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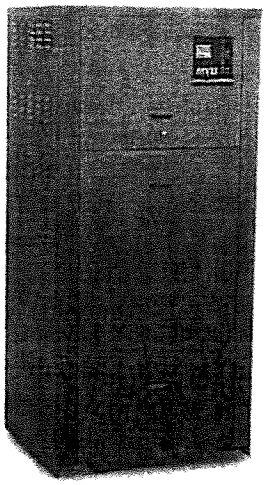
INSTALLATION & OPERATING INSTRUCTIONS

MVB

Modulating Vertical Boiler



Models 503–2003
Types H & 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.

Raypak
A Rheem Company

CATALOG NO. 3400.53D Effective: 01-08-08 Replaces: 07-10-07 P/N 241288 Rev. 5

CONTENTS

WARNINGS

Pay Attention to These Terms

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

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

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

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

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

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

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

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

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

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

CAUTION: 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.

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.

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

BEFORE INSTALLATION

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

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

Product Receipt

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

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

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

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

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

Model Identification

The model identification number and heater serial number are found on the heater rating plate located on the upper rear jacket panel of the heater. The model number will have the form H7-2003 or similar depending on the heater size and configuration. The letter(s) in the first group of characters identifies the application (H = Hydronic Heating, WH = Domestic Hot Water (DHW)). The number which follows identifies the firing mode (7 = electronic modulation). The second group of characters identifies the size of the heater (three or four numbers representing the approximate MBTUH input), and, where applicable, a letter, indicating the manufacturing series.

Ratings and Certifications

Standards:

- ANSI Z21.13 · CSA 4.9 - latest edition, Gas-Fired Hot Water Boilers
- CAN 3.1 - latest edition, Industrial and Commercial Gas-Fired Package Boilers
- ANSI Z21.10.3 · CSA 4.3 - latest edition, Gas Water Heaters
- SCAQMD Rule 1146.2

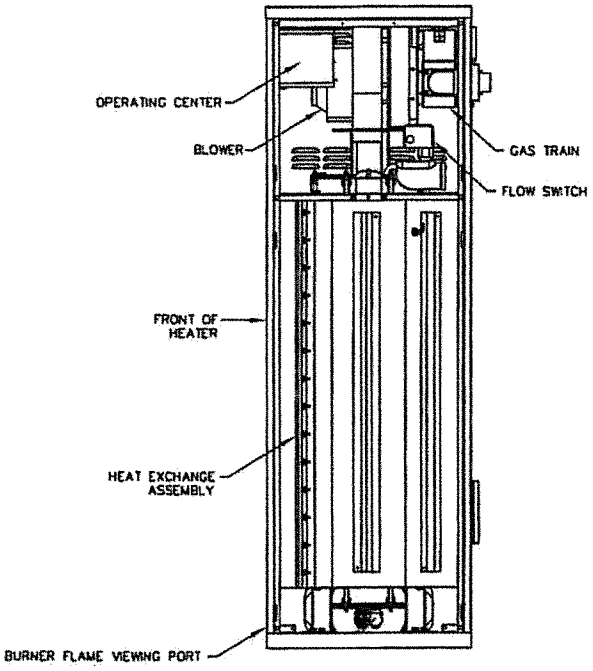
All Raypak heaters are National Board Approved, and design-certified and tested by the Canadian Standards Association (CSA) for the U.S. and Canada. Each heater is constructed in accordance with Section IV of the American Society of Mechanical Engineers (ASME) Heater Pressure Vessel Code and bears the ASME stamp. This heater also complies with the latest edition of the ASHRAE 90.1 Standard.

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

Installations at Elevation

Rated inputs are suitable for up to 4,500 ft elevation without de-rating. Consult the factory for installations at altitudes over 4,500 ft above sea level. No hardware changes are required to the heaters for installations up to 10,000 ft (adjustments may be required).

Component Locations



Panels omitted for clarity

Fig. 1: Component Locations – Side

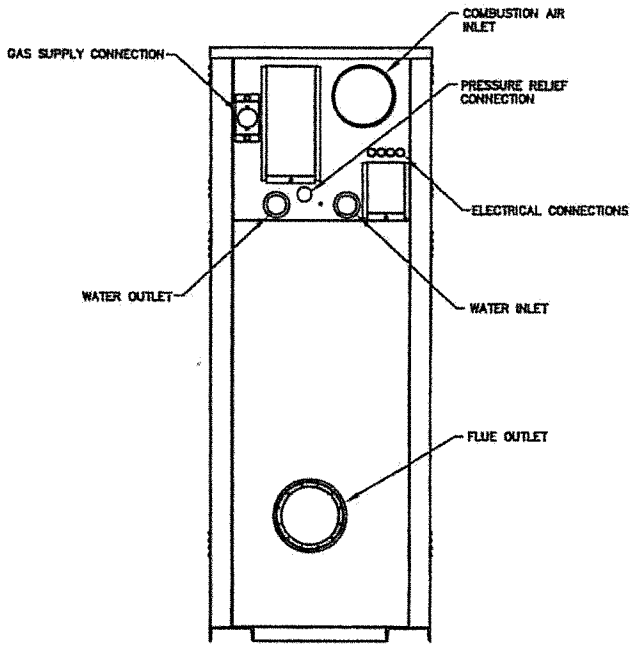
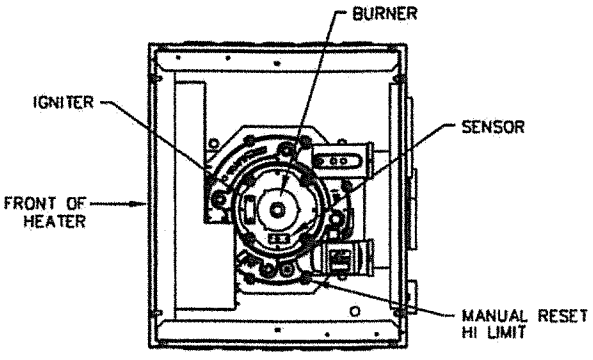


Fig. 3: Component Locations – Rear



Top panel, blower and gas train omitted for clarity

Fig. 2: Component Locations – Top

General Information

Model No.	MBTUH Input		Water Conn. (NPT)	Gas Conn. (NPT)		Vent Size (in.)	
	Max.	Min.		N	P	Flue	Intake
503	500	125	2	1	1	6	6
753	750	188	2	1	1	6	6
1003	999	250	2-1/2	1-1/4	1	6	6
1253	1250	312	2-1/2	1-1/4	1	8	8
1503	1500	375	2-1/2	1-1/4	1	8	8
1753	1750	438	2-1/2	2	1	8	8
2003	1999	500	2-1/2	2	1	8	8

Table A: Basic Data

GENERAL SAFETY

To meet commercial hot water use needs, the high limit safety control on this water heater is adjustable up to 210°F. However, water temperatures over 125°F can cause instant severe burns or death from scalds. When supplying general purpose hot water, the recommended initial setting for the temperature control is 125°F.

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

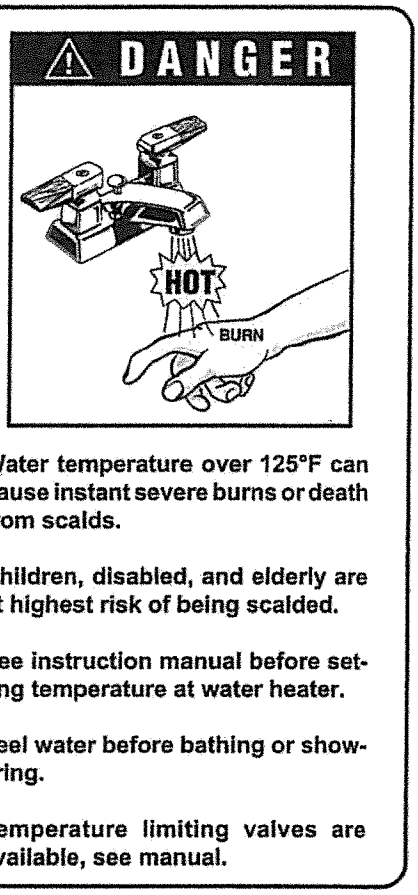
Water temperature over 125°F can cause instant severe burns or death from scalds. Children, disabled and elderly are at highest risk of being scalded.

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

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

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

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



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

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

See instruction manual before setting temperature at water heater.

Feel water before bathing or showering.

Temperature limiting valves are available, see manual.

Time/Temperature Relationships in Scalds

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

Water Temp.	Time to Produce Serious Burn
120°F	More than 5 minutes
125°F	1-1/2 to 2 minutes
130°F	About 30 seconds
135°F	About 10 seconds
140°F	Less than 5 seconds
145°F	Less than 3 seconds
150°F	About 1-1/2 seconds
155°F	About 1 second

Table courtesy of The Shriners Burn Institute

Table B: Time to Produce Serious Burn

The temperature of the water in the heater can be regulated by using the Raypak Modulating Temperature Control. To comply with safety regulations, the control is set at 120°F when shipped from the factory (Mode 3 default setting for Tank Target).

To adjust the water temperature, follow the instruction for the operation of the control starting on page 30 of this manual. The control is shown below for identification purposes only. (See Fig. 4.)

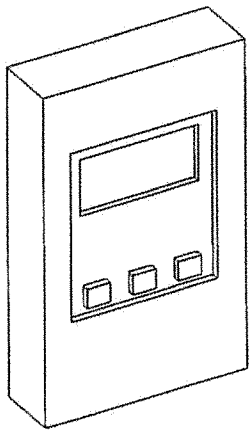


Fig. 4: Modulating Temperature Control

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

INSTALLATION

Installation Codes

Installations must follow these codes:

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

Equipment Base

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

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

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

If the heater needs to be secured to the ground, use the brackets that were used to bolt the heater to the shipping pallet.

Clearances

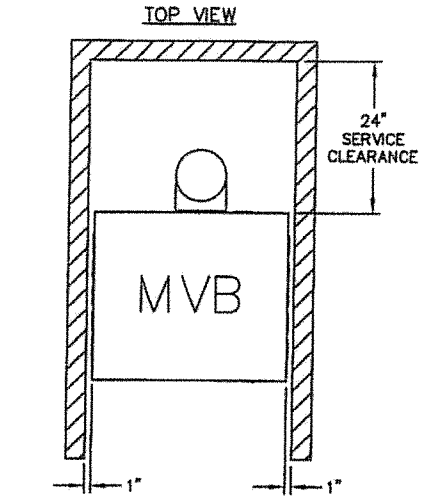
Indoor Installations

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

*DO NOT install on carpeting.

Table C: Clearances – Indoor Installations

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



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

Fig. 5: Minimum Clearances from Combustible Surfaces – Indoor and Outdoor Installations

heater to be serviced in its installed location without movement or removal of the heater.

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

Outdoor Installations

These heaters are design-certified for outdoor installation. Heaters must not be installed under an overhang that is less than 3 ft from the top of the vent terminal. Three sides must be open in the area under the overhang. Roof water drainage must be diverted away from heaters installed under overhangs.

The combustion air intake terminal **MUST** be used for outdoor installations. The hood is shipped loose and installed on the rear of the heater at the job site.

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

Table D: Clearances – Outdoor Installations

Combustion and Ventilation Air

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

Indoor Units

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

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

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

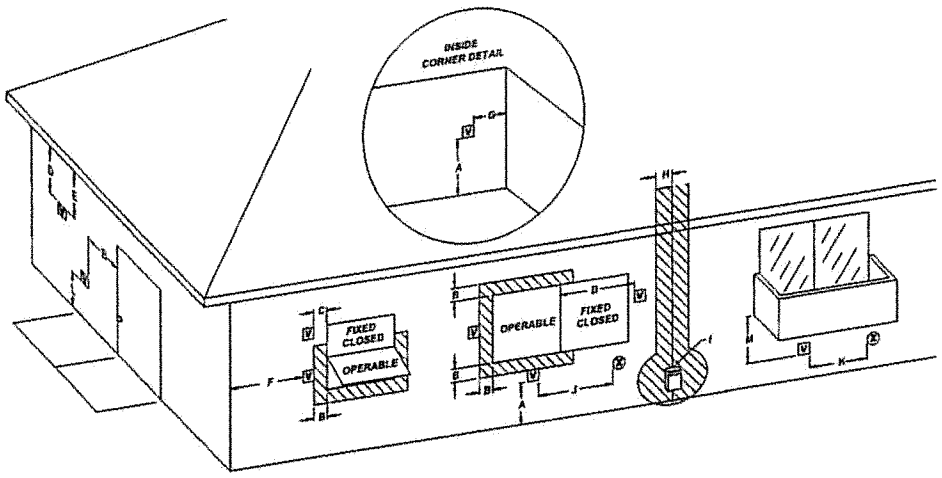


Fig. 6: Minimum Clearances from Vent/Air Inlet Terminations – Indoor and Outdoor Installations

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

1 In accordance with the current ANSI Z223.1/NFPA 54 National Fuel Gas Code
2 In accordance with the current CAN/CGA-B149 Installation Codes
t Vent terminal shall not terminate directly above sidewalk or paved driveway located between 2 single family dwellings that serves both dwellings
TT Permitted only if veranda, porch, deck, or balcony is fully open on a minimum of two sides beneath the floor and top of terminal and underside of veranda, porch, deck or balcony is greater than 1 ft (30cm)
* Clearances in accordance with local installation codes and the requirements of the gas supplier

Table E: Vent/Air Inlet Termination Clearances

Optional Construction Air Filter

An optional construction air filter is available for use. The filter should be removed after construction is finished to allow for unrestricted air flow to the heater.

Direct Vent

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

1. Install combustion air direct vent in accordance with Fig. 24 (horizontal) or Fig. 25 (vertical) of this manual (pages 27 and 28, respectively).

2. Provide adequate ventilation of the space occupied by the heater(s) by an opening(s) for ventilation air at the highest practical point communicating with the outdoors. The total cross-sectional area shall be at least 1 in.^{2} of free area per 20,000 BTUH (111 mm^2 per kW) of total input rating of all equipment in the room when the opening is communicating directly with the outdoors or through vertical duct(s). The total cross-sectional area shall be at least 1 in.^{2} of free area per 10,000 BTUH (222 mm^2 per kW) of total input rating of all equipment in the room when the opening is communicating with the outdoors through horizontal duct(s).

3. In cold climates, and to mitigate potential freeze-up, Raypak highly recommends the installation of a motorized sealed damper to prevent the circulation of cold air through the heater during the non-operating hours.

TruSeal™ Combustion Air

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

All ducting should be self-supported.

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

Conventional Combustion Air Supply

U.S. Installations

All Air from Inside the Building

The confined space shall be provided with **TWO** permanent openings communicating directly with an additional room(s) of sufficient volume so that the combined volume of all spaces meets the criteria for a room large in comparison (NFGC). The total input of all gas utilization equipment installed in the combined space shall be considered in making this determination. **Each opening** shall have a minimum free area of 1 in.^{2} per 1,000 BTUH (2,225 mm^2 per kW) of the total input rating of all gas utilization equipment in the confined space, but not less than 100 in.^{2} (645 cm^2). One opening shall commence within 12 in. (305 mm) of the top, and one opening shall commence within 12 in. (305 mm) of the bottom of the enclosure. The minimum dimension of air openings shall be not less than 3 in. (76 mm) in any direction.

All Air from Outdoors

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

1. **Two permanent openings**, one commencing within 12 in. (305 mm) of the top, and one commencing within 12 in. (305 mm) of the bottom of the enclosure, shall be provided. The openings shall communicate directly, or by ducts, with the outdoors or spaces (crawl or attic) that freely communicate with the outdoors.

   a. Where directly communicating with the outdoors or where communicating to the outdoors through vertical ducts, **each opening** shall have a minimum free area of 1 in.^{2} per 4,000 BTUH (550 mm^2 per kW) of total input rating of all equipment in the enclosure.

b. Where communicating with the outdoors through horizontal ducts, each opening shall have a minimum free area of 1 in.^{2} per 2,000 BTUH (1,100 mm^2 per kW) of total input rating of all equipment in the enclosure.

2. **One permanent opening**, commencing within 12 in. (305 mm) of the top of the enclosure, shall be permitted where the equipment has clearances of at least 1 in. (25 mm) from the sides and back and 6 in. (152 mm) from the front of the appliance. The opening shall directly communicate with the outdoors or shall communicate through a vertical or horizontal duct to the outdoors or spaces that freely communicate with the outdoors, and shall have a minimum free area of:

   a. 1 in.^{2} per 3,000 BTUH (740 mm^2 per kW) of the total input rating of all equipment located in the enclosure, and

   b. Not less than the sum of the areas of all vent connectors in the confined space.

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

Canadian Installations

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

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

2. For heaters using a barometric damper in the vent system there shall be a permanent air supply opening(s) having a cross section area of not less than 1 in.^{2} per 7,000 BTUH (320 mm^2 per kW) up to and including 1 million BTUH, plus 1 in.^{2} per 14,000 BTUH (160 mm^2 per kW) in excess of 1 million BTUH. This opening(s) shall be either located at or ducted to a point not more than 18 in. (450 mm) nor less than 6 in. (152 mm) above the floor level. The duct can also "goose neck" through the roof. The duct is preferred to be straight down and terminated 18 in. (450 mm) from the floor, but not near piping. This air supply opening requirement shall be in addition to the air opening for ventilation air required in 1. (above).

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

3. For heaters not using a barometric damper in the vent system, and when air supply is provided by natural air flow from outdoors for a power burner and there is no draft regulator, drafthood or similar flue gas dilution device installed in the same space, in addition to the opening for ventilation air required in 1., there shall be a permanent air supply opening(s) having a total cross-sectional area of not less than 1 in.^{2} for each 30,000 BTUH (74 mm^2 per kW) of total rated input of the burner(s), and the location of the opening(s) shall not interfere with the intended purpose of the opening(s) for ventilation air referred to in 1. This opening(s) can be ducted to a point not more than 18 in. (450 mm) nor less than 6 in. (152 mm) above the floor level. The duct can also "goose neck" through the roof. The duct is preferred to be straight down 18 in. (450 mm) from the floor, but not near piping.

4. Refer to the B149 Installation Code for additional information.

Water Piping

General

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

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

NOTE: Minimum pipe size for in/out connections is 2 in. NPT for 503 and 753 models and 2-½ in NPT for 1003–2003 models. Verify proper flow rates and ΔT as instructed in this manual.

Relief Valve Piping

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

Temperature & Pressure Gauge

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

Hydrostatic Test

Unlike many types of heaters, this heater does not require hydrostatic testing prior to being placed in operation. The heat exchanger has already been factory-tested and is rated for 160 psi operating pressure. However, Raypak does recommend hydrostatic testing of the piping connections to the heater and the rest of the system prior to operation. This is particularly true for hydronic systems using expensive glycol-based anti-freeze. Raypak recommends conducting the hydrostatic test before connecting gas piping or electrical supply.

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

To perform hydrostatic test:

1. Connect fill water supply. With bleed valve open, fill heater with water. When water flows from bleed valve, shut off water. Close bleed valve. Carefully fill the rest of the system, making sure to eliminate any entrapped air by using high-point vents. Close feed valve. Test at standard operating pressure for at least 24 hours.

2. Make sure constant gauge pressure has been maintained throughout test.

3. Check for leaks. Repair if found.

Cold Water Operation

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

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

Heaters operated with an inlet temperature of less than 120°F (49°C) MUST have a manual bypass (see Fig. 14) or an approved low-temperature operation system to prevent problems with condensation. This piping is like a primary/secondary boiler installation with a bypass acting as the secondary boiler piping. Raypak strongly recommends that thermometer(s) be placed into the heater piping next to the in/out header to facilitate temperature adjustment. Inlet water temperatures below 120°F (49°C) can excessively cool the products of combustion, resulting in collection of condensate in the heat exchanger area beyond the capacity of the condensate evaporation system.

Failure to reach or exceed 120°F (49°C) within 7 minutes may damage or cause failure of the heat exchanger, combustion chamber, or other parts within the combustion chamber. It can cause operational problems, bad combustion, sooting, flue gas leakage and reduced service life of the vent system. A bypass allows part of the heater discharge water to be mixed with the cooler water returning to the heater inlet to increase the heater inlet temperature above 120°F (49°C). This precautionary measure should prevent the products of combustion from condensing beyond the ability of the condensate management system employed in this heater in most installations. **Warranty claims will be denied for damage or failures caused by condensation.**

Cold water operation issues are applicable to both cold water start and cold water run applications. Cold water operation for 7 minutes or less on initial daily start-up is acceptable. Where cold water starts will last longer than 7 minutes or where cold water operation is continuous, provisions must be made to mix higher temperature outlet water with the colder inlet water and thereby raise the inlet temperature to at least 120°F (49°C) within the 7-minute time limit.

Cold Water Starts

Cold water starts, where the inlet water temperature remains below 120°F (49°C) for more than 7 minutes, ***must*** **have cold water start protection.** Known pro-tection methods consist of mixing heated outlet water with the inlet water with a bypass to raise the inlet to 120°F (49°C) or higher. Once the system is heated up and has return water temperatures of 120°F (49°C) or higher, the mixing of outlet water with inlet water is no

longer needed and the bypass can be shut off. If the bypass is not shut off as the system heats up, the outlet temperature may continue to climb and trip the high limit, thereby shutting down the heater. Thus an automatic valve system, such as a three-way proportional valve or a modulating two-way valve to control the bypass, should be utilized.

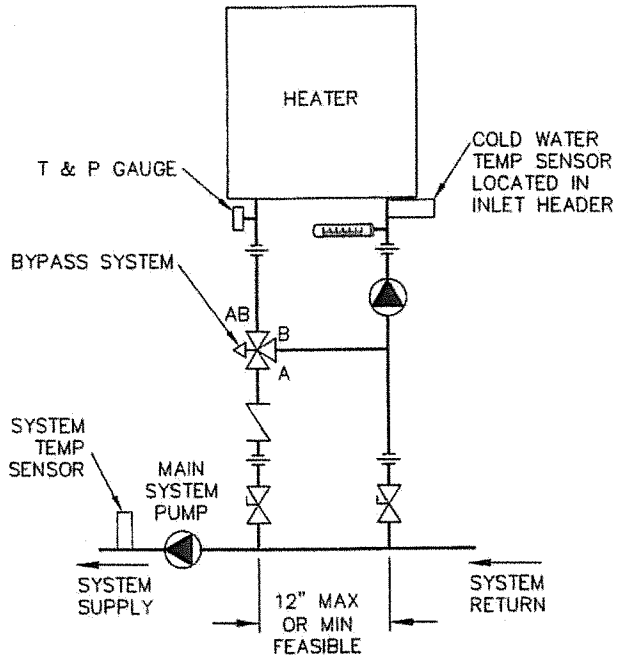


Fig. 7: Cold Water Start

Cold Water Run

Cold water run differs from cold water start in that the system water entering the heater remains below 120°F (49°C) continuously. Typically, this is the case in swimming pool heating and water source heat pump applications as well as some others. If the system water is kept in a narrow temperature range of no more than 10°F (5°C), a permanent manual bypass can be employed and manually adjusted to achieve an inlet temperature of 120°F (49°C) or higher as adjusted at the minimum temperature in this narrow temperature range (i.e. Range 75°F – 85°F – adjust bypass with temperature at 75°F (24°C)) so that when temperature is 85°F (29°C), minimum inlet temperature would be 130°F (54°C). An injector pump arrangement may also be utilized to keep the heater loop at or above 120°F (49°C). An injector pump approach has the added value of being able to adjust to changes in the system water coming back to the heater take-off.

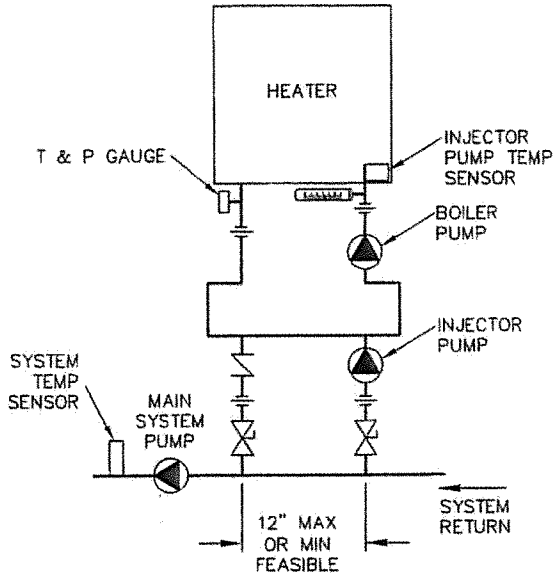


Fig. 8: Cold Water Run

Hydronic Heating

Pump Selection

In order to ensure proper performance of your heater system, you must install a correctly-sized pump. Raypak recommends designing for a ΔT within the range of 10°F to 40°F (5°C to 20°C). See Table F for acceptable flow rates for each model (ΔT is the temperature difference between the inlet and outlet water when the heater is firing at full rate).

Feedwater Regulator

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

Piping

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

The piping system of a hot water heater connected to heating coils located in air handling units where they may be exposed to circulating refrigerated air, must be

Model No.	20°FΔT		30°FΔT		40°FΔT		Min. Flow			Max. Flow		
	gpm	ΔP (ft)	gpm	ΔP (ft)	gpm	ΔP (ft)	gpm	ΔP (ft)	ΔT	gpm	ΔP (ft)	ΔT
503	44	2.8	29	1.4	N/A	N/A	25	1.1	35	100	11.3	9
753	65	6.4	44	3.1	33	1.9	33	1.9	40	100	13.8	13
1003	87	12.0	58	6.0	43	3.7	43	3.7	40	113	18.6	15
1252	109	20.9	73	10.2	54	6.2	54	6.2	40	113	22.2	19
1503	N/A	N/A	87	16.0	65	9.5	65	9.5	40	113	25.5	23
1753	N/A	N/A	102	22.5	76	13.4	76	13.4	40	113	27.2	27
2003	N/A	N/A	116	32.0	87	18.9	87	18.9	40	116	32.0	30

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

Table F: Heater Rates of Flow and Pressure Drops

equipped with flow control valves or other automatic means to prevent gravity circulation of the heater water during the cooling cycle. It is highly recommended that the piping be insulated.

Air-Separation/Expansion Tank

All heaters should be equipped with a properly sized expansion tank and air separator fitting as shown in Fig. 9.

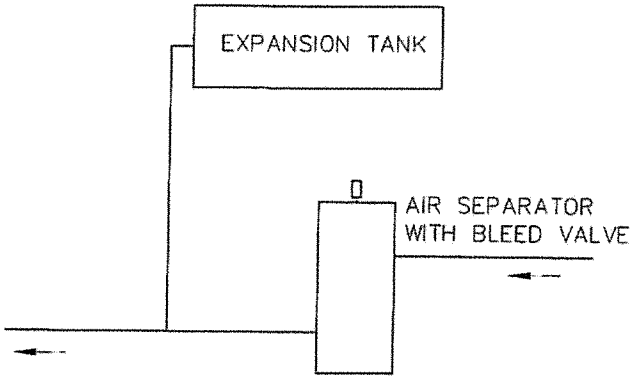


Fig. 9: Air-Separation/Expansion Tank

Three-Way Valves

Three-way valves intended to regulate system water temperatures by reducing flow in the boiler should not be used. Raypak heaters are high-recovery, low-mass heaters which are not subject to thermal shock. See Fig. 14 and instructions on page 17 for adjusting the manual bypass.

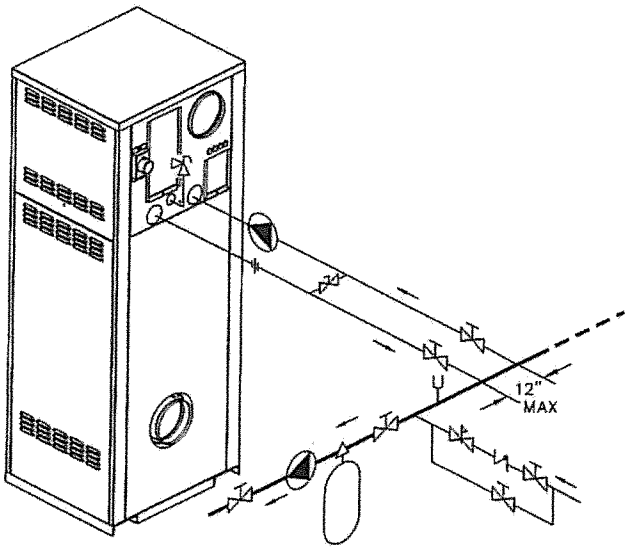


Fig. 10: Single Heater - Low-Temperature (Heat Pump) Application with Primary/Secondary Piping

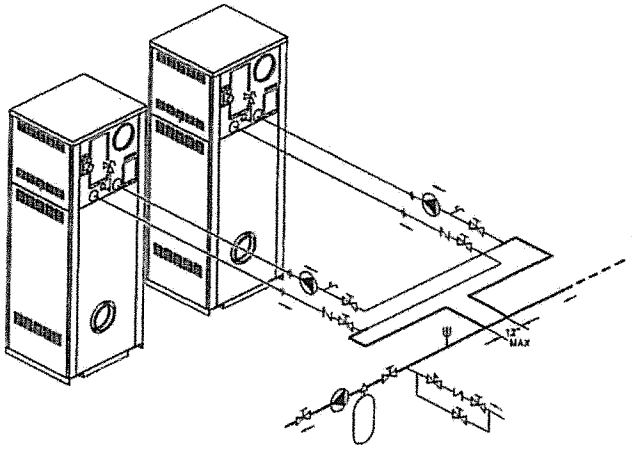


Fig. 11: Dual Heaters (Reverse/Return) with Primary/Secondary Piping

Domestic Hot Water

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

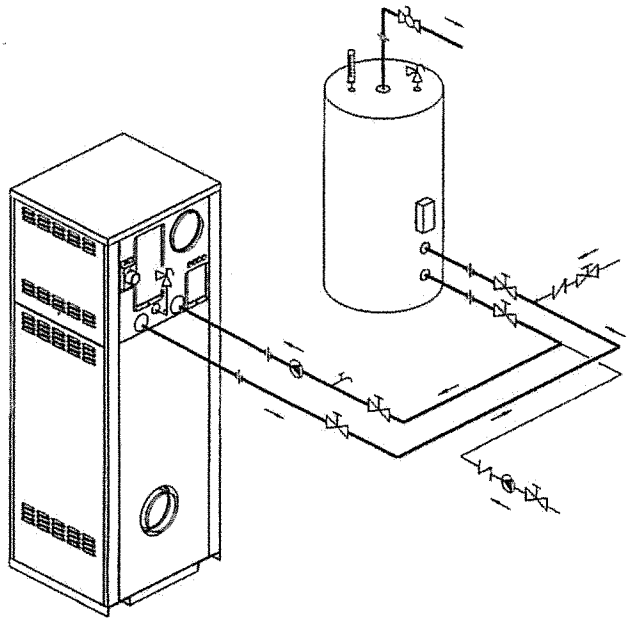


Fig. 12: Single Domestic Hot Water Heater and Storage Tank

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

Potable Water and Space Heating

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

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

Pool Heating

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

The MVB must be equipped with a field-supplied external pump and bypass arrangement. This arrangement blends outlet water with the inlet water to

Model No.	Soft (0-4 grains per gallon)					Medium (5-15 grains per gallon)					Hard* (16-25 grains per gallon)				
	ΔT	gpm	ΔP	MTS	SHL	ΔT	gpm	ΔP	MTS	SHL	ΔT	gpm	ΔP	MTS	SHL
503	17	50	3.6	2	5.9	17	50	3.6	2	5.9	9	95	10.4	2	18.1
753	26	50	4.0	2	6.3	20	65	6.4	2	10.2	13	100	13.8	2	22.2
1003	30	58	6.0	2-1/2	7.2	20	87	12.0	2-1/2	14.4	15	113	18.7	2-1/2	22.6
1253	30	73	10.4	2-1/2	12.1	20	109	21.0	2-1/2	24.6	19	113	22.3	2-1/2	26.3
1503	30	87	16.0	2-1/2	18.5	23	113	25.7	2-1/2	29.6	23	113	25.7	2-1/2	29.6
1753	30	102	22.7	2-1/2	26.0	27	113	27.4	2-1/2	31.3	27	113	27.4	2-1/2	31.3
2003	30	116	32.0	2-1/2	36.1	30	116	32.0	2-1/2	36.1	30	116	32.0	2-1/2	36.1

ΔT = Temperature rise, °F
ΔP = Pressure drop through heat exchanger, ft
SHL = System head loss, ft (based on heater and tank placed no more than 5 ft apart and equivalent length of 25 ft of tubing)
gpm = Gallons per minute, flow rate
MTS = Minimum tubing size
*Must utilize optional cupro-nickel tubes. If over 25 grains per gallon, a water softener/treatment system must be utilized.
Caution: For scale free operation with "Hard Water" (16-25 grains per gallon of total hardness), the operating control must NOT be set higher than 130 F. For higher than 130 F operation, a water softener/treatment system must be utilized.

Table G: Domestic Water Heater Flow Rate Requirements

increase the inlet water temperature to a minimum of 120°F (49°C), thereby reducing the likelihood of condensation forming on the heat exchanger. The pump also serves to circulate water through the heater from the main system piping.

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

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

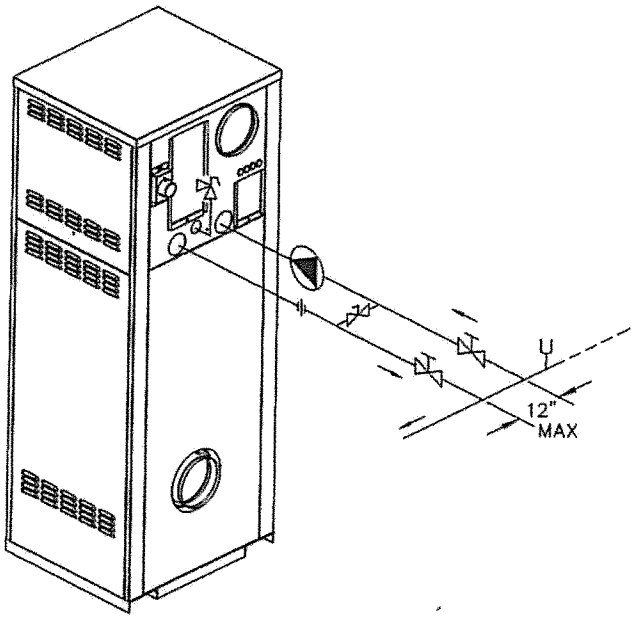


Fig. 13: Single Pool Heater Application

Adjustment of the manual bypass valve is critical to proper operation of the heater. The manual bypass valve should be adjusted to achieve a minimum inlet water temperature of 120°F (49°C) and a system supply water temperature below 140°F (60°C). When starting with a cold pool, make initial adjustments. Make final adjustments when pool water approaches desired temperature.

The use of a bypass is required for proper operation in a pool heating application. Use the following instructions to set the manual bypass:

1. Turn on pump.
2. Turn on heater and wait until heater goes to full fire.
3. With the heater operating at 100% firing rate, set Valve A (the bypass) to ½ open position, and Valve B to fully open position. See Fig. 14.
4. Adjust Valve A until the inlet water temperature is 120°F (49°C).

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

5. If this process does not raise the inlet water temperature to 120°F (49°C) and Valve A is fully open, then slowly throttle Valve B closed to increase the inlet water temperature to 120°F (49°C).

Automatic Chlorinators and Chemical Feeders

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

All chemicals must be introduced and completely diluted into the pool or spa water before being circulated through the heater. Do not place chlorine tablets or bromine sticks in the skimmer. High chemical concentrations will result when the pump is not running (e.g. overnight). Chlorinators must feed downstream of the heater and have an anti-siphoning device to prevent chemical back-up into the heater when the pump is shut off.

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

Winterizing Your Heater

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

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

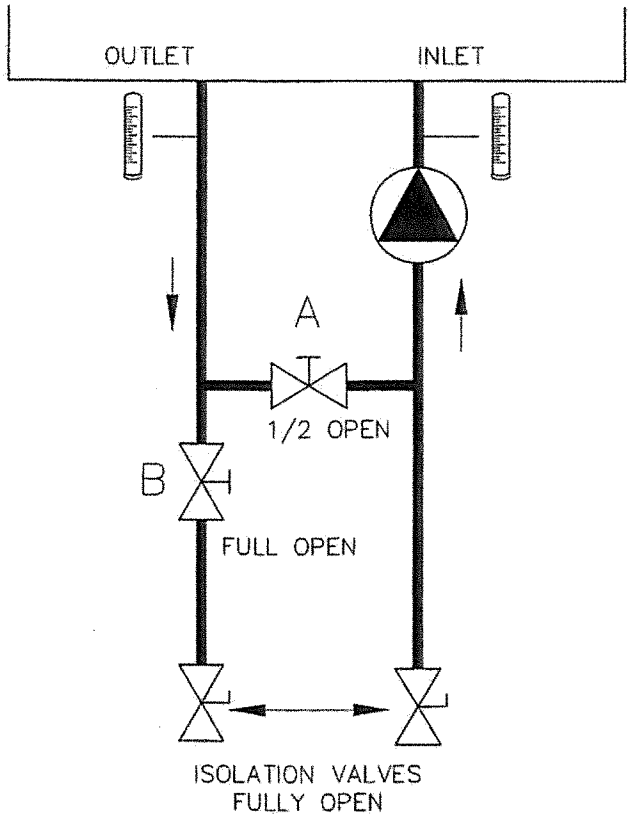


Fig. 14: "H" Bypass Setting

Pool/Spa Water Chemistry

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

Water Hardness

Water hardness is mainly due to the presence of calcium and magnesium salts dissolved in the water. The concentration of these salts is expressed in mg/L, ppm or grains per gallon, as a measure of relative hardness of water. Grains per gallon is the common reference measurement used in the U.S. water heater industry. Hardness expressed as mg/L or ppm may be divided by 17.1 to convert to grains per gallon. Water may be classified as very soft, slightly hard, moderately hard or hard based on its hardness number. The salts in water will precipitate out when the water is heated and will cause accelerated lime and scale accumulation on a heat transfer surface.

Raypak water heaters can operate lime/scale-free using potable water with a hardness not exceeding 25 grains per gallon. Proper operation is achieved by setting the temperature rise/water flow per the guidelines in the installation instructions. If the hardness of the water exceeds the maximum level of 25 grains per gallon special measures must be taken to adjust flow and temperature rise. Water should be softened to a hardness level no lower than 5 grains per gallon. Water softened as low as 0 to 1 grain per gallon may be under-saturated with respect to calcium carbonate resulting in water that is aggressive and corrosive.

pH of Water

pH is a measure of relative acidity, neutrality or alkalinity. Dissolved minerals and gases affect water's pH. The pH scale ranges from 0 to 14. Water with a pH of 7.0 is considered neutral. Water with a pH lower than 7 is considered acidic. Water with a pH higher than 7 is considered alkaline. A neutral pH (around 7) is desirable for most potable water applications. Corrosion damage and water heater failures resulting from water pH levels of lower than 6 or higher than 8 are non-warrantable. The ideal pH range for water used in a storage tank or a copper water heater system is 7.2 to 7.8.

Total Dissolved Solids

Total dissolved solids (TDS) is the measure of all minerals and solids that are dissolved in the water. The concentration of total dissolved solids is usually expressed in parts per million (ppm) as measured in a

water sample. Water with a high TDS concentration will greatly accelerate lime and scale formation in the hot water system. Most high TDS concentrations will precipitate out of the water when heated. This can generate a scale accumulation on the heat transfer surface that will greatly reduce the service life of a water heater. This scale accumulation can also impede adequate flow of water and may totally block the water passages in the tubes of the heat exchanger. A heat exchanger that is damaged or blocked by lime/scale accumulation must be replaced. Failure of a water heater due to lime scale build up on the heating surface is non-warrantable. The manufacturer of the water heater has no control of the water quality, especially the TDS levels in your system. Total dissolved solids in excess of 2,500 ppm will accelerate lime and scale formation in the heat exchanger. Heat exchanger failure due to total dissolved solids in excess of 2,500 ppm is a non-warrantable condition. Raypak offers basic temperature guidelines for operation of a potable water heater on normal to moderate levels of hardness and solids but levels of hardness and total dissolved solids beyond normal limits for operation will require special setup and operation.

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

Gas Supply

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

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

Gas Supply Connection

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

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

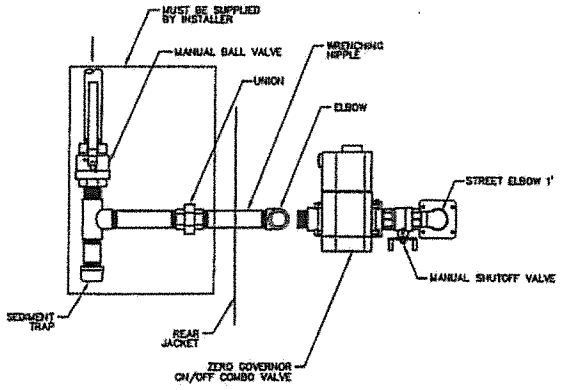


Fig. 15: Gas Supply Connection

CAUTION: Do not use Teflon tape on gas line pipe thread. A pipe compound rated for use with natural and propane gases is recommended. Apply sparingly only on male pipe ends, leaving the two end threads bare.

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

Gas Supply Pressure

A minimum of 4.0 in. WC and a maximum of 10.5 in. WC upstream gas pressure is required under load and no-load conditions for natural gas. A minimum of 4.0 in. WC and a maximum of 13.0 in. WC is required for propane gas. The gas pressure regulator(s) supplied on the heater is for low-pressure service. If upstream pressure exceeds these values, an intermediate gas pressure regulator, of the lockup type, must be installed.

When connecting additional gas utilization equipment to the gas piping system, the existing piping must be checked to determine if it has adequate capacity for the combined load.

Model No.	1" NPT		1-1/4" NPT		1-1/2" NPT		2" NPT		2-1/2" NPT	
	N	P	N	P	N	P	N	P	N	P
503	15	35	65	150	130	360	N/A	N/A	N/A	N/A
753	5	15	65	100	75	180	250	N/A	N/A	N/A
1003	N/A	N/A	35	55	35	90	125	300	300	N/A
1253	N/A	N/A	15	25	25	60	85	225	200	300
1503	N/A	N/A	10	15	15	25	60	150	150	275
1753	N/A	N/A	N/A	N/A	N/A	N/A	45	110	115	230
2003	N/A	N/A	N/A	N/A	N/A	N/A	35	90	85	210

Natural Gas – 1,000 BTU/ft^3, 0.60 specific gravity at 0.5 in. WC pressure drop
Propane Gas – 2,500 BTU/ft^3, 1.53 specific gravity at 0.6 in. WC pressure drop

Table H: Maximum Equivalent Pipe Length

The gas valve pressure regulator on the heater is nominally preset as noted in Table I.

During normal operation, carbon dioxide should be 8.5 to 9.0% at full fire for natural gas and between 9.5 and 10.0% for propane gas. Carbon monoxide should be ‹100ppm.

Model No.	Manifold Gas Pressure (High Fire Values)	
	Natural Gas	Propane Gas
503	-0.1	-0.1
753	-0.4	-0.1
1003	-0.8	-0.2
1253	-1.6	-0.2
1503	-2.4	-0.6
1753	-0.4	-0.1
2003	-1.0	-0.5

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

Table I: Manifold Gas Pressure Settings

Electrical Power Connections

Installations must follow these codes:

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

The MVB 503-1503 heaters are wired for 120 VAC, 12 amps while the MVB 1753 & 2003 heaters are wired for 120 VAC, 18 amps. Consult the wiring diagram shipped with the heater. Before starting the heater, check to ensure proper voltage to the heater and pump.

Boiler mounted pumps (up to ¾ hp) get their power supply directly from the boiler power supply (connections in rear wiring box). Install a circuit breaker sized sufficiently for both the heater and the pump. Pumps larger than ¾ hp must use a separate power supply and run the power through the optional pump contactor which is located in the rear wiring box. Use appropriately-sized wire as defined by NEC, CSA and/or local codes. All primary wiring should be 125% of minimum rating.

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

All field wiring connections to the MVB heater are made inside the rear wiring box as shown in Fig. 16. Pump power should be taken from terminals 2 (Com), 3 (GND) and 6 (Hot) – ¾ hp and smaller ONLY. Power to the MVB heater should be connected to terminals 1, 2, and 3 as noted in Fig. 16. Sensors, interlocks, enable/disable, and various options are wired into terminals 1–12 as noted in Fig. 16.

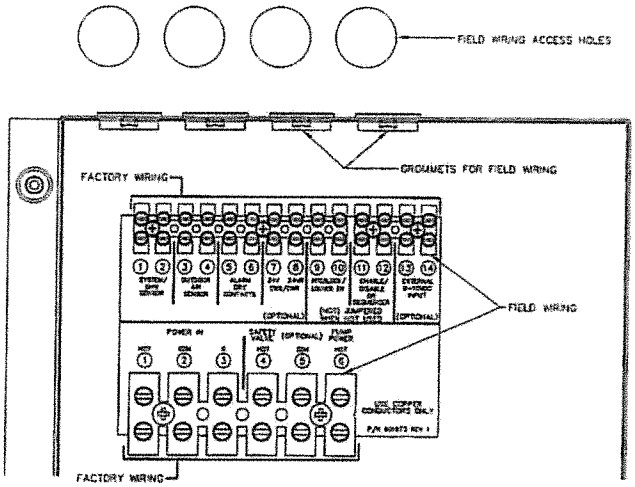


Fig. 16: Rear Wiring Box Electrical Connections

Field-Connected Controllers

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

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

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

Check the Power Source

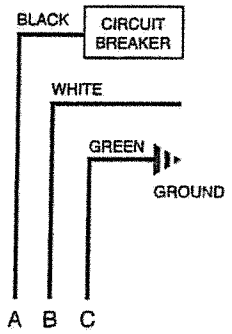


Fig. 17: Wiring Connections

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

Check the power source:

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

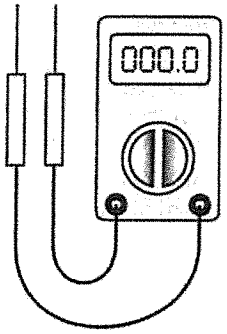


Fig. 18: Multi-meter

Making the Electrical Connections

Refer to Fig. 16-19.

1. Verify that circuit breaker is properly sized by referring to heater rating plate. A dedicated circuit breaker should be provided.

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

3. Turn off all power to the heater. Verify that power has been turned off by testing with a multi-meter prior to working with any electrical connections or components.

4. Observe proper wire colors while making electrical connections. Many electronic controls are polarity sensitive. Components damaged by improper electrical installation are not covered by warranty.

5. Provide overload protection and a disconnect means for equipment serviceability as required by local and state code.

6. Install heater controls, thermostats, or building management systems in accordance with the applicable manufacturers' instructions.

7. Conduit should not be used as the earth ground.

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

Field Wiring Connection

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

DANGER: SHOCK HAZARD

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

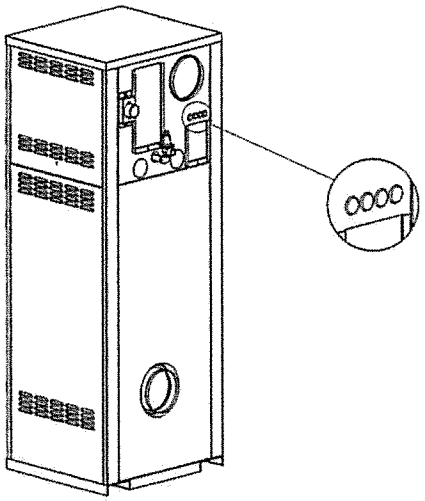


Fig. 19: Wiring Location

Venting

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

General

Appliance Categories

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

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

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

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

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

See Table J for appliance category requirements.

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

CAUTION: Condensate drains for the vent piping are required for installations of the MVB. Follow vent manufacturer instructions for installation and location of condensate drains in the vent. Condensate drain must be primed with water to prevent gas flue leak and must be routed to an appropriate container for neutralization before disposal, as required by local codes.

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

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

Support of Vent Stack

The weight of the vent stack or chimney must not rest on the heater vent connection. Support must be provided in compliance with applicable codes. The vent should also be installed to maintain proper clearances

Combustion Air Supply	Exhaust Configuration	Heater Venting Category	Certified Materials	Combustion Air Inlet Material
From Inside Building (Non-Direct Venting)	Vertical Venting	IV	Stainless Steel AL29-4C	
	Horizontal Through-the-Wall Venting			
From Outside Building (Direct Venting)	Vertical Venting			Galvanized Steel PVC ABS CPVC
	Horizontal Through-the-Wall Venting			

Table J: Venting Category Requirements

from combustible materials. Use insulated vent pipe spacers where the vent passes through combustible roofs and walls.

Vent Terminal Location

1. Condensate can freeze on the vent cap. Frozen condensate on the vent cap can result in a blocked flue condition.

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

2. Give special attention to the location of the vent termination to avoid possibility of property damage or personal injury.

3. Gases may form a white vapor plume in winter. The plume could obstruct a window view if the termination is installed near windows.

4. Prevailing winds, in combination with below-freezing temperatures, can cause freezing of condensate and water/ice build-up on buildings, plants or roofs.

5. The bottom of the vent terminal and the air intake shall be located at least 12 in. above grade, including normal snow line.

6. Un-insulated single-wall Category IV metal vent pipe shall not be used outdoors in cold climates for venting gas-fired equipment without insulation.

7. Through-the-wall vents for Category IV appliances shall not terminate over public walkways or over an area where condensate or vapor could create a nuisance or hazard or could be detrimental to the operation of regulators, relief valves, or other equipment.

8. Locate and guard vent termination to prevent accidental contact by people or pets.

9. DO NOT terminate vent in window well, stairwell, alcove, courtyard or other recessed area.

10. DO NOT terminate above any door, window, or gravity air intake. Condensate can freeze, causing ice formations.

11. Locate or guard vent to prevent condensate from damaging exterior finishes. Use a rust-resistant sheet metal backing plate against brick or masonry surfaces.

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

U.S. Installations

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

Vent termination requirements are as follows:

1. Vent must terminate at least 4 ft below, 4 ft horizontally from or 1 ft above any door, window or gravity air inlet to the building.

2. The vent must not be less than 7 ft above grade when located adjacent to public walkways.

3. Terminate vent at least 3 ft above any forced air inlet located within 10 ft.

4. Vent must terminate at least 4 ft horizontally, and in no case above or below unless 4 ft horizontal distance is maintained, from electric meters, gas meters, regulators, and relief equipment.

5. Terminate vent at least 6 ft away from adjacent walls.

6. DO NOT terminate vent closer than 5 ft below roof overhang.

7. The vent terminal requires a 12 in. vent terminal clearance from the wall.

8. Terminate vent at least 1 ft above grade, including normal snow line.

9. Multiple direct vent installations require a 4 ft clearance between the ends of vent caps located on the same horizontal plane.

WARNING: The Commonwealth of Massachusetts requires that sidewall vented heaters, installed in every dwelling, building or structure used in whole or in part for residential purposes, be installed using special provisions as outlined on page 51 of this manual.

Canadian Installations

Refer to latest edition of the B149 Installation Code.

A vent shall not terminate:

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

2. Less than 7 ft (2.13 m) above a paved sidewalk or paved driveway located on public property.

3. Within 6 ft (1.8 m) of a mechanical air supply inlet to any building.

4. Above a meter/regulator assembly within 3 ft (915 mm) horizontally of the vertical centre-line of the regulator.

5. Within 6 ft (1.8 m) of any gas service regulator vent outlet.

6. Less than 1 ft (305 mm) above grade level.

7. Within 3 ft (915 mm) of a window or door which can be opened in any building, any non-mechanical air supply inlet to any building or the combustion air inlet of any other appliance.

8. Underneath a verandah, porch or deck, unless the verandah, porch or deck is fully open on a minimum of two sides beneath the floor, and the distance between the top of the vent termination and the underside of the verandah, porch or deck is greater than 1 ft (305 mm).

Venting Installation Tips

Support piping:

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

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

Venting Configurations

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

Vertical Venting (Category IV)

CAUTION: This venting system requires the installation of a condensate drain in the vent piping per the vent manufacturer's instructions. Failure to install a condensate drain in the venting system will void all warranties on this heater.

Installation

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

The diameter of vent flue pipe should be sized according to the NFGC (U.S.) and Appendix B of B149 (Canada). The minimum flue pipe diameter for conventional venting using Category IV, stainless steel AL29-4C vent is: 6 in. (152mm) for Models 503-1003; and 8 in. (203mm) for Models 1253-2003.

The connection from the appliance vent to the stack must be as direct as possible and shall be the same diameter as the vent outlet. The horizontal breaching of a vent must have an upward slope of not less than 1/4 inch per linear foot from the heater to the vent terminal. The horizontal portions of the vent shall also be

Model	Certified Vent Material	Vent Size (in.)	Vertical Vent Height[1] (Ft)		Combustion Air Intake Pipe Material	Air Inlet Max. Length** (Ft)		
			Min.	Max.		6" Ø	8" Ø	10" Ø
503	Category IV (AL29-4C)	6	0	15*	Galvanized Steel, PVC, ABS, CPVC	45	100	N/A
753				75				
1003				75				
1253		8		40		N/A	45	85
1503				75				
1753				75				
2003				75				

* Vent length may be extended up to 40 ft. using a barometric damper installed at 15 equivalent feet from the heater where the category of the vent changes from Cat IV to Cat II. NOTE: Special vent materials are still required.

[1] Vent lengths are based on a lateral length of 2 ft. Refer to the latest edition of the NFGC for further details.

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

Table K: Category IV Vertical Venting

supported for the design and weight of the material employed to maintain clearances and to prevent physical damage or separation of joints.

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

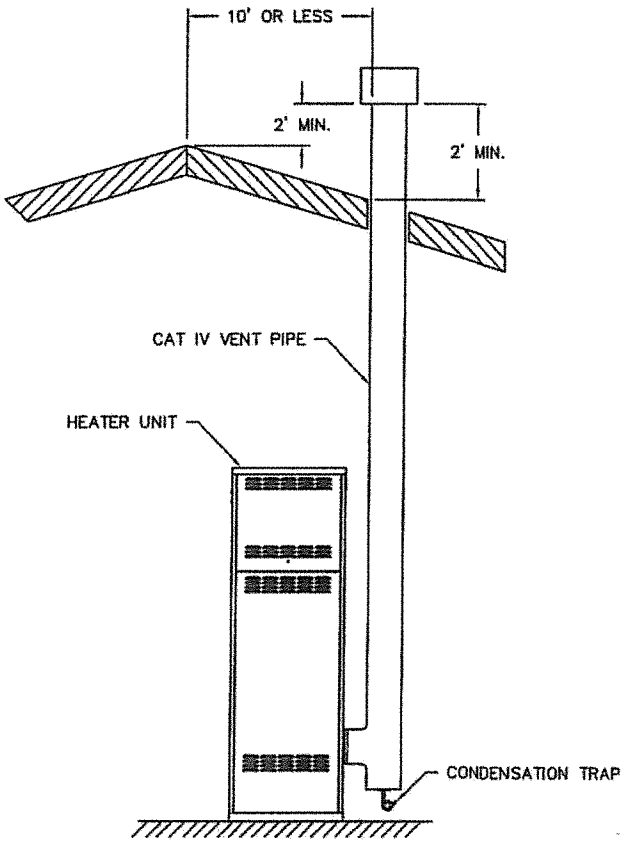


Fig. 20: Vertical Venting

Termination

The vent terminal should be vertical and should terminate outside the building at least 2 ft above the highest point of the roof that is within 10 ft. The vent cap should have a minimum clearance of 4 ft horizontally from and in no case above or below (unless a 4 ft horizontal distance is maintained) electric meters, gas meters, regulators and relief equipment.

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

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

NOTE: For extractor sizing, typical CO_2 levels are 8.5% for natural gas and 9.5% for propane gas and flue temperature of 300° F.

Common Venting

The NFGC does not address sizing guidelines for the common venting of multiple Category IV heaters. This is covered in the NFGC under "Engineered Vent Systems". Table L provides boiler discharge vent pressures at vent pressure switch and volumes of flue products at full fire for the calculation of appropriate vent sizing for common venting.

WARNING: Vent connectors serving any other appliances shall not be connected into any portion of mechanical draft systems operating under a positive pressure. If an MVB heater is installed to replace an existing heater, the vent system MUST be verified to be of the correct size and of Category IV AL29-4C vent material construction. If it is NOT, it MUST be replaced.

Model	Vent Size (in.)	Vent Pressure (in. WC)	Volume of Flue Products (CFM)
503	6	0.1	160
753		0.2	240
1003		0.3	320
1253	8	0.2	400
1503		0.3	480
1753		0.4	560
2003		0.5	640

* NOTE: Data for 100% firing rate.

Table L: Vent Pressure and Volume of Flue Products Data

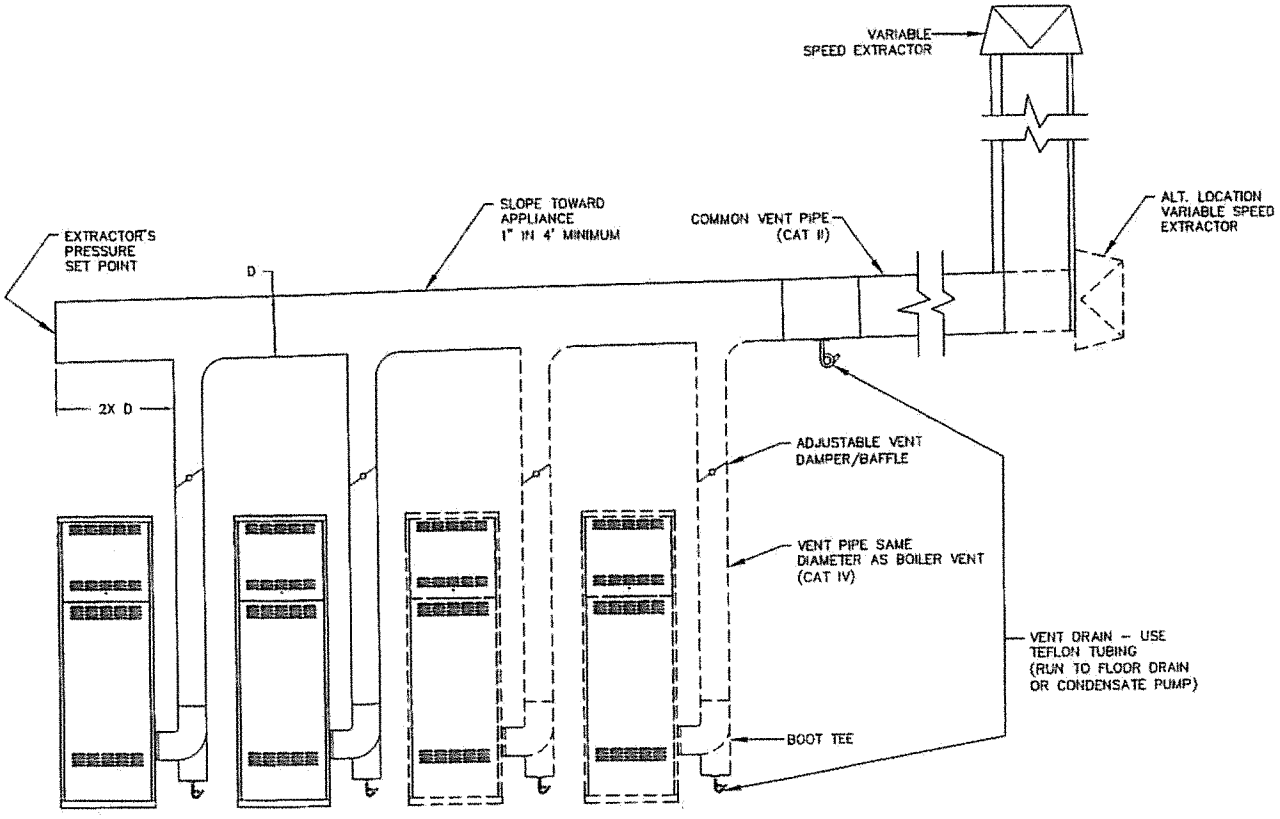


Fig. 21: Typical Common Venting

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

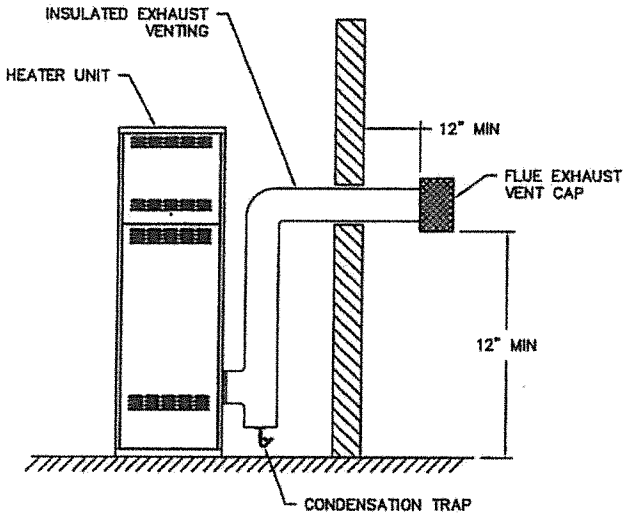


Fig. 22: Horizontal Through-the-Wall Venting

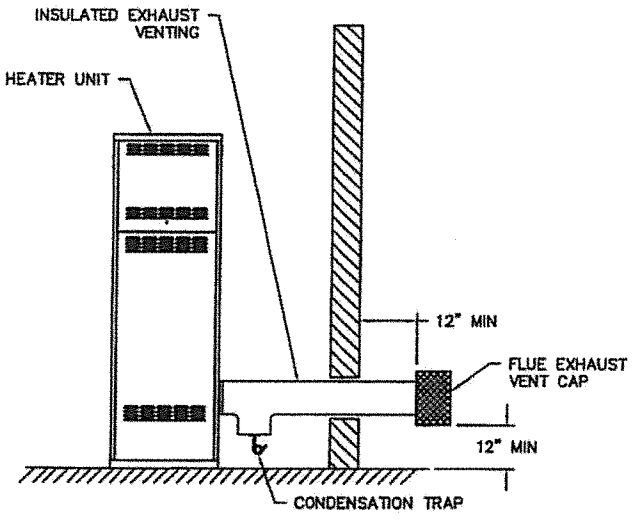


Fig. 23: Alt. Horizontal Through-the-Wall Venting

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

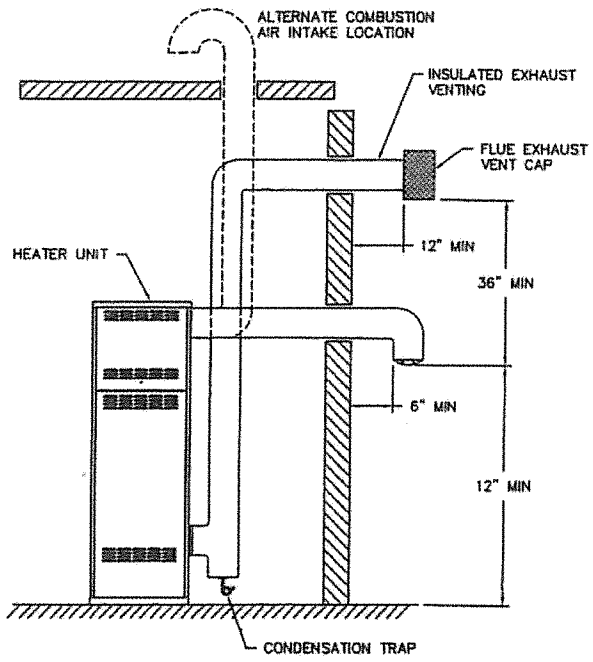


Fig. 24: Horizontal Through-the-Wall Direct Venting

CAUTION: This venting system requires the installation of a condensate drain in the vent piping per the vent manufacturer's instructions. Failure to install a condensate drain in the venting system will void all warranties on this heater.

Installation

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

The total length of the horizontal through-the-wall flue system should not exceed 75 equivalent ft in length. If horizontal run exceeds 75 equivalent ft, an appropriately sized variable-speed extractor must be used. Each elbow used is equal to 10 ft of straight pipe. This will allow installation in one of the four following arrangements:

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

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

Model	Certified Vent Material	Vent Size (in.)	Horizontal Vent Length (Ft)*		Combustion Air Intake Pipe Material	Air Inlet Max. Length (Ft) **		
			Min.	Max.		6"Ø	8" Ø	10" Ø
503	Category IV (AL29-4C)	6	0	75	Galvanized Steel, PVC, ABS, CPVC	45	100	N/A
753								
1003								
1253		8				N/A	45	85
1503								
1753								
2003								

* Vent lengths are based on a lateral length of 2 ft. Refer to the latest edition of the NFGC for further details.
** Subtract 10 ft per elbow. Max. 4 elbows.

Table M: Category IV Horizontal Vent & Horizontal Direct Vent

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

1. The vent must be installed with a condensate drain located in proximity to the heater as directed by the vent manufacturer.

2. The vent must be installed with a slight upward slope of not less than 1/4 inch per foot of horizontal run to the vent terminal.

3. The vent must be insulated through the length of the horizontal run.

Termination

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

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

Direct Vent—Vertical

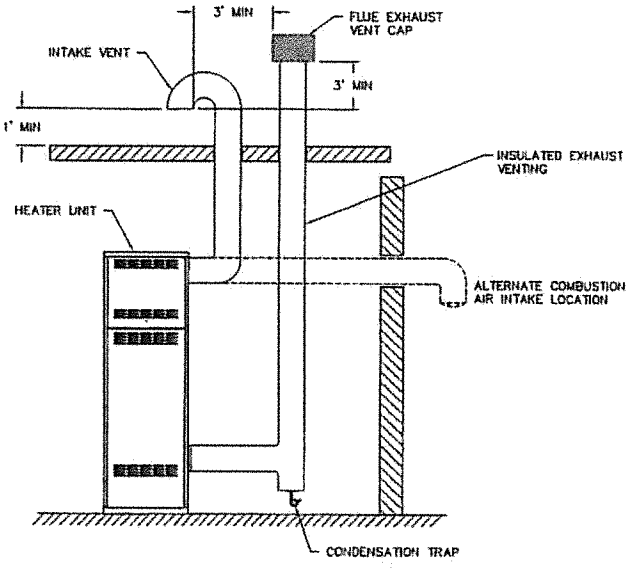


Fig. 25: Direct Vent - Vertical

CAUTION: This venting system requires the installation of a condensate drain in the vent piping per the vent manufacturer's instructions. Failure to install a condensate drain in the venting system will void all warranties on this heater.

Installation

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

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

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

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

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

1. The vent must be installed with a condensate drain located in proximity to the heater as directed by the vent manufacturer.

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

3. The vent must be insulated through the length of the horizontal run.

Termination

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

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

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

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

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

The stainless steel flue direct vent cap must be furnished by the heater manufacturer in accordance with its listing (sales order option D-15).

Outdoor Installation

Outdoor models must be vented with listed vent material per the following instructions and installed with the optional factory-supplied outdoor vent kit. A special vent cap and air intake hood are provided in accordance with CSA requirements. These must be installed directly on the vent pipe as illustrated in Fig. 26.

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

1. Outdoor models must be installed outdoors and must use the outdoor vent cap and air intake hood available from the manufacturer (sales order option D-11).

2. Periodically check venting system. The heater's venting areas must never be obstructed in any way and minimum clearances must be observed to prevent restriction of combustion and ventilation air. Keep area clear and free of combustible and flammable materials.

3. Do not locate adjacent to any window, door, walkway, or gravity air intake. The vent must be located a minimum of 4 ft horizontally from such areas.

4. Install above grade level and above normal snow levels.

5. Vent terminal must be at least 3 ft above any forced air inlet located within 10 ft.

6. Adjacent brick or masonry surfaces must be protected with a rust-resistant sheet metal plate.

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

NOTE: Condensate can freeze on the vent cap. Frozen condensate on the vent cap can result in a blocked flue condition.

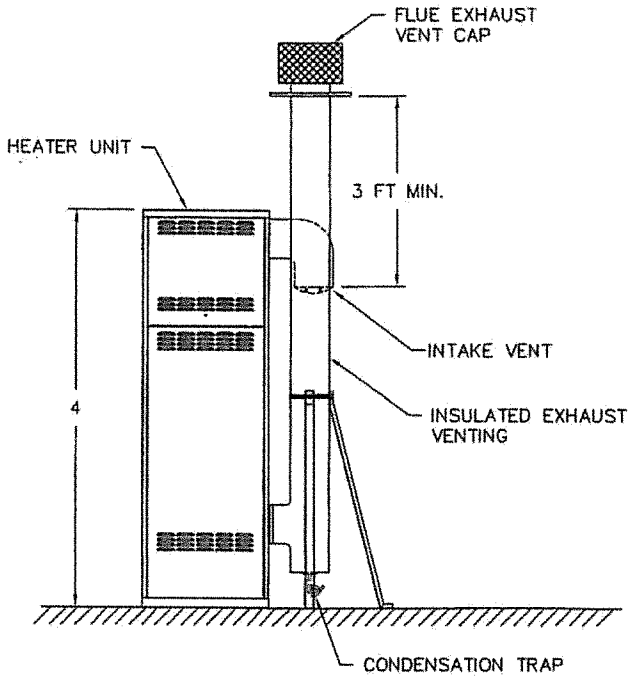


Fig. 26: Outdoor Venting

Freeze Protection

The Raypak electronic temperature control includes a freeze protection feature. In the event the temperature drops below 40°F at any of the boiler temperature sensors, the pump is turned on and will remain on until the temperature at all boiler sensors rises to 45°F.

Controls

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

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

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

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

The Raypak modulating temperature control is provided to maintain the desired system water temperature. The control has various modes of operation which are listed on the following pages.

Operating Modes

Mode 1 – Setpoint operation using primary piping. The heater outlet water temperature is controlled to the boiler target setpoint. See Fig. 27.

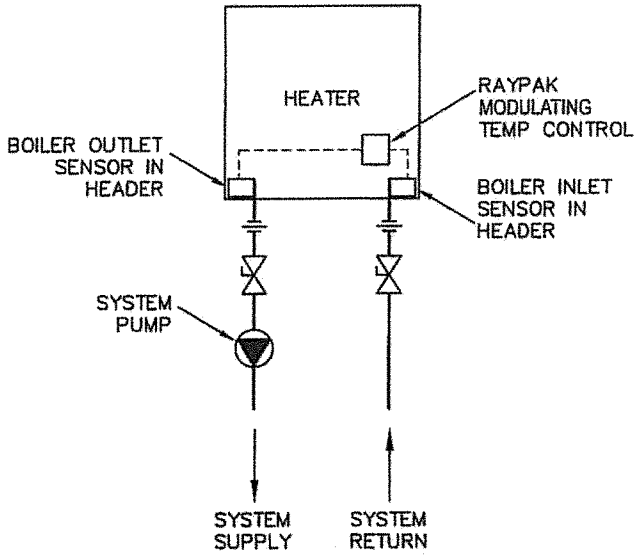


Fig. 27: Mode 1 Primary Piping

Mode 2 – Setpoint operation using primary/secondary piping. The control operates the heater to satisfy a remote system sensor. The heater is turned off based on boiler max and boiler differential (factory default). See Fig. 28.

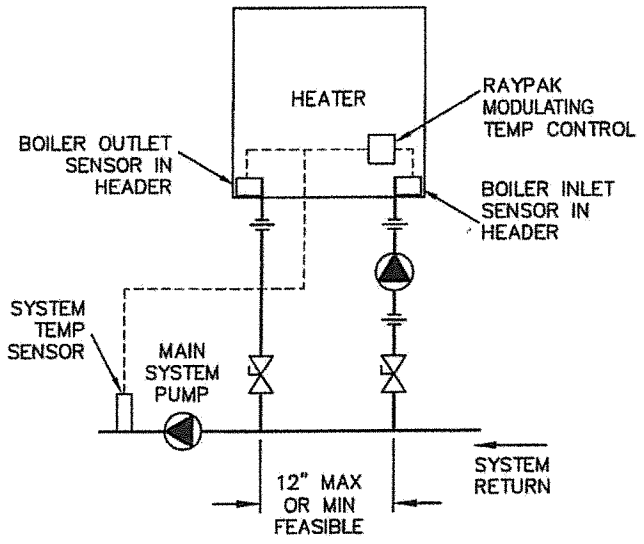


Fig. 28: Mode 2 Primary/Secondary Piping

Mode 3 – Dedicated DHW operation using UniTemp 80 piping. A call for heat is determined by the DHW sensor and the DHW boiler target. The heater outlet water is also controlled to the boiler target temperature. See Fig. 29.

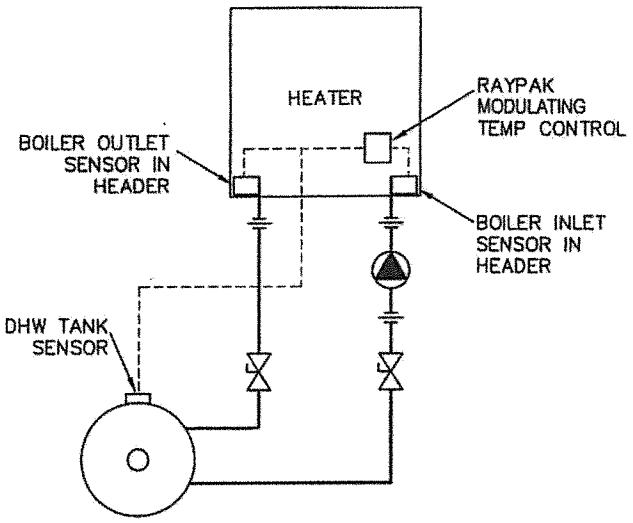


Fig. 29: Mode 3 Dedicated DHW

Mode 4 – Outdoor reset using primary piping. The heater is operated as in Mode 1. However, the target temperature is based on outdoor reset. See Fig. 30.

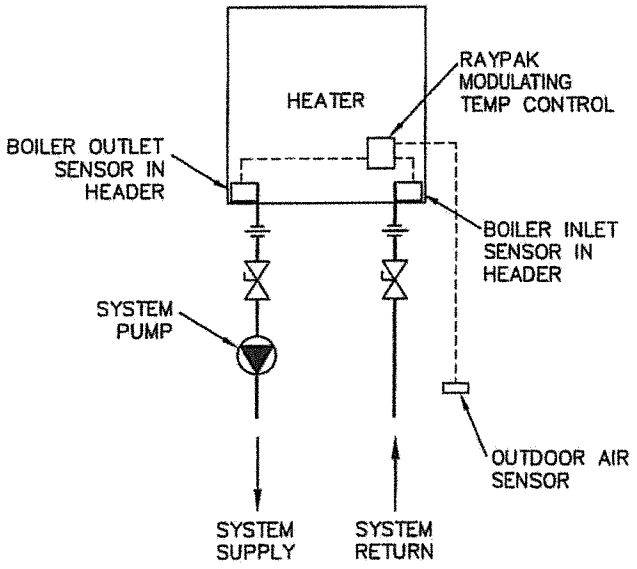


Fig. 30: Mode 4 Primary Piping with Outdoor Reset

Mode 5 – Outdoor reset using primary/secondary piping. The heater is operated as in Mode 2. However, the target temperature is based on outdoor reset. See Fig. 31.

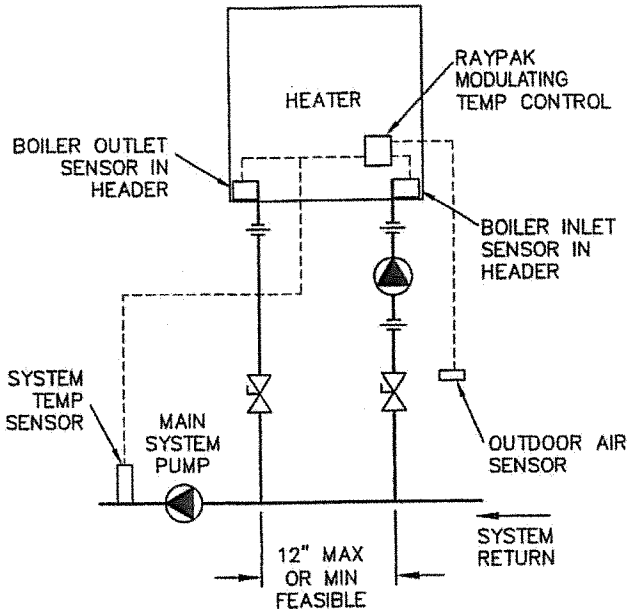


Fig. 31: Mode 5 Primary/Secondary Piping with Outdoor Reset

Mode 6 – Designed for an external input signal with primary piping. The external input signal can be provided from a BMS, an EMS or a sequencing control. The external input signal changes the boiler target according to a linear scale. The control operates the boiler burner to maintain the boiler target at the boiler outlet sensor. See Fig. 32.

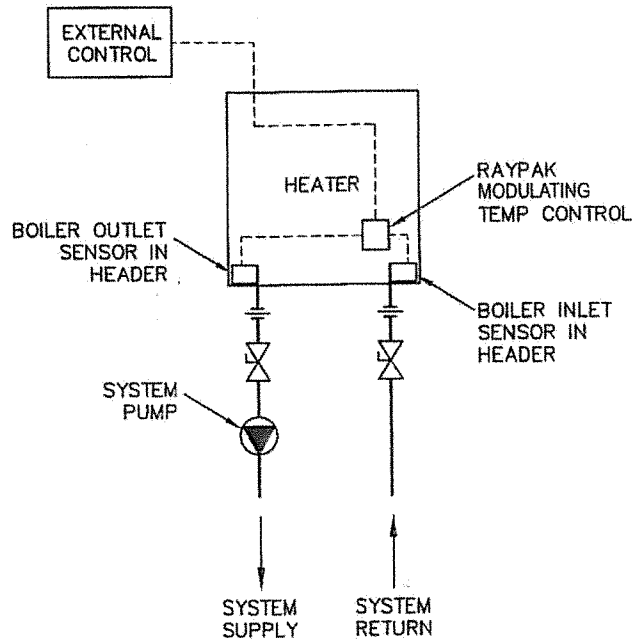


Fig. 32: Mode 6 Primary Piping with External Target Temp

Mode 7 – Designed for an external input signal with primary/secondary piping. The external input signal can be provided from a BMS, an EMS or a sequencing control. The external input signal changes the boiler target according to a linear scale. The control operates the boiler burner to maintain the boiler target at the remote system sensor. See Fig. 33.

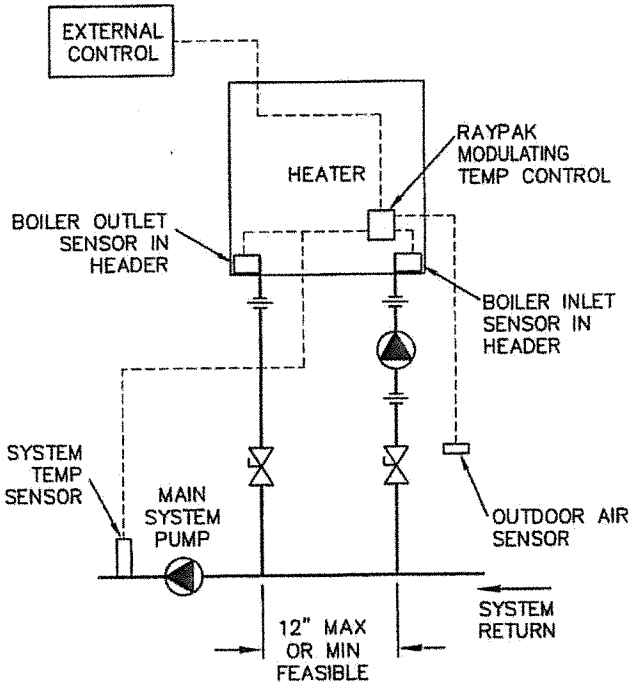


Fig. 33: Mode 7 Primary/Secondary Piping with External Target Temp

Mode 8 – This mode is used for remote control mode. The Boil Max setting is the heater shutdown temperature.

Item	Modes	Default Setting	Range
Boil Target	1, 2	160°F	OFF, 70 to 220°F
	3	160°F	OFF, 70 to 190°F
	4, 5, 6, 7	180°F	OFF, 70 to 220°F
Boil Max	1, 2, 4, 5, 6, 7, 8	200°F	OFF, 120 to 225°F
	3	180°F	OFF, 120 to 190°F
Boil Min	1, 2, 3, 4, 5, 6, 7	150°F	OFF, 80 to 180°F
'Burner' Delay	All	0:00 min	0:00 to 3:00 min
Boil Mass	All	1 (Low)	1 (Low), 2 (Med), 3 (High)
Diff	1, 2, 3, 4, 5, 6, 7	Auto	Auto, 2 to 42°F
DHW Target	3	120°F	OFF, 70 to 190°F
DHW Diff	3	5°F	2 to 10°F
'Pump' Dly	All	3:00 min	OFF, 0:20 to 9:55 min, ON
Outdr Start	4, 5	70°F	35 to 85°F
Outdr Design	4, 5	-10°F	-60 to 32°F
Boil Start	4, 5	135°F	35 to 150°F
Boil Dsgn	4, 5	180°F	120 to 220°F
WWSD	4, 5	70°F	35 to 100°F
Units	All	°F	°F or °C
Mode	N/A	2	1, 2, 3, 4, 5, 6, 7, 8
External Input Signal	6, 7	2 to 10 VDC	2 to 10 VDC or 0 to 10 VDC
Offset	6, 7	0°F	-10°F to 10°F

Table N: Temperature Control Default Setpoints

Definitions

NOTE: The defined terms are not active in all modes of control operation.

