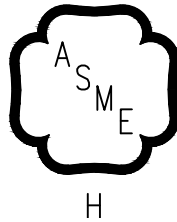


INSTALLATION, OPERATING AND SERVICE INSTRUCTIONS RRO SERIES CAST IRON OIL-FIRED BOILER



For service or repairs to boiler, call your heating contractor. When seeking information on boiler, provide Boiler Model Number and Serial Number as shown on Rating Label.

Boiler Part Number RRO _	Boiler Serial Number	Installation Date
Heating Contractor		Phone Number
Address		

IMPORTANT INFORMATION - PLEASE READ THIS PAGE CAREFULLY

1. Read and understand all instructions, including all those contained in component manufacturers manuals which are provided with the appliance before installing, starting-up, operating, maintaining or servicing this appliance. Keep this manual and literature in legible condition and posted near appliance for reference by owner and service technician.
2. All heating systems should be designed by competent contractors and only persons knowledgeable in the layout and installation of hydronic heating systems should attempt installation of any boiler.
3. All boilers must be installed in accordance with National, State and Local Plumbing, Heating and Electrical Codes and the regulations of the serving utilities. These Codes and Regulations may differ from this instruction manual. Authorities having jurisdiction should be consulted before installations are made.

In all cases, reference should be made to the following Standards:

USA BOILERS

- A. Current Edition of American National Standard ANSI/NFPA 31, "Installation of Oil Burning Equipment", for recommended installation practices.
- B. Current Edition of American National Standard ANSI/NFPA 211, "Chimneys, Fireplaces, Vents, and Solid Fuel Burning Appliances", For Venting requirements.
- C. Current Edition of American Society of Mechanical Engineers ASME CSD-1, "Controls and Safety Devices for Automatically Fired Boilers", for assembly and operations of controls and safety devices.
- D. All wiring on boilers installed in the USA shall be made in accordance with the National Electrical Code and/or Local Regulations.

DANGER

DO NOT store or use gasoline or other flammable vapors or liquids in the vicinity of this or any other appliance.

WARNING

This boiler is suitable for installation on combustible flooring. Do not install boiler on carpeting.

Installation is not complete unless a pressure relief valve is installed into the tapping located on top left corner of rear section - See Piping and Trim Sections of this manual for details.

This boiler is designed to burn No. 2 fuel oil only. Do not use gasoline, crankcase drainings, or any oil containing gasoline. Never burn garbage or paper in this boiler. Do not convert to any solid fuel (i.e. wood, coal). Do not convert to any gaseous fuel (i.e. natural gas, LP). All flammable debris, rags, paper, wood scraps, etc., should be kept clear of the boiler at all times. Keep the boiler area clean and free of fire hazards.

This boiler needs fresh air for safe operation and must be installed so there are provisions for adequate combustion and ventilation air.

This boiler must be connected to an approved chimney in good condition. Serious property damage could result if the boiler is connected to a dirty or inadequate chimney. The interior of the chimney flue must be inspected and cleaned before the start of the heating season for any obstructions. A clean and unobstructed chimney flue is necessary to allow noxious fumes that could cause injury or loss of life to vent safely and will contribute toward maintaining the boiler's efficiency.

Inspect flueways at least once a year - preferably at the start of the heating season. The inside of the combustion chamber, the vent system and boiler flueways should be cleaned if soot or scale has accumulated.

When cleaning this boiler, do not damage combustion chamber liner and/or rear target wall. If damaged, combustion chamber insulation must be replaced immediately.

This boiler requires regular maintenance and service to operate safely. Follow the instructions contained in this manual. Installation, maintenance, and service must be performed only by an experienced, skilled and knowledgeable installer or service agency.

It is the responsibility of the installing contractor to see that all controls are correctly installed and are operating properly when the installation is completed. Do not tamper with or alter the boiler or controls.

Do not operate unit if any control, switch, component, or device has been subject to water.

Oil Burner and Controls must be checked at least once a year or as may be necessitated.

All boilers equipped with burner swing door have a potential hazard which if ignored can cause severe property damage, personal injury or loss of life. Before opening swing door, turn off service switch to boiler to prevent accidental firing of burner outside the combustion chamber. Be sure to tighten swing door fastener completely when service is completed.

Appliance materials of construction, products of combustion and the fuel contain alumina, silica, heavy metals, carbon monoxide, nitrogen oxides, aldehydes and/or other toxic or harmful substances which can cause death or serious injury and which are known to the state of California to cause cancer, birth defects and other reproductive harm. Always use proper safety clothing, respirators and equipment when servicing or working nearby the appliance.

High water temperatures increase the risk of scalding injury. If this boiler is equipped with a tankless heater for domestic water supply, a flow regulator and automatic mixing valve must be installed properly in tankless heater piping. See Piping and Trim Sections of the manual for details.

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I. GENERAL INFORMATION

- A. INSPECT SHIPMENT** carefully for any signs of damage.
1. ALL EQUIPMENT is carefully manufactured, inspected and packed. Our responsibility ceases upon delivery of crated boiler to the carrier in good condition.
 2. ANY CLAIMS for damage or shortage in shipment must be filed immediately against the carrier by the consignee. No claims for variances from, or shortage in orders, will be allowed by the manufacturer unless presented within sixty (60) days after receipt of goods.
- B. LOCATE BOILER** in front of final position before removing crate. See Figures 1a and 1b for applicable positioning.
1. LOCATE so that smoke pipe connection to chimney will be short and direct. **BOILER IS SUITABLE FOR INSTALLATION ON COMBUSTIBLE FLOOR.** Boiler cannot be installed on carpeting.
 2. FOR BASEMENT INSTALLATION, provide a solid base, such as a concrete pad, if floor is not level, or if water may be encountered on floor around boiler.
 3. PROVIDE SERVICE CLEARANCE of at least 24” on top of boiler for cleaning flueways. Provide at least 24” clearance from front jacket panel for servicing.
 4. For minimum clearances to combustible materials. See Figure 2.
- C. PROVIDE AIR SUPPLY AND VENTILATION** to accommodate proper combustion. If natural ventilation is inadequate, provide a screened opening or duct from the boiler room to the outside. The opening or duct must be sized so the boiler input will not exceed 4,000 BTUH/Sq. In. of free area. If other air consuming appliances are near the boiler, the air inlet should be larger. Consult respective manufacturers.

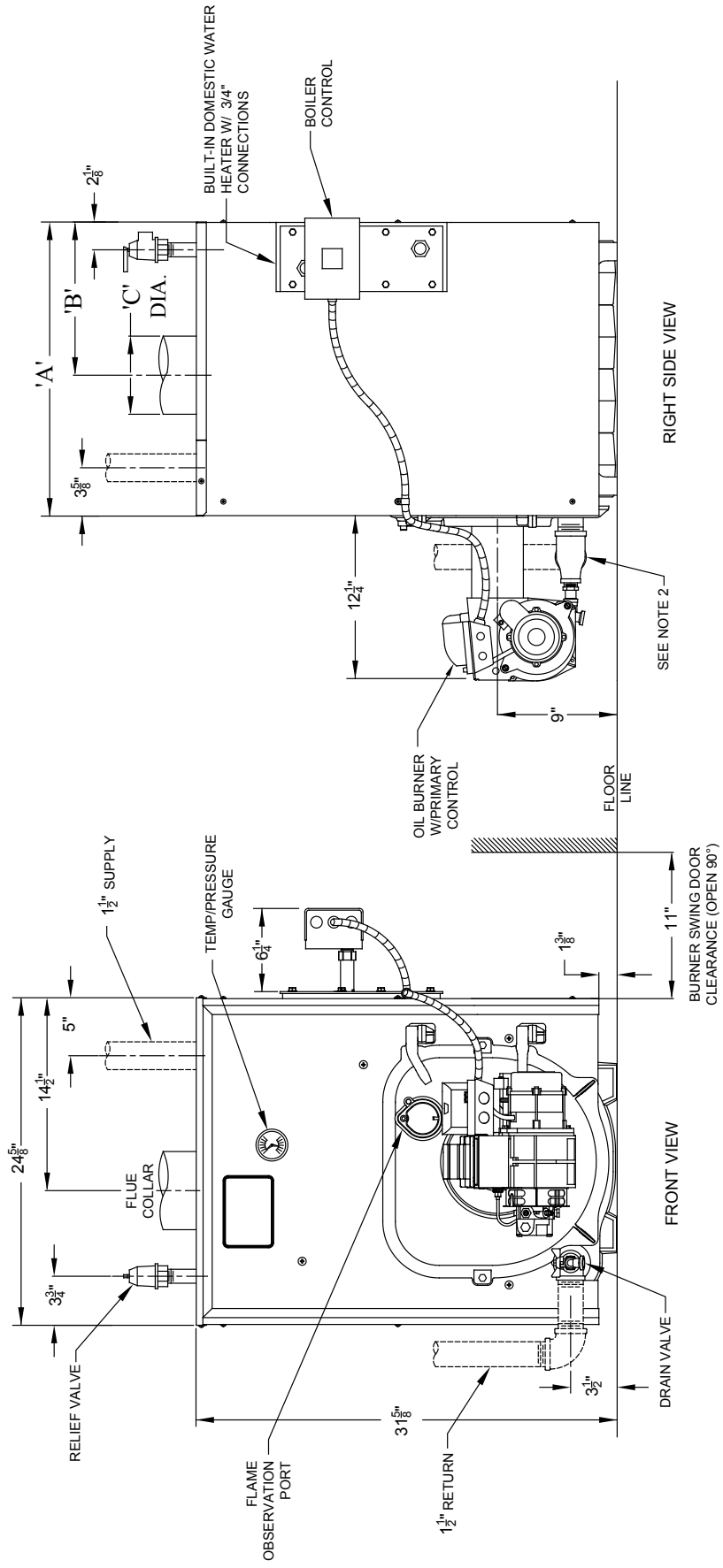


Figure 1b: RRO080 through RRO179 Boiler with Tankless Heater

TABLE 1: DIMENSIONAL DATA (See Figures 1a and 1b)

Boiler Model	Dimensions			Approx. Water Content (Gallons)	Heat Transfer Surface Area (Sq. Ft.)	Approx. Shipping Weight (LBS.)
	"A"	"B"	"C"			
RRO080, RRO092, RRO120	17-3/8"	8-1/4"	5-7/8"	16	14.33	560
RRO111, RRO151, RRO179	22-3/8"	10-7/8"	6-7/8"	20	20.90	680

Maximum Working Pressure - Water: 50 PSI
 Boiler shipped from factory with a 30 PSI relief valve.



TABLE 2: RATING DATA

Boiler Model	Burner Capacity		Heating Capacity (MBH)	NET AHRI Water Ratings (MBH)	AFUE %	Minimum Chimney Requirements		
	GPH	MBH				Round In. Dia.	Rectangle In. x In.	Height Ft.
RRO080	0.65	91	80	70	86.1	6	8 x 8	15
RRO092	0.75	105	92	80	86.0	6	8 x 8	15
RRO120	1.00	140	120	104	84.3	6	8 x 8	15
RRO111	0.90	126	111	97	86.0	7	8 x 8	15
RRO151	1.25	175	151	131	85.1	7	8 x 8	15
RRO179	1.50	210	179	156	84.0	8	8 x 8	15

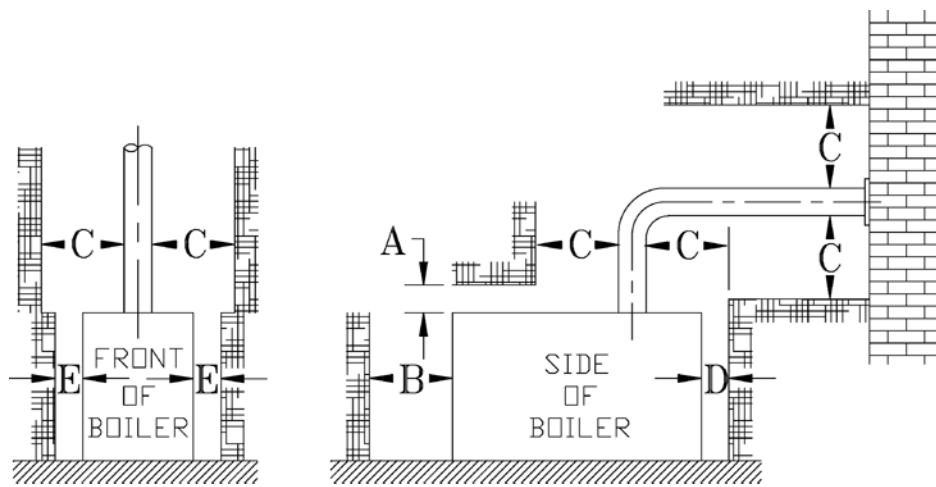


Figure 2: Minimum Installation Clearances To Combustible Materials (Inches)

A	B	C	D	E
Above	Front	Chimney Connector	Rear	Sides
6	24	18	6	6

NOTE 1: Listed clearances comply with American National Standard NFPA 31, Standard for the Installation of Oil Burning Equipment.

NOTE 2: RRO™ Series boilers can be installed in rooms with clearances from combustible material as listed above. Listed clearances cannot be reduced for alcove or closet installations.

NOTE 3: For reduced clearances to combustible material, protection must be provided as described in the ANSI/NFPA 31 standard.

II. INSTALLATION INSTRUCTIONS

A. REMOVE CRATE

1. Remove all fasteners at crate skid.
2. Lift outside container and remove all other inside protective spacers and bracing. Remove miscellaneous water trim carton.
3. Using hand truck or pipe rollers under skid, move boiler into position along side installation site.

B. REMOVAL OF BOILER FROM SKID

1. Boiler is secured to base with 4 carriage bolts, 2 on left side and 2 on right side. See Figure 3. Remove all bolts.

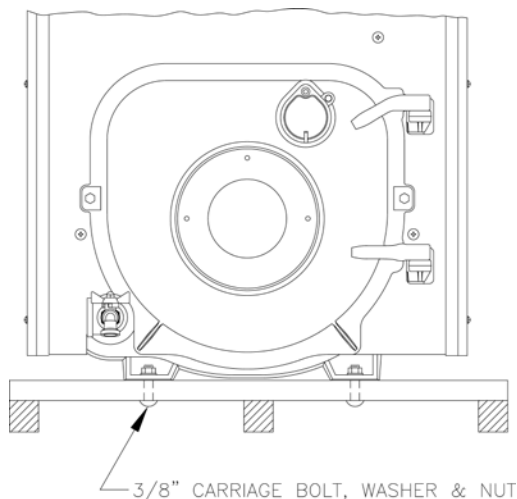


Figure 3: Removal of Boiler From Skid

2. Tilt boiler to right and to rear. Using right rear leg as pivot, rotate boiler 90° in a clockwise direction, and lower left side of boiler to floor. Tilt boiler and remove crate skid. Care should be exercised to prevent damage to jacket or burner.

C. MOVE BOILER TO PERMANENT POSITION by sliding or walking.

D. INSPECT COMBUSTION TARGET WALL AND COMBUSTION CHAMBER LINER

1. OPEN FLAME OBSERVATION DOOR AND/OR BURNER SWING DOOR on front of boiler. Use flashlight to inspect target wall secured to rear section with silastic sealant. Inspect ceramic fiber blanket secured to floor of boiler with water glass adhesive. If either is damaged they must be replaced.

E. INSTALL TRIM AND CONTROLS, AS REQUIRED (see Figure 1a or 1b)

1. Install return piping supplied with boiler. Apply Teflon or Sealant to all joints prior to assembly. Thread 1½" NPT x 5" Lg. return nipple into 1½" NPT tapping located in lower left corner of front

section. Thread 1½" x ¾" x 1½" NPT tee onto 5" nipple. Thread ¾" drain valve into ¾" NPT connection on tee. Tighten all joints with wrench until water tight and 1½" NPT return connection on tee is facing away from boiler horizontally to allow for proper burner swing door clearance, see Figures 1 and 4.

NOTE: Vertical piping will prevent door from opening fully for service and cleaning of boiler.

2. Thread relief valve onto factory installed ¾" NPT x 7/4" nipple located in left rear corner on top of boiler as shown in Figure 1a or 1b. Valve spindle must be in vertical position. Tighten with wrench. Pipe discharge as shown in Figure 4. Installation of the relief valve must be consistent with ANSI/ASME Boiler and Pressure Vessel Code, Section IV.

F. CONNECT SUPPLY AND RETURN PIPING TO HEATING SYSTEM.

1. CLEARANCES — Hot water pipes shall have clearances of at least ½" from all combustible construction.
2. See Figure 4 FOR PIPING. Also, consult Residential Hydronic Heating Installation and Design I=B=R Guide.
3. Use a boiler water bypass if the boiler is to be operated in a system which has a large volume or excessive radiation where low boiler water temperature may be encountered (i.e. converted gravity circulation system, etc.).

Install a pipe tee between the circulator and boiler return along with a second tee in the supply piping as shown in Figure 4. The bypass should be the same size as the supply and return lines. Locate valves in the bypass and supply outlet as illustrated in Figure 4 for regulation of water flow to maintain higher boiler water temperature.

Set the by-pass and boiler supply valves to a half throttle position to start. Operate boiler until the system water temperature is a normal operating range.

Adjust the valves to provide 180° to 200°F supply water temperature. Opening the boiler supply valves will raise the system temperature, while opening the bypass valve will lower the system supply temperature.

4. If this boiler is connected to heating coils located in air handling units where they may be exposed to refrigerated air the boiler piping must be equipped with flow control valves to prevent gravity circulation of boiler water during the operation of the cooling system.

