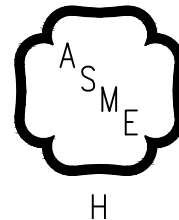


INSTALLATION, OPERATING AND SERVICE INSTRUCTIONS

FR™ SERIES

HORIZONTAL TUBE 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 FR	Boiler Serial Number	Installation Date
Heating Contractor		Phone Number
Address		



New Yorker®

RESIDENTIAL HEATING BOILERS

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:

USA BOILERS

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

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. 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 boiler 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 boiler before installing, starting-up, operating, maintaining or servicing this boiler. Keep this manual and literature in legible condition and posted near boiler 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.

Installation is **NOT** complete unless a pressure relief valve is installed into the tapping located on top of Shell Assembly near rear of boiler - See Piping and Trim Sections of this manual for details.

It is the responsibility of the installing contractor to see that all controls are correctly installed and are operating properly when installation is complete including verifying that the limit sensor is fully installed (seated in bottom of Well).

Failure to properly install Limit Sensor may result in property damage, personal injury or loss of life due to elevated operating temperatures and/or pressures.

This boiler is **NOT** suitable for installation on combustible flooring, unless installed with a combustible floor shield constructed in accordance with NFPA 31. A concrete pad is not sufficient to protect combustible flooring. Concrete over wood joists is considered combustible flooring.

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.) a combustible floor shield must be used.

DO NOT operate on masonry floors, which may contain moisture.

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.

When cleaning this boiler, **DO NOT** damage combustion chamber. If damaged, combustion chamber must be replaced immediately.

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

DO NOT operate boiler with jumpered or absent controls or safety devices.

DO NOT operate boiler if any control, switch, component, or device has been subject to water.

Boiler 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.

WARNING

This boiler contains very hot water under 12 - 15 PSI 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.

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

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

This boiler must be connected to an approved chimney or vent system in good condition. Serious property damage could result if the boiler is connected to a dirty or inadequate chimney or vent system. The interior of the chimney flue must be inspected and cleaned before the start of the heating season for any obstructions. A clean and unobstructed chimney flue is necessary to allow noxious fumes that could cause injury or loss of life to vent safely and will contribute toward maintaining the boiler's efficiency. **DO NOT** operate boiler with the absence of an approved vent system.

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.

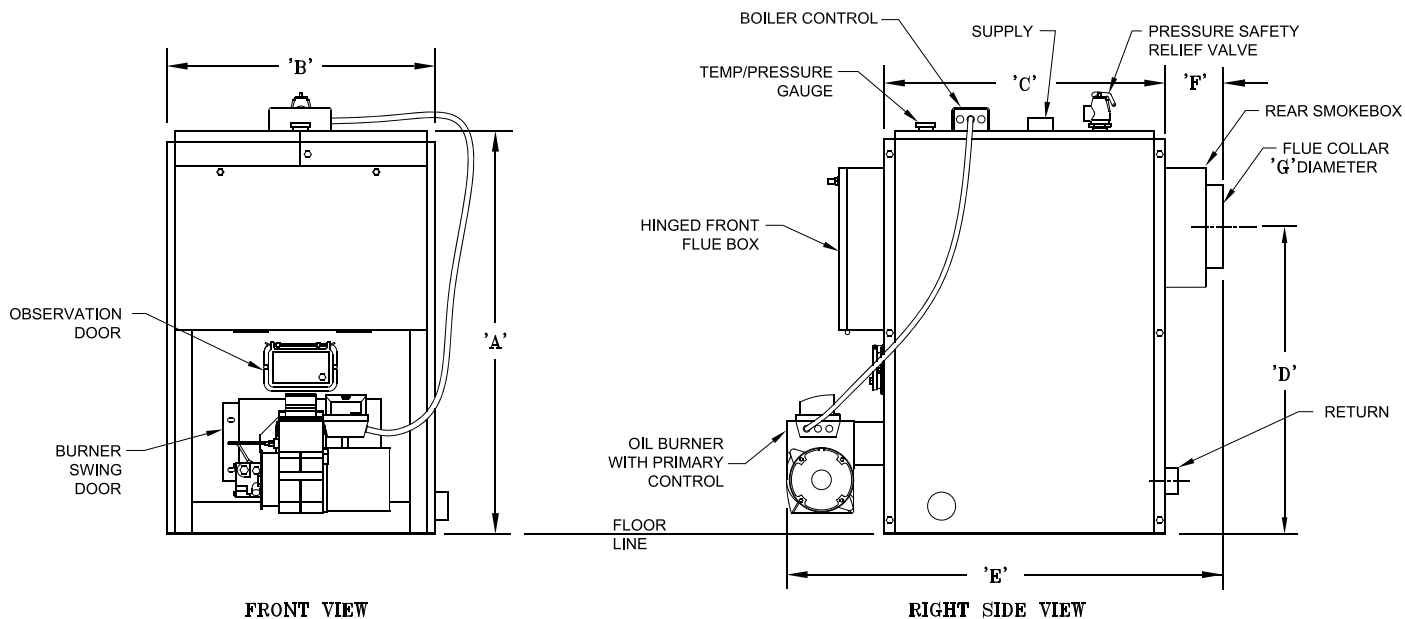
This boiler is designed to burn No. 2 fuel oil only. **DO NOT** use gasoline, crankcase drainings, or any oil containing gasoline. Never burn garbage or paper in this boiler. **DO NOT** convert to any solid fuel (i.e. wood, coal). **DO NOT** convert to any gaseous fuel (i.e. natural gas, LP). All flammable 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.

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

TABLE OF CONTENTS

I. General Information.....	5	IX. Operating	33
II. Pre-Installation	8	X. Maintenance & Service Instructions .	38
III. Knockdown Boiler Assembly.....	10	XI. Boiler Cleaning.....	40
IV. Water Piping and Trim	14	XII. Troubleshooting.....	43
V. Venting	19	XIII. Repair Parts	46
VI. Electrical	21	XIV. Burner Specifications	53
VII. Oil Piping	25	Appendix A - Aftermarket Low Water	
VIII. System Start-Up	27	Cut-Off.....	54

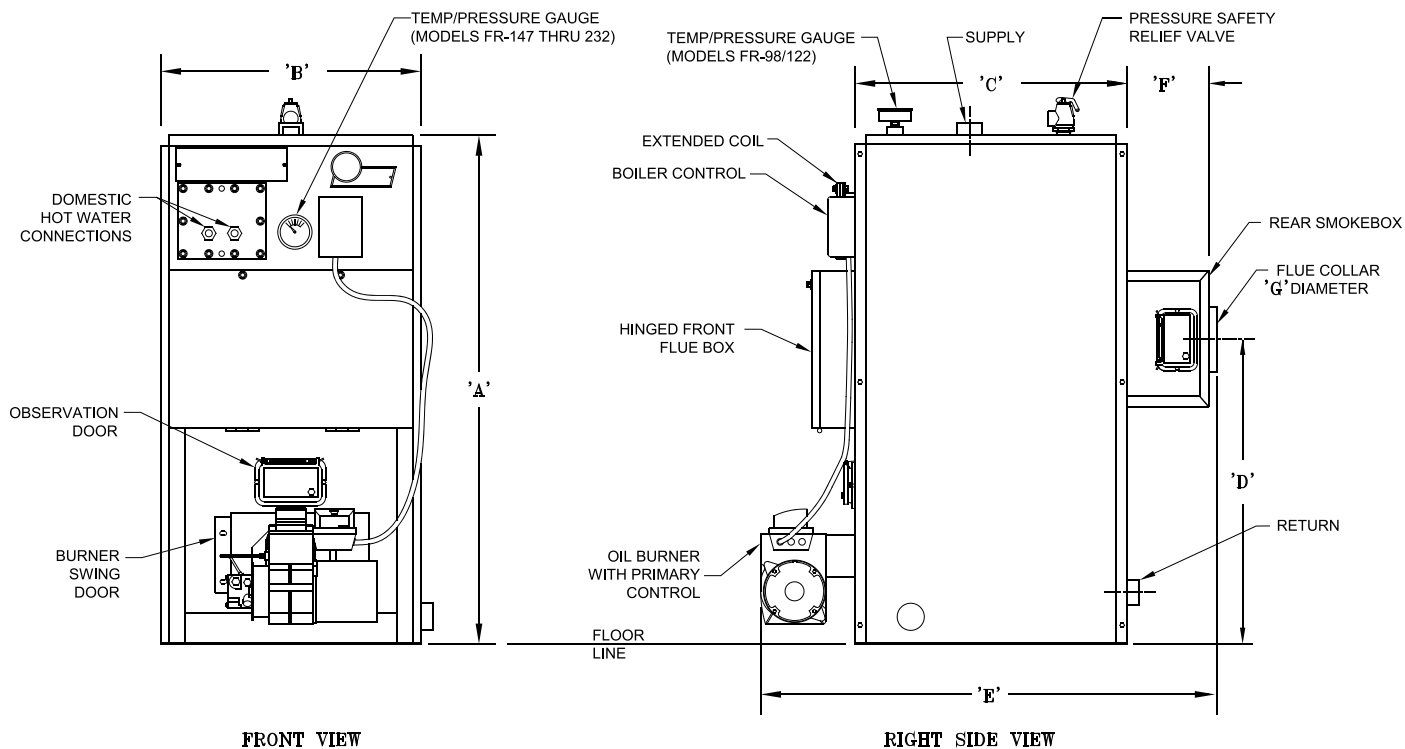
I: GENERAL INFORMATION



NOTES:

1. CIRCULATOR SUPPLIED LOOSE - MAY BE INSTALLED ON SUPPLY (RECOMMENDED) OR RETURN (ACCEPTABLE ALTERNATIVE) PIPING.
2. RETURN FITTINGS AND DRAIN VALVE SHIPPED LOOSE.

Figure 1A: FR-HGS and FR-HGSII Water Boiler (Heat Only), Beckett Burner

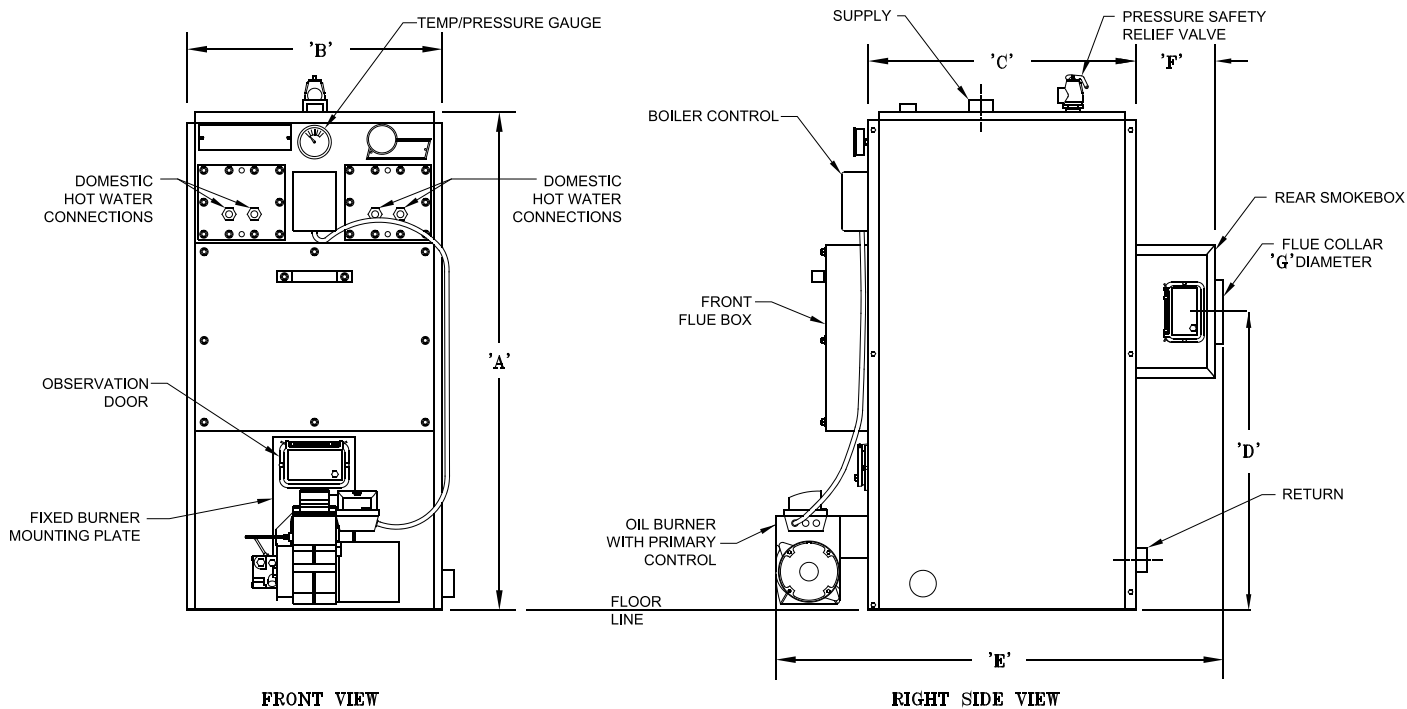


NOTES:

1. CIRCULATOR SUPPLIED LOOSE - MAY BE INSTALLED ON SUPPLY (RECOMMENDED) OR RETURN (ACCEPTABLE ALTERNATIVE) PIPING.
2. RETURN FITTINGS AND DRAIN VALVE SHIPPED LOOSE.

