

# CROWN Boiler Co.

D E S I G N E D T O L E A D

## Series 24

Forced Draft Steam or Water Boilers

### INSTALLATION INSTRUCTIONS

These instructions must be affixed on or adjacent to the boiler.

#### Models:

- 24-03
- 24-04
- 24-05
- 24-06
- 24-07
- 24-08
- 24-09
- 24-10
- 24-11
- 24-12



**WARNING:** Improper installation, adjustment, alteration, service or maintenance can cause property damage, injury, or loss of life. For assistance or additional information, consult a qualified installer, service agency or the gas supplier. This boiler requires a special venting system. Read these instructions carefully before installing.

# CROWN Boiler Co.

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## IMPORTANT INFORMATION - READ CAREFULLY

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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:

- A. Current Edition of American National Standard ANSI/NFPA 31, "Installation of Oil Burning Equipment", for recommended installation practices.
- B. Current Edition of National Fuel Gas Code, NFPA 54/ANSI Z223.1.
- C. Current Edition of American National Standard ANSI/NFPA 211, "Chimneys, Fireplaces, Vents, and Solid Fuel Burning Appliances", For Venting requirements.
- D. 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.
- E. All wiring on boilers shall be made in accordance with the National Electrical Code and/or Local Regulations.

### 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.

## **DANGER**

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

## **WARNING**

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

**This boiler requires regular maintenance and service to operate safely. Follow the instructions contained in this manual. Installation, maintenance, and service must be performed only by an experienced, skilled and knowledgeable installer or service agency. All heating systems should be designed by competent contractors and only persons knowledgeable in the layout and installation of hydronic heating systems should attempt installation of any boiler. It is the responsibility of the installing contractor to see that all controls are correctly installed and are operating properly when the installation is completed. Installation is not complete unless a pressure relief valve is installed into the specified tapping located at the rear of appliance - See Section III of this manual for details.**

**This boiler is suitable for installation on combustible flooring. Do not install boiler on carpeting. Do not operate on floors where heat affected material is below.**

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

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

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

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

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

**Return water cannot be lower than 135°F for prolonged periods of time. Operation under these conditions will result in sustained condensing within the combustion chamber and potentially reduce boiler longevity.**

**In addition, the return water cannot be introduced into the boiler if it is more than 40°F less than the idle boiler temperature. Continued operation under these conditions may result in premature boiler failure through thermal shock.**

**Example: A boiler that has been idle for some time since the last heat demand cycle may have its boiler water temperature reduced to 150°F. The return temperature from the next zone activation cannot be less than 110°F.**

**If the above conditions exist, an RTC system must be installed to protect the boiler from sustained condensing operation and thermal shock.**

## WARNING

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.

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

This appliance must be properly vented and connected to an approved vent system in good condition. 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.

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

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

This boiler is designed to burn No. 2 fuel oil, natural and/or LP gas only. Do not use gasoline, crankcase drainings, or any oil containing gasoline. Never burn garbage or paper in this boiler. Do not convert boiler to burn any solid fuel (i. e. wood, coal) . 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.

Probe and float type low water cutoff devices require annual inspection and maintenance. Refer to instructions on Page 51, Item C for inspection and cleaning instructions.

## NOTICE

All Series 24 cast iron boilers are designed, built, marked and tested in accordance with the ASME Boiler and Pressure Vessel Code, Section IV, Heating Boilers. An ASME Data Label is factory applied to each Series 24 jacket, which indicates the boiler Maximum Allowable Working Pressure (MAWP). Each cast iron section is permanently marked with the MAWP listed on the boiler's ASME Data Label. Those values for the Series 24 are as follows:

MAWP, Steam - 15 psi  
MAWP, Water (USA) - 80 psi  
MAWP, Water (Canada) - 45 psi

It is common and acceptable practice to install these boilers in lower pressure systems, below the boiler MAWP. Therefore, Crown offers safety relief valves set at or below the MAWP of the boiler. See page 9 for standard safety relief valve set pressures.

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#### A. Application Drawings - Mechanical and Electrical

- A1. 3-way RTC in Primary/Secondary – Heating Only/No DHW; with/without Outdoor reset
- A2. 3-way RTC in Primary/Secondary – Heating/DHW with/without priority using Tankless coils and Outdoor reset.
- A3. 3-way RTC in Primary/Secondary – Heating/DHW with/without priority using Indirect Water Heater and Outdoor reset.
- A4. 3-way RTC in Primary/Secondary – Indirect Water Heater as load on primary loop without Outdoor reset.
- A5. 3-way Multiple Boiler RTC in Primary/Secondary – Indirect Water Heater (or other heat exchanger) as Load on Primary Loop using Sequencer and Outdoor Reset.
- A6. Tankless Application Only with boiler circulation loop. No building heating load.
- A7. Indirect Water Heater Only with boiler circulation loop. No building heating load.

#### B. Boiler Circulator and Diverting Valve Selection Charts

- B1. S24, 20 and 40  $\Delta T$  – Taco
- B2. S24, 20 and 40  $\Delta T$  – Grundfos
- B3. S24, 20 and 40  $\Delta T$  – Bell and Gossett
- B4. S24, 20 and 40  $\Delta T$  - Armstrong

#### C. Valve and Actuator Mounting Instructions

# Section I - General Information

BOILER MODEL	NUMBER OF SECTIONS 'A'	NUMBER OF STEAM RISERS 'B'	NUMBER OF HEATERS 'C'	MAXIMUM NUMBER OF HEATERS 'D'	FLUE OUTLET DIAMETER 'E'	BURNER MOUNTING PLATE WIDTH 'F'	BECKETT <sup>1</sup>		APPROX. 2 K.D. B.R. SHIPPING WEIGHT LB.
							CF OIL 'H'	CG GAS 'I'	
24-03	3	18 1/2	12	1	9 1/8	7	9 1/2	20 1/2	1278
24-04	4	24 1/2	18	1	12 1/8	7	11 1/2	21 1/8	1590
24-05	5	30 1/2	24	1	15 1/8	8	11 1/2	21 1/8	1902
24-06	6	36 1/2	30	1	18 1/8	8	20 1/8	21 1/8	2218
24-07	7	42 1/2	36	2	21 1/8	8	20 1/8	28 1/8	2534
24-08	8	48 1/2	42	2	24 1/8	10	20 1/8	28 1/8	2846
24-09	9	54 1/2	48	2	27 1/8	10	21 1/8	29 1/8	3227
24-10	10	60 1/2	54	2	30 1/8	10	21 1/8	29 1/8	3559
24-11	11	66 1/2	60	2	33 1/8	12	22 1/8	29 1/8	3870
24-12	12	72 1/2	66	3	36 1/8	12	22 1/8	29 1/8	4197

- 1 BURNER CONTROL PANEL CONFIGURATION MAY CHANGE THIS DIMENSION.
- 2 DOES NOT INCLUDE BURNER MOUNTING PLATE (SHIPPED SEPARATELY)  
ADD 55 LB. FOR 4" STANDARD BURNER MOUNTING PLATE  
ADD 85 LB. FOR 8" EXTENDED BURNER MOUNTING PLATE
- NOT SUPPLIED AS STANDARD EQUIPMENT

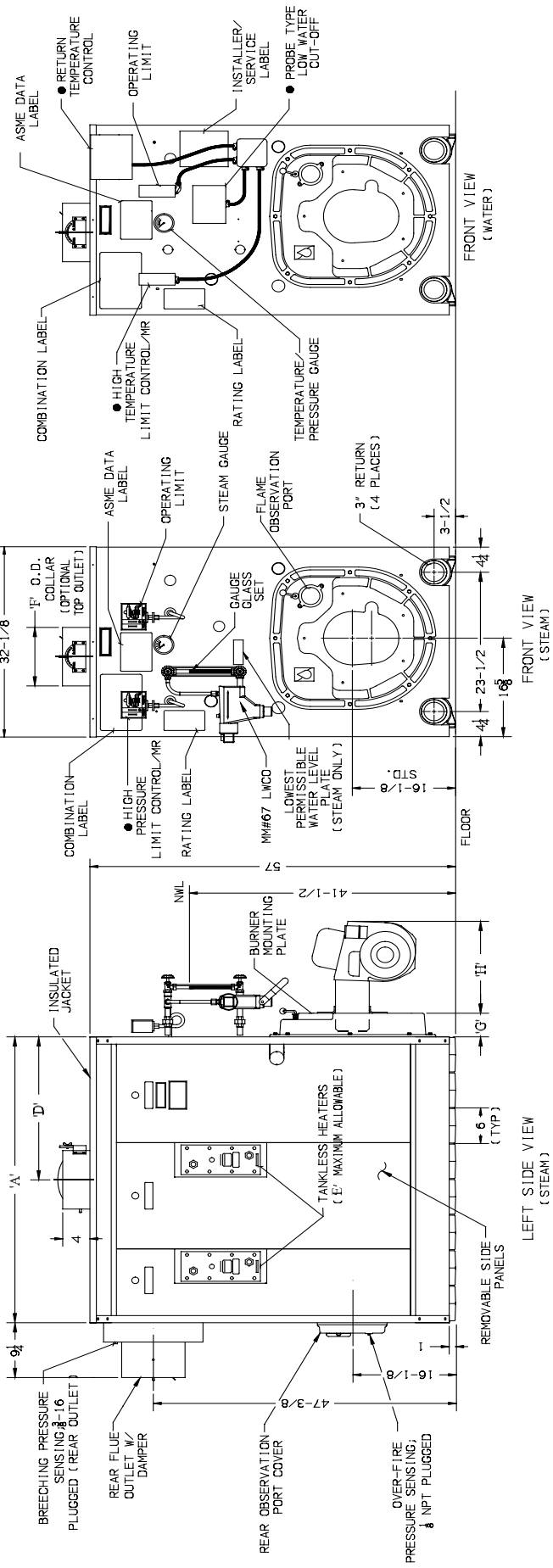
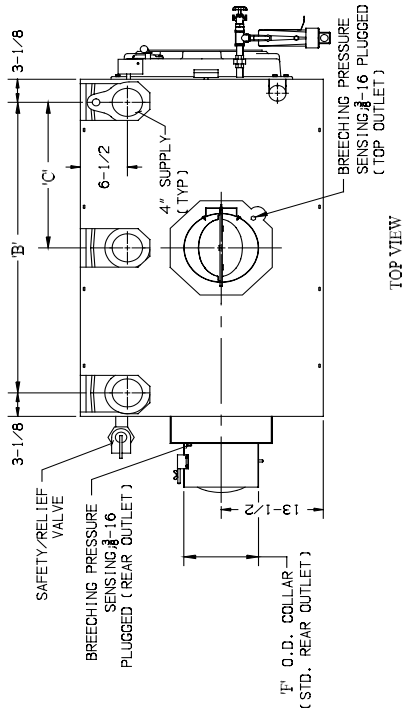


FIGURE 1: Dimensional Information





**TABLE I  
BOILER RATINGS/DATA**

Boiler Model	Horse-Power	Gross Output (MBH)	(2) Net I=B=R Rating			Burner Input		Heating Surface (Sq. Ft.)		Net Firebox Volume (Cu.Ft.)	Pressure in Firebox ("W.C.)	Water Content (Gal.)		Boiler Weight w/ Water (Lbs.)		Vent Dia. (In.)
			Sq. Ft. Steam	MBH Steam	MBH Water	Oil (GPH)	Gas (MBH)	Steam	Water			Steam	Water	Steam	Water	
24-03	10.2	342	1071	257	297	3.05	438	34.2	37.0	3.2	.33	44.5	66.0	1439	1618	7
24-04	14.1	471	1471	353	410	4.10	594	48.6	54.3	4.8	.38	53.0	75.0	1811	1995	7
24-05	18.9	634	1983	476	551	5.50	792	63.0	71.5	6.4	.31	61.5	84.0	2184	2372	8
24-06	23.8	797	2492	598	693	6.90	990	77.5	88.8	7.9	.38	70.0	93.0	2557	2749	8
24-07	28.0	937	2929	703	815	8.10	1174	91.9	106.0	9.5	.36	78.5	102.0	2930	3126	8
24-08	32.5	1087	3396	815	945	9.40	1358	106.3	123.3	11.0	.35	87.0	111.0	3303	3503	10
24-09	39.3	1316	4146	995	1148	11.40	1641	120.7	140.5	12.6	.35	95.5	120.0	3676	3880	10
24-10	45.0	1505	4788	1149	1309	13.00	1867	135.1	157.8	14.2	.40	104.0	129.0	4048	4257	10
24-11	50.5	1690	5429	1303	1470	14.60	2093	149.5	175.0	15.7	.45	112.5	138.0	4421	4634	12
24-12	55.3	1852	5983	1436	1610	16.00	2320	164.0	192.3	17.3	.49	121.0	147.0	4794	5011	12

(1) **Trim Suffix:** S = Steam Boiler, W = Water Boiler  
**Fuel Suffix:** N = Natural Gas, P = LP Gas, O = Oil

(2) I=B=R net ratings shown are based on piping and pick-up allowances which vary from 1.333 to 1.289 for steam and 1.15 for water. Consult manufacturer for installations having unusual piping and pick-up requirements, such as intermittent system operation, extensive piping systems, etc. The I=B=R burner capacity in GPH is based on oil having a heat value of 140,000 BTU per gallon.

(3) Firebox volume does not include added volume of 8" extended burner mounting plate (BMP). If 8" BMP is specified (refer to Figure 1), add 0.7 cu. ft. to volume listed above.

(4) Boiler ratings are based on 12.5% CO<sub>2</sub> (oil) and 9.7% CO<sub>2</sub> (natural gas), + .10" (inches) water column pressure at boiler flue outlet. Ratings shown above apply at altitudes up to 1000 feet on oil and 2000 feet on gas. For altitudes above those indicated, the ratings should be reduced at the rate of 4% for each 1000 feet above sea level.

**Maximum Allowable Working Pressure:** Steam Boiler - 15 PSI, Water Boiler - 50 PSI

**Standard Safety (Relief) Valve Set Pressure:** Steam Boiler - 15 PSI, Water Boiler - 30 PSI

# SECTION I - GENERAL INFORMATION (CONTINUED)

## 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 the receipt of goods.
3. Make sure that appropriate items on the Master Parts List (pg 59) are all on hand.

## B. LOCATE THE UNIT

1. RECOMMENDED SERVICE CLEARANCE - Locate the unit in the boiler room so as to provide ease of venting and adequate clearance for maintenance, serviceability, and installation of piping. Refer to Figure 1 for boiler dimensional data.

**FRONT** — Provide 43" service clearance for removal, maintenance, and servicing of burner and controls.

**REAR** — Provide a minimum clearance from the boiler jacket for access to flame observation port, rear flue damper and vent piping, relief valve, and boiler return piping. See Table III.

**LEFT SIDE** — Provide a minimum clearance from the boiler jacket of 26" for cleaning of flueways and installation and removal of tankless heater(s).

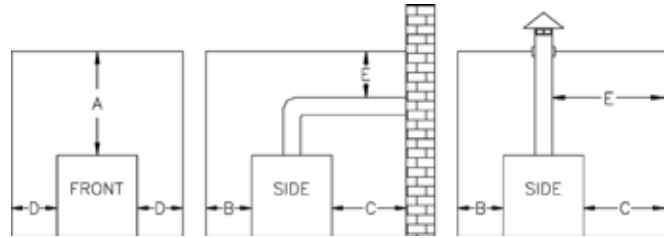
**RIGHT SIDE** — Provide a minimum clearance from

the boiler jacket of 12".

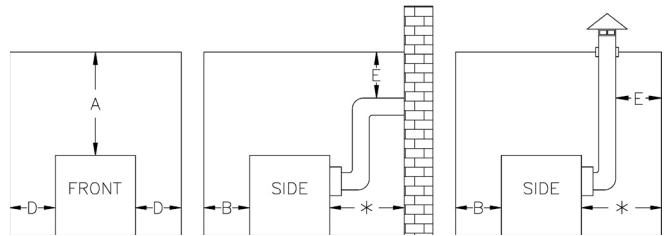
**TOP** — Provide a minimum clearance from the boiler jacket of 24"

2. FOR MINIMUM CLEARANCES to combustible materials, See Table II.
3. PROVIDE ADEQUATE FOUNDATION for the unit. Refer to Figure 2.

**Table II: Minimum Clearances To Combustible Materials (Inches)**



**Boilers with Top Flue Outlet**



**Boilers with Rear Flue Outlet**

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

\* See Table III for Recommended service clearance to access rear of boiler

NOTE 1: Listed clearances comply with American National Standard ANSI/NFPA 31, Installation of oil burning equipment.

NOTE 2: Series 24 boilers can be installed in rooms with clearances from combustible material as listed above. Listed clearances can not be reduced for alcove or closet installations.

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

**Table III: Recommended Rear Service Clearance**

Flue Outlet Size	Top Flue Outlet	Rear Flue Outlet	
		Combustible Surfaces	Non-Combustible Surfaces
7" Dia.	18"	37"	22"
8" Dia.		38"	23"
10" Dia.		40"	25"
12" Dia.		43"	28"

## NOTICE

**Recommended clearance for service may be reduced to minimum clearance to combustible material. However, increased service and maintenance difficulty will result.**

## WARNING

**Boiler is suitable for installation on combustible floor. Do not install boiler on carpeting.**

**Floor construction should have adequate load bearing characteristics to bear the weight of the boiler filled with water (see Table 1). A boiler foundation similar to the one shown in Figure 2 is recommended if the boiler room floor is weak or uneven or if a water condition exists.**

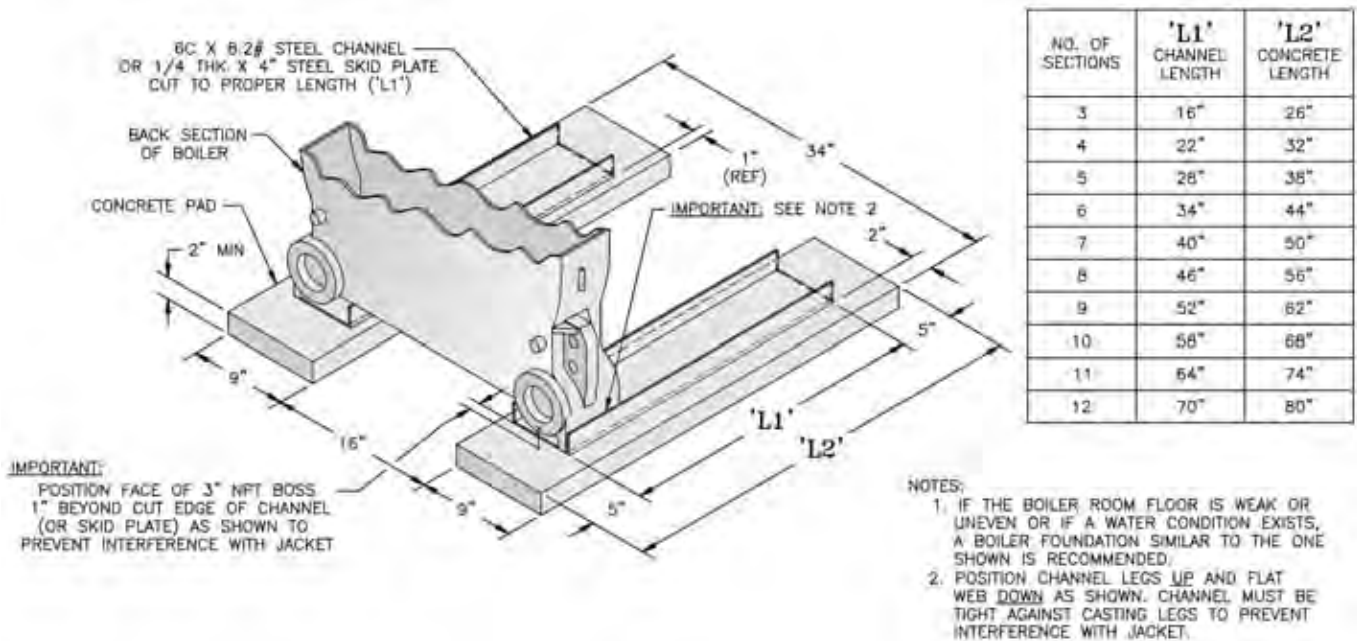


Figure 2: Boiler Foundation

## WARNING

**Failure to supply adequate air to the boiler will result in unsafe boiler operation.**

### C. PROVIDE AIR SUPPLY AND VENTILATION to accommodate proper combustion.

For commercial and industrial equipment, permanent facilities for supplying an ample amount of outside air shall be provided in accordance with the following.

