

INSTALLATION, OPERATING AND SERVICE INSTRUCTIONS FOR

RSA™ SERIES 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 Model Number RSA	Boiler Serial Number	Installation Date
Heating Contractor		Phone Number
Address		



IMPORTANT INFORMATION - READ CAREFULLY

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:

All wiring on boilers installed in the USA shall be made in accordance with the National Electrical Code and/or Local Regulations.

All wiring on boilers installed in Canada shall be made in accordance with the Canadian Electrical Code and/or Local Regulations.

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.

CANADIAN BOILERS

- A. Current Edition of Canadian Standards Association CSA B139, "Installation Code for Oil Burning Equipment", for recommended Installation Practices.

The following terms are used throughout this manual to bring attention to the presence of hazards of various risk levels, or to important information concerning product life.

DANGER

Indicates an imminently hazardous situation which, if not avoided, will result in death, serious injury or substantial property damage.

CAUTION

Indicates a potentially hazardous situation which, if not avoided, may result in moderate or minor injury or property damage.

WARNING

Indicates a potentially hazardous situation which, if not avoided, could result in death, serious injury or substantial property damage.

NOTICE

Indicates special instructions on installation, operation, or maintenance which are important but not related to personal injury hazards.

NOTICE

This boiler has a limited warranty, a copy of which is printed on the back of this manual.

It is the responsibility of the installing contractor to see that all controls are correctly installed and are operating properly when the installation is complete. The warranty for this boiler is valid only if the boiler has been installed, maintained and operated in accordance with these instructions.

DANGER

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

WARNING

Improper installation, adjustment, alteration, service or maintenance can cause property damage, personal injury or loss of life. Failure to follow all instructions in the proper order can cause personal injury or death. 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.

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. 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. 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. Installation is not complete unless a pressure relief valve is installed into the tapping located on top of appliance - See Section III of this manual for details.

This boiler is not suitable for installation on combustible flooring, unless installed with a combustible floor shield (available at extra cost).

Do not install boiler on carpeting.

When boiler is installed on concrete which is over a material that is subject to melting (PVC, PEX radiant tubing, etc.) the combustible floor shield must be used.

A concrete pad is not sufficient to protect combustible flooring.

Do not tamper with or alter the boiler or controls. Retain your contractor or a competent serviceman to assure that the unit is properly adjusted and maintained.

Have Firetubes cleaned at least once a year - preferably at the start of the heating season to remove soot and scale. The inside of combustion chamber should also be cleaned and inspected at the same time.

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

Do not operate unit with jumpered or absent controls or safety devices.

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

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 boiler.

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.

WARNING

This boiler contains very hot water under high pressure. Do not unscrew any pipe fittings nor attempt to disconnect any components of this boiler without positively assuring the water is cool and has no pressure. Always wear protective clothing and equipment when installing, starting up or servicing this boiler to prevent scald injuries. Do not rely on the pressure and temperature gauges to determine the temperature and pressure of the boiler. This boiler contains components which become very hot when the boiler is operating. Do not touch any components unless they are cool.

This appliance must be properly vented and connected to an approved vent system in good condition. Serious property damage could result if the boiler is connected to an approved vent system.

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

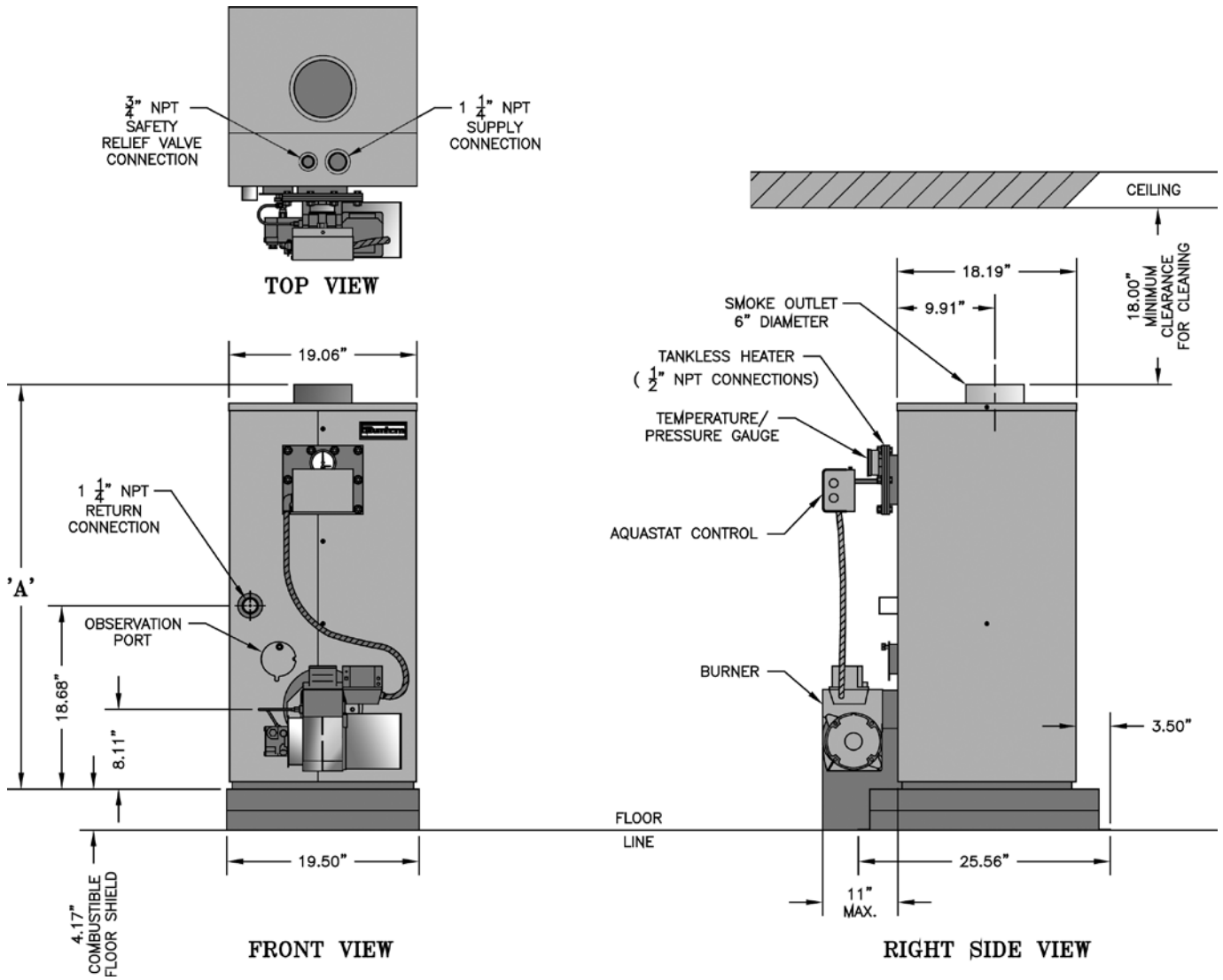
The interior of the venting and air intake systems must be inspected and cleaned before the start of the heating season and should be inspected periodically throughout the heating season for any obstructions. Clean and unobstructed venting and air intake systems are necessary to allow noxious fumes that could cause injury or loss of life to vent safely and will contribute toward maintaining the boiler's efficiency.

This boiler is supplied with controls which may cause the boiler to shut down and not re-start 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.

Do not operate boiler on combustible floor without a factory supplied floor shield. Concrete over wood joists is considered combustible flooring. Do not operate on masonry floors, which may contain moisture.

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Boiler Model Number	Dim. 'A'	Minimum Recommended Chimney Sizes		Water Capacity (gallons)	Approx. Shipping Weight (lb.)
		In. x In. x Ft. (ht.)	In. (dia.) x Ft. (ht.)		
RSA85	34 $\frac{3}{4}$ "	8 x 8 x 20	6 x 15	9.1	300
RSA110				8.5	
RSA125	41 $\frac{1}{4}$ "		7 x 15	13.9	340
RSA135				13.0	355

Figure 1: RSA Packaged Boiler (RSA85 / RSA135)

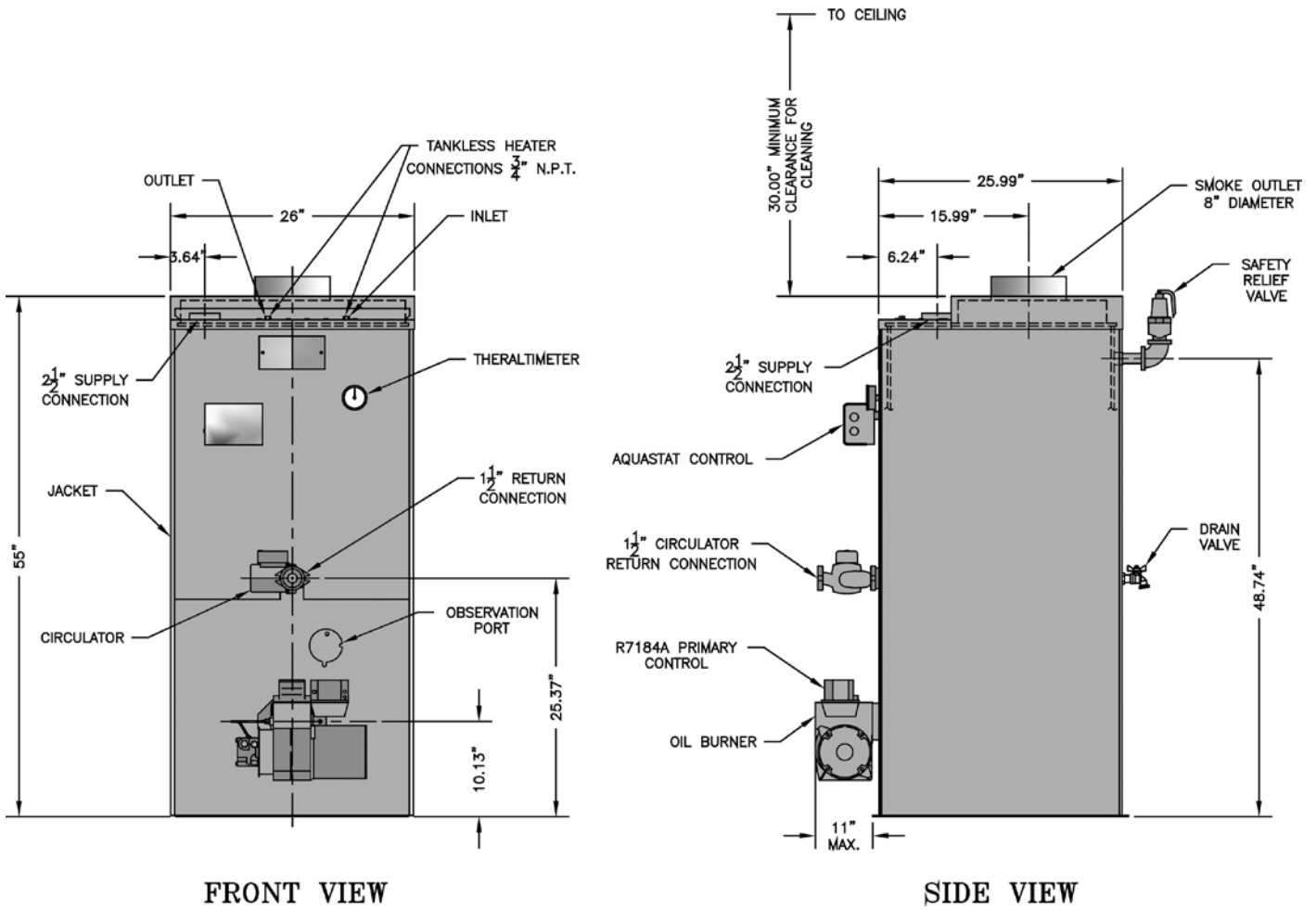


Figure 1A: RSA Packaged Boiler (RSA170 / RSA285)

Boiler Model Number	Bare Boiler Assembly	Minimum Recommended Chimney Sizes		Water Capacity (gallons)	Approx. Shipping Weight (lb.)
		In. x In. x Ft. (height)	In. (dia.) x Ft. (height)		
RSA170	WV-29-10	8 x 8 x 20	7 x 20	42.6	600
RSA195	WV-29-13A		8 x 20	39.9	630
RSA240	WV-29-16A	8 x 12 x 20	8 x 20	37.3	660
RSA285	WV-29-19A		9 x 20	34.6	690

I. Pre-Installation

- A. INSPECT SHIPMENT** carefully for any signs of damage.
1. ALL EQUIPMENT is carefully manufactured, inspected and packed. Our responsibility ceases upon delivery of the crated boiler to the carrier in good condition.
 2. ANY CLAIMS for damage or shortage of shipment must 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.

CAUTION

Do not drop boiler. Do not bump boiler jacket against floor.

1. LOCATE so that smoke pipe connection to chimney will be short and direct. BOILER IS NOT SUITABLE FOR INSTALLATION ON COMBUSTIBLE FLOOR unless combustible floor shield, supplied by Burnham, is used. DO NOT

install on carpeting. See Figure 26 for floor shield part number and installation instructions.

2. FOR BASEMENT INSTALLATION, provide a solid base, such as concrete, if floor is not level, or if water may be encountered on floor around boiler.
3. PROVIDE SERVICE CLEARANCE of at least 48" from the front of the jacket for servicing of burner and removal of tankless heater.

For minimum clearances to combustibles. See Figure 2.

WARNING

Do not support boiler by placing blocks at the four (4) corners of the boiler. Boiler base must be evenly supported under entire base.

Do not operate boiler on combustible floor without a factory supplied floor shield. Concrete over wood joists is considered combustible flooring. Do not operate on masonry floors, which may contain moisture.

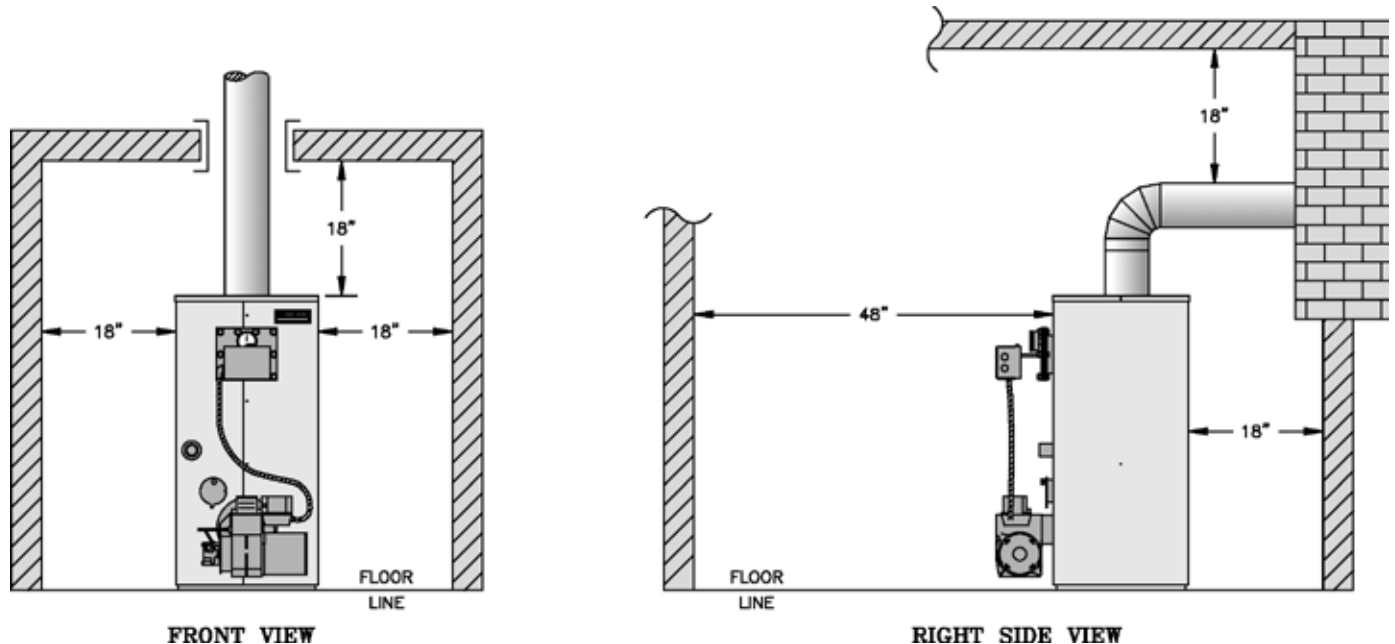


Figure 2: Minimum Clearances to Combustible Materials

NOTE:

1. Listed clearances comply with American National Standard ANSI/NFPA 31, Installation of Oil Burning Equipment.
2. RSA™ boilers can be installed in rooms with clearances from combustible material as listed above. Listed clearances can not be reduced for alcove or closet installations.
3. For reduced clearances to combustible material, protection must be provided as described in the above ANSI/NFPA 31 standard.

- C. PROVIDE COMBUSTION AND VENTILATION AIR. Local code provisions may apply and should be referenced.

WARNING

Adequate combustion and ventilation air must be provided to assure proper combustion and to maintain safe ambient air temperatures.

Do not install boiler where gasoline or other flammable vapors or liquids, or sources of hydrocarbons (i.e. bleaches, fabric softeners, etc.) are used or stored.

1. Determine volume of space (boiler room). Rooms communicating directly with the space in which the appliances are installed, through openings not furnished with doors, are considered a part of the space.
$$\text{Volume}(\text{ft}^3) = \text{Length}(\text{ft}) \times \text{Width}(\text{ft}) \times \text{Height}(\text{ft})$$
2. Determine total input of all appliances in the space. Add inputs of all appliances in the space and round the result to the nearest 1000 BTU per hour.
3. Determine type of space. Divide Volume by total input of all appliances in space. If the result is greater than or equal to 50 ft³/1000 BTU per hour, then it is considered an *unconfined space*. If the result is less than 50 ft³/1000 BTU per hour then the space is considered a *confined space*.
4. For boiler located in an *unconfined space of a conventionally constructed building*, the fresh air infiltration through cracks around windows and doors normally provides adequate air for combustion and ventilation.
5. For boiler located in a confined space or an unconfined space in a building of unusually tight construction, provide outdoor air with the use of two permanent openings which communicate directly or by duct with the outdoors or spaces (crawl or attic) freely communicating with the outdoors. Locate one

opening within 12 inches of top of space. Locate remaining opening within 12 inches of bottom of space. Minimum dimension of air opening is 3 inches. Size each opening per following:

- a. **Direct communication with outdoors.**
Minimum free area of 1 square inch per 4,000 BTU per hour input of all equipment in space.
- b. **Vertical ducts.** Minimum free area of 1 square inch per 4,000 BTU per hour input of all equipment in space. Duct cross-sectional area shall be same as opening free area.
- c. **Horizontal ducts.** Minimum free area of 1 square inch per 2,000 BTU per hour input of all equipment in space. Duct cross-sectional area shall be same as opening free area.
Alternate method for boiler located within confined space. Use indoor air if two permanent openings communicate directly with additional space(s) of sufficient volume such that combined volume of all spaces meet criteria for unconfined space. Size each opening for minimum free area of 1 square inch per 1,000 BTU per hour input of all equipment in spaces, but not less than 100 square inches.

6. Louvers and Grilles of Ventilation Ducts

- a. All outside openings should be screened and louvered. Screens used should not be smaller than 1/4 inch mesh. Louvers will prevent the entrance of rain and snow.
- b. Free area requirements need to consider the blocking effect of louvers, grilles, or screens protecting the openings. If the free area of the louver or grille is not known, assume wood louvers have 20-25 percent free area and metal louvers and grilles have 60-75 percent free area.
- c. Louvers and grilles must be fixed in the open position, or interlocked with the equipment to open automatically during equipment operation.

II. Knock-Down Boiler Assembly

A. REMOVAL OF BOILER.

1. Remove, all boiler to skid, hold down fasteners. Refer to Figure 3.
2. Carefully walk boiler to the edge of skid. Tilt the boiler back, allowing an edge to rest on the floor, and remove the skid.

