

INSTALLATION, OPERATING AND SERVICE INSTRUCTIONS FOR

V8 SERIES OIL - FIRED BOILER



As an
ENERGY
STAR® Partner,
Burnham Hydronics
has determined that the
V83S, V83WM, V84S,
V84WM, V85S, V85WM,
V86S, V86WM and V87
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 _V8 _ _ _ - _ _ _ _ | Boiler Serial Number 6 _ _ _ _ _ | Installation Date |
| Heating Contractor | | Phone Number |
| Address | | |



8142824R9-7/06

Price - \$3.00

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 printed on the back of this manual. The warranty for this boiler is valid only if the boiler has been installed, maintained and operated in accordance with these instructions.

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 appliance.

WARNING

Improper installation, adjustment, alteration, service or maintenance can cause property damage, personal injury or loss of life. Failure to follow all instructions in the proper order can cause personal injury or death. Read and understand all instructions, including all those contained in component manufacturers manuals which are provided with the appliance before installing, starting-up, operating, maintaining or servicing this appliance. Keep this manual and literature in legible condition and posted near appliance for reference by owner and service technician.

This boiler requires regular maintenance and service to operate safely. Follow the instructions contained in this manual.

Installation, maintenance, and service must be performed only by an experienced, skilled and knowledgeable installer or service agency.

All heating systems should be designed by competent contractors and only persons knowledgeable in the layout and installation of hydronic heating systems should attempt installation of any boiler.

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 the installation is completed.

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 unit with jumpered or absent controls or safety devices.

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

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

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

| Boiler Model No. | Dimensions See Figures 1A - 1D | | | Water Content - Gallons | | Heat Transfer Surface Area - Sq. Ft. | Approximate Shipping Weight (LB.) |
|--|-----------------------------------|---------|-----|-------------------------|--------------|--------------------------------------|-----------------------------------|
| | "A" | "B" | "C" | Steam Boiler | Water Boiler | Steam Boiler | |
| V82 | 12-1/8" | 6-5/8" | 5" | | 10.0 | | 450 |
| V83 | 17-1/8" | 9-1/8" | 6" | 10.3 | 12.8 | 15.88 | 542 |
| V84 | 22-1/8" | 11-5/8" | 6" | 12.4 | 15.7 | 22.92 | 634 |
| V85 | 27-1/8" | 14-1/8" | 7" | 14.6 | 18.5 | 29.96 | 726 |
| V86 | 32-1/8" | 16-5/8" | 7" | 16.7 | 21.4 | 37.00 | 818 |
| V87 | 37-1/8" | 19-1/8" | 8" | 18.8 | 24.2 | 44.04 | 910 |
| V88 | 42-1/8" | 21-5/8" | 8" | 20.9 | 27.1 | 51.08 | 1002 |
| V89 | 47-1/8" | 24-1/8" | 8" | 23.0 | 30.0 | 58.12 | 1094 |
| NOTE: 1 The V82 Boiler is available as a packaged water boiler only. | | | | | | | |
| 2 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 | | | Minimum Chmney Requirements | | | AFUE % | |
|--|-----------------|-----|-----------------------------|-------------------|--------------|------------------|--------------------------------|------------------------|---------------|--------|-------|
| | GPH | MBH | DOE Heating Capacity MBH | Water MBH | Steam MBH | Steam Sq. Ft. | Round In. Dia. | Rectangle In. x In. | Height Ft. | Steam | Water |
| V82W | 0.60 | 84 | 70 | 61 | | | 6 | 8 x 8 | 15 | | 82.1 |
| V83W | 1.05 | 147 | 123 | 107 | | | 6 | 8 x 8 | 15 | | 82.6 |
| V83S V83WM | 0.75 | 105 | 91 | 79 | 68 | 283 | 6 | 8 x 8 | 15 | 85.1 | 86.0 |
| V84W | 1.35 | 189 | 159 | 138 | | | 7 | 8 x 8 | 15 | | 83.2 |
| V84S V84WM | 1.05 | 147 | 127 | 110 | | | 95 | 396 | 6 | | 8 x 8 |
| V85W | 1.65 | 231 | 196 | 170 | | | 7 | 8 x 8 | 15 | | 83.9 |
| V85S V85WM | 1.35 | 189 | 164 | 143 | | | 123 | 512 | 7 | | 8 x 8 |
| V86W | 1.90 | 266 | 227 | 197 | | | 8 | 8 x 8 | 15 | | 84.6 |
| V86S V86WM | 1.65 | 231 | 201 | 175 | | | 151 | 629 | 7 | | 8 x 8 |
| V87S V87W | 2.10 | 294 | 252 | 219 | 189 | 787 | 8 | 8 x 8 | 15 | 84.7 | 85.0 |
| V88S | 2.35 | 329 | 266 | | 200 | 833 | 8 | 8 x 12 | 15 | | |
| V88W | 2.35 | 329 | 275 | 239 | | | 8 | 8 x 12 | 15 | | |
| V89S | 2.60 | 364 | 298 | | 224 | 933 | 9 | 8 x 12 | 15 | | |
| V89W | 2.60 | 364 | 299 | 260 | | | 9 | 8 x 12 | 15 | | |
| * Boiler Model Suffix: S=Steam at standard rate, W=Water, WM=Water at minimum rate | | | | | | | | | | | |

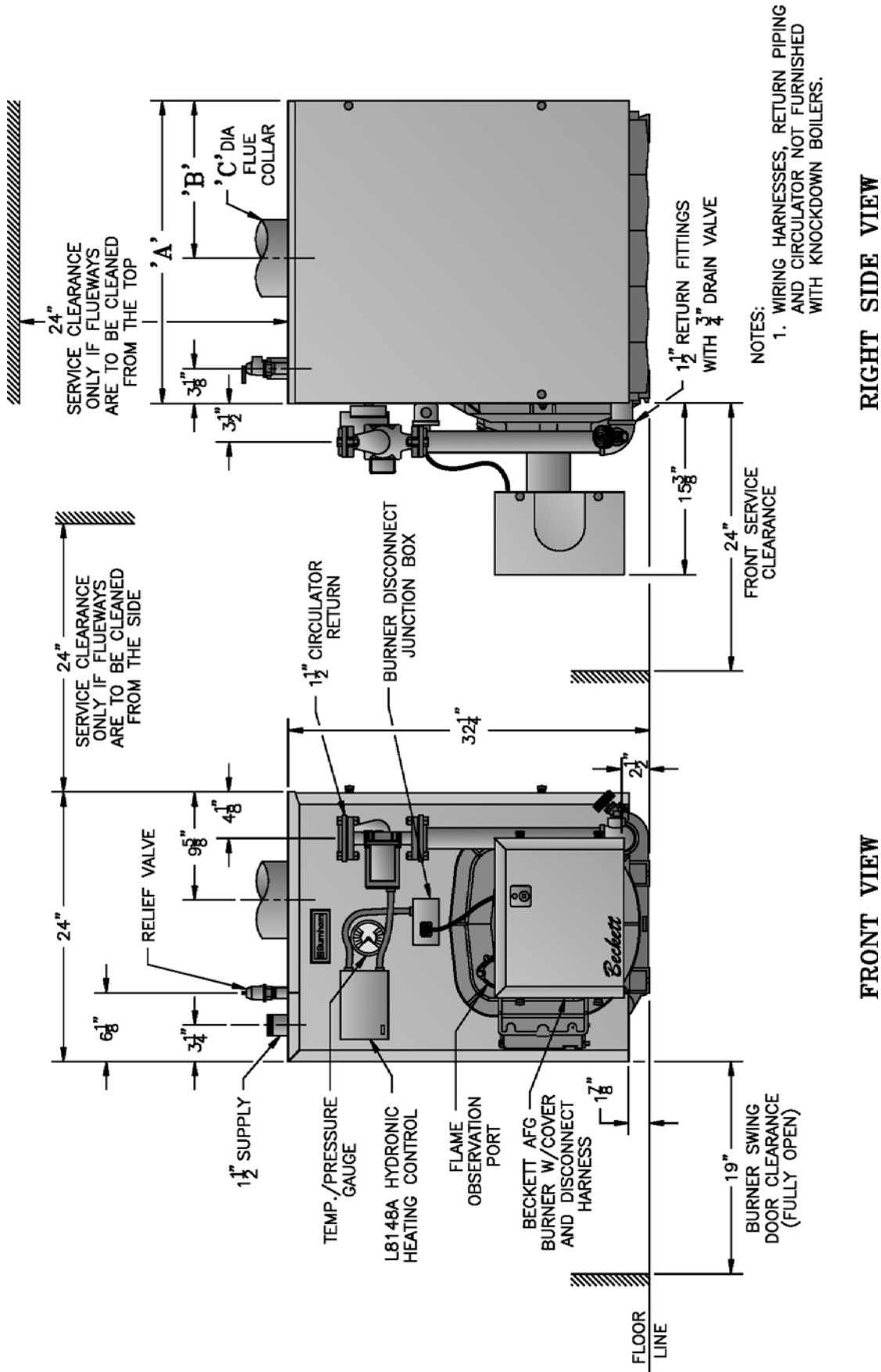


Figure 1A: V82 thru V89 Water Boiler without Tankless Heater

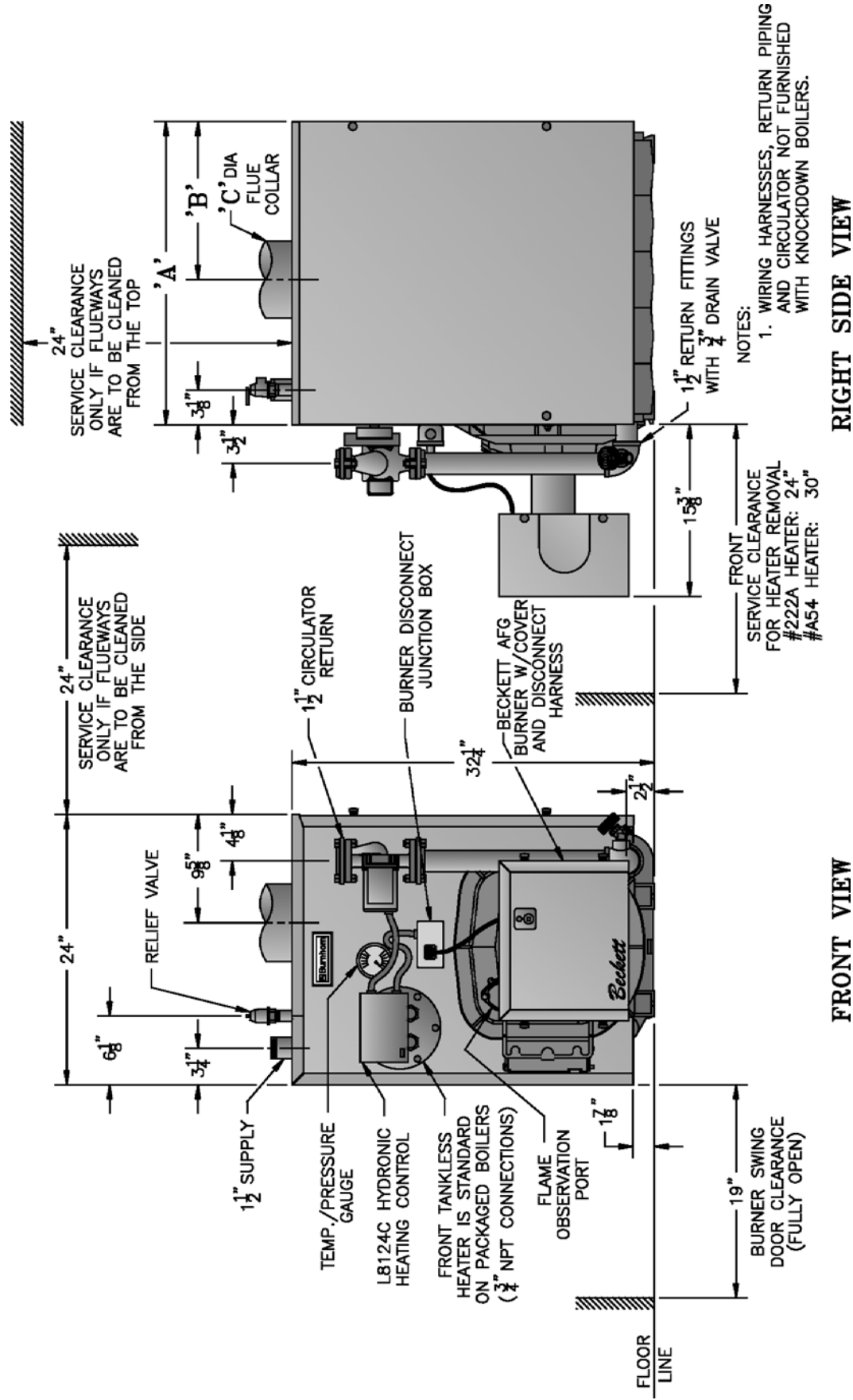


Figure 1B: V83 thru V89 Water Boiler with Front Tankless Heater

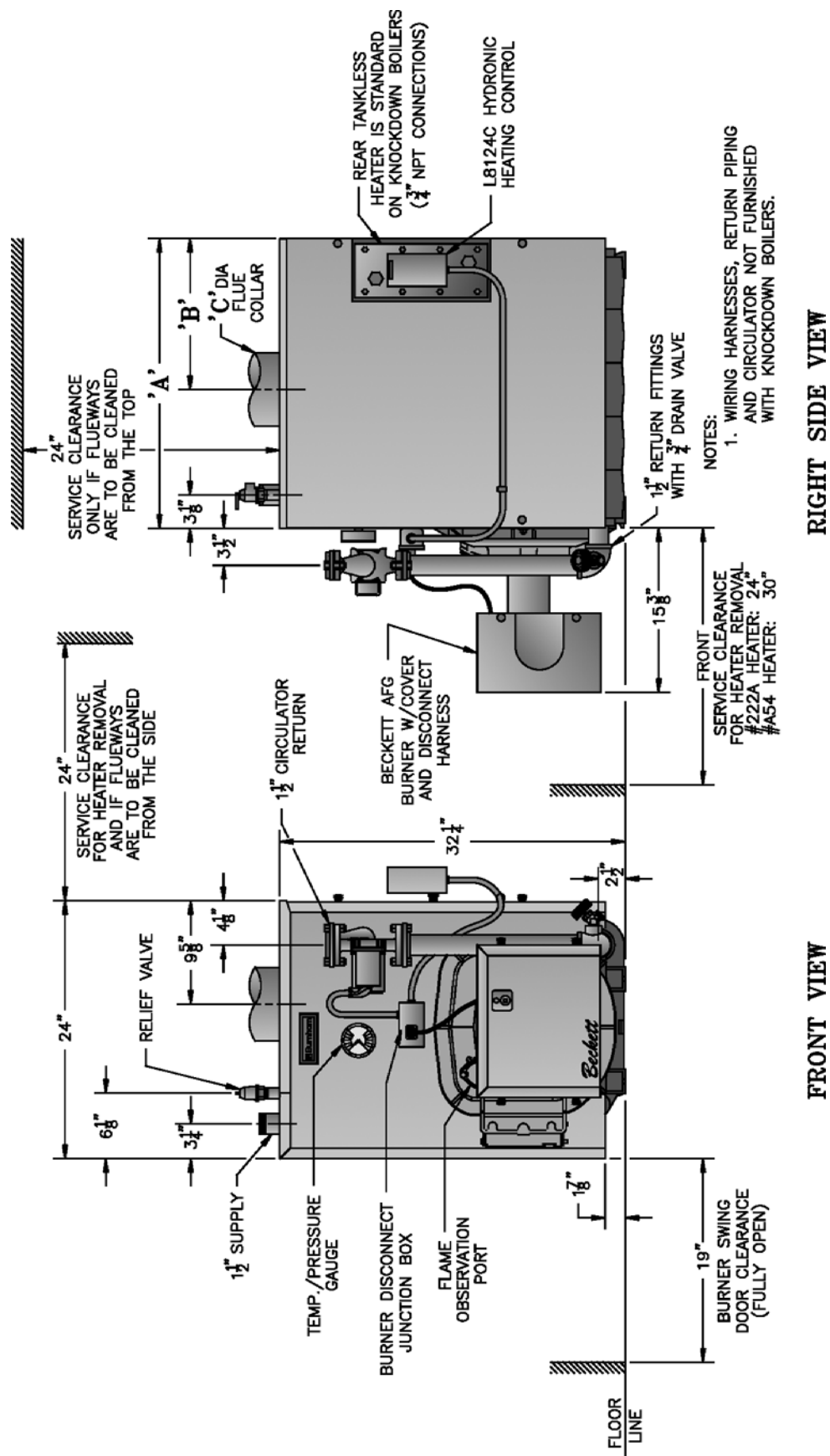


Figure 1C: V83 thru V89 Water Boiler with Rear Tankless Heater

SECTION I: PRE-INSTALLATION

A. INSPECT SHIPMENT carefully for any signs of damage.

1. All equipment is carefully manufactured, inspected and packed. Our responsibility ceases upon delivery of 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. 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.

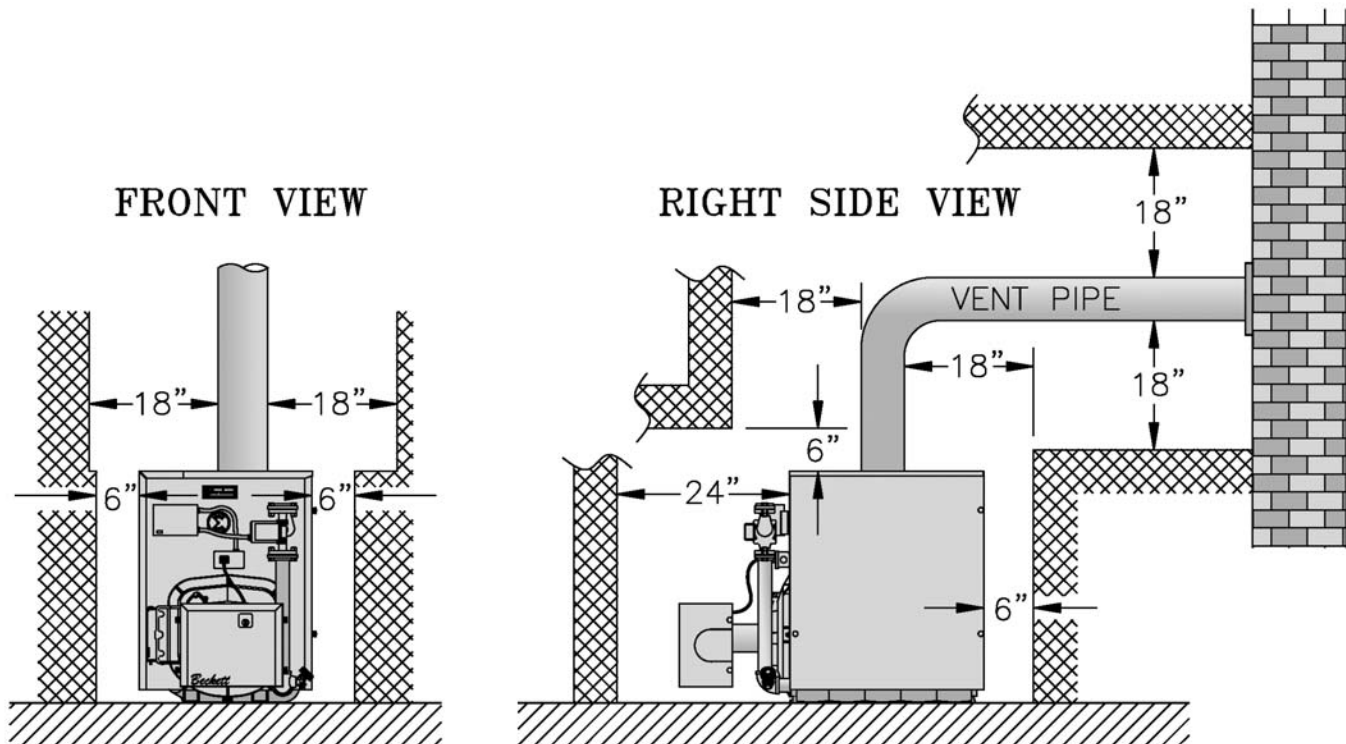


Figure 2: Minimum Installation Clearances To Combustible Materials (Inches)

NOTES:

1. Listed clearances comply with American National Standard ANSI/NFPA 31, Installation of Oil Burning Equipment.
2. V8 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.

- 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 Burnham V8 Inlet Air Accessory Kit, Part Number 611280031 (**ONLY AVAILABLE WITH BECKETT BURNER**). See Section VII for installation 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 II: 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.

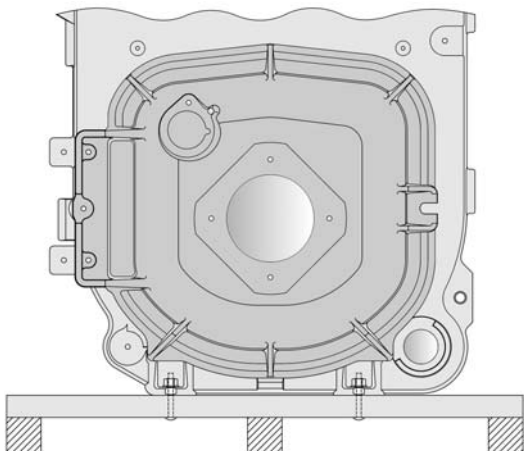


Figure 3: Knockdown Boiler Removal from Skid

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 no 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.

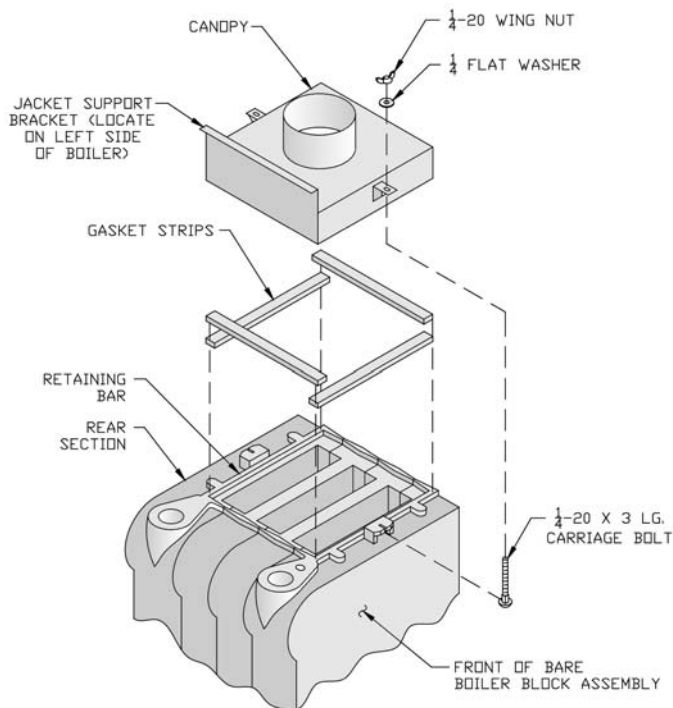


Figure 4: Boiler Canopy Installation

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.

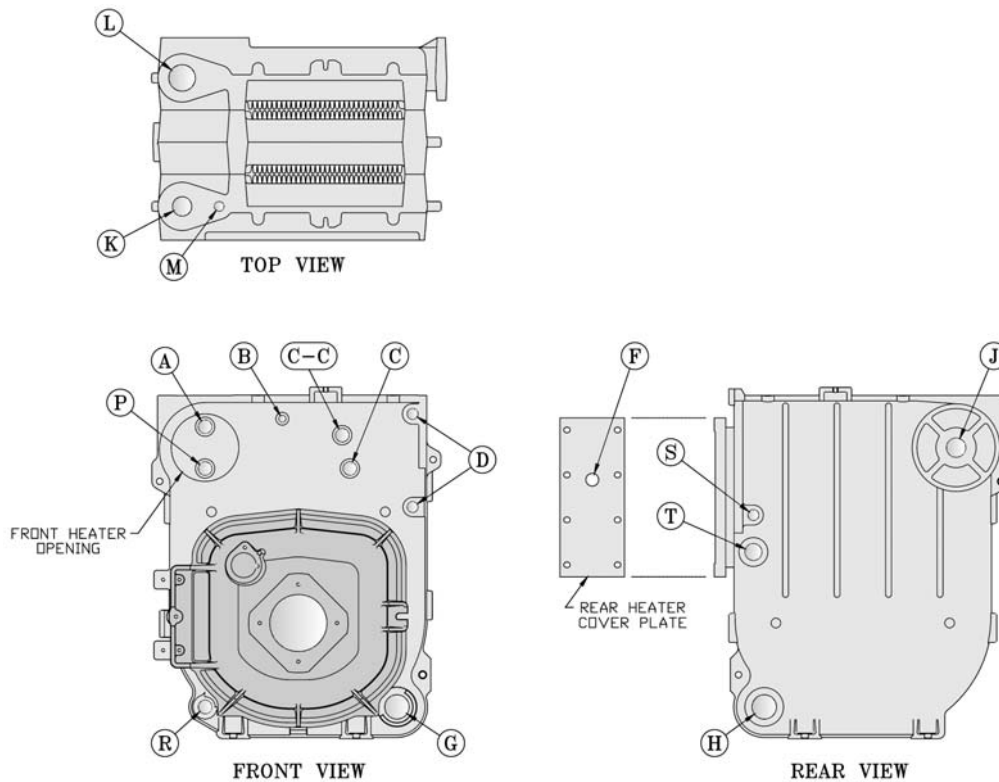


Figure 5: Boiler Tapping Locations and Usage (Knockdown Boilers Only)

| PURPOSE OF TAPPINGS | | | | | | |
|---------------------|----------|---|---|---------------------------------|-----------------------------|-----------------------------|
| Tapping Location | Size NPT | Steam Boiler | | Water Boiler | | |
| | | Non-Heater | w/Heater | Non-Heater | Front Heater | Rear Heater |
| A | 3/4" | Pressure Limit (Probe LWCO) Plugged (Float LWCO) | | L8148A Operating Control | L8124C Operating Control | Flush Plug |
| B | 1/4" | Pressure Gauge | | Temperature/Pressure Gauge | | |
| C | 3/4" | Probe LWCO Std. Plugged (Float LWCO) | | N/A | | |
| C-C | 3/4" | Flush Plug | Flush Plug | N/A | | |
| D | 1/2" | Water Gauge Glass (Probe LWCO) Water Gauge Glass, Pressuretrol, and LWCO (Float) | | N/A | | |
| F | 3/4" | N/A | L4006A Operating Control | N/A | N/A | L8124C Operating Control |
| G | 1 1/2" | Bushed to 3/4" for Drain Valve (Optional Return) | | Return | | |
| H | 1 1/2" | Return | | Plugged | | |
| J | 1 1/2" | 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 | 3/4" | Safety Valve | | Relief Valve | | |
| P | 3/4" | Auxiliary Tapping - Plugged | | Aux. Tapping - Plugged | N/A | Aux. Tapping - Plugged |
| R | 3/4" | Aux. Tapping - Plugged (Indirect Return) | Aux. Tapping - Plugged (Indirect Return) * | Auxiliary Tapping - Plugged | | |
| S | 1/2" | Indirect Limit | Indirect Limit * | N/A | | |
| T | 1" | Indirect Supply | Indirect Supply * | N/A | | |

* In lieu of Tankless Heater

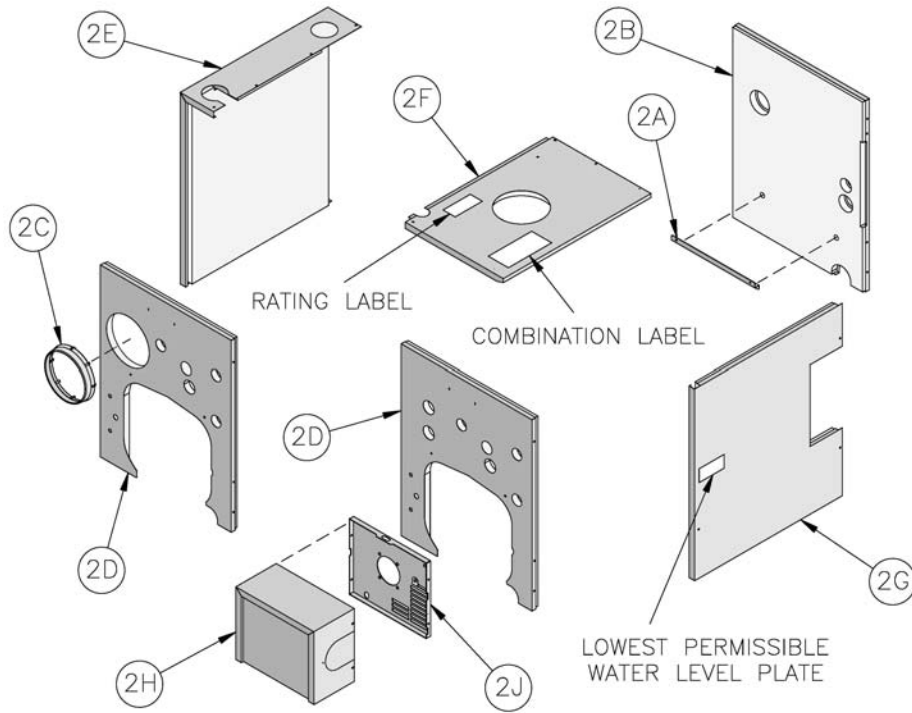


Figure 6: Knockdown Boiler Jacket Assembly

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 V83 thru V85, if only one supply riser is used.
- b. Tapping "M" — Install $\frac{3}{4}$ " NPT coupling and $\frac{3}{4}$ " NPT x 8" long nipple into $\frac{3}{4}$ " 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 $\frac{3}{4}$ " NPT x 8" long nipple into $\frac{3}{4}$ " 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. 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.