% OUT - Current percent modulation rate of heater.

BOIL DSGN - Design boiler water temperature used in heat loss calculations.

BOIL MASS - This setting allows adjustment in the field for high or low thermal masses; High thermal mass (setting=3) provides slower reaction, lower thermal mass (setting=1) provides faster reaction.

BOIL MAX - Highest outlet water temperature that the control is allowed to use as a target temperature.

BOIL MIN - Lowest outlet water temperature that the control is allowed to use as a target temperature.

BOIL ON - Accumulated runtime of heater (up to 999 hours, then resets to 0).

BOIL OUT - Actual heater outlet water temperature.

BOIL START - Starting boiler water temperature.

BOIL SUP - Actual system supply water temperature.

BOIL TARGET - Target temperature that the heater is trying to maintain.

'BURNER' DELAY - Holds control output at ignition setting from the start of the ignition sequence to the specified burner delay time (0 to 3:00 min.).

DEM 1 - Indicates 24 VDC signal has been supplied to the H+D terminal.

DEM 2 - Indicates 24 VDC Flame Proof signal is present.

DIFF - The operating differential of the heater; The heater outlet water temperature is allowed to rise above the BOIL TARGET temperature by ½ of this differential before the heater shuts off. For example, if the heater target temperature is set to 160°F (71°C) and the differential is set to 10°F (5°C), on temperature rise, the heater will shut off at 165°F (74°C). Once the heater shuts off, it will not come on again until the temperature falls to 155°F (68°C).

EXTERNAL INPUT SIGNAL – Selects external input signal range (0-10VDC or 2-10VDC):

0-10VDC or 0-20 mA external input signal – When the 0-10VDC signal is selected, an input voltage of 1 VDC corresponds to a boiler target temperature of 50°F (10°C). An input voltage of 10 VDC corresponds to a boiler target temperature of 220°F (104°C). As the voltage varies between 1 VDC and 10 VDC, the boiler target temperature varies linearly between 50°F (10°C) and 220°F (104°C). If a voltage below 0.5 VDC is received, the boiler target temperature is displayed as "– – –" indicating that there is no longer an internal heat demand. A 0-20 mA signal can be converted to a 0-10 VDC signal by installing a 500 Ω resistor on the external input signal device's terminals.

2-10VDC or 4-20 mA external input signal – When the 2-10VDC signal is selected, an input voltage of 2 VDC corresponds to a boiler target temperature of 50°F (10°C). An input voltage of 10 VDC corresponds to a boiler target temperature of 220°F (104°C). As the voltage varies between 2 VDC and 10 VDC, the boiler target temperature varies linearly between 50°F (10°C) and 220°F (104°C). If a voltage below 1.5 VDC is received, the boiler target temperature is displayed as "– – –" indicating that there is no longer an internal heat demand. A 4-20 mA signal can be converted to a 2-10 VDC signal by installing a 500 Ω resistor on the external input signal device's terminals.

FP - Flame proof warning.

MODE - Operating mode of the heater.

OFFSET - The Offset setting allows the boiler target temperature to be fine tuned to the external input signal. The control reads the external input signal and converts this to a boiler target temperature. The Offset setting is then added to the boiler target temperature.

OUTDR - Outdoor air temperature.

OUTDR DESIGN - Design outdoor air temperature used in the heat loss calculation.

OUTDR START - Starting outdoor air temperature.

PUMP DLY - Sets the operating time of the pump once the CFH is satisfied.

TANK - Current DHW tank temperature (Mode 3).

TANK DIFF - Storage tank differential (Mode 3).

TANK TARGET - Target temperature in the DHW storage tank (Mode 3).

UNITS - Selects the temperature units to be displayed (°F or °C).

Rank	Item Field	Number Field	Type	Fault Description
0	E01	Err	Error	EEPROM error
1	FP	Err	Warning	Flame proof warning
2	BOIL OUT	SHr	Error	Boiler outlet sensor short
3	BOIL OUT	OPn	Error	Boiler outlet sensor open
4	BOIL IN	SHr	Error	Boiler inlet sensor short
5	BOIL IN	OPn	Error	Boiler inlet sensor open
6	SUP	SHr	Error	System sensor short
7	SUP	OPn	Error	System sensor open
8	OUTDR	SHr	Error	Outdoor sensor short
9	OUTDR	OPn	Error	Outdoor sensor open
10	DHW	SHr	Error	DHW sensor short
11	DHW	OPn	Error	DHW sensor open

Table O: Error Codes

WWSD - Selects the outdoor temperature that shuts the heater off, no matter what the demand. NOTE: The WWSD segment is displayed on the LCD.

Operation

The Raypak modulating temperature control uses a Liquid Crystal Display (LCD) as a method of supplying information. The LCD is used to setup and monitor system operation by means of three push buttons (*Item*, ▲ and ▼) shown at the bottom of Fig. 34.

All items displayed by the control are organized into two menus, the view menu and the adjust menu. The active menu is displayed in the upper right hand side of the display in the menu field. The default menu is the view menu.

When the temperature control is powered up, the control turns on all segments in the display for 2 seconds, then the software version is displayed for 2 seconds. At the end of that 4 second period, the control enters the normal operating mode and "VIEW" is displayed. Pressing the scroll button "scrolls" through the displayed values in the "VIEW" menu.

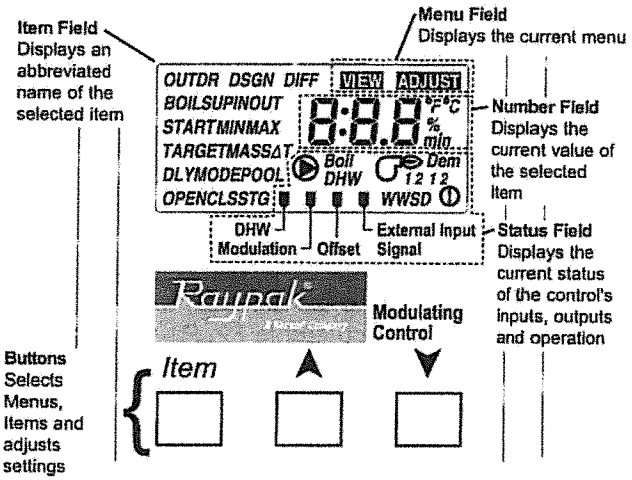


Fig. 34: Modulating Temperature Control Display

To make an adjustment to a setting in the control, begin by selecting the "ADJUST" menu. To change from the view menu to the adjust menu, simultaneously press and hold all three buttons for 1 second. The menu name, "ADJUST" will be displayed in the menu field.

The menu will automatically revert back to the view menu after 20 seconds of keyboard inactivity. Then scroll to the desired item using the scroll button. Finally, use the ▲ or ▼ button to make the adjustment. In the absence of other information, the values provided in Tables N and O should be used as default settings.

Heater Sequence of Operation

Models 503–1503

1. The black (hot) wire lead, located at the right-middle front inside the control compartment, goes directly to the main power switch.

2. When the main power switch is placed in the "ON" position, the 120 VAC terminal block in the control compartment, the N.O. contacts of pump relay, the N.O. contacts of blower relay, the 120/24 VAC transformer, and terminals L1 and F1 of the ignition module are powered.

3. The 120/24 VAC transformer sends a 24 VAC hot power signal to the 24V Terminal Block.

4. 24 VAC is sent from the 24V Terminal Block to the NO pump contacts on the modulating temperature control (pin #13), to pin TP2 of the optional alarm relay, to terminal R of the alarm circuit on the modulating temperature control (pin #24) and the green "Power On" LED on the front of the heater will illuminate.

5. 24 VAC power is sent from 24V Terminal Block to Pin P1-1 of the UDB board, the 24 VAC terminal of the ignition control module, the common contact of the manual high limit, pin P3-1 of the UDB board and L1 of the Low Water Cut Off (if equipped).

6. A 24 VAC signal is sent from the NC contact of the manual high limit to the common terminal of the Blocked Vent Switch and to Pin P1-1 of the UDB board. During a blocked vent condition a 24 VAC signal is sent from the NO open contacts of the Blocked Vent Switch to pin P3-5 of the UDB board to indicate a safety fault.

7. During normal operation of the heater the 24 VAC signal exits the NC contacts of the Blocked Vent Switch and is sent to the common terminal of the Low Gas Pressure Switch (if equipped). During a low gas pressure condition 24 VAC is sent from the NC contacts of the Low Gas Pressure Switch to pin P3-6 of the UDB board to indicate a safety fault.

8. 24 VAC is sent from the NO contacts of the Low Gas Pressure Switch to the common terminal of the High Gas Pressure Switch (if equipped). During a high gas pressure condition 24 VAC is sent from the NO contacts of the High Gas Pressure Switch to pin P3-7 of the UDB board to indicate a safety fault.

9. 24 VAC is sent from the NC contact of the High Gas Pressure Switch to the common terminal of the Low Water Cut Off (if equipped). Upon loss of water in the heater, the Low Water Cut Off (if equipped) will send a 24VAC signal to pin P3-4 of the UDB board to indicate a safety fault.

10. 24VAC is sent from the NO contact of the Low Water Cut Off to the common contact of the Auto Reset High Limit (if equipped) and energizes the coil of the alarm relay. If the Auto Hi Limit opens, 24 VAC is sent from the NO contacts of the Auto Hi Limit to pin P3-3 of the UDB board to indicate a safety fault.

11. 24 VAC is sent from the NC contacts of the Auto Reset Hi Limit to the common terminal of the burner switch located on the front exterior panel of the heater.

12. When the burner switch is closed, 24VAC power then travels from the NO contact of the burner switch to the remote enable/disable connection at terminal 11 of the rear j-box low voltage terminal block and to the NO contact of the Enable/Disable relay.

13. When 24VAC power is returned from terminal 12 of the rear j-box low voltage terminal block to the coil of the Enable/Disable relay, the relay contacts close, and 24VAC is transmitted to the Ht D (heat demand) connection of the modulating temperature control and to the stage contact of the modulating temperature control, pin #15.

14. When the stage contact closes on the modulating temperature control, 24 VAC is sent to the common terminal of the flow switch and to pin P1-3(CFH) of the UDB board. In addition, the amber "Call-for-Heat" LED on the front of the heater will illuminate.

15. The pump contact on the modulating temperature control closes sending 24 VAC to the pump switch located on the front exterior panel of the heater.

16. When the pump switch is closed, 24 VAC is sent to the coil of the pump relay.

17. The pump relay energizes and closes the contacts, starting the heater pump.

18. Upon sufficient flow, the flow switch closes and sends 24 VAC to the common terminal of the air pressure switch and the TH terminal of the ignition module. If the flow switch does not close, a 24

VAC signal is sent to pin P4-9 of the UDB board to indicate an insufficient flow condition.

19. When 24 VAC is received at TH on the ignition module, the contacts between pins F1 and F2 close and send 120 VAC to pin 1 of the blower relay.

20. The coil of the blower relay energizes closing the NO contacts sending 120 VAC to energize the combustion air blower motor.

21. Once sufficient air flow is proven the air pressure switch closes the NO contacts, 24 VAC is sent to the heater interlock connection at terminal 9 of the rear j-box low voltage terminal block. If air pressure is insufficient or lost during heater operation a 24VAC signal is sent from the NC contacts of the air pressure switch to pin P4-10 of the UDB board to indicate insufficient air pressure.

22. When 24VAC is returned to terminal 10 of the rear j-box low voltage terminal block, power then travels to the P Switch terminal of the ignition module. The ignition module employs a 15 second prepurge before the next sequence.

23. After 15 seconds of combustion chamber prepurge, pin S1 sends 120 VAC to the Hot Surface Igniter.

24. The Hot Surface Igniter will be energized for approximately 30 seconds and must exceed 3.1 amp draw during heat up.

25. Once the ignition module determines the proper operation of the Hot Surface Igniter, a 24 VAC signal is output from the Valve pin on the module to energize the gas valve.

26. The gas valve is energized and the blue "Burner On" LED on the front of the heater energizes.

27. The remote sensor is now trying to rectify the flame. If the flame is not rectified within 4 seconds, the ignition module will shut down the gas valve and lock out.

28. When burner flame is rectified, the heater will operate based on the electronic operating control. In the event of an ignition lockout, the ignition module sends a signal to pin P4-12 (ignition lockout) of the UDB board.

29. When the CFH is satisfied, the heater will return to a standby condition awaiting the next CFH.

Heater Sequence of Operation

Models 1753–2003

1. The black (hot) wire lead, located at the right-middle front inside the control compartment, goes directly to the main power switch.

2. When the main power switch is placed in the "ON" position, the 120 VAC terminal block in the control compartment, the N.O. contacts of pump relay, the N.O. contacts of blower relay, the 120/24 VAC transformer, and terminals L1 and F1 of the ignition module are powered.

3. The 120/24 VAC transformer sends a 24 VAC hot power signal to the 24V Terminal Block.

4. 24 VAC is sent from the 24V Terminal Block to the NO pump contacts on the modulating temperature control (pin #13), to pin TP2 of the optional alarm relay, to terminal R of the alarm circuit on the modulating temperature control (pin #24) and the green "Power On" LED on the front of the heater will illuminate.

5. 24 VAC power is sent from 24V Terminal Block to Pin P1-1 of the UDB board, the 24 VAC terminal of the ignition control module, the common contact of the manual high limit, pin P3-1 of the UDB board and L1 of the Low Water Cut Off (if equipped).

6. A 24 VAC signal is sent from the NC contact of the manual high limit to the common terminal of the Blocked Vent Switch and to Pin P1-1 of the UDB board. During a blocked vent condition a 24 VAC signal is sent from the NO open contacts of the Blocked Vent Switch to pin P3-5 of the UDB board to indicate a safety fault.

7. During normal operation of the heater the 24 VAC signal exits the NC contacts of the Blocked Vent Switch and is sent to the common terminal of the Low Gas Pressure Switch (if equipped). During a low gas pressure condition 24 VAC is sent from the NC contacts of the Low Gas Pressure Switch to pin P3-6 of the UDB board to indicate a safety fault.

8. 24 VAC is sent from the NO contacts of the Low Gas Pressure Switch to the common terminal of the High Gas Pressure Switch (if equipped). During a high gas pressure condition 24 VAC is sent from the NO contacts of the High Gas Pressure Switch to pin P3-7 of the UDB board to indicate a safety fault.

9. 24 VAC is sent from the NC contact of the High Gas Pressure Switch to the common terminal of the Low Water Cut Off (if equipped). Upon loss of water in the heater, the Low Water Cut Off (if equipped) will send a 24VAC signal to pin P3-4 of the UDB board to indicate a safety fault.

10. 24VAC is sent from the NO contact of the Low Water Cut Off to the common contact of the Auto Reset High Limit (if equipped) and energizes the coil of the alarm relay. If the Auto Hi Limit opens, 24 VAC is sent from the NO contacts of the Auto Hi Limit to pin P3-3 of the UDB board to indicate a safety fault.

11. 24 VAC is sent from the NC contacts of the Auto Reset Hi Limit to the common terminal of the burner switch located on the front exterior panel of the heater.

12. When the burner switch is closed, 24VAC power then travels from the NO contact of the burner switch to the remote enable/disable connection at terminal 11 of the rear j-box low voltage terminal block and to the NO contact of the Enable/Disable relay.

13. When 24VAC power is returned from terminal 12 of the rear j-box low voltage terminal block to the coil of the Enable/Disable relay, the relay contacts close, and 24VAC is transmitted to the Ht D (heat demand) connection of the modulating temperature control and to the stage contact of the modulating temperature control, pin #15.

14. When the stage contact closes on the modulating temperature control, 24 VAC is sent to the common terminal of the flow switch and to pin P1-3(CFH) of the UDB board. In addition, the amber "Call-for-Heat" LED on the front of the heater will illuminate.

15. The pump contact on the modulating temperature control closes sending 24 VAC to the pump switch located on the front exterior panel of the heater.

16. When the pump switch is closed, 24 VAC is sent to the coil of the pump relay.

17. The pump relay energizes and closes the contacts, starting the heater pump.

18. Upon sufficient flow, the flow switch closes and sends 24 VAC to the common terminal of the air pressure switch and the F1 and TH terminals of the ignition module. If the flow switch does not close, a 24 VAC signal is sent to pin P4-9 of the UDB board to indicate an insufficient flow condition.

19. When 24 VAC is received at TH on the ignition module, the contacts between pins F1 and F2 close and send 24 VAC to J5-6 of the UGB board.

20. The blower is controlled by a PWM (pulse width modulation) signal sent from J6-4 to start the blower operating at 50% speed. The combustion air blower will operate at 50% of capacity for approximately ninety (90) seconds before the modulating signal from the temperature control will control the blower speed in relationship to the system water temperature.

21. Once sufficient air flow is proven the air pressure switch closes the NO contacts, 24 VAC is sent to the heater interlock connection at terminal 9 of the rear j-box low voltage terminal block. If air pressure is insufficient or lost during heater operation a 24VAC signal is sent from the NC contacts of the air pressure switch to pin P4-10 of the UDB board to indicate insufficient air pressure.

22. When 24VAC is returned to terminal 10 of the rear j-box low voltage terminal block, power then travels to the P Switch terminal of the ignition module. The ignition module employs a 15 second prepurge before the next sequence.

23. After 15 seconds of combustion chamber prepurge, pin S1 sends 120 VAC to the Hot Surface Igniter. Voltage is monitored by the UGB board at pins J4-1 and J4-3.

24. The Hot Surface Igniter will be energized for approximately 30 seconds and must exceed 3.1 amp draw during heat up.

25. Once the ignition module determines the proper operation of the Hot Surface Igniter, a 24 VAC signal is output from the Valve pin on the module to energize the gas valve.

26. The gas valve is energized and the blue "Burner On" LED on the front of the heater energizes. This voltage is also monitored by the UGB board at pin J5-2.

27. The remote sensor is now trying to rectify the flame. If the flame is not rectified within 4 seconds, the ignition module will shut down the gas valve and lock out.

28. When burner flame is rectified, the heater will operate based on the electronic operating control. In the event of an ignition lockout, the ignition module sends a signal to pin P4-12 (ignition lockout) of the UDB board.

29. When the CFH is satisfied, the heater will return to a standby condition awaiting the next CFH.

Ignition Module

When additional heat is needed, the combustion air blower starts to purge air from the combustion chamber for 15 seconds. On proof-of-air flow, the air-proving switch closes and the igniter is energized. To ensure safe operation, the gas valve cannot open until the igniter is verified. The main burner is automatically lit when the device is powered and pre-purged. The heater performs its own safety check and opens the main valve only after the igniter is proven to be capable of ignition. The standard single-try ignition module will lock out after failing to light one time. To reset it, press and release the small, recessed black push button located inside of the cut-out on the lower right-hand corner of the ignition module case. **Turning off the power to the heater WILL NOT reset the ignition module.**

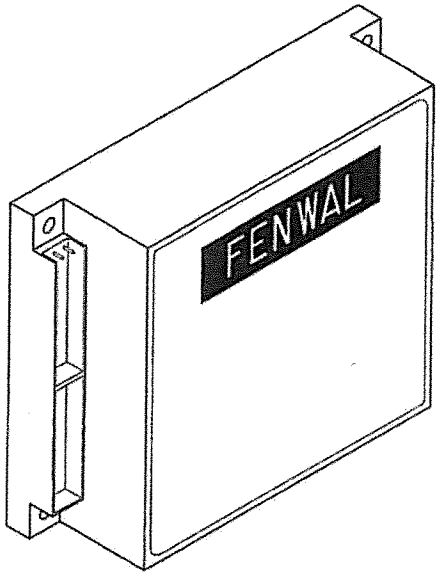


Fig. 35: Ignition Module

The optional ignition module will attempt to light three times before locking out. To reset it, turn off power to the heater, wait 30 seconds and re-apply power.

Code	Condition
On	System OK; No faults present
Off	Possible control fault; Check power
1 Flash	Low air
2 Flashes	Flame in combustion chamber; No call for heat
3 Flashes	Ignition lockout
4 Flashes	Low HSI current
5 Flashes	Low 24 VAC
6 Flashes	Internal fault; Replace control

Table P: Ignition Module Diagnostic LED Flash Codes

High Limit—Manual Reset

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

The fixed setting manual reset high limit is located on the In/Out header of the heat exchanger on the right side of the heater (accessible through the front door for reset as necessary).

The optional adjustable manual reset high limit is located inside the heater junction box. Push the reset button and adjust the setting to approx. 40°F (20°C) above desired outlet temperature.

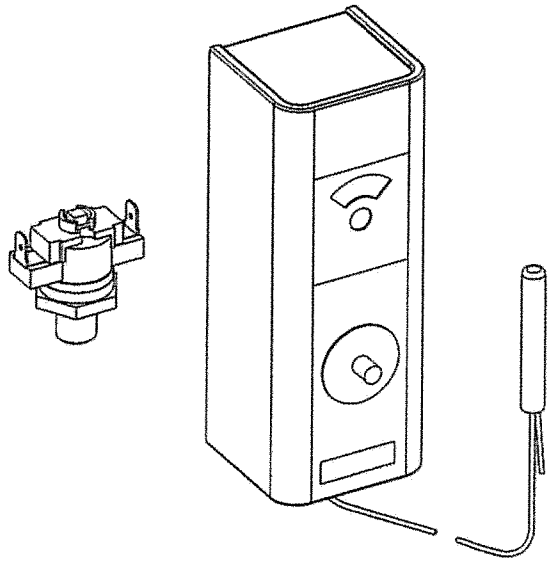


Fig. 36: High Limit (Manual Reset)

High Limit—Auto Reset (Optional)

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

The optional adjustable auto reset high limit is located inside the heater junction box. Adjust the setting to approx. 20°F (10°C) above desired outlet temperature.

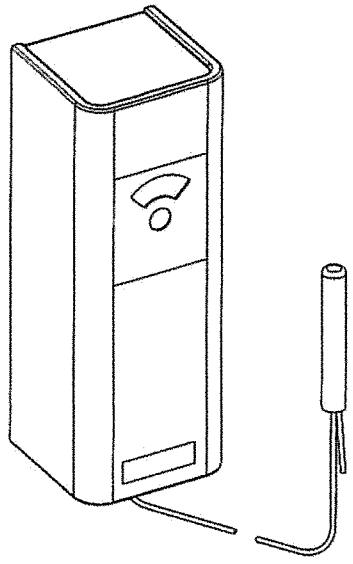


Fig. 37: Adjustable High Limit (Auto Reset)

Flow Switch

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

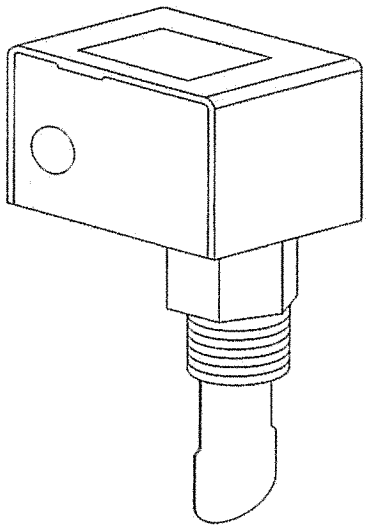


Fig. 38: Flow Switch

Modulating Temperature Control

This heater is equipped with a Raypak modulating temperature control. Refer to information starting on page 30 for information on the setting and use of this control.

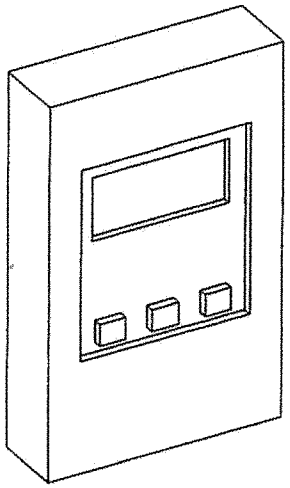


Fig. 39: Modulating Temperature Control

Low Water Cut-Off (Optional)

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

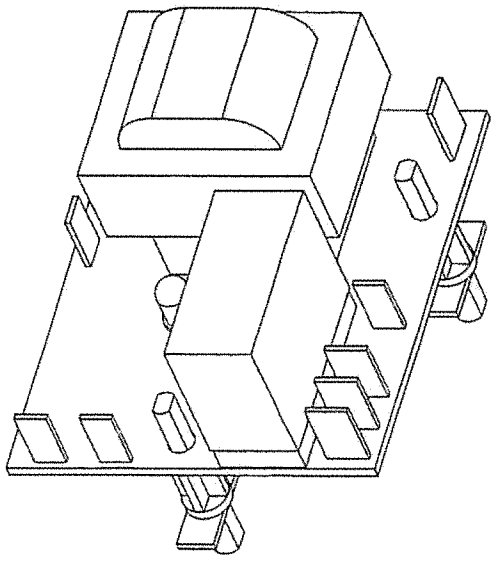


Fig. 40: Low Water Cut-Off

High & Low Gas Pressure Switches (Optional)

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

The optional high gas pressure switch connection mounts down-stream of the gas valve. Special ports are located on the backside of the gas valve and accessible from the front of the heater (to reset the gas pressure switch) or through the removable access panels on the rear of the heater (to reset the gas pressure switch), as necessary. If the gas pressure regulator in the valve fails, the high gas pressure switch automatically shuts down the burner.

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

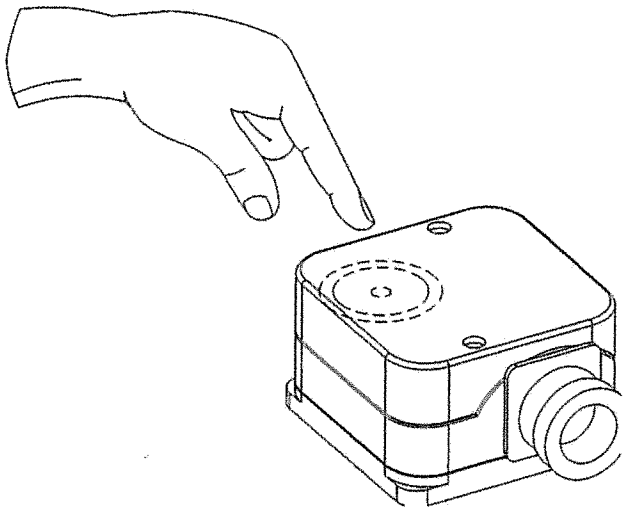


Fig. 41: High/Low Gas Pressure Switch

Air Pressure Switch

This heater is equipped with an air pressure switch to prove the operation of the blower before allowing the ignition control to begin a Call for Heat. It is located on the right side of the lower flange of the blower mounting assembly, directly behind the junction box.

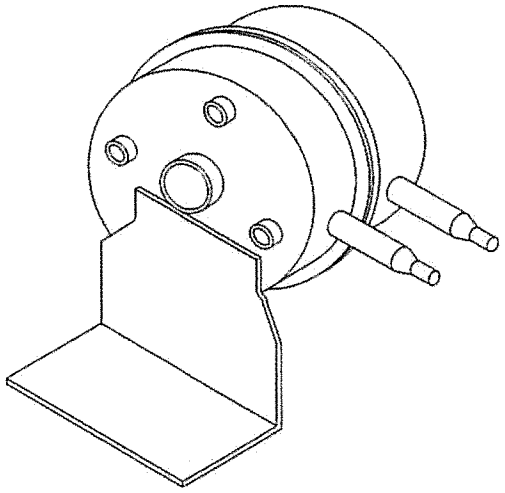


Fig. 42: Air Pressure Switch

Blocked Vent Switch

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

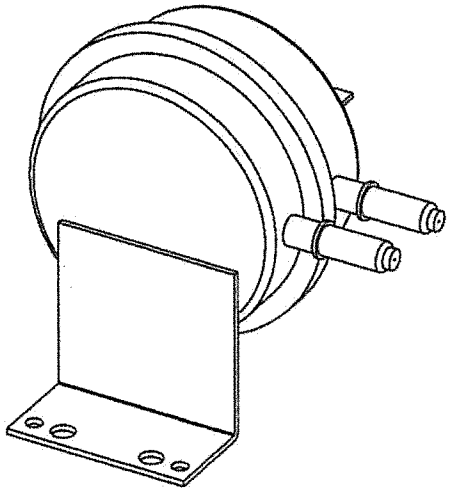


Fig. 43: Blocked Vent Switch

UDB Diagnostic Board

This heater is equipped with a diagnostic board which will indicate faults as they occur. It has the ability to retain up to 256 faults in history. Refer to the Troubleshooting section for instructions on accessing, reviewing and clearing these faults.

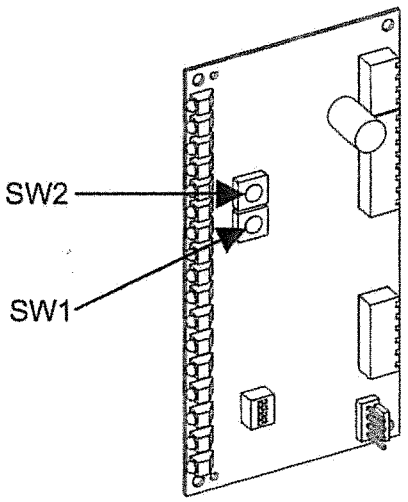
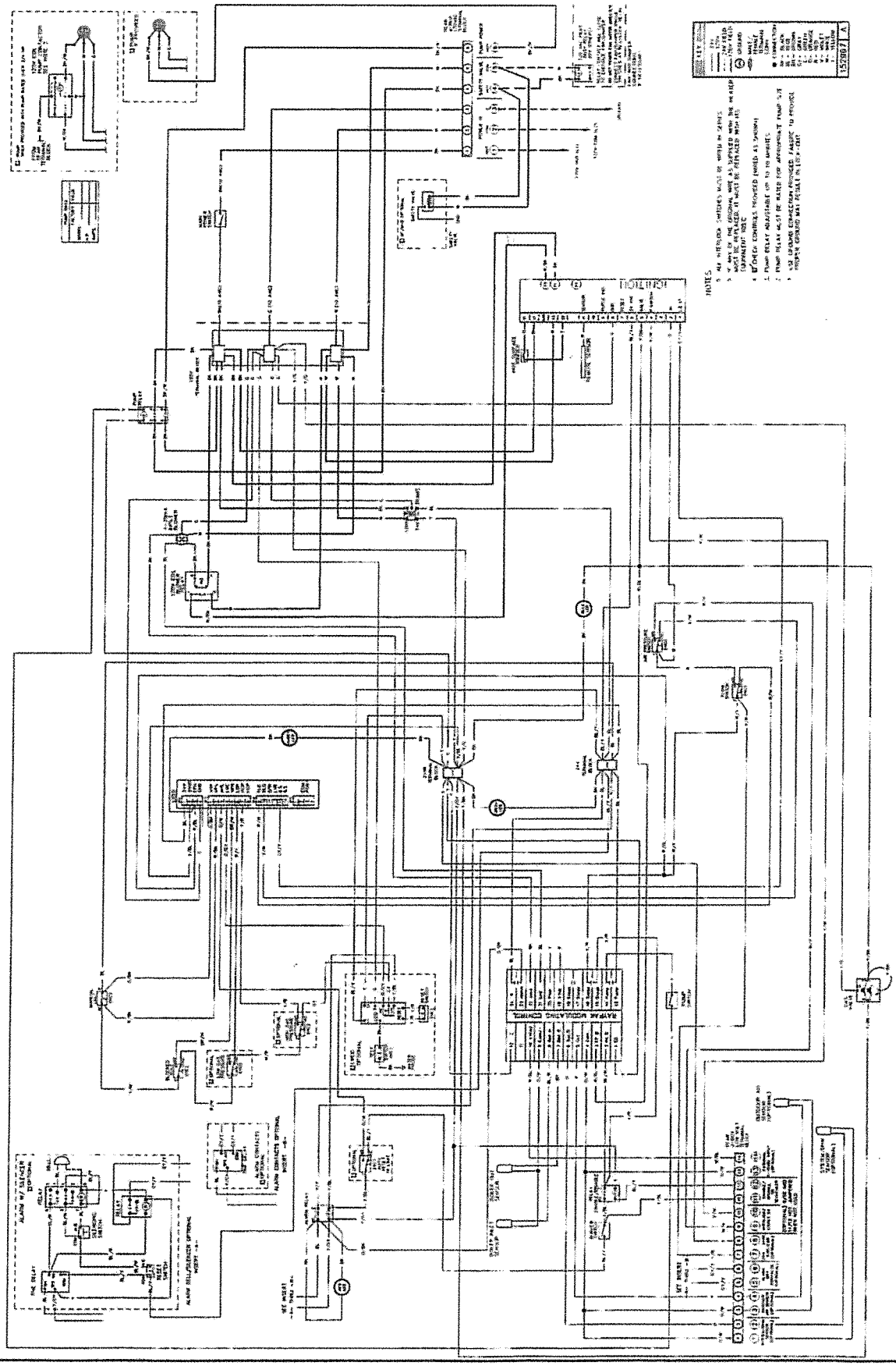
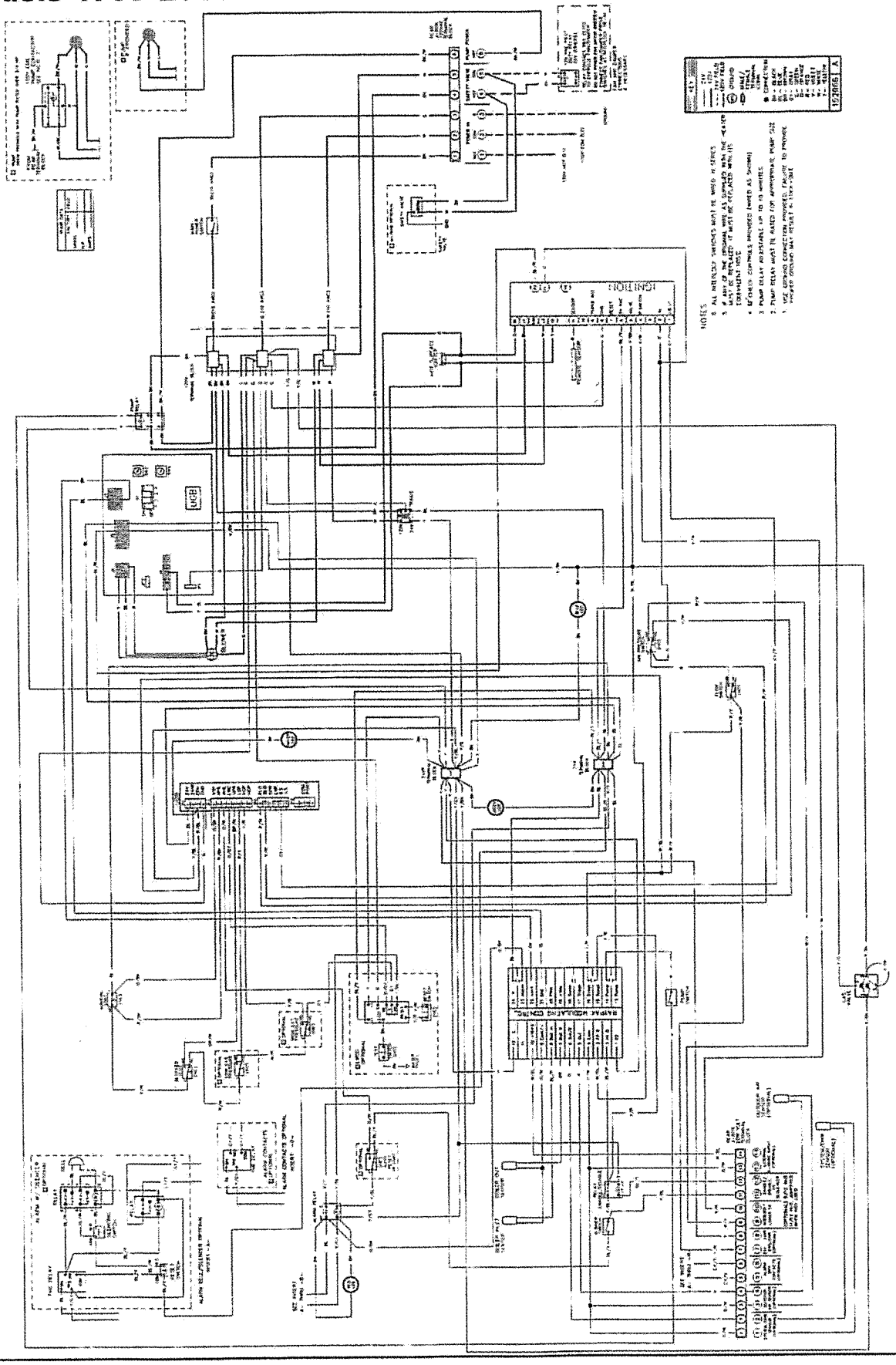


Fig. 44: UDB Diagnostic Board

WIRING DIAGRAMS - Models 503–1503



Models 1753–2003



START-UP

Pre Start-up

Filling System (Heating Boilers)

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

Air Purge (Domestic Hot Water Heaters)

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

Raypak offers an optional air vent for the MVB heaters which can be screwed directly into the inlet side of the header to ensure that air is purged from the system. This option also includes an adapter to allow the air vent to be piped (in the field) to a suitable drain as required by the jurisdiction having authority.

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

Venting System Inspection

1. Check all vent pipe connections and flue pipe material.

2. Make sure vent terminations are installed per code and are clear of all debris or blockage.

For Your Safety

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

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

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

WHAT TO DO IF YOU SMELL GAS:

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

Pre Start-up Check

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

Initial Start-up

Required tools

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

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

NOTE: Digital manometers are not recommended.

Preparation

WARNING: Do not turn on gas at this time.

Check Power Supply

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

Hot - Common (≈120 VAC)

Hot - Ground (≈120 VAC)

Common - Ground (< 1 VAC)

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

Attach Manometers to Measure Pressures

1. Turn off main gas valve.
2. Attach (1) 12" scale manometer to an upstream bleedle valve on the gas supply pipe to the heater (Measure point "A" in Fig. 45).
3. Attach (1) 24" scale manometer to the manifold pressure tap located on the elbow downstream of the valve (Measure point "D" in Fig. 45).
4. Attach (1) 12" scale manometer near the fan-proving switch. Pull black cap from air pressure switch tee and connect the manometer. NOTE: Retain caps for reinstallation later.

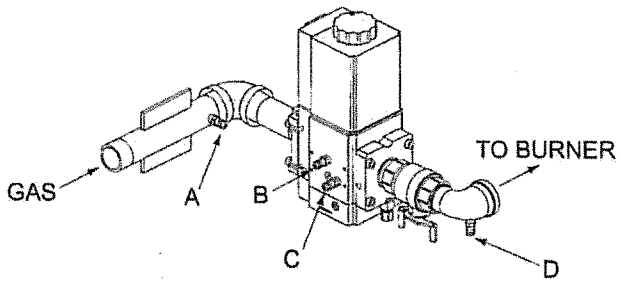


Fig. 45: Gas Pressure Measurement Locations

Check Gas Supply Pressure

1. Slowly turn on main gas shut-off valve.
2. Read the gas supply pressure from the manometer; minimum supply pressure for natural gas is 4.0 in. WC, recommended supply is 7.0 in. WC, minimum supply pressure for propane gas is 4.0 in. WC, recommended supply is 11.0 in. WC (dynamic readings, full fire input).
3. If the gas pressure is greater than 14.0 in. WC, turn off the main gas shut-off valve.

Start-Up

NOTE: The values in Tables Q, R and S represent the conditions when the heater is at full firing rate at sea level.

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

Blower Check

1. Check blower suction using the manometer attached to the fan pressure switch tee, with the heater firing at 100% input. The reading should be as noted in Table Q for both natural and propane gas.
2. **FOR REFERENCE ONLY:** Measure the blower amp draw with the heater firing at 100% input and compare the measured value to the values in Table R. The amp draw is measured with a clamp-on type amp probe clamped to the 14 AWG black power wire going into the blower.

NOTE: Most commercially available amp probes are not accurate enough and/or are not shielded well enough to read accurately in the heater environment. Blower amp draw readings are for reference only.

3. When firing at 100%, the desired heater combustion CO2 is between 8.5 and 9.0% for natural gas and 9.5 and 10.0% for propane with CO less than 100 ppm. If this combustion cannot be achieved with the blower suction within the tolerances specified in Table Q, contact the factory. The reference amp draw reading may help to indicate if there is a problem with the system or if blower adjustment is required.

Manifold Check

1. Check manifold gas pressure at the gas valve outlet pressure tap (connection "D" in Fig. 45). This pressure should read per the values in Table S for natural and propane gas.

2. If the pressure reading differs by more than ± 0.2 in. WC, **STOP – Call the factory for directions on what to do next!**

Model	Air Pressure Setting (in. WC)	Setting Tolerance
503	-2.3	± 0.2 in. WC
753	-2.9	± 0.2 in. WC
1003	-3.0	± 0.2 in. WC
1253	-3.5	± 0.2 in. WC
1503	-4.0	± 0.2 in. WC
1753	-4.6	± 0.2 in. WC
2003	-4.1	± 0.2 in. WC

Table Q: MVB Air Pressure Settings

Model	Amp Draw	Setting Tolerance
503	1.9	+0.0/-0.2
753	2.9	+0.0/-0.2
1003	4.8	+0.0/-0.2
1253	6.3	+0.0/-0.2
1503	8.1	+0.0/-0.2
1753	10.5	+0.0/-0.5
2003	13.0	+0.0/-0.5

Table R: MVB Amp Draw—Reference Information

Model	Manifold Gas Pressure Setting High Fire Values (in. WC)	
	Natural Gas	Propane Gas
503	-0.1	-0.1
753	-0.4	-0.1
1003	-0.8	-0.2
1253	-1.6	-0.2
1503	-2.4	-0.6
1753	-0.4	-0.1
2003	-1.0	-0.5

Table S: MVB Manifold Pressure Settings

CAUTION: Special manifold and air settings may be required.

Finishing

1. Record all data on the "Start-up Checklist" located at the back of this manual.

2. Disconnect the manometers and reconnect the cap on the fan pressure switch tee and reinsert the sealing screws into the bleedle valves.

3. Start-up is complete and the heater should be operating properly.

Safety Inspection

1. Check all thermostats and high limit settings.

2. During the following safety checks leave manometers hooked up, check and record.

3. If other gas-fired appliances in the room are on the same gas main, check all pressures on the MVB with all other equipment running.

4. Check thermostats for ON-OFF operation.

5. Check high limits for ON-OFF operation.

6. While in operation, check flow switch operation.

7. Check the low gas pressure switch (if provided). (For proper adjustment, use the attached manometers, if available, to set pressure. The scales on the switch are approximate only.) Low

gas pressure switch (if provided) must be set at 3.0 in. WC for natural gas and propane gas.

8. Make sure that the high gas pressure switch (optional) is set to 3.0 in. WC for both natural gas and propane gas.

Follow-Up

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

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

Leak Test Procedure: Dual-Seat Gas Valve

Proper leak testing requires three pressure test points in the gas train.

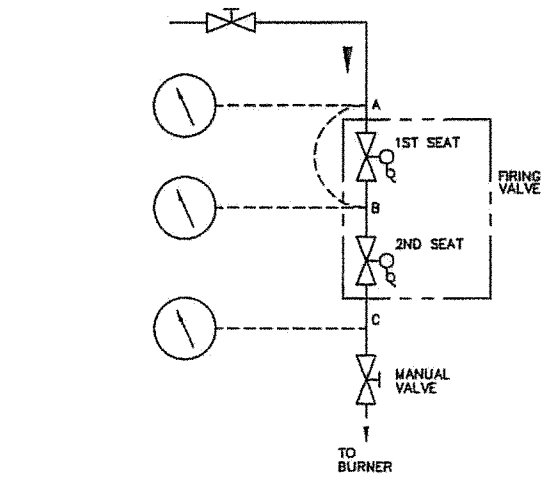
Remove the access panel on the rear of the heater to access the gas valve for this test. Test point A is a bleedle valve located upstream of the combination gas valve on the supply manifold.

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

Test point C is a bleedle valve located downstream of both automatic gas valve seats and upstream of the manual valve. Refer to Fig. 46.

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

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



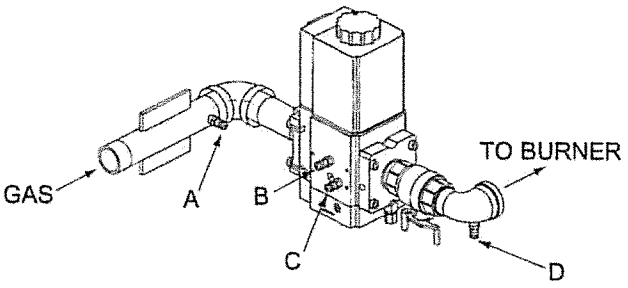


Fig. 46: Leak Test Procedure

Post Start-Up Check

Check off steps as completed:

1. Verify that the heater and heat distribution units or storage tank are filled with water.

2. Confirm that the automatic air vent (if used) was opened two full turns during the venting procedure.

3. Verify that air has been purged from the system.

4. Verify that air has been purged from the gas piping, and that the piping has been checked for leaks.

5. Confirm that the proper start-up procedures were followed.

6. Inspect burner to verify flame.

7. Test safety controls: If heater is equipped with a low water cut-off or additional safety controls, test for operation as outlined by manufacturer. Burner should be operating and should go off when controls are tested. When safety devices are restored, burners should re-ignite after pre-purge time delay.

8. Test limit control: While burner is operating, move indicator on high limit control below actual water temperature. Burner should go off while blower and circulator continue to operate. Raise setting on limit control above water temperature and burner should re-ignite after pre-purge time delay. **NOTE: Ignition control may have to be reset after this portion of the test.**

9. Test ignition system safety device:

   a. Open manual gas valve. Turn power on.

   b. Set thermostat to call for heat.

   c. When the heater is in operation, pull cap off of tee in air switch hose. The burner should go off almost immediately.

   d. Reattach cap on tee. Burner should re-ignite after pre-purge time delay. **NOTE: Ignition control may have to be reset after this portion of the test.**

10. To restart system, follow lighting instructions in the Operation section.

11. Check to see that the high limit control is set above the design temperature requirements of the system. For multiple zones: Check to make sure the flow is adjusted as required in each zone.

12. Check that the heater is cycled with the thermostat. Raise the setting on the thermostat to the highest setting and verify that the heater goes through the normal start-up cycle. Reduce to the lowest setting and verify that the heater goes off.

13. Observe several operating cycles for proper operation.

14. Set the heater thermostat to desired temperature.

15. Review all instructions shipped with this heater with owner or maintenance person, return to envelope and give to owner or place the instructions inside front panel on heater.

OPERATION

Lighting Instructions

1. Before lighting, make sure you have read all of the safety information in this manual.

2. Remove upper front panel.

3. Set the thermostat to the lowest setting.

4. Turn off all electrical power to the appliance.

5. This appliance is equipped with an ignition device which automatically lights the burner. Do not try to light the burner by hand.

6. Turn on main manual gas valve field installed near gas inlet connection on back of heater.

7. Wait 5 minutes to clear out any gas. Then smell for gas, especially near the floor. If you then smell gas, STOP! Follow the steps in the safety information on the front cover of this manual. If you do not smell gas, go to next step.

8. Turn on all electrical power to the appliance.

9. Set thermostat to desired setting. The appliance will operate. The igniter will glow after the pre-purge time delay (15 seconds). After igniter reaches temperature (30 seconds) the main valve should open. System will try for ignition up to three

times (one time on optional single-try ignition module). If flame is not sensed, lockout will commence.

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

11. Replace upper front panel.

12. If heater fails to start, verify the following:

    a. There are no loose connections or that the service switch is off.

    b. High temperature limit switch is set above water temperature or manual reset high limit is not tripped.

    c. Thermostat is set above water temperature.

    d. Gas is on at the meter and the heater.

    e. Incoming dynamic gas pressure to the gas valve is NOT less than 4.0 in. WC for natural gas or propane gas.

To Turn Off Gas To Appliance

1. Shut off manual gas valve field installed near gas inlet connection on back of heater.

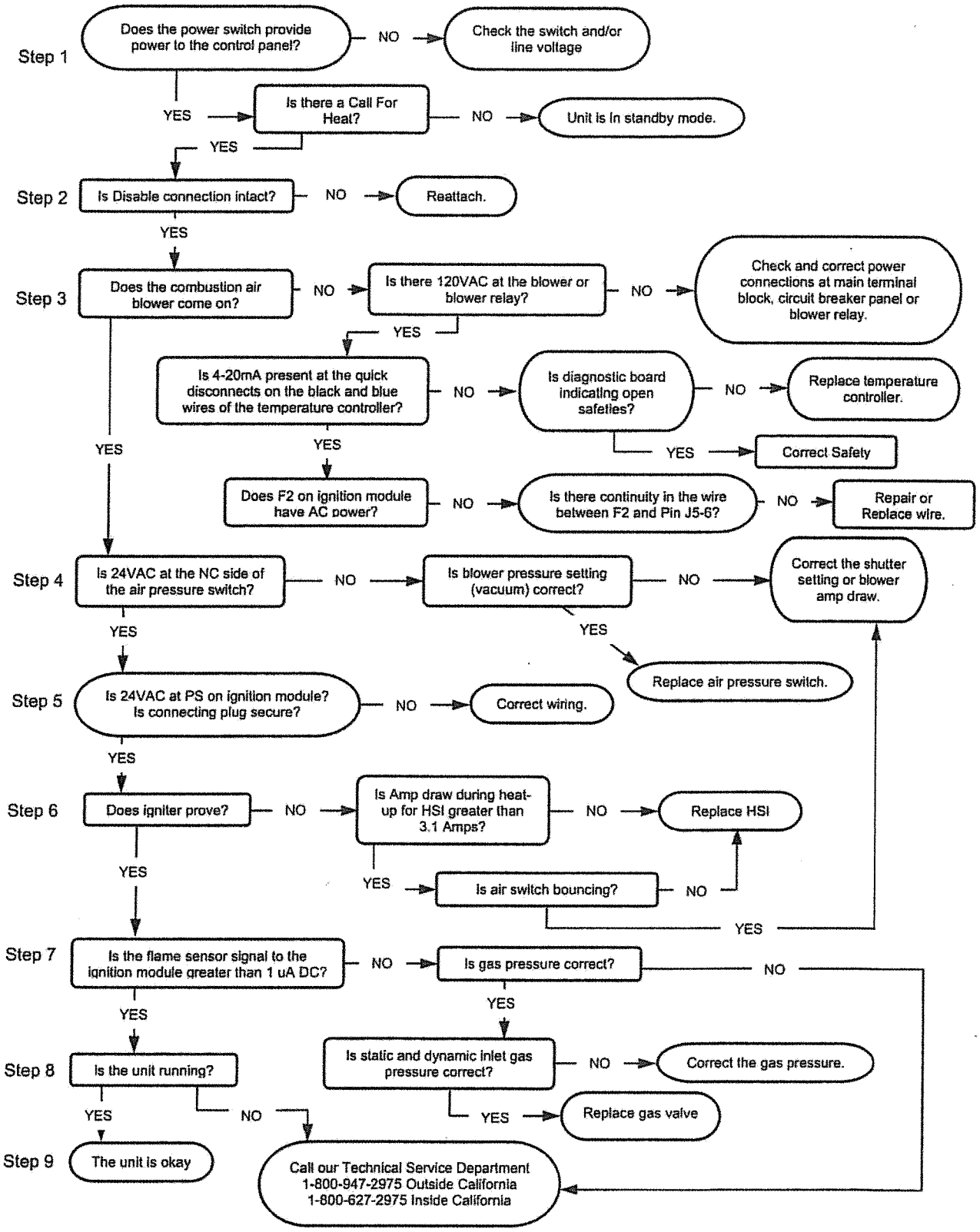
2. Remove upper front panel.

3. Set the thermostat to lowest setting.

4. Turn off all electrical power to the appliance if service is to be performed.

5. Replace access panel.

TROUBLESHOOTING



UDB Fault History

To view the fault codes in the UDB history file:

1. Press and hold the switch labeled "SW1" for 5 seconds to access the fault history. LED 17 will begin to flash when the history has been accessed. See Fig. 44 on page 42.

2. Press the switch labeled "SW2" to scroll through the recorded faults in history.

3. When a fault is being displayed, the corresponding LED will light AND LED 17 will flash at a rate that corresponds to the fault number.

4. The faults are recorded and displayed on a last in, first out basis. The last fault recorded will be the first fault displayed. There is no time or date stamp associated with these faults.

5. Continue to push "SW2" to view subsequent faults.

6. When the history of faults has been exhausted, pushing "SW2" again will roll the fault history over and it will start again.

7. To exit the fault history, press and hold "SW1" for 5 seconds, or wait for 4 minutes and the board will automatically exit the history mode (fault LEDs will go out).

To clear the fault history, press and hold both "SW1" and "SW2" for 5 seconds while the power is on.

NOTE: Once the history has been cleared, it cannot be recovered.

MAINTENANCE

Suggested Minimum Maintenance Schedule

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

Maintenance as outlined below may be performed by the owner.

Daily

1. Check that the area where the heater is installed is free from combustible materials, gasoline, and other flammable vapors and liquids.

2. Check for and remove any obstruction to the flow of combustion or ventilation air to heater.

Monthly

1. Check for piping leaks around pumps, mixing valves, relief valves, and other fittings. If found, repair at once. DO NOT use petroleum-based stop-leak compounds.

2. Visually inspect burner flame.

3. Visually inspect venting system for proper function, deterioration or leakage.

4. Visually inspect for proper operation of the condensate drain in the venting. If leaks are observed repair at once.

5. Check air vents for leakage.

Yearly (Beginning Of Each Heating Season)

Schedule annual service call by qualified service agency.

1. Visually check top of vent for soot. Call service person to clean. Some sediment at bottom of vent is normal.

2. Visually inspect venting system for proper function, deterioration or leakage. Ensure that condensate drain is inspected and ensure that condensate is being directed to appropriate con-

densate management system or drain, as required by local codes.

3. Check that area is free from combustible materials, gasoline, and other flammable vapors and liquids.

4. Check for and remove any obstruction to the flow of combustion or ventilation air to heater.

5. Follow pre-start-up check in the Start-up section.

6. Visually inspect burner flame. It should be light blue at full input. Remove and visually inspect hot surface igniter and sensor for damage, cracking or debris build-up.

7. Check operation of safety devices. Refer to manufacturers' instructions.

8. Follow oil-lubricating instructions on pump (if required). Over-oiling will damage pump. Water-lubricated circulators do not need oiling.

9. To avoid potential of severe burn, DO NOT REST HANDS ON OR GRASP PIPES. Use a light touch; return piping will heat up quickly.

10. Check blower and blower motor

11. Check for piping leaks around pumps, relief valves and other fittings. Repair, if found. DO NOT use petroleum-based stop-leak.

Periodically

1. Check relief valve. Refer to manufacturer's instructions on valve.

2. Test low water cut-off (if equipped). Refer to manufacturer's instructions.

Preventive Maintenance Schedule

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

Daily

1. Check gauges, monitors and indicators.

2. Check instrument and equipment settings. (See "Post Start-Up Check" on page 48.)

3. Check burner flame. (Should see light blue flame at full input rate).

Weekly

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

Monthly

1. Check flue, vent, stack, or outlet dampers.

2. Test blower air pressure. (See "Blower Check" on page 46.)

3. Test high and low gas pressure interlocks (if equipped). (See "Safety Inspection" on page 47.)

Semi-Annually

1. Recalibrate all indicating and recording gauges.

2. Check flame failure detection system components.

3. Check firing rate control by checking the manifold pressure. (See "Manifold Check" on page 46.)

4. Check piping and wiring of all interlocks and shut-off valves.

Annually

1. Test flame failure detection system and pilot turn-down.

2. Test high limit and operating temperature. (See "Post Start-Up Check," page 48.)

3. Check flame sensor.

4. Conduct a combustion test at full fire. Carbon dioxide should be 8.0 to 9.0% at full fire for natural gas, and between 9.0 to 10.0% for propane gas. Carbon monoxide should be < 100 ppm.

5. Check valve coil for 60 cycle hum or buzz. Check for leaks at all valve fittings using a soapy water solution (while heater is operating). Test other operating parts of all safety shut-off and control valves and increase or decrease settings (depending on the type of control) until the safety circuit opens. Reset to original setting after each device is tested.

6. Perform leakage test on gas valves. (See Fig. 46.)

7. Test air switch in accordance with manufacturer's instructions. (Turn panel switch to the "On" position until blower is proven, then turn the switch to "Off."

8. Inspect and clean burner using shop air.

As Required

1. Recondition or replace low water cut-off device (if equipped).

2. Check drip leg and gas strainers.

3. Check flame failure detection system. (See "Post Start-Up Check," page 48.)

4. Check igniter. (Resistance reading should be 42-70 ohms at ambient temperature).

5. Check flame signal strength. (Flame signal should be greater than 1 microampere as measured at the 2 pins on the upper left corner of the ignition control).

6. Check firing rate control by checking the manifold pressure. (See "Manifold Check" on page 46.)

7. Test safety/safety relief valves in accordance with ASME Heater and Pressure Vessel Code Section IV.

APPENDIX

Inside Air Contamination

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

1. Installation is in an area containing contaminants listed below which will induce acidic condensation.

2. You want to reduce infiltration into your building through openings around windows and doors.

3. You are using AL29-4C stainless steel vent pipe, which is more corrosion-resistant than standard metallic vent pipe. In extremely contaminated areas, this may also experience deterioration.

Products causing contaminated combustion air:

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

Areas where contaminated combustion air commonly exists:

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

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

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

Important Instructions for the Commonwealth of Massachusetts

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

GAS PRESSURE SUPERVISION

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

LIMITED PARTS WARRANTY
MVB – TYPES H AND WH
MODELS 503-2003

SCOPE

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

HEAT EXCHANGER WARRANTY

Domestic Hot Water

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

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

Space Heating (Closed Loop System)

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

Thermal Shock Warranty

Twenty (20) years from date of heater installation against "Thermal Shock" (excluded, however, if caused by heater operation at large changes exceeding 150°F between the water temperature at intake and heater temperature, or operating at heater temperatures exceeding 230°F).

ANY OTHER PART MANUFACTURED BY RAYPAK

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

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

ADDITIONAL WARRANTY EXCLUSIONS

This warranty does not cover failures or malfunctions resulting from:

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

PARTS REPLACEMENT

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

TO MAKE WARRANTY CLAIM

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

EXCLUSIVE WARRANTY - LIMITATION OF LIABILITY

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

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

Original Owner	Model Number
Mailing Address	Serial Number
	Date of Installation
City State Zip Code	Installation Site
Daytime Telephone Number	Contractor/Installer

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

NOTES:

START-UP CHECKLIST FOR FAN-ASSISTED RAYPAK PRODUCTS - MVB

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

GAS SUPPLY DATA

Regulator Model & Size _____ / _____CFH
Gas Line Size (in room) _____In. NPT
Length of Gas Line _____Eq Ft
Low Gas Pressure Setting _____In. WC
High Gas Pressure Setting _____In. WC
Gas Shut-Off Valve Type _____
(Ball, Lube cock)
Sediment Trap _____Y/N
Port _____Std_____Full

VISUAL INSPECTION OF COMPONENTS

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

Wiring Harness _____ Y/N
Burner/s (flame) _____ Y/N
Refractory (visual) _____ Y/N
Remote flame sense _____ Y/N
Covers in place for outdoor _____ Y/N

VENTING

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

EMISSIONS SETTINGS AND TEST INFORMATION (AT FULL FIRE)

Blower Pressure Setting	_____In. WC	See manual or card tag
Supply Gas Pressure	_____In. WC	See manual or card tag
Verify stable pressure static &	dynamic condition	
Pilot Gas Pressure	_____In. WC	See manual or card tag
Manifold Gas Pressure	_____In. WC	See manual or card tag

The following measurements must be obtained with a Combustion Analyzer.

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

Model Number: _____ Serial Number: _____
*** Note: draw venting with details, such as extractors, barometric dampers, blast dampers or draft inducers
Site Altitude Above Sea Level _____Ft.

CLEARANCES

Front Clearance _____In.
Right Side Clearance _____In.
Left Side Clearance _____In.
Rear Clearance _____In.
Overhead Clearance _____In.

ELECTRICAL

Voltage Supply (VAC) No Load_____ Load_____
Voltage -24 VAC _____VAC
Voltage Com to Ground _____VAC
Hot Surface Igniter _____Ohms
Auto High Limit Setting _____deg F
Manual Reset High Limit Setting _____deg F
Operating Control Setting _____deg F

Sketch plumbing on reverse side

WATER SUPPLY

Flow Rate in GPM or Delta T _____If Avail
Measure flow rate at full fire
Pump Economaster setting _____Minutes
Low Water Cutoff _____Test
Number of Tanks and Size Qty____ _____Gallons
Plumbing Size _____
Pump Size: _____(boiler) Pump HP: _____
Impeller trim_____ Pump Model_____
Louvers _____ Screens_____

Nominal Factory Recommended Settings

Job Name _____

Address _____

Physical Location of Boiler: Indoors_____; Outdoors_____; Ground Level_____; Roof_____; Below Grade_____

Mechanical Contractor / Installer _____

Date and Time of Start-up _____Print Name and Signature of Start-up Technician_____

Information must be faxed to: (805) 278-5471 in order to ensure warranty consideration Attn: Service Manager

Registered Quality Management System

www.raypak.com

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

COMMERCIAL
MODELS: MVB 503 THRU 2003

CATALOG NO. 9300.74
Effective: 05-01-09
Replaces: 03-30-09

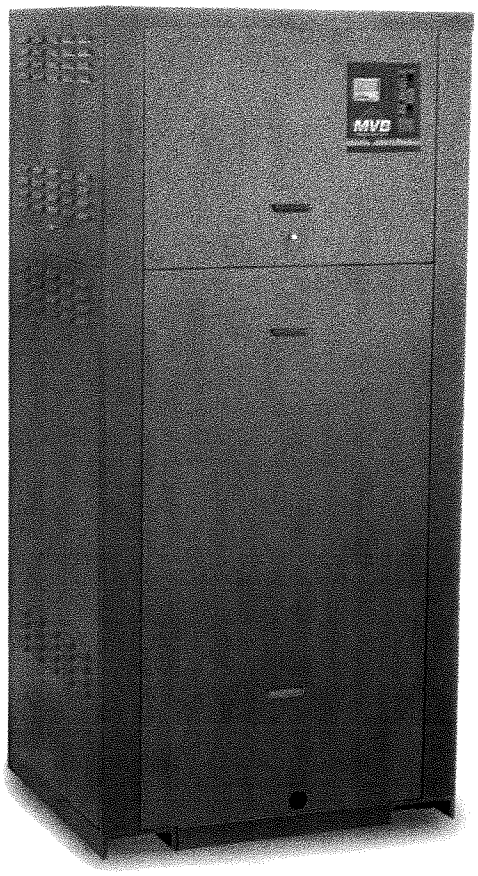
RAYPAK ILLUSTRATED PARTS LIST

MODEL SIZES: 503, 753, 1003, 1253, 1503, 1753 & 2003

MODEL TYPES: MODULATING VERTICAL BOILER H, WH CAT IV

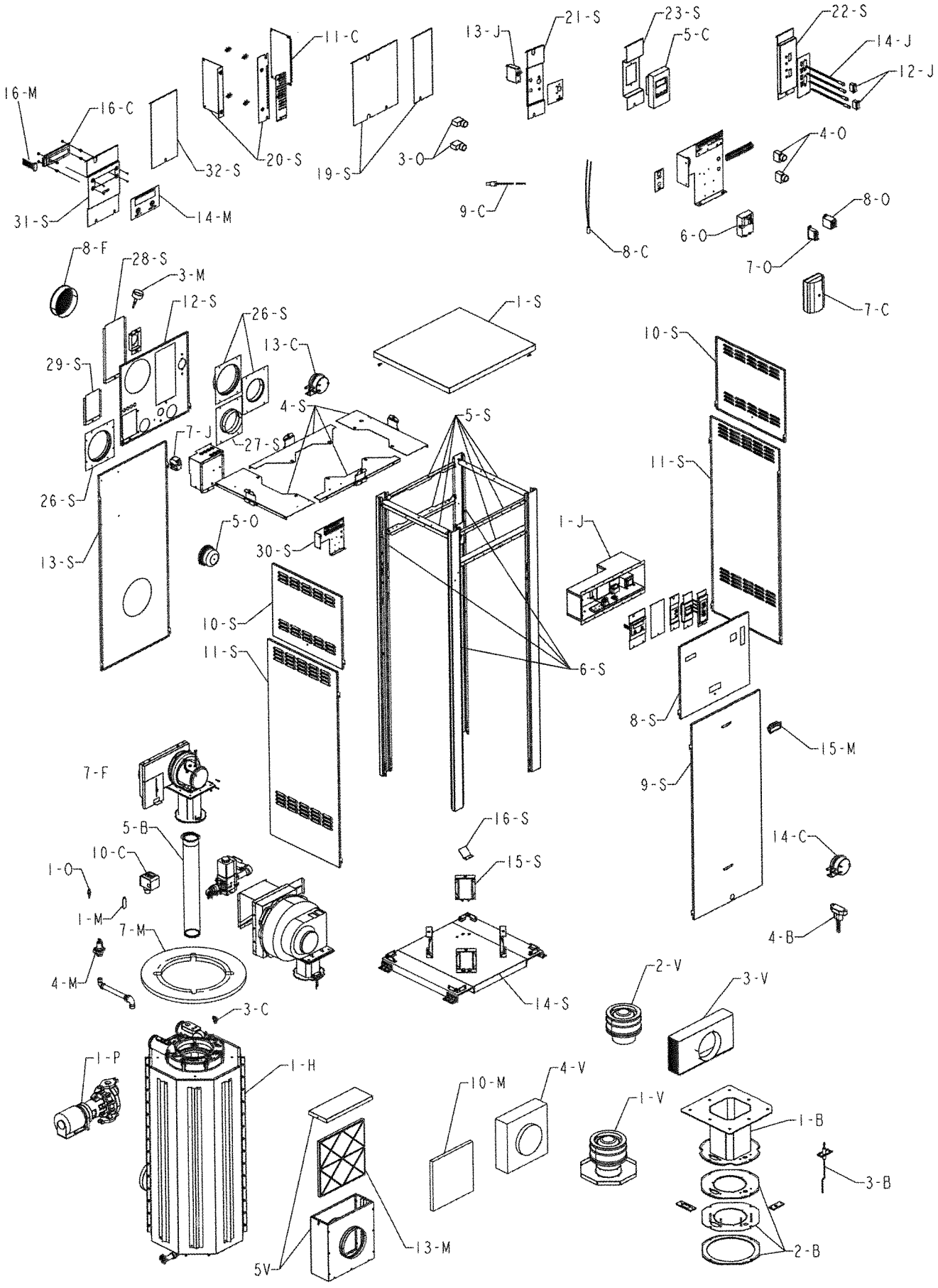
DATES OF MANUFACTURE: 6-01-06 THROUGH CURRENT

THE PARTS LISTED ARE FOR STANDARD EQUIPMENT FOR THIS MODEL TYPE. RAYPAK RESERVES THE RIGHT TO SUBSTITUTE, DELETE OR CHANGE ANY PART WITHOUT NOTIFICATION. THE ADDITION OF OPTIONS MAY ALSO CHANGE SOME OF THE PARTS. ORDER REPLACEMENT PARTS FROM ACTUAL HEATER COMPONENTS.

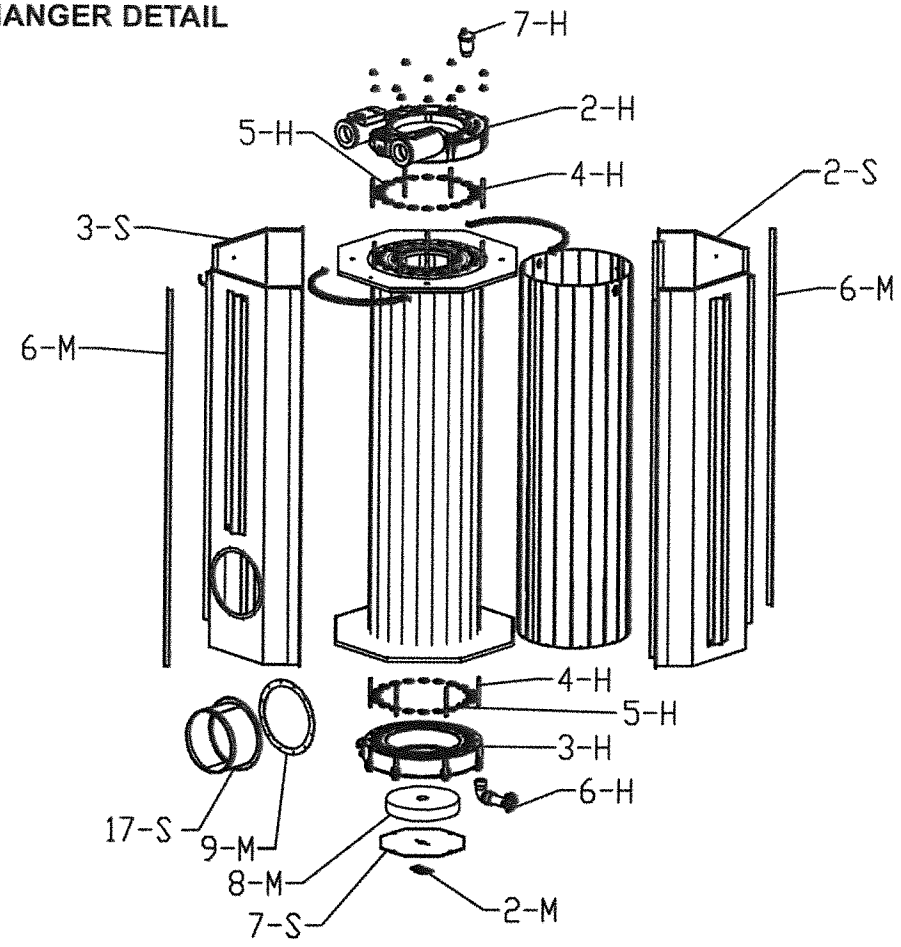


FOR DETAILED INSTRUCTIONS, SEE "HOW TO USE YOUR RAYPAK ILLUSTRATED PARTS LIST", CATALOG NO. 9001.10

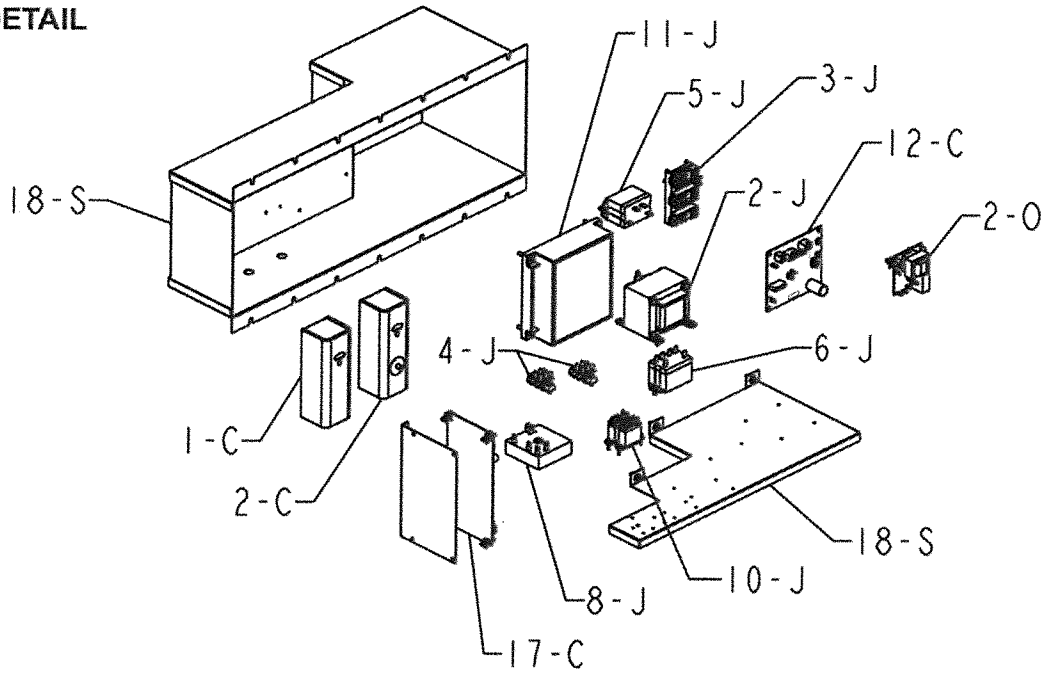
Raypak, Inc., 2151 Eastman Avenue, Oxnard, CA 93030
(805) 278-5300 FAX (805) 278-5489
Litho In U.S.A.
P/N 241293


16-M
16-C
31-S
32-S
11-C
20-S
19-S
3-O
13-J
21-S
9-C
23-S
5-C
22-S
14-J
12-J
4-O
8-C
6-O
8-O
7-O
7-C
14-M
8-F
28-S
3-M
12-S
29-S
26-S
13-S
26-S
13-C
4-S
7-J
27-S
1-S
5-S
5-O
30-S
10-S
11-S
6-S
10-S
11-S
1-J
8-S
15-M
9-S
14-C
4-B
7-F
5-B
10-C
1-O
1-M
7-M
4-M
3-C
16-S
15-S
14-S
2-V
3-V
1-P
1-H
10-M
4-V
1-V
1-B
3-B
2-B
5V
13-M

HEAT EXCHANGER DETAIL

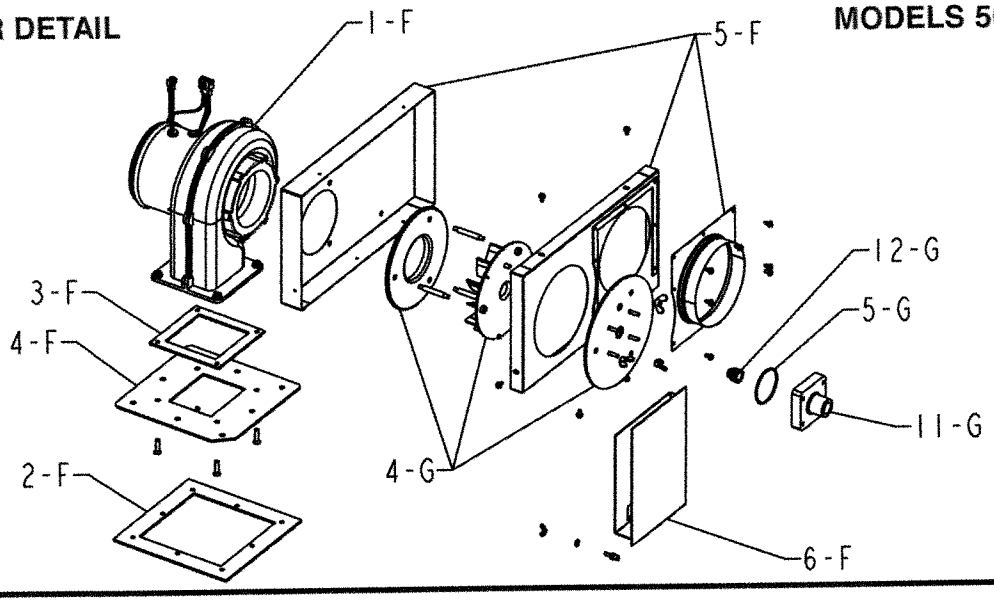


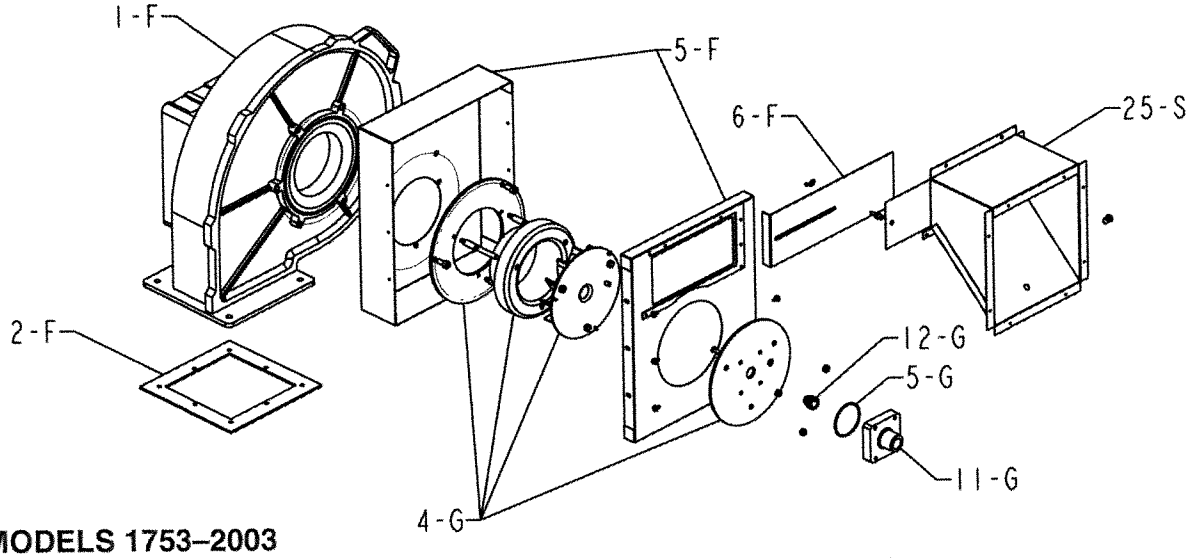
J-BOX DETAIL



BLOWER DETAIL

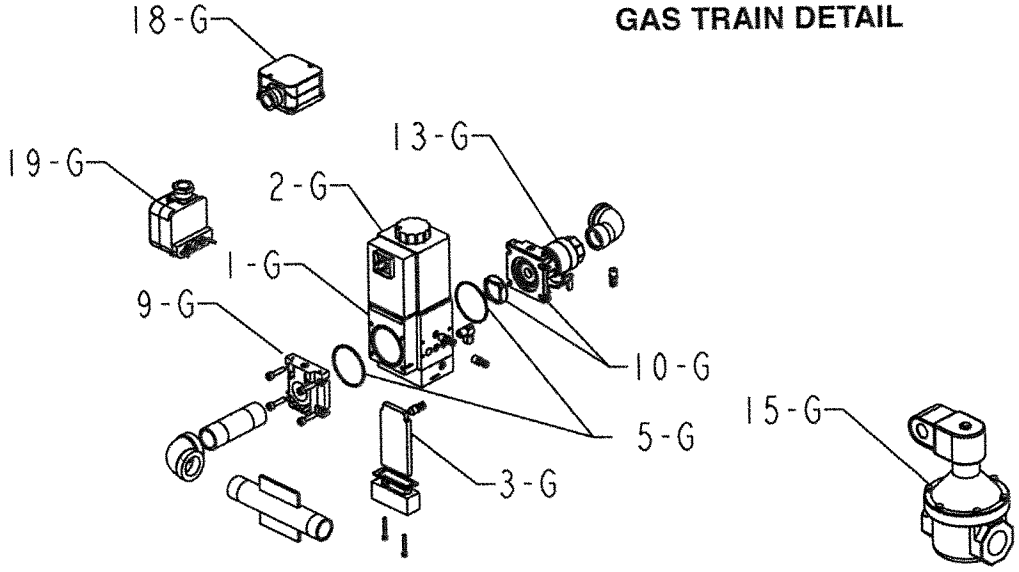
MODELS 503–1503





MODELS 1753–2003

GAS TRAIN DETAIL



CALL OUT	DESCRIPTION	503	753	1003	1253	1503	1753	2003
B	**BURNER ASSEMBLY**							
1-B	Adapter Assembly	011749F	011749F	011749F	011749F	011749F	011750F	011750F
2-B	Adapter Gaskets and Heat Sheild	011751F	011751F	011751F	011751F	011751F	011751F	011751F
3-B	Flame Sensor Probe	011752F	011752F	011752F	011752F	011752F	011752F	011752F
4-B	Igniter	007400F	007400F	007400F	007400F	007400F	007400F	007400F
5-B	Burner	011753F	011754F	011754F	011755F	011755F	011756F	011756F
C	**CONTROLS**							
1-C	Auto Reset Adjustible High Limit 240°F Max	011860F	011860F	011860F	011860F	011860F	011860F	011860F
	Auto Reset Adjustible High Limit 180°F Max	006445F	006445F	006445F	006445F	006445F	006445F	006445F
	Auto Reset Adjustible High Limit 200°F Max	012546F	012546F	012546F	012546F	012546F	012546F	012546F
2-C	Manual Reset Adjustible High Limit 240°F Max	007144F	007144F	007144F	007144F	007144F	007144F	007144F
	Manual Reset Adjustible High Limit 200°F Max	008081F	008081F	008081F	008081F	008081F	008081F	008081F
3-C	Manual Reset Fixed High Limit 240°F	008520F	008520F	008520F	008520F	008520F	008520F	008520F
	Manual Reset Fixed High Limit 200°F	008093F	008093F	008093F	008093F	008093F	008093F	008093F
4-C	Remote Aquastat (Tankstat) 2-Stage B-3 (Not Shown)	007392F	007392F	007392F	007392F	007392F	007392F	007392F
5-C	Controller Modulating (Tekmar)							
	Units manufactured prior to 1/21/08 (601809)	011757F	011757F	011757F	011757F	011757F	011757F	011757F
	Units manufactured from 1/21/08 (601845)	012407F	012407F	012407F	012407F	012407F	012407F	012407F
6-C	Controller 4-Stage B-21 Digital Optional (Not Shown)	009862F	009862F	009862F	009862F	009862F	009862F	009862F
	Controller 2-Stage B-26 Digital Optional (Not Shown)	009861F	009861F	009861F	009861F	009861F	009861F	009861F
7-C	Sensor Outdoor Air B-23	010786F	010786F	010786F	010786F	010786F	010786F	010786F
8-C	Sensor Water B-21 thru B-26	010787F	010787F	010787F	010787F	010787F	010787F	010787F
9-C	Sensor Water screw-In (Tekmar)	011861F	011861F	011861F	011861F	011861F	011861F	011861F
15-C	Sensor Water (Temp Tracker) B-36 thru B-38	012187F	012187F	012187F	012187F	012187F	012187F	012187F
10-C	Flow Switch	007142F	007142F	007142F	007142F	007142F	007142F	007142F
11-C	Printed Circuit Board UDB (Diagnostic) w/LED Lights	011758F	011758F	011758F	011758F	011758F	011758F	011758F
17-C	Printed Circuit Board UDB (Diagnostic) w/LCD Display	012571F	012571F	012571F	012571F	012571F	012571F	012571F
16-C	Diagnostic Display	012662F	012662F	012662F	012662F	012662F	012662F	012662F
12-C	Printed Circuit Board UGB (Blower)	N/A	N/A	N/A	N/A	N/A	011759F	011759F
13-C	Air Vent Pressure Switch	011862F	011862F	011760F	011862F	011760F	011760F	011760F
14-C	Air Intake Pressure Switch	011761F	011761F	011761F	011761F	011761F	011761F	011761F
J	**CONTROL BOX**							
1-J	Control Box Complete	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2-J	Transformer 120/24	011762F	011762F	011762F	011762F	011762F	011762F	011762F
3-J	Terminal Block w / Ground Lug	008523F	008523F	008523F	008523F	008523F	008523F	008523F
4-J	Terminal Block 2 Space	011763F	011763F	011763F	011763F	011763F	011763F	011763F
5-J	Blower Relay 120 VAC	008977F	008977F	008977F	008977F	008977F	N/A	N/A
6-J	Pump Relay 24 VAC	007925F	007925F	007925F	007925F	007925F	007925F	007925F
7-J	Pump Contactor 120 VAC (Over 3/4 HP Pumps)	007906F	007906F	007906F	007906F	007906F	007906F	007906F
8-J	Time Delay Contactor 5 Second	008921F	008921F	008921F	008921F	008921F	008921F	008921F
	Time Delay Contactor 5 Second Make/2Second Break	012184F	012184F	012184F	012184F	012184F	012184F	012184F
11-J	Ignition Control HSI Single Try	009057F	009057F	009057F	009057F	009057F	009057F	009057F
	Ignition Control HSI Three Try	007374F	007374F	007374F	007374F	007374F	007374F	007374F
12-J	Rocker Switch (Burner / Pump)	006872F	006872F	006872F	006872F	006872F	006872F	006872F
13-J	On / Off Shut Down Switch	007380F	007380F	007380F	007380F	007380F	007380F	007380F
14-J	Indicator Lamp	011848F	011848F	011848F	011848F	011848F	011848F	011848F
F	**FAN**							
1-F	Blower Combustion Air	012442F	012443F	012444F	012445F	012446F	011765F	011765F
2-F	Blower Gasket	011885F	011885F	011885F	011885F	011885F	011885F	011885F
3-F	Adapter Gasket	011886F	011886F	011886F	011886F	011886F	N/A	N/A
4-F	Adapter Plate	011887F	011887F	011887F	011887F	011887F	N/A	N/A
5-F	Plenum Assembly	011863F	011863F	011863F	011863F	011863F	011864F	011864F
6-F	Air Shutter	011875F	011875F	011875F	011875F	011875F	011876F	011876F
7-F	Hose Duct 6"	007420F	007420F	007420F	007420F	007420F	N/A	N/A
8-F	Screen Intake Vent Cap	007162F	007162F	007162F	011865F	011865F	011865F	011865F
G	**GAS TRAIN**							
1-G	Valve Gas Modulating (Dungs) Natural Gas	011766F	011766F	011766F	011766F	011766F	011768F	011768F
	Valve Gas Modulating (Dungs) Propane Gas	011766F	011766F	011766F	011766F	011766F	011766F	011766F
2-G	Valve Coil Nat	012310F	012310F	012310F	012310F	012310F	012311F	012311F
	Valve Coil Pro	012310F	012310F	012310F	012310F	012310F	012310F	012310F
3-G	Inlet Gas Filter	012294F	012294F	012294F	012294F	012294F	012295F	012295F
4-G	Swirler	011888F	011888F	011888F	011888F	011888F	011889F	011889F
5-G	O Rings (Includes Gas Valve and Adapter O Rings)	012440F	012440F	012440F	012440F	012440F	012441F	012441F
5-G	O Rings (Includes Gas Valve and Adapter O Rings)	012440F	012440F	012440F	012440F	012440F	012441F	012441F
	Adapter Gas Valve 1-1/4" Inlet (Includes O Rings)	N/A	N/A	011916F	011916F	011916F	N/A	N/A
	Adapter Gas Valve 2" Inlet (Includes O Rings)	N/A	N/A	N/A	N/A	N/A	011917F	011917F
10-G	Adapter Gas Valve Outlet (Includes O Ring)							
	Units manufactured prior to 4/7/08	012296F	012296F	012296F	012296F	012296F	012297F	012297F
	Units manufactured from 4/8/08	012545F	012545F	012545F	012545F	012545F	012297F	012297F
11-G	Adapter Swirl Plate	012298F	012298F	012298F	012298F	012298F	012298F	012298F
12-G	Nozzle Natural Gas	012299F	012300F	012301F	012302F	012303F	012304F	012305F
	Nozzle Propane Gas	012306F	012307F	012308F	012308F	012308F	012300F	012301F
13-G	Valve Gas Ball (WOG)	011769F	011769F	011769F	011769F	011769F	011769F	011769F
14-G	Motorized Safety Shut Off Valve (Optional)	011908F	011908F	011908F	011908F	011908F	011908F	011908F
15-G	Solenoid Safety Shut Off Valve Nat (Optional)	011909F	011909F	011910F	011910F	011910F	011911F	011911F
	Solenoid Safety Shut Off Valve Pro (Optional)	011909F	011909F	011909F	011909F	011909F	011909F	011909F
17-G	Vent Valve Gas (Optional) Not Shown	011913F	011913F	011914F	011914F	011914F	011914F	011914F
18-G	Switch Low Gas Pressure (Optional)	011770F	011770F	011770F	011770F	011770F	011770F	011770F
19-G	Switch High Gas Pressure (Optional)	011771F	011771F	011771F	011771F	011771F	011771F	011771F