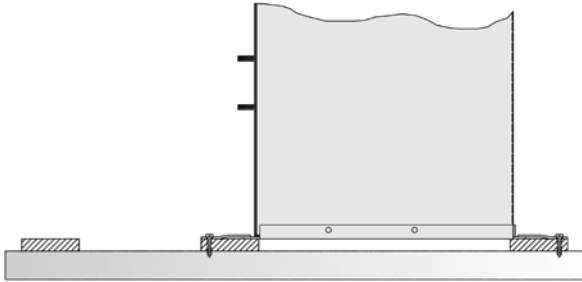


Figure 3: Base on Skid

B. TEST HEAT EXCHANGER FOR LEAKS before proceeding with jacket assembly. Heat exchanger, canopy, and base are preassembled.

1. Install pressure gauge supplied, a hose to the city water and a valve in the supply tapping. Plug remainder of tappings.
2. Fill boiler with water and apply a pressure of at least 10 psig but no more than 30 psig.

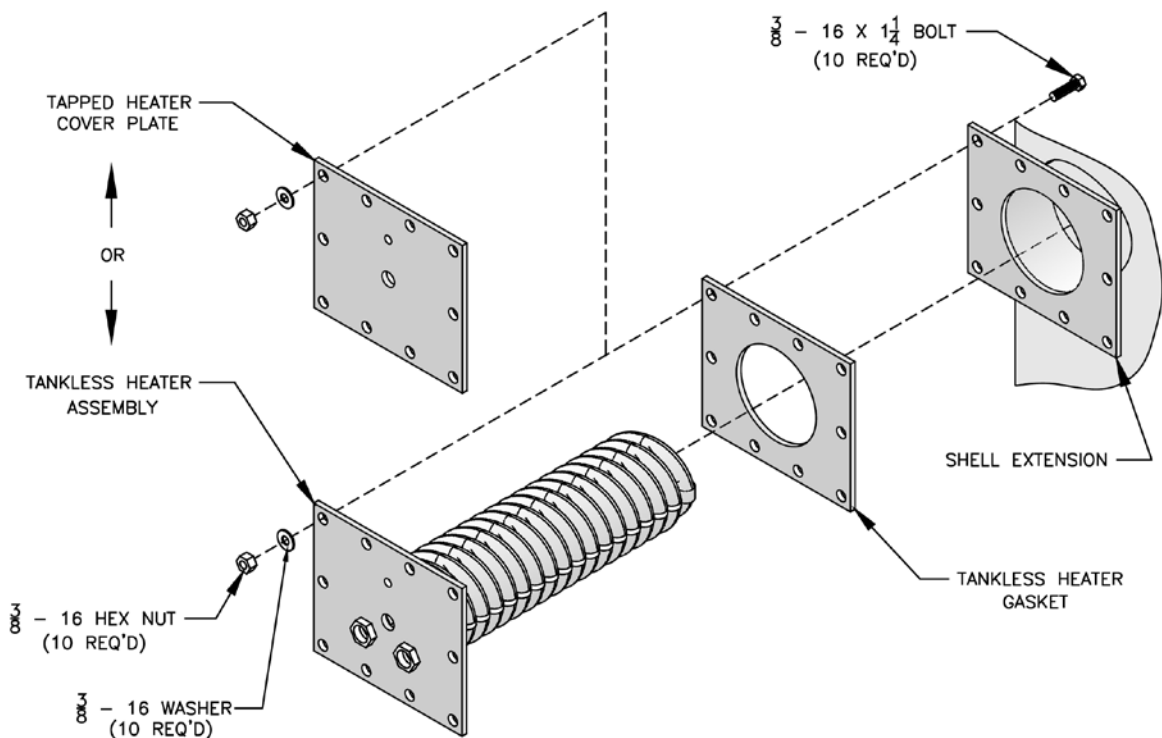


Figure 4: Coil Plate Attachment

WARNING

Do not apply more than 30 psig to boiler.

WARNING

Any combustion chamber which was damaged must be replaced immediately.

CAUTION

If heat exchanger is not square on base DO NOT twist. Carefully lift and reposition.

WARNING

Do not assemble boiler without cerafelt gaskets between heat exchanger and combustion chamber. Gaskets must also be between canopy and heat exchanger.

C. INSTALLING THE JACKET

1. Before jacket can be secured to boiler assembly tankless heater coil or blank plate must be attached. Using rubber gasket and bolts provided secure heater coil or blank plate to boiler extension by inserting the bolts from the backside of the extension. Refer to Figure 4.

2. Bend jacket according to Figure 28. Starting from the front, wrap the jacket around the boiler. Make sure that return pipe, observation port and shell extension fit proper into their corresponding clearance holes. Continue bending jacket around until front panels meet.
3. Attach jacket to boiler assembly with provided screws at appropriate locations. Make sure that the jacket is at least 1/2" to 3/4" off of the floor before attaching.
4. Attach top panel with provided screws.

D. INSTALLATION OF BOILER CONTROLS

1. Install provided pressure/temperature gauge and immersion well into appropriate holes on tankless heater coil plate. Tighten so not to have any water leaks.
2. Mount the aquastat control onto the immersion well. Wire the control according to Figure 13 or 14, in the Electrical and Sequence of Operation Section.
3. Mount burner on Base front panel and wire according to instructions provided with the burner. Refer to Figure 5.

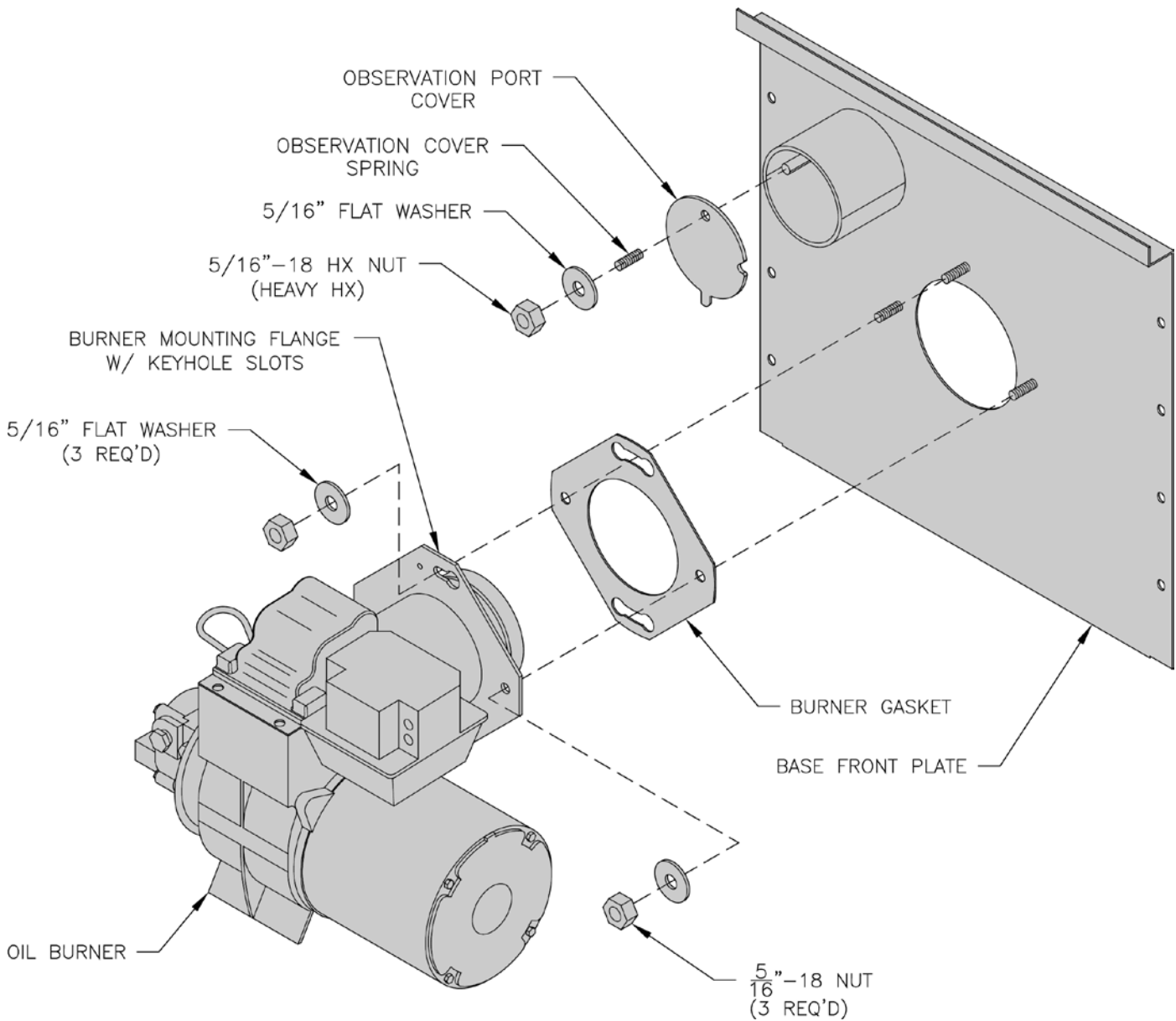


Figure 5: Burner Mounting

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III. Water Piping and Trim

WARNING

Failure to properly pipe boiler may result in improper operation and damage to boiler or structure.

Oxygen contamination of boiler water will cause corrosion of iron and steel boiler components, and can lead to boiler failure. Burnham'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.

- A. Design a piping system and install boiler which will prevent oxygen contamination of boiler water and frequent water additions.
1. There are many possible causes of oxygen contamination such as:
 - a. Addition of excessive make-up water as a result of system leaks.
 - b. Absorption through open tanks and fittings.
 - c. Oxygen permeable materials in the distribution system.
 2. In order to insure long product life, oxygen sources should be eliminated. This can be accomplished by taking the following measures:
 - a. Repairing system leaks to eliminate the need for addition of make-up water.
 - b. Eliminating open tanks from the system.
 - c. Eliminating and/or repairing fittings which allow oxygen absorption.
 - d. Use of non-permeable materials in the distribution system.
 - e. Isolating the boiler from the system water by installing a heat exchanger.

- a. 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 7. Also, consult I=B=R Installation and Piping Guides.

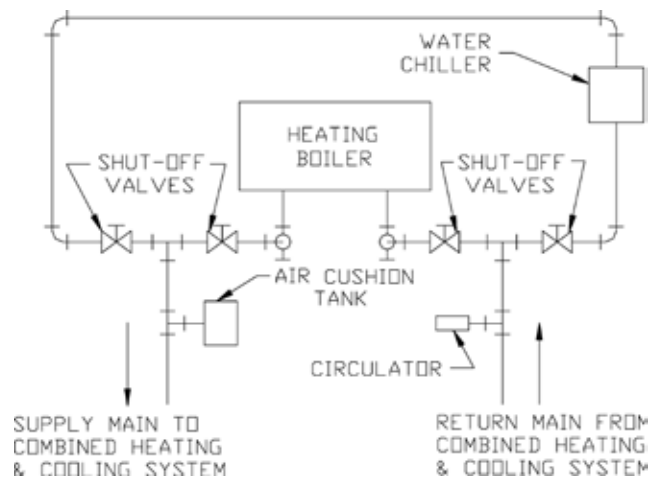


Figure 7: Recommended Piping for Combination Heating and Cooling (Refrigeration) System

- b. 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.
- c. If boiler is used with an Alliance™ Indirect-Fired Domestic Water Heater, install the Alliance™ as a separate heating zone. Refer to the Alliance™ Installation, Operating, and Service Instructions for additional information.
- d. Use a system bypass if the boiler is to be operated in a system which has a large volume or excessive radiation where low boiler water temperatures may be encountered (i.e. converted gravity circulation system, etc.) The bypass should be the same size as the supply and return lines with valves located in the bypass

WARNING

System supply and return piping must be connected to correct boiler pipe.

Burnham recommends sizing the system circulator to supply sufficient flow (GPM) to allow a 20°F temperature differential in the system. When sizing the system circulator, the pressure drop of all radiators, baseboard and radiant tubing and all connecting piping must be considered.

3. Connect System supply and return piping to boiler. See Figures 8 and 9. Also, consult I=B=R Installation and Piping Guides. Maintain minimum ½ inch clearance from hot water piping to combustible materials.

and return line as illustrated in Figures 8 and 9 in order to regulate water flow for maintenance of higher boiler water temperature. Set the bypass and return valves to a half throttle position to start. Operate boiler until the system water temperature reaches its normal operating range. Adjust the valves to maintain 180°F to 200°F boiler water temperature and greater the 120°F return temperature. Adjust both valves simultaneously. Closing the boiler return valve while opening the bypass valve will raise the boiler return temperature. Opening the boiler return valve while closing the by-pass valve will lower the boiler return temperature.

- e. A water boiler installed above radiation level must be provided with a low water cutoff device as part of the installation.

If a low water cut-off is required, it must be mounted in the system piping above the boiler.

The minimum safe water level of a hot water boiler is just above the highest water containing cavity of the boiler; that is, a hot water boiler must be full of water to operate safely.

- B.** Install Safety Relief Valve. See Figures 8 and 9. Safety Relief Valve must be installed with spindle in the vertical position. Installation of the relief valve

must be consistent with ANSI/ASME Boiler and Pressure Vessel Code, Section IV.

WARNING

Safety (relief) valve discharge piping must be piped near floor to eliminate potential of severe burns. Do not pipe in any area where freezing could occur. Do not install any shut-off valves, plugs or caps.

- C.** Install Drain Valve in return piping. See Figures 8 and 9.
- D.** Oil, grease, and other foreign materials which accumulate in new hot water and a new or reworked system should be boiled out, and then thoroughly flushed. A qualified water treatment chemical specialist should be consulted for recommendations regarding appropriate chemical compounds and concentrations which are compatible with local environmental regulations.
- E.** After the boiler and system have been cleaned and flushed, and before refilling the entire system add appropriate water treatment chemicals, if necessary, to bring the pH between 7 and 11.

WARNING

Installation is not complete unless a safety relief valve is installed as shown in Figure 1 or 1A.

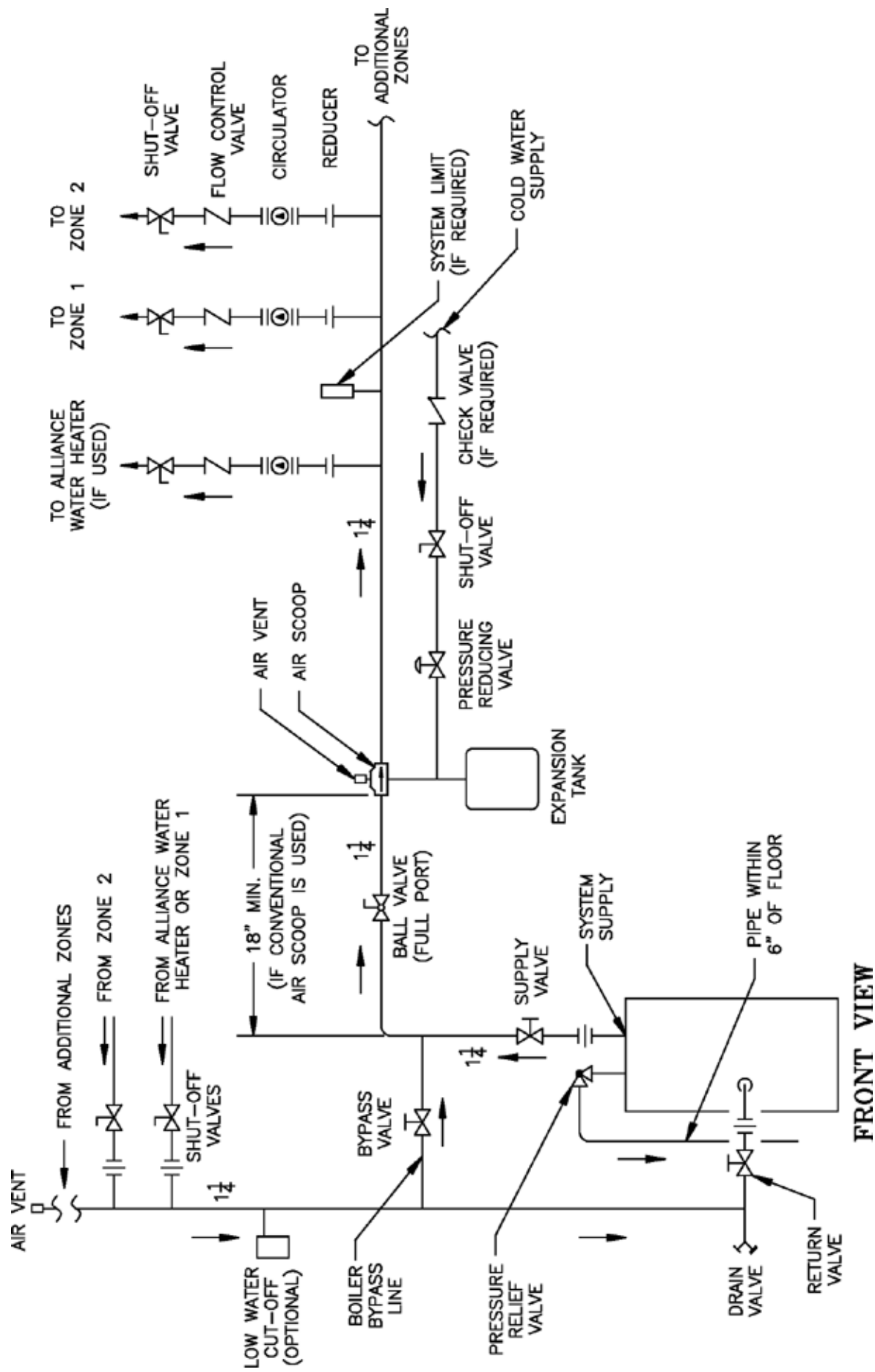


Figure 8: Recommended Water Piping for Circulator Zoned Heating Systems

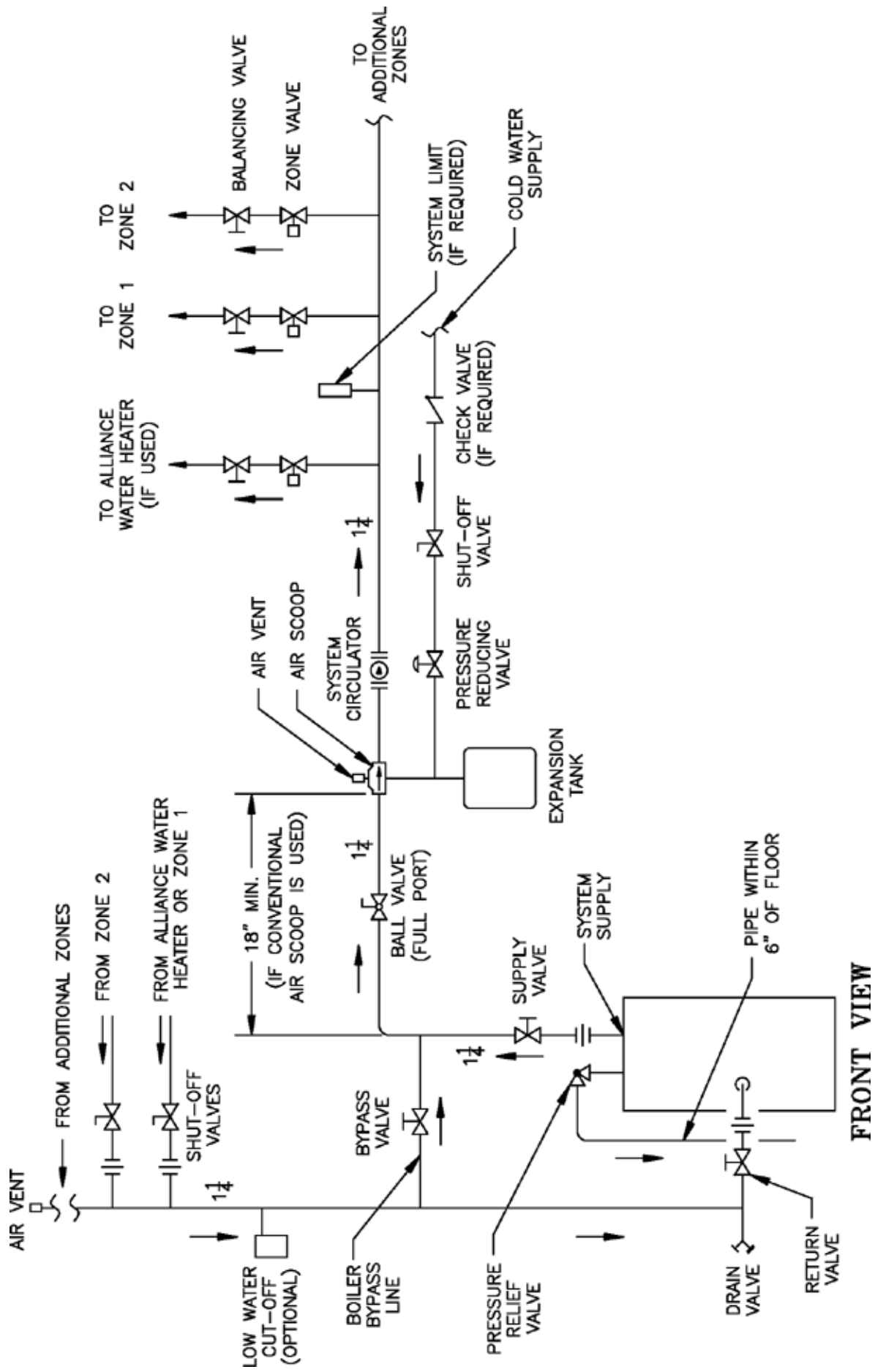


Figure 9: Recommended Water Piping for Zone Valve Zoned Heating Systems

- F. CONNECT TANKLESS HEATER PIPING AS SHOWN IN FIGURE 10. See Table 1 for Tankless Heater Rating.

