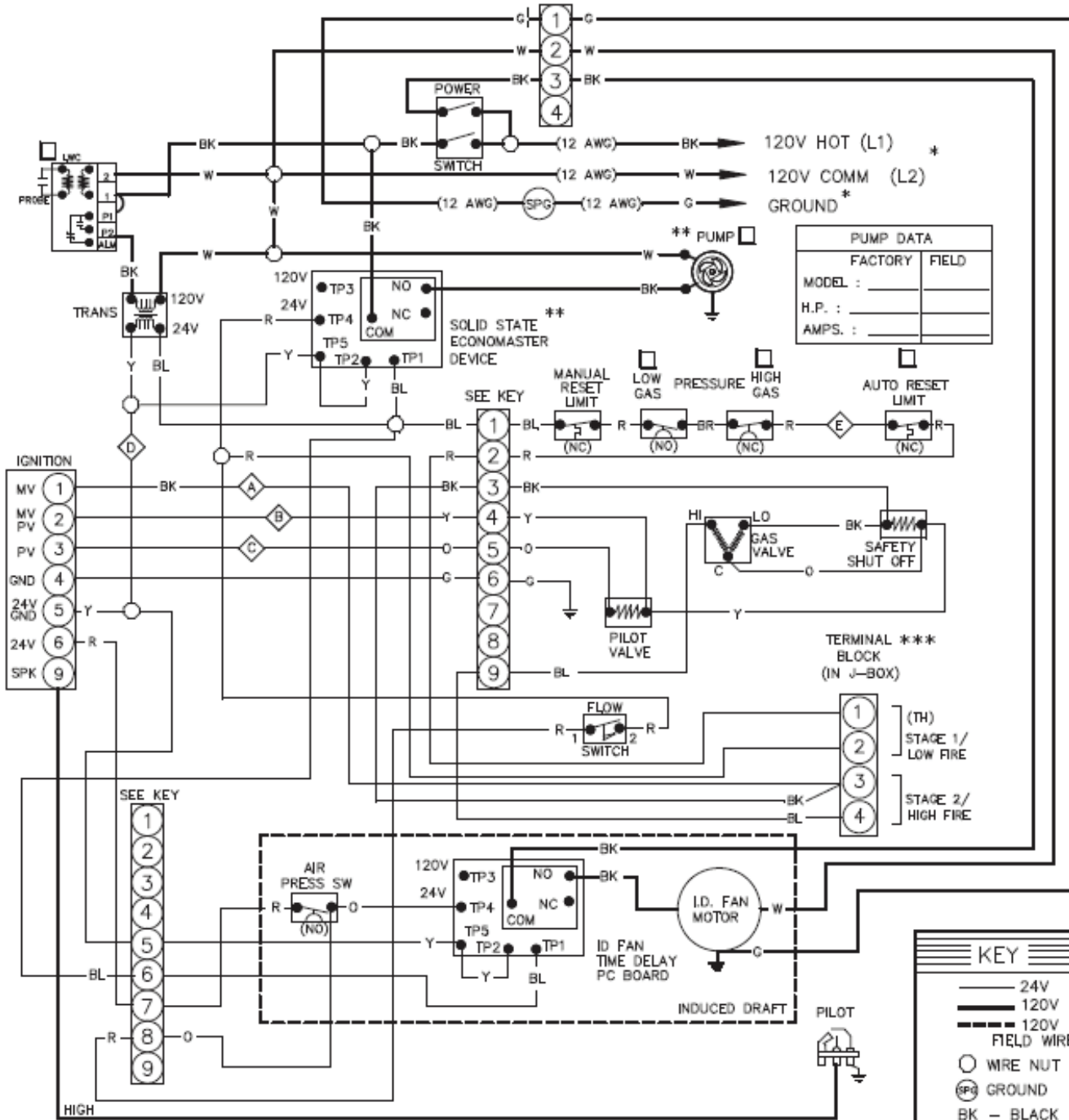
*** FOR TWO STAGE OPERATION OR MULTIPLE BOILER SYSTEM, SEE INSTALLATION AND OPERATING INSTRUCTION MANUAL.