CALL OUT	DESCRIPTION	503	753	1003	1253	1503	1753	2003
H	**HEAT EXCHANGER**							
1-H	Heat Transfer Cupro-Nickle Bronze (Includes 15-S)	011780F	011781F	011782F	011783F	011784F	011785F	011786F
	Heat Transfer Cupro-Nickle Cast Iron (Includes 15-S)	011959F	011961F	011963F	011965F	011967F	011969F	011971F
	Heat Transfer Copper Bronze (Includes 15-S)	011773F	011774F	011775F	011776F	011777F	011778F	011779F
	Heat Transfer Copper Cast Iron (Includes 15-S)	011958F	011960F	011962F	011964F	011966F	011968F	011970F
2-H	Inlet/Outlet Header Bronze	009102F	009102F	009103F	009103F	009103F	009103F	009103F
	Inlet/Outlet Header Cast Iron	012331F	012331F	012332F	012332F	012332F	012332F	012332F
3-H	Return Header Bronze	007204F	007204F	007204F	007204F	007204F	007204F	007204F
	Return Header Cast Iron	012330F	012330F	012330F	012330F	012330F	012330F	012330F
4-H	Studbolt	009104F	009104F	009104F	009104F	009104F	009104F	009104F
5-H	Header Gasket (20 PCS)	007343F	007343F	007343F	007343F	007343F	007343F	007343F
6-H	Drain Valve	006536F	006536F	006536F	006536F	006536F	006536F	006536F
7-H	Air Vent Valve	011866F	011866F	011866F	011866F	011866F	011866F	011866F
M	**MISCELLANEOUS COMPONENTS**							
1-M	Flow Switch Paddle (Taco)	010026F	010026F	010026F	010026F	010026F	010026F	010026F
2-M	Window Combustion Chamber	006947F	006947F	006947F	006947F	006947F	006947F	006947F
3-M	T & P Guage 0-75 PSI	007205F	007205F	007205F	007205F	007205F	007205F	007205F
	T & P Guage 0-200 PSI	007399F	007399F	007399F	007399F	007399F	007399F	007399F
4-M	PRV 30 PSI	007217F	007218F	007748F	007748F	007748F	007748F	007748F
	PRV 45 PSI	007220F	007346F	007221F	007221F	007751F	007751F	007752F
	PRV 60 PSI	007222F	007222F	007222F	007753F	007753F	007754F	007754F
	PRV 75 PSI	007223F	007223F	007223F	007223F	007756F	007756F	007756F
	PRV 125 PSI	007224F	007224F	007224F	007224F	007224F	007758F	007758F
	PRV 150 PSI	007225F	007225F	007225F	007225F	007225F	007225F	007225F
5-M	RTV Sealant 2.8 oz (Not Shown)	008924F	008924F	008924F	008924F	008924F	008924F	008924F
	RTV Sealant 10 oz (Not Shown)	005755F	005755F	005755F	005755F	005755F	005755F	005755F
6-M	Flue Collector Vertical Seal Gasket	011772F	011772F	011772F	011772F	011772F	011772F	011772F
7-M	Heat Transfer Insulation Blanket	011896F	011896F	011896F	011896F	011896F	011896F	011896F
8-M	Insulation Blanket Return Header	007241F	007241F	007241F	007241F	007241F	007241F	007241F
9-M	Flue Exhaust Adapter Gasket	009735F	009735F	009735F	009736F	009736F	009736F	009736F
10-M	Inline Intake Air Filter	008402F	008402F	008402F	011897F	011897F	011897F	011897F
13-M	Inline Intake Air Filter Premium	012552F	012552F	012552F	012553F	012553F	012553F	012553F
14-M	Membrane Switch	012598F	012598F	012598F	012598F	012598F	012598F	012598F
11-M	Touch up Paint (Green) Not Shown	750125	750125	750125	750125	750125	750125	750125
	Touch up Paint (Dark Gray) Not Shown	750126	750126	750126	750126	750126	750126	750126
12-M	Wire Harness							
	Units manufactured without 30-S Wiring Panel	012538F	012538F	012538F	012538F	012538F	012538F	012538F
	Units manufactured with 30-S Wiring Panel	012566F	012566F	012566F	012566F	012566F	012566F	012566F
	Units manufactured with 16-C LCD Display	012625F	012625F	012625F	012625F	012625F	012625F	012625F
16-M	LCD Display Wire Harness	011715F	011715F	011715F	011715F	011715F	011715F	011715F
15-M	Plastic Handle	012681F	012681F	012681F	012681F	012681F	012681F	012681F
O	**OPTIONS**							
1-O	Remote Sensor (LWCO)	007228F	007228F	007228F	007228F	007228F	007228F	007228F
2-O	Control PC Board (LWCO)	007157F	007157F	007157F	007157F	007157F	007157F	007157F
3-O	Test / Reset Switch (LWCO)	005641F	005641F	005641F	005641F	005641F	005641F	005641F
4-O	Silencer/Reset Switch (Alarm)	005641F	005641F	005641F	005641F	005641F	005641F	005641F
5-O	Alarm Bell 3"	005642F	005642F	005642F	005642F	005642F	005642F	005642F
	Alarm Bell 4"	005643F	005643F	005643F	005643F	005643F	005643F	005643F
6-O	Time Delay Contactor 5 Second (Alarm / Dry contacts)	008921F	008921F	008921F	008921F	008921F	008921F	008921F
7-O	Relay SPDT 24 VAC (Alarm / Dry Contact)	009039F	009039F	009039F	009039F	009039F	009039F	009039F
8-O	Relay DPDT 24 VAC (Alarm)	011720F	011720F	011720F	011720F	011720F	011720F	011720F
P	**PUMPS**							
1-P	Pump -Circulating - Bronze (Soft Water)	007226F	007226F	007227F	011845F	007348F	007351F	007351F
	Pump -Circulating - Bronze (Medium Water)	007226F	007347F	011845F	007351F	007351F	007937F	007937F
	Pump -Circulating - Bronze (Hard Water)	007349F	007349F	007351F	007351F	007351F	007937F	007937F
	Pump -Circulating - CI (Soft Water)	007232F	007232F	007233F	011846F	007354F	007357F	007357F
	Pump -Circulating- CI (Medium Water)	007232F	007353F	011846F	007357F	007357F	007938F	007938F
	Pump -Circulating- CI (Hard Water)	007355F	007355F	007357F	007357F	007357F	007938F	007938F
S	**SHEETMETAL**							
1-S	Jacket Top	011833F	011833F	011833F	011833F	011833F	011833F	011833F
2-S	Flue Collector Front (No Opening) (Includes **6-M** and **8-M**)	011787F	011788F	011789F	011790F	011791F	011792F	011793F
3-S	Flue Collector Rear (Opening) (Includes **6-M** and **8-M**)	011794F	011795F	011796F	011797F	011798F	011799F	011800F
4-S	Heat Transfer Supports	009107F	009107F	009107F	009107F	009107F	009107F	009107F
5-S	Upper Cabinet Supports	011849F	011849F	011849F	011849F	011849F	011849F	011849F
6-S	Vertical Cabinet Supports	011801F	011802F	011803F	011804F	011805F	011806F	011807F
7-S	Return Header Cover	007257F	007257F	007257F	007257F	007257F	007257F	007257F
8-S	Jacket Upper Front Panel	011808F	011808F	011808F	011808F	011808F	011809F	011809F
	Jacket Upper Front Panel w/LCD Display	012699F	012699F	012699F	012699F	012699F	012700F	012700F
9-S	Jacket Lower Front Panel	011810F	011811F	011812F	011813F	011814F	011815F	011816F
10-S	Jacket Upper Side Panel	011817F	011817F	011817F	011817F	011817F	011818F	011818F
11-S	Jacket Lower Side Panel	011819F	011820F	011821F	011822F	011823F	011824F	011825F
12-S	Jacket Upper Rear Panel	011877F	011877F	011878F	011879F	011879F	011880F	011880F
13-S	Jacket Lower Rear Panel	011826F	011827F	011828F	011829F	011830F	011831F	011832F
14-S	Base Assembly	009129F	009129F	009129F	009129F	009129F	009129F	009129F
15-S	Leg Bracket (4 pcs per boiler)	007306F	007306F	007306F	007306F	007306F	007306F	007306F
16-S	Base Reflector Panel	007307F	007307F	007307F	007307F	007307F	007307F	007307F
17-S	Flue Exhaust Adapter Assembly	011900F	011900F	011900F	011901F	011901F	011901F	011901F
18-S	Control Box Assy	011869F	011869F	011869F	011869F	011869F	011869F	011869F
19-S	Control Box Cover (2 Panels)	011870F	011870F	011870F	011870F	011870F	011870F	011870F
20-S	Control Box Cover Panel w/Lights	011871F	011871F	011871F	011871F	011871F	011871F	011871F
31-S	Control Box Cover Panel w/LCD Display	012697F	012697F	012697F	012697F	012697F	012697F	012697F
32-S	Control Box Cover Panel	012698F	012698F	012698F	012698F	012698F	012698F	012698F
21-S	Power Switch Mounting Panel	011872F	011872F	011872F	011872F	011872F	011872F	011872F
22-S	Blower/Pump Switch Mounting Panel	011873F	011873F	011873F	011873F	011873F	011873F	011873F
23-S	Controller Mounting Panel	011874F	011874F	011874F	011874F	011874F	011874F	011874F
25-S	Intake Air Vent	N/A	N/A	N/A	N/A	N/A	011881F	011881F
25-S	Intake Air Adapter	N/A	N/A	N/A	N/A	N/A	011881F	011881F
27-S	Intake Air Collar (Inside)	011905F	011905F	011905F	011905F	011905F	N/A	N/A
28-S	Access Panel	011883F	011883F	011883F	011883F	011883F	011884F	011884F
29-S	Access Panel Wiring Box	011906F	011906F	011906F	011906F	011906F	011906F	011906F
30-S	24V Wiring Panel	012567F	012567F	012567F	012567F	012567F	012567F	012567F
V	**VENTING**							
1-V	Outdoor Stack	011894	011894	011894	011895	011895	011895	011895
2-V	Vent Cap Vertical for Indoor Units	010802	010802	010802	010803	010803	010803	010803
3-V	Vent Cap Horizontal Thru-the-Wall for Indoor Units	006644	006644	006644	006646	006646	006646	006646
4-V	Inline Air filter (Complete)	006926	006926	006926	006927	006927	006927	006927
5-V	Inline Air filter Premium (Complete)	012460	012460	012460	012461	012461	012461	012461

Registered Quality Management System

www.raypak.com

INSTALLATION & OPERATING INSTRUCTIONS

TEMP-TRACKER

2 & 4-Stage Temperature Controllers

For Raytherm™ & Hi Delta™ Boilers & Water Heaters

Raypak®
A Rheem® Company

Catalog No. 5000.66C Effective: 05-23-08 Replaces: 04-09-07 P/N 241177 Rev. 4

Rev. 4 reflects the following: **Changes to:** some of the headings in the **Piping** section on pages 4 through 6, Fig. 10 on page 5, Fig. 21 and Fig. 24 on page 20 and the text in step 3 in the **Quick Start Set-up & Programming Tips** section on page 21; **The addition of:** a wiring note on page 3 and a note in reference to Table D on the bottom of page 16.

CONTENTS

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

INTRODUCTION

The Temp-Tracker 2-stage and 4-stage temperature controllers (Controller) are designed to be mounted on boilers with up to four stages of operation in order to provide accurate water temperature control in a variety of applications. The Controllers may be used to provide a setpoint temperature, outdoor reset with reset override, or dedicated domestic hot water (DHW) generation. An additional relay contact is included to provide an alarm signal in case of a sensor failure.

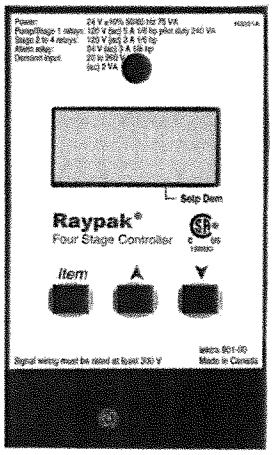
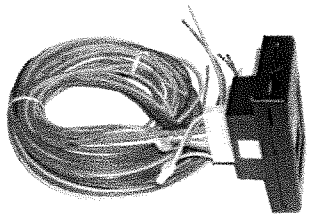


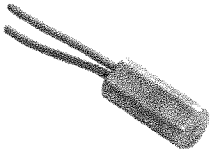
Fig. 1: Temp-Tracker Controller

You should have received:

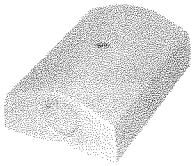
(1) Controller with wiring harness
(3) Water sensors
(1) Outdoor air sensor (optional)



Controller with Wiring Harness



Water Sensor



Outdoor Air Sensor

Fig. 2: Temp-Tracker Controller Kit

USER INTERFACE

The Controller uses a Liquid Crystal Display (LCD) as a method of supplying information. You use the LCD in order to setup and monitor the operation of your system. The Controller uses three push buttons (*Item*, ▲, ▼) for selecting and adjusting the settings (see Fig. 3). As you program your Controller, record your settings in the actual settings columns of the Adjust menu in tables E & F, found on pages 17 & 18.

Fig. 3: Controller Push Buttons

Menu

All of the items displayed by the Controller are organized into two menus. These menus are listed on the upper right-hand side of the display (Menu Field). The default menu for Controller is the View menu. While in

the View menu, the View segment is displayed. To select the Adjust menu, press and hold all three buttons simultaneously for two seconds (see Fig. 3). The display then advances to the Adjust menu and the Adjust segment is turned on in the display. The display will automatically revert back to the View menu after 20 seconds of keypad inactivity. Once in a menu, there will be a group of items that can be viewed within that menu.

NOTE: Before adjusting the controller, set DIP switch "1" (Advanced/Installer), located on the back of the Controller, to the ON position.

Fig. 4: DIP Switches

Item

The abbreviated name of the selected item will be displayed in the item field of the display. To view the next available item in a menu, pressing and releasing the Item button will return the display to the first item in the selected menu (see Fig. 5).

Fig. 5: Item Button

Adjust

To make an adjustment to a setting in the Controller, begin by selecting the Adjust menu by pressing and holding simultaneously all three buttons for two seconds. Then select the desired item using the Item button. Finally, use the ▲ or ▼ button to make the adjustment (see Fig. 6).

Fig. 6: Adjust Buttons

Additional information can be gained by observing the Status field of the LCD. The status field will indicate which of the Controller's outputs are currently active. Most symbols in the status are only visible when the ***View*** menu is selected.

Display

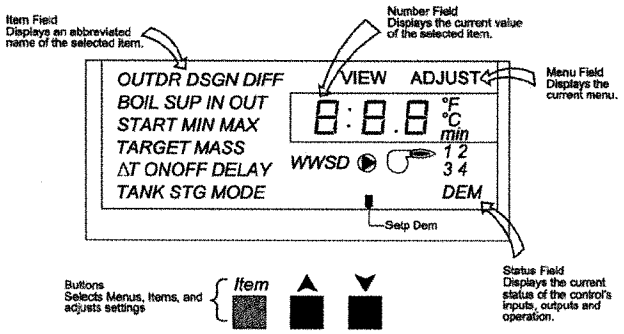


Fig. 7: Display

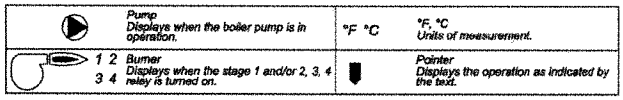


Fig. 8: Symbol Description

SEQUENCE OF OPERATION

General

Powering up the Controller

When the Controller is powered up, it turns on all segments in the display for 2 seconds. Next, the software version is displayed for 2 seconds. Finally, the Controller enters into the normal operating mode.

Piping

Primary Piping (4 Stages Only)

In primary piping applications, the boiler outlet temperature is typically the same temperature that is being delivered out to the system. Therefore, the operating sensor in primary piping applications is the boiler outlet sensor (see Fig. 9).

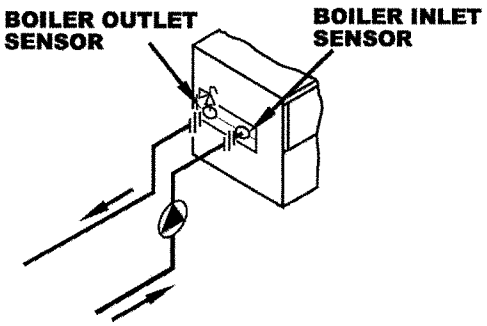


Fig. 9: Primary Piping

Primary/Secondary Piping

In primary/secondary applications, the boiler outlet temperature is typically higher than the system loop temperature. Therefore, the Controller uses an additional sensor (demand) to measure the temperature in the system. The operating sensor in primary/ secondary piping applications is the demand sensor. See Fig. 10.

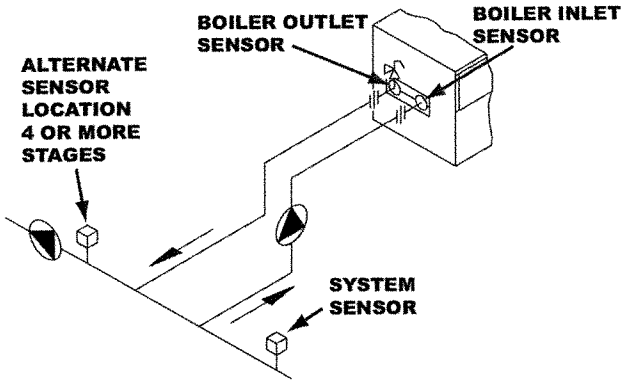


Fig. 10: Primary/Secondary Piping

Modes of Operation (Mode)

NOTE: Mode of operation MUST be programmed into the Controller. See Fig. 20 through 24 on pg. 20.

The Controller allows for six modes of operation in order to define the Controller operation and piping arrangement used. The piping arrangement can be categorized into primary or primary/secondary. The mode of operation is selected using the MODE item in the adjust menu. The operating sensor measures the temperature being controlled out to the heating system.

The piping arrangement determines which sensor the Controller uses as the operating sensor. The operating sensor is either the boiler outlet sensor or the demand sensor. (See page 20 for typical applications)

Typically, Raypak recommends Mode 2 for primary/secondary hydronics; Mode 3 for domestic hot water; and Mode 5 for primary/secondary hydronics using outdoor reset.

Setpoint Operation, Primary Piping — Mode 1 (MODE = 1) (Not Recommended)

Mode 1 is designed for setpoint operation using series piping. Once a heat demand is present, the Controller operates the boiler stages to maintain a fixed temperature at the boiler outlet sensor. Refer to page 9 for a description of setpoint operation.

Mode 1 requires the use of two water sensors. The inlet water sensor (terminals 8 and 9) is located in the inlet side of the in/out header. The outlet sensor (terminals 7 and 9) is located in the outlet side of the in/out header.

To program:

1. Set DIP Switch "1" to ON.

2. Press and hold the "*Item*", "▲" & "▼" buttons simultaneously for 2 seconds to enter the program mode.

3. Use the following settings as a guide to program the Controller; your settings may differ depending upon the system requirements.

Mode:	1 (see Fig. 20)
Stgmode:	PID
Boil Target:	170°
Boil Max:	190°
Boil Min:	105°
Boil Mass:	1
Diff:	20°
Dly:	Off
Meas:	°F

Setpoint Operation, Primary/Secondary Piping — Mode 2 (MODE = 2)

Mode 2 is designed for setpoint operation using primary/secondary piping. Once a heat demand is present, the Controller operates the boiler stages to maintain a fixed temperature at the demand sensor. Refer to page 9 for a description of setpoint operation.

Mode 2 requires the use of three water sensors. The inlet water sensor (terminals 8 and 9) is located in the inlet side of the in/out header. The outlet sensor (terminals 7 and 9) is located in the outlet side of the in/out header. The demand sensor (terminals 6 and 9) must be located as shown in Fig. 21.

General Heating Setup (Staged Control)

Mode:	2 (see Fig. 21)
Stage Mode:	PID
Boiler Target:	180°
Boiler Max:	200°
Boiler Min:	105°
Mass:	1
Diff:	5°
Delay:	Off
Meas:	°F

Water Source Heat Pump Setup (On/Off Control Only—Sales Option B28)

Domestic Hot Water Operation, Uni-Temp 80 Piping (Mode 3)

Mode 3 is designed for dedicated DHW operation using Unitemp 80 piping. The Controller operates the boiler based on the boiler outlet sensor to maintain a tank temperature at the demand sensor. Refer to page 10 for a description of dedicated DHW operation.
Mode 3 requires the use of three water sensors. The inlet water sensor (terminals 8 and 9) is located in the inlet side of the in/out header and the outlet sensor (terminals 7 and 9) is located in the outlet side of the in/out header. The demand sensor (terminals 6 and 9) must be located in the storage tank.

To program:

1. Set DIP Switch "1" to ON.

2. Press and hold the "*Item*", "▲" & "▼" buttons simultaneously for 2 seconds to enter the program mode.

3. Use the following settings as a guide to program the Controller; your settings may differ depending upon the system requirements.

Mode:	3 (see Fig. 11 & 22)
Stage Mode:	PID
Boiler Target:	Tank Target + Max ΔT°
Target Tank:	130°
Tank Diff:	10°
Boil Max:	Tank Target + Max ΔT°
Boil Min:	105°
Boil Mass:	1
Diff:	10°
Dly Pump:	Off
Meas:	°F

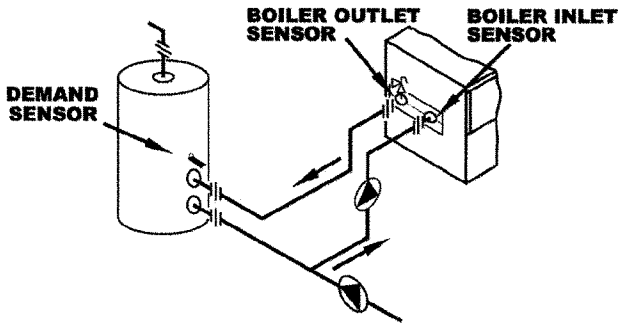


Fig. 11: Domestic Hot Water Piping

Primary Piping with Outdoor Reset (Mode 4) (No Recommended)

Mode 4 is designed for outdoor reset operation using primary piping. Once a heat demand is present, the Controller operates the boiler stages to maintain an outdoor reset temperature at the boiler outlet sensor.

Mode 4 requires the use of two water sensors and one air sensor. The inlet water sensor (terminals 8 and 9) is located in the inlet side of the in/out header and the outlet sensor (terminals 7 and 9) is located in the outlet side of the in/out header (see Fig. 23 on pg. 20).

The outdoor air sensor (terminals 4 and 5) must be located on the coldest side of the building in a shaded area out of direct sunlight.

To program:

1. Set DIP Switch "1" to ON.

2. Press and hold the "*Item*", "▲" & "▼" buttons simultaneously for 2 seconds to enter the program mode.

3. Use the following settings as a guide to program the Controller, your settings may differ depending upon the system requirements.

Mode:	4 (see Fig. 23)
Stage Mode:	PID
Boiler Target:	140°
Outdoor Start:	70°
Outdoor Design:	32°
Boiler Start:	105°
Boiler Design:	180°
Boiler Max:	200°
Boiler Min:	105°
Mass:	1
Diff:	20°
Dly Pump:	Off
WWSD:	80°
Meas:	°F

Primary/Secondary Piping with Outdoor Reset (Mode 5)

Mode 5 is designed for outdoor reset operation using primary/secondary piping. Once a setpoint demand is present, the Controller operates the boiler stages to maintain a setpoint temperature at the demand sensor. Refer to page 10 for a description of outdoor reset operation.

Mode 5 requires the use of three water sensors and one air sensor. The inlet water sensor (terminals 8 and 9) is located in the inlet side of the in/out header. The outlet sensor (terminals 7 and 9) is located in the outlet side of the in/out header. The demand sensor (terminals 6 and 9) must be located on the system supply pipe. (See Fig. 24 on pg. 20.)

The outdoor air sensor (terminals 4 and 5) must be located on the coldest side of the building in a shaded area out of direct sunlight.

To program:

1. Set DIP Switch "1" to ON.
2. Press and hold the "*Item*", "▲" & "▼" buttons simultaneously for 2 seconds to enter the program mode.
3. Use the following settings as a guide to program the Controller, your settings may differ depending upon the system requirements.

Mode:	5 (see Fig. 24)
Stg Mode:	PID
Boil Target:	140°
Outdoor Start:	70 °
Outdoor Design:	32°
Boiler Start:	105°
Boiler Design:	180°
Boiler Max:	200°
Boiler Min:	105°
Mass:	1
Diff:	20°
Dly Pump:	Off
WWSD:	80°
Meas:	°F

External Boiler Control Operation (Mode 6)

Mode 6 is NOT supported by Raypak to operate multiple boilers.

Code Descriptions

Boiler Differential (DIFF)

A heat source must be operated with a differential in order to prevent short cycling. The boiler differential is divided around the boiler target temperature. The first-stage contact will close when the water temperature at the operating sensor is 1/2 of the differential setting below the boiler target temperature, and will open when the water temperature at the operating sensor is 1/2 of the differential setting above the boiler target temperature. The remaining stages will operate sequentially based on the staging mode selected.

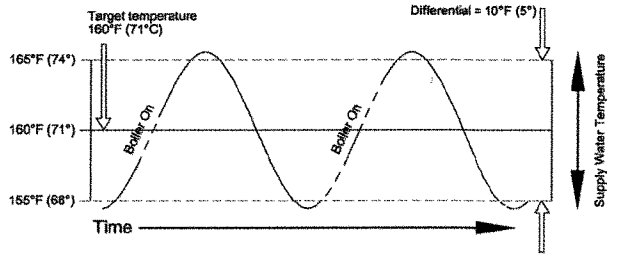


Fig. 12: Boiler Differential

Staging Mode (STGMODE)

The Controller can operate up to four stages in order to supply the required target temperature. The method of staging used by the Controller is either P (proportional) or PID (proportional, integral & derivative), and is selected using the STGMODE item in the adjust menu.

Proportional (P)

Proportional staging is based on manually-adjusted settings that determine when the next stage is required to turn on. These manual settings are based on temperature and time. The interstage differential sets the temperature drop at which the next stage turns on. However, in order for a stage to fire, both the "interstage delay on" and "minimum off" times must first elapse.

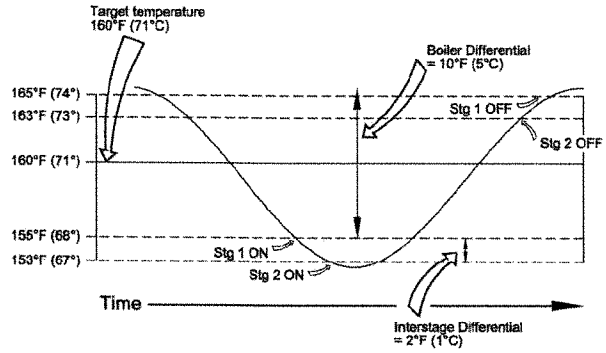


Fig. 13: Proportional Staging

Interstage Differential (STG DIFF)

The "interstage differential" is the temperature drop at which the next stage will turn on. Once a stage turns on, the next stage cannot turn on until the temperature drops the "interstage differential" below the temperature at which the previous stage turned on. The "interstage differential" is adjustable through the STG DIFF setting in the adjust menu.

Interstage Delay On (ON DLY)

The "interstage delay on" is the amount of time that must elapse before turning on the next stage. Once a stage turns on, the next stage cannot turn on until the interstage delay on time elapses. The interstage delay on is adjustable through the ON DLY setting in the adjust menu.

Interstage Delay Off (OFF DLY)

The "interstage delay off" is the amount of time that must elapse before turning off the next stage. Once a stage turns off, the next stage cannot turn off until the interstage delay off time has elapses. The interstage delay off is adjustable through the OFF DLY setting in the adjust menu.

Minimum On Time (MIN ON)

The "minimum on" time is the minimum amount of time that a stage must be on before it is allowed to turn off. Once a stage turns off, the next stage cannot turn off until minimum on time elapses. The minimum on time is adjustable through the MIN ON setting in the Adjust menu.

Minimum Off Time (MIN OFF)

The "minimum off" time is the minimum amount of time that a stage must be off before it is allowed to turn on. Once a stage turns off, it cannot turn on until minimum off time elapses. The minimum off time is adjustable through the MIN OFF setting in the adjust menu.

Proportional, Integral & Derivative (PID)

PID staging allows the Controller to determine when the next stage is required to turn on or off. The Controller automatically determines the settings that are manually selected in the proportional mode.

After each stage is turned on in the firing sequence, the Controller waits a minimum amount of time before turning on the next stage. After the minimum time delay between stages has passed, the Controller examines the control error to determine when the next stage is to fire. The control error is determined using PID logic.

Proportional compares the actual operating sensor temperature to the boiler target temperature. The colder the temperature, the sooner the next stage is turned on.

Integral compares the operating sensor temperature offset (error) to the boiler target temperature over a period of time.

Derivative determines how fast or slow the operating sensor temperature is changing. If the temperature is increasing slowly, the next stage is turned sooner. If the temperature is increasing quickly, the next stage is turned on later, if at all.

Boiler Mass (BOIL MASS)

The boiler mass setting (1, 2 or 3) allows the installer to adjust the Controller to the thermal mass of different types of heat sources used. The boiler mass setting automatically determines the interstage differential, interstage delay on, interstage delay off, minimum on time and minimum off time of the stages when PID staging is used. A higher thermal mass setting provides slower staging, while a lower thermal mass provides faster staging.

Boiler Mass Definitions	
Mass 1	Low Volume, High Recovery
Mass 2	Medium Volume, Medium Recovery
Mass 3	High Volume Low Recovery

Table A: Boiler Mass Definitions

NOTE: It is recommended to use a boiler mass setting of 1 for Raypak equipment. If the Controller continues to stage too rapidly, contact Raypak.

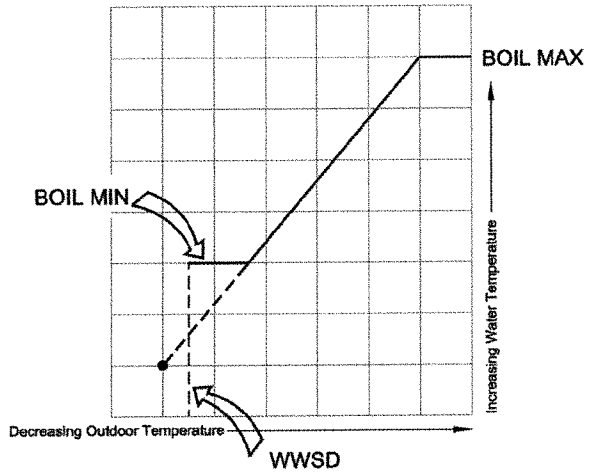


Fig. 14: Warm Weather Shutdown

Boiler Minimum (BOIL MIN)

The BOIL MIN is the lowest water temperature that the Controller is allowed to use as a boiler target temperature (e.g. 105 °F). During mild conditions, if the Controller calculates a boiler target temperature that is below the BOIL MIN setting, the boiler target temperature is adjusted to at least the BOIL MIN setting.

During this condition, if the boiler is operating, the MIN segment turns on in the LCD while the boiler target temperature or boiler operating sensor temperature is viewed. If the installed boiler is designed for condensing or low temperature operation, set the BOIL MIN adjustments to OFF.

Boiler Maximum (BOIL MAX)

The BOIL MAX is the highest water temperature that the Controller is allowed to use as a boiler target temperature. If the Controller does target BOIL MAX, and the boiler outlet sensor is near the BOIL MAX temperature, the MAX segment turns on in the LCD while the boiler target, boiler inlet, boiler outlet or boiler supply temperature is viewed.

Boiler Target Temperature (BOIL TARGET)

The boiler target temperature is determined from the mode of operation. The Controller displays the temperature that it is currently trying to maintain at the operating sensor as BOIL TARGET in the view menu.

The operating sensor for modes 1, 3 and 4 is the boiler outlet sensor, and the operating sensor for modes 2 and 5 is the demand sensor. If the Controller does not presently have a requirement for heat it displays "- - -" in the LCD. In Mode 6, no boiler target temperature is generated.

Boiler Pump Operation

(Not Used)

Boiler Purge (PUMP DLY)

(Not Used)

Boiler Purge (ΔT MIN)

(Not Used; The heater-mounted Economaster II™ incorporates this function.)

Setpoint Operation

When either mode 1 or 2 is selected, the Controller controls the water temperature based on a fixed setpoint. The setpoint temperature is set using the BOIL TARGET item in the adjust menu.

Heat Demand

A heat demand or "call for heat" is required whenever heat is required for the setpoint load. A heat demand is generated when a voltage of 24 VAC is applied across the CD (common demand) and the Ht D (heat demand) terminals (1 and 2).

Once voltage is applied, the Controller turns on the *Dem* segment in the display. The Controller then operates the boiler stages to maintain the setpoint temperature.

Dedicated Domestic Hot Water (DHW) Operation

When mode 3 is selected, the Controller provides dedicated DHW operation.

Internal DHW Demand

A sensor is required to be connected to the *Com* and the *Sup/D* terminals (6 and 9). An internal demand for DHW is generated when the temperature at the DHW sensor drops 1/2 of the tank differential setting below the desired DHW tank temperature. The TANK TARGET setting is used to set the desired DHW tank temperature. Once an internal demand is generated, the *Dem* segment turns on in the LCD.

The Controller then operates the boiler stages to maintain the programmed boiler target temperature at the boiler outlet sensor. The boiler target temperature is set using the BOIL TARGET item in the adjust menu.

Tank Differential (TANK DIFF)

A differential setting that operates 1/2 above and below the TANK TARGET is selectable using the TANK DIFF item in the adjust menu.

Outdoor Reset Operation

When either Mode 4 or 5 is selected, the Controller uses outdoor reset to control the water temperature. Outdoor reset adjusts the target temperature based on the outdoor air temperature and the reset ratio; as the outdoor air temperature rises, the need for heat drops and the setpoint is reduced The reset ratio is determined from the Boiler Start, Boiler Design, Outdoor Start and Outdoor Design settings.

Heat Demand

A heat demand is required whenever heat is required in the system. A heat demand is generated when a voltage of 24 VAC is applied across the CD (common demand) and the Ht D (heat demand) terminals (1 and 2). Once voltage is applied, the Controller turns on the *Dem* segment in the display. If the Controller is not in Warm Weather Shut Down (WWSD), it then operates the boiler stages to maintain the boiler target temperature.

Boiler Start (BOIL START)

The BOIL START temperature is the theoretical boiler supply water temperature that the heating system requires when the outdoor air temperature equals the OUTDR START temperature setting. The BOIL START is typically set to the desired building temperature.

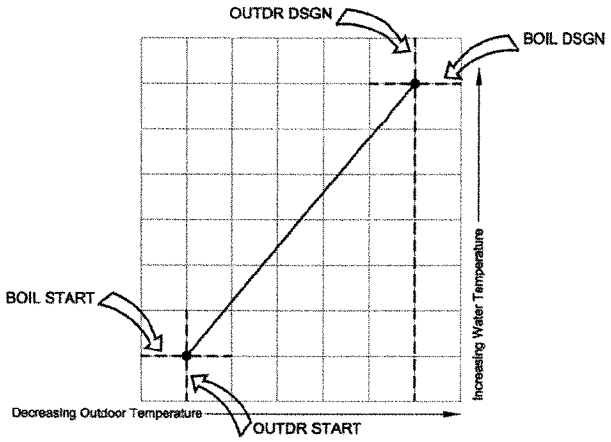


Fig. 15:

Outdoor Start (OUTDR START)

The OUTDR START temperature is the outdoor air temperature at which the Controller provides the BOIL START water temperature to the system. The OUTDR START is typically set to the desired building temperature.

Outdoor Design (OUTDR DSGN)

The OUTDR DSGN is the outdoor air temperature that is the typical coldest temperature of the year where the building is located. This temperature is used when doing heat loss calculations for the building.

Boiler Design (BOIL DSGN)

The BOIL DSGN is the water temperature required to heat the boiler zones when the outdoor air is as cold as the OUTDR DSGN temperature.

Warm Weather Shut Down (WWSD)

When the outdoor air temperature rises above the WWSD setting, the Controller turns on the *WWSD* segment in the display. When the Controller is in Warm Weather Shut Down, the *Dem* segment is displayed if there is a heat demand. However, the Controller does not operate the heating system to satisfy this demand.

Reset Override (SETPOINT DEMAND)
(Not Used)

External Boiler Operation

When mode 6 is selected, the Controller allows for an external boiler control to operate the boiler stages. **Mode 6 is not supported by Raypak.**

Heat Demand

A heat demand is generated when a voltage of 24 VAC is applied across the CD (common demand) and the Ht D (heat demand) terminals (1 and 2). Once voltage is applied, the Controller turns on the *Dem* segment in the display.

The Controller closes the *Stg 1* contacts, which turns on stage 1 of the boiler. The *Stg 1* contact is closed as long as the heat demand is present.

INSTALLATION

Electrical Connections to the Controller

The installer should test to confirm that no voltage is present at any of the wires during installation. The Controller includes a 24-pin connector and wire harness for ease of installation.

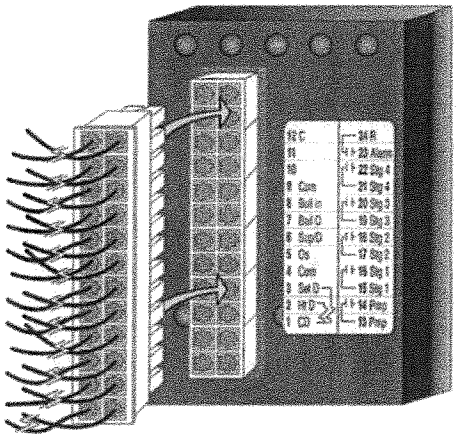


Fig. 16: Electrical Connections

Powered Input Connections

Power, 24 VAC

Connect the 24 VAC power supply to the *HT D* and *R* terminals (2 and 24). This connection provides power to the microprocessor and display of the Controller. Also, this connection provides power to the Alarm terminal (23) from the *R* terminal (24).

Heat Demand

To generate a heat demand, a voltage of 24 VAC must be applied across the CD (common demand) and the Ht D (heat demand) terminals (1 and 2).

Setpoint Demand
(Not Used)

Boiler Pump Contact
(Not Used; The heater-mounted Economaster II™ already incorporates this function.)

Boiler Contacts

The *Stg 1, Stg 2, Stg 3* and *Stg 4* terminals (15 and 16, 17 and 18, 19 and 20, 21 and 22) are isolated outputs in the Controller. There is no power available on these terminals from the Controller. These terminals are to be used as a switch to either make or break the boiler circuit. When the Controller requires boiler stages to fire, it closes the contact between the appropriate terminals.

Alarm Contact

The *Alarm* terminal (23) on the Controller is a powered output. When the relay contact in the Controller closes, 24 VAC from the *R* terminal (24) is provided to the *Alarm* terminal (23). To operate the alarm, connect one side of the alarm circuit to the *Alarm* terminal (23) and the second side of the alarm circuit to the common (C) side of the 24 VAC power supply.

Sensor and Unpowered Input Connections

NOTE: Do not apply power to these terminals as this damages the Controller.

Outdoor Sensor

Connect the two wires from the outdoor sensor to the *Com* (common sensor) and *Os* (outdoor sensor) terminals (4 and 5). The outdoor sensor is used by the Controller to measure the outdoor air temperature.

Boiler Outlet Sensor

Connect the two wires from the Boiler Outlet Sensor to the *Com* (common sensor) and the *Boil O* (boiler outlet sensor) terminals (9 and 7). The boiler outlet sensor is used by the Controller to measure the boiler outlet water temperature from the boiler.

NOTE: The boiler outlet sensor is required for every mode of operation.

Boiler Inlet Sensor

Connect the two wires from the Boiler Inlet Sensor to the *Com* (common sensor) and the *Boil in* (boiler inlet sensor) terminals (9 and 8). The boiler inlet sensor is used by the Controller to measure the boiler inlet water temperature to the boiler.

NOTE: The boiler inlet sensor is required for every mode of operation.

Boiler Demand/DHW Sensor

Either a Boiler Demand Sensor or DHW Sensor may be connected to the Controller. If a sensor is used, connect the two wires from the sensor to the *Com* (common sensor) and the *Sup/D* (demand/DHW sensor) terminals (9 and 6).

TESTING

The wiring harness must be unplugged from the connector on the Controller before testing. To remove the wiring harness, push down on the tab, which fits over the tab on the connector from the Controller, and pull away from the Controller.

A good quality electrical test meter, capable of reading from at least 0 – 300 VAC and at least 0 – 2,000,000 Ohms, is essential to properly test the wiring and sensors.

Testing the Power Supply

Make sure exposed wires and bare terminals are not in contact with other wires or grounded surfaces. Turn on the power and measure the voltage between the *CD* and *HT D* terminals (1 and 2) using an AC voltmeter, the reading should be between 22 VAC and 26 VAC).

Testing the Sensors

In order to test the sensors, the actual temperature at each sensor location must be accurately measured.

A good quality digital thermometer with a surface temperature probe is recommended for ease of use and accuracy. First measure the temperature using the thermometer and then measure the resistance of the sensor at the Controller. Using the chart on page 13, estimate the temperature measured by the sensor.

The sensor and thermometer readings should be close. If the meter reads a very high resistance, there may be a broken wire, a poor wiring connection or a defective sensor. If the resistance is very low, the wiring may be shorted, there may be moisture in the sensor or the sensor may be defective. To test for a defective sensor, measure the resistance directly at the sensor location.

Testing the Heat Demand Inputs

If a heat demand is used, measure the voltage between the *CD* (common demand) and the *Ht D* (heat demand) terminals (1 and 2). When the heat demand device calls for heat, you should measure between 22 VAC and 26 VAC at the terminals. When the heat demand device is off, you should measure less than 1 VAC.

Connecting the Controller

NOTE: Make sure ALL power to the devices and wiring harness is off.

Reconnect the wiring harness to the connector on the Controller by aligning the tab on the wiring harness to the tab on the connector on the Controller and then pushing the wiring harness into the connector on the Controller. The tab on the wiring harness should snap over the tab on the connector of the Controller.

Apply power to the Controller. The operation of the Controller on power up is described in the *Sequence of Operation* section of this manual.

Testing the Controller's Outputs

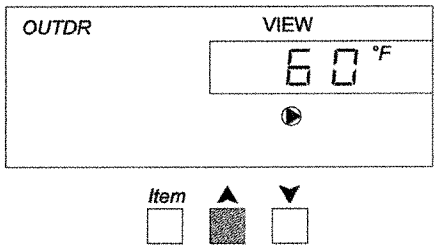


Fig. 17: Testing the Controller's Outputs

The Controller has a built-in test routine, which is used to test the main control functions. The test sequence is enabled when the ▲ button is pressed and held while in the *View* menu. The outputs are tested in the following sequence:

1. After 1 second, the pump is turned on.
2. After 4 seconds, Stage 1 is turned on.
3. After 7 seconds, Stage 2 is turned on.
4. After 10 seconds, Stage 3 is turned on.
5. After 13 seconds, Stage 4 is turned on.
6. After 16 second, the Alarm is turned on.
7. After the ▲ button is released, the Controller continues in normal operation.

Sensor Resistance

Temperature (°F)	Resistance (Ω)
-50	490,813
-40	336,606
-30	234,196
-20	165,180
-10	118,018
0	85,362
10	62,465
20	46,218
30	34,558
40	26,099
50	19,900
60	15,311
70	11,883
77	10,000
80	9,299
90	7,334
100	5,828
110	4,665
120	3,760
130	3,050
140	2,490
150	2,045
160	1,689
170	1,403
180	1,172
190	983
200	829
210	703
220	598

Table B: Sensor Resistance

ELECTRICAL INSTALLATION

Pin #	Label	Function
1	CD	24 VAC return power. Jumped to pin 12 on the Controller
2	Ht D	Heat Demand - Hot 24 VAC – Incoming power for the Controller; Bring hot 24 VAC from the boiler transformer and jumped to pin 24 on the Controller
3	Set D	Setpoint Demand - Not Used
4	Com	Outdoor Sensor (If used)
5	Os	Outdoor Sensor (If used)
6	Sup/D	Supply/Demand Sensor - This is the primary water temperature sensor
7	Boil O	Boiler Outlet Sensor
8	Boil In	Boiler Inlet Sensor
9	Com	Common return lead for all of the sensors; If all 3 are used, connect the return leads here
10		Not Used
11		Not Used
12	C	24 VAC return power; Jumped to pin 1 on the Controller
13	Pmp	Not Used
14	Pmp	Not Used
15	Stg 1	Stage 1, Odd-numbered pin on the stage connection plug
16	Stg 1	Stage 1, Even-numbered pin on the stage connection plug
17	Stg 2	Stage 2, Odd-numbered pin on the stage connection plug
18	Stg 2	Stage 2, Even-numbered pin on the stage connection plug
19	Stg 3	Stage 3, Odd-numbered pin on the stage connection plug
20	Stg 3	Stage 3, Even-numbered pin on the stage connection plug
21	Stg 4	Stage 4, Odd-numbered pin on the stage connection plug
22	Stg 4	Stage 4, Even-numbered pin on the stage connection plug
23	Alarm	Alarm notification circuit – may draw up to 72 VA
24	R	Hot 24 VAC – Incoming power to the Controller. Jumped to pin 2 on the Controller

Table C: Control Pin-outs

WIRING CONNECTIONS

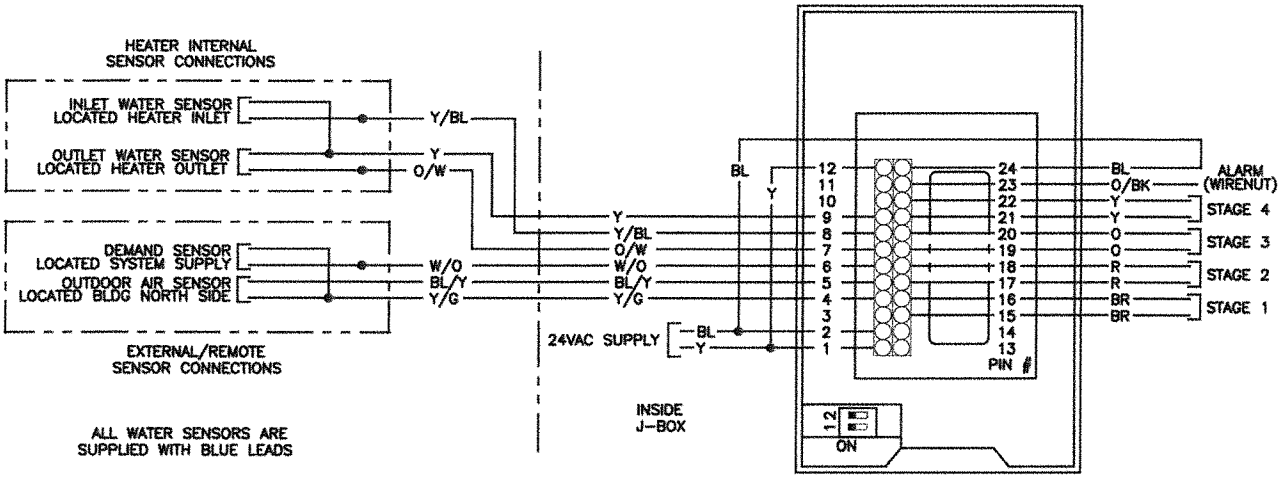


Fig. 18: Wiring Diagram

CONTROLLER SETTINGS

DIP Switch

NOTE: DIP switches are located on the back of the control.

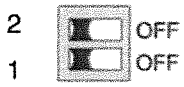


Fig. 19: DIP Switch Settings

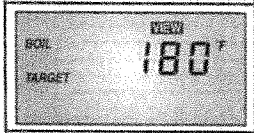
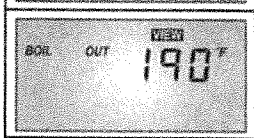
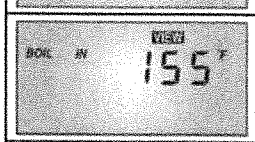
DIP Switch 1 (Advanced/Installer) must be set to "ON"

The Advanced/Installer DIP switch is used to select which items are available to be viewed and/or adjusted in the user interface. The Advanced Access Level includes all of the settings available in the Controller. The Installer Access Level includes the settings and items, which are required for system startup.

For ease of programming, DIP switch "1" should always be in the "ON" position.

(2) DIP switch 2 is not used with this Controller.

View Menu

Item Field	Section	Access Level INST	Access Level ADV	Description	Range
		•	•	Current outdoor air temperature as measured by the outdoor sensor. This is the default display for the control. **MODE = 4, 5**	-60 to 190°F (-51 to 88°C)
	A	•	•	Target boiler supply is the temperature the control is currently trying to maintain at the boiler supply sensor or the boiler outlet sensor. **MODE = 1, 2, 3, 4, 5**	---, 35 to 226°F (2 to 108°C)
	A	•	•	Current boiler supply water temperature as measured by the boiler supply sensor. **MODE = 2, 5**	14 to 266°F * (-10 to 130°C)
	A	•	•	Current boiler outlet water temperature as measured by the boiler outlet sensor. **MODE = 1, 3, 4 (Installer Level)** **MODE = 2, 5 (Advanced Level)**	14 to 266°F * (-10 to 130°C)
	A	•	•	Current boiler inlet water temperature as measured by the boiler inlet sensor.	14 to 266°F * (-10 to 130°C)
	A		•	Current ΔT (temperature difference) between the boiler outlet sensor and the boiler inlet sensor.	-99 to 252°F * (-55 to 140°C)
	A	•	•	Current DHW tank temperature as measured by the DHW sensor. **MODE = 3**	14 to 266°F * (-10 to 130°C)
			•	The total number of running hours of the boiler since this item was last cleared.	0 to 999

* Temperature readings below 14°F will shut down the heater. Max. outlet temperature is 225°F.

Table D: View Menu

Adjust Menu

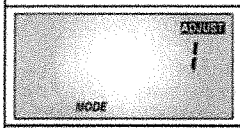
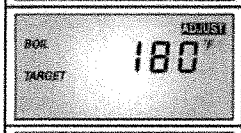
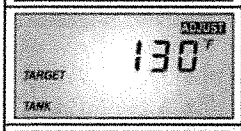
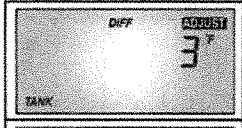
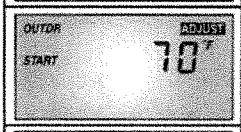
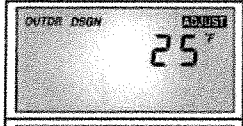
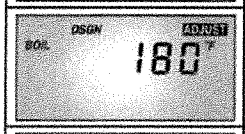
Item Field	Section	Access Level INST	Access Level ADV	Description	Range	Actual Setting
	A	•	•	Sets the operating mode for the control.	1, 2, 3, 4, 5	
	A		•	Selects the staging operation to be either automatic or manual. **MODE = 1, 2, 3, 4, 5**	PID (automatic staging) P (manual staging)	
	A	•	•	Minimum boiler target temperature during reset override, setpoint or DHW operation. **MODE = 1, 2, 3, 4, 5**	OFF, 70 to 220°F (OFF, 21 to 104°C)	
	C	•	•	Sets the DHW storage tank's temperature. **MODE = 3**	OFF, 70 to 190°F (OFF, 21 to 88°C)	
	C	•	•	Sets the differential for the DHW storage tank. **MODE = 3**	2 to 10°F (1 to 6°C)	
	D	•	•	The outdoor starting temperature used in the reset ratio for the heating system. **MODE = 4, 5**	35 to 85°F (2 to 29°C)	
	D	•	•	The design outdoor air temperature used in the heat loss calculations for the heating system. **MODE = 4, 5**	-60 to 32°F (-51 to 0°C)	
	D	•	•	The starting water temperature used in the reset ratio calculation for the heating system. **MODE = 4, 5**	35 to 150°F (2 to 66°C)	
	D	•	•	The design water temperature used in the heat loss calculations for the heating system. **MODE = 4, 5**	70 to 220°F (21 to 104°C)	
	A		•	The maximum boiler target water temperature. **MODE = 1, 2, 3, 4, 5**	120 to 225°F, OFF (49 to 107°C, OFF)	
	A		•	The minimum temperature allowed for the boiler target temperature. **MODE = 1, 2, 3, 4, 5**	OFF, 80 to 180°F (OFF, 27 to 82°C)	

Table E: Adjust Menu

Adjust Menu (cont.)

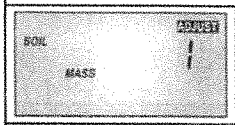
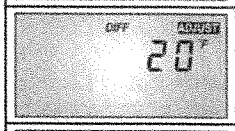
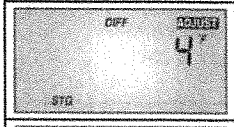
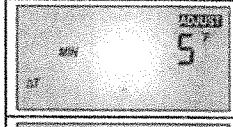
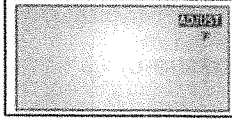
Item Field	Section	Access Level INST	Access Level ADV	Description	Range	Actual Setting
	A	●	●	The thermal mass of the boiler used. **MODE = 1, 2, 3, 4, 5 and STGMODE = PId**	1 (light mass) 2 (medium mass) 3 (heavy mass)	
	A	●	●	The differential that the control is to use when it is operating the boiler. **MODE = 1, 2, 3, 4, 5**	2 to 42°F (1 to 23°C)	
	A		●	The interstage differential that the control is to use when it is operating the boiler. **MODE = 1, 2, 3, 4, 5 and STGMODE = P**	0 to 10°F (0 to 6°C)	
	A		●	The interstage delay that the control is to use when an additional stage is required to turn on. **MODE = 1, 2, 3, 4, 5 and STGMODE = P**	0:10 to 8:00 minutes	
	A		●	The interstage delay that the control is to use when a stage is required to turn off. **MODE = 1, 2, 3, 4, 5 and STGMODE = P**	0:10 to 4:00 minutes	
	A		●	The minimum on time for each stage when manual staging is selected. **MODE = 1, 2, 3, 4, 5 and STGMODE = P**	0:10 to 5:00 minutes	
	A		●	The minimum off time for each stage when manual staging is selected. **MODE = 1, 2, 3, 4, 5 and STGMODE = P**	0:10 to 5:00 minutes	
	A	●	●	Determines when to stop purging.	OFF, 0:20 to 9:55 min, On	
	A	●	●	Determines how long to purge based on the ΔT (temperature difference). *This setting may appear in some models. If this setting is present, the pump DLY setting above will not be available.*	2 to 20°F, OFF (1 to 11°C)	
	D	●	●	The system's warm weather shut down. **MODE = 4, 5**	35 to 100°F, OFF (2 to 38°C, OFF)	
		●	●	The units of measure that all of the temperatures are to be displayed in by the control.	°F, °C	

Table F: Adjust Menu — Continued

Error Messages

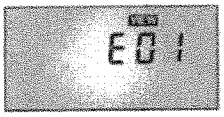
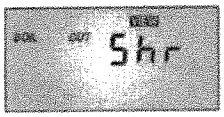
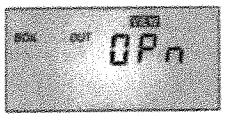
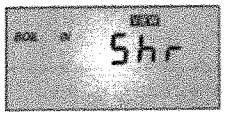
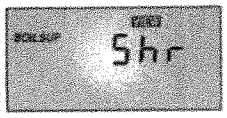
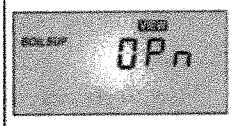
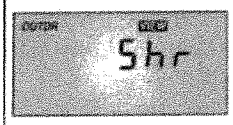
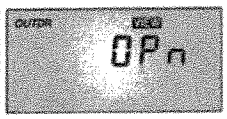
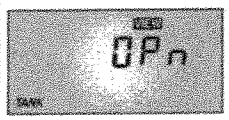
Error Displayed	Description of Error
	The control was unable to read a piece of information from its EEPROM. The control will stop operation until all settings in the Adjust menu have been checked by the user or installer.
	The control is no longer able to read the boiler outlet sensor due to a short circuit. In this case, if the boiler inlet sensor is present and operational, the control will operate using the boiler inlet sensor. Otherwise, the control will not operate the boiler stages.
	The control is no longer able to read the boiler outlet sensor due to an open circuit. In this case, if the boiler inlet sensor is present and operational, the control will operate using the boiler inlet sensor. Otherwise, the control will not operate the boiler stages.
	The control is no longer able to read the boiler inlet sensor due to a short circuit. In this case, the control will continue operation.
	The control is no longer able to read the boiler inlet sensor due to an open circuit. In this case, the control will continue operation.
	The control is no longer able to read the boiler supply sensor due to a short circuit. In this case, if the boiler outlet sensor is present and operational, the control will operate based on the boiler outlet sensor. If the boiler outlet sensor is not available and the boiler inlet sensor is present and operational, the control will operate using the boiler inlet sensor. Otherwise, the control will not operate the boiler stages.
	The control is no longer able to read the boiler supply sensor due to an open circuit. In this case, if the boiler outlet sensor is present and operational, the control will operate based on the boiler outlet sensor. If the boiler outlet sensor is not available and the boiler inlet sensor is present and operational, the control will operate using the boiler inlet sensor. Otherwise, the control will not operate the boiler stages.
	The control is no longer able to read the outdoor sensor due to a short circuit. In this case the control assumes an outdoor temperature of 32°F and continues operation.
	The control is no longer able to read the outdoor sensor due to an open circuit. In this case the control assumes an outdoor temperature of 32°F and continues operation.
	The control is no longer able to read the tank sensor due to a short circuit. In this case the control will not operate the boiler stages.
	The control is no longer able to read the tank sensor due to an open circuit. In this case the control will not operate the boiler stages.

Table G: Error Messages

APPLICATIONS

NOTE: The following are only mechanical concept drawings; they are not intended to describe a complete system, nor any particular system. Consult the factory for piping arrangements not depicted here.

It is up to the designer to determine the necessary components for and the configuration of the particular system being designed, including additional equipment, isolation relays (for loads greater than the Controller's specified output rating), and any safety devices which in the judgment of the designer are appropriate, in order to properly size, configure and design that system and to ensure compliance with building and safety code requirements.

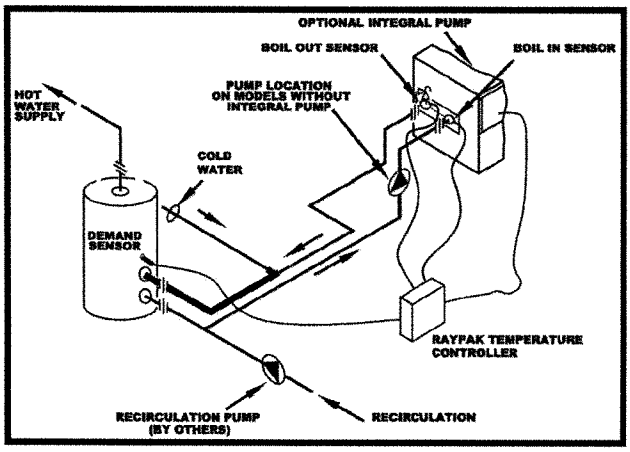


Fig. 22: Unitemp 80 Piping (Mode 3)

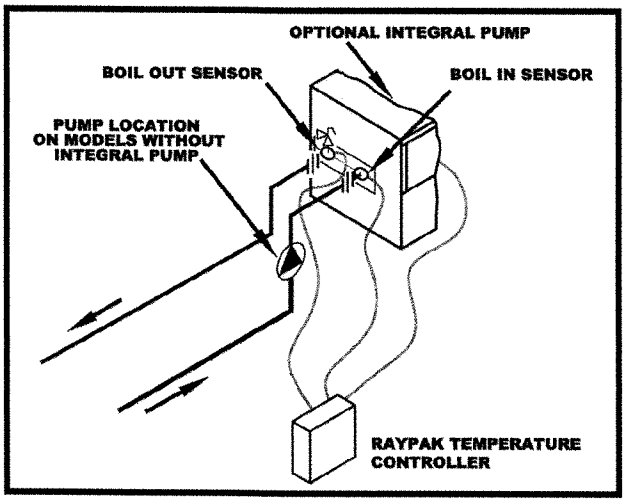


Fig. 20: Primary Piping (Mode 1) (4 Stages Only)

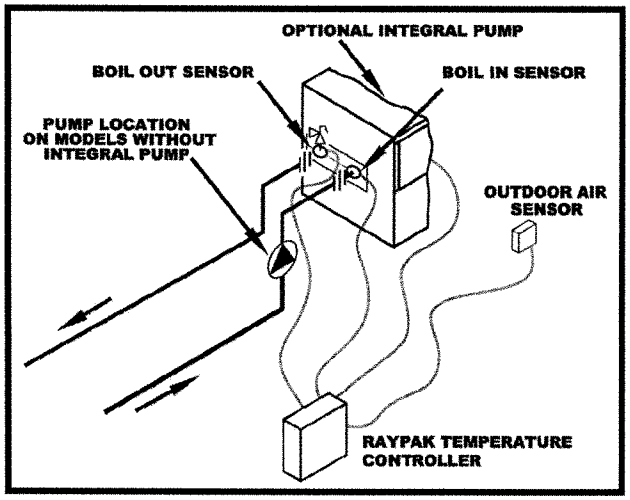


Fig. 23: Primary Piping with Outdoor Reset (Mode 4) (4 Stages Only)

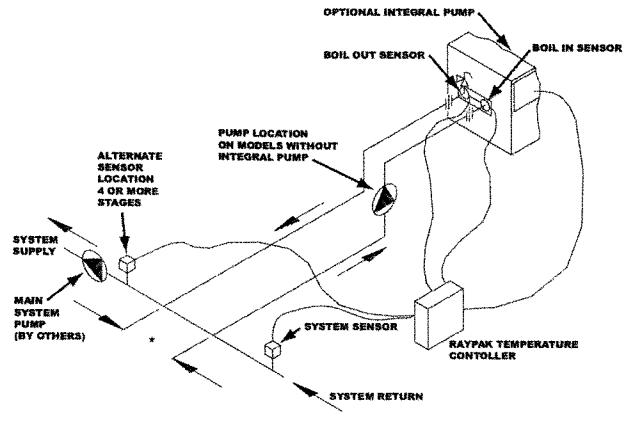


Fig. 21: Primary/Secondary Piping (Mode 2)

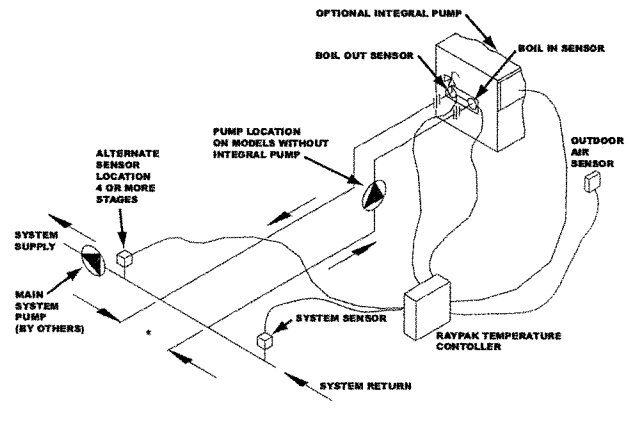


Fig. 24: Primary/Secondary Piping with Outdoor Reset (Mode 5)

TECHNICAL DATA

4-Stage Controller – PN 601738
2-Stage Controller – PN 601764

Controller	Microprocessor PID control; This is not a safety (limit) control
Enclosure	Enclosure D, black Noryl plastic
Dimensions	4-3/4" H x 2-7/8" W x 1-7/8" D (120 x 74 x 48 mm)
Approvals	CSA C US, meets ICES & FCC regulations for EMI/RFI
Ambient Conditions	Indoor use only, -40 to 140 °F (-40 to -60°C), <90% RH non-condensing
Power Supply	24 VAC ±10% 50/60 Hz
Demands	24VAC 3 VA without alarm; 24 VAC 75 VA with alarm
Pump/Stage 1 Relay	120 VAC 5 A 1/6 hp, pilot duty 240 VA
Stage 2 to 4 Relays	120 VAC 3 A 1/6 hp
Alarm Relay	24 VAC 3 A 1/6 hp
Sensors	NTC thermistor, 10kΩ @ 77 °F (25°C ±0.2°C) 3 universal water sensors - P/N 601755 1 outdoor air sensor - P/N 601756

Table H: Technical Data

QUICK START SET-UP & PROGRAMMING TIPS

1. Determine piping arrangement and mode number as depicted on page 20.

2. Set DIP switch 1 located on the rear of the Controller to the "ON" position.

3. Install system sensor and air sensor (for modes 2 and 5 only) as positioned in the mode arrangements located on page 20.

4. Wire the sensors to the Controller as described in Fig. 18 on page 15.

5. Ensure that entire system is ready to start.

   a. Water piping properly filled and purged.
   b. Gas pipe properly installed and purged.
   c. Electrical connections properly installed in conduit.
   d. Vent properly installed and terminated.
   e. Sensor wires properly routed in separate conduit.

6. Turn on boiler power to allow programming the Controller.

7. After piping mode has been determined, program Controller as described on pages 4 to 7. Remember that the "*Item*", "▲" & "▼" buttons must be pressed simultaneously for 2 seconds to enter the program mode.

8. Use mode settings as a guide to set up the Controller. Your settings may differ from the values given in the manual depending upon the temperature settings required.

9. After programming Controller, the settings will be automatically saved after 20 seconds of keypad inactivity.

10. If the Controller display indicates any error(s), turn to page 19 to correct the error(s) that are displayed.

Registered Quality Management System

www.raypak.com

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Litho in U.S.A.

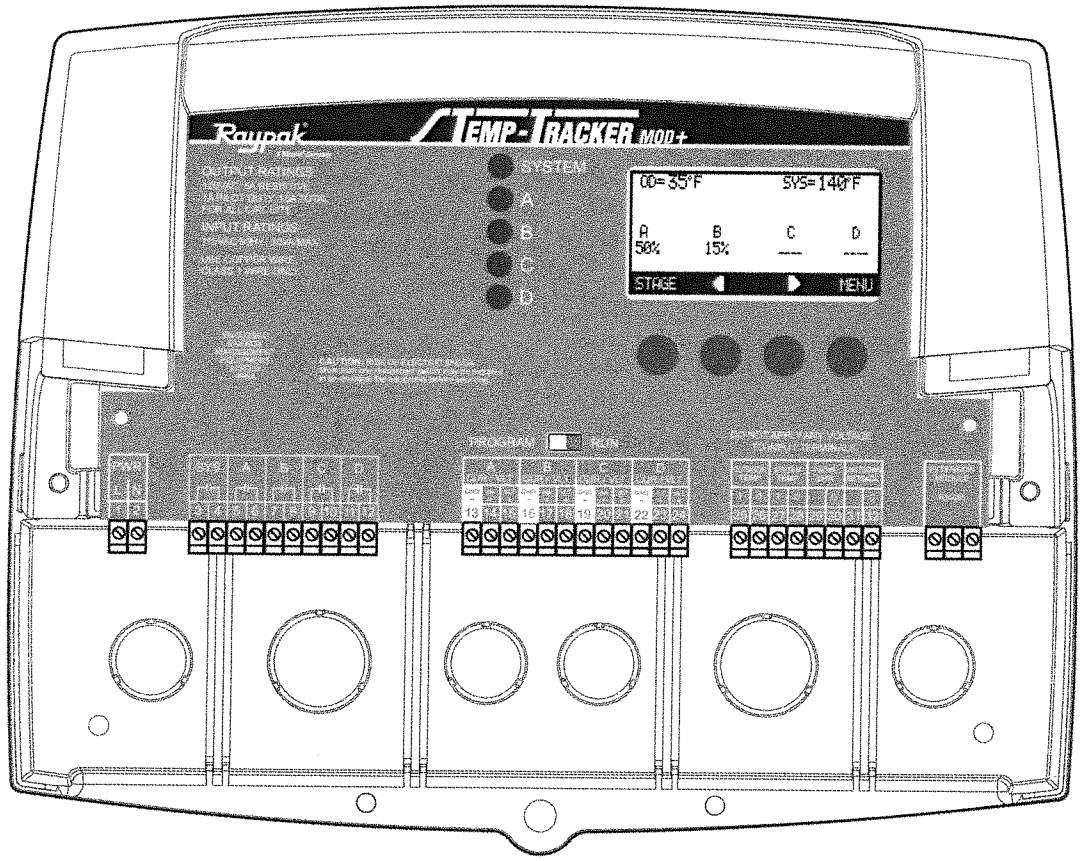
Raypak®
A Rheem® Company

INSTALLATION AND OPERATION INSTRUCTIONS

TEMP-TRACKER MOD+

TEMP-TRACKER MOD+ EXTENSION

SEQUENCING MODULATING CONTROLS for Hydronic Heating Systems



This manual attempted to be complete and accurate at the time of publication. Additional upgrades and new features may change Temp-Tracker mod+ functions. Upgrades to this manual may occur at any time. Contact the factory for further details.

⚠ WARNING

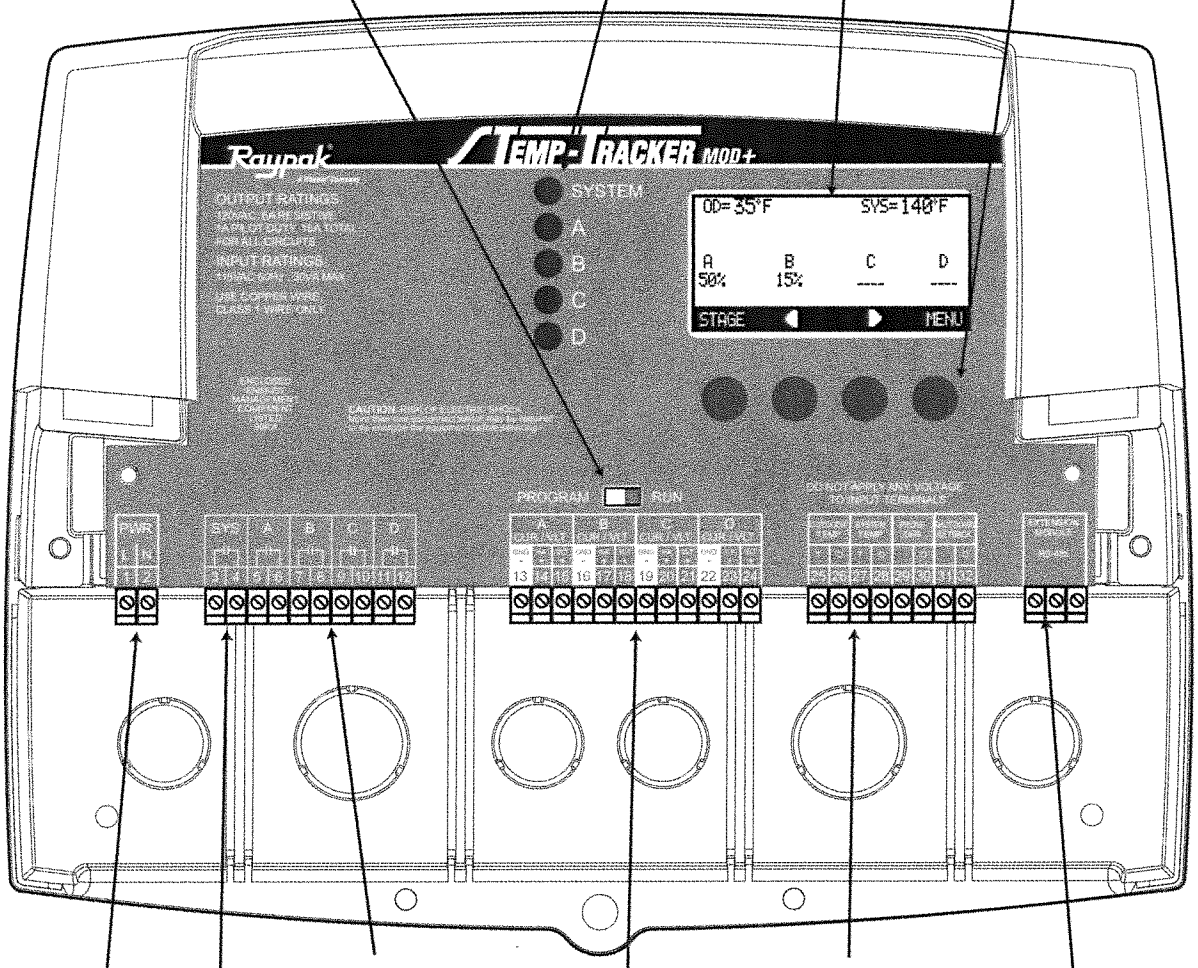
The Temp-Tracker mod+ is strictly an operating control. It CANNOT be used as a limit control. All boilers must have all safety and limit controls required by code. It is the responsibility of the installer to verify that all the safety and limits are working properly before the Temp-Tracker mod+ is installed.

This control must be installed by a licensed electrician.

Cat.# 5000.67 3/29/07 P/N 241297

Contents

TEMP-TRACKER MOD+ LAYOUT



120VAC Power

Four N.O. Boiler startup relay outputs. Each is wired in series with each boiler's limit circuit.

When connecting Outdoor and System Sensors, no Polarity is observed. Prove terminals must be connected for Temp Tracker mod+ to operate boilers.

System Output controls pumps, valves, or other system components.

Four modulation outputs can be 4-20mA, 0-5V, 0-10V, 1-5V, or 2-10V. Go to Startup Menu to determine the type of output for each stage.

Connect Extension panels to add additional stages using a 6 pin phone line only (cable provided with Temp Tracker mod+ Extension).

TEMP-TRACKER MOD+ OVERVIEW

SEQUENCES UP TO 4 FULLY MODULATING STAGES.

The Temp-Tracker mod+ is the perfect control whenever multiple fully modulating stages are required for hydronic heating applications. The Temp-Tracker mod+ controls the on/off and the modulation of each stage to maintain precise system set point control.

PID TYPE LOGIC

The Temp-Tracker mod+'s control algorithms allow it to look at the rate of change in the system. If the system temperature is changing quickly, the Temp-Tracker mod+ will react quickly to adjust the modulating stages' output. If the system temperature changes slowly, the Temp-Tracker mod+ will make slow and gradual output adjustments. Therefore, the Temp-Tracker mod+ adapts to specific system requirements and minimizes fluctuations around the set point.

CONTROLS 4-20MA MODULATING MOTORS OR 0-5 V, 0-10 V, 1-5V, 2-10V MODULATING MOTORS

The Temp-Tracker mod+ is designed to accurately control the output from 25% to 100% of modulation for each of these different types of motors. One Temp-Tracker mod+ can even control a variety of the above different motors.