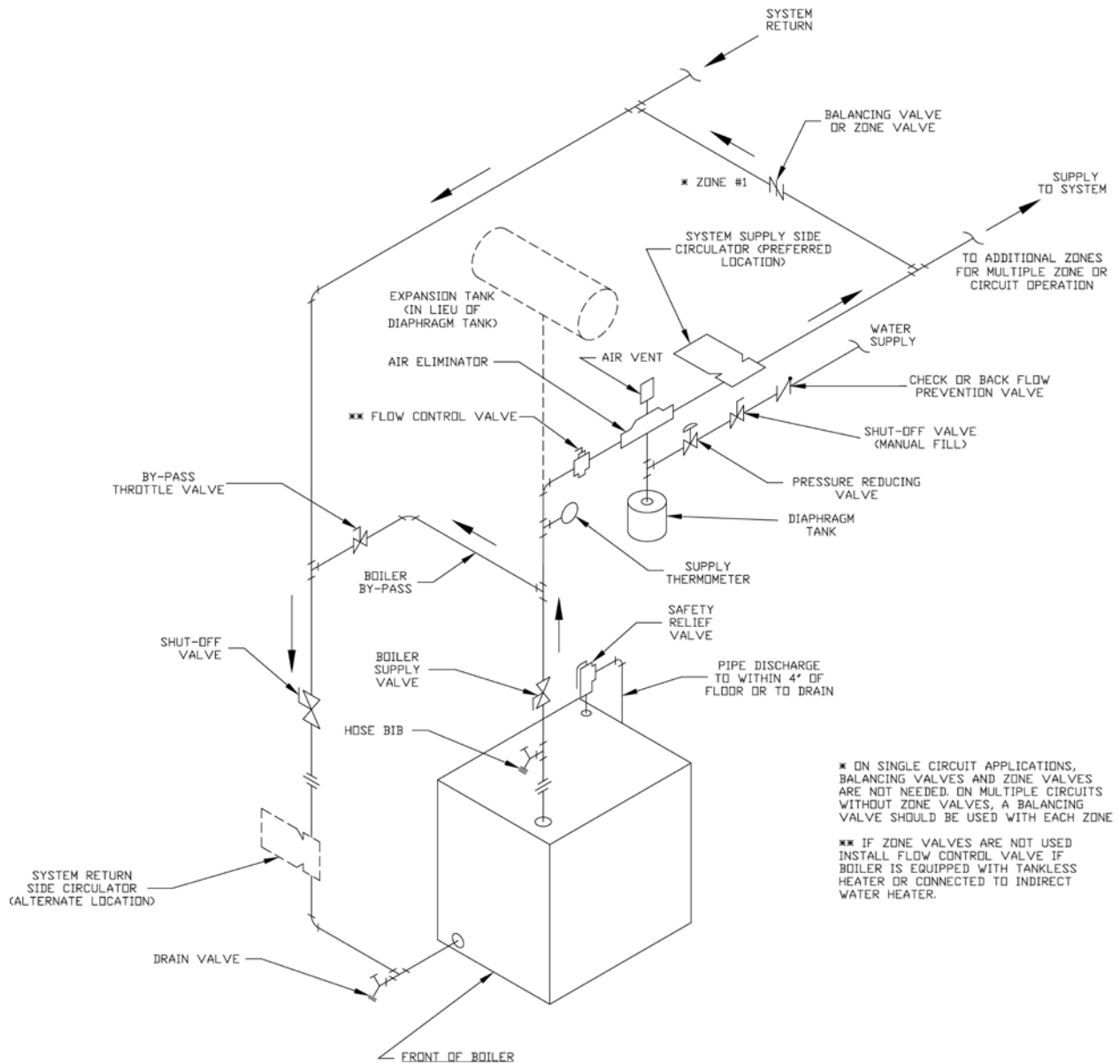


Figure 4: Recommended Boiler Piping for Series Loop Hot Water System

5. If this boiler is used in connection with refrigeration systems, the boiler must be installed so that the chilled medium is piped in parallel with the heating boiler using appropriate valves to prevent the chilled medium from entering the boiler, see Figure 5. Also, consult Residential Hydronic Heating Installation and Design I=B=R Guide.
6. A hot water boiler installed above radiation level must be provided with a low water cutoff device as part of the installation. See Section X, Low Water Cut-Off for additional details.
7. Oxygen Contamination:
 - a. There are many possible causes of oxygen contamination such as:
 - i. Addition of excessive make-up water as a result of system leaks.
 - ii. Absorption through open tanks and fittings.
 - iii. Oxygen permeable materials in the distribution system.
 - b. In order to insure long product life, oxygen sources should be eliminated. This can be accomplished by taking the following measures:
 - i. Repairing system leaks to eliminate the need for addition of make-up water.
 - ii. Eliminating open tanks from the system.
 - iii. Eliminating and/or repairing fittings which allow oxygen absorption.
 - iv. Use of non-permeable materials in the distribution system.
 - v. Isolating the boiler from the system water by installing a heat exchanger.

See Section VI, Paragraph B for additional details.

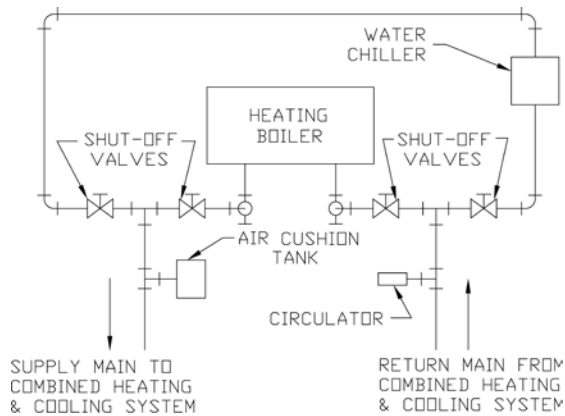


Figure 5: Recommended Piping for Combination Heating & Cooling (Refrigeration) Systems

TABLE 3: TANKLESS HEATER DATA

Boiler Model	Rating (Gal/Min)	Pressure Drop (PSI)
RRO080	2.75	3.9
RRO092	3.00	4.7
RRO120	3.25	5.6
RRO111	3.25	5.6
RRO151	3.75	7.2
RRO179	4.00	8.0

during “off” periods when it is possible for heat to be conducted back through the supply line. The flow regulator also limits the flow of supply water regardless of inlet pressure variations in the range of 20 to 125 psi.

2. **TEMPERING OF HOT WATER** — Installation of an automatic mixing valve will lengthen the delivery of the available hot water by mixing some cold water with the hot. This prevents excessive and possibly scalding hot water at the fixtures. In addition, savings of hot water will be achieved since the user will not waste as much hot water while seeking water temperature to his liking. Higher temperature hot water required by dishwashers and automatic washers is possible by piping the hot water from the heater prior to entering the mixing valve. The mixing valve should be “trapped” by installing it below the cold water inlet to heater to prevent lime formation in the valve.

CAUTION

Oxygen contamination of the boiler water will cause corrosion of iron and steel boiler components, and can lead to boiler failure. RRO's Standard Warranty does not cover problems caused by oxygen contamination of boiler water or scale (lime) build-up caused by frequent addition of water.

- G. **CONNECT TANKLESS HEATER PIPING AS SHOWN IN Figure 6.** See Table 3 for Tankless Heater Ratings.

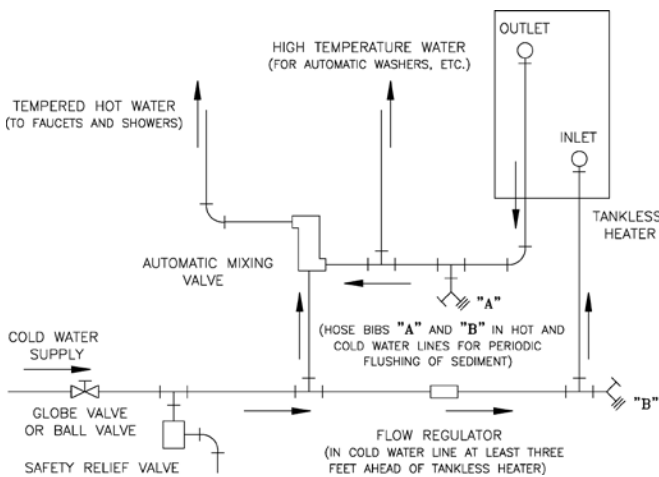


Figure 6: Schematic Tankless Heater Piping

THE FOLLOWING GUIDELINES SHOULD BE FOLLOWED WHEN PIPING THE TANKLESS HEATER:

1. **FLOW REGULATION** — If flow through the heater is greater than its rating, the supply of adequate hot water may not be able to keep up with the demand. For this reason a flow regulator matching the heater rating should be installed in the cold water line to the heater. The flow regulator should preferably be located below the inlet to the heater and a minimum of 3’ away from the inlet so that the regulator is not subjected to excess temperatures that may occur

WARNING

Install automatic mixing valve at tankless heater outlet to avoid risk of burns or scalding due to excessively hot water at fixtures. Adjust and maintain the mixing valve in accordance with the manufacturer's instructions.

3. **FLUSHING OF HEATER** — All water contains some sediment which settles on the inside of the coil. Consequently, the heater should be periodically backwashed. This is accomplished by installing hose bibs as illustrated and allowing water at city pressure to run into hose bib A, through the heater, and out hose bib B until the discharge is clear. The tees in which the hose bibs are located should be the same size as heater connections to minimize pressure drop.
4. **HARD WATER** — A water analysis is necessary to determine the hardness of your potable water. This is applicable to some city water and particularly to well water. An appropriate water softener should be installed based on the analysis and dealer’s recommendation. This is not only beneficial to the tankless heater but to piping and fixtures plus the many other benefits derived from soft water.

WARNING

Vent this boiler according to these instructions. Failure to do so may cause products of combustion to enter the home resulting in severe property damage, personal injury or death.

Insufficient Combustion Air Supply may result in the production and release of deadly carbon monoxide (CO) into the home which can cause severe personal injury or death.

Improper venting may result in property damage and the release of flue gases which contain deadly carbon monoxide (CO) into the home, which can cause severe personal injury, death, or substantial property damage.

Inspect existing chimney and vent connector for obstructions and deterioration before installing boiler. Failure to clean or replace perforated pipe or chimney liner will cause severe injury or death.

Do not de-rate the appliance. Failure to fire the boiler at its designed input may cause excessive condensation upon the interior walls of the chimney. In addition, the lower input may not create enough draft to adequately evacuate the by-products of combustion.

H. CHIMNEY VENTING

1. Chimney venting is an important part of a safe and efficient oil fired appliance system. Contact your local fire and building officials on specific requirements for restrictions and the installation of fuel oil burning equipment. In addition, consult with a professional knowledgeable on the requirements of NFPA 31 – Standard for the Installation of Oil-Burning Equipment and NFPA 211 - Standard for Chimneys, Fireplaces, Vents, and Solid Fuel-Burning Appliances for installations in the United States. Installations in Canada must be reviewed with a professional knowledgeable on the requirements of CSA B139 – Installation Code for Oil-burning Equipment.
2. The safe venting of oil fired boilers is dependant on many factors. Some of these factors include:
 - a. sufficient draft during the entire heating season to allow for the safe discharge of combustion by-products and;
 - b. suitable corrosion protection in the event of condensing flue gases. Only a trained and qualified contractor may install this product.
3. The RRO shall be vented into any of the following:
 - a. Masonry or metal chimney. Build and install in accordance with local buildings codes; or local authority having jurisdiction; or “Standards for Chimney, Fireplace, Vents, and Solid Fuel Burning Appliances”, ANSI/NFPA 211 and/or National Building Code of Canada. Masonry chimney must be lined with listed chimney system. Listed clay flue lined masonry chimneys meet venting requirements.
 - External chimneys are more susceptible to flue gas condensation due to colder outside air temperatures. To prevent corrosion due to flue gas condensation, use a listed corrosion-resistant metal liner in chimney.

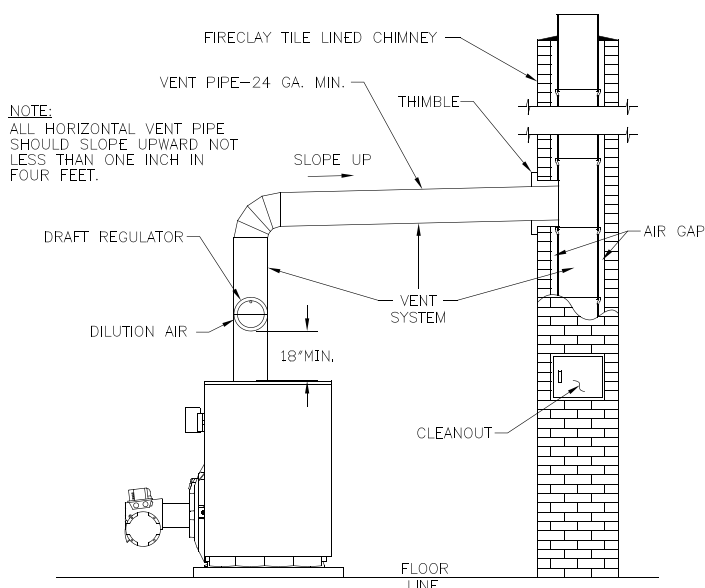


Figure 7: Recommended Smokepipe Arrangement and Chimney Requirements

- Oversized chimneys are more susceptible to flue gas condensation. To reduce the likelihood of flue gas condensation and ensure proper draft, use a properly sized listed metal liner in oversized chimney.
4. Chimney Inspection – Prior to the installation of any new or replacement fuel burning equipment the chimney shall be inspected by a qualified installer. The chimney shall be inspected for integrity as well as for proper draft and condensate control. Some jurisdictions require the use of a liner when changing fuel types. Some jurisdictions require the use of a liner even when the same fuel is used. At a minimum, the chimney shall be examined by a qualified person in accordance with the requirements of Chapter 11 of NFPA 211, Standard for Chimneys, Fireplaces, Vents, and Solid Fuel-Burning Appliances.

- a. Loose Mortar—Loose mortar could be an indication of a prior history of condensing flue gases upon the inside walls of the chimney. Colder climates are more susceptible to this condition. Under no circumstances shall a chimney of this condition be used until it meets the requirements of NFPA 211 or CSA B139.
 - b. Unlined Chimney – Under no circumstances shall a chimney constructed of brick only be used. Only approved clay liners or listed chimney lining systems shall be used as specified in NFPA 31 or CSA B139.
 - c. Abandoned Openings – Openings through the chimney wall that are no longer used shall be sealed in accordance to NFPA 211. Often abandoned openings are improperly sealed and usually covered by a gypsum wall covering.
 - d. Clean Chimney – Chimney shall be free of all loose debris.
5. Draft Regulator – a draft regulator is not supplied with the boiler. A draft regulator must be used with this appliance. Refer to Figures 7 and 8.

DANGER

The chimney and connector shall be inspected annually for signs of debris and corrosion. Loose mortar at the base of the chimney may be a sign of condensate damage to the chimney. A chimney professional shall be contacted immediately to examine the damage and recommend a solution. Long term operation while in this condition may cause a venting failure and force flue gases into the living space. If the chimney is to be re-lined use the recommendations in NFPA 31, Appendix E or CSA B139.

- 2. Vent Connector shall be any of the following and of the same size as the outlet of boiler.
 - a. Type L or a factory built chimney material that complies with the Type HT requirements of ANSI/UL 103. Install in accordance with listing and manufacturer's instructions.
 - b. Steel pipe having resistance to corrosion and heat with a minimum wall thickness of 24 Gauge (0.024").

CHIMNEY CONNECTOR

- 1. A chimney connector (vent pipe) is used to connect the boiler to the base of the chimney. The chimney connector should be kept as short as possible. The horizontal length of the chimney connector shall not be greater than 10 feet.

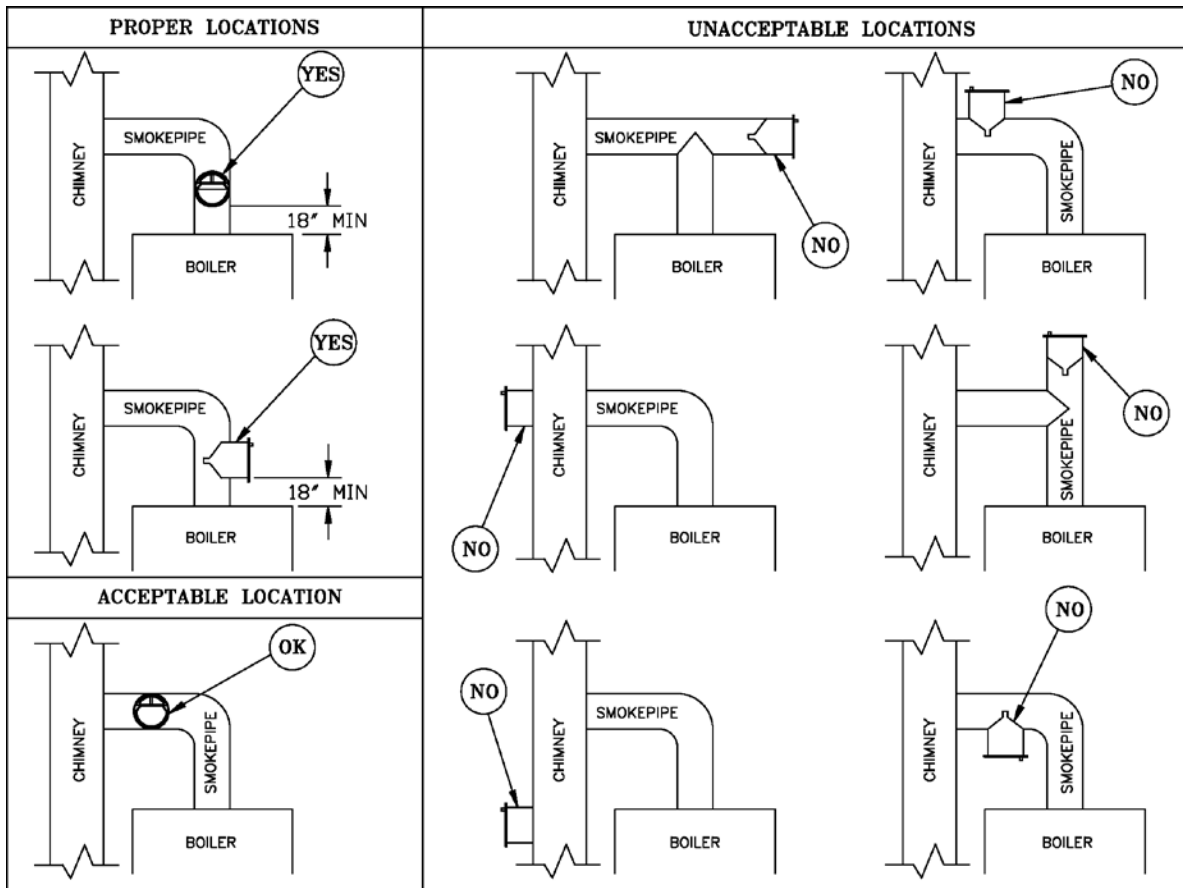


Figure 8: Proper and Improper Locations of Draft Regulator

DANGER

Any signs of condensate seepage at the base of the chimney shall be inspected immediately. The discoloration may be a sign of chimney damage and must be remedied immediately.

DRAFT

1. The natural draft generated through a chimney is dependent on several factors including, chimney height, temperature of flue gases, cross section area of chimney, chimney wall insulation value, dilution air and total volume of flue gases, to name a few. Make sure that the boiler has been running for at least 5 minutes before measuring the draft.
2. Minimum Draft Overfire – The draft induced by a chimney must create at least a pressure of -0.02 inches water column (“ w.c.”). The pressure at the canopy **cannot** be positive since this could create a condition that allows flue gas by-products to escape from the draft regulator. A negative pressure reading up to -.03 inches water column is acceptable for proper operation.

STACK TEMPERATURE

1. The temperature of the flue gases has a significant effect on the amount of draft created in a vertical chimney as well as the propensity to create condensate. The higher the stack temperature, the greater the amount of draft that can be generated. A lower stack temperature not only reduces the amount of draft that can be created but it also increases the possibility that the flue gases could condense in the chimney connector or stack.
2. NFPA 31 and CSA B139 have information to help the installer make an appropriate choice of venting materials. In some cases a chimney may have to be lined to create sufficient draft. In other cases, the chimney may have to be lined to prevent the corrosion of a masonry chimney. Consult with a chimney specialist knowledgeable on the requirements for chimney requirements in your area.

CAUTION

Any doubt on the condition of a chimney or its ability to prevent the generation and accumulation of flue gas condensate, must be relined according to NFPA 31 (United States) or CSA B139 (Canada).

CAUTION

Use the chimney venting tables as a guide. It is highly recommended that any borderline application should result in the relining of the chimney with a suitable liner that creates sufficient draft and to protect against corrosion caused by flue gas condensate.