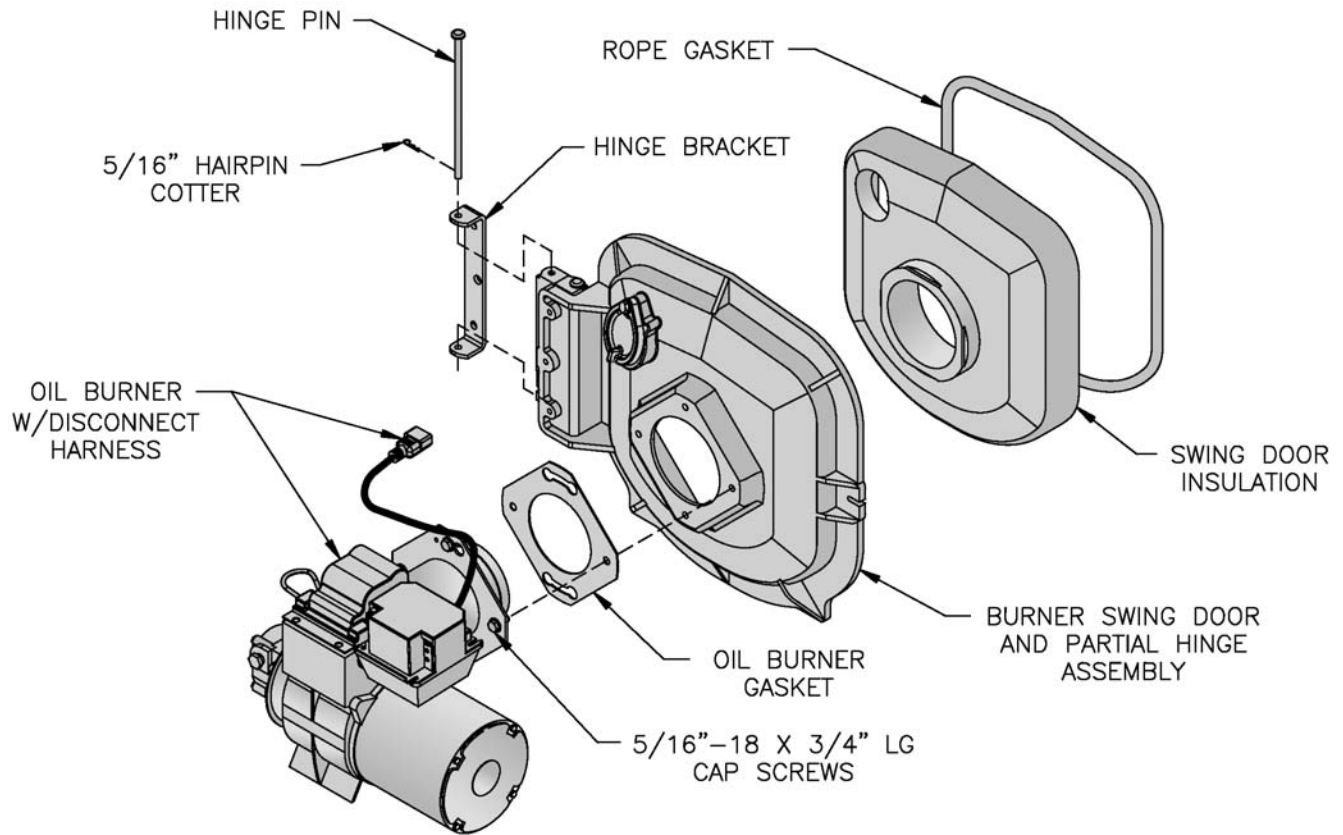


Figure 7: Oil Burner Installation

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 8142803). 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 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 11A and 11B):

Step 1. Lift the door up unto the built-in cast ramp/door rest (protruding from the bottom of the front section casting - see Figure 11A), 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 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.

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 11B). 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.

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

CAUTION

Do not install burner without gasket.

6. Insert oil burner into the opening of the burner swing door. Align holes and install four (4) 5/16" - 18 x 3/4" long cap screws. Level burner and fully tighten all four (4) screws.
7. Install oil nozzle in burner, inspect electrodes and head setting.

DANGER

The burner does not have an oil nozzle installed. The proper oil nozzle, supplied loose, must be installed in the nozzle adaptor. Do not operate burner without the proper oil nozzle installed in the burner.

- a. Select the proper oil nozzle for the installation. Two (2) oil nozzles are supplied loose with each knockdown V83 - V86 boiler. Either nozzle may be used with water boilers. Steam boilers must use the lower input nozzle. The lower input nozzle will provide greater boiler efficiency and for steam boilers, reduce boiler corrosion. However, boiler output will be reduced. Refer to Table 1B for ratings. The nozzle input is stamped on the hex flat of the nozzle.

CAUTION

Steam boilers must only be operated at the lower input. Increasing the firing rate above this input will result in accelerated boiler corrosion and will void the warranty provided with the boiler.

- b. Loosen burner cover knobs and remove cover.
- c. Loosen two (2) igniter latching screws, rotate tabs and swing open igniter about hinge.

- d. Loosen knurled nut and disconnect copper connector tube.
- e. Remove nozzle line electrode assembly.
- f. Remove Beckett MD(V1) or MB(L1) Head.
- g. Remove plug from nozzle adapter and install the proper nozzle. Refer to Table 6 for proper nozzle. The nozzle must be securely installed to assure leak free joints between the nozzle and adapter. When installing the nozzle, be careful not to bump or move the burner electrodes.
- h. Inspect and measure burner electrodes. Refer to Figure 26 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.
- n. Swing igniter closed, rotate tabs and tighten two (2) igniter screws.
- o. Replace burner cover and tighten burner cover knobs.

K. INSTALL TRIM AND CONTROLS. - 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 14. 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.

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.

- a. Thread probe into $\frac{3}{4}$ " 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.
 - b. Install the gauge glass using the two $\frac{1}{2}$ " NPT tapings to the right of the probe LWCO.
5. Install float-type LWCO, if so equipped.
See Figure 8.
 - 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.

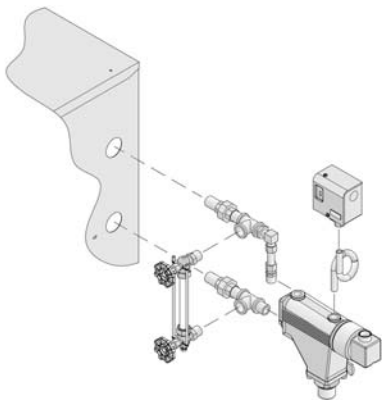


Figure 8: Float-Type Low Water Cut-Off and Pressure Limit Installation

6. Install Pressure Limit Control.
- a. Float LWCO only: Remove $\frac{1}{4}$ " NPT plug from top of Low Water Cut-Off. Install Syphon and Limit into this tapping. See Figure 8.

- b. Probe LWCO only: Install Limit in Tapping "A" using $\frac{3}{4}$ " NPT x 3" long nipple, $\frac{3}{4}$ " NPT elbow, $\frac{3}{4}$ " NPT x $\frac{1}{4}$ " NPT bushing, and syphon. See Figure 9.
- c. Do not tighten the limit by holding the case; apply a wrench to the brass hex below the case.

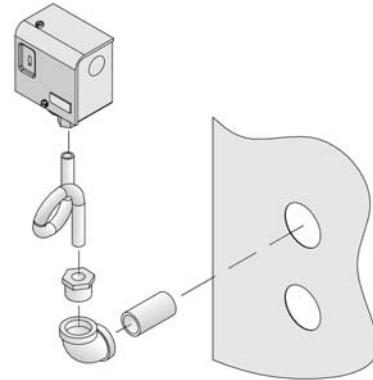


Figure 9: Pressure Limit Installation for Probe LWCO Equipped Boilers

- d. Level an L404A pressure limit by carefully bending the syphon until the limit's leveling indicator hangs freely with its pointer directly over the index mark inside the back of the case.

NOTICE

L404A Pressure Limits contain mercury in a sealed tube. Do *not* place limit in the trash at the end of its useful life. If this limit is replacing a limit that contains mercury in a sealed tube, do *not* place your old limit in the trash. Contact your local waste management authority for instructions regarding recycling and the proper disposal of this limit, or of an old limit containing mercury in a sealed tube. If you have questions, call Honeywell Inc. at 1-800-468-1502.

- e. An L404F pressure limit does not require leveling.
7. On units with a heater opening, install the aquastat controller well in the $\frac{1}{2}$ " NPT or $\frac{3}{4}$ " NPT tapping in tankless heater plate or cover plate. Slip the bulb of the aquastat into the well and secure the control in place with the set screw.

WARNING

Aquastat bulb must be fully inserted into the well.

8. Connect the field wiring to the pressure limit, the LWCO, the R8239A Control Center/J-box and the burner J-box or burner disconnect J-box.
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 Figures 19 thru 21.

NOTE:

- The R7184P Primary Control has pre-installed "T-T" jumper resistor. To activate "T-T" terminals, "T-T" jumper must be removed. To remove, use side cutting pliers to cut jumper (see Figure 28).
- Do not remove (cut) "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 Paragraph M for details on use of burner disconnect junction box provided with all knockdown boiler builds.

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

1. Thread 1/2" NPT pipe plugs into gauge glass tapings in the upper right side of front section.
2. Thread 3/4" NPT pipe plug in probe low water cut off tapping (just left of gauge glass tapings).
3. 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.

4. Screw drain valve into 3/4" NPT side outlet of the 1 1/2" NPT x 90° elbow (note - lower front section tapping "G" is used for standard return on water boilers).
5. If circulator (not supplied with boiler) is to be mounted directly to 1 1/2" NPT boiler return tapping "G", use the piping arrangements outlined in steps a. thru e. as follows: (see Figures 13A, 13B and 13C)
 - 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. Thread 1 1/2" NPT x 15" long nipple into the 1 1/2" NPT x 90° elbow and tighten with a pipe wrench.
 - c. 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.

- d. 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.
 - e. Fasten the second circulator flange and gasket to the circulator.
6. 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 13A, 13B and 13C. 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.

7. On units 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 insert the control's bulb into the well. Secure control to well with set screw.

WARNING

Aquastat bulb must be fully inserted into the well.

8. On units with a heater opening, install the well in 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 insert the control's bulb into the well. Secure control to well with set screw.
9. Connect Field Wiring.
 - a. Water boilers without tankless heater and with front tankless heater. Connect the field wiring from the circulator to the aquastat control and from the control to the burner disconnect J-box or directly to the burner J-box. Make the wiring connections as shown on Figures 22 and 23A.
 - b. Water boilers with rear tankless heater. Connect the field wiring from a standard junction box or burner disconnect J-box to the circulator, aquastat control and burner. Make the wiring connections as shown on Figure 23B.

NOTE:

- Do not remove (cut) "T-T" jumper on R7184P Primary Control for application 9a or 9b above.

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

M. BURNERS SUPPLIED BY BURNHAM 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.

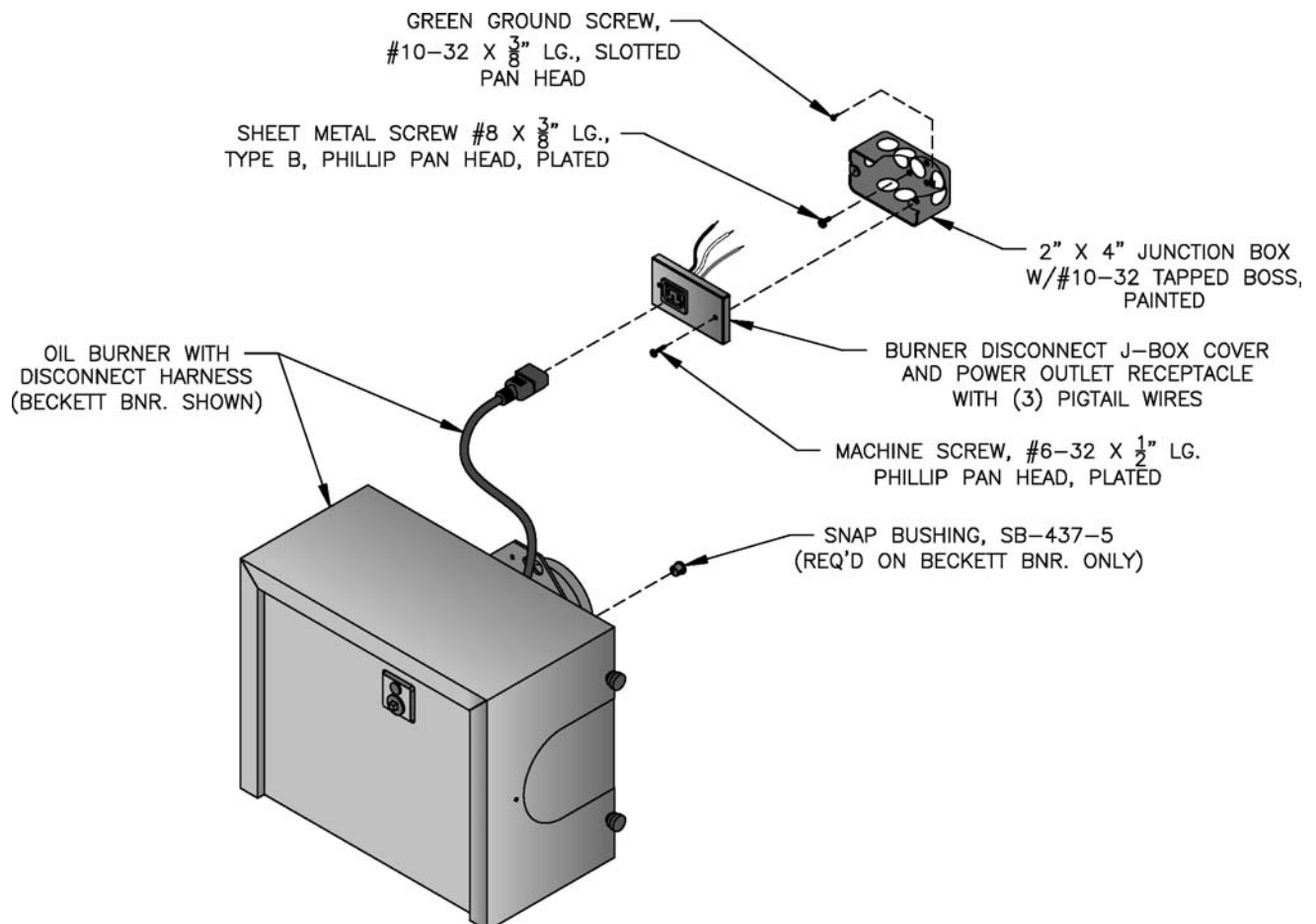
If you are using a burner with the disconnect harness, complete the following assembly instructions for mounting the mating burner disconnect junction box, see Figure 10.

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 K (Install Trim and Controls - Steam Boilers) or L (Install Trim and Controls - Water Boilers). Install end of harness from low water cut-off (LWCO), R8239A Control Center or Aquastat Control into

appropriate knockout of burner disconnect junction box according to source, refer to Figures 1A thru 1D.

4. Use wire nuts to connect wires from control or power source to (3) pigtail wires connected 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 19 thru 23B.
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.
7. Install snap bushing into 7/16" diameter hole in upper right corner of burner enclosure back plate on all Beckett burners, see Figure 10. On certain builds, 18/2 wire from L4006A Aquastat Control mounted in rear heater will pass through this snap bushing and connect to "T-T" terminals on primary control, refer to Figures 20 and 21.

IMPORTANT: Remove (cut) jumper resistor on R7184P Primary Control to activate "T-T" terminals when making a direct connection from thermostat and/or tankless heater aquastat control.



**Figure 10: Burner Disconnect Junction Box with Power Outlet Receptacle
(Mated to Burners with Disconnect Harness)**

SECTION III: 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 11. Remove all bolts.

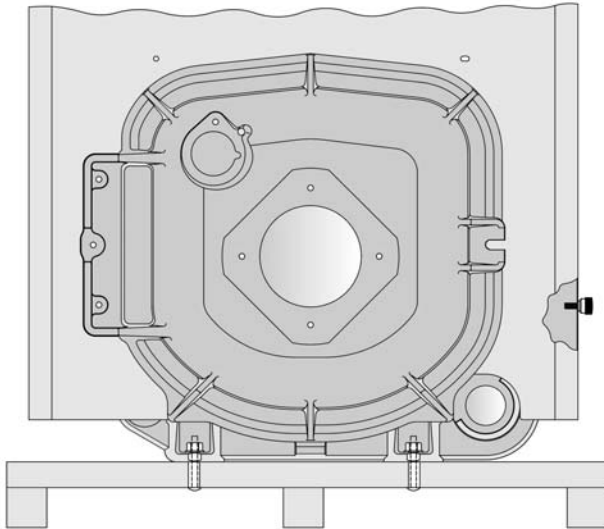


Figure 11: Packaged Boiler Removal from Skid

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 crate skid. Care should be exercised to prevent damage to jacket or burner.

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 11A and 11B).

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 dual 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 11B, Position 2).

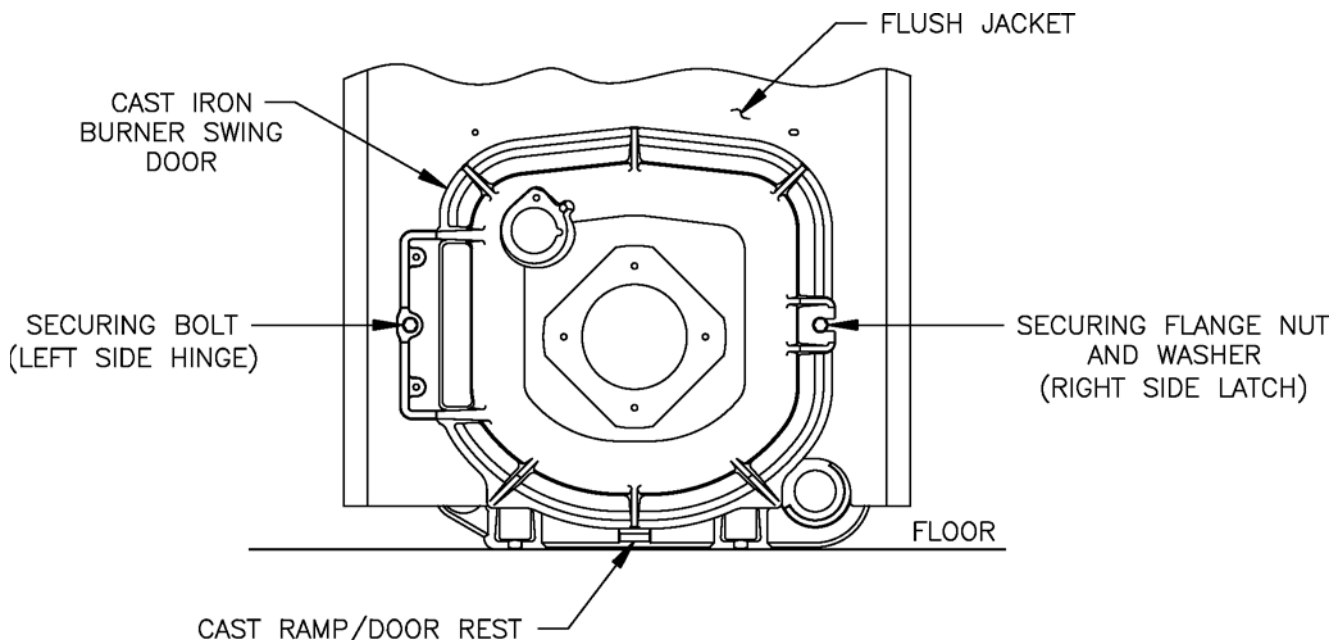


Figure 11A: Partial Front View - Burner Swing Door Mounted to Boiler - Fully Closed and Secured

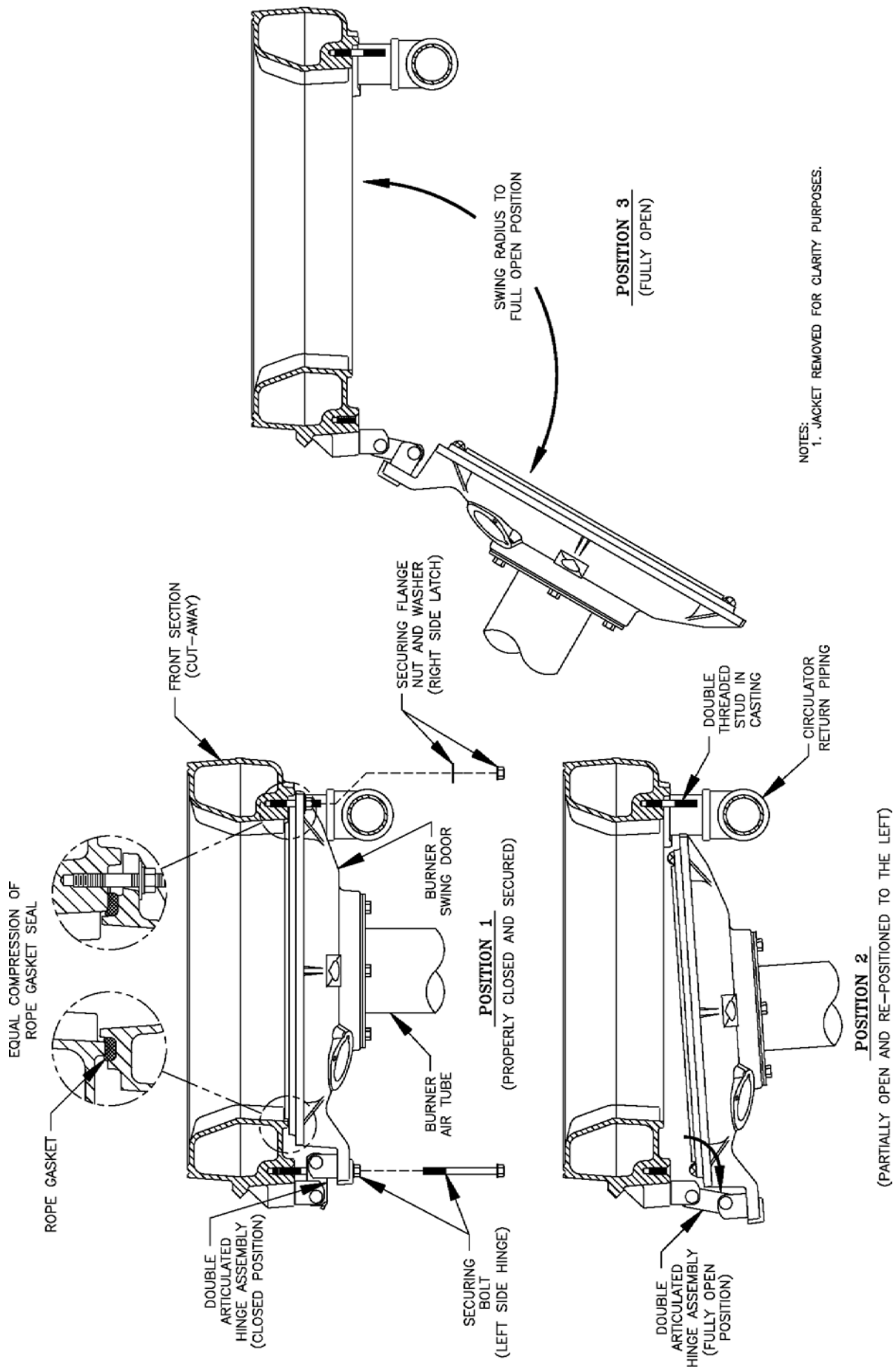


Figure 11B: Top View - Burner Swing Door Mounted to Cast Iron Block Assembly (Jacket Removed for Clarity)

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 11B, Position 3).

2. Perform routine inspection, service or cleaning as necessary.
3. To close Burner Swing Door (see Figures 11A and 11B):

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 11B, 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 11A), 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 11C. Applying excessive torque will only cause thread damage.