ONLY ONE SENSOR

When Set Point sensor type is selected, the Temp-Tracker mod+ requires only one sensor located in the common output header of all stages. However, when Reset is selected, an additional Outdoor Sensor is required for Outdoor Reset Ratio input.

DIGITAL DISPLAY OF ALL SYSTEM SETTINGS

The Temp-Tracker mod+'s alphanumeric digital display names each system parameter in simple English and shows its precise value. The easy to follow menu system allows users to quickly make changes to any system setting without having to learn any specialized codes or keyboard commands.

AUTOMATIC ROTATION AMONG STAGES

Rotating the first stage to be activated on a call for output promotes even wear on each stage. The Temp-Tracker mod+ has three modes of rotation: Manual, Last On, or Time. The Time rotates the lead stage every selected time period from every hour to every 60 days.

OUTDOOR RESET

The Temp-Tracker mod+ has a hydronic outdoor temperature reset function. This allows the Temp-Tracker mod+ to change the set point based on outdoor temperature. Furthermore, additional settings have been added to fine tune this operation, like Offset, Minimum, and Maximum Water Temperature and night setback schedule.

STANDBY BOILERS

Each of the Temp-Tracker mod+ stages can be configured as a Standby boiler with an adjustable Standby delay. A boiler can be used as a backup during extended large demand periods.

SYSTEM OUTPUT

In Set Point or Outdoor Reset modes, the System Output will activate whenever the outdoor temperature is below the Outdoor Cutoff setting. A System Prove input checks the status of components activated by the System output before stages can be activated.

PARALLEL MODULATION

The Temp-Tracker mod+ uses parallel modulation that can modulate several boilers together as a one large boiler. This mode is useful for boilers with lower water content, which are usually more efficient at lower firing points.

ADD UP TO 16 BOILER STAGE (OPTIONAL)

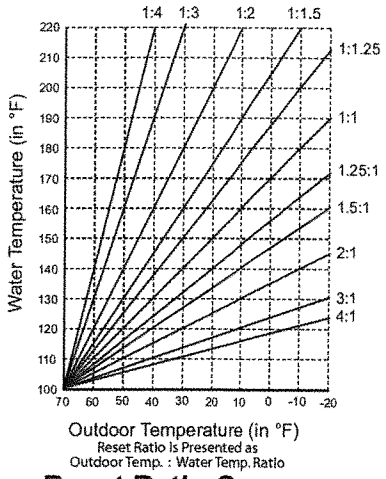
As a stand-alone, the Temp-Tracker mod+ is designed to control four modulating boilers. However, it has the capability of expanding its control to two extension panels each with six boiler stages. Thus, the Temp-Tracker mod+ can control a total of up to 16 boiler stages.

UNDERSTANDING OPERATION CONCEPT

The Temp-Tracker mod+ has multiple operating modes that satisfy most hydronic systems. It can change the System Set Point based on outdoor temperature (Outdoor Reset) or it can modulate its stages to achieve an adjustable fixed Set Point.

In Outdoor Reset, the Temp-Tracker mod+ controls a hot water heating system to provide a building with comfortable and even heat levels. The Temp-Tracker mod+ varies the temperature of the circulating heating water in response to changes in the outdoor temperature. The heating water temperature is controlled through the modulation of stages.

The Temp-Tracker mod+ also controls the system circulating pump with an adjustable Outdoor Cutoff. When the outdoor temperature is above Outdoor Cutoff, the pump is off and no heating water is circulated through the system. When the outdoor temperature drops below the Outdoor Cutoff, the system pump relay is activated and the heating water circulates through the system. The temperature of the heating water is controlled by the Reset Ratio, Water Offset, and changes with Outdoor temperature.



Reset Ratio Curves

RESET RATIO/OUTDOOR RESET

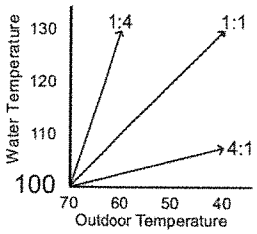
When a building is being heated, heat escapes through the walls, doors, and windows to the colder outside air. The colder the outside temperature, the more heat escapes. If you can input heat into the building at the same rate that it is lost out of the building, then the building temperatures will remain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

The starting point for most systems is the 1.00 (OD):1.00 (SYS) (Outdoor Air Temperature : Heating Water Temperature) ratio. This means that for every degree the outdoor temperature drops, the temperature of the heating water will increase one degree. The starting point of the curves is adjustable, but comes factory selected at 70°F Outdoor Temp. and 100°F Water Temp. For example with a 1.00 (OD):1.00 (SYS) ratio, if the outdoor temperature is 40°F, this means the temperature has fallen 30° from the starting point of 70°F. Therefore, the heating water temperature will increase 30° to 130°F.

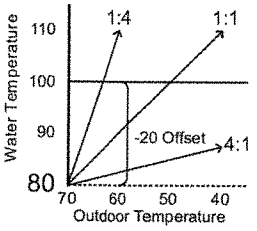
Each building has different heat loss characteristics. A very well insulated building will not lose much heat to the outside air, and may need a Reset Ratio of 2.00 (OD):1.00 (SYS) (Outdoor:Water). This means the outdoor temperature would have to drop 2 degrees to increase the water temperature 1 degree. On the other hand, a poorly insulated building with insufficient radiation may need a Reset Ratio of 1.00 (OD):2.00 (SYS). This means that for each degree the outdoor temperature dropped the water temperature will increase 2 degrees. The Temp-Tracker mod+ has a full range of Reset Ratios to match any buildings heat loss characteristics.

A heating curve that relies not only on Outdoor temperature but also on type of radiation will improve heat comfort. The following are suggested initial settings for different types of radiation based on average building insulation and heat loss. The contractor can fine tune these adjustments based on the specific building need.

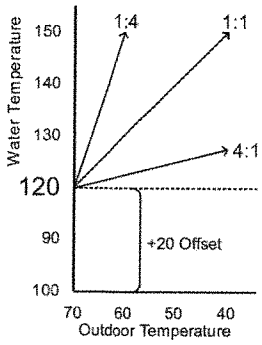
With a 0° Offset, the ratio curves begin at 100° Water Temperature.



With a -20° Offset, the ratio curves begin at 80° Water Temperature.



With a +20° Offset, the ratio curves begin at 120° Water Temperature.



Type of Radiation in Building	Reset Ratio	Offset
Radiators (Steel & Cast Iron)	1.00 (OD) : 1.00 (SYS)	0°F
Baseboard (Finned copper tube& Cast Iron)	1.00 (OD) : 1.00 (SYS)	0°F
Radiant (High Mass/Concrete)	4.00 (OD) : 1.00 (SYS)	-10°F
Radiant (Low Mass/Joists)	2.00 (OD) : 1.00 (SYS)	-10°F
Fan Coils & Air Handlers	1.00 (OD) : 1.00 (SYS)	20°F

⚠ WARNING

When controlling a non condensing boiler directly without the use of a mixing valve, minimum boiler water temperature must be set to boiler manufacturer specifications. In that case, system temperature must not go below such temperature.

MAKE SURE YOU HAVE THE RIGHT CONTROL

If you need the Temp-Tracker mod+ to do additional tasks that either are not listed or do not know how to configure them, contact your local Raypak representative.

INITIAL SETUP

Setting an Initial Program will ease the configuration of the Temp-Tracker mod+ and will give the opportunity to utilize many of the energy saving features and give more comfortable heat when needed.

The program should consist of the following:

- Selecting the features that your system can utilize,
- Installation: Install the Control, switches and sensors,
- Setting the System Startup,
- Setting the System Settings,
- Setting the Stages
- Adjusting Reset Ratio and Water Offset (In Reset Mode Only)

SELECTING THE SYSTEM FEATURES

The Temp-Tracker mod+ has been designed with Hydronic building heating as the primary purpose. With this in mind, many of the Temp-Tracker mod+ features can be utilized to ease, enhance and improve your system performance. Some of these features are listed in this section.

OUTDOOR RESET OR SET POINT

- The Temp-Tracker mod+ can control the System Temperature either by adjusting the calculated temperature according to the Outdoor Temperature (Outdoor Reset) or by maintaining an adjustable Set Point. The earlier relies on an Outdoor Sensor (supplied with the control) and achieves better fuel savings in addition to better comfort.

NUMBER OF STAGES

- The Temp-Tracker mod+ can be configured to control up to 4 modulating boilers. It can control up to 16 boiler stages using a maximum of two Temp-Tracker mod+ Extension Panels

MODULATION MODE

- The Temp-Tracker mod+ stages boilers using parallel modulation. Parallel modulation can modulate several boilers together as a one large boiler. This is useful for boilers which are more efficient at lower firing points.

MODULATING SIGNAL

- The Temp-Tracker mod+ is designed to accurately control the output from 25% to 100% of modulation for each of these different types of equipment. One Temp-Tracker mod+ can even control a variety of the above different modulation equipment.

AUTOMATIC ROTATION AMONG BOILERS

- Rotating the first burner to be activated on a call for output promotes even wear on all burners. The Temp-Tracker mod+ has three modes of rotation: Manual, Last-ON, or Time automatically rotating every selected time period from every hour to every 60 days.

STANDBY BOILER

- Any boiler can be configured as a Standby boiler. It withholds a specific boiler from being included in the Lead Rotation. However, the Standby boiler will be fired only as a backup when all other stages combined cannot satisfy the demand and after an adjustable delay period.

SETBACK OR DAY/NIGHT SCHEDULING

Two Setback modes are available for the Temp-Tracker mod+:

- The Day/Night Scheduling provides an adjustable time-based schedule for the Setback.
- The Setback mode uses an external signal to switch the operation of the Temp-Tracker mod+ in and out of setback mode.

System Run-On

- This feature lets the Temp-Tracker mod+ run the SYS relay for a longer period after the boilers have been turned off. When this relay is used to control a pump, it helps in dissipating the excess heat from the boilers combustion chamber.

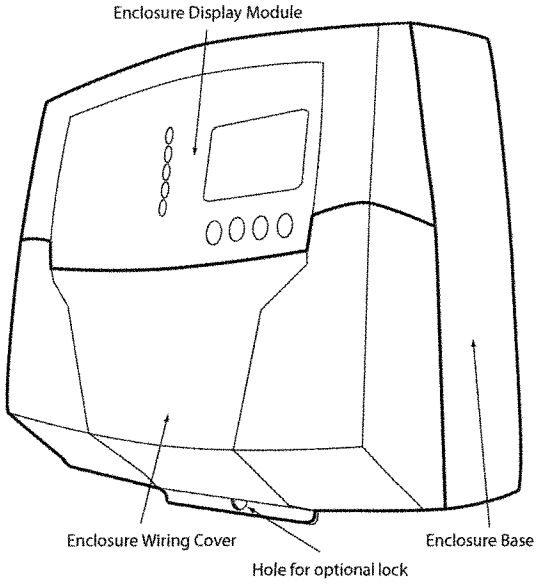
INSTALLATION

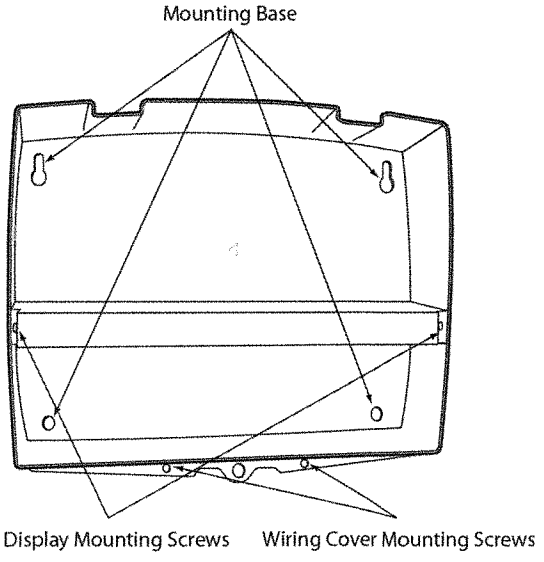
Each of the Temp-Tracker mod+ or Temp-Tracker mod+ Extension consists of three primary enclosure components.

- **The Enclosure Display Module:** contains the display, buttons, LEDs and electric wiring terminals. It has two screws to hold it to the base. A program configuration switch, used to adjust Temp-Tracker mod+ settings, is placed above the terminals. This switch is enclosed with the enclosure wiring cover for security. Wiring terminals are of the plug-in type to ease installation and removal.
- **The Enclosure Base:** contains the holes to mount and hold the control against the wall or any flat surface. All other enclosure components mount on the base. The bottom section of the Enclosure Base contains the wiring chamber with knockouts on the bottom to easy installation.
- **The Enclosure Wiring Cover:** seals the wires from the external environment. It has two screws to hold it the base and a hole to secure a lock on the wiring enclosure. A plastic web that separates the wiring chamber into high and low volt sections has been provided.

MOUNTING THE ENCLOSURE

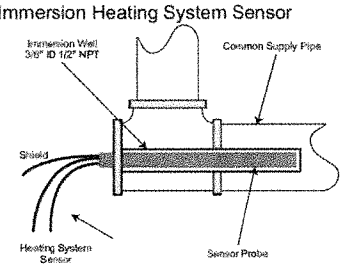
- Select a location near the equipment to be controlled.
- The surface should be flat, and be sufficiently wide and strong to hold the Temp-Tracker mod+ or Temp-Tracker mod+ Extension.
- Keep the control away from extreme heat, cold, or humidity. Ambient control operating temperature is from 20 to 120°F.
- Remove the Enclosure Wiring Cover from the control enclosure by removing the two bottom screws.
- Remove the Enclosure Display Module by removing the middle screws.
- Screw the Enclosure Base to the surface through the upper and lower mounting holes on the back of the enclosure.
- Replace the Enclosure Display Module and replace the middle screws.
- Do not replace the enclosure wiring cover until all wiring is done.





INSTALL THE SENSORS

Immersion Heating System Sensor



HEATING/STORAGE TANK SYSTEM SENSOR (HSS) INSTALLATION

LOCATING HSS

- The sensor must be located where it sees the output of all the boiler stages. If a boiler is piped so that the sensor does not see its output, the Temp-Tracker mod+ will not sequence the boilers correctly.
- Only use a Standard Brass Tube sensor.
- The sensor wires can be extended up to 500' using a shielded 2-conductor cable (Belden #8760 or equivalent.) Do not ground the shield at the sensor but at the panel using one of the terminals marked with an "O".
- Do not run sensor wires in conduit with line voltage wiring.

IMMERSION HEATING SYSTEM SENSOR (HSS) INSTALLATION

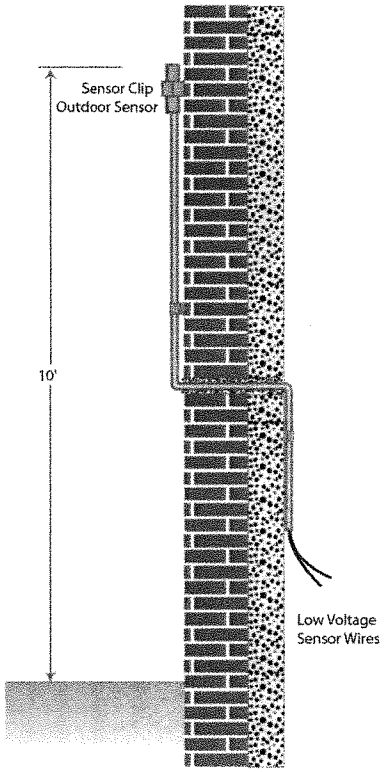
- Install a 3/8"ID 1/2"NPT immersion well.
- Insert the sensor probe of the supplied sensor into the well.

⚠ CAUTION

If the System Sensor can not sense the correct heating system water temperature supplied to the building, the Temp-Tracker mod+ will not provide comfortable heat levels. Be sure the System Sensor is located on a main supply pipe which can not easily be isolated from the system.

OUTDOOR SENSOR INSTALLATION

- Only use the Raypak sensor included with the unit.
- Locate the sensor in the shade on the north side of the building. The sensor should never be in direct sunlight.
- Be sure the location is away from doors, windows, exhaust fans, vents, or other possible heat sources.
- The sensor should be mounted approximately 10' feet above ground level.
- Mount the sensor clip base to the outside of the building. Insert the sensor in the middle and snap close the clip on the sensor.
- The sensor wires can be extended up to 500' using shielded 2-conductor cable. Do not ground the shield at the sensor but at the panel using one of the terminals marked with an "O".
- Do not run sensor wires in conduit with line voltage wiring.



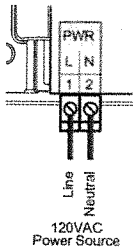
⚠ WARNING

The Temp-Tracker mod+ is an operating control only. All boilers must have all safety and limit controls required by code. It is the responsibility of the installer to verify that all the safety and limits are working properly before the Temp-Tracker mod+ is installed.

⚠ CAUTION

Determining the proper location for the Outdoor Sensor is very important. The Temp-Tracker mod+ will base the heat on the outdoor temperature information it receives from this location. If the sensor is in the sun, or covered with ice, its reading will be different from the actual Outdoor temperature (OD).

WIRING



WIRING THE POWER (TERMINALS 1, 2)

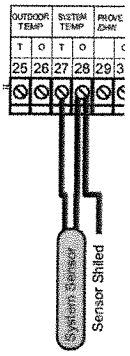
- Bring the 120VAC 60Hz power wires through the bottom Knockout of the enclosure.
- Class 1 voltages must enter the enclosure through a different opening from any Class 2 voltage wiring.
- Connect the hot line to terminal marked L.
- Connect the neutral line to the terminal marked N.
- Raypak recommends installing a surge suppressor on the power source to the Temp-Tracker mod+.

⚠ WARNING

Class 1 voltages must enter the enclosure through a different opening from any Class 2 voltage wiring. Raypak recommends installing a surge suppressor on the power source to the Temp-Tracker mod+.

⚠ WARNING

Connect the shield at the control terminal end and cut the shield wire at the sensor end.

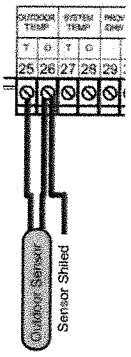


WIRING THE SENSORS

SYSTEM SENSOR WIRING (TERMINALS 27, 28)

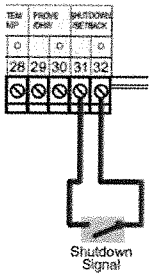
- A Temp-Tracker mod+ must be connected to a temperature sensor located in the common header.
- The Temp-Tracker mod+ is designed to be connected to a temperature sensor for immersion in a 3/8ID well.
- Temperature sensor wires can be extended up to 500' by splicing shielded 2-conductor cable (Belden #8760 or equivalent).
- Temperature sensors have no polarity. Connect the two wires from the sensor to the Temp-Tracker mod+ terminals marked *SYSTEM TEMP 27, 28.*
- Connect the sensor shield to the circled terminal 28 with one of the sensor wires.

OUTDOOR SENSOR WIRING (TERMINALS 25, 26)



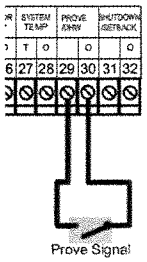
- The Temp-Tracker mod+ will vary the system Set Point when Outdoor Reset is selected based on outdoor temperature.
- Whether in Set Point or Outdoor Reset modes, the outdoor sensor can be used as an Outdoor Cutoff. The Temp-Tracker mod+ will disable all Boilers when the outdoor temperature is above the adjustable Outdoor Cutoff temperature. This feature will automatically be activated when an outdoor sensor is connected.
- For an outdoor sensor use a Raypak outdoor sensor.
- The sensor wires can be extended up to 500' using shielded 2-conductor cable (Belden #8760 or equivalent).
- Temperature sensors have no polarity. Connect the wires from the outdoor sensor to the Temp-Tracker mod+ terminals marked *OUTDOOR TEMP - 25, 26.*
- Connect the shield to the circled terminal *26* with one of the sensor wires.

WIRING THE SYSTEM ENABLE/DISABLE (SHUTDOWN) (TERMINALS 31, 32)



- This feature can be used whenever it is desirable to turn off the Temp-Tracker mod+ stage outputs from a remote location or another controller (i.e. EMS input).
- When the Shutdown feature is enabled by closing a dry contact, all active boilers will immediately modulate down to low. The lead boiler will remain in low for a Soft-Off period and then turn off.
- The System Output relay will remain active until the System Delay is over and then it will turn off.
- The Shutdown signal must be a dry contact only. No voltage can be placed across the SHUTDOWN terminals.
- Bring the two wires from the dry contact to the terminals marked *SHUTDOWN- 31,32.*

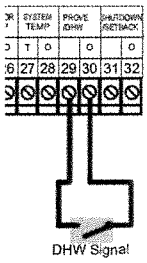
WIRING THE SYSTEM PROVE (TERMINALS 29, 30)



- The Prove feature is provided to check system component operation.
- A typical use of this feature is to check for flow before firing any boiler.
- If the PROVE input is open on a call, the Temp-Tracker mod+ will enable only the System Output. All Boiler outputs will be off when the PROVE input is open.
- A factory-installed jumper provides the Prove signal. Do not remove the jumper unless it will be replaced by a System Prove signal or use the terminals for DHW call.
- The Prove signal must be a dry contact only. No voltage can be placed across the *PROVE - 29, 30* terminals.
- Bring the two wires from the dry contact to the terminals marked *PROVE - 29, 30.*

⚠ WARNING

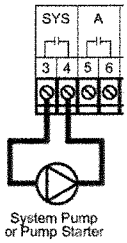
The PROVE input can not be used as a safety limit. All equipment must have its own certified limit and safety controls as required by local codes. If Prove is selected in the startup menu, no boiler stage will start unless Prove terminals are shorted. DO NOT remove the PROVE jumper supplied unless replacing it with a Prove signal.



WIRING FOR DOMESTIC HOT WATER PRIORITY (TERMINALS 29, 30)

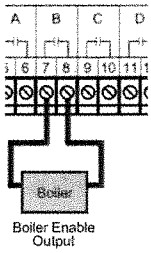
- DHW can be used to raise system Set Point to 200°F or Maximum Water temperature, whichever is lower.
- DHW Call terminals are dry contact N.O. terminals.
- Wire an aquastat or other controls to provide closure on the DHW Call terminals.
- Remove the jumper on the DHW terminals for proper operation.

WIRING THE SYSTEM OUTPUT (TERMINALS 3, 4)



- The SYS output relay will energize whenever the outdoor temperature is below the Outdoor Cutoff.
- The SYS will remain constantly energized while the outdoor temperature is below the Outdoor Cutoff.
- When the outdoor temperature rises 2°F above the Outdoor Cutoff, the SYS output will remain energized for the period set by the System Run-On.
- The SYS output has one Normally Open (N.O.) relay contact.
- The N.O. contacts are dry contacts only. They do not source any voltage.
- Class 1 voltages must enter the enclosure through a different opening from any Class 2 voltage wiring.
- Each N.O. contact is capable of switching 6A resistive at 120VAC.

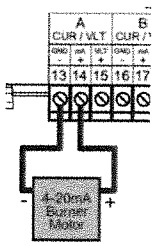
WIRING THE BOILERS



WIRING THE BOILER OUTPUTS (A TERMINALS 5,6), (B TERMINALS 7,8), (C TERMINALS 9,10), ...

- Each Boiler output (A through D) has one Normally Open (N.O.) relay contact.
- The N.O. contacts are dry contacts only. They do not source any voltage.
- Each N.O. contact is capable of switching 6A resistive at 120VAC.
- Total output of all Boilers, including the SYS, must not exceed 15A.
- Wire the N.O. relay contacts to the Enable/Disable connection at the associated unit.
- Class 1 voltages must enter the enclosure through a different opening from any Class 2 voltage wiring.

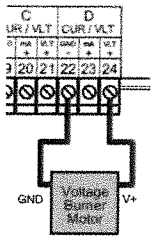
WIRING TO MODULATING MOTORS



Boiler 4-20mA Modulation Output

WIRING THE 4-20MA MODULATING MOTORS (A TERMINALS 13, 14), (B TERMINALS 16, 17),...

- The Temp-Tracker mod+ can be equipped to operate up to four 4-20 mA modulating motors.
- The Temp-Tracker mod+ Extension can be equipped to operate up to six additional modulating motors.
- The Temp-Tracker mod+ and the Temp-Tracker mod+ Extension sources 24VDC excitation voltage for the 4-20mA signal.
- Wire the (-) from the modulating motor to the boiler terminal on the Temp-Tracker mod+ marked (GND). That is for boiler A, the modulating (-) terminal will be 13.
- Wire the (+) from the modulating motor to the boiler terminal on the Temp-Tracker mod+ marked (mA). That is for boiler A, the modulating (+) terminal will be 14.



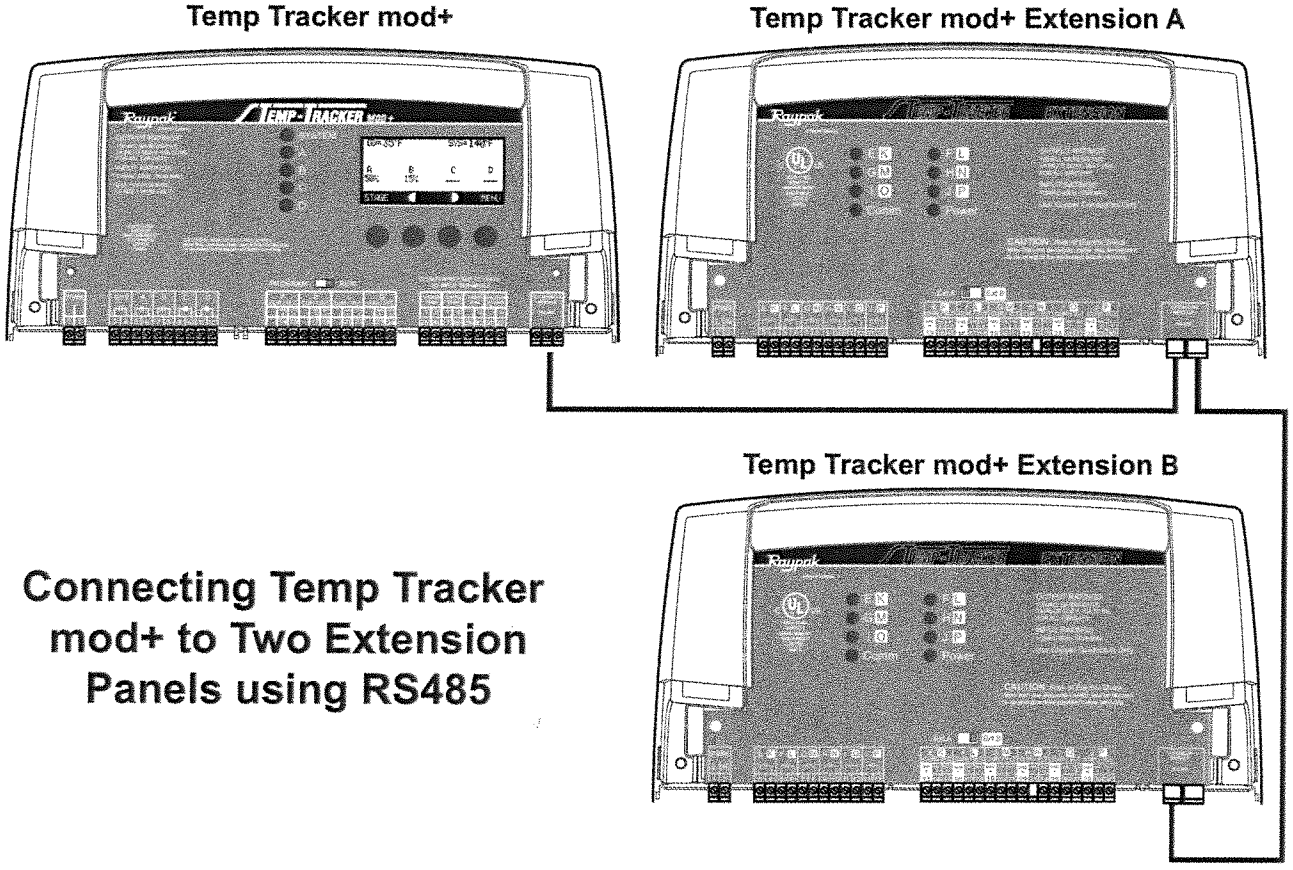
Boiler Voltage Modulation Output

WIRING THE CURRENT VOLTAGE MODULATING MOTORS (A TERMINALS 13,15), (B TERMINALS 16,18),...

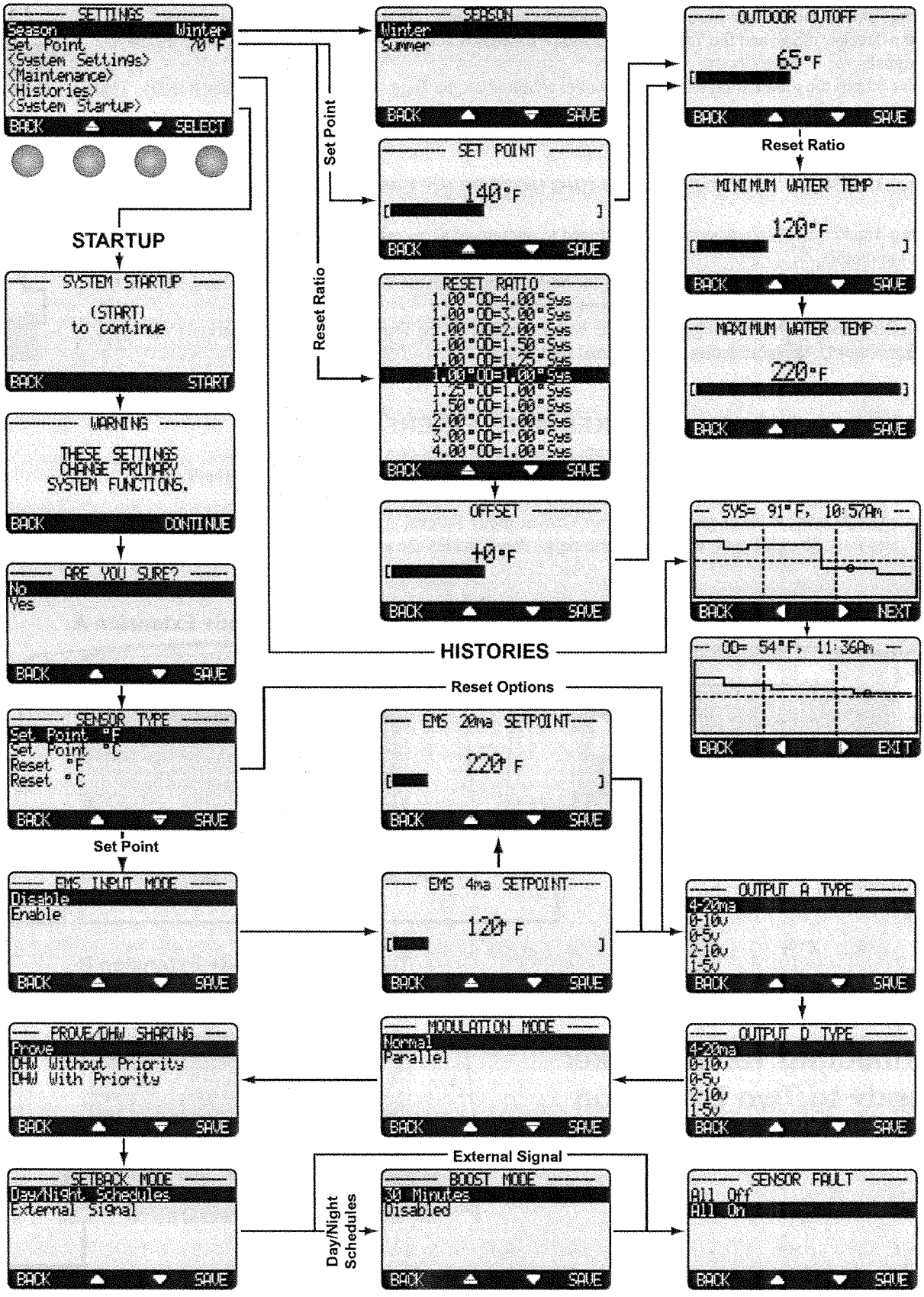
- The Temp-Tracker mod+Extension can be equipped to operate up to six additional 0-5V, 0-10V, 1-5V, or 2-10V modulating motors.
- Wire the (GND) from the modulating motor to the boiler terminal on the Temp-Tracker mod+ marked (GND). That is for boiler D, the modulating (GND) terminal will be 22.
- Wire the (V+) from the modulating motor to the boiler terminal on the Temp-Tracker mod+ marked (VLT+). That is for boiler D, the modulating (V+) terminal will be 23.

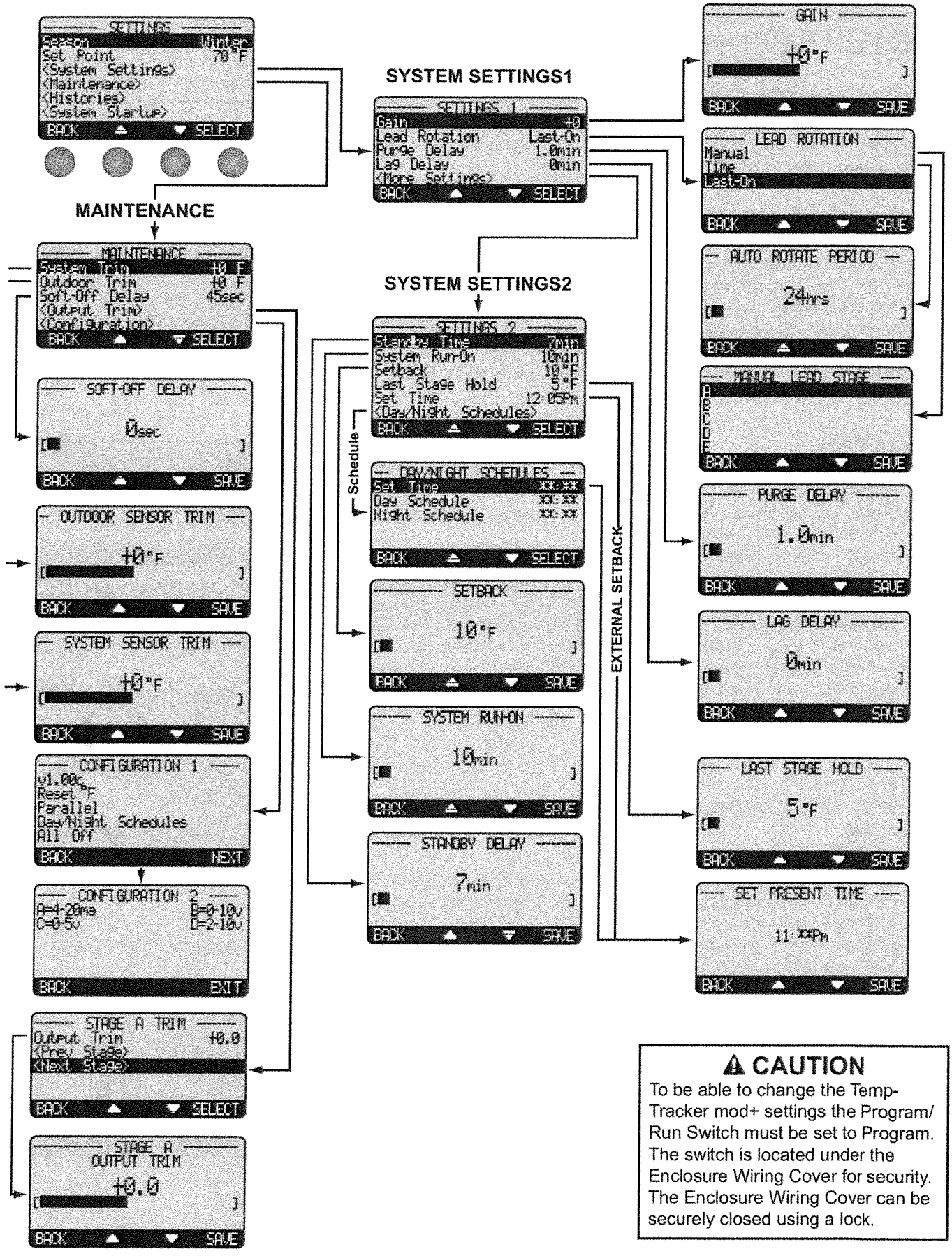
CONNECTING TO THE TEMP-TRACKER MOD+ EXTENSION PANELS

- The Temp-Tracker mod+ is equipped with a 6-pin phone socket to connect to extension panels.
- The Temp-Tracker mod+ Extension is equipped with two 6-pin phone sockets to connect to Temp-Tracker mod+ and an additional Temp-Tracker mod+ Extension panel.
- Connection cable is provided as part of the Temp-Tracker mod+ Extension package.
- Phone cables must be of a 6-wire with 6-pin terminals. Phone cables can extend up to 100'.



MENU SEQUENCE





⚠ CAUTION

To be able to change the Temp-Tracker mod+ settings the Program/Run Switch must be set to Program. The switch is located under the Enclosure Wiring Cover for security. The Enclosure Wiring Cover can be securely closed using a lock.

STARTUP SETTINGS

⚠ CAUTION
A good practice after performing any Startup menu modifications is to check all operating settings and adjustments to match the new settings.

PROGRAM CHANGE SETTINGS

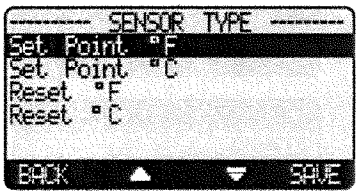
To be able to change the Temp-Tracker mod+ settings the Program/Run Switch must be set to Program. The switch is located under the Enclosure Wiring Cover for security. The Enclosure Wiring Cover can be securely closed using a lock.

STARTUP SEQUENCE

Button: *MENU/<System Startup>*

- When powered, the Temp-Tracker mod+ performs a self-test on its components.
- After the self-test diagnostics have been successfully completed, the Temp-Tracker mod+ will initialize the panel.
- On the first power up, the System Startup screen will appear after the initialization is complete. If it doesn't, the Temp-Tracker mod+ has already been configured.
- The System Startup menu sets the main parameters like the type of sensor, the type of output, and the modulating mode.

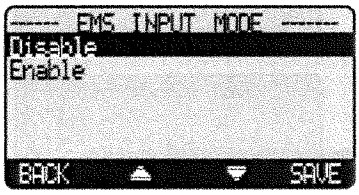
SENSOR TYPE

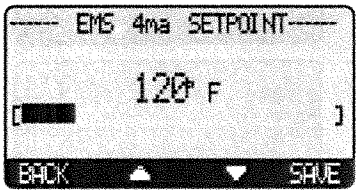


Set Point °F, Set Point °C, Reset °F, Reset °C **Default: Set Point °F**

Button: *MENU/<System Startup>/..../Sensor type*

- Reset mode is only available if an outdoor sensor is connected to terminals 25 and 26. DO NOT select Reset without an outdoor sensor.
- The same Raypak temperature sensor can display either in °F or °C.
- If °F is selected, all temperatures and settings will be displayed in degrees Fahrenheit and the Temp-Tracker mod+ will operate as a Set Point Control in degrees Fahrenheit.
- If °C is selected, all temperatures and settings will be displayed in degrees Celsius and the Temp-Tracker mod+ will operate as a Set Point Control in degrees Celsius.
- Set point mode does not require an outdoor sensor. If an outdoor sensor is connected in Set Point mode it will be used only as an outdoor cutoff point. That is, to turn the boilers and system pump off.





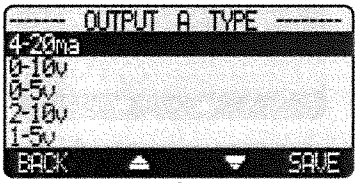
EMS INPUT MODE (AVAILABLE IN SET POINT ONLY)

Disable, Enable **Default: Disable**

Button: *MENU/<System Startup>/..../EMS Input Mode*

- This allows the Temp-Tracker mod+ to receive an external set point from an EMS/BMS system.
- You must select the 4mA (min) and 20 mA (max) Set Points in the following screen.
- The 4mA can be set to any temperature between 70°F to 200°F.
- The 20mA can be set to any temperature between 90°F to 240°F. However, the 20mA minimum setting must be 20°F higher than the 4mA setting.
- Connect the 4-20mA EMS Control Interface to the Temp-Tracker mod+ RS485 connection.

SELECTING THE OUTPUT TYPE

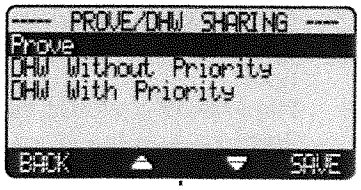


4-20mA, 0-5V, 0-10V, 1-5V, or 2-10V Outputs **Default: 4-20mA**

Button: *MENU/<System Startup>/..../Output A type/Output B type*

- Outputs can be configured for 4-20mA operation (current) or the voltage range can be selected (0-5V, 0-10V, 1-5V, 2-10V).
- Check the modulating motor to determine its control requirements.
- Select the appropriate Output Type for each of the Boilers. The Temp-Tracker mod+ can have a different Output type for each Boiler.

PROVE/DOMESTIC HOT WATER (DHW)



Prove, DHW Without Priority, DHW With Priority **Default: Prove**

Button: *MENU/<System Startup>/..../Prove-DHW Sharing*

- Input Terminals 29 and 30 can be used with either of the above features.
- When Prove is selected, the Temp-Tracker mod+ will not start any boiler stage unless Prove terminals are connected.
- Using those terminals to connect to an aquastat for a Domestic Hot Water call and selecting either of the DHW options will raise the calculated water temperature to the lower of 200°F or Max Water Temperature.
- Domestic hot water without priority allows the SYS relay, mostly controlling a primary system pump, to remain energized during a domestic hot water call (aquastat call on terminals 29 and 30). In Summer or when outdoor temperature is above Outdoor Cutoff, a DHW call will energize the SYS relay. After the DHW call termination, the SYS relay will continue to run for the System Run-On period before turning off.
- However, domestic hot water with priority de-energizes the SYS relay during a domestic hot water call (aquastat call on terminals 29 and 30) for a period of one hour. If after the hour period the DHW call still exist, the SYS relay will energize and the Temp-Tracker mod+ will continue in the higher temperature setting until the domestic hot water call has terminated.

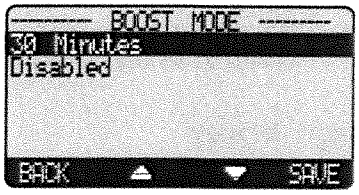
SETBACK MODE

Day/Night Schedules, External Signal **Default: Day/Night Schedules**

Button: *MENU/<System Startup>/..../Setback Mode*

- The Temp-Tracker mod+ has two levels of heat, a normal/day and a setback/night. The normal heat level is good for when buildings are occupied and people are active. The setback/night heat level holds a lower system temperature and is for when buildings are unoccupied or inactive.
- The Day/Night Schedules provides the user with a Day Time setting for normal operation and a Night Time setting for setback.
- The External Signal option switches the Temp-Tracker mod+ to Setback mode when an external signal is received through the Setback terminals. This is allows the Temp-Tracker mod+ to be managed by an external device or control to provide setback.

BOOST MODE

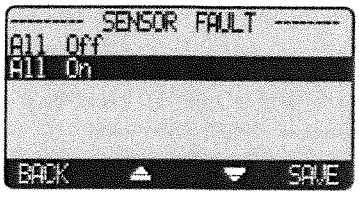


30 Minutes, Disabled **Default: 30 Minutes**

Button: *MENU/<System Startup>/..../Boost Mode*

- If you do not want a Boost simply select Disabled from the boost menu.
- Boost is only available if Day/Night Schedules is selected as a Setback option.
- The morning Boost is designed to return the building to comfortable ambient temperatures after the cooler Night (Setback) period. The Temp-Tracker mod+ will accomplish this by running elevated water temperatures (will add Setback setting to calculated water temperature) for 30 minutes before the start of the Day schedule setting. That is, if the normal day set point at a specific outdoor was 145°F and the Setback setting was 20°F, the boost will raise the system calculated temperature to 165°F for 30 minutes before the start of the Day Schedule setting.

SENSOR FAULT



All Off, All On **Default: All On**

Button: *MENU/<System Startup>/..../Sensor Fault*

The Sensor Fault will determine the operating status of all output stages that are set to Auto when a sensor reads Short or Open.

RESET MODE

- When All-On is selected, the Temp-Tracker mod+ will turn all boilers On to a 100% when System reads Short or Open and Outdoor is below Outdoor Cutoff. When Outdoor reads Short or Open, the Temp-Tracker mod+ will turn all boilers On to a 100%.
- When All-Off is selected, the Temp-Tracker mod+ will turn all boilers Off when either System or Outdoor sensor reads Short or Open.

SET POINT MODE

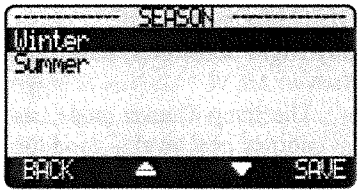
- When All-On is selected, the Temp-Tracker mod+ will turn all boilers On to a 100% when the System sensor reads Short or Open.
- When All-Off is selected, the Temp-Tracker mod+ will turn all boilers Off when the System sensor reads Short or Open.
- The Outdoor Sensor Short or Open status will not affect the control operation in Set Point mode.

OPERATING SETTINGS

PROGRAM CHANGE SETTINGS

To be able to change the Temp-Tracker mod+ settings the Program/Run Switch must be set to Program. The switch is located under the Enclosure Wiring Cover for security. The Enclosure Wiring Cover can be securely closed using a lock.

SEASON



Winter, Summer **Default: Winter**

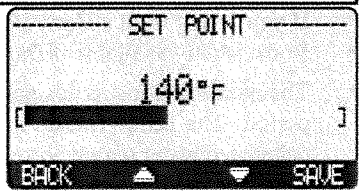
Button: *MENU/Season*

- The Temp-Tracker mod+ will turn all boiler relays off when it is in Summer setting. However, a DHW call will bring boilers back on if needed. The Message Display Line will display *Summer* to show status.
- When in Winter, the Temp-Tracker mod+ will activate the Sys relay whenever the Outdoor temperature (OD) falls to or below the Outdoor Cutoff setting. In addition, it will begin heating whenever the System temperature (SYS) falls below the Set Point Temperature.
- When the heating season is over, it is a good practice to switch the Temp-Tracker mod+ to Summer setting. This will allow DHW calls to operate the boilers when needed.

⚠ CAUTION

DO NOT turn power off to the Temp-Tracker mod+ when heating season is over. If you do so, the battery will run down and will have to be replaced. Instead switch to Summer.

SET POINT

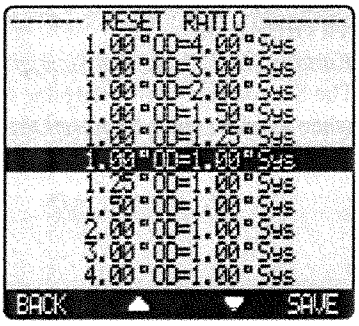


Adjustable 70°F - 250°F **Default: 140°F**

Button: *MENU/Set Point*

- The Set point is the temperature the Temp-Tracker mod+ will use to control the system.
- The Temp-Tracker mod+ will increase, decrease or hold the modulation of the boilers to maintain the system temperature around the Set point.
- The system can be expected to fluctuate around the set point. The amount of fluctuation depends on the Modulation Mode, System Settings, and Stage Settings.

RESET RATIO

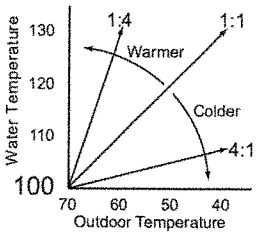


Adjustable 1.00°OD : 4.00°Sys to 4.00°OD : 1.00°Sys **Default: 1.00°OD : 1.00°Sys**

Button: *MENU/Set Point*

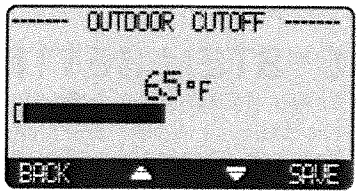
- The Reset Ratio determines how the System water temperature (SYS) will vary with Outside temperature (OD). With any of the ratios, the colder it becomes outside, the hotter the temperature of the system water. The ratios are adjustable from 1.00 (OD):4.00 (SYS) to 4.00 (OD):1.00 (SYS). (See Understanding Operation Concept on page 5)
- With a 1.00 (OD):4.00 (SYS) ratio, the System water temperature (SYS) will increase rapidly as the outside temperature falls, hitting the maximum of 240°F at 24°F outside temperature. With a 4.00 (OD):1.00 (SYS) ratio, the System water temperature (SYS) will increase slowly as the outside temperature falls. Even at -30°F, the system water will only be 125°F, and at 24°F outside, the system water will be 112°F. Such a low Reset Ratio might be used with radiant floor heating applications.

- With most baseboard heating applications, a 1.00 (OD):1.00 (SYS) setting is a good place to start. With a 1.00 (OD):1.00 (SYS) ratio, for every degree the outside temperature falls, the system water temperature is increased one degree.
- If required: **Adjust the RESET RATIO in cold weather.** If the ambient building temperatures are too cold in cold weather, move the ratio to a higher selection. That is, if 1.00 (OD):1.00 (SYS) was initially selected, change the selection to 1.00 (OD):1.25 (SYS). If the building temperatures are too warm in cold weather, move the ratio to a lower selection. That is, if 1.00 (OD):1.00 (SYS) was initially selected, change the selection to 1.25 (OD):1.00 (SYS).



OUTDOOR CUTOFF TEMPERATURE

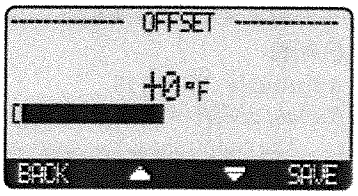
Adjustable Off, 20°F - 100°F, On **Default: 65°F**
Button: *MENU/Set Point/Outdoor Cutoff* **in Set Point**
Button: *MENU/Set Point/Offset/Outdoor Cutoff* **in Reset**



- If the outdoor sensor is installed, the Outdoor Cutoff screen will automatically appear after the temperature Set Point has been selected.
- When the outdoor temperature falls to the adjustable Outdoor Cutoff temperature, the Temp-Tracker mod+ will control and modulate Boilers to hold the calculated temperature.
- When the outdoor temperature rises to the Outdoor Cutoff plus a 2°F differential, the Temp-Tracker mod+ will disable the system. The Message Display Line will display *Outdoor Cutoff.*
- The Outdoor Cutoff can be set from 20°F to 100°F. In addition, the Setting can be set to ON or OFF. In the ON position, the System Relay will run regardless of the Outdoor temperature (OD) and the burner stages will be active to hold the calculated water temperature. (Note: The lowest water temperature the Temp-Tracker mod+ will circulate is 70°F. If the Outdoor Cutoff is turned ON and the Season is set to Winter, the Temp-Tracker mod+ will circulate at least 70°F water even in the hottest of weather.) In the OFF position, the system pump will always be off and all burner stages will be off for heating.

OFFSET

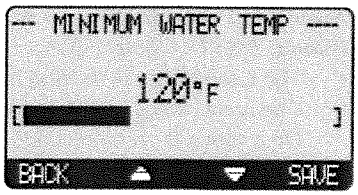
Adjustable 50°F - (-50°F) **Default: 0°F**
Button: *MENU/Set Point/Offset* **in Reset only**



- The Offset setting lets you adjust the starting points of the Reset Ratio curves. This means that, regardless of the Outdoor temperature (OD), or the Reset Ratio that has been selected, when the Offset setting is changed, that change is directly added to or subtracted from the calculated temperature. For example, if the Set Point temperature was 130°F and the Offset was changed from 0° to 10° (an increase of 10°), then the Set Point temperature would increase to 140°F
- The Offset setting does not change the ratio selection. For instance, with 1.00 (OD):1.00 (SYS) Reset Ratio, the System water temperature (SYS) will always increase one degree for each degree change in the Outdoor temperature (OD). What the Offset does is add or subtract a constant temperature value. (See Understanding Operation Concept)
- If required: **Adjust the Water Offset in mild weather**. If the ambient building temperatures are too warm in the mild weather, decrease the Water Offset. If the ambient building temperatures are too cold in the mild weather, increase the Water Offset. The rule of thumb for baseboard radiation is to change the Offset 4°F for every 1°F you wish to change the building temperatures. In radiant heat applications, change the Offset 1°F or 2°F for every 1°F you wish to change the building temperature.

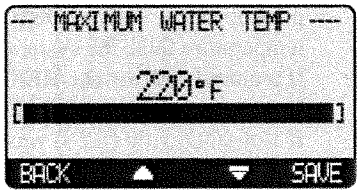
MINIMUM WATER TEMP

Adjustable 70°F - 180°F **Default: 120°F**
Button: *MENU/Set Point/Offset/Outdoor Cutoff/Minimum Water Temp* **in Reset only**



- The Minimum Water Temperature must be set to the boiler manufacturer's specification. The Temp-Tracker mod+ will calculate the Set Point based on the Outdoor temperature (OD), the Reset Ratio, and the Offset value. The Temp-Tracker mod+ will control all boilers modulation to hold either the Set Point temperature, or the Minimum Water Temperature, whichever is higher.
- The Minimum Water Temperature must be at least 20°F lower than the Maximum Temperature (See next setting).

MAXIMUM WATER TEMP

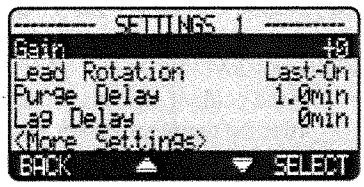


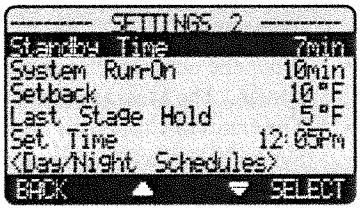
Adjustable 90°F - 240°F **Default: 240°F**

Button: *MENU/Set Point/Offset/..../Maximum Water Temperature* **in Reset only**

- This is the highest temperature heating water the Temp-Tracker mod+ will circulate through the heating system. It is available in Reset mode only.
- When using a radiation system, it should be set according to the tubing or floor manufacturer's specification.
- The Maximum Temperature must be at least 20°F higher than the Minimum Temperature.

SYSTEM SETTINGS





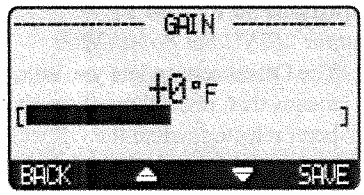
Button: *MENU/<System Settings>*

The Settings 1 and Settings 2 menus provide access to adjusting and fine-tuning the system for enhanced comfort and more fuel savings. The Temp-Tracker mod+ behaves differently based on the selected Control Modes (see Startup Settings).

- Gain
- Lead Rotation
- Purge Delay
- Lag Delay
- Standby Time
- System Run-On
- Setback
- Last Stage Hold
- Day/Night Schedules

> **⚠ CAUTION**
>
> **To be able to change the Temp-Tracker mod+ settings the Program/Run Switch must be set to Program. The switch is located under the Enclosure Wiring Cover for security. The Enclosure Wiring Cover can be securely closed using a lock.**

GAIN

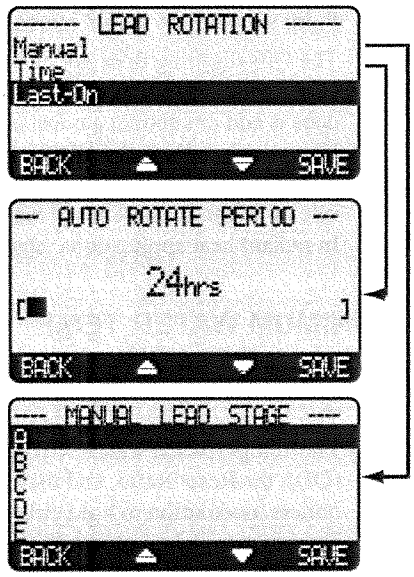


Adjustable -10 to +10 **Default: 0**

Button: *MENU/<System Settings>/Gain*

- The Gain adjusts the aggressiveness of the Temp-Tracker mod+ PID logic to control how much modulation is changed when the system temperature is different from the Set Point.
- A Gain of 0 is a good starting point for all systems.
- If during normal load conditions, the system temperature tends to fluctuate significantly, decrease the Gain by two numbers (for example, from 0 to -2). Wait for at least 15 minutes before evaluating how the change has affected the system.
- If, during normal load conditions the system temperature tends to remain consistently below the Set Point (or consistently above the Set Point), increase the Gain by two numbers (for example, from 0 to 2). Wait for at least 15 minutes before evaluating how the change has affected the system.

LEAD BOILER ROTATION

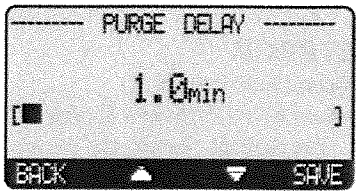


Adjustable Manual, Time (1 hr to 60 Days), Last-On **Default: Last-On**

Button: *MENU/<System Settings>/Lead Rotation*

- The Lead Boiler is the first boiler brought on when output is required.
- The Lead Boiler can be rotated automatically, manually or based on Last-On. The Last-On rotation is recommended.
- The current Lead Boiler is shown in brackets on the main display.
- Only Boilers which are set to Auto Mode can be Lead. Therefore, not all the Boilers may be available when manually selecting a new Lead Boiler.

PURGE DELAY



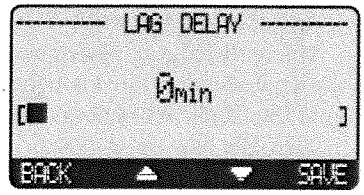
Adjustable 1.0min to 10.0min **Default: 1.0min**

Button: *MENU/<System Settings>/Purge Delay*

- Many boilers go through a purge cycle before they are brought on line.
- When the Temp-Tracker mod+ activates a boiler, it does not start to calculate its output until the Purge Delay is over. This allows the boiler to fully come on line and begin producing output.
- The Purge Delay helps to prevent short cycling of a newly activated burner. Once the burner is activated, it **MUST** run through the entire Purge Delay period.
- The minimum Purge Delay setting **MUST** be set to the time required by the boiler manufacturer. Time entry is in 0.1 of a minute (i.e. 1.5min will equal 90 seconds.)
- The Message Display Line will display *Purge Delay* and the amount of time remaining in the purge.

⚠ CAUTION
Set Purge Delay as per boiler manufacturer recommendation.

LAG DELAY



Adjustable 0min to 60min **Default: 0min**

Button: *MENU/<System Settings>/Lag Delay*

- The Lag Delay requires the previous stage to remain at 100% modulation for the full period of the Lag Delay before another Stage can be activated. For example, if the Lag Delay was set to 10 minutes, the Lead Stage would need to remain at 100% modulation for a full ten minutes (never backing down to even 99%) before a lag stage could be activated. The Message Display Line will display *Lag Delay* and the remaining time.
- Set the Lag Delay to 0 min when two or more Stages will generally be needed to hold the load.
- The Lag Delay is useful in installations where one unit should usually have enough output to hold the load unless it fails or load conditions become extreme.
- The Lag Delay overrides the value of the Modulation Point selected for each stage. Regardless of that setting, the previous stage must reach 100% and stay there before another Stage can be activated.
- The full Lag Delay must always elapse regardless of what happens to system temperature. Therefore, set the Lag Delay to 0 min if you want smooth set point control using multiple units.

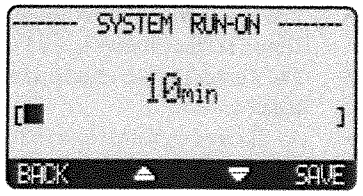
STANDBY TIME

Adjustable 1min to 60min **Default: 10min**

Button: *MENU/<System Settings>/<More Settings>/Standby Time*

- The Standby Delay Time only applies to Boilers in Standby Mode.
- A Standby Boiler can only be activated after all the boilers in Auto Mode have run at 100% modulation for the full Standby Time.
- Standby boilers are used for backup or extreme load conditions only. A Standby Boiler can never be a Lead Stage
- The full Standby Delay Time must always elapse regardless of what happens to system temperature. Therefore, shorter Standby Times will result in smoother set point operation in extreme conditions. Longer Standby Times may prevent a Standby Boiler from firing if the other boilers can eventually meet the load, or if the load decreases.

SYSTEM RUN-ON

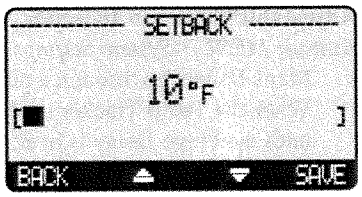


Adjustable 0min to 360min **Default: 10min**

Button: *MENU/<System Settings>/<More Settings>/System run-On*

- The SYS relay will energize whenever the Outdoor temperature (OD) is below the Outdoor Cutoff. When the Outdoor temperature increases 2°F above the Outdoor Cutoff after the last burner relay has de-energized, the SYS relay will stay on for a period set by the System Run-On. This allows the Pump to dissipate the residual heat within the boilers back into the system.
- A common use for the System Run-On is to control a system pump in a heating system. The extra time helps transfer the heat from the boilers to the heating system.
- The System Run-On time should be set based on the size and type of the boilers and pumps. In general, a boiler with low water content and high horsepower will need a longer System Run-On than a boiler with the same horsepower and more water content. (Refer to boiler manufacturer recommendation)

SETBACK



Adjustable 0°F to 75°F **Default: 10°F**

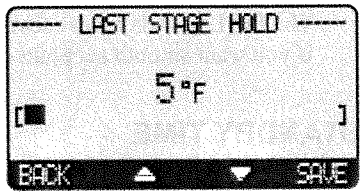
Button: *MENU/<System Settings>/<More Settings>/Setback*

- The Setback feature can be used to provide the Temp-Tracker mod+ with a lower temperature Set Point when less load is required.
- The lower Set Point will appear on the main display indicating this condition.
- For an example, if the calculated temperature is 180°F and the Setback is 20°F, then when in Setback, the Temp-Tracker mod+ will hold a Set Point of 160°F.
- A typical use for Setback is to provide less system temperature to a building during the night or on the weekends when building is not occupied, but heat is still required.
- The amount of Setback selected is subtracted from the Set Point when a Setback External Signal is received or the Night Time schedule setting started.
- If External Signal is selected as a Setback Mode (See Startup menu), the Setback will not be activated unless a dry contact signal source is wired into the Shutdown/Setback terminals (31 and 32) and the Temp-Tracker mod+ receives a SHORT signal.
- If Day/Night Schedules is selected as a Setback Mode (See Startup menu), the Setback will be activated only when Night Schedule time has started.

⚠ CAUTION

When using Soft-Off and Last Stage Hold, the last boiler stage will not turn off until both parameters have elapsed. In this case, Soft-Off will start after the Last Stage Hold.

LAST STAGE HOLD



Adjustable 0°F to 30°F **Default: 5°F**

Button: *MENU/<System Settings>/<More Settings>/Last Stg Hold*

- The Last Stage Hold prevents short cycling of the Lead Stage during low load periods.
- In low load conditions, the system might require only 5% of the output of one Stage. When the Temp-Tracker mod+ brings on the Lead Stage, the Set Point is quickly exceeded, and the Temp-Tracker mod+ turns the Lead Stage off.
- To prolong the run time during this type of condition, use the Last Stage Hold setting.
- The Temp-Tracker mod+ will let the system temperature exceed the Set Point by the number of degrees selected, before the Lead Stage is turned off.
- For example, with a Set Point of 160°F and a Last Stage Hold setting of 10°F, the Lead Stage boiler will remain on, at low modulation, until the Set Point reaches 170°F.
- From an efficiency stand point, it is better to overshoot slightly than to short cycle a boiler.

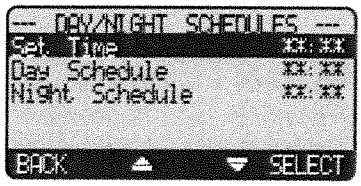
Avoiding Conflicting Boiler Limits

⚠ WARNING

The temperature limits set on the boilers must be higher than the Temp-Tracker mod+ Set Point. Read the section at left for details that will prevent erratic system operation.

- The temperature limits set on the boilers MUST be set considerably higher than the Temp-Tracker mod+'s Set Point for the reasons detailed below.
- The Temp-Tracker mod+ sensor is located in a common header some distance from the boilers.
- As the temperature rises in the header and before reaching the sensor location, energy is dissipated. Therefore, the temperature in the header could be lower than that registered by boiler sensors.
- In addition to the normal drop experienced between the boiler's temperature and that read by the Temp-Tracker mod+ sensor, the Last Stage Hold setting must be accounted for. The boiler limit must be set above the Set Point PLUS the Last Stage Hold PLUS the normal drop experienced in the piping.
- Using the previous example of a 10°F Last Stage Hold with a 160°F Set Point, the boilers' limits must be set enough over 170°F to prevent the boilers' internal limits being reached. In this situation, the boiler high limit should be set at approximately 180°F to prevent the difference in boiler temperature vs. header temperature causing erratic operation.

DAY/NIGHT SCHEDULES

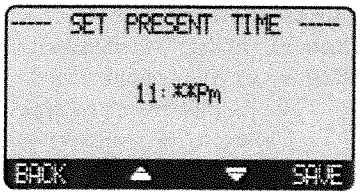


(Available when "Day/Night Schedules" is selected from the Setback Startup menu option only)

Button: *MENU/<System Settings>/<More Settings>/Day/Night Schedules*

- The Temp-Tracker mod+ has two levels of heat. The Day level is used when a building is occupied and people are active.
- The Night (Setback) level is used when a building is not occupied, or when people are sleeping. This setting reduces the calculated temperature by the Setback setting. If the Day calculated water temperature was 150°F and the Setback was 20°F, the Night Schedule will run at (150°F - 20°F) = 130°F.
- If the Boost feature is being used, it uses the Day Schedule as a Boost ending point. That is, if the Day Schedule is set to start at 6:00AM, the Boost will start 30 minutes prior to the Day setting at 5:30AM. The Temp-Tracker mod+ will then raise the calculated water temperature by the Setback amount. Using the previous example, at 5:30AM the Temp-Tracker mod+ will raise the calculated water to 170°F (150°F + 20°F) until 6:00AM.

SET TIME



Button: *MENU/<System Settings>/<More Settings>/Set Time*

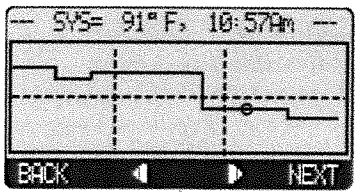
Button: *MENU/<System Settings>/<More Settings>/<Day/Night Schedules>/Set Time*

- Adjust the time by selecting Time from the menu and then scrolling through the hours followed by the minutes. If hours are to be set to PM, scroll through the AM hours to reach the PM hours.

⚠ CAUTION

Remember that the battery is the backup for the Time. If no power is supplied to the Temp-Tracker mod+ and there was no battery or battery had no power, time values will be lost and will need to be reset.

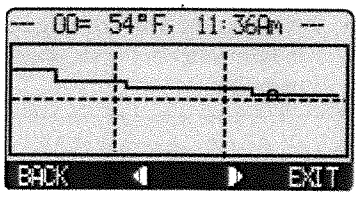
HISTORY



Button: *MENU/<Histories>*

The Temp-Tracker mod+ provides users with a graphical history of the System and Outdoor temperatures for the previous 24 hours. The temperatures are sampled every 12 minutes. That is, readings of both System and Outdoor temperatures are recorded and stored every 12 minutes for the last 24 hours.

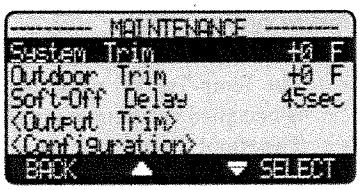
- To view the values of specific time period, use the two middle buttons to scroll to that time and read the upper left temperature.
- The first screen will be the System Temperature History. By clicking on the Next button, you'll be able to view the Outdoor Temperature History.



MAINTENANCE

Button: *MENU/<Maintenance>*

The Maintenance menu gives access to sensor and outputs trimming and Soft-Off. In addition, you'll have access to view the Startup configuration settings.



⚠ CAUTION

To be able to change the Temp-Tracker mod+ settings the Program/Run Switch must be set to Program. The switch is located under the Enclosure Wiring Cover for security. The Enclosure Wiring Cover can be securely closed using a lock.

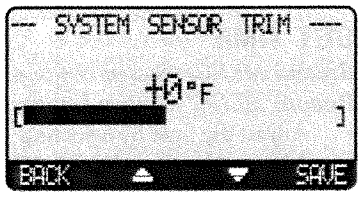
SYSTEM & OUTDOOR SENSOR TRIM

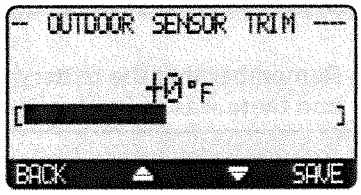
Adjustable -5°F to +5°F **Default: 0°F**

Button: *MENU/<Maintenance>/System Trim*

Button: *MENU/<Maintenance>/Outdoor Trim*

- The Raypak thermistor type sensors are very accurate, and normally require no calibration. Sometimes it may be desirable to make small adjustments to the displayed value for either the Outdoor temperature (OD) or the System temperature (SYS). The Trim setting can adjust the displayed value by ± 5°F.
- Do not use the Trim setting to make the Outdoor temperature sensor match that reported on the radio or TV. Outdoor temperature can vary widely over a broadcast range. Only trim the outdoor sensor based on an accurate thermometer reading taken where the sensor is located.





SOFT-OFF DELAY

Adjustable 0sec to 60sec **Default: 0sec**

Button: *MENU/<Maintenance>/Soft-Off Delay*

- When a stage is no longer needed, the Soft-Off keeps that stage burner in Low Fire prior to turning it off.
- The display will show a percent that is equal to the Ignition % for the stage in Soft-Off delay. That number will blink for the Soft-Off delay period.
- If during the Soft-Off stage delay period the Temp-Tracker mod+ needed that stage to turn back on, the stage will be released from the Soft-Off delay and resume normal operation.

⚠ CAUTION

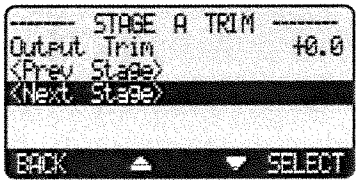
When using Soft-Off and Last Stage Hold, the last boiler stage will not turn off until both parameters have elapsed. In this case, Soft-Off will start after the Last Stage Hold.

OUTPUT TRIM

Adjustable -5 to +5 **Default: 0**

Button: *MENU/<Maintenance>/Output Trim*

- Each of the stages controlled by the Temp-Tracker mod+ has a separate Output Trim setting.
- Output Trim acts as an adjustment to a stage output percent to match the burner motor.
- After adjusting the Output Trim, test the operation to make sure the results match your expectation.



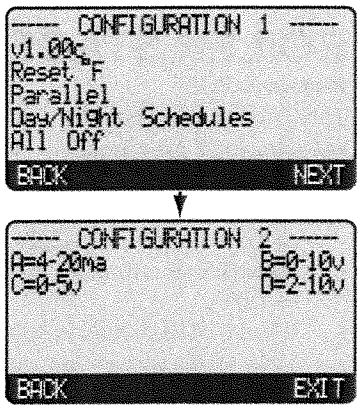
⚠ CAUTION

DO NOT use the Output Trim for a Stage unless it is absolutely necessary. Test burner operation and modulation output matching after adjusting the Output Trim.

CONFIGURATION

Button: *MENU/<Maintenance>/<Configuration>*

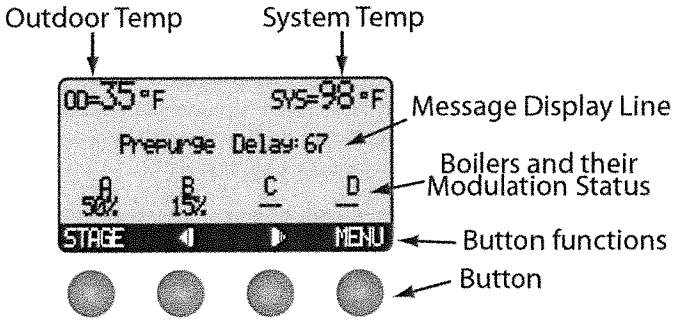
- This menu option provides a consolidated view of the Startup settings the Temp-Tracker mod+ has been set to.
- Additional stage settings will be available by selecting the NEXT option.



DISPLAY

The Temp-Tracker mod+ display layout provides a variety of information that gives an immediate picture of the operation status. The display shows four boilers at a time. The two middle buttons scrolls the screen to view additional boilers. Moreover, all the information is brightly displayed. It can be viewed in brightly or dimly lit rooms.

- The buttons' functionality changes based on the screen and menu level your in. The buttons' functionality are displayed on a dark background on the screen bottom line.
- Horizontal arrows are to scroll through the available stages.
- Vertical arrows are to scroll through the menu functions when in menus or to change values of settings when in its specific screen.



DISPLAY BOILER MODULATION STATUS

The Temp-Tracker mod+ boiler modulation status gives immediate access to each boiler status. The following list show all possible boiler status:

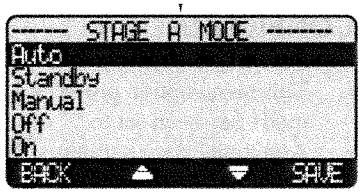
- --- Boiler is off due to no call for heat.
- 97% Boiler is modulating at the indicated percentage.
- ON Boiler Stage Mode is set to ON and boiler is firing at 100% (boiler is in bypass).
- OFF Boiler Stage Mode is set to OFF and boiler stage is unavailable or boiler does not exist.
- m95% Boiler Stage Mode is set to Manual and set to the specified percent.
- h50% Boiler is in post purge for 30 seconds.
- C/E Boiler on Extension panel is communicating back to the Temp-Tracker mod+..

DISPLAY MESSAGES

The Temp-Tracker mod+ normal display layout reserved the second line for message indications. The following is a list of the most common Message Display Line information:

- Summer — The control is set to Summer. No heat is active.
- Shutdown Active — The Shutdown Terminals are Shorted. No boilers will be active.
- DHW Call (171°F) — There is a DHW (Domestic Hot Water) call. The Temp-Tracker mod+ will Raise system Set Point to the indicated temperature. DHW increases calculated temperature to 200°F or Max Water Temperature, whichever is lower.
- Purge Delay: 23 — The current boiler is in purge cycle and the remaining purge time in seconds is 23.
- Holding Until 150°F — The Lead boiler is in Last Stage Hold. This example shows that the lead stage will turn off when system temperature reaches 150°F.
- System Run-On: 46 — The System relay is ON for the System Run-On Delay. This example shows that it will remain in System Run-On for an additional 46 seconds before turning off.

BOILER STAGE SETTINGS



Button: *STAGE/*

The Maintenance menu gives access to sensor and outputs trimming and Soft-Off. In addition, you'll have access to view the Startup configuration settings.

- In most installations, all active Boiler adjustments are the same, but each can be configured differently if desired.
- If the Boilers are not set up properly, the Temp-Tracker mod+ operation may appear to be erratic.
- When STAGE button is depressed, the Boiler A Settings menu will be shown.
- Make all the appropriate settings for Boiler A (See below).
- After completing all the settings for Boiler A (See below), you have the option of copying these settings to all other Boilers. Everything but the Mode -- Auto/Standby/ Manual/Off/On -- will be copied.
- Then select the Next Stage option from the menu to bring up the Boiler B Settings menu and make all the settings. Continue until all Boilers have been set.
- If a Temp-Tracker mod+ Extension is connected to the Temp-Tracker mod+, scrolling through stages using the Next and Prev Stage menu options will scroll through the Temp-Tracker mod+ Extension stages as well.

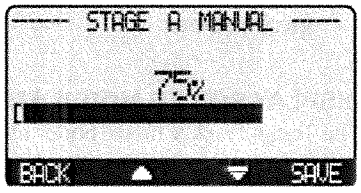
⚠ CAUTION

Remember to set the Mode for each stage. For Stages that do not have a boiler, contractor must change their Mode to OFF. Otherwise the Temp-Tracker mod+ will include them in the modulation calculation and rotation. That might have dire effects on system response.

⚠ CAUTION

To be able to change the Temp-Tracker mod+ settings the Program/Run Switch must be set to Program. The switch is located under the Enclosure Wiring Cover for security. The Enclosure Wiring Cover can be securely closed using a lock.

MODE



Auto, Standby, Manual, Off, On **Default: Auto**

Button: *STAGE/Mode*

- The Temp-Tracker mod+ only controls the modulation of Boilers set to Auto or (after a delay) those set to Standby. None of the other settings is recommended for output Boilers connected to active units.
- Any Boiler without an active unit connected must be set to Off.
- The following list describes the MODE options:

Auto - The Temp-Tracker mod+ will control the Boiler's operation to maintain the desired Set Point. Only Boilers set to Auto can be Lead Boilers.

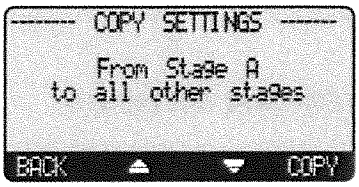
Standby Standby Boilers can only be activated when all Boilers in Auto have been at 100% modulation for a selectable period of time. Standby is generally used when you want a specific boiler to be available in extreme load conditions. Note that a Standby Boiler Cannot be a Lead Boiler.

Manual The Manual Mode should only be used when testing a Boiler. Manual overrides the System Prove input. The exact percent of modulation for a Boiler can be set with the Manual mode. Once selected, the unit will immediately turn on and modulate to the selected percentage.

Off Any output Boiler A through D not connected to a physical unit should be set to Off. The Off Mode can also be used to disable units that are being serviced.

On The On Mode should only be used when testing a Boiler. The On Mode overrides the SYSTEM PROVE input. Once set to On the Boiler will immediately start firing and modulate to 100%.

COPY SETTINGS - BOILER A ONLY



Button: *STAGE/Copy Settings*

- If all the active Boilers will have the same Ignition Start Point and Modulation Point, they can be set for Boiler A and then copied to the other Boilers.
- It is still required to select the Mode for all other Boilers. The Mode will not be copied.

⚠ IMPORTANT

The Mode MUST be set for each Boiler. The Copy Settings command will not set the Mode for Boilers B, C, and D. Only Ignition % and Modulation Start % are copied.

TROUBLESHOOTING

TEMPERATURE INPUTS

Display shows Sensor OPEN

Check the sensor is connected and the wires are continuous to the Temp-Tracker mod+. Finally follow the procedure for Incorrect Temperature Display.

Display shows Sensor SHORT

The Temp-Tracker mod+ sees a short across the input terminals. Remove the wires from either the SYSTEM TEMP or OUT TEMP terminals (whichever is reading SHORT). The display should change to read OPEN. If it doesn't, the Temp-Tracker mod+ may be damaged.

Display shows an Incorrect Temperature Display

Remove the wires from either the SYSTEM TEMP or OUT TEMP terminals (whichever is reading incorrectly). The display should change to read OPEN. If it doesn't, the Temp-Tracker mod+ may be damaged. Take an ohm reading across the detached sensor wires. The ohm reading should correspond to the side chart. If it doesn't, the sensor may be damaged.

Temperature Sensor Chart

TEMPERATURE (in Degrees F)	Value (in Ohms)
-30	117720
-20	82823
-10	59076
0	42683
10	31215
20	23089
25	19939
30	17264
35	14985
40	13040
45	11374
50	9944
55	8714
60	7653
70	5941
80	4649
90	3667
100	2914
110	2332
120	1879
130	1524
140	1243
150	1021
160	842
170	699
180	583
190	489
200	412
210	349
220	297
230	253
240	217
250	187

CONTROL OPERATION

No Heat

- (Check Diagram on next page)

Too Much Heat

Check if the control has any of the following:

- **Domestic Hot Water call** - The Temp-Tracker mod+ will raise the temperature of the system to either 200°F or Maximum Water Temperature on a DHW call, connected to terminals 29 and 30. Check to see if there is a call for DHW and the length of time it lasts.
- **Reset Ratio and Offset** - If excessive heat occurs only in certain weather, adjust the Reset Ratio and Offset (See Understanding Operating Concept). If excessive heat occurs year round, reduce the Offset.
- **Boiler Mode Settings** - The Temp-Tracker mod+ will only modulate boilers their mode is set to Auto or Standby. Check to if any boiler stage is set to Manual or On.
- **Control Settings** - The Last Stage Hold will allow only the Lead boiler to stay on for an additional number of degrees. If the setting is too high, and only the Lead boiler is on, the system can over heat. Reduce the Last Stage Hold setting.

Too Little Heat

Check if the control has any of the following:

- **Reset Ratio and Offset** - If reduced heat occurs only in certain weather, adjust the Reset Ratio and Offset (See Understanding Operating Concept). If reduced heat occurs year round, increase the Offset.
- **Setback and Day/Night Schedule** - If reduced heat occurs only during specific hours, check the Day/Night Schedule and the Setback values. Either reduce the Setback setting or change the Day and Night Schedules.
- **Boiler Mode Settings** - The Temp-Tracker mod+ will only modulate boilers their mode is set to Auto or Standby. Check to if any boiler stage is set to Manual, Off, or Standby.