I. INSPECT NOZZLE, ELECTRODES INSERTION DEPTH AND TURBULATOR SETTING/CHANGE FIRING RATE:

1. Select the proper oil nozzle for the installation. Refer to Table 2 for Firing rates.
If the installed firing rate is desired, inspect the installed nozzle and assure that the nozzle is the correct size and type as specified in Burner Specifications, Table 13 in Section X.
If a different firing rate is desired, remove the nozzle which was factory installed. Locate the desired firing rate nozzle (supplied with burner). Confirm the nozzle is the proper size and type for the desired firing rate as specified in Table 13 in Section X. Install the proper nozzle in the burner nozzle adaptor.
2. Check the settings and to change the nozzle to a different firing rate:
 - a. Loosen two (2) igniter latching screws, rotate tabs and swing open igniter about hinge.
 - b. Loosen knurled nut and disconnect copper connector tube.
 - c. Remove nozzle line electrode assembly.
 - d. If installed firing rate is desired, confirm the nozzle is the proper size and type, refer to Table 13 in Section X, then proceed to Item i. below.
 - e. If a different firing rate is desired, remove the nozzle that was factory installed.
 - f. Remove Beckett MB(L1) or MD(V1) head.
 - g. Locate the desired nozzle. Refer to Table 13 in Section X for proper nozzle. The nozzle must be securely installed to assure leak free joints between the nozzle and adapter. When installing the nozzle, be careful not to bump or move the burner electrodes.
Note: On the RRO080 with firing rate of 0.65 GPH, the low firing rate baffle is required.
 - h. Reinstall Beckett MB(L1) or MD(V1) Head.
 - i. Inspect and measure burner electrodes. Refer to Figure 9 or the proper electrode setting. Readjust electrode setting to the proper dimensions if necessary. Refer to Figure 9.
 - j. Reinstall nozzle line electrode assembly.
 - k. Connect copper connector tube.
 - l. Inspect Beckett head setting on left side of burner by insuring the line on the label MB(L1) or the blue line MD(V1) are aligned, readjust if necessary. Refer to Figure 9.
 - m. Tighten knurled nut.
 - n. Swing igniter closed, rotate tabs and tighten two (2) igniter screws.
 - o. Locate the Conversion Label Envelope with the desired firing rate in the Instruction Assembly Envelope. Apply the Conversion Rating Label

IMPORTANT

Single-pipe installations must be absolutely airtight or leaks or loss of prime may result. Bleed line and fuel unit completely.

TWO-PIPE OIL LINES For two-pipe systems where more lift is required, the two-stage fuel unit is recommended. Table 4 (single-stage) and Table 5 (two-stage) show allowable lift and lengths of 3/8-inch and 1/2-inch OD tubing for both suction and return lines. Refer to Figure 11.

Be sure that all oil line connections are absolutely airtight. Check all connections and joints. Flared fittings are recommended. Do not use compression fittings.

Open the air-bleed valve and start the burner. For clean bleed, slip a 3/16" ID hose over the end of the bleed valve and bleed into a container. Continue to bleed for 15 seconds after oil is free of air bubbles. Stop burner and close valve.

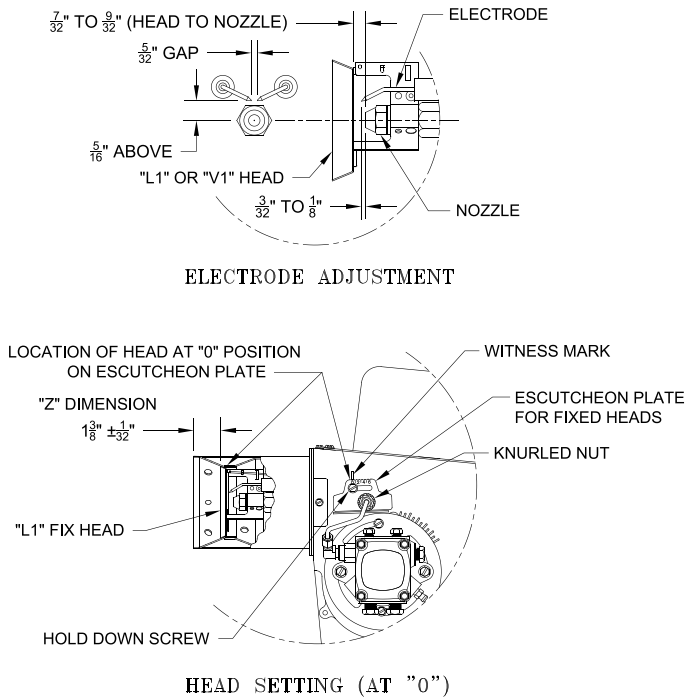


Figure 9: "L1" and "V1" Head Electrode Positioning and Gun Setting (Beckett AFG)

near the existing Rating Label on the boiler. DO NOT REMOVE or COVER-UP the existing Rating Label.

J. FUEL UNITS AND OIL LINES

SINGLE-PIPE OIL LINES Standard burners are provided with single-stage 3450 rpm fuel units with the by-pass plug removed for single-pipe installations.

The single-stage fuel unit may be installed single-pipe with gravity feed or lift. Maximum allowable lift is 8 feet. See Figure 10.

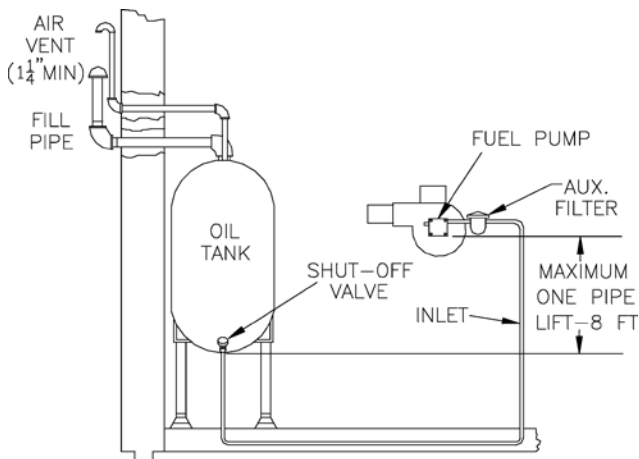


Figure 10

TABLE 4: SINGLE STAGE UNITS (3450 RPM) TWO PIPE SYSTEMS

Lift "H" (See Figure)	Maximum Length of Tubing "H" + "R" (See Figure)	
	3/8" OD Tubing (3 GPH)	1/2" OD Tubing (3 GPH)
0'	84'	100'
1'	78'	100'
2'	73'	100'
3'	68'	100'
4'	63'	100'
5'	57'	100'
6'	52'	100'
7'	47'	100'
8'	42'	100'
9'	36'	100'
10'	31'	100'
11'	26'	100'
12'	21'	83'
13'	---	62'
14'	---	41'

**TABLE 5: TWO-STAGE UNITS (3450 RPM)
TWO-PIPE SYSTEMS**

Lift "H" (See Figure)	Maximum Length of Tubing "H" + "R" (See Figure)	
	3/8" OD Tubing (3 GPH)	1/2" OD Tubing (3 GPH)
0'	93'	100'
2'	85'	100'
4'	77'	100'
6'	69'	100'
8'	60'	100'
10'	52'	100'
12'	44'	100'
14'	36'	100'
16'	27'	100'
18'	---	76'

K. SINGLE ZONE WIRING

1. 120 Volt Wiring - The boiler should be provided with its own 15A branch circuit with fused disconnect. All 120 volt connections are made inside the HydroStat relay as follows (see Figures 11a and 11b).
 - Hot ("black") - Wire Nut with Black wire of ON/OFF Toggle Switch
 - Neutral ("white") - Terminal "L2"
 - Ground ("green" or bare) - Ground screw on the case
2. Thermostat Wiring - Follow thermostat manufacturer instructions. To insure proper thermostat operation, avoid installation in areas of poor air circulation, hot spots (near any heat source or in direct sunlight), cold spots (outside walls, walls adjacent to unheated areas, locations subject to drafts). Provide Class II circuit between thermostat and boiler. Connect thermostat wire leads to terminals "T" and "T" (see Figures 11a and 11b).

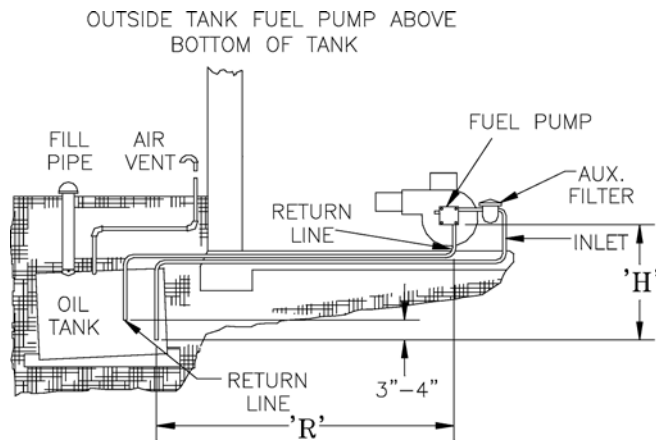


Figure 11

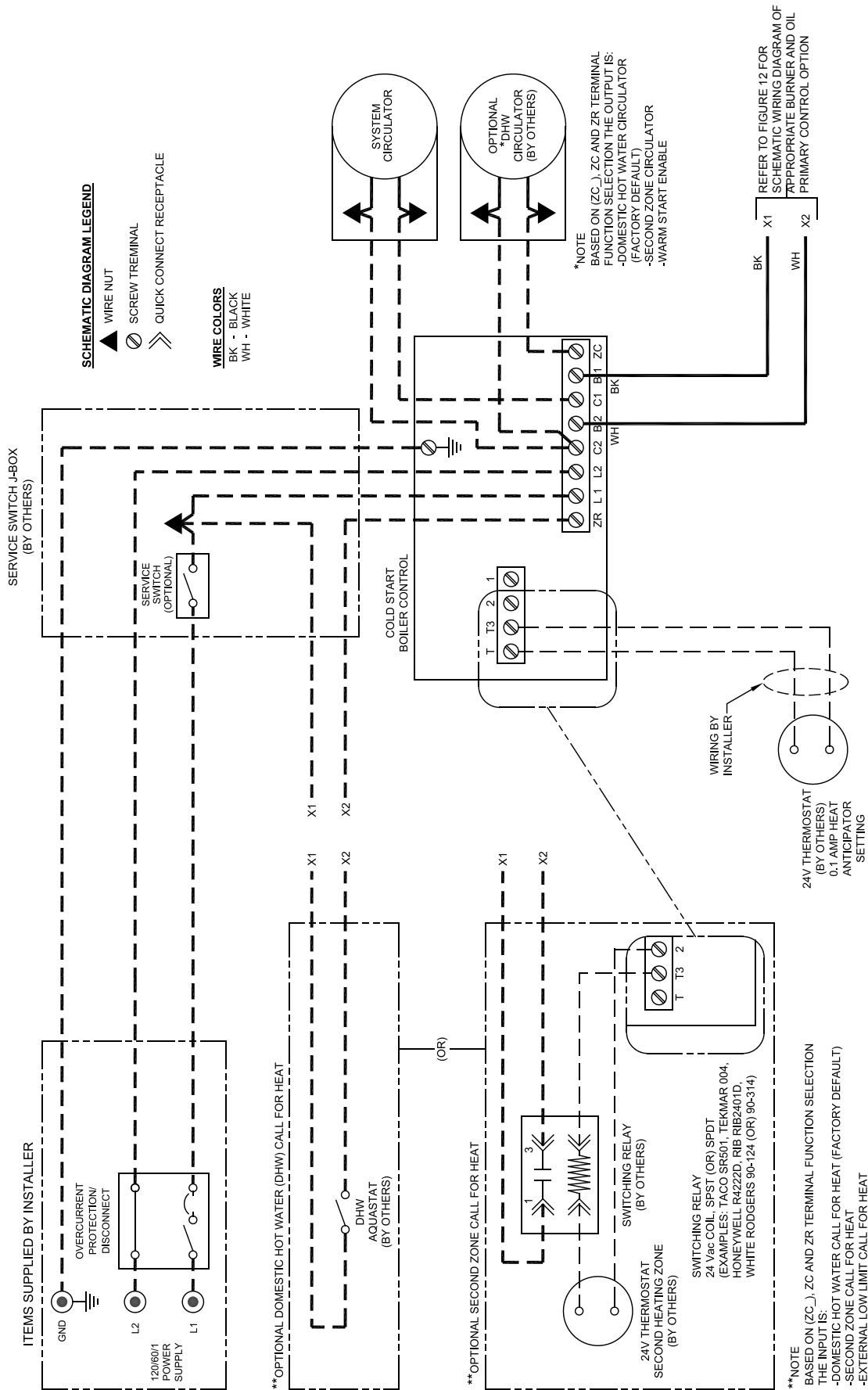


Figure 11a: Schematic Wiring Diagram, without Tankless Heater, Cold Start Control

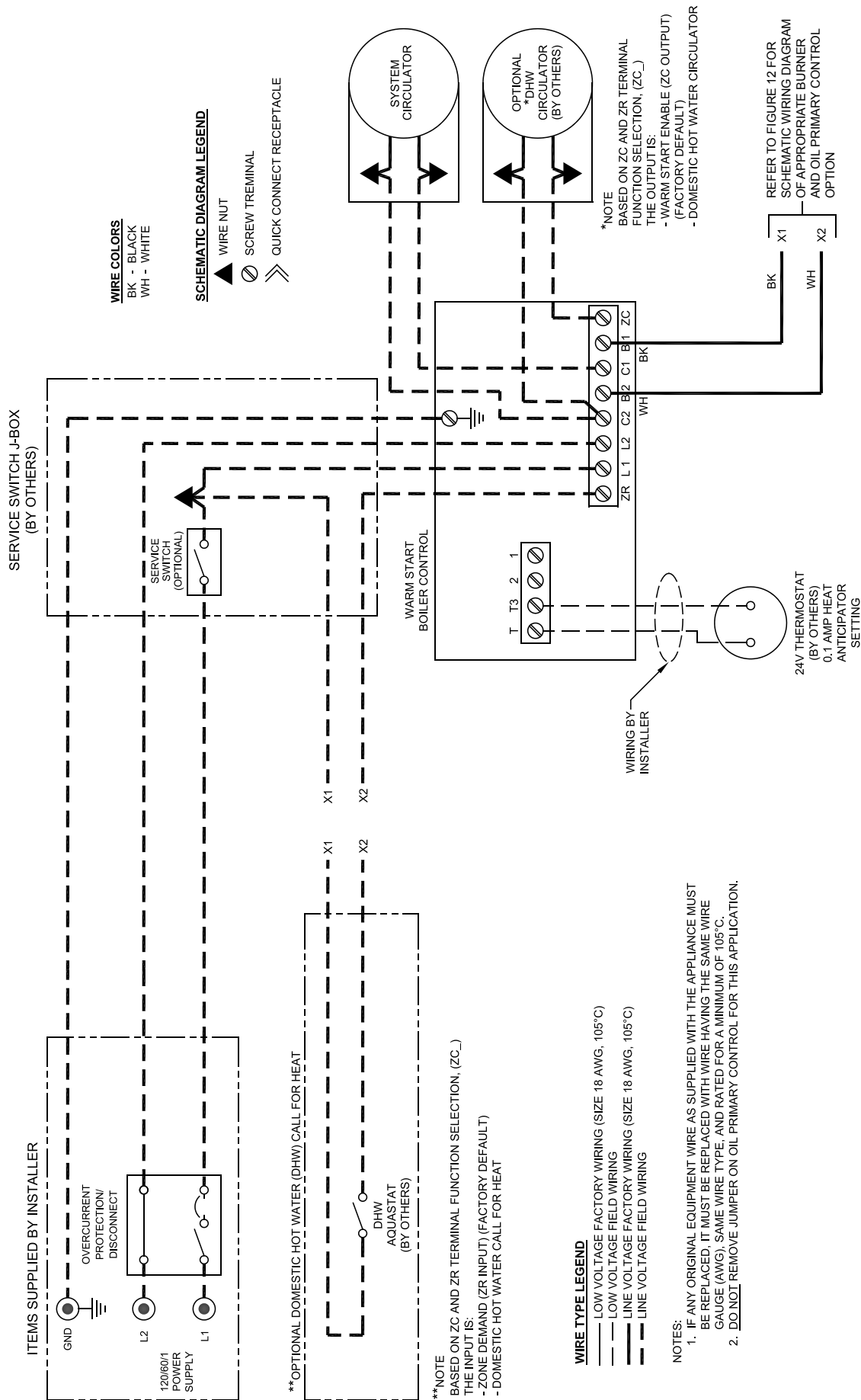
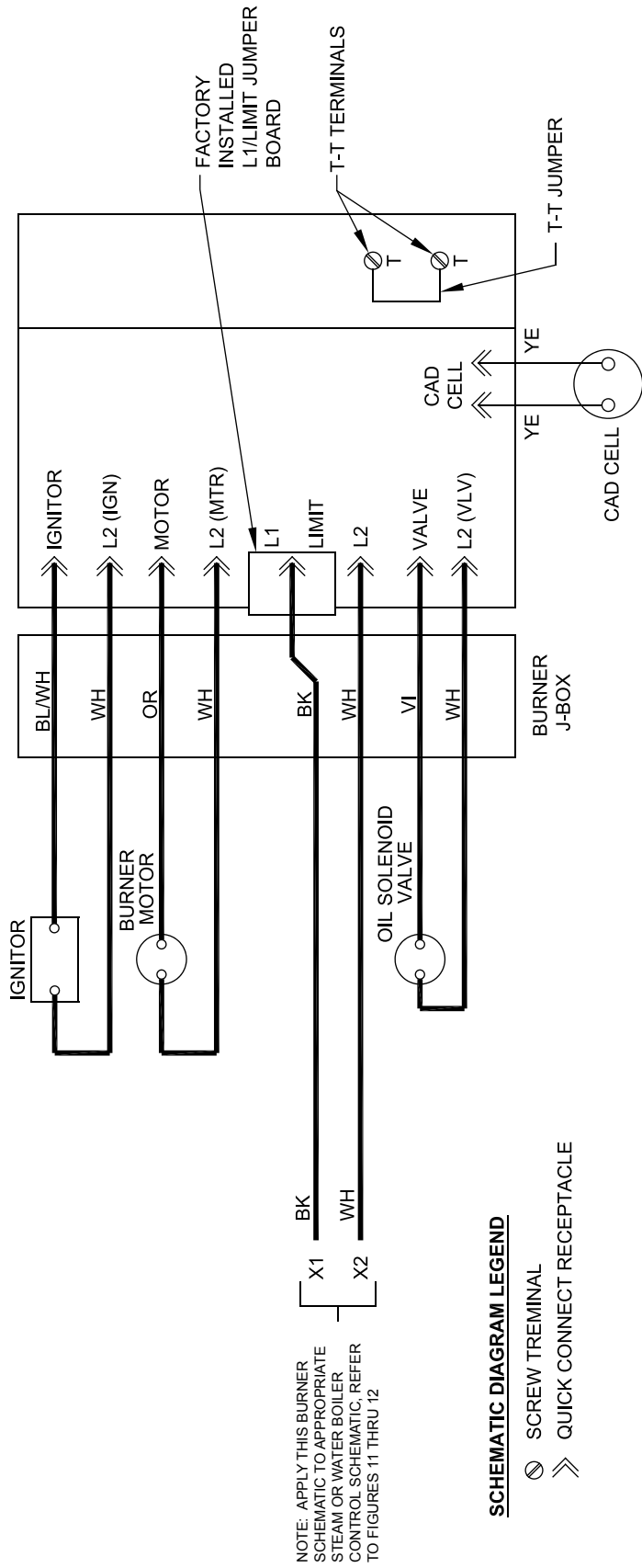


Figure 11b: Schematic Wiring Diagram, with Tankless Heater, Warm Start Control



NOTES:

- IF ANY ORIGINAL EQUIPMENT WIRE AS SUPPLIED WITH THE APPLIANCE MUST BE REPLACED, IT MUST BE REPLACED WITH WIRE HAVING THE SAME WIRE GAUGE (AWG), SAME WIRE TYPE, AND RATED FOR A MINIMUM OF 105°C.