Figure 1B: FR-98 Thru FR-232 Water Boiler With or Without Tankless Heater, Beckett Burner

I: General Information (continued)



NOTES:

1. CIRCULATOR SUPPLIED LOOSE - MAY BE INSTALLED ON SUPPLY (RECOMMENDED) OR RETURN (ACCEPTABLE ALTERNATIVE) PIPING.
2. RETURN FITTINGS AND DRAIN VALVE SHIPPED LOOSE.

Figure 1C: FR-265 Thru FR-462 Water Boiler With or Without Tankless Heater, Beckett Burner

TABLE 1: DIMENSIONAL DATA (SEE FIGURES 1A THRU 1C)

Boiler Series	Dimensions - Inches							Approx. Water Content - Gallons
	A	B	C	D	E	F	G	
FR-HGS	31-7/8	19-7/8	18-3/8	25-3/4	31-3/8	3-1/8	5-7/8	9.5
FR-HGSII	31-7/8	19-7/8	18-3/8	26-1/2	31-3/8	3-1/8	6-7/8	9.0
FR-98/122	37-7/8	19-7/8	18-3/8	25-1/4	30-1/2	3-7/8	5-7/8	20.0
FR-147/173	46-5/8	21-7/8	21-5/8	30-1/4	35-3/4	5-3/8	6-7/8	40.0
FR-205/232	51-1/8	21-7/8	25-7/8	29-3/4	40-3/4	6-1/8	7-7/8	46.0
FR-265/305	51-1/8	21-7/8	25-7/8	34	38-3/4	6-1/8	7-7/8	52.0
FR-350/400	58	25-7/8	27-7/8	35-3/4	40-7/8	6-1/8	9-7/8	70.0
FR-462	58	25-7/8	33-7/8	35-3/4	46-3/4	6-1/8	9-7/8	80.0

I: General Information (continued)



TABLE 2: RATING DATA

Boiler Series	Boiler Model	Burner Capacity		** Output MBH	Net Ratings Water, MBH	AFUE %	Thermal Efficiency %	Minimum Chimney Requirements		
		GPH	MBH					Round In. Dia.	Rectangle In. x In.	Height Ft.
FR-HGS	* FRHGSL	0.80	112	100	87	87.8		6	8 x 8	15
	FRHGS	1.00	140	122	106	86.3		6	8 x 8	15
FR-HGSII	FRHGSII	1.30	182	158	137	85.0		7	8 x 8	15
FR-98	FR98	0.85	119	104	90	86.4		6	8 x 8	15
FR-122	FR122	1.10	154	132	115	85.1		6	8 x 8	15
FR-147	FR147	1.25	175	154	134	86.7		7	8 x 8	15
FR-173	FR173	1.50	210	184	160	85.9		7	8 x 8	15
FR-205	FR205	1.75	245	215	187	86.0		8	8 x 8	15
FR-232	FR232	2.00	280	242	210	85.1		8	8 x 8	15
FR-265	FR265W	2.35	329	265	230	82.2		10	8 x 12	15
FR-305	FR305W	2.60	364	305	265	83.4		10	8 x 12	18
FR-350	FR350W	3.00	420	350	304	83.1		10	8 x 12	20
FR-400	FR400W	3.50	490	402	350	82.0		10	8 x 12	20
FR-462	FR462W	4.00	560	462	402	82.7		10	12 x 12	20

* Field Converted from Boiler Model FRHGS

** "Output" is "Heating Capacity" for units with inputs < 300 MBH and "Gross Output" for units ≥ 300 MBH
Maximum Allowable Working Pressure = 30 PSI

II: 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 crated boiler to the carrier in good condition.
 2. Any claims for damage or shortage in shipment must be filed immediately against the carrier by the consignee. No claims for variances from, or shortage in orders, will be allowed by the manufacturer unless presented within sixty (60) days after receipt of goods.
- B. LOCATE BOILER** near final position before removing crate. See Figures 1A thru 1C. Using hand truck or pipe rollers under skid, move boiler into position along side installation site.

CAUTION

DO NOT drop boiler. **DO NOT** bump boiler jacket against floor.

1. LOCATE so that vent pipe connection to chimney will be short and direct.
2. BOILER IS **NOT** SUITABLE FOR INSTALLATION ON COMBUSTIBLE FLOOR unless installed with a Combustible Floor Shield constructed in accordance with NFPA31.. Boiler cannot be installed on carpeting.

3. FOR BASEMENT INSTALLATION, provide a solid elevated base, such as concrete, if floor is not level, or if water may be encountered on floor around boiler.

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.

Concrete over wood joists is considered combustible flooring. Do not operate on masonry floors, which may contain moisture.

4. PROVIDE SERVICE CLEARANCE of at least 48" clearance from front jacket panel for servicing and removal of front tankless heater.
5. For minimum clearances to combustible materials. See Figure 2.

NOTICE

Clearance to venting is for single wall vent pipe. If Type L vent is used, clearance may be reduced to the minimum required by the vent pipe manufacturer.

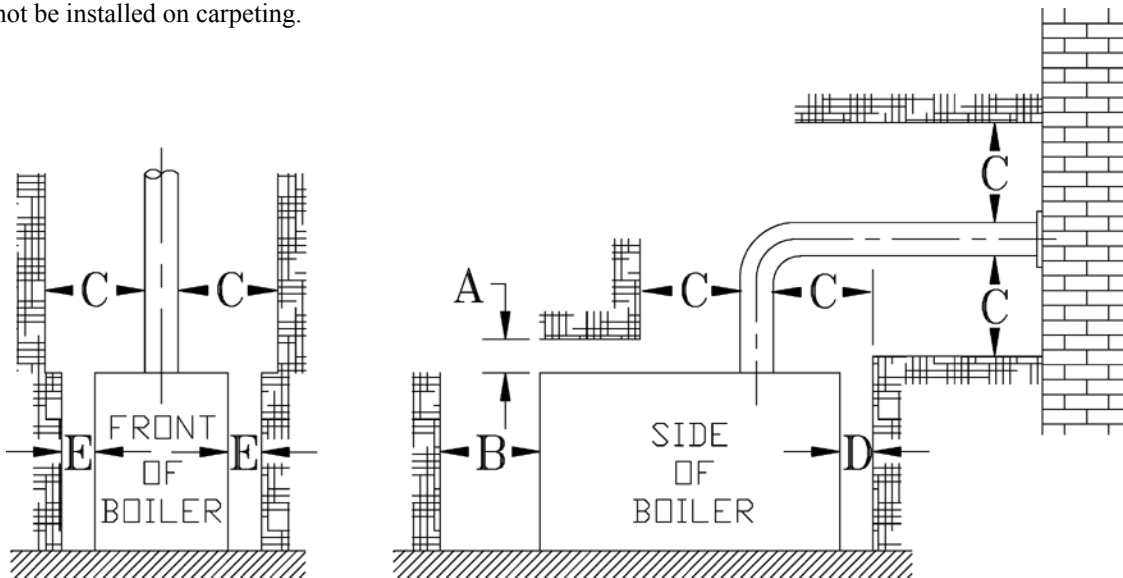


Figure 2: Minimum Installation Clearances to Combustible Materials (Inches)

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

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

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

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

II: Pre-Installation (continued)

- C. PROVIDE COMBUSTION AND VENTILATION AIR. Local and National Codes 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.
Outdoor air may be provided 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.

III: KNOCK-DOWN BOILER ASSEMBLY

A. REMOVAL OF BOILER from skid.

1. Remove all boiler-to-skid hold down fasteners.
2. FR-HGS thru FR-232: Carefully walk boiler to the edge of skid. Tilt the boiler back, allowing an edge to rest on the floor, and remove the skid.

FR-265 thru FR-462: A mechanical lifting device may be required to safely remove boiler from skid.

B. TEST HEAT EXCHANGER FOR LEAKS before proceeding with jacket assembly.

1. Install pressure relief valve supplied, a hose to the city water to a valve in the supply tapping. Plug remainder of tapings.
2. Fill boiler with water and apply a pressure of at least 10 psig but no more than 25 psig, to prevent weeping from seat of relief valve.

WARNING

Do not apply more than 30 psig to boiler.

CAUTION

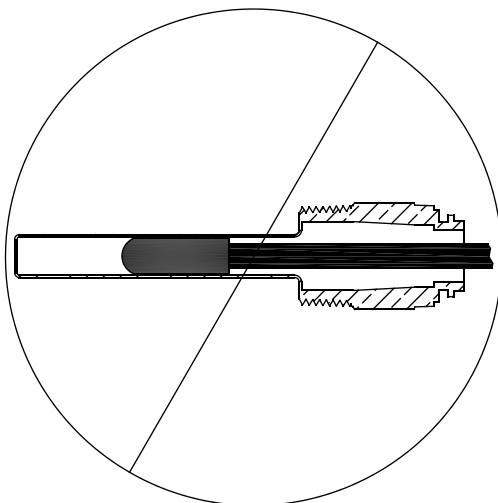
If front flue box or rear smoke box fasteners are removed, tighten them to 26 ft/lbs when replacing them.

C. INSTALLING THE JACKET

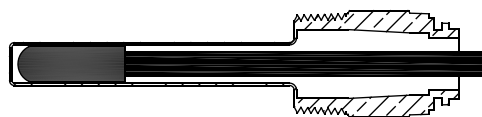
1. Attach lower rear jacket panel to left side and right side jacket panels with the screws provided so that the assembled components make a “U” shape and can stand alone (see Figure 23).
2. Approaching the boiler from the rear, place the assembled jacket pieces from Step 1 around the boiler so that the lower rear panel passes below the rear smokebox.
3. Attach the lower front panel, upper front panel, and upper rear panel. Make sure the jacket clearance holes line up properly with the appropriate boiler extensions and tapings.
4. Attach the top panel assembly (left and right pieces).
5. See Figures 4A thru 4C and Table 3 for label placement.

D. INSTALLATION OF BOILER CONTROLS

1. Install provided pressure/temperature gauge into $\frac{1}{4}$ ” NPT coupling located on front or top of the boiler. Tighten so not to have any water leaks. See Figures 1A thru 1C.
2. Mount the limit control. Thread the provided immersion well into the $\frac{3}{4}$ ” NPT tapping located on the front or top of boiler, see Figures 1A thru 1C. Place the Boiler Control on immersion well and tighten clamp screws to secure control to immersion well. Apply heat transfer paste (not furnished) to limit sensor and fully insert limit sensor into immersion well such that the tip on the limit sensor touches the bottom of the immersion well. See Figure 3.



INCORRECT

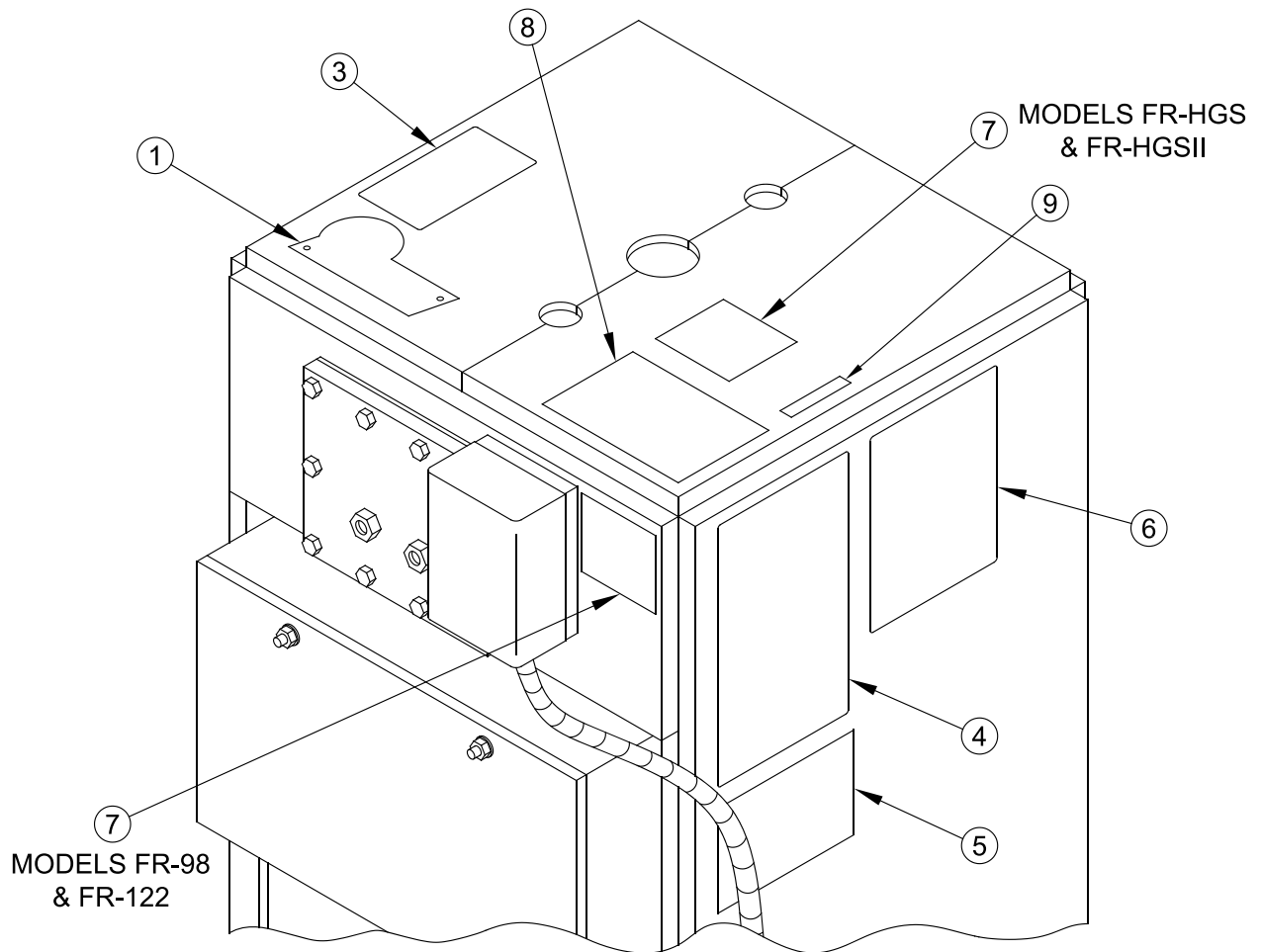


(FULLY INSERTED)