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. Do not operate tankless heater without mixing valve.

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 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 the possibility of 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 a water temperature. 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. Refer to Figure 10.
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.

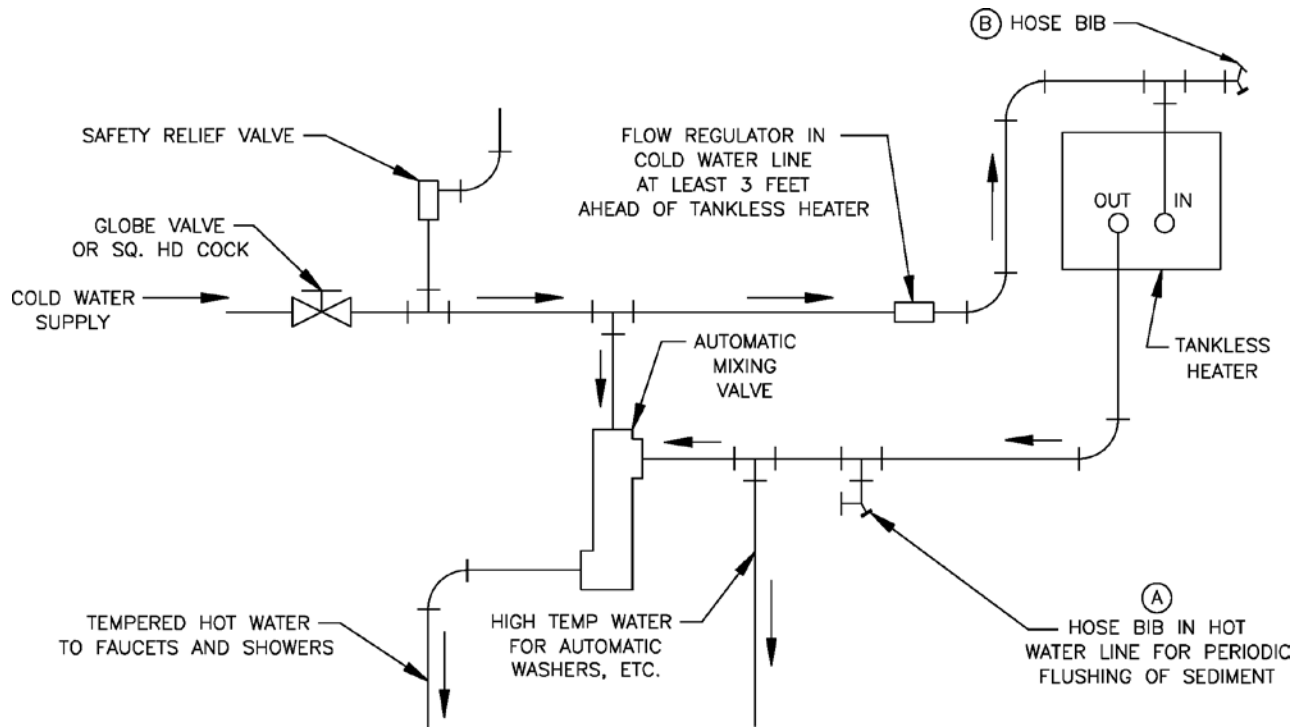


Figure 10: Schematic Tankless Heater Piping

Table 1: Tankless Heater Ratings

Boiler Model	S350		S375	
	GPM	PSID	GPM	PSID
RSA85 & 110	3	12	3½	15
RSA110, 125 & 135	3¼	16	3¾	25
RSA125 & 135	3½	19		

Boiler Model	STD. #7524		OPT. #7530	
	GPM	PSID	GPM	PSID
RSA170	3¾	25½	4	26½
RSA195, 240 & 285	4	29	4¼	31

IV. Venting

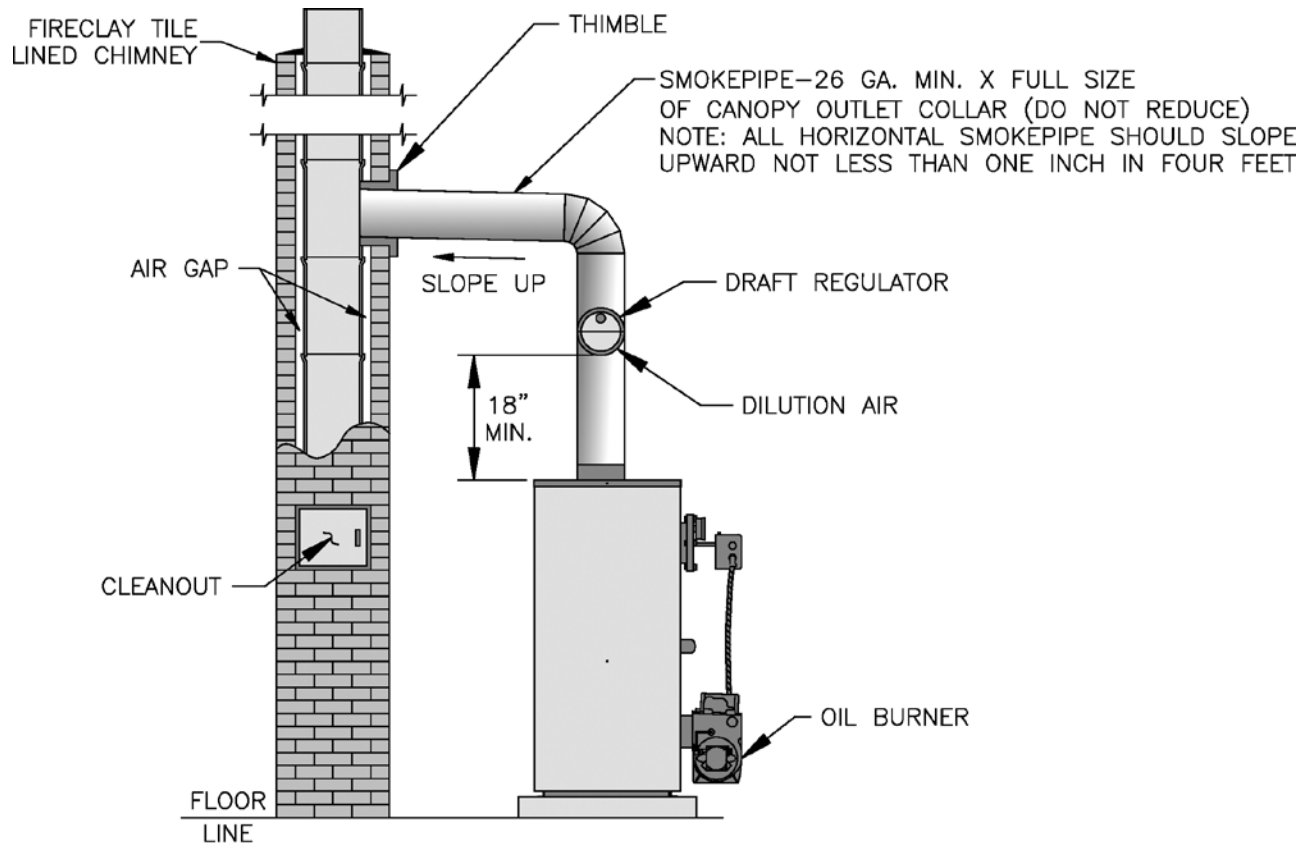
A. General Guidelines.

1. Vent system installation must be in accordance with these instructions and applicable provisions of local building codes. Contact local building or fire officials about restrictions and installation inspection in your area.
2. The RSA Series is designed to be vented into a fireclay tile-lined masonry chimney or chimney constructed from type-L vent or a factory built chimney that complies with the type HT requirements of UL103. The chimney or vent pipe shall have a sufficient draft at all times, to assure safe proper operation of the boiler. See Figure 11 for recommended installation.
 - a. Install a draft regulator (supplied by installer) following the instructions furnished with the regulator. See Figure 12 for alternate regulator locations.
 - b. With any new or replacement installation the chimney has to be considered. Chimneys that have a high heat loss become less suitable as the heat loss of the home goes down and the efficiency of the boiler goes up. Most homes have a chimney appropriate for the fuel and the era in which the home was built. That may have been a coal fired or an inefficient oil fired boiler built into a home without insulation or storm windows. With increasing fuel prices that home probably has been insulated and fitted with storm windows so that the heat loss of the home has been reduced. This requires less fuel to be burned and sends less heat up the chimney. A new boiler probably has a higher efficiency

than the boiler being replaced. That probably means that the stack temperature from the new boiler will be lower than that from the old boiler and with less room air being drawn up the chimney to dilute the stack gases. The combination of a large uninsulated chimney, reduced firing rate, reduced firing time, lower stack temperature and less dilution air can, in some cases, contribute to the condensing of small amounts of water vapor in the chimney. Such condensation, when it occurs, can cause chimney deterioration. In extreme cases, the chimney may have to be lined to insulate the chimney and thus prevent the condensation. The addition of dilution air into the chimney may assist in drying the chimney interior surfaces.

A massive chimney on a cold, or exposed outside wall may have produced adequate draft when it was fired with a higher input and greater volumes of heated gases. With reduced input and volume, the draft may be severely affected. In one instance our research showed a new chimney of adequate sizing produced only $-.035''$ W.C. after 30 minutes of continuous firing at 13.0% CO_2 . Outside wall chimneys take longer to heat up and can have $.00''$ W.C. draft at burner start-up. You may have to consider a special alloy chimney flue liner with insulation around it and stabilizing draft cap or even a draft inducing fan in severe cases.

- c. For the same reasons as in (2.) above, heat extractors mounted into the breeching are not recommended.
3. For minimum clearances to combustible materials refer to Figure 2.



LEFT SIDE VIEW

Figure 11: Recommended Smoke Pipe Arrangement and Chimney Requirements

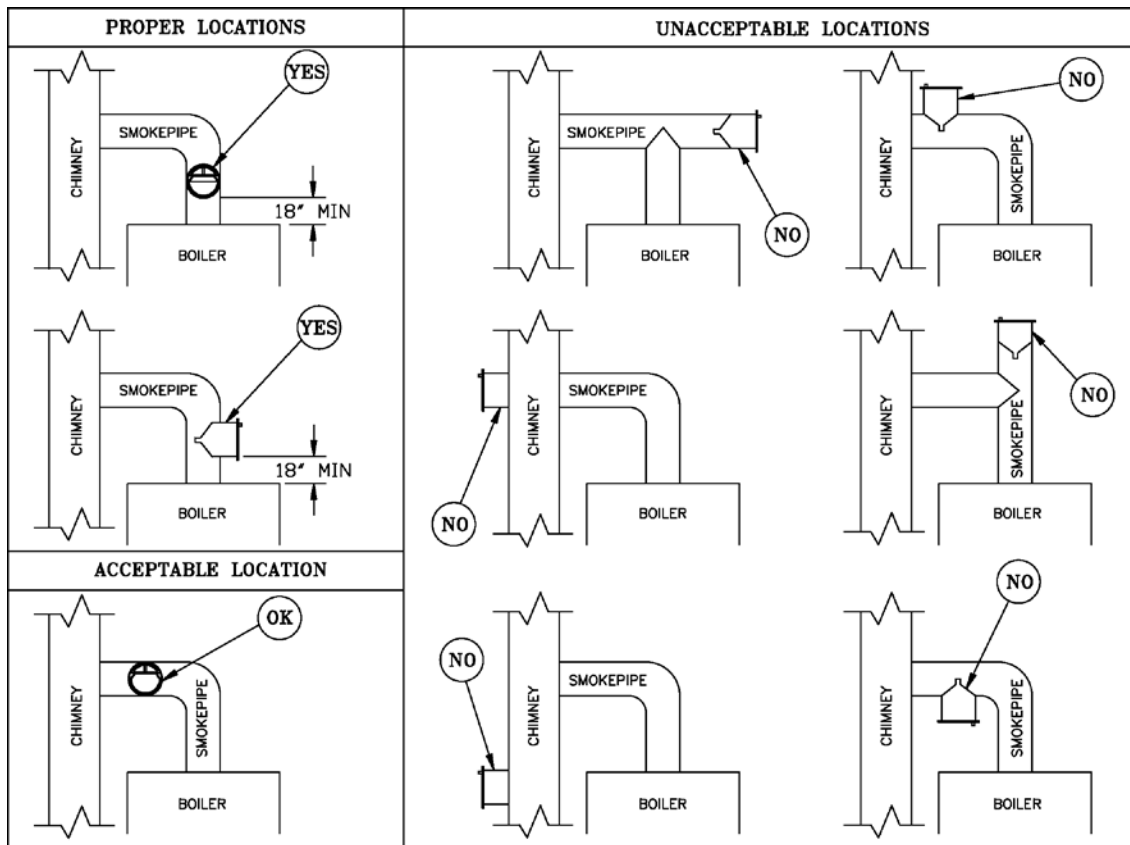


Figure 12: Draft Regulator Locations

V. Electrical

DANGER

Positively assure all electrical connections are unpowered before attempting installation or service of electrical components or connections of the boiler or building. Lock out all electrical boxes with padlock once power is turned off.

WARNING

Failure to properly wire electrical connections to the boiler may result in serious physical harm.

Electrical power may be from more than one source. Make sure all power is off before attempting any electrical work.

Each boiler must be protected with a properly sized fused disconnect.

Never jump out or make inoperative any safety or operating controls.

The wiring diagrams contained in this manual are for reference purposes only. Refer to the wiring diagram of any controls used with the boiler. Read, understand and follow all wiring instructions supplied with the controls.

A. General

1. Install wiring and electrically ground boiler in accordance with requirements of the authority having jurisdiction, or in absence of such requirements the National Electrical Code, ANSI/NFPA 70, and/or the CSA C22.1 Electric Code.
2. A separate electrical circuit must be run from the main electrical service with an over-current device/disconnect in the circuit. A service switch is recommended and may be required by some local jurisdictions.
3. Wiring should conform to Figure 13 and/or 14.

B. System Controls and Wiring

1. Refer to National Electric Code or Local Electric Codes for proper size and type of wire required. Follow Code.
2. Use anti-short bushings on all wiring passing through boiler jacket, junction boxes and/or control boxes.
3. Use armored cable (BX) over all exposed line voltage wiring.
4. If an Alliance indirect water heater is used, use priority zoning. Do not use priority zoning for Hydro-Air Systems.

5. Single Zone System – Refer to Figure 13 or 14 of this manual for the electrical diagram for this type of system. Connect the system circulator wire leads to the proper locations on the Aquastat control, L7224C/L7248C.

Connect the thermostat to the ‘T-T’ terminals on the L7224C/L7248C control. Set thermostat heat anticipator settings to 0.60 amps.

6. Conventional Circulator Zoned System – Refer to Figure 15 for the electrical diagram for this type of system.
Read, understand and follow all of the instructions provided with the Honeywell R8888 control.

7. Conventional Zone Valve Zoned System – Refer to Figure 16. Wiring to the most popular models of zone valves are given in Figure 17.

Locate C1 and C2 inside the L7224C Honeywell control. Connect the two (2) terminals to the system circulator wire leads, supplied with boiler.

Connect the H1 and H2 terminals inside the R8889 to the ‘T-T’ terminals in the L7224C Honeywell Control. Refer to Figure 16.

Connect the thermostat of each zone and the circulator for that zone to R8889 panel. If an Alliance indirect water heater is used, connect the Alliance thermostat and circulator to the Zone 1 terminals of the R8889. Set thermostat anticipator settings to 0.12 amps.

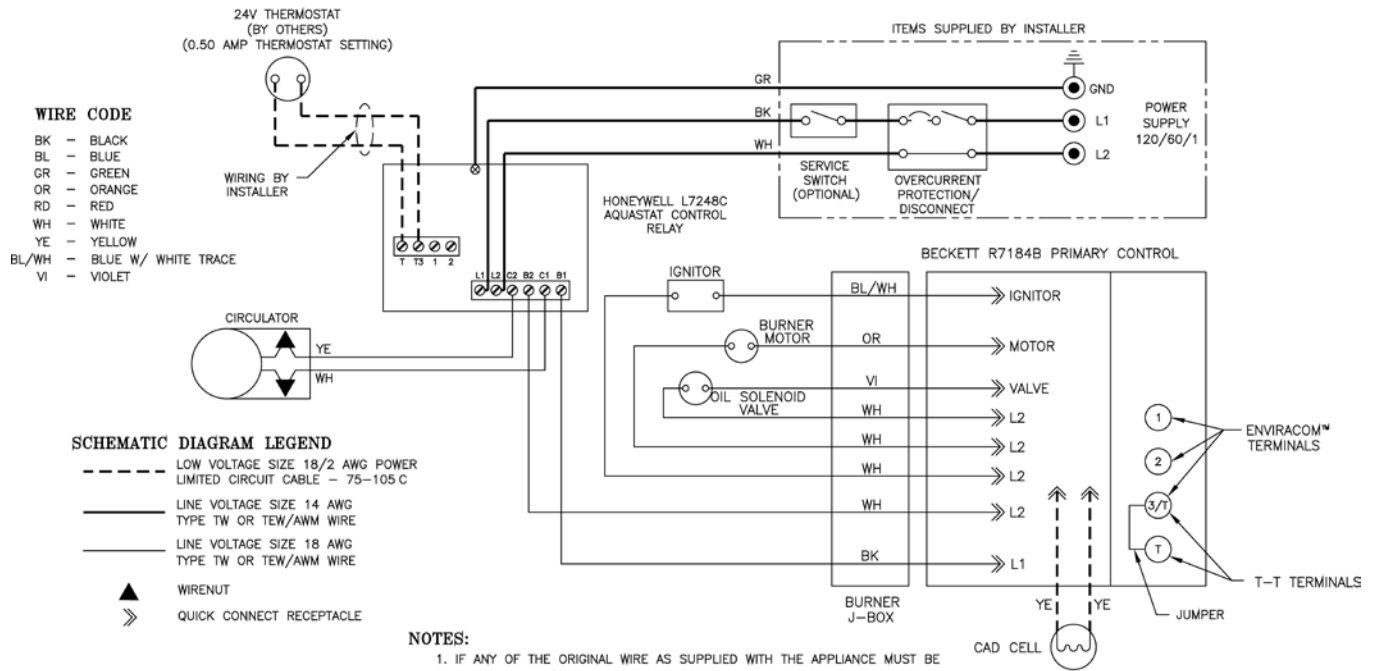


Figure 13: "RSAL" Wiring Less Tankless, Single Circulator
Sequence of Operation

A call for heat by the thermostat energizes the L7224C/L7248C control which in turn energizes the Honeywell R4184D primary control to turn on the burner. If burner ignites within approximately 45 seconds and the cad cell sees flame, the burner will continue to operate until the call for heat is satisfied or the setting of the high limit is reached. The circulator will operate as long as the thermostat is calling for heat. If the thermostat is not satisfied and the high limit is reached, the circulator will continue to operate, and the burner will stop until the high limit is closed by a drop in water temperature.