Figure 12: Schematic Wiring Diagrams For Burner Primary Controls

III. INDIRECT WATER HEATER PIPING

A. CONNECT Indirect Water Heater Piping as shown in Figure 13. Refer to Indirect Water Heater Instruction Manual for additional installation information.

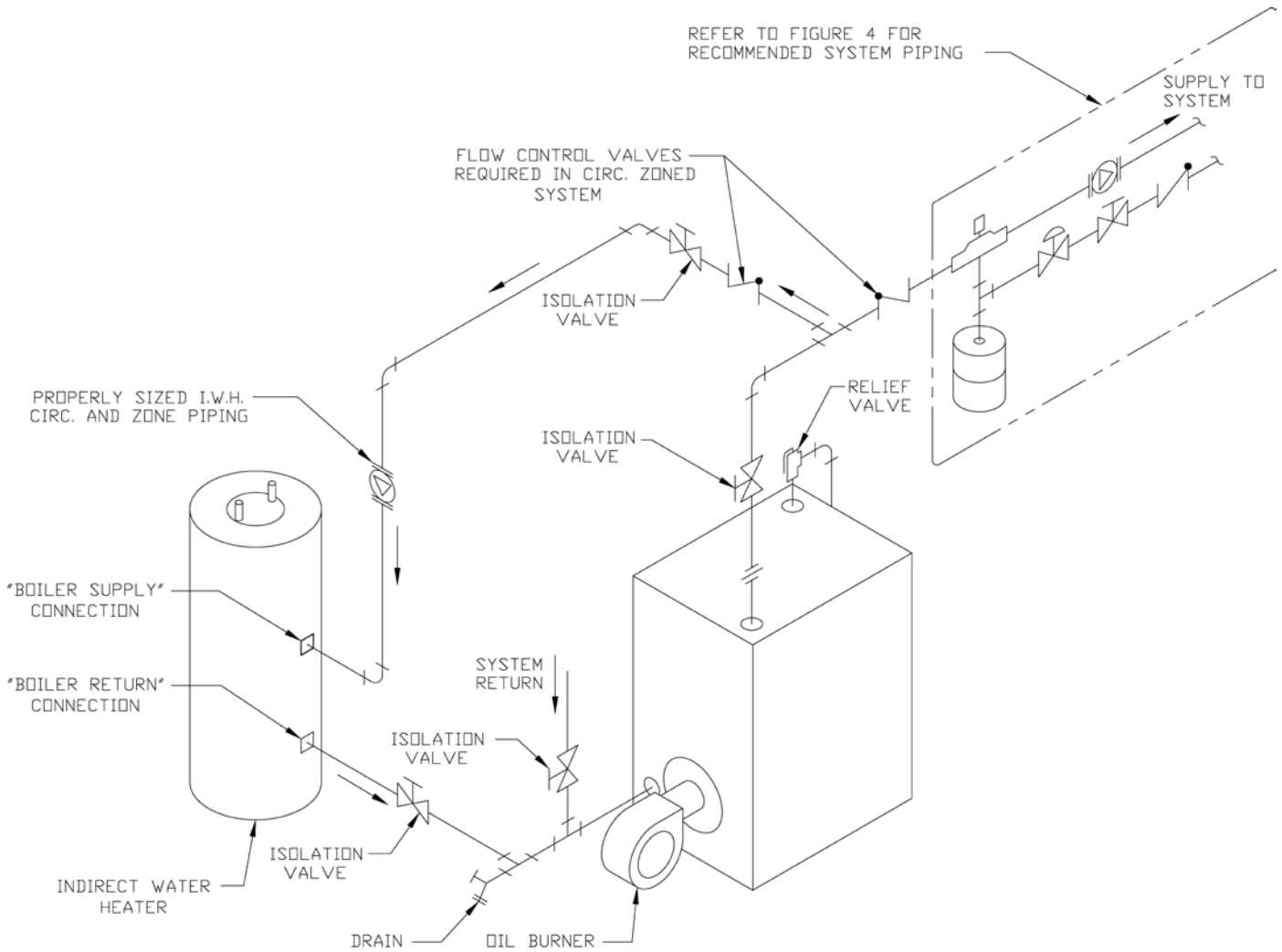


Figure 13: Indirect Water Heater Piping on RRO Series Water Boiler

RRO Series Water Boiler - Figure 13 shows indirect water heater piping on typical hot water heating system. Boiler piping is the same as for any two-zone system. Figure 13 shows circulator zoning, which is usually preferred for indirect water heaters. Size the circulator and indirect water heater piping to obtain the boiler water flow through the indirect water heater called for by the indirect water heater manufacturer. Refer to the indirect water heater instruction manual for additional details.

IV. SYSTEM START-UP

WARNING

All boilers equipped with burner a swing door have a potential hazard which can cause severe property damage, personal injury or loss of life if ignored. Before opening swing door, turn off service switch to boiler to prevent accidental firing of burner outside the combustion chamber. Be sure to tighten swing door fastener completely when service is completed.

A. ALWAYS INSPECT INSTALLATION BEFORE STARTING BURNER.

1. Verify that the venting, water piping, oil piping, and electrical system are installed properly. Refer to Installation Instructions contained in this manual.
2. Confirm all electrical, water and oil supplies are turned off at the source and that the vent is clear from obstructions.

WARNING

Completely read, understand and follow all instructions in this manual before attempting start up.

B. FILL HEATING SYSTEM WITH WATER.

Fill entire heating system with water and vent air from system. Use the following procedure on a series loop or multi-zoned system installed as per Figure 4, to remove air from system when filling:

1. Close full port ball valve in boiler system piping.
2. Isolate all zones by closing zone valves or shut-off valves in supply and return of each zone(s).
3. Attach a hose to vertical purge valve in boiler system piping.
(Note - Terminate hose in five gallon bucket at a suitable floor drain or outdoor area).
4. Starting with one zone at a time, open zone valve or shut-off valve in boiler supply and return piping.
5. Open purge valve.
6. Open shut-off valve in cold water supply piping located between the air scoop and expansion tank.
7. Allow water to overflow from bucket until discharge from hose is bubble free for 30 seconds.
8. When zone is completely purged of air, close zone valve or shut-off valve. Open zone valve to the next zone to be purged. Repeat this step until all zones have been purged. At completion, open all zone valves.
9. Close purge valve, continue filling the system until the pressure gauge reads 12 psi. Close shut-off valve in cold water supply piping.

WARNING

The maximum operating pressure of this boiler is posted on the ASME Data Label located on the top of the boiler. Never exceed this pressure. **DO NOT** plug safety relief valve.

NOTICE

If make-up water line is equipped with pressure reducing valve, system will automatically fill to 12 psi. Follow fill valve manufacturer's instructions.

10. Open full port ball valve in boiler system piping.
11. Remove hose from purge valve.
12. Confirm that the boiler and system have no water leaks.

C. CHECK CONTROLS, WIRING AND BURNER

to be sure that all connections are tight and burner is rigid, that all electrical connections have been completed and fuses installed, and that oil tank is filled and oil lines have been tested.

D. ADJUST CONTROL SETTINGS with burner service switch turned "ON".

1. SET ROOM THERMOSTAT about 10°F below room temperature.
2. PRESS RED RESET BUTTON on front of burner cover. Hold button for one (1) second and release to reset primary control.
3. BOILERS WITHOUT TANKLESS HEATERS are equipped with an Intelligent Oil Boiler Control (Boiler Control). The Boiler Control is factory programmed with a High Limit setpoint of 180°F. The High Limit setpoint is adjustable between 140°F and 240°F. This temperature may be varied to suit the installation requirements.
HIGH LIMIT DIFFERENTIAL is factory programmed at 15°F and is adjustable between 10°F and 30°F.
4. BOILERS WITH TANKLESS HEATERS are equipped with a Warm Start Intelligent Oil Boiler Control (Warm Start Boiler Control). The Warm Start Boiler Control is factory programmed with a High Limit setpoint of 180°F. The High Limit

setpoint is adjustable between 140°F and 240°F. High Limit Differential is factory programmed at 10°F. Additionally, the Warm Start Boiler Control is factory programmed with a Low Limit setpoint of 110°F. The Low Limit setpoint is adjustable between 110°F and 220°F. These temperatures may be varied to suit the installation requirements.

5. CHECKOUT

Put the system into operation and observe at least one complete cycle to make sure that the controller operates properly. See Troubleshooting Section to use LED to assist in determining system operation.

E. ADJUST OIL BURNER BEFORE STARTING.

1. CHECK BURNER SETTINGS and readjust if necessary, see Table 13 in Section X.
 - a. Inspect burner head setting on left side of burner housing by insuring the blue line MD(V1) or the line on the label MB(L1) are aligned, readjust if necessary. Refer to Figure 16 and Table 13 in Section X.
 - b. Check burner air band and air shutter settings. Readjust if necessary, see Burner Specifications Table 13 in Section X.
 - c. OPEN ALL OIL LINE VALVES.
 - d. Attach a plastic hose to fuel pump vent fitting and provide a pan to catch the oil.
 - e. OPEN FLAME OBSERVATION PORT COVER on burner swing door.

CAUTION

Air Band is set for maximum input and must be readjusted prior to starting burner, if nozzle was changed to a lower firing rate.

F. START OIL BURNER.

1. Open vent fitting on fuel pump.
2. TURN 'ON' BURNER service switch and allow burner to run until oil flows from vent fitting in a SOLID stream without air bubbles for approximately 10 seconds.
3. Close vent fitting and burner flame should start immediately after prepurge is completed. Prepurge prevents burner flame until 10 seconds has elapsed after initial power is applied to burner. During prepurge the motor and igniter will operate but the oil valve will remain closed. Refer to Oil Primary Control Instructions for more details.
4. Adjust oil pressure.
 - a. When checking a fuel unit's operating pressure, a reliable pressure gauge may be installed in either the bleeder port or the nozzle port. For Beckett burner refer to Figure 14.

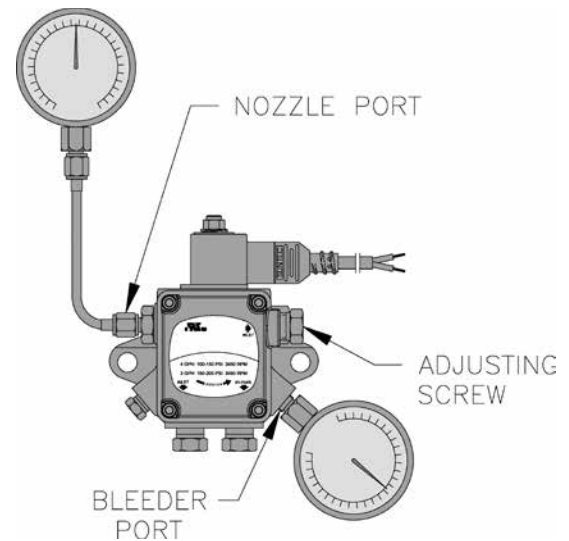


Figure 14: Adjusting Fuel Pump Pressure

- b. Locate oil pressure adjusting screw and turn screw to obtain proper pump pressure, refer to Table 13 in Section X.
- c. To check the cutoff pressure, deadhead a reliable pressure gauge onto the copper connector tube attached to the nozzle port. Run the burner for a short period of time. Shut the burner off. The pressure should drop and hold.
- d. Remove the gauge and install bleeder port and/or reconnect the nozzle port line.

G. ADJUST OIL BURNER WHILE OPERATING.

(flame present)

1. SET ROOM THERMOSTAT about 10°F below room temperature.
2. PRESS RED RESET BUTTON on Oil Primary Control and release.
3. READJUST THE HEAD SETTING only if necessary.
 - a. RRO080 thru RRO111:
Beckett MB(L1) Head burners have a fixed head which are non-adjustable.
 - b. RRO151 thru RRO179:
Beckett MD(V1) (variable) Head burners have the ability to control air by moving the head. It might be necessary to move the head forward or back one position at a time to optimize the smoke and CO₂ readings. See Figure 16 and Table 13 in Section X.
4. READJUST THE AIR DAMPER SETTING (air Band/Air Shutter/Air Gate) on the burner for a light orange colored flame while the draft over the fire is -0.02". Use a smoke tester and adjust air for minimum smoke (not to exceed #1) with a minimum of excess air. Make final check using suitable instrumentation to obtain a CO₂ of 11.5

to 12.5% with draft of -0.02" (water gauge) in fire box. These settings will assure a safe and efficient operating condition. If the flame appears stringy instead of a solid fire, try another nozzle of the same type. Flame should be solid and compact. After all adjustments are made, recheck for a draft of -0.02" over the fire.

5. ONLY READJUST THE HEAD/TURBULATOR SETTING if necessary.
 - a. Move the setting forward or back one position at a time to optimize the smoke and CO₂ readings.
 - b. Steps outlined in Paragraph 3 and 4 above must be repeated every time the Head/Turbulator or Air Damper Setting is readjusted.

WARNING

DO NOT loosen or remove any oil line fittings while burner is operating.

6 FLAME FAILURE

The RRO boiler controls operate the burner automatically. If for unknown reasons the burner ceases to fire and the reset button on the primary control has tripped, the burner has experienced ignition failure. Refer to Oil Primary Control features, Paragraph D, Step 2 of this Section and Section VIII, Troubleshooting, Paragraph B. If the failure re-occurs, call your heating contractor immediately before pressing the reset button.

WARNING

DO NOT attempt to start the burner when excess oil has accumulated, when the boiler is full of vapor, or when the combustion chamber is very hot.

7. CAD CELL LOCATION AND SERVICE

The burner is supplied with a cadmium sulfide flame detector mounted at the factory, mounted on the bottom of the electronic ignitor. See Figure 15. To service cad cell or to replace the plug in portion, swing open the ignitor. After service is complete, be sure to fasten down the ignitor.

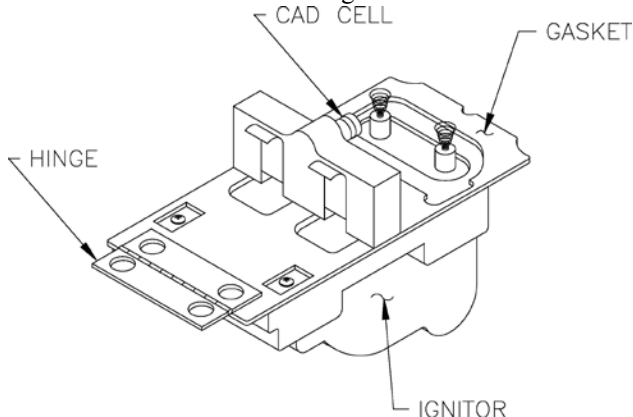


Figure 15: Cad Cell Location

H. CHECK FOR CLEAN CUT OFF OF BURNER.

1. AIR IN THE OIL LINE between fuel unit and nozzle will compress when burner is on and will expand when burner stops, causing oil to squirt from nozzle at low pressure as burner slows down and causing nozzle to drip after burner stops. Usually cycling the burner operation about 5 to 10 times will rid oil line of this air.
2. IF NOZZLE CONTINUES TO DRIP, repeat Paragraph H, Step 1 above. If this does not stop the dripping, remove cut-off valve and seat, and wipe both with a clean cloth until clean, then replace and readjust oil pressure. If dripping or after burn persist replace fuel pump.

I. TEST CONTROLS.

1. Check thermostat operation. Raise and lower thermostat setting as required to start and stop burner.

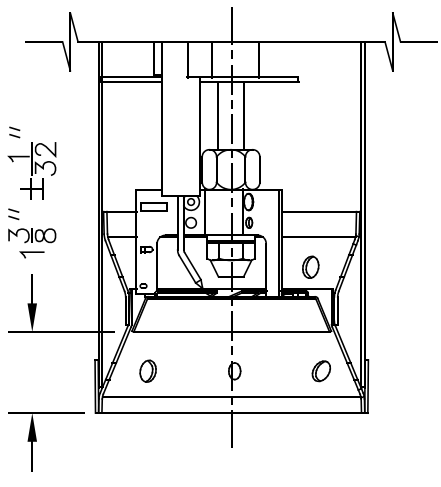
WARNING

Before installation of the boiler is considered complete, the operation of all boiler controls must be checked, particularly the primary control and high limit control.

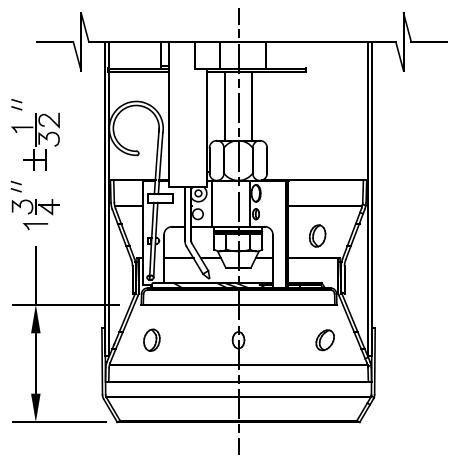
2. VERIFY OIL PRIMARY CONTROL FEATURES using procedures outlined in Instructions furnished with control or instructions as follows:

GeniSys 7505 Control Features, see Figure 17.

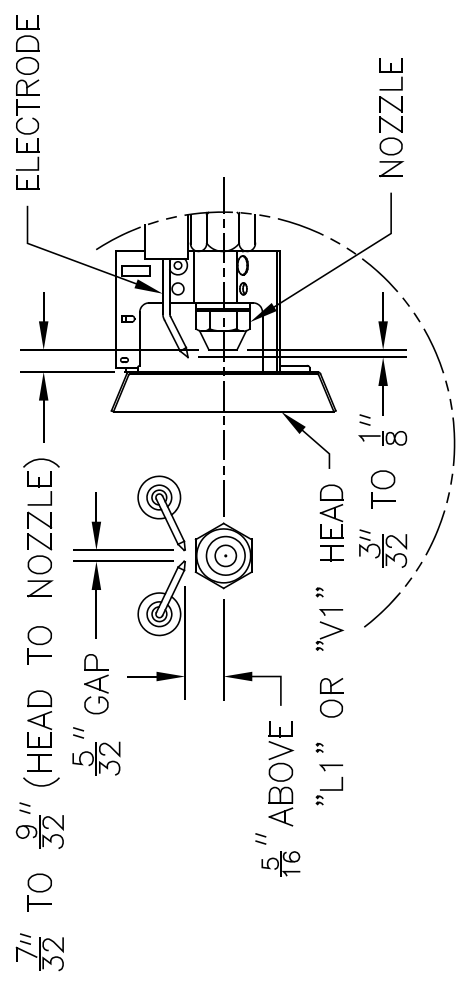
- a. The GeniSys 7505 is a microprocessor-based control. The indicator light provides diagnostic information for lockout, recycling and cad cell status. There is a manual reset button to exit the Lockout Mode.
- b. Pump Priming Cycle: To facilitate purging air from the oil lines and filters, the 7505 can be placed in a purge routine by:
 - After the burner starts, press and hold the reset button for 15 seconds until the yellow light turns on. This indicates that the button has been held long enough.
 - Release the reset button. The yellow light will turn off and the burner will start up again.
 - At burner start up, click the reset button while the igniter is still on. This will transition the control to a dedicated Pump Prime mode, during which the motor, igniter, and valve are powered for four (4) minutes. The yellow light will be on.