CORRECT

Figure 3: Limit Sensor Insertion

III: Knock-Down Boiler Assembly (continued)



FR-HGS THRU FR-122-W KNOCKDOWN BOILERS
(MODEL FR-122-W BUILD SHOWN)

Figure 4A: Marking Locations for FR-HGS thru FR-122-W Knockdown Boilers (Model FR-122-W Shown)

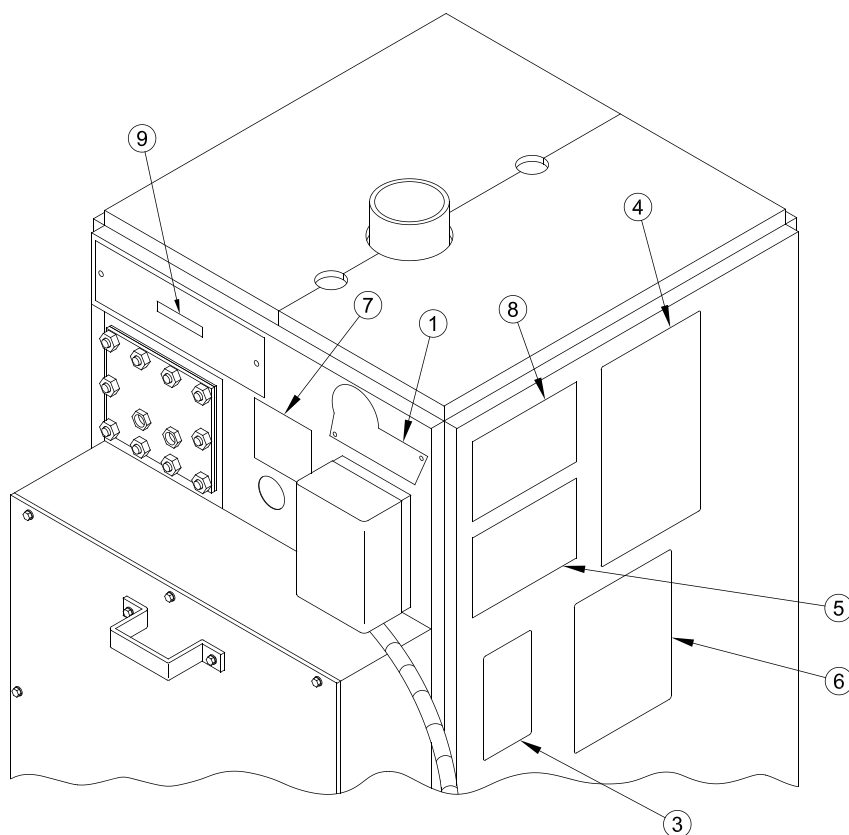
TABLE 3: LABELS

ITEM	DESCRIPTION	APPLICATION	PART NUMBER
1	New Yorker Logo Plate	All Builds	8143705
3	Rating Label	All Builds	81460234
4	Combo Warning / Safety Label, Combustible Floor	All Builds	103026-04
5	Burner Spec. Label, Beckett Burners	All Builds	L23760
	Burner Spec. Label, Riello Burners		L23765
6	Energy Guide Label	FR-HGS thru FR-232	101988-01
7	Limit Sensor Insertion Depth Warning Label	All Builds	103106-03
8	Cold Start Boiler Control Interface Label	Water Boiler Without Tankless Heater	103971-01
	Warm Start Boiler Control Interface Label	Water Boiler With Tankless Heater	103972-01
9	ASME Cover Plate Label	All Builds	81460041

Notes:

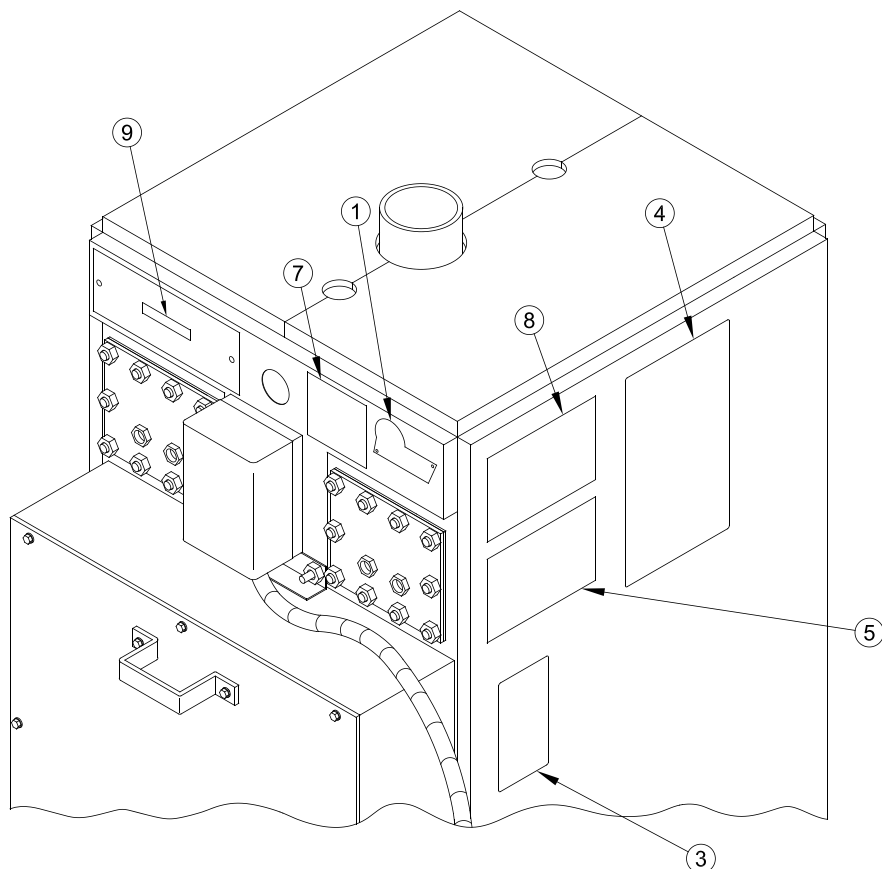
1. Installation is **Not** complete unless all labels furnish with this boiler are attached in appropriate location as shown.
2. It is the responsibility of the installing contractor to see that all labels are applied correctly as depicted.

III: Knock-Down Boiler Assembly (continued)



FR-147-W THRU FR-305-W KNOCKDOWN BOILERS

Figure 4B: Marking Locations for FR-147-W thru FR-305-W Knockdown Boilers



FR-350-W THRU FR-462-W KNOCKDOWN BOILERS

Figure 4C: Marking Locations for FR-350-W thru FR-462-W Knockdown Boilers

III: Knock-Down Boiler Assembly (continued)

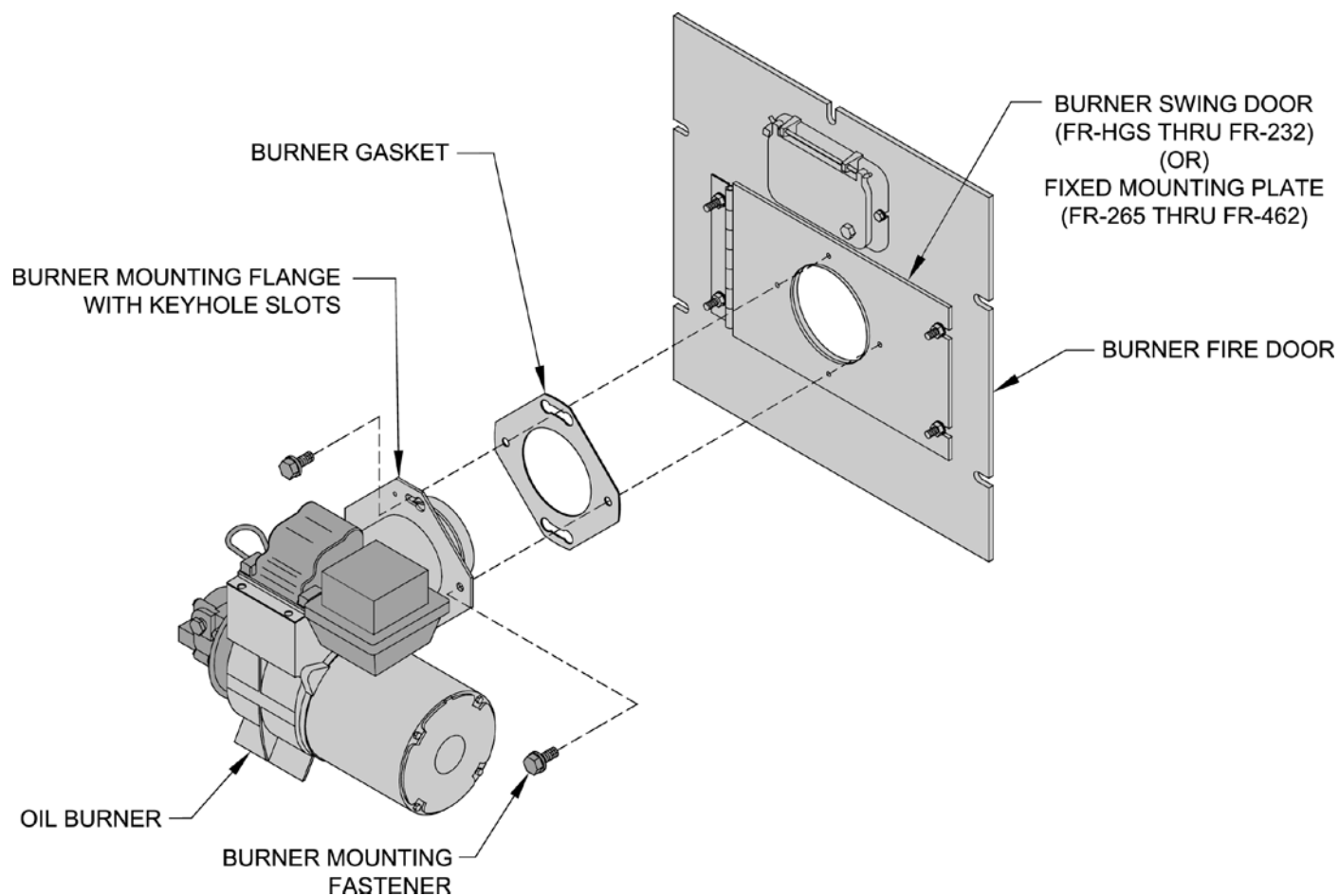


Figure 5: Burner Mounting

3. Mount burner to front fire door and wire according to instructions provided with the burner. Refer to Figure 5.

IV: 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. New Yorker'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.
3. Connect System supply and return piping to boiler. See Figures 6A and 6B. Also, consult I=B=R "Residential Hydronic Heating Installation and Design Guide". Maintain minimum ½ inch clearance from hot water piping to combustible materials.

NOTICE

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

New Yorker® 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.

- 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 6. Also, consult I=B=R "Residential Hydronic Heating Installation and Design Guide".

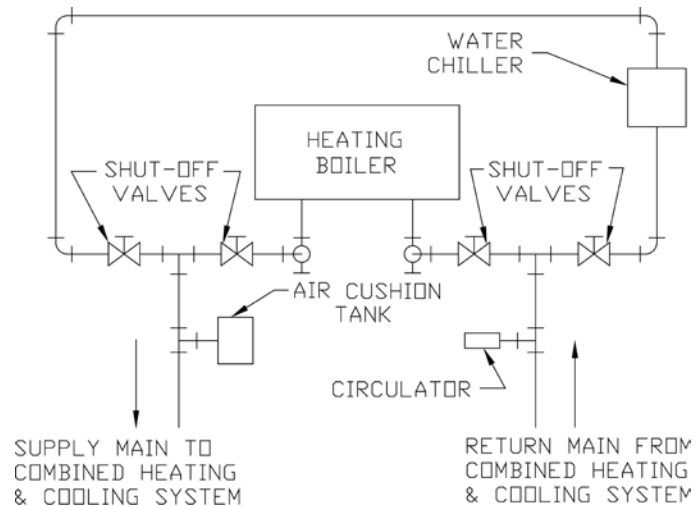


Figure 6: Recommended Piping for Combination Heating and Cooling (Refrigeration) System

- 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 Indirect-Fired Domestic Hot Water Heater, install the Indirect-Fired Domestic Hot Water Heater as a separate heating zone. Refer to the Indirect-Fired Domestic Hot Water Heater 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 and return line as illustrated in Figures 7A and 7B 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.