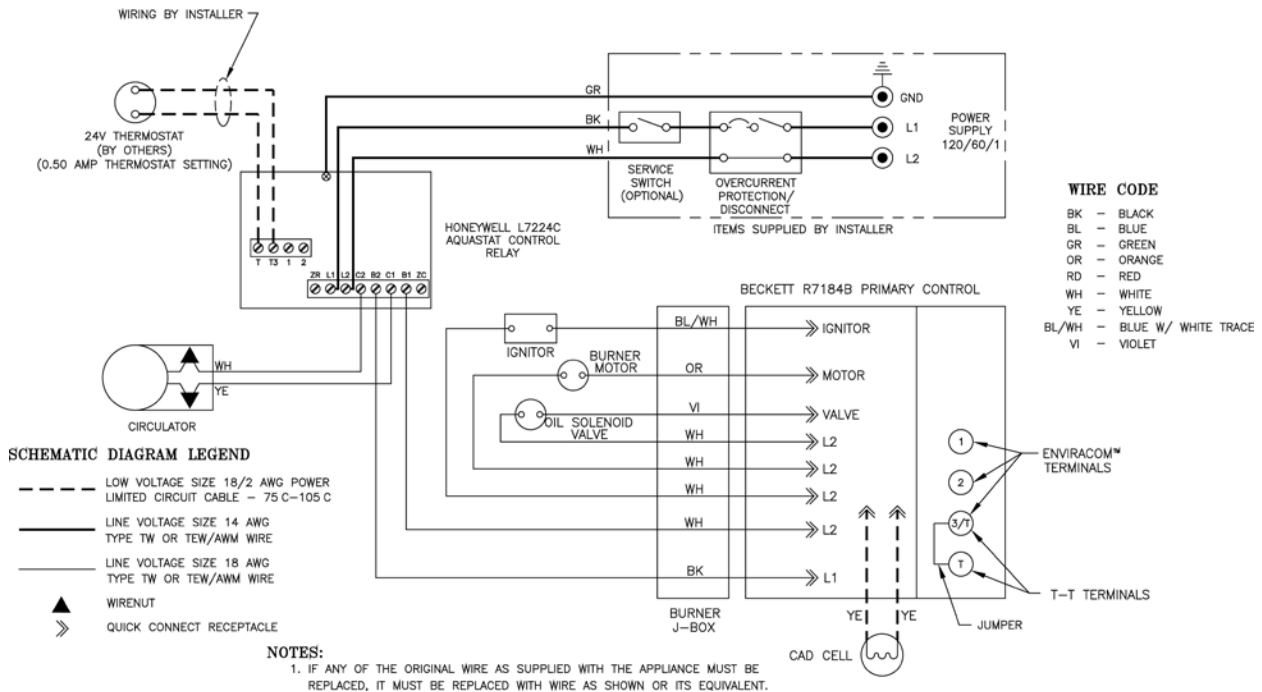


Figure 14: "RSAT" or "RSAR" Wiring with Tankless, Single Circulator
Sequence of Operation

A call for heat by the thermostat energizes the L7224C/L7248C control which in turn energizes the Honeywell R4184D primary control to turn on the burner. If burner ignites within approximately 45 seconds and the cad cell sees flame the burner will continue to operate until the call for heat is satisfied. The circulator will also operate when the thermostat calls for heat if the boiler water temperature is up to the setting of the low limit in the L8124C control. If boiler water temperature is below the low limit setting the burner will operate but the circulator will not, giving preference to the domestic hot water demand.

On call for heat by the thermostat the burner will continue to operate until the thermostat is satisfied or the setting of the high limit is reached. If the thermostat is not satisfied when the high limit is reached the burner will stop but the circulator will continue to operate until the thermostat is satisfied. Any time the boiler water temperature drops below the setting of the low limit the burner will be energized in order to maintain domestic water temperature.

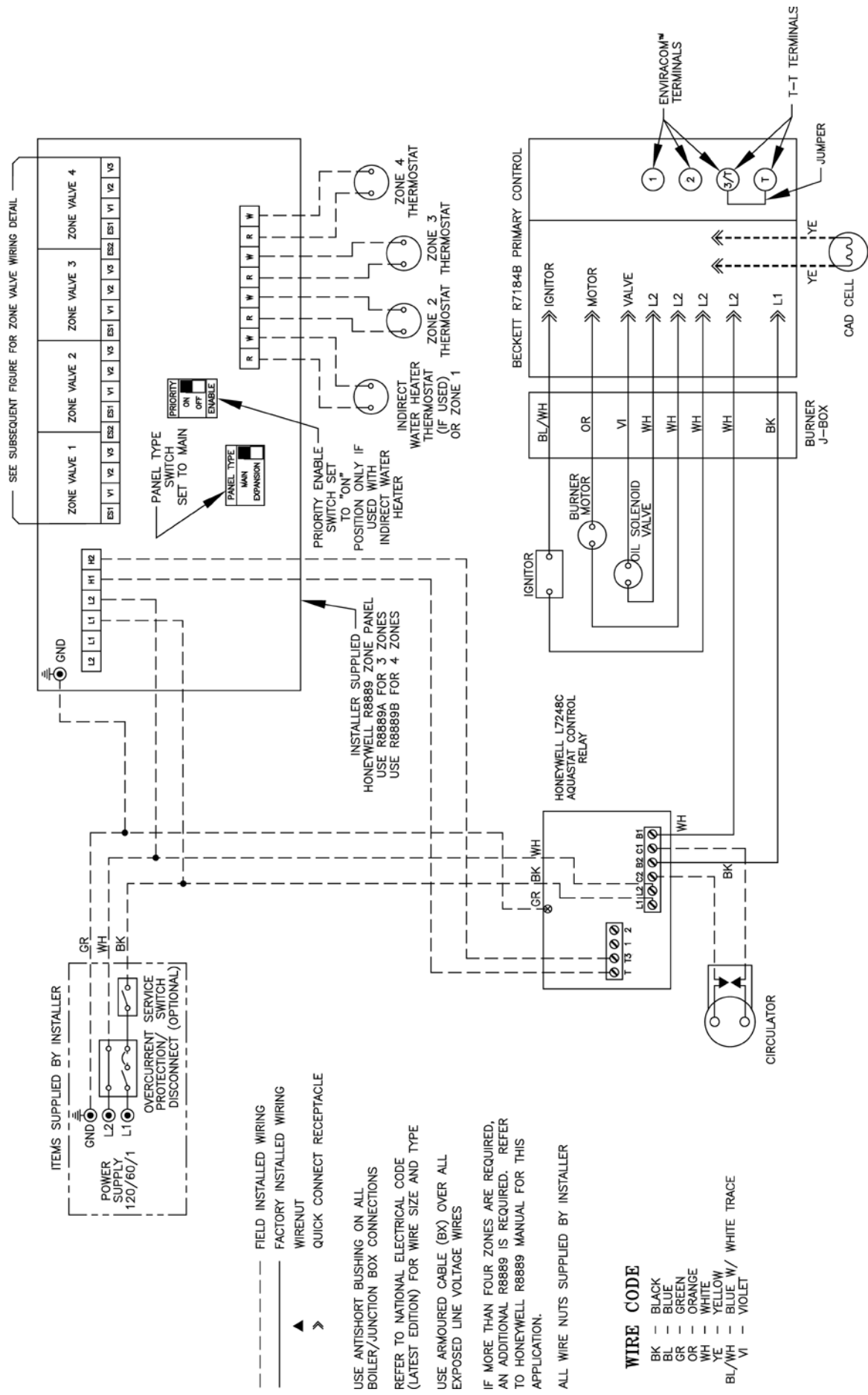
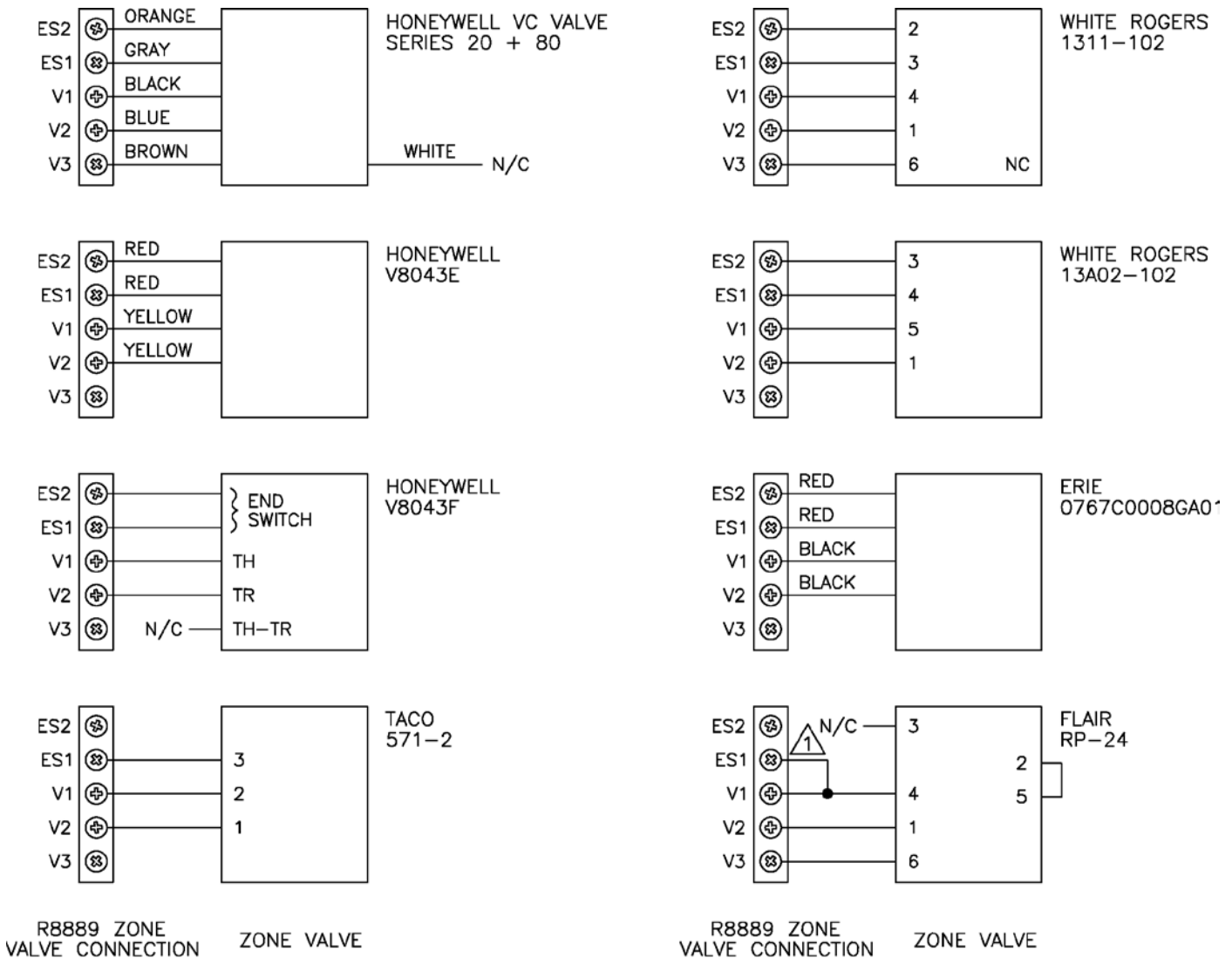


Figure 16: Zone Valve Zoned Wiring for R8889

NOTICE

The Honeywell R8889 Control is available in two three (3) zone models and two four (4) zone models. Burnham recommends using Model R8889A for three (3) zone systems and Model R8889B for four (4) zone systems. Models R8889C and R8889D have less load capacity and may not operate with certain types of zone valves. Up to four (4) R8889's may be used together to provide up to sixteen (16) individual zones. Only one (1) zone, the first zone of the main control will provide priority zoning for the Alliance indirect water heater. If more than four (4) zones are required, connect additional R8889's by wiring the A, B and C terminals of each control together. Each R8889 requires a 120 volt power supply. If more than one (1) R8889 is used, set the panel type switch to "main" on the first R8889 and set the panel type switch to "expansion" on the second, third or fourth R8889.



⚠️ JUMPER V1 TO ES1 WHEN USING ZONE VALVES WITHOUT END SWITCHES.

Figure 17: Different Manufacturer's Zone Valve Connections to Honeywell R8889

NOTICE

The Burnham EC5000 Control includes a water temperature sensor. Mount this sensor to the system supply piping.

8. Burnham EC5000 Circulator Zoned System – Refer to Figure 18 of this manual for the electrical diagram for this type of system. Wire the system as indicated in that diagram. Refer to the manual provided with the Burnham EC5000 Control for control operation and setup details.
9. Burnham EC5000 Zone Valve Zoned System – Refer to Figure 19 of this manual for the electrical diagram for this type of system. Wire the system as indicated in that diagram. Refer to the manual provided with the Burnham EC5000 for control operation and setup details.

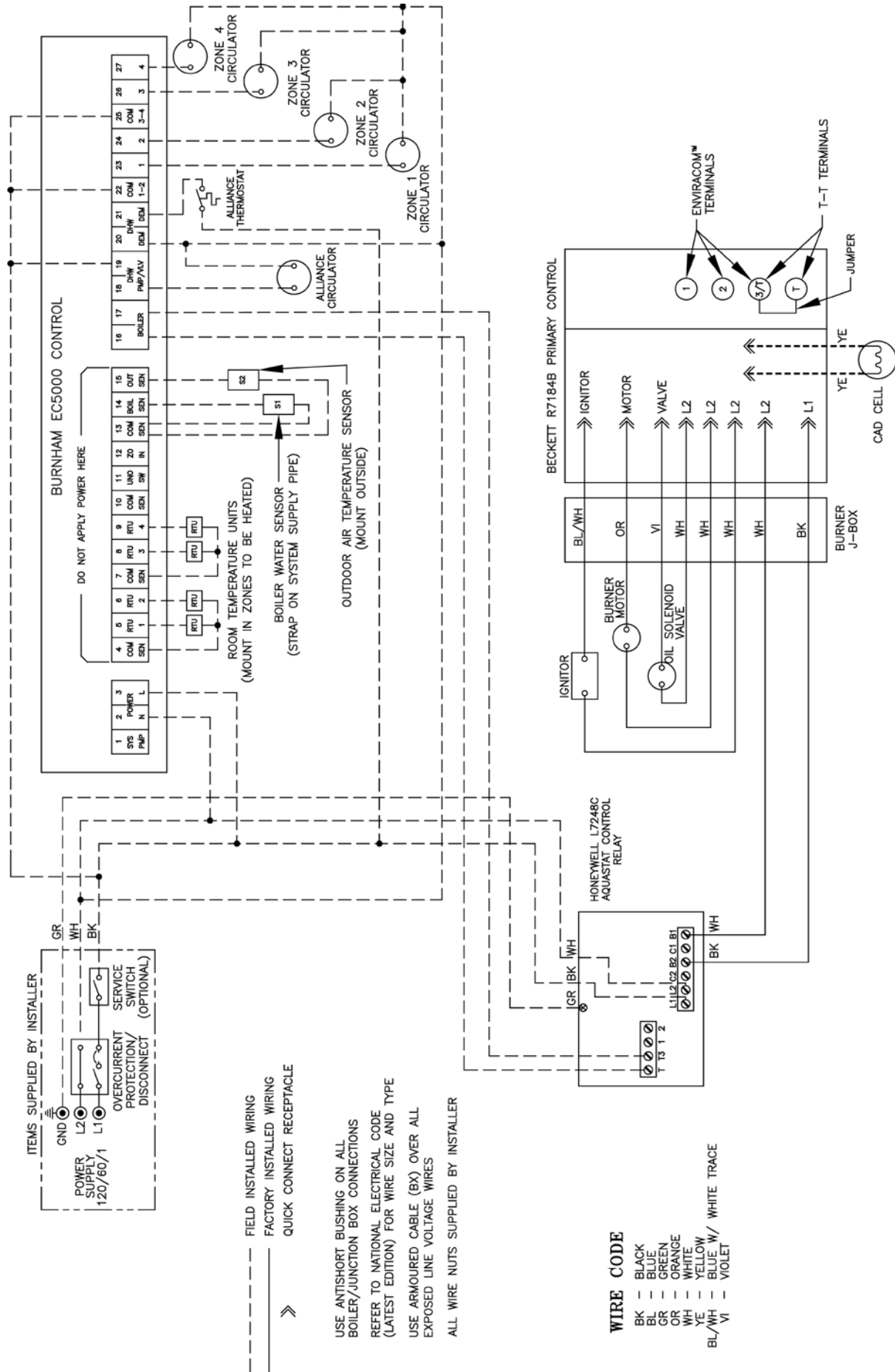


Figure 18: Circulator Zoning with EC5000 Wiring Schematic

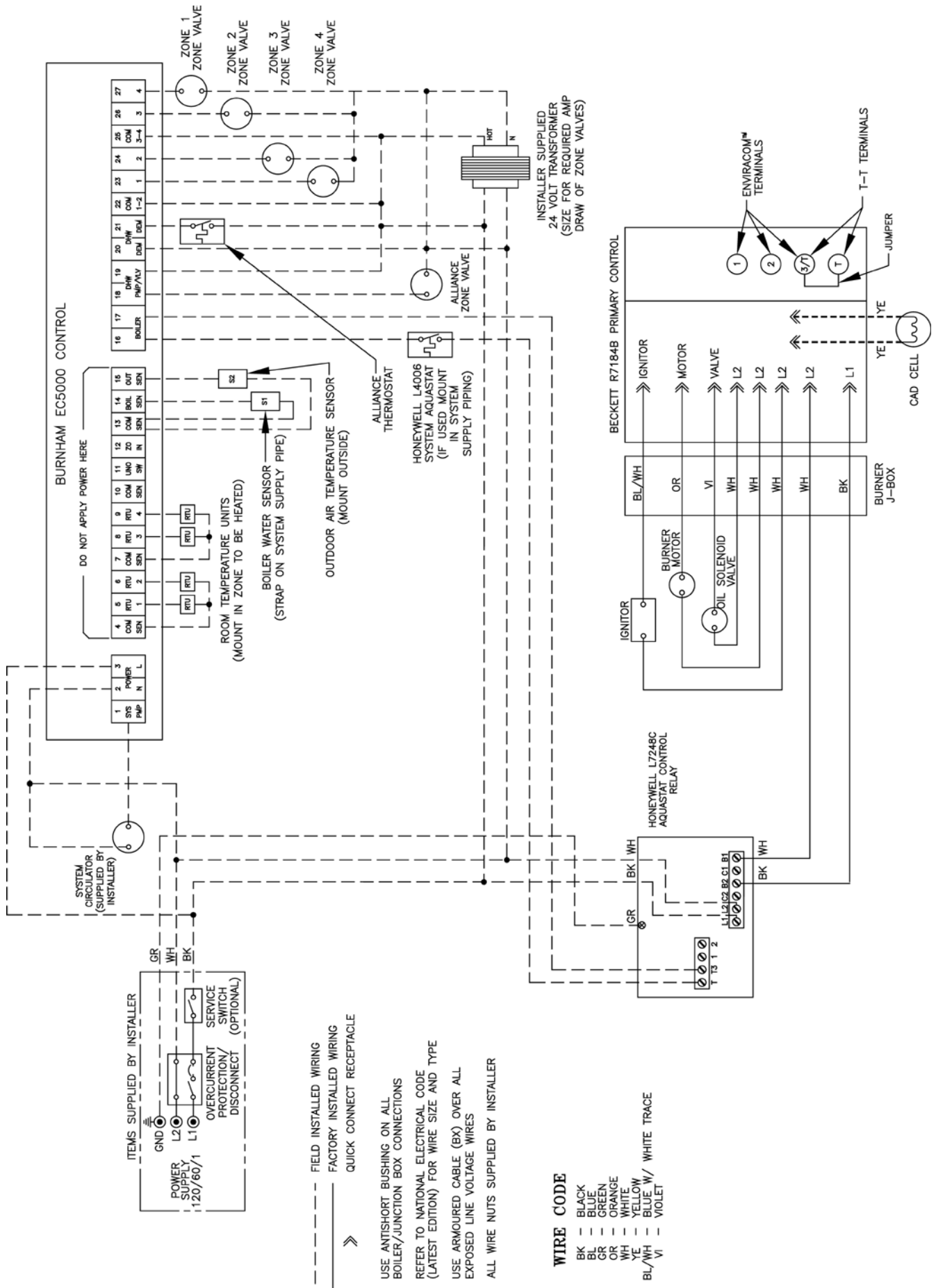


Figure 19: Zone Valve Zoned with EC5000 Wiring Schematic

VI. Oil Piping

A. General.

1. Use flexible oil line(s) so that burner can be removed without disconnecting the oil supply.
2. A supply line fuel oil filter is recommended as a minimum for all firing rates but a pleated paper fuel oil filter is recommended for the lowest firing rate application to prevent nozzle fouling.
3. Use Flared fittings only. Do not use compression fittings.
4. Use of a high efficiency micron filter (Garber or equivalent) in addition to conventional filter is highly recommended.