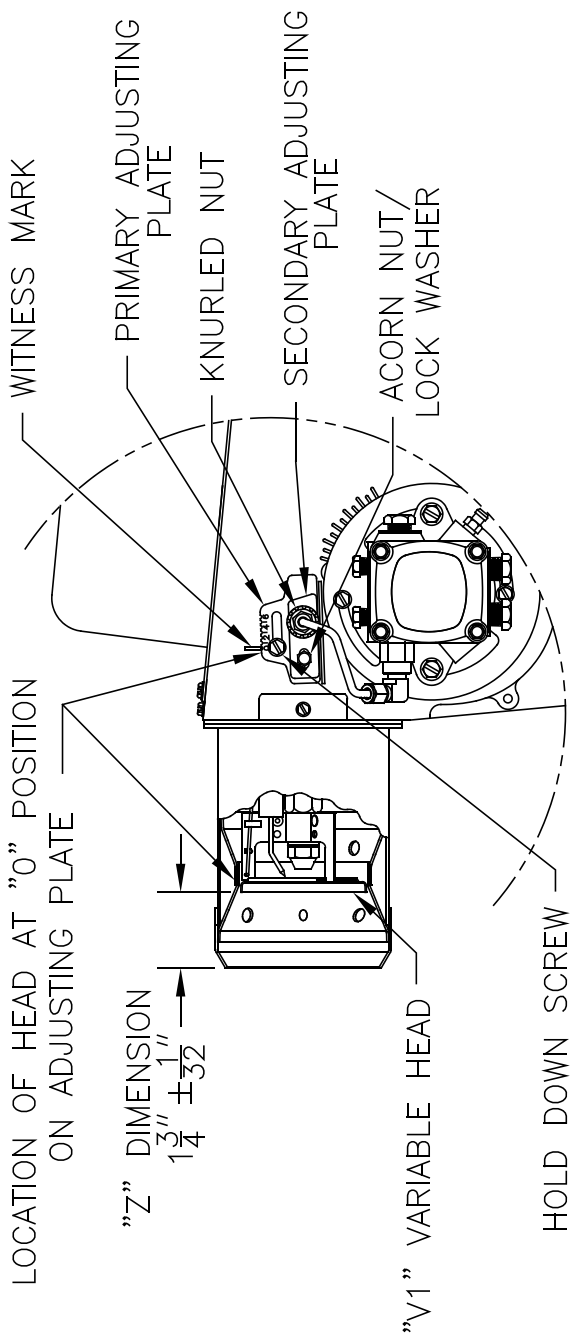
L1 HEAD



V1 HEAD



**ELECTRODE ADJUSTMENT
"L1" OR "V1" HEAD**



**HEAD SETTING (AT "0")
"V1" HEAD**

Figure 16: "L1" and "V1" Head Electrode Positioning and Gun Setting

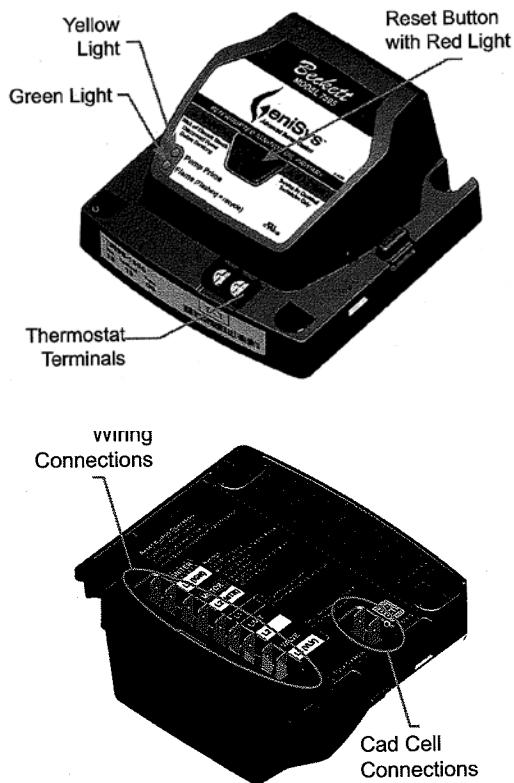


Figure 17: GeniSys 7505 Oil Primary Terminals, LED's and Reset Button

- At the end of four (4) minutes, the yellow light will turn off and the control will automatically return to standby mode.
 - c. Limited Recycle: This feature limits the number of recycle trials (for each call for heat) to a maximum of three trials. If the flame is lost three times and does not successfully satisfy a call for heat, the 7505 locks out.
 - d. Limited Reset (Restricted Mode): In order to limit the accumulation of unburned oil in the combustion area, the control can only be reset three times. The reset count returns to zero each time a call for heat is successfully completed.
 - e. T-T Jumper: Select models have pre-installed T-T jumper. **DO NOT** remove jumper.
- Note: DO NOT** remove "T-T" jumper **unless** wiring diagram indicates a direct connection from thermostat and/or tankless heater aquastat control to the oil burner primary control's "T-T" terminal. Refer to appropriate wiring diagram, see Figure 11a or 11b.
- f. Diagnostic LED: The indicator light on oil primary control provides lockout, recycle and cad cell indications as follows:
 - Flashing at 1 Hz (½ second on, ½ second off): system is locked out or in Restricted Mode.
 - Flashing at ¼ Hz (2 seconds on, 2 seconds off): control is in Recycle Mode.

- On: cad cell is sensing flame.
 - Off: cad cell is not sensing flame.
- vii. Cad Cell Resistance Check: For proper operation it is important that the cad cell resistance is below 1600 ohms. During a normal call for heat, the cad cell leads can be unplugged from the control and the resistance measured with a meter in the conventional way. Conduct these tests with flame present, see chart below.

Flame Detection Range
Normal (0 - 1600 ohms)
Limited (1600 ohms to lockout)

3. CHECK OIL PRIMARY CONTROL

CAUTION

Due to the potential hazard of line voltage, only a trained, experienced service technician should perform the following safety checks.

This control contains no field-serviceable parts. DO NOT attempt to take it apart. Replace entire control if operation is not as described.

- a. Preliminary Steps
 - Check wiring connections and power supply.
 - Make sure power is on to the controls.
 - Make sure limit control is closed.
 - Check contacts between ignitor and the electrodes.
 - Check the oil pump pressure.
 - Check the piping to the oil tank.
 - Check the oil nozzle, oil supply and oil filter.
- b. Check Safety Features

Safe Start:

 - Place a jumper across cad cell terminals.
 - Follow procedure to turn on burner. Burner must not start, indicator light turns on and control remains in Idle Mode.
 - Remove jumper.
- c. Simulate Ignition or Flame Failure:
 - Follow procedure to turn on burner.
 - Check cad cell resistance. If resistance is below 1600 OHMS and burner runs beyond safety cut-out time, cad cell is good.
 - If safety switch shuts down burner and resistance is above 1600 OHMS, open line switch to boiler. Access cad cell under ignitor, clean face of cad cell and see that cell is securely in socket. Check gasket around

perimeter of ignitor lid for proper seal. If gasket is missing or damaged, replace gasket. Room light can effect cad cell resistance. Reset safety switch.

- Close line switch to boiler. If burner starts and runs beyond safety switch cut-off time, cell is good. If not, install new cell.
 - Close hand valve in oil supply line.
 - Failure occurs, device enters Recycle Mode.
 - Device tries to restart system after approximately 60 seconds.
 - After third Recycle Mode trial, safety switch locks out within safety switch timing indicated on label and control enters Restricted Mode. Ignition and motor stop and oil valves closes.
- d. Power Failure Check: After Flame is established, turn the power off to the control/burner. The burner should shut down safely. When power is restored a normal ignition sequence should be started.

WARNING

Cad Cell Jumper must be removed after this check.

4. CHECK HIGH LIMIT

- a. Adjust system thermostat(s) to highest setting.
- b. Allow burner to run until boiler water temperature exceeds high limit setting. The burner should shut down and circulators continue running.
- c. Allow the temperature to drop below control setting. The burner must restart.
- d. Boiler installation is not considered complete until this check has been made.

5. CHECK LOW WATER CUT-OFF CONTROL

See Appendix "A" for Low Water Cut Off Installation.

6. CHECK OPERATING CONTROL on boiler applications equipped with tankless heater(s). With burner off, draw hot water until burner starts, then turn off hot water and check burner shut-down.

J. IF CONTROLS MEET REQUIREMENT

outlined in Paragraph I, allow boiler to operate for approximately 30 minute, confirm the boiler and system have no leaks.

K. IF CONTROLS DO NOT MEET

REQUIREMENTS outlined in Paragraphs I-1 thru I-6, replace control and repeat checkout procedures.

V: OPERATING

A. WATER BOILERS SEQUENCE OF OPERATION

1. **Water Boilers Without Tankless Heaters (Cold Start), Sequence Of Operation:**
 - a. The RRO Boiler is equipped with an Intelligent Oil Boiler Control (Cold Start Boiler Control). The boiler control replaces the traditional electronic aquastat and circulator relays and adds energy saving thermal purge features. Energy is saved by starting the circulator and delaying the burner start when there is residual heat available in the boiler.
 - b. The boiler's sequence of operation is shown as Status Codes on Boiler Control display. See Table 6 and Figure 18.
 - c. When the thermostat calls for heat the boiler control starts the system circulator and the thermal purge (circulator pre-purge time) begins. If the time is completed or boiler temperature is less than the Start Temperature (140 F default) the start sequence continues by energizing the oil primary to operate the following sequence: blower is started and operates for pre-purge time; spark is energized and fuel valve is opened for ignition trial time; burner fires until the thermostat is satisfied.
 - d. If the thermostat is not satisfied and the Operating Setpoint (SP) is reached the system circulator will continue to operate and the burner will stop. When the boiler water temperature drops below the setpoint less the differential setting the burner will restart.
 - e. After the thermostat is satisfied the burner and circulator are stopped.
 - f. When an indirect water heater aquastat call for heat is wired to the "ZR" terminal the Boiler Control starts a domestic hot water circulator connected to the "ZC" terminal and when the boiler temperature is less than Operating Setpoint (SP), the boiler control energizes the oil primary to turn on the burner without circulator pre-purge delay.
 - g. On burner start, if the CAD cell does not see flame within approximately 15 seconds, primary control will shut down the burner and enter into a lockout mode. A lockout is reset by pressing the reset button located on the primary control. If the flame is lost while the burner is firing, the primary control shuts down the burner, enters a 60 second recycle delay, and repeats the ignition sequence. If after three (3) trials for ignition, flame is not detected, primary control will enter into restricted mode. Restricted mode is reset by holding down the reset button for 15 seconds.

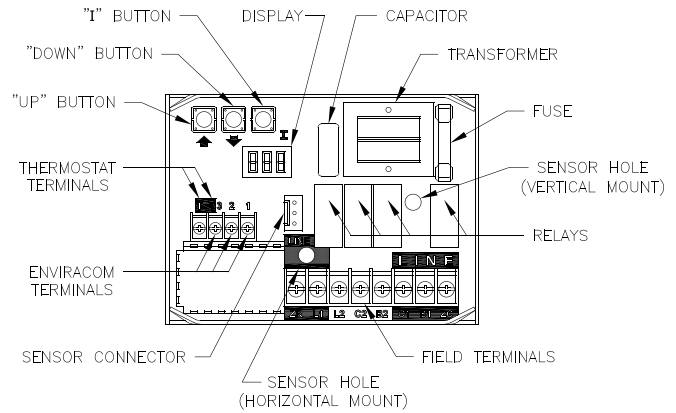


Figure 18: Intelligent Oil Boiler Control

2. **Water Boilers with Tankless Heaters (Warm Start), Sequence Of Operation:**
 - a. The RRO Boiler is equipped with a Warm Start Intelligent Oil Boiler Control (Warm Start Boiler Control). The Warm Start Boiler Control replaces the traditional high and low limit aquastat and circulator relays.
 - b. The boiler's sequence of operation is shown as Status Codes on Boiler Control display. See Table 6 and Figure 18.
 - c. When the thermostat calls for heat the boiler control starts the system circulator and the start sequence continues by energizing the oil primary to operate the following sequence: blower is started and operates for pre-purge time; spark is energized and fuel valve is opened for ignition trial time; burner fires until the thermostat is satisfied. Optionally, the thermal purge (circulator pre-purge time) maybe added adjusting the Circulator Pre-purge time parameter. This feature saves energy by starting the circulator and delaying the burner start when there is residual heat available in the boiler .

TABLE 6: SEQUENCE OF OPERATION

Status Codes Displayed in <i>5LR</i> Mode		
<i>5LR</i>	Status	Description
<i>1</i>	Standby (burner off, pump off)	No call for heat detected
<i>1</i>	Standby (burner off, pump on)	Either condition is true: a. Call for heat detected and boiler temperature higher than operating setpoint. b. Call for heat detected and boiler temperature higher than 140 F and Pump Pre-Purge Time has not expired.
<i>8</i>	Running	The burner runs until the call for heat is satisfied.
<i>17</i>	Self Test	Control internal checking

- d. If the thermostat is not satisfied and the Operating Setpoint (SP) is reached the system circulator will continue to operate and the burner will stop. When the boiler water temperature drops below the setpoint less the differential setting the burner will restart.
- e. After the thermostat is satisfied the burner and circulator are stopped.
- f. The Warm Start Boiler Control also includes a low limit control function. When the boiler water temperature falls below the Low Limit Setpoint less the Low Limit Differential the "ZC" terminal and System Circulator outputs are de-energized and the oil primary is energized to start the burner. As temperature rises above the Low Limit Setpoint the burner is stopped, the "ZC" output is energized and the System Circulator is enabled to run in response to a call for heat.
- g. On burner start, if the CAD cell does not see flame within approximately 15 seconds, primary control will shut down the burner and enter into a lockout mode. A lockout is reset by pressing the reset button located on the primary control. If the flame is lost while the burner is firing, the primary control shuts down the burner, enters a 60 second recycle delay, and repeats the ignition sequence. If after three (3) trials for ignition, flame is not detected, primary control will enter into restricted mode. Restricted mode is reset by holding down the reset button for 15 seconds.

3. Using Boiler Control

The Boiler Control is located on front of boiler. The Boiler Control display, along with Up ↑, Down ↓, and "I" keys may be used to view boiler operating status (Figure 19).

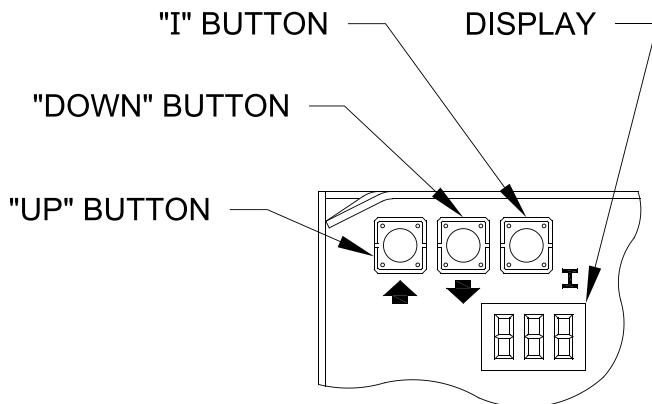


Figure 19: Boiler Control Key Function & Orientation

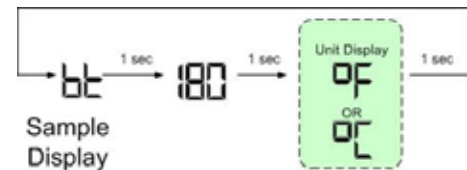
4. Viewing the Operating Mode Options

In operating mode the user may view (but not change) boiler operating status, settings and troubleshooting information. To view Boiler Control display information:

Press and release the "I" key on the Boiler Control to change from one parameter to the next. Each setting will alternately flash between the relevant display code and its corresponding value.

Operating Mode Options	
Status Numbers:	
5LR	1 Standby
	8 Running
	7 Self Test)
bL	Boiler Temperature
SP	Operating Setpoint (Outdoor Reset)
HL	High Limit Setting
HdF	High Limit Differential
LL	Low Limit Setpoint (warm start only)
LdF	Low Limit Differential (warm start only)
hr	Heat Request Status
dh	DHW Request Status
Err	Boiler Error

For example, when the "I" key is pressed on the Boiler Control until "bL" is displayed, it will then flash a three digit number (such as "180") followed by either "F" (or "C"). This indicates that the boiler water temperature is 180°F. Other operating parameters display the information in a similar fashion.



Please note that in operating mode to hold the display on the value the user can press and hold either the Up ↑ or Down ↓ keys and the value will be continuously shown. This may be helpful in watching a value "live".

5. Changing the Adjustable Parameters

To adjust parameters such as the High Limit Setpoint and High Limit Differential:

- a. Using the Boiler Control display, access the adjustment mode by pressing and holding the Up ↑, Down ↓, and "I" keys simultaneously for three (3) seconds. This procedure is intended to discourage unauthorized changes or accidental changes to limit settings.
- b. Press the "I" key to display available Adjustment Mode options. Select an option.

Cold Start Boiler Control Adjustment Mode Options		
HL ₋	140-240°F	Adjust High Limit Setting
HdF	10-30°F	Adjust High Limit Differential
ZC ₋	dh, Zr or ELL	ZC and ZR Terminal Function
Or ₋	0-10 minutes	Pump Overrun Time
PP ₋	2-20 minutes	Pump Pre-purge Time
St ₋	140 - 180°F	Start Temperature
Pt ₋	On or Off	Priority Time
F-C	F or C	Select degrees F or C Mode
bAc		Back to Operating Mode

Warm Start Boiler Control Adjustment Mode Options		
HL ₋	140-240°F	Adjust High Limit Setting
LL ₋	110-220°F	Adjust Low Limit Setting
LdF	10-25°F	Adjust Low Limit Differential Setting
ZC ₋	Zr or dh	ZC and ZR Terminal Function
Or ₋	0-10 minutes	Pump Overrun Time
PP ₋	0-20 minutes	Pump Pre-purge Time
St ₋	140 - 180°F	Start Temperature
Pt ₋	On or Off	Priority Time
F-C	F or C	Select degrees F or C Mode
bAc		Back to Operating Mode

- c. Press the Up ↑ and Down ↓ keys to adjust the displayed setpoint to the desired value.
- d. To return to the normal operating mode from the Adjustment Mode, when the "bAc" option is displayed, press either the Up ↑ or Down ↓ key. If no keys are pressed, after five (5) minutes the Boiler Control will automatically return to the Operating Mode.

6. More Information about Adjustable Parameters

- a. High Limit (HL₋)
The Boiler Control is factory programmed with a High Limit Setpoint of 180°F. The boiler turns "off" when the boiler water temperature (bt) is above this value. The High Limit setpoint is adjustable between 140° and 240°F. The Operating Setpoint (5P) will equal the High Limit Setpoint.
- b. High Limit Differential (HdF)
 - i. The Cold Start Boiler Control is factory programmed with a Differential of 15°F. The Differential is the number of degrees the boiler temperature must decrease below the Operating Setpoint before the boiler can restart. The differential is adjustable between 10° and 30°F.
 - ii. On Warm Start Boiler Control the High Limit Differential is not adjustable and is fixed at 10°F.

c. Low Limit (LL₋)

The Warm Start Boiler Control is factory programmed with a Low Limit Setpoint of 110°F. On falling temperature the boiler turns "on" and the "ZC" terminal and System Circulator outputs are de-energized when the boiler temperature is less than the Low Limit Setpoint less the differential. On a rising temperature when the boiler temperature is above the Low Limit Setpoint the boiler turns "off", the "ZC" terminal output is energized and the System circulator is enabled to respond to a call for heat. The Low Limit Setpoint is adjustable between 110°F and 220°F.

d. Low Limit Differential (LdF)

The Warm Start Boiler Control is factory programmed with a Low Limit Differential Setpoint of 10°F. The Low Limit Differential is the number of degrees the boiler temperature must decrease below the Low Limit Setpoint before the Warm Start Boiler Control takes actions to warm the boiler. These actions include starting the burner and stopping water flow through the boiler. The Low Limit Differential is adjustable between 10°F and 25°F.

e. Circulator Overrun Time (Or₋)

Circulator Overrun Time (also called "circulator off delay" or "circulator post purge") continues circulator operation after a call for heat has ended, sending excess heat from the boiler into the priority zone. Ensure system piping and zone panel settings allow water flow to the priority zone after the call for heat ends. The Circulator Overrun Time has a factor setting of 0 minutes and is field adjustable between 0 and 10 minutes.

f. Circulator Pre-Purge Time (PP₋)

When the boiler is warm [boiler water temperature higher than 140°F (adjustable using Start Temperature parameter)] and there is a thermostat call for heat, the system circulator is started and boiler firing is delayed pre-purge minutes. If the temperature drops below 140°F or there is a DHW Call for Heat the boiler is started without delay. Additionally, the boiler is started without delay if the thermostat call for heat is initiated when the boiler water temperature is less than 140°F. This feature helps save energy by satisfying home heating needs with residual boiler heat rather than cycling the boiler. The Circulator Pre-purge time has a factory setting of 2 minutes and is field adjustable between 2 and 20 minutes. Refer to Table 7.