IV: Water Piping and Trim (continued)

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.
- B. INSTALL SAFETY RELIEF VALVE.** See Figures 7A and 7B. 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

Installation is NOT complete unless a safety relief valve is installed as shown in Figure 6A or 6B. 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 7A and 7B.
- 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.

16 IV: Water Piping and Trim (continued)

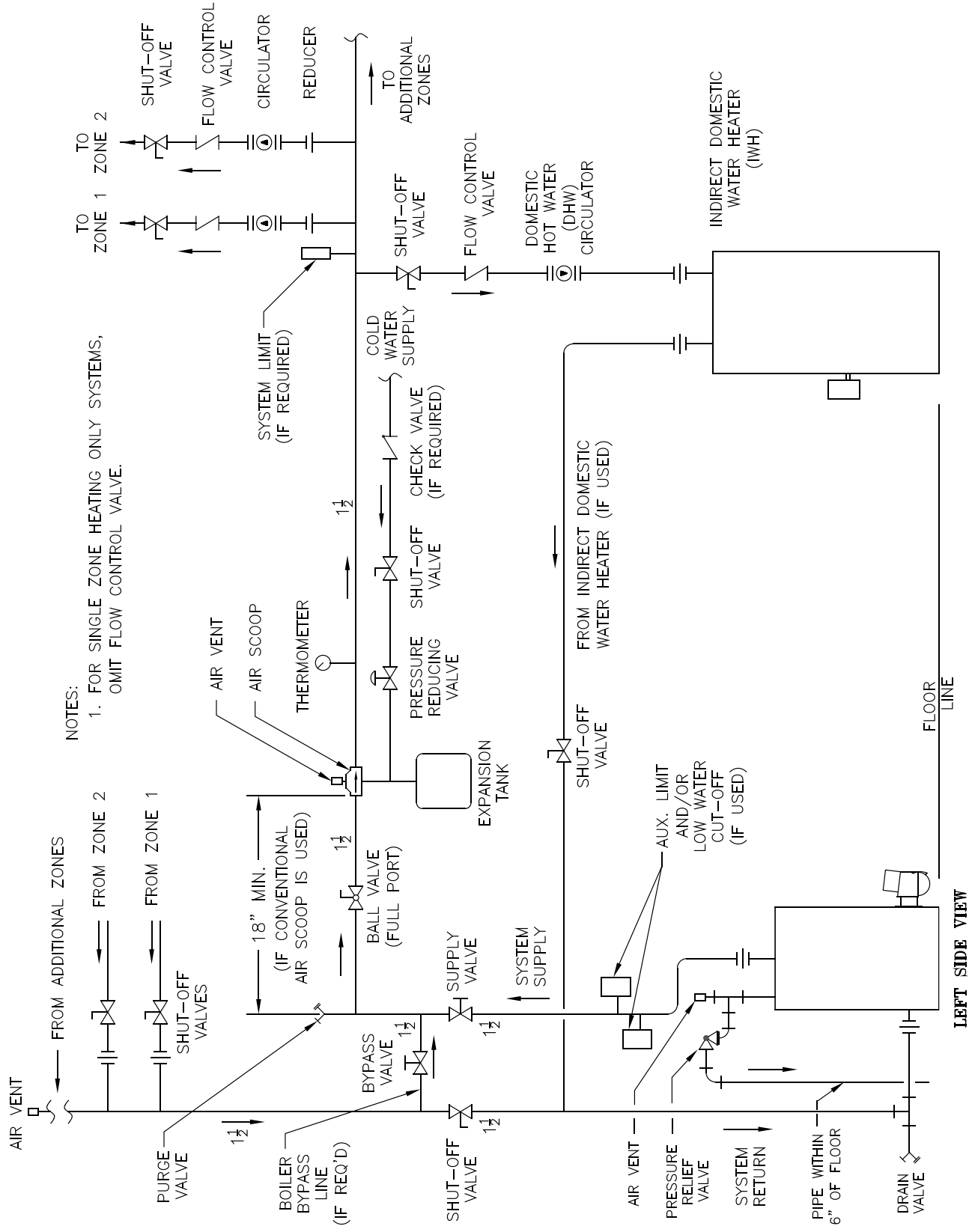


Figure 7A: Recommended Water Piping for Circulator Zoned Heating Systems

IV: Water Piping and Trim (continued)

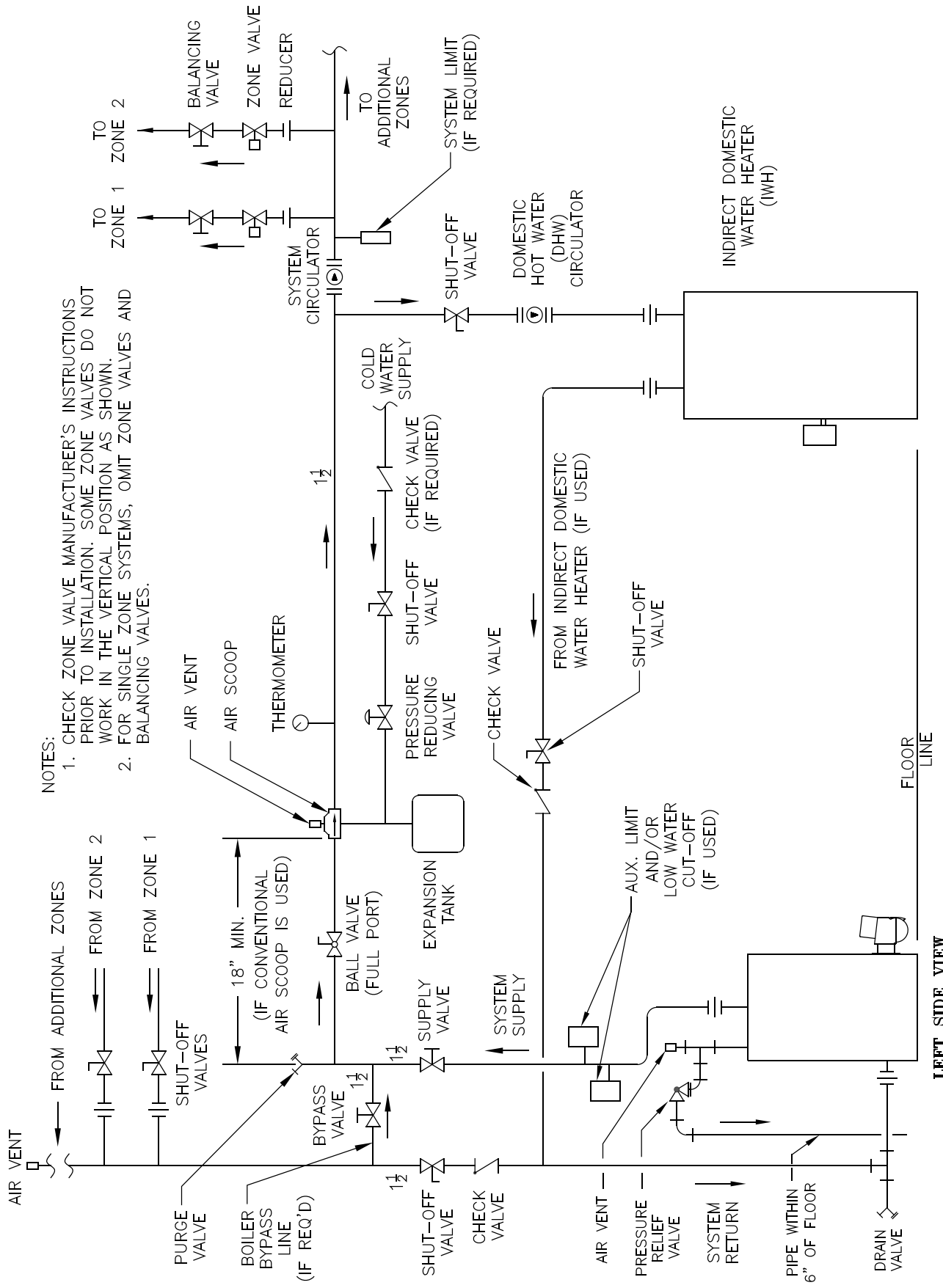


Figure 7B: Recommended Water Piping for Zone Valve Zoned Heating Systems

IV: Water Piping and Trim (continued)

F. CONNECT TANKLESS HEATER PIPING AS SHOWN IN FIGURE 8.

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 8.

3. **FLUSHING OF HEATER** — All water contains some sediment which settles on the inside of the coil. Consequently, the heater should be periodically back washed. 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.

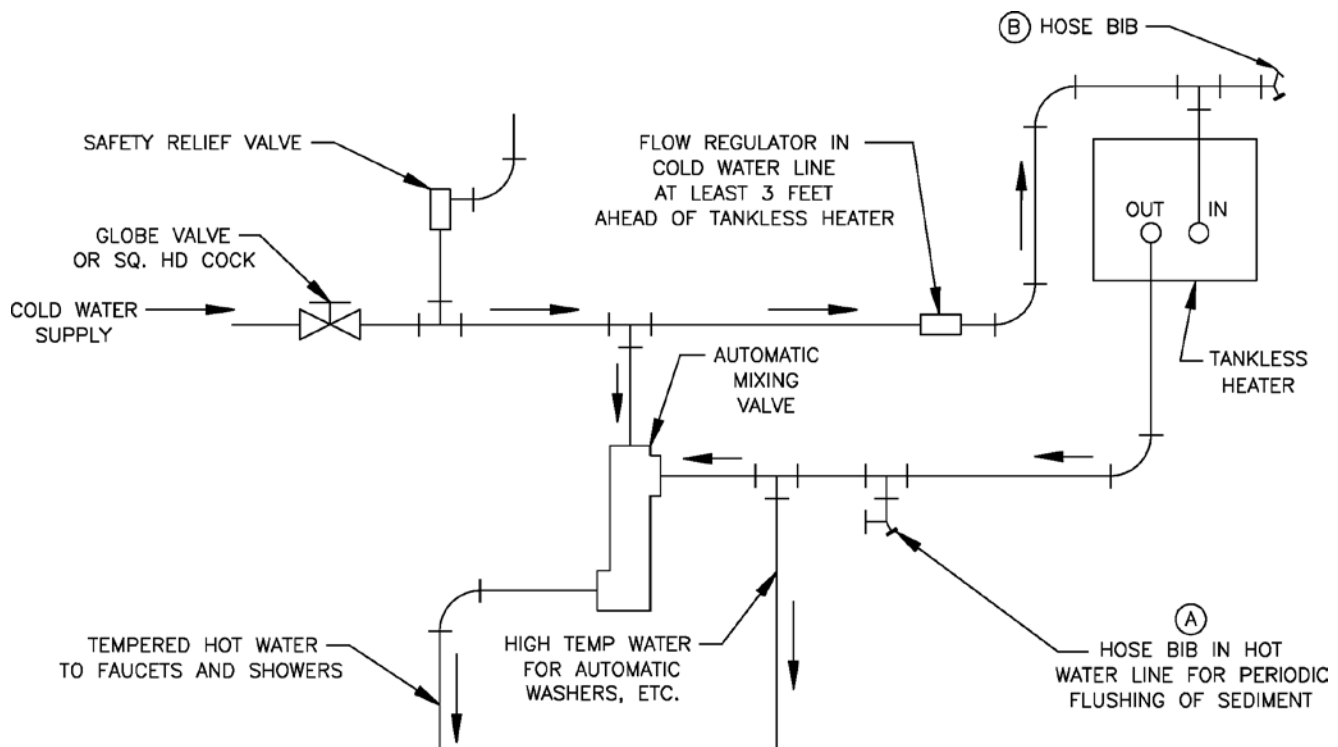


Figure 8: Schematic Tankless Heater Piping

V: 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 FR™ 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 9 for recommended installation.
 - a. Install a draft regulator (supplied by installer) following the instructions furnished with the regulator. See Figure 10 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.