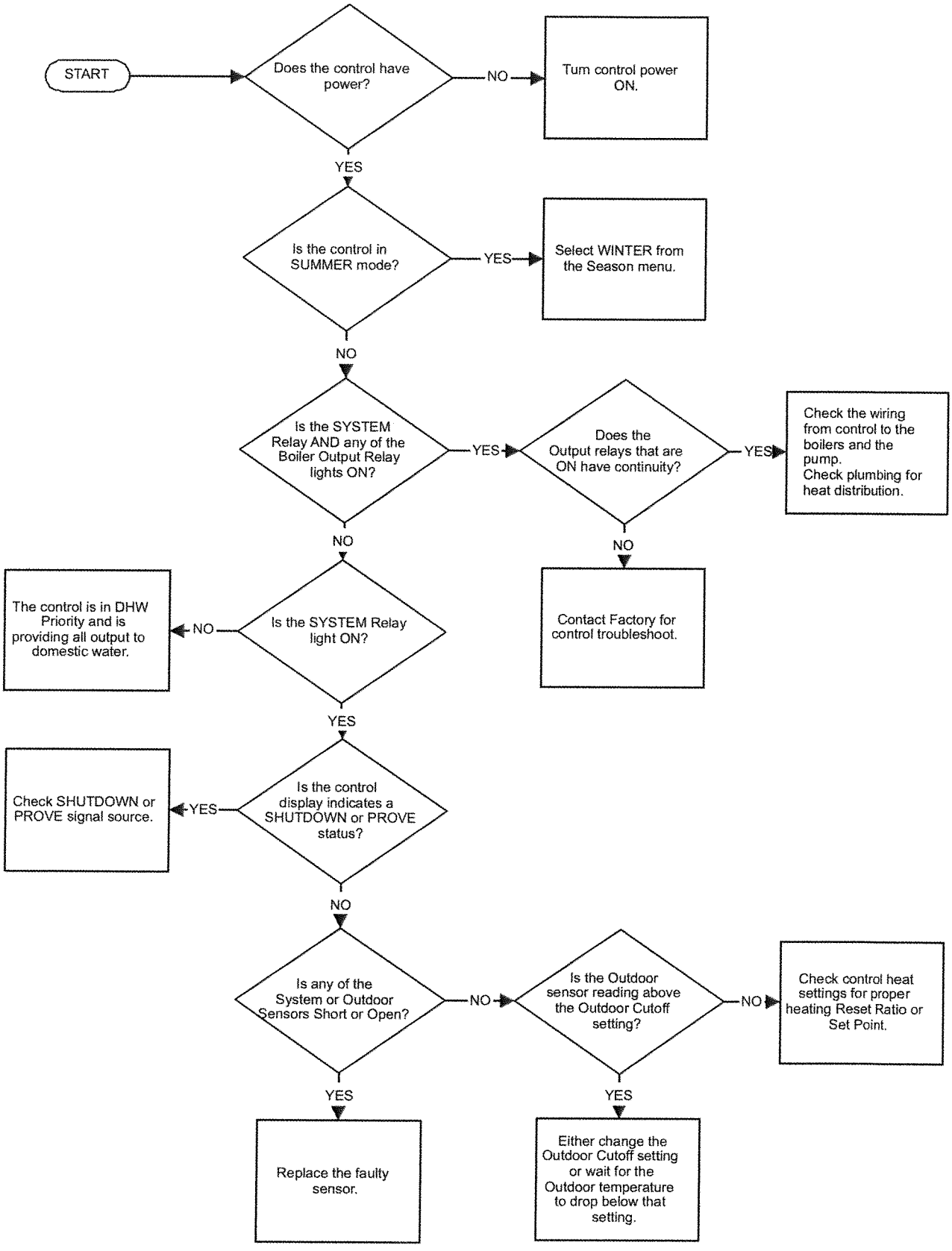
Boilers are Short-Cycling

- **Lag Delay** - Increase the Lag Delay only if all boilers tend to short-cycle.
- **Last Stage Hold** - Increase the Last Stage Hold only if the lead boiler tends to short-cycle.

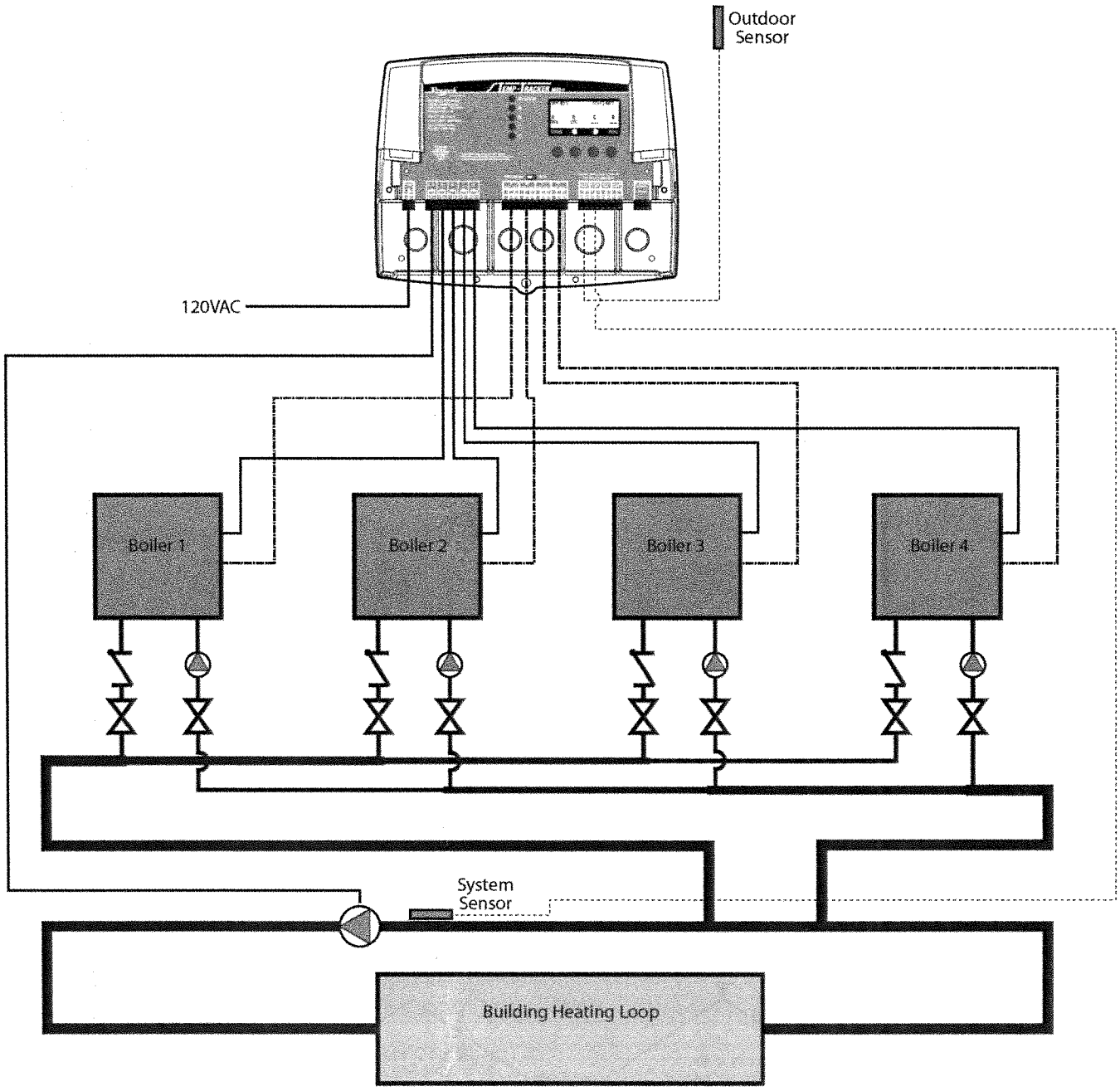
System is Overshooting or Undershooting

- **Gain** - If the system is overshooting reduce the Gain.
- **Gain** - If the system is undershooting increase the Gain.

TROUBLESHOOT - NO HEAT



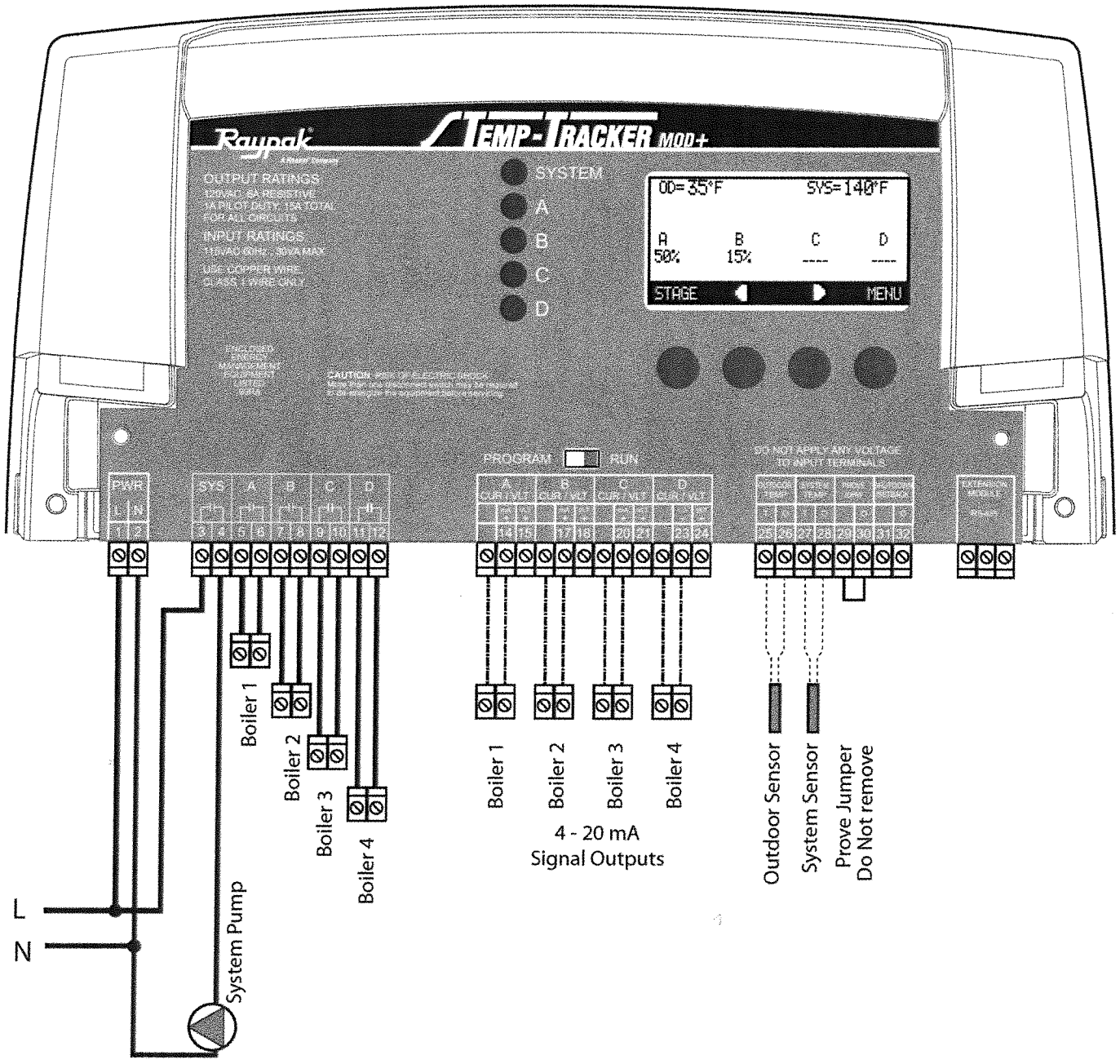
MULTIPLE MODULATING BOILERS
DIRECT HEATING PIPING DIAGRAM



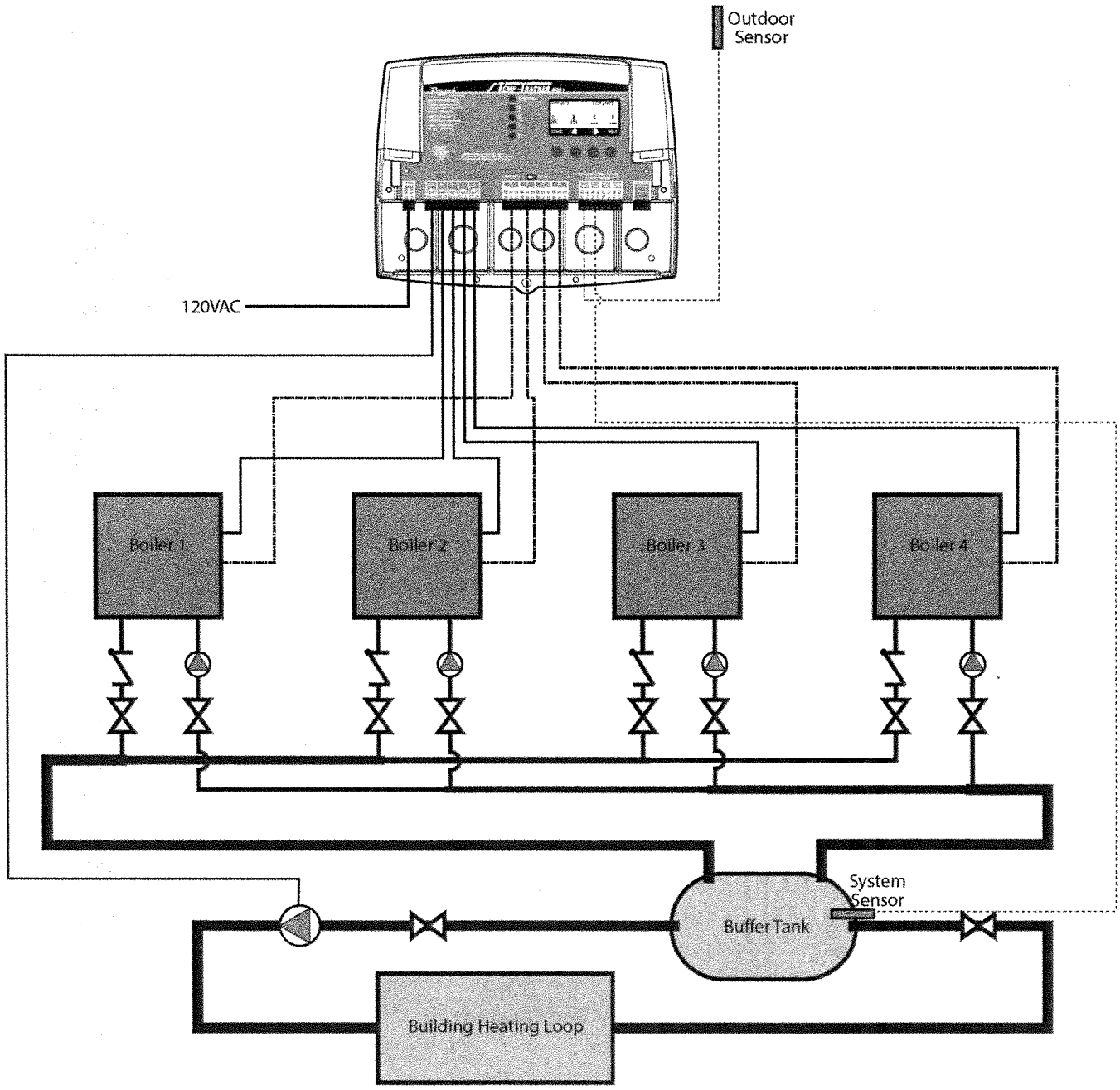
System:
The Temp Tracker provides 4 Raypak modulating boilers using a 4 - 20mA modulating signal. The boilers are piped in Reverse Return on the primary loop. The System output is controlling the System Pump.

Raypak is aware that each installation is unique. Thus, Raypak is not responsible for any installation related to any electrical or plumbing diagram generated by Raypak. The provided illustrations are to demonstrate Raypak's control operating concept only.

MULTIPLE MODULATING BOILERS
DIRECT HEATING WIRING DIAGRAM



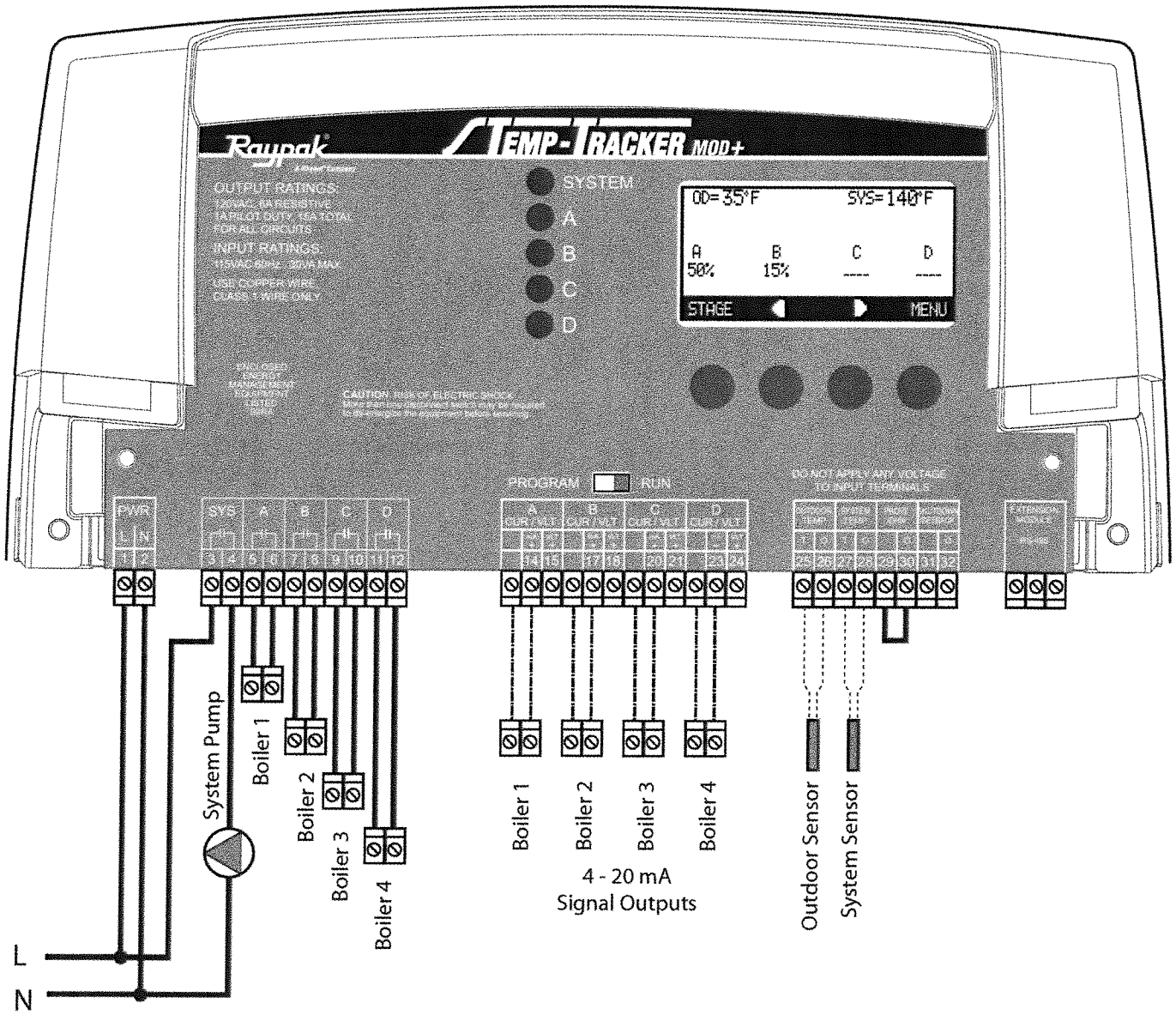
MULTIPLE MODULATING BOILERS
HEATING WITH BUFFER TANK PIPING DIAGRAM



System:
The Temp Tracker provides 4 Raypak modulating boilers using a 4 - 20mA modulating signal. The System output relay is controlling a the Primary System Pump.

Raypak is aware that each installation is unique. Thus, Raypak is not responsible for any installation related to any electrical or plumbing diagram generated by Raypak. The provided illustrations are to demonstrate Raypak's control operating concept only.

MULTIPLE MODULATING BOILERS
HEATING WITH BUFFER TANK WIRING DIAGRAM



Specifications

Voltage Input: . . . . . 120 VAC 60 Hz
Power Consumption: . . . . . 12 VA Max
Operating Temperature: . . . . . 20°F to 120°F
Operating Humidity: . . . . . 20% to 80%
Dimensions: . . . . . 11"W x 9" H x 3 ¾" D
Weight: . . . . . 2.5 pounds

Temp-Tracker mod+ Specifications

Lead Stage Rotation: . . . . . Time (1 to 1440 Hours (60 days)), Manual, Last-On
Pump Output: . . . . . (1) N.O. S.P.S.T
Boiler Modes: . . . . . Auto, Manual, Standby, On, Off
Standby Time: . . . . . 1 to 60 minutes
Modulating Output Types: . . . . . (4) 4-20mA, 0-5V, 0-10V, 1-5V, 2-10V
Output Relay Ratings: . . . . . (5) 1 Amp inductive, 6Amp resistive at 120 VAC 60 Hz, 15A total for all circuits
Add-On Temp-Tracker mod+ Extension Panels: . . up to two Temp-Tracker mod+ Extension Panels using RS485
Ignition Point %: . . . . . ---
Modulation Start Point %: 75%
Modulation Mode: . . . . . Parallel
Temperature Display: . . . . . Fahrenheit or Celsius.
Display: . . . . . Graphical Alphanumeric (7 rows x 21 char. each)
LED: . . . . . (1) System Output relay, (4) Boiler Output relays
Sensor Ranges: . . . . . Outdoor temperature sensor - minus 35°F to 250°F
Heating system sensor - minus 35°F to 250°F
Outdoor Cutoff Range: . . . . . 20°F to 100°F, ON and OFF
Reset Ratio Range: . . . . . (1.00 : 4.00) to (4.00 : 1.00) (Outdoor : System Water)
Offset Adjustment: . . . . . minus -40°F to plus 40°F
Minimum Water Temperature: . . . . . 70°F to 170°F
Maximum Water Temperature: . . . . . 90°F to 240°F
Set Point Temperature Range: . . . . . 70°F to 250°F
EMS Temperature Range: . . . . . 70°F to 240°F
Domestic Hot Water: . . . . . with Priority or without Priority
Pump Run-On: . . . . . 10 to 360 minutes
Purge Delay: . . . . . 1.0 to 10.0 minutes
Lag Delay: . . . . . 0 to 60 minutes
Last Stage Hold: . . . . . 0 to 30°F
Schedules: . . . . . (1) Day and (1) Night (Setback) settings per day
Night Setback: . . . . . 0°F to 75°F
Power Backup: . . . . . Lithium coin battery, 100 days minimum 5 year replacement (Maintains Clock in power outages).
External Inputs: . . . . . Shutdown Input, and Prove Input. (Dry Contacts Only)
Season: . . . . . Winter and Summer.

Temp-Tracker mod+ Extension Specifications

(Each Temp-Tracker mod+ Extension can add up to (6) additional modulating boilers. A maximum of two Temp-Tracker mod+ Extensions can be added to a single Temp-Tracker mod+.)

Extension Numbering: . . . . . Toggle Switch A or B
Boiler Outputs: . . . . . (6) N.O. S.P.S.T.
Modulating Output Types: . . . . . (6) 4-20mA, 0-5V, 0-10V, 1-5V, 2-10V
Output Relay Ratings: . . . . . 1 Amp inductive, 6Amp resistive at 120 VAC 60 Hz, 15A total for all circuits
Connection to Temp-Tracker mod+ and another extension: Two RS485 connections using 6 wire phone cable (Cable is provided)

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2805 Slough St. Mississauga
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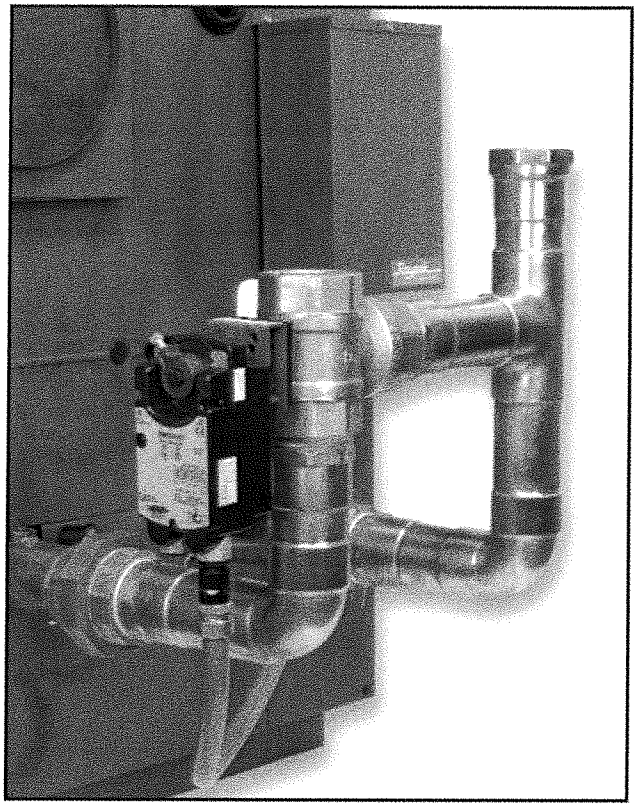
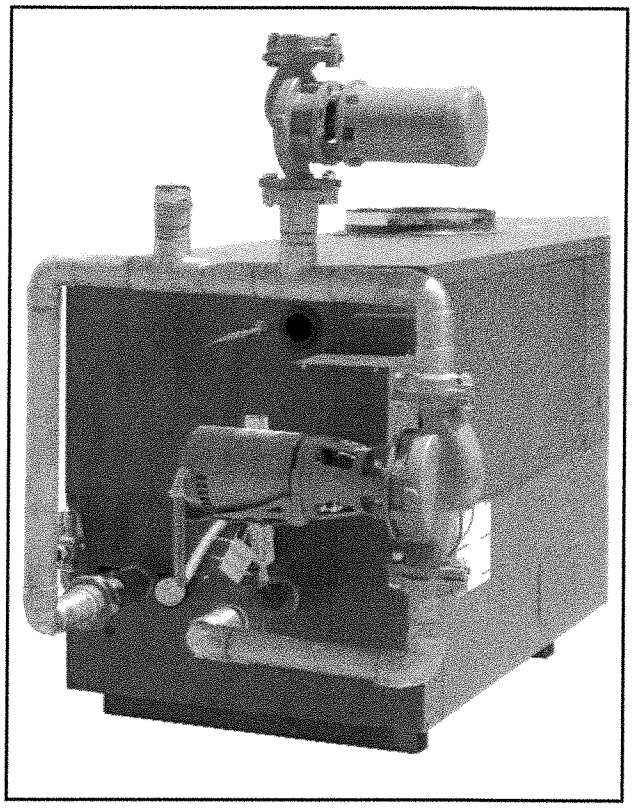
PH: (905) 677-7999
FAX: (905) 677-8036
059042-00R

INSTALLATION & OPERATING INSTRUCTIONS

Cold Water Start & Cold Water Run





For Hi Delta, MVB & Raytherm Heaters & Boilers

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

Raypak®
A Rheem® Company

Catalog No: 1000.57F Effective: 06-19-08 Replaces: 03-14-08 P/N 241275 Rev. 7

Rev. 7 reflects the following: **Changes to:** Fig. 12 on page 10 and paragraph one of the **Mounting the Control Box** section on page 20; **the deletion of:** the **Indoor and Outdoor Installations** section on page 20.

CONTENTS

WARNINGS

Pay Attention to These Terms

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

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

NOTE: Piping diagrams in this manual are not intended to replace an engineered piping system.

NOTE: Consult the factory for units with a 30 pound pressure relief valve (PRV).

GENERAL SAFETY

To meet commercial hot water use needs, the high limit safety control on this water heater is adjustable up to 210°F. However, water temperatures over 125°F can cause instant severe burns or death from scalds. When supplying general purpose hot water, the recommended initial setting for the temperature control is 125°F.

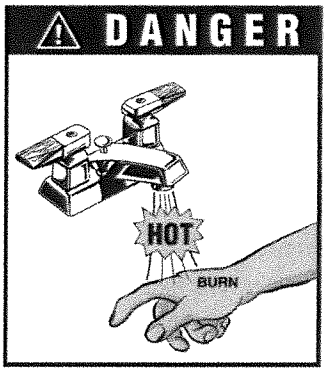
Safety and energy conservation are factors to be considered when setting the water temperature on the thermostat. The most energy-efficient operation will result when the temperature setting is the lowest that satisfies the needs of the application.

Water temperature over 125°F can cause instant severe burns or death from scalds. Children, disabled and elderly are at highest risk of being scalded.

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

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

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



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

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

See instruction manual before setting temperature at water heater.

Feel water before bathing or showering.

Temperature limiting valves are available, see manual.

Time/Temperature Relationships in Scalds

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

Water Temp.	Time to Produce Serious Burn
120°F	More than 5 minutes
125°F	1-1/2 to 2 minutes
130°F	About 30 seconds
135°F	About 10 seconds
140°F	Less than 5 seconds
145°F	Less than 3 seconds
150°F	About 1-1/2 seconds
155°F	About 1 second

Table courtesy of The Shriners Burn Institute

Table A: Time to Produce Serious Burn

COLD WATER START

Before beginning the installation, it's important to first inspect the system and determine what materials you will need. Some parts are included with the controller while others you will need to provide.

1 Control Box

1 Temperature Sensor

1 Valve assembly with actuator (Shipped separately)

Wiring and mounting hardware (Provided by installer)

Installation

Check the Power Source

CAUTION: Do not use for swimming pool applications

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

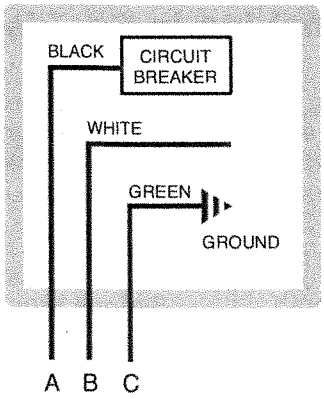


Fig. 1: Wiring Connections

Check the power source:

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

Mounting the Control Box

The control box should be mounted on the side of the heater to which the system piping and valve assembly are to be attached as shown in Fig. 3–7. The controller should be mounted so as to provide maximum support

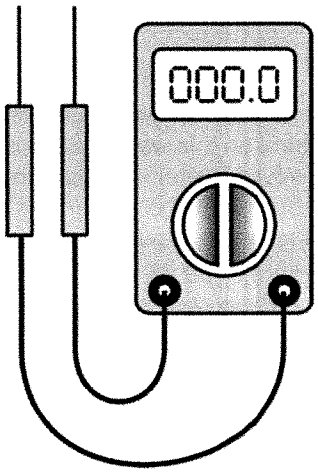


Fig. 2: Multi-meter

by using the mounting holes provided on the base of the controller to the side center brace on the heater. On MVB and Hi Delta models, locating dimples are provided for ease of drilling the mounting holes. You will need to drill mounting holes through the heater side panel for the routing of wiring and the sensor.

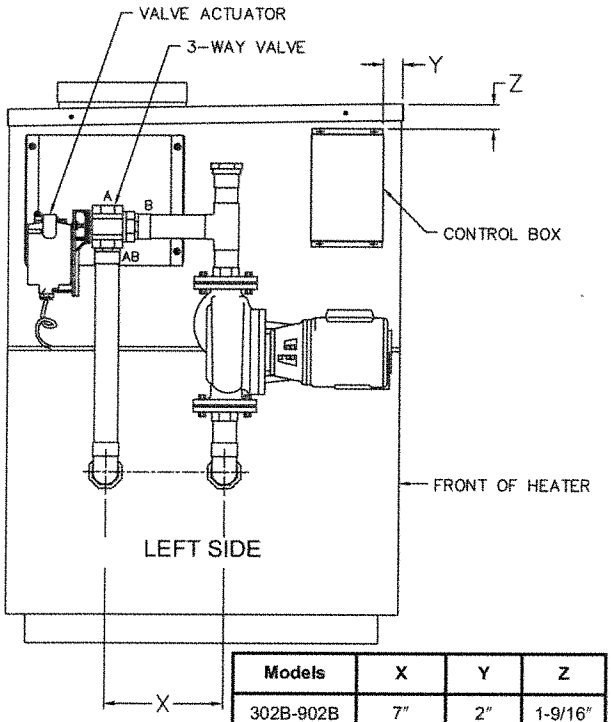
Installing the Temperature Sensor

Avoid routing wiring on or near other electrical wires, conduit, motors, spark igniters or other sources of high, intermittent voltage or current. The sensor should be placed in the dry well on the inlet header. Ensure it is installed using thermo-paste (field supplied) and that it is held firmly at the bottom of the well.

Connecting the Valve Assembly

Connect valve assembly "T CONNECTION " into the piping with the actuator input wiring facing the heater side panel. Route wiring to the control thru the bottom panel knockouts to TB2. Refer to the wiring diagram provided on the inside of control cover assembly.

NOTE: Four knockouts are located on the bottom of the control for ease of installation.



Models	X	Y	Z
302B-902B	7"	2"	1-9/16"
992B-2342B	13-1/4"	1-5/16"	6-5/8"

Fig. 3: Component Locations—Hi Delta

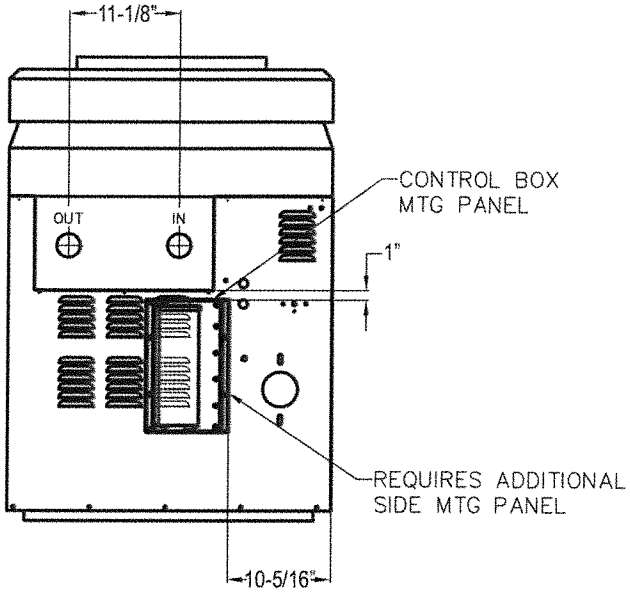


Fig. 5: Component Locations—Raytherm Models 926–1826

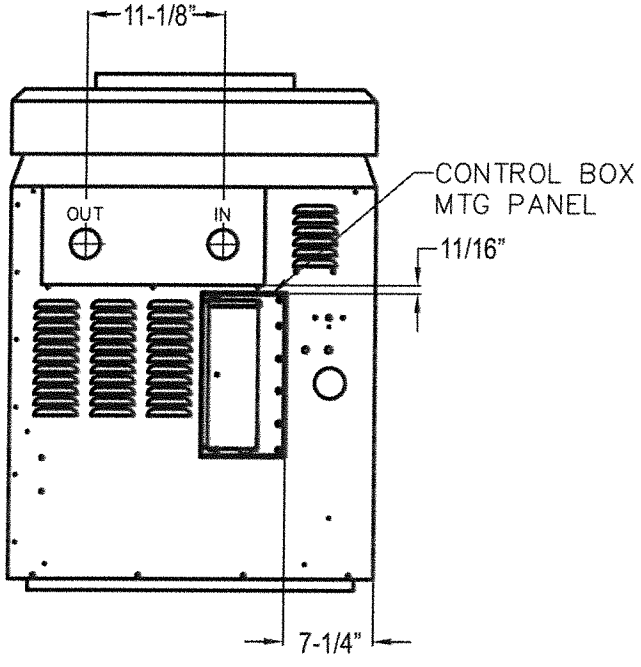


Fig. 4: Component Locations—Raytherm Models 514–824

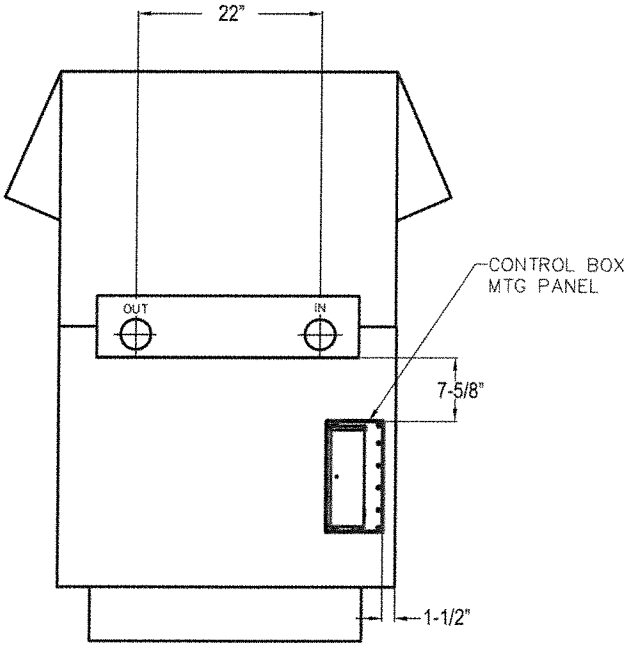


Fig. 6: Component Locations—Raytherm Models 2100–4001

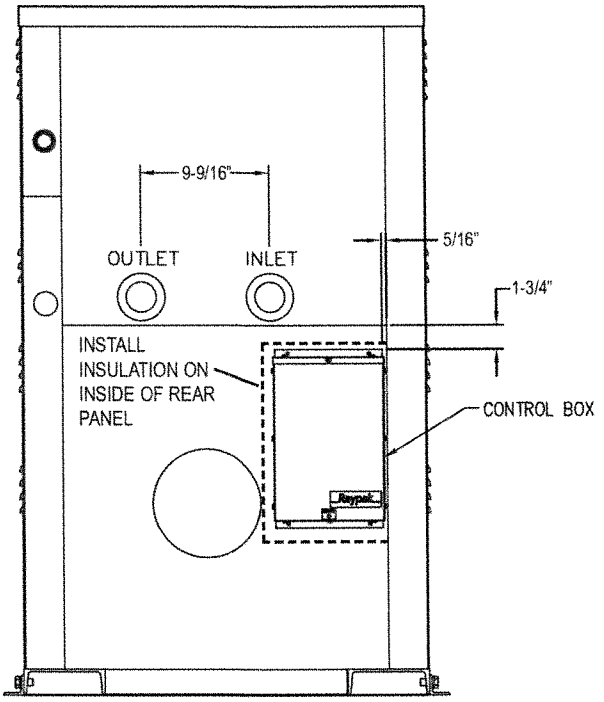
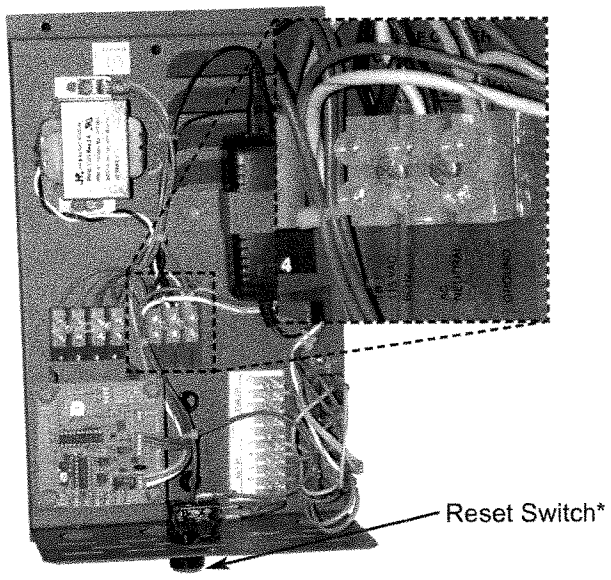


Fig. 7: Component Locations—MVB

CAUTION: Install the foil-faced insulation on the inside of the rear panel of MVB heaters as indicated in Fig. 7. Use spray adhesive or high temp foil tape to attach the insulation. Ensure that the foil faces the heat exchanger assembly. Failure to install this insulation as directed can cause overheating of the components and may void the warranty on the control.

Connecting Power to the Controller

Supply power from the 120 VAC power input from the heater to the controller power inputs Terminal Block (TB1). This is accomplished by connecting wiring from the control box to the heater TB1 board 120 VAC power input connections. Refer to wiring diagrams.



*The reset switch may be located on the front control panel on some MVB models.

Fig. 8: Location of TB1 in Control Box

Connecting Boiler to Cold Water Start

Installer to provide five 18AWG stranded wires between boiler and terminal block. Wiring to be run in separate conduit from line voltage to ensure proper operation. Refer to the diagram on page 14 for connection points depending on Raypak product being used.

Operation

Verify the following upon a CALL FOR HEAT signal from the heater:

1. CALL FOR HEAT LED on PCB illuminates GREEN.
2. START UP MODE LED on PCB illuminates YELLOW. Before 7 minutes it should go out if boiler inlet temperature is approaching the set point temperature.
3. The "ACTUATOR" should be in the fully open position or move to the fully open position if not already there. (Actuator at the fully CCW position)
4. Before 7 minutes time has elapsed if the control is operating properly the "START UP MODE" LED should go out. The inlet water temperature should be stable at a temperature between 105° F and 120° F (Normally set to 110° F) corresponding to the Set Point Pot setting on the PCB. The actuator should have stopped moving.

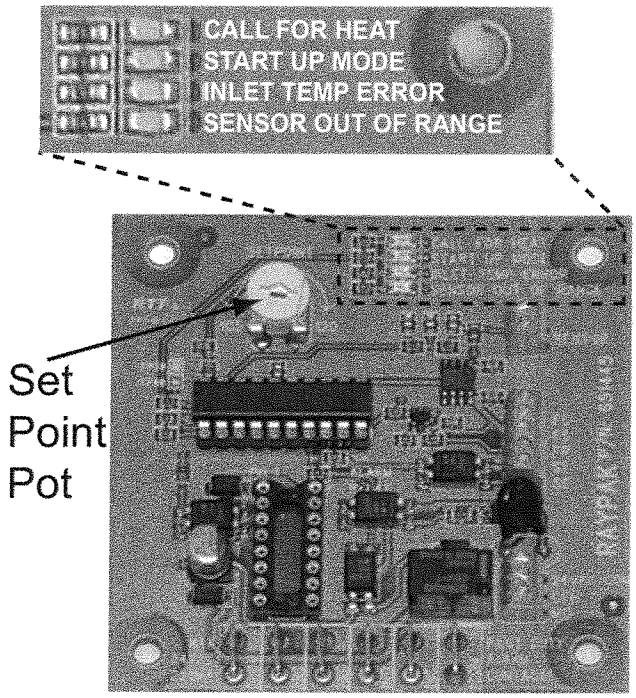


Fig. 9: Control PCB

NOTE: The minimum return water temperature to the heater to prevent condensate is 105°F on standard heaters and 120°F on 87% efficiency heaters. Ensure that during operation the Set Point Pot is adjusted properly.

NOTE: If a "DIP" switch is provided on the control PCB, verify that the switch settings are correct: 1 = OFF, 2 = ON, 3 = OFF.

Cold Start Sequence of Operation

1. 120VAC to heater sends 120VAC to Cold Start control on terminal block 1.
2. 120/24VAC transformer and 120VAC-12VDC converter are powered.
3. 120/24VAC transformer outputs 24VAC to pin 2 of terminal block 2
4. 24VAC leaves pin 2 of terminal block 2 and goes to the modulating three way valve on the 20-30VAC lead, and to the NO contacts of the SPST relay located in the cold start control panel.
5. 120VAC-12VDC converter outputs 12VDC to the common terminal of the reset switch, located on the bottom of the cold start control panel.
6. The 12VDC signal crosses over the reset switch and goes to Pin FS on cold start circuit board.
7. Cold start control remains on standby until a Call for heat occurs at heater.
8. The heater outputs 24VAC to terminal 4 of terminal block 3 located in Cold Start controller.
9. Terminal 4 of TB 3 sends 24VAC to the coil of the SPST relay located in the cold start control panel.
10. The SPST relay coil is energized and closes the contacts allowing 24VAC to energize the CFH pin on the cold start circuit board.
    a) A two second delay occurs from the CFH signal waiting to send power from terminal MC of the cold start circuit board.
11. 24 VAC is sent from terminal 2 of terminal block 3 to the NO contacts of the DPST relay located in the cold start control panel.
12. After the two second delay on the cold start circuit board, pin MC outputs a 24 VAC signal to the coil of the DPST relay located in the cold start control panel.
13. The DPST relay coil energizes and closes the NO contacts.
14. Once the NO contacts of the DPST close, the heater 24 VAC is sent back to the heater to complete the circuit (pin 3 of terminal block 3) and the interlock circuit (pin 1 & 2 of terminal block 3) allowing the heater to fire.
15. Pin FR on the TVC board outputs 10VDC to the modulating three way valve actuator to drive it fully open for two-minutes waiting for the heater to reach full fire.
16. After the two-minute delay the 10VDC output signal from pin FR reduces to approximately 8VDC.
17. The output signal continues to vary depending on the heater inlet temperature.

The heater will lockout and shut down if the set point on the inlet temperature is not achieved within seven-minutes from a call for heat.

The DIP switches on the 3-way valve actuator must be set as indicated in the Fig. 10.

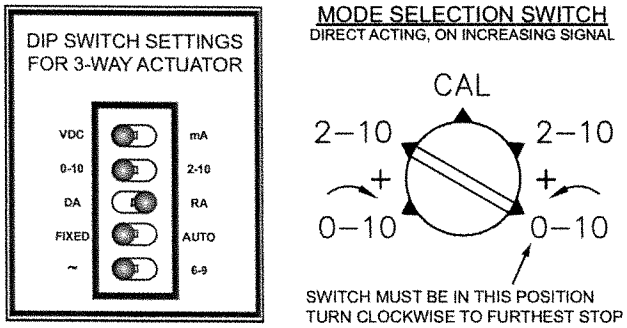


Fig. 10: Set Dip Switch Settings — Delta Actuator

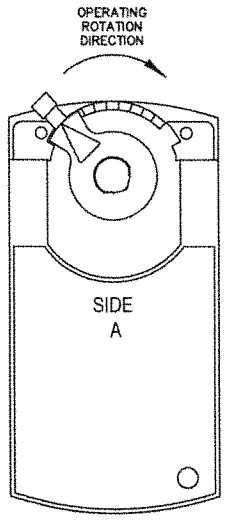


Fig. 11: Delta Actuator — Actuator Shown in Full System Flow Position

CAUTION: Delta actuator requires a weatherproof cover for outdoor installations.

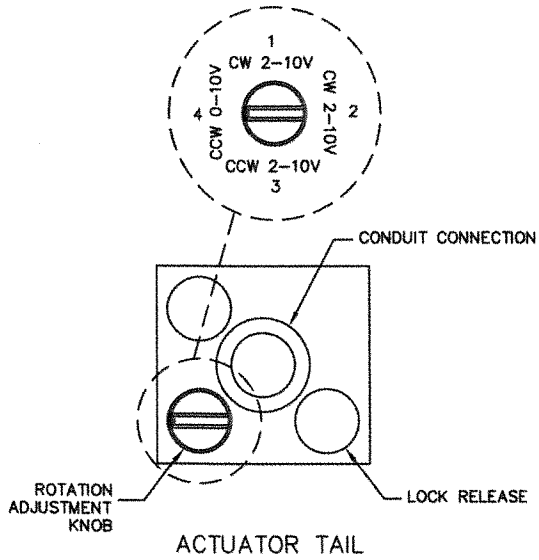


Fig. 12: Elodrive Actuator — Rotation Knob Setting

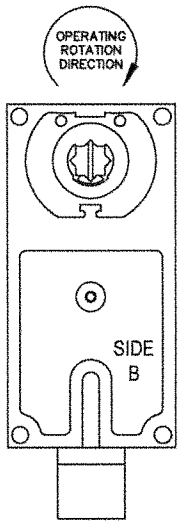


Fig. 13: Elodrive Actuator — Actuator Shown in Full System Flow Position

NOTE: Elodrive actuator is Nema 4 rated.

Troubleshooting

Check your power source using a Volt-Ohm meter; check the following voltages at TB1 terminal block:

TB1-1 to TB1-2 = 108 VAC Minimum, 132 VAC Maximum

TB1-1 to TB1-3 = 108 VAC Minimum, 132 VAC Maximum

TB1-2 to TB1-3 = Must be less than .6 VAC

IF CALL FOR HEAT LED does not illuminate when the heater has a CFH signal, check for 24VAC between pins 4 and 5 of TB3 on the cold start control. If voltage is present, check wiring using the wiring diagram. If voltage is not present, the problem exists in the heater.

IF VALVE DOES NOT MOVE: Check for voltage out at TB2-1: Should be a 1VDC to 10VDC output to the actuator valve. If no voltage is present, check for voltage at pin FS on the control board, there should be a 12VDC signal. If the 12VDC signal is not present, verify that the converter is wired correctly using the wiring diagram.

IF INLET TEMP ERROR is illuminated: The set point temperature has not been reached within the 7 minute time period.

- Push the Reset Switch (see Fig. 8) or remove power and watch for proper operation.

- Check pump sizing and valve/piping sizing and correct as necessary.

IF SENSOR OUT OF RANGE LED is illuminated: The sensor may have a short or open circuit.

- Push the Reset Switch (see Fig. 8) or remove power and watch for proper operation.
- Replace sensor.
- Check wiring using wiring diagram.

Mounting the Actuator to the Valve

When mounting the actuator to the valve, ensure that the valve stem is oriented with the machined flat notch positioned in parallel with the "A" and "AB" ports as shown in Fig. 14.

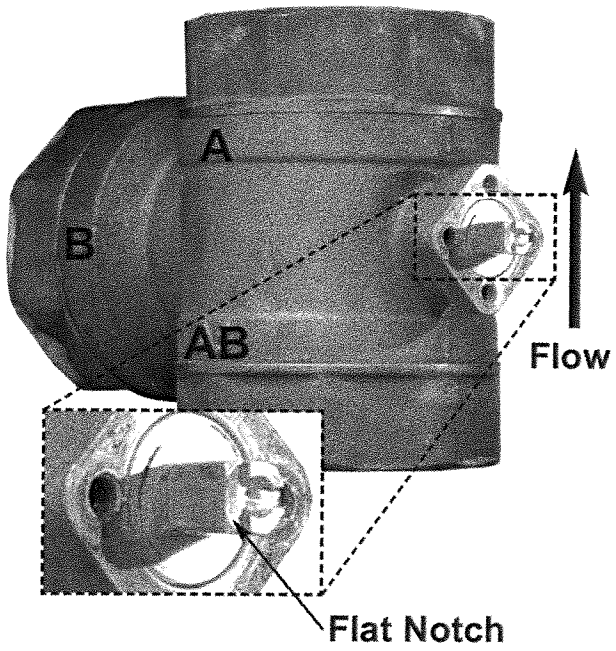


Fig. 14: Orient Notch Parallel with "A" and "AB" Ports

Actuator to Valve Orientation

Install the actuator so that the tail is pointing downward as shown in Fig. 15. You may also install it horizontally, however, DO NOT mount it so that the tail is pointing up as shown in Fig. 16. Doing so will allow water and debris to collect in the cup where the wiring exits the actuator potentially causing damage.

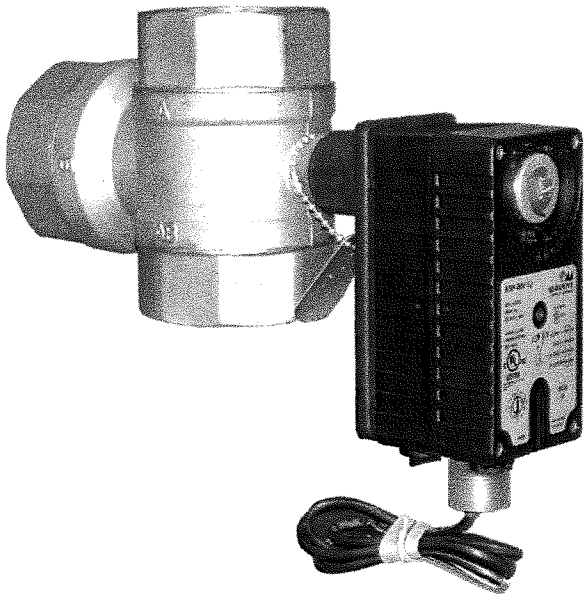


Fig. 15: Recommended Orientation of Actuator

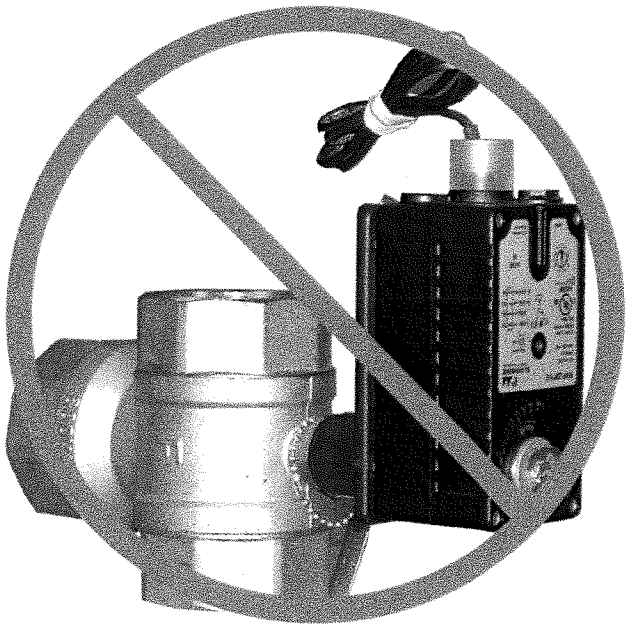
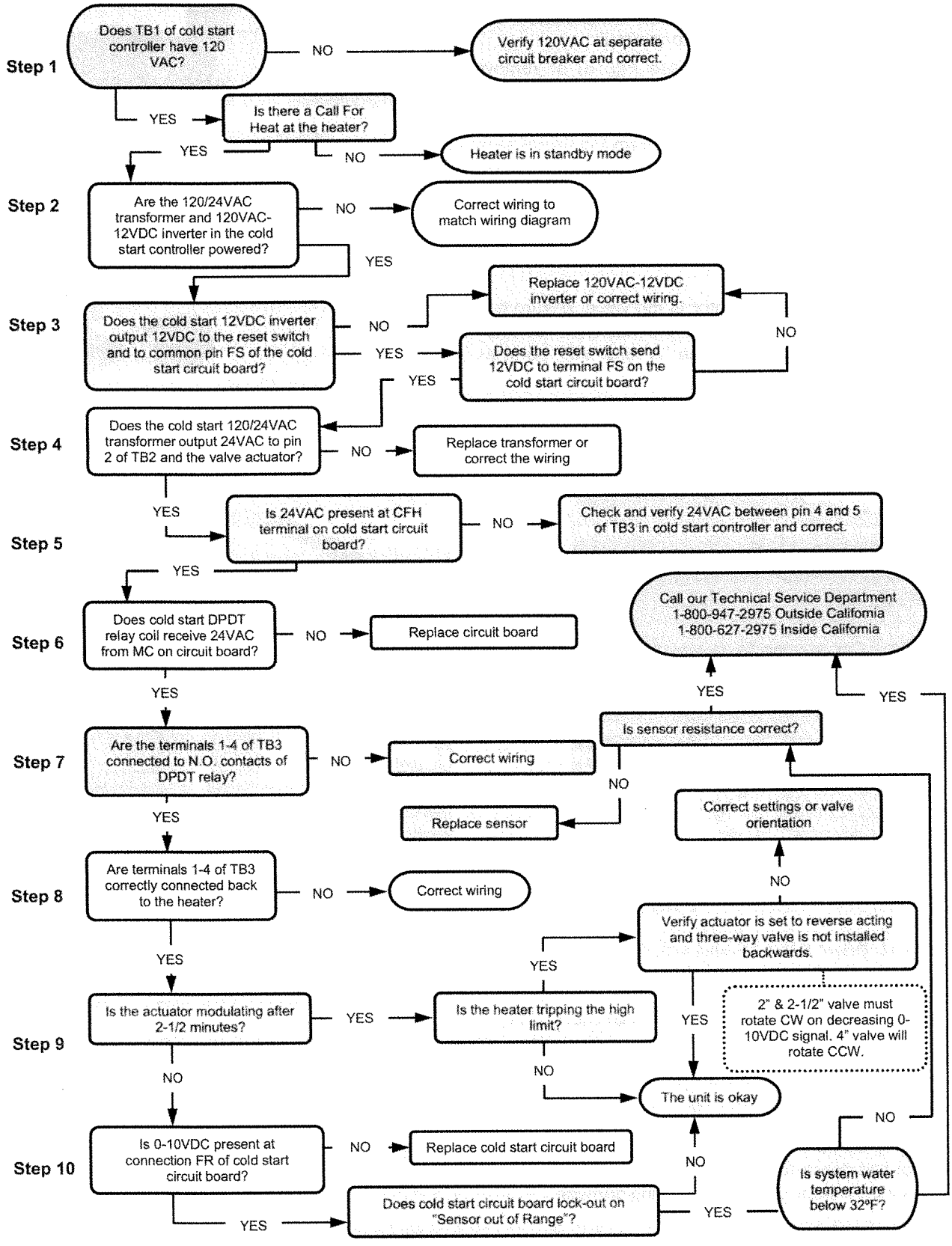


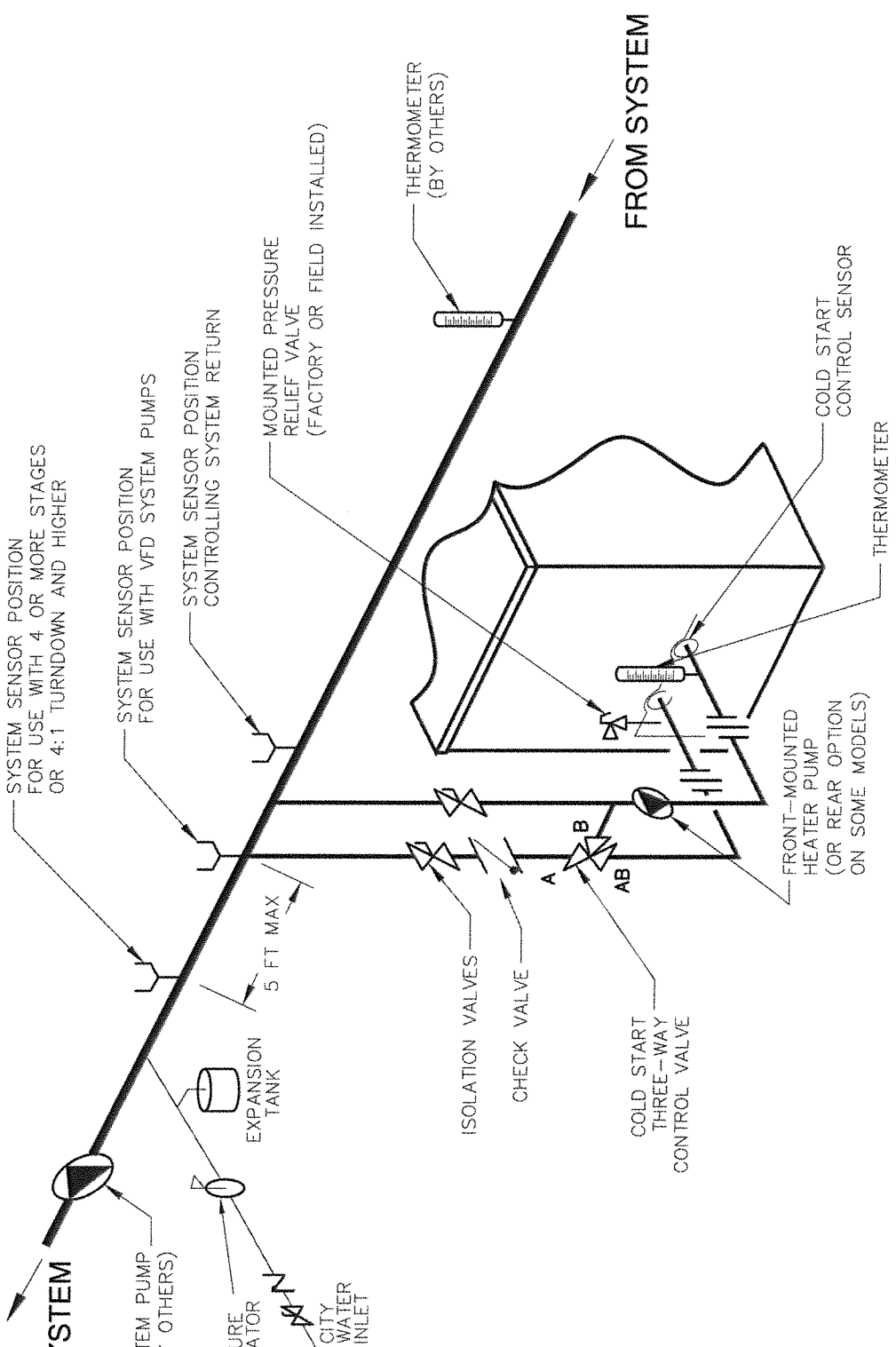
Fig. 16: Incorrect Orientation of Actuator

Cold Water Start Troubleshooting Guide

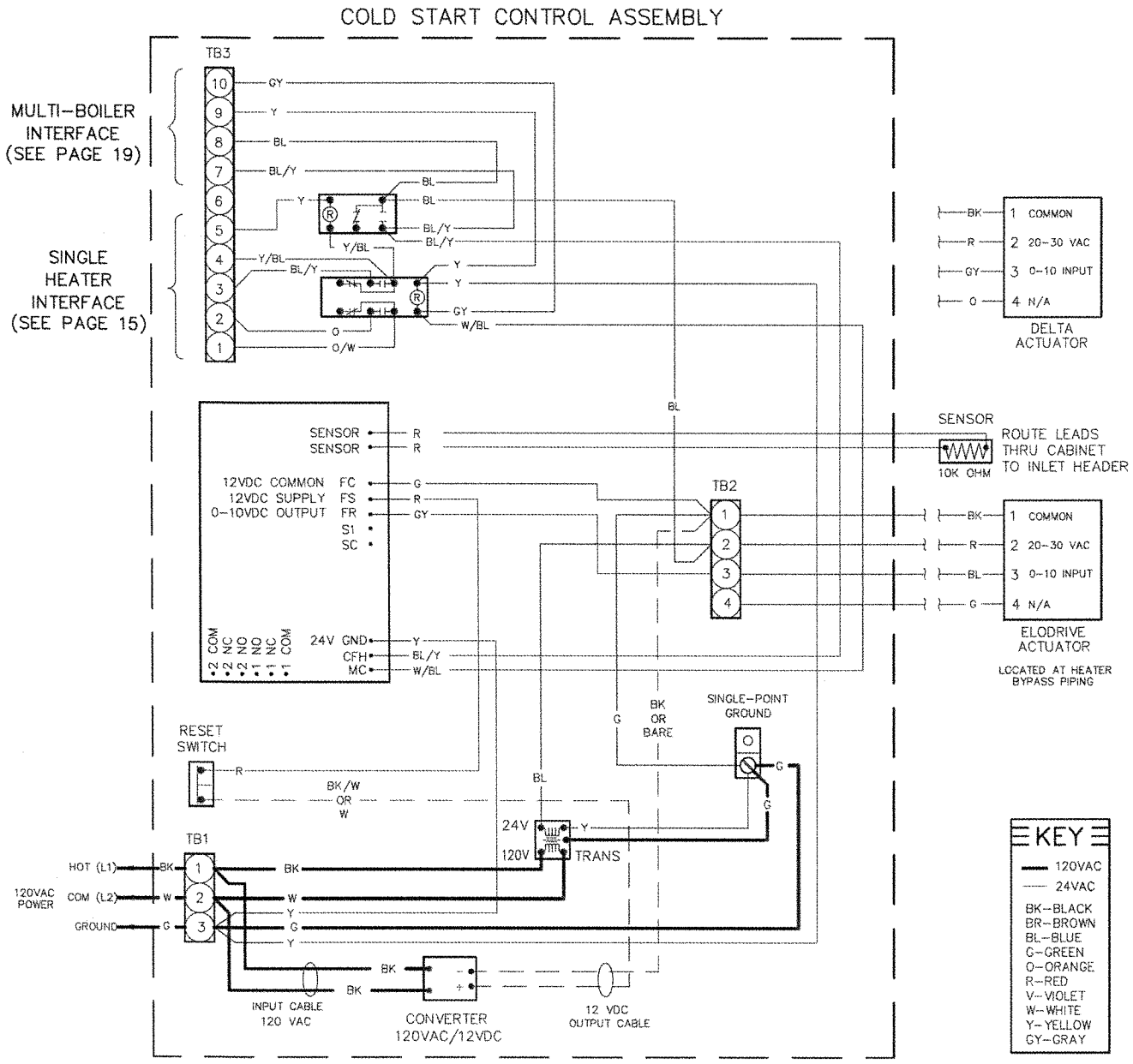


Typical Cold Water Start Piping

NOTES:
1. LOCATE UNOINS TO FACILITATE SERVICING OF PLUMBING SIDE.
2. PLUMB SWING CHECK VALVE IN GRAVITY–CLOSED POSITION.
3. PIPE ALL RELIEF VALVES TO DRAIN, OR AS LOCAL CODES REQUIRE.
4. BUFFER TANK REQUIRED WHEN WATER VOLUME IN BOILER LOOP IS NOT ADEQUATE TO PROVIDE STABLE TEMPERATURE CONTROL. CONSULT FACTORY FOR TANK SIZING.

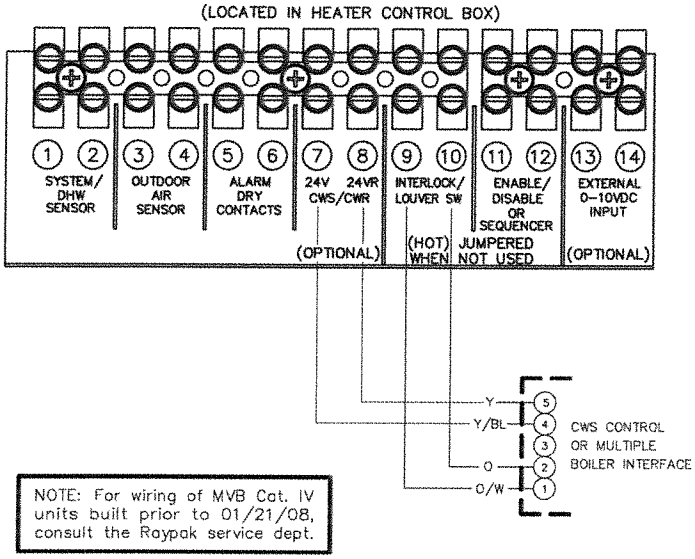


Wiring Diagrams—Cold Water Start



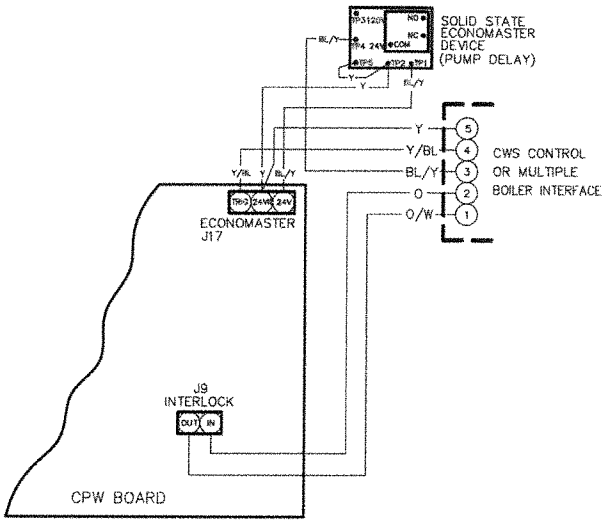
HEATER INTERFACE WIRING

MVB (503–2004)



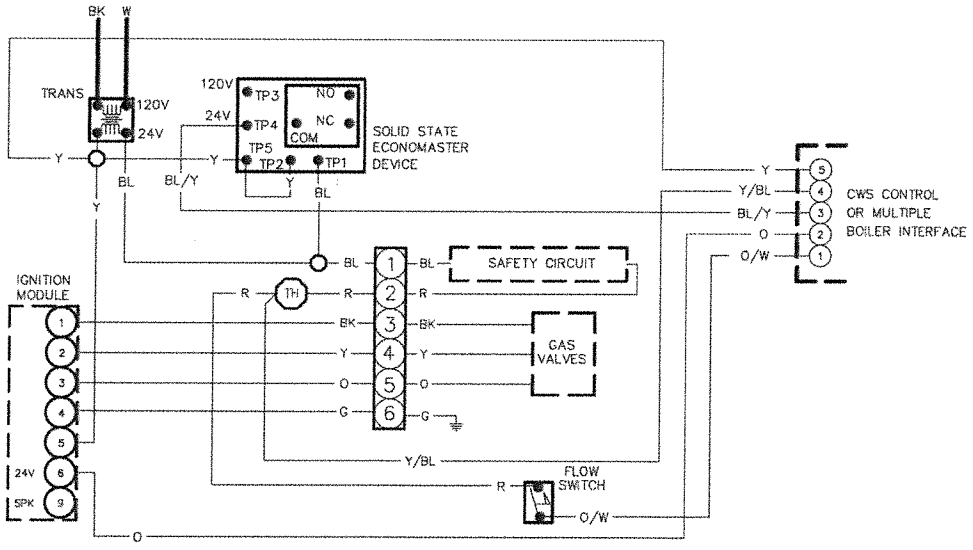
NOTE: For wiring of MVB Cat. IV units built prior to 01/21/08, consult the Raypak service dept.

HI DELTA (302–2342)



RAYTHERM

(SOME COMPONENTS REMOVED FOR CLARITY)



COLD WATER START—MULTIPLE BOILER
(Maximum 4 boilers)

Materials Included

1 Cold Start Control Box
1 Multi-Boiler Interlock Box
1 Water Sensor & Well
1 3-way Diverting Valve assembly with Actuator

NOTE: Flanges, bolts and gaskets for flanged valves supplied by others.

Installation

Mounting the Control Boxes

Cold Start Control and Multi-Boiler Interlock should be mounted in such a manner as to allow for easy access for wiring of the boiler interlock connections.

Installing the Temperature Sensor

Temperature sensor to be installed in a drywell with thermo-paste at the location indicated in the diagram on page 18 to ensure proper operation of the control system. Installer must ensure the drywell extends at least 2 inches into the water flow path. Sensor wiring must be run in separate conduit from line voltage and should be a minimum of 18 AWG shielded cable. Refer to diagram on page 19 for wiring information.

Installing the 3-way Valve

Install 3-way diverting valve into common boiler piping manifold as shown in the diagram on page 18. Boiler common outlets to be connected at port AB. Discharge to system from port A with bypass port being port B. Common pipe sizing may be larger than 3-way valve port connections requiring the use of increasers for installation (see Table B for valve sizing). It is recommended that 3-way valve be installed as near the main system piping as is feasible. Route control wiring in separate conduit to the Cold Water Start control box and wire as shown in the diagram on page 19.

Connecting Power to the Controller

Installer to provide a dedicated 120V circuit with local disconnect to the Cold Water Start Control. Refer to wiring Fig 8 on page 8 for detailed instruction.

Connecting Cold Water Start to Multi-Boiler Interlock Box

Installer to provide four 18AWG stranded wires between pins 7-10 on the Cold Start Control and 7-10 on the Multi-Boiler Interlock as shown in the diagram on page 19. Do not use solid core wire when wiring any portion of the Cold Start Multi-Boiler system.

Connecting Boiler to Cold Water Start Multi-Boiler Interlock

Installer to provide five 18AWG stranded wires between each boiler and Multi-Boiler Interlock box. Wiring to be run in separate conduit from line voltage to ensure proper operation. Refer to the diagram on page 19 for connection points depending on Raypak product being used.

Total Load (MBTU)	Valve Size	Pipe Size	Cv	Flow Rate (gpm)	Valve Pressure Drop	ΔT @ Max Size	ΔT @ Min. Size	Order No.
600-1000	2" NPT	2	57	70	3.5 ft	22	14.4	012228
1001-1800	2.5" NPT	2.5	74	100	4.2 ft	30.2	16.8	012229
1801-2600	2.5" NPT	3	100	150	5.2 ft	29.1	20.1	012230
2601-4000	4" FLG*	4	152	220	4.8 ft	30.5	22.9	012231
4001-6000	4" FLG*	4	254	330	3.9 ft	30.5	20.3	012232
6001-8000	4" FLG*	6	327	440	4.2 ft	30.5	22.5	012233

Standard boiler pump options offered by Raypak may **NOT** be appropriate for these applications.
***CAUTION:** Approved for closed loop systems only.

Table B: Valve Sizing Chart

4 Inch Valve Orientation

The valve must be installed so that the combined boiler outlets enter through Port "AB" (See Fig 17). Port "B" is the bypass port and port "A" is the return to the system (port designations are cast into the stem of the valve body). The valve body should be installed so that the actuator input shaft is in the vertical or horizontal position. The Actuator stem should never be hanging downward.

The actuator, as shipped from the factory, is in the horizontal position when the valve is installed as shown in Fig 17. The actuator position can be changed to suit job site conditions.

Under no circumstances should the actuator be positioned such that the electrical connection is pointing upwards (see Fig. 16) as this can allow for moisture or debris to enter the actuator assembly and potentially damage the actuator.

Once installed into the piping system, verify the valve is positioned properly by referring to Fig. 17 and the diagram on page 18.

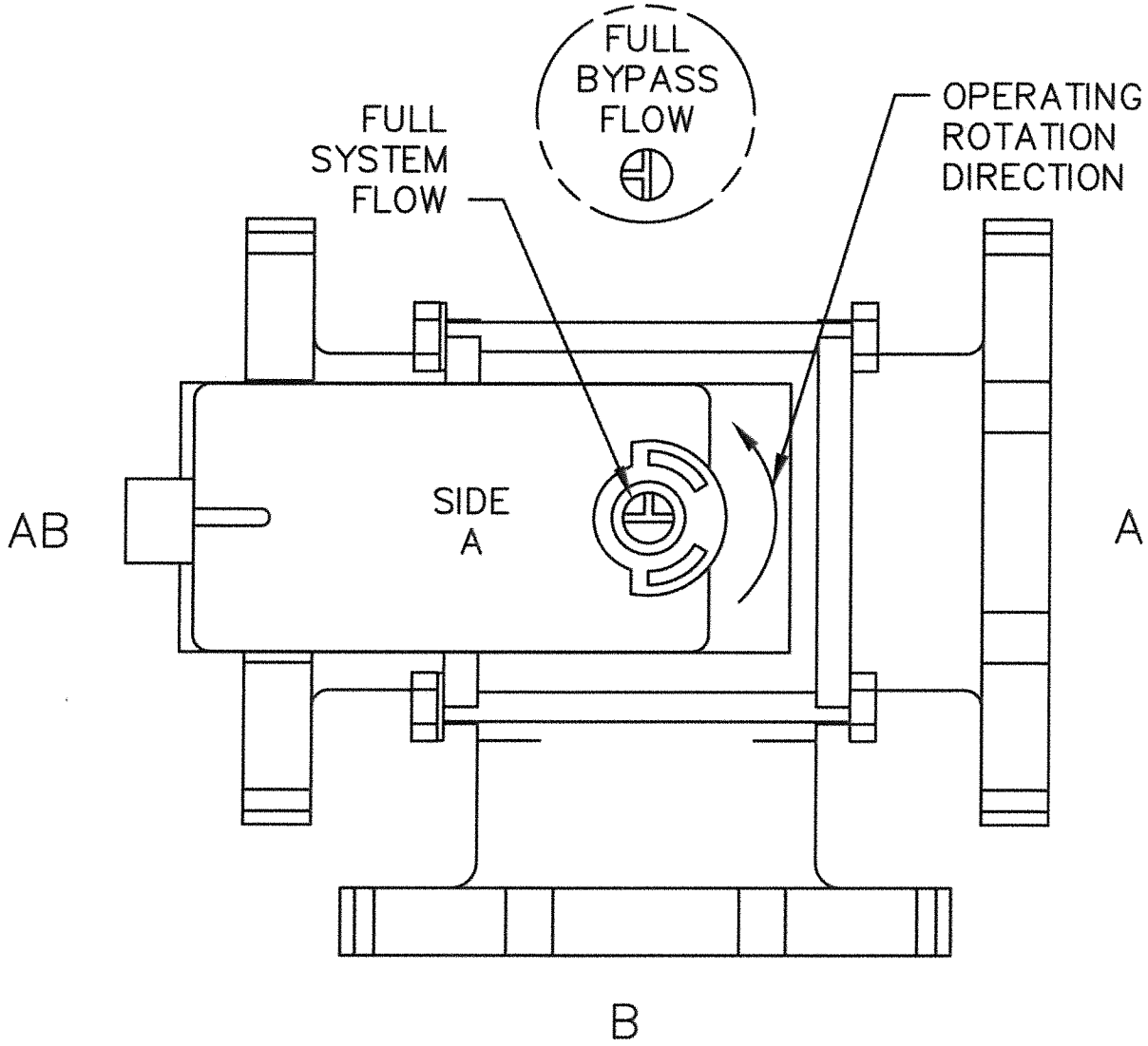
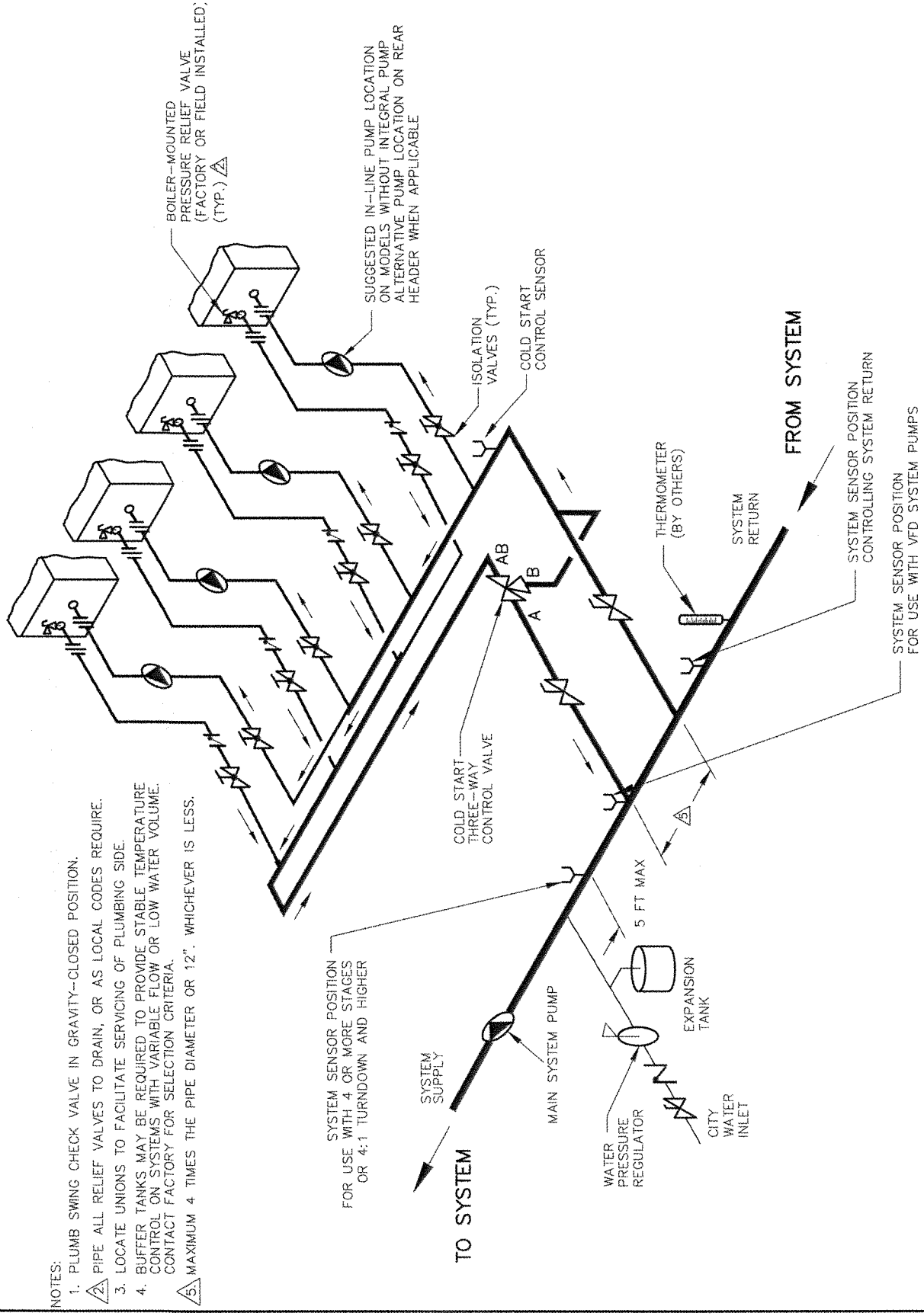
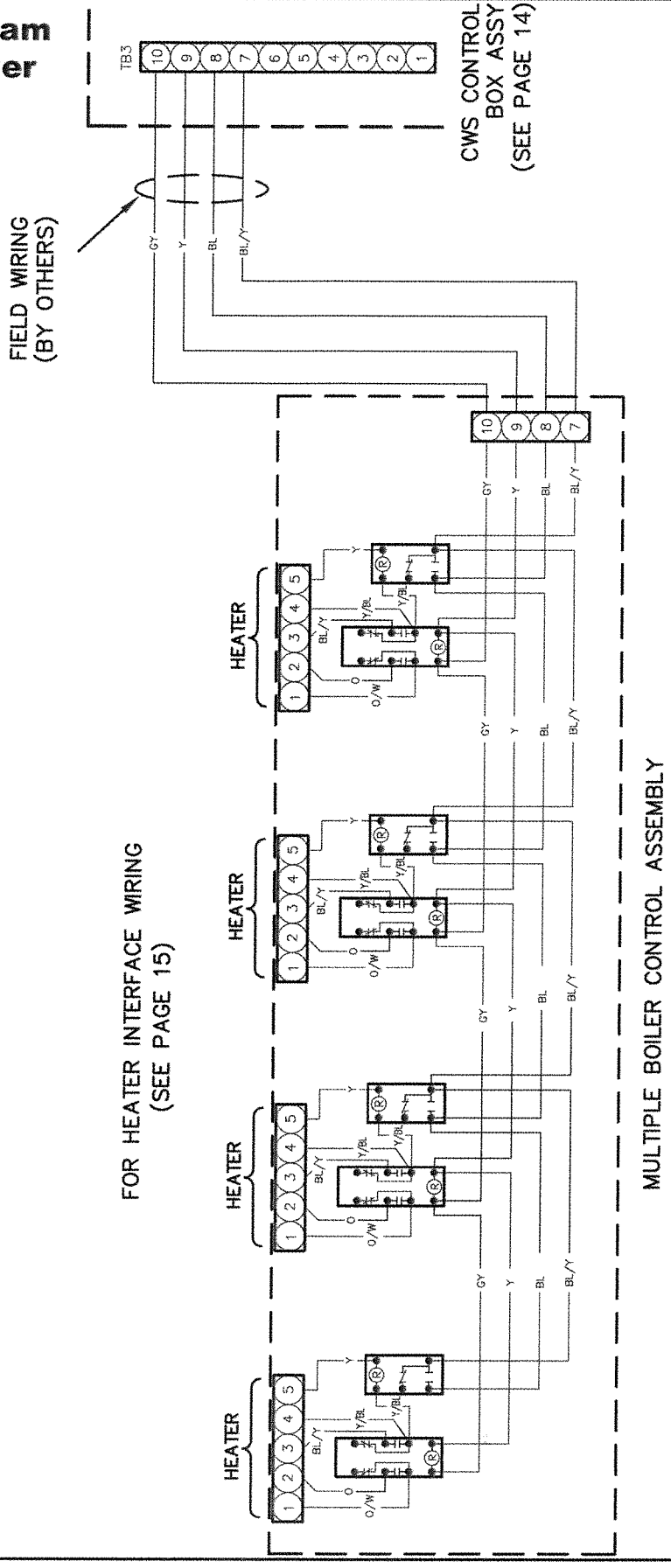


Fig. 17: Valve Orientation

Typical Cold Water Start Multiple Boiler Piping



Wiring Diagram
Multiple Boiler



COLD WATER RUN

Purpose

The Cold Water Run system utilizes a variable-speed pump to inject the proper amount of water from the main system loop into the boiler to maintain the optimum inlet temperature. This approach allows the full capacity of the boiler to be utilized to meet the system load, while at the same time continuously maintaining the optimum inlet water temperature to prevent condensation.

