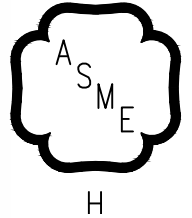


INSTALLATION, OPERATING AND SERVICE INSTRUCTIONS FOR

V8H™ SERIES OIL - FIRED BOILER



As an ENERGY STAR® Partner, U.S. Boiler Company has determined that the V8H3S, V8H3W, V8H4S, V8H4W, V8H5S, V8H5W, V8H6S, V8H6W and V8H7 meet the ENERGY STAR® guidelines for Energy efficiency established by the United States Environmental Protection Agency (EPA).



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

Boiler Model Number V8H	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:

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.

CANADIAN BOILERS

- A. Current Edition of Canadian Standards Association CSA B139, "Installation Code for Oil Burning Equipment", for recommended Installation Practices.
- B. All wiring on boilers installed in Canada shall be made in accordance with the Canadian 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 included with this boiler. The warranty for this boiler is valid only if the boiler has been installed, maintained and operated in accordance with these instructions.

Surface rust on cast iron sections may be attributed to the manufacturing process as well as condensation during storage. Surface rust is normal and does not affect the performance or longevity of a boiler.

DANGER

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

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 left corner of front section- 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 suitable for installation on combustible flooring. **DO NOT** install boiler on carpeting.

DO NOT tamper with or alter the boiler or controls.

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

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

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 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.

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 must be properly vented and connected to an approved vent system in good condition. **DO NOT** operate boiler with the absence of 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.

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.

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.

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SECTION I: PRODUCT DESCRIPTION, SPECIFICATION AND DIMENSIONAL DATA

The V8H Series boiler is a cast iron oil-fired water boiler designed for closed forced circulation heating systems or a low pressure steam boiler designed for use in closed heating steam systems. This boiler must be vented by natural draft 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 UL03. An adequate supply of air for combustion, ventilation and dilution of flue gases must be available in the boiler room.

Water Boilers

The V8H Series water boiler uses an Intelligent Oil Boiler Control (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. A Warm Start Intelligent Oil Boiler Control (Warm Start Boiler Control) is included with a tankless heater option to generate domestic hot water.

Steam Boilers

The V8H Series steam boiler uses a L404F Pressure Limit and Low Water Cut-off. This boiler has indirect domestic water heater connections to generate domestic hot water. Optionally, this boiler may include a L4006 Temperature Limit and a tankless heater to generate domestic hot water.

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

Boiler Model No.	Dimensions See Figures 1A thru 1D			Water Content - Gallons		Heat Transfer Surface Area - Sq. Ft.		Approximate Shipping Weight (LB.)
	"A"	"B"	"C"	Steam Boiler	Water Boiler	Water Boiler	Steam Boiler	
V8H3	17-1/8"	9-1/8"	6"	10.3	12.8		15.88	542
V8H4	22-1/8"	11-5/8"	6"	12.4	15.7		22.92	634
V8H5	27-1/8"	14-1/8"	7"	14.6	18.5		29.96	726
V8H6	32-1/8"	16-5/8"	7"	16.7	21.4		37.00	818
V8H7	37-1/8"	19-1/8"	8"	18.8	24.2		44.04	910
V8H8	42-1/8"	21-5/8"	8"	20.9	27.1		51.08	1002
V8H9	47-1/8"	24-1/8"	8"	23.0	30.0		58.12	1094

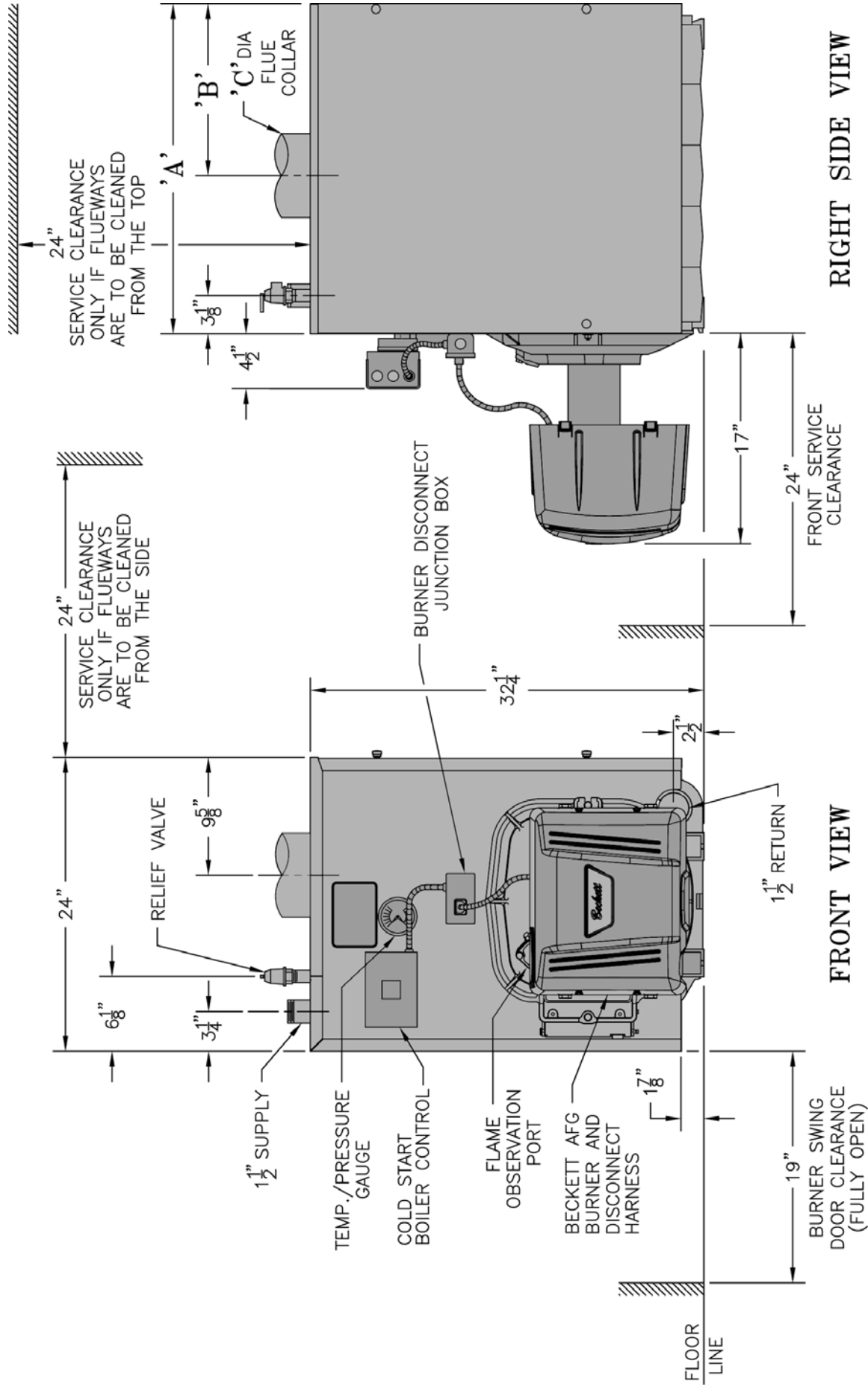
NOTE: 1 Maximum working Pressure: Steam: 15 PSI; Water: 30 PSI Shipped From Factory (Std.), 40 PSI Optional, 50 PSI Optional

TABLE 1B: RATING DATA

Boiler Model No. *	Burner Capacity			I=B=R NET Ratings			AFUE % (Thermal Effy.)		Minimum Chimney Requirements		
	GPH	MBH	DOE Heating Capacity MBH	Water MBH	Steam MBH	Steam Sq. Ft.	Steam	Water	Round In. Dia.	Rectangle In. x In.	Height Ft.
V8H3S	0.75	1.05	91		68	283	85.1		6	8 x 8	15
V8H3W	1.05	147	125	109				85.0	6	8 x 8	15
V8H4S	1.05	147	127		95	396	85.3		6	8 x 8	15
V8H4W	1.35	189	162	141				85.3	7	8 x 8	15
V8H5S	1.35	189	164		123	512	85.4		7	8 x 8	15
V8H5W	1.65	231	198	172				85.3	7	8 x 8	15
V8H6S	1.65	231	201		151	629	85.7		7	8 x 8	15
V8H6W	1.90	266	228	198				85.3	8	8 x 8	15
V8H7S V8H7W	2.10	294	252	219	189	787	84.7	85.0	8	8 x 8	15
V8H8S	2.35	329	266		200	833	(81.4)		8	8 x 12	15
V8H8W	2.35	329	275	239				(82.0)	8	8 x 12	15
V8H9S	2.60	364	298		224	933	(82.3)		9	8 x 12	15
V8H9W	2.60	364	299	260				(82.3)	9	8 x 12	15

* Boiler Model Suffix: S=Steam, W=Water

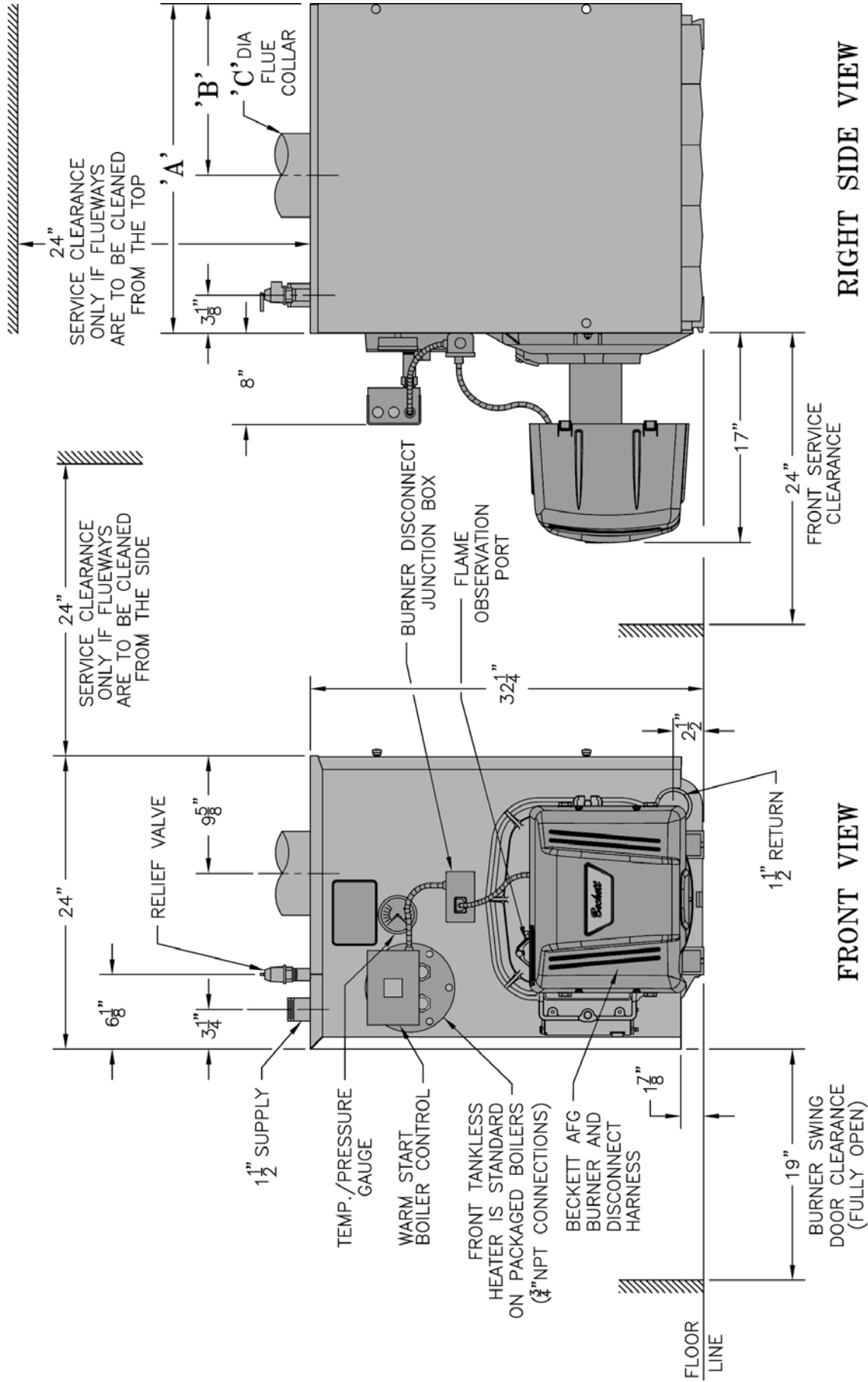
SECTION I: PRODUCT DESCRIPTION, SPECIFICATION AND DIMENSIONAL DATA (continued)



- NOTES:
1. WIRING HARNESES, RETURN PIPING AND CIRCULATOR NOT FURNISHED WITH KNOCKDOWN BOILERS.

Figure 1A: V8H3 thru V8H9 Water Boiler without Tankless Heater

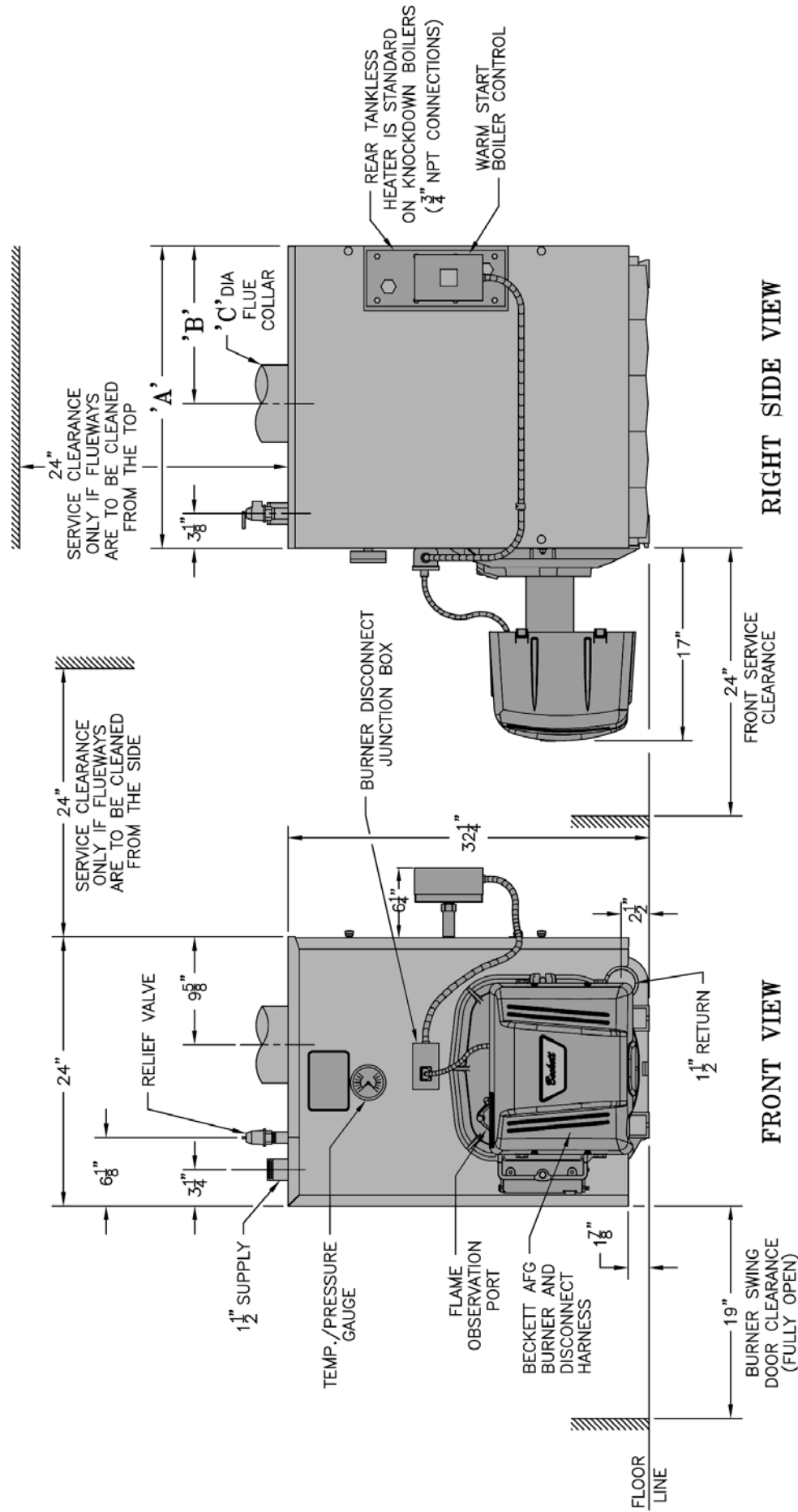
SECTION I: PRODUCT DESCRIPTION, SPECIFICATION AND DIMENSIONAL DATA (continued)



- NOTES:
1. WIRING HARNESES, RETURN PIPING AND CIRCULATOR NOT FURNISHED WITH KNOCKDOWN BOILERS.

Figure 1B: V8H3 thru V8H9 Water Boiler with Front Tankless Heater

SECTION I: PRODUCT DESCRIPTION, SPECIFICATION AND DIMENSIONAL DATA (continued)



NOTES:
 1. WIRING HARNESSES, RETURN PIPING AND CIRCULATOR NOT FURNISHED WITH KNOCKDOWN BOILERS.

Figure 1C: V8H3 thru V8H9 Water Boiler with Rear Tankless Heater

SECTION I: PRODUCT DESCRIPTION, SPECIFICATION AND DIMENSIONAL DATA (continued)

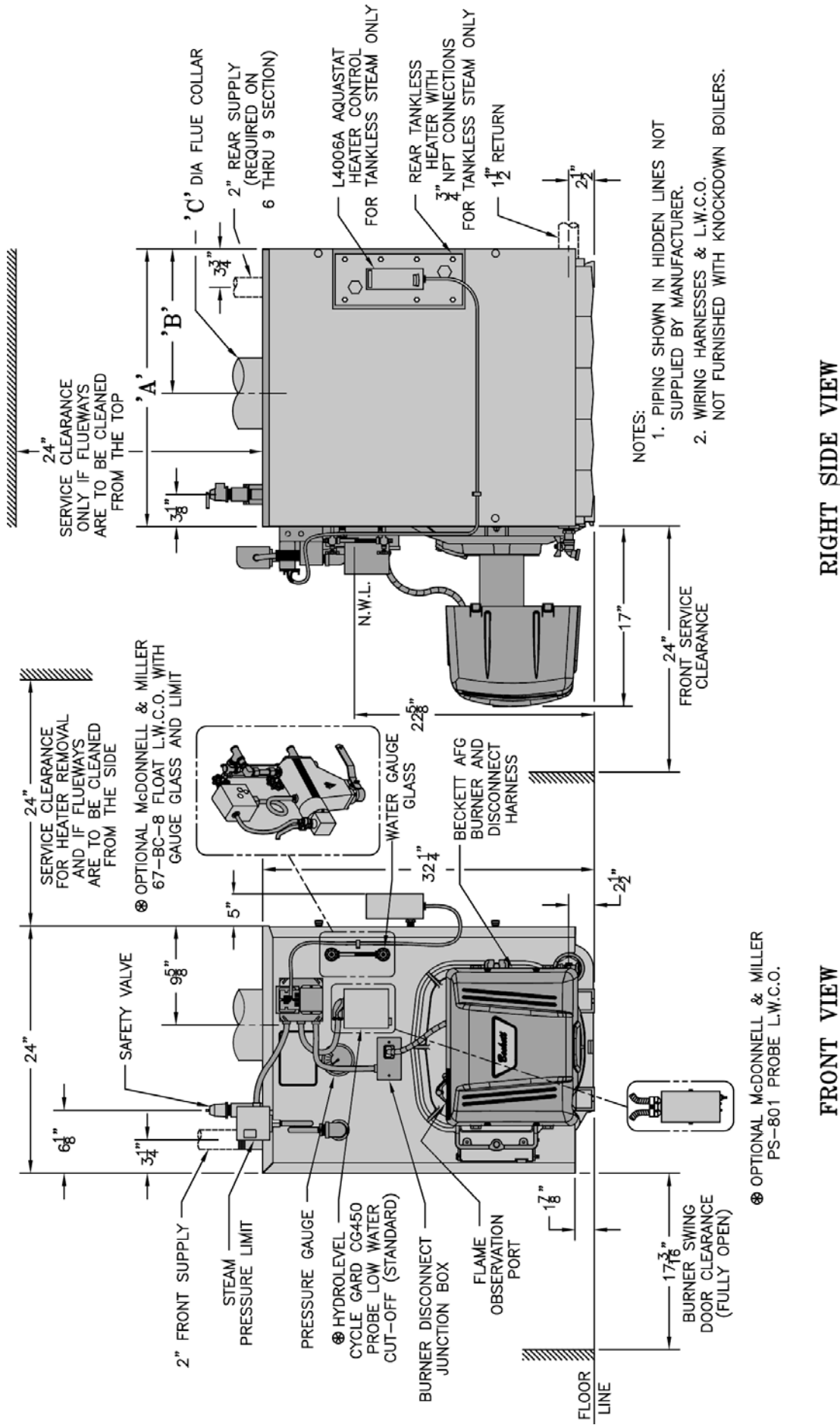


Figure 1D: V8H3 thru V8H9 Steam Boiler with or without Tankless Heater

SECTION 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 in front of final position before removing crate. See Figures 1A thru 1D.

1. LOCATE so that vent pipe connection to chimney will be short and direct.
2. BOILER IS SUITABLE FOR INSTALLATION ON COMBUSTIBLE FLOOR. 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.

4. PROVIDE SERVICE CLEARANCE of at least 24" clearance from front jacket panel for servicing and removal of front tankless heater (increase to 30" for #A54 heater). If boiler is equipped with a rear tankless heater, provide at least 24" service clearance on the right side of the boiler. Boiler flueways may be cleaned either from the top **or** from the right side. Provide at least 24" clearance from either the right side of the boiler **or** the top of the boiler for cleaning flueways.
5. For minimum clearances to combustibles 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.

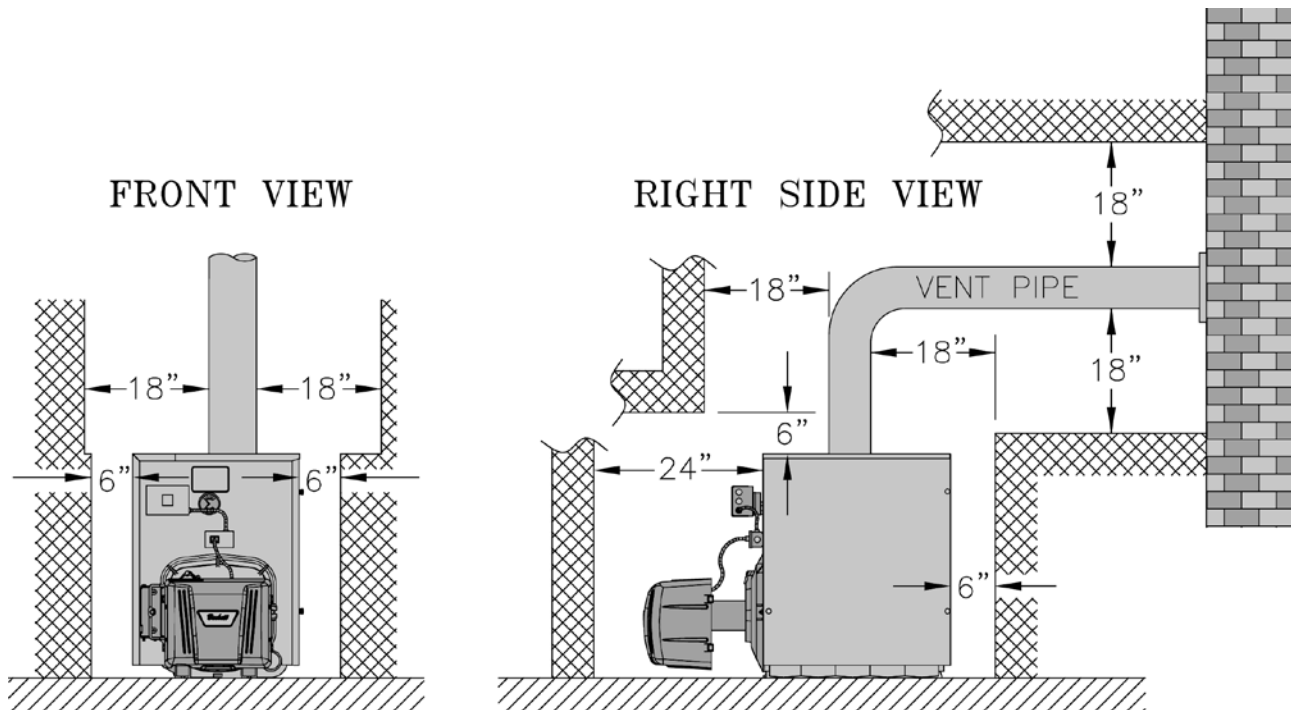


Figure 2: Minimum Installation Clearances To Combustible Materials (Inches)

NOTES:

1. Listed clearances comply with American National Standard ANSI/NFPA 31, Installation of Oil Burning Equipment.
2. V8H 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.

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

SECTION 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.
 - a. Outdoor air for combustion may be provided with an optional U.S. Boiler Company V8H™ Fresh Air Accessory Kit (**ONLY AVAILABLE ON BECKETT BURNERS WITH PLASTIC COVER APPLICATION, P/N 102119-01**). Refer to Fresh Air Accessory Kit Instructions for installation and air intake piping details.

or

- b. 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:
 - i. **Direct communication with outdoors.** Minimum free area of 1 square inch per 4,000 BTU per hour input of all equipment in space.
 - ii. **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.
 - iii. **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.

SECTION III: KNOCKDOWN BOILER ASSEMBLY

A. REMOVAL OF BARE BOILER FROM SKID

1. Boiler is secured to skid with 4 bolts, 2 in front and 2 in rear of shipping skid, see Figure 3. Remove all bolts.

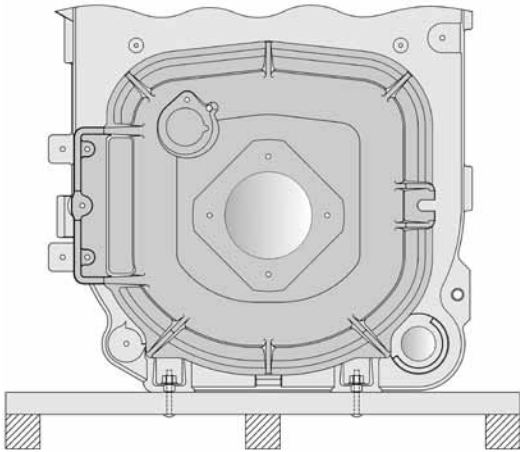


Figure 3: Knockdown Boiler Removal from Skid

2. Tilt boiler to right and to rear. Using right rear leg as pivot, rotate boiler 90° in a clockwise direction, and lower left side of boiler to floor. Tilt boiler and remove skid.

B. MOVE BOILER TO PERMANENT POSITION

by sliding or walking.

C. TEST BOILER FOR LEAKS before installing controls, trim, and jacket, and before connecting to heating system.

1. Loosen nuts on tie rods until only finger tight.
2. Install pressure gauge (at least 50 PSI capacity), a hose to the city water and a valve in the supply tapping. Plug remainder of tappings.
3. Fill boiler with water and apply a pressure of at least 10 PSI but no more than 50 PSI gauge pressure.

WARNING

Assure that there is not air left inside boiler when checking for leaks. **DO NOT** test for leaks with pressurized air.

4. Examine boiler carefully inside and outside for leaks or damage due to shipment or handling.

D. DRAIN WATER FROM BOILER. Remove gauge, valve and plugs from those tappings to be used. Leave other tappings plugged or bushed according to Figure 5.

E. INSPECT JOINTS BETWEEN SECTIONS. All joints are factory sealed. If there are any spaces due to shipment or handling, seal them with boiler putty.

F. INSPECT FLUE COVER PLATES for tightness. If loose, retighten mounting hardware. If flue plate or sealing rope is damaged, repair or replace as needed.

G. INSTALL AND SECURE CANOPY with gasket and hardware provided to ensure gas tight seal — see Figure 4.

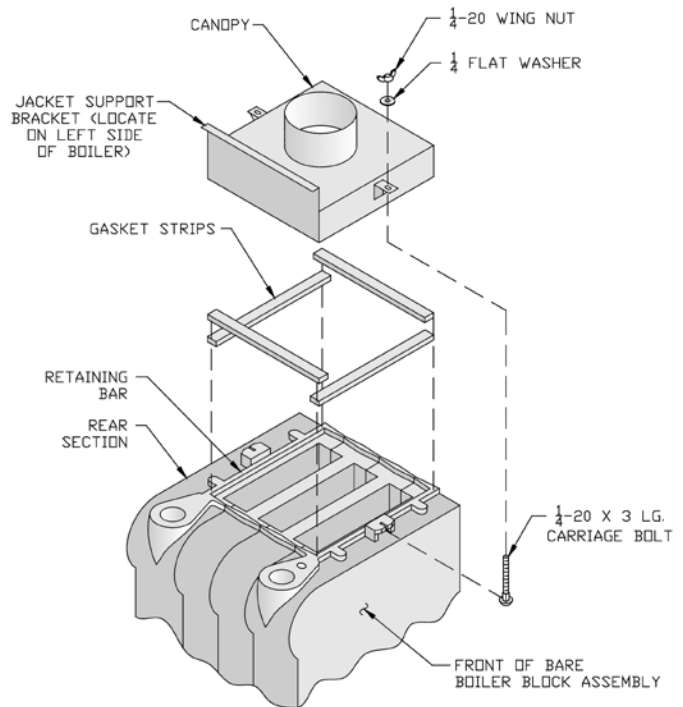


Figure 4: Boiler Canopy Installation

1. Cut two (2) strips 13 3/4" long from the roll of gasket insulation. Place one (1) strip across the top of the front section and the other across the rear section as shown in Figure 4.
2. Cut the remainder of the roll into two (2) equal pieces. Place each piece along the sides, allowing the ends to overlap the front and rear pieces.

CAUTION

DO NOT allow any flueway blockage by gasket.

3. Position canopy body within the retaining bar which borders the flueway openings on top of the bare boiler block assembly.

NOTICE

Jacket support bracket must be facing left side of boiler - see Figure 4. Jacket will not fit if bracket is not oriented correctly.

4. Secure canopy to boiler with two (2) 1/4" - 20 x 3" long carriage bolts, 1/4" flat washers and 1/4" - 20 wing nuts provided.

SECTION III: KNOCKDOWN BOILER ASSEMBLY (continued)

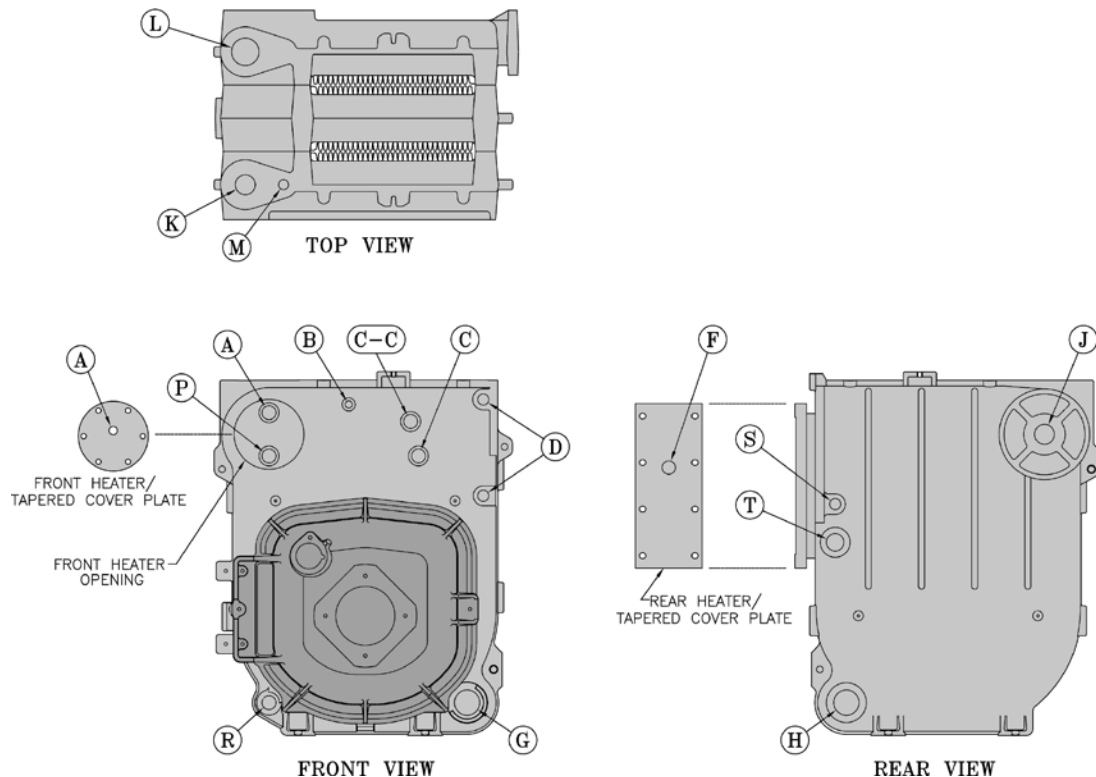


Figure 5: Boiler Tapping Locations and Usage (Knockdown Boilers Only)

PURPOSE OF TAPPINGS						
Tapping Location	Size NPT	Steam Boiler		Water Boiler		
		Non-Heater	w/Heater	Non-Heater	Front Heater	Rear Heater
A	¾"	Pressure Limit (Probe LWCO) Plugged (Float LWCO)		L7248 Boiler Control	L7224 Boiler Control	Flush Plug
B	¼"	Pressure Gauge		Temperature/Pressure Gauge		
C	¾"	Probe LWCO Std. Plugged (Float LWCO)		N/A		
C-C	¾"	Flush Plug	Flush Plug	N/A		
D	½"	Water Gauge Glass (Probe LWCO) Water Gauge Glass, Pressuretrol, and LWCO (Float)		N/A		
F	¾"	N/A	L4006A Operating Control	N/A	N/A	L7224 Boiler Control
G	1½"	Bushed to ¾" for Drain Valve (Optional Return)		Return		
H	1½"	Return		Plugged		
J	1½"	Surface Blowoff - Plugged		Flush Plug		
K	2"	Front Supply (3 thru 9 Section)		Front Supply (3 thru 9 Section)		
L	2"	Plugged, Optional Second Supply (3 thru 5 Section) Required Second Supply (6 thru 9 Section)		Plugged (3 thru 9 Section)		
M	¾"	Safety Valve		Relief Valve		
P	¾"	Auxiliary Tapping - Plugged		Aux. Tapping - Plugged	N/A	Aux. Tapping - Plugged
R	¾"	Aux. Tapping - Plugged (Indirect Return)	Aux. Tapping - Plugged (Indirect Return) *	Auxiliary Tapping - Plugged		
S	½"	Indirect Limit	Indirect Limit *	N/A		
T	1"	Indirect Supply	Indirect Supply *	N/A		

* In lieu of Tankless Heater

SECTION III: KNOCKDOWN BOILER ASSEMBLY (continued)

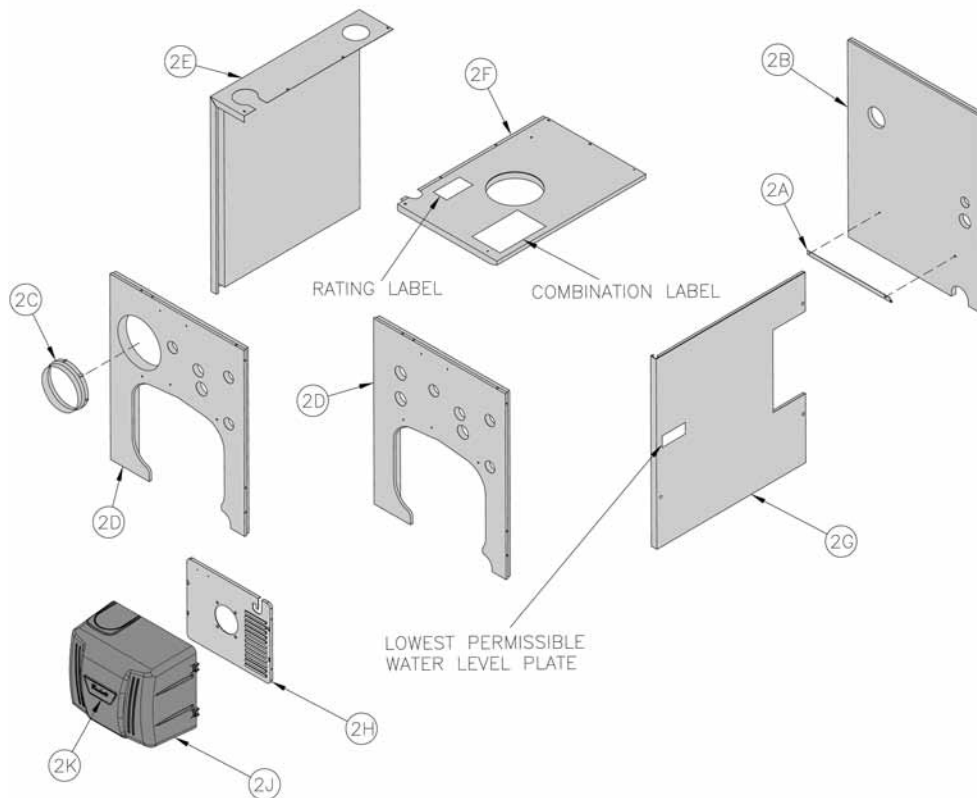


Figure 6: Knockdown Boiler Jacket Assembly

H. INSTALL TRIM. The following steam or water trim will be concealed or inaccessible after boiler jacket is installed, see Figure 5 for boiler tapping locations and usage.