◆ — ◆ 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. 1781	
02/17/84	
CHG E.O. 5764	
06/28/17	
Raupak	
BOILER INPUTS:	726,000 THRU 1,826,000 BTUH
BOILER SIZE:	724-1826
BOILER TYPE:	H3, W3, WH3

KEY		
—	24V	
—	120V	
- - -	120V	FIELD WIRE
○	WIRE NUT	
⊕	GROUND	
BK	BLACK	
BR	BROWN	
R	RED	
O	ORANGE	
Y	YELLOW	
G	GREEN	
BL	BLUE	
V	VIOLET	
W	WHITE	
PLUG (ACTUAL)		
3	2	1
6	5	4
9	8	7
FRONT VIEW		
151931		15



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

** PUMP USED MUST BE RATED 10 AMPS MAX OR 3/4 HP MAX. PUMP DELAY ADJUSTABLE BETWEEN 3 & 10 MINUTES.
 ***FOR TWO STAGE OPERATION OR MULTIPLE BOILER SYSTEM, SEE INSTALLATION AND OPERATING INSTRUCTION MANUAL.
 ◆-◆ CONNECTIONS FOR OPTIONAL E-4 ALARM PANEL.
 CHECK CONTROLS PROVIDED (WIRED AS SHOWN)
 REPLACE WIRING WITH 105°C WIRE ONLY

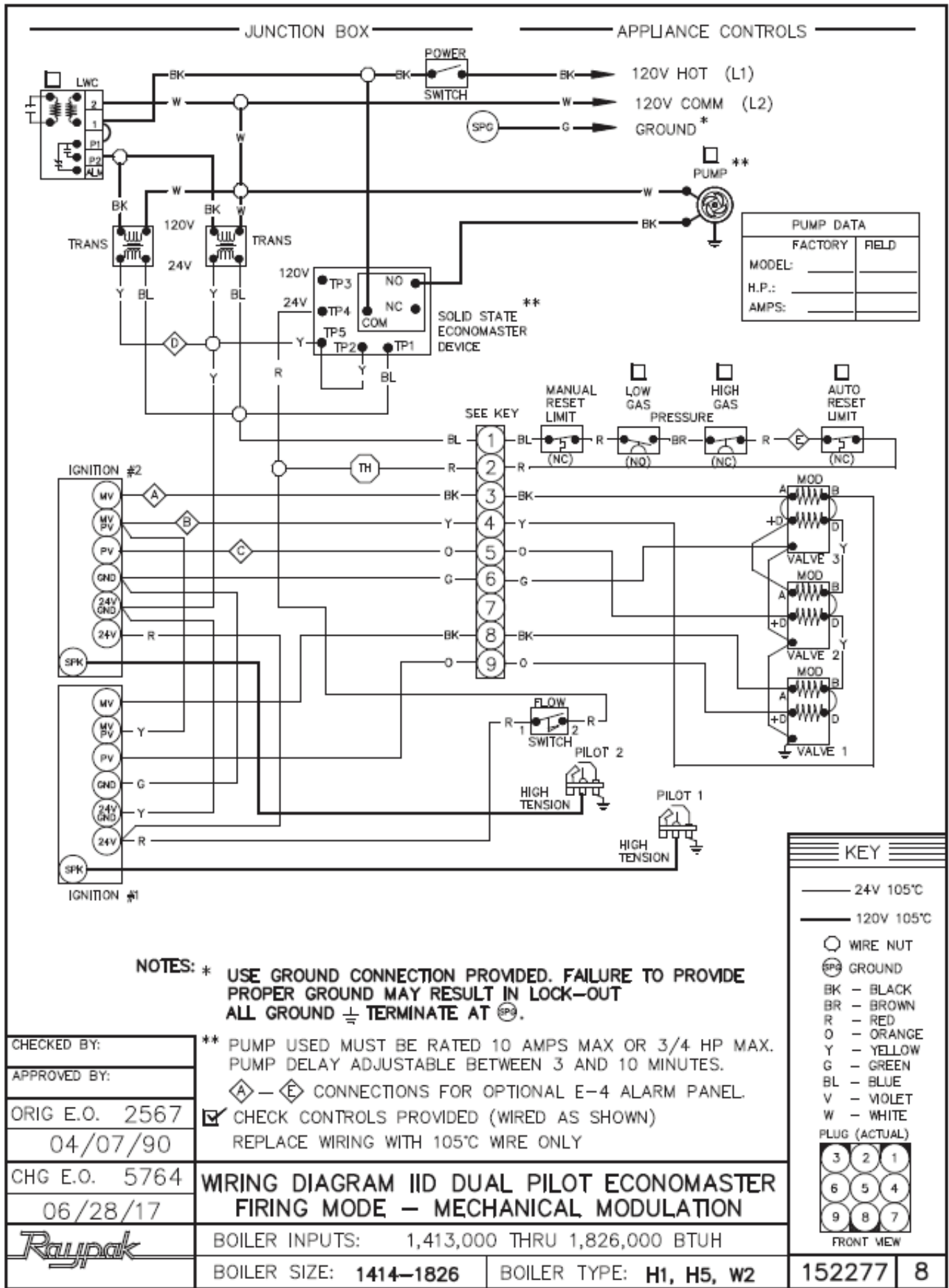
CHECKED BY:	
APPROVED BY:	
ORIG E.O. 1781	
02/17/84	
CHG E.O. 5764	
06/28/17	
Raupak	