For boiler rooms adjacent to outside walls, and where combustion air is provided by natural ventilation from the outside, there shall be a permanent air supply inlet having a total free area of not less than 1 sq. inch per 4,000 Btu per hr. (35 sq. inch per gallon per hour) (5.5 cm<sup>2</sup> per kw.) of total input rating of the burner or burners and in no case less than 35 sq. inch (0.425m<sup>2</sup>).

For boiler rooms not adjacent to outside walls, the combustion air shall be supplied in a manner acceptable to the authority having jurisdiction.

1. In the absence of local requirements, the confined space shall be provided with two permanent openings, one in or near the top of the room and one near the bottom. The openings shall communicate by means of ducts, with the outdoors or to such spaces (crawl or attic) that communicate with the outdoors.
  - a. Where communicating by means of vertical ducts, each opening shall have a free area of not less than 1 sq. inch per 4,000 Btuh (35 sq. inch per gph) (5.5 cm<sup>2</sup> per kw) of total input rating of all appliances in the enclosure.

- b. If horizontal ducts are used, each opening shall have a free area of not less than 1 sq. inch per 2,000 Btuh (70 sq. inch per gph.) (11 cm<sup>2</sup> per kw) of total input of all appliances in the enclosure.

### D. CHIMNEY OR VENT

The Series 24 boiler is designed for forced draft firing and may be used with a conventional natural draft stack (15' minimum height) or a stub vent, sometimes called a diesel stack (see Figure 3a). See Table I for the proper vent outlet size. For low silhouette vent terminations, see Figure 3b. Draft controls are not normally required, although they may be used on installations where a natural draft stack is used or on multiple boiler installations with a common stack. The boiler is provided with a breeching damper, which should be adjusted to maintain a positive pressure of 0.1" W.C. in the vent connector box during burner high fire operation (see breeching pressure sensing port in Figure 1).

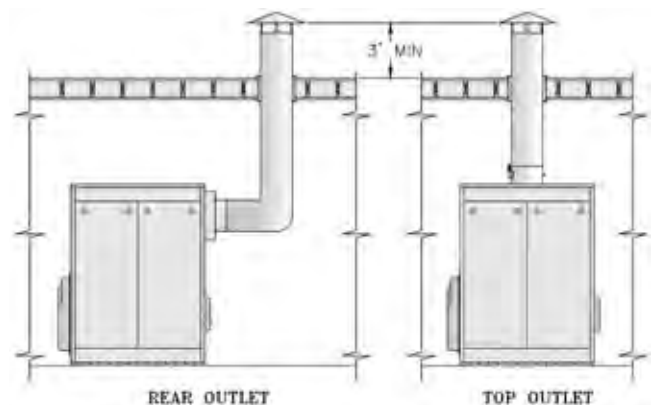


Figure 3a: Typical Arrangement for Stub Vent

If the venting system is designed for positive or forced draft venting, the boiler, vent connector and stack will operate under positive pressure. Gas tight vent systems designed for pressure systems must be used to prevent flue by-product leakage. The vent height is usually limited to prevent negative draft, typically three (3) feet above the roof line (see Figure 3a). The damper shall be adjusted to maintain a positive pressure of 0.1" W.C. in the vent connector box during burner high fire operation (see breeching pressure sensing port in Figure 1).

If the venting system is designed for negative pressure (natural draft), the boiler still operates with positive pressure in the chamber and up to the fixed damper on the flue collar. However, if the venting system is larger than what is required, the stack will provide a surplus draft (or negative pressure) that may require the use of a barometric damper to maintain the positive 0.1" W.C. pressure at the flue outlet. Multiple forced draft boiler stacks should always be designed as negative to ensure the products of combustion do not exit a boiler that is not firing.

## WARNING

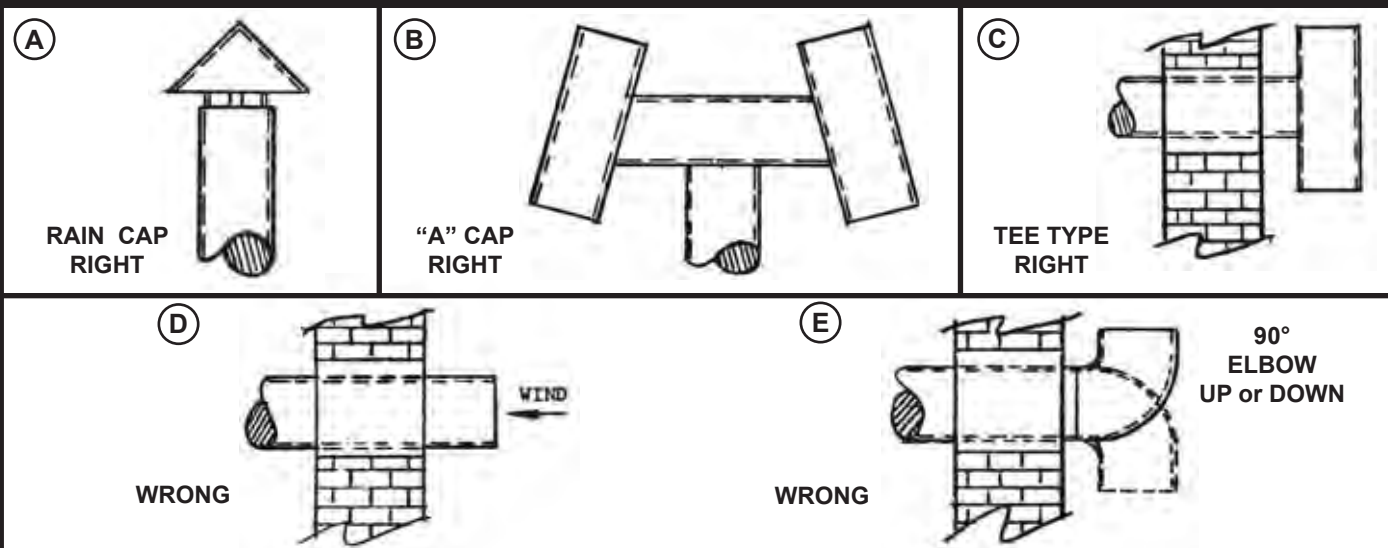
**Venting Instructions are recommendations only. Consult a venting expert on the design of a specific vent system for your application. The ASHRAE Venting Guide and The National Fuel Gas Code, NFPA 54 should be considered in all venting systems.**

**Conventional vent material may not be suitable for the application. Flue gases can leak carbon monoxide from the joints on these materials and can result in severe personal injury or death.**

**Installations having long horizontal runs or an excessive amount of tees or elbows will restrict the flow of combustion gases and can result in condensation, flue gas leakage of carbon monoxide, resulting in severe personal injury or death.**

**FIGURE 3b: VENTS — FAULTS & SUGGESTIONS**

**TYPICAL VENTS THAT ARE USED ON FORCED DRAFT BOILERS, ON LOW SILHOUETTE BUILDINGS**



**VENT SIZING** - Area must be the same as or greater than the boiler breeching (Smoke Outlet). A barometric damper may be required on installations with a high draft condition.

### FAULTY BOILER BURNER OPERATION

1. If improper vent is suspected, remove pipe at breeching and operate boiler. This will determine if excessive down draft, blocked or restricted flue, etc. is causing the problem.
2. If using type shown in A above, be sure cap is raised sufficiently above main pipe to allow flue gases to vent unimpeded.
3. A popular type cap is shown in B.
4. The tee is frequently used as shown in C.
5. D and E should not be used due to possible fluctuations in back pressure.

## SECTION II - CAST IRON BLOCK ASSEMBLY

### CAUTION

**Boiler sections must be drawn-up on perfectly level surface or improper assembly may result.**

**A. FIELD ASSEMBLED SECTIONS** — If the boiler was ordered to be field assembled, follow the assembly procedure outlined on the following pages.

**1. ASSEMBLY OF SECTIONS (MANUAL DRAW-UP)**

These sections are designed to be drawn together, one section at a time, using the 9<sup>3</sup>/<sub>4</sub>" long draw-up rods (provided) and ordinary hand tools.

Tools required:

- (1) 3/4" Drive Ratchet
- (1) 1-1/16" Socket
- (1) 1-1/16" Combination or Open End Wrench
- (1) Container of grease, oil or other appropriate lubricant.

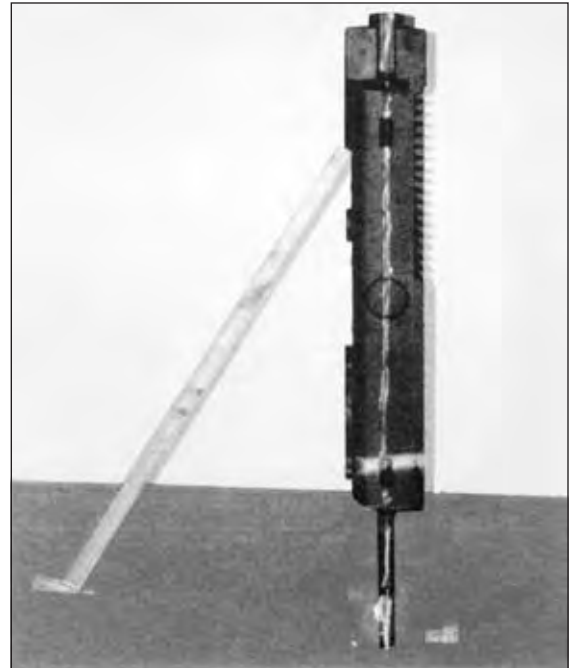
### CAUTION

**When assembling sections without hydraulic draw-up equipment, never assemble more than one section at a time.**

- a. Place the rear section in its approximate final position, as outlined in Section I, and support it with a suitable prop and wedges. See Figure 5.
- b. On size 24-03 only— Open target wall carton, apply Silastic to back of target wall and secure target wall to rear section.
- c. Clean the groove in the ground joint along the edge of the section with the wire brush.
- d. Open the Boiler Assembly Carton(s) and remove the bottle of adhesive. Using the dauber supplied in the bottle, apply the adhesive to the groove. Be sure to use enough adhesive to sufficiently coat the entire groove surface. If so desired, a multi-purpose spray adhesive (supplied by others) may be used instead. **HOWEVER, GREAT CARE MUST BE TAKEN TO**

ENSURE THAT THE ADHESIVE DOES NOT COME IN CONTACT WITH THE NIPPLES OR NIPPLE PORTS.

- e. Clean nipples and nipple ports thoroughly with a de-greasing solvent. Use the Loctite #592 supplied to lubricate the nipples and nipple ports. Apply the lubricant to the nipples and nipple ports, then use a brush to disperse it evenly around the nipples and the nipple ports. Use approximately 25 ml of Loctite #592 per flueway [(1) 7" and (2) 3" nipples and their (6) corresponding nipple ports].
- f. Drive nipples squarely into section using block of wood and hammer, or preferably, an aluminum head hammer. (Crown offers a Polyethylene Block for setting the nipples, part number 330010). Place block over entire nipple edge and hit the wood with the hammer.



**Figure 5: Positioning of Back Section**



## WARNING

**Nipples must be driven in evenly and to the proper depth to assure tight joints. Most nipple leaks are caused by tilted or cocked nipples.**

**DO NOT use steel/iron head hammer to drive nipples without using a wood block. Nipple damage may result.**

- g. A special nipple setting gauge is provided for the nipples. Gauge nipple in both directions to insure that it is driven to the proper depth into the nipple opening (nipple port). Cut-out in gauge must rest on nipple, with legs of gauge touching finished face of section, when nipple is properly driven. See Figure 6.
- h. Remove a 96" length of fiberglass rope from the assembly carton. Starting with the area around the upper 7" nipple port, firmly press the rope into the groove, so that the adhesive holds it in place. (If more than 25 minutes have passed since the adhesive was applied, it may be necessary to reapply.) Continue to affix the rope to the groove in this fashion around the perimeter of the section. Make sure that the rope does not droop or hang outside of the groove. When the end of the groove is reached, cut off the excess rope. Push the length of excess rope into the groove at the top corner of the section face (opposite of the 7" nipple port.) Cut off and discard any remaining rope after groove is filled. See Figure 7.

## WARNING

**Sections must be drawn-up tight immediately after properly applying sealant for best results. Although sections may be joined within two (2) hours of applying sealant, humidity and temperature affect cure time. If a "thick skin" has been formed on the sealant bead, remove and re-apply sealant.**

**Sealant must be properly applied to ALL grooves. Failure to properly seal the boiler joints will result in combustion gas leaks through the joint. DO NOT operate boiler with combustion gas leaks.**

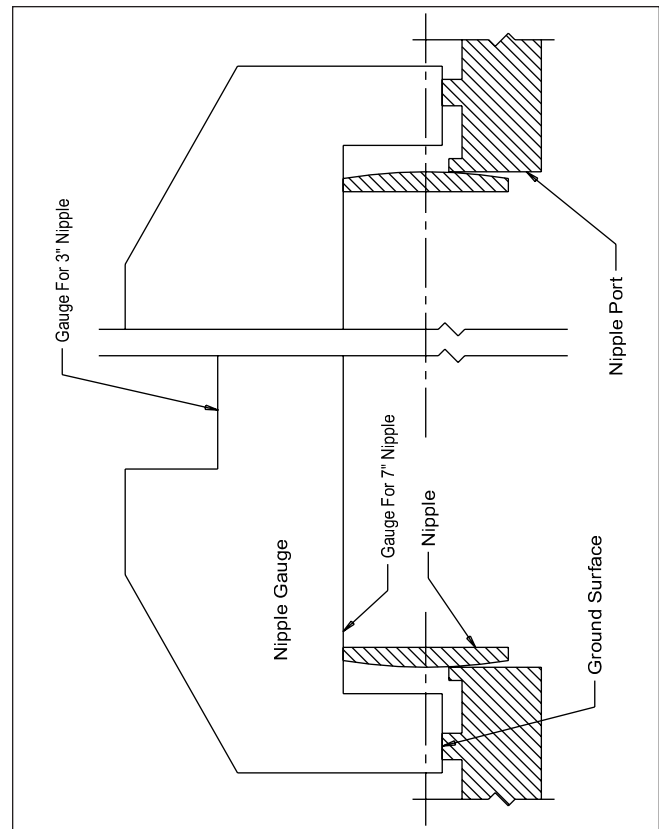


Figure 6: Nipple Gauge

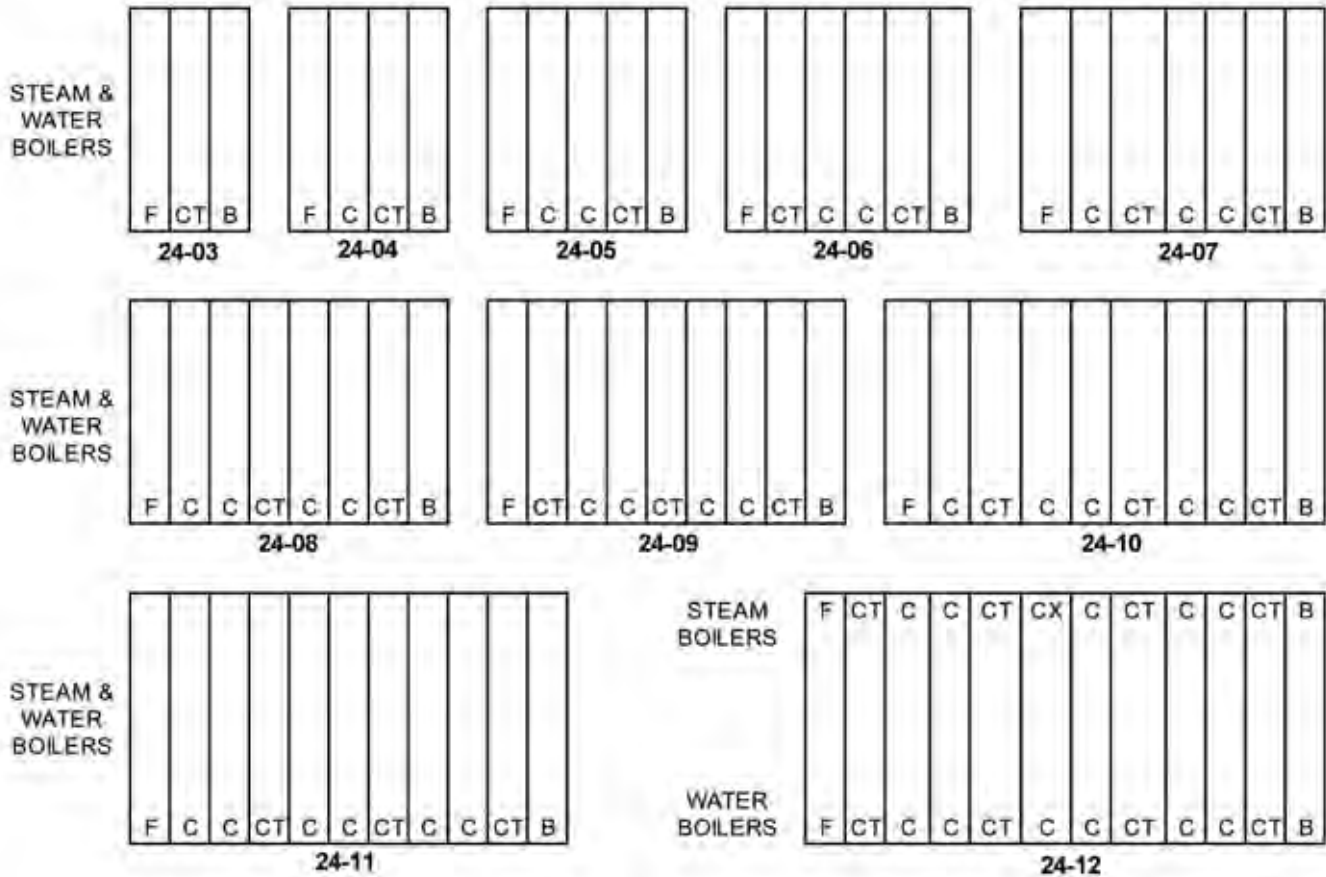


Figure 7: Affixing the Fiberglass Rope

BOILER SECTION IDENTIFICATION CODE

F = FRONT SECTION WITH 4" SUPPLY TAPPING  
 B = BACK SECTION WITH 4" SUPPLY TAPPING

C = CENTER SECTION  
 CX = CENTER SECTION WITH 4" TOP SUPPLY TAPPING



NOTES: FOR BOILERS LESS TANKLESS HEATER, REPLACE THE "CT" SECTIONS WITH "C" SECTIONS.