1. **STEAM BOILER** — Top tappings:
 - a. Tapping "L" — Install 2" NPT plug in rear section top supply tapping on boiler sizes V8H3 thru V8H5, if only one supply riser is used.
 - b. Tapping "M" — Install 3/4" NPT coupling and 3/4" NPT x 8" long nipple into 3/4" NPT tapping located next to front section top supply tapping — all boiler sizes.

2. **WATER BOILER** — Top tappings:
 - a. Tapping "L" — Install 2" NPT plug in rear section top supply tapping — all boiler sizes.
 - b. Tapping "M" — Install 3/4" NPT x 8" long nipple into 3/4" NPT tapping located next to front section top supply tapping — all boiler sizes.

I. INSTALL BOILER JACKET. (See Figure 6).

1. Remove burner swing door and hinge assembly. Remove one (1) 5/16"-18 flange nut and washer from right side latching stud and one (1) 5/16"-18 x 3 1/2" cap screw on left side used for securing burner swing door to the boiler section. Swing door open and remove 5/16" hairpin cotter from rear hinge pin (see Figure 7). While holding swing door remove hinge pin and set door aside. Remove two (2) 5/16"-18 x 3/4" long cap screws securing the hinge bracket to the boiler section.

2. Install jacket rear panel support bracket. (See Figure 6, Item 2A). Align bracket with two (2) 5/16"-18 tapped holes in rear section and secure with two (2) 5/16"-18 x 1/2" long cap screws.
3. Install jacket rear panel. (See Figure 6, Item 2B). Align holes in jacket rear panel and support bracket. Secure with two (2) #8 x 1/2" long sheet metal screws.
4. **Jacket Front Panel**
 - a. Install black plastic collar extension to jacket front panels for 7-13/16" diameter tankless heater opening. (See Figure 6, Items 2C and 2D). Engage two (2) of the collar retaining tabs over raw edge of jacket opening. Provide support behind the panel with one hand while applying pressure on collar to snap each tab over edge of opening until all eight (8) tabs are securing collar.
 - b. Install jacket front panel. Locate two (2) 11/32" diameter holes, one round, one obround, on front panel approximately 16" up from the bottom of the panel. Align these holes with the similarly located 5/16"-18 tappings on the front section. Secure with two (2) 5/16"-18 x 1/2" long cap screws.
5. Install jacket left side panel. (See Figure 6, Item 2E). Fold panel at perforation keeping insulation inward. Align left side panel mounting holes with the front and rear panel holes. Secure with #8 x 1/2" long sheet metal screws.

SECTION III: KNOCKDOWN BOILER ASSEMBLY (continued)

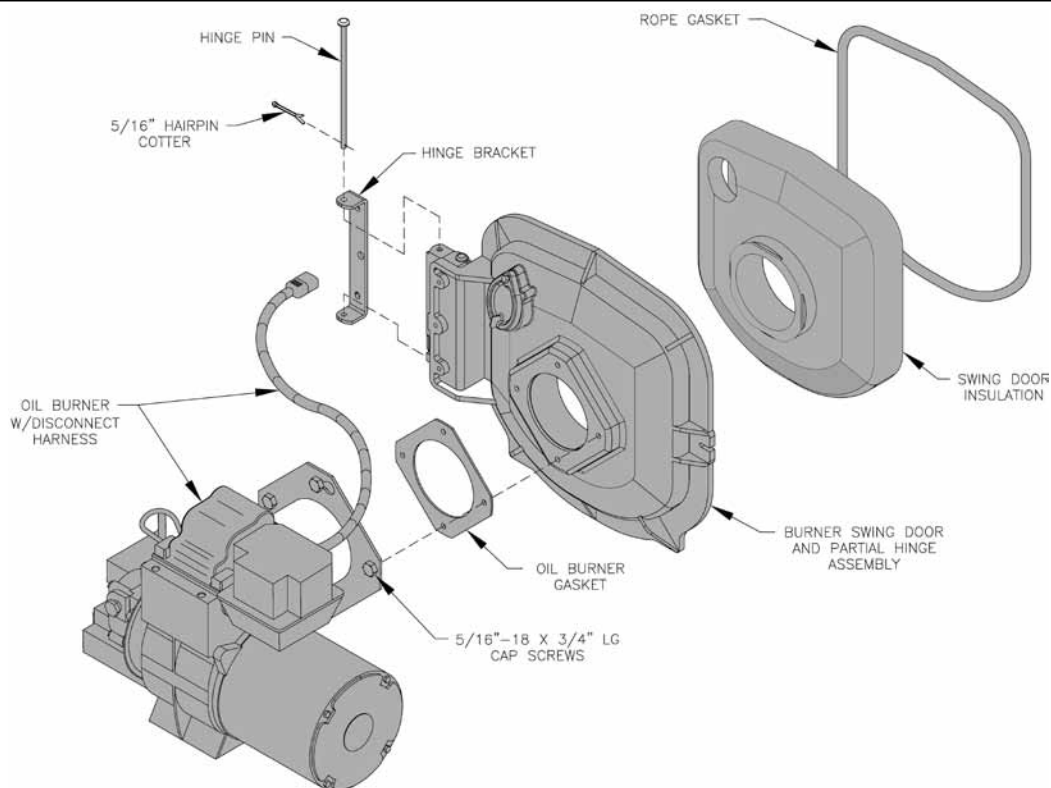


Figure 7: Oil Burner Installation (Beckett Burner Shown)

6. Install jacket top panel. (See Figure 6, Item 2F). Place jacket top panel on boiler and secure to front, rear and left side panels with #8 x 1/2" long sheet metal screws.
7. Install jacket right side access panel. (See Figure 6, Item 2G). Align right side panel mounting holes with front and rear panel holes. Secure with #8 x 1/2" long sheet metal screws.
8. Attach the labels shipped in the instruction envelope as follows:
 - a. Locate both the Rating Label and Combination Warning Label (P/N 101265-01). Remove paper backing from the labels and apply to the jacket top panel in approximate locations shown in (Figure 6, Item 2F).
 - b. On steam boilers only; locate Lowest Permissible Water Level Plate (Form No. 1204 shipped in Steam Trim Carton). Align plate with two 1/8" diameter holes located near the front edge; in line with the lower sight glass tapping, of the jacket right side access panel. Attach plate with two (2) #8 x 1/2" long sheet metal screws. (See Figure 6, Item 2G).

J. INSTALL BECKETT OIL BURNER.

(See Figure 7).

1. Check target wall and combustion chamber blanket. If any damage or movement occurred during shipment, replace as needed.

2. Locate burner swing door and hinge assembly removed in Paragraph I, No. 1. Check the burner swing door insulation and rope gasket for damage and adhesion. If damaged, replace insulation or gasket. If insulation or gasket is loose, reattach to swing door with RTV 732 or 736 silicone caulk.
3. Install burner swing door in reverse order from Paragraph I, No. 1.
4. Use the following procedure to properly close and secure the burner swing door after it has been removed and re-installed for Field Assembly (Knockdown Boiler) or opened for inspection, cleaning or field service (refer to Figures 13A and 13B):

Step 1. Lift the door up onto the built-in cast ramp/door rest (protruding from the bottom of the front section casting - see Figure 13A), while rotating the articulated hinge and door to the right and engaging the slot (on right side of door) onto the 5/16" stud protruding from the front section.

Step 2. Use one hand to help hold door in position by applying pressure directly to the door while re-installing the securing hardware with your opposite hand. **Always install right side latching hardware (5/16" flange nut and flat washer) first, then install left side hinge hardware (5/16" x 3-1/2" lg. hex head flange bolt) second.** Apply additional pressure while hand tightening the hardware as far as possible, then release the pressure.

SECTION III: KNOCKDOWN BOILER ASSEMBLY (continued)

NOTICE

When securing burner swing door make sure door is drawn-in equally on both sides.

Step 3. Use a hand wrench to tighten door hardware and **always start with the right side flange nut first** (see Figure 13B). Use an alternating tightening method from right side flange nut to left side flange bolt to tighten door equally until sealed without applying excessive torque.

Never tighten left side flange bolt first or tighten either piece of hardware 100% without using the alternating tightening method described above.

Failure to follow the prescribed procedure could cause thread damage to casting or a leak in the door seal. If left side flange bolt is tightened before right side flange nut, right side of door can **not** be drawn-in to provide an air tight seal, as shown in Figure 13C. Applying excessive torque will only cause thread damage.

5. Place oil burner gasket on burner and align holes.

CAUTION

DO NOT install burner without gasket.

6. Back out (4) 5/16"-18 x 3/4" long cap screws factory installed into burner swing door about 1/4". Insert oil burner into the opening of the burner door, rotate slightly clockwise to align burner mounting flange teardrop cutouts with cap screw hex heads and engage all four cap screws simultaneously. Then, rotate the burner slightly counterclockwise, level it and fully tighten all four cap screws.
7. Inspect electrodes, head setting and factory installed oil nozzle.

NOTICE

The burner for knockdown boilers has a pre-installed nozzle for steam applications. For water boiler applications, refer to Paragraph 8 in this Section for installation instructions to change nozzles.

- a. Remove burner cover.
- b. Loosen two (2) igniter latching screws, rotate tabs and swing open igniter about hinge.
- c. Loosen knurled nut and disconnect copper connector tube.
- d. Remove nozzle line electrode assembly.
- e. Remove Beckett MD(V1) or MB(L1) Head.
- f. Inspect and measure burner electrodes. Refer to Figure 29A for the proper electrode setting. Readjust electrode setting to the proper dimensions if necessary.

- g. Reinstall Beckett MD(V1) or MB(L1) Head.
 - h. Reinstall nozzle line electrode assembly.
 - i. Connect copper connector tube.
 - j. Inspect Beckett head setting on left side of burner by insuring the blue line MD(V1) or the line on the label MB(L1) are aligned, readjust if necessary.
 - k. Tighten knurled nut.
 - l. Swing igniter closed, rotate tabs and tighten two (2) igniter screws.
 - m. Replace burner cover and tighten burner cover knobs.
8. For water boiler applications, refer to Table 12 at the rear of this manual for proper nozzle and burner settings.
 - a. Remove nozzle for water application attached to copper connector tube.
 - b. Loosen two (2) igniter latching screws, rotate tabs and swing open igniter about hinge.
 - c. Loosen knurled nut and disconnect copper connector tube.
 - d. For V8H3, remove the Low fire Baffle.
 - e. Remove nozzle line electrode assembly.
 - f. Remove Beckett MD(V1) or MB(L1) Head.
 - g. Remove nozzle for steam application from nozzle adapter and install the water application nozzle provided in Step 8a above. Refer to Burner Specifications, Table 12 at the rear of this manual for proper nozzle and burner settings. The nozzle must be securely installed to assure leak free joints between the nozzle and adapter. When installing the nozzle, be careful not to bump or move the burner electrodes.
 - h. Inspect and measure burner electrodes. Refer to Figure 29A for the proper electrode setting. Readjust electrode setting to the proper dimensions if necessary.
 - i. Reinstall Beckett MD(V1) or MB(L1) Head.
 - j. Reinstall nozzle line electrode assembly.
 - k. Connect copper connector tube.
 - l. Inspect Beckett head setting on left side of burner by insuring the blue line MD(V1) or the line on the label MB(L1) are aligned, readjust if necessary.
 - m. Tighten knurled nut. Connect the flared fitting on the copper oil line to the nozzle line and tighten.
 - n. Swing igniter closed, rotate tabs and tighten two (2) igniter screws.

K. INSTALL CARLIN ELITE EZ OIL BURNER, 3 thru 6 Section (See Figure 7).

Follow instructions in Paragraph J, Steps 1 through 6.

SECTION III: KNOCKDOWN BOILER ASSEMBLY (continued)

7. Inspect oil nozzle, electrodes and head setting.
 - a. Installation/Removal of Drawer Assembly
 - i. Loosen screws, rotate latches and swing open the transformer.
 - ii. The combustion head assembly can be removed with the blower wheel access cover in place or removed. If the access cover is removed, the head assembly will not have to be rotated.

Disconnect the flared fitting to the oil line and remove the aluminum thumb-nut from the nozzle line. Remove the combustion head assembly from the air tube. Rotating the assembly upside down will ease removal.
 - iii. Loosen the clamp screw on the retention ring assembly and slide the retention ring off the adaptor.

Inspect the nozzle for size and type. See Burner Specifications, Table 12 at the rear of this manual.
 - iv. Replace the retention ring assembly, slipping one of the riveted arms through the 1/8-inch gap between the electrode tips. This arm should be straight up. Also, be sure that the retention ring clamp is tight against the shoulder on the adaptor. Then tighten the clamping screw.
 - v. Check the electrode settings specified as follows and shown in Figure 29B. 1/8-inch gap, 1/4 to 5/16-inch above the nozzle centerline, and flush to 1/16-inch ahead of the nozzle tip.
 - vi. Re-install the combustion head assembly holding it upside down while inserting into the housing. The flame retention ring end of the assembly must be lifted and guided through the throttle cone (a reduced diameter) in the end of the air tube. **DO NOT FORCE IT.**
 - vii. After attaching the proper positioning bar, refer to Paragraph 7b below, run the thumb-nut onto the nozzle line and tighten it lightly. Connect the flared fitting on the copper oil line to the nozzle line and tighten.
 - b. Combustion Head Positioning Bars
 - i. The Elite EZ-1HP and EZ-2HP burners are supplied with the proper positioning bar installed onto the housing that matches the input oil nozzle installed in the burner. Verify that the installed positioning bar matches the input oil nozzle installed in the burner, refer to Table 12 at the rear of this

manual.

In the case of the EZ-1HP, the proper head positioning bar is still matched by the size of the nozzle, not the input. For example, if nozzle size is 0.75 GPH, input @ 150 psi is approximately 0.90 GPH and the proper bar is 0.75 GPH.

- ii. Model EZ-1HP Positioning Bars: 0.50 GPH, 0.60-0.65 GPH, 0.75 GPH, 0.85-1.00 GPH, 1.10-1.25 GPH, 1.35-1.50 GPH, 1.65 GPH.
 - iii. Model EZ-2HP Positioning Bars: 1.50 GPH, 1.65-1.75 GPH, 2.00 GPH, 2.25 GPH.
- c. Initial Air Band Setting
 - i. The nozzle size in GPH INPUT is printed directly on the air band. Loosen the locking screw, move the air band until the pointer on the air shutter and housing lines up with the appropriate GPH INPUT. Tighten the locking screws.
 - ii. The Elite burners use calibrated air bands marked in nozzle sizes. Models EZ-1HP and EZ-2HP have air bands calibrated to deliver the proper amount of air for their specific pump pressure. The air bands on H.P. models are designed to be set by the rating stamped on the nozzle.
 - iii. The burner is now set at the approximate air band setting for the gallonage indicated. During final adjustment, using combustion testing equipment, the air band may need minor adjustment to achieve the desired efficiency.

L. INSTALL CARLIN 102CRD OIL BURNER, 7 thru 9 Section (See Figure 7).

Follow instructions in Paragraph J, Steps 1 through 6.

7. Inspect electrodes, head setting and factory installed oil nozzle.
 - a. Installation/Removal of Drawer Assembly
 - i. Loosen screws, rotate latches and swing open the transformer.

Disconnect the flared fitting to the oil line and remove the aluminum thumb-nut from the nozzle line. Remove the combustion head assembly from the air tube. Rotating the assembly upside down will ease removal. Inspect the nozzle for size and type, refer to Section XVII Burner Specifications, Table 12 at the rear of this manual.
 - ii. Check the electrode settings specified as follows and shown in Figure 29C. 1/8-inch gap, 1/4-inch above the nozzle centerline, and 3/16-inch ahead of the nozzle tip. **17**

SECTION III: KNOCKDOWN BOILER ASSEMBLY (continued)

- iii. Re-install the combustion head assembly into the air tube. It may be necessary to turn nozzle line assembly upside down to ease insertion into the air tube. Then the threaded adapter on the end of the nozzle line is passed through the opening in the left side of the housing.
 - iv. Run the aluminum (knurled) thumb-nut onto the nozzle line and tighten hand-tight.
 - v. Connect the flared fitting on the copper oil line to the nozzle line and tighten.
 - vi. Swing the transformer to the closed position, rotate latches and tighten screws.
- b. Combustion Head Setting/Adjustment
- i. Verify combustion head setting, refer to Table 12 at the rear of this manual. Read the scale embossed in the housing, which is calibrated in 1/16-inch divisions (dimension 'A') the position of the flame retention ring in relation to the air cone can be determined at a glance. Refer to Figure 7A.
 - ii. By moving the electrode and combustion head assembly forward or backward, the location of the flame retention ring relative to the throttle ring can be controlled. Refer to Figure 7A.
By loosening the locking screw and thumb-nut and turning the adjusting screw using a 5/32-inch allen wrench, the assembly can be moved to the required position.

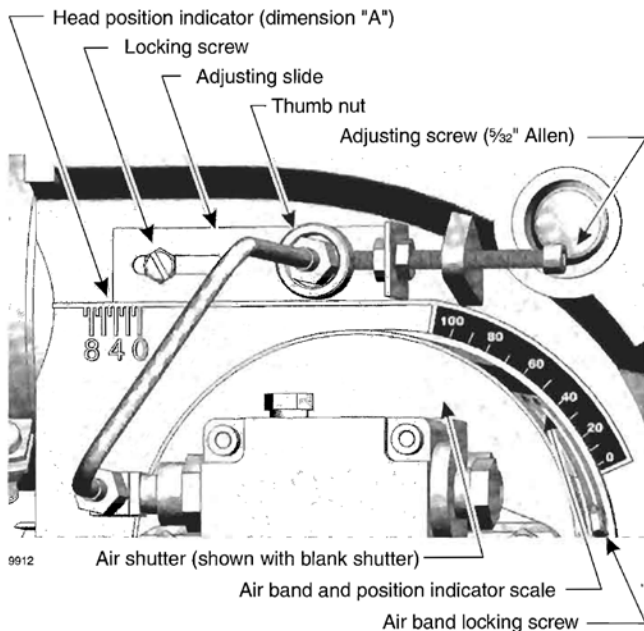


Figure 7A: Combustion Head Adjustment - 102CRD Burner

Turn the adjusting crew clockwise to move the combustion head forward, increasing the 'A' dimension, counterclockwise will pull the head back, decreasing the 'A' dimension. To lock in place, first tighten the thumb-nut and then the locking screw.

- c. Initial Air Shutter/Band Setting
- i. The air shutter has a pointer which indicated the percent of opening against a calibrated scale (9 = 90%, fully open = 100%). The setting is locked in place by a screw just above the fuel unit.
 - ii. The air band is adjusted by loosening the screw, rotating the air band and then tighten screw to lock in place after final adjustment. Refer to Table 12 at the rear of this manual for initial settings.
 - iii. The burner is now set at the approximate air band setting for the gallonage indicated. During final adjustment, using combustion testing equipment, the air band may need minor adjustment to achieve the desired efficiency.

M. INSTALL RIELLO OIL BURNER. (See Figure 7).

Follow instructions in Paragraph J, Steps 1 through 6.

7. Verify oil nozzle installed in burner, inspect electrodes and head setting.
- a. Installation/Removal of Drawer assembly, refer to Figure 7B.
- i. Removal:
 - Disconnect oil delivery tube nut from pump.
 - Loosen SCREW (3), and then unplug PRIMARY CONTROL (1) by carefully pulling it back and then up.

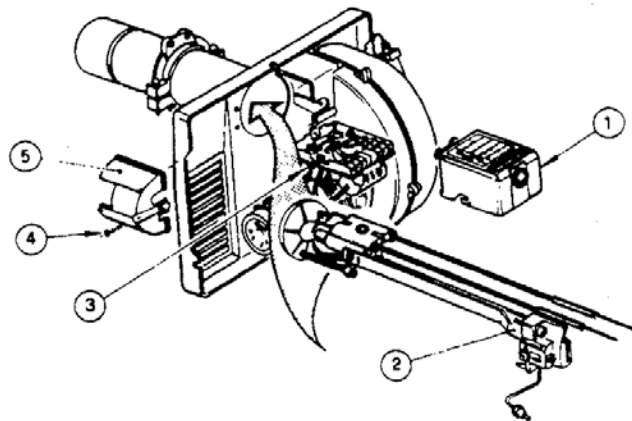


Figure 7B: Installation/Removal of Riello Drawer Assembly

SECTION III: KNOCKDOWN BOILER ASSEMBLY (continued)

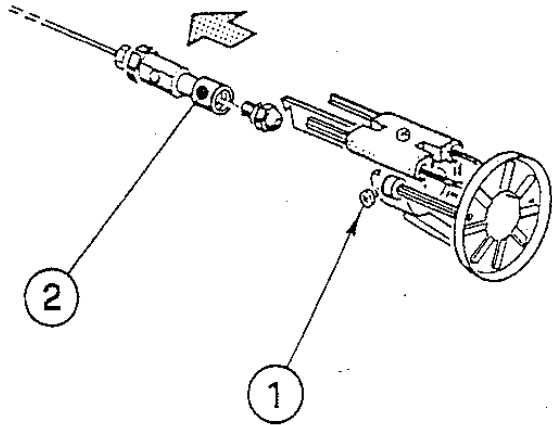


Figure 7C: Riello Nozzle Replacement

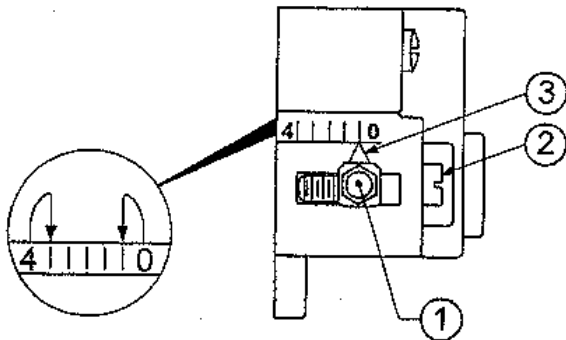


Figure 7D: Riello Turbulator Setting

- Remove the AIR TUBE COVER PLATE (5) by loosening the retaining SCREW (4) (Two SCREWS-Model F5).
 - Loosen SCREW (2), and then slide the complete drawer assembly out of the combustion head as shown.
- ii. Installation:
To insert drawer assembly, reverse the procedure in Step *i* above.
- b. Check factory installed oil nozzle for size and type. Refer to Burner Specifications, Table 12 at the rear of this manual for details.

If nozzle needs replacement, follow steps below
Also refer to Figure 7C.

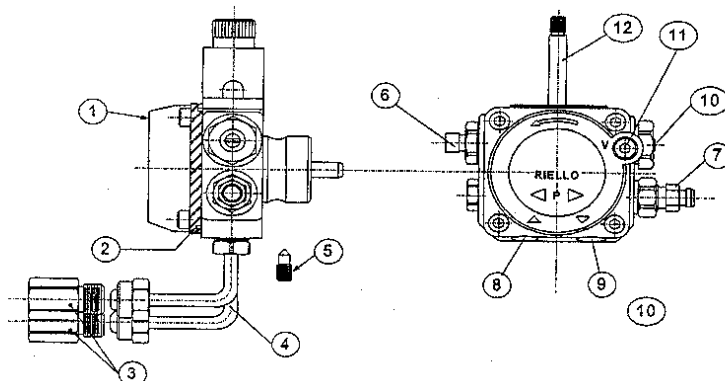
- i. Remove the nozzle adapter (2) from the drawer assembly by loosening the screw (1).
 - ii. Remove existing nozzle from nozzle adapter.
 - iii. Insert the proper nozzle into nozzle adapter and tighten securely (**DO NOT** over tighten).
 - iv. Replace adapter, with nozzle installed, into drawer assembly and secure with screw (1).
- c. Inspect and measure burner electrodes. Refer to Figure 29D for the proper electrode settings.
- d. Re-install Drawer Assembly into Combustion Head per Step 7a above.
- e. Insertion Depth, verify the distance between the tip of the end cone is equal to the distance specified in Table 12 at the rear of this manual.
- f. Turbulator Setting, refer to Figure 7D.
- i. Confirm the turbulator setting is correct for input oil nozzle installed in the burner, readjust, if needed, to index mark specified in Table 12 at the rear of this manual.
 - ii. Loosen nut (1) and turn screw (2) until the index marker (3) is aligned with the correct index number in the Burner Setup Chart (Table 12 at the rear of this manual).
 - iii. Retighten the retaining nut (1).

MODEL F5 (3 thru 5 Section): Zero and four are scale indicators only. From left to right the first line is 4 and the last line 0.

MODEL F10 (6 thru 9 Section): Same as above, except, scale indicators are 0 and 5.

- g.. Pump Connections and Port Identification, refer to Figure 7E.

This burner is shipped with the oil pump set to operate on a **single** line system. To operate on a **two-line** system the bypass plug must be installed.



PUMP LEGEND

1. PUMP COVER
2. PUMP COVER O-RING
3. BSPP TO NPT ADAPTERS
4. SUPPLY AND RETURN OIL LINES
5. RETURN PORT BY PASS SCREW
6. NOZZLE PORT - PUMP OULET TO NOZZLE
7. PUMP PRESSURE PORT AND BLEEDER PORT
8. PUMP SUPPLY PORT
9. PUMP RETURN PORT
10. PUMP PRESSURE REGULATING SCREW
11. VACUUM PORT
12. PUMP VALVE STEM

Figure 7E: Riello Pump Connections and Port Identification

SECTION III: KNOCKDOWN BOILER ASSEMBLY (continued)

WARNING: DO NOT operate a **single** line system with the by-pass plug installed. Operating a single line system with the by-pass plug installed will result in damage to the pump shaft seal.

NOTE: Pump pressure was factory pre-set but must be checked at time of burner start-up. A pressure gauge is attached to the PRESSURE/ BLEEDER PORT (7) for pressure readings. Two PIPE CONNECTORS (4) are supplied with the burner for connection to either a single or two-line system. Also supplied are two ADAPTORS (3), two female 1/4" NPT to adapt oil lines to burner pipe connectors. All pump port threads are **British Parallel Thread** design. Direct connection of NPT threads to the pump **will damage** the pump body.

Riello manometers and vacuum gauges **DO NOT** require any adapters, and can be safely connected to the pump ports. An NPT x metric adapter **must** be used when connecting other gauge models.

- g. Replace Burner Cover and Tighten Burner Cover Screws.

N. INSTALL TRIM AND CONTROLS WITH BECKETT BURNER, - Water Boilers Only (See Figures 1A, 1B, 1C and 5).

1. Thread combination pressure/temperature gauge into 1/4" NPT tapping. Tighten with wrench applied to the square shank of the gauge.

CAUTION

DO NOT apply pressure to the gauge case - this may result in inaccurate readings.

2. Lower front section tapping "G" is used for standard return on water boilers, see Figure 5. If circulator (supplied with boiler) is to be mounted in return piping connected directly to 1/2" NPT boiler return tapping "G", use the piping arrangements outlined in steps a. thru e. as follows: (see Figures 15A and 15B)
 - a. Thread 1 1/2" NPT x 3" long nipple and 1 1/2" NPT x 90° elbow with 3/4" NPT side outlet into the return tapping and tighten with a pipe wrench.
 - b. Screw drain valve into 3/4" NPT side outlet of the 1 1/2" NPT x 90° elbow.
 - c. Thread 1 1/2" NPT x 18" long nipple (supplied by others) into the 1 1/2" NPT x 90° elbow and tighten with a pipe wrench.
 - d. Thread one of the circulator flange onto the nipple and tighten with a pipe wrench. Position flange so that the bolt slots are parallel to the boiler front.

- e. Place a circular flange gasket in the flange groove on the circulator and mount the circulator on the flange. Note that this is the return piping and the flow arrow on the circulator should point down ↓. Fasten circulator with 7/16" - 14 x 1 1/2" long cap screws and 7/16" - 14 nuts.
 - f. Fasten the second circulator flange and gasket to the circulator.
 - g. Remove supplied circulator harness from Part Bag. Remove circulator junction box cover and knockout in circulator junction box flange. Insert harness end with two wires having bare-stripped ends through knockout hole and push-in to engage harness connector into flange. Connect harness conductors to circulator junction box wires as follows - White to White and Blue to Yellow (or, Blue) and secure with wire nuts (installer provided).
3. Install relief valve, as shown in Figure 1A, 1B, and 1C, onto 3/4" NPT x 8" nipple previously installed in Paragraph H, No. 2, step b. Tighten with wrench. Pipe discharge as shown in Figures 15A and 15B. Installation of the relief valve must be consistent with ANSI/ASME Boiler and Pressure Vessel Code, Section IV.

WARNING

Safety 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.

4. On boilers without a heater opening, install the well into the 3/4" NPT tapping "A" located on the front of the boiler in the upper left corner. See Figures 1A and 5. Tighten the well 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 8. Secure control to immersion well with setscrew.

WARNING

Aquastat bulb must be fully inserted into the well.

5. On boilers with a heater opening, install the well in either the 1/2" NPT or 3/4" NPT tapping on the tankless heater plate or cover plate. See Figures 1B, 1C and 5. Tighten the well and fully insert limit sensor into immersion well such that the tip on the limit sensor probe touches the bottom of the immersion well. See Figure 8. Secure control to immersion well with setscrew.

SECTION III: KNOCKDOWN BOILER ASSEMBLY (continued)

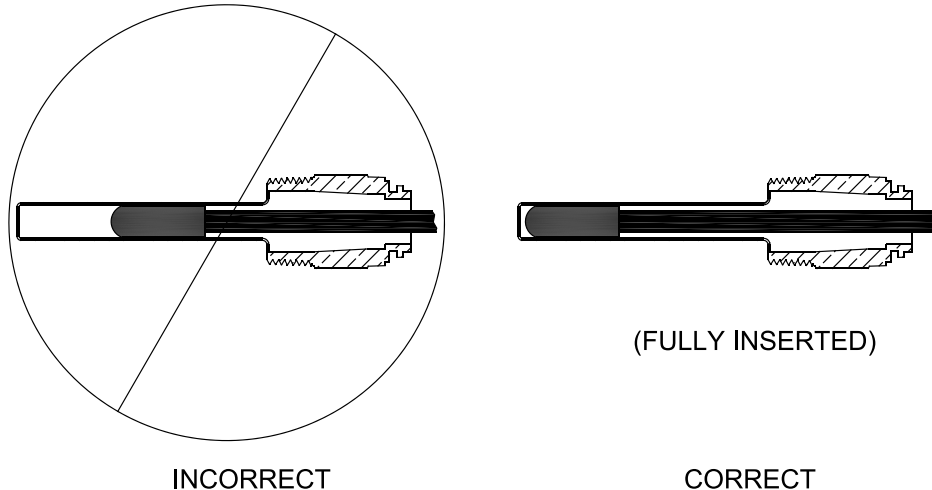


Figure 8: Limit Sensor Insertion

6. After control is installed and secured, remove control cover. Then, remove knockout located directly above factory connected limit harness on right side flange of control. Insert circulator harness end with attached fork terminals thru knockout hole and push-in to engage harness connector into flange. Connect wires to control terminals as follows - Blue to C1 and White to C2 and tighten securely. Re-install control cover.
7. Connect Field Wiring.
 - a. Water boilers without tankless heater. Connect the field wiring to the aquastat control. Make the wiring connections as shown on Figure 21A.
 - b. Water boilers with front or rear tankless heater. Connect the field wiring to the aquastat control. Make the wiring connections as shown on Figure 21B.
 - c. Refer to Paragraph R for details on use of burner disconnect junction box provided with all knockdown boiler builds.

O. INSTALL TRIM AND CONTROLS WITH BECKETT BURNER. - Steam Boiler Only
(see Figures 1D & 5).

1. Thread the pressure gauge into the 1/4" NPT tapping "B", of the front section. Tighten with wrench applied to the square shank of the gauge.

CAUTION

DO NOT apply pressure to the gauge case - this may result in inaccurate readings.

2. Thread 1 1/2" NPT x 3/4" NPT bushing and a 3/4" NPT drain valve into the 1 1/2" NPT tapping located in the lower right corner of the front section. Tighten with wrench.

NOTICE

Lower rear section Tapping "H" is used for standard condensate return on steam boilers.

3. Thread safety valve, as shown in Figure 1D, into 3/4" NPT coupling and 3/4" NPT x 8" nipple previously installed in Paragraph H, No. 1, step b. Tighten with wrench. Pipe discharge as shown in Figure 16. Installation of the safety (relief) valve must be consistent with ANSI/ASME Boiler and Pressure Vessel Code, Section IV.

WARNING

Safety 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.

4. Install probe type Low Water Cut-Off (LWCO) if so equipped.
 - a. Thread probe into 3/4" NPT tapping "C" located on the front section, down and to the right of the pressure gauge. Slip the low water cut-off (LWCO) control over the probe and clamp in place. Connect the wire(s) between the probe and control per the manufacturer's instructions.

WARNING

Read the manufacturer's instructions packed with the probe LWCO for proper pipe dope application. DO NOT use Teflon tape on probe threads. Use of teflon can render the probe LWCO inoperational.

- b. Install the gauge glass using the two 1/2" NPT tappings to the right of the probe LWCO.