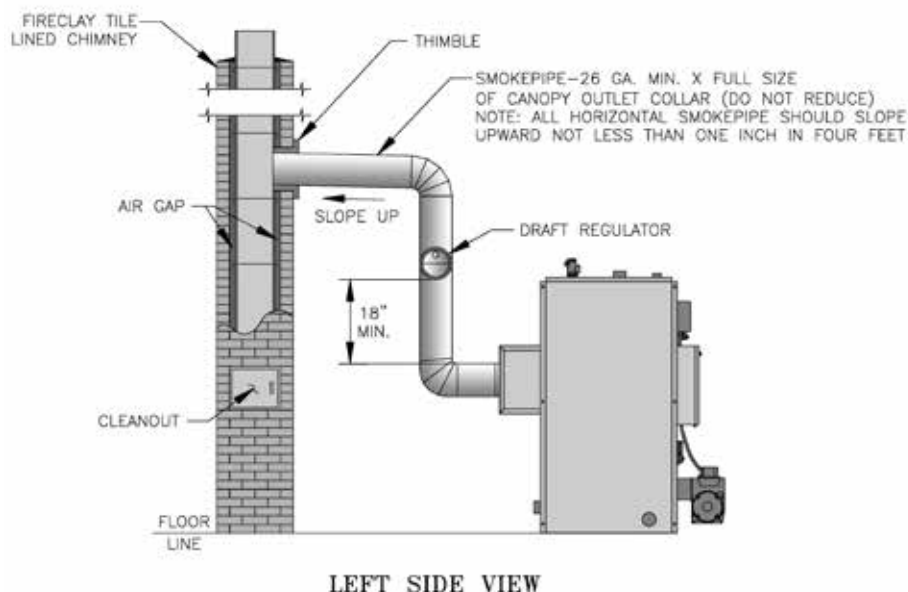


Figure 9: Recommended Smoke Pipe Arrangement and Chimney Requirements

V: Venting (continued)

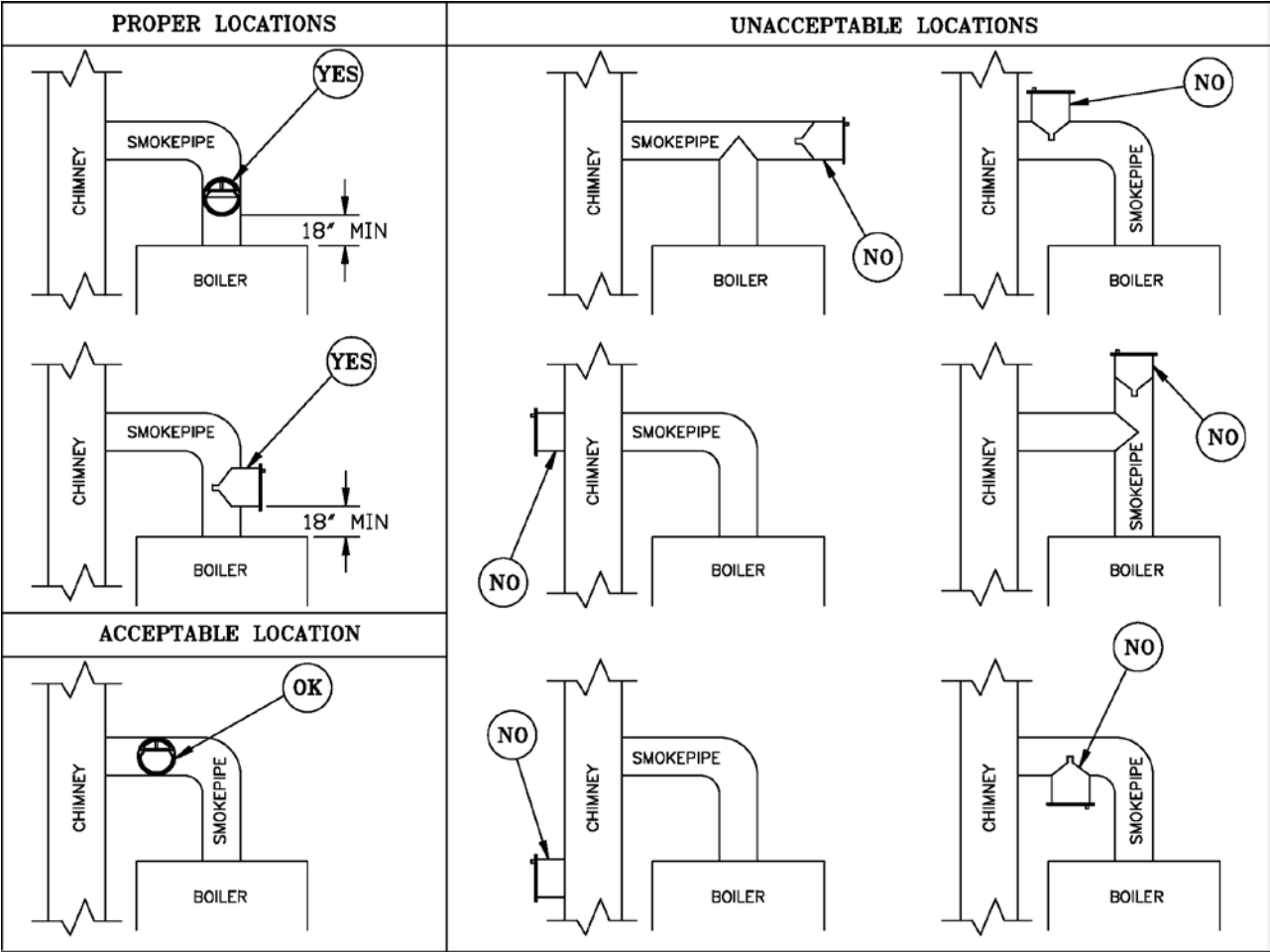


Figure 10: Draft Regulator Locations

VI: 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. Refer to National Electric Code or Local Electric Codes for proper size and type of wire required. Follow Code.
3. A separate electrical circuit must be run from the main electrical service with an over-current device/disconnect in the circuit. A 15 amp circuit breaker is recommended. A service switch is recommended and may be required by some local jurisdictions.
4. Wiring should conform to Figures 11 thru 13 of this manual.

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 Indirect-Fired Domestic Hot Water Heater is used, use priority zoning. Do not use priority zoning for Hydro-Air Systems.
5. Single or Multiple Zone Water System – Refer to Figures 11 and 12 for electrical diagram. Connect the system circulator wire leads to the proper locations on the Aquastat control, L7224 or L7248. See Figure 11 or 12.

- C. INSTALL A ROOM THERMOSTAT on an inside wall about four feet above floor. Never install thermostat on an outside wall or where it will be influenced by drafts, hot or cold water pipes, lighting fixtures, television, rays of the sun or near a fireplace. Keep large furniture away from thermostat so there will be free movement of room air around this control.
Connect the thermostat to the 'T-T' terminals on the L7224 or L7248 control.
Heat Anticipator in Thermostat should be set to .1 amps. If system tends to overheat above the thermostat's temperature setting, reduce heat anticipator setting by .1 or .2 amps. If system tends to short cycle without reaching desired room temperature, increase heat anticipator setting by .1 or .2 amps.

WARNING

The maximum allowable current for each circulator is 5 amps at 120V AC. For circulators with higher amp ratings, you must install a circulator relay or starter coil to provide line voltage to the circulator and connect only the relay or starter coil to boiler terminals. The combined boiler and circulator amperage must not exceed 15 amps. Install over-current protection in accordance with authority having jurisdiction or, in the absence of such requirements, follow the National Electric Code, NFPA 70, and/or CSA C22.1 Electrical Code. Do not provide over-current protection greater than 15 amperes.

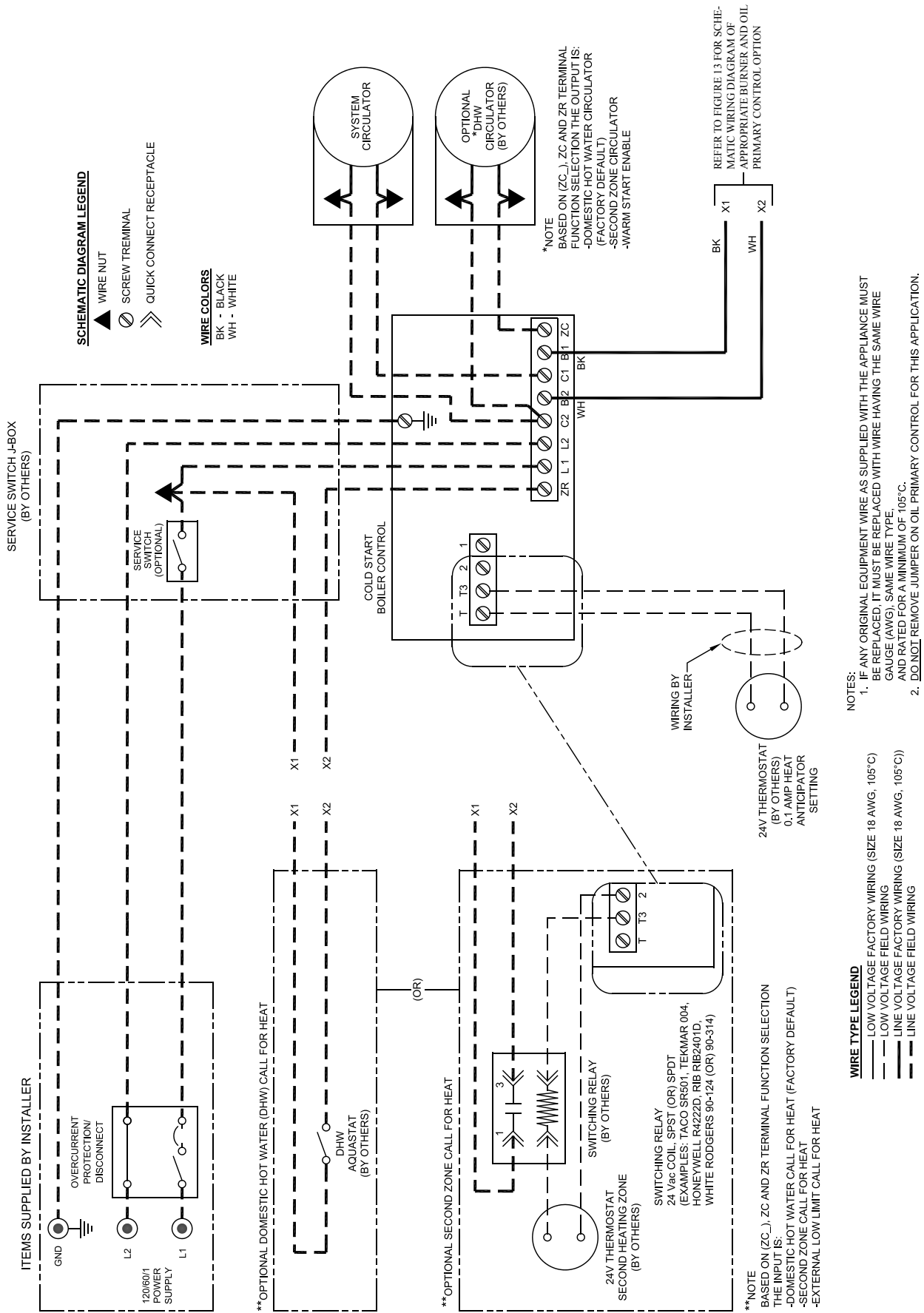


Figure 11: Schematic Wiring Diagram, without Tankless Heater, Cold Start Control (Beckett Burner)

VI: Electrical (continued)

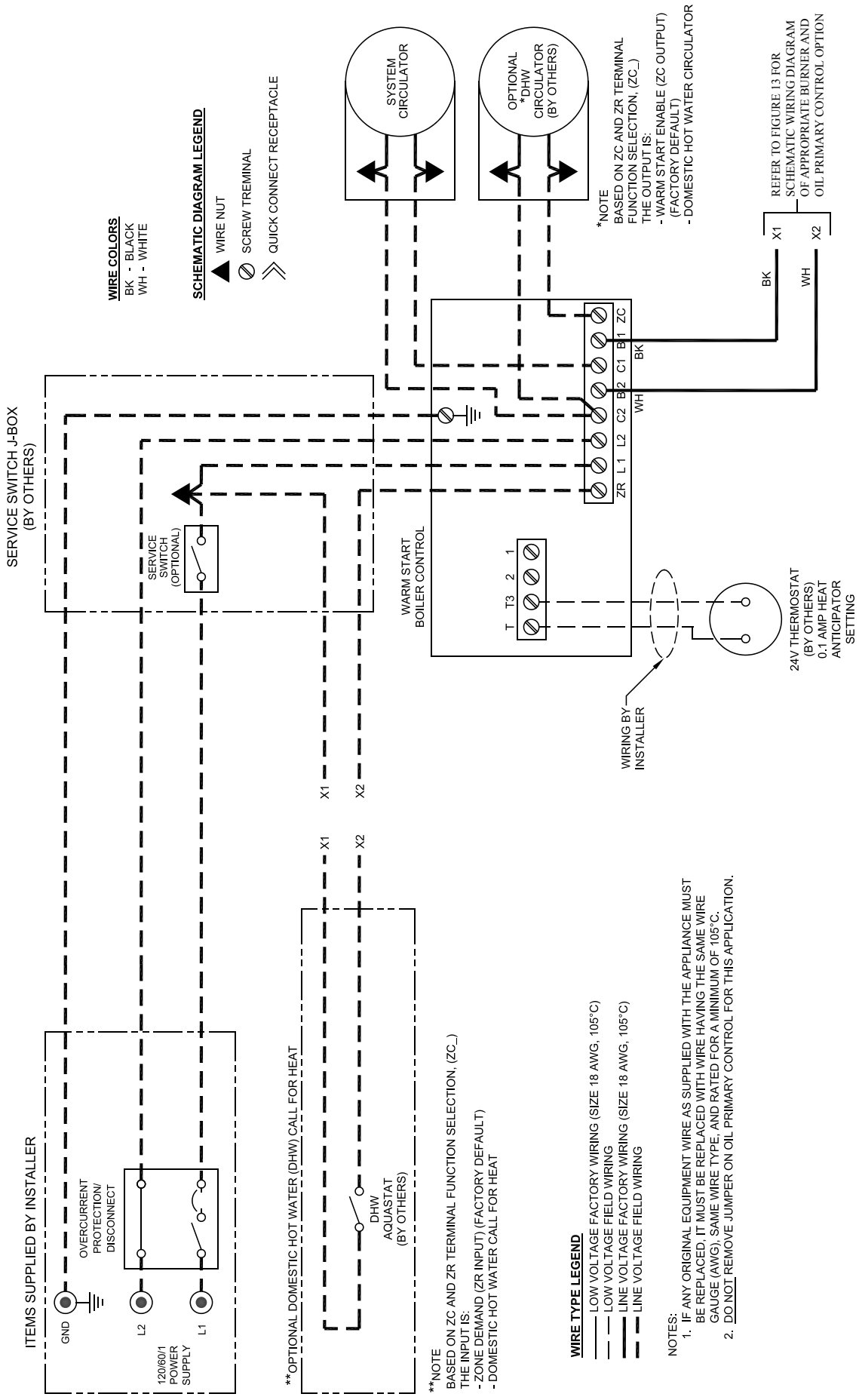


Figure 12: Schematic Wiring Diagram, with Tankless Heater, Warm Start Control (Beckett Burner)