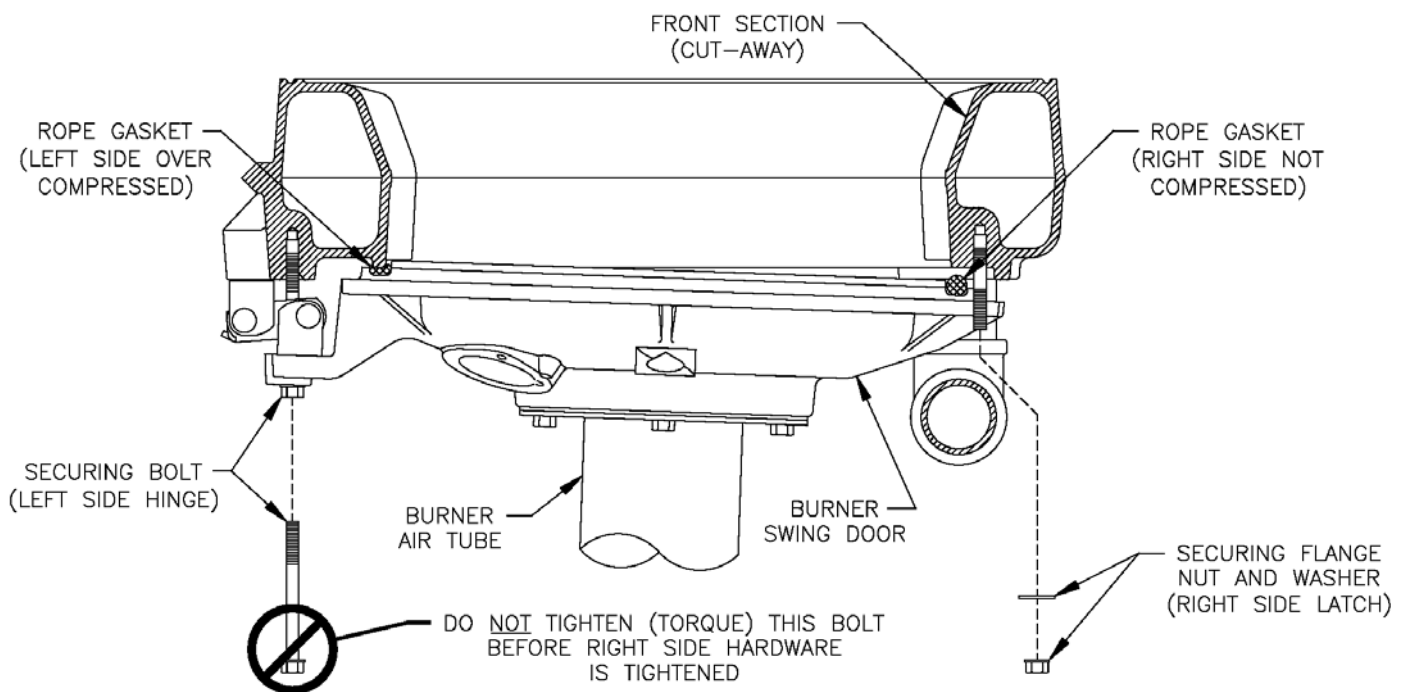


Figure 11C: Top View - Burner Swing Door Fully Closed but Not Properly Secured or Sealed

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.
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. INSPECT NOZZLE AND ELECTRODES / CHANGE FIRING RATE. Refer to Section II, Paragraph J, No. 7, steps b through o for nozzle installation, electrode and head setting inspection.

1A. Water Boilers Only

Packaged V8 water boilers are shipped with the higher input oil nozzle installed in the burner.

A second oil nozzle for the lower (minimum) firing rate is shipped loose for the V83 - V86 models, attached to the burner. Select the proper oil nozzle for the installation. The lower (minimum) input nozzle will provide greater boiler efficiency. However, boiler output will be reduced. Refer to Table 1B for ratings. If the higher rate is desired, inspect the installed nozzle and assure that the nozzle is the correct size and type as specified in Table 6 of this manual.

If the lower (minimum) input is desired, remove the nozzle which was factory installed. Locate the lower (minimum) firing rate nozzle that is supplied loose. Confirm the nozzle is the proper size and type for the lower firing rate as specified in Table 6 of this manual. Install the proper nozzle in the burner nozzle adaptor.

1B. Steam Boilers Only

Packaged V83 - V86 steam boilers are shipped with the lower (standard) firing rate nozzle installed. Packaged V87 - V89 boilers are provided with one nozzle, installed in the burner, that provides the same firing rate as the water boiler of the same size.

Inspect the installed nozzle and assure that the nozzle is the correct size and type as specified in Table 6 of this manual.

2. Inspect and measure burner electrodes. Refer to Figure 27 of this manual for the proper electrode settings.

3. Close the burner swing door and securely seal the door to the boiler front section by reinstalling the hardware and securing the door using procedure previously outlined in Paragraph D of this section.

G. INSTALL SAFETY OR RELIEF VALVE IN TAPPING "M".

Use 3/4" NPT x 8" nipple and/or 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 13A, 13B, 13C and 14. Installation of the safety or relief valve must be consistent with ANSI/ASME Boiler and Pressure Vessel Code, Section IV.

WARNING

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

H. PACKAGED BOILERS WITH PROBE STYLE

LWCO Install Limit in Tapping "A" using 3/4" NPT x 2" nipple, 3/4" NPT elbow, 3/4" NPT x 1/4" NPT bushing, and syphon included in trim bag. See Figure 9.

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. Level an L404A pressure limit by carefully bending the syphon until the limit's leveling indicator hangs freely with its pointer directly over the index mark inside the back of the case.

NOTICE

L404A Pressure Limits contain mercury in a sealed tube. Do *not* place limit in the trash at the end of its useful life. If this limit is replacing a limit that contains mercury in a sealed tube, do *not* place your old limit in the trash. Contact your local waste management authority for instructions regarding recycling and the proper disposal of this limit, or of an old limit containing mercury in a sealed tube. If you have questions, call Honeywell Inc. at 1-800-468-1502.

4. An L404F pressure limit does not require leveling.

SECTION IV: 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.

WARNING

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

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

CAUTION

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

B. CONNECT SYSTEM SUPPLY AND RETURN PIPING TO BOILER. See Figures 13A, 13B and 13C. Also, consult I=B=R Installation and Piping Guides.

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 12. Also, consult I=B=R Installation and Piping Guides.
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 Alliance™ Indirect-Fired Domestic Water Heater, install the Alliance™ as a separate heating zone. Refer to the Alliance™ Installation, Operating, and Service Instructions for additional information.
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 13A, 13B and 13C in order to regulate water flow for maintenance of higher boiler water temperature.

WARNING

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

If a low water cut-off is required, it must be mounted in the system piping above the boiler. The minimum safe water level of a hot water boiler is just above the highest water containing cavity of the boiler; that is, a hot water boiler must be full of water to operate safely.

5. **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.

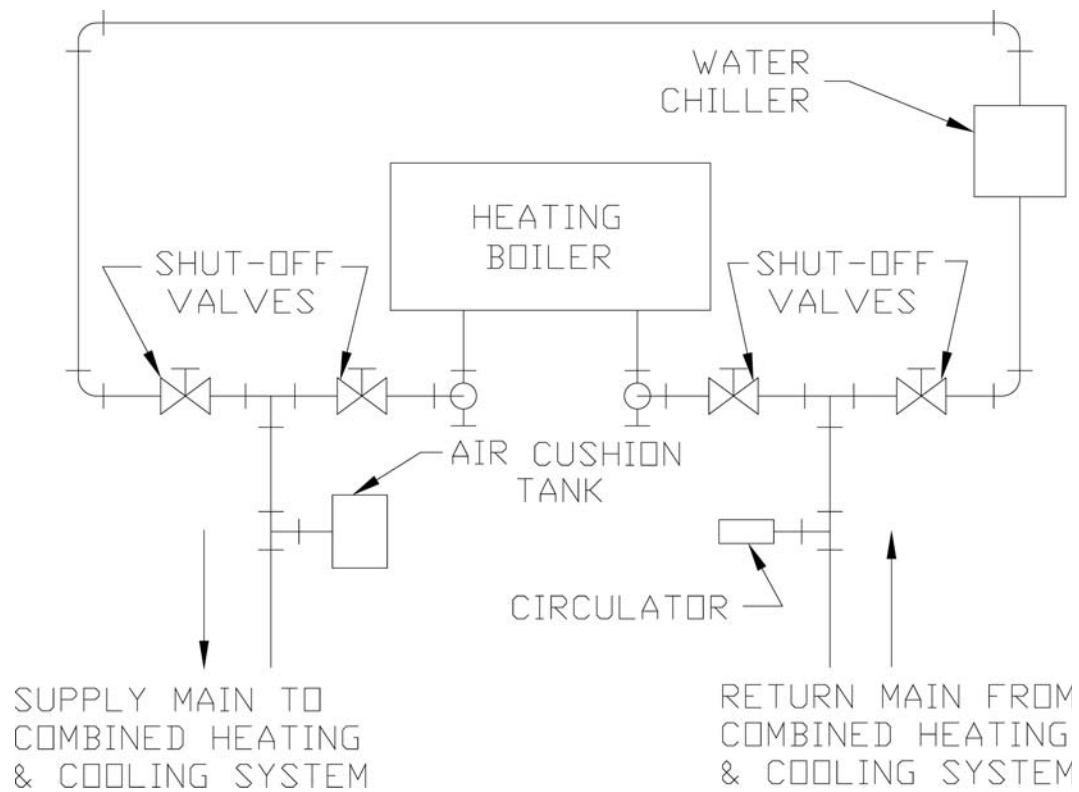


Figure 12: Recommended Piping for Combination Heating and Cooling (Refrigeration) System

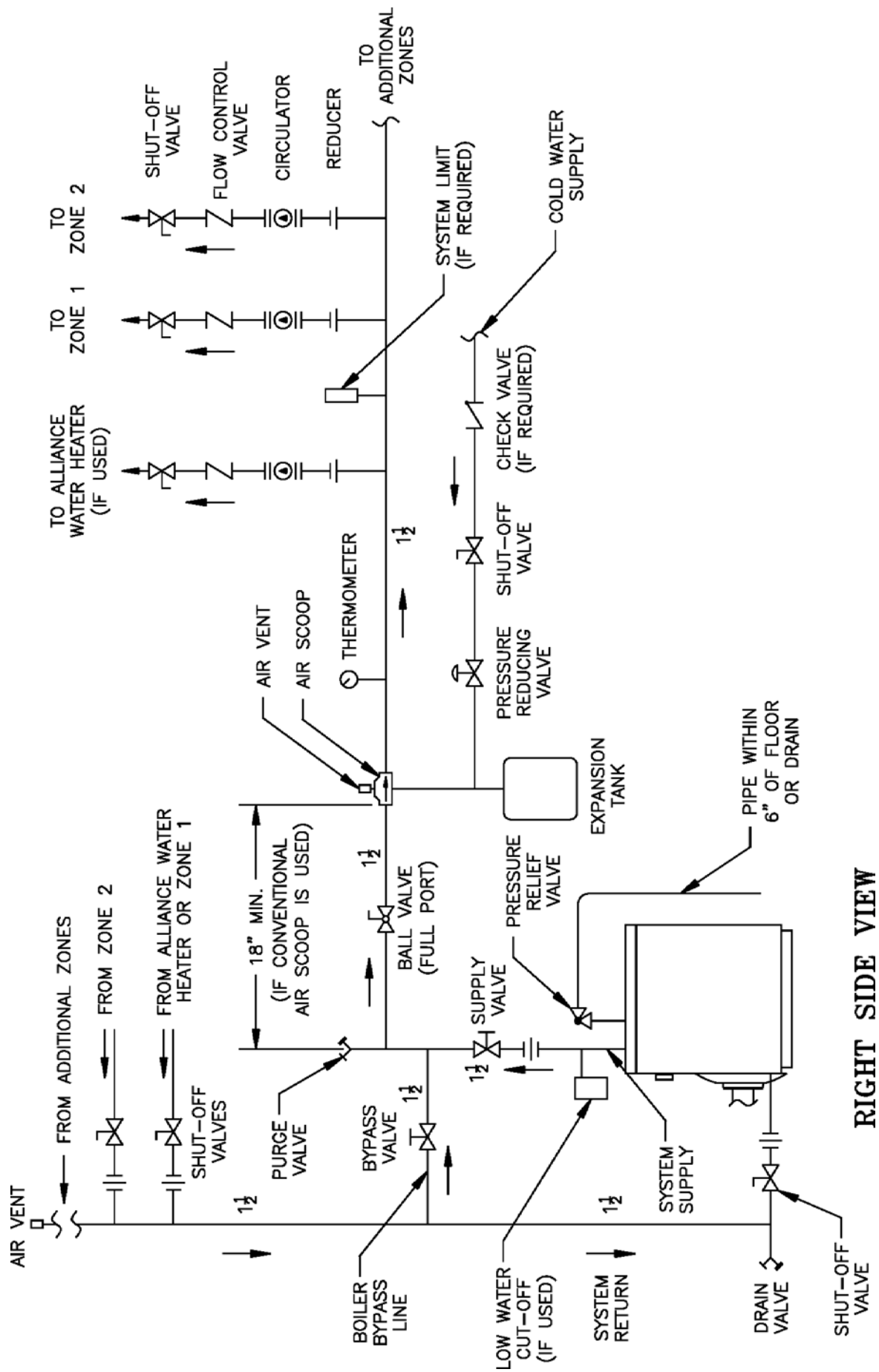


Figure 13A: Water Boiler Piping for Circulator Zoned Heating System

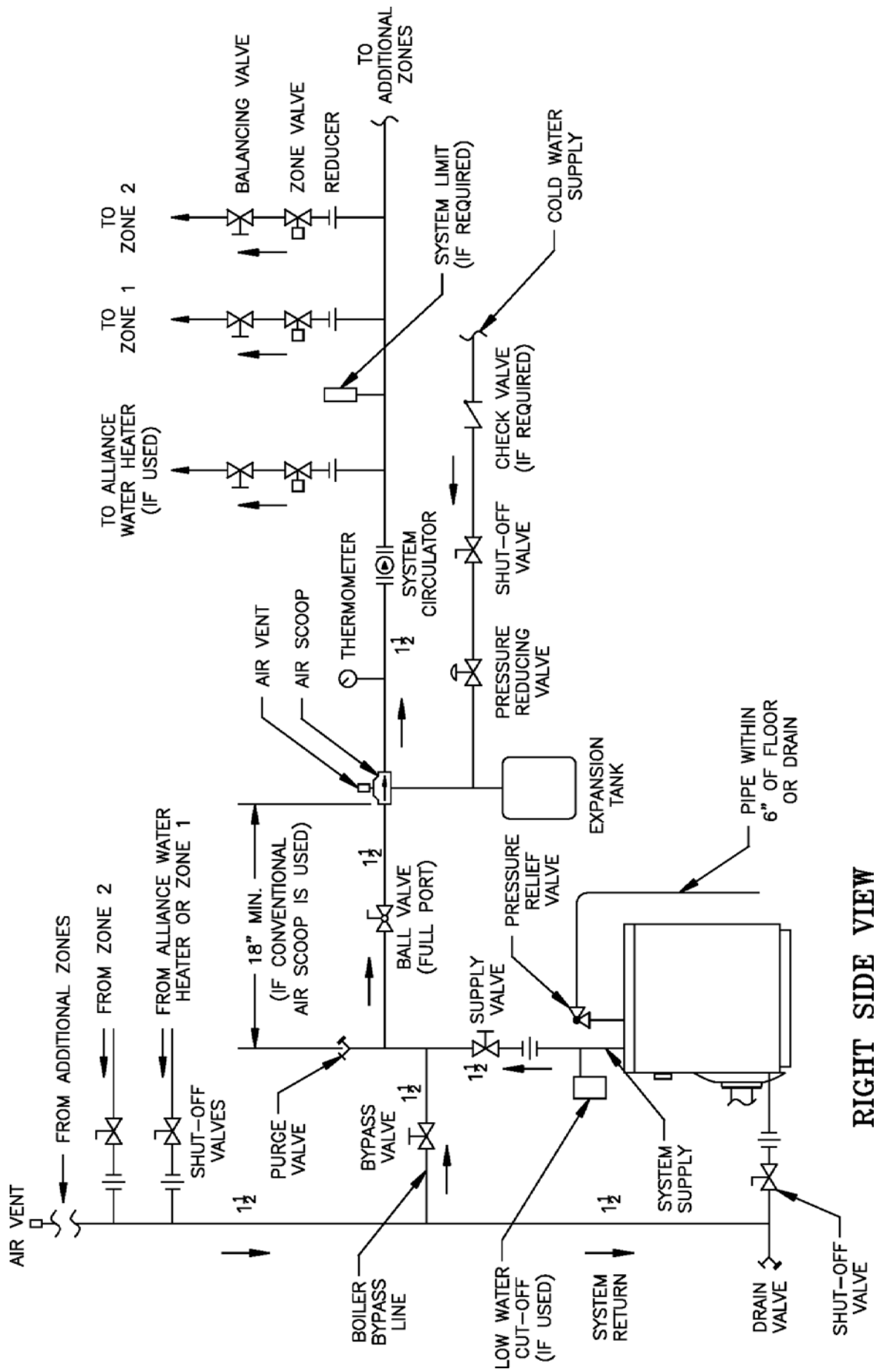


Figure 13B: Preferred Water Boiler Piping for Zone Valve Zoned Heating System - Supply Side Circulator

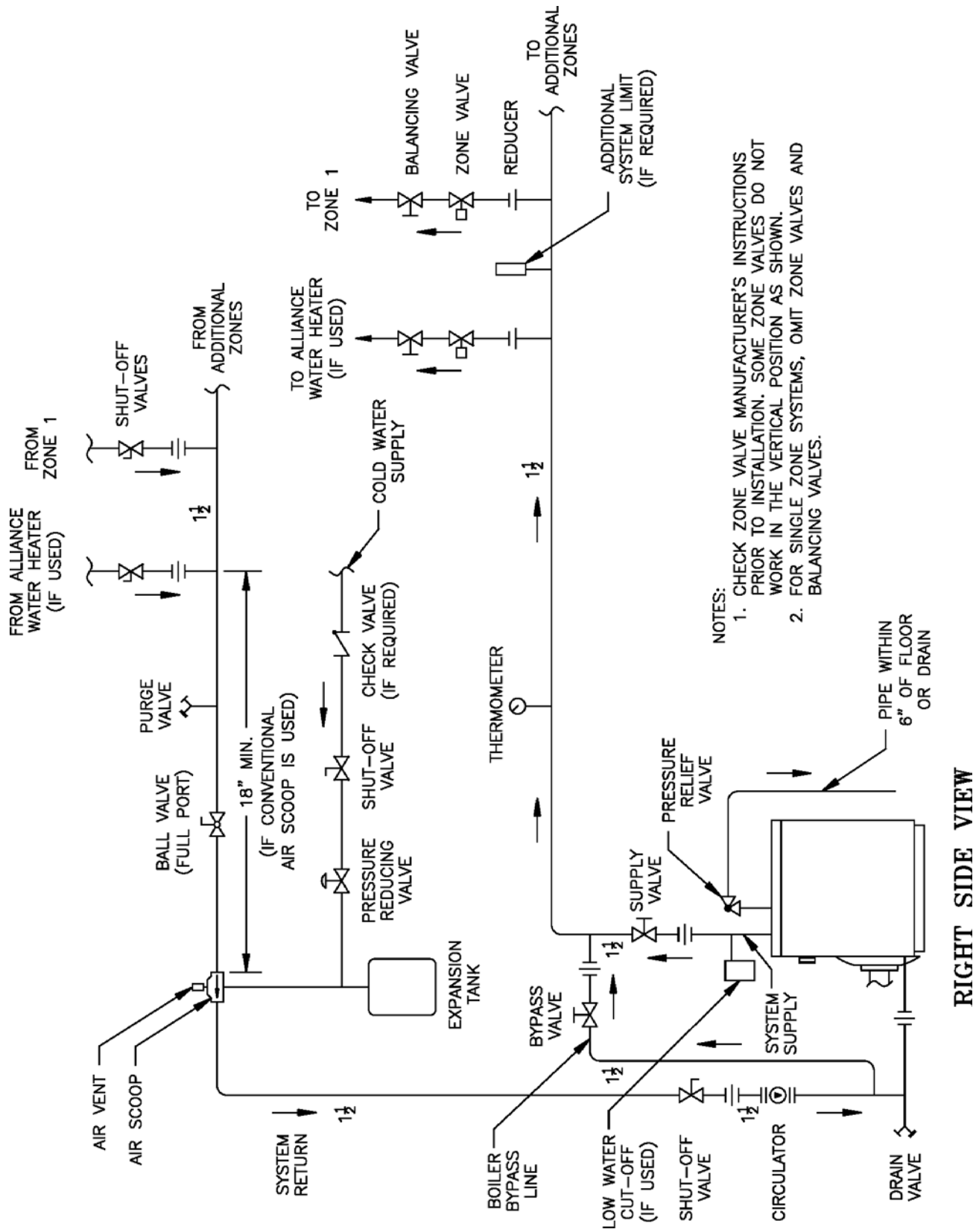


Figure 13C: Optional Water Boiler Piping for Zone Valve Zoned Heating System - Return Side Circulator

SECTION V: 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.

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 14 for piping details. Also consult I=B=R Installation and Piping Guides.

CAUTION

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

NOTICE

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. Burnham's Standard Warranty does not cover problems caused by oxygen contamination of boiler water or scale (lime) build-up caused by frequent addition of water.

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.

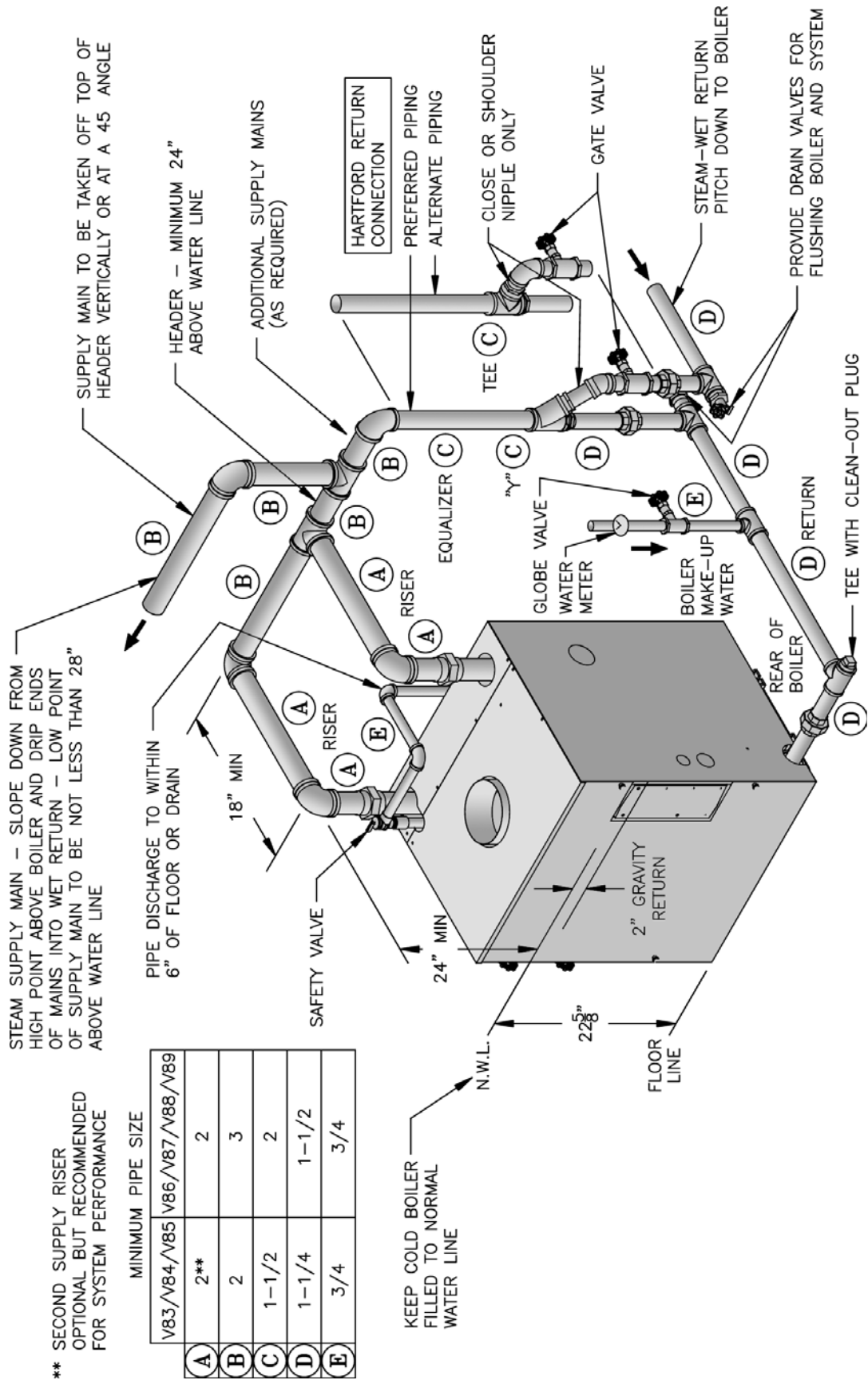


Figure 14: V83 Thru V89 Recommended Boiler Piping For Gravity Return Steam Boiler

NOTICE

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

SECTION VI: TANKLESS AND INDIRECT WATER HEATER PIPING

- A. **CONNECT TANKLESS HEATER PIPING** as shown in Figure 15A. 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 15A.

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 and reduce the useful life of the coil.