SECTION III: KNOCKDOWN BOILER ASSEMBLY (continued)

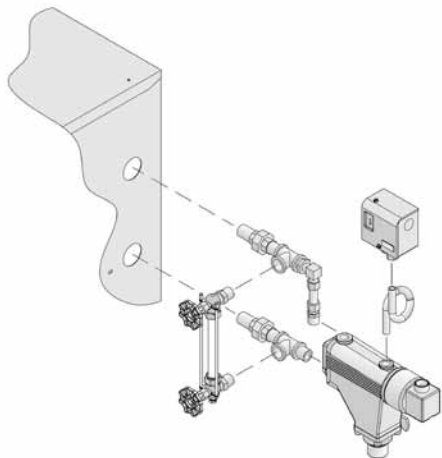


Figure 9: Float-Type Low Water Cut-Off and Pressure Limit Installation

5. Install float-type LWCO, if so equipped.
See Figures 5 and 9.
 - a. Install nipples and unions in "D" Tappings.
 - b. Mount hardware to low water cut-off body. Install assembly.
 - c. Install water gage glass on low water cut-off assembly's tee fittings.
6. Install Pressure Limit Control.
 - a. Float LWCO only: Remove 1/4" NPT plug from top of Low Water Cut-Off. Install Syphon and Limit into this tapping. See Figure 9.
 - b. Probe LWCO only: Install Limit in Tapping "A" using 3/4" NPT x 3" long nipple, 3/4" NPT elbow, 3/4" NPT x 1/4" NPT bushing, and syphon. See Figures 5 and 10.
 - c. **DO NOT** tighten the limit by holding the case; apply a wrench to the brass hex below the case.
 - d. An L404F pressure limit does not require leveling.
7. Connect the field wiring to the LWCO or the R8239A Control Center/J-box, or burner disconnect J-box.
 - a. If equipped with tankless heater, connect field wiring from the aquastat control to the R8239A Control Center transformer terminals or oil burner primary control's "T-T" terminals. Make the wiring connections as shown in appropriate wiring diagram, refer to Figure 22, 23A, 23B, 24A or 24B.

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" terminals.

Also refer to Section XI, Paragraph I, Item 2, "Verify Oil Primary Control" for more details.

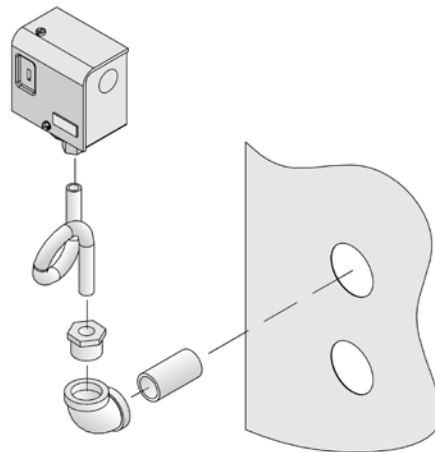


Figure 10: Pressure Limit Installation for Probe LWCO Equipped Boilers

- b. Refer to Paragraph R for details on use of burner disconnect junction box provided with all knockdown boiler builds.

P. INSTALL TRIM AND CONTROLS WITH CARLIN BURNERS.

Water boilers Only (see Figures 1A, 1B, 1C and 5).

Follow instructions in Paragraph N, Steps 1 through 7.

Steam Boilers Only (see Figures 1D and 5).

Follow instructions in Paragraph O, Steps 1 through 6.

7. Connect Field Wiring

- a. Steam Boiler with Hydrolevel CG450 LWCO, Carlin Burner.
Connect the field wiring to the R8239A Control Center. If equipped with tankless heater, connect field wiring from the aquastat control to the R8239A Control Center's "R-G" terminals. Make the wiring connections as shown in Figure 22.
- b. Steam Boiler with McDonnell & Miller PS-801 or McDonnell & Miller 67 LWCO, Carlin Burner.
Connect the field wiring to the LWCO or the burner disconnect J-box. If equipped with tankless heater, connect field wiring from the aquastat control to the oil burner primary control's "T-T" Terminals. Make the wiring connections as shown in appropriate wiring diagram, refer to Figure 23A, 23B, 24A or 24B.

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" terminals.

Also refer to Section XI, Paragraph I, Item 2, "Verify Oil Primary Control" for more details.

SECTION III: KNOCKDOWN BOILER ASSEMBLY (continued)

- c. Refer to Paragraph R for details on use of burner disconnect junction box provided with all knockdown boiler builds.

Q. INSTALL TRIM AND CONTROLS WITH RIELLO BURNER.

Water Boilers Only (see Figures 1A, 1B, 1C and 5).

Follow instructions in Paragraph N, Steps 1 through 7.

Steam Boilers Only (see Figures 1D and 5).

Follow instructions in Paragraph O, Steps 1 through 6.

7. Connect Field Wiring

- a. Steam boiler with Hydrolevel CG450, McDonnell & Miller PS-801 or McDonnell & Miller 67 LWCO, Riello Burner.

Connect the field wiring to the R8239A Control Center. If equipped with tankless heater, connect field wiring from the aquastat control to the R8239A Control Center's "R-G" terminals.

Make the wiring connections as shown in appropriate wiring diagram, refer to Figure 22, 23A, 23B, 24A or 24B.

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" terminals.

Also refer to Section XI, Paragraph I, Item 2, "Verify Oil Primary Control" for more details.

- b. Refer to Paragraph R for details on use of burner disconnect junction box provided with all knockdown boiler builds.

R. BURNERS SUPPLIED BY U.S. BOILER COMPANY utilize a burner disconnect harness that is pre-wired into the burner junction box and primary control. Packed in the canopy carton is the mating burner disconnect junction assembly and mounting hardware for use with these burners.

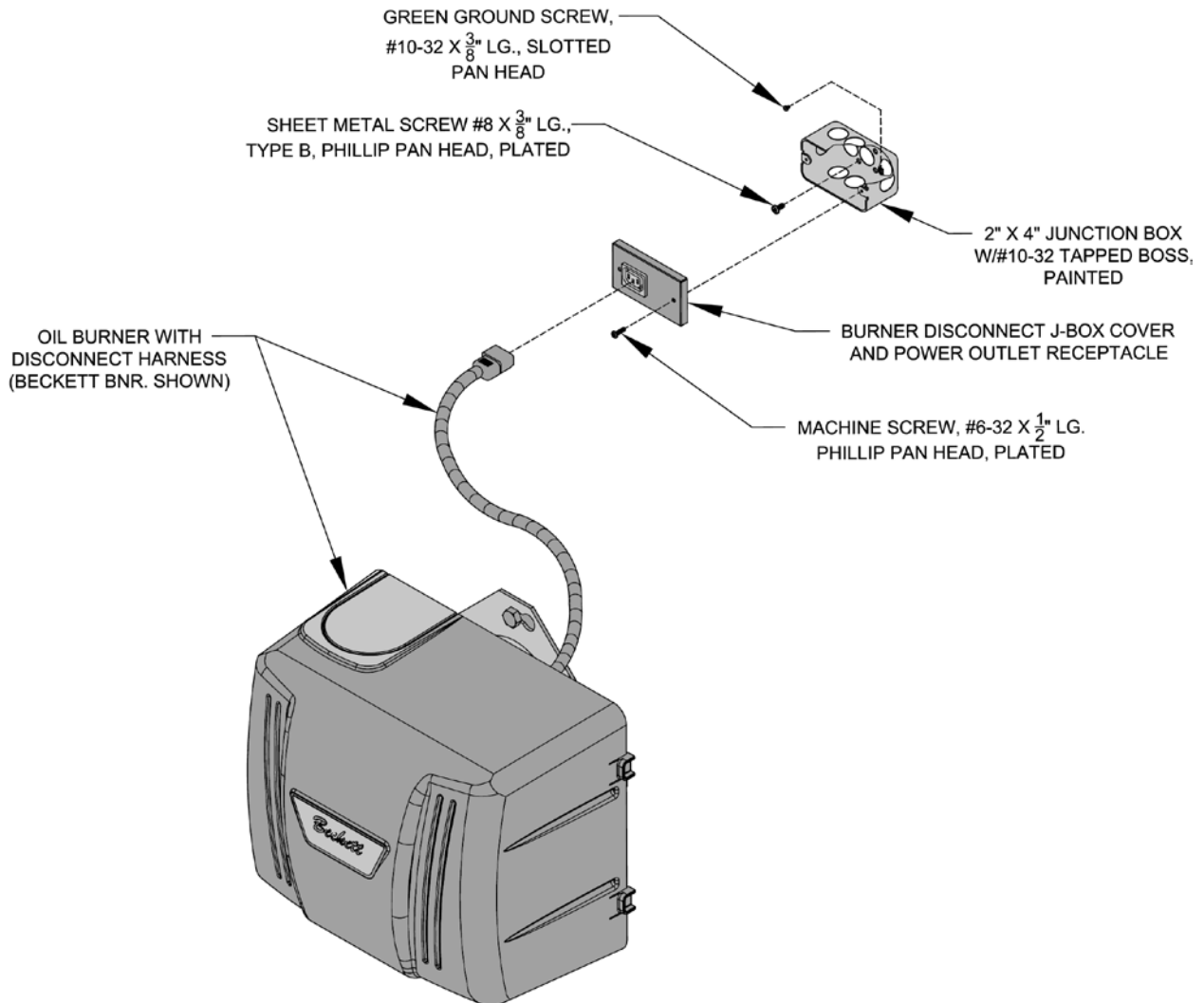


Figure 11: Burner Disconnect Junction Box with Power Outlet Receptacle (Mated to Burners with Disconnect Harness)

SECTION III: KNOCKDOWN BOILER ASSEMBLY (continued)

If you are using a burner with the disconnect harness, complete the following assembly instructions for mounting the mating burner disconnect junction box, see Figure 11.

1. Remove (2) #6 x 1/2" lg. machine screws and J-box cover from junction box.
2. Secure 2" x 4" junction box to jacket front panel with (2) #8 x 3/8" lg. sheet metal screws using pre-punched holes below tridicator or pressure gauge tapping.
3. Complete the field wiring phase of Paragraphs N & O (Beckett), P (Carlin) or Q (Riello) Install end of harness from low water cut-off (LWCO), R8239A Control Center or Boiler Control into appropriate knockout of burner disconnect junction box

according to source, refer to Figures 1A thru 1D.

4. Connect (3) wires from boiler control LWCO or R8239A Control Center to spade terminals on rear of power outlet receptacle. Make the connections as shown in appropriate wiring diagram based on boiler configuration, refer to Figures 21A thru 25.
5. Secure J-box cover to junction box with (2) #6 x 1/2" lg. machine screws.
6. Insert mating end of burner disconnect harness (power cord) into power outlet receptacle on J-box.

SECTION IV: PACKAGED BOILER ASSEMBLY

A. REMOVE CRATE.

1. Remove all fasteners at crate skid.
2. Lift outside container and remove all other inside protective spacers and bracing. Remove draft regulator box and miscellaneous trim bag containing safety or relief valve, and pipe fittings.

B. REMOVE BOILER FROM SKID.

1. Boiler is secured to base with 4 bolts, 2 in front and 2 in rear of shipping skid, see Figure 12. Remove all bolts.
2. Tilt boiler to right and to rear. Using right rear leg as pivot, rotate boiler 90° in a clockwise direction, and lower left side of boiler to floor. Tilt boiler and remove crate skid. Care should be exercised to prevent damage to jacket or burner.

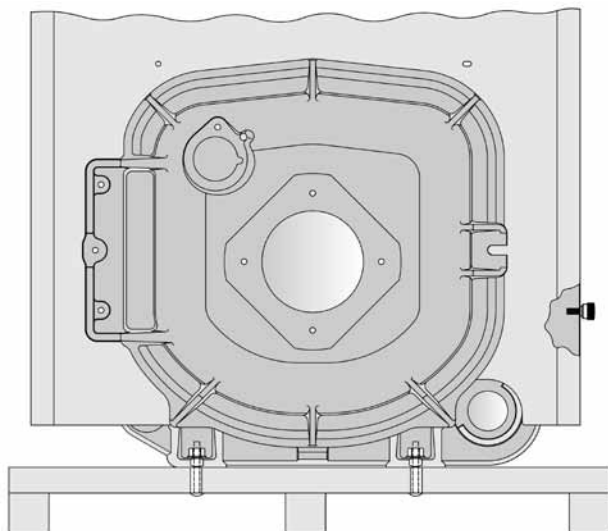


Figure 12 : Packaged Boiler Removal from Skid

CAUTION

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

C. MOVE BOILER TO PERMANENT POSITION

by sliding or walking.

D. PROCEDURE TO OPEN, CLOSE AND SECURE BURNER SWING DOOR

with articulated hinge.

Throughout this manual you will be instructed to open and close the burner swing door for various reasons. There is a proper and improper method to closing and securing the burner swing door after it has been removed and re-installed for Field Assembly (Knockdown Boiler) or opened for inspection, cleaning or field service.

1. **TO OPEN BURNER SWING DOOR** (see Figures 13A and 13B).

Step 1. Loosen and remove right side latching hardware (5/16" flange nut and washer).

Step 2. Loosen and remove left side hinge hardware (5/16" x 3-1/2" lg. hex head flange bolt).

Step 3. The duel pivot articulated hinge allows right side of door to be pulled outward and rotated to the left all in one motion. To do so, place your right hand under burner air tube and lift up slightly to help carry the weight of the door and burner. Use your left hand to grasp the door's left side hinge flange, pull outward to rotate the hinge, this motion will move the door outward and to the left approximately 3" (see Figure 13B, Position 2).

SECTION IV: PACKAGED BOILER ASSEMBLY (continued)

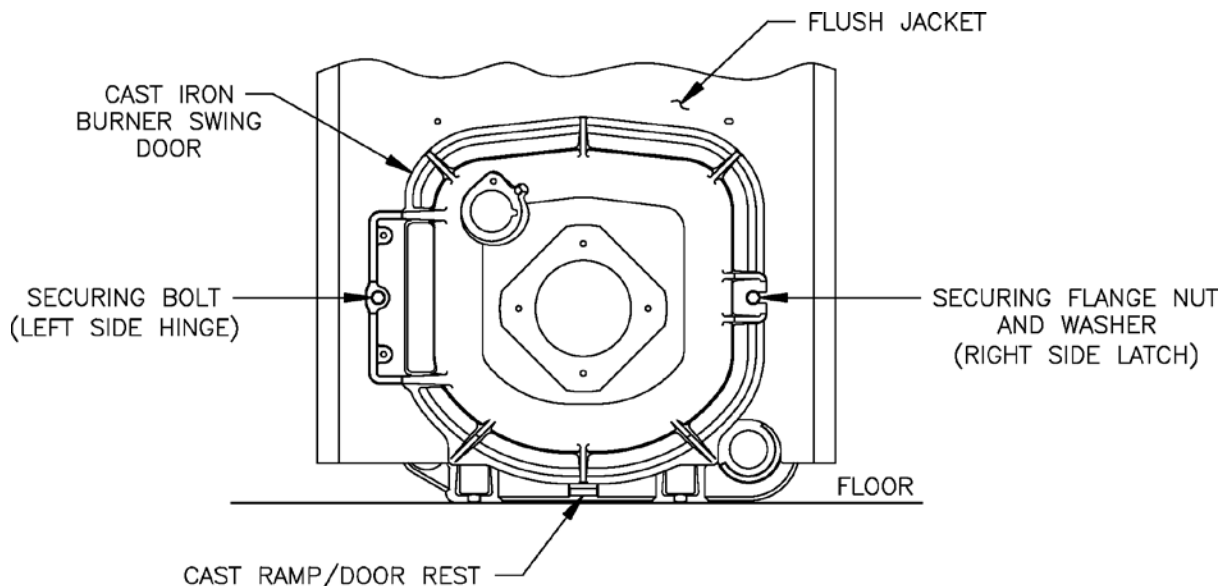


Figure 13A: Partial Front View - Burner Swing Door Mounted to Boiler - Fully Closed and Secured

- Step 4.** From this position the door can be swung clear of the vertical circulator return piping to provide full access to the combustion chamber and burner head (see Figure 13B, Position 3).
2. Perform routine inspection, service or cleaning as necessary.
 3. To close Burner Swing Door (see Figures 13A and 13B):
Step 1. From the fully open position, rotate Burner Swing Door toward the closed position. Make sure that the articulated hinge is rotated to the extreme left position to allow the door to clear the vertical circulator return piping as shown in Figure 13B, Position 2.
Step 2. Grasp the door's left side hinge flange in your left hand and place your right hand under the burner air tube to lift upward. Lift the door up onto the built-in cast ramp/door rest (protruding from the bottom of the front section casting - see Figure 13A), while rotating the articulated hinge and door to the right and engaging the slot (on right side of door) unto the 5/16" stud protruding from the front section.
Step 3. Use one hand to help hold door in position by lifting up on rear burner housing or applying pressure directly to the door while re-installing the securing hardware with your opposite hand. **Always install right side latching hardware (5/16" flange nut and flat washer) first**, then install left side hinge hardware (5/16" x 3-1/2" lg. hex head flange bolt) second. Apply additional pressure while hand tightening the hardware as far as possible, then release the pressure.

NOTICE

When securing burner swing door make sure door is drawn-in equally on both sides.

- Step 4.** Use a hand wrench to tighten door hardware and **always start with the right side flange nut first.** Use an alternating tightening method from right side flange nut to left side flange bolt to tighten door equally until sealed without applying excessive torque. **Never** tighten left side flange bolt first or tighten either piece of hardware 100% without using the alternating tightening method described above.
- Failure to follow the prescribed procedure could cause thread damage to casting or a leak in the door seal. If left side flange bolt is tightened before right side flange nut, right side of door can **not** be drawn-in to provide an air tight seal, as shown in Figure 13C. Applying excessive torque will only cause thread damage.

E. INSPECT COMBUSTION CHAMBER TARGET WALL AND LINER, AND SWING DOOR GASKET.

1. Open burner swing door using procedure previously outlined in Paragraph D of this section.
2. Using a flashlight, inspect the rear target wall and liner. The target wall should be rigidly secured to the rear boiler section. The combustion chamber liner should be evenly distributed in the boiler chamber. If either is damaged, they must be replaced.

SECTION IV: PACKAGED BOILER ASSEMBLY (continued)

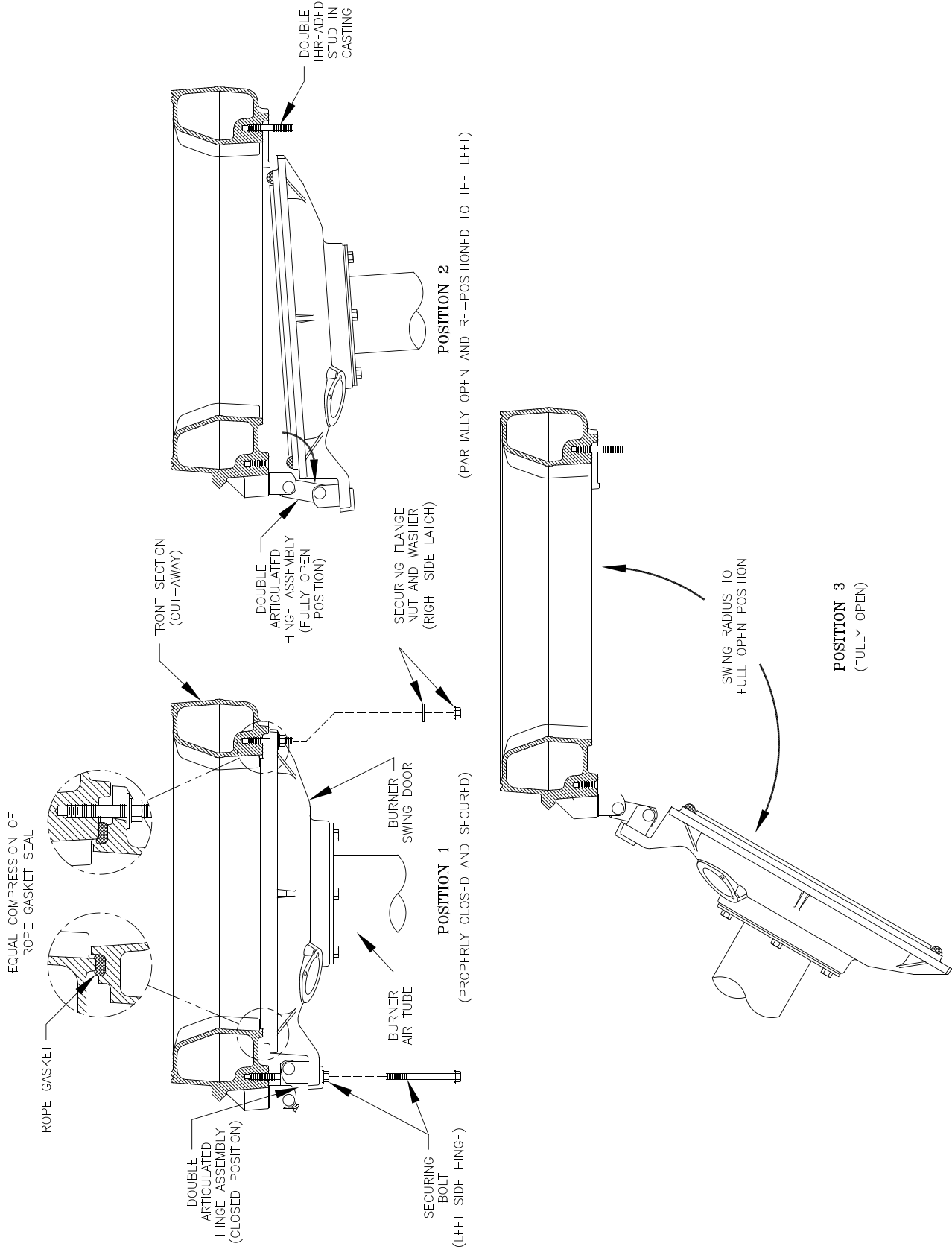


Figure 13B: Top View - Burner Swing Door Mounted to Cast Iron Block Assembly (Jacket Removed for Clarity)

SECTION IV: PACKAGED BOILER ASSEMBLY (continued)

3. Inspect ceramic rope located on the swing door. The rope must be evenly distributed around the perimeter of the door groove and cannot bunch or overhang. There must not be a gap where the two ends of the rope meet. Repair or replace if the rope is damaged or if there is a gap between the ends.

F. INSTALL BECKETT OIL BURNER. Refer to Section III, Paragraph J for burner installation instructions.

NOTICE

The burner for packaged boilers has a pre-installed nozzle for steam applications. For water boiler applications, refer to Section III, Paragraph J, No. 8, steps 'a' through 'm' for nozzle installation, electrode and head setting inspection.

G. INSTALL CARLIN ELITE EZ OIL BURNER, 2 THRU 6 SECTION. Refer to Section III, Paragraph K for installation instructions.

H. INSTALL CARLIN 102CRD OIL BURNER, 7 THRU 9 SECTION. Refer to Section III, Paragraph L for installation instructions.

I. INSTALL RIELLO OIL BURNER. Refer to Section III, Paragraph M for installation instructions.

J. INSTALL SAFETY OR RELIEF VALVE IN TAPPING "M", see Figure 5.

Use $\frac{3}{4}$ " NPT x 8" nipple and/or $\frac{3}{4}$ " NPT coupling included in trim bag. Safety or Relief Valve must

be installed with spindle in vertical position. Pipe discharge as shown in Figures 15A and 15B. Installation of the safety or relief valve must be consistent with ANSI/ASME Boiler and Pressure Vessel Code, Section IV.

WARNING

Safety 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.

K. PACKAGED STEAM BOILERS WITH PROBE STYLE LWCO. Install Limit in Tapping "A" using $\frac{3}{4}$ " NPT x 2" nipple, $\frac{3}{4}$ " NPT elbow, $\frac{3}{4}$ " NPT x $\frac{1}{4}$ " NPT bushing, and syphon included in trim bag. See Figures 5 and 10.

1. **DO NOT** tighten the limit by holding the case; apply a wrench to the brass hex below the case.
2. Connect wiring harness from Low Water Cut-Off to steam pressure limit.
3. An L404F pressure limit does not require leveling.

L. PACKAGED WATER BOILERS WITH CIRCULATORS. If your boiler build comes with factory supplied circulator and circulator is to be mounted in return piping connected directly to $\frac{1}{2}$ " boiler return tapping "G", use piping and wiring arrangements outlined in Section III: Knockdown Boiler Assembly, Paragraph N, Step 2.

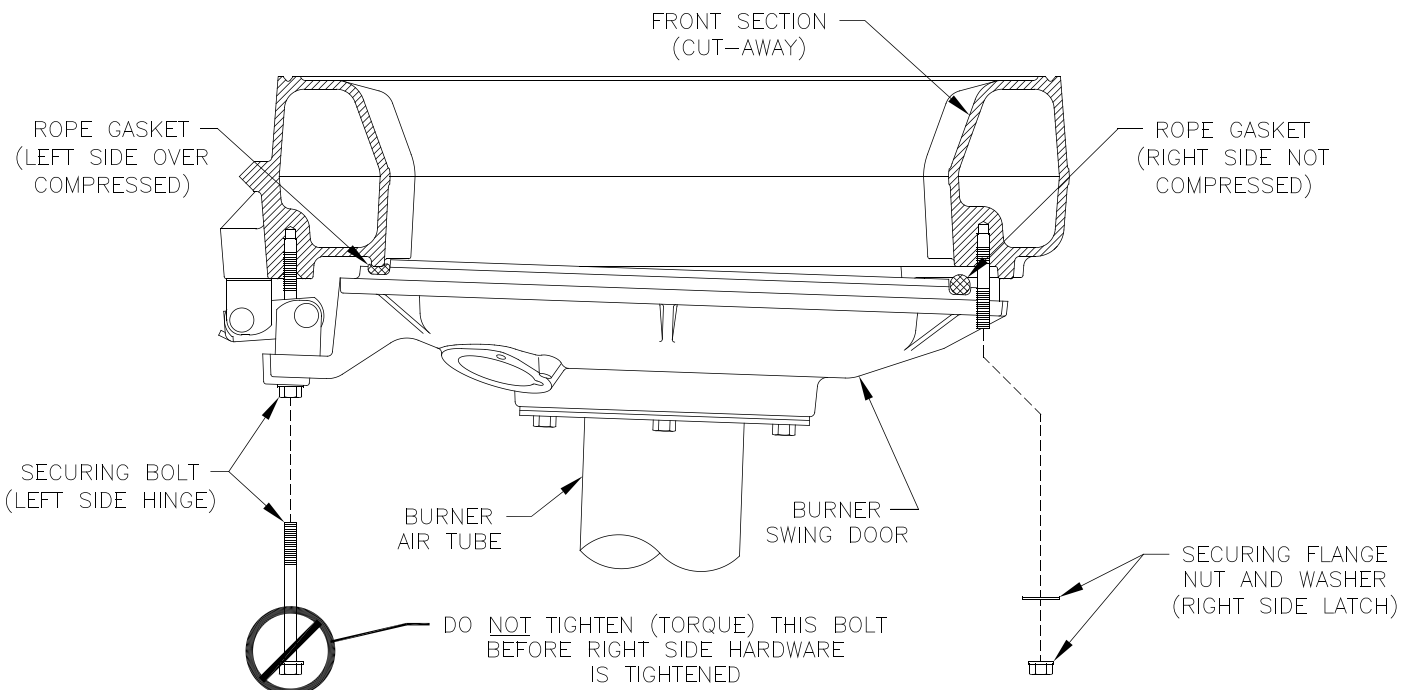


Figure 13C: Top View - Burner Swing Door Fully Closed but Not Properly Secured or Sealed

SECTION V: WATER BOILER PIPING AND TRIM

NOTICE

Failure to pipe boiler as specified in this manual may result in excessive system noise, water line fluctuations and water carry over.

A. EVALUATE THE EXISTING WATER SYSTEM.

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 must 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.

B. CONNECT SYSTEM SUPPLY AND RETURN PIPING TO BOILER.

See Figures 15A and 15B. Also, consult Residential Hydronic Heating Installation and Design I=B=R Guide.

1. 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 14. Also, consult Residential Hydronic Heating Installation and Design I=B=R Guide.
2. 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.
3. If boiler is used with an Indirect Domestic Water Heater, install the Indirect Water Heater as a separate heating zone. Refer to the Indirect Water Heater Installation, Operating, and Service Instructions for additional information.
4. Use a boiler 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 15A and 15B in order to regulate water flow for maintenance of higher boiler water temperature.

WARNING

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

U.S. Boiler Company 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.

WARNING

The use of a low water cut-off device, while not required unless radiation level is below the boiler, is highly recommended.

CAUTION

Maintain minimum ½ inch clearance from hot water piping to combustible materials.

5. If a Low Water Cut-Off (LWCO) 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. Refer to Appendix A at the rear of this manual.

SECTION V: WATER BOILER PIPING AND TRIM (continued)

6. If it is required to perform a long term pressure test of the hydronic system, the boiler should first be isolated to avoid a pressure loss due to the escape of air trapped must first be removed from the boiler.

To perform a long term pressure test including the boiler, ALL trapped air must first be removed from the boiler.

A loss of pressure during such a test, with no visible water leakage, is an indication that the boiler contained trapped air.

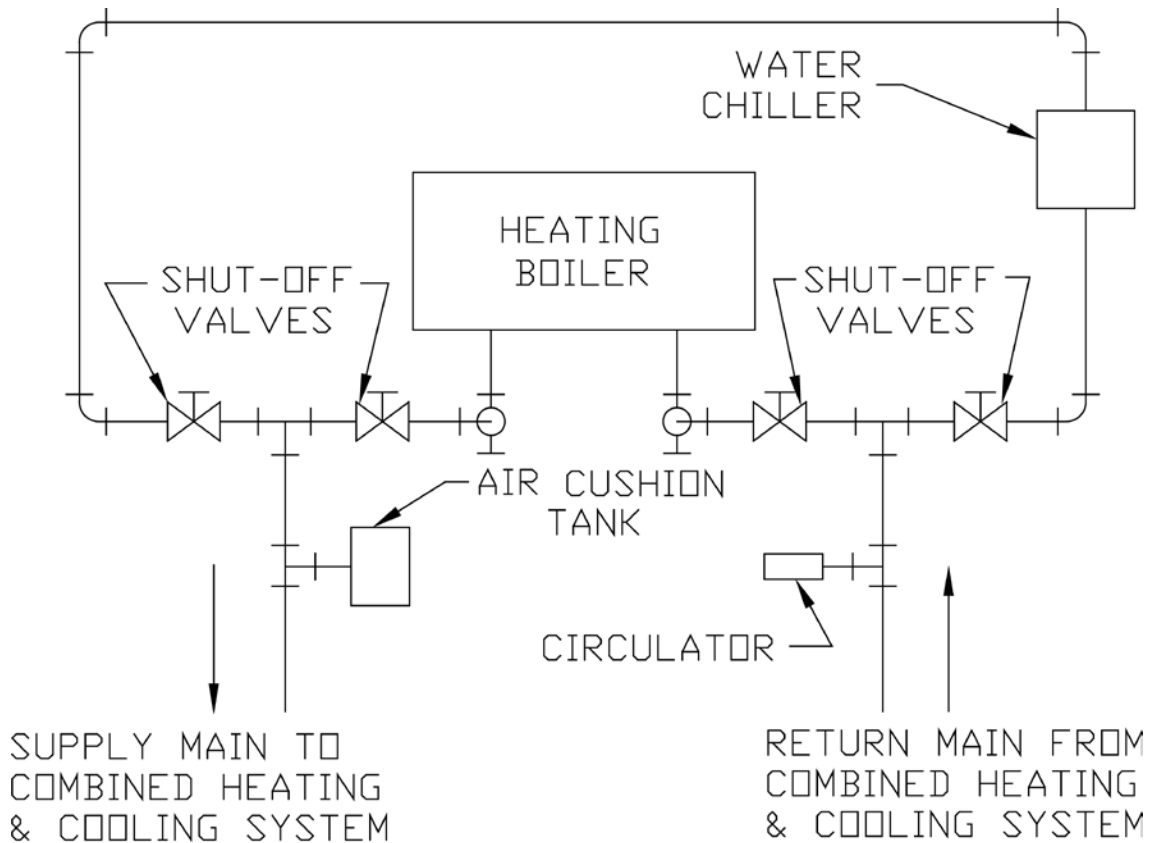
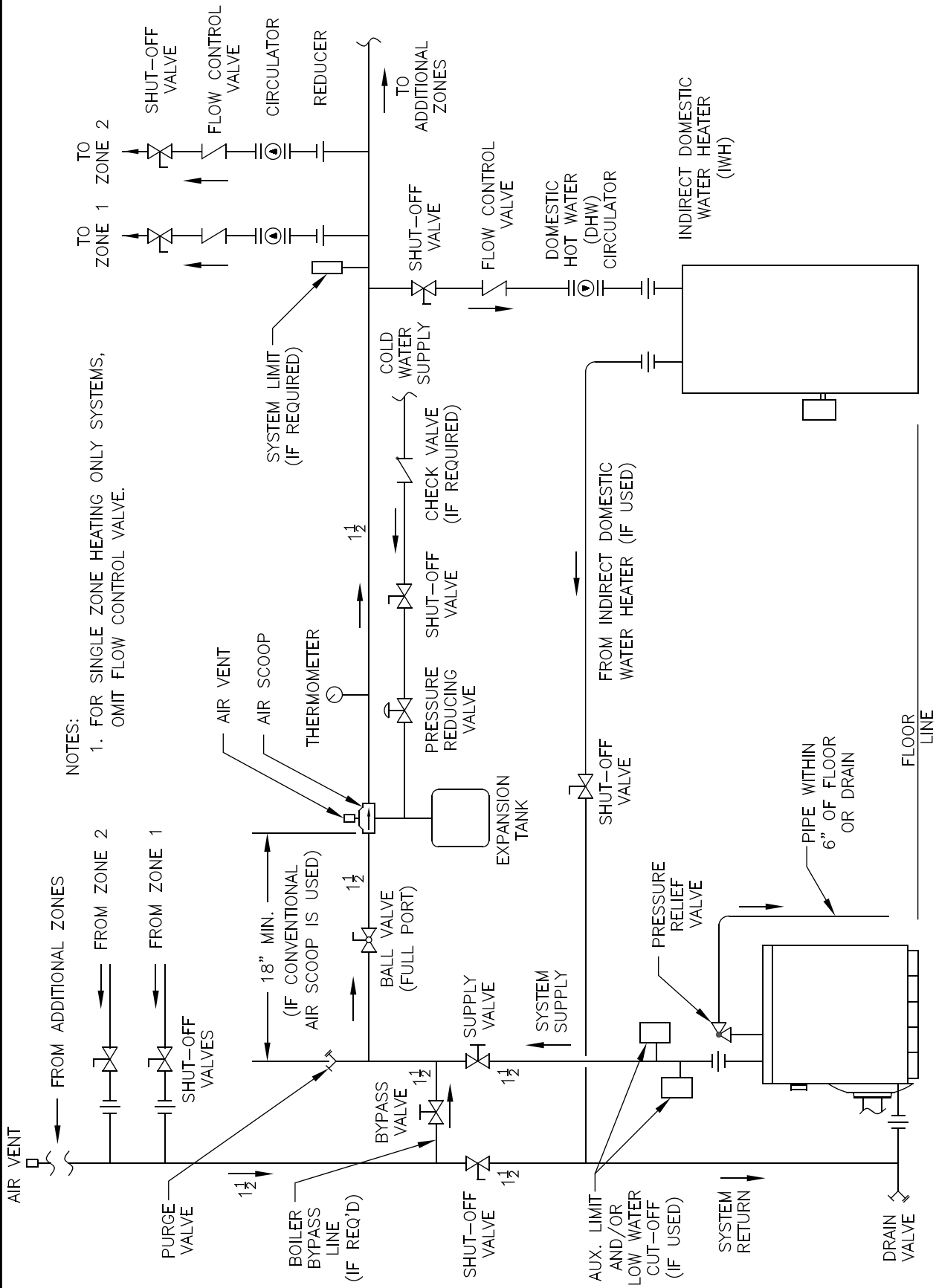


Figure 14: Recommended Piping for Combination Heating and Cooling (Refrigeration) System

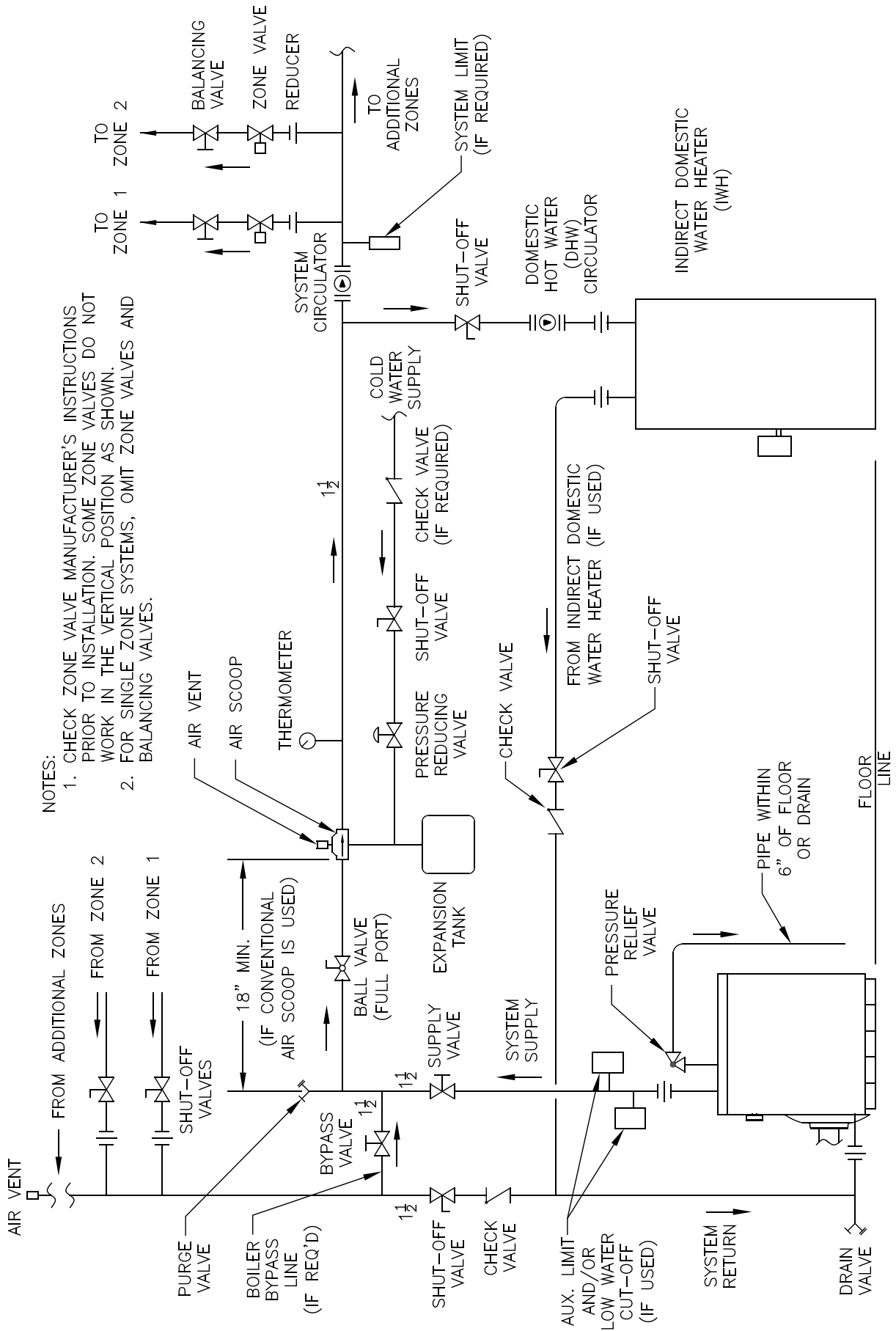
SECTION V: WATER BOILER PIPING AND TRIM (continued)



RIGHT SIDE VIEW

Figure 15A: Recommended Water Piping for Circulator Zoned Heating System - Supply Side Circulators

SECTION V: WATER BOILER PIPING AND TRIM (continued)



NOTES:

1. CHECK ZONE VALVE MANUFACTURER'S INSTRUCTIONS PRIOR TO INSTALLATION. SOME ZONE VALVES DO NOT WORK IN THE VERTICAL POSITION AS SHOWN.
2. FOR SINGLE ZONE SYSTEMS, OMIT ZONE VALVES AND BALANCING VALVES.