24 VI: Electrical (continued)

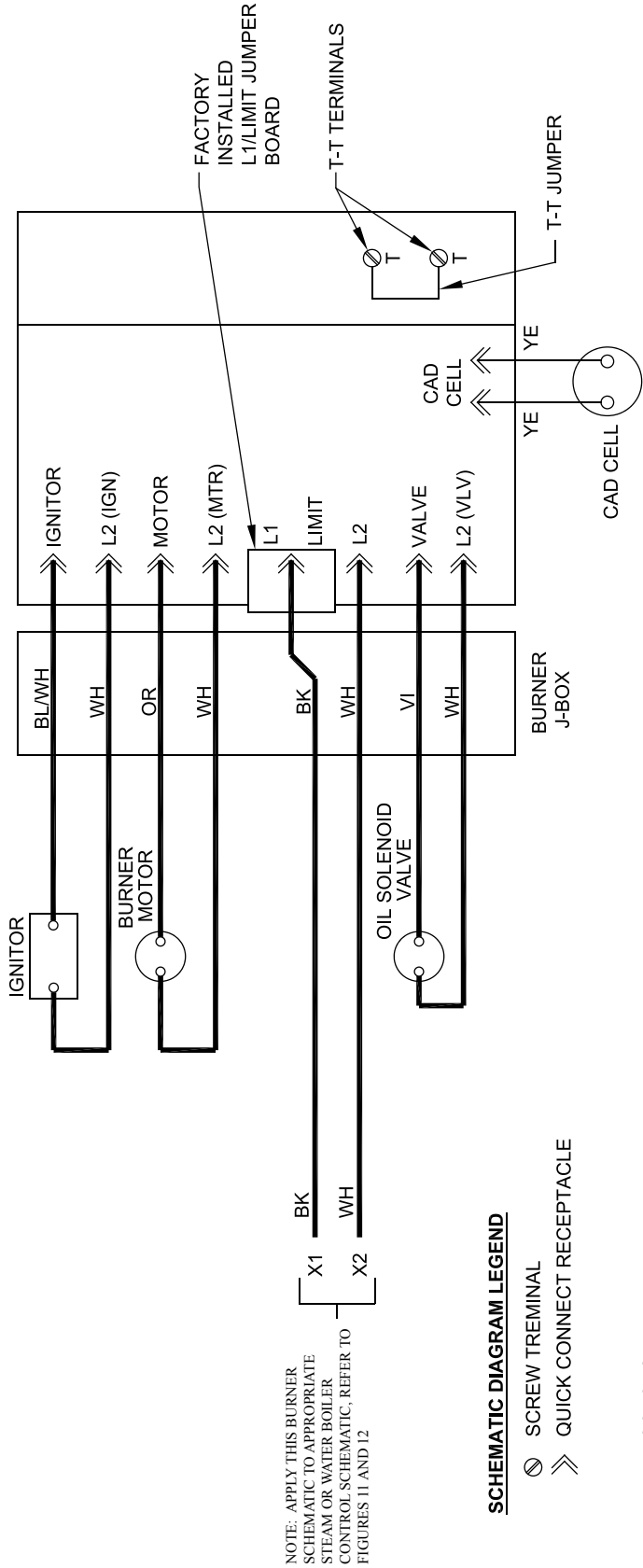


Figure 13: Schematic Wiring Diagram For Beckett Burner w/GeniSys Oil Primary Control

VII: OIL PIPING

A. GENERAL

1. Use flexible oil line(s) so that burner door can be opened, or 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 applications 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 the 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 14.

NOTICE

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

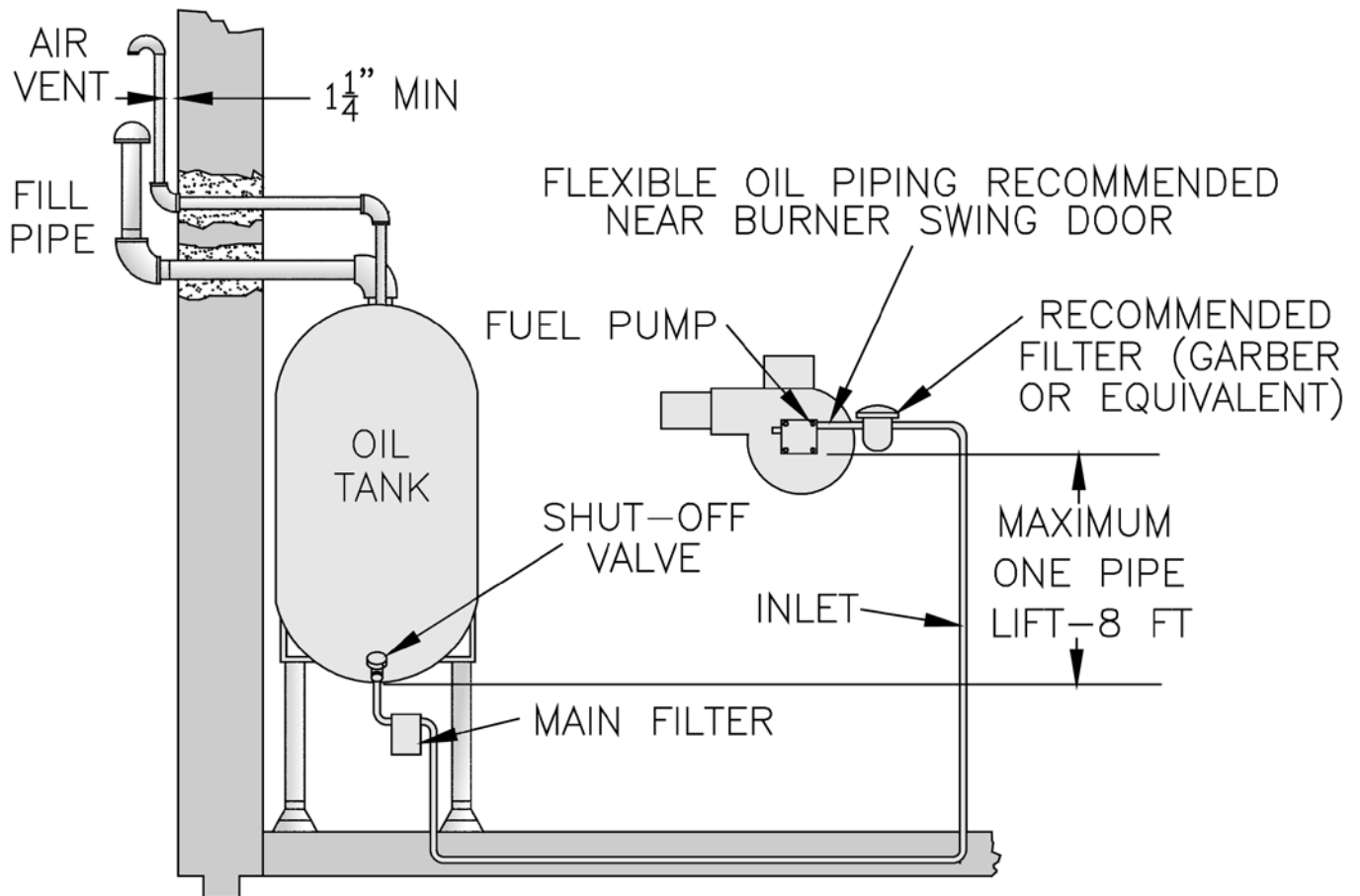


Figure 14: Single-Pipe Installation

VII: Oil Piping (continued)

TABLE 4: SINGLE STAGE UNITS (3450 RPM)
Two Pipe Systems

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

TABLE 5: TWO-STAGE UNITS (3450 RPM)
Two Pipe Systems

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

C. TWO-PIPE OIL LINES

- For two-piped systems, where more lift is required, the two-stage fuel unit is recommended. Table 4 (single-stage) and Table 5 (two-stage) show allowable lift and lengths of 3/8 inch and 1/2 inch OD tubing for both suction and return lines. Refer to Figure 15.

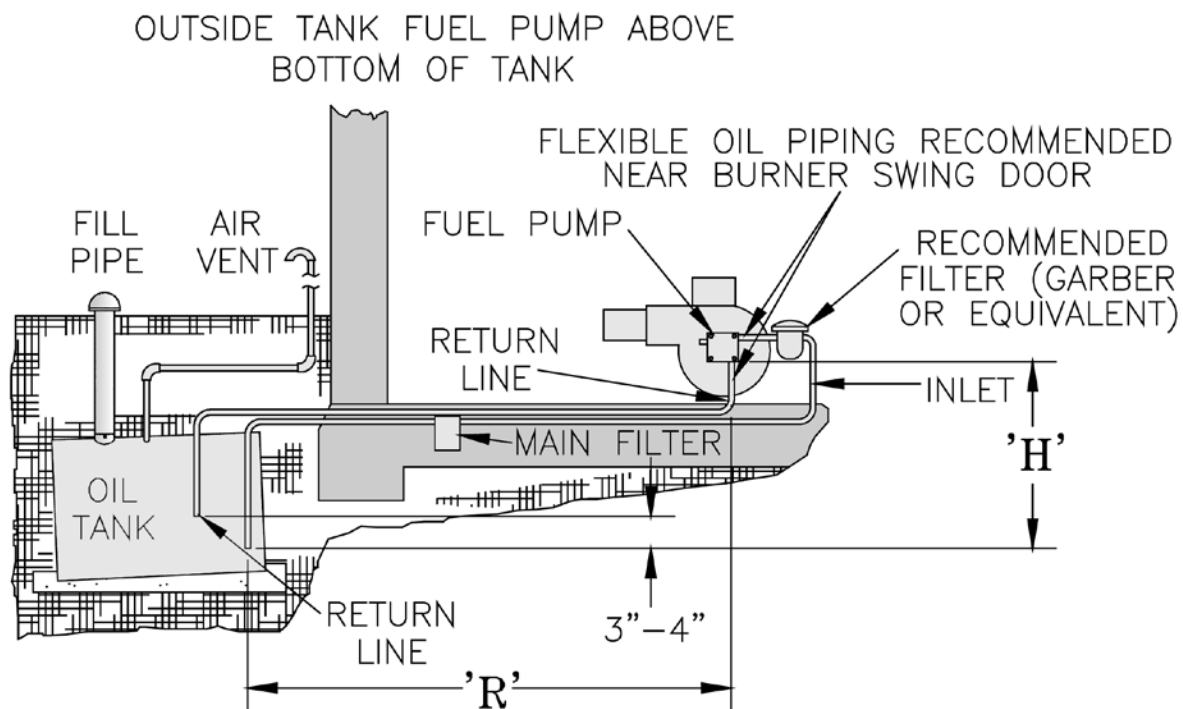


Figure 15: Two-Pipe Installation

VIII: SYSTEM START-UP

WARNING

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

A. ALWAYS INSPECT INSTALLATION BEFORE STARTING BURNER.

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

WARNING

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

B. FILL HEATING SYSTEM WITH WATER.

CLEAN HEATING SYSTEM if boiler water is dirty. Refer to Maintenance and Service Instructions Section of this manual for proper cleaning instructions for water boilers.

1. 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 Figures 7A, and 7B, to remove air from system when filling:
 - a. Close full port ball valve in boiler system piping.
 - b. Isolate all zones by closing zone valves or shut-off valves in supply and return of each zone(s).
 - c. Attach a hose to vertical purge valve in boiler system piping.
(**Note** - Terminate hose in five gallon bucket at a suitable floor drain or outdoor area).
 - d. Starting with one zone at a time, open zone valve or shut-off valve in boiler supply and return piping.
 - e. Open purge valve.
 - f. Open shut-off valve in cold water supply piping located between the air scoop and expansion tank.
 - g. Allow water to overflow from bucket until discharge from hose is bubble free for 30 seconds.

- h. When zone is completely purged of air, close zone valve or shut-off valve. Open zone valve to the next zone to be purged. Repeat this step until all zones have been purged. At completion, open all zone valves.
- i. Close purge valve, continue filling the system until the pressure gauge reads 12 psi. Close shut-off valve in cold water supply piping.