The Warm Start Boiler Control Pre-purge Time is factor set to 0 minutes.

TABLE 7: CIRCULATOR PRE-PURGE TIME EXAMPLE, PARAMETER PP_ = 2 MINUTES

Call for Heat	ZC and ZR Terminal Function ($\mathcal{Z}\mathcal{L}_-$)	Boiler Temp.	Boiler Status, (B1 Output)
TT = on	--	< 140	Start with no delay
TT = on	--	>140	Start after 2 minute delay
ZR = on	$\mathcal{Z}\mathcal{L}_- = \mathcal{Z}r$	<140	Start with no delay
ZR = on	$\mathcal{Z}\mathcal{L}_- = \mathcal{Z}r$	>140	Start after 2 minute delay
ZR = on	$\mathcal{Z}\mathcal{L}_- = dH$	<140	Start with no delay
ZR = on	$\mathcal{Z}\mathcal{L}_- = dH$	>140	Start with no delay

g. Start Temperature ($5\mathcal{L}_-$)

The amount of “Heat available” is calculated by taking the difference between measured boiler water temperature and the Start Temperature setting. Useful “Heat Available” is dependent on the type of heating emitter installed in the home. Heat emitters require a certain minimum temperature to operate effectively. Our default settings reflect cast iron radiators. Fan Coils may require a start temperature setting of 180°F or 160°F before providing heat to the home. The Start Temperature has a factory setting of 140°F and is field adjustable between 140°F and 180°F.

h. Priority Time ($P\mathcal{L}_-$)

When the Priority Time parameter is set to “on” and Domestic Hot Water (DHW) call for heat is “on” the DHW demand will take “Priority” over home heating demand and the system circulator will be forced “off”. Priority Time ends and the system circulator is released to service home heating demand when Domestic Hot Water call for heat is over. When Priority Time parameter is set to “Off” the DHW call for heat does not force “off” the system circulator. The Priority Time has a factory setting of “On” and is field adjustable between “On” and “Off” Refer to Table 8.

TABLE 8: DOMESTIC HOT WATER DEMAND, (PARAMETER $\mathcal{Z}\mathcal{L}_- = dH$)

Call for Heat		Priority Time ($P\mathcal{L}_-$)	Circulator Status	
T-T Input	ZR Input		System Circulator Output	DHW Circulator ZC Output
on	off	On	on	off
on	on	On	off	on
off	on	On	off	on
on	off	OFF	on	off
on	on	OFF	on	on
off	on	OFF	off	on

i. ZC and ZR Terminal Function ($\mathcal{Z}\mathcal{L}_-$)

The boiler control allows configuration of the ZC output functionality to help the RRO integrate into each installation more effectively. The ZC output can be connected to a domestic hot water circulator or a second heating zone circulator or be used to enable pumps in a warm start application. These applications are selected as follows:

i. When $\mathcal{Z}\mathcal{L}_-$ is set equal to Domestic Hot Water Demand (dH)

When there is an Indirect Water Heater (IWH) the boiler control provides a “ZR” input terminal for the IWH Aquastat and “ZC” output terminal for the DHW Circulator. When there is a DHW call for heat, the System Circulator is “forced off”, the DHW Circulator terminal is energized and the circulator pre-purge time delay control logic is bypassed to allow the boiler to fire without delay. When DHW demand ends the System Circulator “force off” is removed, the circulator can respond normally, and the DHW Circulator is de-energized. The DHW call for heat is detected by a voltage on to the "ZR" terminal. When a Priority Time parameter is set to “off” the System Circulator is not forced off for a DHW call for heat. Refer to Table 8.

ii. When $\mathcal{Z}\mathcal{L}_-$ is set equal to Zone Request ($\mathcal{Z}r$)

When there is no IWH the Cold Start Boiler Control “ZC” output may be configured to control a second heating zone. This is particularly helpful when the home uses only two heating zones. The boiler control replaces the need for a two circulator zone panel. When DHW Terminal Function (dH_-) is set to $\mathcal{Z}r$ the boiler control’s two circulator outputs are used to control two independent heating zones. Refer to Table 9. A "TT" input causes a call for heat and energizes the System Circulator output to service heating zone 1. A second zone’s thermostat may be wired to the "ZR" input to energize heating zone 2 circulator wired to the "ZC" output. Both outputs function

TABLE 9: ZONE REQUEST, PARAMETER $\mathcal{Z}\mathcal{L}_- = \mathcal{Z}r$

Call for Heat		Circulator Status	
T-T Input	ZR Input	C1 Output	ZC Output
off	off	off	off
on	off	on	off
on	on	on	on
off	on	off	on

independently, "TT" input controls only the System Circulator output and the "ZR" input controls only the "ZC" output. Both inputs cause a boiler call for heat.

The Warm Start Boiler Control with \overline{ZC} set equal to Zone Request (\overline{Zr}) energizes the "ZC" terminal while the boiler is warm as described earlier in this section (refer to Paragraph A,2,f). The "ZR" input is a call for heat that starts the boiler.

iii. External Low Limit, Parameter $\overline{ZC} = ELL$

The Cold Start Boiler Control is capable of functioning as a warm start control when external limit control is installed that closes a contact when boiler water temperature falls below a setpoint. When an external limit contact closes (boiler water is cold) the boiler is started and the "ZC" and "C1" output terminals are de-energized. When

the "ZR" terminal is de-energized (boiler water temperature is above setpoint) the call for heat is ended and the "C1" terminal is released to operation and the "ZC" terminal is energized. An External Low Limit Request is detected by sensing a voltage on the "ZR" terminal. The Warm Start Boiler Control does not have the External Low Limit Option. Refer to Table 10.

TABLE 10: EXTERNAL LOW LIMIT, PARAMETER $\overline{ZC} = ELL$

Call for Heat		Circulator Status	
T-T Input	ZR Input	C1 Output	ZC Output
off	off	off	on
on	off	on	on
on	on	off	off
off	on	off	off

VI. MAINTENANCE AND SERVICE INSTRUCTIONS

A. WATER BOILERS

1. Filling of boiler and system.

GENERAL — In a hot water heating system, the boiler and entire system (other than the expansion tank) must be full of water for satisfactory operation. Water should be added to the system until the boiler pressure gauge registers 12 psi. To insure that the system is full, water should come out of all air vents when opened.

2. BOILING OUT OF BOILER AND SYSTEM. The oil and grease which accumulate in a new hot water boiler can be washed out in the following manner:
 - a. Remove relief valve using extreme care to avoid damaging it.
 - b. Add an appropriate amount of recommended boil out compound.
 - c. Replace relief valve.
 - d. Fill the entire system with water.
 - e. Start firing the boiler.
 - f. Circulate the water through the entire system.
 - g. Vent the system, including the radiation.
 - h. Allow boiler water to reach operating temperature, if possible.
 - i. Continue to circulate the water for a few hours.
 - j. Stop firing the boiler.
 - k. Drain the system in a manner and to a location that hot water can be discharged with safety.
 - l. Remove plugs from all available returns and wash the water side of the boiler as thoroughly as possible, using a high-pressure water stream.
 - m. Refill the system with fresh water.
3. Add appropriate boiler water treatment compounds as recommended by your qualified water treatment company.
4. Make pH or Alkalinity Test.

After boiler and system have been cleaned and refilled as previously described, test the pH of the water in the system. This can easily be done by drawing a small sample of boiler water and testing with hydriion paper which is used in the same manner as litmus paper, except it gives specific readings. A color chart on the side of the small hydriion dispenser gives the reading pH. Hydriion paper is inexpensive and obtainable from any chemical supply house or through your local druggist. The pH should be higher than 7 but lower than 11. Add some of the washout chemical (caustic soda), if necessary, to bring the PH within the specified range.

5. Boiler is now ready to be put into service.

IMPORTANT

IF, DURING NORMAL OPERATION, IT IS NECESSARY TO ADD MORE WATER THAN INDICATED BELOW, CONSULT A QUALIFIED SERVICE TECHNICIAN TO CHECK YOUR SYSTEM FOR LEAKS.

Boiler Model	Gallons Per Month	Gallons Per Year
RRO080, RRO092, RRO120	0.3	4
RRO111, RRO151, RRO179	0.4	5

B. EXCESSIVE MAKE-UP WATER

A leaky system will increase the volume of make-up water supplied to the boiler, which can significantly shorten the life of the boiler. Entrained in make-up water are dissolved minerals, salts and oxygen. When the fresh, cool make-up water is heated in the boiler, the minerals fall out as sediment, the salts coat the inside of the boiler, and the oxygen escapes as a gas. The accumulation of sediment eventually isolates the water from contacting the cast iron. When this happens the cast iron in that area gets extremely hot and eventually cracks. The presence of free oxygen or chloride salts in the boiler corrodes the cast iron from the inside. More make-up water and higher concentrations of contaminants damage the boiler sooner. **Our warranty does not cover corrosion and sediment-related damage.** Clearly it is in everyone's best interest to prevent this type of failure. You can do your part by ensuring that your system is leak-free, keeping leakage to less than 2 percent of the total water volume each month.

C. HINTS ON COMBUSTION

1. NOZZLES — Although the nozzle is a relatively inexpensive device, its function is critical to the successful operation of the oil burner. The selection of the nozzle supplied with the RRO boiler is the result of extensive testing to obtain the best flame shape and efficient combustion. Other brands of the same spray angle and spray pattern may be used but may not perform at the expected level of CO₂ and smoke. Nozzles are delicate and should be protected from dirt and abuse. Nozzles are mass-produced and can vary from sample to sample. For all of those reasons a spare nozzle is a desirable item for a serviceman to have.

2. **FUEL LEAKS** — Any fuel leak between the pump and the nozzle will be detrimental to good combustion results. Look for wet surfaces in the air tube, under the ignitor, and around the air inlet. Any such leaks should be repaired as they may cause erratic burning of the fuel and in the extreme case may become a fire hazard.
3. **AIR LEAKS** — Any such leaks should be repaired, as they may cause erratic burning of the fuel and in extreme cases may become a fire hazard.
4. **SUCTION LINE LEAKS** -
Whatever it takes, **The Oil Must Be Free of Air**. This can be a tough problem, but it must be resolved. Try bleeding the pump through a clear tube. There must be no froth visible. There are various test kits available to enable you to look at the oil through clear tube. There must be no froth visible. There are various test kits available to enable you to look at the oil through clear tubing adapted to the supply line at the pump fitting. Air eliminators are on the market that have potential. Also, electronic sight glasses are being used with good success. At times, new tubing must be run to the tank or new fittings put on. Just make sure you get the air out before you leave.
Any air leaks in the fuel line will cause an unstable flame and may cause delayed ignition noises. Use only flare fittings in the fuel lines.
5. **GASKET LEAKS** — If 11.5 to 12.5% CO₂ with a #1 smoke cannot be obtained in the breeching, look for air leaks around the burner mounting gasket, observation door, and canopy gasket. Such air leaks will cause a lower CO₂ reading in the breeching. The smaller the firing rate the greater effect an air leak can have on CO₂ readings.
6. **DIRT** — A fuel filter is a good investment. Accidental accumulation of dirt in the fuel system can clog the nozzle or nozzle strainer and produce a poor spray pattern from the nozzle. The smaller the firing rate, the smaller the slots become in the nozzle and the more prone to plugging it becomes with the same amount of dirt.
7. **WATER** — Water in the fuel in large amounts will stall the fuel pump. Water in the fuel in smaller amounts will cause excessive wear on the pump, but more importantly water doesn't burn. It chills the flame and causes smoke and unburned fuel to pass out of the combustion chamber and clog the flueways of the boiler.
8. **COLD OIL** — If the oil temperature approaching the fuel pump is 40°F or lower poor combustion or delayed ignition may result. Cold oil is harder to atomize at the nozzle. Thus, the spray droplets get larger and the flame shape gets longer. An outside fuel tank that is above grade or has fuel lines in a shallow bury is a good candidate for cold oil. The best solution is to bury the tank and lines deep enough to keep the oil above 40°F.

9. **FLAME SHAPE** — Looking into the combustion chamber through the observation door, the flame should appear straight with no sparklers rolling up toward the crown of the chamber. If the flame drags to the right or left, sends sparklers upward or makes wet spots on the target wall, the nozzle should be replaced. If the condition persists look for fuel leaks, air leaks, water or dirt in the fuel as described above.

10. HIGH ALTITUDE INSTALLATIONS

Air settings must be increased at high altitudes. Use instruments and set for 11.5 to 12.5% CO₂.

11. **START-UP NOISE** — Late ignition is the cause of start-up noises. If it occurs recheck for electrode settings, flame shape, air or water in the fuel lines.
12. **SHUT DOWN NOISE** — If the flame runs out of air before it runs out of fuel, an after burn with noise may occur. That may be the result of a faulty cut-off valve in the fuel pump, or it may be air trapped in the nozzle line. It may take several firing cycles for that air to be fully vented through the nozzle. Water in the fuel or poor flame shape can also cause shut down noises.

NOTICE

CHECK TEST PROCEDURE. A very good test for isolating fuel side problems is to disconnect the fuel system and with a short length of tubing, fire out of an auxiliary five gallon pail of clean, fresh, warm #2 oil from another source. If the burner runs successfully when drawing out of the auxiliary pail then the problem is isolated to the fuel or fuel lines being used on the jobsite.

D. ATTENTION TO BOILER WHILE NOT IN OPERATION

1. IMPORTANT:

IF BOILER IS NOT USED DURING WINTER TIME, IT MUST BE FULLY DRAINED TO PREVENT FREEZE DAMAGE.

2. Always keep the manual fuel supply valve shut off if the burner is shut down for an extended period of time.

WARNING

This boiler contains controls which may cause the boiler to shut down and not restart without service. If damage due to frozen pipes is a possibility, the heating system should not be left unattended in cold weather; or appropriate safeguards and alarms should be installed on the heating system to prevent damage if the boiler is inoperative.

3. To recondition the heating system in the fall season after a prolonged shut down, follow the instructions outlined in Section IV, Paragraphs A through K.

VII. BOILER CLEANING

WARNING

All boiler cleaning must be completed with burner service switch turned off.

A. CLEAN THE FLUEWAYS (See Figure 20).

1. Disconnect oil line(s) and remove burner and burner mounting plate. See Figure 1a or 1b.
2. Lay protective cloth or plastic over combustion chamber blanket.
3. Remove the smokepipe as necessary to gain access to the boiler canopy.
4. Remove the jacket top panels.
5. Remove the canopy being careful not to damage the canopy gaskets.
6. Using a 1¼" diameter wire or fibre bristle brush (30" handle) clean the flueways. Brush from the top using diagonal strokes for best results. DO NOT allow brush to strike the target wall or liner in the chamber.

B. CLEAN TOP OF BOILER SECTIONS.

1. Brush and vacuum the tops of the boiler sections.

C. CLEAN THE FIREBOX.

1. Using wire or fibre bristle brush, clean crown of boiler and inside of water legs. DO NOT allow brush to strike target wall or blanket in the combustion chamber.

- #### D. AFTER CLEANING, remove protective cloth with debris and vacuum as necessary, but be careful not to damage blanket. Inspect target wall, combustion chamber blanket and burner mounting plate insulation for signs of damage. If damaged, replace as needed.

E. REASSEMBLE BOILER.

CAUTION: Do not start the burner unless canopy, smokepipe and burner swing door are secured in place.

1. Install the canopy taking care to align the gaskets without blocking the flueways. If gasket is damaged, replace as needed.
2. Close and secure burner swing door to front section with fasteners.
3. Reconnect oil line(s).
4. Reinstall Top Panels and secure with sheet metal screws.
5. Reinstall smokepipe on canopy and secure to collar with sheet metal screws.

NOTES:

1. PRIOR TO CLEANING BOILER, LAY A PROTECTIVE CLOTH OR PLASTIC OVER THE BLANKET TO COLLECT DEBRIS FALLING FROM FLUEWAYS.
2. AFTER CLEANING, INSPECT TARGET WALL, COMBUSTION CHAMBER BLANKET AND BURNER SWING DOOR INSULATION FOR SIGNS OF DAMAGE. IF DAMAGED, REPLACE AS NEEDED.
3. REPLACE CANOPY GASKET STRIPS AS NEEDED IF DAMAGED.

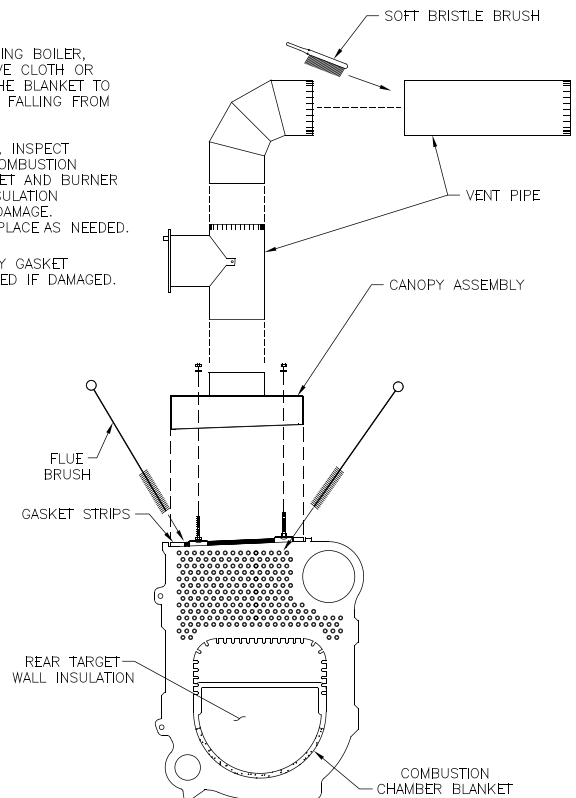


Figure 20: Cleaning of Boiler Flueways

WARNING

The boiler must be connected to an approved chimney in good condition. Serious property damage could result if the boiler is connected to a dirty or inadequate chimney. The interior of the chimney flue must be inspected and cleaned before the start of the heating season and should be inspected periodically throughout the heating season for any obstructions. A clean and unobstructed chimney flue is necessary to allow noxious fumes that could cause injury or loss of life to vent safely and will contribute toward maintaining the boiler's efficiency.

Important Product Safety Information **Refractory Ceramic Fiber Product**

Warning:

The Repair Parts list designates parts that contain refractory ceramic fibers (RCF). RCF has been classified as a possible human carcinogen. When exposed to temperatures above 1805°F, such as during direct flame contact, RCF changes into crystalline silica, a known carcinogen. When disturbed as a result of servicing or repair, these substances become airborne and, if inhaled, may be hazardous to your health.