RIGHT SIDE VIEW

Figure 15B: Recommended Water Piping for Zone Valve Zoned Heating System - Supply Side Circulator

SECTION VI: STEAM BOILER PIPING AND TRIM

WARNING

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

DO NOT increase steam boiler input above the ratings.

DO NOT use softened water in steam boilers. Accelerated boiler corrosion will result. Tie in fresh water supply to the boiler upstream of a water softener.

Oxygen contamination of boiler water will cause corrosion of iron and steel boiler components, and can lead to boiler failure. U.S. Boiler Company'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. EVALUATE THE EXISTING STEAM SYSTEM.

The single most important factor in determining the expected life cycle of a steam boiler, is the amount of fresh water added to the boiler during operation. Fresh water brings minerals and oxygen into the boiler. These contaminants greatly accelerate corrosion of the cast iron boiler sections.

1. Assure that all system radiators, piping and vents are absolutely leak tight.
 - a. When a steam boiler is installed in an existing system, ALL air vents should be replaced at the same time. This assures that the new boiler will not be compromised by existing system leaks.
 - b. If the system contains hidden supply or return piping (hidden behind walls, buried in concrete, etc.) pressure test this piping to assure there are no leaks.

2. Repair any leaks in the system.

3. Install accurate water meter on the fresh water supply to the boiler.

B. CONNECT SYSTEM SUPPLY AND RETURN PIPING TO BOILER. See Figure 16 for piping details. Also consult Residential Hydronic Heating Installation and Design I=B=R Guide.

CAUTION

Maintain minimum ½ inch clearance from hot water piping to combustible materials.

NOTICE

Before using copper for steam piping, consider the following characteristics of copper piping:

- 1) high coefficient of thermal expansion can induce mechanical stresses and cause expansion/contraction noises if not accounted for in the piping system design and installation,
- 2) high heat transfer rate (heat loss) of uninsulated copper piping must be included in the normal piping and pickup factors used to size the boiler,
- 3) soldering or brazing pastes and fluxes that end up in the system can cause poor heat transfer, surging, an unsteady water line and wet steam if not thoroughly removed during the boil out procedure and,
- 4) galvanic corrosion of the adjoining metal may occur due to dissimilar metals in certain water chemistries if dielectric unions are not used.

SECTION VI: STEAM BOILER PIPING AND TRIM (continued)

NOTICE

Failure to pipe boiler as specified in this manual may result in excessive system noise, water line fluctuations and water carry over.

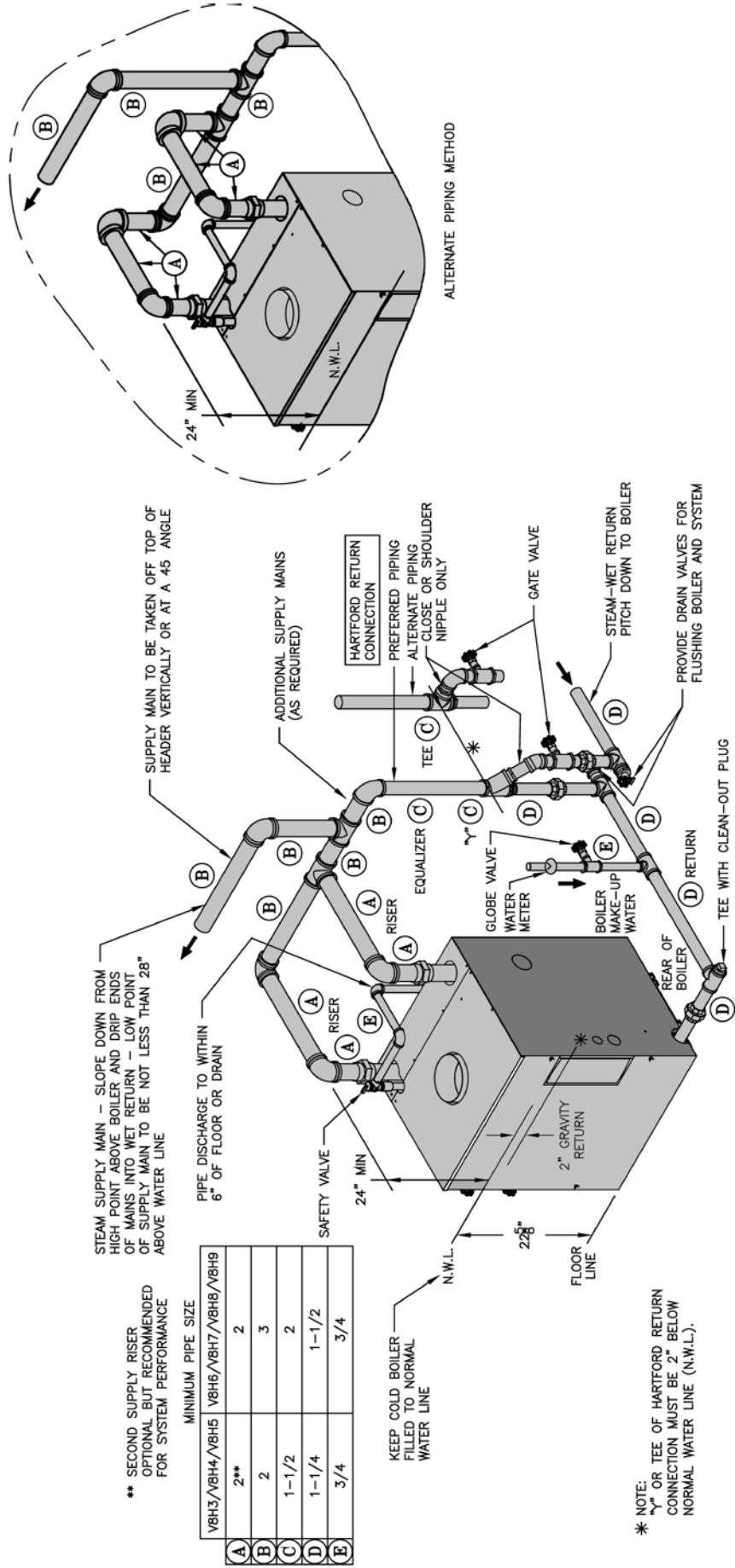


Figure 16: Recommended Boiler Piping for Gravity Return Steam Boiler

SECTION VII: TANKLESS AND INDIRECT WATER HEATER PIPING

- A. **CONNECT TANKLESS HEATER PIPING** as shown in Figure 17A. See Tables 2A and 2B 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 17A.

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.

NOTICE

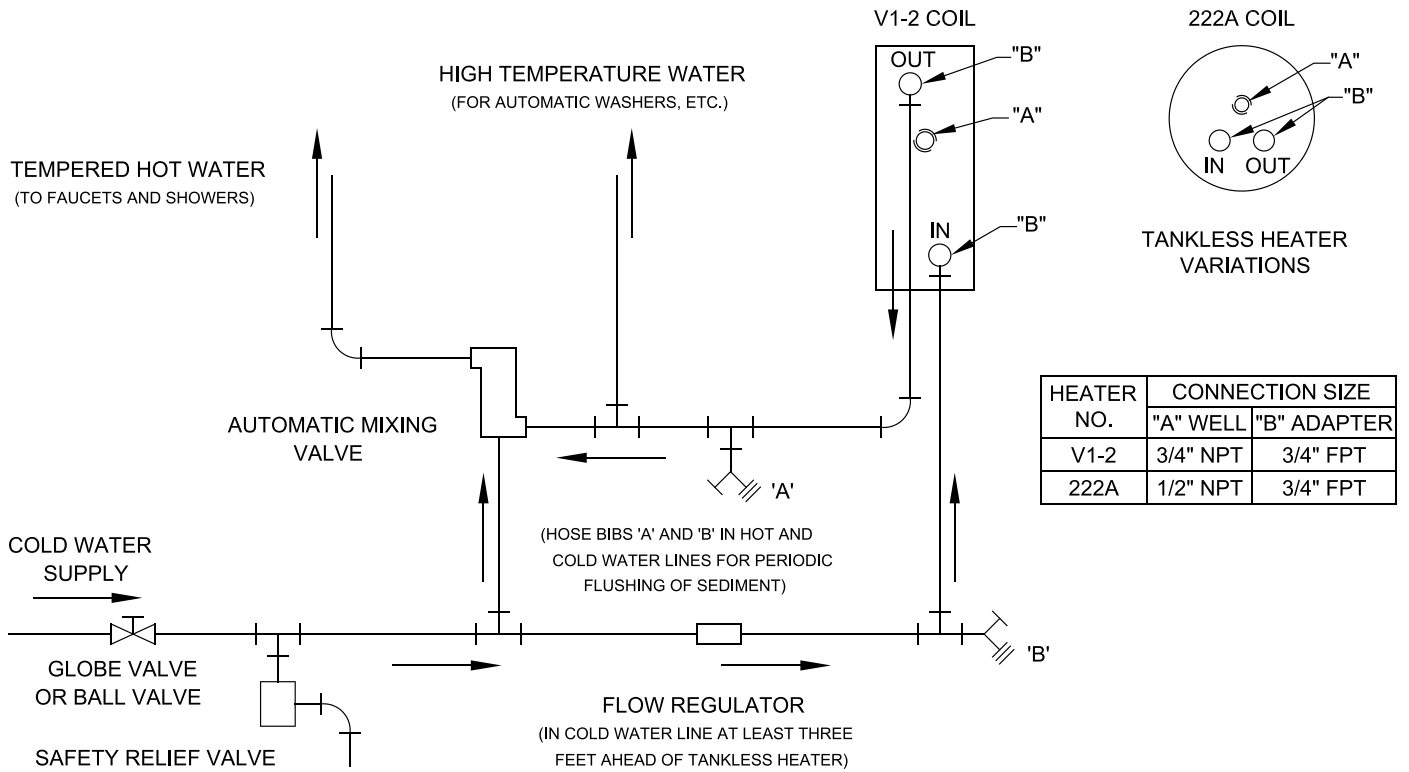
During summertime operation, the normal water line on a steam boiler can be raised 1", from 22-5/8" to 23-5/8" (see Figure 1D) for improved tankless heater performance on steam boilers.

Use street elbow fittings in tankless in and out connections to assure adequate clearance of piping.

CAUTION

Use of hard water with a tankless coil will, over a short period of time, reduce the output of the coil, reduce flow due to increased pressure drop and reduce the useful life of the coil.

SECTION VII: TANKLESS AND INDIRECT WATER HEATER PIPING (cont'd)



**TABLE 2A: TANKLESS HEATER DATA:
Rear Mounted Heater on Steam and Water Boilers**

Boiler Model	Heater No.	Heater Rating (GPM)		Pressure Drop thru Heater (PSI)	
		Steam	Water	Steam	Water
V8H3	V1-2	2.75	3	3.9	4.7
V8H4	V1-2	3	3.25	4.7	5.6
V8H5	V1-2	3.25	3.5	5.6	6.4
V8H6	V1-2	3.75	3.75	7.2	7.2
V8H7	V1-2	3.75	4	7.2	8
V8H8	V1-2	4	4.5	8	9.8
V8H9	V1-2	4	4.5	8	9.8

**TABLE 2B: TANKLESS HEATER DATA:
Front Mounted Heater on Water Boilers**

Boiler Model	Heater No.	Heater Rating (GPM)	Pressure Drop thru Heater (PSI)
V8H3	222A	3	22
V8H4	222A	3.5	22
V8H5	222A	4	30.5
V8H6	222A	4.5	33
V8H7	222A	4.6	33
	A54	5.5	36
V8H8	222A	4.75	40
	A54	6	39.5
V8H9	222A	4.75	40
	A54	6	39.5

SECTION VII: TANKLESS AND INDIRECT WATER HEATER PIPING (cont'd)

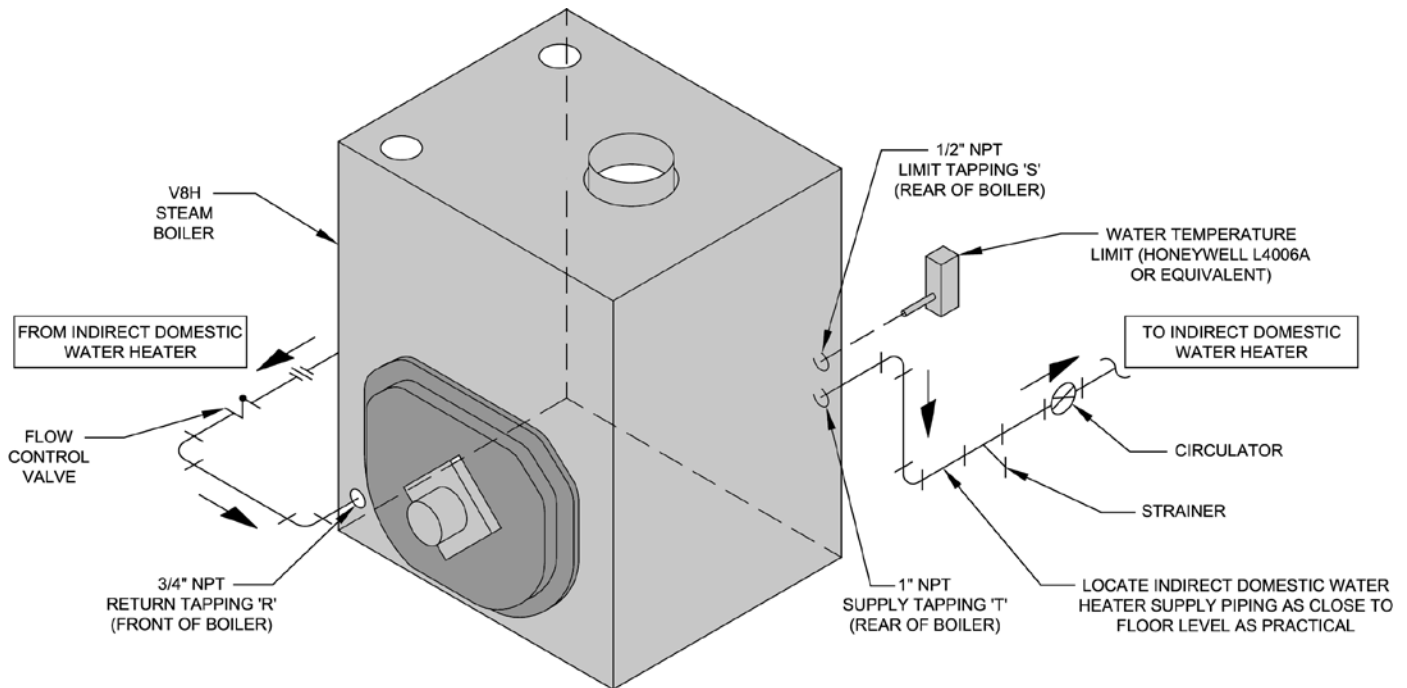


Figure 17B: Indirect Domestic Water Heater Piping with V8H Steam Boiler

B. CONNECT INDIRECT DOMESTIC WATER HEATER PIPING as shown in Figure 17B.

1. Refer to Indirect Water Heater Installation, Operating, and Service Instructions for additional information.

SECTION VIII: VENTING AND AIR INTAKE PIPING

A. GENERAL VENTING 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 V8H 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 and vent pipe shall have a sufficient draft at all times, to assure safe proper operation of the boiler. See Figure 18 for recommended installation.
 - a. Install a draft regulator (supplied with boiler) following the instructions furnished with the regulator. See Figure 19 for alternate draft regulator locations.
 - b. For Models V8H4W and V8H6W, the minimum recommended round chimney size from Table 1B is one size larger than the smokebox outlet. For a vertical vent, place the increaser on the smokebox outlet collar. Otherwise, locate the increaser in the horizontal vent at the entrance to the chimney.
 - c. With any new or replacement installation the chimney has to be considered. Chimneys that have a high heat loss may become less suitable as the heat loss of the home goes down and the efficiency of the boiler installed 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% CO₂. 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 a stabilizing draft cap or even a draft inducing fan in severe cases.

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

B. OPTIONAL AIR INTAKE PIPING

INSTALLATION - Outdoor air for combustion may be provided with an optional U.S. Boiler Company V8H™ Fresh Air Accessory Kit (**ONLY AVAILABLE ON BECKETT BURNERS**, with plastic cover application, P/N 102119-01), refer to Figure 20. Refer to Fresh Air Accessory Kit Instructions for installation and air intake piping details.

WARNING

DO NOT reduce size of air intake pipe.

Read, understand and follow combustion air instruction restrictions contained in the Pre-Installation Section of this manual.

1. General
 - a. Use 4 inch diameter, single wall galvanized metal pipe and fittings available at most heating distributors for air intake piping. Maximum allowable air intake length is 50 equivalent feet. Each elbow is equal to 6 equivalent feet.

WARNING

DO NOT exceed maximum allowable air intake length.

- b. Start at Burner. Work toward air intake terminal.
- c. Maintain minimum of ¼ inch per foot slope in horizontal run to air intake terminal. Slope down toward air intake terminal.
- d. Seal all joints gas-tight, using silicone caulk or self-adhesive aluminum tape.

SECTION VIII: VENTING AND AIR INTAKE PIPING (continued)

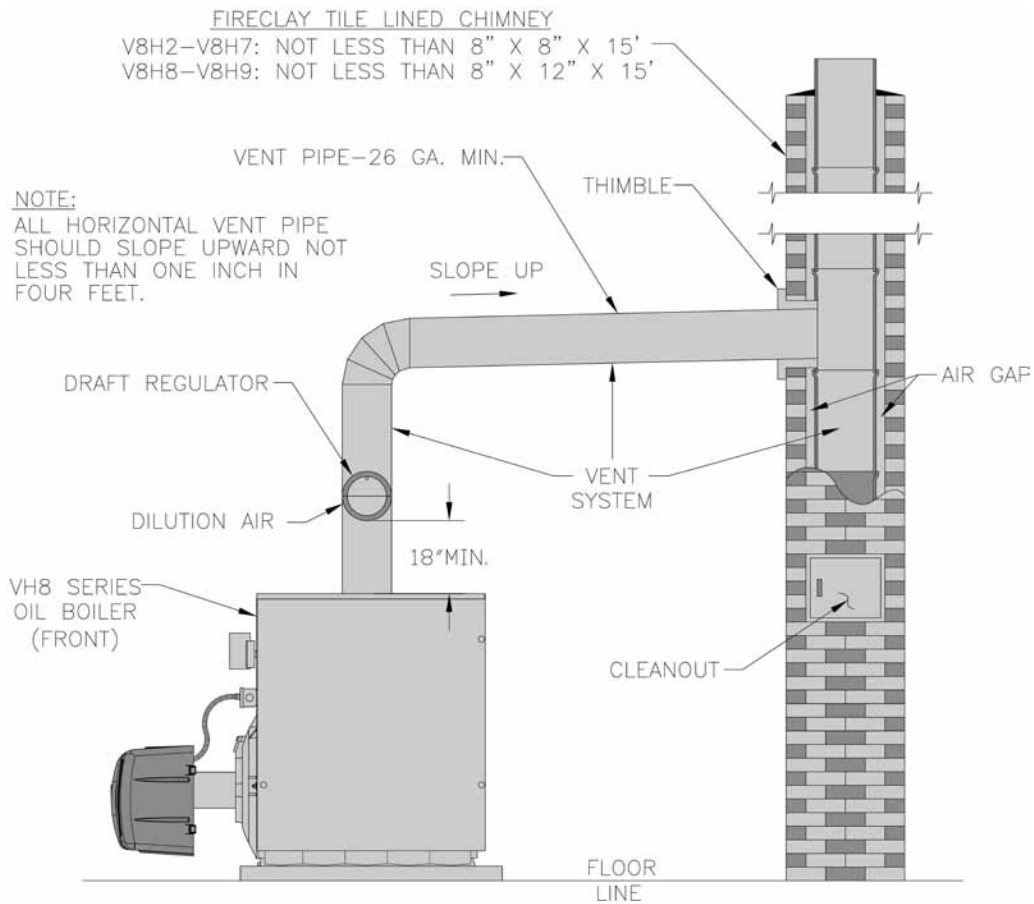


Figure 18: Recommended Vent Pipe Arrangement and Chimney Requirements

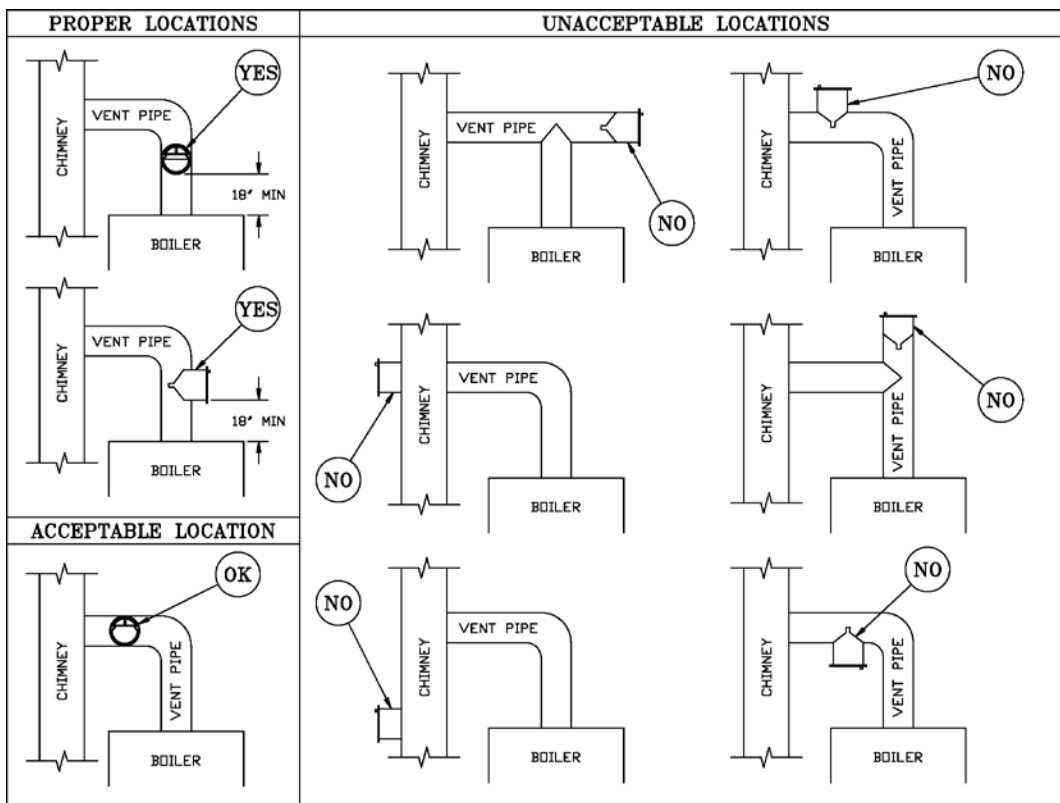


Figure 19: Proper and Improper Locations of Draft Regulator

SECTION VIII: VENTING AND AIR INTAKE PIPING (continued)

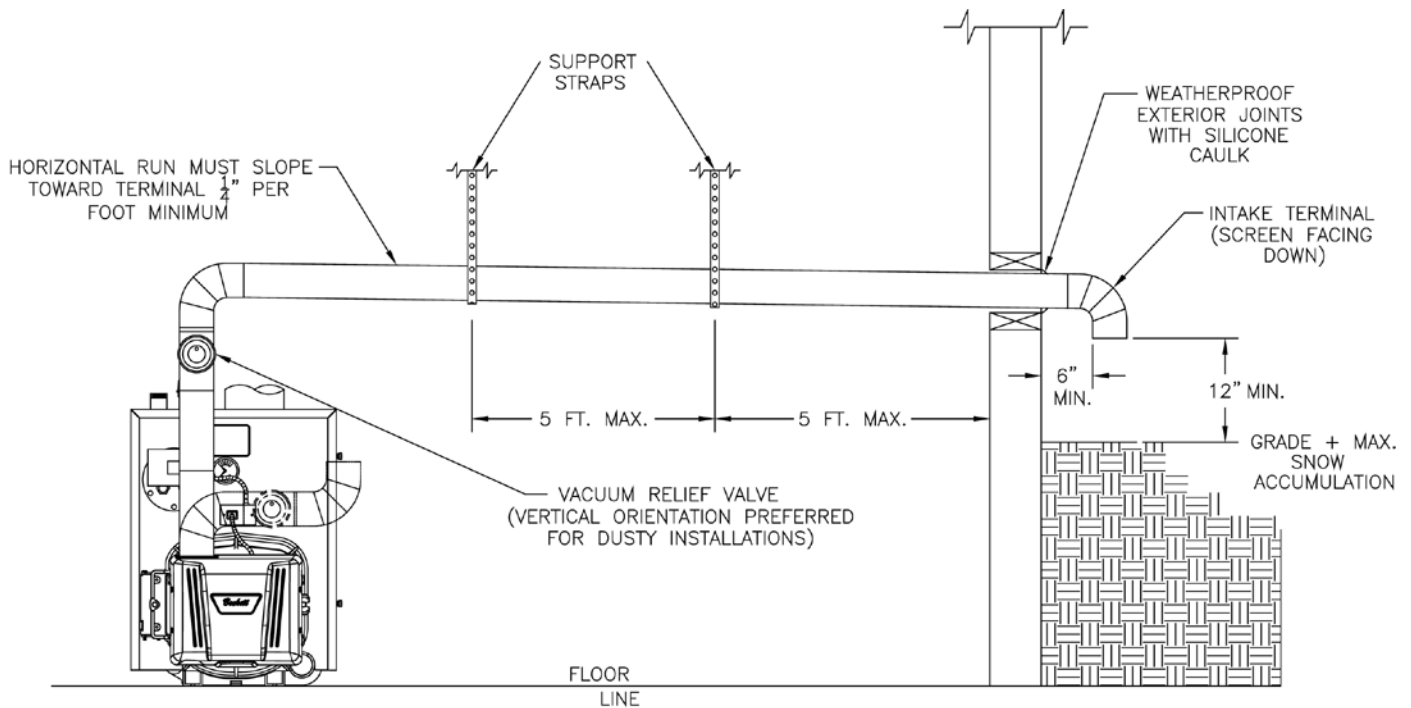
2. After determining location, cut a hole in the wall to accept 4 inch air intake pipe. See Figure 20.
3. Remove the metal knockout in right side of burner cover. Install U.S. Boiler Company Inlet Air Accessory Kit, P/N 611280031.
4. Mount the Vacuum Relief Valve Tee Assembly (P/N 8116268 included with Kit) or 90° elbow into the burner inlet ring. See Figure 20.
 - a. Secure with at least three (3) sheet metal screws evenly spaced around the burner inlet ring.
 - b. Assemble the vacuum relief valve balance weight onto the gate. Refer to the vacuum relief valve manufacturer's instructions.
 - c. Mount the vacuum relief valve into the tee and fasten with a screw and nut in collar tabs. To ensure proper operation, the gate must be level across the pivot point and plumb. Refer to vacuum relief valve manufacturer's instructions.
5. Install remainder of air intake, securing each joint with at least three (3) sheet metal screws evenly spaced.
6. Install air intake terminal. See Figure 20.
7. Seal all external joints with weatherproof caulk.

NOTICE

Intake terminal must be at least 12 inches above grade plus snow accumulation.

WARNING

DO NOT locate air intake where petroleum distillates, CFC's, detergents, volatile vapors or any other chemicals are present. Severe boiler corrosion and failure will result.



FRONT VIEW

Figure 20: Optional Air Intake Piping Installation - Only Available with Beckett Burner

SECTION IX: 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.

WARNING

The primary control may be damaged or may not function properly if 120 volt power supply is **NOT** wired into control as follows:

The 120V interrupted hot (black) wire must be connected to the primary control black wire, the 120V neutral (white) wire must be connected to the primary control white wire and the 120V constant hot (red) wire must be connected to the primary control red wire.

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 service switch is recommended and may be required by some local jurisdictions.
4. Use anti-short bushings on all wiring passing through boiler jacket, junction boxes and/or control boxes.
5. Use armored cable (BX) over all exposed line voltage wiring.
6. If an indirect domestic water heater is used, use priority zoning. **DO NOT** use priority zoning for Hydro-Air Systems.

7. If boiler is installed in Canada, a blocked vent safety switch must be installed. Refer to Blocked Vent Safety Switch Instruction Supplement provided with boiler (Canada only).
8. Wiring should conform to Figures 21A through 25.

- B. 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.
- Heat Anticipator in Thermostat should be set to match the requirements of the control to which it is connected. See Figures 21A thru 25 for desired system and heat anticipator setting. 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.