Typical Cold Water Run Applications

- Swimming pools.
- Any system with steady state return water temperature below 105°F.

CWR vs. CWS

- Cold water start is for transient cold water operation.
- Cold water run is for continuous operation below 105°F system return temperature.
- Cold water start maintains design flow rate at system design temperature but reduces boiler flow rate during heavy bypass operation.
- Cold water run maintains constant design flow rate in the boiler.

Installation

Before beginning the installation, it's important to first inspect the system and determine what materials you will need. Some parts are included with the controller while others you will need to provide.

Installation Codes

Installations must be in accordance with local, state, provincial, and national codes, laws, regulations and ordinances. In the absence of local codes, installations must be in accordance with the latest editions of the:

- National Fuel Gas Code, ANSI Z223.1/NFPA 54
- National Electrical Code, ANSI/NFPA 70
- For Canada only: CAN/CGA B149.1 Installation Code and CSA C22.1 C.E.C. Part 1 and Part 2

Mounting the Control Box

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

The control box should be mounted on the side of the heater to which the system piping and pump assemblies are to be attached as shown in Fig. 3–7 on pages 7 & 8. The controller should be mounted so as to provide maximum support by using the mounting holes provided on the base of the controller to the side center brace on the heater. You will need to drill mounting holes for #10 hardware and 3/4" conduit access holes through the heater side panel for the routing of wiring and the sensor.

CAUTION: Remote mounted controller must be installed within 25 feet of wire length to the heater.

Injector & Heater Pump Comparison

Heater Model	Heater Pump				Injector Pump		
	Flow	Temp. Rise	Press. Drop	Pump Model/Imp.	Flow	Temp. Rise	Pump Model-hp
302	32	16	2	112	13	40	1911-¼ hp
402	34	20	2	112	17	40	1911-¼ hp
502	42	20	2.3	1630/4.0	22	40	1911-¼ hp
652	55	20	4.1	1630/4.0	28	40	1911-¼ hp
752	63	20	5.7	1630/4.2	32	40	1911-¼ hp
902	76	20	8.4	1630/4.2	38	40	1911-¼ hp
992	83	20	5.2	1630/4.7	42	40	1911-¼ hp
1262	107	20	9.6	1630/4.7	54	40	1911-⅓hp
1532	120	22	12.4	1632/5.6	62	42	1911-⅓hp
1802	120	25	13	1632/5.6	68	45	1911-⅓hp
2002	132	26	19	1634/6.1	74	46	1935-¾hp
2072	132	27	19	1634/6.1	75	47	1935-¾hp
2342	132	30	21.4	1634/6.1	80	50	1935-¾hp

Table C: Injector and Heater Pump Specifications—Hi Delta

Heater Model	Heater Pump				Injector Pump		
	Flow	Temp. Rise	Press. Drop	Pump Model	Flow	Temp. Rise	Pump Model-hp
503	58	15	2.4	1611	29	30	1911-¼ hp
753	63	21	5.6	1611	44	30	1911-¼ hp
1003	87	20	8.2	1630	58	30	1911-⅓ hp
1253	86	25	12.2	1630	73	30	1911-⅓ hp
1503	100	26	18.5	1632	87	30	1911-⅓ hp
1753	109	28	26	1634	102	30	1911-⅓ hp
2003	116	30	36.2	1636	116	30	1935-¾ hp

Table D: Injector and Heater Pump Specifications—MVB

Heater Model	Heater Pump				Injector Pump		
	Flow	Temp. Rise	Press. Drop	Pump Model/Imp.	Flow	Temp. Rise	Pump Model-hp
926/962	79	20	8.5	1630/4.7	50	32	1911-¼ hp
1083/1125	90	21	12.0	1630/4.7	50	37	1911-¼ hp
1178/1223	90	22	12.5	1630/4.7	60	33	1911-⅓ hp
1287/1336	90	25	13.2	1630/4.7	60	37	1911-⅓ hp
1414/1468	90	27	14.0	1632/5.65	60	40	1911-⅓ hp
1571/1631	90	30	14.5	1632/5.65	60	45	1911-⅓ hp
1758/1826	90	34	15.4	1632/5.65	60	50	1911-⅓ hp
2100	172	20	11.0	1641/6.9	130	26	1935-¾hp
2500	200	21	15.8	1641/6.9	130	32	1935-¾hp
3001	200	25	16.7	1641/6.9	130	38	1935-¾hp
3500	200	29	17.5	1641/6.9	130	44	1935-¾hp
4001	200	33	18.7	1641/6.9	130	50	1935-¾hp

Table E: Injector and Heater Pump Specifications—Raytherm

Check the Power Source

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

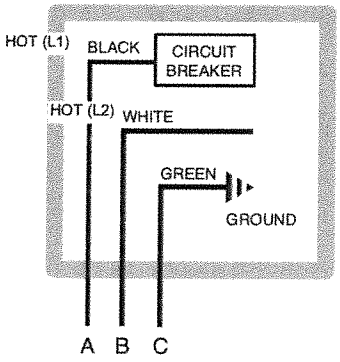


Fig. 18: Wiring Connections

Check the power source:

AC = 104 VAC Minimum, 126 VAC MAX
AB = 208 VAC Minimum, 252 VAC MAX
BC = 104 VAC Minimum, 126 VAC MAX

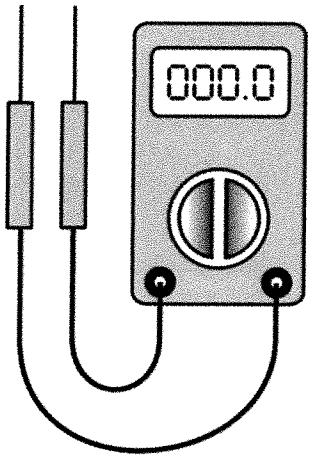


Fig. 19: Multi-meter

Injection Pump Cover Installation (Required for Outdoor Installation Only)

Before Starting

1. Turn off power to the unit at the circuit breaker.
2. Turn off gas supply.
3. Shut off the water supply to the heater and, if necessary, drain water from the system.
4. Allow heater to cool down before attempting work.

In order to install the pump cover, you will need to rotate the pump body so that the electrical box is pointing downward, as outlined in the following steps:

1. Loosen and remove the eight (8) 9/16" wrench bolts holding the pump body in place. See Fig. 20.

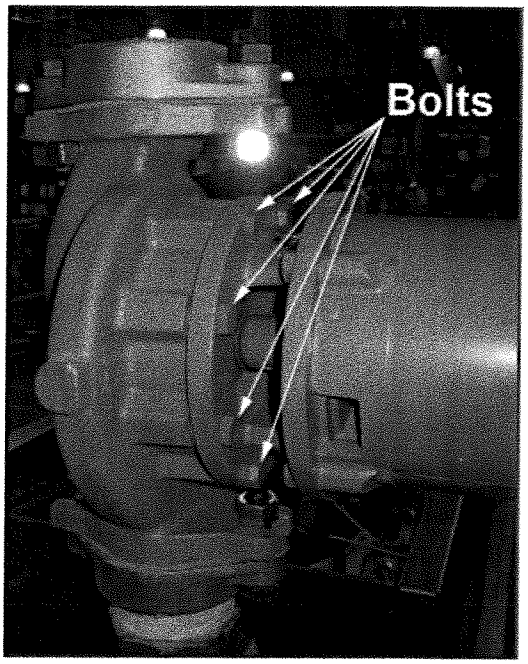


Fig. 20: Remove the eight bolts holding the pump body in place

2. Remove the pump body then rotate it so that the electrical box is pointing downward, ensuring not to damage the seal. See Fig. 21, 22 and 23.
3. Insert and tighten all eight (8) wrench bolts, securing the pump body in place.
4. You will now be able to install the pump cover. See Fig. 24 and 25.

Fig. 21: Remove the pump body

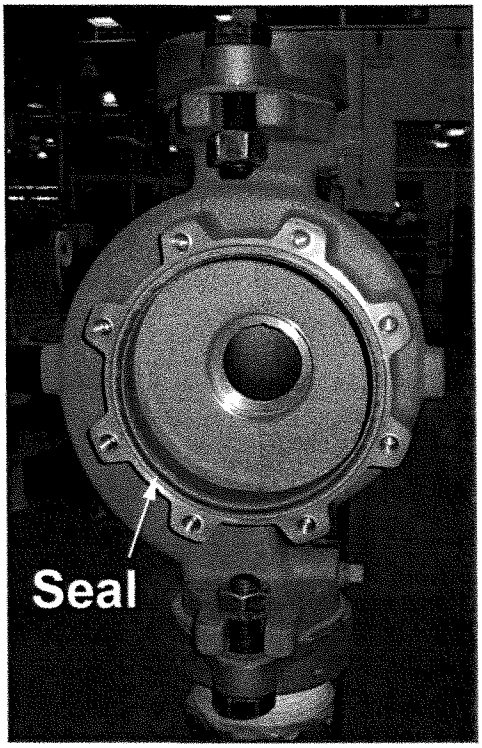


Fig. 22: Be sure not to damage the seal when removing or replacing the pump body

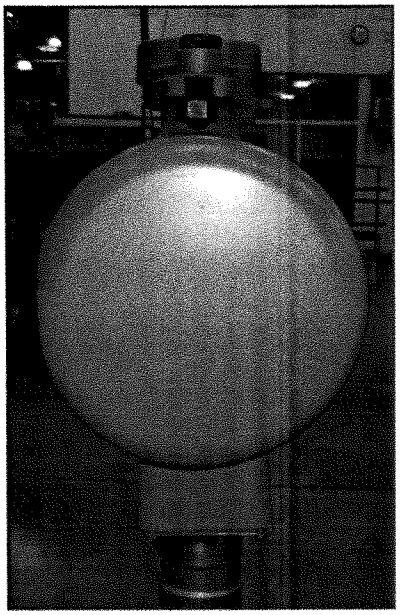


Fig 23: Reposition the pump body so that the electrical box points downward

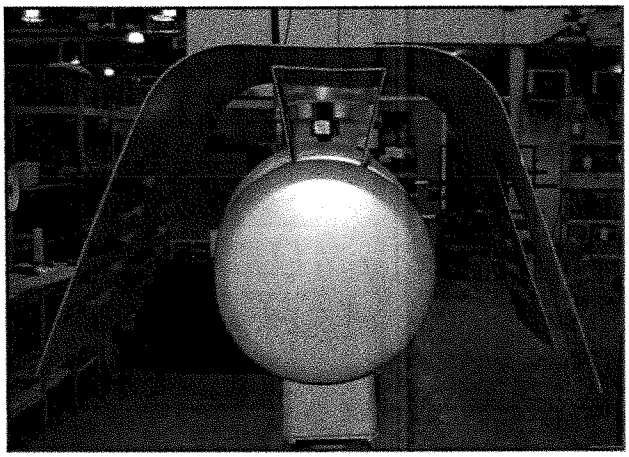


Fig. 24: Place the cover on the pump

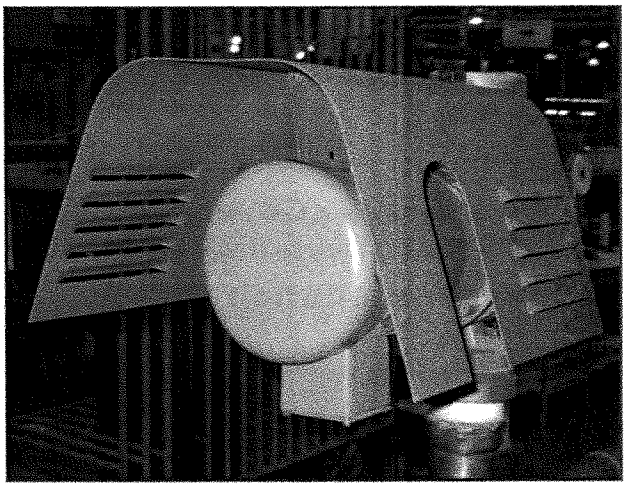
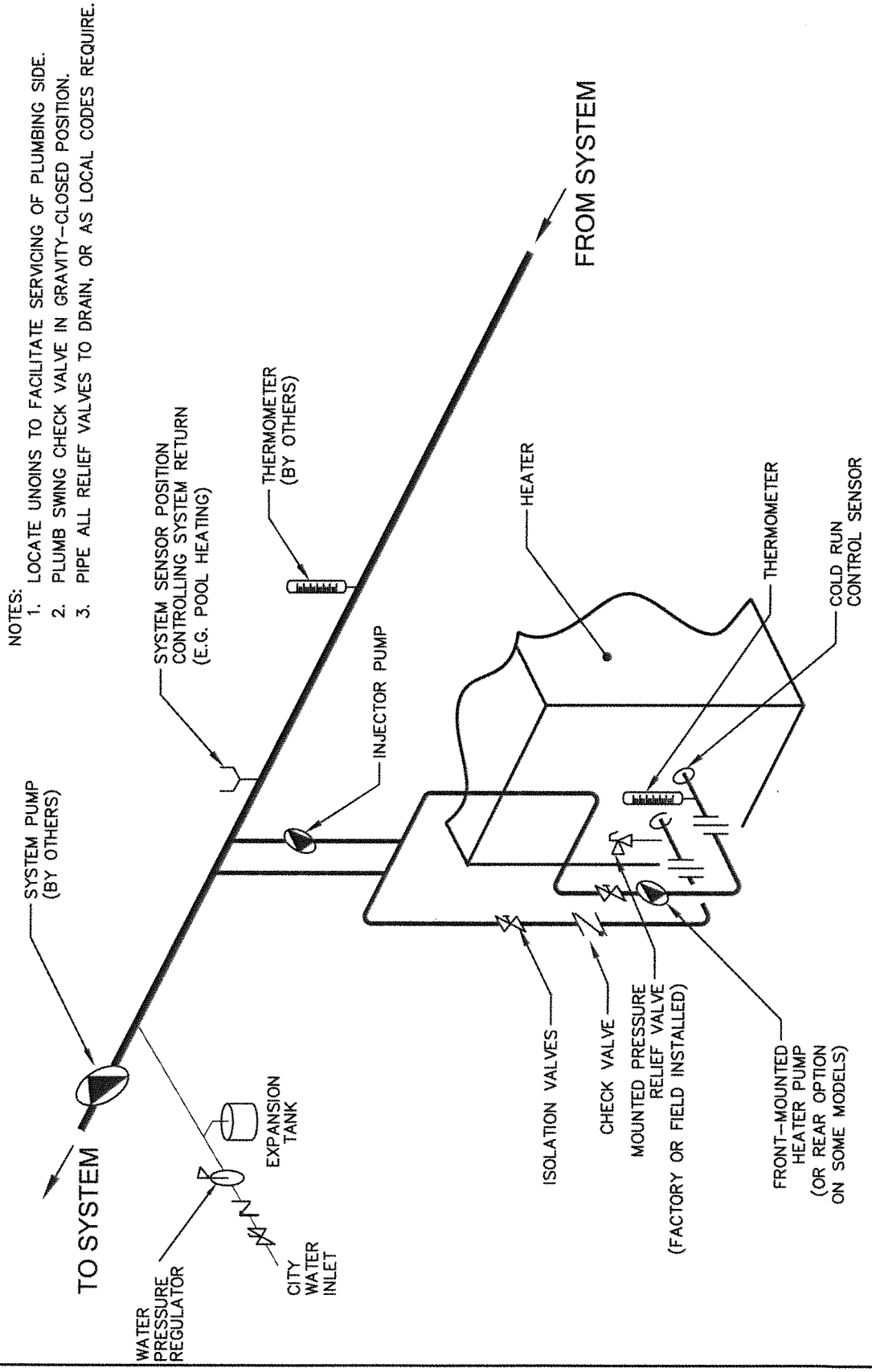


Fig 25: Pump cover - angle view

Typical Cold Water Run Piping



Operation

- Run full system flow for two minutes.
- Initiate PID pump control to achieve target inlet temperature by slowing injector pump.
- Boiler ΔT will not increase during bypass operation.
- If target temperature is not achieved after seven minutes from "call for heat", the system will shut down.

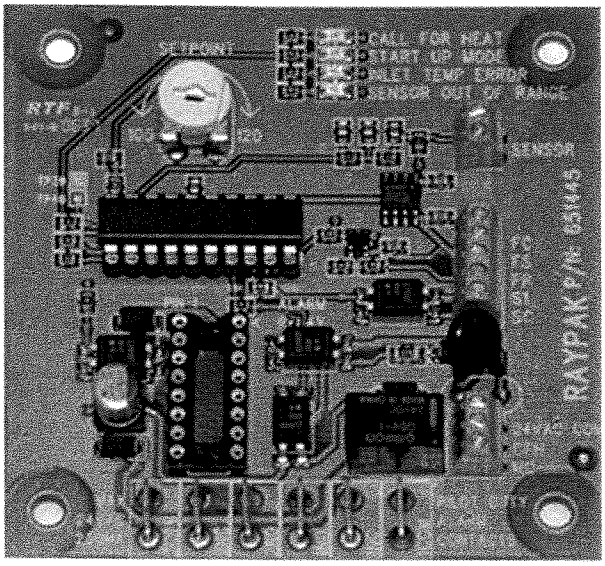


Fig. 26: Control Board

Cold Run Sequence of Operation

1. Supply separate 220VAC, 1 Ø, 60 Hz power to Cold Run control.
2. Call for heat occurs at heater.
3. The heater outputs 24VAC to terminal 4 of terminal block 3 located in Cold Run controller.
4. Terminal 4 of TB 3 sends 24VAC to the coil of the SPST relay located in the cold run control panel.
5. The SPST relay coil is energized and closes the contacts allowing 24VAC from the Cold Run control transformer to be sent to the CFH terminal of the Cold Run circuit board.
   a) A two second delay occurs from the CFH signal waiting to send power from terminal MC of the cold run circuit board.
6. 24 VAC is sent from terminal 2 of terminal block 3 to the NO contacts of the DPST relay located in the cold run control panel.
7. After the two second delay on the cold run circuit board, pin MC outputs a 24 VAC signal to terminal AL0 of the Hitachi inverter.
8. The AL0 relay closes and outputs a 24 VAC signal to the coil of the DPST relay located in the cold run control panel.
9. The DPST relay coil energizes and closes the NO contacts.
10. Once the NO contacts of the DPST close, the heater 24 VAC is sent back to the heater to complete the circuit (pin 3 of terminal block 3) and the interlock circuit (pin 1 & 2 of terminal block 3) allowing the heater to fire.
11. Pin SC of the cold run circuit board sends 24VAC to Pin 1 (Forward) on Hitachi Inverter.
12. PCS terminal on Inverter outputs 12VDC signal to the common terminal of the reset switch located on the bottom of the cold run control panel.
13. The 12VDC signal crosses over the reset switch and goes to Pin FS and to pin S1 on cold run circuit board.
14. Pin FR on the TVC board outputs 10VDC to pin O of the Inverter to drive injector pump at full speed for two-minutes waiting for the heater to reach full fire.
15. After the two-minute delay the 10VDC output signal from pin FR reduces to approximately 8VDC at the inverter thus slowing the pump to approximately 50 Hz.
16. The output signal continues to vary depending on the heater inlet temperature.

The heater will lockout and shut down if the set point on the inlet temperature is not achieved within seven-minutes from a call for heat.

The DIP switches on the Hitachi Inverter must be set as indicated on Fig. 27 below.

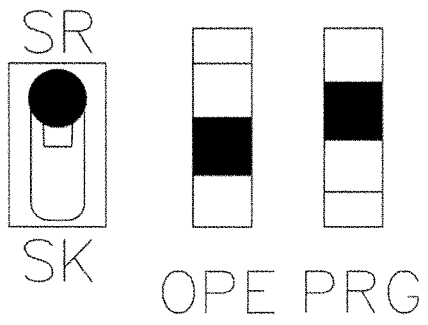
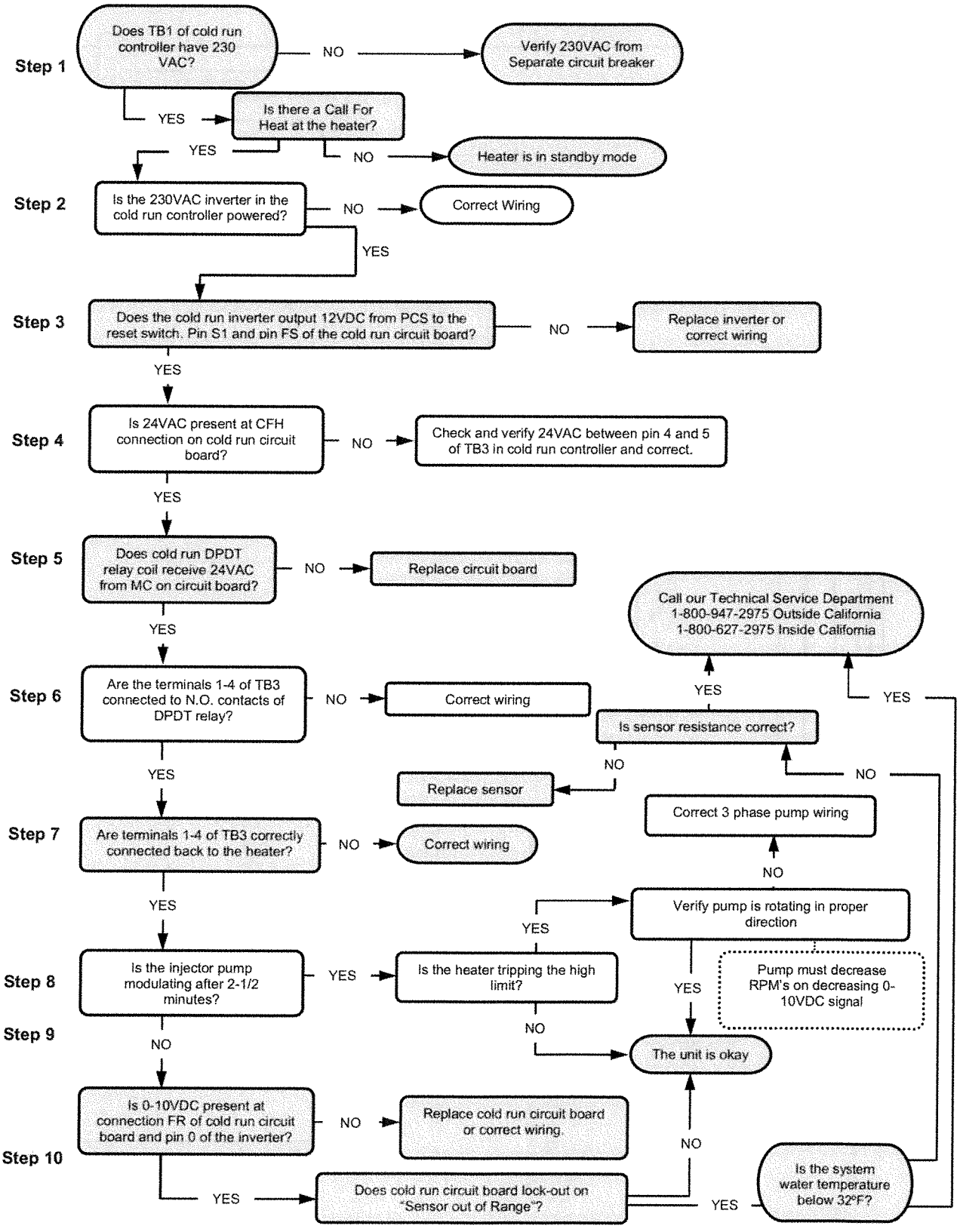
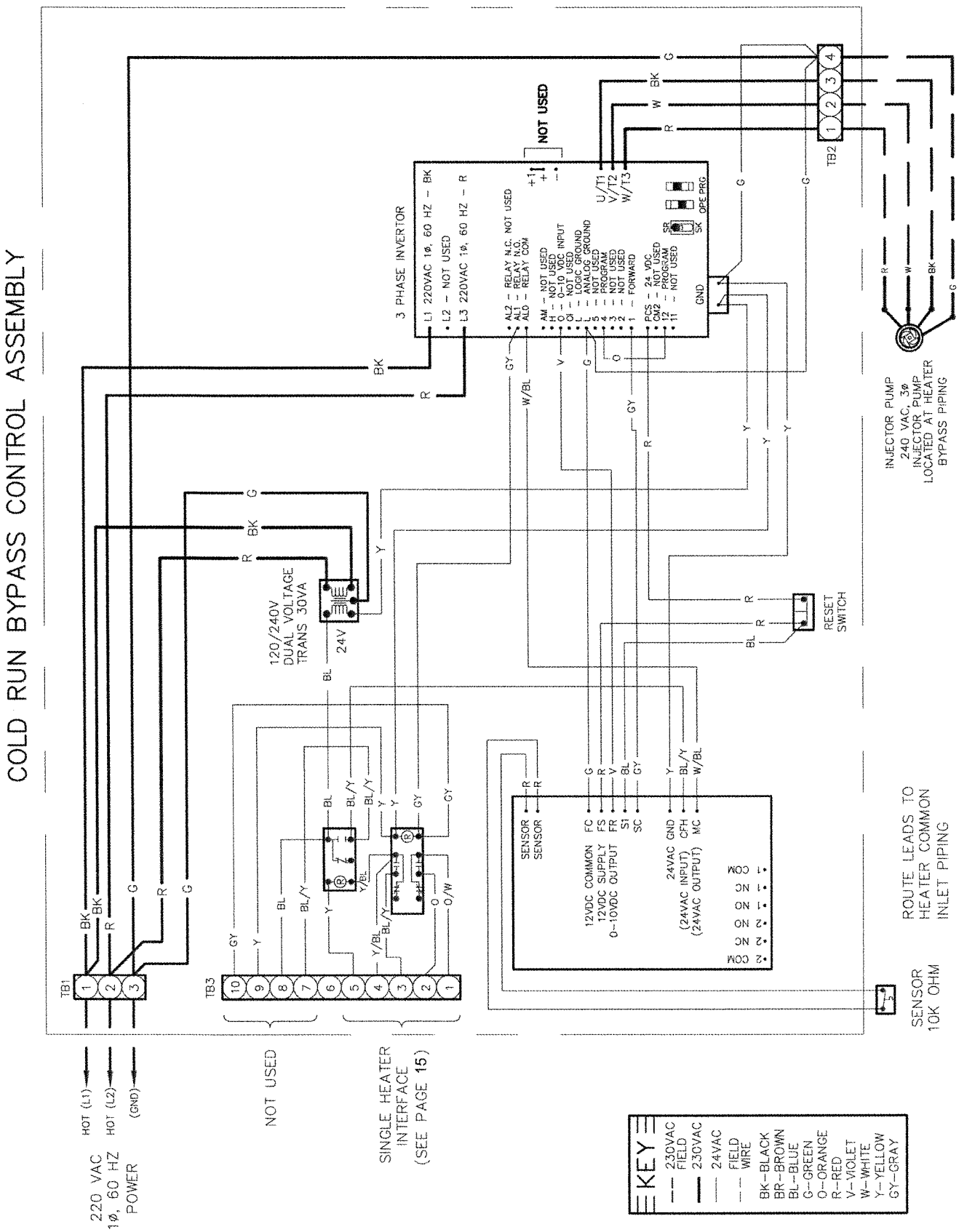


Fig. 27: DIP Switch Settings

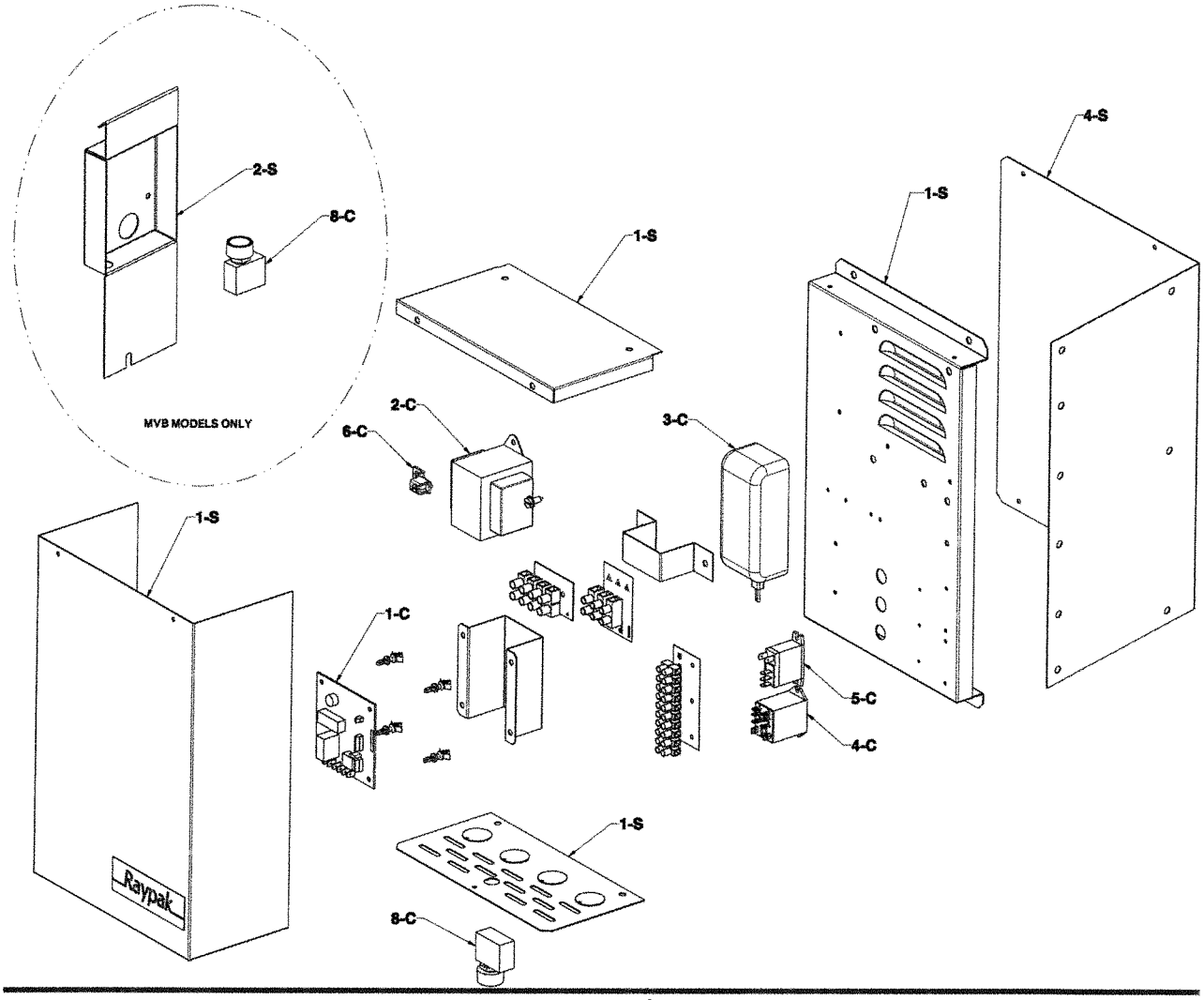
Cold Water Run Troubleshooting Guide



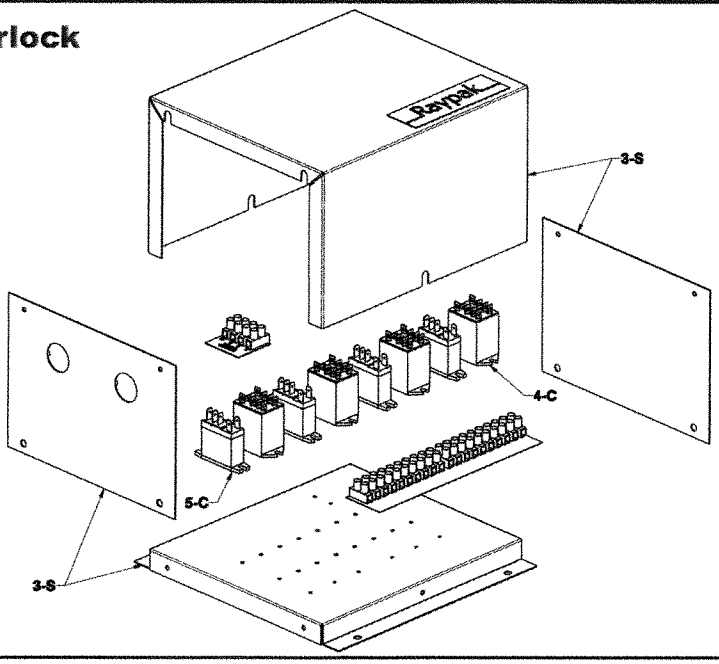
Wiring Diagram—Cold Water Run



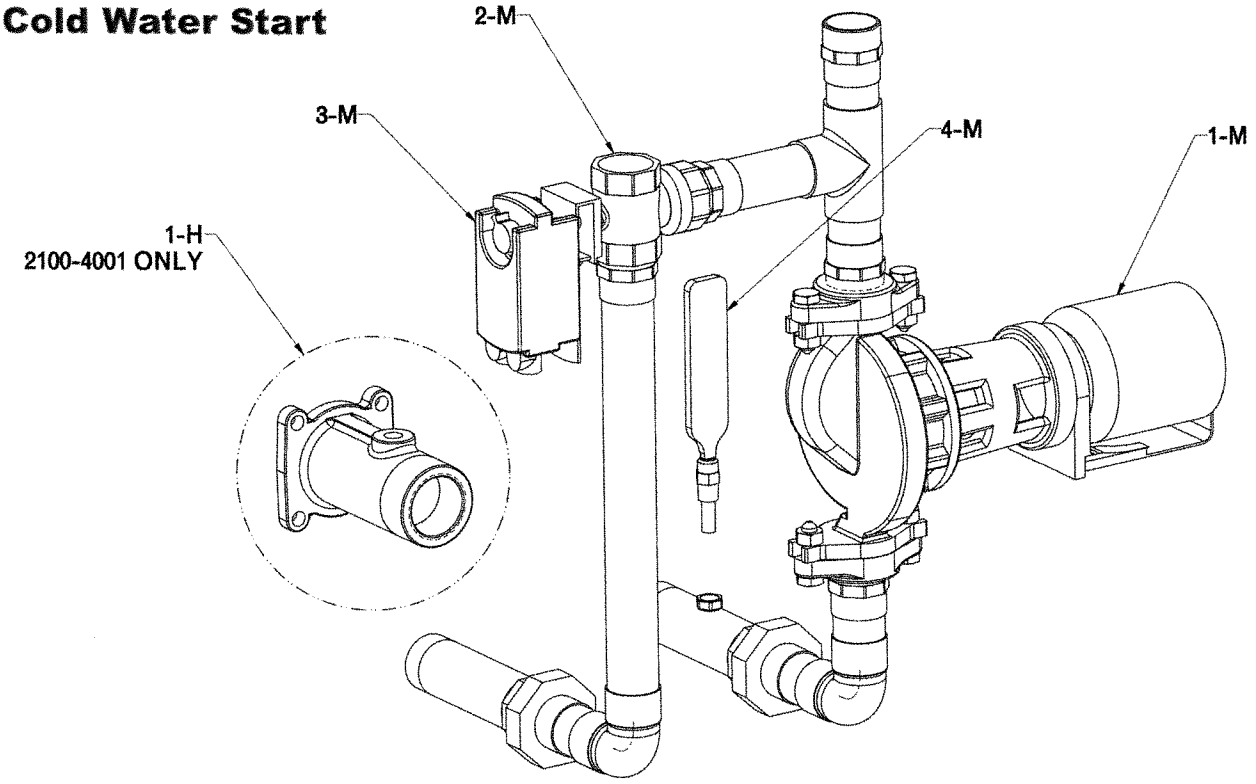
ILLUSTRATED PARTS LISTS Cold Water Start

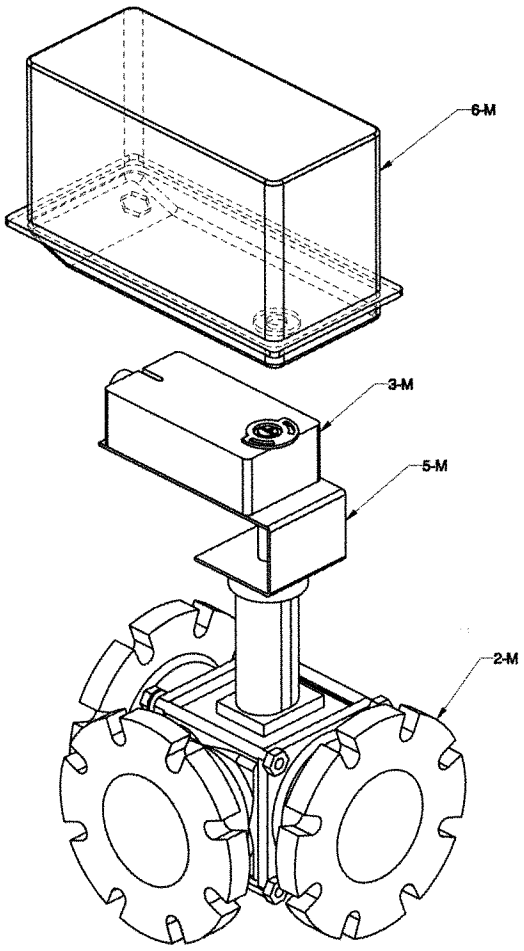


Multiple Boiler Interlock



Cold Water Start

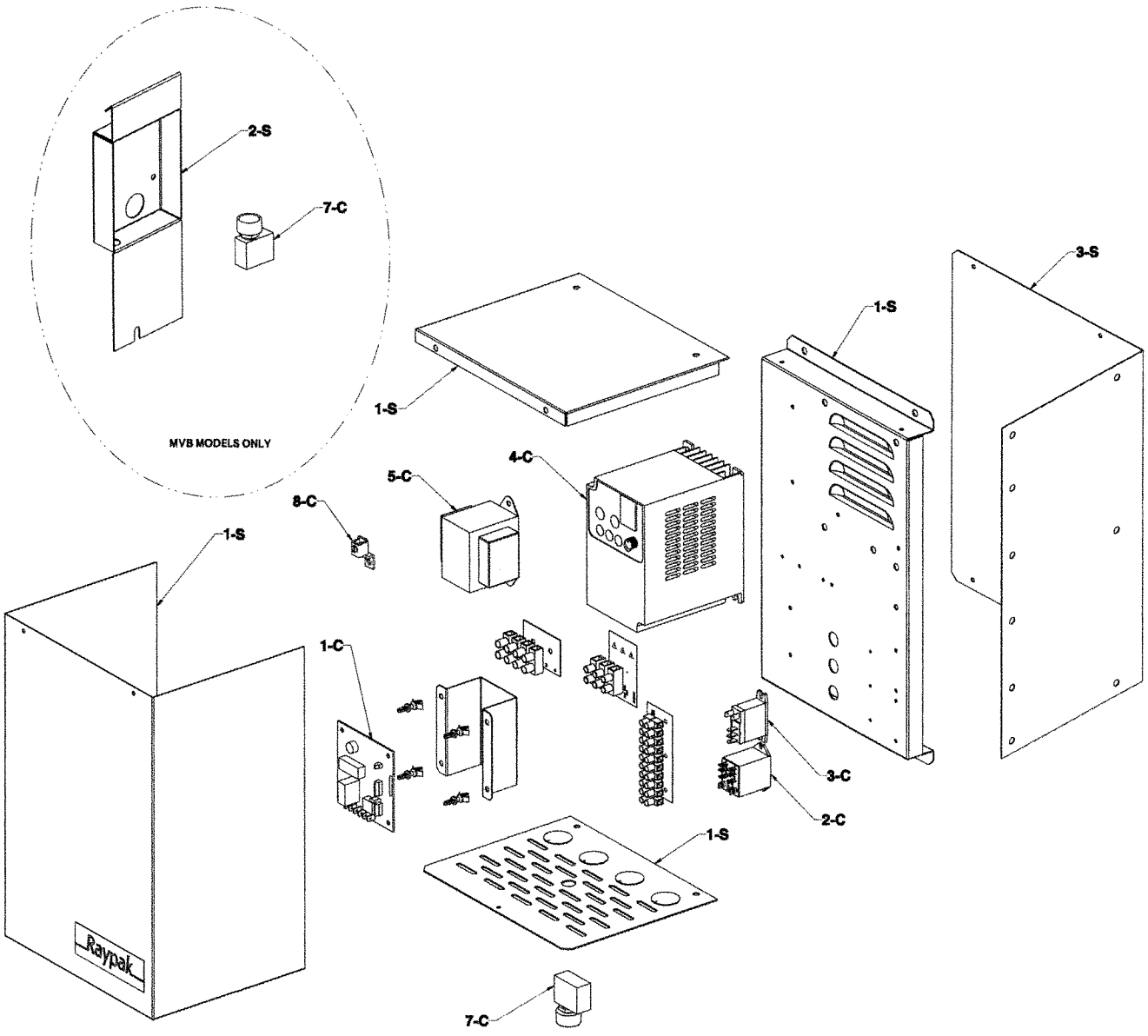




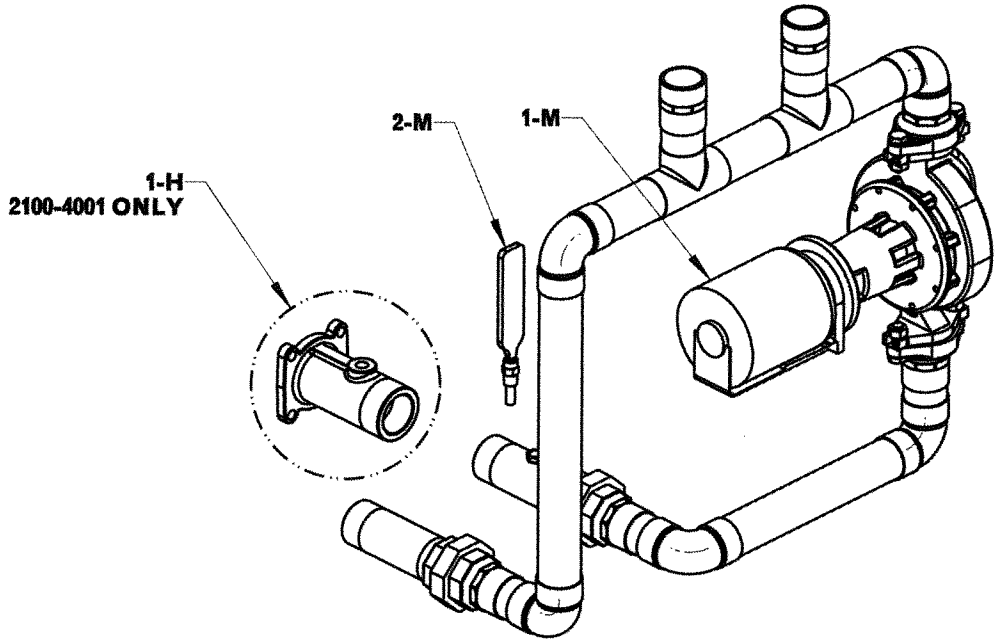
CALL OUT	DESCRIPTION	HI DELTA	MVB	RAYTHERM
1-C	PC BOARD ASSY-CONTROL	011717F	011717F	011717F
2-C	TRANSFORMER	011718F	011718F	011718F
3-C	POWER SUPPLY 120VAC/12VDC	011719F	011719F	011719F
4-C	RELAY-DPDT 24V	011720F	011720F	011720F
5-C	RELAY-SPDT 24V	009039F	009039F	009039F
6-C	GROUND LUG	007155F	007155F	007155F
7-C	TEMP SENSOR 10K (NOT SHOWN)	010787F	010787F	010787F
8-C	ALARM RESET SWITCH	005641F	005641F	005641F
1-H	INLET ADAPTER 2-1/2 NPT	N/A	N/A	012315F
1-M	PUMP-WATER BR 2" FLANGE, 1/4 HP	007226F	007226F	007226F
	PUMP-WATER CI 2" FLANGE, 1/4 HP	007232F	007232F	007232F
	PUMP-WATER BR 2" FLANGE, 1/2 HP	N/A	007347F	007347F
	PUMP-WATER CI 2" FLANGE, 1/2 HP	N/A	007353F	007353F
	PUMP-WATER BR 2-1/2" FLANGE, 3/4 HP	007348F	007348F	007348F
	PUMP-WATER CI 2-1/2" FLANGE, 3/4 HP	007354F	007354F	007354F
	PUMP-WATER BR 2-1/2" FLANGE, 1 HP	007348F	007348F	007348F
	PUMP-WATER CI 2-1/2" FLANGE, 1 HP	007354F	007354F	007354F
	PUMP-WATER BR 2-1/2" FLANGE, 1.5 HP	N/A	007937F	007937F
	PUMP-WATER CI 2-1/2" FLANGE, 1.5 HP	N/A	007938F	007938F
	PUMP-WATER BR 2-1/2" FLANGE, 2.0 HP	N/A	N/A	012317F
	PUMP-WATER CI 2-1/2" FLANGE, 2.0 HP	N/A	N/A	012318F
2-M	3-WAY VALVE ASSY 2" NPT 24 Cv	011939F	011939F	011939F
	3-WAY VALVE ASSY 2" NPT 38 Cv	011721F	011721F	011721F
	3-WAY VALVE ASSY 2" NPT 57 Cv	011722F	011722F	011722F
	3-WAY VALVE ASSY 2-1/2" NPT 74 Cv	011723F	011723F	011723F
	3-WAY VALVE ASSY 2-1/2" NPT 100 Cv	011724F	011724F	011724F
	3-WAY VALVE ASSY 4" NPT 152 Cv	012231	012231	012231
	3-WAY VALVE ASSY 4" NPT 254 Cv	012232	012232	012232
	3-WAY VALVE ASSY 4" NPT 327 Cv	012233	012233	012233
3-M	ACTUATOR-35 IN LBS (ELODRIVE)	012447F	012447F	012447F
	ACTUATOR-53 IN LBS (DELTA CONTROLS)	011834F	011834F	011834F
	ACTUATOR-132 IN LBS (ELODRIVE)	012448F	012448F	012448F
	ACTUATOR-177 IN LBS (DELTA CONTROLS)	012449F	012449F	012449F
4-M	THERMOMETER-VERTICAL	000919	N/A	000919
5-M	MOUNTING KIT (ELODRIVE)	012450F	012450F	012450F
	MOUNTING KIT (DELTA CONTROLS)	012452F	012452F	012452F
	MOUNTING KIT 4" VALVE (ELODRIVE)	012451F	012451F	012451F
	MOUNTING KIT 4" VALVE (DELTA CONTROLS)	012453F	012453F	012453F
6-M	ACTUATOR COVER (DELTA CONTROLS ONLY)	012454F	012454F	012454F
	ACTUATOR COVER 4" (DELTA CONTROLS ONLY)	012455F	012455F	012455F
1-S	CONTROL BOX SHEET METAL	011716F	011716F	011716F
2-S	CONTROL BOX COVER	N/A	011978F	N/A
3-S	INTERLOCK BOX SHEET METAL	012249F	012249F	012249F
4-S	CONTROL BOX MTG BRACKET	N/A	N/A	012367F

NOTE: Sizing is specific to the application.

Cold Water Run



Cold Water Run



CALL OUT	DESCRIPTION	HI DELTA	MVB	RAYTHERM
1-C	PC BOARD ASSY-CONTROL	011717F	011717F	011717F
2-C	RELAY-DPDT 24VAC	011720F	011720F	011720F
3-C	RELAY-SPDT 24VAC	009039F	009039F	009039F
4-C	INVERTER-1/2 HP	011835F	011835F	011835F
	INVERTER-1 HP	011836F	011836F	011836F
5-C	TRANSFORMER	011718F	011718F	011718F
6-C	TEMPERATURE SENSOR 10K (NOT SHOWN)	010787F	010787F	010787F
7-C	ALARM RESET SWITCH	005641F	005641F	005641F
8-C	GROUND LUG	007155F	007155F	007155F
1-H	INLET ADAPTER-2-1/2 NPT (2100-4001)	N/A	N/A	012316F
1-M	PUMP-WATER BR 2" FLANGE, 1/4 HP	007226F	007226F	007226F
	PUMP-WATER CI 2" FLANGE, 1/4 HP	007232F	007232F	007232F
	PUMP-WATER BR 2-1/2" FLANGE, 3/4 HP	007348F	007348F	007348F
	PUMP-WATER CI 2-1/2" FLANGE, 3/4 HP	007354F	007354F	007354F
	PUMP-WATER BR 2-1/2" FLANGE, 1 HP	007351F	007351F	007351F
	PUMP-WATER CI 2-1/2" FLANGE, 1 HP	007357F	007357F	007357F
2-M	THERMOMETER-VERTICAL	000919	000919	000919
3-M	INJECTOR PUMP, BR 1/4 HP (NOT SHOWN)	951414	951414	951414
	INJECTOR PUMP, CI 1/4 HP (NOT SHOWN)	951415	951415	951415
	INJECTOR PUMP, BR 1/3 HP (NOT SHOWN)	951394	951394	951394
	INJECTOR PUMP, CI 1/3 HP (NOT SHOWN)	951413	951413	951413
	INJECTOR PUMP, BR 3/4 HP (NOT SHOWN)	951411	951411	951411
	INJECTOR PUMP, CI 3/4 HP (NOT SHOWN)	951416	951416	951416
1-S	CONTROL BOX SHEET METAL	012315F	012315F	012315F
2-S	CONTROL BOX COVER	N/A	011978F	N/A
3-S	CONTROL BOX MTG BRACKET	N/A	N/A	012367F

NOTE: Sizing is specific to the application.

Registered Quality Management System

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Litho in U.S.A.

Bell & Gossett

INSTRUCTION MANUAL

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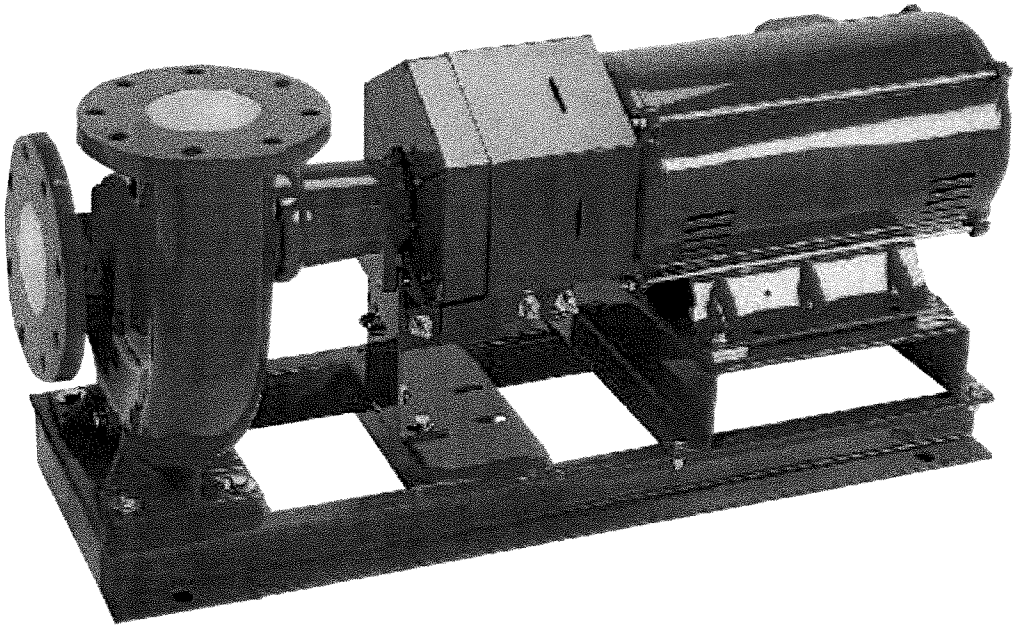
REVISION F



Series 1510 and 1510/Universal Centrifugal Pumps

Installation, Operation and Service Instructions

INSTALLER: PLEASE LEAVE THIS MANUAL FOR THE OWNER'S USE.

Bell & Gossett

ITT Industries
Engineered for life

DESCRIPTION

The Series 1510 centrifugal pump is a frame mounted pump which features – high efficiency, rugged construction, foot mounted volute with back pullout bearing frame, center drop out coupler and regreasable bearings. These features make installation, operation and service easy to perform.

PUMP APPLICATION

The standard Series 1510 centrifugal pump's bronze fitted construction make it ideal for service with following liquids: unheated domestic and fresh water, boiler feed water, condensate, hydronic cooling or heating, pressure boosting, general pumping and benign liquids.

For other applications contact your local B&G Representative.

OPERATION LIMITS

Unless special provisions have been made for your pump by Bell & Gossett, the operational limits for Series 1510 Pumps are as follows:

Maximum Working Pressure
Listed on pump nameplate.

SEAL OPERATING LIMITS

Standard Seals
BUNA-PH Limitations 7-9; Temperature Range -40 to +225°F
EPTH-PH Limitations 7-11; Temperature Range -40 to + 250°F
For use on closed or open systems which are relatively free of dirt and/or other abrasive particles.

Flushed Single Seals
PH Limitations 7-9; Temperature Range 0 to +250°F†
NOTE: On closed or open low pressure systems that contain a high concentration of abrasives an external flush is required.

Flushed Double Seals
PH Limitations 7-9; Temperature Range 0 to +250°F
NOTE: On closed or open low pressure systems that contain a high concentration of abrasives an external flush is required.

Packing
PH Limitations 7-9; Temperature Range 0 to +200°F
For use on open or closed systems which require a large amount of makeup water, as well as systems which are subjected to widely varying chemical conditions and solids buildup.

† For operating temperatures above 250°F a cooled flush is required and is recommended for temperatures above 225°F for optimum seal life. On closed systems cooling is accomplished by inserting a small heat exchanger in the flush line to cool the seal flushing fluid.

Flush-line Filters and Sediment Separators are available on special request.

⚠ SAFETY INSTRUCTIONS

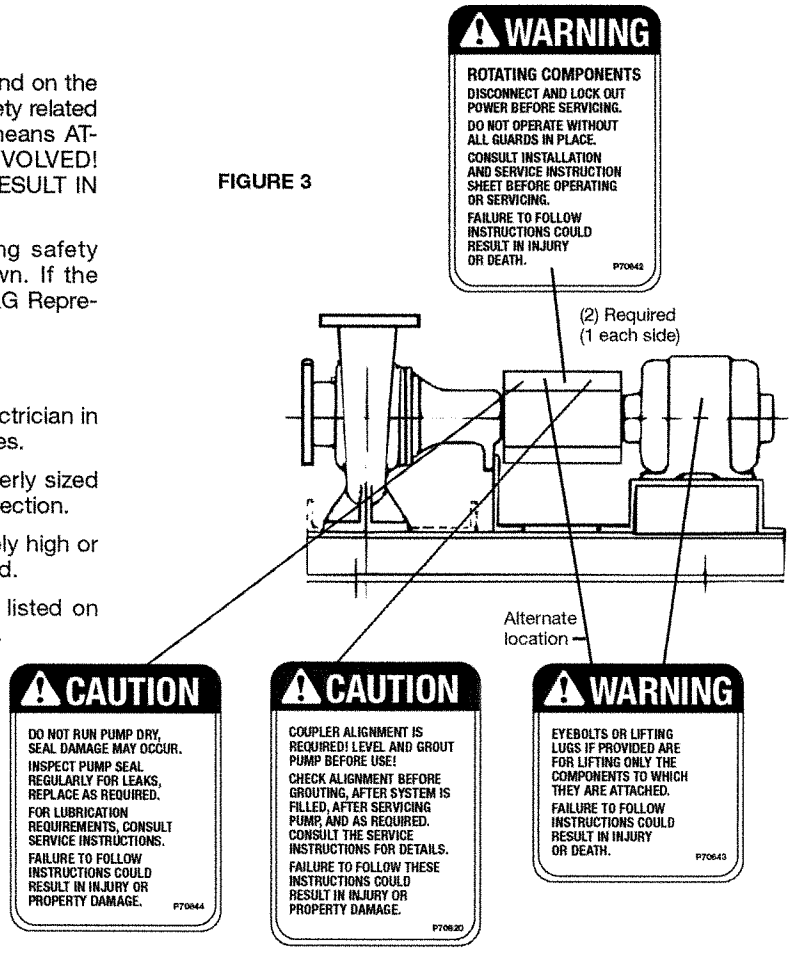
This safety alert symbol will be used in this manual and on the pump Safety Instruction decal to draw attention to safety related instructions. When used, the safety alert symbol means ATTENTION! BECOME ALERT! YOUR SAFETY IS INVOLVED! FAILURE TO FOLLOW THE INSTRUCTIONS MAY RESULT IN A SAFETY HAZARD.

Your Series 1510 Pump should have the following safety instruction decals located approximately as shown. If the decals are missing or illegible contact your local B&G Representative for a replacement.

Additional Safety Requirements:

1. Electrical connections to be made by qualified Electrician in accordance with all National, State and Local codes.
2. Motor must have properly sized starter with properly sized heaters to provide overload and undervoltage protection.
3. If pump, motor or piping are operating at extremely high or low temperatures, guarding or insulation is required.
4. The maximum working pressure of the pump is listed on the pump nameplate, do not exceed this pressure.

FIGURE 3



ADDITIONAL SAFETY REQUIREMENTS:

ELECTRICAL SAFETY:

⚠ WARNING: Electrical Shock Hazard
Electrical connections to be made by a qualified electrician in accordance with all applicable codes, ordinances, and good practices. Failure to follow these instructions could result in serious personal injury or death, or property damage.

⚠ WARNING: Electrical Overload Hazard
Three phase motors must have properly sized heaters to provide overload and undervoltage protection. Single phase motors have built-in overload protectors. Failure to follow these instructions could result in serious personal injury or death, or property damage.

THERMAL SAFETY:

⚠ WARNING: Extreme Temperature Hazard
If pump, motor, or piping are operating at extremely high or low temperatures, guarding or insulation is required. Failure to follow these instructions could result in serious personal injury or death, or property damage.

MECHANICAL SAFETY:

⚠ WARNING: Unexpected Startup Hazard
Disconnect and lockout power before servicing. Failure to follow these instructions could result in serious personal injury or death, or property damage.

⚠ WARNING: Excessive System Pressure Hazard
The maximum working pressure of the pump is listed on the nameplate, do not exceed this pressure. Failure to follow these instructions could result in serious personal injury or death, or property damage.

⚠ WARNING: Excessive Pressure Hazard
Volumetric Expansion
The heating of water and other fluids causes volumetric expansion. The associated forces may cause failure of system components and release of high temperature fluids. This will be prevented by installing properly sized and located compression tanks and pressure relief valves. Failure to follow these instructions could result in serious personal injury or death, or property damage.

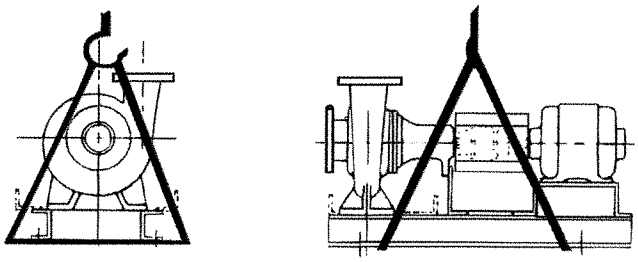
PUMP LOCATION

Locate the pump so there is sufficient room for inspection, maintenance and service. If the use of a hoist or tackle is needed, allow ample head room.

⚠ WARNING: FALLING OBJECT HAZARD
Eyebolts or lifting lugs if provided are for lifting only the components to which they are attached. Failure to follow these instructions could result in serious personal injury or death, or property damage.

If lifting of the entire pump is required, do so with slings placed under the base rails as shown.

FIGURE 4



The best pump location for sound and vibration absorption is on a concrete floor with subsoil underneath. If the pump location is overhead, special precautions should be undertaken to reduce possible sound transmission, consult a sound specialist.

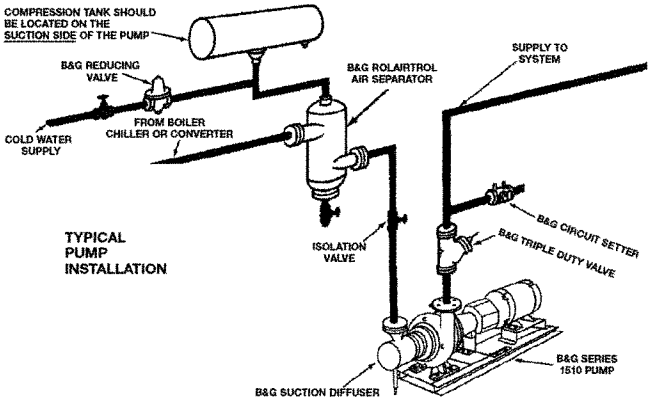
If the pump is not on a closed system, it should be placed as near as possible to the source of the liquid supply, and located to permit installation with the fewest number of bends or elbows in the suction pipe.

The installation must be evaluated to determine that the Net Positive Suction Head Available (NPSHA) meets or exceeds the Net Positive Suction Head Required (NPSHR), as stated by the pump performance curve.

IMPORTANT

Do not install and operate Bell & Gossett Pumps, 3D Valves, Suction Diffusers, etc., in closed systems unless the system is constructed with properly sized safety devices and control devices. Such devices include the use of properly sized and located pressure relief valves, compression tanks, pressure controls, temperature controls, and flow controls as appropriate. If the system does not include these devices, consult the responsible engineer or architect before making pumps operational.

FIGURE 5



INSTALLATION

This pump is built to provide years of service if installed properly and attached to a suitable foundation. A base of concrete weighing 2½ times the weight of the pump is recommended. (Check the shipping ticket for pump weight.)

If possible, tie the concrete pad in with the finished floor. Use foundation bolts and larger pipe-sleeves to give room for final bolt location. (See Figure 6A.)

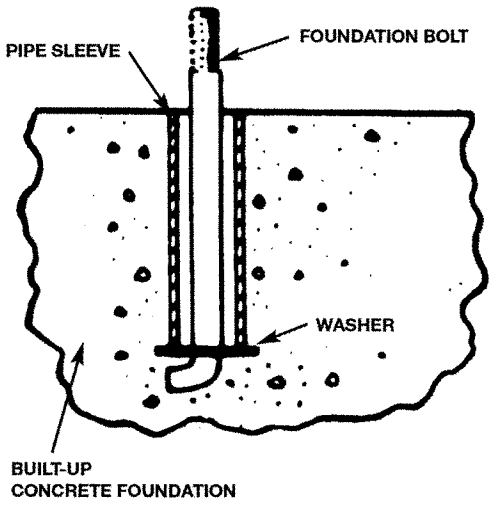
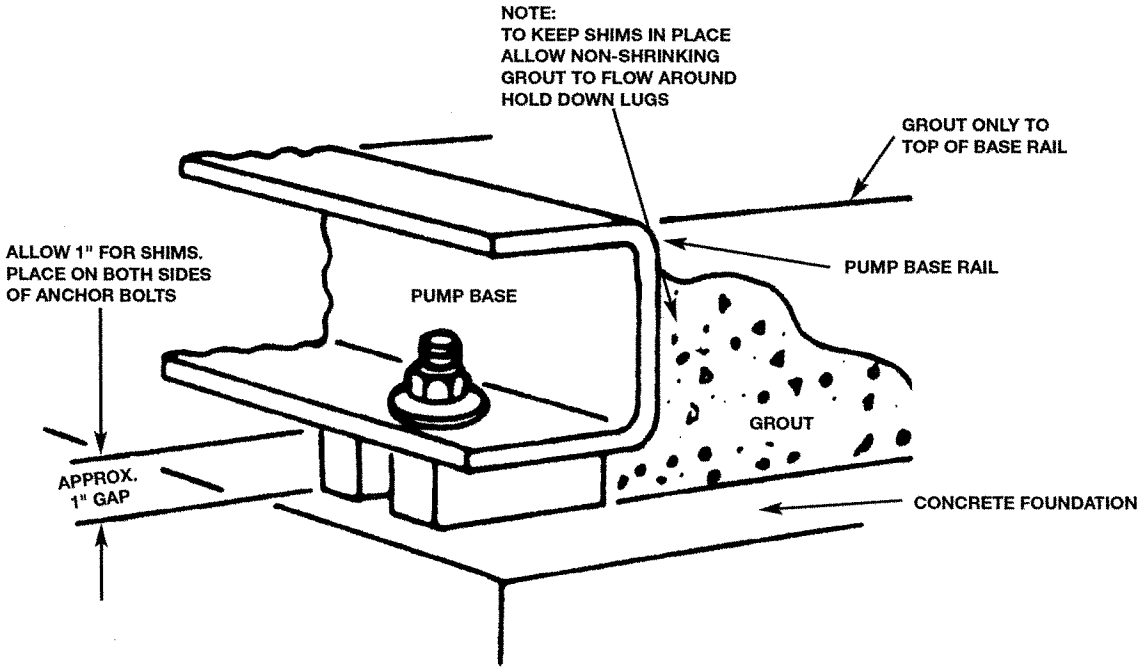


FIGURE 6A

INSTALLATION OF FOUNDATION BOLTS

FIGURE 6B **LEVELING OF PUMP BASE ON CONCRETE FOUNDATION**



LEVELING

Place the pump on its concrete foundation supporting it with steel wedges or shims totaling 1" in thickness. These wedges or shims should be put on both sides of each anchor-bolt to provide a means of leveling the base. (See Figure 6B.)

IT IS VERY IMPORTANT THAT THE PUMP-BASE BE SET LEVEL TO AVOID ANY MECHANICAL DIFFICULTIES WITH THE MOTOR OR PUMP. THIS PUMP WAS PROPERLY ALIGNED (IF FURNISHED WITH A MOTOR) AT THE FACTORY. HOWEVER, SINCE ALL PUMP BASES ARE FLEXIBLE THEY MAY SPRING AND TWIST DURING SHIPMENT. DON'T PIPE THE PUMP UNTIL IT IS REALIGNED. AFTER PIPING IS COMPLETED AND AFTER THE PUMP IS GROUTED-IN AND BOLTED-DOWN, ALIGN IT AGAIN. IT MAY BE NECESSARY TO RE-ADJUST THE ALIGNMENT FROM TIME TO TIME WHILE THE UNIT AND FOUNDATION ARE NEW.

GROUTING

After the pump has been leveled, securely bolted to the floor, and properly aligned, a good grade of non-shrinking grout should be poured inside the pump base. To hold wedges or shims in place, allow the grout to flow around them. (See Figure 6B).

ROTATION

Pump rotation is clockwise when viewed from back of the motor. An arrow is also located on the pump to show the direction of rotation.

COUPLER ALIGNMENT

All alignment should be done by moving or shimming the motor only. Adjustments in one direction may alter alignment in another. Therefore, check alignment in all directions after a correction is made. **Black rubber sleeves have different horsepower load ratings then orange Hytrel sleeves, they should not be interchanged.**

> **WARNING: UNEXPECTED STARTUP HAZARD**
> Disconnect and lockout power before servicing. Failure to follow these instructions could result in serious personal injury or death, or property damage.

Standard Sleeve Type Coupler with Black Rubber Sleeve

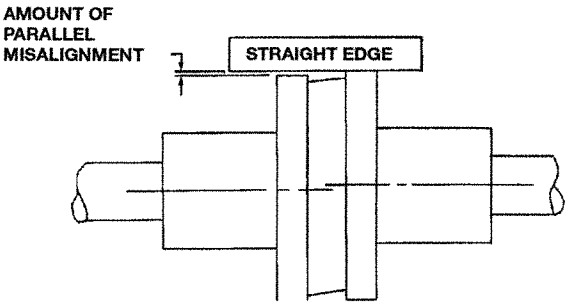
Before aligning the coupler, make sure there is at least 1/8" end clearance between the sleeve and the two coupler halves.

1. Check angular misalignment using a micrometer or caliper. Measure from the outside face of one flange to the outside face of the opposite flange at four points 90° apart. Refer to figure 7B. DO NOT ROTATE COUPLER. Misalignment up to 1/64" per inch of coupler radius is permissible.
2. At four points 90° apart (DO NOT ROTATE COUPLER), measure the parallel coupler misalignment by laying a straight edge across one coupler half and measuring the gap between the straight edge and opposite coupler half. Up to a 1/64" gap is permissible. Refer to figure 7A.

For Fine Alignment, Orange Hytrel Sleeves, 3500 RPM Operation, or All Other Coupler Types

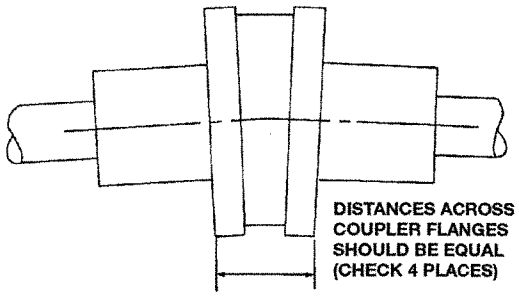
Use a dial indicator when greater alignment accuracy is required. Use the following alignment tolerances unless specified otherwise by the coupler manufacturer. On sleeve type couplers make sure there is at least 1/8" end clearance between the sleeve and the two coupler halves.

1. To check angular misalignment, mount the dial indicator base to one coupler half, or shaft, and position the dial indicator button on the front or rear face of the opposite coupler half. Set the dial to zero. Rotate both coupler halves **together**, making sure the indicator button always indicates off the same spot. Misalignment values within 0.004" TIR per inch of coupler radius are permissible.
2. To check parallel misalignment, mount the dial indicator base to one coupler half, or shaft, and position the dial indicator button on the outside diameter of the opposite coupler half. Set the dial to zero. Rotate both coupler halves **together**, making sure the indicator button always indicates off the same spot. Misalignment within 0.004" TIR is permissible.



PARALLEL ALIGNMENT CHECK

FIGURE 7A



ANGULAR ALIGNMENT CHECK

FIGURE 7B

> **WARNING: ROTATING COMPONENT HAZARD**
> Do not operate pump without all guards in place. Failure to follow these instructions could result in serious personal injury or death, or property damage.

PIPING

Always install a section of straight pipe between the suction side of the pump and first elbow or install a B&G Suction Diffuser. This reduces turbulence of the suction by straightening out the flow of liquid before it enters the pump. The length should be equal to five times the diameter of the pipe.

Be sure to eliminate any pipe-strain on the pump. Support the suction and discharge pipes independently by use of pipe hangers near the pump. Line up the piping so that the bolt-holes in the pump flanges match the bolt-holes in the pipe flanges. DO NOT ATTEMPT TO SPRING THE SUCTION OR DISCHARGE LINES INTO POSITION. Coupling and bearing wear will result if suction or discharge lines are forced into position. The code for Pressure Piping (A.S.A.B. 31.1) lists many types of supports available for various applications.

As a rule, ordinary wire or band hangers are not adequate to maintain alignment. It is very important to provide a strong, rigid support for the suction and discharge lines.

Where considerable temperature changes are anticipated, fittings for absorbing expansion should be installed in the system in such a way as to avoid strain on the pump.

On an open-system with a suction-lift, use a foot-valve of equal or greater area than the pump suction piping. Prevent clogging by using a strainer at the suction inlet next to the foot-valve. The strainer should have an area three times that of the suction pipe with a mesh hole diameter of no less than 1/4".

When using an isolation base, flexible piping should be used on both the suction and discharge sides of the pump.

A Triple Duty Valve, such as the one manufactured by Bell & Gossett, installed in the discharge line will serve as a check valve to protect the pump from water hammer, as an isolation valve for servicing and for throttling.

NOTES:

1. The pipeline should have isolation valves around the pump and have a drain valve in the suction pipe.
2. When installing the suction and discharge connections to a threaded pump housing the use of teflon tape sealer or a high quality thread sealant is recommended.

PUMP INSULATION

When insulating a Series 1510 pump, ensure that the bearing assembly grease fittings remain accessible and visible. The vent slots on the sides and bottom of the bearing assembly should remain uncovered and completely open.

LUBRICATION

While pump is running regrease pump bearing with NLGI Grade #2 lithium base petroleum grease after every 2500 hours of operation or every 6 months whichever occurs first.

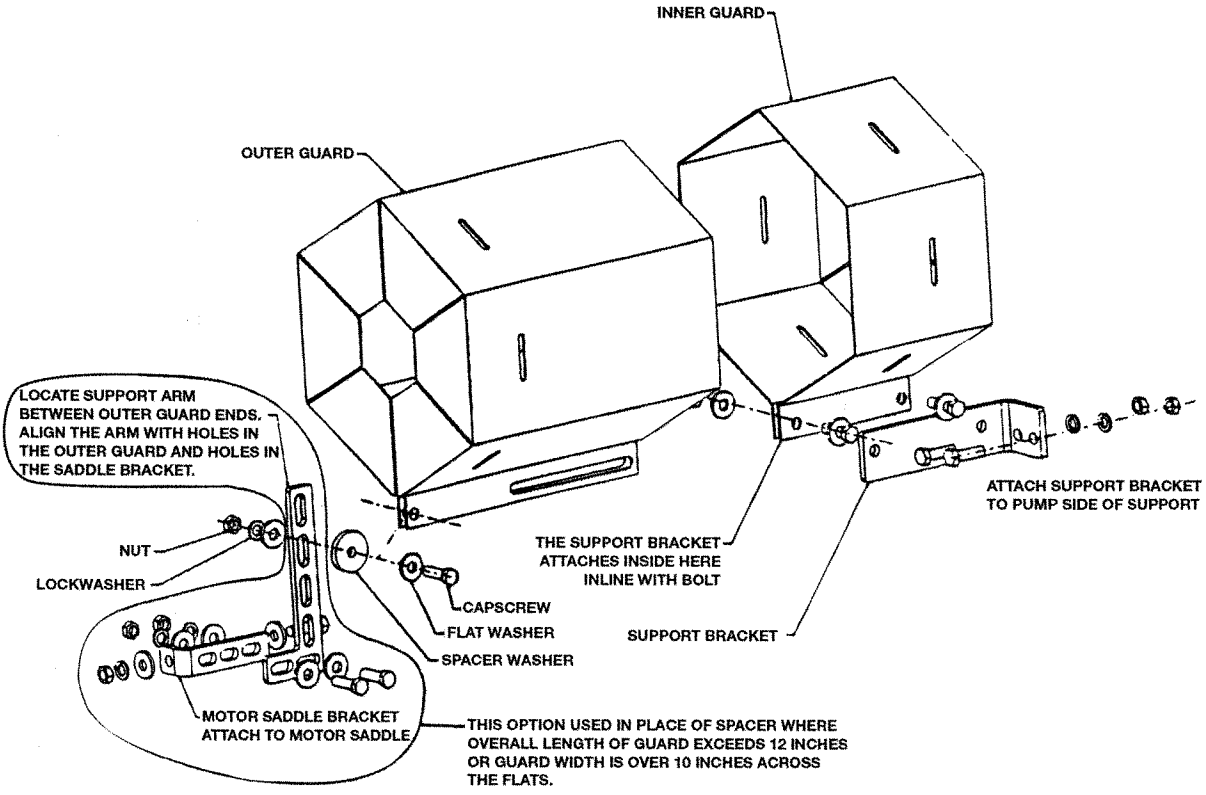
Lubricate motor per motor manufacturer's instructions.

GENERAL INSTRUCTIONS

1. Keep this pump and motor properly lubricated.
2. When there is a danger of freezing, drain the pump.
3. Inspect pump regularly for leaky seals or gaskets and loose or damaged components. Replace or repair as required.