AVOID Breathing Fiber Particulates and Dust

Precautionary Measures:

Do not remove or replace RCF parts or attempt any service or repair work involving RCF without wearing the following protective gear:

1. A National Institute for Occupational Safety and Health (NIOSH) approved respirator
 2. Long sleeved, loose fitting clothing
 3. Gloves
 4. Eye Protection
- Take steps to assure adequate ventilation.
 - Wash all exposed body areas gently with soap and water after contact.
 - Wash work clothes separately from other laundry and rinse washing machine after use to avoid contaminating other clothes.
 - Discard used RCF components by sealing in an airtight plastic bag. RCF and crystalline silica are not classified as hazardous wastes in the United States and Canada.

First Aid Procedures:

- If contact with eyes: Flush with water for at least 15 minutes. Seek immediate medical attention if irritation persists.
- If contact with skin: Wash affected area gently with soap and water. Seek immediate medical attention if irritation persists.
- If breathing difficulty develops: Leave the area and move to a location with clean fresh air. Seek immediate medical attention if breathing difficulties persist.
- Ingestion: Do not induce vomiting. Drink plenty of water. Seek immediate medical attention.

VIII: TROUBLESHOOTING

A. COMBUSTION

1. **NOZZLES** — Although the nozzle is a relatively inexpensive device, its function is critical to the successful operation of the oil burner. The selection of the nozzle supplied with the RRO boiler is the result of extensive testing to obtain the best flame shape and efficient combustion. Other brands of the same spray angle and spray pattern may be used but may not perform at the expected level of CO₂ and smoke. Nozzles are delicate and should be protected from dirt and abuse. Nozzles are mass-produced and can vary from sample to sample. For all of those reasons a spare nozzle is a desirable item for a serviceman to have.
2. **FUEL LEAKS** — Any fuel leak between the pump and the nozzle will be detrimental to good combustion results. Look for wet surfaces in the air tube, under the ignitor, and around the air inlet. Any such leaks should be repaired as they may cause erratic burning of the fuel and in the extreme case may become a fire hazard.
3. **SUCTION LINE LEAKS** — Any such leaks should be repaired, as they may cause erratic burning of the fuel and in extreme cases may become a fire hazard. Whatever it takes, **The Oil Must Be Free of Air**. This can be a tough problem, but it must be resolved. Try bleeding the pump through a clear tube. There must be no froth visible. There are various test kits available to enable you to look at the oil through clear tubing adapted to the supply line at the pump fitting. Air eliminators are on the market that have potential. Also, electronic sight glasses are being used with good success. At times, new tubing must be run to the tank or new fittings put on. Just make sure you get the air out before you leave.

Any air leaks in the fuel line will cause an unstable flame and may cause delayed ignition noises. Use only flare fittings in the fuel lines.
4. **GASKET LEAKS** — If 11.5 to 12.5% CO₂ with a #1 smoke cannot be obtained in the breeching, look for air leaks around the burner mounting gasket, observation door, and canopy gasket. Such air leaks will cause a lower CO₂ reading in the breeching. The smaller the firing rate the greater effect an air leak can have on CO₂ readings.
5. **DIRT** — A fuel filter is a good investment. Accidental accumulation of dirt in the fuel system can clog the nozzle or nozzle strainer and produce a poor spray pattern from the nozzle. The smaller the firing rate, the smaller the slots become in the nozzle and the more prone to plugging it becomes with the same amount of dirt.
6. **WATER** — Water in the fuel in large amounts will stall the fuel pump. Water in the fuel in smaller amounts will cause excessive wear on the pump, but more importantly water doesn't burn. It chills the flame and causes smoke and unburned fuel to pass out of the combustion chamber and clog the flueways of the boiler.
7. **COLD OIL** — If the oil temperature approaching the fuel pump is 40°F or lower, poor combustion or delayed ignition may result. Cold oil is harder to atomize at the nozzle. Thus, the spray droplets get larger and the flame shape gets longer. An outside fuel tank that is above grade or has fuel lines in a shallow bury is a good candidate for cold oil. The best solution is to locate the tank near the boiler in the basement utility room or bury the tank and lines deep enough to keep the oil above 40°F. Check environmental issues with local authorities having jurisdiction.
8. **FLAME SHAPE** — Looking into the combustion chamber through the observation port, the flame should appear straight with no sparklers rolling up toward the crown of the chamber. If the flame drags to the right or left, sends sparklers upward or makes wet spots on the target wall, the nozzle should be replaced. If the condition persists look for fuel leaks, air leaks, water or dirt in the fuel as described above.
9. **HIGH ALTITUDE INSTALLATIONS** — Air openings must be increased at higher altitudes. Use instruments and set for 11.5 to 12.5% CO₂.
10. **START-UP NOISE** — Late ignition is the cause of start-up noises. If it occurs recheck for electrode settings, flame shape, air or water in the fuel lines.
11. **SHUT DOWN NOISE** — If the flame runs out of air before it runs out of fuel, an after burn with noise may occur. That may be the result of a faulty cut-off valve in the fuel pump, or it may be air trapped in the nozzle line. It may take several firing cycles for that air to be fully vented through the nozzle. Water in the fuel or poor flame shape can also cause shut down noises.

NOTICE

CHECK TEST PROCEDURE. A very good test for isolating fuel side problems is to disconnect the fuel system and with a 24" length of tubing, fire out of an auxiliary five gallon pail of clean, fresh, warm #2 oil from another source. If the burner runs successfully when drawing out of the auxiliary pail then the problem is isolated to the fuel or fuel lines being used on the jobsite.

B. OIL PRIMARY CONTROL (Oil Primary)

1. Burner (Oil Primary) will not come on.
 - a. No power to Oil Primary.
 - b. Oil Primary is in lockout or restricted mode. Press reset button for one (1) second to exit lockout. If control has recycled three times within the same call for heat, it will enter into restricted mode. To reset from restricted mode, refer to Section V, Paragraph I, Step 2 for details.
 - c. CAD cell seeing light.
 - d. CAD assembly defective.
 - e. Control motor relay is stuck closed (see note below).
2. Burner (control) will light, then shut down after a short time, then restart after one (1) minute.
 - a. CAD cell is defective.
 - b. Air leaking into oil line causing flame out.
 - c. Defective nozzle causing flame to be erratic.
 - d. Excessive airflow or draft causing flame to leave burner head.
 - e. Excessive back pressure causing flame to be erratic.
3. Control locks out after Trial For Ignition (TFI).
 - a. No oil to burner.
 - b. Shorted electrodes.
 - c. Nozzle clogged.
 - d. Airflow too high.
 - e. Ignitor module defective.
 - f. CAD cell defective.
 - g. Oil valve stuck open or closed.

Note: The Safety Monitoring Circuit (SMC) is designed to provide lockout in the event of a stuck or welded motor relay.

Also refer to Model EZ-1/2/3 Oil Burner - Instruction Manual (Form #MNEZ123) for additional information.

NOTICE

If flame is not established within 15 seconds of oil valve actuation (known as Trial For Ignition [TFI]) lockout will occur. Lockout is indicated by a red LED solid-on located on the oil primary control.

Hard Lockout will occur if the Oil Primary Control locks-out three (3) times during a call for heat. This is indicated by red light reset button solid-on.

C. INTELLIGENT OIL BOILER CONTROL

- **Cold Start Boiler Control** is used on Boilers without Tankless Heaters.
 - **Warm Start Boiler Control** is used on Boilers with Tankless Heaters
1. When a problem occurs with the boiler operation, the Boiler Control easily provides specific, valuable information to help resolve the issue quickly. The display on the Boiler Control should be the first place to check.
 - a. If an Error Code "Err" **IS NOT** displayed on the Boiler Control: In this circumstance, Table 11 can be used to determine the problem and possible causes.

TABLE 11: TROUBLESHOOTING GUIDE

System Condition	Diagnostic Condition	Check	Action
Boiler is cold, house is cold.	Display is OFF.	120 Vac System power.	Turn system power on.
	Display is ON.	24 Vac T-T	No 24 V; replace control.
		24 V present; disconnect thermostat, short T-T.	Boiler starts, check wiring and thermostat.
		120 Vac at B1-B2	<ul style="list-style-type: none"> • If no, replace control. • If yes, check burner and wiring.
		Refer to Err on display.	-----
Boiler is hot, house is cold.	Display is ON.	120 Vac at C1-C2	<ul style="list-style-type: none"> • 120 Vac at C1-C2, check wiring to pump. • Wiring OK, is pump running? • If not, replace the pump. • If pump is running, check for trapped air or closed zone valves
		Boiler below the Low Limit temperature, wait for boiler to go above Low Limit temperature.	-----
		Boiler above LL? If yes, check for 120 Vac between ZC and L2.	<ul style="list-style-type: none"> • If no 120 Vac, replace control. • If yes, check zone relays, circulators and wiring.

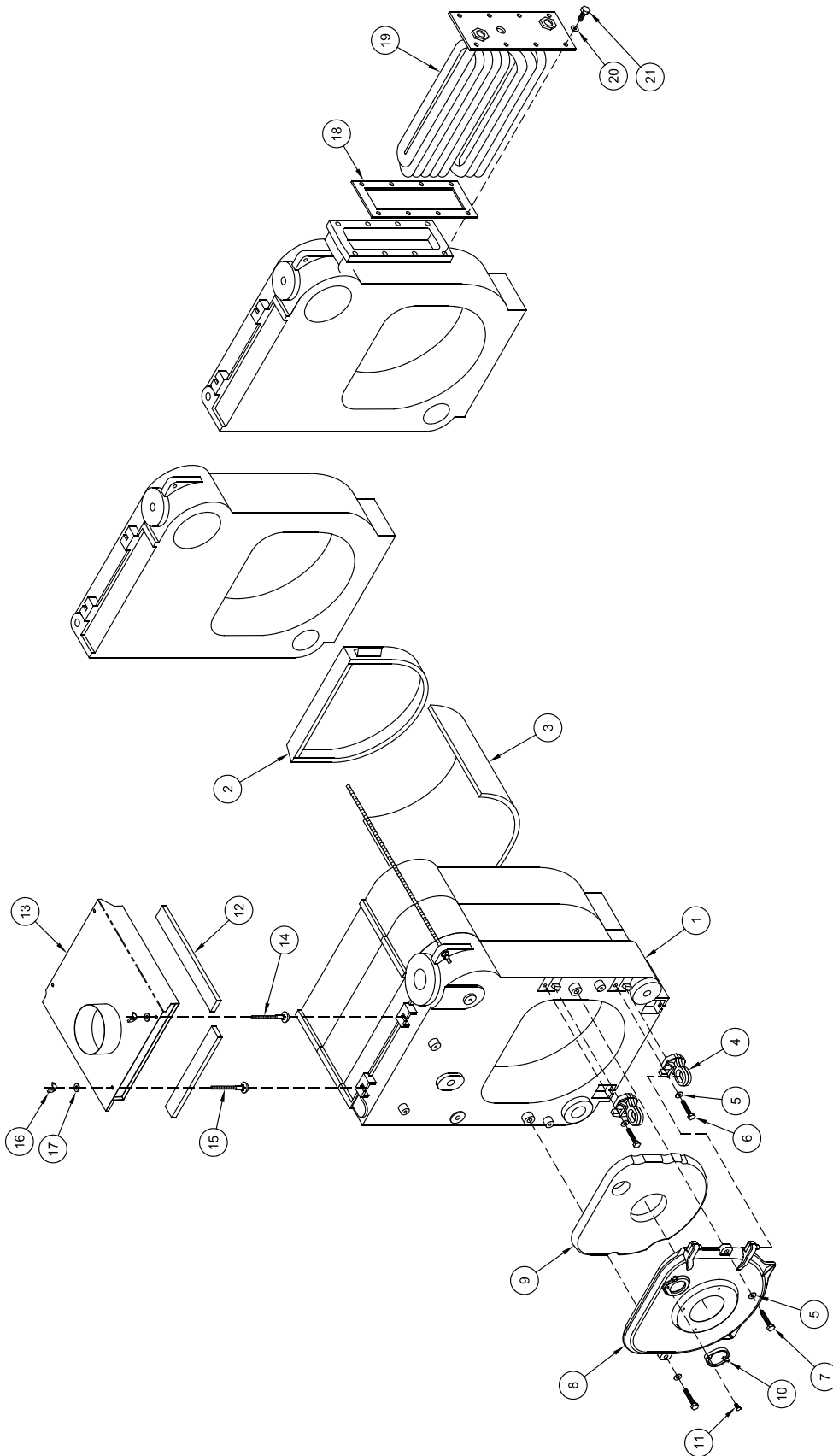
- b. If the Boiler Control detects an error it will flash "Err" (boiler control error) followed by a number. Use this text and number to identify the boiler problem and corrective action in Table 12 below.

TABLE 12: BOILER CONTROL ERROR NUMBERS

Display	Status	Recommended Corrective Actions
Err 1	Temperature Sensor Fault	Temperature sensor failure, wire harness loose or shorted connection or control hardware failure: <ul style="list-style-type: none"> - Check sensor is securely attached to boiler control - Check that sensor wire is not damaged - If secure and in good condition, replace sensor - If problem persists, replace control
Err 2	Communication Fault	EnviraCom terminal is shorted to ground or line voltage. <ul style="list-style-type: none"> - Check wiring to EnviraCOM terminals 1,2 and 3. Wiring to external EnviraCom device is incorrect.
Err 3	Internal Hardware Fault	Error detected with AC power supply frequency or boiler control failure. Cycle power to the control. Replace control if problem persists.
Err 4	Burner Output (B1) Fault	B1 output sensed powered during safety output relay check sequence or un-powered during running, or powered in idle in combination with water temperature above 264°F limit. Cycle power to the control. Replace control if problem persists.
Err 5	Line Voltage Fault (< 80 Vac)	AC voltage out of specification high or low; check L1, L2, 110 VAC.
Err 6	Fuse missing	Internal fuse is blown or missing. The fuse protects the Aquastat from miswiring the L1 and L2 on Oil Primary. When the Oil Primary is correctly wired the fuse is useless and not detected. If Primary is wired incorrectly the fuse is blown out and Aquastat report error 6. EnviraCOM message is sent when the wiring is fixed and the error disappears to indicate the end of the error state. Check wiring and replace fuse.
Err 7	User settings lost, (reset to factory defaults)	Warning: Generated if user adjustments are lost and the device uses factory default values. Error is cleared by entering and exiting the Adjustment mode. Replace control if problem persists.
Err 8	Manual Reset Lockout (resettable)	Set if Err 4 was invoked four times in a row. Check wiring and clear Lockout by pressing all three user keys for 30 seconds.

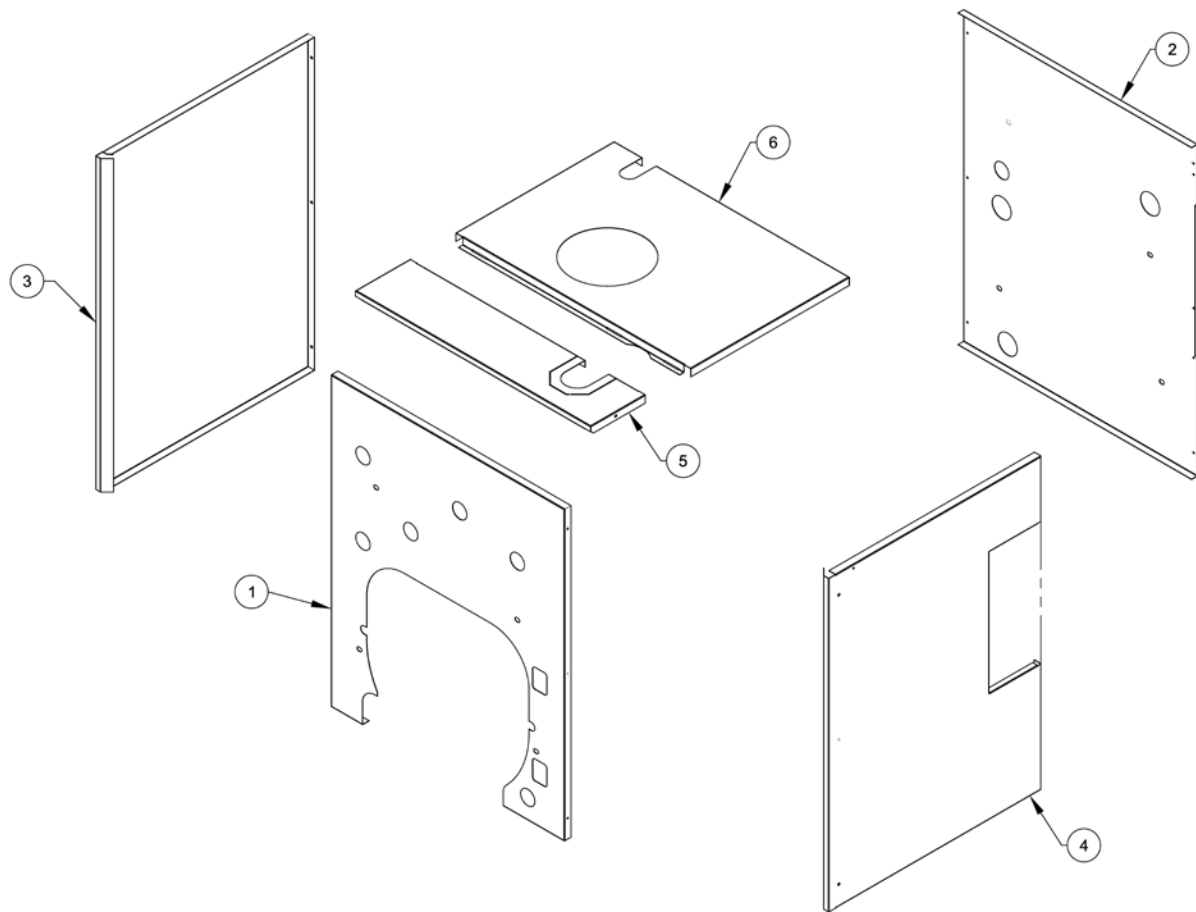
IX. REPAIR PARTS

All RRO™ repair parts may be obtained by contacting your local HAJOCA branch.