SECTION IX: ELECTRICAL (continued)

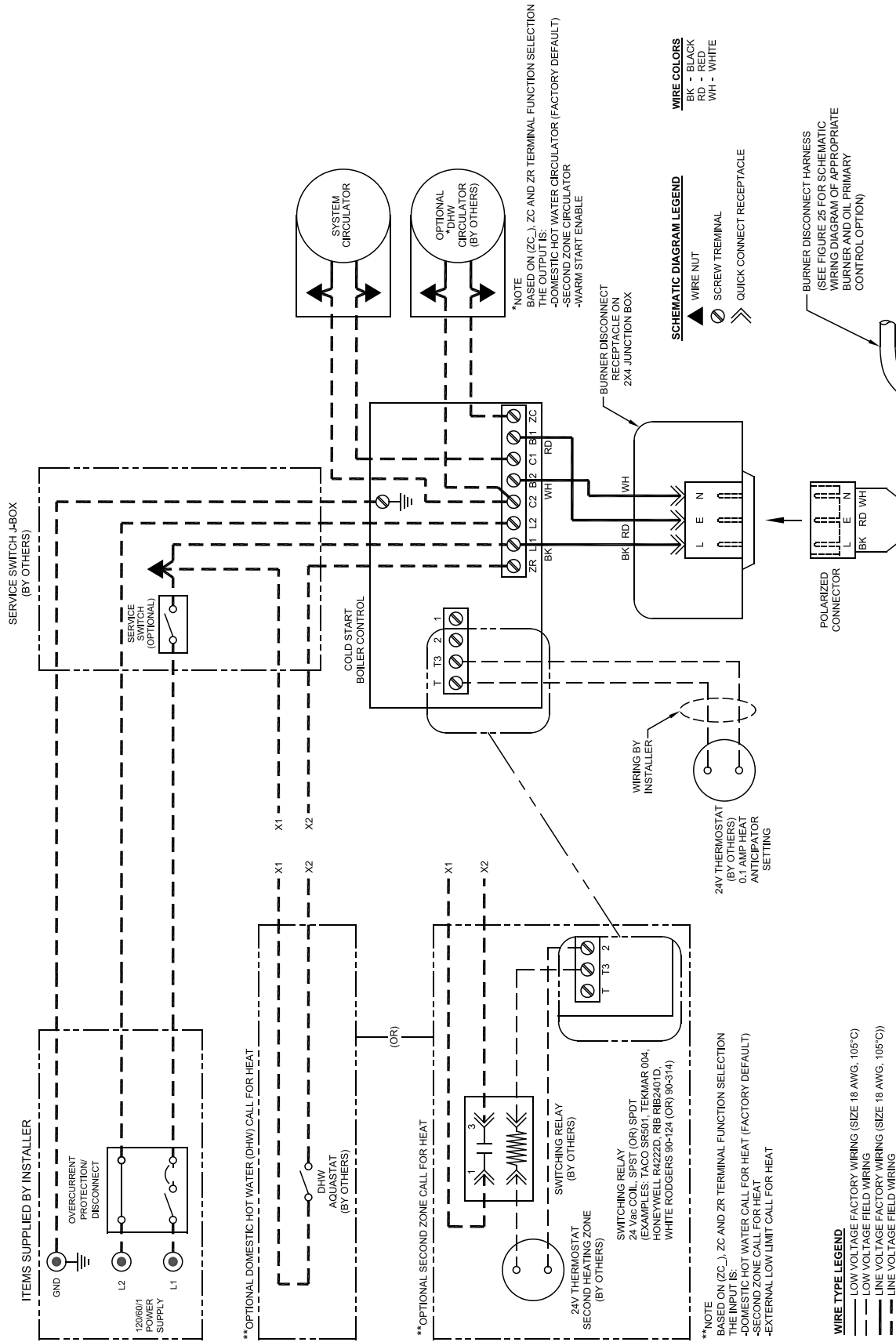


Figure 21A: Schematic Wiring Diagram, Water Boiler without Tankless Heater, Cold Start Control (All Burner Options)

SECTION IX: ELECTRICAL (continued)

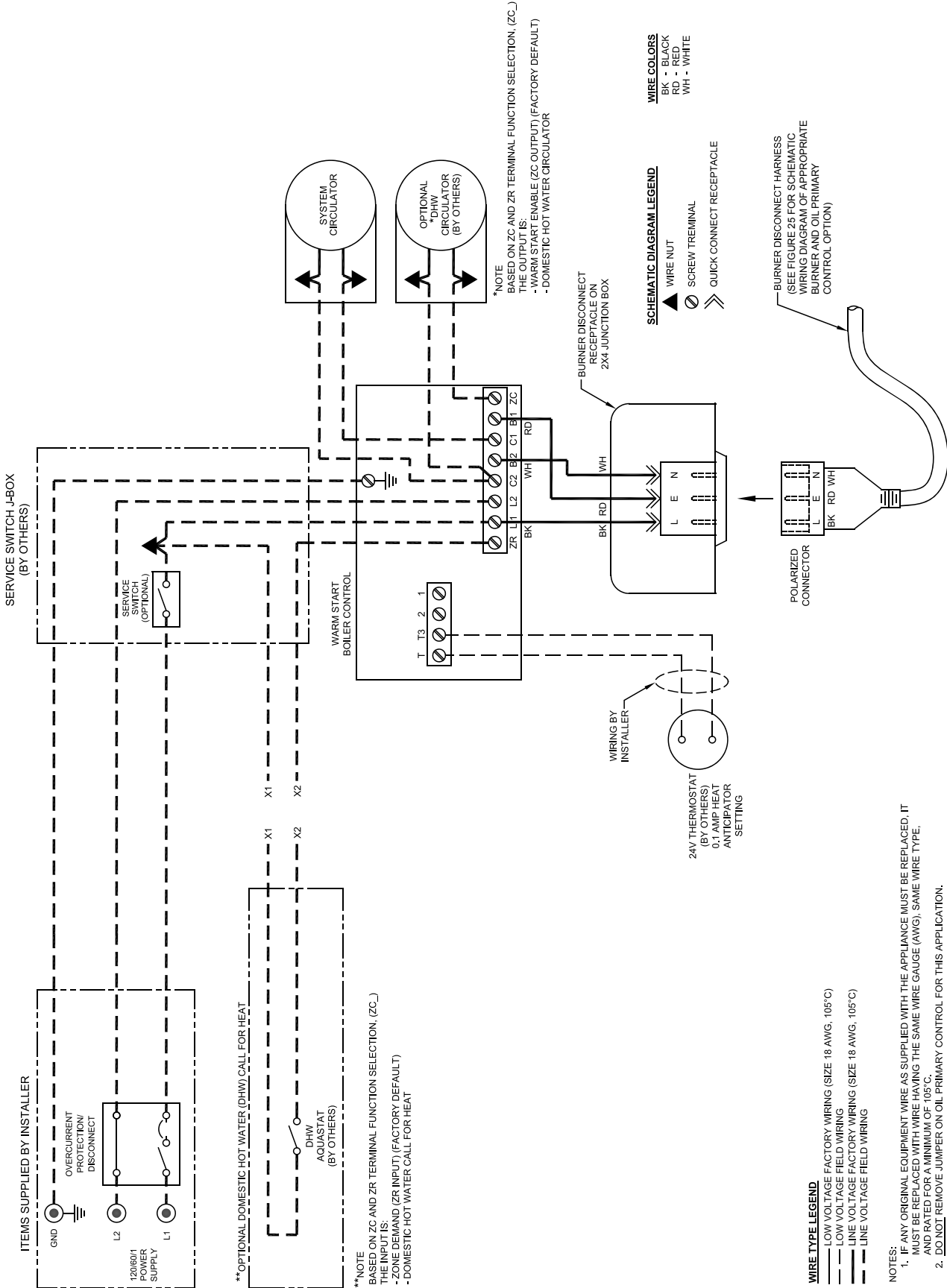


Figure 21B: Schematic Wiring Diagram, Water Boiler with Front or Rear Tankless Heater, Warm Start Control (All Burner Options)

NOTES:
 1. IF ANY ORIGINAL EQUIPMENT WIRE AS SUPPLIED WITH THE APPLIANCE MUST BE REPLACED, IT MUST BE REPLACED WITH WIRE HAVING THE SAME WIRE GAUGE (AWG), SAME WIRE TYPE, AND RATED FOR A MINIMUM OF 105°C.
 2. DO NOT REMOVE JUMPER ON OIL PRIMARY CONTROL FOR THIS APPLICATION.

SECTION IX: ELECTRICAL (continued)

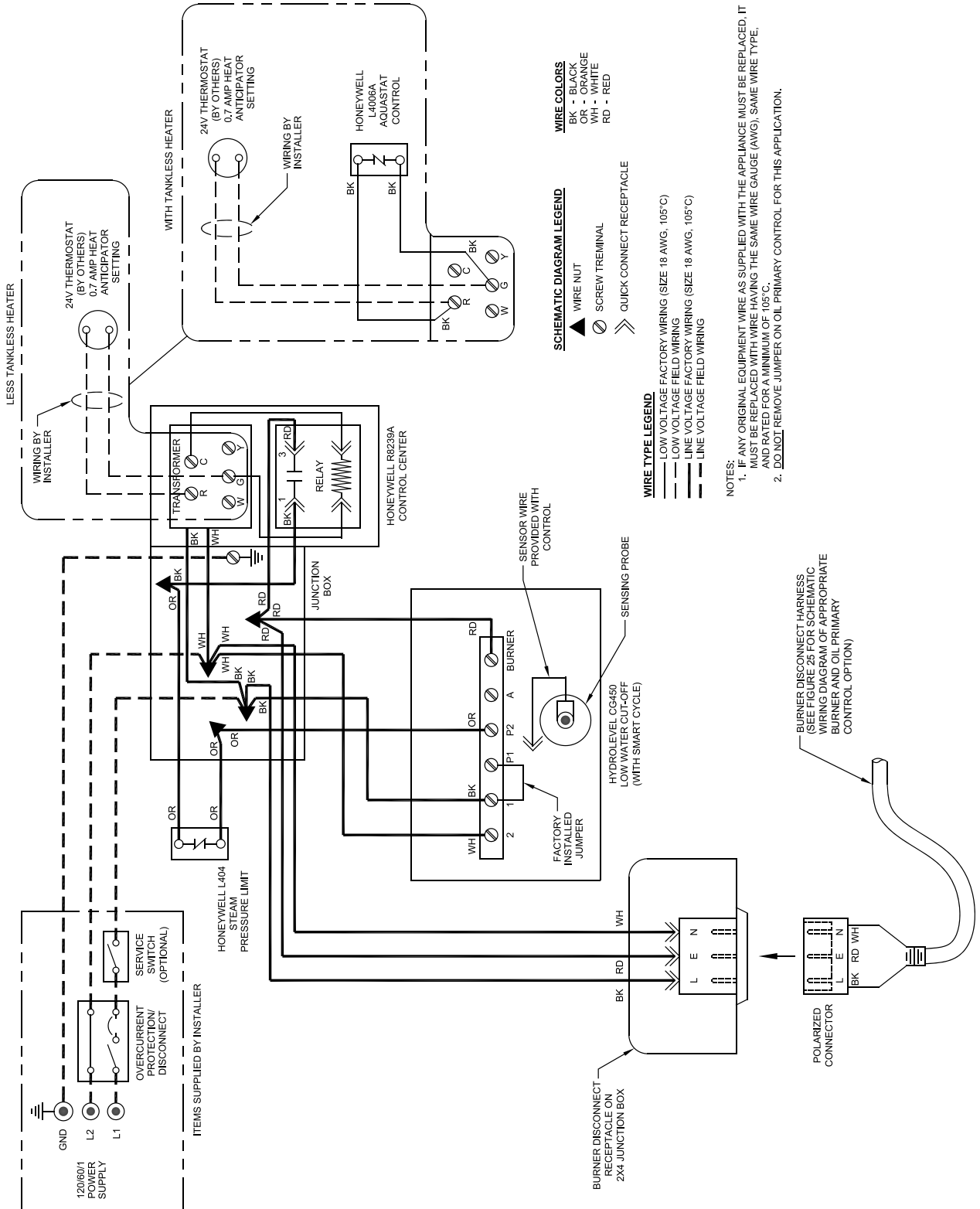


Figure 22: Schematic Wiring Diagram, Steam Boiler, Hydrolevel CG450 Probe LWCO (All Burner Options)

SECTION IX: ELECTRICAL (continued)

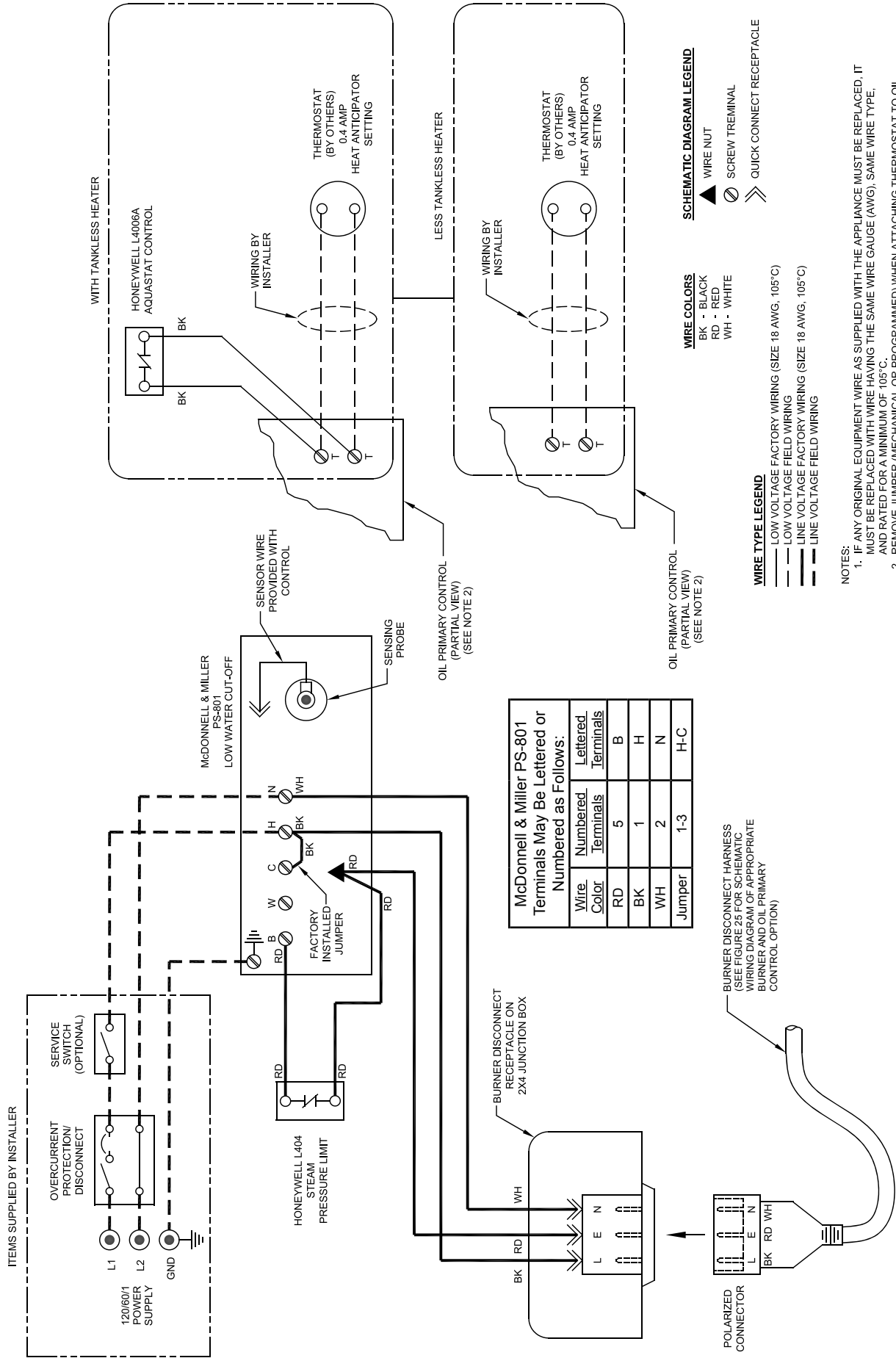


Figure 23A: Schematic Wiring Diagram, Steam Boiler, McDonnell & Miller PS-801 Probe LWCO (Beckett & Carlin Burners)

SECTION IX: ELECTRICAL (continued)

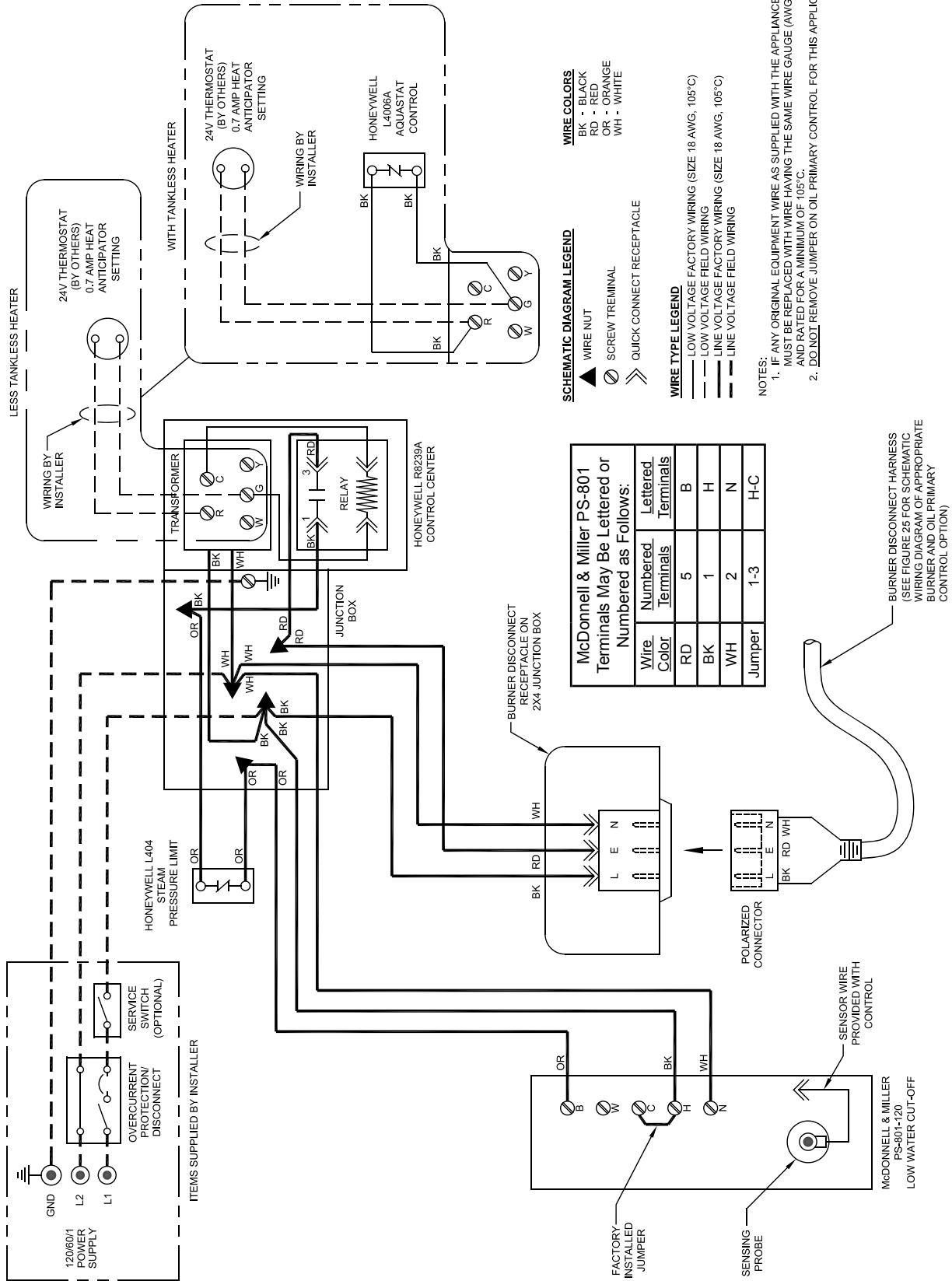


Figure 23B: Schematic Wiring Diagram, Steam Boiler, McDonnell & Miller PS-801 Probe LWCO (Riello Burners)

SECTION IX: ELECTRICAL (continued)

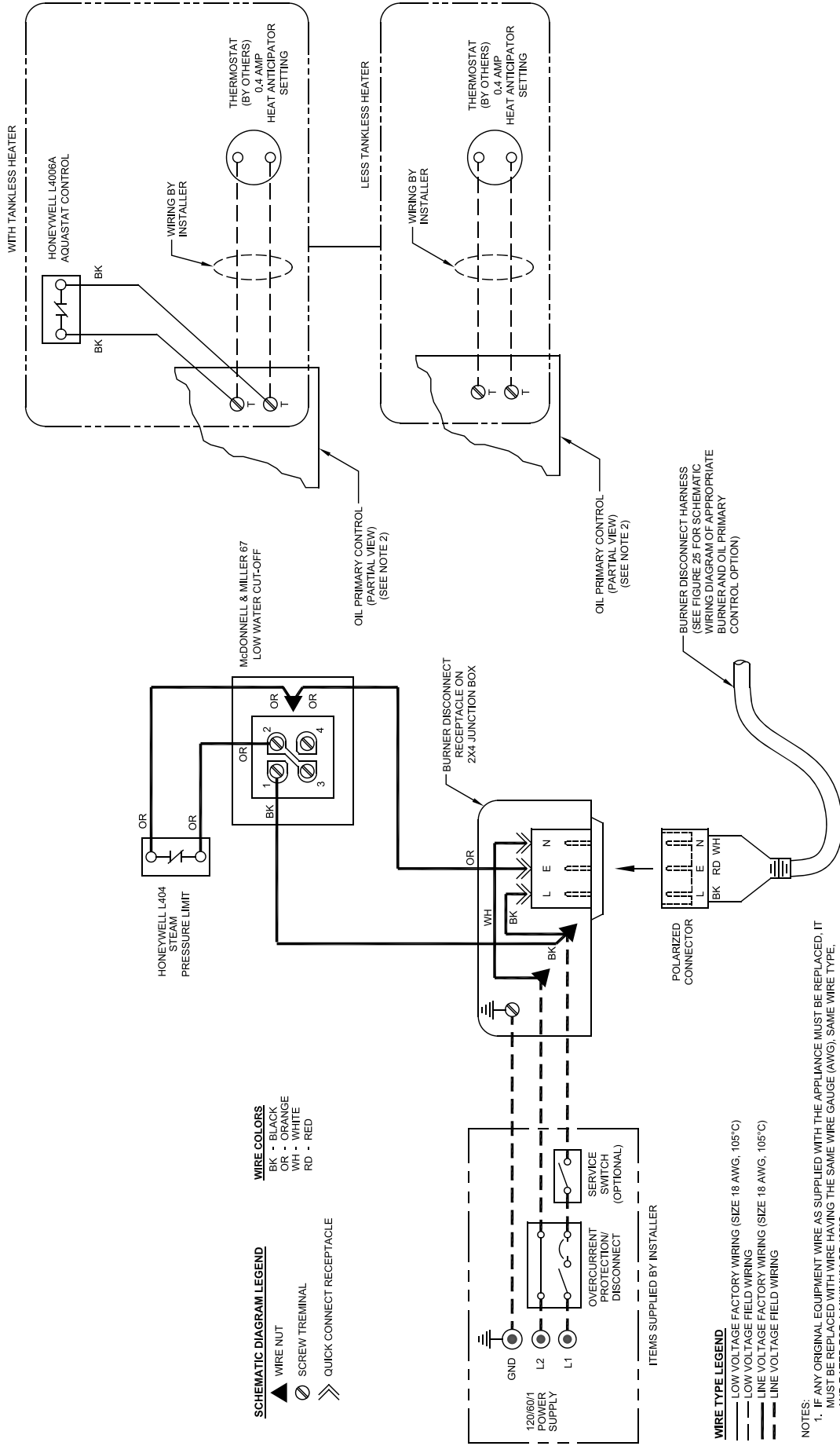
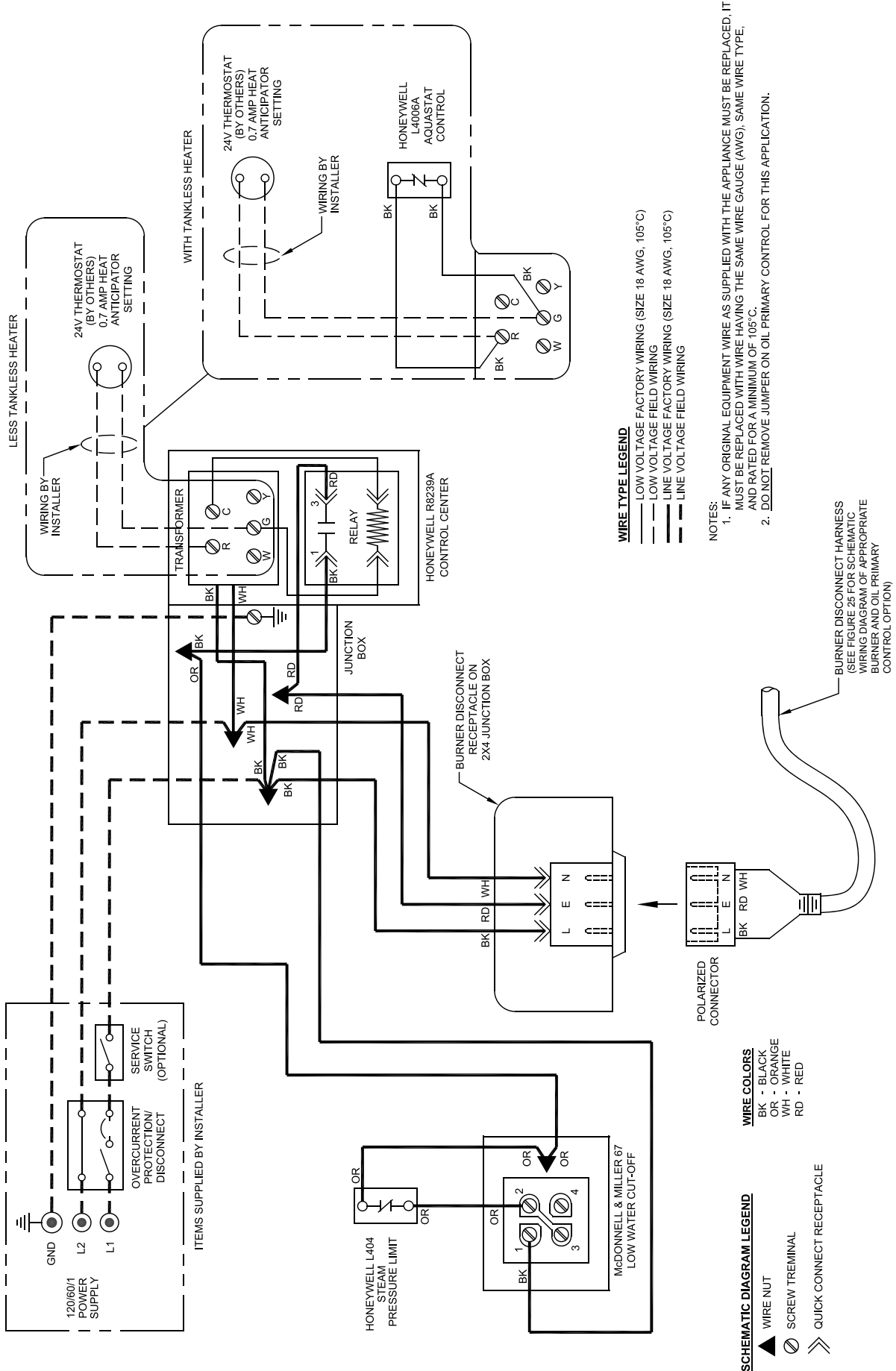


Figure 24A: Schematic Wiring Diagram, Steam Boiler, McDonnell & Miller 67 Float LWCO (Beckett & Carlin Burners)

SECTION IX: ELECTRICAL (continued)



WIRE TYPE LEGEND

- LOW VOLTAGE FACTORY WIRING (SIZE 18 AWG, 105°C)
- - - LOW VOLTAGE FIELD WIRING
- LINE VOLTAGE FACTORY WIRING (SIZE 18 AWG, 105°C)
- LINE VOLTAGE FIELD WIRING

NOTES:

1. IF ANY ORIGINAL EQUIPMENT WIRE AS SUPPLIED WITH THE APPLIANCE MUST BE REPLACED, IT MUST BE REPLACED WITH WIRE HAVING THE SAME WIRE GAUGE (AWG), SAME WIRE TYPE, AND RATED FOR A MINIMUM OF 105°C.
2. DO NOT REMOVE JUMPER ON OIL PRIMARY CONTROL FOR THIS APPLICATION.

WIRE COLORS

- BK • BLACK
- OR • ORANGE
- WH • WHITE
- RD • RED

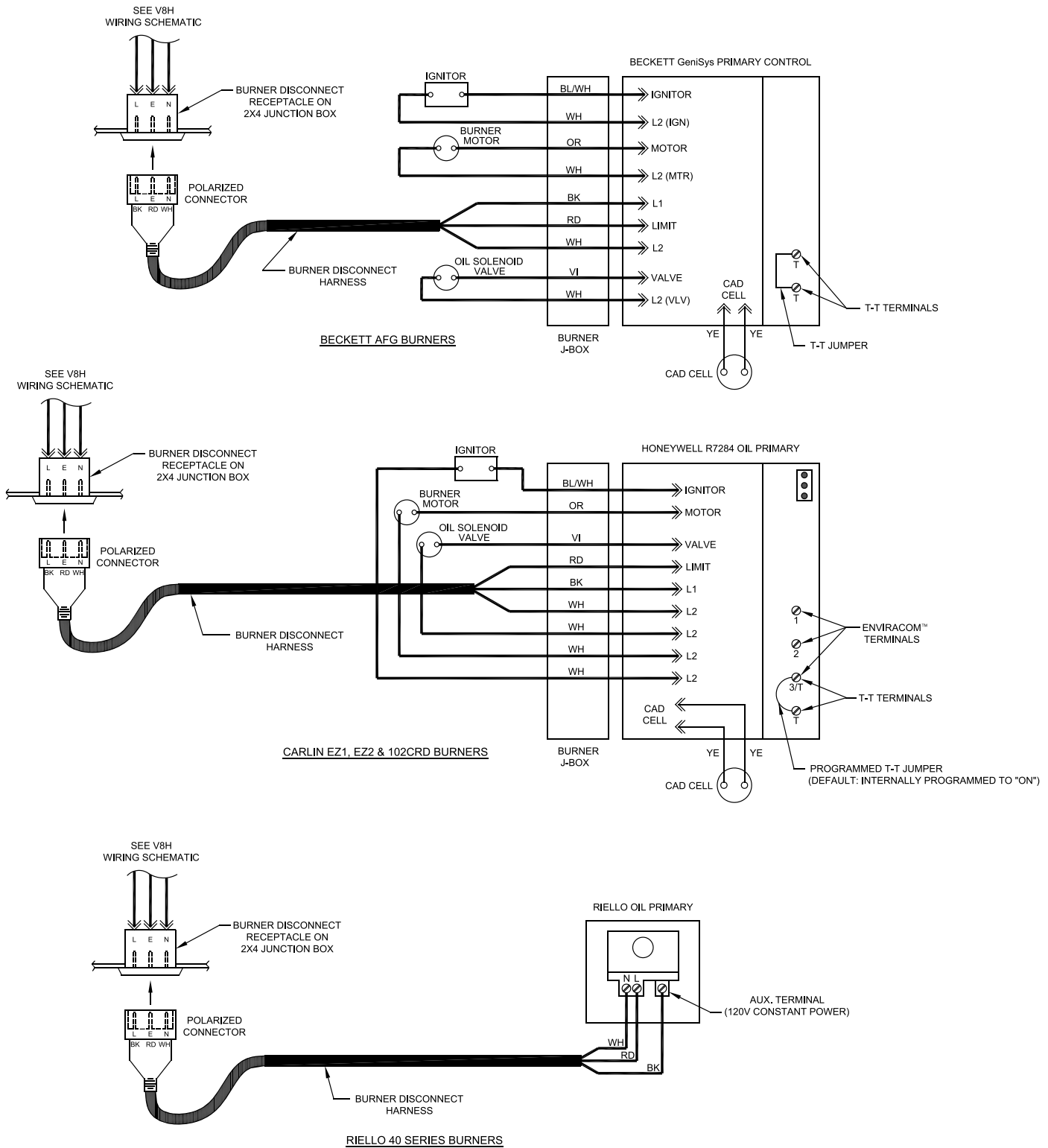
SCHEMATIC DIAGRAM LEGEND

- ▲ WIRE NUT
- ⊗ SCREW TERMINAL
- ⋈ QUICK CONNECT RECEPTACLE

BURNER DISCONNECT HARNESS (SEE FIGURE 25 FOR SCHEMATIC WIRING DIAGRAM OF APPROPRIATE BURNER AND OIL PRIMARY CONTROL OPTION)

Figure 24B: Schematic Wiring Diagram, Steam Boiler, McDonnell & Miller 67 Float LWCO (Riello Burners)

SECTION IX: ELECTRICAL (continued)



WIRE TYPE LEGEND

- LOW VOLTAGE FACTORY WIRING (SIZE 18 AWG, 105°C)
- - - LOW VOLTAGE FIELD WIRING
- LINE VOLTAGE FACTORY WIRING (SIZE 18 AWG, 105°C)
- - - LINE VOLTAGE FIELD WIRING

NOTES:

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

SCHEMATIC DIAGRAM LEGEND

- ⊙ SCREW TERMINAL
- QUICK CONNECT RECEPTACLE

WIRE COLORS

- BK - BLACK
- BL/WH - BLUE W/ WHITE TRACE
- WH - WHITE
- RD - RED
- VI - VIOLET
- YE - YELLOW
- OR - ORANGE

Figure 25: Schematic Wiring Diagrams For All Burner Options w/Variou Oil Primary Controls

SECTION X: OIL PIPING

A. GENERAL

1. Use flexible oil line(s) so the burner swing door can be opened without disconnecting the oil supply piping.
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 firing rates below 1.0 GPH to prevent nozzle fouling.
3. Use Flared fittings only. Cast iron fittings cannot be used.

NOTICE

DO NOT use compression fittings.

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

Refer to your local jurisdictions regarding any special considerations for fuel supply requirements. In addition, refer to NFPA 31, Standard for the Installation of Oil-Burning Equipment for Installations in the United States and CSA B139-04 for Installation in Canada.

4. Use of a high efficiency micron filter (Garber or equivalent) in addition to a conventional filter is highly recommended.
5. Piping used to connect the oil burner to the oil supply tank shall not be smaller than 3/8" iron pipe or 3/8" OD copper tubing. Copper tubing shall have a .032" minimum wall thickness.

WARNING

Under no circumstances can copper with sweat style connectors be used.

NOTICE

Some jurisdictions require the use of a fusible shutoff valve at the tank and/or the burner. In addition, some jurisdictions require the use of a fusible electrical interlock with the burner circuit. Check your local Codes for special requirements.

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 26.
3. Fuel Oil Line Deaerator – On many occasions a leaky oil delivery line can introduce air into the fuel oil supply system. This often creates a rough starting condition and can create a burner lockout state. In addition to fixing the leak, a fuel line deaerator can be installed to eliminate air. The single line from the fuel tank is connected to the deaerator. The burner pump must be connected to the deaerator as a two pipe system. Follow the oil pump manufacturer's recommendations for conversion to a two pipe system.

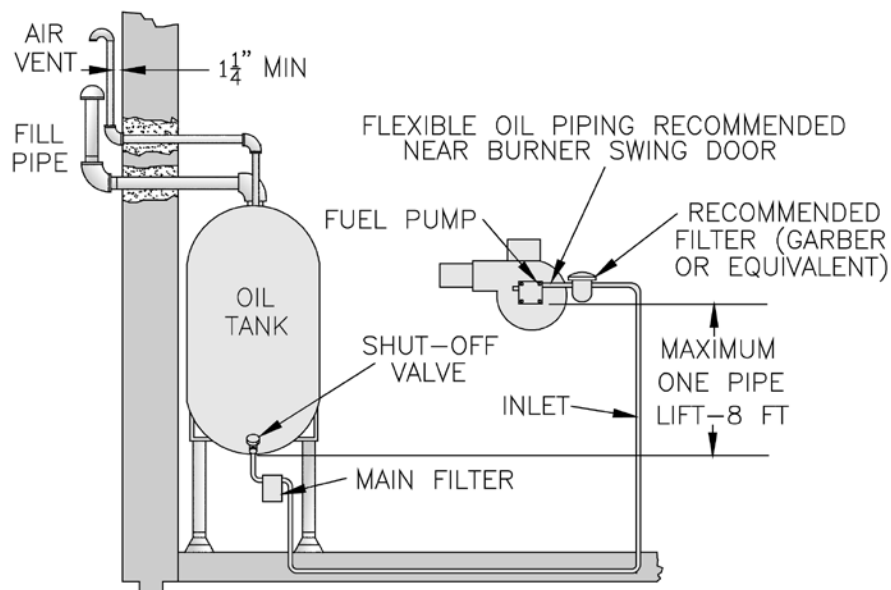


Figure 26: Single Pipe Oil Line

SECTION X: OIL PIPING (continued)

C. TWO PIPE OIL LINES

- For two piped systems, where more lift is required, the two-stage fuel unit is recommended. Table 3 (two-stage) and Table 4 (single-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 27.