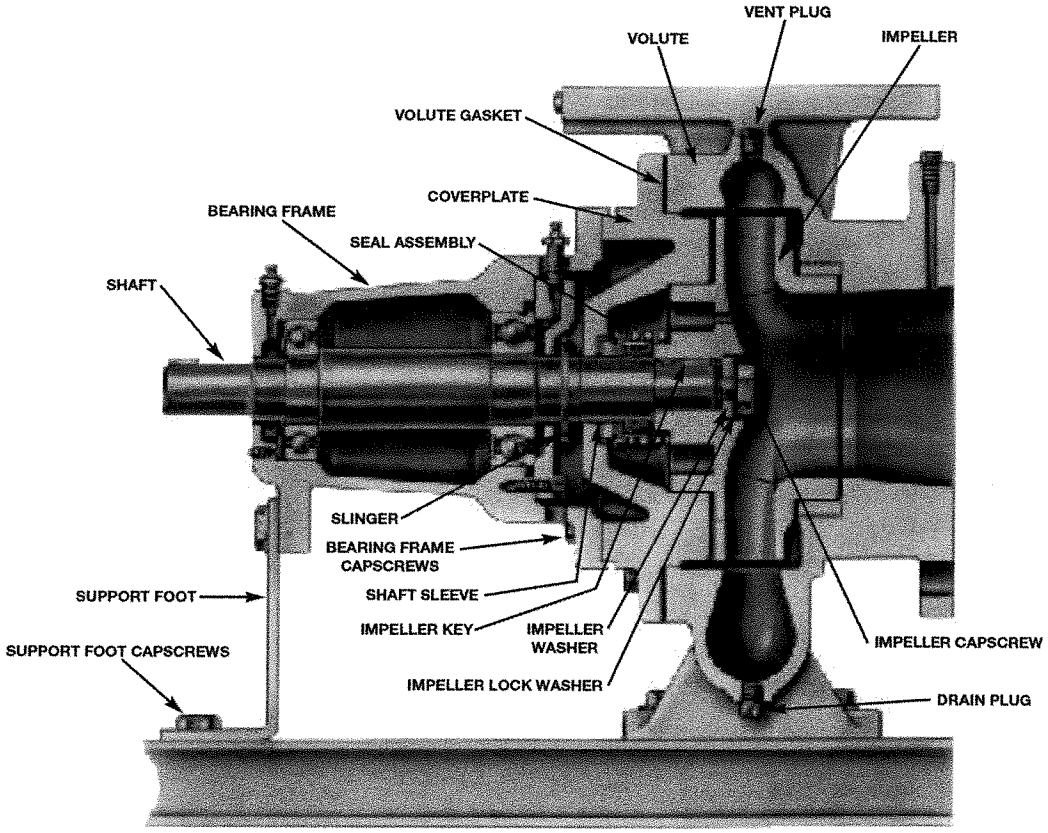
HEX GUARD EXPLODED VIEW FOR TYPICAL INSTALLATION

FIGURE 8



STANDARD MECHANICAL SEAL CONSTRUCTION

FIGURE 9



STUFFING BOX CONSTRUCTION

FIGURE 10

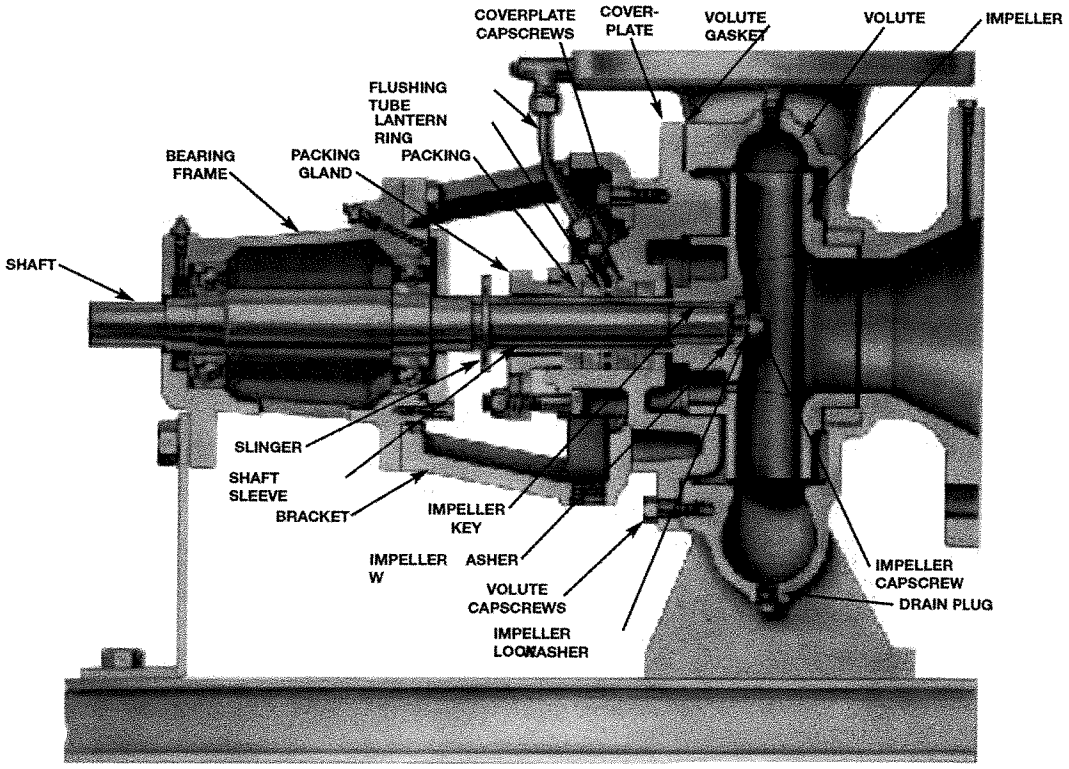


FIGURE 11
1510-S

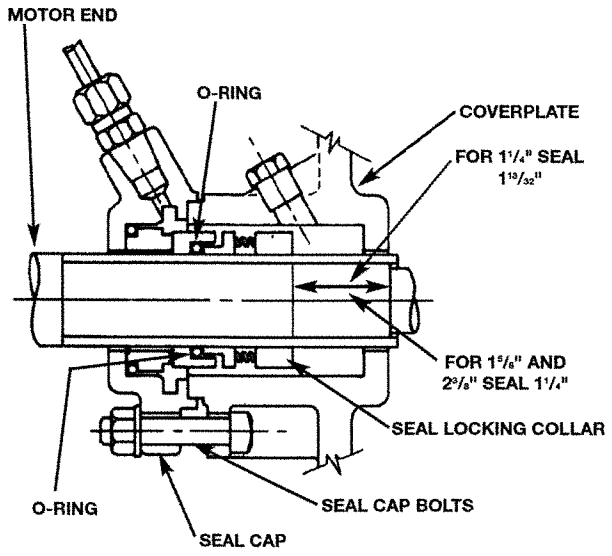
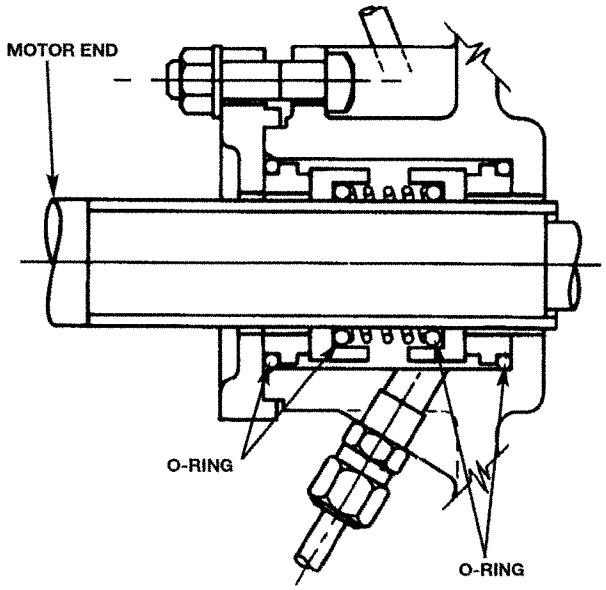


FIGURE 12
1510-D



SERVICE INSTRUCTIONS

⚠ WARNING: UNEXPECTED STARTUP HAZARD
Disconnect and lock out power before servicing. Failure to follow these instructions could result in serious personal injury or death, or property damage.

1. Close valves on suction and discharge sides of pump. (If no valves have been installed, it will be necessary to drain the system.)

⚠ CAUTION: EXTREME TEMPERATURE HAZARD
Allow pump temperature to reach acceptable levels before proceeding. Open drain valve, do not proceed until liquid stops coming out of drain valve. If liquid does not stop flowing from drain valve, isolation valves are not sealing and should be repaired before proceeding. After liquid stops flowing from the drain valve, leave valve open and continue. Remove the drain plug located on the bottom of the pump housing. Do not reinstall plug or close drain valve until re-assembly is completed. Failure to follow these instructions could result in property damage and/or moderate personal injury.

2. Remove the Hex Coupler Guard as follows (see figure 8):
   a. Remove the two cap screws that hold the outer (motor side) coupler guard to the support bracket(s).
   b. Spread the outer guard and pull it off the inner guard. **NOTE:** Do not spread the inner and outer guards more than necessary for guard removal. Over spreading the guards may alter their fit and appearance.
   c. Remove the cap screw that holds the inner guard to the support bracket.
   d. Spread the inner guard and pull it over the coupler.
3. Loosen set screws in both coupler halves and slide each half back as far as possible on its shaft. Remove coupler sleeve. Where a full diameter impeller is used, it may be necessary to remove the pump side coupler half and to slide the motor back on its base in order to gain sufficient clearance to remove the pump assembly from the volute.
4. Remove support foot capscrews. Loosen volute capscrews, do not remove them. Use capscrews in the jack screw holes (Not on 8G). Loosen the pump assembly from the volute.

⚠ WARNING: EXCESSIVE PRESSURE HAZARD
Make certain internal pressure of the pump is relieved before continuing. Failure to follow these instructions could result in serious personal injury or death, or property damage.

Remove seal flushing tube, if used.

Remove the volute capscrews and remove the pump assembly from the volute.

Continue to the section which pertains to your pump type.

1510 and 1510-F
With Standard Mechanical Seal – Figure 9

5. Remove the impeller capscrew, lock washer and washer. Remove the impeller.
6. Remove the rotating portion of the seal, use a screwdriver to loosen the rubber ring.
7. Remove the seal insert along with the insert gasket and retainer (if used).
8. Thoroughly clean the shaft sleeve and the coverplate seal cavity. Inspect for surface damage like pitting, corrosion, nicks or scratches. Replace if necessary.

9. Lubricate the shaft sleeve and coverplate seal cavity with soapy water (do not use petroleum lubricant). Install a new insert gasket and a new seal insert with indentation side down into the cup.
10. Slide a new rotating seal assembly onto the shaft sleeve. With a screwdriver push on the top of the compression ring until the seal is tight against the seal insert. Install seal spring, with narrow end toward seal.
11. Install impeller, impeller washer, lock washer and capscrew. Tighten capscrew per torque chart (See Table 1).
12. Install new volute gasket then install pump assembly into volute. Tighten volute capscrews per torque chart (See Table 1). Install seal flushing tube, if used. Install support foot capscrews and tighten per torque chart (See Table 1). Install coupler and align. Install drain plug, close drain valve.
13. Install the Hex Coupler Guard as follows:
    a. Spread the inner guard and place it over the coupler. **NOTE:** Do not spread the inner and outer guards more than necessary for guard installation. Over spreading the guards may alter their fit and appearance.
    b. With the inner guard straddling the support bracket, install a cap screw through the hole in the support bracket and guard located closest to the pump. Do not tighten the capscrew.
    c. Spread the outer guard and place it over the inner guard.
    d. Install the outer guard cap screws by following the step stated below which pertains to your particular pump:
        I) *For pumps with a motor saddle support bracket:* Ensure the outer guard is straddling the support arm, and install but do not tighten the two remaining cap screws.
        II) *For pumps without a motor saddle support bracket:* Insert the spacer washer between the holes located closest to the motor in the outer guard, and install but do not tighten the two remaining cap screws.
    e. Position the outer guard so it is centered around the shaft, and so there is less than a ¼" of shaft exposed.
    f. Holding the guard in this position, tighten the three cap screws.
14. Open isolation valves, inspect pump for leaks, if not leaking return pump to service.

1510-S Stuffing Box
With Special Single Mechanical Seal – Figure 10 and 11

5. Remove the impeller capscrew, lock washer and washer. Remove the impeller.
6. Remove hex nuts from seal cap bolts and remove coverplate capscrews. Remove coverplate from bracket.
7. Remove seal assembly. Thoroughly clean and inspect seal sleeve and seal cap, replace if required.
8. Lubricate shaft sleeve and seal cap with soapy water (do not use petroleum lubricant). Insert stationary seal with O-ring into the seal cap and slide onto the shaft. Replace the seal cap gasket. Slide rotating portion of the seal assembly onto shaft sleeve and lock in place. For 1¼" I.D. seals, the collar should be 1$^{13}/_{32}$" from the impeller end of the shaft sleeve. For 1⅝" and 2⅜" I.D. seals, the distance should be 1¼". (See Figure 11).
9. Assemble coverplate to bracket, tighten capscrews per torque chart (See Table 1). Assemble seal cap to coverplate, tighten hex nuts on seal cap bolts per torque chart (See Table 1).
10. Go to Step 11 of 1510 Standard Mechanical Seal Instructions.

1510-D Stuffing Box
With Special Double Mechanical Seal – Figure 10 and 12

5. Remove the impeller capscrew, lock washer and washer. Remove the impeller.
6. Remove hex nuts from seal cap bolts and remove coverplate capscrews. Remove coverplate from bracket.
7. Remove seal assembly. Thoroughly clean and inspect shaft sleeve, seal cap, and coverplate seal cavity, replace if required.
8. Lubricate shaft sleeve, seal cap and coverplate cavity with soapy water (do not use petroleum lubricant). Insert one stationary seal and O-ring into seal cap and the other into the coverplate.* Slide the seal cap onto the shaft. Replace seal cap gasket.* Slide rotating portion of seal assembly onto shaft sleeve.
9. Assemble coverplate to bracket, tighten capscrews per torque chart (See Table 1). Assemble seal cap to coverplate, tighten hex nuts on seal cap bolts per torque chart (See Table 1).
10. Go to Step 11 of 1510 Standard Mechanical Seal Instructions.

*For 1¼" I.D. Seal both parts will be housed in the coverplate as shown in Figure 12. Seal cap gasket is not used.

1510-8G
With Standard Mechanical Seal – Figure 13

5. Remove the impeller nut and washer. Remove the impeller and impeller key.
6. Remove spacer sleeve and two nuts holding the gland to the stuffing box.
7. Pull the coverplate off the bearing frame assembly. Remove the seal, sleeve and gland.
8. Thoroughly clean the shaft, shaft sleeve and the coverplate seal cavity. Inspect for surface damage like pitting, corrosion, nicks or scratches.
9. Apply Dow Corning Silicone Rubber #732 or equal to the shaft at sleeve location. Slide the shaft sleeve onto the shaft and spin sleeve to distribute sealant. Wipe off excess.
10. Slide the seal gland (flat side towards the stuffing box) on the shaft.
11. Lubricate the outer surface of the shaft sleeve, interior of the stuffing box and seal elastomer with soapy water (do not use petroleum lubricant). Install the stationary element and rotating assembly of the mechanical seal on the shaft sleeve; being certain that the two wearing surfaces face each other and rotating half of the seal is installed closest to the impeller end.
12. Install the seal spring and spring retainer onto the shaft sleeve. Slide the coverplate onto the bearing frame.
13. Install spacer sleeve (over the shaft sleeve), impeller key, impeller, washer and impeller nut, then tighten impeller nut to 25-30 ft-lbs. Install and tighten the gland nuts evenly against the stuffing box.

14. Inspect volute "O" ring for damage, replace if necessary. Install "O" ring around coverplate seat. Slide the bearing frame / coverplate assembly into the volute (coverplate flush tube fitting must be to top). Install volute capscrews and gradually tighten with a star pattern (prevents impeller rub) to 25-30 ft-lbs. Install drain plug. Close drain valve.
15. Go to step 13 of 1510 Standard Mechanical Seal Instructions.

1510-PF Stuffing Box With Packing – Figure 10

5. Remove the impeller capscrew, lock washer and washer. Remove the impeller and impeller key.
6. Remove hex nuts from packing gland and remove coverplate capscrews. Remove coverplate from bracket.
7. Remove packing rings from the stuffing box.
8. Check condition of shaft sleeve and replace if scored or otherwise damaged.
9. Insert two packing rings in the stuffing box followed by the lantern ring and then the remaining two pieces of packing. Make certain that the packing joints are staggered 90 degrees.
10. Install, but do not tighten the packing gland.
11. Install coverplate over the pump shaft, tighten capscrews per torque chart (See Table 1).
12. Tighten packing gland to compress packing, read note on packed pump operation.
13. Go to step 11 of 1510 Standard Seal Instructions.

NOTE ON PACKED PUMP OPERATION:

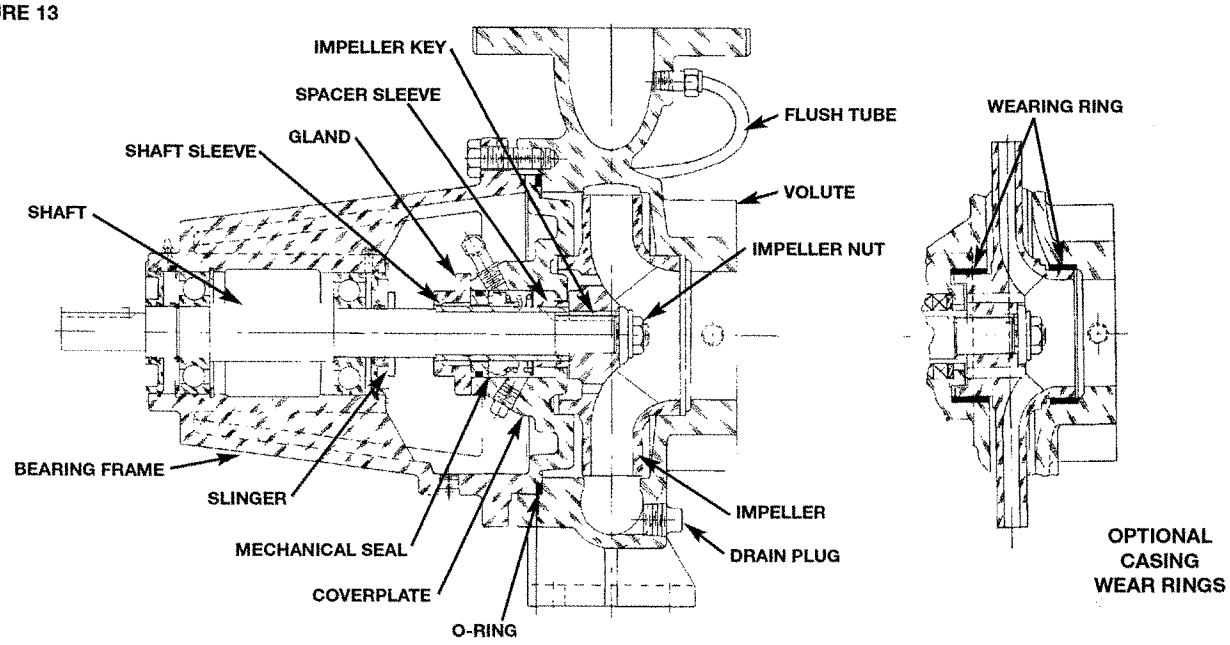
Before starting pump, back off packing gland nuts or screws until gland is loose. Re-tighten with fingers until gland is just snug against the first packing ring. Initially, water may run freely from packing. This is normal and should be allowed to continue for a period of time before further tightening of the gland. Tighten gland nuts slowly and uniformly, one flat at a time.

An adequate leakage rate is not one single value for all pumps and installations, but is the amount required to provide adequate cooling and lubrication. The required leakage will be largely influenced by operating pressure, fluid temperature, shaft speed, etc.

For fluid temperatures in the range of 32° to 190°F, average leakage rates of 60 to 80 drops per minute are recommended. However, each individual pump and installation will have unique operating conditions that will result in broadly variable leakage rate requirements.

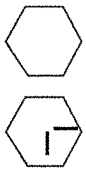
At fluid operating temperatures near the upper limit of 190°F, the maximum temperature rise of the leakage is particularly important. A packed pump should never operate with steam forming at the gland. This necessarily limits the temperature rise to a maximum of about 20°F. If the formation of steam persists at higher leakage rates, cooling water must be provided by means of an external supply, or a heat exchanger used to cool the by-pass flush.

FIGURE 13



8G – STANDARD MECHANICAL SEAL CONSTRUCTION

TABLE 1 – TORQUE CHART

Capscrew Type	Head Marking	CAPSCREW TORQUE (FOOT-POUND) Capscrew Diameter 1/4	5/16	3/8	7/16	1/2	5/8
SAE Grade 1& 2 Stainless Steel		3	6	10	16	24	46
SAE Grade 5		8	17	30	50	76	48

DEALER SERVICING

If trouble occurs that cannot be rectified contact your local representative. He will need the following information in order to give you assistance.

1. Complete nameplate data of pump and motor.
2. Suction and discharge pipe pressure gauge readings.
3. Ampere draw of the motor.
4. A sketch of the pump hook-up and piping.

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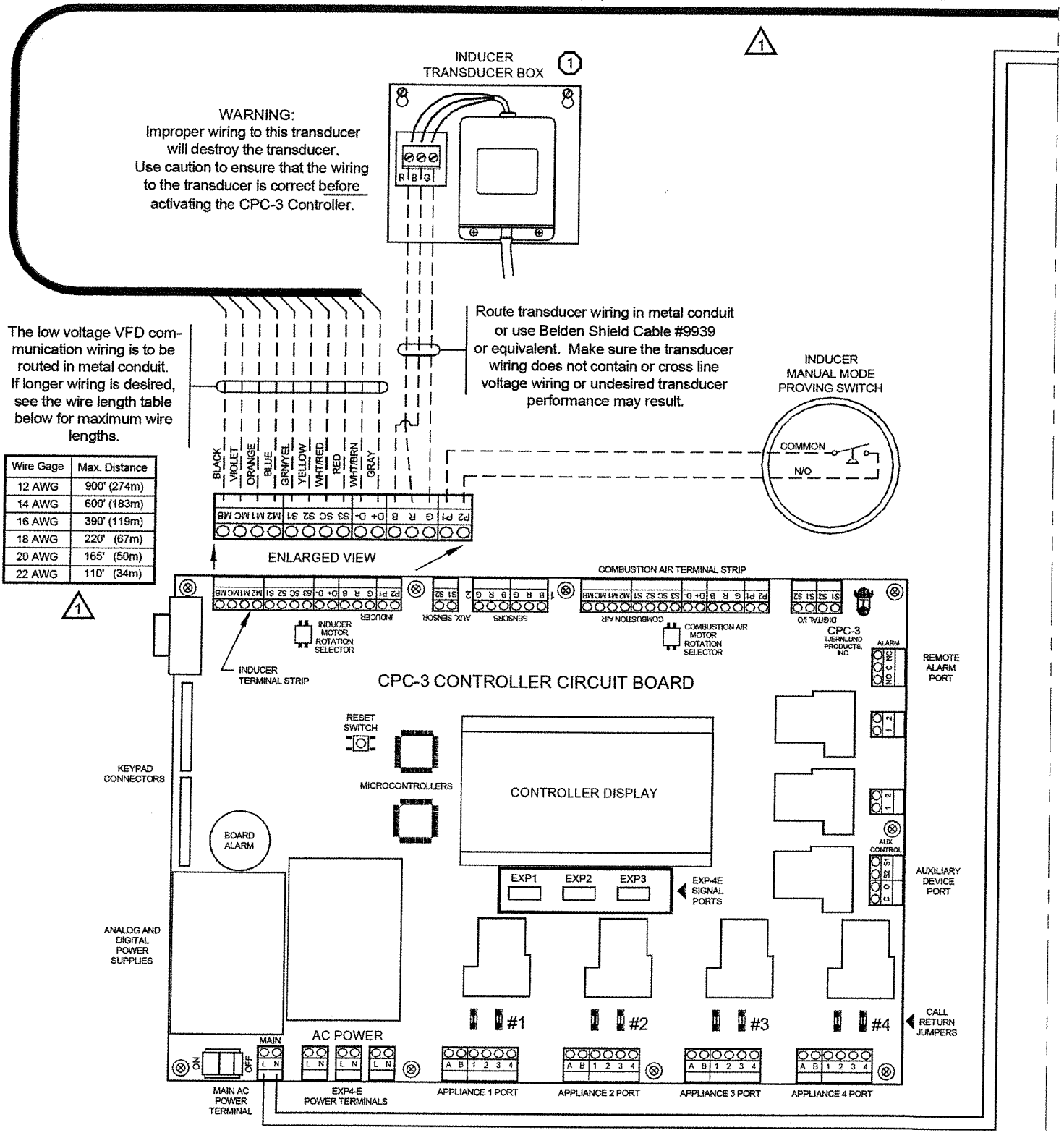
Modulating Induced Draft System with VSUB 8/12/16/20 Blower, CPC-3 Controller and 460 volt VFD

11/18/04 8052018 SHEET 1

PROJECT: Cranbrook

10' (3m) COMMUNICATIONS CABLE PROVIDED WITH EACH VFD



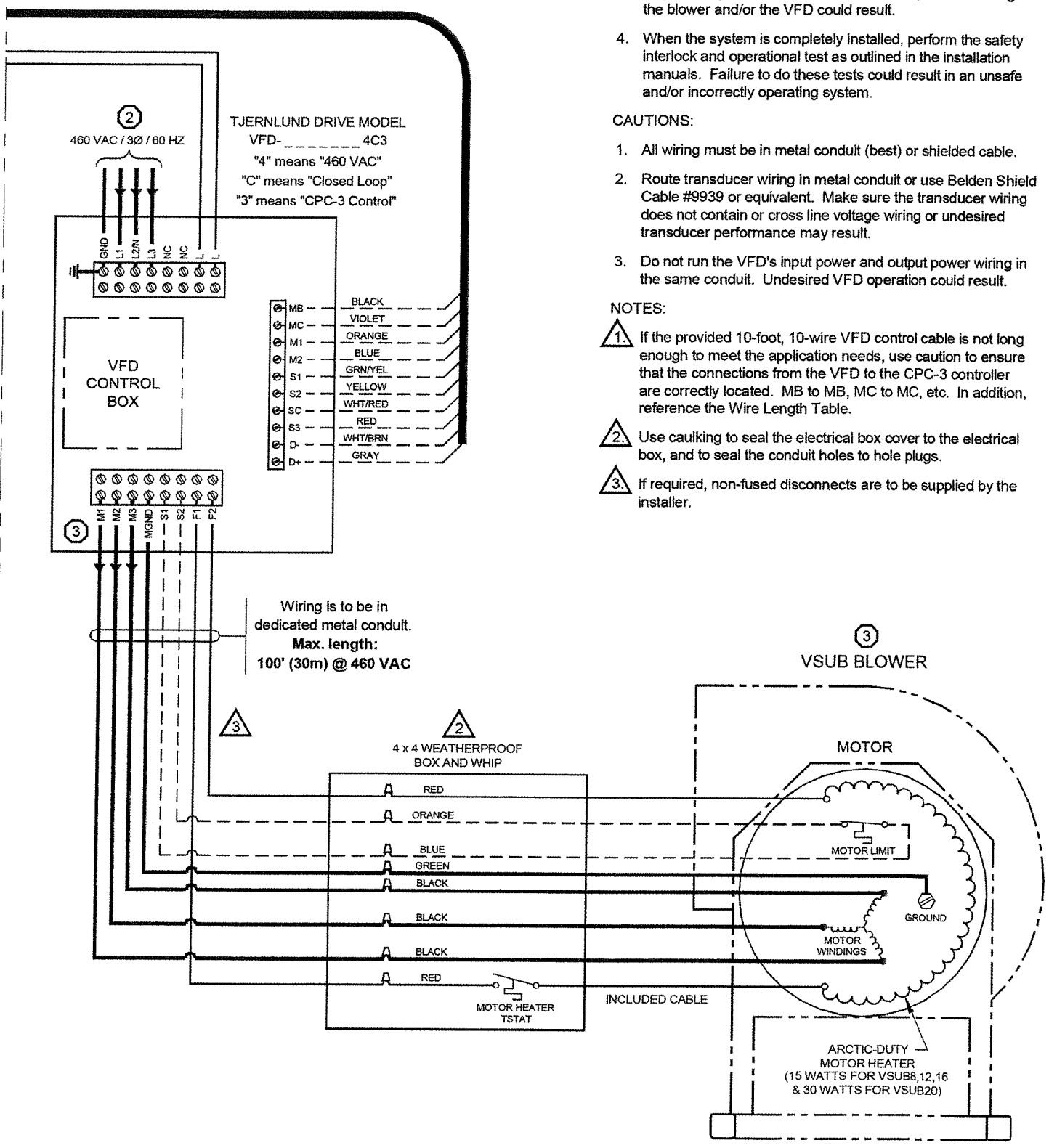
Wire Gage	Max. Distance
12 AWG	900' (274m)
14 AWG	600' (183m)
16 AWG	390' (119m)
18 AWG	220' (67m)
20 AWG	165' (50m)
22 AWG	110' (34m)

8052018 SHEET 2

LEGEND:

- LOW VOLTAGE / DC CONTROL WIRING
- 230 VAC SUPPLY / LOAD WIRING
- 460 VAC SUPPLY / LOAD WIRING
- VFD COMMUNICATIONS CABLE

FIGURE 8052018 11/18/04



WARNINGS:

1. Improper wiring to the transducer will destroy the transducer. Use caution to ensure that the wiring to the transducer is correct before activating the CPC-3 controller.
2. Verify that the input power voltage matches the VFD's name-plate rating before applying power. Improper supply voltage to the VFD could damage the VFD.
3. Verify that the blower (VSUB 8/12/16/20) is wired for the output voltage from the VFD. If not correct, severe damage to the blower and/or the VFD could result.
4. When the system is completely installed, perform the safety interlock and operational test as outlined in the installation manuals. Failure to do these tests could result in an unsafe and/or incorrectly operating system.

CAUTIONS:

1. All wiring must be in metal conduit (best) or shielded cable.
2. Route transducer wiring in metal conduit or use Belden Shield Cable #9939 or equivalent. Make sure the transducer wiring does not contain or cross line voltage wiring or undesired transducer performance may result.
3. Do not run the VFD's input power and output power wiring in the same conduit. Undesired VFD operation could result.

NOTES:

1. If the provided 10-foot, 10-wire VFD control cable is not long enough to meet the application needs, use caution to ensure that the connections from the VFD to the CPC-3 controller are correctly located. MB to MB, MC to MC, etc. In addition, reference the Wire Length Table.
2. Use caulking to seal the electrical box cover to the electrical box, and to seal the conduit holes to hole plugs.
3. If required, non-fused disconnects are to be supplied by the installer.

tekmar® - Data Brochure

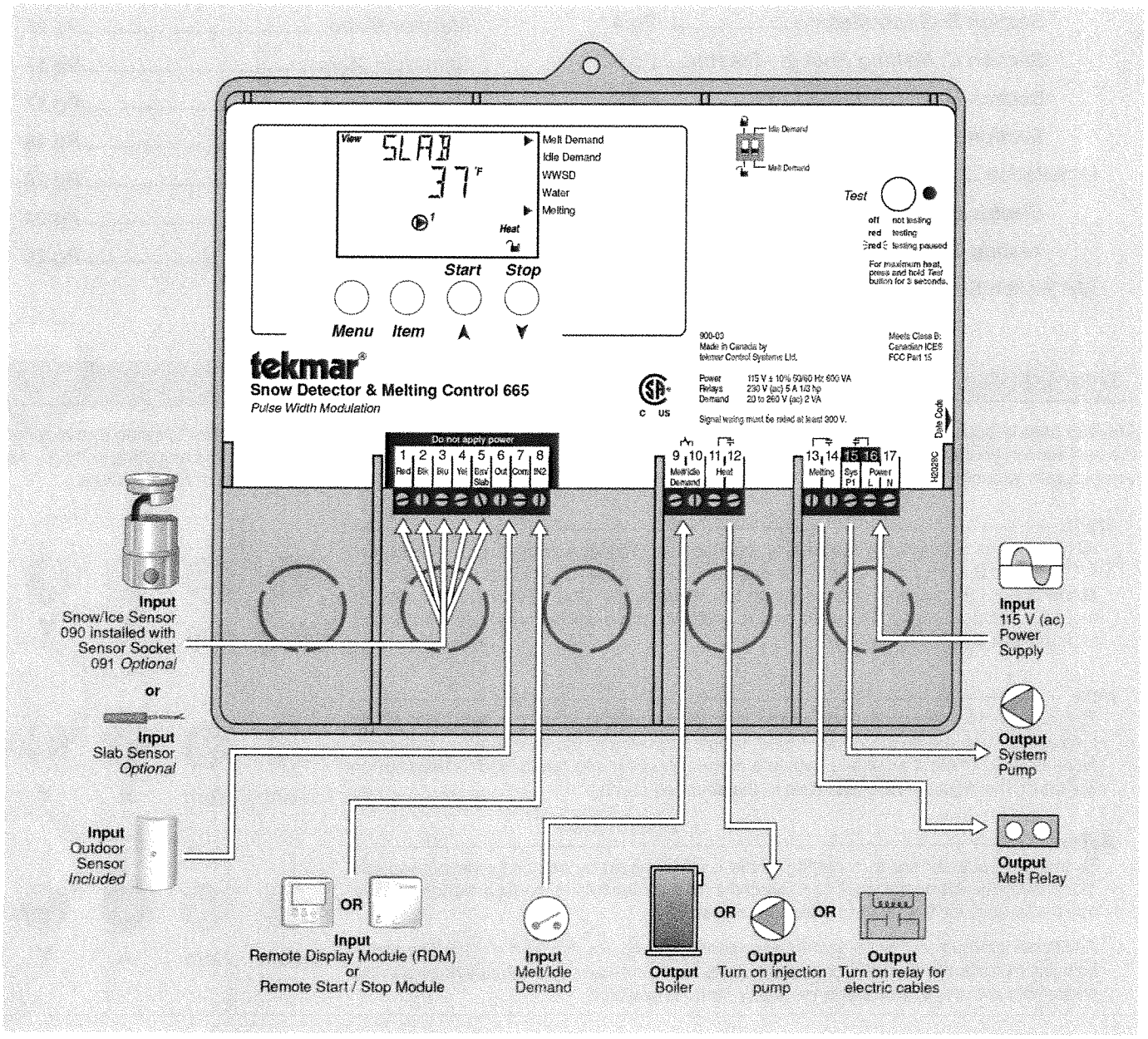
Snow Detector & Melting Control 665

D 665
12/08

The Snow Detector & Melting Control 665 is a microprocessor-based control which operates a single zone snow melting system. The control can operate automatically when a Snow / Ice Sensor 090 is installed or the user can manually enable and/or disable the system. When the control is in the melting mode, the slab is maintained at a "Melting" temperature through an on/off output which operates a contactor for electrical cables, a boiler, an injection pump or an injection valve. When the control is not in the melting mode, the melt system can either be shut down or it can be maintained at an idle temperature for faster response and improved safety. The 665 control includes a large Liquid Crystal Display (LCD) in order to view system status and operating information.

Additional features include:

- Temporary Idle
- Manual Override
- Adjustable Warm Weather Shut Down (WWSD)
- Cold Weather Cut Out (CWCO)
- Remote display and adjustment capabilities
- Test sequence to ensure proper component operation
- Pump and valve exercising
- CSA C US Certified (approved to applicable UL standards)



How To Use The Data Brochure

This brochure is organized into four main sections. They are: 1) *Sequence of Operation*, 2) *Installation*, 3) *Control Settings*, and 4) *Troubleshooting*. The Sequence of Operation section has 5 sub-sections. We recommend reading Section A: General of the *Sequence of Operation*, as this contains important information on the overall operation of the control. Then read to the sub-sections that apply to your installation.

The *Control Settings* section (starting at DIP Switch Settings) of this brochure describes the various items that are adjusted and displayed by the control. The control functions of each adjustable item are described in the *Sequence of Operation*.

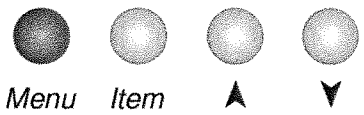
Table of Contents

User Interface

The 665 uses a Liquid Crystal Display (LCD) as the method of supplying information. You use the LCD in order to setup and monitor the operation of your system. The 665 has four push buttons (***Menu***, ***Item***, ▲ (Start), ▼ (Stop)) for selecting and adjusting settings. As you program your control, record your settings in the ADJUST Menu table which is found in the second half of this brochure.

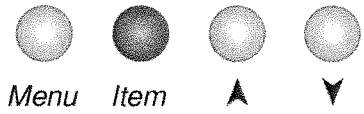
Menu

All of the items displayed by the control are organized into various menus. These menus are listed on the left hand side of the display (Menu Field). To select a menu, use the ***Menu*** button. By pressing and releasing the ***Menu*** button, the display will advance to the next available menu. Once a menu is selected, there will be a group of items that can be viewed within the menu.



Item

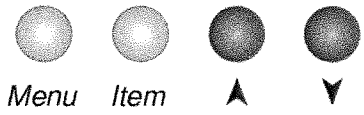
The abbreviated name of the selected item will be displayed in the item field of the display. To view the next available item, press and release the ***Item*** button. Once you have reached the last available item in a menu, pressing and releasing the ***Item*** button will return the display to the first item in the selected menu.



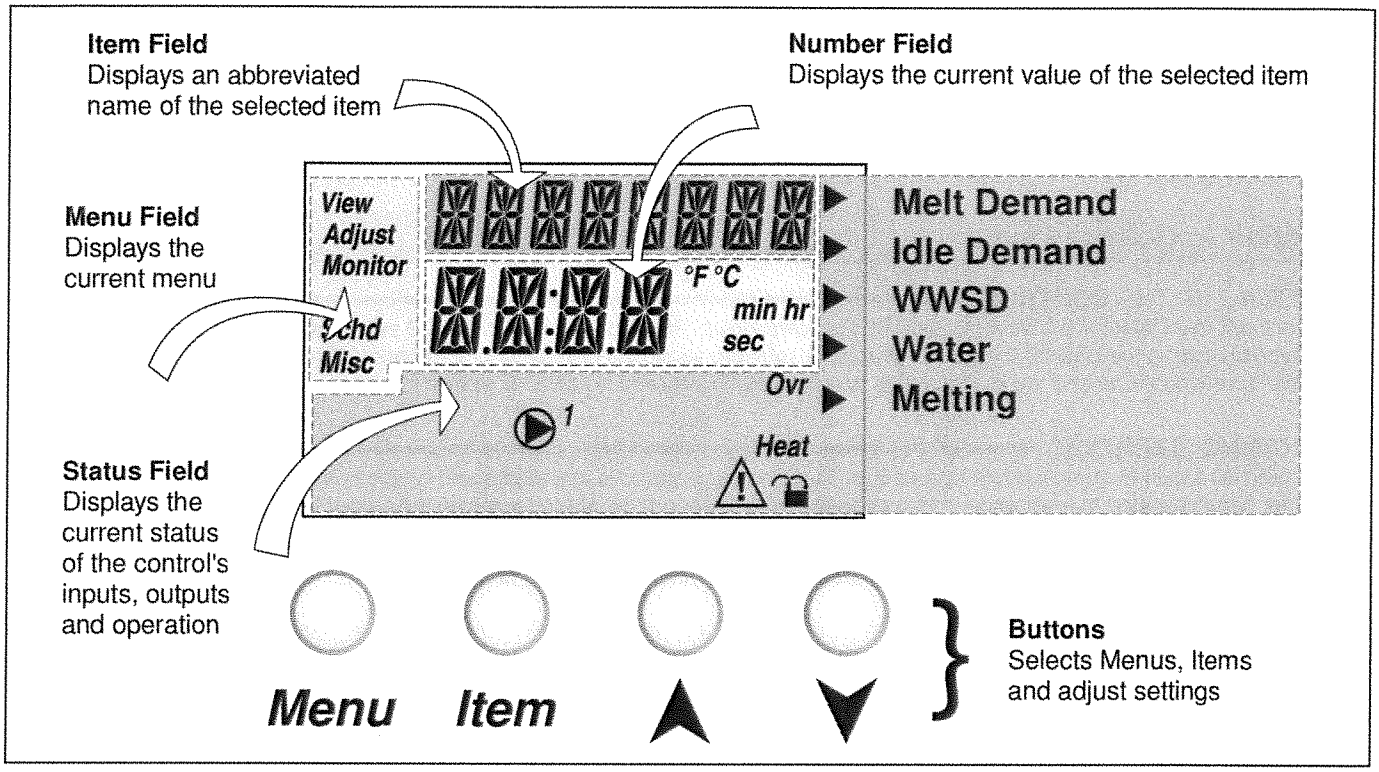
Adjust

To make an adjustment to a setting in the control, begin by selecting the appropriate menu using the ***Menu*** button. Then select the desired item using the ***Item*** button. Finally, use the ▲ and / or ▼ button to make the adjustment.

Additional information can be gained by observing the Status field of the LCD. The status field will indicate which of the control's outputs are currently active. Most symbols in the status field are only visible when the VIEW Menu is selected.



Display



Symbol Description

1	**Pump** Displays when the system pumps are operating.	▶	**Pointer** Displays the control operation as indicated by the text.
Ovr	**Override** Displays when the control is in override mode.	°F °C min hr sec	**°F, °C, min, hr, sec** Units of measurement.
⚠	**Warning** Displays when an error exists or when a limit has been reached.	Heat	**Heat** Displays when the Heat relay is turned on.
🔓	**Lock / Unlock** Displays when the access levels are locked or unlocked.		

Definitions

The following defined terms and symbols are used throughout this manual to bring attention to the presence of hazards of various risk levels, or to important information concerning the life of the product.

⚠ - Warning Symbol: Indicates presence of hazards which can cause severe personal injury, death or substantial property damage if ignored.

⧈ - Double insulated

INSTALLATION CATEGORY II - Local level, appliances

Sequence of Operation

Section A: General Operation

POWERING UP THE CONTROL

When the Snow Detector & Melting Control 665 is powered up, the control displays all LCD segments for 2 seconds, then the control type number in the LCD for 2 seconds. Next, the software version is displayed for 2 seconds. Finally, the control enters into the normal operating mode and the LCD defaults to displaying the current outdoor air temperature.

EXERCISING (EXERCISE)

The 665 has a built-in pump exercising function. The exercising period is adjustable and is factory set at 70 hours. If a pump output has not been operated at least once during every exercising period, the control turns on the output for 10 seconds. This minimizes the possibility of a pump or valve seizing during a long period of inactivity.

Note: The exercising function does not work if power to the control or pumps is disconnected.

Section B: Snow Melting

Section B1: General Snow Melting

WARM WEATHER SHUT DOWN (WWSD)

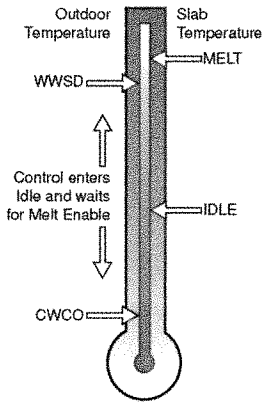
The control has a warm weather shut down that prevents the control from entering the melt or idle modes in order to conserve energy. While in WWSD, the word WWSD is displayed in the STATUS item in the VIEW menu and the WWSD pointer is on the display. The WWSD item in the ADJUST menu can be either set to Automatic or it can be set to a temperature.

Automatic (Auto)

When the WWSD is set to *AUTO*, the WWSD occurs when the slab temperature and the outdoor temperature exceed the *Melting* setting by 2°F (1°C). The control exits the WWSD when the slab or outdoor temperature falls to the *Melting* setting temperature.

Adjustable WWSD

When the WWSD is set to a temperature, the WWSD occurs when the outdoor air temperature exceeds the *WWSD* setting by 1°F (0.5°C) and when the slab temperature exceeds 34°F (1°C). The control exits WWSD when the outdoor air temperature falls 1°F (0.5°C) below the *WWSD* setting or if the slab temperature falls below 34°F (1°C). This allows the *Melting Temperature* setting to be set higher than the WWSD. This is useful where high slab temperatures are required to melt the snow or ice. A good example of this is installations using paving bricks on top of sand and concrete layers.



COLD WEATHER CUT OUT (CWCO)

Maintaining the system at either the melting or idling temperature during extremely cold temperatures can be expensive or impossible. The control turns the snow melting system off when the outdoor air temperature drops below the Cold Weather Cut Out (CWCO) temperature. While the control is in CWCO, the word CWCO is displayed in the STATUS item in the VIEW menu. The heater in the sensor is kept on during CWCO until the control detects moisture. If water is detected, the heater is turned off but the control retains the moisture detected information. When the outdoor temperature rises above the CWCO temperature, the control exits CWCO and if the Snow / Ice Sensor 090 detected moisture during CWCO, the control initiates Melting mode. If the control has been started prior to the CWCO, it resumes the Melting mode once the outdoor air temperature rises above the CWCO temperature.

RUNNING TIME (RUN TIME)

The running time is the length of time that the system operates once it has reached its slab target temperature. During the time that the system is approaching its slab target temperature, the RUN TIME does not decrease. Once the system reaches its slab target temperature, the RUN TIME begins counting down. When the RUN TIME reaches 0:00 as displayed in the Status item in the VIEW menu, the system has finished melting.

Note: The running time is only applicable when a manual melting enable signal starts the snow melting system. Refer to Section C1 for a description of a manual melting enable.

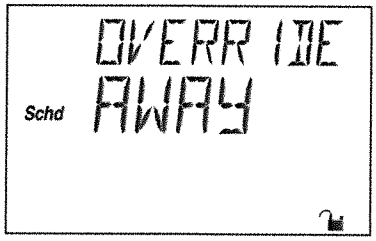
STATUS (STATUS)

While in the VIEW menu there are a number of items available to determine the current status of the system. To view the current status of the system, select the STATUS item in the VIEW menu.

- **STRT** — The word STRT is displayed after the snow melting system has been manually enabled. It is displayed until the zone reaches its slab target temperature. If the zone is at its slab target temperature, STRT is displayed for five seconds after the snow melting system has started operation. This is to verify that the control has entered into the Melting mode.
- **STOP** — The word STOP is displayed for five seconds after the snow melting system has been manually disabled. The word STOP is also displayed if either a Remote Start / Stop Module 039, Remote Display Module 040 or the ***Stop*** on the control stops the snow melting system and an external melt demand is still present.
- **IDLE** — The word IDLE is displayed as long as the zone is operating at its idling temperature.
- **"IDLE"** — The word IDLE is flashed on the display as long as the zone is operating in temporary idle.
- **EXT** — The word EXT is displayed when the RUN TIME has reached 0:00 and the control still has an external melt demand. In this situation, the zone continues melting until the melt demand is removed or the control is stopped.
- **DET** — The word DET is displayed after the snow melting system has been automatically enabled by the Snow / Ice Sensor 090 and the zone is at its slab target temperature. DET is also displayed once the control is manually enabled after automatic detection by the 090 and the running time has counted down to 0:00.
- **0:00 to 23:59 hr** — While the zone is up to temperature and melting, the remaining RUN TIME is displayed.
- **INF** — If an infinite RUN TIME is selected and the zone is melting, INF is displayed.
- **WWSD** — When the zone is in Warm Weather Shut Down, WWSD is displayed.
- **CWCO** — When the control is in Cold Weather Cut Out, CWCO is displayed.

SNOW MELTING OVERRIDE

If the *AWAY* setting is selected in the SCHEDULE menu, the snow melting system is shut down. Both the Melting and Idling temperatures are ignored as long as the control remains in the Away mode.

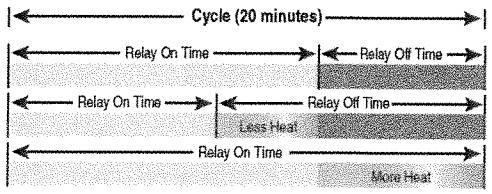


SYSTEM PUMP OPERATION (SYS P1)

The system pump (*Sys P1*) contact closes and remains closed as long as the system is either in the Melting or Idling mode. The system pump contact shuts off if the control is in CWCO, WWSD, or if there is no call for Melting or Idling.

HEAT CONTACT OPERATION

The control uses the *Heat* contact to control the temperature of the slab. When the control is either Melting or Idling, the *Heat* contact operates on a 20 minute cycle. If the slab requires more heat, the on time in each cycle is increased. If the slab requires less heat, the on time of each cycle is decreased. The *Heat* contact shuts off if the control is in Cold Weather Cut Out (CWCO), Warm Weather Shut Down (WWSD), or if there is no call for Melting or Idling.



MELTING CONTACT OPERATION

The *Melting* contact (terminals 13 and 14) closes and remains closed as long as the system is in the melting mode. This contact can be used as an external signal to indicate that the system is currently in the melting mode. This contact can also be used as a means of prioritizing or enabling multiple snow melting controls.

PURGE

The system pump (*Sys P1*) and zoning device continue to operate for 20 seconds after the last demand is removed. This purges the residual heat from the boiler(s) into the snow melting slab.

Section C: Melting Enable / Disable

Section C1
Snow Melting Enable

Section C2
Snow Melting Disable

Section C1: Snow Melting Enable

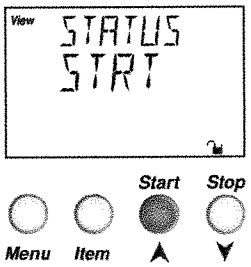
The snow melting system can be enabled manually or automatically. A melting enable signal applied to the control places the system into the melting mode. If a melting enable signal is applied once the system is already in the melting mode, the control responds to the last command received.

MANUAL MELTING ENABLE

A manual melting enable signal requires the user to manually start the snow melting system and can be provided from the ***Start*** button on the control, Remote Start / Stop Module 039, Remote Display Module 040, or an external melt demand.

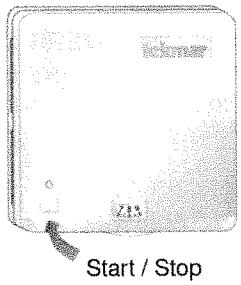
Start Button on the Control

The snow melting system is enabled by pressing the ***Start*** button on the control while in the VIEW menu. The control then displays the *RUN TIME* setting to allow the user to adjust it. Once the snow melting system is enabled, the word STRT is displayed for at least 5 seconds in the STATUS item while in the VIEW menu. If the ***Start*** button on the control is pressed while the system is already melting and up to temperature, the running time counter is reset to the *RUN TIME* setting.



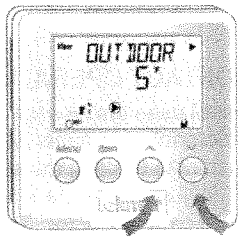
Remote Start / Stop Module 039

The snow melting system is enabled by pressing the button on the front of the 039. While the zone is coming up to temperature, a green indicator light flashes on the front of the 039. Once the zone is up to temperature and the RUN TIME is counting down, the green indicator light on the front of the 039 is on solid.



Remote Display Module 040

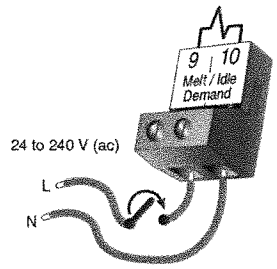
The snow melting system is enabled by pressing the ▲ button on the 040 while in the VIEW menu. The 040 then displays the *RUN TIME* setting to allow the user to adjust it. Once the snow melting system is enabled, the word STRT is displayed for at least 5 seconds in the STATUS item while in the VIEW menu.

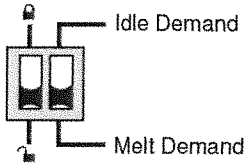


External Melt Demand (DIP switch set to Melt Demand)

The snow melting system is enabled when a voltage between 24 and 240 V (ac) is applied across the *Melt/Idle Demand* terminals (9 and 10). An external melt demand must be present for at least 4 seconds in order to start the snow melting system. If the RUN TIME reaches 0:00 and the external melt demand is still present, the control continues melting until the external melt demand is removed or the system is otherwise stopped.

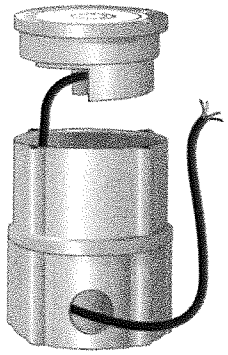
Note: This operation only occurs if the Idle Demand / Melt Demand DIP switch is set to the *Melt Demand* position.





AUTOMATIC MELTING ENABLE (Snow / Ice Sensor 090)

The 665 uses the Snow / Ice Sensor 090 to provide an automatic melting enable signal to start the snow melting system. The control continually monitors the 090 for the presence of moisture. Once moisture is detected, the *water* pointer is displayed in the LCD and the snow melting system is enabled.



Water Detection Sensitivity (SENSTVTY)

The 665 has a *Sensitivity* setting which compensates for varying outdoor conditions which could affect how the moisture detector in the 090 interprets the presence of moisture. This adjustable setting is available through the SENSTVTY item in the ADJUST menu of the control. As snow becomes contaminated with dirt, and as the sensor itself becomes dirty, the control may incorrectly indicate the presence of water. If this condition occurs, clean the surface of the sensor and / or turn down the SENSTVTY setting. If the snow in your area is very clean, the SENSTVTY setting may need to be increased before snow is detected. If AUTO is selected, the control automatically adjusts the sensitivity level used to detect moisture.

Section C2: Snow Melting Disable

The snow melting system can be disabled manually or automatically. A melting disable signal applied to the control takes the zone out of the melting mode. Once the snow melting system is disabled, the zone operates in the idling mode. The idling mode allows the zone to be operated at either a lower temperature or turned off.

MANUAL MELTING DISABLE

A manual melting disable signal requires the user to manually stop the snow melting system and can be provided from the ***Stop*** button on the control, Remote Start / Stop Module 039, Remote Display Module 040, or an external idle demand.

Stop Button on the Control

The ***Stop*** button on the control can be used to stop the snow melting system. The snow melting system is disabled by pressing the ***Stop*** button on the control while in the VIEW menu. Once the snow melting system is disabled, the word STOP is displayed for 5 seconds in the STATUS item of the appropriate zone while in the VIEW menu.

Remote Start / Stop Module 039

A Remote Start / Stop Module 039 can be used to stop the snow melting system. The snow melting system is disabled by pressing the button on the face of the 039. When the system is stopped, a solid Red Indicator Light is displayed on the face of the 039 for five seconds. If the snow melting system is disabled while there is still an external melt demand for snow melting, the 039 displays a solid red indicator light until the external demand is removed.

Remote Display Module 040

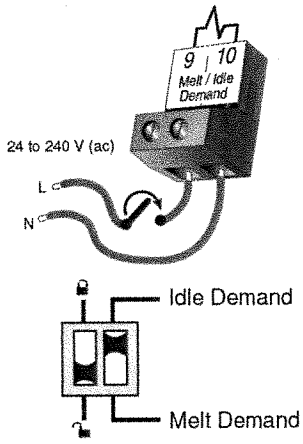
A Remote Display Module 040 can be used to stop the snow melting system. The snow melting system is disabled by pressing the ▼ button on the 040 while in the VIEW menu. Once the snow melting system is disabled, the word STOP is displayed for 5 seconds in the STATUS item while in the VIEW menu.

External Idle Demand (DIP switch set to Idle Demand)

The snow melting system is disabled when a voltage between 24 and 240 V (ac) is applied across the *Melt/Idle Demand* terminals (9 and 10). An external idle demand must be present for at least 4 seconds in order to stop the snow melting system.

Note: This operation only occurs if the Idle Demand / Melt Demand DIP switch is set to the Idle Demand position.

If the snow melting system is placed into Idling mode by an external idle demand, then a manual melting enable signal is applied, the idle demand is overridden until either the running time has expired, a stop signal is given, or the external idle demand is removed and reapplied.



AUTOMATIC MELTING DISABLE (Snow / Ice Sensor 090)

Once the 090 is dry, the *Water* pointer turns off in the LCD. The system slab temperature has to be at least the slab target temperature for a minimum of thirty minutes in order for the system to turn off. If a manual melting disable signal is applied the snow melting system turns off immediately.

Section D: Melting Operation

Section D1
General Melting Operation

Section D1: General Melting Operation

In order for the snow melting system to be started, one of the methods described in section D1 must be used. Once a melting enable signal is applied and the system is not in WWSD or CWCO, the Melting mode begins. When the control is in the Melting mode, the *Melting* pointer is visible in the VIEW menu. The *MELT* setting in the ADJUST menu sets the slab surface temperature. When the system is melting and the slab temperature is warming up to the slab target temperature, STRT is displayed in the STATUS item while in the VIEW menu. The system finishes melting when the slab temperature has been at least the slab target temperature for a period of time. This period of time is based on whether an automatic or manual melting enable signal starts the snow melting system.

If an automatic melting enable signal starts the snow melting system and the slab temperature reaches the slab target temperature, DET is displayed in the STATUS item while in the VIEW menu. The system continues to melt until the 090 becomes dry and any additional running time has expired. Once the Melting mode is complete, the system operates in the Idling mode.

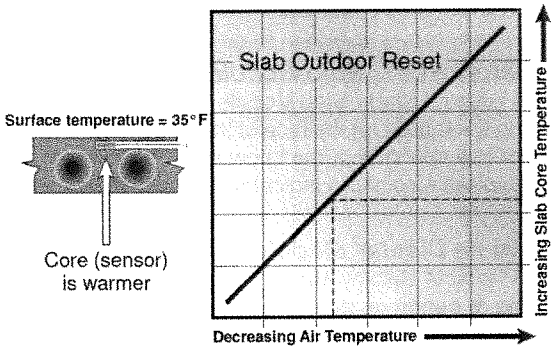
If a manual melting enable signal starts the snow melting system, the Running Time is displayed in the STATUS item while in the VIEW menu and begins counting down once the slab temperature reaches the slab target temperature. The system continues to melt until the running time counts down to 0:00 and there is no external melt demand. Once the Melting mode is complete, the system operates in the Idling mode. The table on page 14 describes how the control responds to enable and disable signals.

SLAB TEMPERATURE CONTROL

The 665 uses a snow / ice sensor or slab sensor to provide slab temperature control.

Slab Sensor

If a Slab Sensor is used, the control assumes that the sensor is approximately 1 inch below the surface of the snow melting slab. Since this point is closer to the source of the heat, this point is warmer than the surface of the slab. Therefore, the sensor must be maintained at a higher temperature in order to ensure that the surface of the slab is maintained at the correct temperature. The amount of temperature difference between the surface of the slab and the slab sensor changes with the outdoor temperature. Therefore, the slab core temperature is increased as the outdoor air temperature drops. The temperature displayed as SLAB is the temperature of the slab sensor.



Slab Surface Temperature is Constant

Snow / Ice Sensor 090

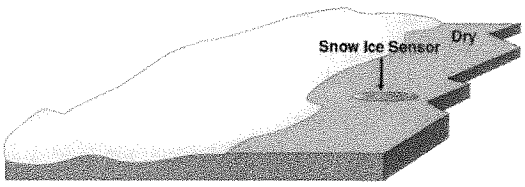
The slab temperature is displayed as SLAB in the VIEW menu. This temperature is calculated from the edge and center sensors built into the 090.

SLAB TARGET TEMPERATURE (SLB TRG)

The SLAB TRG temperature is determined from the *Melting* setting, or *Idle* setting and the outdoor air temperature. The control displays the temperature that it is currently trying to maintain at the slab sensor. If the control does not presently have a requirement for heat, it displays "– – –" in the STATUS item while in the VIEW menu.

ADDITIONAL MELTING TIME (ADD MELT)

In cases where areas of the snow melting system haven't completely melted after the melting mode has finished and the 090 is dry, the 665 has a function in which additional time can be added to melt the zone. This is an adjustable time through the ADD MELT item in the ADJUST menu of the control. The ADD MELT time is calculated into a running time and is displayed in the STATUS item while in the VIEW menu. Once the 090 becomes dry and the slab temperature is at least the slab target temperature, the ADD MELT time starts counting down.



Section E: Idling Operation

Section E1 General Idling Operation

Section E2 Temporary Idle

Section E1: General Idling Operation

When the snow melting system starts from a cold temperature, the time required for the system to reach the melting temperature may be excessive. To decrease this start up time, the 665 has an idling feature which can maintain the zone at a lower temperature. This feature is also useful for preventing frost and light ice formation. The *IDLING* setting in the ADJUST menu sets the slab surface temperature while the control is in the idling mode. When in the idling mode, IDLE is displayed in the STATUS item of the VIEW menu. If idling is not desirable, the *IDLING* setting may be set to *OFF.*

Section E2: Temporary Idle (TMPY IDL)

The temporary idle allows the control to enter the idle state for a set amount of time. If the snow ice detector does not detect snow during the temporary idle period, the control then leaves the idle state and returns to the OFF state. This is useful in applications where there is the possibility of snow and the slab can be pre-heated in order to have a short heat up time if snow is detected.

To enable a temporary idle, the *Temporary Idle* setting in the ADJUST menu must be set from OFF to the length of the temporary idle. The DIP Switch must be set to IDLE DEMAND and the IDLING must be set to a temperature. To activate a temporary idle, a voltage between 24 and 240 V (ac) must be applied across the *Melt/Idle Demand* terminals for at least 4 seconds.

When a *Temporary Idle* time is selected, the control has three available states: OFF, Temporary Idle, and Melting. The table below describes the action of the control:

Control State	Action	Result
OFF	External Idle Demand	Temporary Idle
OFF	Manual or Auto Melt Start	Melting
Melting	External Idle Demand	Melting
Melting	Manual or Auto Melt Start	Melting
Melting	Manual or Auto Melt Stop	OFF
Temporary Idle	Temporary Idle Expires	OFF
Temporary Idle	Manual or Auto Melt Start	Melting
Temporary Idle	Manual Melt Stop	OFF

Installation

CAUTION

Improper installation and operation of this control could result in damage to the equipment and possibly even personal injury. It is your responsibility to ensure that this control is safely installed to all applicable codes and standards. This electronic control is not intended for use as a primary limit control. Other controls that are intended and certified as safety limits must be placed into the control circuit. Do not open the control. Refer to qualified personnel for servicing. Opening voids warranty and can result in damage to the equipment and possibly even personal injury.

STEP ONE — GETTING READY

Check the contents of this package. If any of the contents listed are missing or damaged, please contact your wholesaler or tekmar sales representative for assistance.

Type 665 includes: One Snow Detector & Melting Control 665, One Outdoor Sensor 070, Data Brochures D 665, D 070, D 001, User Brochure U 665, and Application Brochure A 665.

Note: Carefully read the details of the Sequence of Operation to ensure that you have chosen the proper control for your application.

STEP TWO — MOUNTING THE BASE

Remove the control from its base by pressing down on the release clip in the wiring chamber and sliding the control away from it. The base is then mounted in accordance with the instructions in the Data Brochure D 001.

STEP THREE — ROUGH-IN WIRING

All electrical wiring terminates in the control base wiring chamber. The base has standard 7/8" (22 mm) knockouts which accept common wiring hardware and conduit fittings. Before removing the knockouts, check the wiring diagram and select those sections of the chamber with common voltages. Do not allow the wiring to cross between sections as the wires will interfere with safety dividers which should be installed at a later time.

- Power must not be applied to any of the wires during the rough-in wiring stage.
- All wires are to be stripped to a length of 3/8" (9mm) to ensure proper connection to the control.
- Install the Outdoor Sensor 070, Boiler Sensor 071 and Mixing Sensor(s) 071 according to the installation instructions in the Data Brochure D 070 and run the wiring back to the control.
- Install the Snow / Ice Sensor 090 according to the installation instructions in the Data Brochure D 090 and run the wiring back to the control. See Data Brochure D 090 for very important details on sensor location and installation.
- If a Slab Sensor is used, install the slab sensor according to the installation instructions in the Data Brochure D 079 and run the wiring back to the control. See page 8 for very important details on sensor location and installation.
- If a Remote Display Module (RDM) 040 is used, install the RDM according to the installation instructions in the Data Brochure D 040 and run the wiring back to the control.
- If a Remote Start / Stop Module 039 is used, install the module according to the installation instructions in the Data Brochure D 039 and run the wiring back to the control.
- Run wire from other system components (pumps, boiler, etc.) to the control.
- Run wires from the 115 V (ac) power to the control. Use a clean power source with a minimum 15 A circuit to ensure proper operation. Multi-strand 16 AWG wire is recommended for all 115 V (ac) wiring due to its superior flexibility and ease of installation into the terminals.

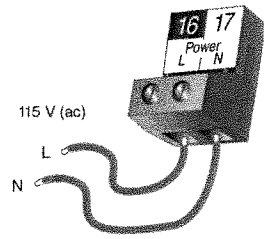
STEP FOUR — ELECTRICAL CONNECTIONS TO THE CONTROL

The installer should test to confirm that no voltage is present at any of the wires. Push the control into the base and slide it down until it snaps firmly into place.

⚠ *Powered Input Connections*

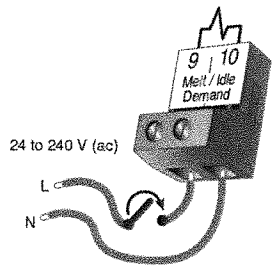
115 V (ac) Power

Connect the 115 V (ac) power supply to the *Power L* and *Power N* terminals (16 and 17). This connection provides power to the microprocessor and display of the control. As well, this connection provides power to the *Sys P1* terminal (15) from the *Power L* terminal (16).



Melt / Idle Demand

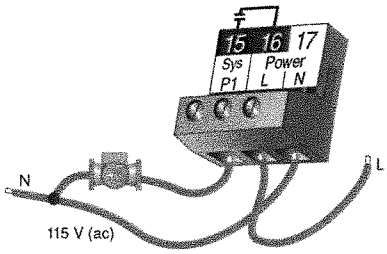
To generate a melt demand or idle demand, a voltage between 24 V (ac) and 240 V (ac) must be applied across the *Melt / Idle Demand* terminals (9 and 10).



⚠ *Output Connections*

System Pump Contact (Sys P1)

The *Sys P1* output terminal (15) on the 665 is a powered output. When the relay in the 665 closes, 115 V (ac) is provided to the *Sys P1* terminal (15) from the *Power L* terminal (16). To operate the system pump, connect one side of the system pump circuit to terminal and the second side of the pump circuit to the neutral (N) side of the 115 V (ac) power supply.



Melting Contact

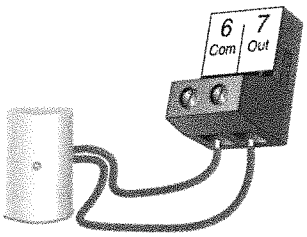
The *Melting* terminals (11 and 12) are an isolated output in the 665. There is no power available on these terminals from the control. These terminals are used as a switch to make or break an external circuit.

⚠ *Sensor and Unpowered Input Connections*

Do not apply power to these terminals as this will damage the control.

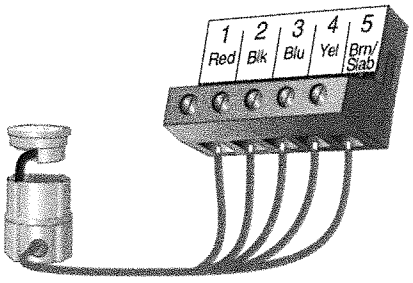
Outdoor Sensor

Connect the two wires from the Outdoor Sensor 070 to the *Out* and *Com* terminals (6 and 7). The outdoor sensor is used by the 665 to measure the outdoor air temperature.



EITHER: Snow / Ice Sensor 090

Connect the red wire from the sensor cable to the *Red* terminal (1), connect the black wire from the sensor cable to the *Blk* terminal (2), connect the blue wire from the sensor cable to the *Blu* terminal (3), connect the yellow wire from the sensor cable to the *Yel* terminal (4) and connect the brown wire from the sensor cable to the *Brn / Slab* terminal (5). The snow / ice sensor is used by the 665 to measure the slab surface temperature of the zone. This sensor must be installed flush with the slab surface and 1/2 way between the heating pipes. See Data Brochure D 090 for installation instructions regarding the Snow / Ice Sensor 090 and Sensor Socket 091



OR: Slab Sensor

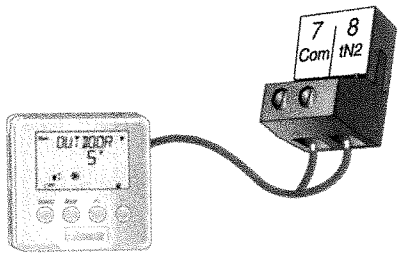
If a Snow / Ice Sensor 090 is not used, a slab sensor can be used. If a slab sensor is used, connect the two wires from the slab sensor to the *Blk* and *Brn / Slab* terminals (2 and 5). The slab sensor is used by the 665 to measure the slab temperature of the zone.

Note: Proper sensor placement is critical for correct operation of the 665 control. The slab sensor must be installed 1/2 way between the heating pipes and 1" (25 mm) below the surface of the slab. Although the sensor can be installed directly into the slab, we recommend that the sensor be installed in tubing or conduit in such a manner that the sensor can be removed and replaced in case of failure.

tekmar Net™ (tN2) Device

A Remote Display Module (RDM) 040 or Remote Start / Stop Module 039 can be connected to the tekmar *Net™* (tN2) input. Connect the *Com* terminal from the appropriate tN2 device to the *Com* terminal (7) on the 665. Connect the *tN2* terminal from the appropriate tN2 device to the *tN2* terminal (8) on the 665.

Note: The wires from the RDM and Remote Start / Stop Module are polarity sensitive. The tN2 device does not operate correctly if the wires are reversed.



STEP FIVE — TESTING THE WIRING

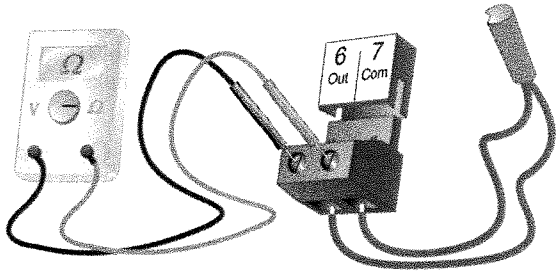
Each terminal block must be unplugged from its header on the control before power is applied for testing. To remove the terminal block, pull straight down from the control.

The following tests are to be performed using standard testing practices and procedures and should only be carried out by properly trained and experienced persons.

A good quality electrical test meter, capable of reading from at least 0 – 300 V (ac) and at least 0 – 2,000,000 Ω, is essential to properly test the wiring and sensors.

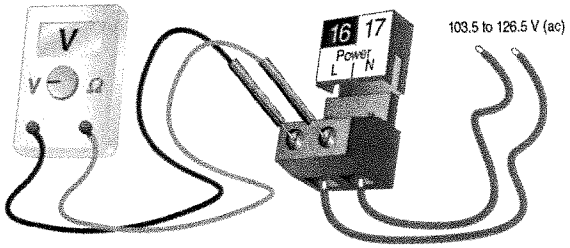
⚠ *Test The Sensors*

In order to test the sensors, the actual temperature at each sensor location must be measured. A good quality digital thermometer with a surface temperature probe is recommended for ease of use and accuracy. Where a digital thermometer is not available, a spare sensor can be strapped alongside the one to be tested and the readings compared. Test the sensors according to the instructions in the Data Brochure D 070, D 079 or D 090.



⚠ *Test The Power Supply*

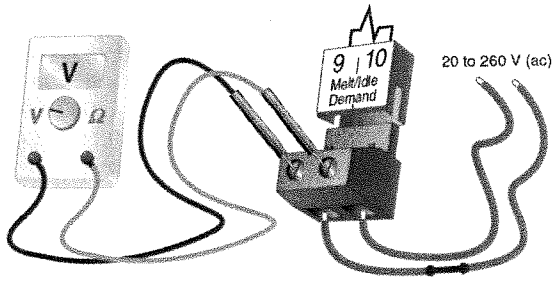
Make sure exposed wires and bare terminals are not in contact with other wires or grounded surfaces. Turn on the power and measure the voltage between the *Power L* and *Power N* terminals (16 and 17) using an AC voltmeter, the reading should be between 103.5 and 126.5 V (ac).



⚠ *Test The Powered Inputs*

Melt / Idle Demand

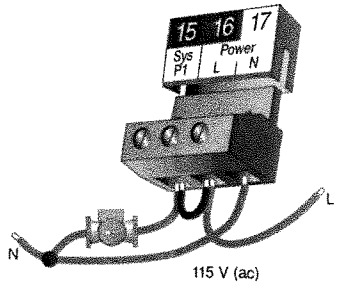
If a Melt/Idle demand is used, measure the voltage between the *Melt/Idle Demand* terminals (9 and 10). When the melting or idling device calls for heat, you should measure between 20 and 260 V (ac) at the terminals. When the melting or idling device is off, you should measure less than 5 V (ac).



⚠ *Test The Outputs*

System Pump (Sys P1)

If a system pump is connected to the *Sys P1* terminal (15), make sure that power to the terminal block is off and install a jumper between the *Sys P1* and *Power L* terminals (15 and 16). When power is applied to the *Power L* and *Power N* terminals (16 and 17), the system pump should start. If the pump does not turn on, check the wiring between the terminal block and pump and refer to any installation or troubleshooting information supplied with the pump. If the pump operates properly, disconnect the power and remove the jumper.



Heat Contact

If a zone pump or zone valve is connected to *Heat* terminals (11 and 12), make sure power to the pump or valve circuit is off and install a jumper between the *Heat* terminals (11 and 12). When the circuit is powered up, the zone pump should turn on or the valve should open completely. If no response occurs, check the wiring between the terminal and the pump or valve and refer to any installation or troubleshooting information supplied with these devices.

Melting

If a device is connected to the *Melting* terminals (13 and 14), make sure power to the circuit is off, and install a jumper between the terminals. When the circuit is powered up, the device should operate. If the device does not operate, refer to any installation or troubleshooting information supplied with the device. If the device operates properly, disconnect the power and remove the jumper.

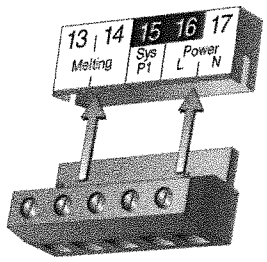
⚠ *Connecting The Control*

Make sure all power to the devices and terminal blocks is off, and remove any remaining jumpers from the terminals.

Reconnect the terminal blocks to the control by carefully aligning them with their respective headers on the control, and then pushing the terminal blocks into the headers. The terminal blocks should snap firmly into place.

Install the supplied safety dividers between the unpowered sensor inputs and the powered wiring chambers.

Apply power to the control. The operation of the control on power up is described in the Sequence of Operation section of the brochure.

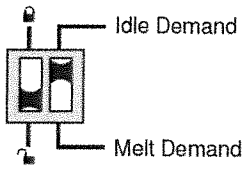


Cleaning

The control's exterior can be cleaned using a damp cloth. Moisten cloth with water and wring out prior to wiping control. Do no use solvents or cleaning solutions.

DIP Switch Settings

The DIP switch settings on the control are very important and should be set to the appropriate settings prior to making any adjustments to the control through the User Interface. The DIP switch settings change the items that are available to be viewed and / or adjusted in the User Interface.



LOCK / UNLOCK (FACTORY SETTING IS UNLOCK)

The Lock / Unlock DIP switch is used to lock and unlock the access level of the control and tekmar Net™ tN2 device. Once locked, access levels can not be changed. To determine if the control is currently locked or unlocked, a small segment representing a padlock is viewed in the bottom right hand corner of the display. When the padlock is closed, the access level cannot be changed.

To change the access level, set the DIP switch to the unlocked, or down position. The current access level of the control or tekmar Net™ tN2 device is viewed in its Miscellaneous (*Misc*) menu. While viewing the access level, use the ▲ and ▼ keys to select between the Limited (LTD), User (USER), Installer (INST) or Advanced (ADV) access levels.

To lock the access level, select the appropriate access level in the Miscellaneous (Misc) and move the DIP switch from the unlocked position to the locked position. As long as the DIP switch is in the locked position, the access level of the control or tekmar Net™ tN2 device can no longer be viewed or adjusted in its Miscellaneous (*Misc*) menu.

IDLE DEMAND / MELT DEMAND (FACTORY SETTING IS MELT DEMAND)

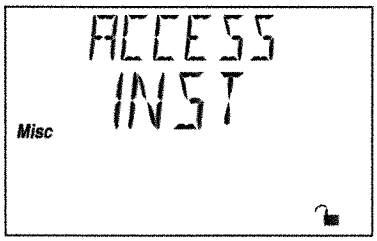
The Idle Demand / Melt Demand DIP switch is used for melting and idling operation. The position of the DIP switch determines what the *Melt/Idle Demand* terminals (9 and 10) are used for. When the DIP switch is set to the Melt Demand position, the *Melt/Idle Demand* terminals (9 and 10) are used to place the snow melting system into melting mode.

When the DIP switch is set to the Idle Demand position, the *Melt/Idle Demand* terminals (9 and 10) are used to force the snow melting system into idling mode.

Access Levels

The tekmar Snow Detector & Melting Control 665 comes with four Access Level settings. These Access Levels restrict the number of Menus, Items and Adjustments that can be accessed by the user. The four access levels are Limited (LTD), User (USER), Installer (INST) and Advanced (ADV).

The access level of the control is found in the Miscellaneous (Misc) menu when the Lock / Unlock DIP switch is set to the Unlocked position. In the Advanced access level, all of the control settings are available to the user. In the User access level, only a few of the menus and items are available. The Limited access level is the most restricted of them all. The control's factory setting is Installer (INST). This access level is sufficient for the normal set up of the control. Once the control is set up, the appropriate access level should be selected for the people that deal with the control on a regular basis.



665 View Menu (1 of 1)

Item Field	Section	Access Level: LTD	USER	INST	ADV	Description	Range
OUTDOOR		•	•	•	•	**Outdoor** Current outdoor air temperature as measured by the outdoor sensor.	-67 to 149°F (-55 to 65°C)
SLAB TRG	D1			•	•	**Slab Target** Slab sensor target temperature.	---, 20 to 110°F (---, -7 to 43°C)
SLAB	D1		•	•	•	**Slab** Current slab sensor temperature.	-58 to 167°F (-50 to 75°C)
STATUS	B1	•	•	•	•	**Status** Operating status.	STRT, STOP, IDLE, EXT, 0:00 to 23:59 hr, ----, INF, WWSD, CWCO, DET, IDLE

Item Field	Section	Access Level: LTD	USER	INST	ADV	Description	Range	Actual Setting
RUN TIME	B1	•	•	•	•	**Run Time** The time for which a zone is operated once it has reached its melting temperature. This item cannot be viewed if a Remote Start / Stop Module 039 has been connected.	0:30 to 17:00 hr, INF (Infinity) Default = 4:00 hr	
ADD MELT	D1				•	**Add Melt** The additional time for which a zone is operated once the Snow / Ice Sensor 090 becomes dry. **090 is present**	0:00 to 6:00 hr Default = 0:30 hr	
SENSTVTY	C1		•	•	•	**Sensitivity** Sensitivity of water detection of the Snow / Ice Sensor 090. **090 is present**	AUTO, 20 to 80% Default = AUTO	
MELTING	D1		•	•	•	**Melting** The desired slab surface temperature while in the Melting mode.	32 to 95°F (0 to 35°C) Default = 36°F (2°C)	
IDLING	E1			•	•	**Idling** The desired slab surface temperature while in the Idling mode.	OFF, 20 to 95°F (OFF, -7 to 35°C) Default = OFF	
TMPY IDL	A				•	**Temporary Idle** Time for which the temporary idle is active.	OFF, 0:30 to 40:00 hr Default = OFF	
WWSD	B			•	•	**WWSD** Warm Weather Shut Down. Slab must exceed 34°F to enter WWSD.	AUTO, 32 to 95°F (AUTO, 0 to 36°C) Default = AUTO	
CWCO	B1			•	•	**CWCO** The Cold Weather Cut Out temperature for the snow melting system.	OFF, -30 to 50°F (OFF, -34 to 10°C) Default = 10°F (-12°C)	
EXERCISE	A				•	**Exercise** The frequency with which the control exercises the pumps and valves that are operated by the control.	30 to 240 hours, (in 10 hour steps) Default = 70 hr	

665 **Monitor** Menu (1 of 1)

Note: To clear the recorded information in the specific item field, press and hold ▲ and ▼.

Item Field	Access Level LTD	USER	INST	ADV	Description	Range
OUT HI	•	•	•	•	**Outdoor High** The highest recorded outdoor air temperature since this item was last cleared.	-67 to 149°F (-55 to 65°C)
OUT LO	•	•	•	•	**Outdoor Low** The lowest recorded outdoor air temperature since this item was last cleared.	-67 to 149°F (-55 to 65°C)
SLAB HI		•	•	•	**Slab High** The highest recorded temperature at the slab sensor since this item was last cleared.	-58 to 167°F (-50 to 75°C)
SLAB LO		•	•	•	**Slab Low** The lowest recorded temperature at the slab sensor since this item was last cleared.	-58 to 167°F (-50 to 75°C)
SYS PUMP			•	•	**System Pump** The total number of system pump (Sys P1) running hours since this item was last cleared.	0 to 9999 hr
HEAT			•	•	**Heat** The total number of running hours of the *Heat* contact since this item was last cleared.	0 to 9999 hr
HEAT CYC				•	**Heat Cycle** The total number of cycles of the *Heat* contact since this item was last cleared. This item can be used in conjunction with the Heat item to determine the average cycle length of the *Heat* contact.	0 to 9999 hr
NO HEAT				•	**No Heat** This item is an adjustable warning. If the slab temperature does not reach its slab target temperature within the set time, the control displays a warning message.	1 to 24 hr, OFF Default = OFF
COP				•	**Cop** The number of times that the microprocessor in the control has reset since this item was last cleared. The control will reset itself if it has experienced some form of interference that has disrupted its operation. This can be used to give an indication of the quality of the electrical environment that the control has been installed in.	0 to 255
NON-COP				•	**Non-Cop** The number of times that the control has been powered up since this item was last cleared. This number will increase if there is a lowering of the input voltage beyond the control's usable range. This item can be used as an indication of the quality of the power source.	0 to 255
tN2 COMM				•	**tN2 Communication** The number of times that a communication error has been detected between the control and either an RDM or Remote Start / Stop Module since this item was last cleared. If the wires between the control and the tekmar Net™ tN2 device are run in a noisy electrical environment, this can cause interference in the communication between the control and the tN2 device.	0 to 255

665 **Schd** (Schedule) Menu (1 of 1)

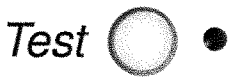
Item Field	Section	Access Level: LTD	USER	INST	ADV	Description	Range
OVERRIDE	B1	•	•	•	•	**Override** The setback override that is in effect for the snow melting system.	NONE, AWAY (Ovr) Default = NONE

665 **Misc** (Miscellaneous) Menu (1 of 1)

Item Field	Access Level: LTD	USER	INST	ADV	Description	Range
UNITS	•	•	•		**Units** The units of measure that all of the temperatures are to be displayed in by the control.	°F, °C Default = °F
BACKLITE	•	•	•		**Backlite** The operating mode for the back lighting on the LCD as well as time of keypad inactivity until the control automatically returns to the default display.	OFF, 30 sec, ON Default = ON
ACCESS	•	•	•	•	**Access** The access level that is to be used by the control. **DIP switch = *Unlock***	ADV, INST, USER, LTD Default = INST

Testing the Control

The Snow Detector & Melting Control 665 has a built-in test routine which is used to test the main control functions. The 665 continually monitors the sensors and displays an error message whenever a fault is found. See the following pages for a list of the 665's error messages and possible causes. When the ***Test*** button is pressed, the test light is turned on. The individual outputs and relays are tested in the following test sequence.



off not testing
red testing
red testing paused

TEST SEQUENCE

Each step in the test sequence lasts 10 seconds.

During the test routine, the test sequence is paused by pressing the ***Test*** button. While paused, the control displays the testing step as well as the word PAUS. If the ***Test*** button is not pressed again for 5 minutes while the test sequence is paused, the control exits the entire test routine. If the test sequence is paused, the ***Test*** button can be pressed again to advance to the next step. This can also be used to rapidly advance through the test sequence. To reach the desired step, repeatedly press and release the ***Test*** button until the appropriate device and segment in the display turn on

Step 1 The system pump contact (*Sys P1*) is turned on for 10 seconds.