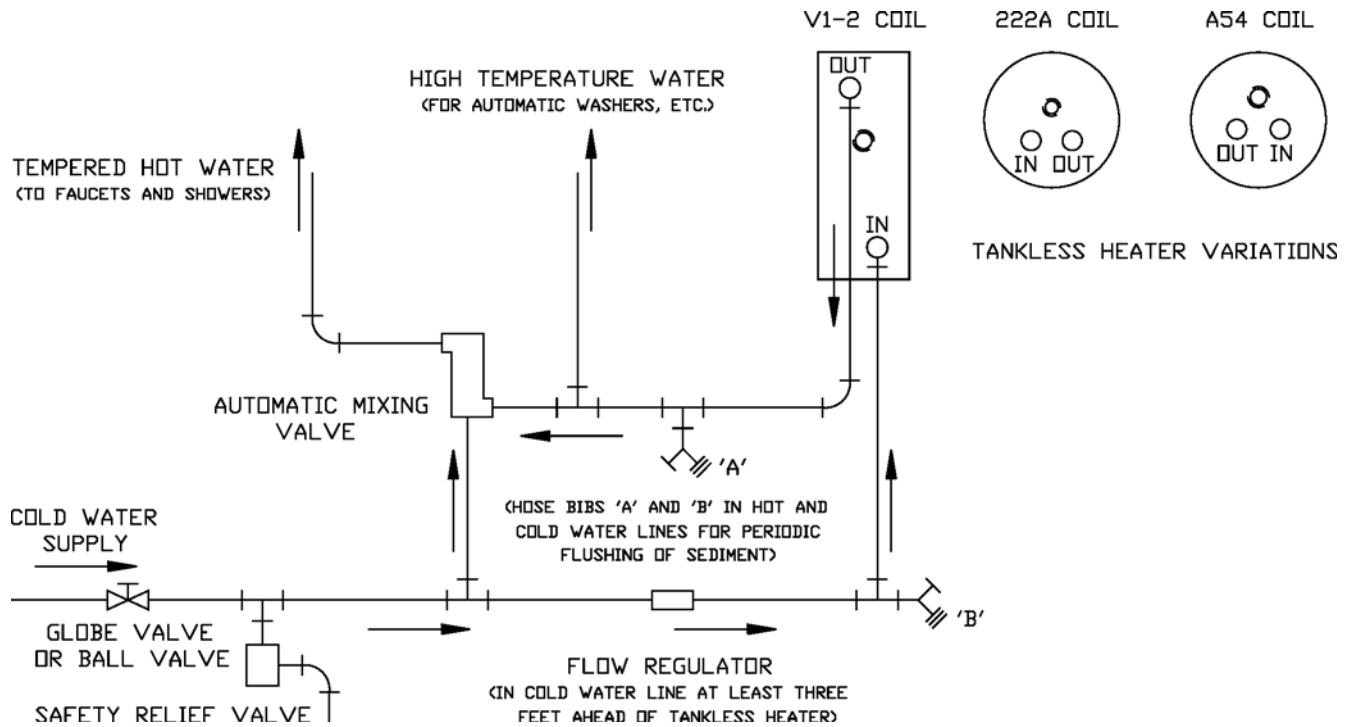


Figure 15A: Schematic Tankless Heater Piping

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 |
| V83 | V1-2 | 2.75 | 3 | 3.9 | 4.7 |
| V84 | V1-2 | 3 | 3.25 | 4.7 | 5.6 |
| V85 | V1-2 | 3.25 | 3.5 | 5.6 | 6.4 |
| V86 | V1-2 | 3.75 | 3.75 | 7.2 | 7.2 |
| V87 | V1-2 | 3.75 | 4 | 7.2 | 8 |
| V88 | V1-2 | 4 | 4.5 | 8 | 9.8 |
| V89 | 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) |
|--------------|------------|---------------------|---------------------------------|
| V83 | 222A | 3 | 22 |
| V84 | 222A | 3.5 | 22 |
| V85 | 222A | 4 | 30.5 |
| V86 | 222A | 4.5 | 33 |
| V87 | 222A | 4.6 | 33 |
| | A54 | 5.5 | 36 |
| V88 | 222A | 4.75 | 40 |
| | A54 | 6 | 39.5 |
| V89 | 222A | 4.75 | 40 |
| | A54 | 6 | 39.5 |

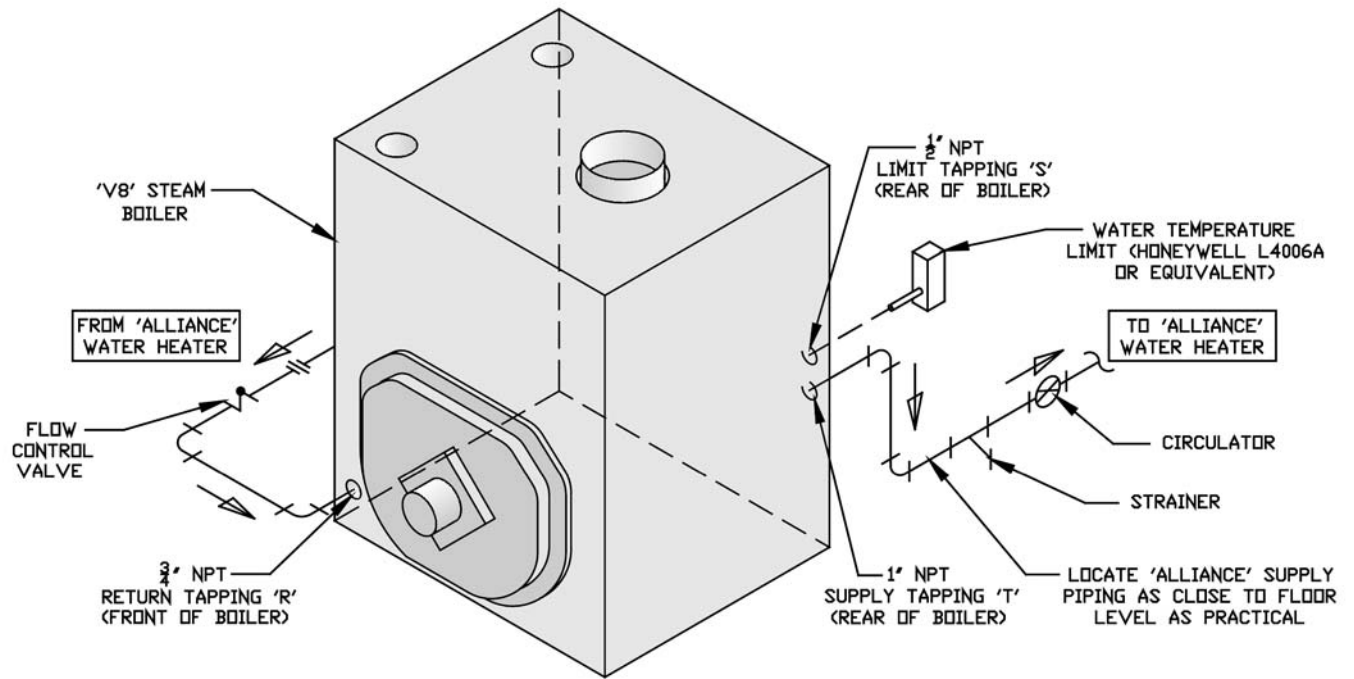


Figure 15B: Alliance™ Water Heater Piping with V8 Boiler

B. CONNECT ALLIANCE™ INDIRECT WATER HEATER PIPING as shown in Figure 15B.

1. Refer to Alliance™ manual for additional information.

SECTION VII: 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 V8 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 16 for recommended installation.
 - a. Install a draft regulator (supplied with boiler) following the instructions furnished with the regulator. See Figure 17 for alternate draft regulator locations.
 - b. For the V82W, V84W and V86W the minimum recommended 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 - All air for combustion can be supplied directly to the burner from outdoors (**ONLY AVAILABLE WITH BECKETT BURNER**). See Figure 18.

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.

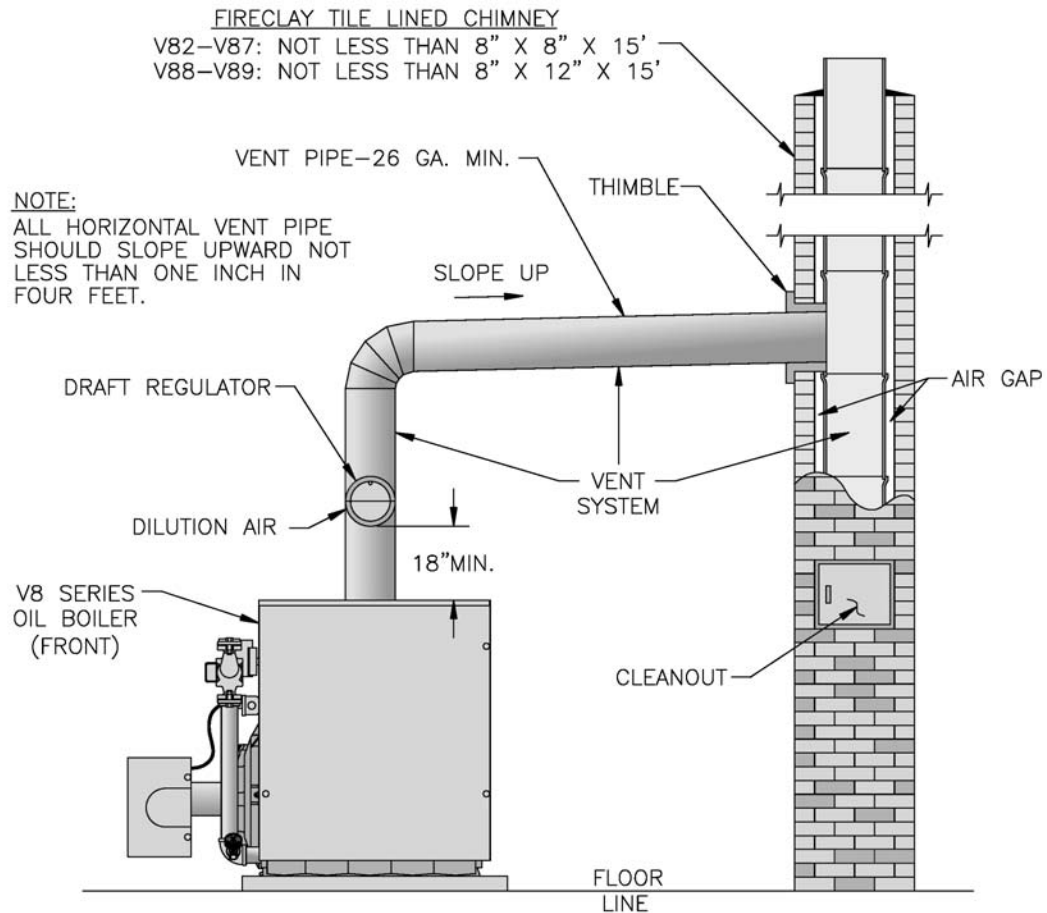


Figure 16: Recommended Vent Pipe Arrangement and Chimney Requirements

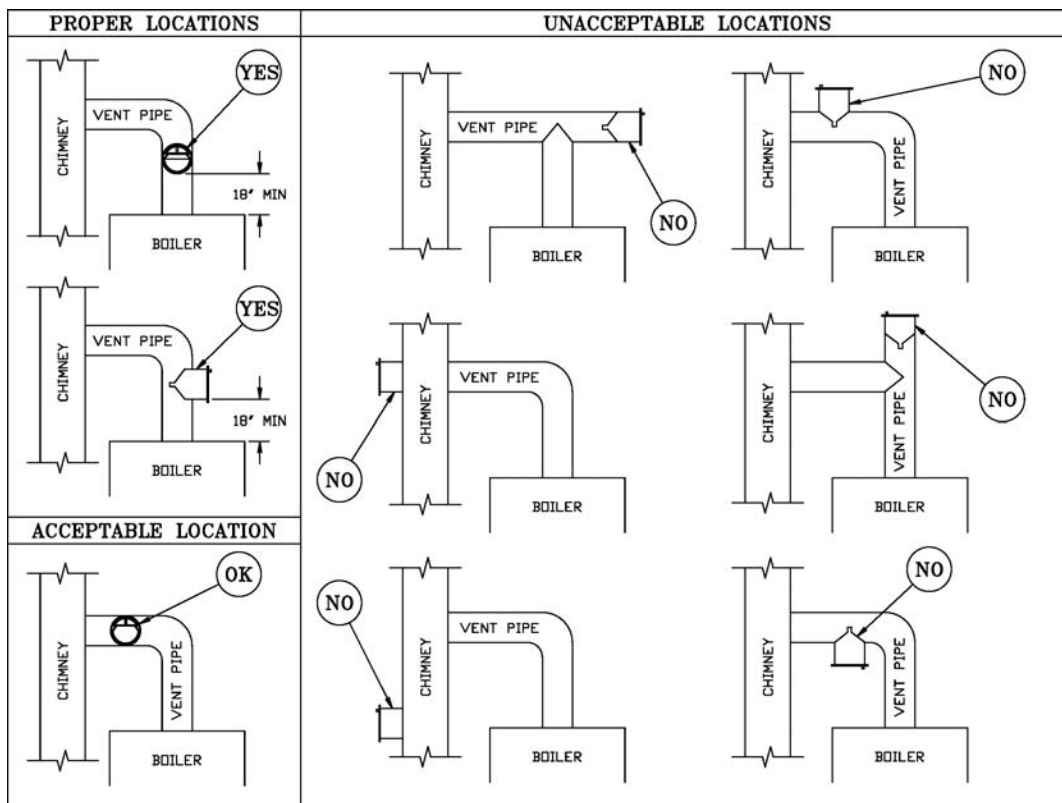


Figure 17: Proper and Improper Locations of Draft Regulator

2. After determining location, cut a hole in the wall to accept 4 inch air intake pipe. See Figure 18.
3. Remove the metal knockout in right side of burner cover. Install Burnham Inlet Air Accessory Kit, Part Number 611280031.
4. Mount the Vacuum Relief Valve Tee Assembly (Part Number 8116268 included with Kit) or 90° elbow into the burner inlet ring. See Figure 18.
 - 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 18.

NOTICE

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

7. Seal all external joints with weatherproof caulk.

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.

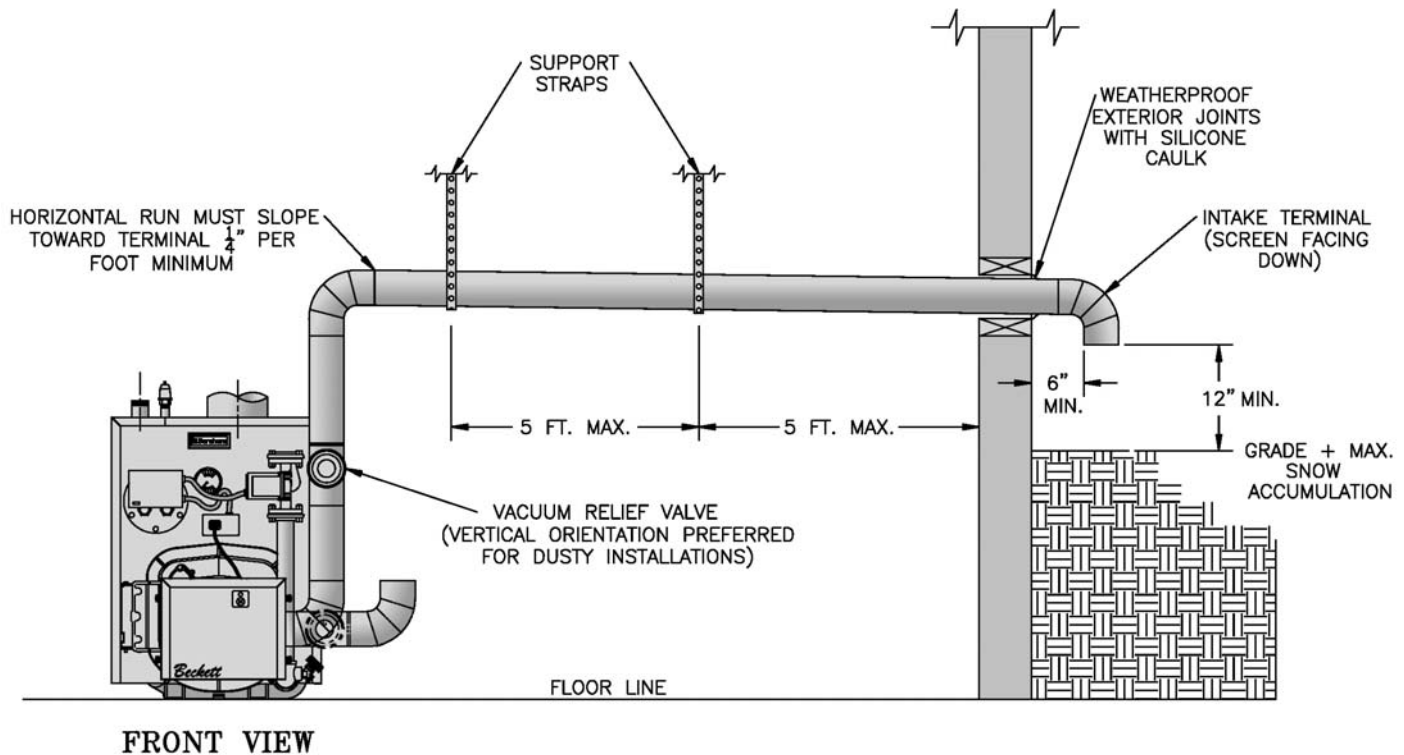


Figure 18: Optional Air Intake Piping Installation - Only Available with Beckett Burner

SECTION VIII: 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.

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 Alliance™ indirect 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 19 through 23B.

- 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 19 thru 23B 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.

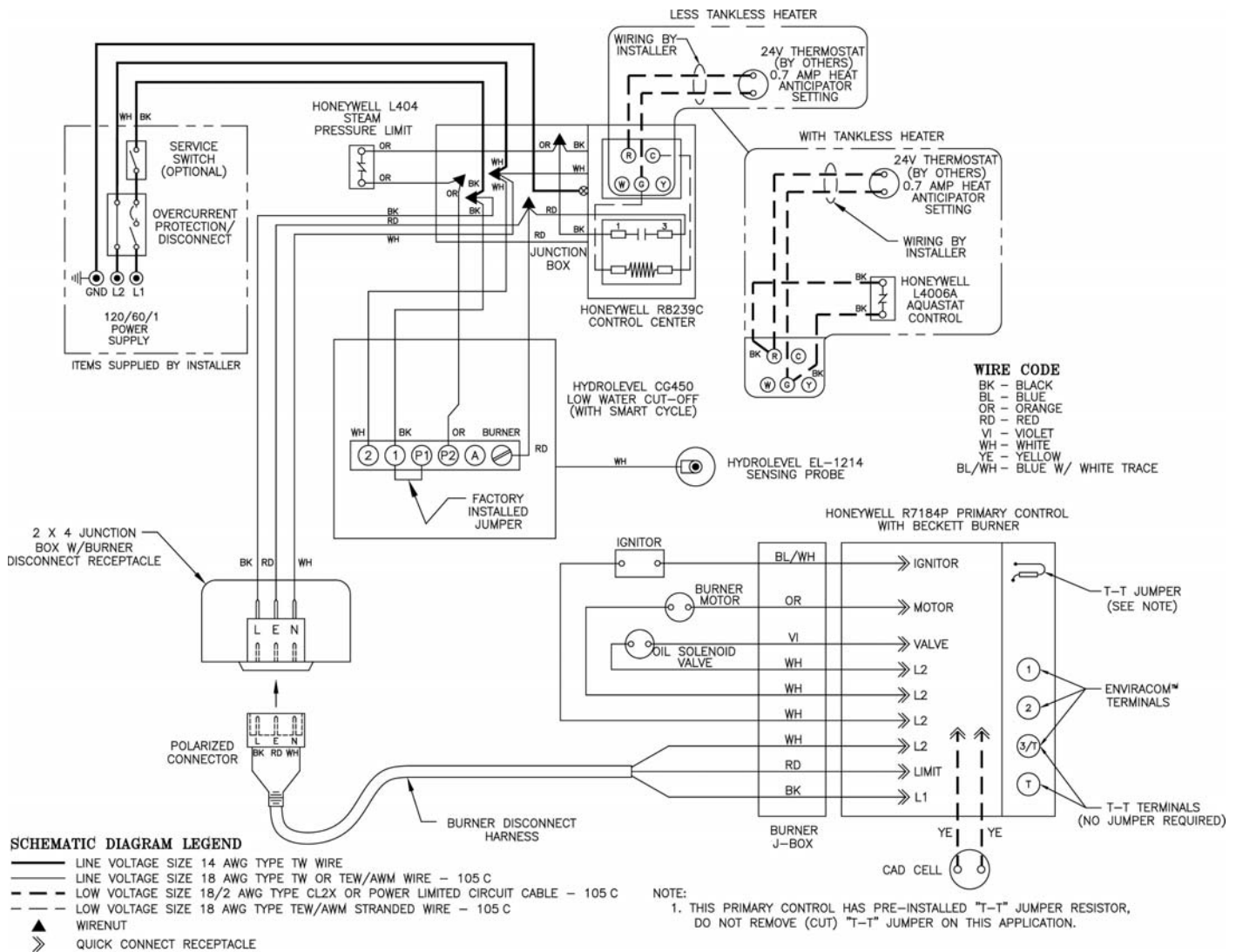


Figure 19: Wiring Diagram, Steam, Hydrolevel CG450 Probe LWCO

BOILER SEQUENCE OF OPERATION WITH PROBE LWCO

When the thermostat calls for heat, it energizes the R8239C Control Center relay which in turn energizes the cad cell primary control, bringing on the burner. The burner will operate in the following sequence: Prepurge for the first 10 seconds; fire until the thermostat is satisfied or the limit setting on the high limit is reached; post-purge for the last 10 seconds. When the high limit control restores the circuit on a drop in pressure, the burner will start if the thermostat is still calling for heat.

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 probe 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 burner down and enter into a recycle mode, after 60 seconds burner will restart and repeat trial for ignition. If after three (3) trials for ignition, flame is not detected, control will enter into restricted mode and must be reset manually before burner can be restarted.

When there is no demand for heat, the operating control will maintain the boiler water temperature at the selected setting for proper operation of the domestic water heater, if equipped with optional tankless heater.

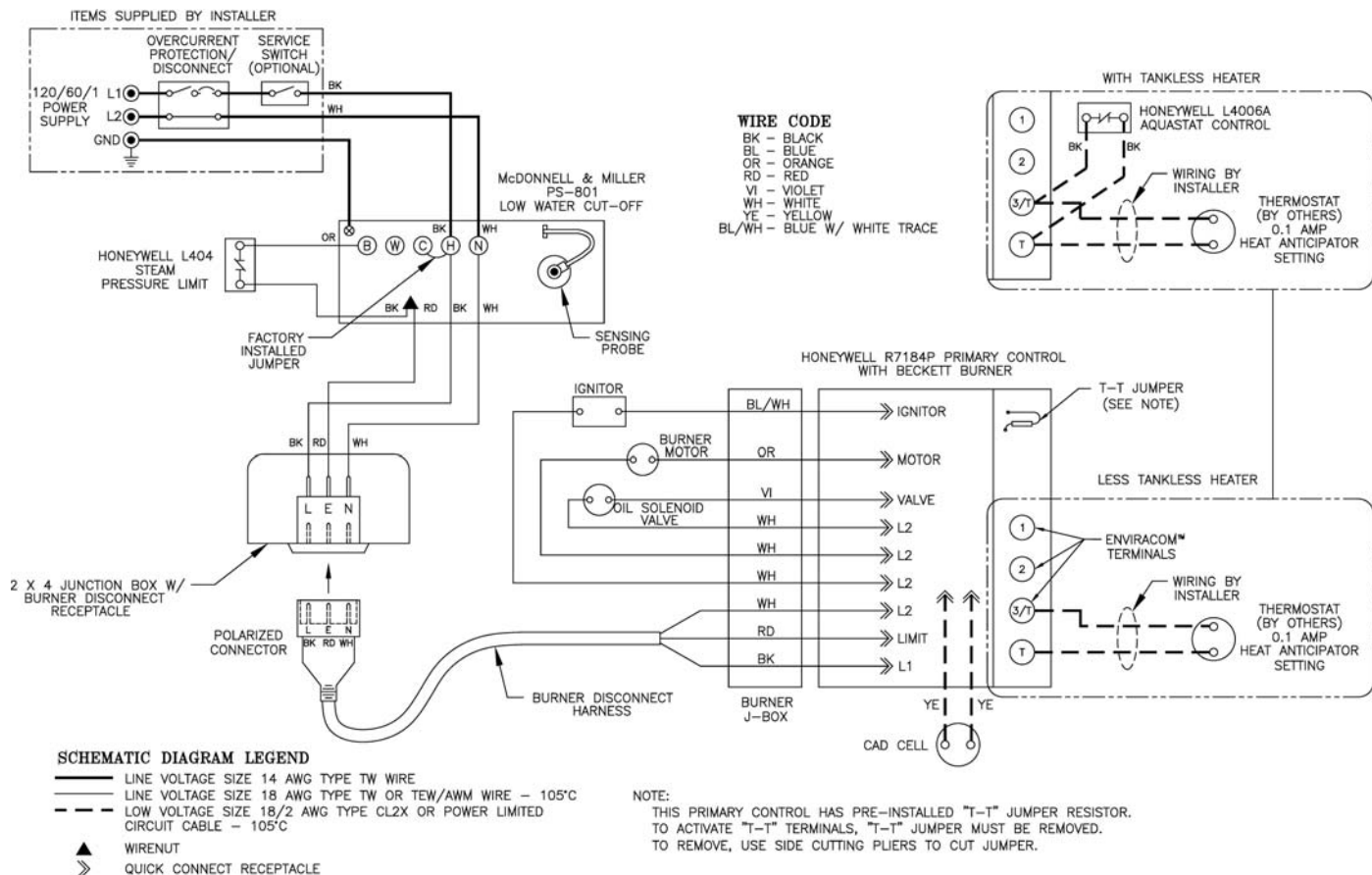


Figure 20: Wiring Diagram, Steam, McDonnell & Miller PS-801 Probe LWCO

BOILER SEQUENCE OF OPERATION WITH PROBE LWCO

When the thermostat calls for heat, it energizes the cad cell primary control, bringing on the burner. The burner will operate in the following sequence: Prepurge for the first 10 seconds; fire until the thermostat is satisfied or the limit setting on the high limit is reached; post-purge for the last 10 seconds. When the high limit control restores the circuit on a drop in pressure, the burner will start if the thermostat is still calling for heat.

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 probe 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 burner down and enter into a recycle mode, after 60 seconds burner will restart and repeat trial for ignition. If after three (3) trials for ignition, flame is not detected, control will enter into restricted mode and must be reset manually before burner can be restarted.