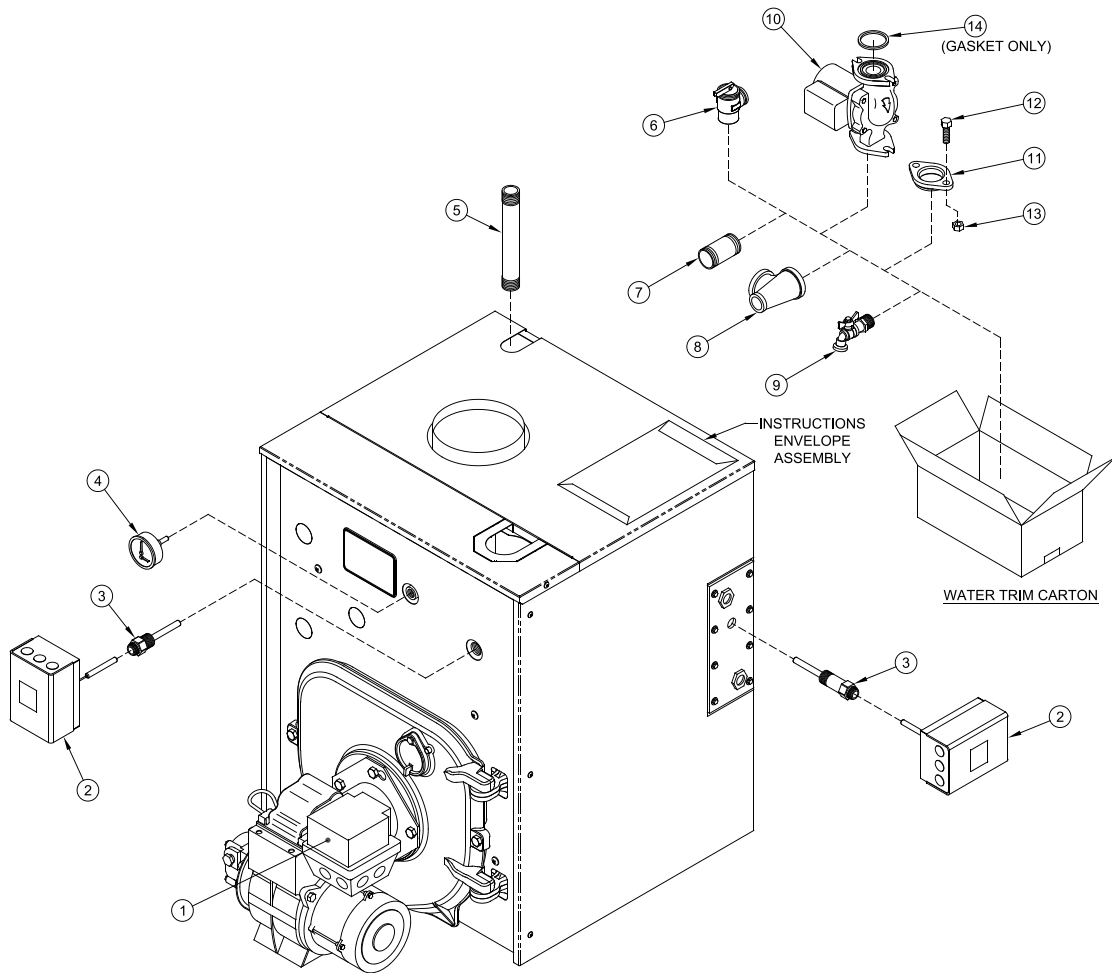
Bare Boiler Assembly (Exploded View)

Item No.	Description	Boiler Size / Quantity		Part No.
		RRO120	RRO111 & RRO179	
Bare Boiler Assembly				
1	Water Replacement Block Assembly, less coil	1	---	CL3-WN
	Water Replacement Block Assembly, less coil	---	1	CL4-WN
	Water Replacement Block Assembly, with coil	1	---	CL3-WR
	Water Replacement Block Assembly, with coil	---	1	CL4-WR
2	Rear Target Wall Insulation	1	1	82020002
3	Combustion Chamber Liner, 1/2" x 19-1/2" x 9-3/4"	1	---	82020031
	Combustion Chamber Liner, 1/2" x 19-1/2" x 14-3/4"	---	1	82020041
4	BSD Hinge Loop Bracket	2	2	100795-02
5	5/16" Flat Washer - Plated	4	4	80860611
6	5/16-18 x 1" Lg. Cap Screw, Plated	2	2	80861341
7	5/16-18 x 1-1/2" Lg. Cap Screw, Plated	2	2	80861349
8	Burner Swing Door (only), Machined / Painted	1	1	100793-01
9	Burner Swing Door Insulation	1	1	82020001
10	Observation Port Cover, Machined / Painted	1	1	71728004
11	5/16-18 x 3/4" Lg. Cap Screw, Plated	1	1	80861340
12	Canopy Sealing Strip (1/2" x 1-1/4" x 10') in Poly Bag	1	1	6206001
13	Canopy Assembly - 3 Section, 5-7/8" Dia. Collar	1	---	104585-03
	Canopy Assembly - 4 Section, 6-7/8" Dia. Collar	---	1	104585-04
14	1/4"-20 x 3" Lg. Carriage Bolt, Plated	2	2	80860119
15	1/4"-20 x 3-1/2" Lg. Carriage Bolt, Plated	2	2	100838-01
16	1/4"-20 Wing Nut - Plated	4	4	80860910
17	1/4" Flat Washer - Plated	4	4	80860603
18	Heater Cover Plate Gasket - Rear Heater	1	1	8036058
19	V1-2 Heater Carton (WT[R] & ST[R]) Rear Heater	1	1	6036031
20	5/16" Flat Washer - Plated	8	8	80860611
28	3/8"-16 x 7/8" Lg. Cap Screw, ASME Grade, Marked SA307B	8	8	80861337



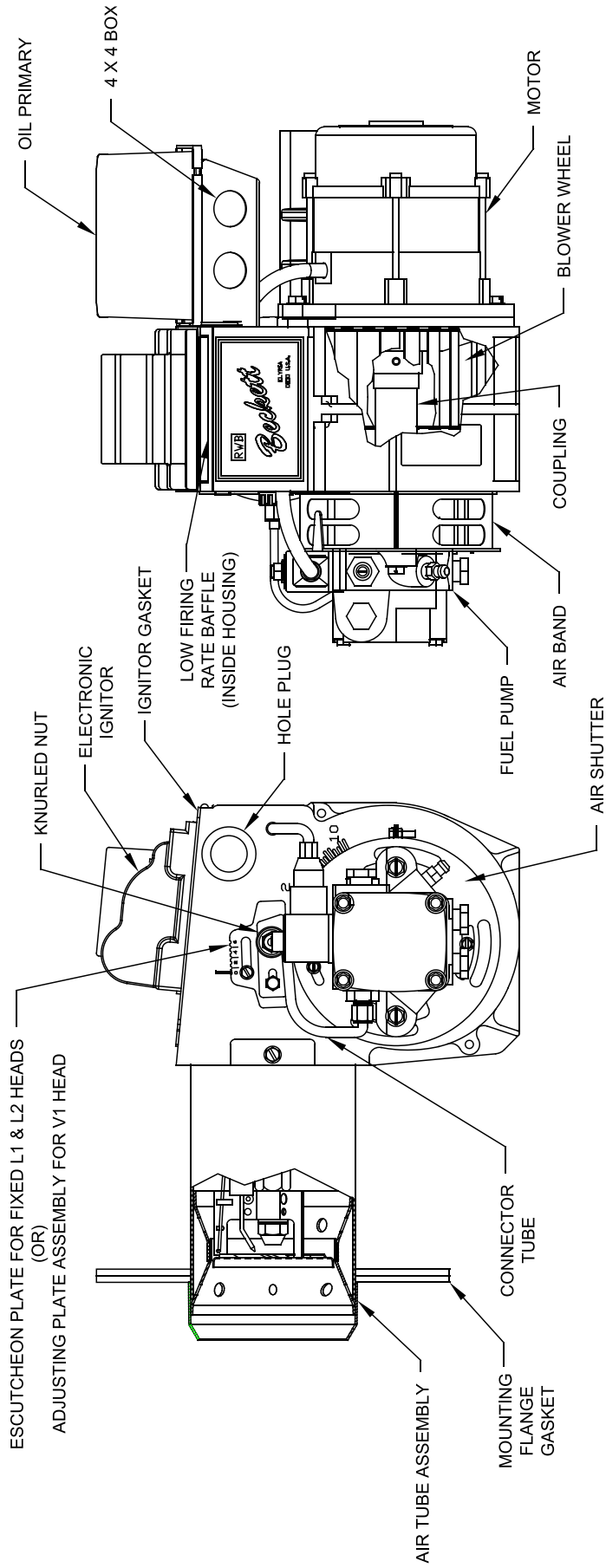
Jacket Assembly (Exploded View)

Item No.	Description	Boiler Size / Quantity		Part No.
		RRO120	RRO111, RRO179	
Jacket Components -- Items 1 thru 6 Include Insulation as Part of Assembly				
1	Jacket Front Panel Assembly	1	1	100819-01
2	Jacket Rear Panel Assembly	1	1	100820-01
3	Jacket Reversible Side Panel Assembly	Non-Heater Build		100821-03
		2	---	100821-03
		---	2	100821-04
		With Heater Build		100821-03
4	Jacket Left Side Heater Panel Assembly (WT[R] & ST[R]) Heater Builds)	1	---	100824-03
		---	1	100824-04
5	Jacket Split Front Top Panel Assembly	1	1	100823-01
6	Jacket Split Rear Top Panel Assembly	1	---	100822-03
		---	1	100822-04



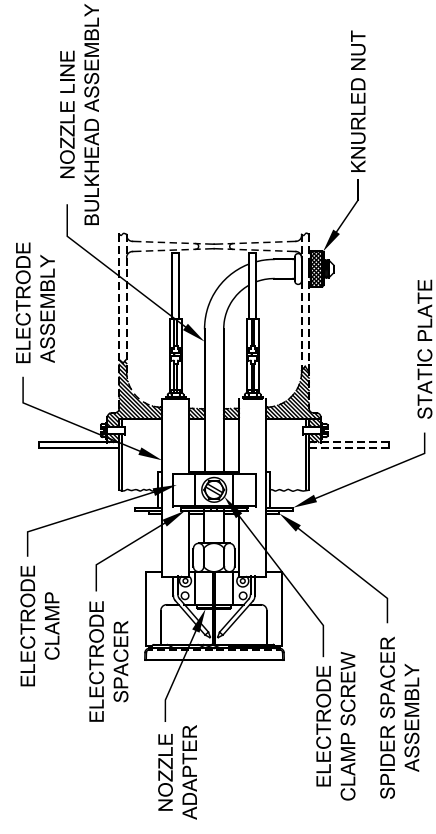
RRO120 , RRO111 and RRO179 - Trim and Controls

Item No.	Description	Boiler Size / Quantity		Part No.	
		RRO120	RRO111, RRO179		
Trim and Controls					
1	Beckett GeniSys 7505B Oil Primary Control	1	1	103447-01	
2	Honeywell L7248L1090 Hi Limit, Circ. Relay (WL) --- (OR)---	1	1	103850-01	
	Honeywell L7224C1010 Hi & Lo Limit, Circ. Relay (WT)			103854-01	
3	1/2" NPT x 1-1/2" Immersion Well, Honeywell 123869A (WL) --- (OR)---	1	1	80160456	
	3/4" NPT x 3" Immersion Well, Honeywell 123871A (WT)			80160452	
4	Temperature / Pressure Gauge, 1/4" NPT x 2-1/2" Dia. x 1-1/2" Lg. Shank	1	1	100282-01	
5	3/4" NPT x 7-1/4" Lg. Nipple, SCH 80, Black	1	1	100839-01	
6	Relief Valve, 3/4" F x 3/4" F, 30 PSI, #10-408-05	1	1	81660319	
7	1-1/2" NPT x 5" Lg. Nipple, Black	1	1	806600060	
8	1-1/2" x 3/4" x 1-1/2" NPT Tee, Black	1	1	806601003	
9	3/4" NPT Ball Drain Valve, Conbraco #35-302-03	1	1	806603061	
10	Circulator w/Gaskets	Taco 007	1	1	8056170
		Grundfos UP15-42F	1	1	8056173
11	Circulator Flange, 1-1/2" NPT	2	2	806602014	
12	Cap Screw, Hex Head, 7/16" -14 x 1-1/2" Lg.	4	4	80861301	
13	Hex Nut, 7/16" -14	4	4	80860406	
14	Taco "00" Series Flange Gasket (Gasket Only)	2	2	806602006	



FRONT VIEW

SIDE VIEW



NOZZLE DETAIL

Beckett AFG Burner

BECKETT AFG OIL BURNER PART NOS. FOR RRO SERIES BOILERS

NOTE: When ordering parts always give the serial and model numbers shown on the boiler and burner. Also provide the name of the part(s) and part number as listed below.

Boiler Model	RRO080, RRO092, RRO120	RRO111	RRO151, RRO179
Air Tube Combination	AFG70MBAS	AFG70MBAS	AFG70MDAS
Beckett's Spec No.	BCB8906	NY2702	NY2703
Air Band	3492A	3492A	3492A
Air Band Nut	4150	4150	4150
Air Band Screw	4198	4198	4198
Air Shutter	3709	3709	3709
Air Shutter Screw	4198	4198	4198
Blower Wheel	2999	2999	2999
Coupling	2454	2454	2454
Low Firing Rate Baffle	5880[1]	----	----
Bulkhead Knurled Locknut	3-666	3-666	3-666
Connector Tube Assembly	5636	5636	5636
Electrode Clamp	1-49	1-49	1-49
Electrode Clamp Screw	4219	4219	4219
Electrode Insulator Assembly	5780	5780	5780
Spider Spacer Assembly	5653	5653	5653
Escutcheon Plate	3493	3493	----
Adjusting Plate Assembly	----	----	5941
Head	5912	5912	5913
Head Screws	4221	4221	4221
Flange Gasket	3416	3416	3416
AFG Housing	5874BK	5874BK	5874BK
Motor	21805	21805	21805
Nozzle Adapter	2-13	2-13	2-13
Nozzle Line Electrode Assembly	NL70MB	NL70MB	NL70MD
Oil Pump, Clean Cut (Single Stage)	2184404U	2184404U	2184404U
Oil Pump, Clean Cut (Two Stage)	21941U	21941U	21941U
Static Plate	3384	3384	3384
Ignitor	51771U	51771U	51771U
Ignitor Hinge Screw	4217	4217	4217
Ignitor Holding Screw	4292	4292	4292
Ignitor Gasket Kit	51304	51304	51304
Junction Box	5770	5770	5770
Flame Detector	7006	7006	7006
Oil Solenoid Valve Coil	21755	21755	21755
Oil Solenoid Valve Cord	21807	21807	21807

[1] 5880 used on CL3-091 firing rate only

X. BURNER SPECIFICATIONS

TABLE 13: BECKETT AFG BURNER SPECIFICATIONS

Beckett AFG							
Boiler Model	Firing Rate GPH	Settings			Nozzle		³ Pump Pressure
		Head (Setting)	Air Shutter	Air Band	GPH x Angle Type	² Shipped	
¹ RRO080	0.65	L1	8	0	0.55 x 70B (Delavan)	Loose	140
RRO092	0.75	L1	6	0	0.65 x 45B (Hago)	Loose	140
RRO120	1.00	L1	10	1	0.85 x 45B (Hago)	Installed	140
RRO111	0.90	L1	7	0	0.75 x 45B (Delavan)	Installed	140
RRO151	1.25	V1(0)	10	1	1.00 x 45B (Hago)	Loose	175
RRO179	1.50	V1(3)	10	2	1.10 x 45B (Hago)	Installed	175

¹ Beckett low firing rate baffle required on RRO080 (0.65 GPH) application only; shipped loose with nozzle.

² Nozzle(s) for alternate boiler model firing rate(s) are shipped loose in bag attached to the burner.

³ Single stage fuel pump is standard. Burner manufacturer has preset single stage fuel pump to settings shown in table above.

APPENDIX A - AFTERMARKET LOW WATER CUT OFF (LWCO)

WARNING

DO NOT ATTEMPT to cut factory wires to install an aftermarket Low Water Cut Off (LWCO). Only use connections specifically identified for Low Water Cut Off.

In all cases, follow the Low Water Cut Off (LWCO) manufacturer's instructions.

When

A low water cutoff is required to protect a hot water boiler when any connected heat distributor (radiation) is installed below the top of the hot water boiler (i.e. baseboard on the same floor level as the boiler). In addition, some jurisdictions require the use of a LWCO with a hot water boiler.

Where

The universal location for a LWCO on oil hot water boilers is above the boiler, in either the supply or return piping. The minimum safe water level of a water boiler is at the uppermost top of the boiler; that is, it must be full of water to operate safely.

It is recommended that the LWCO control is installed above the boiler to provide the highest level of protection. However, where the LWCO control is approved by the LWCO control manufacturer for installation in a high boiler tapping of a water boiler, the use of the listed LWCO control is permitted when it is installed according to the LWCO manufacturer's instructions

What Kind

Typically, in residential applications, a probe type LWCO is used instead of a float type, due to their relative costs and the simplicity of piping for a probe LWCO.

How to Pipe

A "tee" is commonly used to connect the probe LWCO in the supply or return piping, as shown below.

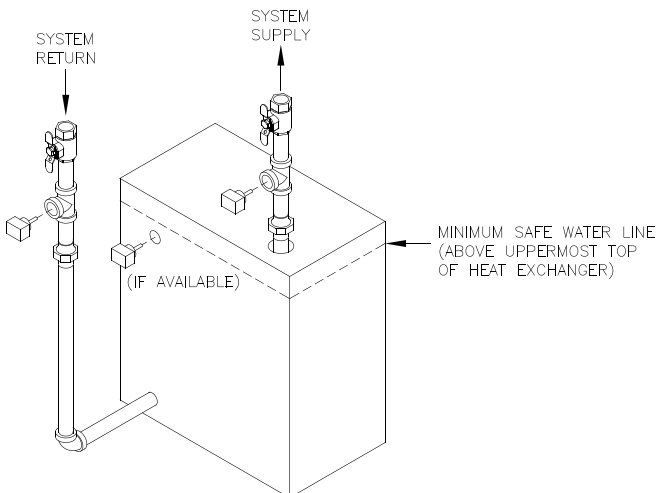


Figure A1: LWCO Location

Select the appropriate size tee using the LWCO manufacturer's instructions. Often, the branch connection must have a **minimum** diameter to prevent bridging between the probe and the tee. Also, the run of the tee must have a minimum diameter to prevent the end of the probe from touching or being located too close to the inside wall of the run of the tee.

Ideally, manual shutoff valves should be located above the LWCO and the boiler to allow for servicing. This will allow probe removal for inspection without draining the heating system. Many probe LWCO manufacturers recommend an annual inspection of the probe.

How to Wire

LWCO's are available in either 120 VAC or 24 VAC configurations. The 120 VAC configuration must be applied to oil boilers by wiring it in the line voltage service to the boiler (after the service switch, if so equipped). Refer to Figure A2.

The presence of water in a properly installed LWCO will cause the normally open contact of the LWCO to close, thus providing continuity of the 120 VAC service to the boiler.

It is recommended to supply power to the probe LWCO with the same line voltage servicing the boiler as shown below.

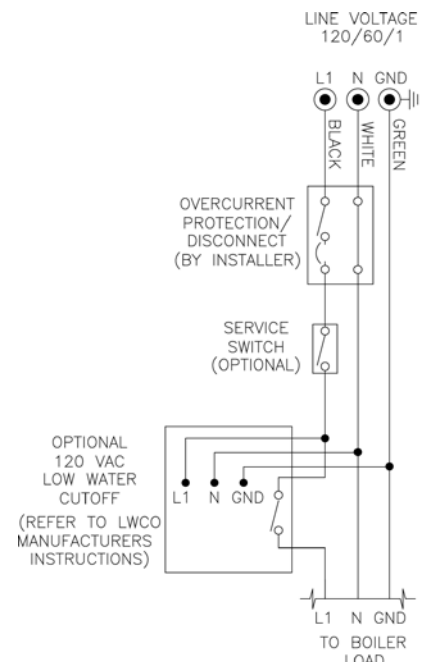


Figure A2: Wiring of Typical LWCO

How to Test

Shut off fuel supply. Close shut-off valves in system supply and return piping located in near boiler piping above LWCO as shown in Figure A1. Open drain valve to lower water level until water is below the LWCO probe. It may be necessary to open relief valve seat to allow air into system for the water to drain, close drain

valve and relief valve once completed. Generate a boiler demand by turning up thermostat. Boiler should not attempt to operate. Open fill valve to increase the water level by filling the system. It may be necessary to open relief valve to allow air to escape during filling process. The boiler should attempt to operate once the water level is above the LWCO.