TABLE 3: TWO-STAGE UNITS (3450 RPM) - TWO PIPE SYSTEMS

Lift "H" (See Fig. 25)	Maximum Length of Tubing "H" + "R" (See Figure 27)	
	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'

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

Lift "H" (See Fig. 25)	Maximum Length of Tubing "H" + "R" (See Figure 27)	
	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'

OUTSIDE TANK FUEL PUMP ABOVE
BOTTOM OF TANK

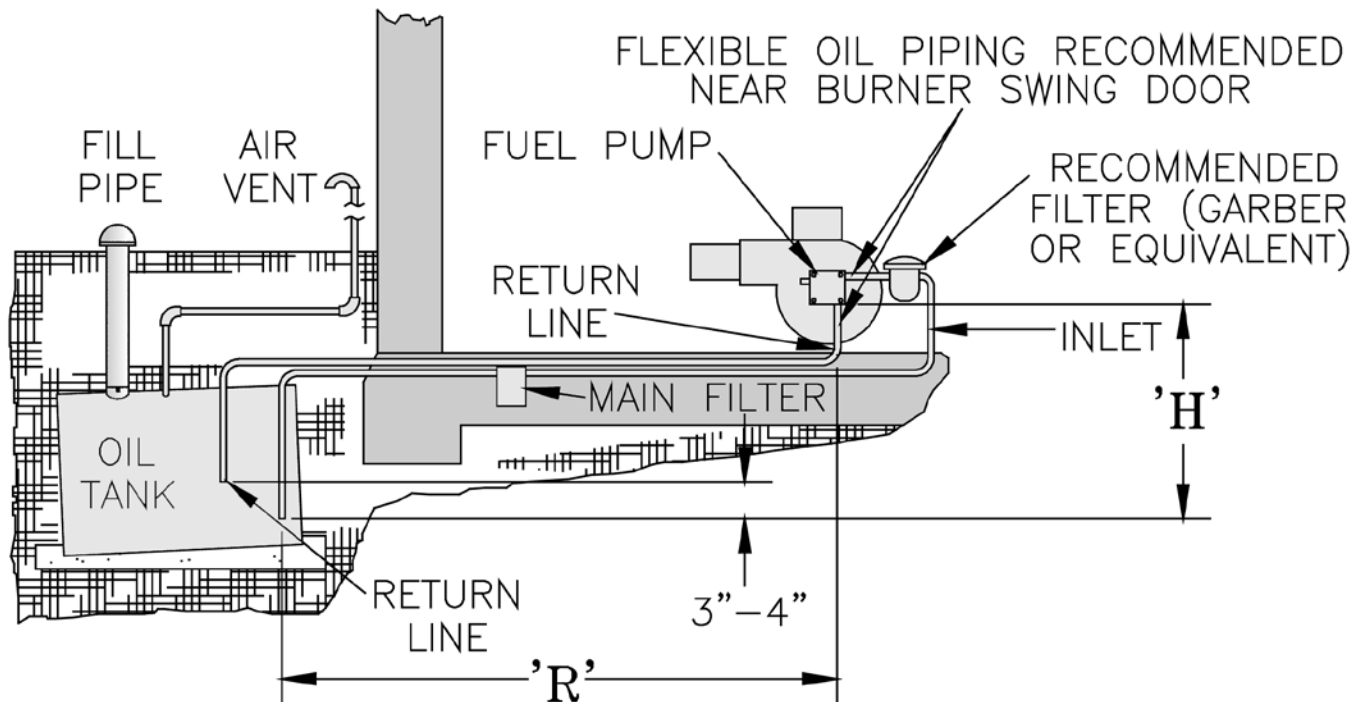


Figure 27: Two Pipe Oil Lines

SECTION XI: 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.

NOTICE

It is important, especially in a steam system, to properly remove the oil and dirt from the system. Failure to clean the system can result in erratic water lines and surging.

CLEAN HEATING SYSTEM if boiler water or condensate return water is dirty or if erratic water lines or surging exist after a few days of boiler operation. Refer to Maintenance and Service Instructions Section of this manual for proper cleaning instructions for steam and water boilers.

1. STEAM BOILERS — Fill boiler to normal water line. Refer to Figure 1D.
2. HOT WATER BOILERS. 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 15A and 15B, 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.

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.

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.

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

C. CHECK CONTROLS, WIRING AND

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

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

1. SET ROOM THERMOSTAT about 10°F below room temperature.
2. PRESS RED RESET BUTTON on front of burner cover (Beckett, Riello burners) or Primary Control (Carlin Burner), hold button for one (1) second and release to reset primary control.

SECTION XI: SYSTEM START-UP (continued)

3. STEAM BOILERS:

With an L404F Pressure Limit - set cut-out pressure (MAIN scale) on the pressure limit for (1) PSI and differential pressure (DIFF.) for .5 PSI. These pressures may be varied to suit individual requirements of the system.

4. STEAM BOILERS WITH TANKLESS

DOMESTIC WATER HEATERS, set boiler water temperature dial on L4006 operating control at 190°F (max.). Set differential at 10°.

5. 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

6. 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. 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.

7. CHECKOUT

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

E. ADJUST OIL BURNER BEFORE STARTING.

1. CHECK BURNER SETTINGS and readjust if necessary, see Burner Specifications, Table 12 at the rear of this manual.

2. Beckett Burners

- 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 29A and Table 12 at the rear of this manual.
- Check burner air band and air shutter settings. Readjust if necessary, see Table 12 at the rear of this manual.
- OPEN ALL OIL LINE VALVES.
- Attach a plastic hose to fuel pump vent fitting and provide a pan to catch the oil.
- OPEN FLAME OBSERVATION PORT COVER on burner swing door.

3. Carlin Elite EZ Burners

- Inspect Carlin head setting on left side of burner to ensure that the proper head positioning bar matches the nozzle that is installed in drawer assembly. Refer to Section III, Paragraph K, Step 7b and Table 12 at the rear of this manual. Replace bar if necessary.
- Check air band settings. Readjust if necessary, see Table 12 at the rear of this manual.
- OPEN ALL OIL LINE VALVES.
- Attach a plastic hose to fuel pump vent fitting and provide a pan to catch the oil.
- OPEN FLAME OBSERVATION PORT COVER on burner swing door.

4. Carlin 102CRD Burners

- Inspect Carlin head setting on left side of burner by reading the scale embossed on the housing. Refer to Figure 7A and Table 12 at the rear of this manual.
- Check air band settings. Readjust if necessary, see Table 12 at the rear of this manual.
- OPEN ALL OIL LINE VALVES.
- Attach a plastic hose to fuel pump vent fitting and provide a pan to catch the oil.
- OPEN FLAME OBSERVATION PORT COVER on burner swing door.

5. Riello Burners

- Inspect Riello head setting on left side of burner by reading the scale embossed on the housing cover. Refer to Figure 7D and Table 12 at the rear of this manual.
- Inspect Riello burner air damper and turbulator setting. Readjust if necessary, see Table 12 at the rear of this manual.
- OPEN ALL OIL LINE VALVES.
- Provide a pan to catch oil.
- Remove pressure port/bleeder plug from fuel pump and install Riello Combination Pressure Gauge and Bleeder Valve Assembly.
- OPEN FLAME OBSERVATION PORT COVER on burner swing door.

F. START OIL BURNER.

- Open vent fitting on fuel pump.
- 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.
- 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

SECTION XI: SYSTEM START-UP (continued)

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 and Carlin burners refer to Figure 28. Refer to Figure 7E for Riello burner.
 - b. Locate oil pressure adjusting screw and turn screw to obtain proper pump pressure, refer to Table 12 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.

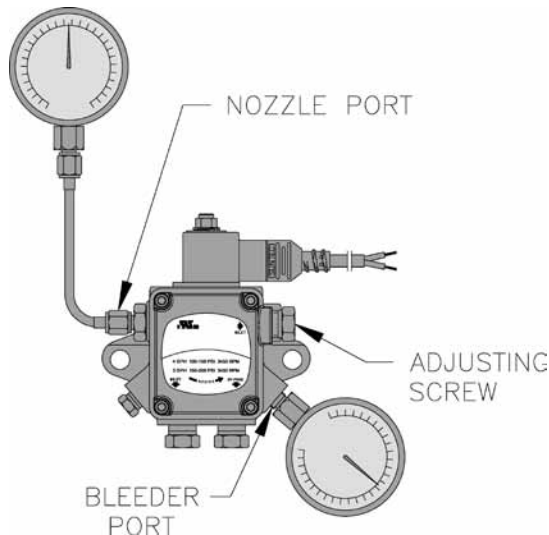


Figure 28: Adjusting Fuel Pump Pressure

G. ADJUST OIL BURNER WHILE OPERATING.

(flame present)

1. SET ROOM THERMOSTAT about 10°F below room temperature.
2. PRESS RED RESET BUTTON on Oil Primary Control and release.
3. READJUST THE HEAD SETTING only if necessary.

Beckett Burners

- a. V8H3:
Beckett MB(L1) Head burners have a fixed head which are non-adjustable.
- b. V8H4 thru V8H9:
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 29A.

Carlin Elite EZ Burners

- a. Carlin EZ-1HP and EZ-2HP burners use a head positioning bar to fix the head setting based on nozzle size. To adjust this setting, bar must be changed to the next larger or smaller bar available. Refer to Section III, Paragraph K, 7b for details.

Carlin 102CRD Burners

- a. V8H7 through V8H9

The Carlin 102 CRD-3 Burner has 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.

- b. If the fire is a little too rich, move the combustion head slightly forward by increasing dimension "A". Refer to Figure 7A.

4. READJUST THE TURBULATOR SETTING only if necessary.

Riello Burners

- a. V8H3 through V8H9

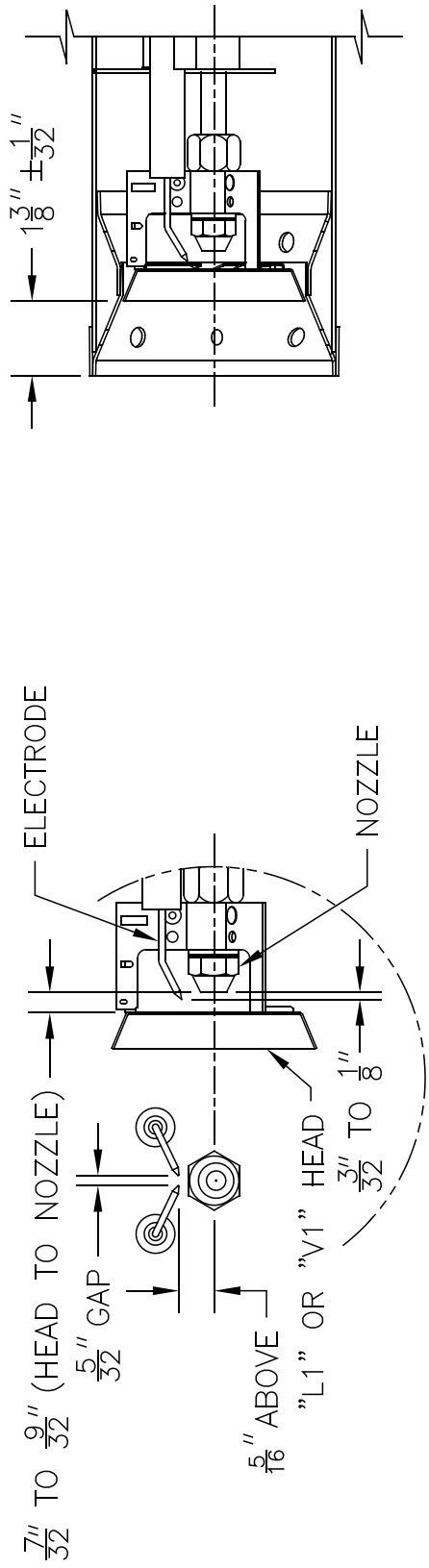
Move the turbulator setting forward or back one position at a time to optimize the smoke and CO₂ readings. Refer to Figure 7D and Table 12 at the rear of this manual.

5. 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.
6. READJUST THE AIR DAMPER SETTING (Air Band, Air Shutter or Air Gate) on the burner for a light orange colored flame while the draft over the fire is -0.02". Use a smoke tester and adjust air for minimum smoke (not to exceed #1) with a minimum of excess air. Make final check using suitable instrumentation to obtain a CO₂ of 11.5 to 12.5% with draft of -0.02" (water gauge) in fire box. These settings will assure a safe and efficient operating condition. If the flame appears stringy instead of a solid fire, try another nozzle of the same type. Flame should be solid and compact. After all adjustments are made recheck for a draft of -0.02" over the fire.
7. ONLY READJUST THE HEAD/TURBULATOR SETTING if necessary.

- a. V8H3 through V8H9

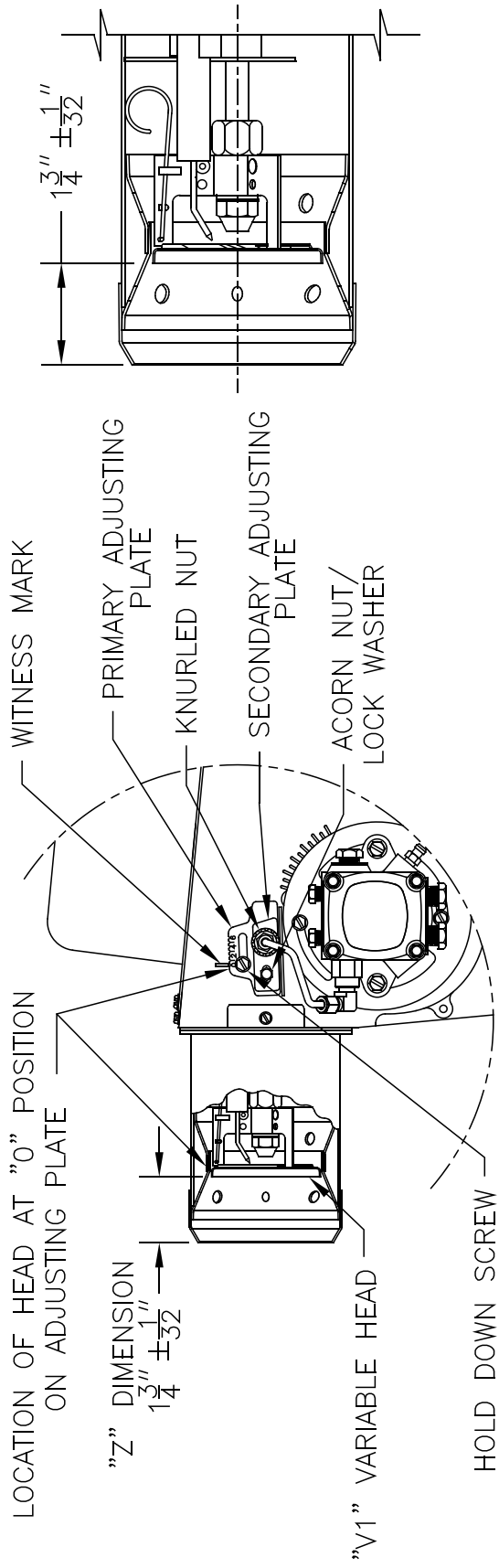
Move the setting forward or back one position at a time to optimize the smoke and CO₂ readings.

SECTION XI: SYSTEM START-UP (continued)



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

L1 HEAD



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

V1 HEAD

Figure 29A: "L1" and "V1" Head Electrode Positioning and Gun Setting (Beckett AFG)

SECTION XI: SYSTEM START-UP (continued)

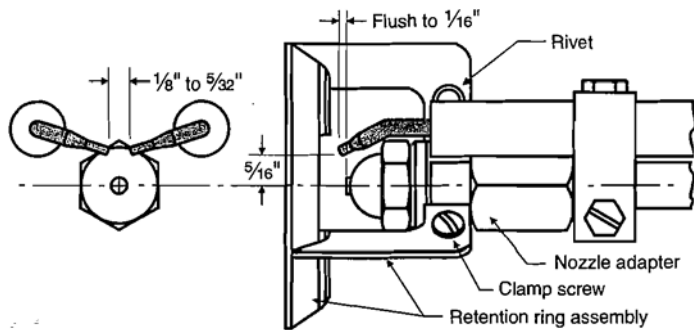


Figure 29B: Electrode Positioning, Retention Ring Assembly and Nozzle Adapter (Carlin EZ-1 / EZ-2)

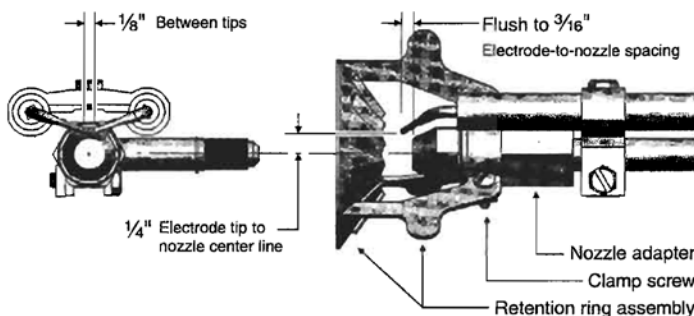


Figure 29C: Combustion Head / Nozzle / Electrode Settings (Carlin 102CRD)

8. Steps outlined in Paragraph 5 and 6 above must be repeated every time the Head/Turbulator or Air Band/ Damper Setting is readjusted.
9. 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.

10. FLAME FAILURE

The V8H 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

IMPORTANT: THESE DIMENSIONS MUST BE OBSERVED AND VERIFIED.

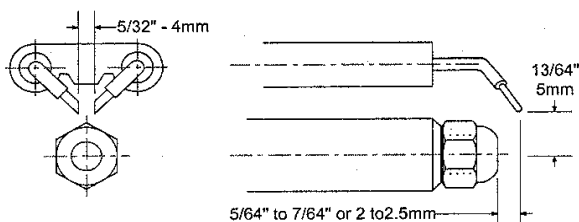


Figure 29D: Electrode Positioning (Riello 40 Series)

features, Paragraph I, Step 2 of this Section and Section XV, 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.

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, No. 1 above. If this does not stop the dripping, remove cut-off valve and seat, and wipe both with a clean cloth until clean, then replace and readjust oil pressure. If dripping or after burn persist replace fuel pump.

I. TEST CONTROLS.

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

WARNING

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

2. VERIFY OIL PRIMARY CONTROL

FEATURES using procedures outlined in Instructions furnished with control or instructions as follows:

- a. **GeniSys 7505 Control Features**, see Figure 30A.
 - 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

SECTION XI: SYSTEM START-UP (continued)

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. To reset a Restricted Mode lockout, hold button down for 15 seconds until the red light turns off and the yellow light turns on.

- v. "T-T" Jumper: Select models have pre-installed "T-T" 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" terminals. Refer to appropriate wiring diagram, see Figure 21A, 21B, 22, 23A, 23B, 24A or 24B.

- 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.
 - 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)

- b. **Honeywell R7284 Control Features**, see Figure 30B.

- i. The Oil Primary is a microprocessor-based control. The display provides diagnostic information for lockout, recycling and cad cell status.
- ii. Pump Priming Cycle: To facilitate purging air from the oil lines and filters, the R7284 can be placed in a purge routine by pressing and releasing the up arrow button during the Trial For Ignition. "Pump Prime" is shown on the oil primary display along with the time left on the Trial for Ignition (TFI). Pressing the up arrow button adds a minute to the TFI time for a maximum of

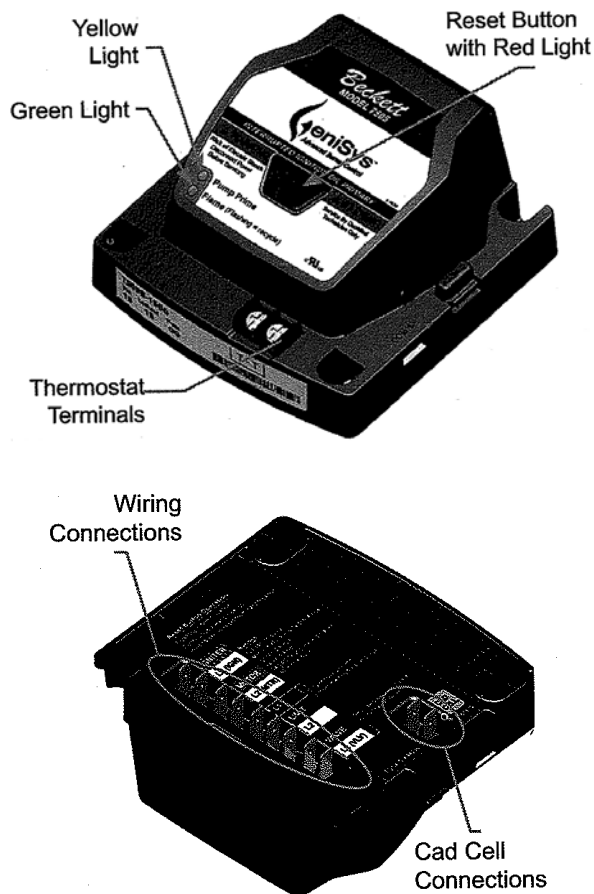


Figure 30A: GeniSys 7505 Oil Primary Terminals. LED's and Reset Button

SECTION XI: SYSTEM START-UP (continued)

10 additional minutes. (press the up arrow button 10 times). Pressing the down arrow subtracts a minute from the TFI time (see Figure 30B).

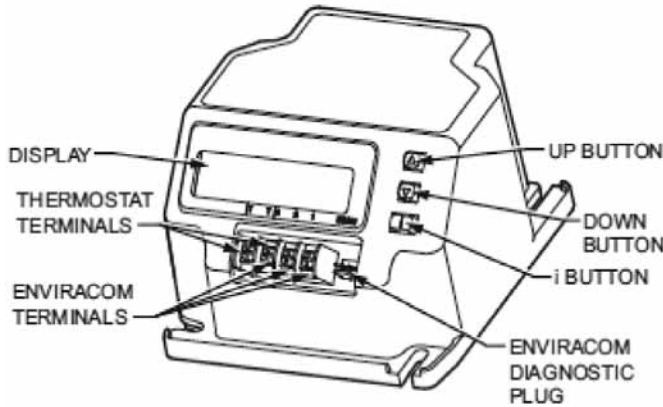


Figure 30B: R7284 Oil Primary Terminals, Display and Function Buttons

- 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 Oil Primary 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: All R7284 models have internal "TT" Configured ON" parameters set to "ON".
- Note:** DO NOT change "T-T" Configured ON" parameters to "OFF" unless wiring diagram indicates a direct connection from thermostat and/or tankless heater aquastat control to the oil burner primary control's "T-T" terminals. Refer to appropriate wiring diagram, see Figure 21A, 21B, 22, 23A, 23B, 24A or 24B.
- vi. Diagnostic Display: The R7284 has an LCD display and simply displays lockout and flame status on it.
 - vii. Cad Cell Resistance Check: For proper operation it is important that the cad cell resistance is below 1600 ohms.

Cad Cell Resistance (ohms) is measured by the oil primary. The thresholds are:
< 1600 Ohms Normal operation
> 1600 Ohms Service burner soon

> 6100 Ohms Flame loss, burner shuts down
> 9999 Ohms Check for broken cell or wire.
R7284 displays resistance in ohms during Running Mode.

b. 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.

- i. 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.
- ii. 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.
- iii. 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, see Figure 31. 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.

SECTION XI: SYSTEM START-UP (continued)

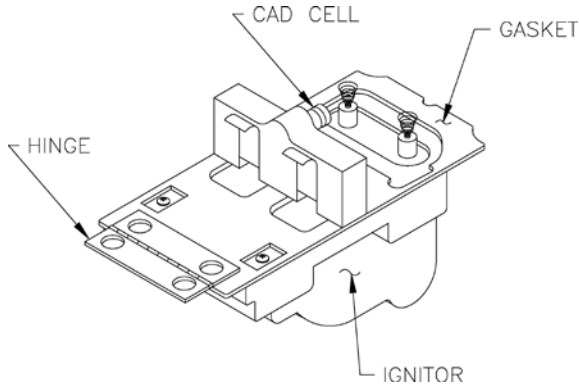


Figure 31: Cad Cell Location

- 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.
- iv. 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.

3. 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.
- e. Check low water cut-off control with water level at normal water line (see Figure 1D). Raise thermostat setting to allow burner to operate. Open boiler drain to allow water level to drop to bottom of sight glass until burner operation is shut-down by low water cut-off. Close boiler drain and refill to normal water line. Burner should automatically restart during fill. Lower thermostat setting.
- f. 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.

SECTION XII: OPERATING

A. WATER BOILERS SEQUENCE OF OPERATION

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

- a. The V8H Boiler is equipped with a Cold Start Intelligent Oil Boiler Control (Cold Start Boiler Control). The Cold Start Boiler Control replaces the traditional electronic aquastat and circulator relays and adds energy saving thermal purge features. Energy is saved by starting the circulator and delaying the burner start when there is residual heat available in the boiler.
- b. The boiler's sequence of operation is shown as Status Codes on Cold Start Boiler Control display. See Table 5 and Figure 32.
- c. When the thermostat calls for heat the boiler control starts the system circulator and the thermal purge (circulator pre-purge time) begins. If the time is completed or boiler temperature is less than the Start Temperature (140 F default) the start sequence continues by energizing the oil primary to operate the following sequence: blower is started and operates for pre-purge time; spark is energized and fuel valve is opened for ignition trial time; burner fires until the thermostat is satisfied.
- d. If the thermostat is not satisfied and the Operating Setpoint (SP) is reached the system circulator will continue to operate and the burner will stop. When the boiler water temperature drops below the setpoint less the differential setting the burner will restart.
- e. After the thermostat is satisfied the burner and circulator are stopped.
- f. When an indirect water heater aquastat call for heat is wired to the "ZR" terminal the Boiler Control starts a domestic hot water circulator connected to the "ZC" terminal and when the boiler temperature is less than Operating Setpoint (SP), the Cold Start Boiler Control energizes the oil primary to turn on the burner without circulator pre-purge delay.
- g. On burner start, if the CAD cell does not see flame within approximately 15 seconds, primary control will shut down the burner and enter into a lockout mode. A lockout is reset by pressing the reset button located on the primary control. If the flame is lost while the burner is firing, the primary control shuts down the burner, enters a 60 second recycle delay, and repeats the ignition sequence. If after three (3) trials for ignition, flame is not detected, primary control will enter into restricted mode. Restricted mode is reset by holding down the reset button for 15 seconds.

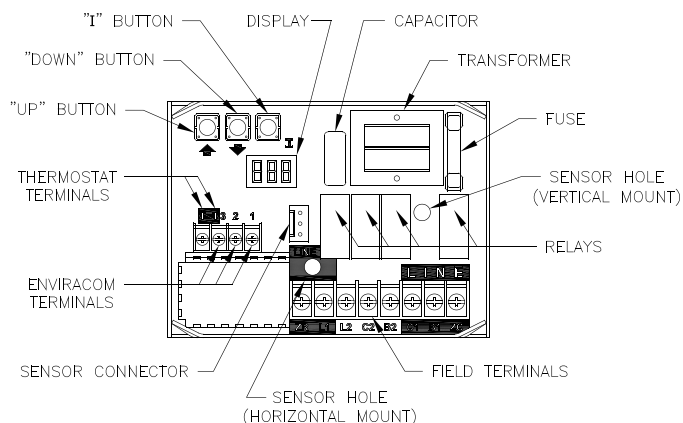


Figure 32: Intelligent Oil Boiler Control

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

- a. The V8H Boiler is equipped with a Warm Start Intelligent Oil Boiler Control (Warm Start Boiler Control). The Warm Start Boiler Control replaces the traditional high and low limit aquastat and circulator relays.
- b. The boiler's sequence of operation is shown as Status Codes on Warm Start Boiler Control display. See Table 5 and Figure 32.
- c. When the thermostat calls for heat the Warm Start 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 5: SEQUENCE OF OPERATION

Status Codes Displayed in <i>StR</i> Mode		
<i>StR</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

SECTION XII: 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 Cold or Warm Start Boiler Control (Boiler Control) Features

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 33).

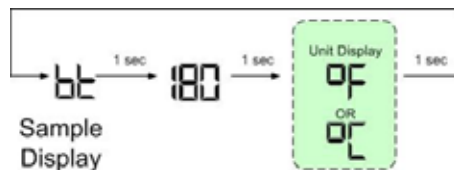
4. Viewing the Operating Mode Options

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

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

Operating Mode Options	
Status Numbers:	
5tA	1 Standby
	8 Running
	∩ Self Test)
bt	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 "bt" is displayed, it will then flash a three digit number (such as "180") followed by either "F" (or "L"). 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.

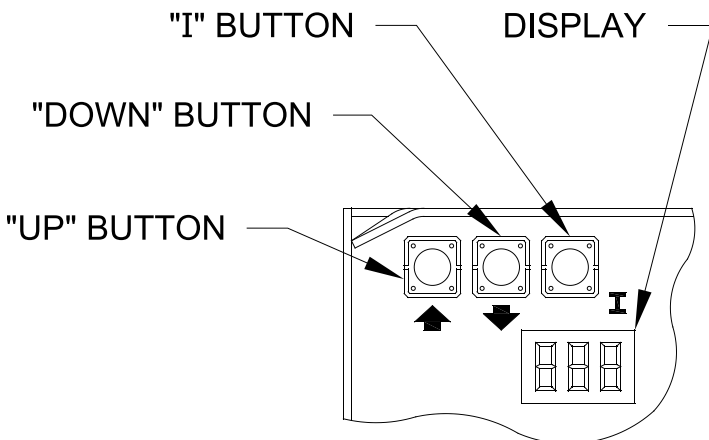


Figure 33: Boiler Control Key Function & Orientation

SECTION XII: OPERATING (CONTINUED)

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

Warm Start Boiler Control Adjustment Mode Options		
<i>HL</i> ₋	140-240°F	Adjust High Limit Setting
<i>LL</i> ₋	110-220°F	Adjust Low Limit Setting
<i>LdF</i>	10-25°F	Adjust Low Limit Differential Setting
<i>ZC</i> ₋	<i>Zr</i> or <i>dh</i>	ZC and ZR Terminal Function
<i>Or</i> ₋	0-10 minutes	Pump Overrun Time
<i>PP</i> ₋	0-20 minutes	Pump Pre-purge Time
<i>St</i> ₋	140 - 180°F	Start Temperature
<i>Pt</i> ₋	<i>On</i> or <i>OFF</i>	Priority Time
<i>F-C</i>	<i>F</i> or <i>C</i>	Select degrees F or C Mode
<i>bRc</i>		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 "bRc" 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 6.

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

SECTION XII: OPERATING (CONTINUED)

TABLE 6: CIRCULATOR PRE-PURGE TIME EXAMPLE, PARAMETER PP_ = 2 MINUTES

Call for Heat	ZC and ZR Terminal Function (ZC_)	Boiler Temp.	Boiler Status, (B1 Output)
TT = on	--	< 140	Start with no delay
TT = on	--	>140	Start after 2 minute delay
ZR = on	ZC_ = Zr	<140	Start with no delay
ZR = on	ZC_ = Zr	>140	Start after 2 minute delay
ZR = on	ZC_ = dH	<140	Start with no delay
ZR = on	ZC_ = dH	>140	Start with no delay

TABLE 7: DOMESTIC HOT WATER DEMAND, (PARAMETER ZC_ = dH)

Call for Heat		Priority Time (PE_)	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

g. Start Temperature (SE_)

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 (PE_)

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 7.

i. "ZC" and "ZR" Terminal Function (ZC_)

The boiler control allows configuration of the "ZC" output functionality to help the V8H 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 ZC_ 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 7.

SECTION XII: OPERATING (CONTINUED)

TABLE 8: ZONE REQUEST, PARAMETER $\mathcal{ZC}_- = \mathcal{Zr}$

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 \mathcal{ZC}_- is set equal to Zone Request (\mathcal{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 Cold Start Boiler Control replaces the need for a two circulator zone panel. When DHW Terminal Function (\mathcal{dh}_-) is set to \mathcal{Zr} the boiler control's two circulator outputs are used to control two independent heating zones. Refer to Table 8. 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.

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

- iii. External Low Limit, Parameter $\mathcal{ZC} = \mathcal{ELL}$
- 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 9.

TABLE 9: EXTERNAL LOW LIMIT, PARAMETER $\mathcal{ZC}_- = \mathcal{ELL}$

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

B. STEAM BOILERS SEQUENCE OF OPERATION

Upon a thermostat call for heat, when provided, the R8239A Control Center Relay or the Oil Primary Control is energized when the steam pressure is below the L404F Pressure Limit and water level is above the Low Water Cut-Off. When energized the Oil Primary Control starts the burner as follows; blower is started and operates for a pre-purge time; spark is energized and fuel valve is opened for ignition trail time; the fuel valve remains open when flame is proven. The burner fires until the thermostat is satisfied or the Pressure Limit setting is reached. The Oil Primary Control stops the burner by closing the fuel valve and operating the blower for post-purge time. Upon a drop in pressure, steam pressure below the L404F Pressure Limit, the burner will re-start if the thermostat is still calling for heat. When there is a tankless heater included and there is no demand for heat, the L4006A operating control will maintain the boiler water temperature at the selected setting for proper operation of the domestic water heater.

The probe low water cut-off will shut down the burner after a 10-15 second delay, if the water level in the boiler drops below the probe level. The Hydrolevel CG450 low water cut-off will shut down the burner for 90 seconds every 10 minutes of firing time to allow water level to stabilize. If the water level is too low the burner will not be allowed to restart. The low water cut-off will reset and restart the burner with a call for heat a few seconds after the water is returned to its normal level.

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.

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.

SECTION XIII: MAINTENANCE AND SERVICE INSTRUCTIONS

A. MAINTENANCE OF LOW WATER CUT-OFF DEVICES

WARNING

Probe and float type low water cut-off devices require annual inspection and maintenance.

1. PROBE TYPE LOW WATER CUT-OFF

Although these devices are solid state in their operation, the probe is exposed to possible contamination in the boiler water and subject to fouling.

It is important to physically remove the probe from the boiler tapping annually and inspect that probe for accumulation of scale or sediment.

Follow these steps to inspect, clean and/or replace the probe:

- a. Turn off electric service to the boiler.
- b. Drain boiler water to a level below the tapping for the probe.
- c. Disconnect wiring connections between the low water cut-off control and the probe.
- d. Remove the low water cut-off control from the probe.

DANGER

Assure that the boiler is at zero pressure before removing the LWCO probe. DO NOT rely on the pressure gauge to indicate that the boiler is at zero pressure. Open the safety valve to relieve all internal pressure prior to proceeding. Safety valve discharge piping must be piped such that the potential for burns is eliminated.

- e. Unscrew the probe from the boiler tapping.
- f. Inspect that portion of the probe that is exposed to the boiler water for a scale or sediment buildup.
- g. Light deposits may be removed by wiping the probe with a damp cloth. Wiping the probe with a cloth soaked in vinegar will remove more tenacious lime deposits. The most stubborn deposits may be removed from the probe by using a diluted amount, 3 parts of water to 1 part of phosphoric acid (H_2PO_4).

CAUTION

Exercise caution when handling phosphoric acid and follow the instruction label on its container.