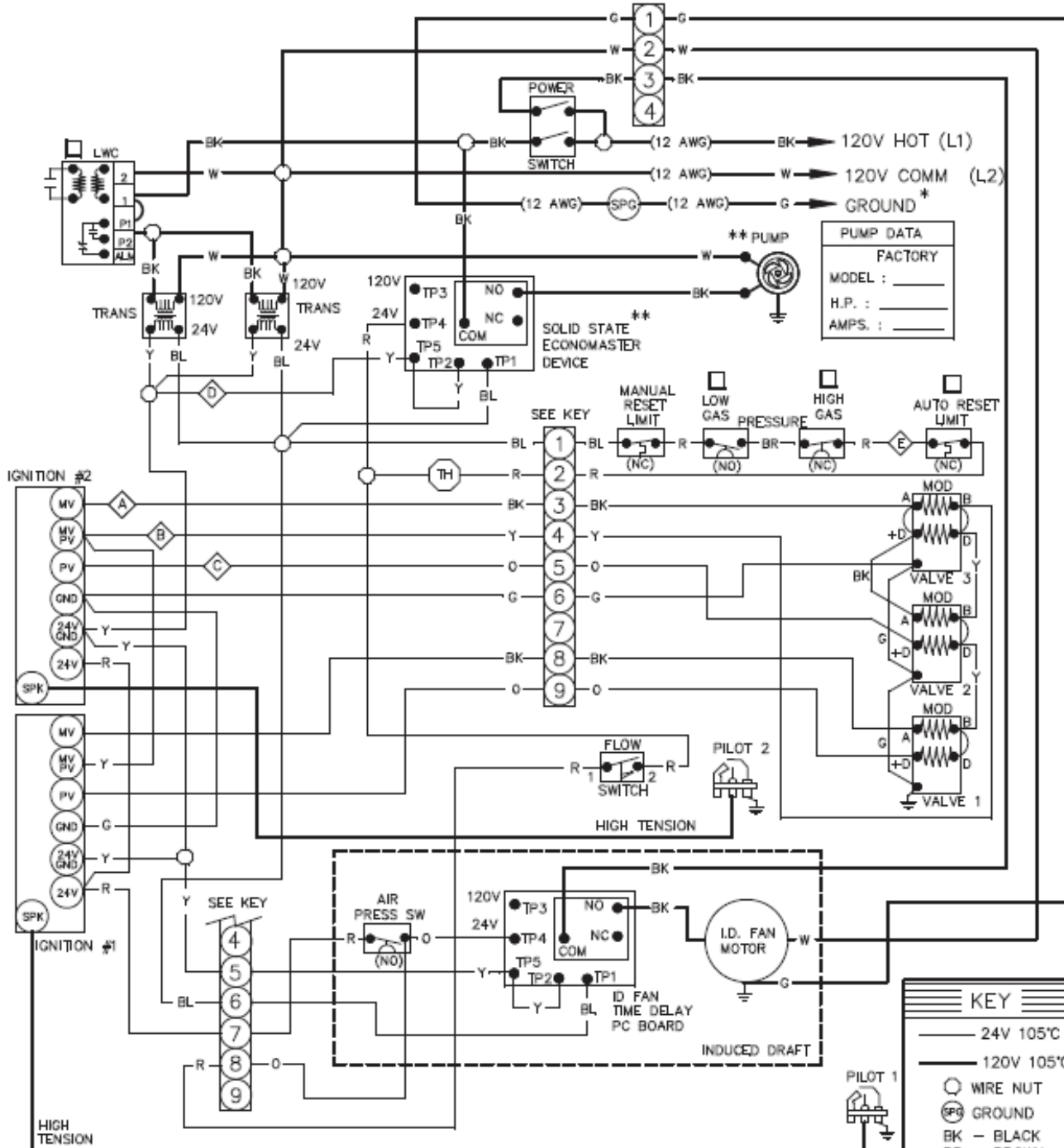
WIRING DIAGRAM IID ECONO INDUCED DRAFT FIRING MODE - 2 STAGE