**Figure 8: Series 24 Section Arrangement**

- i. From the "Section Arrangement" chart, select the next section according to the "Identification Code" at the top of the chart. See Figure 8. Use a wire brush to clean the groove in the face of

(crowbar) under the center of the section and lift the nipple port onto the upper nipple.

- k. Drive section in place with a heavy block of wood, striking blows as squarely as possible over nipple port.
- l. The large draw-up rod lugs with dual holes are cast in the four (4) corners of each casting. Starting with the upper holes, install four (4) 5/8" x 9 3/4" long draw-up rods along with washers and nuts (see Figure 9).

**NOTICE**

**The sections must be assembled according to the arrangement shown to ensure proper operation, proper assembly of canopy, jacket and alignment of piping and tankless heaters with jacket knockouts. Start with the back section and work towards the front.**

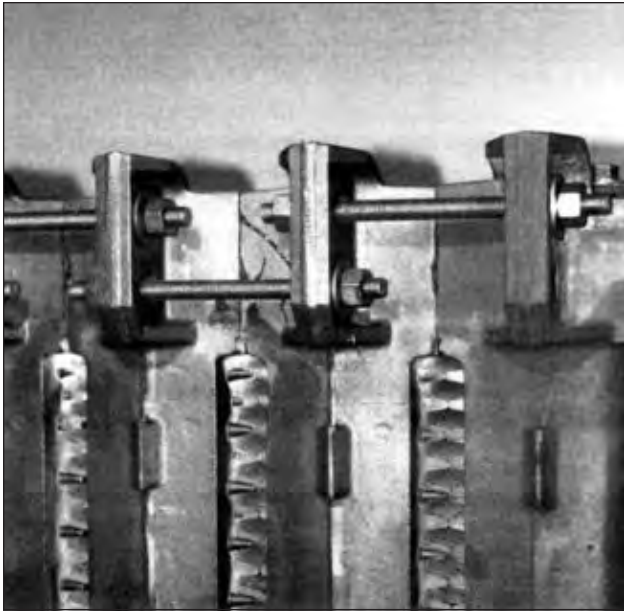
the next section. Then, using a cartridge of RTV 6500 or RTV 736 sealant in a caulking gun, fill the groove in this section with silastic sealant. Touch-up any missed spots before draw-up. Touch-up after draw-up has no value.

- j. Clean and lubricate nipple ports on next section to be assembled and place on nipples previously installed in rear section. To facilitate assembly, it is advisable to enter the upper nipple first in its port. Then enter the lower nipples in their respective ports. If necessary, place a lifting bar

**CAUTION**

**To avoid damage to the draw-up rod threads while drawing up sections, apply oil or other lubricant to tie rod threads while assembling sections to prevent stripping of threads on rod and to make assembling easier.**

- m. DRAW UP SECTION SLOWLY AND EVENLY using an alternating pattern starting with the upper right lug and proceeding to the lower left, lower right and finishing with upper left lug.



**Figure 9: Draw-Up Rods (Alternating Pattern - Manual Draw-up)**

When you start, grind surfaces between adjoining sections should be approximately 3/8" apart. Use three (3) or four (4) passes at tightening the four (4) draw-up rods a little at a time so that sections are pulled up evenly. During the last pass, pay close attention to the silastic sealant as it squeezes when the sections come in close contact. The silastic sealant will continue to squeeze out wafer thin until the sections are connected metal to metal. While tightening the nuts, close attention should be given to the connection area to determine that the silastic has stopped squeezing out from between the sections. This will give assurance that the sections are assembled metal to metal. If the silastic has stopped squeezing out from the connection and the sections still do not appear to be drawn metal to metal, measure any gaps between the sections with a feeler gauge. A maximum gap of .025" is acceptable. Gaps should be measured at the outer edge of the connection. **DO NOT PUNCTURE THE GASKET CREATED BY THE FIBERGLASS ROPE AND SILASTIC SEALANT WITH THE FEELER GAUGE.**

## WARNING

**Do not over torque draw up nuts after grind surfaces meet.**

**KEEP NIPPLES ALIGNED WITH NIPPLE PORTS.** If necessary, tap edge of nipples lightly with a blunt tool or rod to keep nipples from cocking while sections are being drawn-up. **DO NOT DRAW UP SECTION WHEN NIPPLES ARE COCKED.** If the torque required becomes

excessive, periodically place a heavy block of wood over each nipple port and strike as squarely as possible with several blows to relieve tension on the draw-up rods.

- n. **CONTINUE ASSEMBLING SECTIONS IN THEIR RESPECTIVE ORDER** alternating the draw-up rods from the upper to lower set of holes in draw-up lugs. Be certain that all sections are drawn up **IRON-TO-IRON** at all three (3) nipple ports.

**BE SURE TO APPLY THE SEALANT** to the groove in the ground joints between adjacent sections as the boiler operates with a positive pressure in the firebox and products of combustion will escape between sections unless the sections are properly sealed. The sealant should be applied before each section is placed on the assembly.

- o. If a joint springs apart it must be redrawn tight within four (4) hours of the time of application of Silastic to that joint.
2. **ASSEMBLY OF SECTIONS (HYDRAULIC DRAW-UP)**

The entire boiler assembly may be drawn up at one time using hydraulic draw-up equipment providing the operation is completed within four (4) hours after application of the sealant.

- a. Repeat steps 1a through 1k under "Field Assembled Sections (Manual Draw-Up)."
- b. Continue driving sections in place (in their respective order) until all sections are in the assembly. Ground surfaces between adjoining sections should be spaced 1/4" to 3/8" apart. Spacing of more than 3/8" will limit number of sections that can be drawn up in one unit and could indicate cocked nipples.

## WARNING

**Sealant must be properly applied to ALL grooves. Failure to properly seal the boiler joints will result in combustion gas leaks through to joint. DO NOT operate boiler with combustion gas leaks. The sealant should be applied before each section is placed on the assembly.**

On long boiler assemblies, it may be necessary to draw-up a partial block if the entire boiler is not ready to be drawn-up tight within four (4) hours of the first application of Silastic. If the block assembly time extends overnight, the partial block completed must be drawn-up tight before leaving the boiler overnight. If a joint springs out, it must be redrawn tight within four (4) hours of first application of Silastic to the joint.

- c. Insert the three (3) 3/4" draw-up rods (and couplings, if appropriate) through the tapped holes in the rear section extending them through the



tapped holes in the front section. Be sure to screw draw-up rods into couplings far enough to prevent stripping threads.

- d. Place a 3" x 12" lg. steel channel on each end of the upper draw-up rod and a 3" x 8½" lg. steel channel on each end of the lower draw-up rods. Refer to Figures 10 and 11 for proper placement of channel block during assembly procedures. Install nuts and washers on one end of the draw-up rods and the hydraulic rams, washers and draw-up rod clamps on the other. See Figure 13.

## CAUTION

**Do not apply pressure directly on threaded tappings on front and rear sections with draw-up channels during assembly procedures.**

**Rods should be approximately centered in openings so that rods and couplings (when used) do not drag on pipe thread in end section tappings.**

## WARNING

**READ THE STATEMENTS BELOW BEFORE ATTEMPTING TO USE HYDRAULIC EQUIPMENT.**

- \* Release pressure in ram pumps before attempting to remove clamps.
- \* Do not stand in line with draw-up rods at either end when hydraulic pressure is being applied. As a safety measure, ends of draw-up rods should be covered while sections are being drawn in case rods should snap while under tension.
- \* Do not operate ram against draw-up coupling.
- \* Do not operate pump after ram has reached stroke limit.

- e. Draw-Up Sections

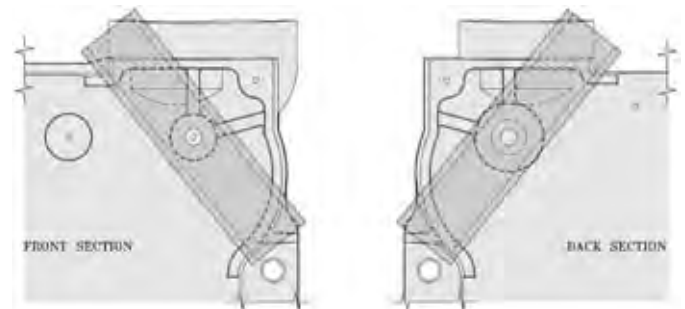
Use hydraulic rams to draw up sections by applying pressure alternately on the draw-up rods. When rams reach stroke limit, release pressure in ram pumps and then move clamps to new position.

- f. Continue to draw-up until all sections make contact at the ground joints.

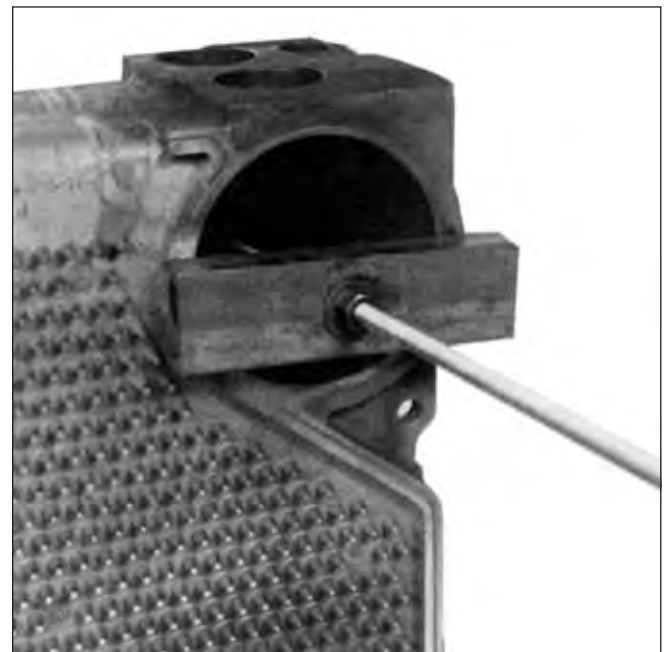
- g. After all sections have been drawn up, but before removing the hydraulic rams and draw-up rods, the 9¾" long tie rods must be installed.

The large draw-up rod lugs with dual holes are cast in the four (4) corners of each casting. Starting with the upper holes in the back section, install four (4) 5/8" x 9¾" long tie rods along with washers and nuts. Continue installing the tie rods alternating from the upper to lower set of holes in draw-up lugs until front section is secured. Be certain that all sections are drawn up IRON TO IRON at all three nipple ports.

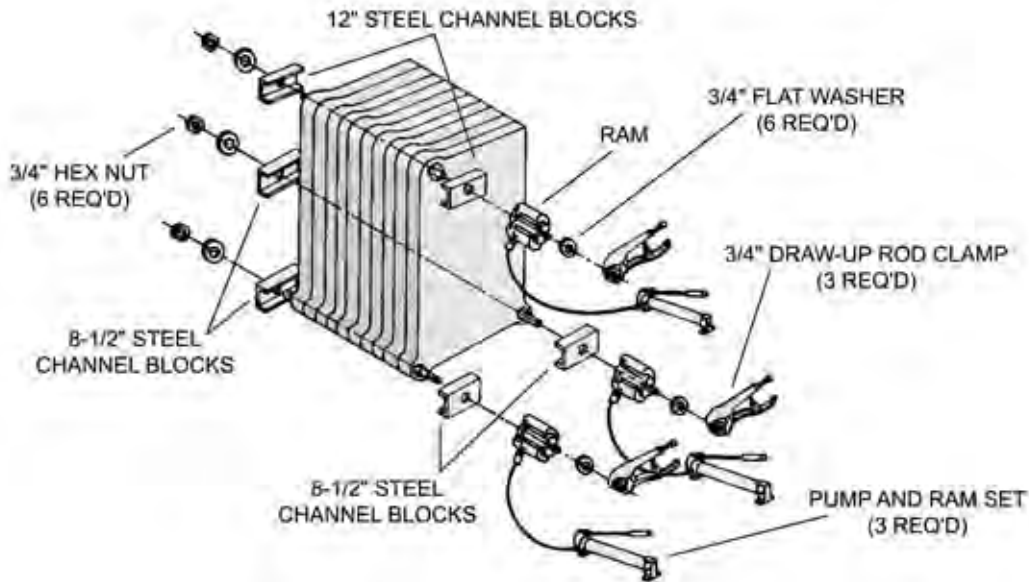
- h. Excess length of draw-up rods must not extend beyond front and rear section. To ensure proper fit of jacket, adjust accordingly. Tighten all tie rod nuts until finger tight. Then tighten them an additional ½ turn with a wrench to prevent section damage to thermal expansion.



**Figure 10: Front and Rear Section Channel Block Positions (Hydraulic Draw-up)**



**Figure 11: Center Section Channel Block Position (Partial Block Draw-Up)**



**Figure 12: Hydraulic Draw-Up of Sections**

**B. HYDROSTATIC TEST** — After the boiler sections have been assembled, it is essential that the boiler be hydrostatically tested before the canopy, flue cover plates, jacket, or piping is installed.

**1. Tankless Heater Installation**

If boiler is ordered with tankless heaters, install heaters with the gaskets provided. Table IV on Page 37 gives the maximum number of heaters permissible per assembly and the heater ratings.

**2. Plug all boiler tappings and fill boiler completely with cold water.**

**4. EXAMINE BOILER CAREFULLY, INSIDE AND OUTSIDE,** to insure against leaks from cocked nipples or through concealed breakage caused in shipping and handling. This precaution is for your protection and will simplify handling of necessary replacements and adjustment claims.

**5. After making certain that there are no leaks,** drain boiler and remove plugs for boiler trim and other connections.

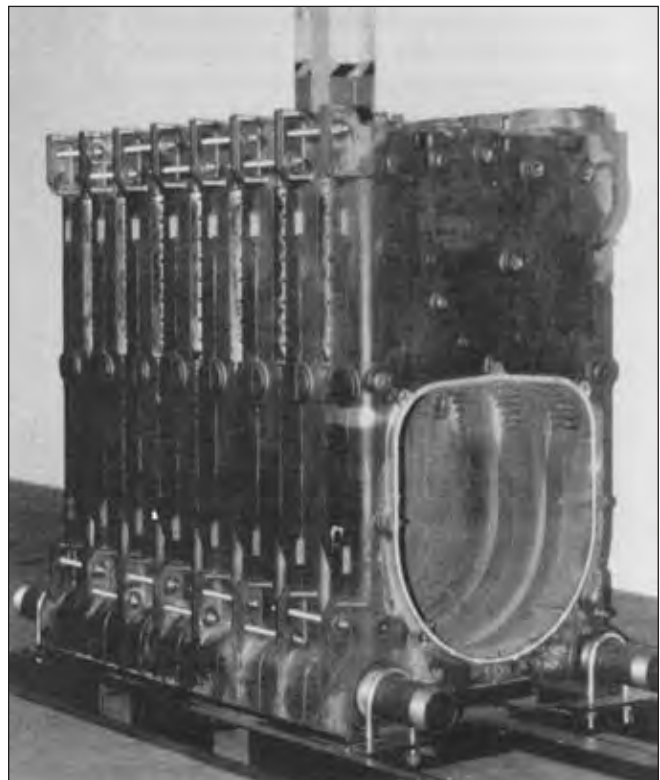
CAUTION

**DO NOT install gauge until after hydrostatic testing the boiler. Gauge failure may result.**

3. All completed boilers must satisfactorily pass the prescribed hydrostatic test.
  - a. **STEAM BOILERS:** The assembled boiler must be subjected to a hydrostatic test of 45 psig to 55 psig.
  - b. **HOT WATER BOILERS:** The assembled boiler must be subjected to a hydrostatic test of not less than 1½ times the maximum allowable working pressure (MAWP).

WARNING

**Failure to properly hydrotest all boilers at the correct pressure may result in section assembly failure in operation.**



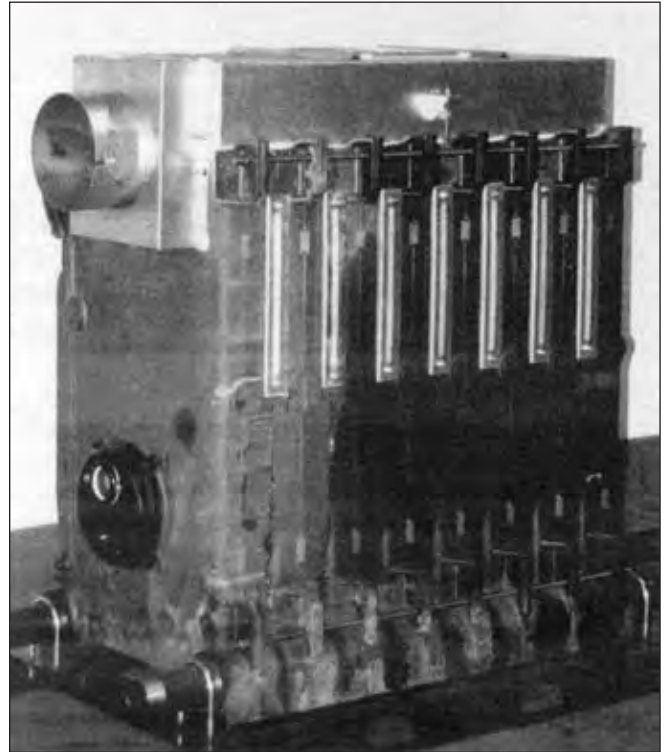
**Figure 13: Boiler Section Assembly**

## SECTION III - INSTALLATION INSTRUCTIONS

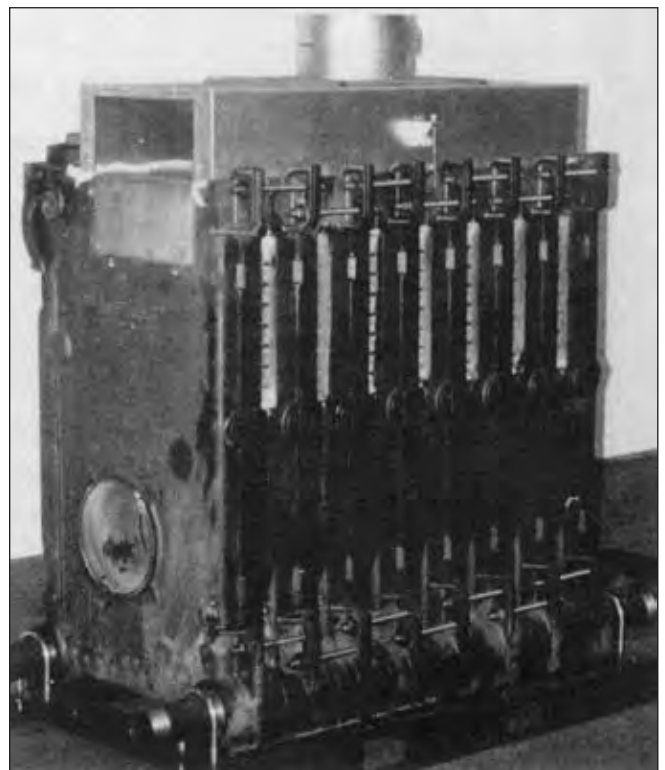
### A. INSTALL CANOPY/FLUE OUTLET ASSEMBLY,

Refer to Figures 14, 15 and 16.