- h. Clean the pipe threads of the probe to remove old, hardened pipe dope and other foreign matter.
- i. Apply a moderate amount of good quality pipe dope to the pipe threads on the probe, leaving the two end threads bare. **DO NOT** use PTFE (Teflon) tape.
- j. Screw the probe into the boiler tapping.
- k. Mount the low water cut-off control on the probe.
 - l. Reconnect the control to probe wiring.
- m. Fill the boiler to its normal waterline.
- n. Add boiler water treatment compound as needed (refer to Paragraph B.).
- o. Restore electric service to the boiler.
- p. Fire burner to bring the water in the boiler to a boil to drive off free oxygen.
- q. **WARNING — BEFORE RETURNING BOILER TO SERVICE:** Follow the low water cut-off check out procedure in Section X, Paragraph I, No. 4.

2. FLOAT TYPE LOW WATER CUT-OFF

During the heating season, if an external low water cut-off is on the boiler, the blow off valve should be opened once a month (use greater frequency where conditions warrant), to flush out the sediment chamber so the device will be free to function properly.

Low water cut-offs and water feeders should be dismantled annually by qualified personnel, to the extent necessary to insure freedom from obstructions and proper functioning of the working parts. Inspect connecting lines to boiler for accumulation of mud, scale, etc., and clean as required. Examine all visible wiring for brittle or worn insulation and make sure electrical contacts are clean and that they function properly. Give special attention to solder joints on bellows and float when this type of control is used. Check float for evidence of collapse and check mercury bulb (where applicable) for mercury separation or discoloration. ***DO NOT attempt to repair mechanisms in the field.*** Complete replacement mechanisms, including necessary gaskets and installation instructions are available from the manufacturer.

B. BOILER AND SYSTEM CLEANING INSTRUCTIONS FOR TROUBLE FREE OPERATION

1. STEAM BOILERS

- a. Oil, greases & sediments which accumulate in a new boiler and piping must be removed in order to prevent an unsteady water line and carry over of the water into the supply main above boiler.

SECTION XIII: MAINTENANCE AND SERVICE INSTRUCTIONS (cont'd)

Operate the boiler with steam in the entire system for a few days allowing the condensate to return to the boiler. If the condensate can temporarily be wasted, operate boiler only for the length of time it takes for condensate to run clear. If the latter cannot be achieved or if the condensate is returned to the boiler, boil out the boiler using the SURFACE BLOW-OFF connection, see Figure 5 (tappings, J).

- i. Drain boiler until 1" of water is visible in gauge glass. Run temporary 1½" NPT pipe line from the surface blow-off connection to an open drain or some other location where hot water may be discharged safely. **DO NOT** install valve in this line.
- ii. Drain about 5 gallons of hot water from boiler into a container and dissolve into it an appropriate amount of recommended boil out compound. Remove safety valve & add solution to boiler water thru exposed tapping using a funnel.

NOTICE

Check with local authorities or consult local water treatment services for acceptable chemical cleaning compounds.

- iii. Start burner and operate sufficiently to boil the water without producing steam pressure. Boil for about 5 hours. Open boiler feed pipe sufficiently to permit a steady trickle of water from the surface blow-off pipe. Continue this slow boiling and trickle of overflow for several hours until the water coming from the overflow is clear.
 - iv. Stop burner and drain boiler in a manner and to a location that hot water can be discharged with safety.
 - v. Refill boiler to normal water line. If water in gauge glass does not appear to be clear, repeat steps (i. thru iii.) and boil out the boiler for a longer time.
- b. Low pressure steam boilers such as the V8H Series should be maintained with appropriate water treatment compounds. Add suitable water treatment compounds as recommended by your qualified water treatment company.
 - c. Remove temporary surface blow-off piping, plug tapping and reinstall safety valve. Boil or bring water temperature to 180°F promptly in order to drive off the dissolved gases in the fresh water.
 - d. If unsteady water line, foaming or priming persist, install gate valve in Hartford Loop and drain valves in return main and at boiler as shown in Figure 16 and proceed as follows:

- i. Connect hoses from drain valves to floor drain. Close gate valve in Hartford Loop and open drain valve in return main. Fill boiler to normal water level, turn on oil burner and operate boiler at this water level for at least 30 minutes after the condensate begins to run hot, then turn off burner. Close all radiator valves. Remove all supply main air valves and plug the openings in supply main.
- ii. Draw about 5 gallons of hot water from boiler into a container and dissolve into it the appropriate amount of a recommended boilout compound. Remove safety valve from boiler and pour this solution into boiler, then reinstall safety valve.
- iii. Turn on oil burner and keep operating while feeding water to boiler slowly. This will raise water level in boiler slowly so that water will be boiling hot and will rise slowly into supply main and back through return main, flowing from drain hose at about 180°F. Continue until water runs clear from drain hose for at least 30 minutes.
- iv. Stop feeding water to boiler but continue operating oil burner until excess water in boiler flows out through supply main and water lowers (by steaming) until it reaches normal level in boiler. Turn off oil burner. Drain boiler. Open all radiator valves. Reinstall all supply main air valves. Open gate valve in Hartford Loop.
- v. When boiler has cooled down sufficiently (crown sheet of sections are not too hot to touch), close the drain valves at boiler and in return main and feed water slowly up to normal level in boiler. Turn on oil burner and allow boiler to steam for 10 minutes, then turn off burner. Draw off one quart of water from bottom gauge glass fitting and discard. Draw off another quart sample and if this sample is not clear, repeat the cycle of draining the boiler and return main and refilling the boiler until sample is clear.
- vi. If the boiler water becomes dirty again at a later date due to additional sediment loosened up in the piping, close gate valve in Hartford Loop, open drain valve in return main, turn on oil burner and allow Condensate to flow to drain until it has run clear for at least 30 minutes while feeding water to boiler so as to maintain normal water level. Turn off oil burner, drain boiler, open gate valve in Hartford Loop, then repeat Step 1 above.

SECTION XIII: MAINTENANCE AND SERVICE INSTRUCTIONS (cont'd)

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

2. WATER BOILERS

- a. *Filling of Boiler and System — General* — In a hot water heating system, the boiler and entire system (other than the expansion tank) must be full of water for satisfactory operation. Water should be added to the system until the boiler pressure gauge registers 12 psi. To insure that the system is full, water should come out of all air vents when opened.
- b. *Boiling Out of Boiler and System.* The oil and grease which accumulate in a new hot water boiler can be washed out in the following manner.
- i. Remove relief valve using extreme care to avoid damaging it.
 - ii. Add an appropriate amount of recommended boil out compound.
 - iii. Replace relief valve.
 - iv. Fill the entire system with water.
 - v. Start firing the boiler.
 - vi. Circulate the water through the entire system.
 - vii. Vent the system, including the radiation.
 - viii. Allow boiler water to reach operating temperature, if possible.
 - ix. Continue to circulate the water for a few hours.
 - x. Stop firing the boiler.
 - xi. Drain the system in a manner and to a location that hot water can be discharged with safety.
 - xii. Remove plugs from all available returns and wash the water side of the boiler as thoroughly as possible, using a high-pressure water stream.
 - xiii. Refill the system with fresh water.

- c. Add appropriate boiler water treatment compounds as recommended by your qualified water treatment company.
- d. *Make pH or Alkalinity Test.*
 After boiler and system have been cleaned and refilled as previously described, test the pH of the water in the system. This can easily be done by drawing a small sample of boiler water and testing with hydrion paper which is used in the same manner as litmus paper, except it gives specific readings. A color chart on the side of the small hydrion dispenser gives the reading pH. Hydrion paper is inexpensive and obtainable from any chemical supply house or through your local druggist. The pH should be higher than 7 but lower than 11. Add appropriate water treatment chemicals, if necessary, to bring the pH within the specified range. With this lower level of protection, care must be exercised to eliminate all of the free oxygen in the system.
- e. Boiler is now ready to be put into service.

C. EXCESSIVE MAKE-UP WATER

IMPORTANT		
IF, DURING NORMAL OPERATION, IT IS NECESSARY TO ADD MORE WATER THAN INDICATED BELOW, CONSULT A QUALIFIED SERVICE TECHNICIAN TO CHECK YOUR SYSTEM FOR LEAKS.		
Model No.	Gallons Per Month	Gallons Per Year
V8H3	0.3	3
V8H4	0.4	5
V8H5	0.5	6
V8H6	0.6	7
V8H7	0.7	8
V8H8	0.7	9
V8H9	0.8	10

A leaky system will increase the volume of make-up water supplied to the boiler which can significantly shorten the life of the boiler. Entrained in make-up water are dissolved minerals, salts and oxygen. When the fresh, cool make-up water is heated in the boiler the minerals fall out as sediment, the salts coat the inside of the boiler, and the oxygen escapes as a gas. The accumulation of sediment eventually isolates the water from contacting the cast iron. When this happens the cast iron in that area gets extremely hot and eventually cracks. The presence of free oxygen or chloride salts in the boiler corrodes the cast iron from the inside.

SECTION XIII: MAINTENANCE AND SERVICE INSTRUCTIONS (cont'd)

More make-up water and higher concentrations of contaminants damage the boiler sooner. **Our warranty does not cover corrosion and sediment-related damage.** Clearly it is in everyone's best interest to prevent this type of failure. You can do your part by ensuring that your system is leak-free, keeping leakage to less than 2 percent of the boiler water volume each month.

D. ATTENTION TO BOILER WHILE NOT IN OPERATION.

NOTICE

If boiler is not used during winter time, it must be fully drained to prevent freeze damage.

1. Spray inside surfaces with light lubricating or crankcase oil using gun with extended stem so as to reach all corners.
2. With steam boilers, at end of season add sufficient water to fill boiler to top of water column and leave it that way until fall when water should be drained again to proper level. If at this time boiler water is dirty, drain water, flush out boiler, and refill with clean water to prescribed water level.

3. Always keep the manual fuel supply valve shut off if the burner is shut down for an extended period of time.
4. To recondition the heating system in the fall season after a prolonged shut down, follow the instructions outlined in Section X, Paragraphs A through K.

WARNING

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

SECTION XIV: BOILER CLEANING

WARNING

All boiler cleaning must be completed with burner service switch turned off. 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. **CLEAN THE FLUEWAYS** (See Figure 34).
1. Prior to cleaning boiler, lay a protective cloth or plastic over combustion chamber blanket to collect debris falling from flueways. Several models **DO NOT** utilize a combustion chamber blanket, see Section XIV, Repair Parts, Item 1 Bare Boiler Assembly for details.
 2. For access to combustion chamber remove two (2) 5/16" - 18 cap screws, one on the right (1¼" long) and one on the left (3¼" long). If boiler is equipped with flexible fuel line(s), swing door open.
 3. For cleaning from the side:
 - a. Remove the jacket right side access panel to expose the flue cover plates.
 - b. Loosen nuts securing the flue cover plates and remove the plates. The rope gasket should be removed with the plates with care to avoid damage to the rope gasket.
 4. For cleaning from the top:
 - a. Remove as much vent pipe as necessary to allow removal of the jacket top panel and canopy.
 - b. Remove the jacket top panel.
 - c. Remove the canopy, being careful not to damage the gasket.
 5. Using a 1¼" diameter wire or fibre bristle brush (30" handle) clean the flueways. Brush from the top and/or side using horizontal and diagonal strokes for best results. **DO NOT** allow brush to strike the target wall or liner in the chamber.

B. **CLEAN TOP OF BOILER SECTIONS**

(if cleaning from the top).

Brush and vacuum the tops of the boiler sections.

C. **CLEAN THE COMBUSTION CHAMBER.**

Using wire or fibre bristle brush, clean crown of boiler and inside of water legs.

- D. **AFTER CLEANING,** remove protective cloth or plastic with debris and vacuum as necessary, but be careful not to damage blanket. Inspect target wall, combustion chamber blanket, burner swing door insulation, and rope gasket for signs of damage. If damaged, replace as needed.

E. **REASSEMBLE BOILER.**

CAUTION

DO NOT start the burner unless canopy, vent pipe, burner swing door and all flue cover plates are secured in place.

1. Install the canopy taking care to align the gasket without blocking the flueways. If gasket is damaged, replace as needed.
2. Reinstall flue cover plates, making sure rope gasket on each plate is in place and forms a gas tight seal. If damaged replace as needed.
3. Reinstall jacket top panel and/or jacket upper right side access panel with #8 x ½" long sheet metal screws.
4. Reinstall vent pipe on canopy and secure to collar with sheet metal screws.
5. Close burner swing door. Secure door to front section with 5/16" flange nut and washer (right side) and 5/16" x 3½" lg. bolt (left side).

NOTICE

When securing burner swing door make sure door is drawn-in equally on both sides.

Tighten swing door hardware to provide adequate seal to rope gasket around perimeter of door.

Use an alternating tightening method from right side flange nut to left side cap screw to pull door tight equally.

WARNING

DO NOT allow brush to strike target wall or blanket in the combustion chamber.

SECTION XIV: BOILER CLEANING (continued)

NOTES:

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

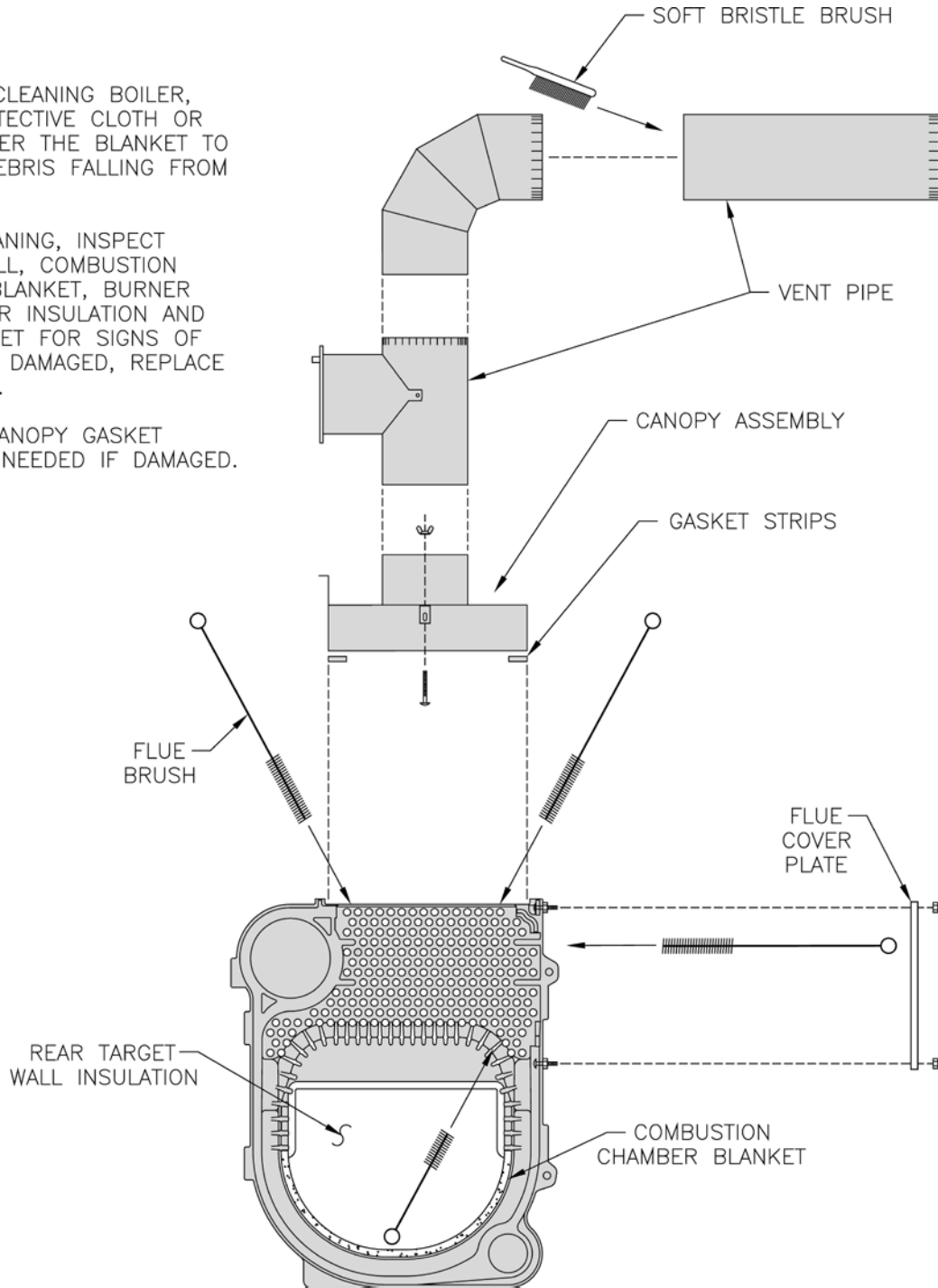


Figure 34: Cleaning of Boiler Flueways

WARNING

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

SECTION XV: TROUBLESHOOTING

A. COMBUSTION

1. **NOZZLES** — Although the nozzle is a relatively inexpensive device, its function is critical to the successful operation of the oil burner. The selection of the nozzle supplied with the V8H boiler is the result of extensive testing to obtain the best flame shape and efficient combustion. Other brands of the same spray angle and spray pattern may be used but may not perform at the expected level of CO₂ and smoke. Nozzles are delicate and should be protected from dirt and abuse. Nozzles are mass-produced and can vary from sample to sample. For all of those reasons a spare nozzle is a desirable item for a serviceman to have.
2. **FUEL LEAKS** — Any fuel leak between the pump and the nozzle will be detrimental to good combustion results. Look for wet surfaces in the air tube, under the ignitor, and around the air inlet. Any such leaks should be repaired as they may cause erratic burning of the fuel and in the extreme case may become a fire hazard.
3. **SUCTION LINE LEAKS** — Any such leaks should be repaired, as they may cause erratic burning of the fuel and in extreme cases may become a fire hazard. Whatever it takes, **The Oil Must Be Free of Air**. This can be a tough problem, but it must be resolved. Try bleeding the pump through a clear tube. There must be no froth visible. There are various test kits available to enable you to look at the oil through clear tubing adapted to the supply line at the pump fitting. Air eliminators are on the market that have potential. Also, electronic sight glasses are being used with good success. At times, new tubing must be run to the tank or new fittings put on. Just make sure you get the air out before you leave.

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

NOTICE

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

SECTION XV: TROUBLESHOOTING (continued)

B. OIL PRIMARY CONTROL (Oil Primary)

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

g. Oil valve stuck open or closed.

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

NOTICE

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

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

C. INTELLIGENT OIL BOILER CONTROL

- **Cold Start Boiler Control** is used on Boilers without Tankless Heaters.
 - **Warm Start Boiler Control** is used on Boilers with Tankless Heaters
1. When a problem occurs with the boiler operation, the Boiler Control easily provides specific, valuable information to help resolve the issue quickly. The display on the Boiler Control should be the first place to check.
 - a. If an **Error Code "Err"** **IS NOT** displayed on the Boiler Control: In this circumstance, Table 10 can be used to determine the problem and possible causes.

TABLE 10: TROUBLESHOOTING GUIDE

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

SECTION XV: TROUBLESHOOTING (continued)

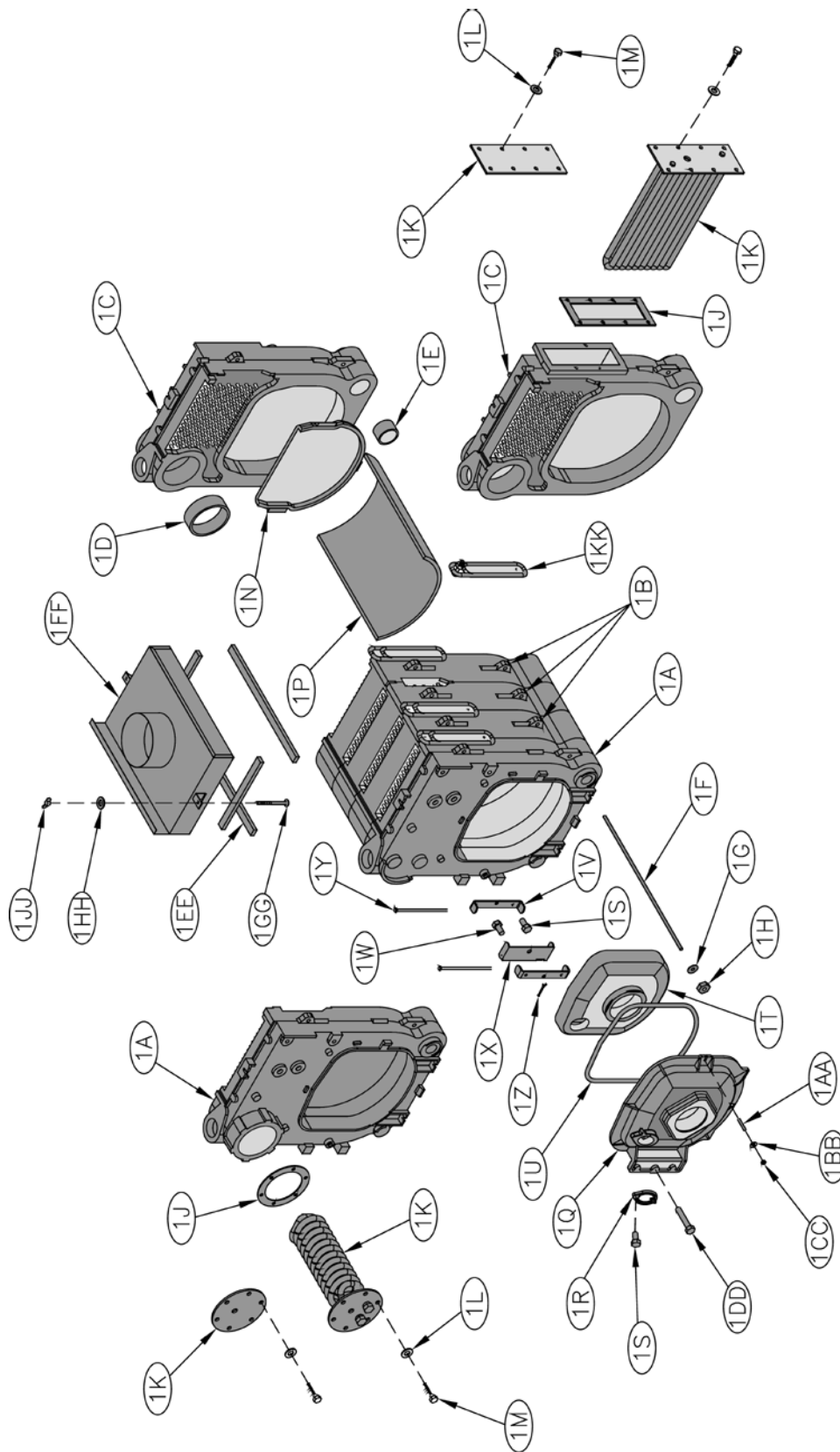
- b. If the Boiler Control detects an error it will flash "Err" (boiler control error) followed by a number. Use this text and number to identify the boiler problem and corrective action in Table 11 below.

TABLE 11: BOILER CONTROL ERROR NUMBERS

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

SECTION XVI: REPAIR PARTS

All V8H™ Series Boiler Repair Parts may be obtained through your local U.S. Boiler Company Wholesale distributor. Should you require assistance in locating a U.S. Boiler Company Distributor in your area, or have questions regarding the availability of U.S. Boiler Company products or repair parts, please contact U.S. Boiler Company Customer Service at (717) 481-8400 or Fax (717) 481-8408.

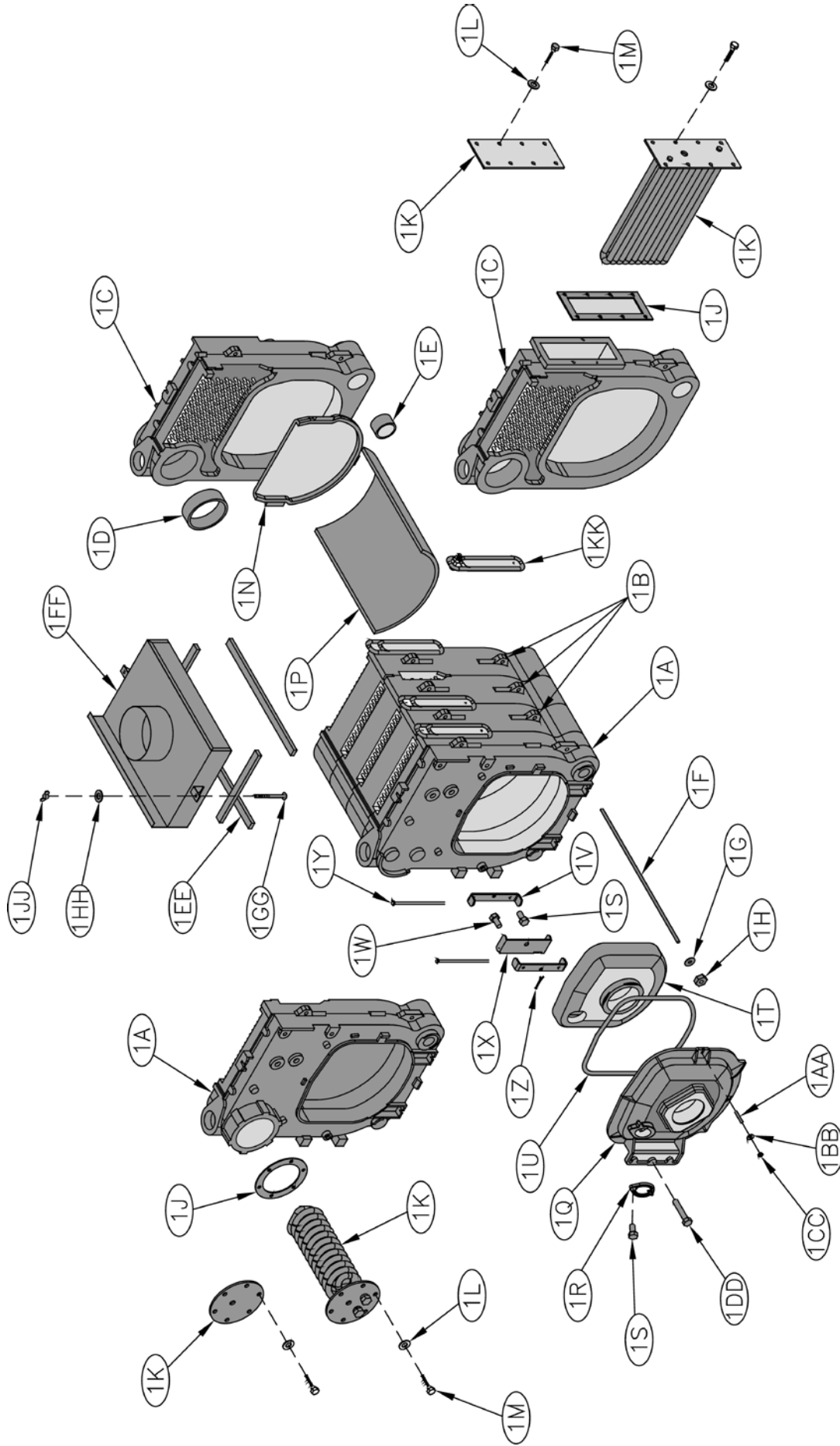


Bare Boiler Assembly

SECTION XVI: REPAIR PARTS (continued)

Item No.	Description	Part No.	V8H3	V8H4	V8H5	V8H6	V8H7	V8H8	V8H9
1. BARE BOILER ASSEMBLY									
1A	Front Section (Non-Htr.), Machined Water ---(OR)---	71728103	1	1	1	1	1	1	1
	Front Section (Non-Htr.), Machined Steam	71728104	1	1	1	1	1	1	1
	Front Heater Section, Machined Water ---(OR)---	71728101	1	1	1	1	1	1	1
	Front Heater Section, Machined Steam	71728102	1	1	1	1	1	1	1
1B	Center Section	71728201	1	2	3	4	5	6	7
1C	Back Section (Non-Htr.), Machined Water ---(OR)---	71728302	1	1	1	1	1	1	1
	Back Section (Non-Htr.), Machined Steam ---(OR)---	71728303	1	1	1	1	1	1	1
	Heater Back Section, Machined Steam/Water	71728301	1	1	1	1	1	1	1
1D	5" Cast Iron Slip Nipple	7066003	2	3	4	5	6	7	8
1E	Slip Nipple, 22-B Steel	806600375	2	3	4	5	6	7	8
1F	Tie Rod, 3/8"-16 x 12½" Lg.	80861010	2	---	---	---	---	---	---
	Tie Rod, 3/8"-16 x 17¾" Lg.	80861032	---	2	---	---	---	---	---
	Tie Rod, 3/8"-16 x 23" Lg.	80861049	---	---	2	---	---	---	---
	Tie Rod, 3/8"-16 x 27½" Lg.	80861014	---	---	---	2	---	---	---
	Tie Rod, 3/8"-16 x 32¾" Lg.	80861035	---	---	---	---	2	---	---
	Tie Rod, 3/8"-16 x 37¾" Lg.	80861105	---	---	---	---	---	2	---
	Tie Rod, 3/8"-16 x 42¾" Lg.	80861106	---	---	---	---	---	---	2
1G	3/8" Flat Washer	80860600	4	4	4	4	4	4	4
1H	3/8" -16 Hex Nut	80860423	4	4	4	4	4	4	4
1J	Heater Cover Plate Gasket - Front Heater	8036068	1	1	1	1	1	1	1
	Heater Cover Plate Gasket - Rear Heater	8036058	1	1	1	1	1	1	1
1K	Blank Heater Cover Plate (WN) - Front Heater	7036002	1	1	1	1	1	1	1
	Tapped Heater Cover Plate (WF[L]) - Front Heater	7036001	1	1	1	1	1	1	1
	Blank Heater Cover Plate (UR & WR) - Rear Heater	7036020	1	1	1	1	1	1	1
	Tapped Heater Cover Plate (WR[L]) - Rear Heater	7036021	1	1	1	1	1	1	1
	222A Heater Carton Assy. - (WF[T]) - Front Heater ---(OR)---	6036036	1	1	1	1	1	1	1
	A54 Heater Carton Assy. - (WF[T]) - Front Heater	6031204	---	---	---	---	1	1	1
1L	5/16" Flat Washer	Front Heater	80860611	6	6	6	6	6	6
		Rear Heater		8	8	8	8	8	8
1M	3/8" -16 x 7/8" Lg. Plated Cap Screw, ASME Grade SA307B	Front Heater	80861337	6	6	6	6	6	6
		Rear Heater		8	8	8	8	8	8
1N	Rear Target Wall Insulation	8202701	1	1	1	1	1	1	1

SECTION XVI: REPAIR PARTS (continued)

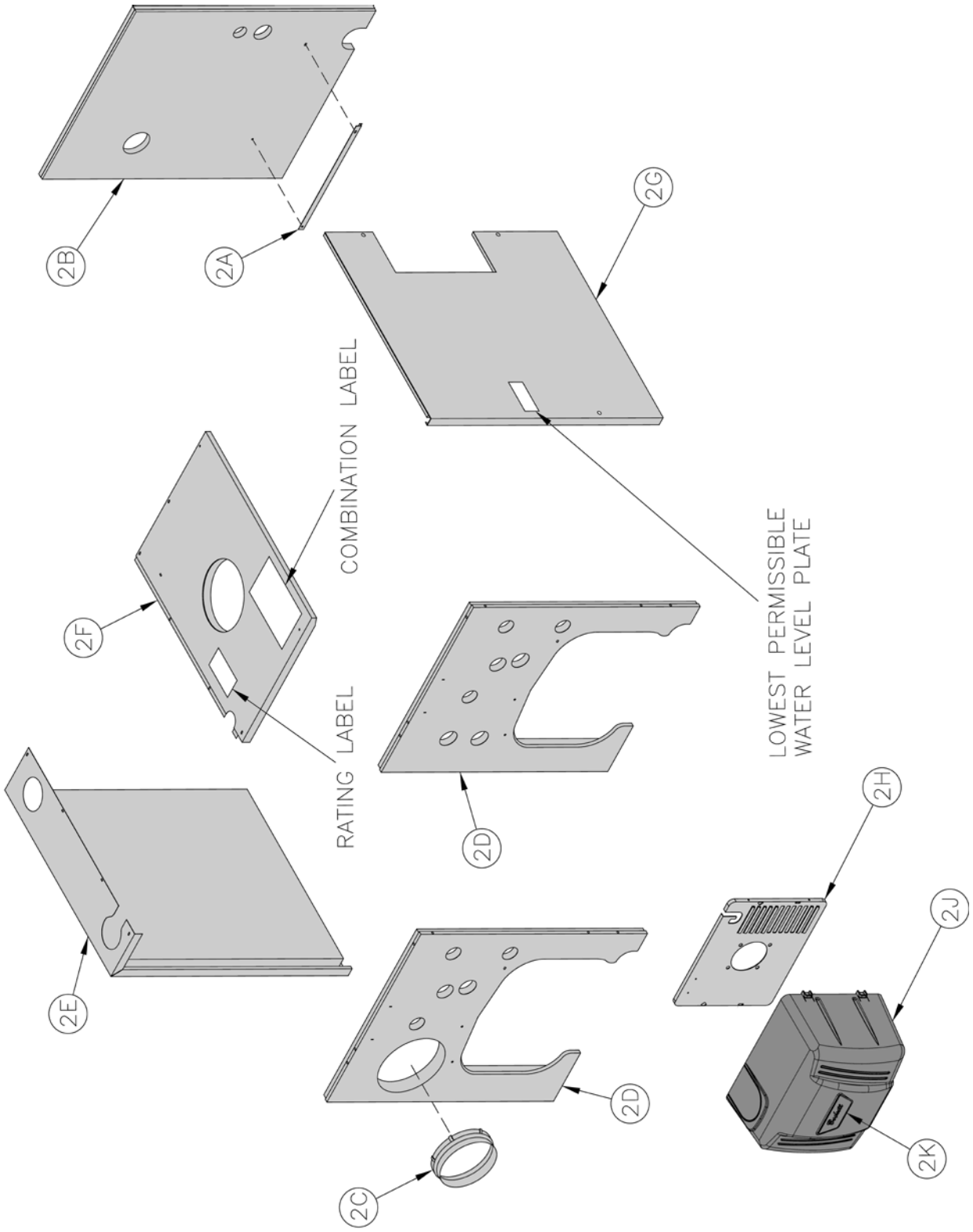


Bare Boiler Assembly (Continued)

SECTION XVI: REPAIR PARTS (continued)