When there is no demand for heat, the operating control will maintain the boiler water temperature at the selected setting for proper operation of the domestic water heater, if equipped with optional tankless heater.

| McDonnell & Miller PS-801 Terminals May Be Lettered or Numbered as Follows: | | |
|---|-----------------------|-----------------------|
| Wire Color | Numbered Terminals | Lettered Terminals |
| RD | 5 | B |
| BK | 1 | H |
| WH | 2 | N |
| Jumper | 1-3 | H-C |

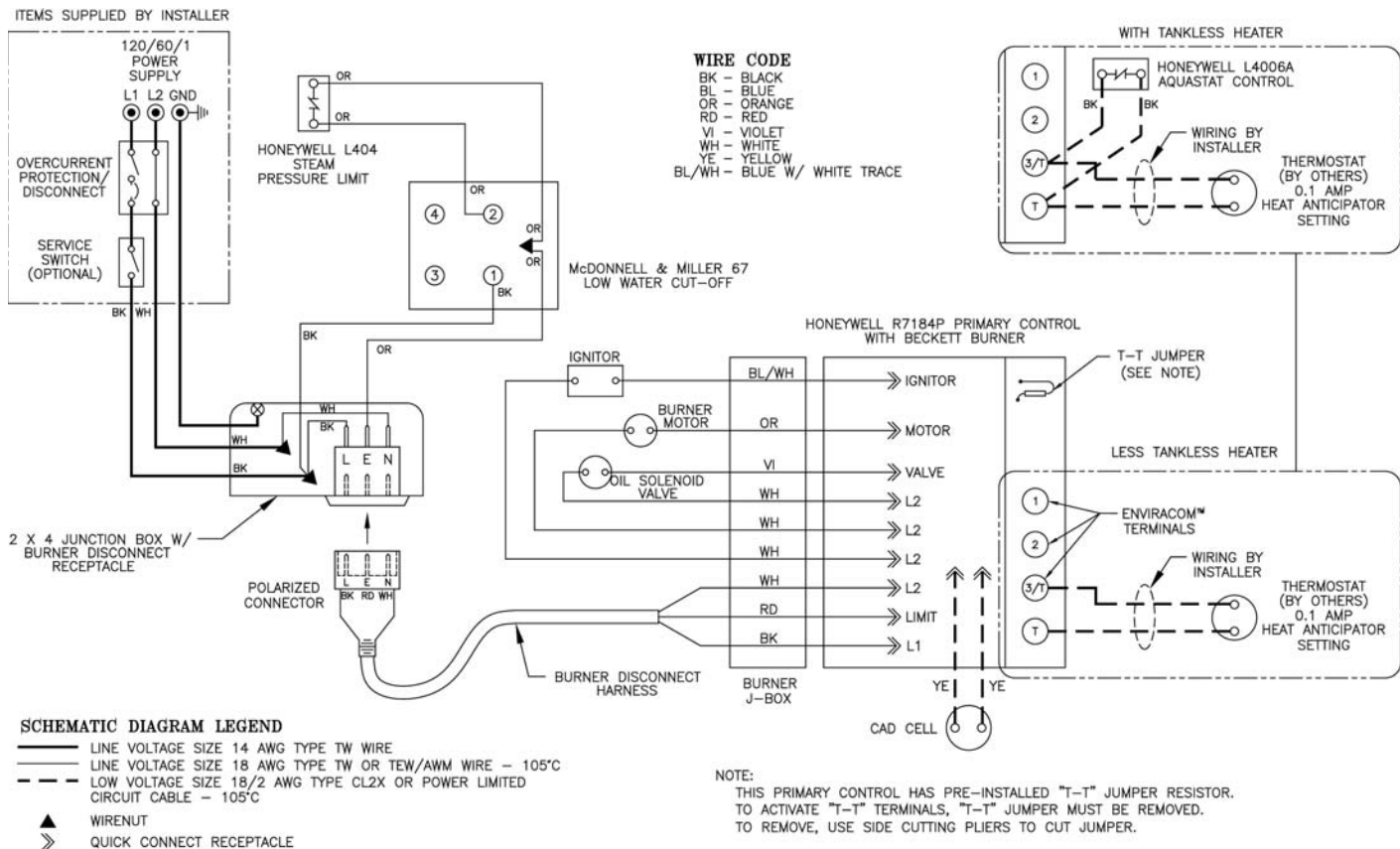


Figure 21: Wiring Diagram, Steam, McDonnell & Miller 67 Float LWCO

BOILER SEQUENCE OF OPERATION WITH FLOAT LWCO

When the thermostat calls for heat, it energizes the cad cell primary control, bringing on the burner. The burner will operate in the following sequence: Prepurge for the first 10 seconds; fire until the thermostat is satisfied or the limit setting on the high limit is reached; post-purge for the last 10 seconds. When the high limit control restores the circuit on a drop in pressure, the burner will start if the thermostat is still calling for heat. The low water cut-off will shut down the burner if the water level in the boiler drops too low. The control resets and restarts 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 burner down and enter into a recycle mode, after 60 seconds burner will restart and repeat trial for ignition. If after three (3) trials for ignition, flame is not detected, control will enter into restricted mode and must be reset manually before burner can be restarted.

When there is no demand for heat, the operating control will maintain the boiler water temperature at the selected setting for proper operation of the domestic water heater, if equipped with optional tankless heater.

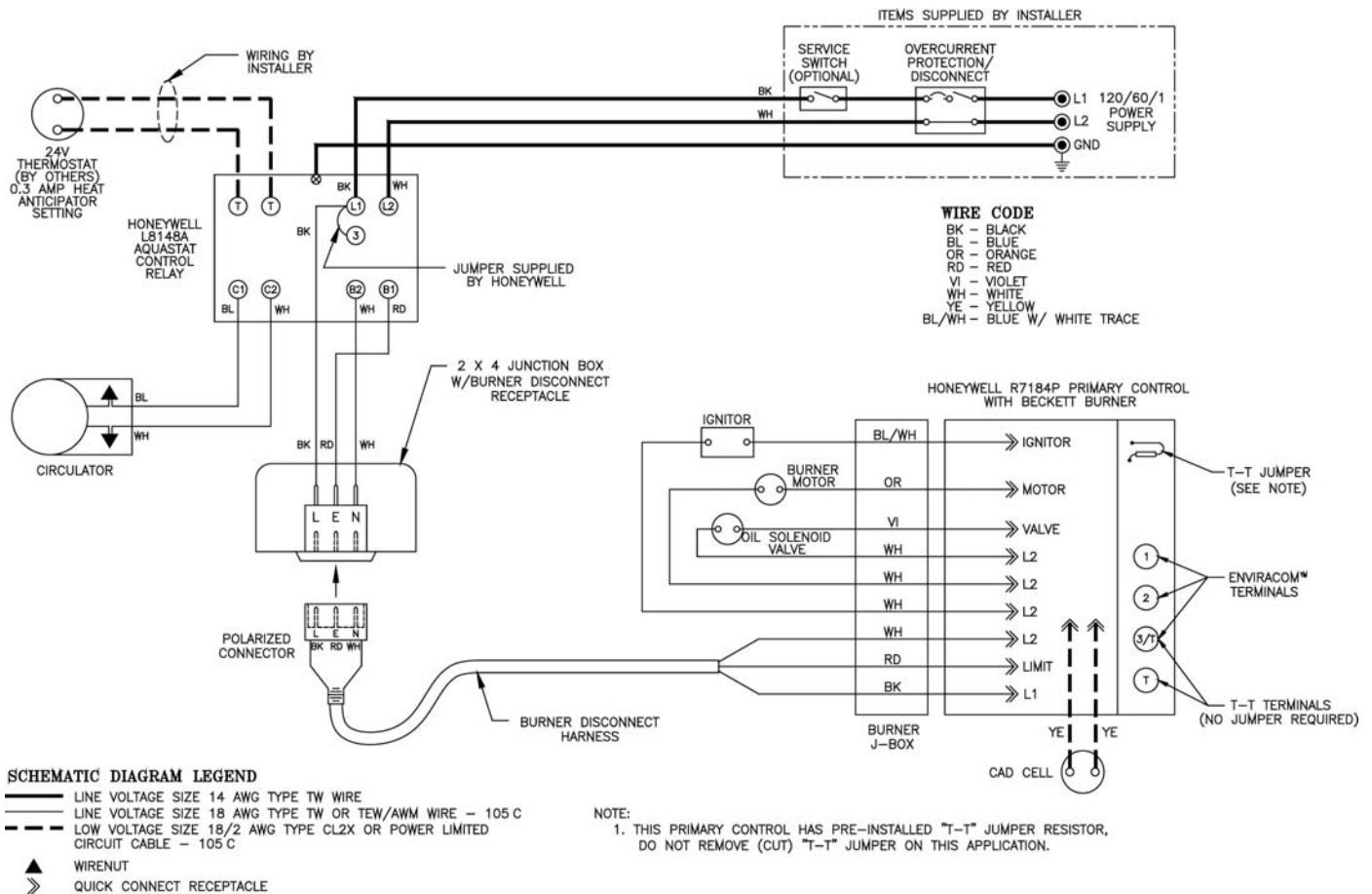


Figure 22: Wiring Diagram, Water without Tankless Heater

BOILER SEQUENCE OF OPERATION

A call for heat by the thermostat energizes the L8148A control which in turn energizes the primary control to turn on the burner. The burner will operate in the following sequence: Prepurge for the first 10 seconds; fire until the thermostat is satisfied or the limit setting on the high limit is reached; post-purge for the last 10 seconds. The circulator will operate as long as the thermostat is calling for heat. If the thermostat is not satisfied and the high limit is reached, the circulator will continue to operate, and the burner will stop until the high limit is closed by a drop in boiler water temperature.

On burner start, if the cad cell does not see flame within approximately 15 seconds, primary control will shut burner down and enter into a recycle mode, after 60 seconds burner will restart and repeat trial for ignition. If after three (3) trials for ignition, flame is not detected, control will enter into restricted mode and must be reset manually before burner can be restarted.

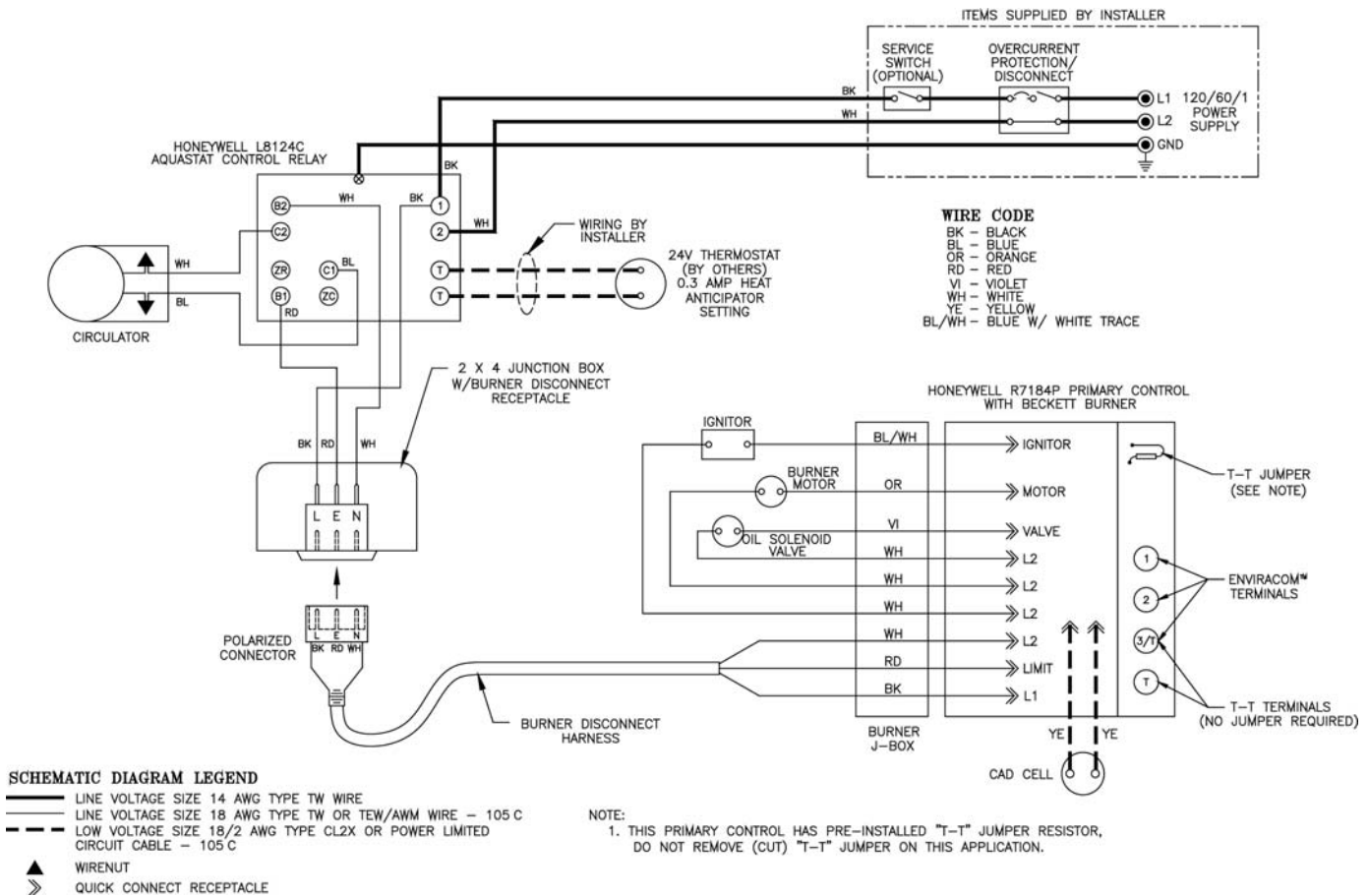


Figure 23A: Wiring Diagram, Water with Front Tankless Heater

BOILER SEQUENCE OF OPERATION

A call for heat by the thermostat energizes the L8124C control which in turn energizes the primary control to turn on the burner. The burner will operate in the following sequence: Prepurge for the first 10 seconds; fire until the thermostat is satisfied or the limit setting on the high limit is reached; post-purge for the last 10 seconds. The circulator will also operate when the thermostat calls for heat if the boiler water temperature is up to the setting of the low limit in the L8124C control. If boiler water temperature is below the low limit setting the burner will operate but the circulator will not, giving preference to the domestic hot water demand.

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

On burner start, if the cad cell does not see flame within approximately 15 seconds, primary control will shut burner down and enter into a recycle mode, after 60 seconds burner will restart and repeat trial for ignition. If after three (3) trials for ignition, flame is not detected, control will enter into restricted mode and must be reset manually before burner can be restarted.

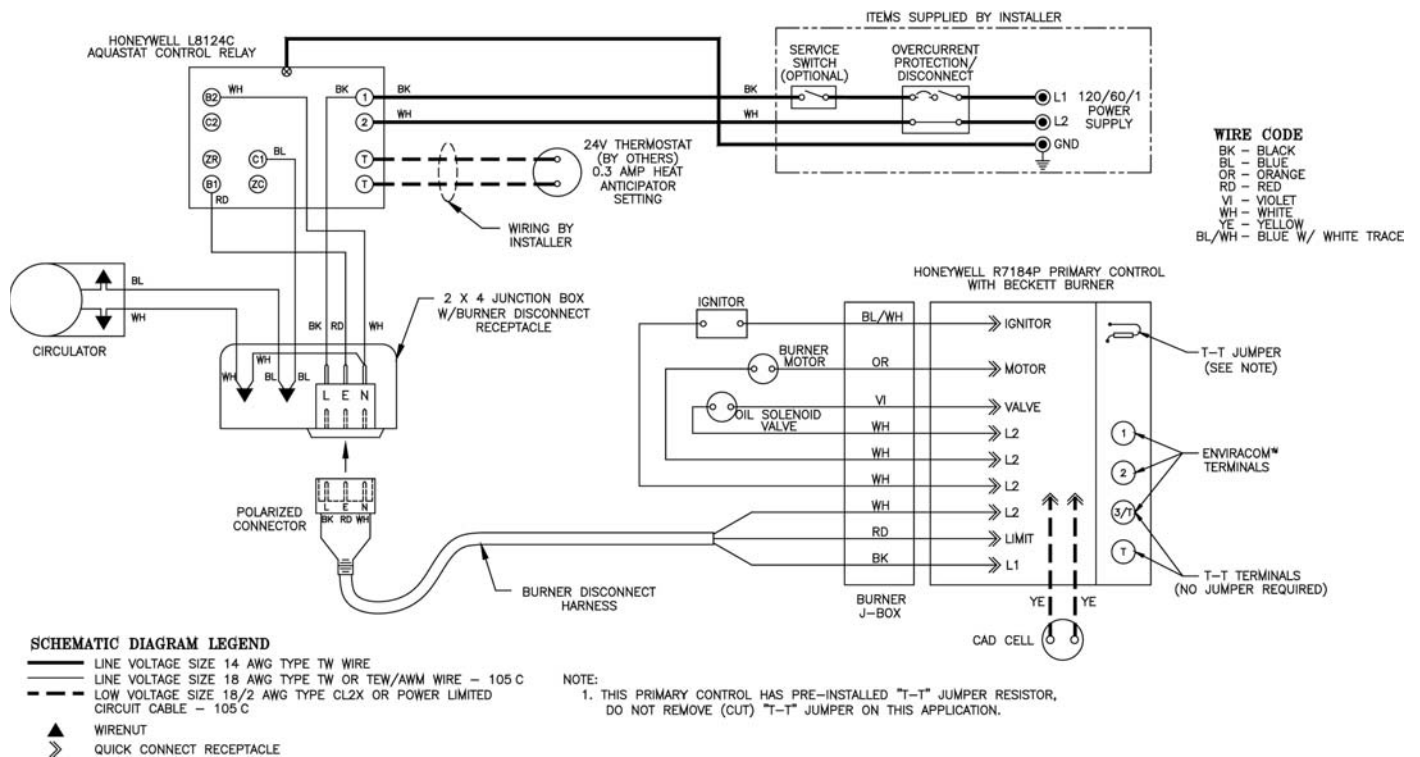


Figure 23B: Wiring Diagram, Water with Rear Tankless Heater

BOILER SEQUENCE OF OPERATION

A call for heat by the thermostat energizes the L8124C control which in turn energizes the primary control to turn on the burner. The burner will operate in the following sequence: Prepurge for the first 10 seconds; fire until the thermostat is satisfied or the limit setting on the high limit is reached; post-purge for the last 10 seconds. The circulator will also operate when the thermostat calls for heat if the boiler water temperature is up to the setting of the low limit in the L8124C control. If boiler water temperature is below the low limit setting the burner will operate but the circulator will not, giving preference to the domestic hot water demand.

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

On burner start, if the cad cell does not see flame within approximately 15 seconds, primary control will shut burner down and enter into a recycle mode, after 60 seconds burner will restart and repeat trial for ignition. If after three (3) trials for ignition, flame is not detected, control will enter into restricted mode and must be reset manually before burner can be restarted.

SECTION IX: 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.

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.**

4. Use of a high efficiency micron filter (Garber or equivalent) in addition to a conventional filter is highly recommended.

B. SINGLE PIPE OIL LINES

1. Standard burners are provided with single-stage 3450 rpm fuel units with the bypass plug removed for single-pipe installations.
2. The single-stage fuel unit may be installed single-pipe with gravity feed or lift. Maximum allowable lift is 8 feet. See Figure 24.

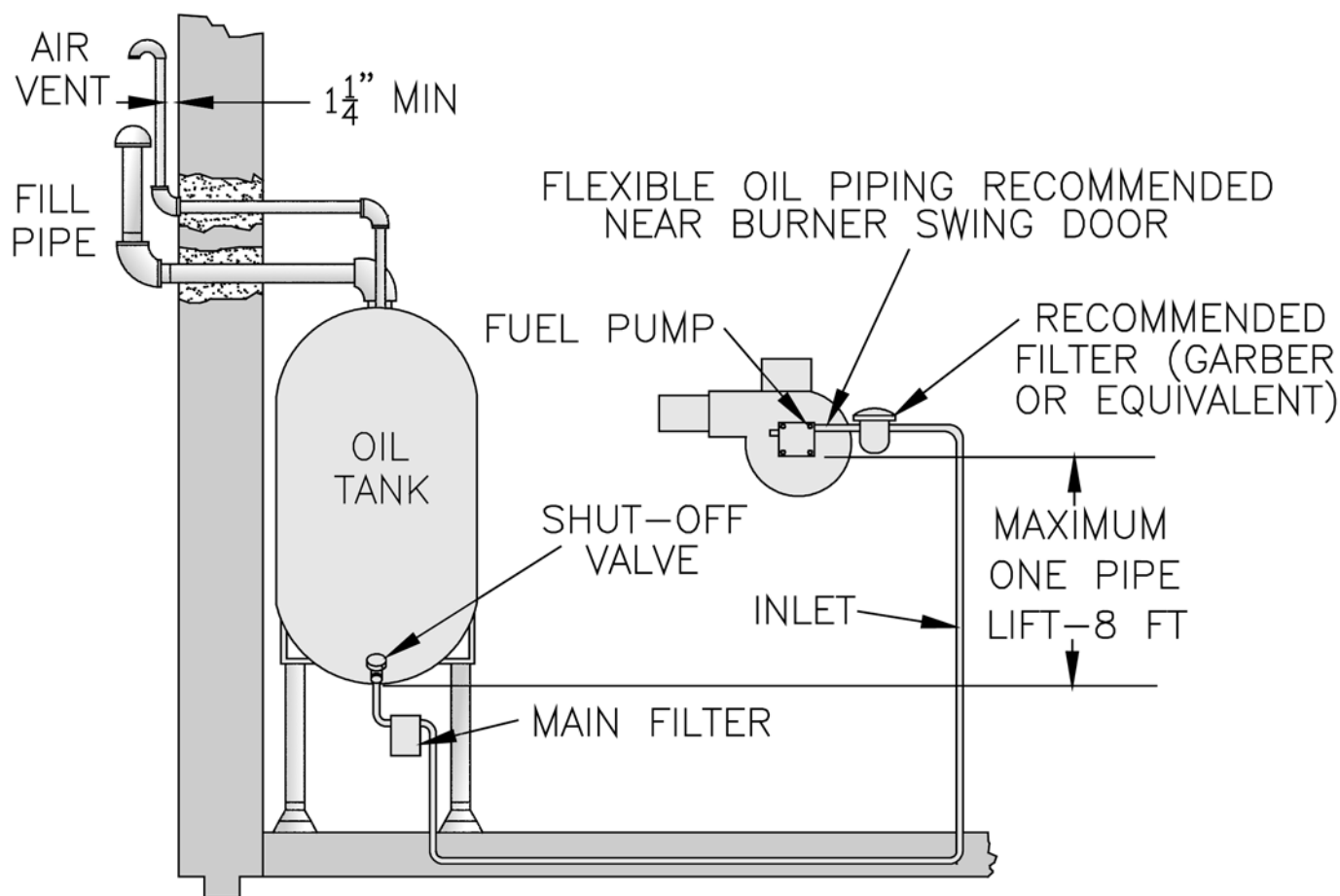


Figure 24: Single Pipe Oil Line

C. TWO PIPE OIL LINES

1. 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 25.

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

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

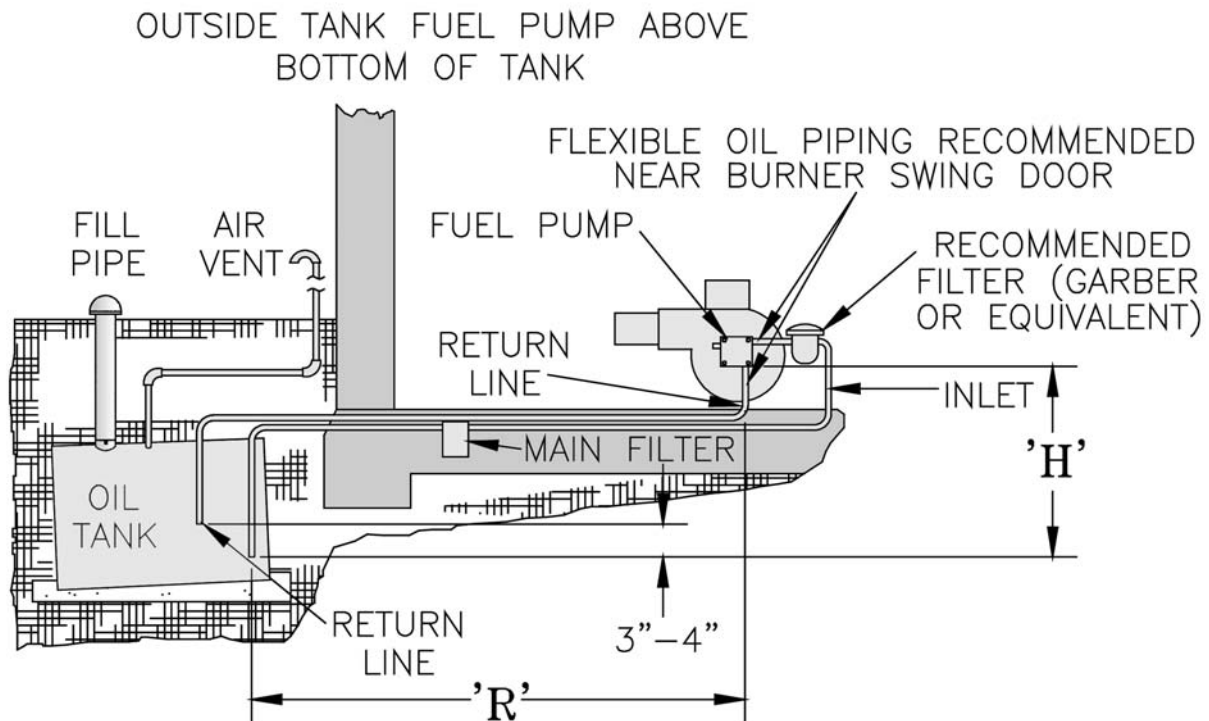


Figure 25: Two Pipe Oil Lines

SECTION X: 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 No. 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 13A, 13B and 13C, 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 valve 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.
- l. 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. SET CONTROLS with burner service switch turned "OFF".

1. **SET ROOM THERMOSTAT** about 10° above room temperature.
2. **PRESS RED RESET BUTTON** on front of burner cover, hold for one (1) second and release to reset primary control.

NOTICE

Burner-specific references in the following instructions pertain to the Beckett AFG, supplied as standard equipment. For optional burners, Riello R40 and Carlin EZ-1HP, EZ-2HP and 102CRD-3, consult Table 5 at the rear of this manual for specifications, the instruction booklet shipped with the burner, and the appropriate Supplemental Instructions shipped with the boiler:

| | | <u>Burnham Part Number</u> |
|---------------------------------------|------------------------------|----------------------------|
| Supplemental Instructions for: | Riello R40 | 8142821 |
| | Carlin EZ-1HP, EZ-2HP | 8142822 |
| | Carlin 102CRD-3 | 8142823 |

3. On STEAM BOILERS:

- With an L404A1354 - set cut-out pressure (MAIN scale) on the pressure limit for (2) PSI and differential pressure (DIFF. scale) below (2) PSI. These pressures may be varied to suit individual requirements of the system.
- With an L404A1651 or an L404F1367 - 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. On 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. On WATER BOILERS WITHOUT TANKLESS HEATERS, set high limit dial on L8148 at 180°F. This temperature may be varied to suit requirements of installation.

6. On WATER BOILERS WITH TANKLESS HEATERS, set operating control dial (low limit) on L8124 at 190°F and high limit dial at 210°F. Operating control (low limit) must be a minimum of 20° below high limit setting. Set differential at 25°.

E. ADJUST OIL BURNER BEFORE STARTING.

- CHECK BURNER AIR BAND AND AIR SHUTTER, readjust if necessary, see Table 6 at rear of manual.

CAUTION

Air Band and Air Shutter are set for maximum input and must be readjusted for steam boilers or WM boilers, prior to starting burner.

- 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.
- OPEN ALL OIL LINE VALVES.
- Attach a plastic hose to fuel pump vent fitting and provide a pan to catch the oil.