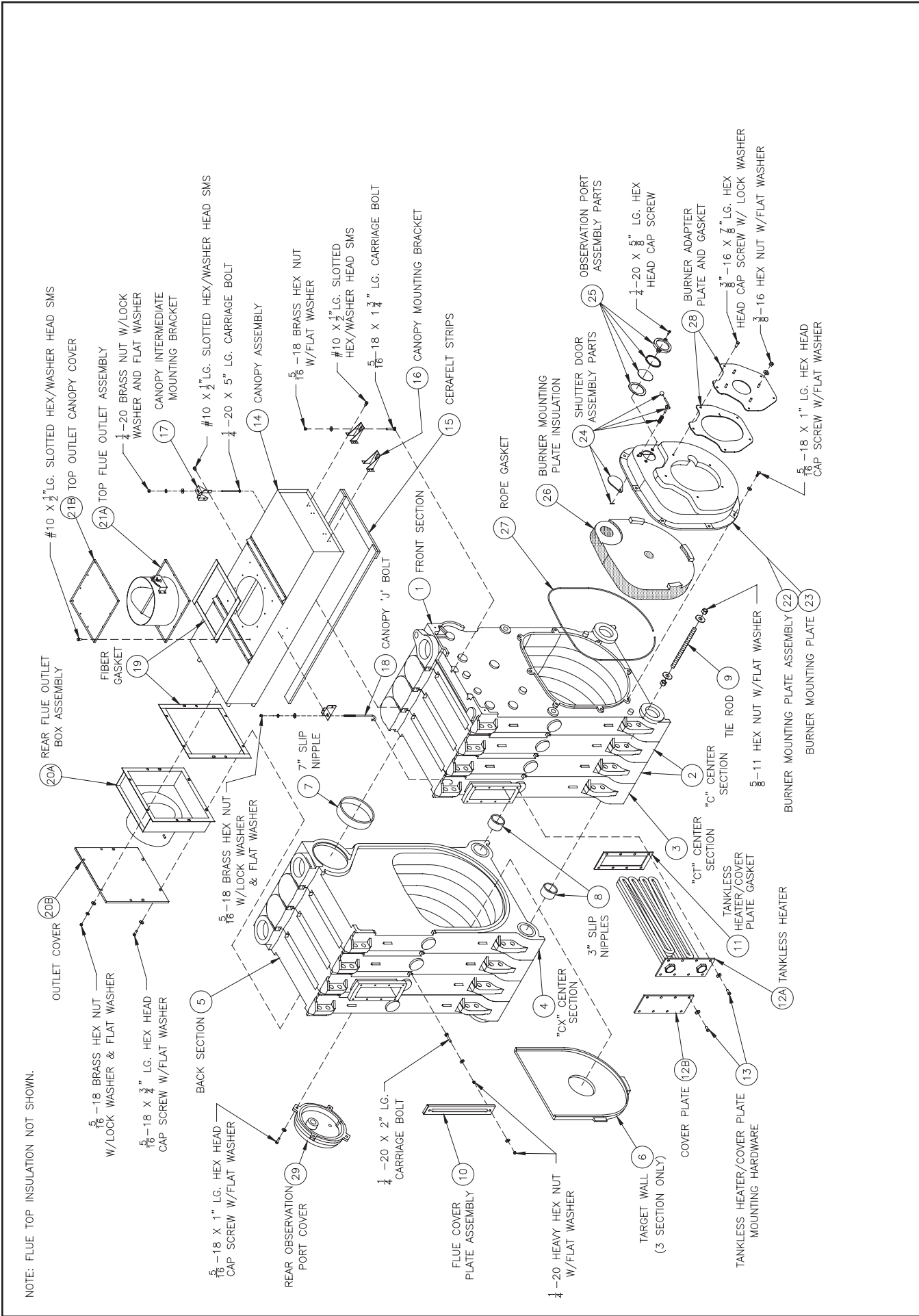
1. Open canopy carton.
2. Attach the two (2) canopy brackets to the front end cap of canopy with four (4) #10 x 1/2" sheet metal screws each.
3. Across the top of the front section and along the top ledges running back each side of the sections, place continuous 2" wide strips of cerafelt and overlap joints at front corners. Cerafelt strip should extend 1/4" beyond rear surface of back section. Cut off excess.
4. Place the canopy on the sections.
5. Position rear flange (end with studs) of canopy flush with rear surface of back section.
6. Loosely attach the canopy brackets to the lugs on the front section of the block assembly with 5/16" carriage bolts, flat washers and locknuts.
7. Check to see if rear flange of canopy is still flush with raised flange on back section.
8. Open either the rear flue outlet carton (standard) or top flue outlet carton (optional).
9. Attach the 1/8" x 1" wide self-adhesive fiber gasket to the surface of either the rear flue outlet damper assembly or rear flue outlet cover that mounts against the canopy and back section. Gasket must be centered over all attachment holes. Do not overlap corners, cut butt joints.
10. Attach either the rear flue outlet damper assembly or rear outlet canopy cover to the canopy with the 5/16" flat washers, lock-washers and brass nuts and tighten securely. Attach the rear flue outlet damper assembly or cover to the back section with the four (4) 5/16" flat washers and cap screws and tighten securely.
11. Tighten front canopy carriage bolt until canopy is secure.
12. On the longer canopy sizes, Intermediate Mounting Brackets are provided, two (2) are required on sizes 24-07 thru 24-09 and four (4) are required on sizes 24-10 thru 24-12A. Refer to Figures 17 and 18.
  - a. Intermediate brackets are shipped flat. Bend side flanges down approximately 90° as shown. Adjust bends until holes in bracket match hole pattern on canopy.
  - b. Secure brackets to both sides of canopy with three (3) #10 x 1/2" sheet metal screws per bracket.
  - c. Secure canopy left side bracket(s) with appropriate canopy 'J' bolt(s). Insert threaded end through holes in brackets and hook 'J' bolt on center section draw-up rod (hooks should



**Figure 14: Canopy with Rear Flue Outlet Damper Assembly**



**Figure 15: Canopy with Top Flue Outlet Damper Assembly (Rear Cover Removed)**



NOTE: FLUE TOP INSULATION NOT SHOWN.

Figure 16: Bare Boiler Assembly



# **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**

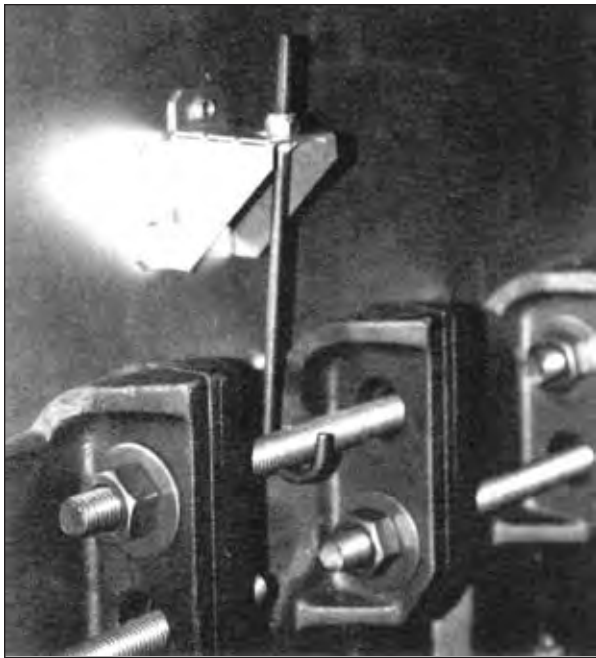
### **Precautionary Measures:**

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.



**Figure 17: Left Side Canopy Intermediate Bracket**

face outward). Secure canopy with 5/16" flat washers, lock washers and brass nuts. See Figure 17.

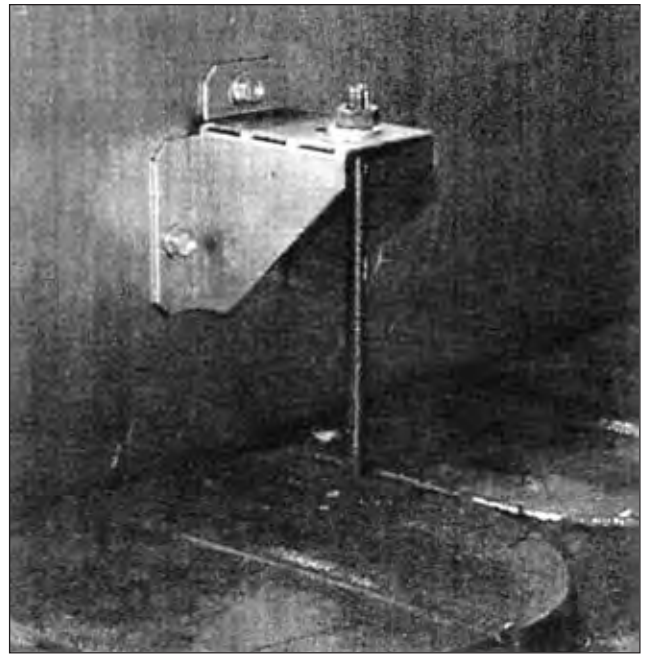
- d. Secure canopy right side bracket(s) with 1/4" - 20 x 5" lg. carriage bolts. Insert head of carriage bolt between canopy body and casting. Slide carriage bolt into slot provided between castings. Lower carriage bolt until threaded end will pass through hole in bracket. Secure canopy with 1/4" flat washers, lock washers and brass nuts. See Figure 18.

13. Attach the 1/8" x 1" wide self-adhesive fiber gasket to the surfaces of either the top flue outlet damper assembly or top outlet canopy cover that mounts against the canopy. Gasket must be centered over all attachment holes. Do not overlap corners, cut butt joints.

14. Secure either the top flue outlet damper assembly or top outlet canopy cover with #10 x 1/2" sheet metal screws.

**B. INSTALL FLUE COVER PLATES** over cleanout openings on left side of boiler as shown in Figure 19. See **Important Product Safety Information on Page 21 of this manual, regarding refractory ceramic fiber product warning.**

1. Locate the cover plates, carriage bolts, nuts and washers in the boiler assembly carton(s).
2. Remove insulation from two (2) 3/8" diameter holes in flue cover plates using a 3/8" drill bit. Rotate bit through insulation by hand.
3. Attach the carriage bolts to the top and bottom of the flue openings with washers and hex nuts to provide a fixed stud.
4. Install flue cover plates over studs with insulation

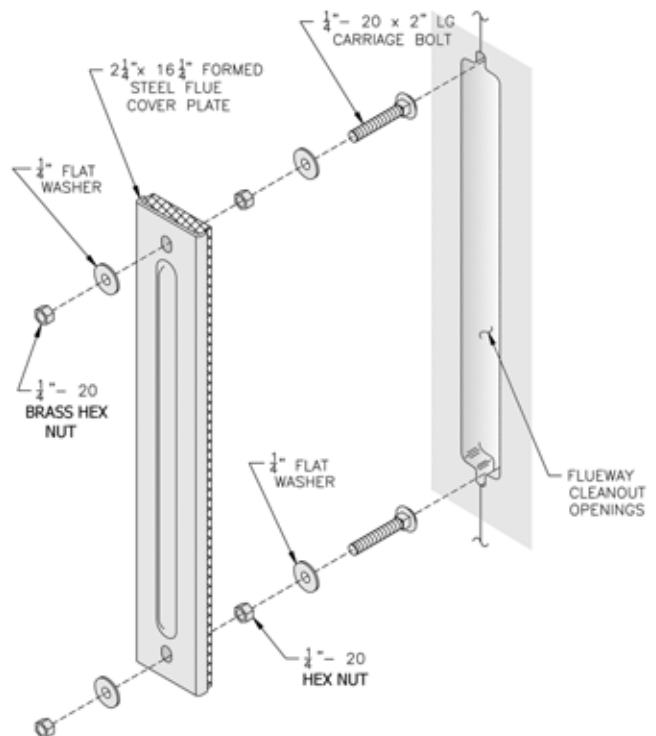


**Figure 18: Right Side Canopy Intermediate Bracket**

against boiler and secure with washers and nuts.

Tighten until insulation on cover plate provides a tight seal to casting. If after tightening, a gap is still evident where the sections join, apply silastic along top and bottom edge of insulation board.

5. Repeat steps 3 through 6 for mounting remaining flue cover plates.



**Figure 19: Flue Cover Plate Attachment**

### C. MOUNT REAR OBSERVATION PORT COVER

Refer to Figure 16.

1. With the silastic sealant, secure the 3/16" diameter rope gasket into the groove around the perimeter of the rear observation port cover.
2. Mount the rear observation port cover onto the rear section (with the word "Top" in the upright position) using the four (4) 5/16" - 18 x 1" lg. cap screws and flat washers provided.

### D. INSPECT ALL BOILER SEALS

1. A visual inspection should be made of all sealed joints and repairs made as necessary. Darken the boiler room and place a light source in the combustion space and canopy to observe any gaps or open seals. Poor seals must be repaired and rechecked before continuing.

### E. JACKET ASSEMBLY - See Figure 22 for Jacket Assembly Details.

1. Open jacket carton and jacket hardware package. Unless otherwise stated, all jacket components are fastened with #8 x 1/2" hex head sheet metal screws. Do not drive sheet metal screws tight until jacket assembly is complete.
2. On boilers with rear flue outlet damper assembly, remove square knockout from jacket rear panel. To remove knockout, use a single hacksaw blade with handle or aviation snips to cut metal tabs between slotted holes.
3. Attach jacket front panel to front section and jacket rear panel to back section using the eight (8) #10 x 1/2" self tapping screws. Tighten these screws securely.
4. Attach jacket lower tie bar panel (approximately 5-5/8" high) to the bottom of the jacket front and rear panels using four (4) sheet metal screws. Repeat for opposite side.
5. Attach jacket upper tie bar panel (approximately 4-1/8" high) to the top of the jacket front and rear panels using four (4) sheet metal screws. Repeat for opposite side.

### 6. Jacket Top Panel Attachment

- a. On boilers with top flue outlet damper assembly, remove octagon shaped knockout. To remove knockout, use a single hacksaw blade with handle or aviation snips to cut metal tabs between slotted holes.
- b. Remove knockout(s) for necessary supply piping in a similar manner.
- c. Attach jacket top panel to the front panel, rear panel and upper tie bar panels with sheet metal screws.

### 7. Install Jacket side Panels

- a. Snap black thumb hole bushings into all side panel holes.
- b. Use the left side panel and right side panel usage charts to determine correct positions of side panels. The three (3) digit panel identification numbers shown in the charts are also stamped along the bottom edge of each panel. Refer to Figures 20 and 21.
- c. Rearward and Intermediate panels have reverse bend flanges on one side of panel. These panels must be installed prior to forward panels.

## NOTICE

**To install multiple side panels, start at the rear of boiler and work forward. To remove panels, reverse order of assembly.**

- d. If boiler is equipped with tankless heaters they should be installed at this time if they were not installed for hydrostatic test outlined on Page 18.
- e. Install right side panels into position by inserting top of panel into 'U' shaped channel, pushing bottom of panel in toward boiler, and sliding panel down into 'J' shaped channel. Repeat procedure until all right side panels are in place.
- f. Remove the knockouts necessary for tankless heater operation on left side panels.
- g. Install left side panels, using the same procedure used to install the right side panels.

JACKET LEFT SIDE PANEL USAGE CHART					
BOILER MODEL	MULTIPLE LEFT SIDE PANELS*				
	PANEL 1	PANEL 2	PANEL 3	PANEL 4	PANEL 5
24-03	L10	L5	-	-	-
24-04	L10	L11	-	-	-
24-05	L10	L17	-	-	-
24-06	L10	L18	L5	-	-
24-07	L10	L18	L11	-	-
24-08	L10	L18	L17	-	-
24-09	L10	L18	L18	L5	-
24-10	L10	L18	L18	L11	-
24-11	L10	L18	L18	L17	-
24-12	L10	L18	L18	L18	L5

RIGHT SIDE PANEL USAGE CHART			
BOILER MODEL	SINGLE / MULTIPLE RIGHT SIDE PANELS*		
	PANEL 3	PANEL 2	PANEL 1
24-03	-	-	R15 (SINGLE)
24-04	-	-	R21 (SINGLE)
24-05	-	-	R27 (SINGLE)
24-06	-	-	R33 (SINGLE)
24-07	-	R15	R24
24-08	-	R21	R24
24-09	-	R27	R24
24-10	-	R27	R30
24-11	-	R33	R30
24-12	R21	R24	R24

\*NOTE: TO INSTALL MULTIPLE SIDE PANELS, START AT THE REAR AND WORK FORWARD. TO REMOVE PANELS, REVERSE ORDER OF ASSEMBLY.