B. Single-pipe Oil Lines.

1. Standard burners are provided with single-stage 3450 rpm fuel units with the bypass plug removed for single-pipe installations.
2. The single-stage fuel unit may be installed single-pipe with gravity feed or lift. Maximum allowable lift is 8 feet. See Figure 20.

NOTICE

Oil piping must be absolutely airtight or leaks or loss of prime may result. Bleed line and fuel unit completely.

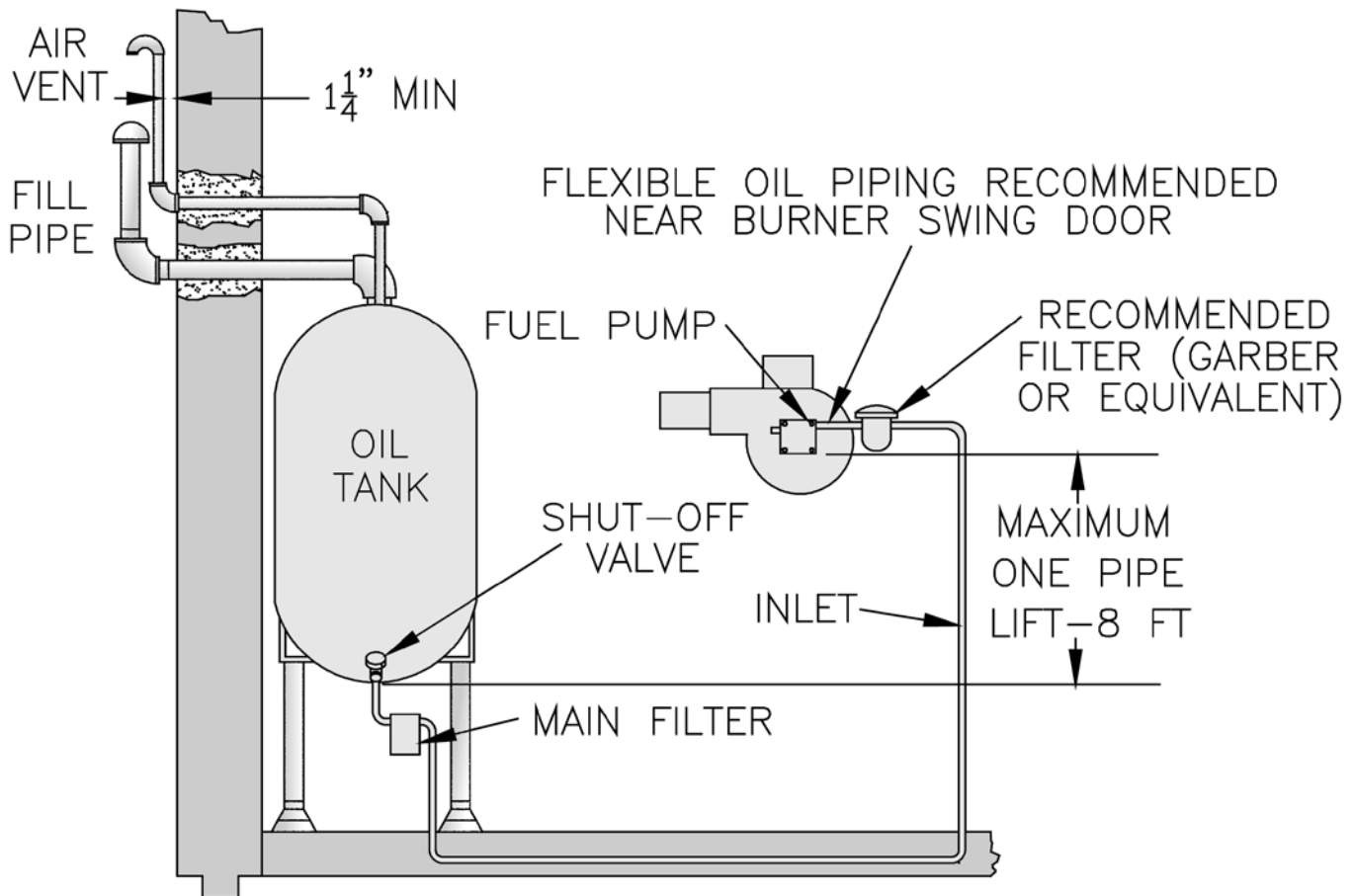


Figure 20: Single-Pipe Installation

Table 2: Single-Stage Units (3450 RPM) - Two Pipe Systems

Lift "H" (See Figure 21)	Maximum Length of Tubing "H" + "R" (See Figure 21)	
	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 3: Two-Stage Units (3450 RPM) - Two Pipe Systems

Lift "H" (See Figure 21)	Maximum Length of Tubing "H" + "R" (See Figure 21)	
	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'

C. Two-Pipe Oil Lines

1. For two-piped systems, where more lift is required, the two-stage fuel unit is recommended. Table 2 (single-stage) and Table 3 (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 21.

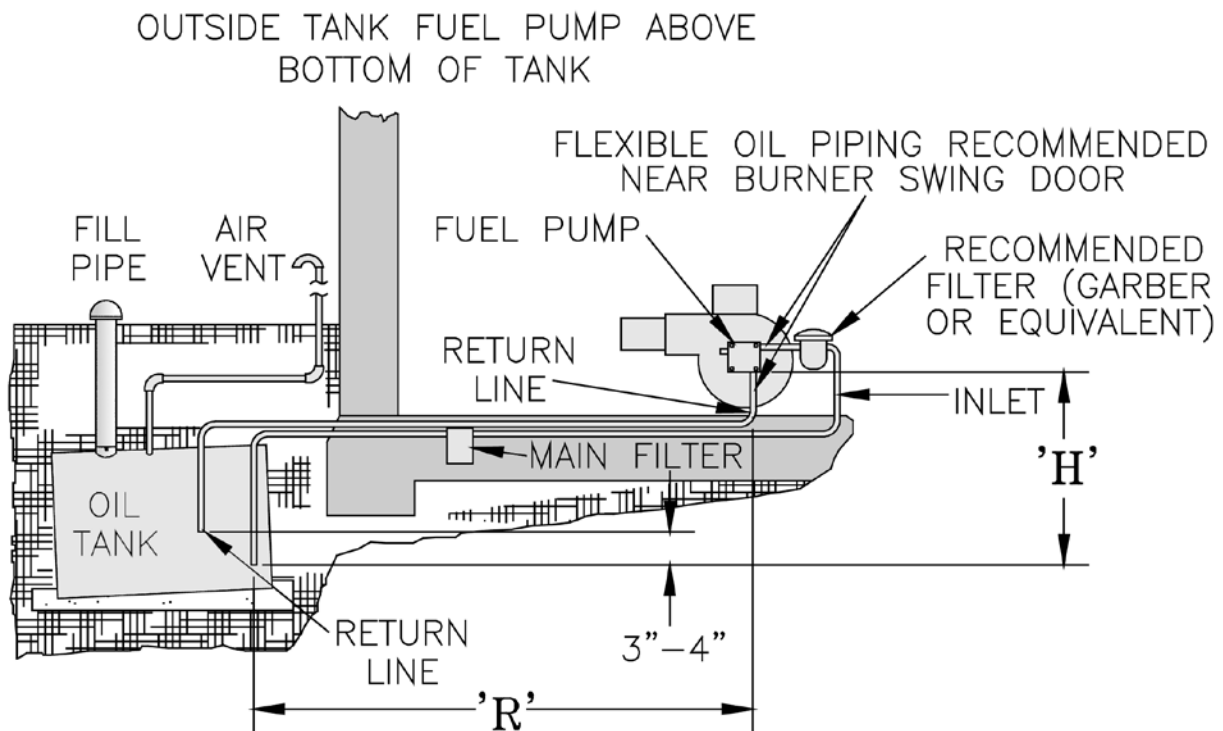


Figure 21: Two-Pipe Installation

VII. System Start-Up

- A. Verify that the venting, water piping, oil piping, and electrical system are installed properly. Refer to installation instructions contained in this manual.
- B. 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.

- C. 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 8 or 9.
1. Close isolation valve in boiler supply piping.
 2. Isolate all circuits by closing zone valves or balancing valves.
 3. Attach a hose to hose bib located just below isolation valve in boiler supply piping. (Note - Terminate hose at a suitable floor drain or outdoor area).
 4. Starting with one circuit at a time, open zone valve or valve.
 5. Open hose bib.
 6. Open fill valve (Make-up water line should be located directly after isolation valve in boiler supply piping between air scoop and expansion tank).
 7. Allow water to flow into drain until discharge from hose is bubble free for 30 seconds.
 8. When zone is completely purged of air, close zone valve or balancing valve. Open the zone valve for the next zone to be purged. Repeat this step until all zones have been purged. At completion, open all zone valves or valves.

WARNING

The maximum operating pressure of this boiler is 30 psig. Never exceed this pressure. Do not plug or change pressure relief valve.

9. Close hose bib, continue filling the system until the pressure gauge reads 12 psig. Close fill valve.
(Note - If make-up water line is equipped with pressure reducing valve, system will automatically fill to 12 psig.)
10. Open isolation valve in boiler supply piping.
11. Remove hose from hose bib.

- D. CONFIRM that the boiler and system have no water leaks.
- E. CHECK CONTROLS, WIRING AND BURNER to be sure that all connections are tight and burner is rigid. Verify that all electrical connections have been completed, fuses installed, that the oil tank is filled and oil lines have been tested.
- F. LUBRICATION. Follow instruction on burner and circulator label to lubricate, if oil lubricated. Most motors currently used on residential type burners employ permanently lubricated bearings and thus do not require any field lubrication. Water lubricated circulators do not need field lubrication.
- G. 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 R7184B Oil Primary Control and release.
 3. On BOILERS WITHOUT TANKLESS HEATERS equipped with L7248 electronic aquastat controller, set High Limit (HL) at 180°F. This temperature can be varied to suit installation requirements. L7248 controller has the High Limit adjustment range from 180°F to 240°F (82°C to 116°C). High Limit Differential is fixed at 15°F (8°C).
 4. On BOILERS WITH TANKLESS HEATERS equipped with L7224 electronic aquastat controller, set operating control (low limit [LL]) at 190°F and high limit (HL) at 210°F. Operating control (low limit) setting must be a minimum of 20°F below high limit setting.
L7224 controller has the High Limit adjustment range from 130°F to 240°F (55°C to 116°C), and the Low Limit adjustment range from 110°F to 220°F (43°C to 104°C). High Limit Differential is fixed at 10°F (6°C), and Low Limit Differential has adjustment range from 10°F (6°C) to 25°F (14°C).
 5. ADJUSTING AQUASTAT CONTROLLER SETTINGS. To discourage unauthorized changing of Aquastat settings, a procedure to enter the ADJUSTMENT mode is required. To enter the ADJUSTMENT mode, press the UP, DOWN, and I buttons (refer to Figure 22) simultaneously for three seconds. Press the I button until the feature requiring adjustment is displayed:
 - HL_ — High Limit.
 - LL_ — Low Limit.
 - Ldf — Low Limit Differential.
 - °F — °C.

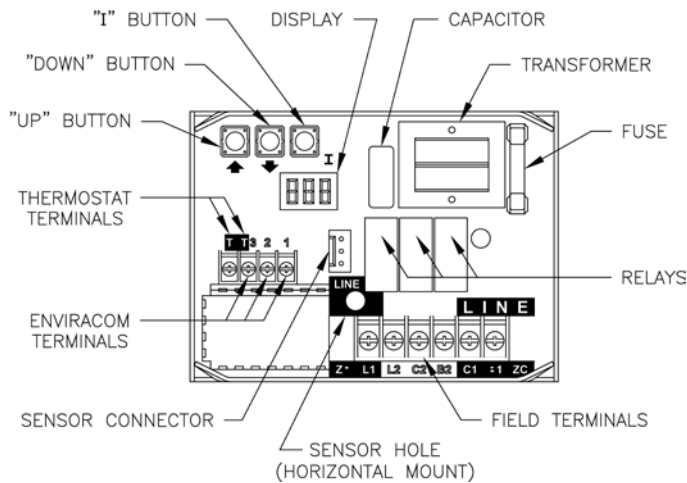


Figure 22: L7248/L7224 Circuit Board Layout - Horizontal Mount

Then, press the **UP** and/or **DOWN** buttons to move the set point to the desired value. After 60 seconds without any button inputs, the control will automatically return to the **RUN** mode.

Note that **L7224** Aquastat Controller will display all four (4) above-listed adjustment features, but **L7248** Aquastat Controller **will not** display Low Limit and Low Limit Differential adjustment features.

6. DISPLAY READOUT

In the **RUN** mode, the Aquastat will flash "bt" (boiler temp) followed by the temperature (i.e., 220), followed by °F or °C.

To read boiler settings, press the **I** key to read the parameter of interest. For example, press **I** High Limit (**HL**) is displayed, followed by a three-digit number, i.e., 220, followed by °F or °C. Pressing the **I** button again (on L7224 models) will display the Low Limit (**LL**) followed by a three-digit number and the corresponding degree designator. See Display Readout, Figure 23.

After approximately 60 seconds without any key presses, the display will enter a dim display mode. To return to the bright display mode, simply press any key.

Text	Description	Display Shows
<i>bt</i>	Boiler Temperature	bt
<i>HL</i>	High Limit	HL
<i>LL</i>	Low Limit	LL
<i>Ldf</i>	Low Limit Differential	Ldf
<i>tt</i>	Local Thermostat Status	tt
<i>tte</i>	Enviracom Thermostat Status	tte
<i>err</i>	Error Code	Err
<i>f</i>	Degrees Fahrenheit	OF
<i>C</i>	Degrees Celsius	OC

Figure 23: Display Readout Definitions

7. OPERATION

The L7224 model can be in any of four operational states - Normal, High Limit, Low Limit and Error. The controller moves back and forth from High Limit to Normal to Low Limit state as part of normal operation.

The L7248 model is restricted to three operational states - Normal, High Limit and Error. The controller moves back and forth from High Limit to Normal state as part of normal operation.

For both models, the controller will enter the Error state when there is an abnormal condition. The operating states are:

- Normal: Boiler temperature went below the High Limit setting (minus the Differential) and has not exceeded the High Limit setting; or the boiler temperature went above the Low Limit setting and has not gone below the Low Limit setting (minus the Differential).
- High Limit: Boiler temperature went above the High Limit setting and has not dropped below the High Limit setting (minus the Differential).
- Low Limit: Boiler temperature went below the Low Limit setting (minus the Low Limit Differential) and has not gone above the Low Limit setting.
- Error: The controller has detected an error condition (e.g., open sensor) and has shut down the burner output. The ZC output is energized. The controller continues to monitor the system and automatically restarts if the error condition clears. Refer to Table 4.

Table 4: LED Error Codes

Error Code	Cause / Action
Err1	Sensor fault; check sensor.
Err2	ECOM fault; check EnviraCOM™ wiring.
Err3	Hardware fault; replace control.
Err4	B1 fault; check B1 wiring/voltage.
Err5	Low Line; check L1-L2, 110 Vac.
Err6	Fuse; check ECOM wires, replace fuse.
Err7	EEPROM, HL, LL, Hdf, Ldf; reset to default values. Restore desired settings.
Err8	Repeated B1 fault (voltage present at B1 when output is turned off); check B1 wiring/voltage.

The operating sequence for the L7224/L7248 is shown in Table 5. See Table 6 for Trouble Shooting Guide.

8. HIGH LIMIT CONTROLLER

The High Limit opens and turns off the burner when the water temperature reaches the setpoint. The High Limit automatically resets after the water temperature drops past the setpoint and through the

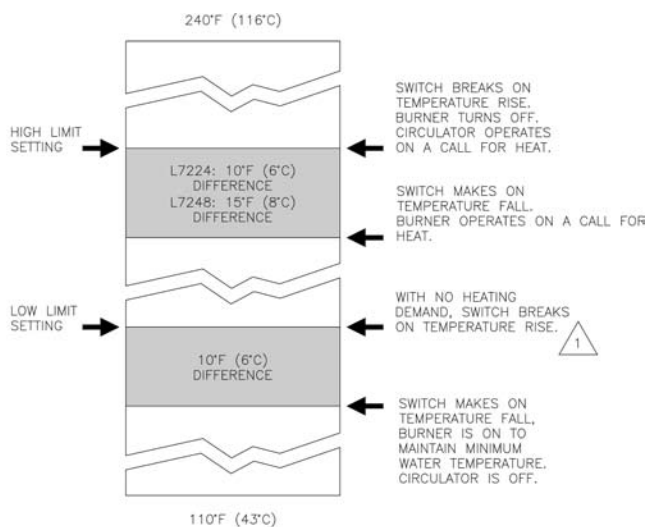
Table 5: L7224 / L7248 Controller Operating Sequence

Action	System Response
Thermostat calls for heat.	Circulator starts when water temperature is above Low Limit setting (if applicable). Boiler temperature is checked. Burner starts when water temperature is below High Limit setting.
Boiler exceeds the High Limit.	Burner is turned off. Burner restarts when the water temperature drops below the High Limit setting minus the Differential.
Thermostat is satisfied.	Circulator and burner turn off.
Error condition 1-5.	If an error condition is detected, all outputs except ZC are shut down. Burner is off. Control continues to function and restarts when error is corrected. During the error check sequence, the system checks for drift in the sensor and corrosion in the connections.
Error condition 6.	EnviraCOM communication is not available.
Error condition 7.	The control has reset the High Limit, Low Limit and Differential setting to a default setting and will continue to run at those settings. Performance of the system will be degraded.
Error condition 8.	If the error condition is detected, all outputs except ZC are shut down. Burner is off. Control continues to function and restarts when all three user keys have been pressed longer than 60 seconds.

Differential. The L7248 models have High Limit Differential presets of 15°F (8°C). The L7224 models have High Limit Differential presets of 10°F (6°C).

9. LOW LIMIT AND CIRCULATOR CONTROLLER

On a temperature rise, with the adjustable Differential at the default setting of 10°F (6°C), the burner circuit breaks and the circulator circuit makes (assuming no call for heat is present) at the Low Limit setpoint. On a temperature drop of 10°F (6°C) below the Low Limit setpoint, the burner circuit makes and the circulator circuit breaks. See Figure 24.



1 WHEN WATER REACHES LOW LIMIT SETTING, THE BURNER SHUTS OFF OR THE CIRCULATOR PUMP STARTS (WHEN CALLING FOR HEAT).

Figure 24: Setpoints and Differentials

Table 6: Trouble Shooting 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.