BOILER INPUTS: 726,000 THRU 1,826,000 BTUH

BOILER SIZE: 724-1826 BOILER TYPE: H3, W3, WH3

KEY										
—	24V									
—	120V									
---	120V FIELD WIRE									
○	WIRE NUT									
⊕	GROUND									
BK	BLACK									
BR	BROWN									
R	RED									
O	ORANGE									
Y	YELLOW									
G	GREEN									
BL	BLUE									
V	VOLET									
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 \perp TERMINATE AT \oplus .

** PUMP USED MUST BE RATED 10 AMPS MAX OR 3/4 HP MAX. 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

WIRING DIA IID (2) PILOT ECONO INDUCED DRAFT FIRING MODE - MECHANICAL MODULATION

BOILER INPUTS: 1,413,000 THRU 1,826,000 BTUH

BOILER SIZE: 1414-1826 BOILER TYPE: H1, H5, W2

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)

FRONT VIEW

CHECKED BY:	
APPROVED BY:	
ORIG E.O. 2567	
04/07/90	
CHG E.O. 5764	
06/28/17	
Raypak	

152277 8

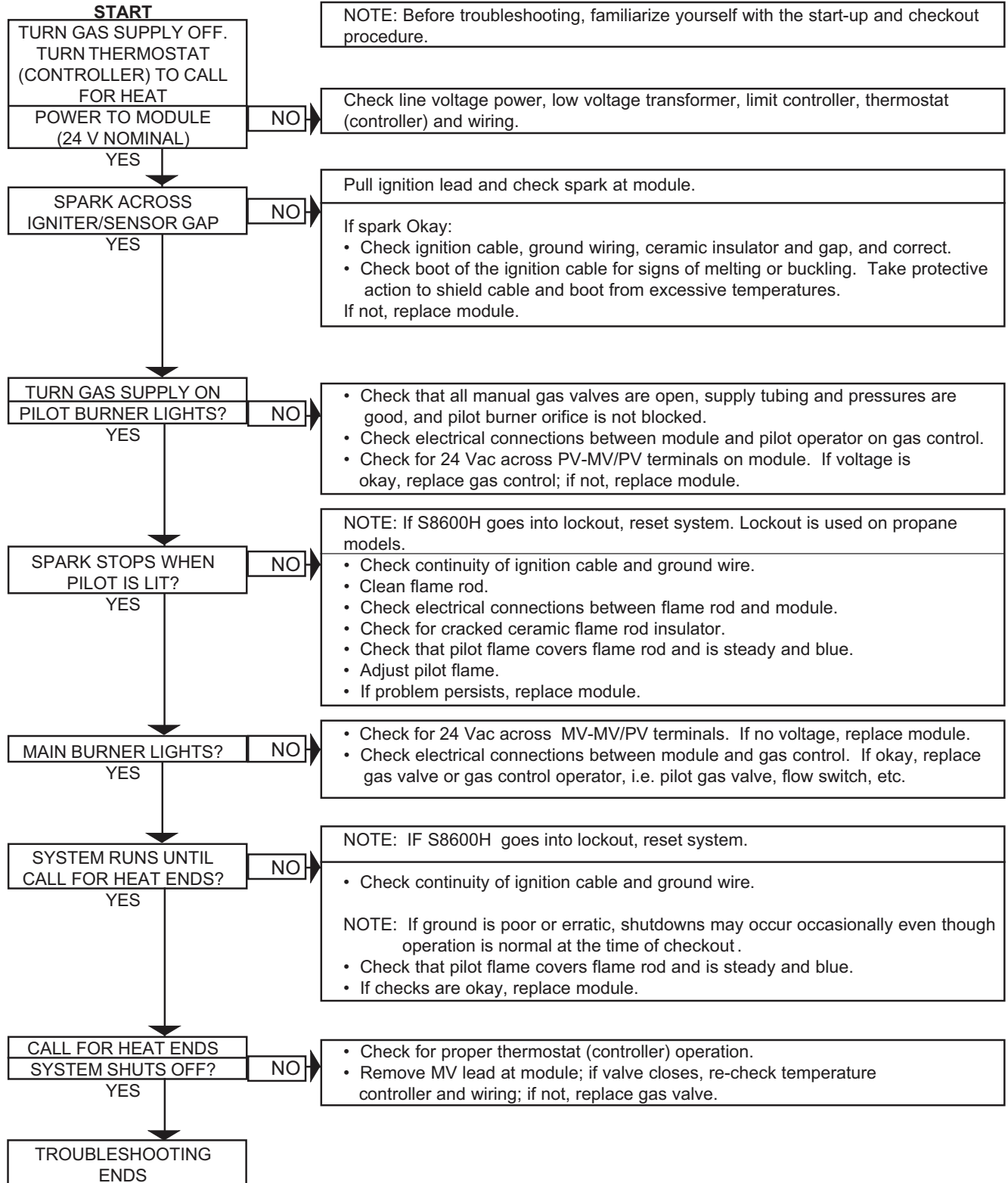
8. TROUBLESHOOTING

Electronic Ignition IID

Intermittent Pilot System Honeywell S8600

⚠ 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 boiler is turned on nothing happens	No power to the boiler	Check the circuit breaker, outdoor controller, etc., upstream of boiler
	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 boiler 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 boiler 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 boiler 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 boiler
	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

Pumps

Failure To Pump

1. Pump not properly primed.
2. Wrong direction of rotation.
3. Speed too low.
4. 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.

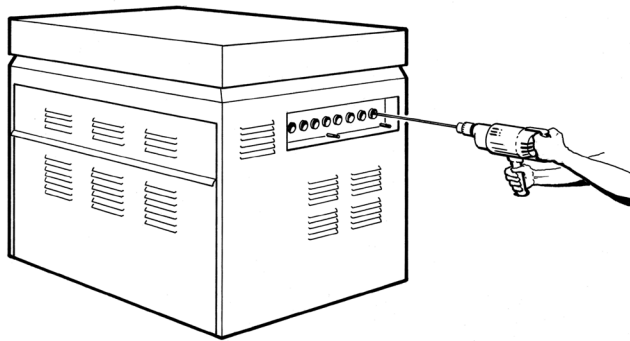


Figure 32. Tube Cleaning Procedure

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.

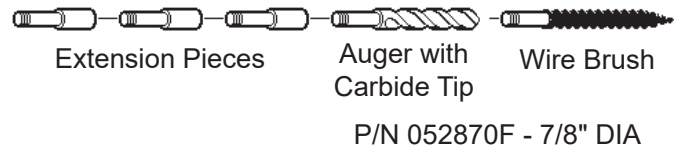