Figure 20: Left Side Panel Usage Chart

Figure 21: Right Side Panel Usage Chart

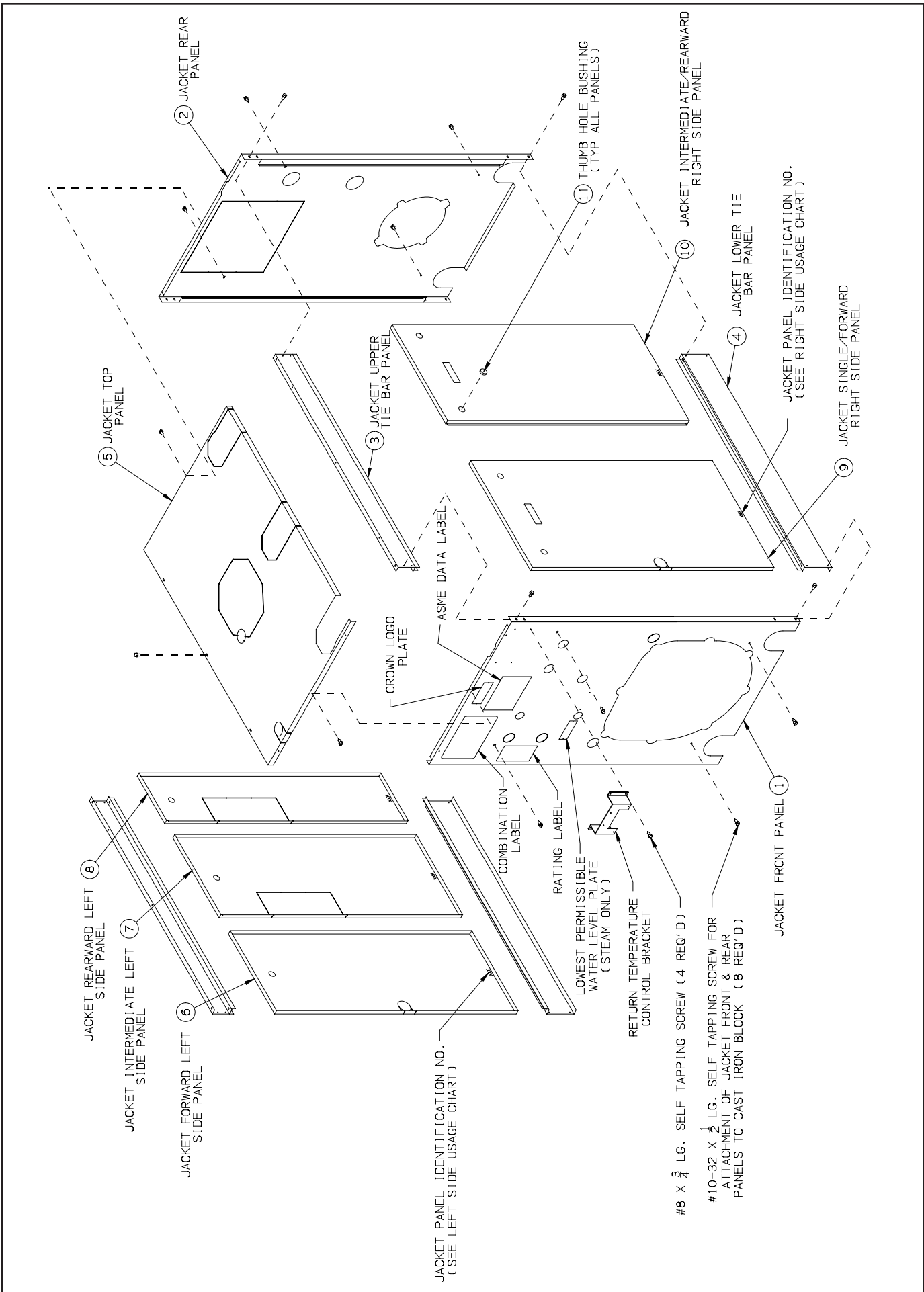


Figure 22: Series 24 Jacket Assembly (Boiler Models 24-03 thru 24-12)



8. Combination Label and Crown Logo Plate were attached to jacket front panel at time of manufacture. If loose or peeling, apply pressure to reset adhesive.
9. On steam boilers, attach lowest permissible water level plate (from steam trim carton) to the front panel using sheet metal screws.
10. Tighten all sheet metal screws to complete jacket assembly.
11. RTC Bracket (if used)- install bracket in top right corner of front panel with four (4) #8 x 3/4" self tapping screws.

**F. BURNER MOUNTING PLATE -** Refer to Figures 16 and 23.

1. Using silastic sealant, secure the 3/16" diameter rope gasket to the groove along the mounting plate opening in the front section.
2. Install 5/16" x 1" lg. cap screw in lower tapping on front section to carry weight of burner mounting plate.
3. Engage bottom slot on burner mounting plate with matching bolt in bottom tapping of front section. Align mounting holes and fasten the mounting plate to the boiler sections with seven (7) remaining 5/16" cap screws and washers. Fully tighten all bolts.

**G. MOUNT BURNER ADAPTER PLATE TO BURNER MOUNTING PLATE.**

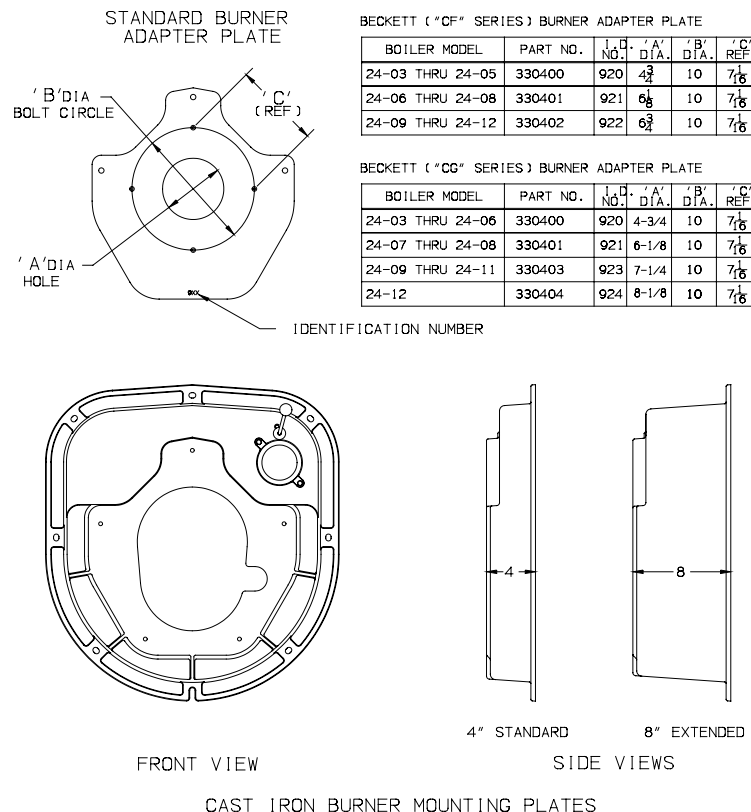
Refer to Figures 16 and 23.

1. In all cases the burner adapter plate carton for the specified burner will be provided by Crown.
2. Open Adaptor Plate carton and remove contents.

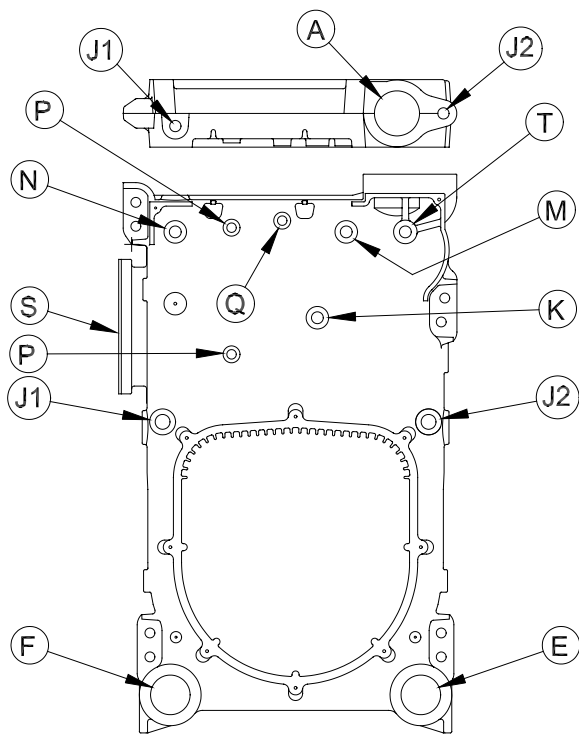
3. Apply four (4) small dabs of silastic on rear surface of adapter plate to temporarily hold gasket in place. Hold adapter plate in position against burner mounting plate, align holes and secure with five (5) 3/8" lock washers and 3/8" x 7/8" lg. cap screws.
3. Follow burner manufacturer's instructions using gasket material and hardware provided with burner.
4. **USE A HOLE SAW OR KNIFE TO CUT BURNER MOUNTING PLATE INSULATION TO MATCH HOLE SIZE ON BURNER ADAPTER PLATE.** After cutting, remove any and all loose pieces of insulation which may become lodged or interfere with the head of a burner air tube after insertion. Confirm that hole in insulation fits snugly around burner blast tube. If hole is oversized, use fiberglass rope gasket provided with burner to fill in any space between insulation and blast tube. If rope gasket is not provided with the burner, use 3/8" fiberglass rope (provided by others).
5. **For boilers without tankless heaters,** proceed to Step **H** (Install Steam Trim) or **I** (Install Water Trim).
6. **For boilers with tankless heaters,** install the tankless heater manifolds according to Figure 37.

**CAUTION**

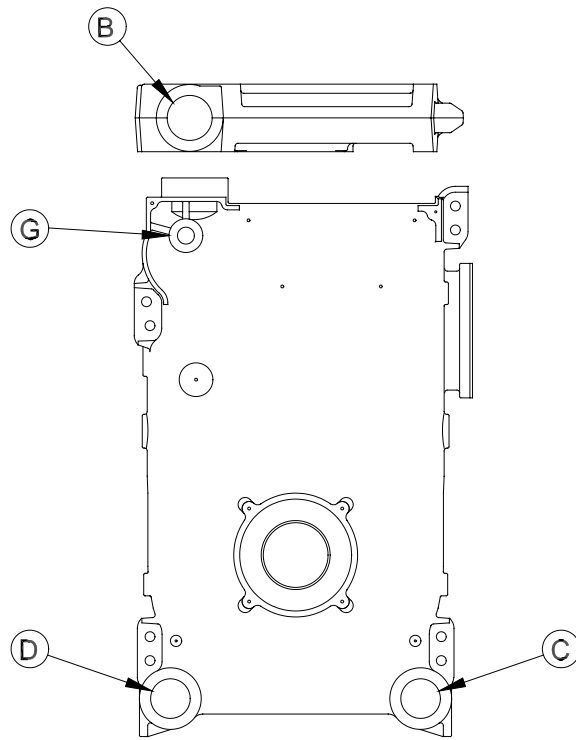
**Failure to properly fill all gaps between the insulation and burner blast tube may result in damage to the burner**



**Figure 23: Burner Mounting Plate/Burner Adapter Plate Options**



FRONT VIEW



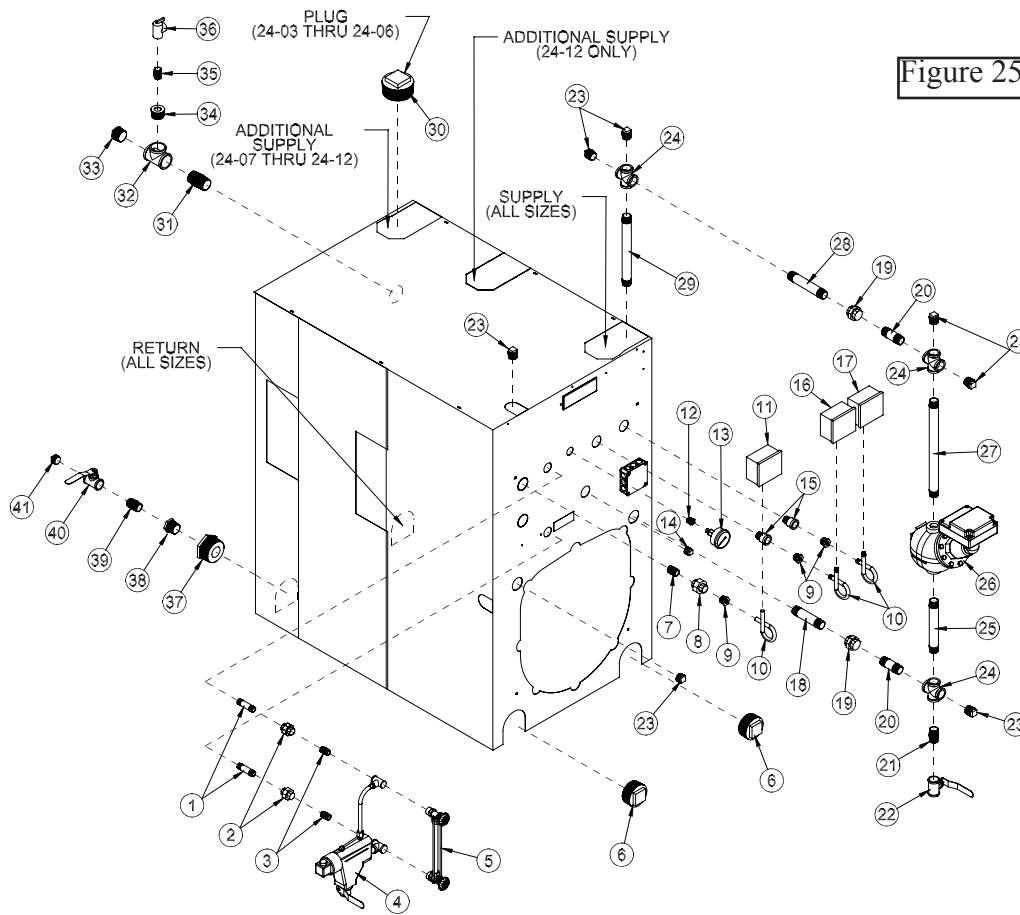
BACK VIEW

Tapping Location	Size (in)	Steam Boiler
A	4	Supply
B	4	Plug (24-03 thru 24-06) Supply (24-07 thru 24-12)
C	3	Blow-Off Valve
D	3	Return
E	3	Plug
F	3	Plug
G	1-1/2	Safety Valve/Surface Skim Tap
J1	1	Plug

Tapping Location	Size (in)	Steam Boiler
J2	1	Float L.W.C.O.
K	3/4	Plug
M	3/4	Operating Pressure Limit Control
N	3/4	Hi Pressure Limit Control/Manual Reset
P	1/2	Gauge Glass/#67 L.W.C.O.
Q	1/2	Steam Gauge (Bush to 1/4")
S	3/4	Tankless Heater Control
T	3/4	Firing Rate Pressure Control

Figure 25a Purpose of Tappings - Steam Boilers

Figure 25b: Steam Trim



KEY	DESCRIPTION	BOILER MODELS	QUANTITY			KEY	DESCRIPTION	BOILER MODELS	QUANTITY		
			STANDARD	OPTIONAL	NOT SUPPLIED				STANDARD	OPTIONAL	NOT SUPPLIED
1	1/2" X 3" BR NIPPLE	ALL	2			29	1" X 12" NIPPLE	CSD-1 EQUIPPED BOILERS PUMPED RETURN			1
2	1/2" BR UNION	ALL	2			30	4" BK PLUG	ALL	1		
3	1/2" BR CLOSE NIPPLE	ALL	2			31	1-1/2" X 4 NIPPLE	ALL	1		
4	LWCO, #67	ALL	2			32	1-1/2" TEE	ALL	1		
5	GAUGE GLASS SET	ALL	2			33	1-1/2" SQ. HD. PLUG	ALL	1		
6	3" SQ. HD. PLUG	ALL	2			34	1-1/2" x 3/4" BLK BUSHING	24-03	1		
7	3/4" X 2" NIPPLE	ALL			1	34	1-1/2" x 1" BLK BUSHING	24-04	1		
8	3/4" UNION	ALL			1	34	1-1/2" x 1-1/4" BLK BUSHING	24-05 THRU 24-08	1		
9	3/4" X 1/4" HEX BUSHING	ALL	1	1	1	35	3/4" CLOSE NIPPLE	24-03			1
10	1/4" 90° BR PIGTAIL	ALL	1	1	1	35	1" CLOSE NIPPLE	24-04			1
11	L404C1147	CSD-1 EQUIPPED BOILERS		1		35	1-1/4" CLOSE NIPPLE	24-05 THRU 24-08			1
12	1/2" X 1/4" BR BUSHING	ALL	1			35	1-1/2" CLOSE NIPPLE	24-09 THRU 24-12			1
13	PRESSURE GAUGE	ALL	1			36	SAFETY VALVE 13-211	24-03	1		
14	3/4" RECESSED HD PLUG	ALL	1			36	SAFETY VALVE 13-202	24-04	1		
15	3/4" BLK EXTENSION	ALL	1	1		36	SAFETY VALVE 13-213	24-05 THRU 24-08	1		
16	L404F1367	ALL	1			36	SAFETY VALVE 13-214	24-09 THRU 24-12	1		
17	FIRING RATE PRES CTRL	MODULATING BOILERS			1	37	3" X 1-1/4" BLK BUSHING	ALL	1		
18	1" X 5-1/2" NIPPLE	CSD-1 EQUIPPED BOILERS PUMPED RETURN			1	38	1-1/4" X 3/4" BUSHING	24-03 THRU 24-04	1		
19	1" UNION	CSD-1 EQUIPPED BOILERS PUMPED RETURN			2	38	1-1/4" X 1" BUSHING	24-05 THRU 24-08	1		
20	1" X 3-1/2" NIPPLE	CSD-1 EQUIPPED BOILERS PUMPED RETURN			2	39	3/4" CLOSE NIPPLE	24-03 THRU 24-04			1
21	1" CLOSE NIPPLE	CSD-1 EQUIPPED BOILERS PUMPED RETURN			1	39	1" CLOSE NIPPLE	24-05 THRU 24-08			1
22	1" BALL VALVE	CSD-1 EQUIPPED BOILERS PUMPED RETURN			1	39	1-1/4" CLOSE NIPPLE	24-09 THRU 24-12			1
23	1" RECESSED HD PLUG	CSD-1 EQUIPPED BOILERS PUMPED RETURN	4		3	40	3/4" BALL VALVE	24-03 THRU 24-04			1
24	1" CROSS	CSD-1 EQUIPPED BOILERS PUMPED RETURN			3	40	1" BALL VALVE	24-05 THRU 24-08			1
25	1" NIPPLE*	CSD-1 EQUIPPED BOILERS PUMPED RETURN			1	40	1-1/4" BALL VALVE	24-09 THRU 24-12			1
26	#150-MD LWCO	CSD-1 EQUIPPED BOILERS PUMPED RETURN		1		41	3/4" SQ. HD. PLUG	24-03 THRU 24-04			1
26	#64 LWCO	CSD-1 EQUIPPED BOILERS GRAVITY RETURN		1		41	1" SQ. HD. PLUG	24-05 THRU 24-08			1
27	1" NIPPLE**	CSD-1 EQUIPPED BOILERS PUMPED RETURN			1	41	1-1/4" SQ. HD. PLUG	24-09 THRU 24-12			1
28	1" NIPPLE***	CSD-1 EQUIPPED BOILERS PUMPED RETURN			1						

\*SIZE NIPPLE TO SET WATER LEVEL OF LWCO.

\*\*SIZE NIPPLE TO MAKE UP LENGTH BETWEEN 24 & 26.

\*\*\*SIZE NIPPLE TO MAKE UP LENGTH BETWEEN 19 & 24.