Item No.	Description	Part No.	V8H3	V8H4	V8H5	V8H6	V8H7	V8H8	V8H9
1. BARE BOILER ASSEMBLY (Continued)									
1P	Combustion Chamber Blanket, 1/2" x 18-3/4" x 8-3/8"	82028035	1	---	---	---	---	---	---
	Combustion Chamber Blanket, 1/2" x 18-3/4" x 13-3/8"	82028045	---	1	---	---	---	---	---
	Combustion Chamber Blanket, 1/2" x 18-3/4" x 18-3/8"	82028055	---	---	1	---	---	---	---
	Combustion Chamber Blanket, 1/2" x 18-3/4" x 23-3/8"	82028065	---	---	---	1	---	---	---
	Combustion Chamber Blanket, 1/2" x 18-3/4" x 28-3/8"	82028075	---	---	---	---	1	---	---
	Combustion Chamber Blanket, 1/2" x 18-3/4" x 33-3/8"	82028085	---	---	---	---	---	1	---
	Combustion Chamber Blanket, 1/2" x 18-3/4" x 38-3/8"	82028095	---	---	---	---	---	---	1
1Q	Burner Swing Door, Painted Black (Door only)	71728005	1	1	1	1	1	1	1
1R	Observation Port Cover, Painted Black	71728004	1	1	1	1	1	1	1
1S	5/16" -18 x 3/4" Lg. Plated Cap Screw	80861340	3	3	3	3	3	3	3
1T	Burner Swing Door Insulation	82028004	1	1	1	1	1	1	1
1U	Rope Gasket - Burner Swing Door	82028005	1	1	1	1	1	1	1
1V	Hinge Bracket	7022802	2	2	2	2	2	2	2
1W	5/16" -18 x 5/8" Lg. Plated Cap Screw	80861377	2	2	2	2	2	2	2
1X	Intermediate Hinge, Painted Black	7022801	1	1	1	1	1	1	1
1Y	Hinge Pin	80861707	2	2	2	2	2	2	2
1Z	.042" Dia. x 15/16" Lg. Hairpin Cotter	80861667	2	2	2	2	2	2	2
1AA	5/16" -18 x 2" Lg. Stud, Threaded Both Ends	80861606	1	1	1	1	1	1	1
1BB	5/16" Flat Washer, Plated	80860611	1	1	1	1	1	1	1
1CC	5/16" -18 Flange Nut, Plated	80860443	1	1	1	1	1	1	1
1DD	5/16" -18 x 3-1/2" Lg. Hex Flange Bolt, Plated	80860895	1	1	1	1	1	1	1
1EE	Canopy Sealing Strip, 1/2" x 1-1/4" x 10', Poly Bag	6206001	1	1	1	1	1	1	1
1FF	V8H3 Canopy Assembly	611280321	1	---	---	---	---	---	---
	V8H4 Canopy Assembly	611280421	---	1	---	---	---	---	---
	V8H5 Canopy Assembly	611280521	---	---	1	---	---	---	---
	V8H6 Canopy Assembly	611280621	---	---	---	1	---	---	---
	V8H7 Canopy Assembly	611280721	---	---	---	---	1	---	---
	V8H8 Canopy Assembly	611280821	---	---	---	---	---	1	---
	V8H9 Canopy Assembly	611280921	---	---	---	---	---	---	1
1GG	1/4" -20 x 3" Lg. Carriage Bolt, Plated	80860119	2	2	2	2	2	2	2
1HH	1/4" Flat Washer, Plated	80860603	2	2	2	2	2	2	2
1JJ	1/4" -20 Wing Nut, Plated	80860910	2	2	2	2	2	2	2
1KK	Flue Cover Plate, Gasket & Hardware Assembly	61128002	2	3	4	5	6	7	8

SECTION XVI: REPAIR PARTS (continued)

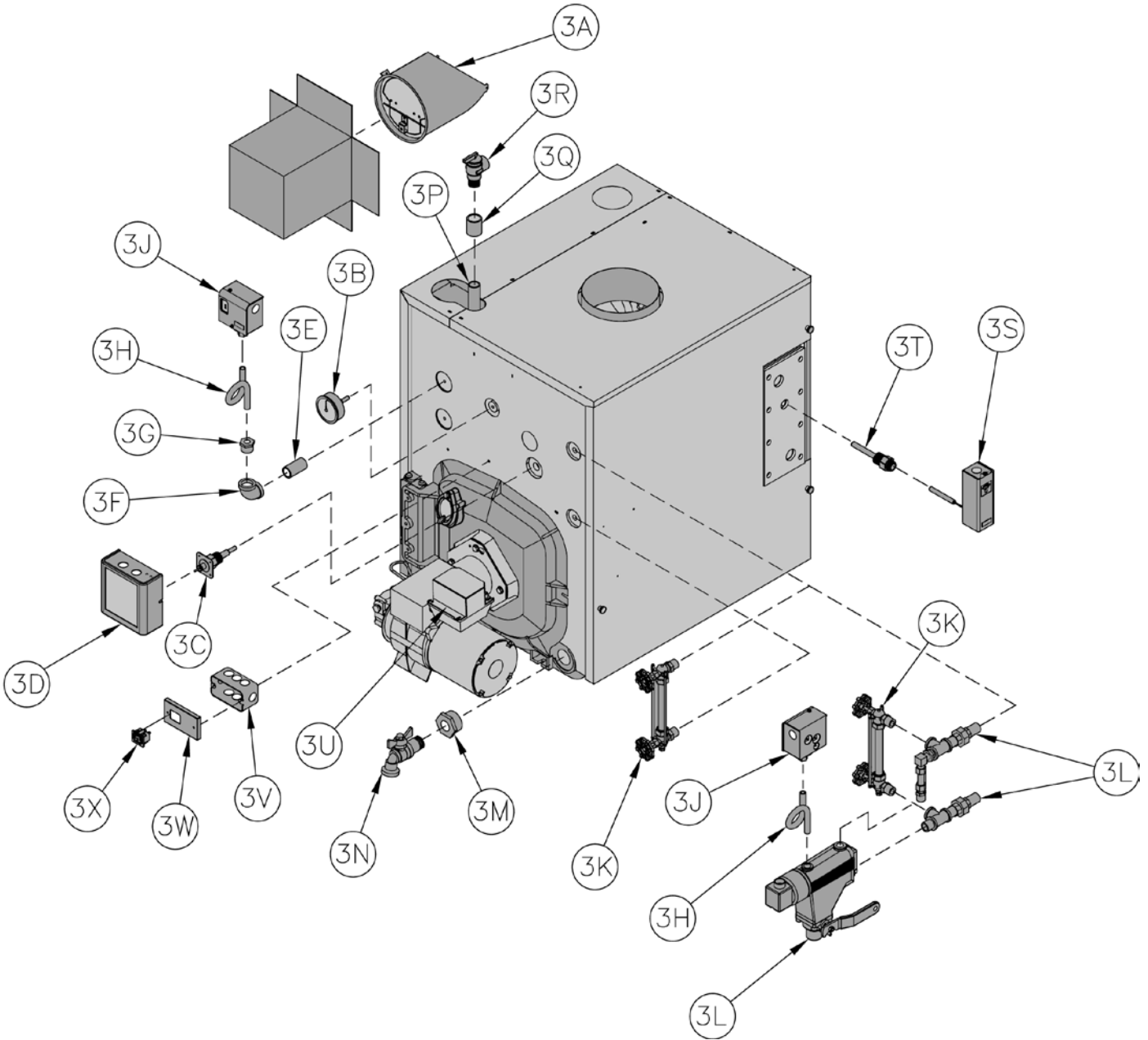


Jacket Assembly

SECTION XVI: REPAIR PARTS (continued)

Item No.	Description	Part No.	V8H3	V8H4	V8H5	V8H6	V8H7	V8H8	V8H9
2. JACKET ASSEMBLY - Insulated Jacket Panel(s)									
2A	Jacket Rear Support Bracket	7042801	1	1	1	1	1	1	1
2B	Jacket Rear Panel Assembly	60428005	1	1	1	1	1	1	1
2C	Plastic Collar Extension - Jkt. Frt. Panel w/Htr. Opg.	8032704	1	1	1	1	1	1	1
2D	Jacket Front Panel Ass'y w/o Htr. Opg. (Wtr. Blr.)	60428001	1	1	1	1	1	1	1
	Jacket Front Panel Ass'y w/o Htr. Opg. (Stm. Blr.)	60428002							
	Jacket Front Panel Ass'y w/ Htr. Opg. (Wtr. Blr.)	60428003							
	Jacket Front Panel Ass'y w/ Htr. Opg. (Stm. Blr.)	60428004							
2E	Jacket Left Side / Top Panel Assembly	102952-02	---	---	---	---	---	---	---
		102952-03	1	---	---	---	---	---	---
		102952-04	---	1	---	---	---	---	---
		102952-05	---	---	1	---	---	---	---
		102952-06	---	---	---	1	---	---	---
		102952-07	---	---	---	---	1	---	---
		102952-08	---	---	---	---	---	1	---
2F	Jacket Top Panel Assembly	604280221	---	---	---	---	---	---	---
		604280321	1	---	---	---	---	---	
		604280421	---	1	---	---	---	---	---
		604280521	---	---	1	---	---	---	---
		604280621	---	---	---	1	---	---	---
		604280721	---	---	---	---	1	---	---
		604280821	---	---	---	---	---	1	---
2G	Jacket Right Side Access Panel Assembly without Heater Opening	604280231	---	---	---	---	---	---	---
		604280331	1	---	---	---	---	---	
		604280431	---	1	---	---	---	---	---
		604280531	---	---	1	---	---	---	---
		604280631	---	---	---	1	---	---	---
		604280731	---	---	---	---	1	---	---
		604280831	---	---	---	---	---	1	---
	604280931	---	---	---	---	---	---	1	
	Jacket Right Side Access Panel Assembly with Heater Opening	604280341	1	---	---	---	---	---	---
		604280441	---	1	---	---	---	---	---
		604280541	---	---	1	---	---	---	---
		604280641	---	---	---	1	---	---	---
		604280741	---	---	---	---	1	---	---
		604280841	---	---	---	---	---	1	---
604280941		---	---	---	---	---	---	1	
2H	Beckett Burner Plastic Enclosure Backer Plate	102233-01	1	1	1	1	1	1	
2J	Beckett Burner Plastic Enclosure Cover	102232-01	1	1	1	1	1	1	
2K	Beckett Burner Plastic Enclosure Name Plate	102231-01	1	1	1	1	1	1	

SECTION XVI: REPAIR PARTS (continued)

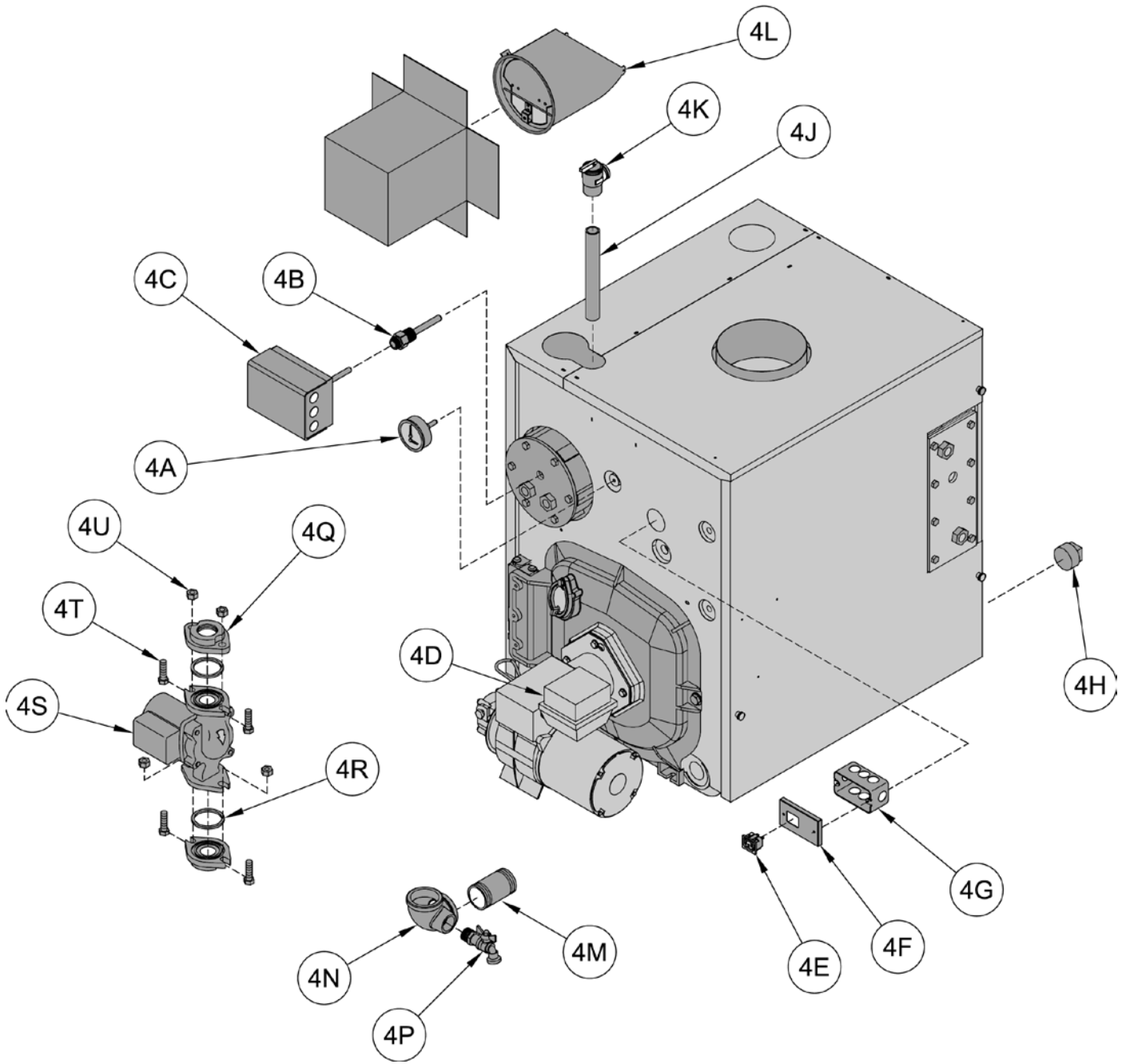


V8H3 Thru V8H9 Steam Boilers - Trim and Controls

SECTION XVI: REPAIR PARTS (continued)

Item No.	Description	Part No.	V8H3	V8H4	V8H5	V8H6	V8H7	V8H8	V8H9
3. V8H3 Thru V8H9 STEAM BOILERS - TRIM AND CONTROLS									
3A	6" Draft Regulator	8116288	1	1	1	1	---	---	---
	7" Draft Regulator	8116289	---	---	---	---	1	1	1
3B	Pressure Gauge	100325-01	1	1	1	1	1	1	1
3C	Probe, Hydrolevel EL-1214 (for Hydrolevel CG450)	80160629	1	1	1	1	1	1	1
3D	Low Water Cut-off, Hydrolevel CG450 (less probe)	80160623	1	1	1	1	1	1	1
	Low Water Cut-off, McDonnell & Miller PS-801 (w/probe)	80160723							
3E	Nipple, 3/4" NPT x 3" Lg.	806600002	1	1	1	1	1	1	1
3F	Elbow, 3/4" NPT, Malleable	806601502	1	1	1	1	1	1	1
3G	Bushing, 3/4" NPT x 1/4" FPT, Malleable	806600508	1	1	1	1	1	1	1
3H	Syphon, 1/4" NPT x 4" x 180°	806603030	1	1	1	1	1	1	1
3J	Pressure Limit, Honeywell L404F1367	80160369	1	1	1	1	1	1	1
3K	Gauge Glass Set, 6", ConBraCo 20-104-10	8056091	1	1	1	1	1	1	1
3L	Low Water Cut-off, McDonnell & Miller 67-BC-8	80160597	1	1	1	1	1	1	1
3M	Bushing, 1 1/2" NPT x 3/4" FPT, Malleable	806600507	1	1	1	1	1	1	1
3N	Drain Valve, 3/4" NPT, ConBraCo 35-302-03	806603061	1	1	1	1	1	1	1
3P	Nipple, 3/4" NPT x 8" Lg.	806600221	1	1	1	1	1	1	1
3Q	Coupling, 3/4" NPT, Malleable	806602561	1	1	1	1	1	1	1
3R	Safety Valve, 3/4" FIP, 15 psi, ConBraCo 13-511-B15	81660530	1	1	1	1	1	1	1
3S	Limit, Honeywell L4006A2015	80160400	1	1	1	1	1	1	1
3T	Well, 3/4" NPT x 3", Honeywell 123871A	80160452	1	1	1	1	1	1	1
3U	Oil Primary Control Beckett GeniSys 7505P1515	103445-01	1	1	1	1	1	1	1
	Oil Primary Control, Honeywell R7284P1080 (Universal)	103880-01	1	1	1	1	1	1	1
3V	2" x 4" Junction Box, Painted Sherpa Blue	61328252	1	1	1	1	1	1	1
3W	Burner Disc. J-Box Cover, Painted Sherpa Blue	51328251	1	1	1	1	1	1	1
3X	Power Outlet Receptacle, Heyco IEC 320-C13	8136522	1	1	1	1	1	1	1

SECTION XVI: REPAIR PARTS (continued)

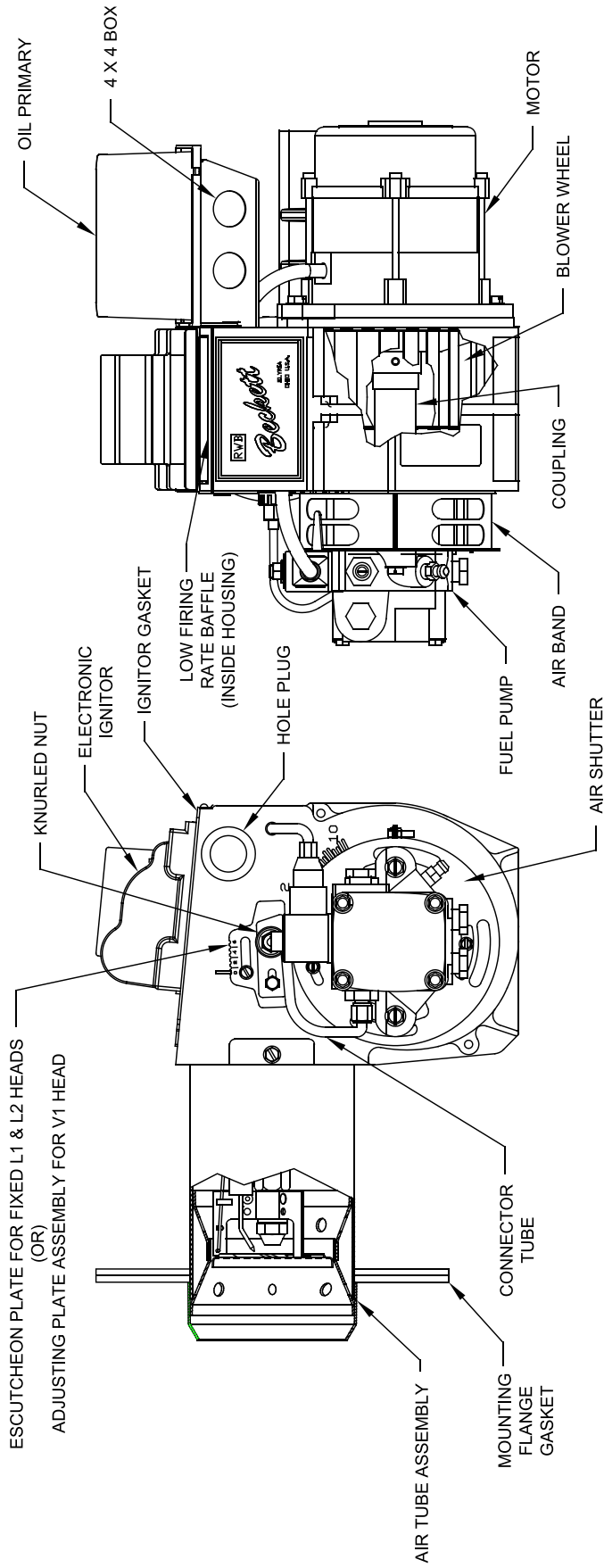


V8H3 Thru V8H9 Water Boilers - Trim and Controls

SECTION XVI: REPAIR PARTS (continued)

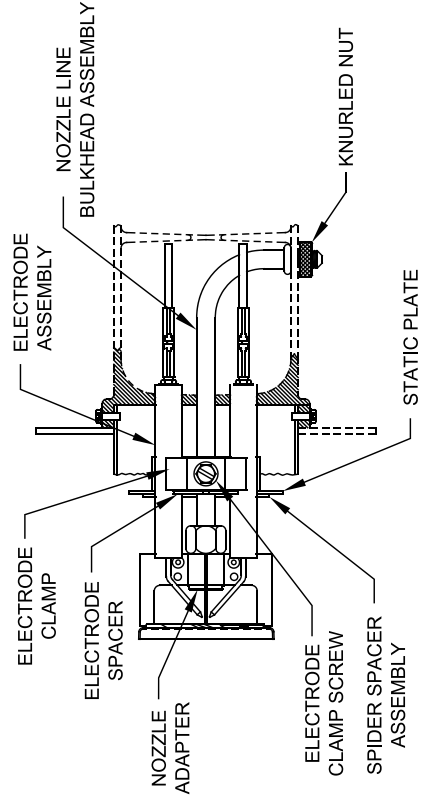
Item No.	Description	Part No.	V8H3	V8H4	V8H5	V8H6	V8H7	V8H8	V8H9
4. V8H3 Thru V8H9 WATER BOILERS - TRIM AND CONTROLS									
4A	Temperature & Pressure Gauge, ¼" NPT x 2½" Dia., 1½" Lg. Shank	100282-01	1	1	1	1	1	1	1
4B	Honeywell #123870A Immersion Well, ¼" NPT x 1½" Insulation (WN)	80160426	1	1	1	1	1	1	1
	--(OR)-- Honeywell #123872A Immersion Well, ½" NPT x 3" Insulation (WF)	80160497	1	1	1	1	1	1	1
	--(OR)-- Honeywell 123871A Immersion Well, ¾" NPT x 3" Insulation (UR & WR)	80160452	1	1	1	1	1	1	1
4C	Honeywell L7248L1080 Hi Limit, Circ. Relay (WN)	103852-01	1	1	1	1	1	1	1
	--(OR)-- Honeywell L7224C1010 Hi & Lo Limit, Circ. Relay (WF and WR)	103854-01	1	1	1	1	1	1	1
4D	Oil Primary Control Beckett GeniSys 7505P1515	103445-01	1	1	1	1	1	1	1
	Oil Primary Control, Honeywell R7284P1080 (Universal)	103880-01	1	1	1	1	1	1	1
4E	Power Outlet Receptacle, Heyco IEC 320-C13	8136522	1	1	1	1	1	1	1
4F	Burner Disc., J-Box Cover, Painted Sherpa Blue	61328251	1	1	1	1	1	1	1
4G	2" x 4" Junction Box, Painted Sherpa Blue	61328252	1	1	1	1	1	1	1
4H	Plug, Square Head, 1½" NPT (Packaged)	806603515	1	1	1	1	1	1	1
	Reducing Bushing, 1½" NPT x ¾" FPT (Knockdown)	806600507							
4J	Nipple, ¾" NPT x 8" Lg.	806600221	1	1	1	1	1	1	1
4K	Relief Valve, Conbraco, ¾" FIP x ¾" FIP	#10-408-05 30 PSI	81660319	1	1	1	1	1	1
		#10-303-07 40 PSI	81660370						
		#10-303-10 50 PSI	81660302						
4L	6" Draft Regulator	8116288	1	1	1	1	---	---	---
	7" Draft Regulator	8116289	---	---	---	---	1	1	1
4M	Nipple, 1½" NPT x 3" Lg.	806600006	1	1	1	1	1	1	1
4N	Side Outlet 90° Elbow 1½" x ¾"	806601636	1	1	1	1	1	1	1
4P	Drain Valve, ¾" NPT, ConBraCo 35-302-03	806603061	1	1	1	1	1	1	1
4Q	Circulator Flange, 1½" NPT	806602014	2	2	2	2	2	2	2
4R	Circulator Gasket	Taco #194-1548	806602006	2	2	2	2	2	2
		Bell & Gossett	Included w/ circulator						
		Grundfos							
4S	Circulator	Taco 007	8056007	1	1	1	1	1	1
		Bell & Gossett NRF22 w/gaskets	8056174						
		Grundfos UP15-42F w/gaskets	8056173						
4T	Cap Screw, Hex Head, 7/16" -14 x 1½" Lg.	80861301	4	4	4	4	4	4	4
4U	Hex Nut, 7/16" -14	80860406	4	4	4	4	4	4	4

SECTION XVI: REPAIR PARTS (continued)



SIDE VIEW

FRONT VIEW



NOZZLE DETAIL

Beckett AFG Burner

SECTION XVI: REPAIR PARTS (continued)

BECKETT AFG OIL BURNER PART NOS. FOR V8H SERIES BOILERS

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

Boiler Model	V8H3W/S	V8H4W/S	V8H5W/S
Air Tube Combination	AFG70MDAQN	AFG70MDAQN	AFG70MDASN
Beckett's Spec. No.	BCB8603	BCB8604	BCB8605
Air Band	3492A	3492A	3492A
Air Band Nut	4150	4150	4150
Air Band Screw	4198	4198	4198
Air Shutter	3709	3709	3709
Air Shutter Screw	4198	4198	4198
Blower Wheel	2999	2999	2999
Coupling	2454	2454	2454
Low Firing Rate Baffle	3708	Less	Less
Bulkhead Knurled Locknut	3666	3666	3666
Connector Tube Assembly	5636	5636	5636
Electrode Clamp	149	149	149
Electrode Clamp Screw	4219	4219	4219
Electrode Insulator Assembly	5780	5780	5780
Support / Spacer Assembly	5992	5992	5992
Escutcheon Plate	3493	---	---
Adjusting Plate Assembly	---	5941	5941
Head	5912	5913	5913
Head Screws	4221	4221	4221
Flange Gasket	3811	3811	3811
AFG Housing	5874GY	5874GY	5874GY
Motor	21805E/218	21805E/218	21805E/218
Nozzle Adapter	213	213	213
Nozzle Line Electrode Assembly	NL70MD	NL70MD	NL70MD
Oil Pump, Clean Cut Single Stage	21844	21844	21844
Oil Pump, Clean Cut Two-Stage	21941	21941	21941
Static Plate	3384	3383	3383
Ignitor	51771U	51771U	51771U
Ignitor Hinge Screw	4217	4217	42176
Ignitor Holding Screw	4292	4292	4292
Ignitor Gasket Kit	51304	51304	51304
Wire Guard	10251	10251	10251
Junction Box	3741	3741	3741
Flame Detector	7006Q	7006Q	7006Q

(Continued on Next Page)

SECTION XVI: REPAIR PARTS (continued)

BECKETT AFG OIL BURNER PART NOS. FOR V8H SERIES BOILERS (continued)

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

Boiler Model	V8H6W/S	V8H7W/S	V8H8W/S	V8H9W/S
Air Tube Combination	AFG70MDASN	AFG70MDASN	AFG70MDASN	AFG70MDASN
Beckett's Spec. No.	BCB8606	BCB8607	BCB8608	BCB8609
Air Band	3492A	3492A	3492A	3492A
Air Band Nut	4150	4150	4150	4150
Air Band Screw	4198	4198	4198	4198
Air Shutter	3709	3709	3709	3709
Air Shutter Screw	4198	4198	4198	4198
Blower Wheel	2999	2999	2999	2999
Coupling	2454	2454	2454	2454
Low Firing Rate Baffle	Less	Less	Less	Less
Bulkhead Knurled Locknut	3666	3666	3666	3666
Connector Tube Assembly	5636	5636	5636	5636
Electrode Clamp	149	149	149	149
Electrode Clamp Screw	4219	4219	4219	4219
Electrode Insulator Assembly	5780	5780	5780	5780
Support / Spacer Assembly	5992	5992	5992	5992
Escutcheon Plate	---	---	---	---
Adjusting Plate Assembly	5941	5941	5941	5941
Head	5913	5913	5913	5913
Head Screws	4221	4221	4221	4221
Flange Gasket	3811	3811	3811	3811
AFG Housing	5874GY	5874GY	5874GY	5874GY
Motor	21805E/218	21805E/218	21805E/218	21805E/218
Nozzle Adapter	213	213	213	213
Nozzle Line Electrode Assembly	NL70MD	NL70MD	NL70MD	NL70MD
Oil Pump, Clean Cut, Single Stage	21844	21844	21844	21844
Oil Pump, Clean Cut, Two-Stage	21941	21941	21941	21941
Static Plate	3383	3383	3383	3383
Ignitor	51771U	51771U	51771U	51771U
Ignitor Hinge Screw	4217	4217	4217	4217
Ignitor Holding Screw	4292	4292	4292	4292
Ignitor Gasket Kit	51304	51304	51304	51304
Wire Guard	10251	10251	10251	10251
Junction Box	3741	3741	3741	3741
Flame Detector	7006Q	7006Q	7006Q	7006Q

SECTION XVI: REPAIR PARTS (continued)

CARLIN EZ and 102CRD OIL BURNER PART NUMBERS FOR V8H SERIES BOILERS

NOTE: When ordering parts always give the serial and model numbers shown on the boiler and burner.

Refer to *Installation and Operating Instructions for Packaged Heating/Burner Units, Carlin Elite EZ-1HP and EZ-2HP Oil Burners* (Form CCT-569A) for an exploded view of the burner and a list of spare parts.

Refer to *Installation and Operation Instructions For Carlin Model 102 CRD Oil Burner* (Form No. 96858) for an exploded view of the burner and a list of spare parts.

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

CCT, Carlin Combustion Technology, Inc.
70 Maple Street
East Longmeadow, MA 01028
Telephone: (413) 525-7700
Facsimile: (413) 525-8306

RIELLO 40 OIL BURNER PART NUMBERS FOR V8H SERIES BOILERS

NOTE: When ordering parts always give the serial and model numbers shown on the boiler and burner.

Refer to Models F3 & F5 Installation Manual, Riello 40 Series Residential Oil Burners (C6501010) or Model F10 Installation Manual, Riello 40 Series Residential Oil Burners (2902554) for an exploded view of the burner and a list of spare parts.

For replacement Riello oil burner parts, contact your wholesaler or the burner manufacturer:

Riello Corporation of America
35 Pond Park Road
Hingham, Massachusetts 02043
Telephone: (617) 749-8292
Facsimile: (617) 740-2069
Toll Free: (outside Massachusetts)
(800) 992-7637

Riello Canada Inc.
2165 Meadowpine Blvd.
Mississauga, Ontario L5N 6H6
Telephone: (905) 542-0303
Facsimile: (905) 542-1525
Toll Free: (800) 387-3898

SECTION XVII: BURNER SPECIFICATIONS

TABLE 12: BURNER SPECIFICATIONS

Boiler Model	Firing Rate GPH	Beckett AFG				Carlin				Riello					
		Settings			Burner Model	Settings			Burner Model	Settings			Burner Model		
		Head (Setting)	Air Shutter	Air Band		1 Nozzle GPH x Angle Type	2 Pump Pressure	Head Bar		Air Band	1 Nozzle GPH x Angle Type	2 Pump Pressure		Air Gate	Turbulator
V8H3S	0.75	L1	10	2	0.60 x 60A	140	0.60/0.65	0.53	0.60 x 60B	150	40-F5	2.25	1.0	0.70 x 90B	145
V8H3W	1.05	L1	7	1	0.85 x 60A	140	0.75	0.65	0.85 x 70B Hago	150	40-F5	2.8	1.0	0.90 x 80B	145
V8H4S	1.05	V1 (0)	7	1	0.85 x 60A	140	0.85/1.00	0.75	0.85 x 60B	150	40-F5	3.75	1.0	0.90 x 80B	145
V8H4W	1.35	V1 (0)	10	2	1.10 x 60B Hago	140	1.10/1.25	0.85	1.10 x 60B	150	40-F5	3.3	3.0	1.20 x 80B	145
V8H5S	1.35	V1 (0)	10	5	1.10 x 60B	140	1.10/1.25	0.80	1.10 x 60B	150	40-F5	5.5	2.0	1.20 x 80B	145
V8H5W	1.65	V1 (2)	10	5	1.35 x 60B	140	1.35/1.50	1.35	1.35 x 60B	150	40-F5	5.2	4.0	1.35 x 70B	145
V8H6S	1.65	V1 (2)	10	3	1.35 x 60B	140	1.50	1.75	1.35 x 60A	170	40-F10	3.2	3.0	1.50 x 45B	145
V8H6W	1.90	V1 (3)	10	3.5	1.50 x 45B	160	EZ-2HP	5	100%	140	40-F10	3.7	2.0	1.65 x 60B	145
V8H7S V8H7W	2.10	V1 (4)	10	3	1.65 x 45B HAGO	170	EZ-66	3	50%	140	40-F10	4.0	4.0	2.00 x 45B	145
V8H8S V8H8W	2.35	V1 (4)	10	5	1.75 x 45B HAGO	170	102CRD-3	4	50%	140	40-F10	4.0	5.0	2.00 x 60B	175
V8H9S V8H9W	2.60	V1 (6)	10	7	2.00 x 45B HAGO	170		5	100%	140	40-F10	7.0	5.0	2.25 x 70B HAGO	145

¹ All burners utilize Delavan nozzles unless otherwise noted.

² Single stage fuel pump is standard, two stage fuel pump is optional. Burner manufacturer has preset single stage fuel pump to settings shown in table above. Two stage fuel pump is factory set at 140 PSI and must be readjusted to settings shown above during burner start-up.

APPENDIX A - LOW WATER CUT OFF (LWCO)

WARNING

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

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

When

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

Where

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

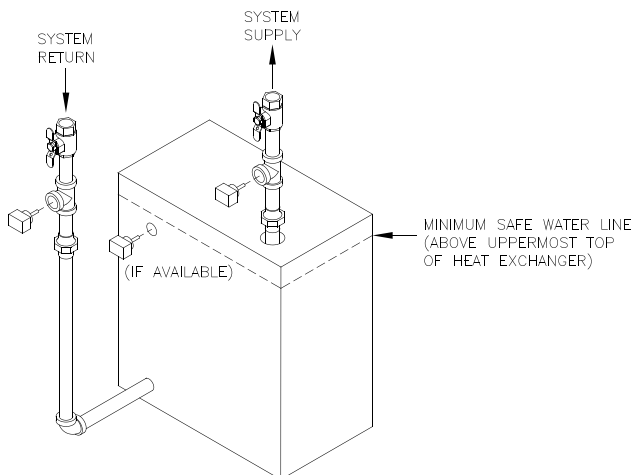
It is recommended that the LWCO control is installed above the boiler to provide the highest level of protection. However, where the LWCO control is approved by the LWCO control manufacturer for installation in a high boiler tapping of a water boiler, the use of the listed LWCO control is permitted when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

What Kind

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

How to Pipe

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



LWCO Location

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

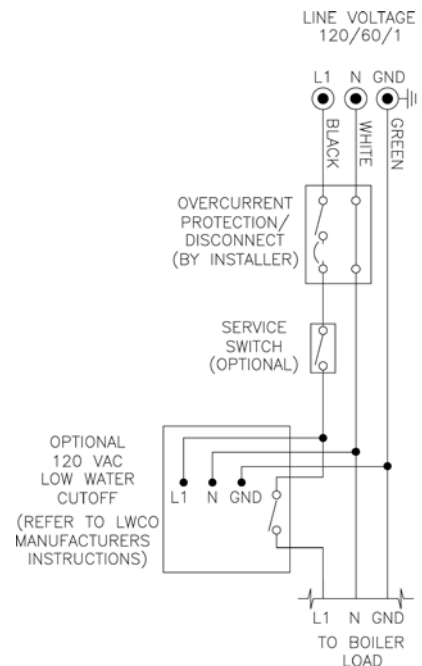
Ideally, manual shutoff valves should be located above the LWCO and the boiler to allow for servicing. This will allow probe removal for inspection without draining the heating system. Many probe LWCO manufacturers recommend an annual inspection of the probe.

How to Wire

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

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

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



Wiring of Typical LWCO

APPENDIX A - LOW WATER CUT OFF (LWCO) (continued)

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.

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