Figure 33. Raypak Tube Cleaning Kit

9. 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" in thickness.

The boiler 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.

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 non-inhibited de-scale solvent.

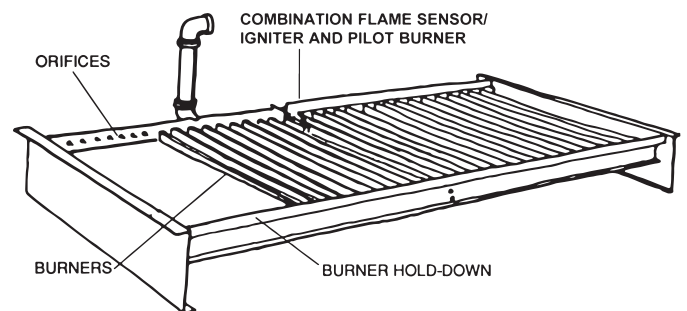


Figure 34. Typical Burner Tray

Burner Tray Removal

1. Shut-off power and gas supply to the boiler. 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.

Gas Valve Removal

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

Main Burner and Orifice Removal

7. Remove screws and burner hold-down bracket.
8. Lift burners from slotted spacer and slide from orifices. Clean with a wire brush.
9. 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 and this usually necessitates replacement of these parts.

Pilot Removal and Cleaning

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

High Limit or Tankstat Removal

13. Turn off electrical power.
14. Remove front inspection panel.
15. Remove wires to high limit and loosen screws holding high limit to cabinet.
16. Remove wedge clip holding sensing bulb in control well.
17. Remove high limit and install a new one.
18. Check control operation before leaving job.

Heat Exchanger Removal

19. Shut water, gas and electricity off, close valves and relieve pressure, remove relief valve. Remove side inspection panels.

20. Remove top holding screws.
21. Remove draft diverter, lift and remove top and flue collector on stack type models. Remove inspection panels.
22. Loosen bolts and disconnect flange nuts on in/out header, loosen union(s) at gas pipe, and slide boiler away from piping until studs clear the heater.
23. Remove heat exchanger corner brackets.
24. Remove combustion chamber clips at the four corners of the heat exchanger.