Note - If make-up water line is equipped with pressure reducing valve, system will automatically fill to 12 psig.

NOTICE

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

WARNING

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

- j. Open full port ball valve in boiler system piping.
- k. Remove hose from purge valve.
- l. Confirm that the boiler and system have no water leaks.

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

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

1. SET ROOM THERMOSTAT about 10°F below room temperature.
2. PRESS RED RESET BUTTON on front of Primary Control. Hold button for fifteen (15) seconds and release to reset primary control.

VIII: System Start-Up (continued)

3. **WATER BOILERS WITHOUT TANKLESS HEATERS** are equipped with an Intelligent Oil Boiler Control (Boiler Control). The Boiler Control is factory programmed with a High Limit setpoint of 180°F. The High Limit setpoint is adjustable between 140°F and 240°F. This temperature may be varied to suit the installation requirements.

HIGH LIMIT DIFFERENTIAL is factory programmed at 15°F and is adjustable between 10°F and 30°F.

4. **WATER BOILERS WITH TANKLESS HEATERS** are equipped with a Warm Start Intelligent Oil Boiler Control (Warm Start Boiler Control). The Warm Start Boiler Control is factory programmed with a High Limit setpoint of 180°F. The High Limit setpoint is adjustable between 140°F and 240°F. High Limit Differential is factory programmed at 10°F. Additionally, the Warm Start Boiler Control is factory programmed with a Low Limit setpoint of 110°F. The Low Limit setpoint is adjustable between 110°F and 220°F. These temperatures may be varied to suit the installation requirements.

5. CHECKOUT

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

E. CHECK OIL BURNER BEFORE STARTING.

If a lower input is desired, remove the nozzle which was factory installed. Locate the lower firing rate nozzle that is supplied loose. Confirm the nozzle is the proper size and type for the lower firing rate as specified in Table 13 (at the rear of this manual). Install the proper nozzle in the burner nozzle adapter.

Adhere the Conversion Rating Label for the selected model on the boiler jacket adjacent to the existing Rating Label on the boiler.

1. **CHECK BURNER SETTINGS** and readjust if necessary, see Burner Specifications, Table 13 at rear of manual.
2. **Beckett Burners**
 - a. Inspect Beckett head setting on left side of burner housing by insuring the blue line MD(V1) or the line on the label MB(L1) are aligned, readjust if necessary. Refer to Figure 2 and Table 13 at the rear of this manual.
 - b. Check burner air band and air shutter settings. Readjust if necessary, see Burner Specifications Table 13 at the rear of this manual.

- c. **OPEN ALL OIL LINE VALVES.**
- d. Attach a plastic hose to fuel pump vent fitting and provide a pan to catch the oil.
- e. **OPEN FLAME OBSERVATION PORT COVER** on burner swing door.

F. START OIL BURNER.

1. Open vent fitting on fuel pump.
2. **TURN 'ON' BURNER** service switch and allow burner to run until oil flows from vent fitting in a **SOLID** stream without air bubbles for approximately 10 seconds.
3. Close vent fitting and burner flame should start immediately after prepurge is completed. Prepurge prevents burner flame until 10 seconds has elapsed after initial power is applied to burner. During prepurge the motor and igniter will operate but the oil valve will remain closed. Refer to Oil Primary Control Instructions for more details.
4. Adjust oil pressure.
 - a. When checking a fuel unit's operating pressure, a reliable pressure gauge may be installed in either the bleeder port or the nozzle port. For Beckett burner refer to Figure 16.
 - b. Locate oil pressure adjusting screw and turn screw to obtain proper pump pressure, refer to Table 13 at the rear of this manual.
 - c. To check the cutoff pressure, deadhead a reliable pressure gauge onto the copper connector tube attached to the nozzle port. Run the burner for a short period of time. Shut the burner off. The pressure should drop and hold.
 - d. Remove the gauge and install bleeder port and/or reconnect the nozzle port line.

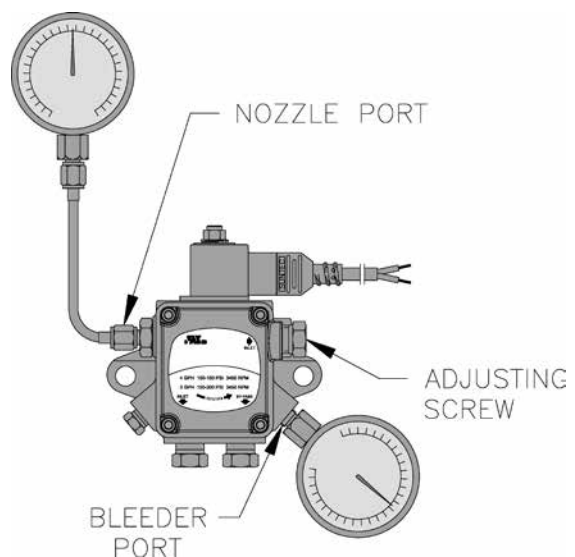


Figure 16: Adjusting Fuel Pump Pressure

VIII: System Start-Up (continued)

G. ADJUST OIL BURNER WHILE OPERATING. (flame present)

1. SET ROOM THERMOSTAT about 10°F below room temperature.
2. PRESS RED RESET BUTTON on Oil Primary Control and release.
3. **Beckett Burners** - READJUST THE HEAD SETTING only if necessary.
 - a. FR-HGS and FR-98:
Beckett MB(L1) Head burners have a fixed head which are non-adjustable.
 - b. FR-HGSII thru FR-232:
Beckett MD(V1) (variable) Head burners have the ability to control air by moving the head. It might be necessary to move the head forward or back one position at a time to optimize the smoke and CO₂ readings. See Figure 17 and Table 13 at the rear of this manual.
4. ADJUST DRAFT REGULATOR for a draft of -0.02" (water gauge) over the fire after chimney has reached operating temperature and while burner is running.
5. READJUST THE AIR DAMPER SETTING (Air Band/Air Shutter) on the burner for a light orange colored flame while the draft over the fire is -0.02". Use a smoke tester and adjust air for minimum smoke (not to exceed #1) with a minimum of excess air. Make final check using suitable instrumentation to obtain a CO₂ of 11.5 to 12.5% with draft of -0.02" (water gauge) in fire box. These settings will assure a safe and efficient operating condition. If the flame appears stringy instead of a solid fire, try another nozzle of the same type. Flame should be solid and compact. After all adjustments are made, recheck for a draft of -0.02" over the fire.
6. ONLY READJUST THE HEAD SETTING if necessary.
 - a. FR-HGS through FR-462 (All Models)
Move the setting forward or back one position at a time to optimize the smoke and CO₂ readings.
 - b. Steps outlined in Paragraph 5 and 6 above must be repeated every time the Head or Air Damper Setting is readjusted.
7. Turn "OFF" burner and remove Riello Combination Pressure Gauge and Bleeder Valve Assembly. Install pressure port/bleeder plug and tighten. Start burner again.

WARNING

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

8. FLAME FAILURE

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

WARNING

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

9. CAD CELL LOCATION AND SERVICE

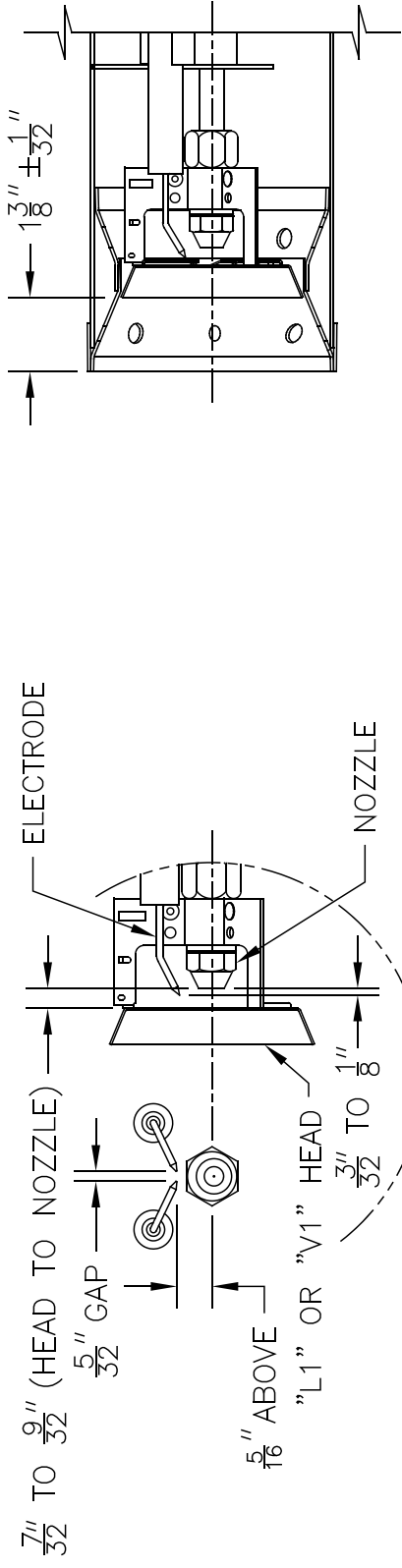
The burner is supplied with a cadmium sulfide flame detector mounted at the factory, mounted on the bottom of the electronic ignitor. See Figure 18. To service cad cell or to replace the plug in portion, swing open the ignitor. After service is complete, be sure to fasten down the ignitor.

H. CHECK FOR CLEAN CUT OFF OF BURNER.

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

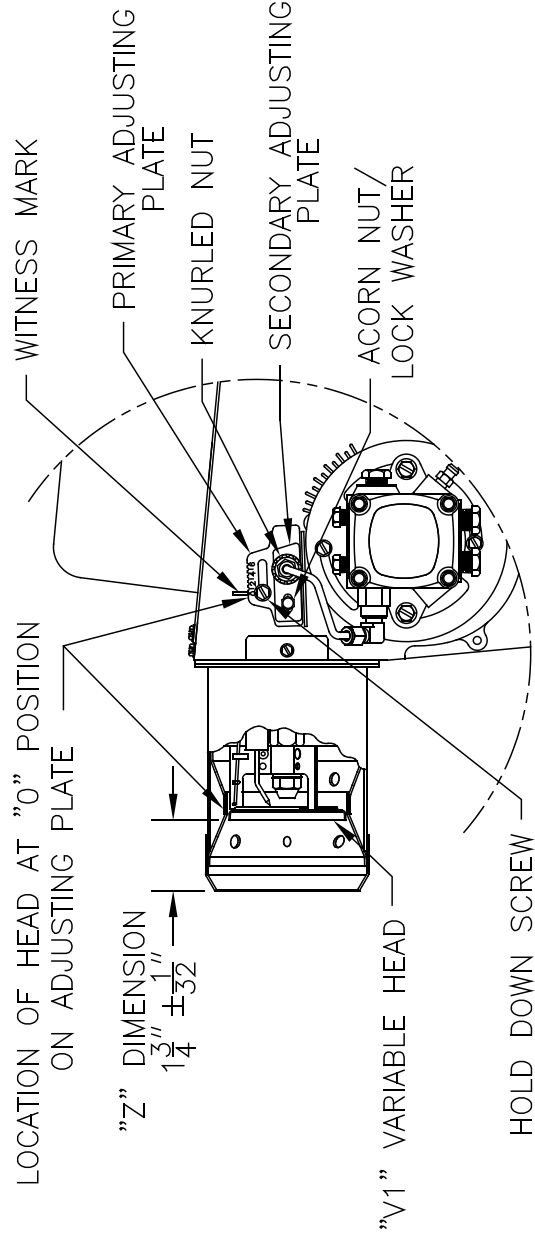
I. TEST CONTROLS

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



ELECTRODE ADJUSTMENT "L1" OR "V1" HEAD

L1 HEAD



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

V1 HEAD

Figure 17: "L1" and "V1" Head Electrode Positioning and Gun Setting (Beckett AFG)

VIII: System Start-Up (continued)

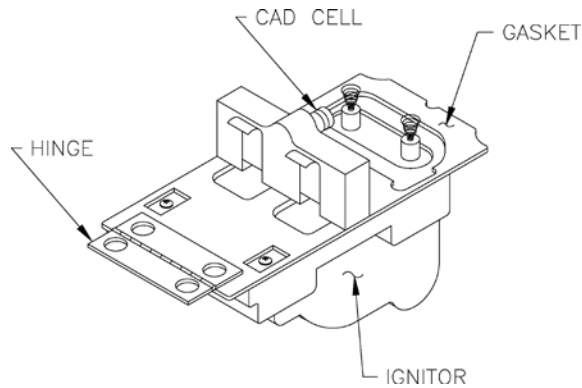


Figure 18: Cad Cell Location

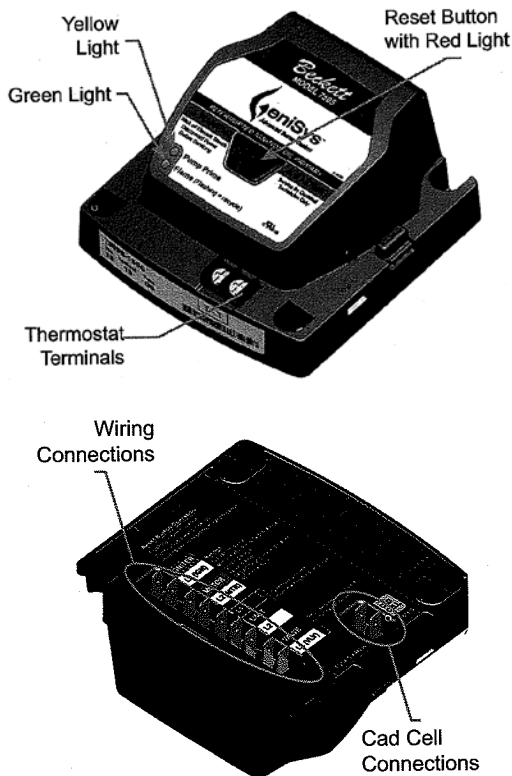


Figure 19: GeniSys 7505 Oil Primary Terminals, LED's and Reset Button

WARNING

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

2. VERIFY OIL PRIMARY CONTROL FEATURES using procedures outlined in Instructions furnished with control or instructions as follows:
 - a. **GeniSys 7505 Control Features**, see Figure 19.
 - i. The GeniSys 7505 is a microprocessor-based control. The indicator light provides diagnostic information for lockout, recycling

and cad cell status. There is a manual reset button to exit the Lockout Mode.