Table 7: Beckett AFG, AF, & SF Burners

Boiler Model	Firing Rate (GPH)	Hago Nozzle	Air		Settings	
			Shutter	Band	Head (stop screw)	Pump Pressure
RSA85*	.85	.75 x 80B	10	0	N/A	140
RSA110	1.10	.90 x 80B	8			
RSA125	1.25	1.0 x 80B	7			
RSA135	1.35	1.10 x 80B	9			
RSA170	1.70	1.65 x 80A	7			100
RSA195	1.95	2.00 x 80B	7			
RSA240	2.40	2.50 x 80B	7			
RSA285	2.85	3.00 x 80B	7			

* Equipped with low firing rate baffle

Table 7A: Becket AFG Burner

Boiler Model	Firing Rate (GPH)	Hago Nozzle	Air		Settings	
			Shutter	Band	Head (stop screw)	Pump Pressure
RSAH85	.75	.65 x 80B	6	0	N/A	140
RSAH110	1.0	.85 x 80B	7			
RSAH125	1.1	.90 x 80B	7			
RSAH135	1.25	1.0 x 80B	9			

Table 7B: Carlin EZ-2HP Burner

Boiler Model	Firing Rate	Manufacturer	GPH	Angle	Type	Head Bar	Air Band Setting
RSA85	.85	Delavan	.75	60°	A	.75	.60
RSAH85	.75		.65		W	.60/.65	.50
RSA110	1.10		.90			.85/1.00	.75
RSAH110	1.00		.85		A	.60	
RSA125	1.25		1.10			1.10/1.25	.90
RSAH125	1.10		.90		.85/1.00	.65	
RSA135	1.35		1.20		W	.85	
RSAH135	1.25		1.10			1.10/1.25	.85

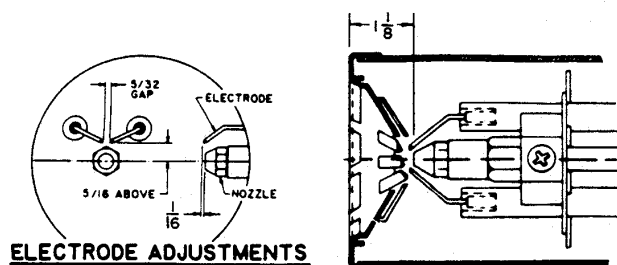


Figure 25: Electrode / Head Setting for Beckett Burner

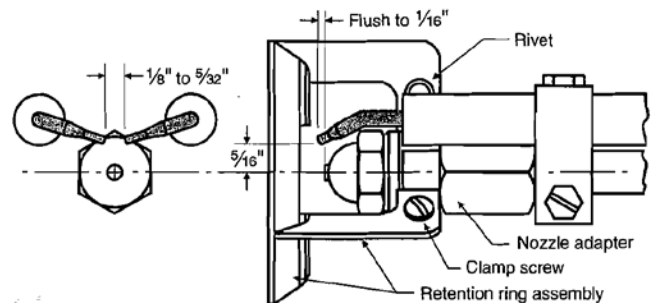


Figure 25A: Electrode / Head Setting for Carlin EZ-1HP Burner

H. REMOVE GUN ASSEMBLY

1. Check nozzle size, head size, gun setting, and positioning of electrodes. This information is shown in Figure 25 and Tables 7 and 7A for Beckett burner, Figure 25A and Table 7B for Carlin EZ-1HP burner.
2. Reinstall gun assembly.

I. VERIFY OIL BURNER SETTINGS BEFORE STARTING

1. BURNER AIR BAND AND AIR SHUTTER SETTINGS, see Tables 7 and 7A for Beckett burner, Table 7B for Carlin EZ-1HP burner.
2. OPEN ALL OIL LINE VALVES.
3. Attach a plastic hose to fuel pump vent fitting and provide a container to catch the oil.
4. REMOVE GAUGE PORT PLUG from fuel pump and install pressure gauge.

J. 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 pre-purge is complete. Pre-purge prevents burner flame until 10 seconds has elapsed after initial power is applied to burner. During pre-purge, the motor and ignitor will operate but the oil valve will remain closed. Refer to Oil Primary Control Instructions for more details.
4. For Carlin burner, refer to *"Installation and Operating Instructions for Packaged Heating/Burner Units, Carlin Elite Oil Burner" (Form CCT-569A)* for instructions for Bleeding the Pump and Starting the Burner.

K. ADJUST OIL PRESSURE

1. Locate oil pressure adjusting screw and turn screw until Pressure Gauge reads the correct pump pressure required for the specific boiler. Refer to Tables 7 & 7A for Beckett burners or Table 7B for Carlin burner (set pump pressure to 150 for Carlin EZ-1HP Burner).
2. DO NOT REMOVE PRESSURE GAUGE until later.

L. OTHER ADJUSTMENTS

Beckett Burner

1. ADJUST THE AIR BAND AND/OR AIR SHUTTER.
 - a. Adjust air supply by loosening lock screws and moving the air shutter and if necessary the air band. Refer to Tables 7 and 7A preliminary settings.

2. ADJUST DRAFT REGULATOR for a draft of $-.02''$ (water gauge) over the fire after chimney has reached operating temperature and while burner is running.
3. READJUST AIR BANDS on burner for a light orange colored flame while draft over the fire is $-.02''$ w.c. Use a smoke test 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 $-.02''$ w.c. in fire box. These settings will assure a safe and efficient operating condition. If the flame appears stringy instead of a solid flame, try another nozzle of the same type. Flame should be solid and compact. After all adjustments have been made, recheck for a draft of $-.02''$ w.c. over the fire.
4. TURN "OFF" BURNER and remove pressure gauge. Install gauge port plug and tighten. Start burner again.

Carlin Burner

- 1-4. Refer to *"Installation and Operating Instructions for Packaged Heating/Burner Units, Carlin Elite Oil Burner" (Form CCT-569A)* for instructions for Bleeding the Pump and Starting the Burner.
5. Turn "off" Burner and remove pressure gauge. Install gauge port plug and tighten. Start burner again.
6. 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 transformer. See *"Installation and Operating Instructions for Packaged Heating/Burner Units, Carlin Elite Oil Burner" (Form CCT-569A)*. To service cad cell or to replace the plug in portion, swing open the transformer. After service is complete, be sure to fasten down the transformer.

M. FLAME FAILURE

The RSA 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. Before pressing the reset button, call your serviceman immediately.

WARNING

Do not attempt to start the burner when excess oil has accumulated, when the unit is full of vapor, or when the combustion chamber is very hot.

N. 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 step N.1. 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.

O. 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 RSA 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 carry.
2. FLAME SHAPE — Looking into the combustion chamber through the flame plug hole, the flame should appear straight with no sparklers rolling up toward the top of the chamber. If the flame drags to the right or left, sends sparklers upward or makes wet spots on the combustion chamber, the nozzle should be replaced. If the condition persists look for fuel leaks, air leaks, water or dirt in the fuel as described below.
3. 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.
4. 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.
There may be many possible causes of leaks in oil lines such as:
 - a. Fitting leaks due to misflared tubing or damaged fitting.
 - b. Fuel line leak due to crushed or bent tubing.
 - c. Filter connection leaks.
 - d. Tank connection leaks.The following actions can eliminate air leaks:
 - a. Bleed pump as detailed in System Start-Up Section of this manual.
 - b. Replace flare fittings.
 - c. Replace oil supply line.
 - d. Repair oil filter leaks
 - e. Replace or repair tank fittings.
5. GASKET LEAKS— If 11.5% to 12.5% CO₂ with a #1 smoke cannot be obtained in stack, look for air leaks around the canopy seal. Such air leaks will cause a lower CO₂ reading in the stack. 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 strainer and produce a poor spray pattern from the nozzle.
7. WATER— Water in the fuel, in large amounts, will stall the fuel pump. Water in the fuel pump, in smaller amounts, will cause excessive wear on the pump, but more importantly water does not burn. It chills the flame, causes smoke, and allows unburned fuel to pass through the combustion chamber and clog the flueways of the boiler.

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.

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 buried in the ground above the frost line is a good candidate for cold oil. The best solution is to place the tank and oil lines in the ground below the frost line.
9. HIGH ALTITUDE INSTALLATIONS
Typically, the rule to use for high altitudes is to increase the air supply by 4% per each 1000 ft. above 2000 ft. altitude from sea level. This means that the air setting will have to be higher than the calibration marks in proportion to the altitude. 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.

P. TEST CONTROLS

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.

1. CHECK THERMOSTAT OPERATION. Raise and lower thermostat setting as required to start and stop burner.
2. VERIFY PRIMARY CONTROL SAFETY FEATURES using procedures outlined in Instructions furnished with control (See back of Control Cover) or Instructions as follows:

WARNING

Service of this boiler should be undertaken only by trained and skilled personnel from a qualified service agency.

a. Simulate flame failure:

- Follow the starting procedure to turn on the burner.
- Close the hand valve in the oil supply line.
- Control enters recycle mode and tries to restart burner after approximately 60 seconds.
- Safety switch should lock out in approximately 15 seconds. Ignition and motor should stop.
- Indicator light will flash ½ second on, ½ second off.
- Push red reset button to reset safety switch.

b. Simulate ignition failure:

- Follow the starting procedure to turn on the burner, but do not open the oil supply hand valve.
- Safety switch should lock out in approximately 15 seconds. Ignition and motor should stop.
- Indicator light will flash ½ second on, ½ second off.
- Push red reset button to reset safety switch.

c. Simulate power failure:

- Follow the starting procedure to turn on the burner.

- With the burner running, turn off the power to the system by tripping the circuit breaker or removing the fuse.
- Burner should stop.
- Restore power. Burner should start.

3. VERIFY HIGH LIMIT OPERATION.

- a. Adjust thermostat to highest setting.
- b. Observe temperature gauge. When temperature is indicated, adjust limit to setting below observed temperature. Burner should stop.
- c. Adjust limit to setting above observed temperature. Burner should start.
- d. Adjust thermostat to lowest setting. Adjust limit to desired setting.

4. CHECK LOW WATER CUTOFF (if so equipped).

- a. Adjust thermostat to highest setting.
- b. With boiler operating, open drain valve and slowly drain boiler.
- c. Burner should stop when water level drops below low water cutoff probe. Verify limit, thermostat or other controls have not shut off boiler.
- d. Adjust thermostat to lowest setting. Refill boiler.

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

IMPORTANT

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

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 and oxygen. When the fresh, cool make-up water is heated in the boiler the minerals fall out as sediment and the oxygen escapes as a gas. Both can result in reduced boiler life. The accumulation of sediment can eventually isolate the water from contacting the steel. When this happens the steel in that area gets extremely hot and eventually cracks. The presence of free oxygen in the boiler creates a corrosive atmosphere which, if the concentration becomes high enough, can corrode the steel through from the inside. Since neither of these failure types are the result of a manufacturing defect the warranty does not apply. Clearly it is in everyone's best interest to prevent this type of failure. The maintenance of system integrity is the best method to achieve this.

INSTALLATION INSTRUCTIONS FOR SHIELD REQUIRED FOR COMBUSTIBLE FLOOR

This shield for combustible floors is intended for use **only** with the following Burnham oil-fired boilers:

Use Part Number 6183504 for the following models:

RSA85 RSA110 RSA125 RSA135
 ADDS 4-3/16" TO BOILER HEIGHT

Use Part Number 6183505 for the following models:

RSA170 RSA195 RSA240 RSA285
 ADDS 5-3/8" TO BOILER HEIGHT

- 1) Place shield on combustible floor with "TOP" surface upward and "FRONT" surface directly below the expected position of the oil burner.
- 2) Locate shield such that clearances to combustible walls are as indicated in Figure 26. These dimensions will assure that the boiler jacket will be at least 18" from the side and rear walls and 48" from the front wall, as required by ANSI/NFPA 31.
- 3) Fasten shield to combustible floor to keep shield from shifting position during setting of boiler.
- 4) Set boiler squarely on top of shield such that base plate of boiler rests flat on top surface of shield and does not over-hang shield on any side. Confirm clearance to combustible walls. Refer to Figure 2.
- 5) Do not enclose boiler (including shield) on all four sides. Boiler may be enclosed on any three sides while maintaining minimum clearances shown in Figure 2 for each of those three sides.

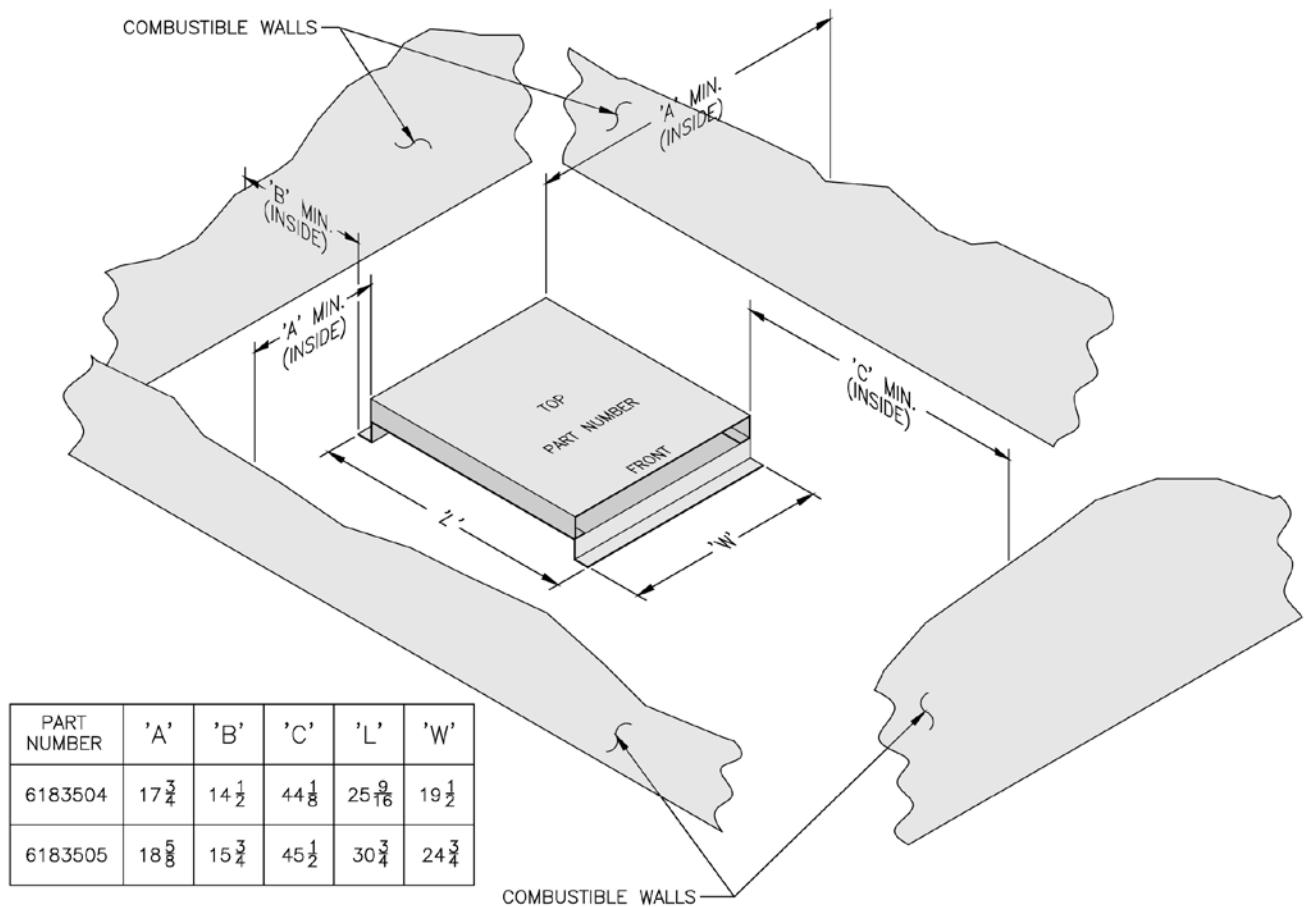


Figure 26

VIII. Service and Cleaning

NOTICE

BURNER SHUTDOWN: Open Service Switch to turn off burner.

Manual Oil Supply Valve should be closed and Electric Service to boiler turned off if boiler will not be operated for an extended period of time.

A. General. Inspection service and cleaning should be conducted annually. Turn off electric power and close oil supply valve while conducting service or maintenance.

B. Firetubes and Combustion Chamber. (See Figure 27)

1. CLEAN THE FIRETUBES

- Disconnect electric to burner and remove stack.
- For access to the firetubes, pull top jacket panel off. Loosen wing nuts, that hold canopy down. Without taking wing nuts off carriage bolts, disengage bolts from slots on tubesheet. Pull canopy off.
- Remove turbulators.
- Using a firetube brush clean firetubes. **DO NOT** extend brush past the end of the bottom tubesheet.
- Assemble the boiler in reverse order.

Units should be cleaned at least once a year, preferably at the end of each heating season.

It is not necessary to remove burner to clean boiler.

Brush, scrape, or vacuum from **top**.

NOTE: UNITS SHOULD BE CLEANED AT LEAST ONCE A YEAR, PREFERABLY AT THE END OF EACH HEATING SEASON.

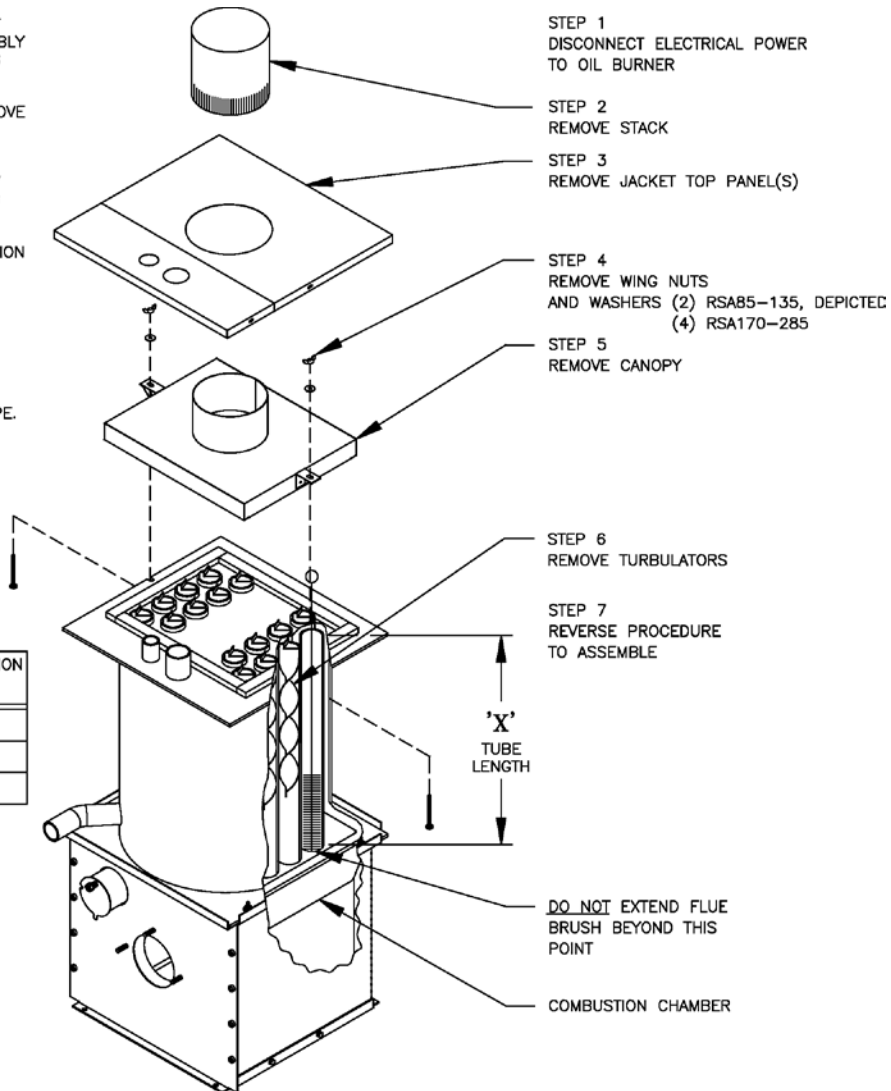
IT IS NOT NECESSARY TO REMOVE BURNER TO CLEAN BOILER.

BRUSH, SCRAPE OR VACUUM CLEAN FLUE TUBES CAREFULLY FROM TOP WITHOUT EXTENDING CLEANING TOOLS BEYOND BOTTOM OF FLUE TUBES TO PREVENT DAMAGE TO COMBUSTION CHAMBER.