5. OPEN FLAME OBSERVATION PORT COVER on burner swing door.

- Beckett burners for boiler models V83 thru V86 are factory equipped with (2) nozzles for dual firing rates. On packaged boiler models PV83W thru PV86W, the higher firing rate nozzle is installed; on knockdown boiler models KV83W/S thru KV86W/S both nozzles are shipped loose. Refer to Table 6 at the rear of this manual for proper nozzle size, air settings and fuel pump pressure setting based on desired firing rate.

If the desired firing rate is the lower GPH:

- replace the loose or factory installed high firing rate nozzle with the loose lower firing rate nozzle,
- change the factory air settings according to Table 6 and,
- reduce the oil pump pressure on models V83 and V86 to the pressure setting specified in Table 6, refer to Paragraph F for details.

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 prepurge the motor and igniter will operate but the oil valve will remain closed. Refer to Oil Primary Control Instructions for more details.
- Adjust oil pressure.
 - When checking a fuel unit's operating pressure, a reliable pressure gauge may be installed in either the bleeder port or the nozzle port. See Figure 26.
 - Locate oil pressure adjusting screw and turn screw to obtain proper pump pressure, refer to Table 6 at rear of manual.

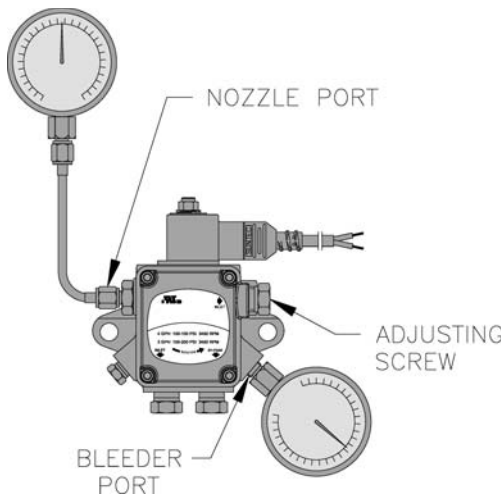


Figure 26: Adjusting Fuel Pump Pressure

- c. To check the cutoff pressure, deadhead a reliable pressure gauge onto the copper connector tube attached to the nozzle port. Run the burner for a short period of time. Shut the burner off. The pressure should drop and hold.
- d. Remove the gauge and install bleeder port and/or reconnect the nozzle port line.

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

1. ADJUST DRAFT REGULATOR for a draft of $-.02''$ (water gauge) over the fire after chimney has reached operating temperature and while burner is running.
2. READJUST THE AIR BAND on burner for a light orange colored flame while the draft over the fire is $-.02''$. 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 CO_2 of 11.5 to 12.5% with draft of $-.02''$ (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 $-.02''$ over the fire.
3. READJUST THE HEAD SETTING only if necessary.
 - a. V82 & V83:
Beckett MB(L1) Head burners have a fixed head which are non-adjustable.
 - b. V84 thru V89:
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 CO_2 readings. See Figure 27.

4. TURN "OFF" BURNER and remove pressure gauge. Install gauge port/bleeder plug and tighten. Start burner again.

WARNING

Do not loosen or remove any oil line fittings while burner is operating.

5. FLAME FAILURE

The V8 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.

WARNING

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

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

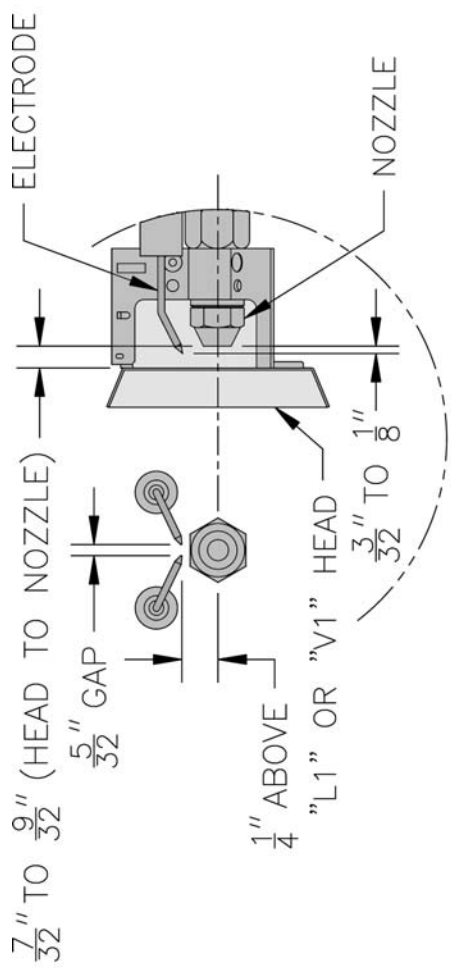
I. TEST CONTROLS.

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

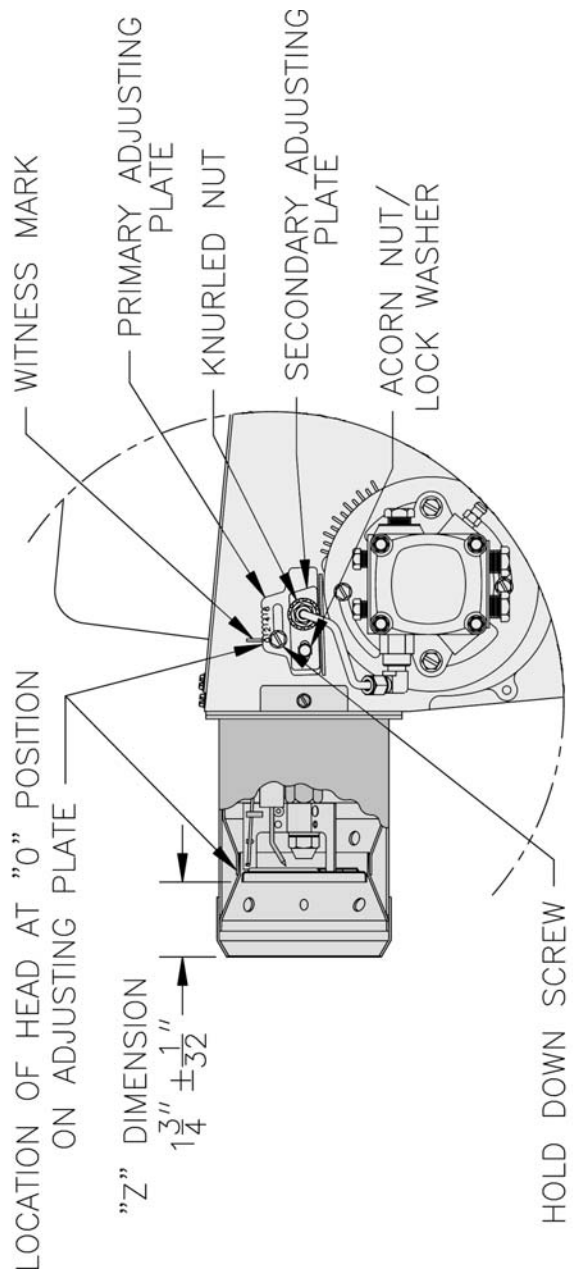
WARNING

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



ELECTRODE ADJUSTMENT



HEAD SETTING (AT "0")

Figure 27: "L1" and "V1" Head Electrode Positioning and Gun Setting (Beckett AFG)

a. FEATURES AND CONTROLS

- i. The R7184 is a microprocessor-based control. The indicator light provides diagnostic information for lockout, recycling and patented cad cell status. There is a manual reset button to exit the Lockout Mode and enter the Idle Mode (see Figure 28).

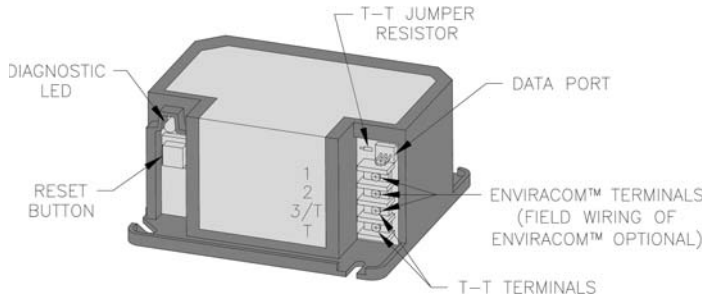


Figure 28: R7184 Terminals, LED and Reset Button

- ii. Pump Priming Cycle: To facilitate purging air from the oil lines and filters, the R7184 can be placed in a purge routine by pressing and releasing the reset button during the safety check, delayed valve-on, ignition or carry-over periods.
- 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 R7184 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 from Restricted Mode: Press and hold the reset button for 30 seconds. When the LED flashes twice, the device has reset.
- v. T-T Jumper: Select models have pre-installed T-T jumper resistor. To remove, use side-cutting pliers to cut jumper (See Figure 28).
- 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, once the control has entered the Run Mode, press and release the reset button. Indicator light will flash 1 to 4 flashes. See Table 5 for equivalent cad cell resistance.

TABLE 5: CAD CELL RESISTANCE WHEN SENSING FLAME

| Flashes | Cad Cell Resistance in ohms |
|---------|-----------------------------------|
| 1 | Less than 400 |
| 2 | More than 400 and less than 800 |
| 3 | More than 800 and less than 1600 |
| 4 | More than 1600 and less than 5000 |

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.

- Close hand valve in oil supply line.
- Failure occurs, device enters Recycle Mode. Indicator light flashes at ¼ Hz rate (2 seconds on, 2 seconds off).
- 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. Indicator light flashes at 1 Hz rate (½ second on, ½ second off). Ignition and motor stop and oil valves closes.
- To reset from Restricted Mode: Press and hold the reset button for 30 seconds. When the LED flashes twice, the device has reset.

iv. Cad Cell Check: See Figure 29.

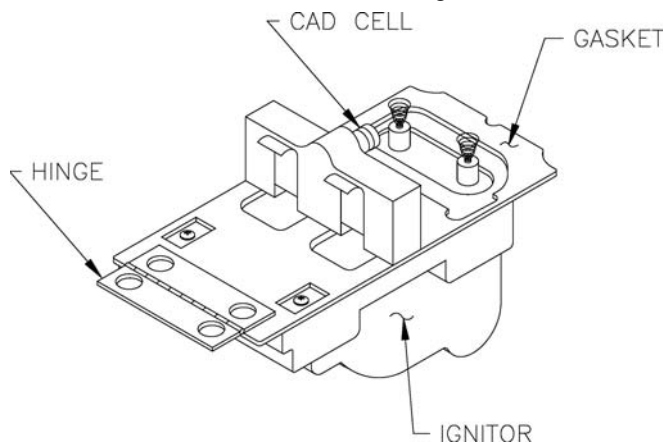


Figure 29: Cad Cell Location

- Perform cad cell resistance check as outlined in control feature. If resistance is below 1600 OHMS and burner runs beyond safety cut-out time, cad cell is good.
 - If safety switch shuts down burner and resistance is above 1600 OHMS, open line switch to boiler. Access cad cell under ignitor, clean face of cad cell and see that cell is securely in socket. Check gasket around perimeter of ignitor lid for proper seal. If gasket is missing or damaged, replace gasket. Room light can effect cad cell resistance. Reset safety switch.
 - Close line switch to boiler. If burner starts and runs beyond safety switch cut-off time, cell is good. If not, install new cell.
- v. 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.

3. **WARNING** — Check High Limit Control — Jumper Thermostat Terminals. Allow burner to operate until shut-down by limit. Installation is not considered complete until this check has been made.

WARNING

Jumper must be removed after this check.

4. 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.
5. Check operating control on boiler equipped with tankless heaters. With burner off, draw hot water until burner starts, then turn off hot water and check burner shut-down.

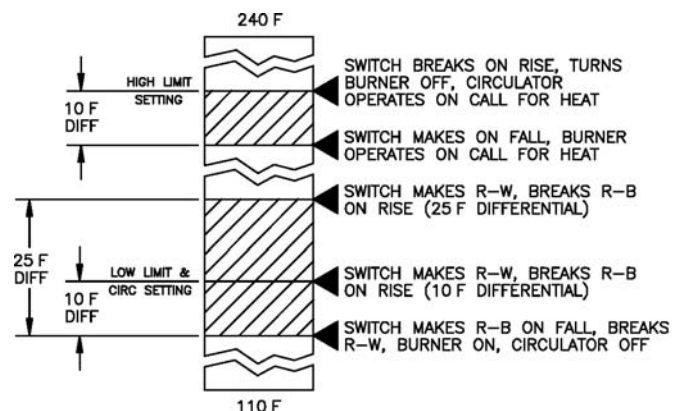
J. IF CONTROLS DO NOT MEET

REQUIREMENTS outlined in Paragraph I., replace control and repeat checkout procedures.

AQUASTAT SWITCHING ACTION WITHIN L8124C CONTROL

The switching action within the L8124C control has three settings:

1. high limit
2. low limit
3. adjustable differential



L8124C CONTROL

HIGH LIMIT OPERATION —

The high limit opens and turns off the burner when the water temperature reaches the set point. The high limit automatically resets after the water temperature drops past the set point and through the 10°F differential.

Set the indicator at desired shut-off temperature.

LOW LIMIT OPERATION —

On a temperature rise, with the adjustable differential at the minimum setting of 10°F, the burner circuit (R-B) breaks and the circulator circuit (R-W) makes at the low limit set point. On a temperature drop of 10°F below the set point, the R-B circuit makes and the R-W circuit breaks.

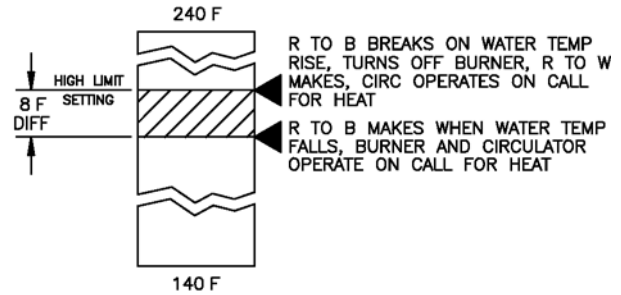
ADJUSTABLE DIFFERENTIAL —

At any differential setting greater than 10°F, the R-B make temperature and R-W break temperature will remain the same-control setting minus 10°F. The R-B break and R-W make temperature will be the set point temperature plus the difference between the differential setting and 10°F. **EXAMPLE:** Set point of 140°F; differential set at 25°F. On a temperature rise, R-B will break and R-W will make at 155°F. On a temperature fall, R-B will make and R-W will break at 130°F.

Set low limit indicator at the minimum temperature recommended for domestic hot water supply. This setting *must* be at least 20°F below high limit setting to prevent one switch from locking out the other.

Set the differential the desired number of degrees. 25°F differential gives longest burner cycles.

AQUASTAT SWITCHING ACTION WITHIN L8148A CONTROLS



L8148A CONTROL

The switching action in the L8148A control has one setting, the high limit. The switching relay is controlled by the low voltage room thermostat. On a call for heat, the relay contacts make to complete the line voltage circulator circuit and also the burner circuit if the boiler water temperature is below the high limit setting. The high limit switch shuts off the burner if boiler water temperature exceeds the high limit setting.

Set the indicator at the desired shut-off temperature.

Important Product Safety Information

Refractory Ceramic Fiber Product

Warning:

This product contains refractory ceramic fibers (RCF). RCF has been classified as a possible human carcinogen. After this product is fired, RCF may, when exposed to extremely high temperature (>1800F), change into a known human carcinogen. When disturbed as a result of servicing or repair, RCF becomes airborne and, if inhaled, may be hazardous to your health.

AVOID Breathing Fiber Particulates and Dust

Precautionary Measures:

Do not remove or replace previously fired RCF (combustion chamber insulation, target walls, canopy gasket, flue cover gasket, etc.) 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 air tight plastic bag.

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 XI: 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:

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

- Unscrew the probe from the boiler tapping.
- Inspect that portion of the probe that is exposed to the boiler water for a scale or sediment buildup.
- 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.

- Clean the pipe threads of the probe to remove old, hardened pipe dope and other foreign matter.
- 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.
- Screw the probe into the boiler tapping.
- Mount the low water cut-off control on the probe.
- Reconnect the control to probe wiring.
- Fill the boiler to its normal waterline.
- Add boiler water treatment compound as needed (refer to Paragraph B.).
- Restore electric service to the boiler.
- Fire burner to bring the water in the boiler to a boil to drive off free oxygen.
- 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

- 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.

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.

- 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 V8 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 14 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.
 - 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. FREQUENT WATER ADDITION

NOTICE

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

EXCESSIVE WATER ADDITION: (Gal/Month)

| | | | |
|---------------|----------------|-----------------|----------------|
| V83: 6 | V85: 9½ | V87: 13 | V89: 16 |
| V84: 8 | V86: 11 | V88: 14½ | |

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

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 J.

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 XII: 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 30).

1. Prior to cleaning boiler, lay a protective cloth or plastic over combustion chamber blanket to collect debris falling from flueways.
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 (¾" 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.

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.

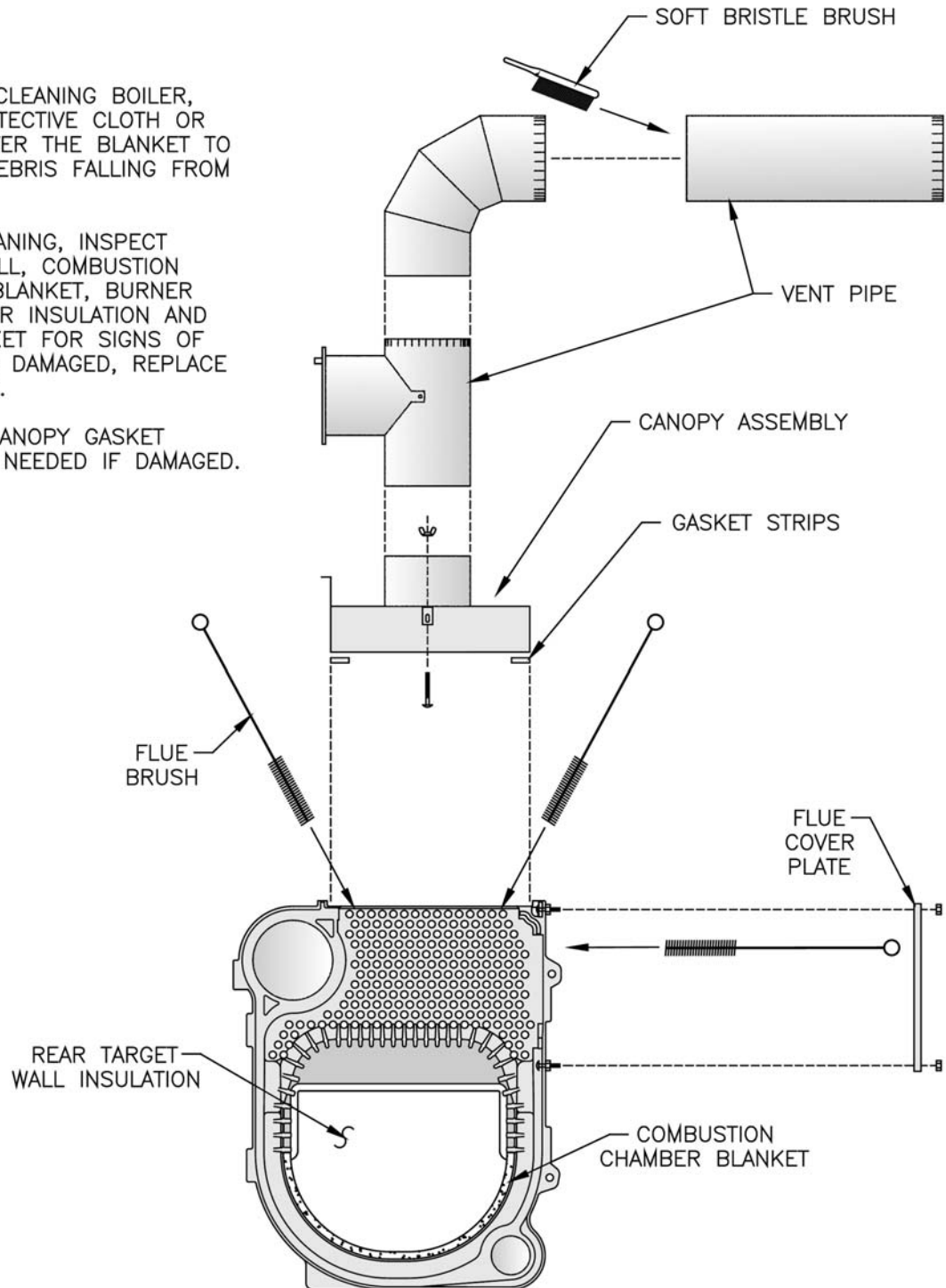


Figure 30: Cleaning of Boiler Flueways

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 XIII: TROUBLE SHOOTING

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 V8 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. **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.
3. **FUEL LEAKS** — Any fuel leak between the pump and the nozzle will be detrimental to good combustion results. Look for wet surfaces in the air tube, under the ignitor, and around the air inlet. Any such leaks should be repaired as they may cause erratic burning of the fuel and in the extreme case may become a fire hazard.
4. **AIR LEAKS** — Any such leaks should be repaired, as they may cause erratic burning of the fuel and in extreme cases may become a fire hazard.
5. **GASKET LEAKS** — If 11.5 to 12.5% CO₂ with a #1 smoke cannot be obtained in the breeching, look for air leaks around the burner mounting gasket, observation door, and canopy gasket. Such air leaks will cause a lower CO₂ reading in the breeching. The smaller the firing rate the greater effect an air leak can have on CO₂ readings.
6. **DIRT** — A fuel filter is a good investment. Accidental accumulation of dirt in the fuel system can clog the nozzle or nozzle strainer and produce a poor spray pattern from the nozzle. The smaller the firing rate, the smaller the slots become in the nozzle and the more prone to plugging it becomes with the same amount of dirt.
7. **WATER** — Water in the fuel in large amounts will stall the fuel pump. Water in the fuel in smaller amounts will cause excessive wear on the pump, but more importantly water doesn't burn. It chills the flame and causes smoke and unburned fuel to pass out of the combustion chamber and clog the flueways of the boiler.

8. **COLD OIL** — If the oil temperature approaching the fuel pump is 40°F or lower, poor combustion or delayed ignition may result. Cold oil is harder to atomize at the nozzle. Thus, the spray droplets get larger and the flame shape gets longer. An outside fuel tank that is above grade or has fuel lines in a shallow bury is a good candidate for cold oil. The best solution is to bury the tank and lines deep enough to keep the oil above 40°F.
9. **HIGH ALTITUDE INSTALLATIONS** — Air openings must be increased at higher altitudes. Use instruments and set for 11.5 to 12.5% CO₂.
10. **START-UP NOISE** — Late ignition is the cause of start-up noises. If it occurs recheck for electrode settings, flame shape, air or water in the fuel lines.
11. **SHUT DOWN NOISE** — If the flame runs out of air before it runs out of fuel, an after burn with noise may occur. That may be the result of a faulty cut-off valve in the fuel pump, or it may be air trapped in the nozzle line. It may take several firing cycles for that air to be fully vented through the nozzle. Water in the fuel or poor flame shape can also cause shut down noises.

NOTICE

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

B. OIL PRIMARY CONTROL

1. Burner (control) will not come on.
 - a. No power to control.
 - b. Control 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 X, 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.

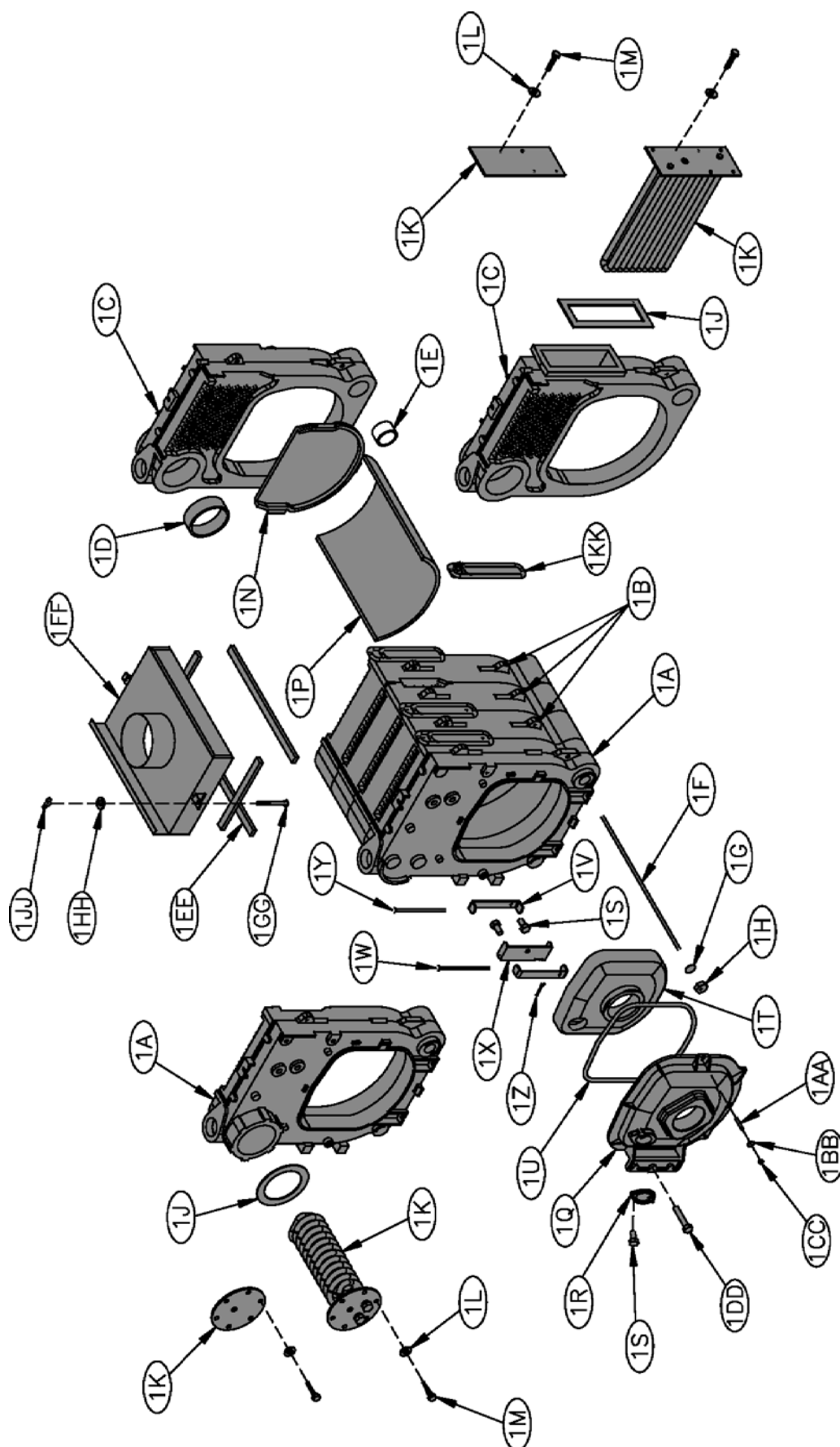
NOTICE

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.