## H. STEAM BOILERS — INSTALL STEAM TRIM

Items for steam trim are located in the steam trim carton (except for the separately ordered low water cutoff and tankless heater control). Figures 25a and 25b show the proper tapings for each item.

1. Install the gauge glass set.
2. Install the low water cut-off. Follow manufacturer's instructions furnished with control.
3. Install the pressure limit control as shown in Figure 25b.
4. Level the pressure limit control by carefully bending the syphon until the control's leveling indicator hangs freely with its pointer directly over the index mark inside the back of the case.
5. Install the steam gauge using the ½" NPT x ¼" FPT hex bushing.
6. Install the safety valve as shown in Figures 25a and 40a. Safety valve must be installed in vertical position.
7. For boilers with tankless heaters, install the operating control in an unused tapping through one of the heater plates.
8. Plug extra boiler tapings.
9. Install required bottom blowoff/drain valve and connecting piping (supplied by others) per minimum piping requirements for steam boilers. See Figure 25b.

### NOTICE

**Some L404 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.**

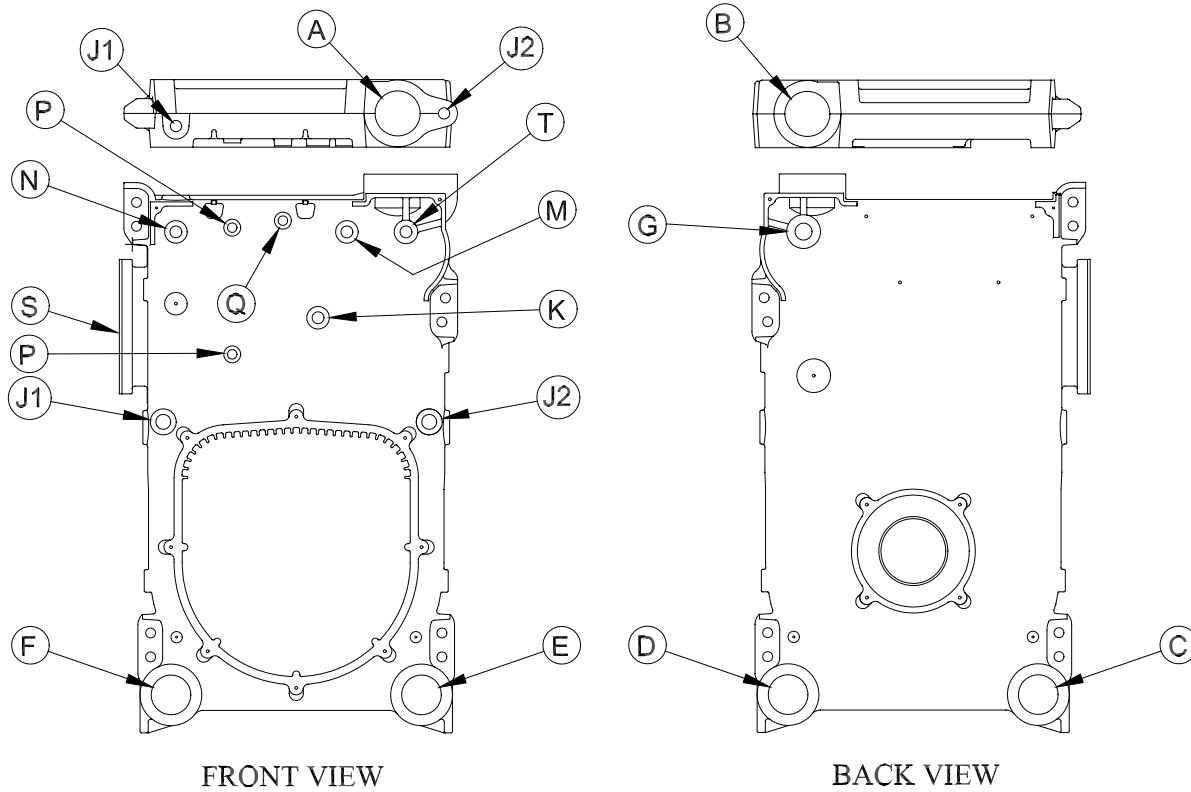
**Contact your local waste management authority for instructions regarding recycling and the proper disposal of this limit, or of an old limit containing mercury in a sealed tube.**

**If you have questions, call Honeywell Inc. at 1-800-468-1502.**

### WARNING

**Safety valve discharge piping must be piped to within six (6) inches of floor or to floor drain 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 in discharge piping.**

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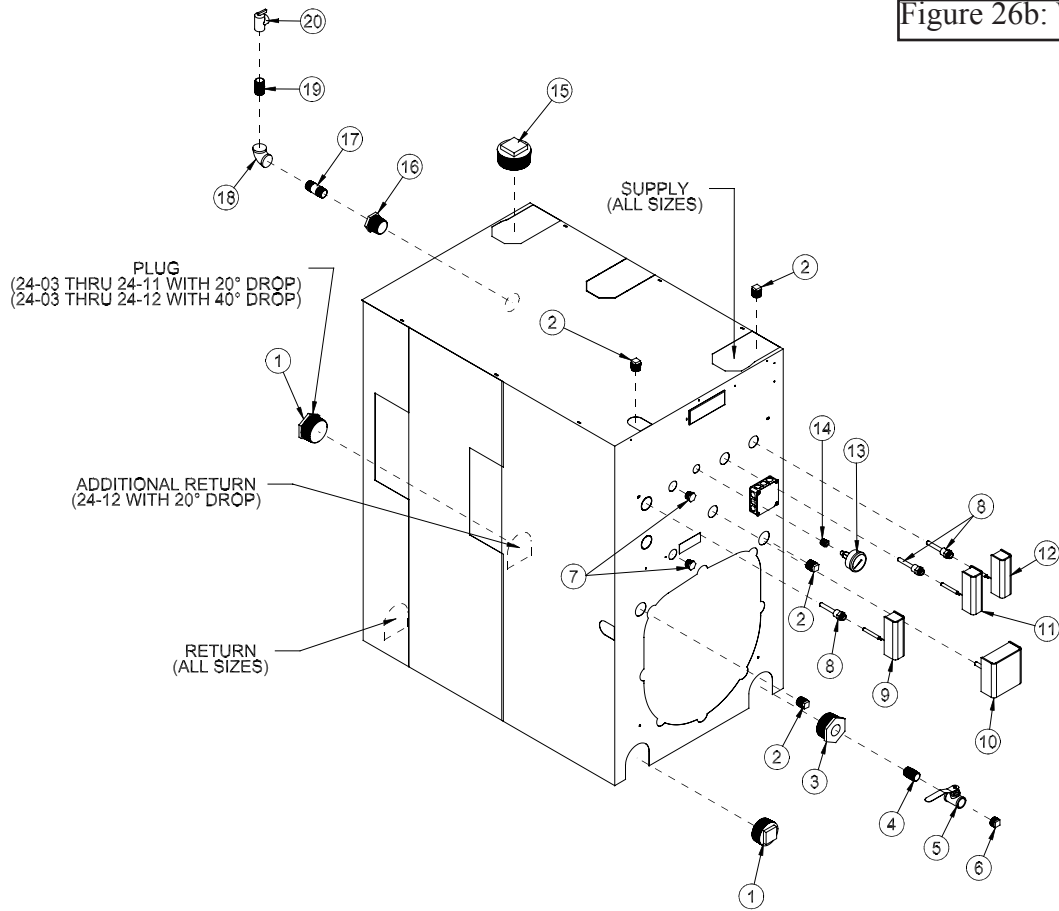


Tapping Location	Size (in)	Water Boiler
A	4	Supply
B	4	Plug
C	3	Return
D	3	Plug (24-03 thru 24-11) Return (24-12)
E	3	Blow-Off / Drain Valve
F	3	Plug
G	1-1/2	Relief Valve
J1	1	Plug

Tapping Location	Size (in)	Water Boiler
J2	1	Plug
K	3/4	Probe L.W.C.O.
M	3/4	Operating Temperature Limit Control
N	3/4	Hi Temperature Limit Control/Manual Reset
P	1/2	Plug
Q	1/2	Temperature/Pressure Gauge (Bush to 1/4")
S	3/4	Tankless Heater Control
T	3/4	Firing Rate Temperature Control

**Figure 26a: Purpose of Tappings - Water Boilers**

Figure 26b: Water Trim



KEY	DESCRIPTION	BOILER MODELS	QUANTITY			KEY	DESCRIPTION	BOILER MODELS	QUANTITY		
			STANDARD	OPTIONAL	NOT SUPPLIED				STANDARD	OPTIONAL	NOT SUPPLIED
1	3" SQ. HD. PLUG	24-03 THRU 24-12	2			16	1-1/2" x 3/4" BLK BUSHING	24-03 THRU 24-07	1		
1	3" SQ. HD. PLUG	24-12 WITH 20° DROP	1			16	1-1/2" x 1" BLK BUSHING	24-08 THRU 24-10	1		
2	1" RECESSED HD PLUG	ALL	4			16	1-1/2" x 1-1/4" BLK BUSHING	24-11 THRU 24-12	1		
3	3" X 3/4" BLK BUSHING	ALL	1			17	3/4" X 3" NIPPLE	24-03 THRU 24-07	1		
4	3/4" CLOSE NIPPLE	ALL			1	17	1" X 4" NIPPLE	24-08 THRU 24-10	1		
5	3/4" BALL VALVE	ALL			1	17	1-1/4" X 4" NIPPLE	24-11 THRU 24-12	1		
6	3/4" SQ. HD. PLUG	ALL			1	18	3/4" 90° ELBOW	24-03 THRU 24-07	1		
7	1/2" RECESSED HD PLUG	ALL	2			18	1" 90° ELBOW	24-08 THRU 24-10	1		
8	3/4" LONG WELL	ALL	1	1	1	18	1-1/4" 90° ELBOW	24-11 THRU 24-12	1		
9	L4006E1109	CSD-1 EQUIPPED BOILERS		1		19	3/4" CLOSE NIPPLE	24-03 THRU 24-07	1		
10	#550 PROBE LWCO	CSD-1 EQUIPPED BOILERS		1		19	1" CLOSE NIPPLE	24-08 THRU 24-10	1		
11	L4006A2015	ALL	1			19	1-1/4" CLOSE NIPPLE	24-11 THRU 24-12	1		
12	FIRING RATE TEMP CTRL	MODULATING BOILERS			1	20	RELIEF VALVE 10-408-05	24-03 THRU 24-04	1		
13	TRIDICATOR GAUGE	ALL	1			20	RELIEF VALVE 10-614-05	24-05 THRU 24-07	1		
14	1/2" X 1/4" BLK BUSHING	ALL	1			20	RELIEF VALVE 10-615-05	24-08 THRU 24-10	1		
15	4" BK PLUG	ALL	1			20	RELIEF VALVE 10-616-05	24-11 THRU 24-12	1		
NOT SHOWN	3/4" RECESSED HD. PLUG	ALL	4								

## I. WATER BOILERS - INSTALL WATER TRIM

Items for water trim are located in the water trim carton (except for the separately ordered low water cutoff and tankless heater control). Figures 26a and 26b show the proper tapings for each item.

1. Install the temperature pressure gauge.
2. Install the low water cutoff (supplied by others). Follow manufacturer's instructions furnished with control.
3. Install the immersion well and mount the aquastat (limit control) onto the well.
4. Install the pressure relief valve as shown in Figure 40b. Relief valve must be installed in vertical position.
5. Plug extra boiler tapings.
6. Install required bottom blowoff/drain valve (supplied by others) per minimum piping requirements for water boilers, see Figures 31, 32 and 33.

### WARNING

**Relief valve discharge piping must be piped within six (6) inches of floor or to floor drain 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 in discharge piping.**

## J. BURNER INSTALLATION

Refer to burner manufacturer's installation manual for proper installation, fuel piping, wiring, burner adjustment, burner start-up and service instructions. Consult Section VI of this manual for burner specifications and burner settings.

## K. BOILER PIPING - HEATING APPLICATIONS

CONNECT SUPPLY AND RETURN PIPING TO HEATING SYSTEM (see Figures 31, 32 and/or 33 for water boilers and Figures 34 and 35 for steam boilers).

### WARNING

**Failure to properly pipe boiler may result in improper, unsafe system operation and void manufacturer's warranty. DO NOT improperly pipe boiler.**

### WARNING

**All steam and hot water pipes must have clearances of at least 1/2" from all combustible construction.**



## WARNING

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

1. **HOT WATER HEATING** - This boiler must be installed in strict accordance to the instructions found in this installation manual. Deviations from these installation instructions may void manufacturer's warranty. See warning below to determine the use of the RTC. A Return Temperature Control (RTC) may be provided to protect the boiler from thermal shock and sustained condensing operation. In addition, a properly selected boiler circulator and diverting valve, along with the return sensor, must be installed when using the RTC. A number of typical Crown applications have been added to the appendix (Appendix A). Select the appropriate application before proceeding.

a. **Parallel Piping Systems** – An existing parallel piping system may be used, provided the return water is not below 135°F for prolonged periods of time, and the return water temperature is not more than 40°F less than the idle boiler temperature (see warning below). A flow analysis should be performed to determine the flow through the boiler when the minimum (and smallest) and maximum number of zones are activated. A sufficient flow through the boiler should be maintained to assure a maximum of 40°F difference between the boiler supply and return.

If the conditions above cannot be met, then parallel piping systems must be converted to a primary/secondary arrangement, de-coupling the system pump from the boiler loop. The system pump cannot influence the flow through the boiler(s) in a primary/secondary piping arrangement. The concept must be for the boiler loop to inject heat into a primary loop, provided the return water into the boiler is at least 135°F.

A by-pass containing two closely spaced tees must be installed to de-couple the boiler loop from the primary loop (see Figure 30). Care must be taken to avoid dead heading the system pump. Conversions should be reviewed and approved by a Consulting Engineer or other qualified professional to avoid system deficiencies.

b. **Primary/Secondary Piping** – Boiler(s) must be installed into a heating system that is (are) designed as a primary/secondary piping arrangement when the flow through the boiler cannot be maintained to provide a 20°F - 40°F difference between the boiler supply and return. When using an RTC, the boiler loop contains a boiler, boiler circulator and diverting valve, along with the return temperature control (RTC) and return sensor. The diverting valve consists of a 3-way valve, positioned through the use of an electronic actuator. The boiler loop injects heat into the primary loop, provided the temperature of the boiler return water is greater than 135°F. If the temperature is below 135°F, the diverting valve closes, recirculating the boiler water until it has heated above the 135°F minimum limit. The supply and return of the boiler loop is connected to the primary loop through the use of two closely spaced "Tees", at a maximum branch centerline distance of 4 times the primary loop diameter (4 x D Max.) The RTC provides a signal to the actuator based on the absolute water temperature and the rate of change in water temperature.

c. **Multiple Boilers** – Multiple boilers are installed the same as single boiler installations. Each boiler loop will contain its own boiler circulator, diverting valve, RTC and return sensor (see Appendix A). Commonly available sequencers can be used in conjunction with the Return Temperature Control by energizing the control's heat demand circuit. The outdoor reset feature of the sequencer must be used in multiple boiler installations. The outdoor reset feature

## WARNING

**Return water cannot be lower than 135°F for prolonged periods of time. Operation under these conditions will result in sustained condensing within the combustion chamber and potentially reduce boiler longevity.**

**In addition, the return water cannot be introduced into the boiler if it is more than 40°F less than the idle boiler temperature. Continued operation under these conditions may result in premature boiler failure through thermal shock.**

**Example: A boiler that has been idle for some time since the last heat demand cycle may have its boiler water temperature reduced to 150°F. The return temperature from the next zone activation cannot be less than 110°F.**

**If the above conditions exist, an RTC system must be installed to protect the boiler from sustained condensing operation and thermal shock.**

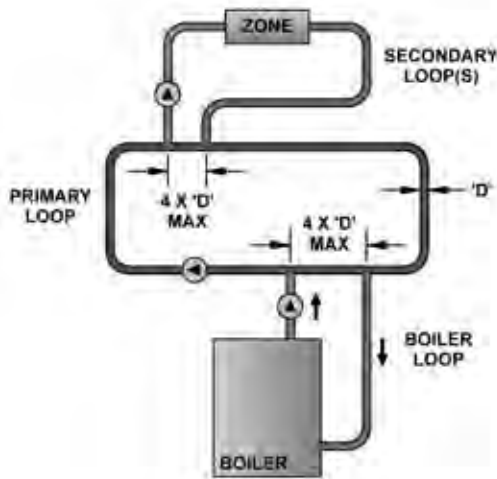


Figure 27:  
Typical Crown Boiler - Primary - Secondary Loop System (Return Temps always Greater than 135°F.)

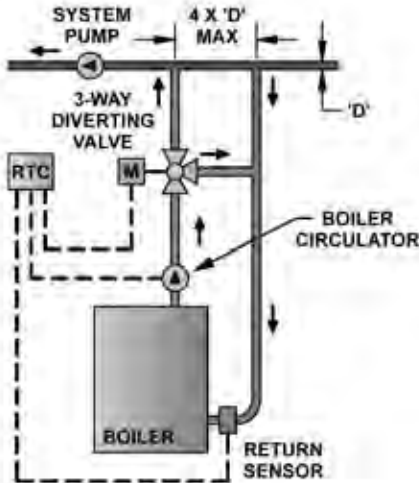
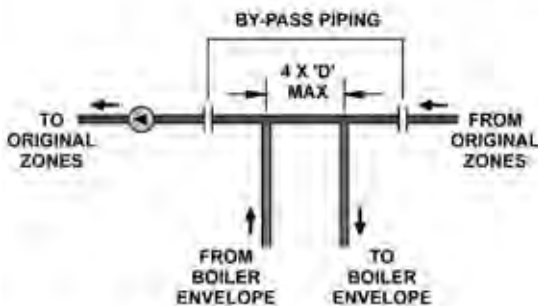


Figure 28:  
Typical Crown Boiler Loop w/3-way Diverting Valve, Where System Return may be Less than 135°F.



NOTE: CLOSELY SPACED TEES MUST BE WITHIN 4 PIPE DIAMETERS OF MAIN CIRCUIT.

Figure 30: Parallel Piping Conversion

of the RTC cannot be used on multiple boiler installations.

- d. Boiler Circulator – The boiler circulator selection will maintain a constant and minimum flow through the boiler during every heat demand. In addition, the circulator will maintain a flow around the return sensor. The circulator must be properly selected, based on the design temperature between the boiler supply and boiler return. Appendix B lists the appropriate pumps for both 20 °F and 40 °F applications. A boiler circulator must be used with and without an RTC System for a primary/secondary piping arrangement.