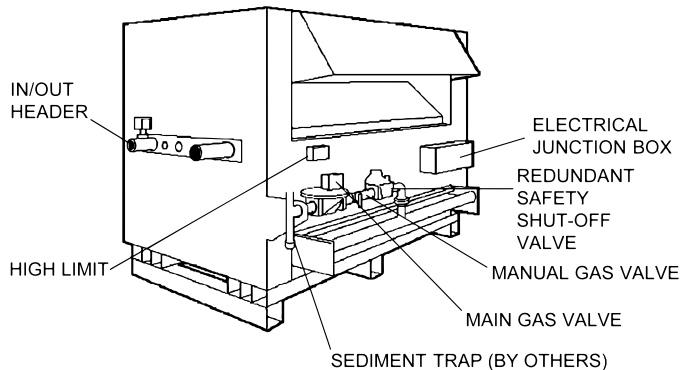


Figure 35. Model 2100-4001 Boiler

25. Lift heat exchanger straight up using caution not to damage refractory.

Heat Exchanger Re-Assembly

26. Heat exchanger water header O-rings should be replaced with new ones.
27. Install in/out and return water headers and install header retainer nuts and torque nuts evenly.
28. Install the four (4) corner clips between tube sheets and refractory. Replace "V" baffles.
29. Install thermostat sensing bulbs in header wells and replace bulb retaining clips.
30. Install inlet and return pipes in water headers using pipe thread sealant.
31. Install water pressure relief valve, flow switch, and low water cut-off devices, if so equipped.
32. Open water supply and return shut-off valves. Fill boiler and water piping system with water. Check boiler and piping system for leaks at full line pressure. Run system circulating pump for a minimum of 1/2 hour with boiler off.
33. 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.
34. Install flue collector, jacket top and inspection panels. Install top holding screws. Install draft diverter and vent piping if so equipped.

35. If gas piping was disconnected, reconnect gas piping system and check for leakage using a soapy solution.
36. 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.
37. 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.

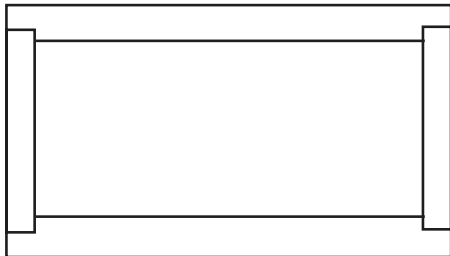


Figure 36. Refractory Panels - Top View

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

38. Remove heat exchanger from boiler following instructions outlined under HEAT EXCHANGER REMOVAL on page 34.
39. Remove in/out and return headers. Remove "V" baffle from damaged tube.
40. Remove damaged tube by cutting with a hack saw or shearing with a chisel adjacent to each tube sheet.
41. 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.
42. 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.
43. Insert the tube roller into tube opening up to stop, making certain that 1/8" of tube projects beyond the tube sheet.
44. Attach drill to tube roller, holding it straight and level.
45. 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.

46. **DO NOT** apply excessive torque during rolling operation and avoid thinning any wall of the tube beyond 0.015".
47. Use same procedure on opposite end.
48. Apply line pressure test. Re-roll if necessary.
49. Reinstall as outlined under HEAT EXCHANGER RE-ASSEMBLY on page 34.

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.

50. Lift off draft hood and flue collector by removing bolts and screws.
51. Remove "V" baffles from heat exchanger.
52. Remove burner tray.
53. Take garden hose and wash heat exchanger, making sure soot is removed from between fins. (Avoid excessive water against refractory).
54. Reassemble; when boiler is fired, some steam will form from wet refractory. This is normal.
55. 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.

10. WARRANTY

LIMITED WARRANTY RAYTHERM TYPES H AND 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.

Space Heating (Closed Loop System)

Ten (10) years from Effective Date. Includes both cupronickel and copper 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, or operating at heater temperatures exceeding 240°F).

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

11. 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 Boiler or 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) _____

VENTING

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

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: _____

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 _____

12. QR CODE

View this Installation Manual on your smart device.

The QR Code below will take you to the most current version of this Installation Manual from the Raypak Website.

Previous version of this Installation Manual can be found in the document library at Raypak.com.

P/N: 240035 RAYTHERM H 0514-4001



NOTES