CAUTION

COMBUSTION CHAMBER IS A LIGHTWEIGHT CERAMIC TYPE. **DO NOT** EXTEND CLEANING TOOLS BEYOND BOTTOM OF FLUE TUBES TO PREVENT DAMAGE TO COMBUSTION CHAMBER.

BOILER MODEL	DIMENSION 'X'
RSA85&110	13 $\frac{3}{8}$
RSA125&135	19 $\frac{1}{8}$
RSA170-285	28



CLEANING INSTRUCTIONS

Figure 27: Cleaning of RSA Boiler

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 about 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.

IX. Repair Parts

All RSA™ Repair Parts may be obtained through your local Burnham Wholesale distributor. Should you require assistance in locating a Burnham distributor in your area, or have questions regarding the availability of Burnham products or repair parts, please contact Burnham Customer Service at (717) 481-8400 or Fax (717) 481-8408.

For Carlin oil burner replacement parts, contact your wholesaler or Carlin:

CCT, Carlin Combustion Technology, Inc.

70 Maple Street

East Longmeadow, MA 01028

Tel: (413) 525-7700

Fax: (413) 525-8306

ITEM	DESCRIPTION	PART NUMBER
1	Jacket Rear Top Panel	604350864
2	Jacket Front Top Panel	604350863
3	Jacket Wrap-A-Round Panel, RSA85/110	60435087
	Jacket Wrap-A-Round Panel, RSA125/135	60435088
4	Temperature / Pressure Gauge	100282-03
5	Honeywell L7248C1014 Hi-Limit Control	100059-01
	Honeywell L7224C1004 Limit Control	100862-01
6	Observation Port Cover	7026001
	Observation Cover Sprint V1	8026015
	Flat Washer, SAE, 5/16"	80860647
	Hex Nut, 5/16" -18, Heavy	80860402
7	Burner Primary Control, R7184B	80160847

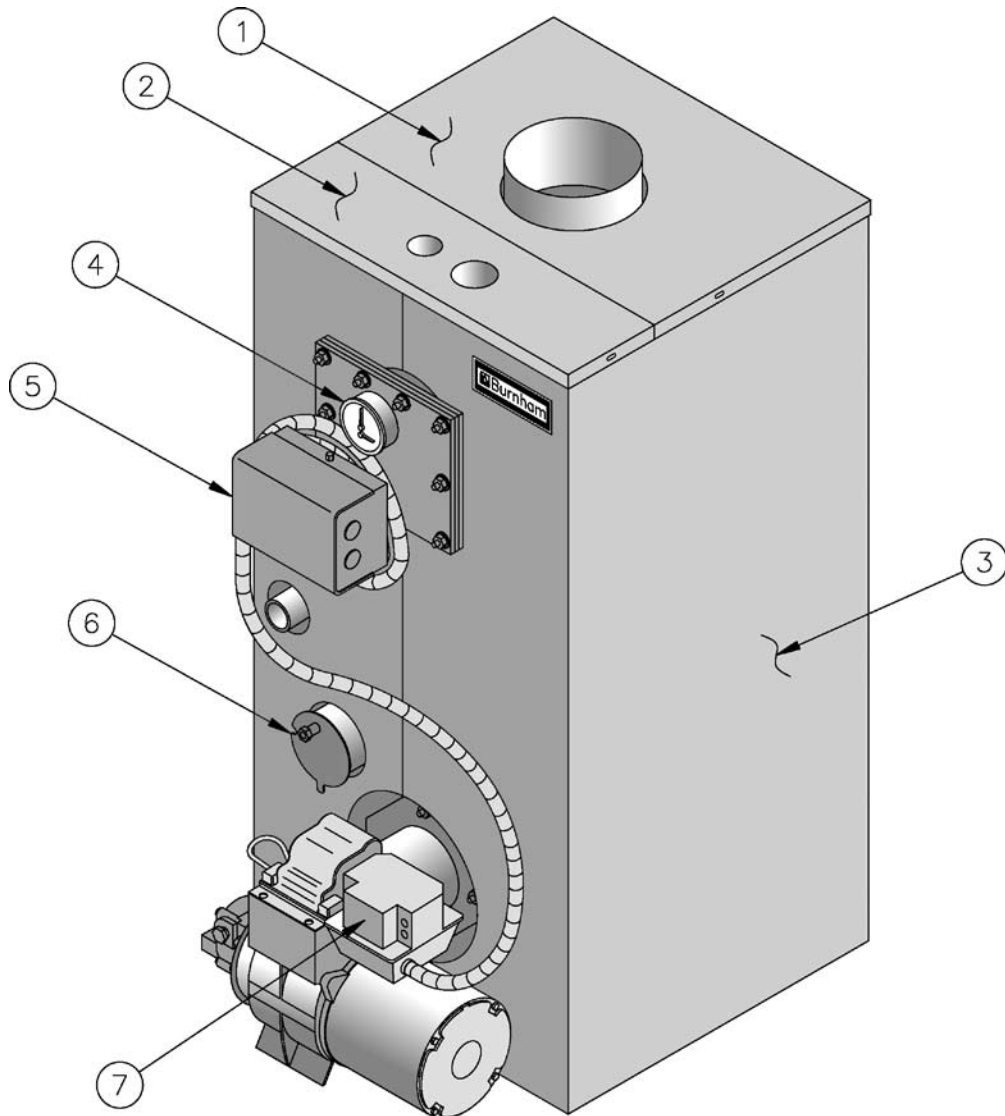


Figure 28: Assembled Boiler

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

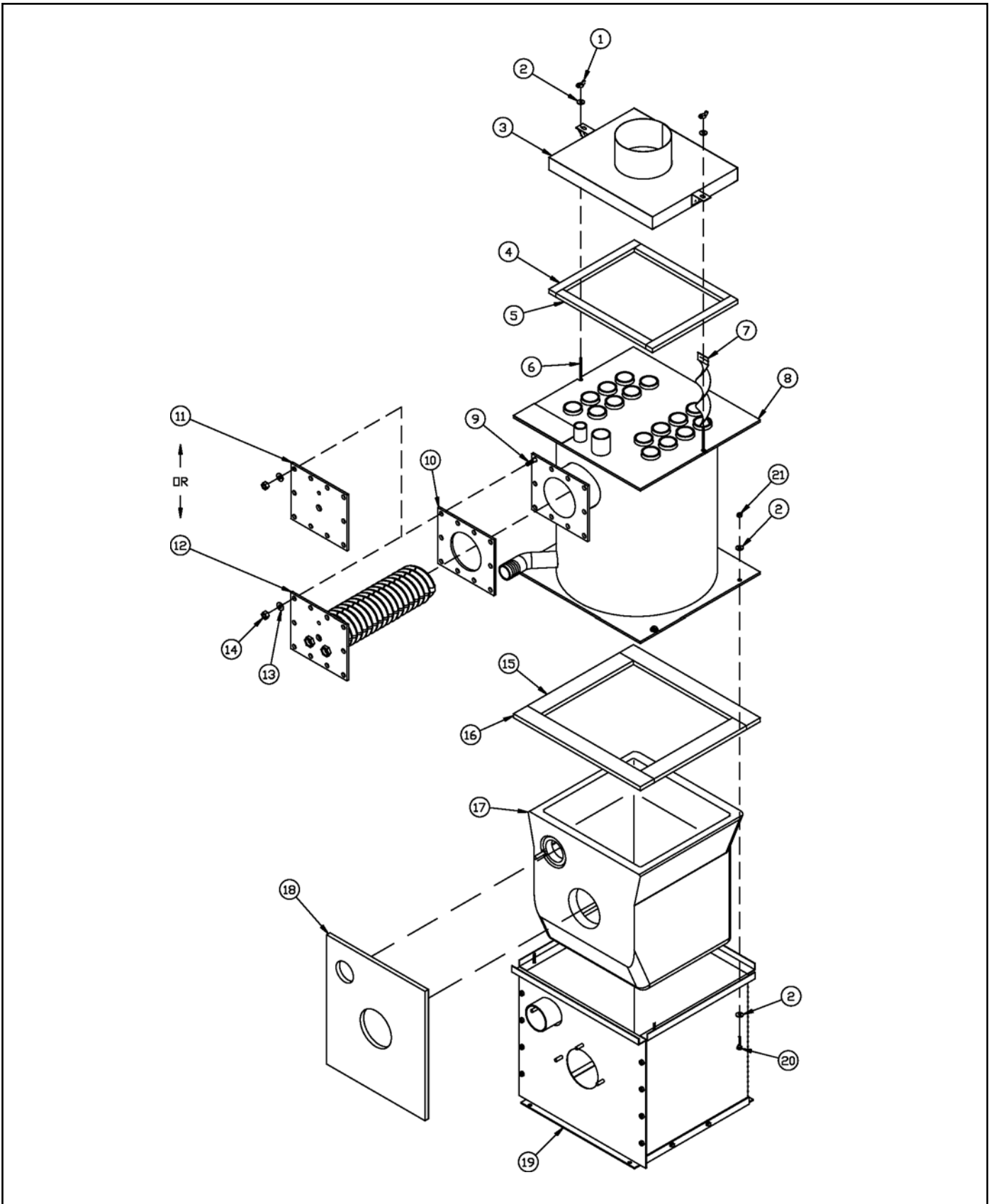


Figure 29: RSA85-135 Bare Boiler Repair Parts

ITEM	QTY.	DESCRIPTION	PART NUMBER
1	2	Wing Nut, 1/4 -20	80860910
2	10	Washer, Flat 1/4 (SAE)	80860633
3	1	Canopy Assembly	6113509
4	2	1/2" Thick x 1" x 12-3/8" Cerafelt Strip	9206005
5	2	1/2" Thick x 1" x 12-3/8" Cerafelt Strip	9206005
6	2	Carriage Bolt, 1/4 -20 x 3" Lg.	80860119
7	'A'	Turbulator	7116037
8	1	Heat Exchanger Assembly	'B'
9	10	SA307B 3/8 -16 x 1-1/4" Bolt	80861360
10	1	Tankless Heater Gasket	8206036
11	1	Tapped Heater Cover Plate	7036030
12	1	Tankless Heater Coil, (Standard S350) (Includes Item 10)	6033509
		Tankless Heater Coil, (Optional S375) (Includes Item 10)	6033510
13	10	Washer, Flat (USS), 3/8"	80860645
14	10	Hex Nut, 3/8 -16, Steel, Plain	80860400
15	2	1/2" Thick x 2" x 13-3/4" Cerafelt Strip	9206003
16	2	1/2" Thick x 2" x 18-1/2" Cerafelt Strip	9206003
17	1	Combustion Chamber	8203006
18	1	Cerablanket	8203512
19	1	Base Assembly	6183508
20	4	Machine Screw, Hex Head, 1/4 -20 x 1-1/4"	80860810
21	4	Hex Nut, 1/4 -20 (Heavy Hex)	80860407

BOILER MODEL	'A'	'B'
RSA85	12	603350112
RSA110	16	603350116
RSA125	12	603350212
RSA135	16	603350216

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

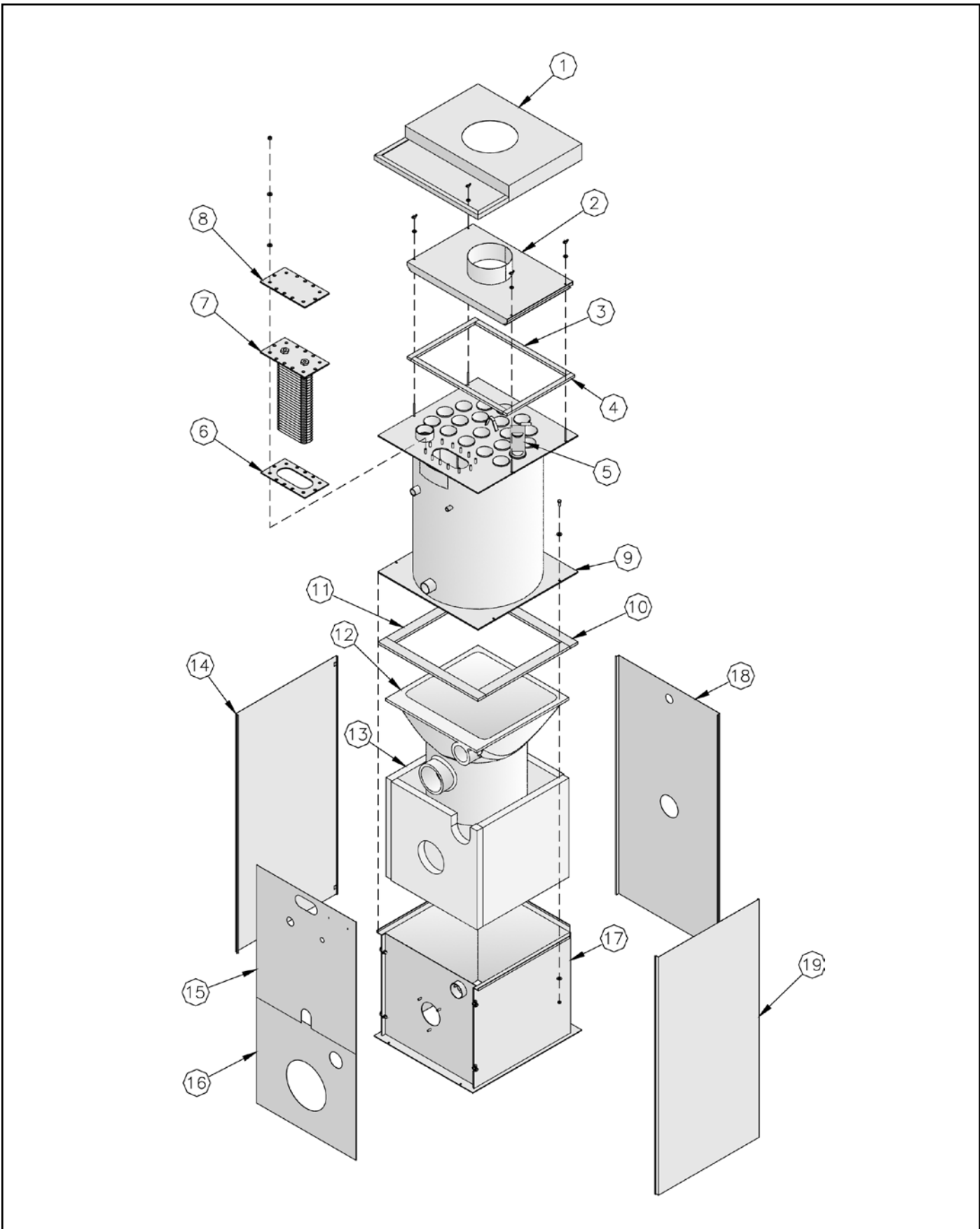


Figure 30: RSA170-285 Boiler Repair Parts

ITEM	DESCRIPTION	PART NUMBER
1	Jacket Top Panel Assembly	60435022
2	Canopy Assembly	6113510
3	1/2" Thick x 1" x 23" Cerafelt Strip	9206005
4	1/2" Thick x 1" x 17" Cerafelt Strip	9206005
5	Turbulator, See 'A' for Quantity	6113504
6	Tankless Heater Gasket	8036025
7	#7524 Tankless Heater Assembly (Includes Item 6)	6033507
	#7530 Tankless Heater Assembly (Includes Item 6)	6033508
8	Blank Heater Cover Plate	7033501
9	Heat Exchanger Assembly	'B'
10	1/2" Thick x 2" x 25" Cerafelt Strip	9206003
11	1/2" Thick x 2" x 21" Cerafelt Strip	9206003
12	Combustion Chamber	8203003
13	Block Insulation Assembly	Supplied with Item #12
14	Jacket Left Side Panel Assembly	60435061
15	Jacket Upper Front Panel Assembly	60435033
16	Jacket Lower Front Panel Assembly	60435042
17	Base Assembly with Insulation	6186031
18	Jacket Rear Panel Assembly	60435071
19	Jacket Right Side Panel Assembly	60435051
21	Hex Nut, 1/4 -20 (Heavy Hex)	80860407

BOILER MODEL	'A'	'B'
RSA85	12	603350112
RSA110	16	603350116
RSA125	12	603350212
RSA135	16	603350216

BECKETT BURNER PARTS LIST FOR RSA SERIES STEEL BOILERS

FOR REPLACEMENT OIL BURNER PARTS, CONTACT YOUR WHOLESALER OR THE BURNER MANUFACTURER:

R. W. BECKETT CORP.
38251 CENTER RIDGE RD.
P. O. BOX 1289
ELYRIA, OHIO 44036
1-800-645-2876

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(s) number as listed below.

Boiler Model	RSA85	RSA110	RSA125	RSA135
Burner Model	AFG	AFG	AFG	AFG
Air Tube Combination	AF60BN	AF60XN	AF60J2	AF60JZSS
Spec. No.	BCB6211	BCB6212	BCB6213	BCB6214
Air Band	3492BKA	3492BKA	3492BKA	3492BKA
Air Band Nut	4150	4150	4150	4150
Air Band Screw	4198	4198	4198	4198
Air Shutter	3709BK	3709BK	3709BK	3709BK
Air Shutter Screw	4198	4198	4198	4198
Blower	2999	2999	2999	2999
Bulkhead Fitting	3488	3488	3488	3488
Bulkhead Fitting Locknut	3666	3666	3666	3666
Connector Tube Assembly	5636	5636	5636	5636
Coupling	2454	2454	2454	2454
Electrode Clamp	149	149	149	149
Electrode Clamp Screw	4219	4219	4219	4219
Electrode Insulator Assembly	EA21502	EA21502	EA21502	EA21502
Spider Spacer Assembly	5653	5653	5653	5653
Escutcheon Plate	3493	3493	3493	3493
Flange and Air Tube Assembly	3146812	3146812	3146812	3146812
Gasket	31498	31498	31498	31498
Head	360003	360003	360006	360006
Head Screws	4221	4221	4221	4221
Hole Plug	2139	2139	2139	2139
Housing Assembly w/Inlet Bell	5624	5624	5624	5624
Motor	2456	2456	2456	2456
Nozzle Adapter	213	213	213	213
Nozzle Line Electrode Assembly	NC6058	NC6058	NC6058	NC6048
Pump (Includes Valve)	21844	21844	21844	21844
Static Plate	31646	3383P	31646	31646
Ignitor	51771U	51771U	51771U	51771U
Ignitor Hinge Screw	4217	4217	4217	4217
Ignitor Holding Screw	4198	4198	4198	4198
Ignitor Gasket Kit	51304	51304	51304	51304
Wire Guard	3345	3345	3345	3345
Baffle	3708	N/A	N/A	N/A