## WARNING

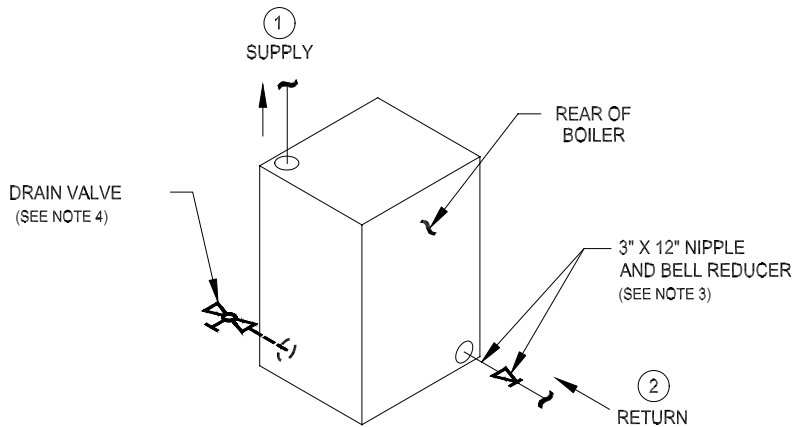
If the boiler circulator you have selected is greater than 1/3 HP, an isolation relay must be added when using the RTC. If a 3-phase boiler circulator has been selected than a properly sized motor starter must be installed when using the RTC.

- e. Diverting Valve – A diverting 3-way valve must be part of the boiler loop for boiler protection to be active when using the RTC. Only a Crown approved valve and actuator may be used for boiler protection. The valve sizing does change based on the designed boiler  $\Delta T$ , since the flow rate and the pressure drop change for each. See Appendix B for proper valve selection.
- f. Glycol Antifreeze Solutions - Many systems today use ethylene or propylene glycol antifreeze solutions as a measure for freeze protection, as well as a pump lubricator and corrosion inhibitor. The properties of the glycol mixture have an impact on valve and pump sizing. All glycol solutions have a lower specific heat than water. This means that the glycol solution cannot transfer heat as well as pure water, resulting in the need for higher flow rates. In addition, the viscosity of the glycol solution is usually higher than water, requiring a higher pump head for the same given flow. Consult factory for specific applications, pump selection and flow rate.
- g. Nipple and Sensor - The 3 x 12 special nipple must be installed in the lower right return connection when looking at the rear section, when using the RTC. Insert the return sensor using pipe dope.

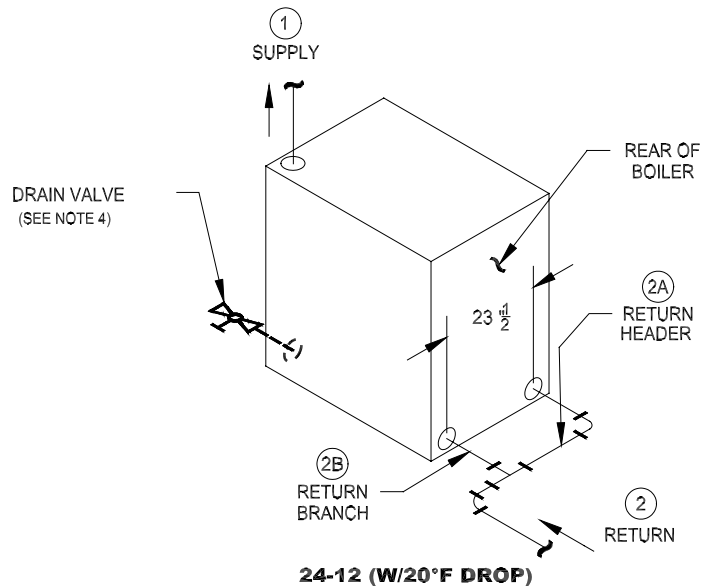
2. STEAM HEATING, consult I=B=R Installation and Piping Guide No. 200. For piping details, see Figure 34. Figure 35 shows a typical pumped return/boiler feed unit arrangement. Figure 36 illustrates the required mounting elevations for McDonnell and Miller 150 and 63 float low water cut-offs.

### Recommendation 1 — Use when:

- system return water is not less than 135° F for prolonged periods of time
- system flow does not impact flow through the boiler



**24-03 THRU 24-11 (W/20°F DROP)**  
**24-03 THRU 24-12 (W/40°F DROP)**



**24-12 (W/20°F DROP)**

### Pipe Sizing and Notes

MODEL	SUPPLY PIPING SIZE (IN) (1)		RETURN PIPING SIZE (IN)			
			RETURN (2)		RETURN HEADER (2A)	RETURN BRANCH (QTY.) SIZE (2B)
	20°F DROP	40°F DROP	20°F DROP	40°F DROP	20°F DROP	20°F DROP
24-03	2	1-1/2	2	1-1/2	—	—
24-04	2	1-1/2	2	1-1/2	—	—
24-05	2	1-1/2	2	1-1/2	—	—
24-06	2-1/2	1-1/2	2-1/2	1-1/2	—	—
24-07	2-1/2	2	2-1/2	2	—	—
24-08	2-1/2	2	2-1/2	2	—	—
24-09	3	2	3	2	—	—
24-10	3	2-1/2	3	2-1/2	—	—
24-11	3	2-1/2	3	2-1/2	—	—
24-12	4	2-1/2	4	2-1/2	3	(2) 3

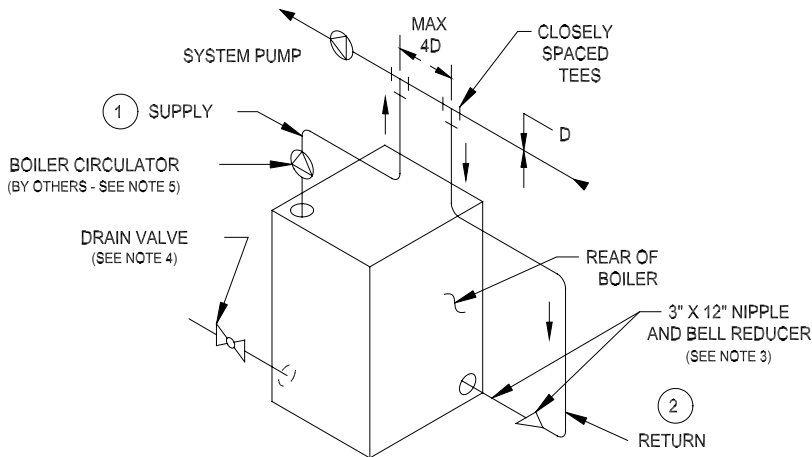
#### NOTES:

1. All piping is schedule 40.
2. Pipe sizes listed are based on a 20°F or 40°F differential (temperature drop). Select one to match application.
3. When specified return piping size is less than 3", install 3" X 12" nipple and appropriate size bell reducer directly into boiler return tapping as shown.
4. Drain valve — ball valve preferable, gate valve acceptable alternative (supplied by others).  
 - Minimum valve size per ASME code is 3/4" NPT.

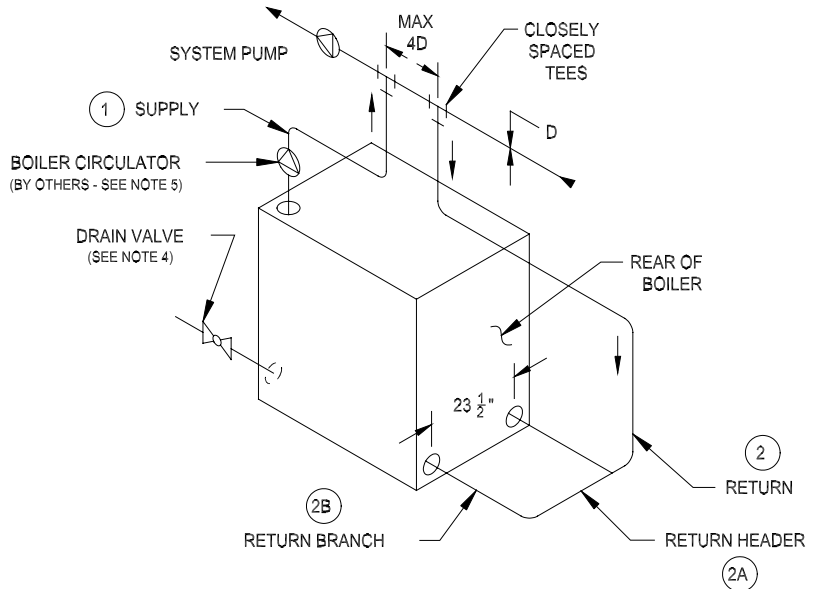
**Figure 31: Series 24 Minimum Piping Recommendation 1 - Water Boiler**

## Recommendation 2 — Use when:

- system return water is not less than 135° F for prolonged periods of time
- system flow does impact flow through the boiler (ie. zoning, mixing)



**24-03 THRU 24-11 (W/20°F DROP)**  
**24-03 THRU 24-12 (W/40°F DROP)**



**24-12 (W/20°F DROP)**

## Pipe Sizing and Notes

MODEL	SUPPLY PIPING SIZE (IN) (1)		RETURN PIPING SIZE (IN)			
			RETURN (2)		RETURN HEADER (2A)	RETURN BRANCH (QTY.) SIZE (2B)
	20°F DROP	40°F DROP	20°F DROP	40°F DROP	20°F DROP	20°F DROP
24-03	2	1-1/2	2	1-1/2	—	—
24-04	2	1-1/2	2	1-1/2	—	—
24-05	2	1-1/2	2	1-1/2	—	—
24-06	2-1/2	1-1/2	2-1/2	1-1/2	—	—
24-07	2-1/2	2	2-1/2	2	—	—
24-08	2-1/2	2	2-1/2	2	—	—
24-09	3	2	3	2	—	—
24-10	3	2-1/2	3	2-1/2	—	—
24-11	3	2-1/2	3	2-1/2	—	—
24-12	4	2-1/2	4	2-1/2	3	(2) 3

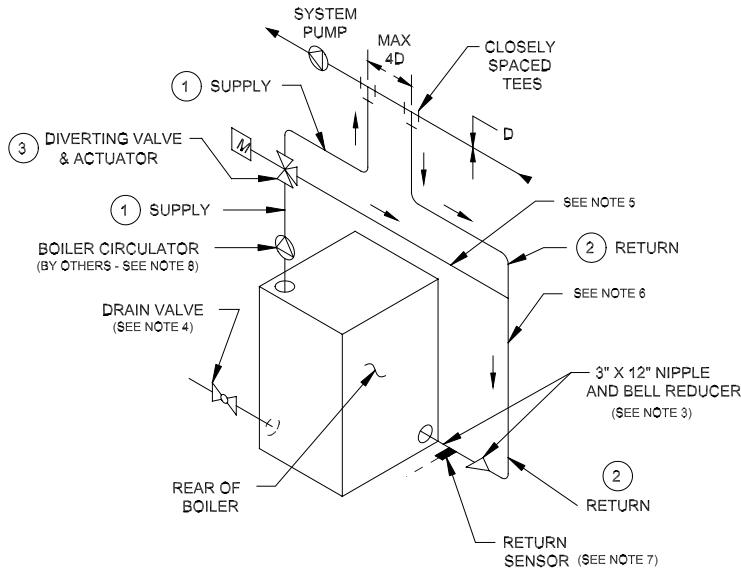
### NOTES:

1. All piping is schedule 40.
2. Pipe sizes listed are based on a 20°F or 40°F differential (temperature drop). Select one to match application.
3. When specified return piping size is less than 3", install 3" X 12" nipple and appropriate size bell reducer directly into boiler return tapping as shown.
4. Drain valve — ball valve preferable, gate valve acceptable alternative (supplied by others).  
- Minimum valve size per ASME code is 3/4" NPT
5. Proper boiler circulator sizing is listed in Appendix B.

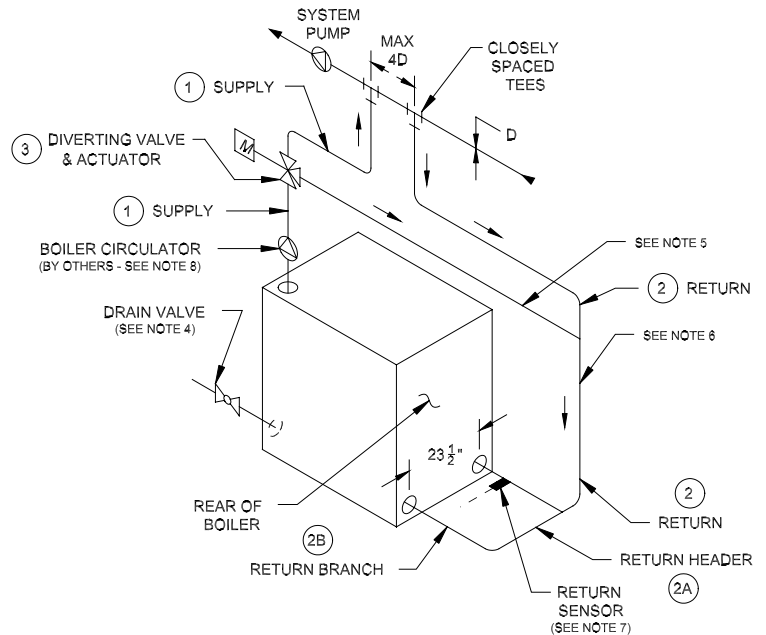
**Figure 32: Series 24 Minimum Piping Recommendation 2 - Water Boiler**

### Recommendation 3 — Use when:

- system return water is less than 135° F for prolonged periods of time
- system flow does impact flow through the boiler (ie. zoning, mixing)
- requires addition of RTC Return Temperature Control and accessories



**24-03 THRU 24-11 (W/20°F DROP)**  
**24-03 THRU 24-12 (W/40°F DROP)**



**24-12 (W/20°F DROP)**

### Pipe Sizing and Notes

MODEL	SUPPLY PIPING SIZE (IN) (1)		RETURN PIPING SIZE (IN)			
			RETURN (2)		RETURN HEADER (2A)	RETURN BRANCH (QTY.) SIZE (2B)
	20°F DROP	40°F DROP	20°F DROP	40°F DROP	20°F DROP	20°F DROP
24-03	2	1-1/2	2	1-1/2	—	—
24-04	2	1-1/2	2	1-1/2	—	—
24-05	2	1-1/2	2	1-1/2	—	—
24-06	2-1/2	1-1/2	2-1/2	1-1/2	—	—
24-07	2-1/2	2	2-1/2	2	—	—
24-08	2-1/2	2	2-1/2	2	—	—
24-09	3	2	3	2	—	—
24-10	3	2-1/2	3	2-1/2	—	—
24-11	3	2-1/2	3	2-1/2	—	—
24-12	4	2-1/2	4	2-1/2	3	(2) 3

#### NOTES:

1. All piping is schedule 40.
2. Pipe sizes listed are based on a 20°F or 40°F differential (temperature drop). Select one to match application.
3. When specified return piping size is less than 3", install 3" X 12" nipple and appropriate size bell reducer directly into boiler return tapping as shown.
4. Drain valve — ball valve preferable, gate valve acceptable alternative (supplied by others).  
- Minimum valve size per ASME code is 3/4" NPT
5. Maximum linear feet of pipe from 3-way bypass port to sensor location = 11 feet. Bypass line shall be the same diameter as return A.
6. Minimum linear feet of pipe from point of mixing (where bypass meets return line) to sensor location = 4 feet.
7. Install special 3" x 12" nipple with 1/4" NPT side tapping closest to boiler. Where applicable, use bell reducer to adapt to recommended return pipe size.
8. Proper boiler circulator sizing is listed in Appendix B.

**Figure 33: Series 24 Minimum Piping Recommendation 3 - Water Boiler**

## WARNING

**A properly constructed Hartford Loop must be installed on all gravity return steam systems. Hartford Loop is not required on pumped return systems.**

### L. BOILER PIPING, DOMESTIC HOT WATER (DHW) APPLICATION

– This section of the manual identifies the boiler piping details when domestic hot water is required. The two methods described for domestic hot water production are through the use of an indirect hot water heater or tankless coils. If a shell and tube or plate heat exchanger is desired, follow the instructions for the indirect water heater. Always consult the heat exchanger manufacturer for specific instructions and limitations.

1. Hot Water Boiler/Indirect Water Heater – The use of indirect water heaters for domestic hot water generation is common. Consider prioritizing the generation of domestic hot water using an indirect water heater (See notice below).
  - a. Dedicated Boiler for DHW Production – If the boiler(s) is (are) dedicated to production of domestic hot water production, the diverting valve is not necessary. (see Appendix A.11 for details) However, the RTC should be used, along with a boiler circulation loop that includes a boiler circulator and return sensor. The boiler circulator and piping must be sized to circulate at a minimum, the flow rate required for a 40 °F  $\Delta T$  application. See Appendix B for circulator details. The circulator for the domestic hot water system is separate from the boiler circulator.

## NOTICE

**DO NOT use the boiler circulator as an indirect domestic hot water system circulator.**

- b. Shared Boiler for DHW Production – If the boiler(s) is(are) shared between the heating system and the production of domestic hot water, the diverting valve and all of the RTC components should be used. The piping arrangement is different between a system that utilizes the outdoor reset feature vs. one that doesn't. See Appendix A for various applications. If the outdoor reset feature of the RTC is used, the domestic hot water piping is part of the boiler loop, independent of the diverting valve. Although this bypasses the protection devices of the RTC system, the volume and temperature conditions of a DHW system presents no deleterious impact on the boiler. This prevents a reset system loop temperature from affecting DHW production.

Multiple boiler applications, utilizing an indirect water heater arrangement, require the use of a sequencer and connection to the indirect water heater as a load on the secondary loop. An outdoor reset function for multiple boiler applications with DHW, require a DHW priority or reset override. Consult your sequencer manufacturer for recommendations.
2. Hot Water Boiler/Tankless Coil – Tankless coils, mounted into the side of boilers, have been used successfully for many years. Tankless coils may still be used in single and multiple boiler applications. (See Appendix A for typical applications.)