- ii. **Pump Priming Cycle:** To facilitate purging air from the oil lines and filters, the 7505 can be placed in a purge routine by:
 - After the burner starts, press and hold the reset button for 15 seconds until the yellow light turns on. This indicates that the button has been held long enough.
 - Release the reset button. The yellow light will turn off and the burner will start up again.
 - At burner start up, click the reset button while the igniter is still on. This will transition the control to a dedicated Pump Prime mode, during which the motor, igniter, and valve are powered for four (4) minutes. The yellow light will be on.
 - At the end of four (4) minutes, the yellow light will turn off and the control will automatically return to standby mode.
- iii. **Limited Recycle:** This feature limits the number of recycle trials (for each call for heat) to a maximum of three trials. If the flame is lost three times and does not successfully satisfy a call for heat, the 7505 locks out.
- iv. **Limited Reset (Restricted Mode):** In order to limit the accumulation of unburned oil in the combustion area, the control can only be reset three times. The reset count returns to zero each time a call for heat is successfully completed.
- v. **T-T Jumper:** Select models have pre-installed T-T jumper. **DO NOT** remove jumper.

Note: **DO NOT** remove “T-T” jumper unless wiring diagram indicates a direct connection from thermostat and/or tankless heater aquastat control to the oil burner primary control’s “T-T” terminal. Refer to appropriate wiring diagram, see Figures 11 and 12.
- vi. **Diagnostic LED:** The indicator light on oil primary control provides lockout, recycle and cad cell indications as follows:

- Flashing at 1 Hz (½ second on, ½ second off): system is locked out or in Restricted Mode.
- Flashing at ¼ Hz (2 seconds on, 2 seconds off): control is in Recycle Mode.

VIII: System Start-Up (continued)

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

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

3. CHECK OIL PRIMARY CONTROL

CAUTION

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

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

- a. Preliminary Steps
- Check wiring connections and power supply.
 - Make sure power is on to the controls.
 - Make sure limit control is closed.
 - Check contacts between ignitor and the electrodes.
 - Check the oil pump pressure.
 - Check the piping to the oil tank.
 - Check the oil nozzle, oil supply and oil filter.
- b. Check Safety Features
- Safe Start:
- Place a jumper across cad cell terminals.
 - Follow procedure to turn on burner. Burner must not start, indicator light turns on and control remains in Idle Mode.
 - Remove jumper.
- c. Simulate Ignition or Flame Failure:
- Follow procedure to turn on burner.
 - Check cad cell resistance. If resistance is below 1600 OHMS and burner runs beyond safety cut-out time, cad cell is good.
 - If safety switch shuts down burner and resistance is above 1600 OHMS, open line switch to boiler. Access cad cell under ignitor,

clean face of cad cell and see that cell is securely in socket. Check gasket around perimeter of ignitor lid for proper seal. If gasket is missing or damaged, replace gasket. Room light can effect cad cell resistance. Reset safety switch.

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

WARNING

Cad Cell Jumper must be removed after this check.

4. CHECK HIGH LIMIT

- a. Adjust system thermostat(s) to highest setting.
- b. Allow burner to run until boiler water temperature exceeds high limit setting. The burner should shut down and circulators continue running.
- c. Allow the temperature to drop below control setting. The burner must restart.
- d. Boiler installation is not considered complete until this check has been made.
5. CHECK OPERATING CONTROL on boiler applications equipped with tankless heater(s). With burner off, draw hot water until burner starts, then turn off hot water and check burner shut-down.

J. IF CONTROLS MEET REQUIREMENT outlined in Paragraph I.

1. Allow boiler to operate for approximately 30 minute, confirm the boiler and system have no leaks.

K. IF CONTROLS DO NOT MEET REQUIREMENTS outlined in Paragraphs I-1 thru I-6, replace control and repeat checkout procedures.

IX: OPERATING

A. WATER BOILERS SEQUENCE OF OPERATION

1. Water Boilers Without Tankless Heaters (Cold Start), Sequence Of Operation:

- The FR Boiler is equipped with an Intelligent Oil Boiler Control (Cold Start Boiler Control). The boiler control replaces the traditional electronic aquastat and circulator relays and adds energy saving thermal purge features. Energy is saved by starting the circulator and delaying the burner start when there is residual heat available in the boiler.
- The boiler's sequence of operation is shown as Status Codes on Boiler Control display. See Table 6 and Figure 20.
- When the thermostat calls for heat the boiler control starts the system circulator and the thermal purge (circulator pre-purge time) begins. If the time is completed or boiler temperature is less than the Start Temperature (140 F default) the start sequence continues by energizing the oil primary to operate the following sequence: blower is started and operates for pre-purge time; spark is energized and fuel valve is opened for ignition trial time; burner fires until the thermostat is satisfied.
- If the thermostat is not satisfied and the Operating Setpoint (SP) is reached the system circulator will continue to operate and the burner will stop. When the boiler water temperature drops below the setpoint less the differential setting the burner will restart.
- After the thermostat is satisfied the burner and circulator are stopped.
- When an indirect water heater aquastat call for heat is wired to the "ZR" terminal the Boiler Control starts a domestic hot water circulator connected to the "ZC" terminal and when the boiler temperature is less than Operating Setpoint (SP), the boiler control energizes the oil primary to turn on the burner without circulator pre-purge delay.

- On burner start, if the CAD cell does not see flame within approximately 15 seconds, primary control will shut down the burner and enter into a lockout mode. A lockout is reset by pressing the reset button located on the primary control. If the flame is lost while the burner is firing, the primary control shuts down the burner, enters a 60 second recycle delay, and repeats the ignition sequence. If after three (3) trials for ignition, flame is not detected, primary control will enter into restricted mode. Restricted mode is reset by holding down the reset button for 15 seconds.

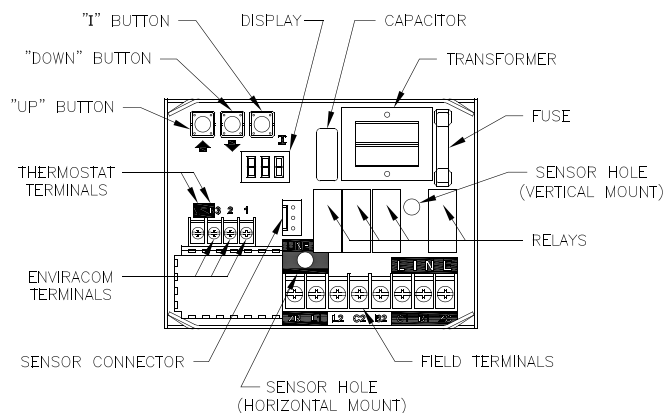


Figure 20: Intelligent Oil Boiler Control

2. Water Boilers with Tankless Heaters (Warm Start), Sequence Of Operation:

- The FR Boiler is equipped with a Warm Start Intelligent Oil Boiler Control (Warm Start Boiler Control). The Warm Start Boiler Control replaces the traditional high and low limit aquastat and circulator relays.
- The boiler's sequence of operation is shown as Status Codes on Boiler Control display. See Table 6 and Figure 20.
- When the thermostat calls for heat the boiler control starts the system circulator and the start sequence continues by energizing the oil primary to operate the following sequence: blower is started and operates for pre-purge time; spark is energized and fuel valve is opened for ignition trial time; burner fires until the thermostat is satisfied. Optionally, the thermal purge (circulator pre-purge time) maybe added adjusting the Circulator Pre-purge time parameter. This feature saves energy by starting the circulator and delaying the burner start when there is residual heat available in the boiler .

TABLE 6: SEQUENCE OF OPERATION

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

IX: OPERATING (continued)

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

3. Using Boiler Control

The Boiler Control is located on front of boiler. The Boiler Control display, along with Up ↑, Down ↓, and “I” keys may be used to view boiler operating status (Figure 21).

4. Viewing the Operating Mode Options

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

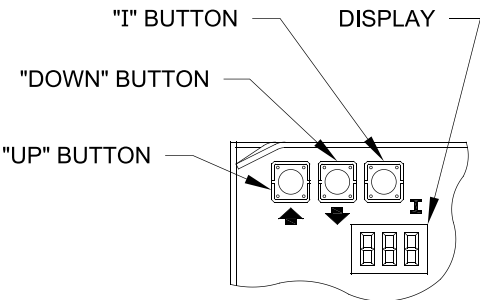
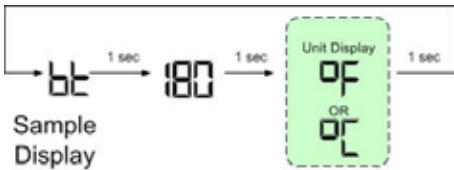


Figure 21: Boiler Control Key Function & Orientation

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

Operating Mode Options	
StAr	Status Numbers: 1 Standby 8 Running 17 Self Test)
	bL Boiler Temperature
	SP Operating Setpoint (Outdoor Reset)
	HL High Limit Setting
HdF	High Limit Differential
LL	Low Limit Setpoint (warm start only)
LdF	Low Limit Differential (warm start only)
hr	Heat Request Status
dh	DHW Request Status
Err	Boiler Error

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



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

5. Changing the Adjustable Parameters

- To adjust parameters such as the High Limit Setpoint and High Limit Differential:
- a. Using the Boiler Control display, access the adjustment mode by pressing and holding the Up ↑, Down ↓, and “I” keys simultaneously for three (3) seconds. This procedure is intended to discourage unauthorized changes or accidental changes to limit settings.
 - b. Press the “I” key to display available Adjustment Mode options. Select an option.

IX: OPERATING (continued)

Cold Start Boiler Control Adjustment Mode Options		
HL_	140-240°F	Adjust High Limit Setting
HdF	10-30°F	Adjust High Limit Differential
ZC_	dh, Zr or ELL	ZC and ZR Terminal Function
Or_	0-10 minutes	Pump Overrun Time
PP_	2-20 minutes	Pump Pre-purge Time
St_	140 - 180°F	Start Temperature
Pt_	On or OFF	Priority Time
F-C	F or C	Select degrees F or C Mode
bAc		Back to Operating Mode

Warm Start Boiler Control Adjustment Mode Options		
HL_	140-240°F	Adjust High Limit Setting
LL_	110-220°F	Adjust Low Limit Setting
LdF	10-25°F	Adjust Low Limit Differential Setting
ZC_	Zr or dh	ZC and ZR Terminal Function
Or_	0-10 minutes	Pump Overrun Time
PP_	0-20 minutes	Pump Pre-purge Time
St_	140 - 180°F	Start Temperature
Pt_	On or OFF	Priority Time
F-C	F or C	Select degrees F or C Mode
bAc		Back to Operating Mode

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

6. More Information about Adjustable Parameters

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

c. Low Limit (LL_)

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

d. Low Limit Differential (LdF)

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

e. Circulator Overrun Time (Or_)

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

f. Circulator Pre-Purge Time (PP_)

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

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

IX: OPERATING (continued)

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

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

g. Start Temperature ($\mathcal{S}\mathcal{T}_-$)

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

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

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

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

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

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

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

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

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

IX: OPERATING (continued)

TABLE 9: ZONE REQUEST, PARAMETER $\overline{ZC} = \overline{Zr}$

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

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

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

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

- The Warm Start Boiler Control with \overline{ZC} set equal to Zone Request (\overline{Zr}) energizes the “ZC” terminal while the boiler is warm as described earlier in this section (refer to Paragraph A,2,f). The “ZR” input is a call for heat that starts the boiler.
- iii. External Low Limit, Parameter $\overline{ZC} = \overline{ELL}$
- The Cold Start Boiler Control is capable of functioning as a warm start control when external limit control is installed that closes a contact when boiler water temperature falls below a setpoint. When an external limit contact closes (boiler water is cold) the boiler is started and the “ZC” and “C1” output terminals are de-energized. When the “ZR” terminal is de-energized (boiler water temperature is above setpoint) the call for heat is ended and the “C1” terminal is released to operation and the “ZC” terminal is energized. An External Low Limit Request is detected by sensing a voltage on the “ZR” terminal. The Warm Start Boiler Control does not have the External Low Limit Option. Refer to Table 10.