Latch-up will occur if the control locks-out three (3) times during a call for heat. This is indicated by red and amber LED's solid-on.

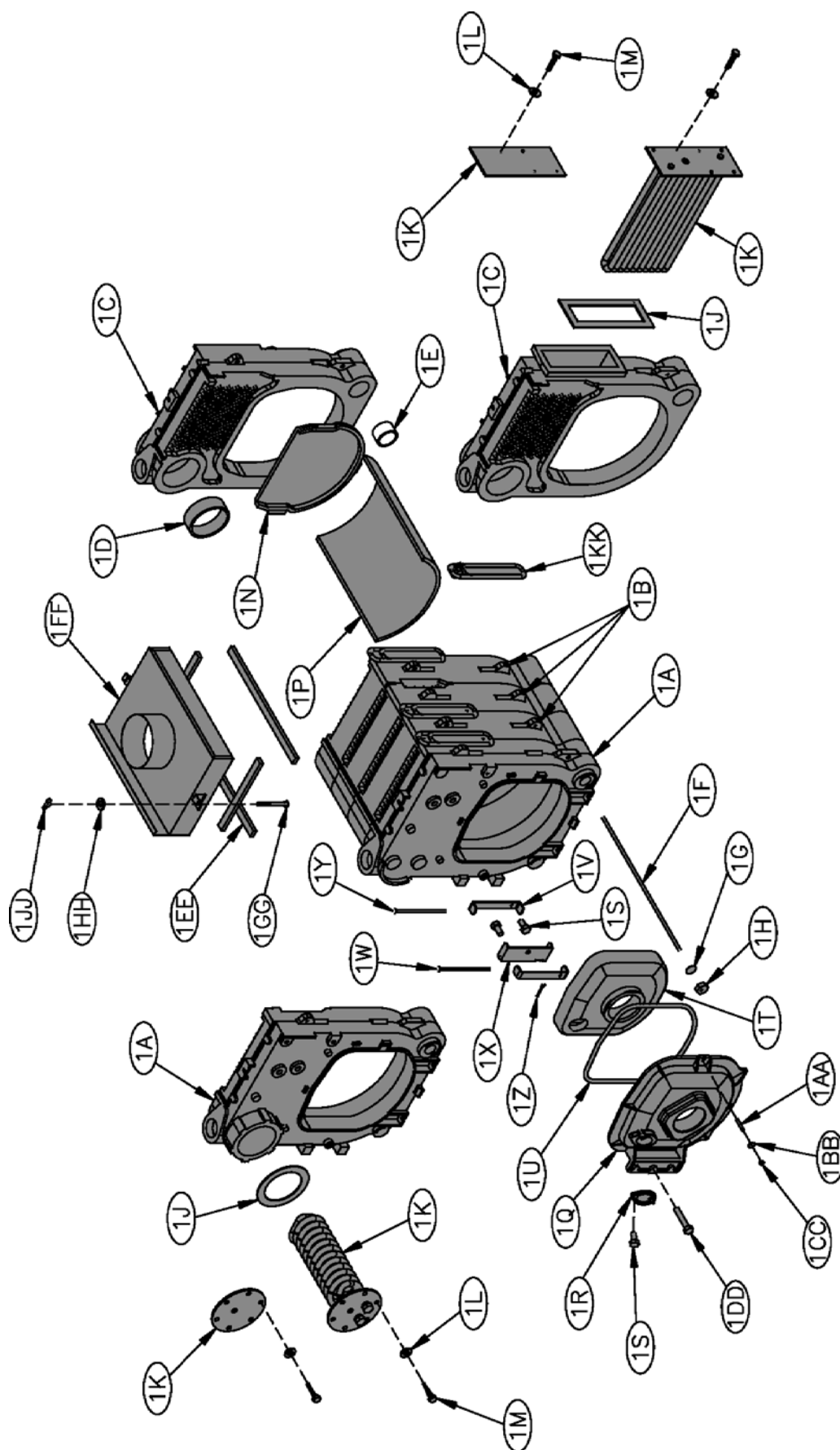
SECTION XIV: REPAIR PARTS

All V8 Series Boiler Repair Parts may be obtained through your local Burnham Wholesale distributor. Should you require assistance in locating a Burnham Distributor in your area, or have questions regarding the availability of Burnham products or repair parts, please contact Burnham Customer Service at (717) 481-8400 or Fax (717) 481-8408.



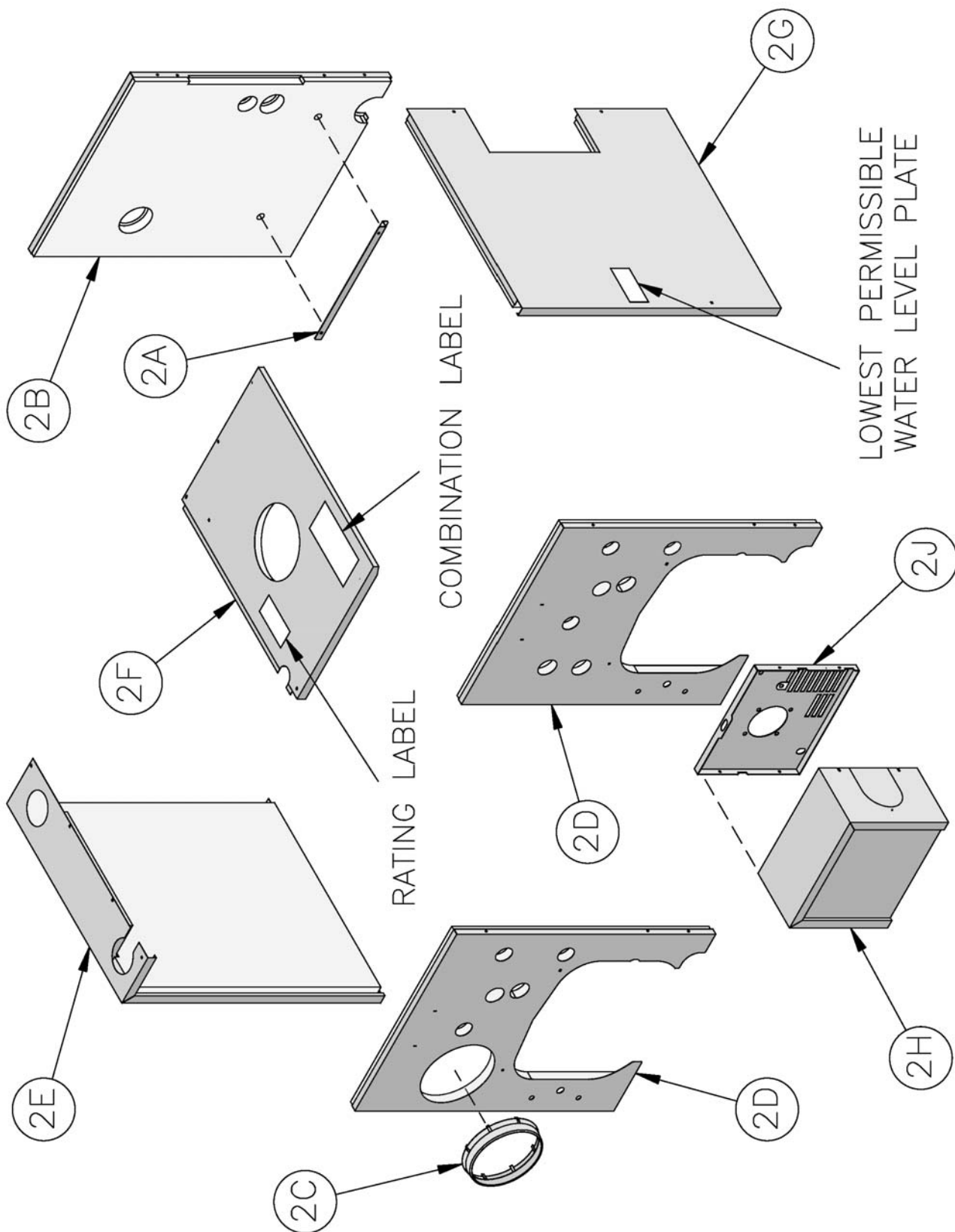
Bare Boiler Assembly

| Item No. | Description | Part No. | V82 | V83 | V84 | V85 | V86 | V87 | V88 | V89 |
|--------------------------------|---|-----------------|-----------------|-----|-----|-----|-----|-----|-----|-----|
| 1. BARE BOILER ASSEMBLY | | | | | | | | | | |
| 1A | Front Section (Non-Htr.), Machined Water ---(OR)--- | 71728103 | 1 | 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 | 1 |
| | Back Section (Non-Htr.), Machined Steam ---(OR)--- | 71728303 | --- | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | Heater Back Section, Machined | 71728301 | --- | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 1D | 5" Cast Iron Slip Nipple | 7066003 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| 1E | Slip Nipple, 22-B Steel | 806600375 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| 1F | Tie Rod, 3/8"-16 x 7¾" Lg. | 80861072 | 2 | --- | --- | --- | --- | --- | --- | --- |
| | 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 | Common Hardware | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| 1H | 3/8" - 16 Hex Nut | Common Hardware | 4 | 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 |
| | V1-2 Heater Carton Assy. - (UR[T] & WR[T]) - Rear Heater | 6036031 | --- | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 1L | 5/16" Flat Washer | Front Heater | Common Hardware | 6 | 6 | 6 | 6 | 6 | 6 | 6 |
| | | Rear Heater | | 8 | 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 | 6 |
| | | Rear Heater | | 8 | 8 | 8 | 8 | 8 | 8 | 8 |
| 1N | Rear Target Wall Insulation | 82028002 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |



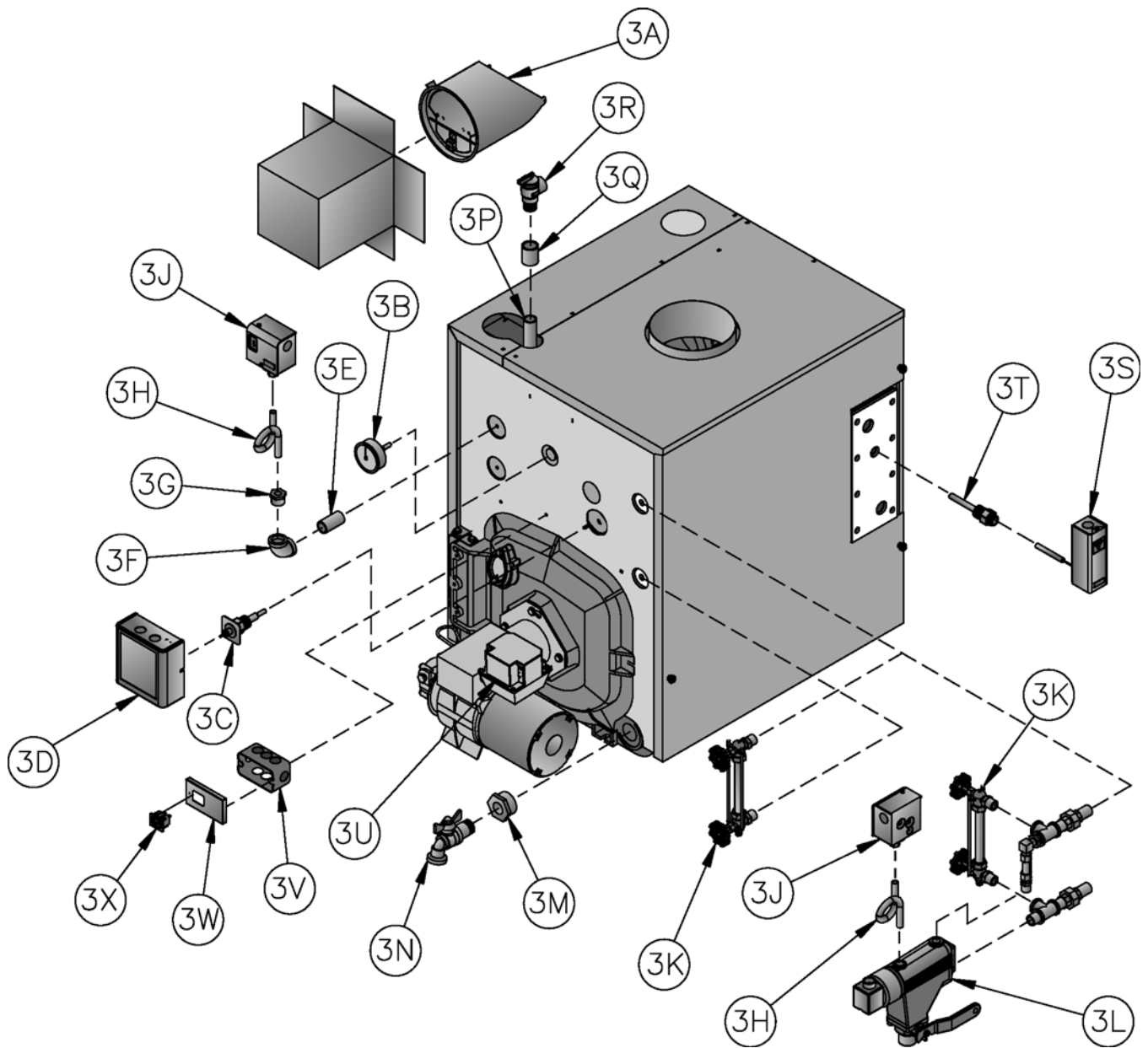
Bare Boiler Assembly (Continued)

| Item No. | Description | Part No. | V82 | V83 | V84 | V85 | V86 | V87 | V88 | V89 |
|--|--|-----------------|-----|-----|-----|-----|-----|-----|-----|-----|
| 1. BARE BOILER ASSEMBLY (Continued) | | | | | | | | | | |
| 1P | Combustion Chamber Blanket, 1/2" x 18-3/4" x 3-3/8" | 82028025 | 1 | --- | --- | --- | --- | --- | --- | --- |
| | 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 (Only) | 71728005 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 1R | Observation Port Cover | 71728004 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 1S | 5/16" - 18 x 3/4" Lg. Plated Cap Screw | Common Hardware | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| 1T | Burner Swing Door Insulation | 82028004 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 1U | Rope Gasket - Burner Swing Door | 82028005 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 1V | Hinge Bracket | 7022802 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| 1W | 5/16" - 18 x 5/8" Lg. Plated Cap Screw | Common Hardware | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| 1X | Intermediate Hinge | 7022801 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 1Y | Hinge Pin | 80861707 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| 1Z | 5/16" Hairpin Cotter | 80861667 | 2 | 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 | 1 |
| 1BB | 5/16" Flat Washer | Common Hardware | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 1CC | 5/16" - 18 Flange Nut | | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 1DD | 5/16" - 18 x 3 1/2" Lg. Hex Flange Bolt | | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 1EE | Canopy Sealing Strip (1/2" x 1" x 10') | 6206001 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 1FF | V82 Canopy Assembly | 611270201 | 1 | --- | --- | --- | --- | --- | --- | --- |
| | V83 Canopy Assembly | 611280321 | --- | 1 | --- | --- | --- | --- | --- | --- |
| | V84 Canopy Assembly | 611280421 | --- | --- | 1 | --- | --- | --- | --- | --- |
| | V85 Canopy Assembly | 611280521 | --- | --- | --- | 1 | --- | --- | --- | --- |
| | V86 Canopy Assembly | 611280621 | --- | --- | --- | --- | 1 | --- | --- | --- |
| | V87 Canopy Assembly | 611280721 | --- | --- | --- | --- | --- | 1 | --- | --- |
| | V88 Canopy Assembly | 611280821 | --- | --- | --- | --- | --- | --- | 1 | --- |
| | V89 Canopy Assembly | 611280921 | --- | --- | --- | --- | --- | --- | --- | 1 |
| 1GG | 1/4" - 20 x 3" Lg. Carriage Bolt | Common Hardware | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| 1HH | 1/4" Flat Washer | | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| 1JJ | 1/4" - 20 Wing Nut | | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| 1KK | Flue Cover Plate, Gasket, & Hardware Assembly | 61128002 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |



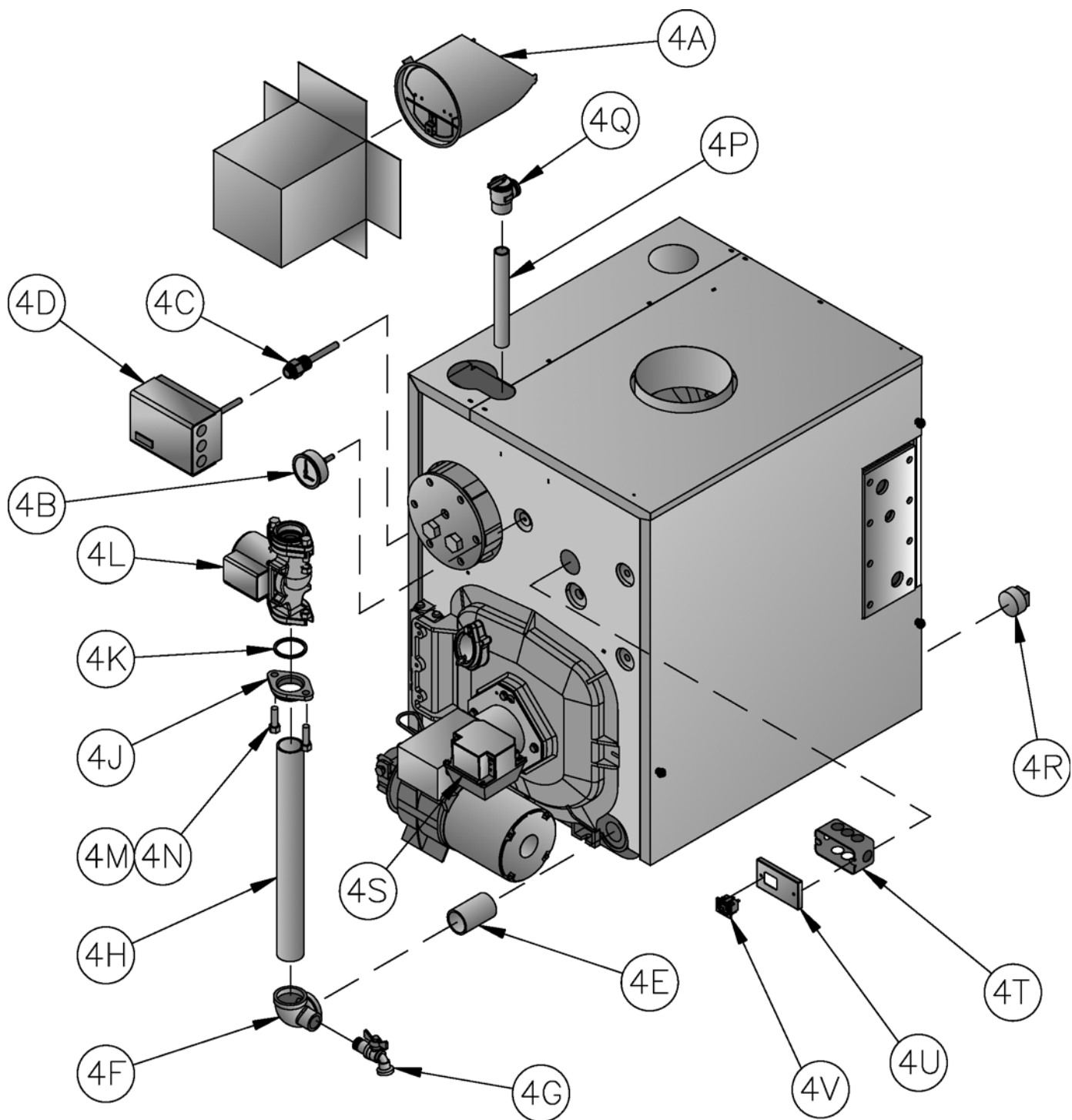
Jacket Assembly

| Item No. | Description | Part No. | V82 | V83 | V84 | V85 | V86 | V87 | V88 | V89 |
|--|--|-----------|-----|-----|-----|-----|-----|-----|-----|-----|
| 2. JACKET ASSEMBLY - Insulation included with Jacket Panel(s) | | | | | | | | | | |
| 2A | Jacket Rear Support Bracket | 7042801 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 2B | Jacket Rear Panel Assembly | 60428005 | 1 | 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 | 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 | 604280211 | 1 | --- | --- | --- | --- | --- | --- | --- |
| | | 604280311 | --- | 1 | --- | --- | --- | --- | --- | --- |
| | | 604280411 | --- | --- | 1 | --- | --- | --- | --- | --- |
| | | 604280511 | --- | --- | --- | 1 | --- | --- | --- | --- |
| | | 604280611 | --- | --- | --- | --- | 1 | --- | --- | --- |
| | | 604280711 | --- | --- | --- | --- | --- | 1 | --- | --- |
| | | 604280811 | --- | --- | --- | --- | --- | --- | 1 | --- |
| | | 604280911 | --- | --- | --- | --- | --- | --- | --- | 1 |
| 2F | Jacket Top Panel Assembly | 604280221 | 1 | --- | --- | --- | --- | --- | --- | --- |
| | | 604280321 | --- | 1 | --- | --- | --- | --- | --- | --- |
| | | 604280421 | --- | --- | 1 | --- | --- | --- | --- | --- |
| | | 604280521 | --- | --- | --- | 1 | --- | --- | --- | --- |
| | | 604280621 | --- | --- | --- | --- | 1 | --- | --- | --- |
| | | 604280721 | --- | --- | --- | --- | --- | 1 | --- | --- |
| | | 604280821 | --- | --- | --- | --- | --- | --- | 1 | --- |
| | | 604280921 | --- | --- | --- | --- | --- | --- | --- | 1 |
| 2G | Jacket Right Side Access Panel Assembly without Heater Opening | 604280231 | 1 | --- | --- | --- | --- | --- | --- | --- |
| | | 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 Enclosure | 60228002 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 2J | Beckett Burner Enclosure Backer Plate | 60228001 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |



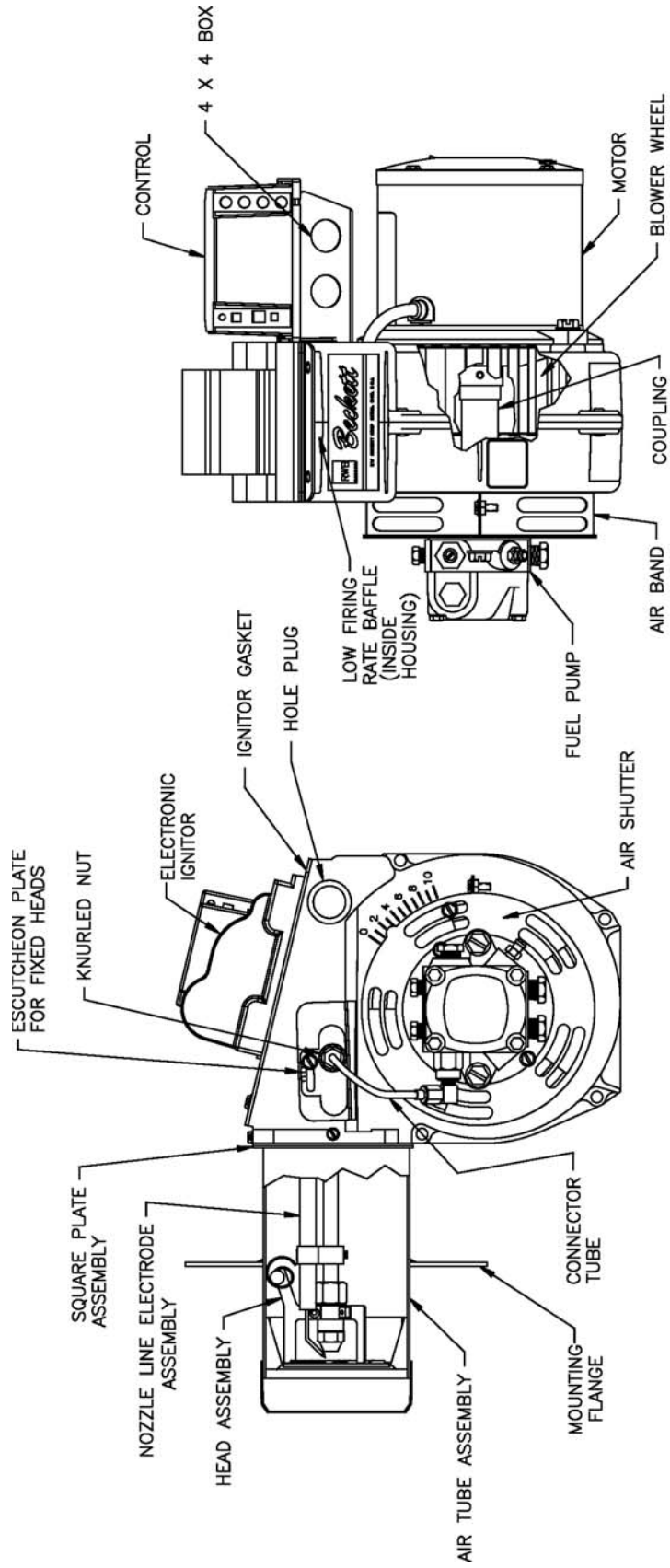
V83 Thru V89 Steam Boilers - Trim and Controls

| Item No. | Description | Part No. | V83 | V84 | V85 | V86 | V87 | V88 | V89 |
|--|--|---------------|-----|-----|-----|-----|-----|-----|-----|
| 3. V83 Thru V89 STEAM BOILERS - TRIM AND CONTROLS | | | | | | | | | |
| 3A | 6" Draft Regulator | 8116288 | 1 | 1 | 1 | 1 | --- | --- | --- |
| | 7" Draft Regulator | 8116289 | --- | --- | --- | --- | 1 | 1 | 1 |
| 3B | Pressure Gauge | 8056010 | 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 | 80160723 | | | | | | | |
| 3E | Nipple, ¾" NPT x 3" Lg. | Common Piping | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 3F | Elbow, ¾" NPT | Common Piping | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 3G | Bushing, ¾" NPT x ¼" NPT | Common Piping | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 3H | Syphon, ¼" 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 | 80160597 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 3M | Bushing, 1½" NPT x ¾" NPT | Common Piping | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 3N | Drain Valve, ¾" NPT, ConBraCo 35-302-03 | 806603061 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 3P | Nipple, ¾" NPT x 8" Lg. | Common Piping | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 3Q | Coupling, ¾" NPT | Common Piping | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 3R | Safety Valve, ¾" NPT, 15 psi, ConBraCo 13-511-08 | 81660530 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 3S | Limit, Honeywell L4006A2015 | 80160400 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 3T | Well, ¾" NPT x 1½", Honeywell 123870A | 80160426 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 3U | Oil Primary Control, Carlin 60200 | 80160289 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | Oil Primary Control, Honeywell R7184 | 80160849 | | | | | | | |
| 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 | 61328251 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 3X | Power Outlet Receptacle, Heyco #0937 | 8136522 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |



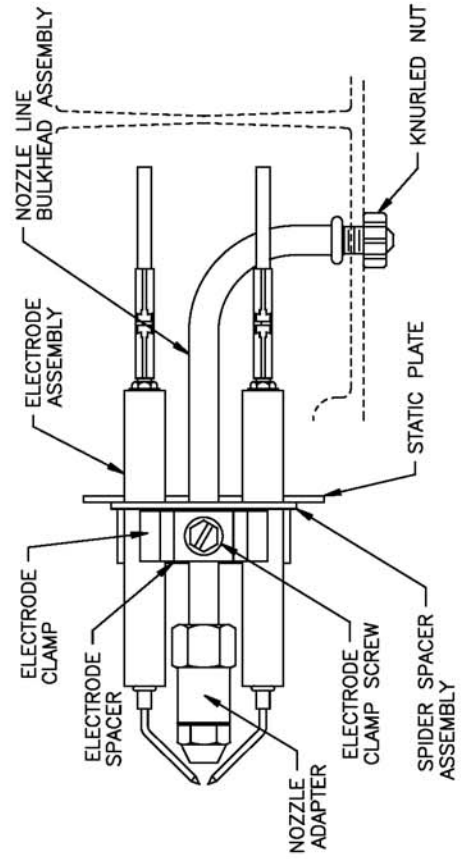
V82 Thru V89 Water Boilers - Trim and Controls

| ITEM NO. | DESCRIPTION | | Part No. | V82 | V83 | V84 | V85 | V86 | V87 | V88 | V89 |
|---|---|--------------------------------|-----------------------|------|------|------|------|------|------|------|------|
| 4. V82 Thru V89 WATER BOILERS - TRIM AND CONTROLS | | | | | | | | | | | |
| 4A | 6" Draft Regulator | | 8116288 | 1 | 1 | 1 | 1 | 1 | ---- | ---- | ---- |
| | 7" Draft Regulator | | 8116289 | ---- | ---- | ---- | ---- | ---- | 1 | 1 | 1 |
| 4B | Temperature & Pressure Gauge, 3¼" Dia., ENFM #4104-3¼-¼-10CHR | | 8056263 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 4C | Honeywell #123870A Immersion Well, ¾" NPT x 1½" Insulation (WN) -- OR -- | | 80160426 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | Honeywell #123872A Immersion Well, ½" NPT x 3" Insulation (WF) -- OR -- | | 80160497 | ---- | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | Honeywell 123871A Immersion Well, ¾" NPT x 3" Insulation (WR) | | 80160452 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 4D | Honeywell L8148A1090 Hi Limit, Circ.Relay (WN) --OR-- | | 80160449U | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | Honeywell L8124C1102 Hi & Lo Limit, Circ. Relay (WF and WR) | | 80160406U | ---- | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 4E | Nipple, 1½" NPT x 3" Lg. | | Common Piping | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 4F | Side Outlet 90° Elbow 1½" x ¾" | | 806601636 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 4G | Drain Valve, ¾" NPT, ConBraCo 35-302-03 | | 806603061 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 4H | Nipple, 1½" NPT x18" Lg. | | Common Piping | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 4J | Circulator Flange, 1½" NPT | | 806602014 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| 4K | Circulator Gasket | Taco | 806602006 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| | | Bell & Gossett | included w/circulator | | | | | | | | |
| | | Grundfos | | | | | | | | | |
| 4L | Circulator | Taco 007 | 8056007 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | | Bell & Gossett NRF22 w/gaskets | 8056174 | | | | | | | | |
| | | Grundfos UP15-42F w/gaskets | 8056173 | | | | | | | | |
| 4M | Cap Screw, Hex Head, 7/16" -14 x 1½" Lg. | | Common Hardware | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| 4N | Hex Nut, 7/16" - 14 | | Common Hardware | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| 4P | Nipple, ¾" NPT x 8" Lg. | | Common Piping | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 4Q | Relief Valve, ¾" NPT, F/F | 30 PSI | 81660319 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | | 40 PSI | 81660370 | | | | | | | | |
| | | 50 PSI | 81660302 | | | | | | | | |
| 4R | Plug, Square Head, 1½" NPT (Packaged) | | Common Piping | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | Reducing Bushing, 1½" x ¾" NPT (Knockdown) | | | | | | | | | | |
| 4S | Oil Primary Control, Carlin 60200 | | 80160289U | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | Oil Primary Control, Honeywell R7184 | | 80160849 | | | | | | | | |
| 4T | 2" x 4" Junction Box, Painted Sherpa Blue | | 61328252 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 4U | Burner Disc. J-Box Cover, Painted Sherpa Blue | | 61328251 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 4V | Power Outlet Receptacle, Heyco #0937 | | 8136522 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |



FRONT VIEW

SIDE VIEW



NOZZLE DETAIL

Beckett AFG Burner

BECKETT OIL BURNER PART NOS. FOR V8 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 | V82 | V83 | V84 | V85 |
|--|------------|------------|------------|----------|
| Air Tube Combination | AFG70MMASN | AFG70MMAQN | AFG70MDAQN | AFG70MD |
| Beckett's Spec No. | BCB7319 | BCB7322V | BCB7325V | BCB7328 |
| Air Band | 3626BKA | 3492 | 3492 | 3492 |
| Air Band Nut | 4150 | 4150 | 4150 | 4150 |
| Air Band Screw | 4198 | 4198 | 4198 | 4198 |
| Air Shutter | 32211 | 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 | --- | 5880 [1] | --- | --- |
| Bulkhead Knurled Locknut | 3-666 | 3-666 | 3-666 | 3-666 |
| Connector Tube Assembly | 5636 | 5636 | 5636 | 5636 |
| Electrode Clamp | 1-49 | 1-49 | 1-49 | 1-49 |
| Electrode Clamp Screw | 4219 | 4219 | 4219 | 4219 |
| Electrode Insulator Assembly | 5780 | 5780 | 5780 | 5780 |
| Spider Spacer Assembly | 5-503 | 5-503 | 5-503 | 5-503 |
| Escutcheon Plate | 3493 | 3493 | 5941 | 5941 |
| Adjusting Plate Assembly | --- | --- | | |
| Head | 5912 | 5912 | 5913 | 5913 |
| Head Screws | 4221 | 4221 | 4221 | 4221 |
| Flange Gasket | 31498 | 31498 | 31498 | 31498 |
| AFG Housing | 5877 | 5877 | 5877 | 5877 |
| Motor | 21805 | 21805 | 21805 | 21805 |
| Nozzle Adapter | 2-13 | 2-13 | 2-13 | 2-13 |
| Nozzle Line Electrode Assembly | NL70MB | NL70MM | NL70MD | NL70MD |
| Oil Pump, Clean Cut (Single Stage) | 2184404U | 2184404U | 2184404U | 2184404U |
| Oil Pump, Two-Stage | 2583U | 2583U | 2583U | 2583U |
| Oil Solenoid Valve Kit (Required with Two-Stage Pump) | 2182402U | 2182402U | 2182402U | 2182402U |
| Static Plate | 3384 | 3384 | 3383P | 3383P |
| 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 | 5770 | 5770 | 5770 | 5770 |
| Flame Detector | 7006 | 7006 | 7006 | 7006 |
| Oil Solenoid Valve Coil | 21755 | 21755 | 21755 | 21755 |
| Oil Solenoid Valve Cord | 21807 | 21807 | 21807 | 21807 |

[1] 5880 used on V83S and V83WM firing rates only

(Continued on Next Page)

BECKETT OIL BURNER PART NOS. FOR V8 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 | V86 | V87 | V88 | V89 |
|--|----------|----------|----------|----------|
| Air Tube Combination | AFG70MD | AFG70MD | AFG70MD | AFG70MD |
| Beckett's Spec No. | BCB7331 | BCB7332 | BCB7333 | BCB7334 |
| Air Band | 3492 | 3492 | 3492 | 3492 |
| 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 | --- | --- | --- | --- |
| Bulkhead Knurled Locknut | 3-666 | 3-666 | 3-666 | 3-666 |
| Connector Tube Assembly | 5636 | 5636 | 5636 | 5636 |
| Electrode Clamp | 1-49 | 1-49 | 1-49 | 1-49 |
| Electrode Clamp Screw | 4219 | 4219 | 4219 | 4219 |
| Electrode Insulator Assembly | 5780 | 5780 | 5780 | 5780 |
| Spider Spacer Assembly | 5-503 | 5-503 | 5-503 | 5-503 |
| Escutcheon Plate | 5941 | 5941 | 5941 | 5941 |
| Adjusting Plate Assembly | | | | |
| Head | 5913 | 5913 | 5913 | 5913 |
| Head Screws | 4221 | 4221 | 4221 | 4221 |
| Flange Gasket | 31498 | 31498 | 31498 | 31498 |
| AFG Housing | 5877 | 5877 | 5877 | 5877 |
| Motor | 21805 | 21805 | 21805 | 21805 |
| Nozzle Adapter | 2-13 | 2-13 | 2-13 | 2-13 |
| Nozzle Line Electrode Assembly | NL70MD | NL70MD | NL70MD | NL70MD |
| Oil Pump, Clean Cut, (Single Stage) | 2184404U | 2184404U | 2184404U | 2184404U |
| Oil Pump, Two-Stage | 2583U | 2583U | 2583U | 2583U |
| Oil Solenoid Valve Kit (Required with Two-Stage Pump) | 2182402U | 2182402U | 2182402U | 2182402U |
| Static Plate | 3383P | 3383P | 3383P | 3383P |
| 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 | 5770 | 5770 | 5770 | 5770 |
| Flame Detector | 7006 | 7006 | 7006 | 7006 |
| Oil Solenoid Valve Coil | 21755 | 21755 | 21755 | 21755 |
| Oil Solenoid Valve Cord | 21807 | 21807 | 21807 | 21807 |

| Boiler Model | Firing Rate GPH | Beckett AFG | | | | | Carlin | | | | | Riello | | | | |
|--|-----------------|----------------|-------------|----------|---------------------------------|-----------------|--------------|-----------|----------|---------------------------------|-----------------|--------------|----------|------------|---------------------------------|---------------|
| | | Settings | | | 2 Nozzle GPH x Angle Type | 3 Pump Pressure | Burner Model | Settings | | 2 Nozzle GPH x Angle Type | 3 Pump Pressure | Burner Model | Settings | | 2 Nozzle GPH x Angle Type | Pump Pressure |
| | | Head (Setting) | Air Shutter | Air Band | | | | Head Bar | Air Band | | | | Air Gate | Turbulator | | |
| V82W | 0.60 | L1 | 7 | 0 | 0.50 x 60A | 140 | EZ-1HP | 0.5 | 0.45 | 0.50 x 60A | 150 | 40-F3 | 3.4 | 0.0 | 0.50 x 80°A DOF | 145 |
| ¹ V83S ¹ V83WM | 0.75 | L1 | 10 | .5 | 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 90°B | 145 |
| V83W | 1.05 | L1 | 10 | 1.5 | 0.85 x 60A | 140 | | 0.85/1.00 | 0.80 | 0.85 x 60B | 150 | 40-F5 | 3.5 | 1.0 | 0.90 x 80°B | 145 |
| V84S V84WM | 1.05 | V1 (0) | 10 | .5 | 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 80°B | 145 |
| V84W | 1.35 | V1 (0) | 10 | 2 | 1.10 x 60B HAGO | 140 | | 1.10/1.25 | 0.90 | 1.10 x 60B | 150 | 40-F5 | 6.0 | 3.0 | 1.20 x 80°B | 145 |
| V85S V85WM | 1.35 | V1 (0) | 10 | 1 | 1.10 x 60B | 140 | EZ-2HP | 1.10/1.25 | 0.80 | 1.10 x 60B | 150 | 40-F5 | 5.5 | 2.0 | 1.20 x 80°B | 145 |
| V85W | 1.65 | V1 (2) | 10 | 5 | 1.35 x 60B | 140 | | 1.35/1.50 | 1.20 | 1.35 x 60B | 150 | 40-F5 | 6.0 | 4.0 | 1.35 x 80°B | 145 |
| V86S V86WM | 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 45°B | 145 |
| V86W | 1.90 | V1 (3) | 10 | 3.5 | 1.50 x 45B | 160 | 102CRD-3 | 2.0 | 1.80 | 1.65 x 60A | 140 | 40-F10 | 3.8 | 4.0 | 1.75 x 45°B HAGO | 145 |
| V87S V87W | 2.10 | V1 (4) | 10 | 3 | 1.65 x 45B HAGO | 170 | | 3 | 50% | 1.75 x 60B | 140 | 40-F10 | 4.0 | 4.0 | 2.00 x 45°B | 145 |
| V88S V88W | 2.35 | V1 (4) | 10 | 5 | 1.75 x 45B HAGO | 170 | | 4 | 50% | 2.00 x 60B | 140 | 40-F10 | 4.0 | 5.0 | 2.00 x 60°B | 175 |
| V89S V89W | 2.60 | V1 (6) | 10 | 7 | 2.00 x 45P HAGO | 170 | | 5 | 100% | 2.25 x 70B | 140 | 40-F10 | 7.0 | 5.0 | 2.25 x 60°P HAGO | 145 |
| ¹ Beckett builds that utilize a low firing rate baffle: V83S Packaged Boiler (installed in burner) V83WM Packaged Boiler [shipped loose; install for low firing rate (0.75 GPH) application] V83W/S Knockdown Boiler - burner carton [shipped loose; install for low firing rate (0.75 GPH) application] | | | | | | | | | | | | | | | | |
| ² All burners utilize Delavan nozzles unless otherwise noted. | | | | | | | | | | | | | | | | |
| ³ 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. | | | | | | | | | | | | | | | | |

¹ Beckett builds that utilize a low firing rate baffle:

V83S Packaged Boiler (installed in burner)

V83WM Packaged Boiler (shipped loose; install for low firing rate (0.75 GPH) application)

V83W/S Knockdown Boiler - burner carton (shipped loose; install for low firing rate (0.75 GPH) application)

² All burners utilize Delavan nozzles unless otherwise noted.

³ 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.

Table 6: BURNER SPECIFICATIONS

XV. LOW WATER CUT OFF (LWCO)

WARNING

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

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

When

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

Where

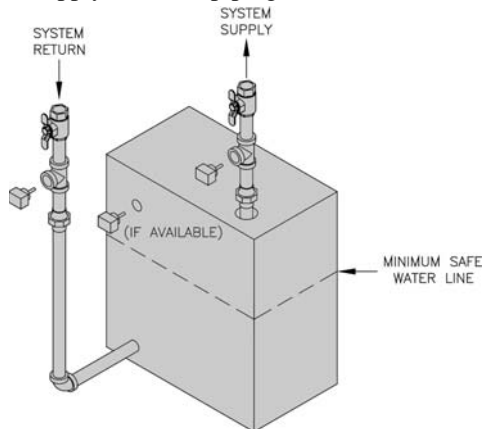
The universal location for a LWCO on both gas and oil hot water boilers is above the boiler, in either the supply or return piping. The minimum safe water level of a water boiler is at the uppermost top of the boiler; that is, it must be full of water to operate safely.

What Kind

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

How to Pipe

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



LWCO Location

Select the appropriate size tee using the LWCO manufacturer's instructions. Often, the branch connection must have a **minimum** diameter to prevent bridging between the probe and the tee. Also, the run of the tee must have a minimum diameter to prevent the end of the probe from touching or being located too close to the inside wall of the run of the tee. Ideally, manual shutoff valves should be located above the LWCO and the boiler to allow for servicing. This will allow probe removal for inspection without

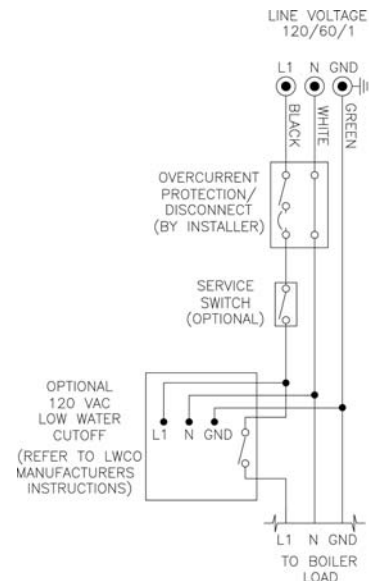
draining the heating system. Many probe LWCO manufacturers recommend an annual inspection of the probe.

How to Wire

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

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

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



Wiring of Typical LWCO

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

How to Test

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

SERVICE RECORD

DATESERVICE PERFORMEDThis image shows a single sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

SERVICE RECORD

DATESERVICE PERFORMED[illegible]

Limited Warranty

FOR RESIDENTIAL CAST IRON WATER BOILERS

Subject to the terms and conditions set forth below, U.S. Boiler™ Co., Inc. Lancaster, Pennsylvania hereby extends the following limited warranties to the original owner of a residential grade water boiler manufactured and shipped on or after July 1, 1991:

ONE YEAR LIMITED WARRANTY ON RESIDENTIAL GRADE WATER BOILERS

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

LIFETIME LIMITED WARRANTY ON HEAT EXCHANGER

U.S. Boiler Co., Inc. warrants to the original owner that the heat exchanger of its residential grade water boilers will remain free from defects in material and workmanship under normal usage for the lifetime of the original owner at the original place of installation. If a claim is made under this warranty during the first ten years from the date of original installation, U.S. Boiler Co., Inc. will, at its option, repair or replace the heat exchanger. If a claim is made under this warranty after the expiration of ten years from the date of original installation, U.S. Boiler Co., Inc. will, at its option and upon payment of the pro-rated service charge set forth below, repair or replace the heat exchanger. The service charge applicable to a heat exchanger warranty claim is based upon the number of years the heat exchanger has been in service and will be determined as a percentage of the retail price of the heat exchanger model involved at the time the warranty claim is made as follows:

| Years In Service | 1-10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 |
|-------------------------------------|-----------|----|----|----|----|----|----|----|
| Service Charge as % of Retail Price | No Charge | 5 | 10 | 15 | 20 | 25 | 30 | 35 |

| Years In Service | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 and above |
|-------------------------------------|----|----|----|----|----|----|----|--------------|
| Service Charge as % of Retail Price | 40 | 45 | 50 | 55 | 60 | 65 | 70 | 75 |

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

ADDITIONAL TERMS AND CONDITIONS

1. **Applicability:** The limited warranties set forth above are extended only to the original owner at the original place of installation within the United States and Canada. These warranties are applicable only to water boilers designated as residential grade by U.S. Boiler Co., Inc. and installed in a single or two-family residence and do not apply to steam boilers of any kind or to commercial grade boilers.
2. **Components Manufactured by Others:** Upon expiration of the one year limited warranty on residential grade water boilers, all boiler components manufactured by others but furnished by U.S. Boiler Co., Inc. (such as oil burner, circulator and controls) will be subject only to the manufacturer's warranty, if any.
3. **Proper Installation:** The warranties extended by U.S. Boiler Co., Inc. are conditioned upon the installation of the residential grade water boiler in strict compliance with U.S. Boiler Co., Inc. installation instructions. U.S. Boiler Co., Inc. specifically disclaims liability of any kind caused by or relating to improper installation.
4. **Proper Use and Maintenance:** The warranties extended by U.S. Boiler Co., Inc. are conditioned upon the use of the residential grade

water boiler for its intended purposes and its maintenance accordance with U.S. Boiler Co., Inc. recommendations and hydronics industry standards. These warranties will be inapplicable if the residential grade water boiler is used or operated over its rated capacity, is subjected to unauthorized modification, or is damaged as a result of being otherwise improperly operated or serviced including, but not limited to, damage from any of the following: operation with insufficient water, allowing the boiler to freeze, subjecting the boiler to flood conditions, and operation with unapproved water or fuel additives which cause deposits or corrosion.

5. **Removal and Installation:** These warranties do not cover expenses of removal or reinstallation. The owner is responsible for the cost of removing and reinstalling any defective part and its replacements and all labor and material connected therewith.
6. **Exclusive Remedy:** U.S. Boiler Co., Inc. obligation for any breach of these warranties is limited to the repair or replacement of its parts in accordance with the terms and conditions of these warranties.
7. **Limitation of Damages:** Under no circumstances shall U.S. Boiler Co., Inc. be liable for incidental, indirect, special or consequential damages of any kind whatsoever under these warranties, including, but not limited to, injury or damage to persons or property and damages for loss of use, inconvenience or loss of time. U.S. Boiler Co., Inc. liability under these warranties shall under no circumstances exceed the purchase price paid by the owner for the residential grade water boiler involved. Some states do not allow the exclusion or limitation of incidental or consequential damages, so the above limitation or exclusion may not apply to you.
8. **Limitation of Warranties:** These warranties set forth the entire obligation of U.S. Boiler Co., Inc. with respect to any defect in a residential grade water boiler and U.S. Boiler Co., Inc. shall have no express obligations, responsibilities or liabilities of any kind whatsoever other than those set forth herein. These warranties are given in lieu of all other express warranties.

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

PROCEDURE FOR OBTAINING WARRANTY SERVICE

In order to assure prompt warranty service, the owner is requested to complete and mail the attached Warranty Card within ten days after the installation of the boiler, although failure to comply with this request will not void the owner's rights under these warranties.

Upon discovery of a condition believed to be related to a defect in material or workmanship covered by these warranties, the owner should notify the installer, who will in turn notify the distributor. If this action is not possible or does not produce a prompt response, the owner should write to U.S. Boiler Co., Inc., Burnham Hydronics, at P.O. Box 3079, Lancaster, PA 17604, giving full particulars in support of the claim.

The owner is required to make available for inspection by U.S. Boiler Co., Inc. or its representative the parts claimed to be defective and, if requested by U.S. Boiler Co., Inc. to ship these parts prepaid to U.S. Boiler Co., Inc. at the above address for inspection or repair. In addition, the owner agrees to make all reasonable efforts to settle any disagreement arising in connection with a claim before resorting to legal remedies in the courts.

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



03/03

Limited Warranty

FOR RESIDENTIAL CAST IRON STEAM BOILERS

By this Warranty Statement the U.S. Boiler Co., Inc. of Lancaster, Pennsylvania issues limited warranties subject to the terms and conditions stated below. These limited warranties apply to residential cast iron boilers labeled Independence®, Independence® PV and V8™ Series, these warranties are issued only to the original homeowner at the original place of installation.

FIRST YEAR - LIMITED WARRANTY FOR RESIDENTIAL CAST IRON STEAM BOILERS

U.S. Boiler Co., Inc. warrants its residential cast iron steam boilers labeled Independence, Independence PV and V-8 Series to be free of defects in material and workmanship when shipped and to remain free of such defects under normal usage for a period of one year from the date of original installation. In the event that any part of such a steam boiler is found to be defective in material or workmanship during the one-year period, then U.S. Boiler Co., Inc. will repair or replace, at its option, the defective part.

SECOND THROUGH 10 YEAR - LIMITED WARRANTY FOR THE CAST IRON SECTION ASSEMBLY OF RESIDENTIAL CAST IRON STEAM BOILERS

U.S. Boiler Co., Inc. warrants the cast iron section assembly of its residential cast iron steam boilers labeled Independence, Independence PV and V-8 Series, to be free of defects in material and workmanship when shipped and to remain free of such defects under normal usage for a period of 10 years from the date of original boiler installation. In the event that such cast iron section assembly is found to be defective in material or workmanship during this period, U.S. Boiler Co., Inc. will repair or replace, at its option, the defective cast iron section assembly.

LIFETIME NIPPLE LEAKAGE WARRANTY

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

ADDITIONAL TERMS AND CONDITIONS

1. This warranty does not cover expenses for removal or reinstallation. The homeowner will be responsible for the cost of removing and reinstalling the defective part or its replacement and all labor and material connected therewith. Replacement material will be invoiced to the distributor in the usual manner and will be subject to adjustment upon proof of defect.
2. This warranty, in no way, can be considered as a guarantee of workmanship of an installer connected with the installation of the U.S. Boiler Co., Inc. boiler or as imposing on U.S. Boiler Co., Inc. liability of any nature for unsatisfactory performance as a result of faulty workmanship in the installation, which liability is expressly disclaimed.
3. This warranty will not be applicable if the boiler is used or operated over its rated capacity; or installed for uses other than home heating; or is not maintained in accordance with U.S. Boiler Co., Inc. recommendation or accepted good practice as determined by hydronics industry standards.
4. This warranty will not be applicable if the boiler has been damaged as a result of being improperly serviced or operated, including but not limited to the following: operated with insufficient water, allowed to freeze; subject to flood conditions; or operated with water conditions and/or fuels or additives which cause unusual deposits or corrosion in or on the heat exchanger.

5. This warranty applies only to boilers installed within the United States, and Canada.
6. In order for this warranty to be effective:
 - a.) The boiler must have been properly installed in a single or two-family residential dwelling. This warranty does not apply to boilers installed in apartments or to commercial or industrial installation.
 - b.) The boiler must have been assembled in strict compliance with installation instructions furnished with the boiler by U.S. Boiler Co., Inc.
 - c.) Boiler components must not have been damaged in handling during shipment or installation.
7. The foregoing provisions of this warranty shall be effective to the maximum extent permitted by applicable law, and, to the extent that any such provision would otherwise be inconsistent with applicable law, such provision shall be limited in effect to the minimum extent necessary to avoid such unconscionable result or inconsistency with applicable law.
8. The remedy for breach of this warranty is expressly limited to the repair or replacement of any part found to be defective under conditions of normal use; and the remedy for breach of this warranty or for negligence does not extend to liability for incidental, special or consequential damages or losses such as loss of the use of the materials, inconvenience or loss of time. Some states do not allow the exclusion or limitation of incidental or consequential damages so the above limitation or exclusion may not apply to you.
9. This warranty is in lieu of all others, and any and all express or implied warranties (including, without limitation, any implied warranties of merchantability or fitness for a particular purpose) are expressly limited in duration to the period of the warranty as previously stated herein. Some states do not allow limitation on how long an implied warranty lasts, so the above limitation may not apply to you.
10. Notwithstanding any of the above provisions, U.S. Boiler Co., Inc. liability under this warranty shall not exceed the selling price of the product found to be defective.

PROCEDURE FOR OBTAINING WARRANTY SERVICE

In order to assure prompt warranty service the homeowner is requested to complete and mail the attached Warranty Card within ten days after the installation of the boiler, although failure to comply with this request will not void the homeowner's rights under this warranty.

Upon discovery of a condition believed to be related to a defect in material or workmanship covered by this warranty statement, the homeowner should notify the installer who will in turn notify the distributor. If this action is not possible or does not produce a prompt response, the homeowner should write to U.S. Boiler Co., Inc., at P.O. Box 3079, Lancaster, PA 17604 giving full particulars in support of the claim.

The homeowner is required to make available for inspection by U.S. Boiler Co., Inc. or its representative the parts claimed to be defective and, if requested by U.S. Boiler Co., Inc., to ship said parts prepaid to Burnham Hydronics at the above address for inspection or repair. In addition, the homeowner agrees to make all reasonable efforts to settle any disagreement arising in connection with his claim before resorting to legal remedies in the courts.

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