Step 2 The *Heat* contact is turned on for 10 seconds. After 10 seconds, the *Heat* relay and the *Sys P1* relay are turned off.

Step 3 The *Melting* contact is turned on for 10 seconds. After 10 seconds, the melting relay is turned off.

MAX HEAT

The Snow Detector & Melting Control 665 has a function called Max Heat. In this mode, the 665 turns on and operates the system up to the maximum set temperatures, and the mixing device at the set percentage. The control continues to operate in this mode for up to 24 hours or until either the ***Item***, ***Menu*** or ***Test*** button is pressed. This mode may be used for running all circulators during system start-up in order to purge air from the piping. To enable the Max Heat feature, use the following procedure.

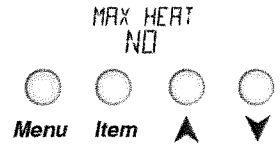
1) Press and hold the ***Test*** button for more than 3 seconds. At this point, the control displays the words MAX HEAT and the word NO.

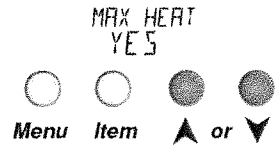
2) Using the ▲ or ▼ buttons, select the word YES. After 3 seconds, the control flashes the word MANUAL and the number 100. This number represents the % on time of the Heat relay during each 20 minute cycle.

3) Set the desired Heat relay % on time by using the ▲ and / or ▼ buttons on the control.

4) To cancel the Max Heat mode, press either the ***Item***, ***Menu***, or ***Test*** button.

5) Once the Max Heat mode has either ended or is cancelled, the control resumes normal operation.





Troubleshooting

When troubleshooting any heating system, it is always a good idea to establish a set routine to follow. By following a consistent routine, many hours of potential headaches can be avoided. Below is an example of a sequence that can be used when diagnosing or troubleshooting problems in a hydronic heating system.

Establish the Problem

Establish the problem. Get as much information from the customer as possible about the problem. Is there too much heat, not enough heat, or no heat? Is the problem only in one particular zone or area of the building or does the problem affect the entire system? Is this a consistent problem or only intermittent? How long has the problem existed for? This information is critical in correctly diagnosing the problem.

Understanding the Sequence of Operation

Understand the sequence of operation of the system. If a particular zone is not receiving enough heat, which pumps or valves in the system must operate in order to deliver heat to the affected zone? If the zone is receiving too much heat, which pumps, valves or check valves must operate in order to stop the delivery of heat?

Use the Test Routine

Press the ***Test*** button on the control and follow the control through the test sequence as described in the Testing section. Pause the control as necessary to ensure that the correct device is operating as it should.

Sketch the Piping in the System

Sketch the piping of the system. This is a relatively simple step that tends to be overlooked, however it can often save hours of time in troubleshooting a system. Note flow directions in the system paying close attention to the location of pumps, check valves, pressure bypass valves and mixing valves. Ensure correct flow direction on all pumps. This is also a very useful step if additional assistance is required.

Document the Control

Document the control for future reference. Before making any adjustments to the control, note down all of the items that the control is currently displaying. This includes items such as error messages, current temperatures and settings, and which devices should be operating as indicated by the LCD. This information is an essential step if additional assistance is required to diagnose the problem.

Isolate the Problem

Isolate the problem between the control and the system. Now that the sequence of operation is known and the system is sketched, is the control operating the proper pumps and valves at the correct times? Is the control receiving the correct signals from the system as to when it should be operating? Are the proper items selected in the menus of the control for the device that is to be operated?

Test the Contacts, Voltages and Sensors

Test the contacts, voltages and sensors. Using a multimeter, ensure that the control is receiving adequate voltage to the power terminals and the demand terminals as noted in the technical data. Use the multimeter to determine if the internal contacts on the control are opening and closing correctly. Follow the instructions in the Testing the Wiring section to simulate closed contacts on the terminal blocks as required. Test the sensors and their wiring as described in the sensor Data Brochures.

Monitor the System

Monitor the system over a period of time. Select the applicable items in the MONITOR menu of the control and reset them to zero. Allow the system and the control to operate over a known period of time and then record the Monitor items. Use this information to help diagnose any remaining problems.

665 **Error** Messages (1 of 2)

Error Displayed	Description of Error
CTRL ERR EE W	The control was unable to store a piece of information into its EEPROM. This error can be caused by a noisy power source. The control will display the error message and will continue to operate as normal. Pressing either the ***Menu*** or ***Item*** button will clear this error.
CTRL ERR ADJS	The control was unable to read a piece of information stored in the ADJUST menu. Because of this, the control was required to load the factory settings into all of the items in the ADJUST menu. The control will stop operation until all of the items available in the ADJUST menu of the control have been checked by the user or installer. ***Note:*** Access level must be ADV in order to clear the error.
CTRL ERR MNTR	The control was unable to read a piece of information stored in the MONITOR menu. Because of this, the control was required to load the factory settings into all of the items in the MONITOR menu. The control will continue to display the error message until all of the items available in the MONITOR menu of the control have been checked by the user or installer. ***Note:*** Access level must be ADV in order to clear the error.
CTRL ERR SCHD	The control was unable to read a piece of information stored in the SCHEDULE menu. Because of this, the control was required to load the factory settings into all of the items in the SCHEDULE menu. The control will continue to display the error message until all of the items available in the SCHEDULE menu of the control have been checked by the user or installer. ***Note:*** Access level must be ADV in order to clear the error.
CTRL ERR MISC	The control was unable to read a piece of information stored in the MISCELLANEOUS menu. Because of this, the control was required to load the factory settings into all of the items in the MISCELLANEOUS menu. The control will continue to display the error message until all of the items available in the MISCELLANEOUS menu of the control have been checked by the user or installer. ***Note:*** Access level must be ADV in order to clear the error.
tN2 TYPE	An incorrect device has been connected to the *tekmar Net™ tN2* input terminal. Once the problem has been corrected, press either the ***Menu*** or ***Item*** button to clear the error message from the control.
tN2 SHRT	A short circuit has been read between the *tN2* terminal and a *Com* terminal on the control. Either the wires leading to the tN2 device are shorted or the polarity of the wires is reversed. Determine the cause and remove the short. To clear this error, press either the ***Menu*** or ***Item*** button.
OUTDOOR SHRT	The control is no longer able to read the outdoor sensor due to a short circuit. In this case the control assumes an outdoor temperature of 32°F and continues operation. Locate and repair the problem as described in the Data Brochure D 070. To clear the error message from the control after the sensor has been repaired, press either the ***Menu*** or ***Item*** button.
OUTDOOR OPEN	The control is no longer able to read the outdoor sensor due to an open circuit. In this case the control assumes an outdoor temperature of 32°F and continues operation. Locate and repair the problem as described in the Data Brochure D 070. To clear the error message from the control after the sensor has been repaired, press either the ***Menu*** or ***Item*** button.
SLAB SHRT	The control is no longer able to read the slab sensor due to a short circuit. In this case, if the control is currently in the Melting mode, the control turns off the Heat relay. Locate and repair the problem as described in the Data Brochure D 079 or D 090. To clear the error message from the control after the sensor has been repaired, press either the ***Menu*** or ***Item*** button.

665 **Error** Messages (2 of 2)

Error Displayed	Description of Error
SLAB OPEN	The control is no longer able to read the slab sensor due to an open circuit. In this case, if the control is currently in the Melting mode, the control will turn off the Heat relay. Locate and repair the problem as described in the Data Brochure D 079 or D 090. To clear the error message from the control after the sensor has been repaired, press either the ***Menu*** or ***Item*** button.
YELLOW SHRT	The control is no longer able to read the yellow sensor due to a short circuit. In this case, the control will turn off the heater in the Snow / Ice Sensor 090. Check the 090 yellow temperature sensor (*black* and *yellow* wires, terminals 2 and 4), and the wiring from the terminal plug to the sensor. To clear the error message from the control after the sensor has been repaired, press either the ***Menu*** or ***Item*** button.
YELLOW OPEN	The control is no longer able to read the yellow sensor due to an open circuit. In this case, the control will turn off the heater in the Snow / Ice Sensor 090. Check the 090 yellow temperature sensor (*black* and *yellow* wires, terminals 2 and 4), and the wiring from the terminal plug to the sensor. To clear the error message from the control after the sensor has been repaired, press either the ***Menu*** or ***Item*** button.
BLUE SHRT	The control is no longer able to read the water detection circuit due to a short circuit. In this case, if the control is currently in the Melting mode, the control will finish the snow melting cycle. The snow melting system can only be operated using an external melt demand, Remote Display Module 040, Remote Start / Stop Module 039 or the ***Start*** button on the control. Otherwise, the control will operate as if the Snow / Ice Sensor 090 is dry. Check the 090 water detection circuit (*black* and *blue* wires, terminals 2 and 3) according to the Data Brochure D 090. To clear the error message from the control after the error has been repaired, press either the ***Menu*** or ***Item*** button.
BLUE OPEN	The control is no longer able to read the water detection circuit due to an open circuit. In this case, if the control is currently in the Melting mode, the control will finish the snow melting cycle. The snow melting system can only be operated using an external melt demand, Remote Display Module 040, Remote Start / Stop Module 039 or the ***Start*** button on the control. Otherwise, the control will operate as if the Snow / Ice Sensor 090 is dry. Check the 090 water detection circuit (*black* and *blue* wires, terminals 2 and 3) according to the Data Brochure D 090. To clear the error message from the control after the error has been repaired, press either the ***Menu*** or ***Item*** button.
RED ERR	The control is reading a heater malfunction. In this case, unless the yellow sensor becomes too hot, the heater continues to try to operate. The snow melting system can only be operated using an external melt demand, Remote Display Module 040, Remote Start / Stop Module 039 or the ***Start*** button on the control. Check the 090 heater circuit (*red* and *black* wires, terminals 1 and 2) according to the Data Brochure D 090. Make sure the yellow and brown wires are not reversed. To clear the error message from the control after the error has been repaired, press either the ***Menu*** or ***Item*** button.
CTRL ERR HOT	The control's internal sensor is too hot (Above 160°F (71°C)). In this case, the control will turn off the heater in the Snow / Ice Sensor 090 until the control cools off. To clear the error message from the control after the error has been repaired, press either the ***Menu*** or ***Item*** button.
NO HEAT SLAB	This warning message will be displayed if the Slab temperature does not increase to the SLAB TRG temperature while the system is melting within a set time. The time limit is set using the NO HEAT item in the MONITOR menu. To clear this warning, press either the ***Menu*** or ***Item*** button.

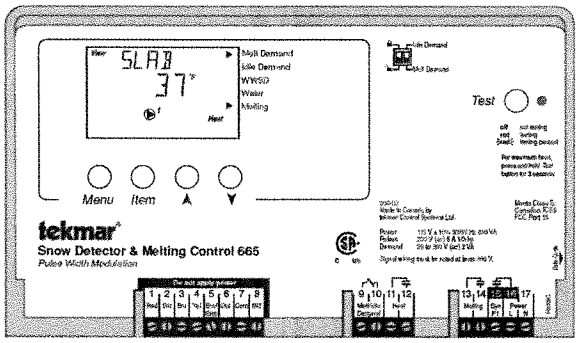
Notes

Notes

Technical Data

Snow Detector & Melting Control 665 *Pulse Width Modulation*

Literature	—	D 665, A 665's, U 665, D 001, D 070.
Control	—	Microprocessor PID control; This is **not a safety (limit) control.**
Packaged weight	—	3.1 lb. (1400 g), Enclosure A, blue PVC plastic
Dimensions	—	6-5/8" H x 7-9/16" W x 2-13/16" D (170 x 193 x 72 mm)
Approvals	—	CSA C US, CSA 22.2 N°24 and UL 873, meets class B: ICES & FCC Part 15.
Ambient conditions	—	Indoor use only, 32 to 104°F (0 to 40°C), < 90% RH non-condensing.
Power supply	—	115 V (ac) ±10%, 50/60 Hz, 600 VA
Relay capacity	—	230 V (ac) 5 A, 1/3 hp
Demands	—	20 to 260 V (ac) 2 VA
Sensors included	—	NTC thermistor, 10 kΩ @ 77°F (25°C ±0.2°C) ß=3892 Outdoor Sensor 070
Optional devices	—	tekmar type #: 039, 040, 072, 073, 090, 091.



The installer must ensure that this control and its wiring are isolated and/or shielded from strong sources of electromagnetic noise. Conversely, this Class B digital apparatus complies with Part 15 of the FCC Rules and meets all requirements of the Canadian Interference-Causing Equipment Regulations. However, if this control does cause harmful interference to radio or television reception, which is determined by turning the control off and on, the user is encouraged to try to correct the interference by re-orientating or relocating the receiving antenna, relocating the receiver with respect to this control, and/or connecting the control to a different circuit from that to which the receiver is connected.

Cet appareil numérique de la classe B respecte toutes les exigences du Règlement sur le matériel brouilleur du Canada.

Caution The nonmetallic enclosure does not provide grounding between conduit connections. Use grounding type bushings and jumper wires.

Attention Un boîtier nonmétallique n'assure pas la continuité électrique des conduits. Utiliser des manchons ou des fils de accord spécialement conçus pour la mise á la terre.

Limited Warranty and Product Return Procedure

Limited Warranty ***The liability of tekmar under this warranty is limited. The Purchaser, by taking receipt of any tekmar product ("Product"), acknowledges the terms of the Limited Warranty in effect at the time of such Product sale and acknowledges that it has read and understands same.***

The tekmar Limited Warranty to the Purchaser on the Products sold hereunder is a manufacturer's pass-through warranty which the Purchaser is authorized to pass through to its customers. Under the Limited Warranty, each tekmar Product is warranted against defects in workmanship and materials if the Product is installed and used in compliance with tekmar's instructions, ordinary wear and tear excepted. The pass-through warranty period is for a period of twenty-four (24) months from the production date if the Product is not installed during that period, or twelve (12) months from the documented date of installation if installed within twenty-four (24) months from the production date.

The liability of tekmar under the Limited Warranty shall be limited to, at tekmar's sole discretion: the cost of parts and labor provided by tekmar to repair defects in materials and/or workmanship of the defective product; or to the exchange of the defective product for a warranty replacement product; or to the granting of credit limited to the original cost of the defective product, and such repair, exchange or credit shall be the sole remedy available from tekmar, and, without limiting the foregoing in any way, tekmar is not responsible, in contract, tort or strict product liability, for any other losses, costs, expenses, inconveniences, or damages, whether direct, indirect, special, secondary, incidental or consequential, arising from ownership or use of the product, or from defects in workmanship or materials, including any liability for fundamental breach of contract.

The pass-through Limited Warranty applies only to those defective Products returned to tekmar during the warranty period. This Limited Warranty does not cover the cost of the parts or labor to remove or transport the defective Product, or to reinstall the repaired or replacement Product, all such costs and expenses being subject to Purchaser's agreement and warranty with its customers.

Any representations or warranties about the Products made by Purchaser to its customers which are different from or in excess of the tekmar Limited Warranty are the Purchaser's sole responsibility and obligation. Purchaser shall indemnify and hold tekmar harmless from and against any and all claims, liabilities and damages of any kind or nature which arise out of or are related to any such representations or warranties by Purchaser to its customers.

The pass-through Limited Warranty does not apply if the returned Product has been damaged by negligence by persons other than tekmar, accident, fire, Act of God, abuse or misuse; or has been damaged by modifications, alterations or attachments made subsequent to purchase which have not been authorized by tekmar; or if the Product was not installed in compliance with tekmar's instructions and/or the local codes and ordinances; or if due to defective installation of the Product; or if the Product was not used in compliance with tekmar's instructions.

THIS WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, WHICH THE GOVERNING LAW ALLOWS PARTIES TO CONTRACTUALLY EXCLUDE, INCLUDING, WITHOUT LIMITATION, IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, DURABILITY OR DESCRIPTION OF THE PRODUCT, ITS NON-INFRINGEMENT OF ANY RELEVANT PATENTS OR TRADEMARKS, AND ITS COMPLIANCE WITH OR NON-VIOLATION OF ANY APPLICABLE ENVIRONMENTAL, HEALTH OR SAFETY LEGISLATION; THE TERM OF ANY OTHER WARRANTY NOT HEREBY CONTRACTUALLY EXCLUDED IS LIMITED SUCH THAT IT SHALL NOT EXTEND BEYOND TWENTY-FOUR (24) MONTHS FROM THE PRODUCTION DATE, TO THE EXTENT THAT SUCH LIMITATION IS ALLOWED BY THE GOVERNING LAW.

Product Warranty Return Procedure All Products that are believed to have defects in workmanship or materials must be returned, together with a written description of the defect, to the tekmar Representative assigned to the territory in which such Product is located. If tekmar receives an inquiry from someone other than a tekmar Representative, including an inquiry from Purchaser (if not a tekmar Representative) or Purchaser's customers, regarding a potential warranty claim, tekmar's sole obligation shall be to provide the address and other contact information regarding the appropriate Representative.

tekmar® Control Systems

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All specifications are subject to change without notice.
Printed in Canada. D 665 - 12/08.

tekmar® - Data Brochure

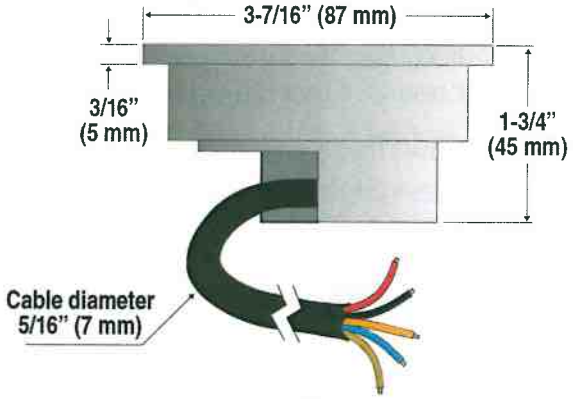
Snow / Ice Sensor 090 / 094, Sensor Socket 091

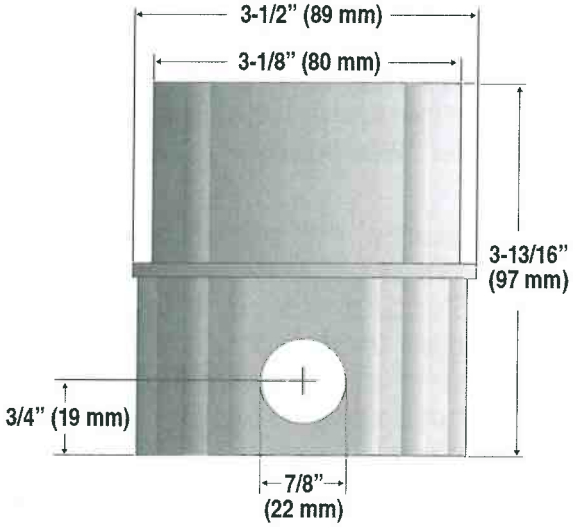
D090
07/09

The tekmar Snow/Ice Sensor 090/094 and tekmar Sensor Socket 091 are used with all tekmar snow/ice melt controls. The 090 has a 65' (20 m) cable while the 094 has a 208' (64 m) cable.

The Snow/Ice Sensor is designed to sit flush with the slab surface after being mounted into the Sensor Socket. The socket is installed directly into the snow melt slab halfway between the heating elements or pipes.

The sensor measures the slab temperature, sensor surface temperature and sensor surface moisture level.





Installation

Caution

Improper installation and operation of this sensor could result in damage to equipment and possibly even personal injury. It is your responsibility to ensure that this sensor is safely installed according to all applicable codes and standards. Please follow these step-by-step instructions to gain a full understanding of this device.

STEP ONE — GETTING READY

Check the Contents

Check the contents of this package. If any of the contents listed are missing or damaged, please refer to the Limited Warranty and Product Return Procedure on the back of this brochure and contact your wholesaler or tekmar sales representative for assistance.

Type 090 includes: • One Snow/Ice Sensor 090 with "O" ring • Four, #6-32 x 3/8" screws • Four, #4-40 x 7/16" screws • One Data Brochure D 090

Type 094 includes: • One Snow/Ice Sensor 094 with "O" ring • Four, #6-32 x 3/8" screws • Four, #4-40 x 7/16" screws • One Data Brochure D 090

Type 091 includes: • One Snow/Ice Sensor Socket 091 • One protective plastic plug • One plastic mounting plate • Eight, #6-32 x 3/8" screws • One Data Brochure D 090

STEP TWO — MOUNTING THE SENSOR

Location of the Sensor

- The location of the snow/ice sensor determines how well the snow melt detector responds to conditions on the snow melting slab. The sensor measures the temperature of the slab surface, and would normally be installed in a location that is representative of the average surface temperature and moisture conditions. The only exception to this practice would be those applications where the sensor is placed in a specific problem area where ice or snow often forms first.
- The installer should be careful to place the sensor in a location where it will not be affected by abnormal temperature conditions that may occur near buildings, hot air exhaust ducts or other heat sources, or sunny areas within a larger slab area.
- As well as reading temperatures, the sensor also detects surface water. The installer should be careful not to place the sensor where standing water could accumulate on its surface. Standing water in the socket may cause the snow melt system to be held on far longer than necessary, as the control will be getting a signal that water is present even though the rest of the slab surface may be dry. In addition, the sensor should not be placed in areas where drainage is considerably better than the surrounding area.
- The snow/ice sensor should not be installed in locations where vehicles park, near building overhangs or near trees since this may interfere with snow fall accumulation. If in doubt about the location of these obstacles, a second spare

socket and conduit can be installed in order to provide a backup sensor location if the first location is not found to be ideal.

- Vehicle tire and pedestrian traffic can track water and contaminants onto the snow melt area. If the snow/ice sensor is located in the traffic area, snow melting will be triggered by the passing traffic. This may be desirable in commercial areas where excessive traffic can cause the surface to become icy. In residential installations, the amount of traffic is usually limited, and it may be desirable to locate the snow/ice sensor away from the traffic area. This will reduce the number of snow melt events that occur and thereby reduce the annual fuel consumption.
- The location of the sensor should be midway between the heating pipes or elements.

Conduit

Place the sensor socket at the chosen location and run a conduit for the cable from the socket to the snow/ice detection control. If more than 210' (64 m) of cable is required to reach the control, run the conduit to a weatherproof junction box. The sensor cable should be run in its own conduit and not in combination with high voltage wiring.

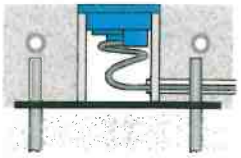
The conduit length from the sensor to the junction box should be less than the 210' (64 m) of cable supplied with the 094 snow/ice sensor.

At the junction box, additional 18 AWG, 5 conductor cable can be spliced on to increase the total length to 500' (150 m) from the sensor to control.

Avoid tying the conduit to the rebar within 6' (2 m) of the socket. This allows the rebar grid to move without disturbing the position of the socket.

Sloped Surfaces

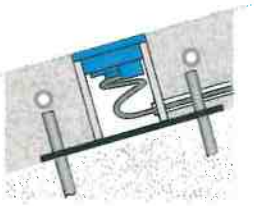
The top of the snow/ice sensor should be flush and parallel to that of the snow melt surface.



When the sensor is installed on a sloped driveway, the sensor must be installed near the lowest elevation of the slope. This is required since the melting snow or ice runoff water will drain toward the lowest point on the driveway and keep this area wet for longer periods of time.

Installing the Socket

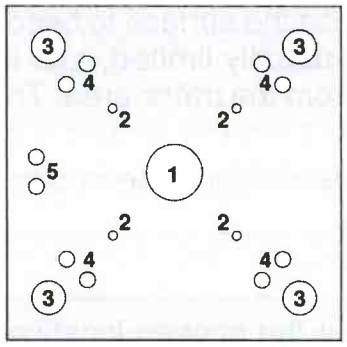
A mounting plate has been included to simplify the installation of the sensor socket. When possible, the mounting plate should be located directly on top of gravel in order to provide good drainage. If the slab is more than 4" thick, a mound of crushed rock or a styrofoam or wooden block can be used to elevate the socket. A hole must be punched or drilled in the styrofoam or wooden block in order to provide drainage.



Failure to provide adequate drainage under the socket may reduce the life expectancy of the snow/ice sensor.

The mounting plate can be fastened to the ground by driving 1/2" (12.7 mm) rebar through the four holes located on each of the four corners and then tying the mounting plate to the rebar.

1) Cut four pieces of rebar at least 12" (300 mm) long.
2) Drive the rebar into the ground through each of the mounting plate rebar holes. Leave approximately 2" (50 mm) of rebar above the ground.
3) Cut several 12" (300 mm) pieces of steel wire.

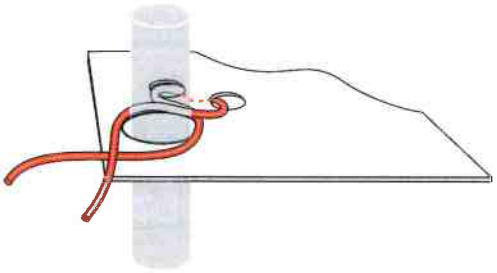


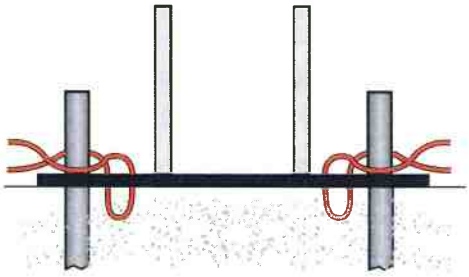
Mounting Plate

1. Drainage hole
2. Socket screw holes
3. Rebar holes
4. Rebar tie holes
5. Conduit tie holes

4) Form a "U" shape and pull wire through the rebar tie hole from the bottom to the top side.
5) Repeat by pulling the "U" shape from the top to the bottom side.
6) Repeat (4) and (5) for each of the four corners.
7) Cross the wire, then wrap around the rebar.
8) Twist wire using pliers to tighten.

The mounting plate also has conduit tie holes to allow a cable tie or steel wire to fasten the conduit to the mounting plate.





Placing Concrete

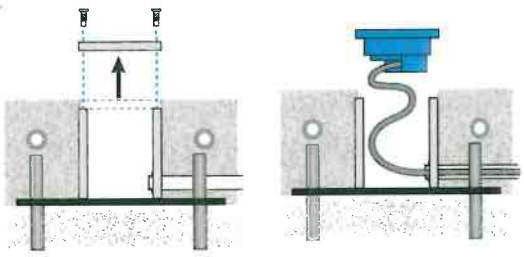
A plastic plug is provided with the socket to prevent it from being accidentally filled with concrete. The plastic plug is the same thickness as the sensor flange. This allows the finished surface of the concrete (asphalt, etc.) to be troweled flush with the plug. The plug must be installed prior to placing the concrete. Also ensure that the mounting plate drainage hole remains unplugged once the concrete has cured.

Installing Brick Pavers

If using brick pavers instead of concrete, it is recommended to mortar surrounding brick pavers to the side of the socket. This ensures good thermal conduction from the brick pavers to the socket. The top of the brick pavers should be level with the socket when the plastic plug is installed.

Install the Sensor and Cable

When the snow melt surface is finished, remove the plastic plug from the socket and fish the cable through the conduit until there is only 6 to 12" (150 to 300 mm) of cable between the sensor and conduit. Loop this remaining extra wire in a loose coil so as to not twist it, and place it, and the sensor into the socket. Secure the sensor to the socket with the four screws provided, making sure the "O" ring is in place and properly seated.



Replacing old 090 or 094

Current versions of the Snow/Ice socket 091 use #6-32 screws. Previous versions of the 091 used smaller #4-40 screws. When replacing an 090 or 094, both sets of screws are provided. It is recommended to try the smaller screws first to avoid cross threading.

Salt and Brine Contamination

The performance of the snow/ice sensor water detection can be compromised when exposed to de-icing agents such as road salt, magnesium chloride, or calcium chloride. These contaminants can permanently damage the sensor. It is recommended to locate the sensor away from areas exposed to these deicing agents when at all possible. Locations to avoid could include tire track areas or areas close to a curb where traveling vehicles may splash contaminated water on to the sensor.

Maintenance

The Snow/Ice Sensor is installed in a hostile environment. Accumulation of dirt, salty grime, etc., on its surface will inhibit proper water detection. It should be checked on a regular basis and, when necessary, cleaned. Before cleaning, the control power should be shut off to prevent the control from entering the snow melt mode. Next, use a soft bristle brush and warm soapy water to clean the sensor surface. Do not use a steel wire brush as this will damage the sensor. Then use a paper towel to thoroughly dry the sensor surface. After cleaning, re-power the control and push the test button to cycle the control through the test routine.

STEP THREE — WIRING THE SENSOR

Electrical Connections

The snow/ice sensor cable has 5 wires: Red, Black, Blue, Yellow, and Brown. The wires connect to the respective Red, Black, Blue, Yellow and Brown terminals on the Snow Detector & Melting Control.

Testing and Troubleshooting

TEST THE SENSOR

When performing these tests:

- The sensor head should be installed in the slab.
- The five cable wires at the control should be disconnected (unplug terminal plug).
- Use a good quality electrical testing meter with an ohm scale range of 0 to 2,000,000 Ohms.

The sensor has two 10k Ohm thermistors. One reads slab surface temperature, and the other checks sensor heater temperature.

If the sensor has been disconnected from the control for an hour or more, the readings for both thermistors should be very close.

- Using the ohmmeter and standard testing practices, measure the resistance between:
  - (a) the yellow and black sensor wires (sensor temperature), and
  - (b) the brown and black sensor wires (slab temperature).

The table below lists the expected resistance values at various sensor temperatures.

- Measure the resistance between the blue and black wires. When the sensor surface is dry, the reading should be 2,000,000 Ohms. When the sensor surface is wet it should be between 10,000 and 300,000 Ohms.
- Measure the resistance between the red and black wires of the heating element. This reading should be close to 50 Ohms.

Temperature		Resistance	Temperature		Resistance	Temperature		Resistance
°F	°C	Ω	°F	°C	Ω	°F	°C	Ω
-49	-45	472,000	5	-15	72,900	59	15	15,700
-40	-40	337,000	14	-10	55,300	68	20	12,500
-31	-35	243,000	23	-5	42,300	77	25	10,000
-22	-30	177,000	32	0	32,600	86	30	8,060
-13	-25	130,000	41	5	25,400	95	35	6,530
-4	-20	97,000	50	10	19,900	104	40	5,330

Technical Data

Snow / Ice Sensor 090 / 094	
Literature	D 090
090 Packaged weight	4.4 lbs (2000 g)
094 Packaged weight	10.5 lbs (4762 g)
Dimensions	1-3/4" H x 3-7/16 O.D. (45 x 87 O.D. mm)
Material	Brass, epoxy
Cable material	18 AWG, 5 conductor stranded wire with polyethylene jacket
090 Cable length	65' +/- 1' (20 +/- 0.3 m)
094 Cable length	208' +/- 2' (64 +/- 0.6 m)
Approvals	CSA C US with applicable tekmar snow melting controls
Operating range	-30 to 170°F (-34 to 77°C)
Sensor	NTC thermistor, 10kΩ @ 77°F (25°C ± 0.2°C), ß = 3892

Snow / Ice Sensor Socket 091	
Literature	D 090
Packaged weight	1.5 lbs (675 g)
Dimensions	3-13/16" H x 3-1/2 O.D. (97 x 89 O.D. mm)
Socket material	Brass
Cap material	Polyethylene
Mounting plate material	Polyethylene
Approvals	CSA C US with applicable tekmar snow melting controls

Limited Warranty and Product Return Procedure

Limited Warranty ***The liability of tekmar under this warranty is limited. The Purchaser, by taking receipt of any tekmar product ("Product"), acknowledges the terms of the Limited Warranty in effect at the time of such Product sale and acknowledges that it has read and understands same.***

The tekmar Limited Warranty to the Purchaser on the Products sold hereunder is a manufacturer's pass-through warranty which the Purchaser is authorized to pass through to its customers. Under the Limited Warranty, each tekmar Product is warranted against defects in workmanship and materials if the Product is installed and used in compliance with tekmar's instructions, ordinary wear and tear excepted. The pass-through warranty period is for a period of twenty-four (24) months from the production date if the Product is not installed during that period, or twelve (12) months from the documented date of installation if installed within twenty-four (24) months from the production date.

The liability of tekmar under the Limited Warranty shall be limited to, at tekmar's sole discretion: the cost of parts and labor provided by tekmar to repair defects in materials and / or workmanship of the defective product; or to the exchange of the defective product for a warranty replacement product; or to the granting of credit limited to the original cost of the defective product, and such repair, exchange or credit shall be the sole remedy available from tekmar, and, without limiting the foregoing in any way, tekmar is not responsible, in contract, tort or strict product liability, for any other losses, costs, expenses, inconveniences, or damages, whether direct, indirect, special, secondary, incidental or consequential, arising from ownership or use of the product, or from defects in workmanship or materials, including any liability for fundamental breach of contract.

The pass-through Limited Warranty applies only to those defective Products returned to tekmar during the warranty period. This Limited Warranty does not cover the cost of the parts or labor to remove or transport the defective Product, or to reinstall the repaired or replacement Product, all such costs and expenses being subject to Purchaser's agreement and warranty with its customers.

Any representations or warranties about the Products made by Purchaser to its customers which are different from or in excess of the tekmar Limited Warranty are the Purchaser's sole responsibility and obligation. Purchaser shall indemnify and hold tekmar harmless from and against any and all claims, liabilities and damages of any kind or nature which arise out of or are related to any such representations or warranties by Purchaser to its customers.

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tekmar® Control Systems

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Web Site: www.tekmarcontrols.com

SINCE 1908

wessels company

SUBMITTAL

TYPE: NTA ASME EXPANSION TANKS FOR HEATING & COOLING SYSTEMS

MODELS: NTA-15 TO NTA-280
Submittal Sheet No. A-3360A Date: 1-04

JOB Cranbrook

Wessels Representative Performance Engineering Group, Inc.

Unit Tag No. _____ Order No. _____ Date _____

Engineer _____ Submitted By _____ Date _____

Contractor Goyette Mechanical Approved By _____ Date _____

DESCRIPTION

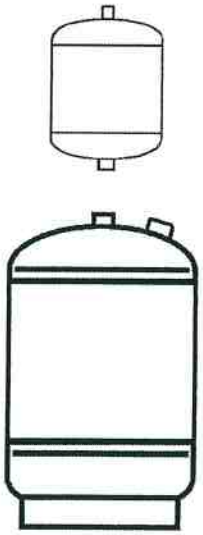
Wessels Type NTA Tanks are ASME fixed diaphragm type pre-charged expansion tanks. They are designed to absorb the expansion forces and control the pressure in heating/cooling systems. The system's expanded water (fully compatible with water/glycol mixtures) is contained in a heavy-duty bladder preventing tank corrosion and waterlogging problems. NTA expansion tanks reduce tank sizes up to 80%.

CONSTRUCTION

Shell: Carbon Steel
Diaphragm: Heavy duty butyl

PERFORMANCE LIMITATIONS

Maximum Design Temperature: 240°F
Maximum Design Pressure: 125 PSIG



Model	Gal.	Accept.	Dia.	Ht.	Syst. Conn.	Wt. (Lbs.)
NTA-15	7.8	4.8	12	19	3/4	44
NTA-20	10.9	4.8	12	26	3/4	47
NTA-40	25.0	10.5	16	33	1	90
NTA-60	35.0	10.5	16	45	1	111
NTA-80	45.0	21.0	20	38	1	147
NTA-100	60.0	21.0	20	49	1	167
NTA-120	70.0	52.5	24	46	1 1/2	225
NTA-144	80.0	52.5	24	49	1 1/2	245
NTA-180	90.0	52.5	24	52	1 1/2	265
NTA-200	115.0	52.5	24	66	1 1/2	295
NTA-240	140.0	52.5	24	78	1 1/2	425
NTA-260	158.0	79.0	30	61	1 1/2	475
NTA-280	211.0	84.0	30	79	1 1/2	645

TYPICAL SPECIFICATION

Furnish and install as shown on plans a _____ gallon _____" diameter X _____" (high) pre-charged steel expansion tank with heavy-duty butyl rubber diaphragm. The tank shall have NPT system connections and a .302"-32 charging valve connection (standard tire valve) to facilitate the on-site charging of the tank to meet system requirements. The tank must be constructed in accordance with most recent addition of Section VIII of the ASME Boiler and Pressure Vessel Code.

Each tank shall be Wessels model number NTA_____ or approved equal.

101 TANK ST • GREENWOOD, IN 46143 • (317) 888-9800 • (317) 888-9988 FAX • www.westank.com

SINCE 1908
wessels company

SUBMITTAL

TYPE: SPA ASME AIR SEPARATOR WITH STRAINER

MODELS: SPA 2S TO SPA 24S

SUBMITTAL SHEET No. B-3305 Date: 2-01

JOB Cranbrook

Wessels Representative Performance Engineering Group, Inc.

Unit Tag No. _____

Engineer _____

Contractor Goyette Mechanical

Order No. _____ Date _____

Submitted By _____ Date _____

Approved By _____ Date _____

DESCRIPTION

Wessels SPA Vortex type Air Separators eliminate air quickly and efficiently from open and closed loop heating/cooling systems. Water enters and exits through unique "tangential" connections, which promote a low velocity swirling effect in the center of the unit. Natural centrifugal forces allow the heavier air-free water to move towards the outer edges while entrained air is captured within the "eye" of the vortex and released out the top of the separator. The water then exits near the bottom of the unit, bubble free, protecting the system against the noise, corrosion, and damage commonly caused by entrained air. SPA shall have a system strainer.

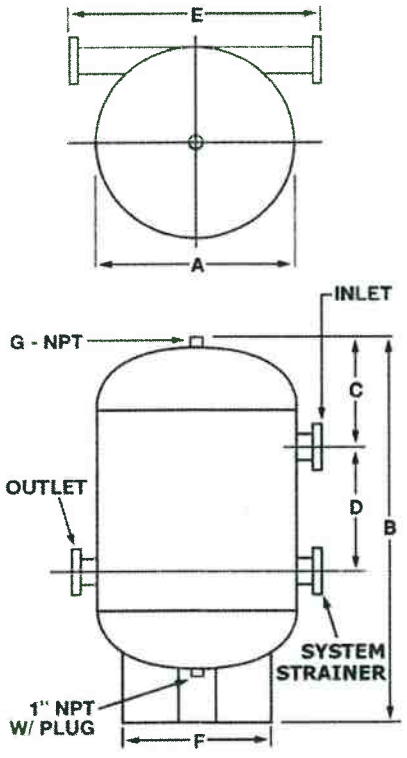
CONSTRUCTION

Shell: Carbon steel
Heads: Carbon steel

PERFORMANCE LIMITATIONS

Maximum Design Pressure: 125 PSIG
Maximum Design Temperature: 450°F

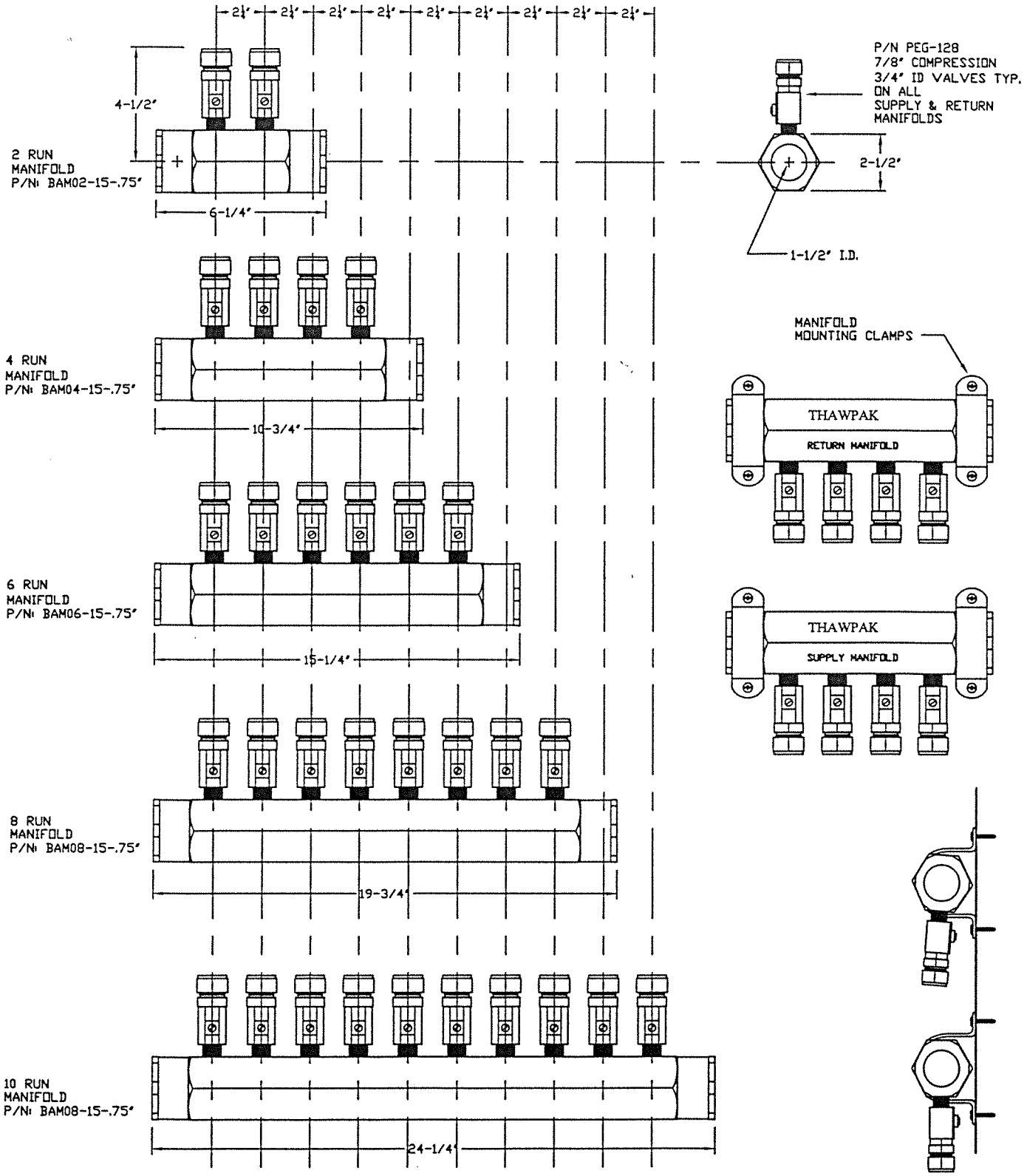
Model Number	Max GPM	Conn. Size	Type	Dimensions in inches							Approx. Lbs.
				A	B	C	D	E	F	G	
SPA 2S	56	2	NPT	12	22 1/2	5 1/2	8 1/2	16 5/8	9 1/2	1 1/4	55
SPA 2-1/2S	90	2.5	NPT	12	22 1/2	5 1/2	8 1/2	16 5/8	9 1/2	1 1/4	61
SPA 3S	190	3	FLANGED	12	22 1/2	5 3/4	8	19 3/4	9 1/2	1 1/4	66
SPA 4S	300	4	FLANGED	14	32	9 1/8	10 3/4	21 3/4	11 1/2	1 1/2	99
SPA 5S	530	5	FLANGED	14	32	9 1/8	10 3/4	21 3/4	11 1/2	1 1/2	163
SPA 6S	850	6	FLANGED	20	44	13 1/4	14 1/2	28	18	2	210
SPA 8S	1900	8	FLANGED	20	44	13 1/4	14 1/2	28	18	2	417
SPA 10S	3200	10	FLANGED	30	60 1/2	19	20	41	24	2	658
SPA 12S	4800	12	FLANGED	30	60 1/2	19	20	41	24	2	1042
SPA 14S	6100	14	FLANGED	36	78	22	31 1/2	46 3/8	30	2	1848
SPA 16S	8000	16	FLANGED	48	108	30	40	60	38	2	2530
SPA 18S	9700	18	FLANGED	54	124	33	50	66	44	2	3559
SPA 20S	12000	20	FLANGED	60	138	35	60	72	50	2	5610
SPA 22S	15000	22	FLANGED	66	150	38	66	78	56	2	6765
SPA 24S	17000	24	FLANGED	72	150	38	66	78	56	2	7931



TYPICAL SPECIFICATION

Furnish and install as shown on plans, a vortex type air separator Model SPA_____ with system strainer, sized for_____GPM, with _____" (NPT / Flanged) tangential connections, as manufactured by Wessels Company. The air separator shall be designed in accordance with the latest revisions of the ASME Code for Boilers and Pressure Vessels, Section VIII, Division 1, and shall be constructed and stamped for 125 PSI working pressure @ 450°F. A blowdown connection shall be provided to facilitate routine cleaning of the unit. Each air separator shall be Wessels SPA _____ or approved equal.

101 TANK STREET, GREENWOOD, IN 46143 TEL: 317-888-9800 FAX: 317-888-9988 www.westank.com



TITLE

1-1/2" SUPPLY & RETURN MANIFOLDS W/ 7/8" BALL VALVES

DWG. #	DRAWN BY:	DATE:	SCALE:	PAGE:
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THAW-PAK
RADIANT HEATING & SNOW MELTING SYSTEMS
32995 INDUSTRIAL RD. LIVONIA, MI. 48152
OFFICE:(734)266-5300 FAX:(734)266-5310

PLUMBING

TechData
PRODUCT SPECIFICATION SHEET

Viega PureFlow SYSTEMS

ViegaPEX™ Cross-linked Polyethylene (PEX)

Scope
This material specification designates the requirements for ViegaPEX hot and cold water distribution tubing. All ViegaPEX tubing is copper tube size dimension (CTS), SDR-9 wall thickness and meets the respective requirements of ASTM F876 and F877.

Materials
All ViegaPEX tubing is manufactured from a cross-linkable high density polyethylene produced by grafting organo-silanes onto a polyethylene base. A catalyst (accelerator) added to the cross-linkable polyethylene during extrusion initiates the cross-linking process. Cross-linking is completed with hot water or steam (sauna). ViegaPEX tubing is available in red, white, or blue for easy identification of hot and cold lines.

Marking and Certification
All ViegaPEX tubing is marked with the name Viega as the manufacturer, nominal size, plastic tubing material designation code (PEX 1006), design pressure and temperature ratings, relevant ASTM standards, manufacturing date and production code, as well as both the NSF-pw and the NSF CL-R/CL-TD stamps indicating third-party certification by NSF International for meeting and exceeding performance and toxicological standards, as well as achieving the highest chlorine resistance rating (NSF Protocol P171) in the PEX industry. NSF conducts random on-site inspections of Viega manufacturing facilities and independently tests ViegaPEX tubing for compliance with physical, performance and toxicological standards. ViegaPEX is also certified to meet the Uniform Plumbing Code, IAPMO, CSA B137.5 Warnock Hersey, the ICBO Evaluation Service and HUD (Housing and Urban Development).

Recommended Uses
ViegaPEX tubing is intended and recommended for use in hot and cold potable water distribution systems. Design temperature and pressure ratings for ViegaPEX is 160 psi @ 73°F and 100 psi @ 180°F. ViegaPEX tubing can also be used in "continuously-recirculating" plumbing systems at temperatures of up to 140°F while still maintaining excellent chlorine resistance. For information on the suitability for other hot and cold water applications not listed here, consult with your Viega representative.

Handling and Installation
ViegaPEX cross-linked polyethylene tubing is tough yet flexible. However, it is softer than metals and may be damaged by abrasion or by objects with a cutting edge. Use of these materials in hot and cold water distribution systems must be in accordance with good plumbing practices, applicable code requirements, and current installation practices available from Viega. ViegaPEX is manufactured to meet written national standards. Contact a Viega representative or the applicable code enforcement bureau for information about approvals for specific applications.

Property	ASTM Test Method	Typical Values	
		English Units	SI Units
Density	D 792	–	0.946 g/cc
Melt Index[1] (190°C/2.16 kg)	D 1238	–	0.7g/10 min
Flexural Modulus[2]	D 790	120,000 psi	830 MPa
Tensile Strength @ Yield (2 in/min)	D 638	2,900 psi	20 MPa
Coefficient of Linear Thermal Expansion @ 68°F	D 696	$8x10^{2}$/°F	$15x10^{-5}$/°C
Hydrostatic Design Basis @ 73°F (23°C)	D 2837	1,250 psi	8.6 MPa
Hydrostatic Design Basis @ 180°F (82°C)	D 2837	800 psi	5.5 MPa
Vicat Softening Point	D 696	255°F	124°C
Thermal Conductivity	D 177	2.4 Btu-in (hr)(ft²)(°F/in)	$3.5x10^{-3}$ Watts/(cm²)(°C/cm)

1. Before Cross-linking
2. 73°F

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TechData
PRODUCT SPECIFICATION SHEET

PLUMBING

Viega PureFlow SYSTEMS

ViegaPEX™

Quality Assurance
When the product is marked with the ASTM F876/F877 designation, it affirms that the product was manufactured, inspected, sampled and tested in accordance with these specifications and has been found to meet the specified requirements.

Certifications
NSF-pw - tested for health effects to ANSI/NSF standard 61 and performance to ANSI/NSF standard 14.

NSF CL-R/CL-TD - Tested and conforms to NSF Protocol P171, Chlorine Resistance of Plastic Piping Materials. Meets and exceeds pass/fail criteria of both Traditional Domestic and Domestic Continuous Recirculation ratings. NSF tested according to ASTM Standard F2023, Evaluating the Oxidative Resistance of Crosslinked Polyethylene (PEX) Tubing and Systems to Hot Chlorinated Water greatly exceeding the minimum chlorine resistance requirements of ASTM F876.

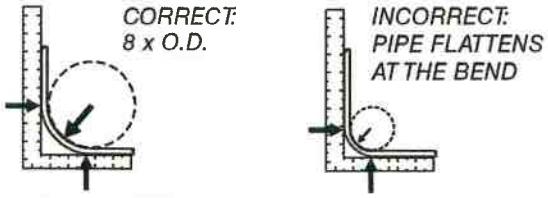
- **IAPMO Certified**

- **ICBO ER #5287** - listed for plumbing and hydronic heating applications.

- **Intertek Testing Services** (Warnock Hersey) - certification to CSA B137.5 (Canadian Standards Association)

HUD (Housing and Urban Development) - MR 1276

Minimum Bend Radius



NOTE: ViegaPEX tubing may be bent to a minimum of 5 x O.D. with approved bend support.

SDR-9 PEX Tubing
ASTM F876/F877/CTS-OD SDR-9

STOCK CODE	TUBING SIZE	O.D.	WALL THICKNESS	NOM. I.D.	WEIGHT PER FT	VOLUME (Gal.) PER 100 FT
PX2	3/8"	0.500±.003	0.070+.010	0.350	.0413	0.50
PX3	1/2"	0.625±.004	0.070+.010	0.475	.0535	0.92
PX4	3/4"	0.875±.004	0.097+.010	0.671	.1023	1.82
PX5	1"	1.125±.005	0.125+.013	0.863	.1689	3.04

NOTE: Dimensions are in English units. Tolerances shown are ASTM requirements. ViegaPEX is manufactured within these specifications.

Pressure Drop Table
Expressed as PSI/ft. Pressure Drop

GPM	SIZE 3/8"	1/2"	3/4"	1"
1	.070	.016		
1.5	.149	.034		
2.2	.303	.069		
2.5	.385*	.087		
3	.539	.122	.023	
3.5	.717	.162	.030	
4		.208*	.039	
5		.314	.059	
6		.440	.082	.024
7		.586	.109	.032
8			.140	.041
9			.174*	.051
10			.211	.062
11			.252	.074
12			.296	.087
13			.343	.101
14				.116
16				.148*
18				.184
20				.224
22				.267

EXAMPLE: To calculate the pressure drop of a 1/2" line, 40 ft. long, with a 3 gpm flow rate, calculate .122 psi x 40 ft. = 4.9 psi pressure drop. Most plumbing codes require 8 psi residual pressure at the fixture. Refer to your local code requirements.

*Indicates 8 fps maximum velocity required by some plumbing codes. NOTE: Maximum flow for each size based on 12 FPS velocity. PSI x 2.307 = head loss.

Minimum Burst Pressure (PSI) Per ASTM F876/F877

SIZE	73°F (23°C)	180°F (82°C)
3/8"	620	275
1/2"	480	215
3/4"	475	210
1"	475	210

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ProRadiant Warranty

VIEGA LLC LIMITED WARRANTY PRORADIANT HYDRONIC RADIANT HEATING/COOLING AND SNOW MELT

Subject to the conditions and limitations in this Limited Warranty, VIEGA LLC (VIEGA) warrants to owners of real property in the United States with hydronic radiant heating/cooling and/or snow melt systems properly installed by Viega trained contractors that its VIEGAPEX™ BARRIER, PEXTRON®, and FOSTAPEX® tubing, under normal conditions of use, will be free from failure caused by manufacturing defect for a period of twenty-five (25) years from date of installation. This warranty also applies to those supplying products covered by this warranty and installed on the property.

In addition, Viega warrants that properly installed fittings sold by Viega for use with the above listed tubing in hydronic radiant heating/cooling and snow melt systems will be free from failure caused by manufacturing defect for a period of ten (10) years from date of initial installation and warrants that any controls, manifolds, manifold stations, valves, or panels sold by Viega and used in those systems will be free from failure caused by manufacturing defect for a period of two (2) years from date of initial installation.

Power tools and jaws used with Press fittings are warranted by the manufacturer and Viega extends no separate warranty on those tools or jaws. Viega warrants that PEX Press hand and Pneumatic PEX Hammer tools sold by Viega, under normal conditions of use, shall be free from failure caused by manufacturing defects for a period of two (2) years from date of sale.

Under this limited warranty, you only have a right to reimbursement if the failure or leak resulted from a manufacturing defect in the products covered by this warranty and the failure or leak occurred during the warranty period. You do not have a remedy or right of reimbursement under this warranty and the warranty does not apply if the failure or any resulting damage is caused by (1) components in the systems other than those manufactured or sold by Viega or components not recommended for use in the systems with the particular tubing used; (2) not installing, inspecting, or testing the tubing in accordance with Viega's installation instructions at the time of the installation, applicable code requirements and accepted industry practices (for example, guidelines of the Radiant Panel Association); (3) improper design, including determining proper heat-load, of the system; (4) exposure to unauthorized solvents or chemicals, antifreeze, rust inhibitor or other treatment fluids, inadequate freeze protection, or by failure to appropriately limit recommended water temperature levels or other misuse or abuse of the tubing in the handling of the pipe and tubing prior to or during installation or by other construction activity on the property; (5) acts of nature such as earthquakes, fire, flood, wind, or lightning.

In the event of a leak or other failure in the system, it is the responsibility of the property owner to obtain and pay for the repairs. Only if the warranty applies will Viega be responsible for reimbursement under this warranty. The part or parts which you claim failed should be kept and Viega contacted by writing to the address below or telephoning 1-877-843-4262 within thirty (30) days after the leak or other failure and identifying yourself as having a warranty claim. You should be prepared to ship, at your expense, the product which you claim failed due to a manufacturing defect, document the date of installation, and the amount of any claimed bills for which you claim reimbursement. Within a reasonable time after notification, Viega will investigate the reasons for the failure, which includes the right to inspect the product at Viega and reasonable access to the site of the damage in order to determine whether the warranty applies. Viega will notify you in writing of the results of its review.

In the event that Viega determines that the failure or leak and any resulting damages were the result of a manufacturing defect in the products and occurred during the time periods covered by this warranty, Viega will reimburse the property owner for reasonable repair or replacement charges resulting from the failure or leak and, during the first ten years of the warranty, additionally will reimburse damages to personal property resulting from the failure or leak. VIEGA SHALL NOT BE LIABLE FOR CONSEQUENTIAL ECONOMIC LOSS DAMAGES UNDER ANY LEGAL THEORY AND WHETHER ASSERTED BY DIRECT ACTION, FOR CONTRIBUTION OR INDEMNITY OR OTHERWISE.

THE ABOVE LIMITED WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. IF FOUND APPLICABLE, ANY IMPLIED WARRANTIES ARE LIMITED TO THE DURATION OF THE TIME LIMITS SET OUT IN THIS WRITTEN WARRANTY. Other than this limited warranty, Viega does not authorize any person or firm to create for it any other obligation or liability in connection with its products. This written warranty applies for the full term of the applicable warranty regardless of any change of ownership of the property.

In the event that tubing covered by this warranty is used in potable water plumbing systems, the Viega Limited Warranty for PureFlow® potable water plumbing systems will apply.

Some states do not allow the exclusion or limitation of incidental or consequential damages or limitations on the duration of implied warranties in certain types of transactions, so the above exclusion or limitations may not apply to you. This limited warranty gives you specific legal rights and you also may have other rights which vary from state to state. This warranty shall be interpreted and applied under the law of the state in which the product is installed.

HRH WARR 9/01/07

Material Safety Data Sheet

Product Name: 8406 **Revision Date:** June 20, 2000

Section #1: Chemical Product And Company Identification

Product Name: 8406

Manufacturer / Distributor: Enerco Corporation

Address: 317 North Bridge Street, Grand Ledge, MI 48837

Telephone: (517) 627-8444 Fax: (517) 627-8037

For chemical emergency - spill, leak, fire, exposure or accident - call CHEMTREC - day or night - (800) 424-9300

Section #2: Composition/Information on Ingredients

Chemical Name:	CAS Number	WT %:
Propylene Glycol	57-55-6	>95

* Indicates hazardous substances. Remainder of components comprise proprietary information. This document is prepared pursuant to the OSHA Hazard Communication Standard, 29 CRF 1910.1200. In addition, other substances not "hazardous" per this OSHA standard may

Section #3: Hazards Identification

EMERGENCY OVERVIEW: May cause irritation to skin and eyes.

Potential Health Effects: See Section 11 for toxicological data

Effects Of Acute Exposure:

Eye: Mild irritation may occur.
Skin: Mild irritation may occur.
Inhalation: Harmful effects are not expected from short term inhallation.
Ingestion: Not expected to result in harmful effects under anticipated conditions of normal use. Excessive ingestion may cause central nervous system effects.

Effects Of Chronic Exposure: May aggrevate pre-existing eye disease.

Medical Conditions Generally Aggravated By Exposure: May aggrevate pre-existing eye disease.

Section #4: First Aid Measures

Eye:

Immediately flush with water for 15 minutes - be sure eyelids are held open during flushing. If irritation occurs, consult physician.

Skin:

Flush with water for 15 minutes. If irritation occurs, consult physician.

Inhalation:

First aid not normally required. Remove to fresh air if effects occur. Consult physician if symptoms persists.

Ingestion:

First aid not normally required. If symtoms develop, consult physician - get medical attention. Never give anything by mouth to an unconscious person.

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Material Safety Data Sheet

Product Name: 8406 **Revision Date:** June 20, 2000

Continued from previous page...

Section #5: Fire-Fighting Measures

Flash Point: Greater than 200°F.

Flammable Limits: Not determined.

Extinguishing Media: Water, fog, dry chemical, carbon dioxide, foam.

Special Fire Fighting Procedures: Fire fighters should wear full protective gear including self-contained breathing apparatus.

NFPA Code Legend
4 - Severe Hazard
3 - Serious Hazard
2 - Moderate Hazard
1 - Slight Hazard
0 - Minimal Hazard

Unusual Fire And Explosive Hazards:

May form carbon dioxide and carbon monoxide.

NFPA Hazard Codes - (Health / Flammability / Reactivity):

0 / 1 / 0

Section #6: Accidental Release Measures

Spill And Leak Procedure:

Contain spill. Keep out of drains, sewers, lakes, streams, or other water systems. Use absorbent to clean up. Transfer to suitable container for disposal.
Large spills: Dike or contain material and recover it for use as originally intended.

Disposal:

Dispose of in accordance with applicable environmental standards.

Section #7: Handling And Storage

Precautions To Be Taken In Handling:

Avoid contact with eyes, skin, and clothing. Avoid breathing vapor.
Keep container tightly closed when not in use. Do not ingest.

Precautions To Be Taken In Storage:

Store in a cool, dry place. Store below 120°F. Normal shelf life 1 year.
Do not store with or near food supplies or potable water.

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Material Safety Data Sheet

Product Name: 8406 **Revision Date:** June 20, 2000

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Section #8: Exposure Controls / Personal Protection

Ventilation: Use adequate ventilation to keep airborne levels below the exposure limits.

Eye Protection: Chemical safety goggles.

Skin Protection: Rubber gloves.

Respiratory Protection: None needed, if ventilation is adequate.

Other Protection Equipment: Not Applicable.

Permissible Exposure Limits: None established for product.

Section #9: Physical And Chemical Properties

Appearance And Odor: Clear liquid (unless dye requested) Little or no odor.

Evaporation Rate Similar to water

Boiling Point (°F): Greater than 212

pH: 9 - 10

Vapor Pressure <0.1 mm Hg

Solubility In Water: Complete

Vapor Density: 2.6 (air = 1)

Section #10: Stability And Reactivity

Chemical Stability: Stable

Conditions To Avoid: Avoid temperatures above 120°F or below 40°F.

Incompatibility: Strong bases. Strong acids. Oxidizing agents.

Hazardous Decomposition Products: Carbon monoxide and other toxic vapors.

Hazardous Polymerization: Will not occur.

Section #11: Toxicological Information

Skin and eye (mild irritation) are expected to be the primary target organs of this product. May be harmful if ingested in large quantities.

Ingredients As Carcinogens:

To the best of our knowledge, this product does not contain any substances that are considered by OSHA, NTP, IARC, or ACGIH to be 'probable' or 'suspected' human carcinogens.

Section #12: Ecological Information

Practicallly non toxic to mammalian wildlife. Insignificant toxic hazard to aquatic organisms and fish.

Section #13: Disposal Considerations

Best route is to use product for its originally intended purpose.
Dispose of in accordance with applicable environmental standards.

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Material Safety Data Sheet

Product Name: 8406 **Revision Date:** June 20, 2000

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Section #14: Transport Information

DOT Proper Shipping Name: Not hazardous as regulated by DOT.

DOT Hazard Class: Not Applicable.

DOT Label: Not Applicable

Section #15: Regulatory Information

TSCA: All ingredients are on the TSCA inventory or are not required to be listed on the TSCA inventory.

RCRA Hazard Class: No components of this product are listed.

CERCLA RQ: No components of this product are listed.

SARA Title III:

Extremely Hazardous Substance: No components of this product are listed.

Hazardous Substance: Hazard due to: Irritability

Hazard Catagorization:

- ☐ Sudden Release Of Pressure
- ☐ Reactive
- ☑ Immediate (Acute) Health
- ☐ Delayed (Chronic) Health
- ☐ Fire

Section 313 Chemicals: No components of this product are listed.

STATE RIGHT-TO-KNOW:

CHEMICAL NAME	CAS NUMBER	LIST
Propylene Glycol	57-55-6	PA1, MN

PA1=Pennsylvania Hazardous Substance (present at greater than or equal to 1.0%)
MN=Minnesota Hazardous Substance.

Section #16: Other Information

Submittal Data Sheet
CPC-3 CONSTANT PRESSURE CONTROLLER

Description
The CPC-3 is a microprocessor-based control that can simultaneously control both draft and/or combustion air pressures. It typically controls the operation and speed of an Auto-Draft® Inducer and/or a Universal Blower to maintain draft or pressure set points. A third function provides for an interface with a motorized louver. The CPC-3 also serves as the safety interlock with associated burner controls.

Features
The CPC-3 has an 80 character vacuum florescent display that provides real-time system status and a soft touch keypad. All primary functions can be programmed via distinct buttons, eliminating scrolling through multiple screens. Included are four burner interlock terminal strips that can interface with millivolt, 24 Volt, 115 Volt or 230 Volt burner control circuits. The addition of up to three EXP-4E Expansion Modules allows up to 16 separate burners to be interlocked. LED status indicators on the face of the keypad show which interlocked burner is calling for heat and when the CPC-3 safety circuits approve burner operation. Additional LED's indicate venter limit(s) status and VFD operation and fault status. Correct venter rotation can be determined by display prompts and changed through a dip switch on the circuit board. Included quick connect cabling completes all control circuit connections between the CPC-3 and VFD. Features system fault diagnosis with date and time reference for easy troubleshooting. Built in alarm alerts building maintenance personnel if system faults. Alarm relay also allows interface with building management system.

Programming Options
Draft Pressure Set Point, Combustion Air Pressure Set Point, Pre and Post purge, Automatic or Manual operation. Combustion air modes of operation include “Open” room pressure or ducted “Sealed” pressure for sealed combustion burners.

Operation
Upon a call for heat from an interlocked burner the CPC-3 references the vent system draft and/or combustion air pressure as measured by the TD-Series Pressure Transducer(s) and activates the Variable Frequency Drive. The VFD quickly speeds up the inducer/blower until the vent system draft and/or combustion air set point is reached. When the set point is reached the CPC-3 completes the circuit to the interlocked appliance allowing the normal firing sequence to resume. Additional burner stages will create a momentary decrease in vent system pressures, causing the inducer/blower to speed up to maintain the set point. If sufficient natural draft and/or combustion air is present the CPC-3 will deactivate the inducer/blower until it is needed. The interlocked burners will be deactivated if the vent system draft set point cannot be maintained within 0.01" w.c. during predefined time limits based on combustion air or draft modes of operation.

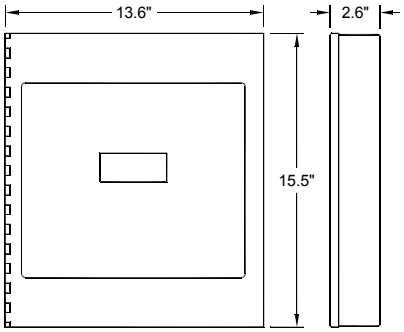
Material
The housing is made from 18 gauge aluminized steel and is painted with an industrial powder coating. It has NEMA class 1 construction.

Listings
ETL Listed # 56826
UL508 - Standard for industrial control equipment

CSA C22.2 No. 14-95 - Standard for industrial control equipment

Warranty
2 year warranty

IMPORTANT: FOR “OPEN” COMBUSTION AIR APPLICATIONS WHERE THE CPC-3 IS CONTROLLING THE MECHANICAL ROOM PRESSURE. The system will not maintain room pressure unless doors have sweeps and all obvious voids to spaces outside the mechanical room are sealed.



CPC-3 CONTROLLER	
Power Supply	115 / 208-230 / 50 - 60 Hz / 0.5 Amp
Control Signal	Drive: 2 each 0 - 10 VDC, 10 mA each Sensor: 5 each 0 - 10 VDC, 0.25 mA each 1 Digital Input 3.4 - 5.0 VDC, 24 mA max 1 Digital Output 3.4 - 5.0 VDC, 24 mA max
Sensor Supply	4 each 24 VDC, 420 mA total
Inducer Range of Operation	+0.15 to -0.60 In WC / +37 to -159 Pa
Combustion Air Range of Operation Open System: Sealed System:	 +0.15 to -0.60 In WC / +37 to -159 Pa +0.10 to -0.10 In WC / +24 to -24 Pa
Pressure Tolerance	0.0002 In WC / 0.05 Pa
Operating Temperature	32° to 122° F / 0° to 50° C
Appliance / Pump / AUX Relays	General Purpose 20 A, 240 VAC Motor: 1 HP, 125 VAC 2 HP, 250 VAC
Alarm Relay	2 A, 125 VAC
Dimensions, H x W x D	15.5 x 13.6 x 2.6 in 394 x 345 x 66 mm
Weight	9.5 lbs / 4.3 kg

FIGURE 8067002 7/26/04

Tjernlund Products, Inc. • 1601 Ninth Street • White Bear Lake, MN 55110 • (651) 426-2993 • (800) 255-4208 • FAX (651) 426-9547 • www.tjernlund.com
P/N 8513016

Submittal Data Sheet
VFD-SERIES VARIABLE FREQUENCY DRIVES

Description
Tjernlund VFD-Series Drives from Yaskawa are pulse width modulated to generate an adjustable voltage to frequency three phase output for complete speed control of Tjernlund Auto-Draft® Series Commercial Ventilation and Draft Systems. All Drives are factory programmed for the Inducer or Blower they are controlling and specific mode of operation.

An Automatic-Variable Speed system includes a closed loop VFD, CPC-3 Constant Pressure Controller, TD-Series Pressure Transducer and an Auto-Draft® Inducer or Universal Blower. This system will automatically adjust the Inducer/Blower speed based on the pressure in the stack or room to always deliver perfect draft or combustion air. Closed loop VFD's include 10' quick connect cable to connect VFD and Inducer/Blower limit circuits to CPC-3.

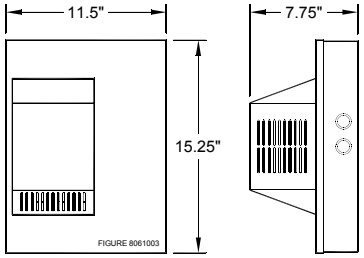
An Adjustable-Fixed Speed system includes an an open loop VFD and an Auto-Draft® Inducer or Universal Blower. Inducer/Blower speed is manually adjusted by the installer with the VFD. Open loop VFD's include a Relay for easier interlock with the UC1 Universal Control.

Construction
The housing is constructed from 18 gauge aluminized steel and is coated with an industrial powder coating. It has NEMA class 1 construction.

Listings
UL, ULc and CE compliant.

VFD MODEL	MODEL USED WITH	INPUT VOLTAGE (ALL DRIVES PRODUCE 3 PHASE OUTPUT)	HP	3 PHASE AMPS
VFD-1/2H1A82C3	VSAD8-230	208-230 Volt Single or 3 Phase	1/2 HP	3.0
VFD-1/2H1A84C3	VSAD8-460A	460 Volt 3 Phase	1/2 HP	1.2
VFD-1H1A81C3	VSAD8-230	115 VAC input/230 Volt 3 Phase Output	1 HP	5.0
VFD-1H1A101C3	VSAD10-230	115 VAC input/230 Volt 3 Phase Output	1 HP	5.0
VFD-1H1A102C3	VSAD10-230	208-230 Volt Single or 3 Phase	1 HP	5.0
VFD-1H1A104C3	VSAD10-460A	460 Volt 3 Phase	1 HP	3.4
VFD-2H1A122C3	VSAD12-230	208-230 Volt Single or 3 Phase	2 HP	8.0
VFD-2H1A124C3	VSAD12-460A	460 Volt 3 Phase	2 HP	3.4
VFD-1/2H1A82O3	VSAD8-230	208-230 Volt Single or 3 Phase	1/2 HP	3.0
VFD-1/2H1A84O3	VSAD8-460A	460 Volt 3 Phase	1/2 HP	1.2
VFD-1H1A81O3	VSAD8-230	115 VAC input/230 Volt 3 Phase Output	1 HP	3.0
VFD-1H1A1O1O3	VSAD10-230	115 VAC input/230 Volt 3 Phase Output	1 HP	5.0
VFD-1H1A102O3	VSAD10-230	208-230 Volt Single or 3 Phase	1 HP	5.0
VFD-1H1A104O3	VSAD10-460A	460 Volt 3 Phase	1 HP	3.4
VFD-2H1A122O3	VSAD12-230	208-230 Volt Single or 3 Phase	2 HP	8.0
VFD-2H1A124O3	VSAD12-460A	460 Volt 3 Phase	2 HP	3.4
VFD-5H2A122C3	(2) VSAD12-230	208-230 Volt Single or 3 Phase	5 HP	17.5
VFD-5H2A124C3	(2) VSAD12-460A	460 Volt 3 Phase	5 HP	8.6
VFD-1/2H1U82C3	VSUB8	208-230 Volt Single or 3 Phase	1/2 HP	3.0
VFD-1/2H1U84C3	VSUB8	460 Volt 3 Phase	1/2 HP	1.2
VFD-1H1U81C3	VSUB8	115 VAC input/230 Volt 3 Phase Output	1 HP	5.0
VFD-1H1U121C3	VSUB12	115 VAC input/230 Volt 3 Phase Output	1 HP	5.0
VFD-1H1U122C3	VSUB12	208-230 Volt 3 Phase	1 HP	5.0
VFD-1H1U124C3	VSUB12	460 Volt 3 Phase	1 HP	3.4
VFD-2H1U162C3	VSUB16	208-230 Volt 3 Phase	2 HP	8.0
VFD-2H1U164C3	VSUB16	460 Volt 3 Phase	2 HP	3.4
VFD-3H1U202C3	VSUB20	208-230 Volt 3 Phase	3 HP	11.0
VFD-3H1U204C3	VSUB20	460 Volt 3 Phase	3 HP	4.8
VFD-1/2H1U82O3	VSUB8	208-230 Volt Single or 3 Phase	1/2 HP	3.0
VFD-1/2H1U84O3	VSUB8	460 Volt 3 Phase	1/2 HP	1.2
VFD-1H1U81O3	VSUB8	115 VAC input/230 Volt 3 Phase Output	1 HP	3.0
VFD-1H1U121O3	VSUB12	115 VAC input/230 Volt 3 Phase Output	1 HP	5.0
VFD-1H1U122O3	VSUB12	208-230 Volt 3 Phase	1 HP	5.0
VFD-1H1U124O3	VSUB12	460 Volt 3 Phase	1 HP	3.4
VFD-2H1U162O3	VSUB16	208-230 Volt 3 Phase	2 HP	8.0
VFD-2H1U164O3	VSUB16	460 Volt 3 Phase	2 HP	3.4
VFD-3H1U202O3	VSUB20	208-230 Volt 3 Phase	3 HP	11.0
VFD-3H1U204O3	VSUB20	460 Volt 3 Phase	3 HP	4.8

MOTOR DRIVE (VFD)

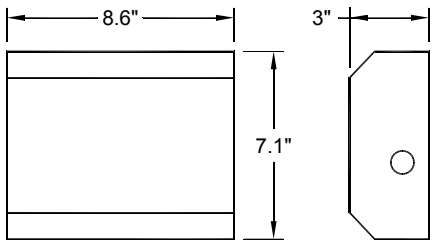


Submittal Data Sheet

EXP-4E EXPANSION MODULE
TD-SERIES PRESSURE TRANSDUCERS
FFP-1 FIRE & FREEZE PROTECTION LIMIT
IPS-1 INDOOR PRESSURE SENSOR

EXP-4E Appliance Interlock Expansion Module
Description
The EXP-4E Expansion Module allows up to four additional appliances to be interlocked with the CPC-3 Constant Pressure Controller. Three EXP-4E modules can be used with one CPC-3 for controlling up to sixteen appliances. It communicates with the CPC-3 via a plug in ribbon cable and has LED lights that provide the status of each appliance interlocked. Comes with a control box that has NEMA class 1 construction.

EXP-4E



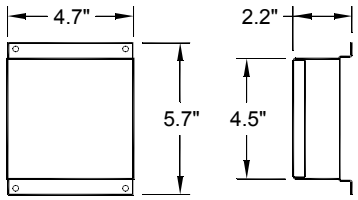
FRONT VIEW END VIEW

TD-Series Pressure Transducers
Description
The TD-Series pressure transducers measure draft pressure within the vent pipe or mechanical room 10 times a second. They communicate with the CPC-3 which modulates the VFD to increase or decrease the Inducer/Blower motor to maintain perfect draft or combustion air. Includes automatic recalibration to stop electronic set point drifting and is not position sensitive.

TD-2 (+0.15" to -0.60" w.c.) for draft or "Sealed" (ducted sealed combustion air) sensing.

TD-3 (+0.10" to -0.10" w.c.) for "Open" (room pressure) combustion air sensing.

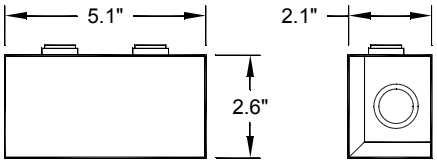
PRESSURE TRANSDUCER



FRONT VIEW SIDE VIEW

FFP-1 Fire & Freeze Protection Limit
Description
The FFP-1 Fire and Freeze Protection Limit helps protect the boiler room from temperature extremes. It is used with Tjernlund Series Commercial Combustion Air Systems. The FFP-1 is designed to disrupt power to a combustion air supply blower in the event of a boiler room fire or an extended period where frigid outdoor air supply could cause pipes to freeze.

FREEZE / FIRE PROTECTOR (FFP-1)



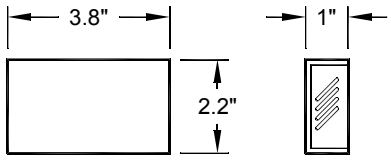
FRONT VIEW END VIEW

WARNING

Do not wire an FFP-1 into a flue gas exhaust system or interuption of the exhaust system may occur if boiler room temperature falls below Freeze Limit temperature setting.

IPS-1 Indoor Pressure Sensor
Description
Decorative cover for indoor reference pressure probe for room pressure combustion air sensing. Includes sampling tube and fittings. For use with TD-Series pressure transducers.

INDOOR PRESSURE SENSOR (IPS-1)



FRONT VIEW END VIEW

Tjernlund Products, Inc. • 1601 Ninth Street • White Bear Lake, MN 55110 • (651) 426-2993 • (800) 255-4208 • FAX (651) 426-9547 • www.tjernlund.com

P/N 8513008 REV C 11/04

Submittal Data Sheet

VSUB16 Variable Speed Universal Blower

Description:
VSUB-Series Variable Speed Universal Blowers are suitable for providing combustion air or sidewall or vertically venting non-condensing heating appliances, dryers and ovens. Can be installed indoors or outdoors.

Use with the CPC-3 Constant Pressure Controller, Closed Loop VFD and TD-Series Pressure Transducer for an Automatic-Variable Speed system which will modulate to always deliver the perfect amount of draft or combustion air. For an Adjustable-Fixed Speed system, use an Open Loop VFD to manually adjust speed of the VSUB.

Housing Construction:
Constructed of 14-gauge, Type 316L stainless steel with continuous welds. The blower outlet rotates 180° for installation flexibility. The motor chassis slides away from the housing on polyethylene guides for easy motor and impeller access.

Impeller:
Backward inclined, high temperature coated, Class 1 impeller is both dynamically and statically balanced with permanently attached balancing weights.

Motor:
Three phase, 2 HP, 208-230/460 VAC, TEFC, EPACT High Efficiency Rated, arctic-duty, thermal overload protected, permanently lubricated and sealed ball bearing.

Standard Equipment:
- 4" x 4" weatherproof junction box with 4' conduit
- Square to round vent pipe adapter
- PSA-1 Fan Proving Switch
- FFP-1 Freeze and Fire Protection Limit
  (FFP-1 For combustion air applications only!)
- Condensate drain kit

Optional Controls:
- CPC-3 Constant Pressure Controller
- IPS-1 Indoor Pressure Sensor decorative cover, fittings
- TD-2 Pressure Transducer (+0.15" to -0.60" w.c.)
  For draft or "Sealed" (ducted sealed combustion air) sensing
- TD-3 Pressure Transducer (+0.10" to -0.10" w.c.)
  For "Open" (room pressure) combustion air sensing
- VFD-Series Variable Frequency Drives

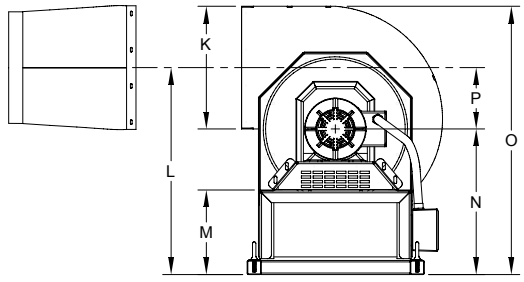
Temperature Rating:
U.S. and Canada 575°F / 300°C

Listings:
ETL # 56826
UL 378 - Draft Equipment / Variable Speed
UL 705 - Power Ventilators
CSA-CAN3-B255-M81

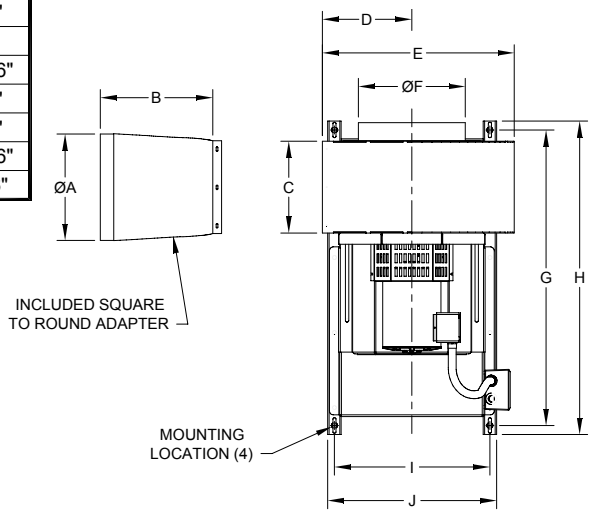
Warranty:
2 year mechanical

Model VSUB16		208-230 Volt	460 Volt
Power	hp	2	2
Amps	A	6.0 - 5.6	2.8
Voltage	VAC	3x208-230	3x460
Weight		285 Lbs. / 129 Kgs.	

	VSUB16
A	15 7/8"
B	14"
C	11 15/16"
D	13 5/16"
E	27 1/2"
F	15 7/8"
G	41 11/16"
H	43 11/16"
I	23 1/4"
J	24 3/4"
K	16"
L	26 13/16"
M	11 3/4"
N	18 7/8"
O	34 13/16"
P	7 15/16"



END VIEW



TOP VIEW