Ordering Information for Quality Replacement Parts

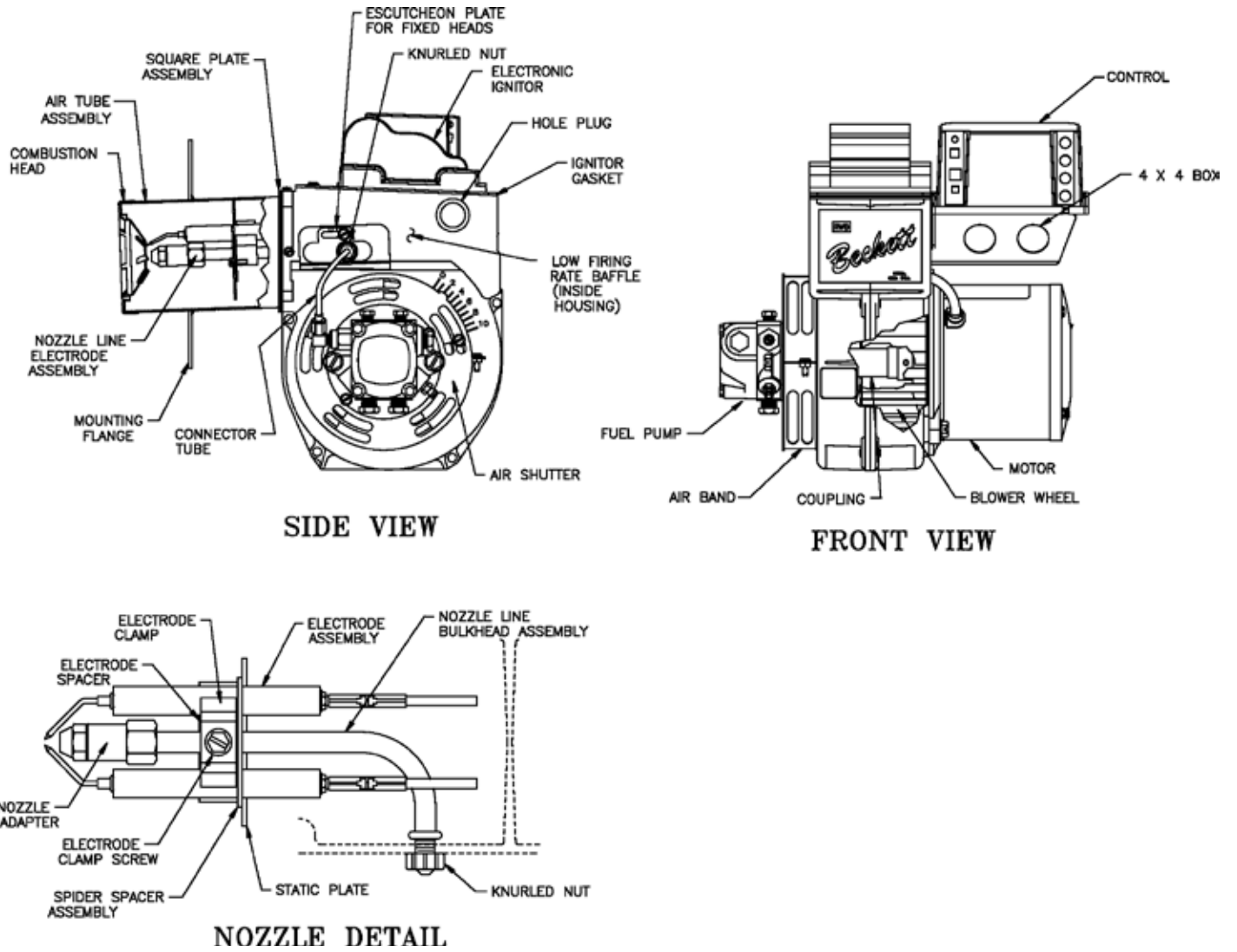


Figure 31: BECKETT AFG MODEL BURNER

BECKETT BURNER PARTS LIST FOR RSA SERIES STEEL BOILERS

FOR REPLACEMENT OIL BURNER PARTS, CONTACT YOUR WHOLESALE OR THE BURNER
MANUFACTURER:

R. W. BECKETT CORP.
38251 CENTER RIDGE RD.
P. O. BOX 1289
ELYRIA, OHIO 44036
1-800-645-2876

Boiler Model	RSA170	RSA195	RSA240/285
Burner Model	AF	AF	SF
Air Tube Combination	AF60XO	AF60XP	SF60FY
Spec. No.	BCB114	BCB116	BCB211
1) Air Band	3492	3492	3492
Air Band Nut	4150	4150	460
Air Band Screw	4198	4198	4219
2) Air Shutter	3494	3494	3215
Air Shutter Screw	4198	4198	493
6) Blower	2459	2459	2288
7) Bulkhead Fitting	3488	3488	3488
8) Bulkhead Fitting Locknut	3666	3666	3666
9) Connector Tube Assembly	5636	5636	5636
10) Coupling	2454	2454	2433
11) Electrode Clamp	149	149	149
Electrode Clamp Screw	4219	4219	4219
12) Electrode Insulator Assembly	EA21502	EA21502	EA21502
15) Spider Spacer Assembly	5653	5653	5653
16) Escutcheon Plate	3493	3493	3493
18) Flange and Air Tube Assembly	58115	58115	58115
Gasket	3616	3616	3616
19) Head	360012	360022	5434
Head Screws	4221	4221	4221
Hole Plug	2139	2139	2139
20) Housing Assembly w/Inlet Bell	5624	5624	53485
21) Motor	2456	2456	2364
22) Nozzle Adapter	213	213	213
23) Nozzle Line Electrode Assembly	NC6048	NC6058	NC6048
25) Pump (Includes Valve)	21844	21844	21844
27) Static Plate	3383	3383	3383
28) Ignitor	51824U	51824U	51824U
29) Ignitor Hinge Screw	4217	4217	4217
30) Ignitor Holding Screw	4198	4198	4198
31) Ignitor Gasket Kit	51304	51304	51304
21) Wire Guard	3345	3345	3345

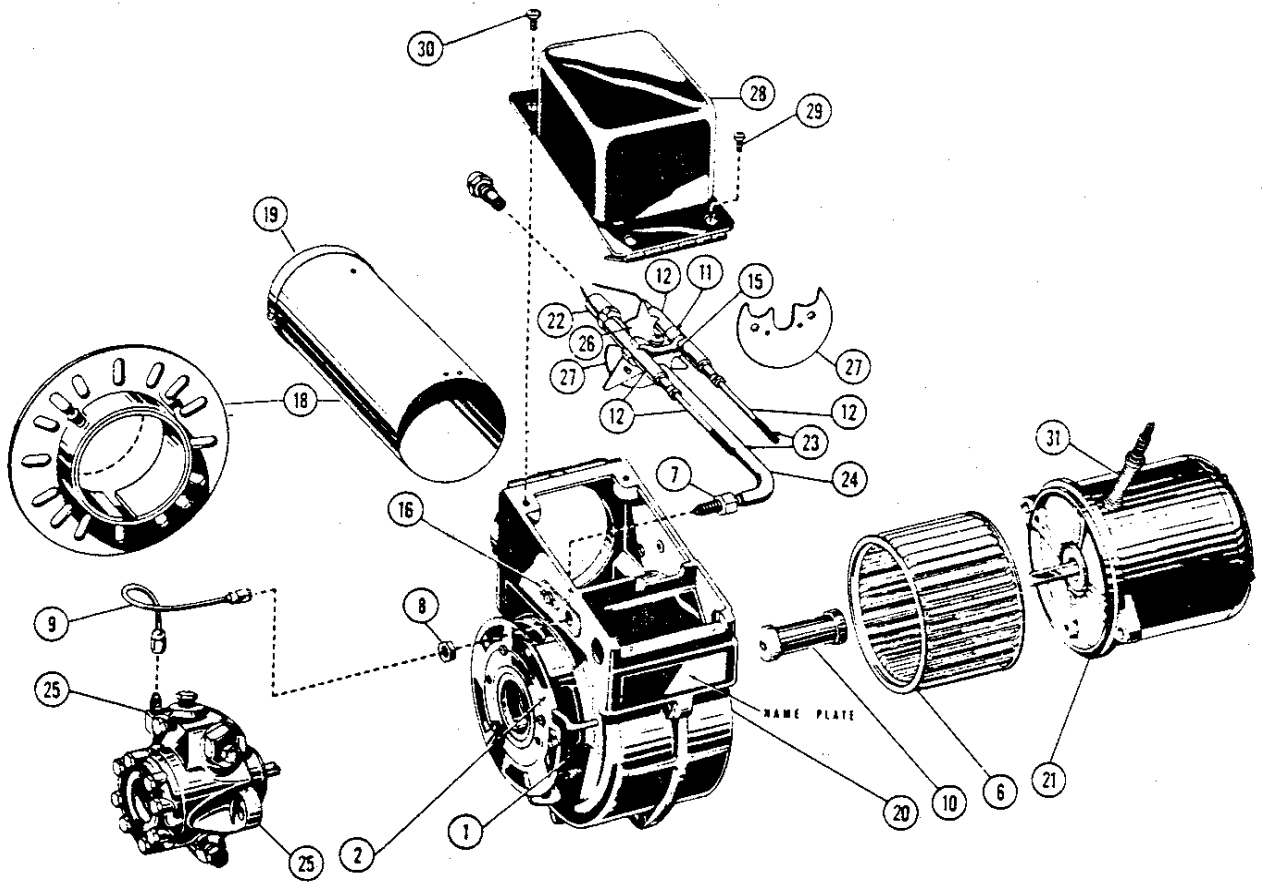


Figure 32: BECKETT AF and SF MODEL BURNERS

X. 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

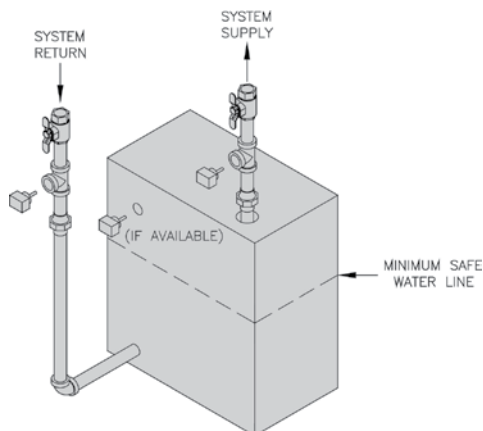
The universal location for a LWCO on both gas and oil hot water boilers is above the boiler, in either the supply or return piping. The minimum safe water level of a water boiler is at the uppermost top of the boiler; that is, it must be full of water to operate safely.

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 to the supply or return piping, as shown below.



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

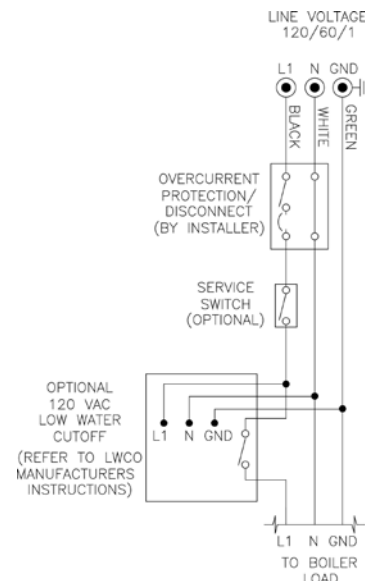
draining the heating system. Many probe LWCO manufacturers recommend an annual inspection of the probe.

How to Wire

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

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 boiler service as shown below.



Wiring of Typical LWCO

A 24 VAC LWCO is used primarily for gas fired boilers where a 24 volt control circuit exists within the boiler. However, a 24 VAC LWCO can only be used if the boiler manufacturer has provided piping and wiring connections and instructions to allow for this application.

How to Test

Shut off fuel supply. Lower water level until water level is BELOW the LWCO. Generate a boiler demand by turning up thermostat. Boiler should not attempt to operate. Increase the water level by filling the system. The boiler should attempt to operate once the water level is above the LWCO.

Limited Warranty

For Residential Grade Water and Steam Boilers

Using Cast Iron, Carbon Steel, Cast Aluminum,
or Stainless Steel Heat Exchangers
and Parts/Accessories

Subject to the terms and conditions set forth below, U.S. Boiler Company, Inc. Lancaster, Pennsylvania hereby extends the following limited warranties to the original owner of a residential grade water or steam boiler or U.S. Boiler Company, Inc. supplied parts and/or accessories manufactured and shipped on or after July 1, 2008:

ONE YEAR LIMITED WARRANTY ON RESIDENTIAL GRADE BOILERS AND PARTS / ACCESSORIES SUPPLIED BY U.S. BOILER COMPANY, INC.

U.S. Boiler Company, Inc. warrants to the original owner that its residential grade water and steam boilers and parts/accessories comply at the time of manufacture with recognized hydronic industry standards and requirements then in effect and will be free of defects in material and workmanship under normal usage for a period of one year from the date of original installation. If any part of a residential grade boiler or any part or accessory provided by U.S. Boiler Company, Inc. is found to be defective in material or workmanship during this one year period, U.S. Boiler Company, Inc. will, at its option, repair or replace the defective part.

HEAT EXCHANGER WARRANTIES

U.S. Boiler Company, Inc. warrants to the original owner that the heat exchanger of its residential grade boilers will remain free from defects in material and workmanship under normal usage for time period specified in the chart below of the original owner at the original place of installation. If a claim is made under this warranty during the "No Charge" period from the date of original installation, U.S. Boiler Company, Inc. will, at its option, repair or replace the heat exchanger. If a claim is made under this warranty after the expiration of the "No Charge" period from the date of original installation, U.S. Boiler Company, Inc. will, at its option and upon payment of the pro-rated service charge set forth below, repair or replace the heat exchanger. The service charge applicable to a heat exchanger warranty claim is based upon the number of years the heat exchanger has been in service and will be determined as a percentage of the retail price of the heat exchanger model involved at the time the warranty claim is made as follows:

Years in Service	Service Charge as a % of Retail Price																												
	1-5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25+								
Cast Iron Water	No Charge					5	10	15	20	25	30	40	45	50	55	60	65	70	75										
Cast Iron Steam*	No Charge					100																							
Carbon Steel	No Charge					5	10	15	20	25	30	40	45	50	55	60	65	70	75										
Cast Aluminum	No Charge					30	40	50	60	70	100																		
Stainless Steel	No Charge					30	40	50	60	70	100																		

NOTE: If the heat exchanger involved is no longer available due to product obsolescence or redesign, the value used to establish the retail price will be the published price as shown in the Burnham Repair Parts Pricing where the heat exchanger last appeared or the current retail price of the then nearest equivalent heat exchanger.

***MegaSteam Waterside Corrosion Warranty:** U.S. Boiler Company, Inc. warrants the cast iron sections of the MegaSteam boiler to resist Temperature Induced Chloride Activated Graphitic Corrosion for a period of five years from the date of original installation. In the event that any cast iron section of a Mega Steam boiler fails due to this corrosion mechanism during this period, U.S. Boiler Company, Inc. will repair or replace, at its option, the cast iron section assembly.

LIFETIME NIPPLE LEAKAGE WARRANTY

U.S. Boiler Company, Inc. warrants the cast iron and steel nipples that join the cast iron boiler sections to be free of defects in material and workmanship for the lifetime of the original owner at the original place of installation. In the event that such nipples are found to be defective in material and workmanship during this period, U.S. Boiler Company, Inc. will repair or replace at its option, the cast iron section assembly.

ADDITIONAL TERMS AND CONDITIONS

1. **Applicability:** The limited warranties set forth above are extended only to the original owner at the original place of installation within the United States and Canada. These warranties are applicable only to boilers, parts, or accessories designated as residential grade by U.S. Boiler Company, Inc. and installed in a single or two-family residence and do not apply to commercial grade products.
2. **Components Manufactured by Others:** Upon expiration of the one year limited warranty on residential grade boilers, all boiler components manufactured by others but furnished by U.S. Boiler Company, Inc. (such as oil burner, circulator and controls) will be subject only to the manufacturer's warranty, if any.
3. **Proper Installation:** The warranties extended by U.S. Boiler Company, Inc. are conditioned upon the installation of the residential grade boiler, parts, and accessories in strict compliance with U.S. Boiler Co., Inc. installation instructions. U.S. Boiler Company, Inc. specifically disclaims liability of any kind caused by or relating to improper installation.
4. **Proper Use and Maintenance:** The warranties extended by U.S. Boiler Company, Inc. conditioned upon the use of the residential grade boiler, parts, and accessories for its intended purposes and its maintenance accordance with U.S. Boiler Company, Inc. recommendations and hydronics industry standards. For proper installation, use, and maintenance, see all applicable sections of the Installation and Operating, and Service Instructions Manual furnished with the unit.
5. This warranty does not cover the following:
 - a. Expenses for removal or reinstallation. The homeowner will be responsible for the cost of removing and reinstalling the alleged defective part or its replacement and all labor and material connected therewith, and transportation to and from U.S. Boiler Company, Inc.
 - b. Components that are part of the heating system but were not furnished by U.S. Boiler Company, Inc. as part of the residential boiler.
 - c. Improper burner adjustment, control settings, care or maintenance.

- d. This warranty cannot be considered as a guarantee of workmanship of an installer connected with the installation of the U.S. Boiler Company, Inc. boiler, or as imposing on U.S. Boiler Company, Inc. liability of any nature for unsatisfactory performance as a result of faulty workmanship in the installation, which liability is expressly disclaimed.
 - e. Boilers, parts, or accessories installed outside the 48 contiguous United States, the State of Alaska and Canada.
 - f. Damage to the boiler and/or property due to installation or operation of the boiler that is not in accordance with the boiler installation and operating instruction manual.
 - g. Any damage or failure of the boiler resulting from hard water or scale buildup in the heat exchanger.
 - h. Any damage caused by improper fuels, fuel additives or contaminated combustion air that may cause fireside corrosion and/or clogging of the burner or heat exchanger.
 - i. Any damage resulting from combustion air contaminated with particulate which cause clogging of the burner or combustion chamber including but not limited to sheetrock or plasterboard particles, dirt, and dust particulate.
 - j. Any damage, defects or malfunctions resulting from improper operation, maintenance, misuse, abuse, accident, negligence including but not limited to operation with insufficient water flow, improper water level, improper water chemistry, or damage from freezing.
 - k. Any damage caused by water side clogging due to dirty systems or corrosion products from the system.
 - l. Any damage resulting from natural disaster.
 - m. Damage or malfunction due to the lack of required maintenance outlined in the Installation and Operating Manual furnished with the unit.
6. **Exclusive Remedy:** U.S. Boiler Company, Inc. obligation for any breach of these warranties is limited to the repair or replacement of its parts in accordance with the terms and conditions of these warranties.
 7. **Limitation of Damages:** Under no circumstances shall U.S. Boiler Company, Inc. be liable for incidental, indirect, special or consequential damages of any kind whatsoever under these warranties, including, but not limited to, injury or damage to persons or property and damages for loss of use, inconvenience or loss of time. U.S. Boiler Company, Inc. liability under these warranties shall under no circumstances exceed the purchase price paid by the owner for the residential grade boiler involved. Some states do not allow the exclusion or limitation of incidental or consequential damages, so the above limitation or exclusion may not apply to you.
 8. **Limitation of Warranties:** These warranties set forth the entire obligation of U.S. Boiler Company, Inc. with respect to any defect in a residential grade boiler, parts, or accessories and U.S. Boiler Company, Inc. shall have no express obligations, responsibilities or liabilities of any kind whatsoever other than those set forth herein. These warranties are given in lieu of all other express warranties.

ALL APPLICABLE IMPLIED WARRANTIES, IF ANY, INCLUDING ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE ARE EXPRESSLY LIMITED IN DURATION TO A PERIOD OF ONE YEAR EXCEPT THAT IMPLIED WARRANTIES, IF ANY, APPLICABLE TO THE HEAT EXCHANGER IN A RESIDENTIAL GRADE BOILER SHALL EXTEND TO THE ORIGINAL OWNER FOR THE TIME SPECIFIED IN THE HEAT EXCHANGER SECTION SHOWN ABOVE AT THE ORIGINAL PLACE OF INSTALLATION. SOME STATES DO NOT ALLOW LIMITATION ON HOW LONG AN IMPLIED WARRANTY LASTS, SO THE ABOVE LIMITATION MAY NOT APPLY TO YOU.

PROCEDURE FOR OBTAINING WARRANTY SERVICE

In order to assure prompt warranty service, the owner is requested to complete and mail the Warranty Card provided with the product or register product online at www.burnham.com within ten days after the installation of the boiler, although failure to comply with this request will not void the owner's rights under these warranties. Upon discovery of a condition believed to be related to a defect in material or workmanship covered by these warranties, the owner should notify the installer, who will in turn notify the distributor. If this action is not possible or does not produce a prompt response, the owner should write to U.S. Boiler Company, Inc., C/O Burnham, P.O. Box 3079, Lancaster, PA 17604, giving full particulars in support of the claim. The owner is required to make available for inspection by U.S. Boiler Company, Inc. or its representative the parts claimed to be defective and, if requested by U.S. Boiler Company, Inc. to ship these parts prepaid to U.S. Boiler Company, Inc. at the above address for inspection or repair. In addition, the owner agrees to make all reasonable efforts to settle any disagreement arising in connection with a claim before resorting to legal remedies in the courts.

THIS WARRANTY GIVES YOU SPECIFIC LEGAL RIGHTS AND YOU MAY ALSO HAVE OTHER RIGHTS WHICH VARY FROM STATE TO STATE.