## NOTICE

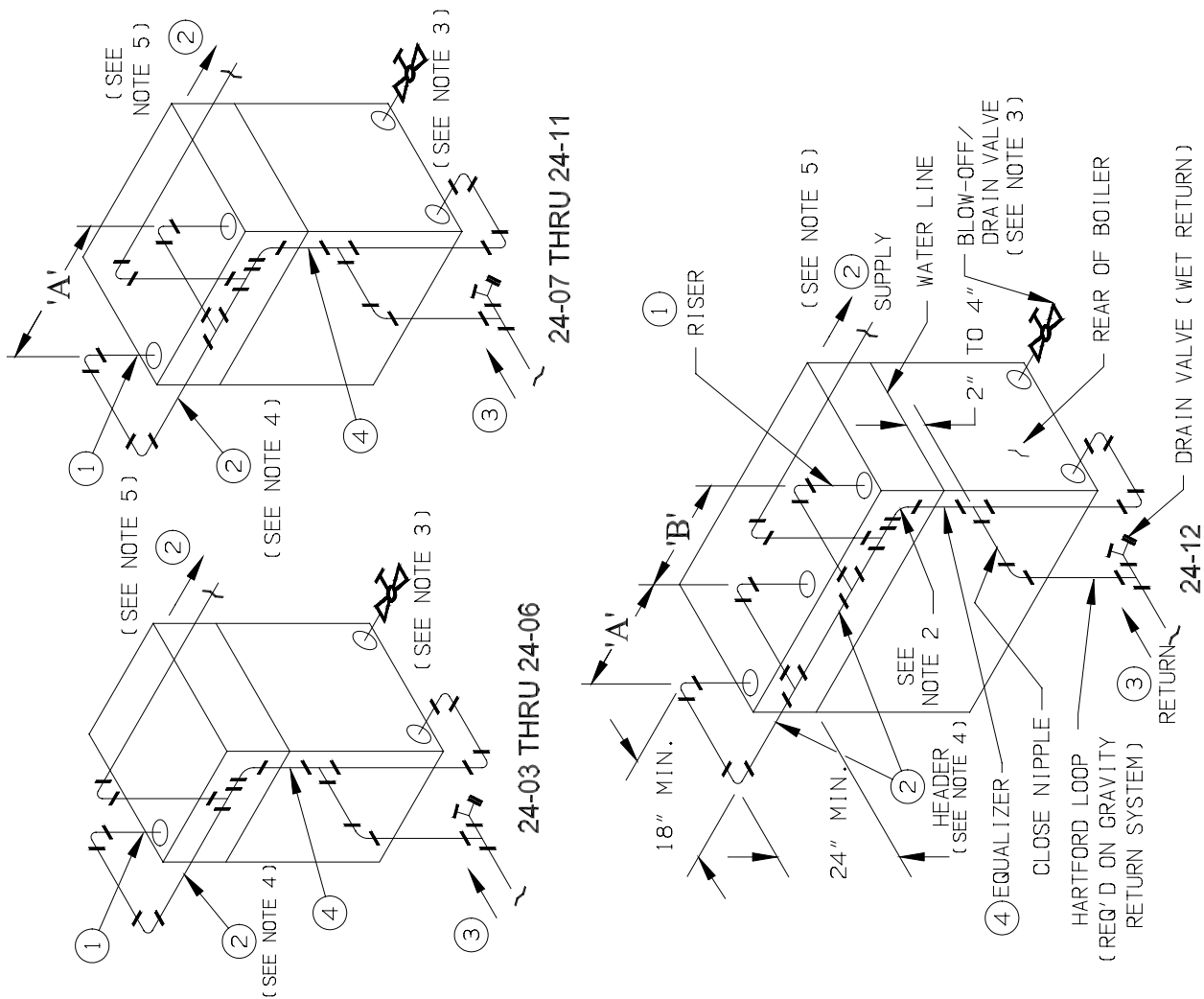
**When possible, domestic hot water production should utilize a dedicated boiler(s). This will allow the other boiler(s) to be shut down and isolated during the summer months. If the boiler load is shared between heating and domestic hot water, then one needs to determine if a hot water priority is required. If a priority is not selected, erratic domestic hot water production may result during the beginning and end of every heating season. Conversely, a priority for domestic hot water production may cause a significant heating zone activation delay, in an improperly balanced system. Parallel piping conversions may require isolation from the heating system to prevent system flow influence on DHW performance. Consult a qualified system heating professional to design for the proper application.**



BOILER MODEL	PIPING SIZE				RISER SPACING	
	(1) RISER (QTY)/SIZE	(2) HEADER & SUPPLY	(3) RETURN	(4) EQUALIZER	'A'	'B'
24-03	(1) 3"	3"	1½"	2"	—	—
24-04	(1) 4"	4"	2"	2"	—	—
24-05	(1) 4"	4"	2"	2"	—	—
24-06	(1) 4"	4"	2½"	2½"	—	—
24-07	(2) 4"	6"	2½"	2½"	36"	—
24-08	(2) 4"	6"	2½"	2½"	42"	—
24-09	(2) 4"	6"	2½"	2½"	48"	—
24-10	(2) 4"	6"	3"	3"	54"	—
24-11	(2) 4"	6"	3"	3"	60"	—
24-12	(3) 4"	6"	3"	3"	30"	36"

**NOTES:**

- All piping is schedule 40.
- To prevent condensate from being trapped in header, do not reduce equalizer elbow at header connection.
- Ball valve preferable, gate valve acceptable alternative (supplied by others).
  - Minimum valve size per ASME code is 3/4" NPT 24-03/24-04; 1" NPT 24-05/24-08; 1-1/4" NPT 24-09/24-12.
- In all cases, piping connecting blowoff valve to boiler shall be full size to the point of discharge.
- Header piping may be run over top of the boiler if space does not allow for piping arrangement shown. Increased service requirements will result however.
- Supply from the boiler header must be connected between the first boiler riser and the header drip (or Hartford Loop). Do not connect supply between risers or opposite end of boiler header.



**Figure 34: Minimum Piping Requirements For Gravity Return Series 24 Steam Boilers**

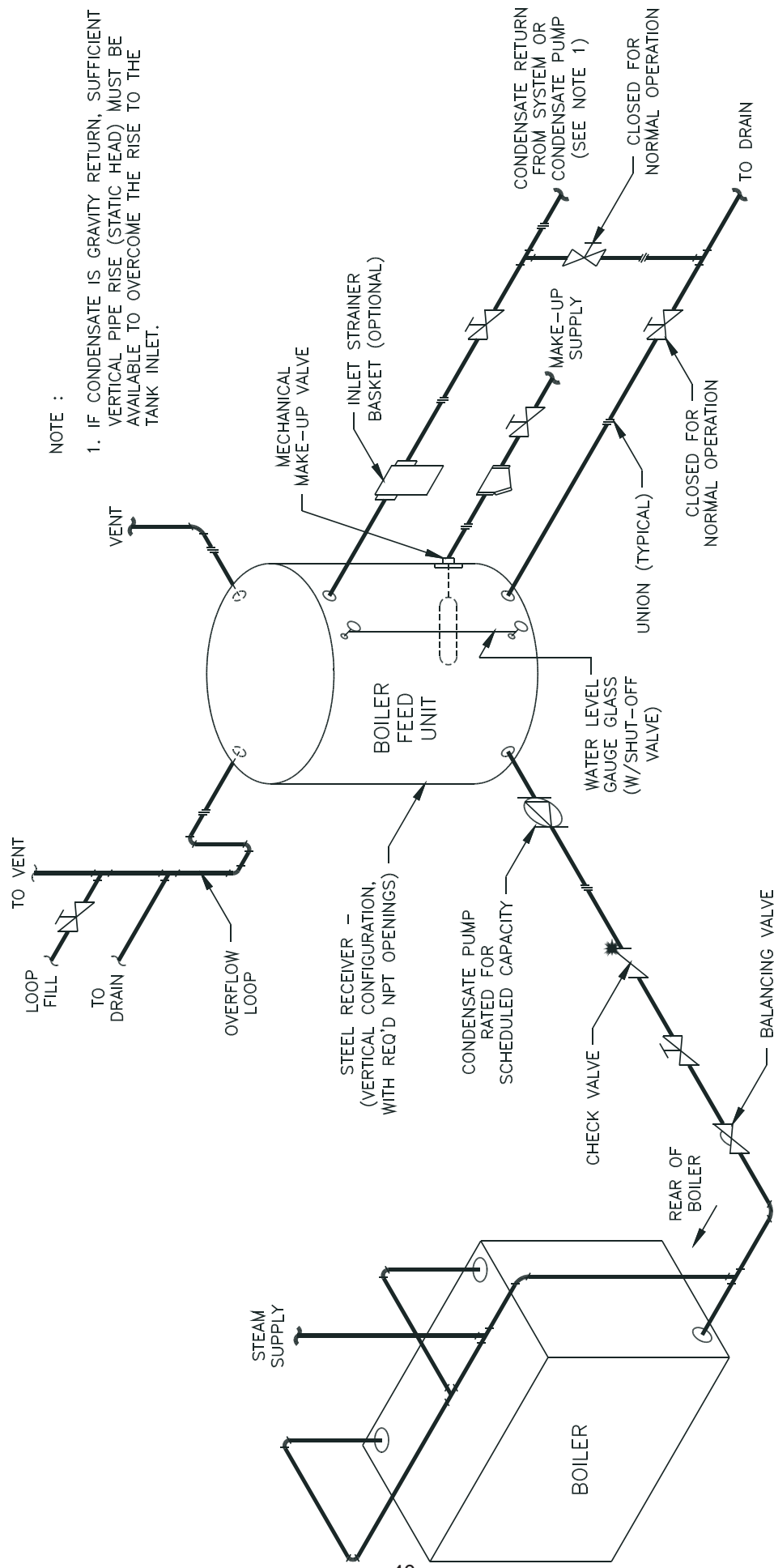
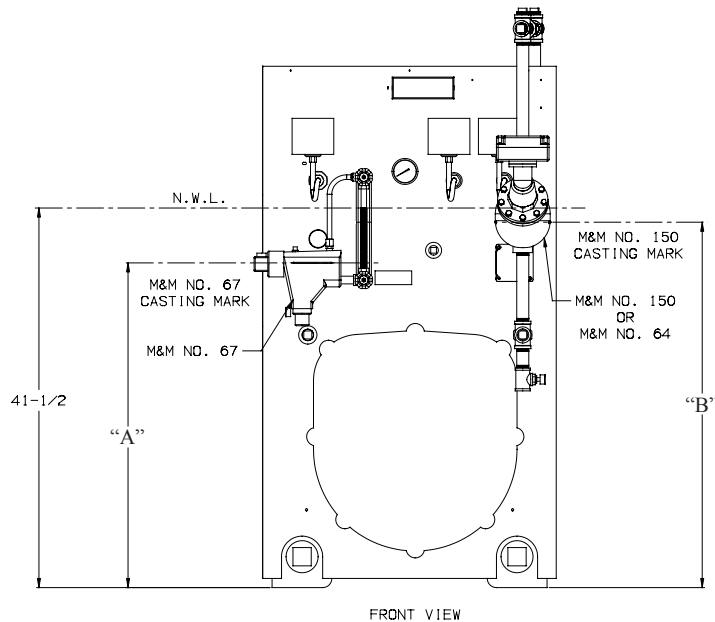


Figure 35: Typical Steam Piping Arrangement for Boilers with Pumped Condensate Return and Boiler Feed Unit





L.W.C.O.	Application	Cut-Off Height	
		"A"	"B"
67	Primary or Secondary	35-1/2"	-
64	Primary (Gravity Return)	-	37-1/2"
150	Primary (Pumped Return)	-	40"

**Figure 36:  
Mounting Elevations  
of M&M 150, 64 and 67  
Float Low Water Cut-offs.**

**M. CONNECT TANKLESS HEATER PIPING** as shown in Figure 38. See Table IV for Tankless Heater Ratings.

## NOTICE

**The following guidelines should be followed when piping the tankless heater:**

### 1. Install Flow Regulator

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. Refer to Figure 36 for piping recommendations. Locate the flow regulator below the inlet (cold water side) of the heater and a minimum of 36" away from the inlet so that the regulator is not subjected to excess temperatures during "off" periods when it is possible for heat to be conducted back through the supply line. The flow regulator will limit the flow of supply water regardless of inlet pressure variations ranging from 20 to 125 psi.

### 2. Install Water Temperature Mixing Valve

Refer to Figure 38 for piping recommendations. Adjust and maintain the mixing valve in accordance with manufacturer's instructions.

Installation of a mixing valve will also lengthen the delivery of the available hot water by mixing some

cold water with the hot. In addition, savings of hot water will be achieved since the user will not waste as much hot water while seeking desired 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. An electric hot water booster can also be used. The mixing valve should be "trapped" by installing it below the cold water inlet to heater to prevent lime formation in the valve.

### 3. Flushing of Heater

All water contains some sediment which settles on the inside of the coil. Consequently, the heater should be periodically backwashed. This is accomplished by installing hose bibs as illustrated in Figure 38 and allowing water at city pressure to run into hose bib A, through the heater, and out hose bib B until the discharge is clear. The tees in which the hose bibs are located should be the same size as heater connections to minimize pressure drop.

### 4. Hard Water

A water analysis is necessary to determine the hardness of your potable water. This is applicable to some city water and particularly to well water. An appropriate water softener should be installed based on the analysis and dealer's recommendation. This is not only beneficial to the tankless heater but to piping and fixtures plus the many other benefits derived from soft water.

## WARNING

**Install a mixing valve at the tankless heater outlet to avoid risk of burns or scalding due to excessively hot water at fixtures. Do not operate the boiler when equipped with a tankless heater unless mixing valve is operating properly.**

## CAUTION

**Do not operate tankless heater with hard water. Tankless failure will result. Install water softener if hard water is present.**

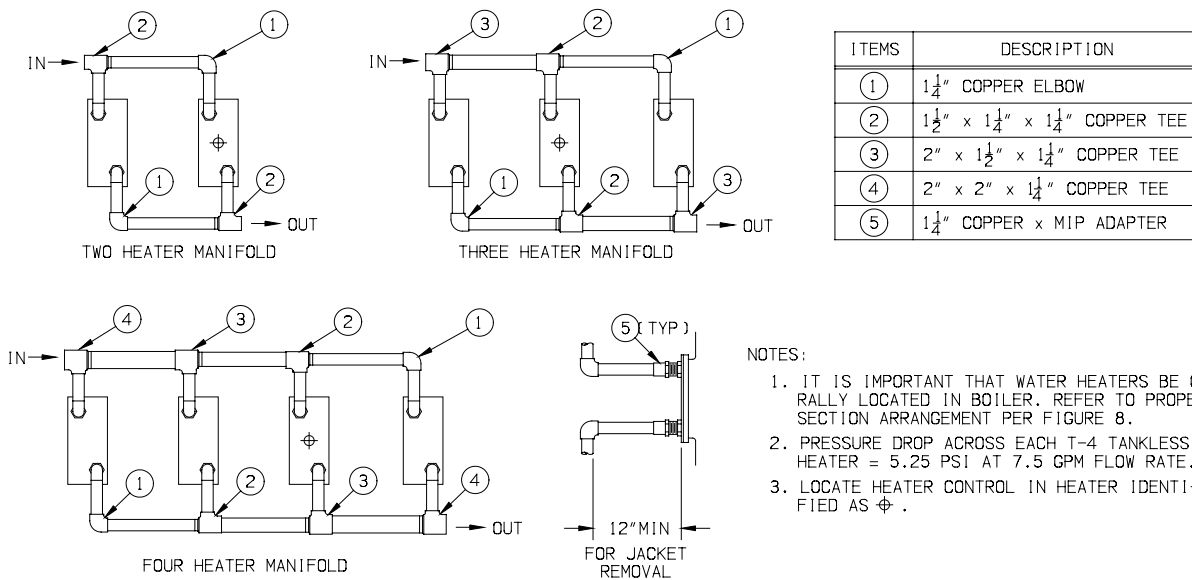


Figure 37: Minimum Piping Requirements for Series 24 Tankless Heater Manifolds

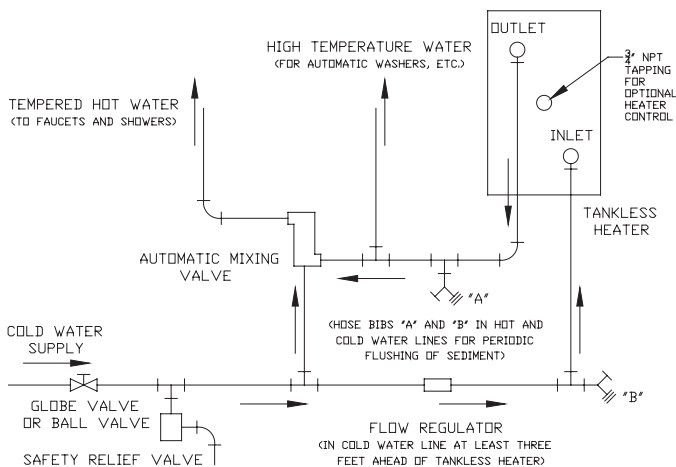


Figure 38: Schematic Tankless Heater Piping

Table IV Tankless Heater Ratings

Boiler Model	Number of T-4 Tankless Heaters Installed			
	1	2	3	4
24-03	6.75	---	---	---
24-04	7.5	---	---	---
24-05	7.5	---	---	---
24-06	7.5	15	---	---
24-07	7.5	15	---	---
24-08	7.5	15	---	---
24-09	7.5	15	22.5	---
24-10	7.5	15	22.5	---
24-11	7.5	15	22.5	---
24-12	7.5	15	22.5	30

Notes:

- Ratings are given in gallons per minute continuous flow of water heated from 40°F to 140°F with 200°F boiler water.
- For tankless heater quantities less than maximum allowable, it is important that water heaters be centrally located in the boiler. See Figure 8 for appropriate locations.
- Tankless heater pressure drop is 5.5 PSI at 7.5 GPM.

**N. ELECTRIC WIRING** - Install all field wiring in accordance with the National Electric Code and Local Regulations.

Control voltage and/or 3-phase line voltage must be supplied to the burner panel box through a fused disconnect.

When using the RTC, a separate fused control circuit shall feed the control to allow the exercising of the valve actuator and boiler circulator during dormant boiler operation.

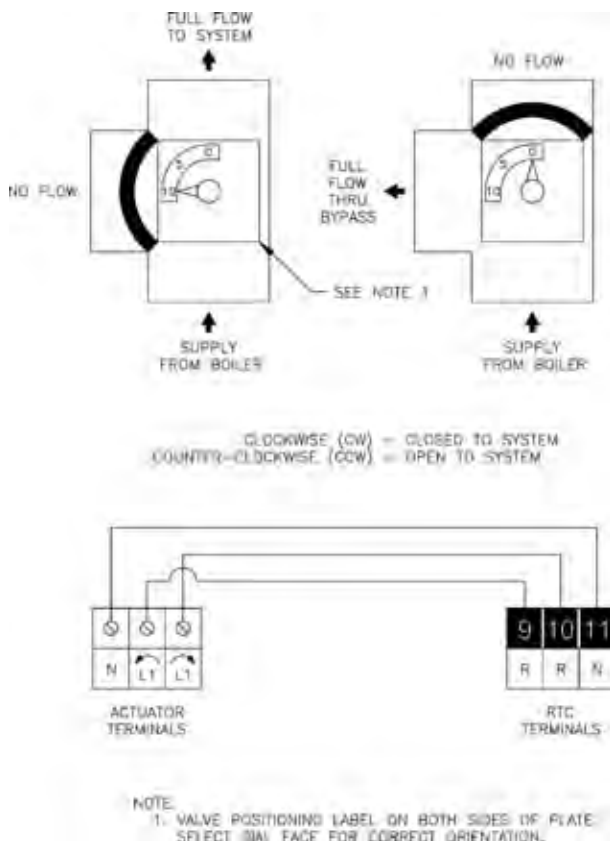
Review electrical schematics in Appendix A and Burner Electrical Diagram for more information.

**O. RETURN TEMPERATURE CONTROL AND COMPONENTS**

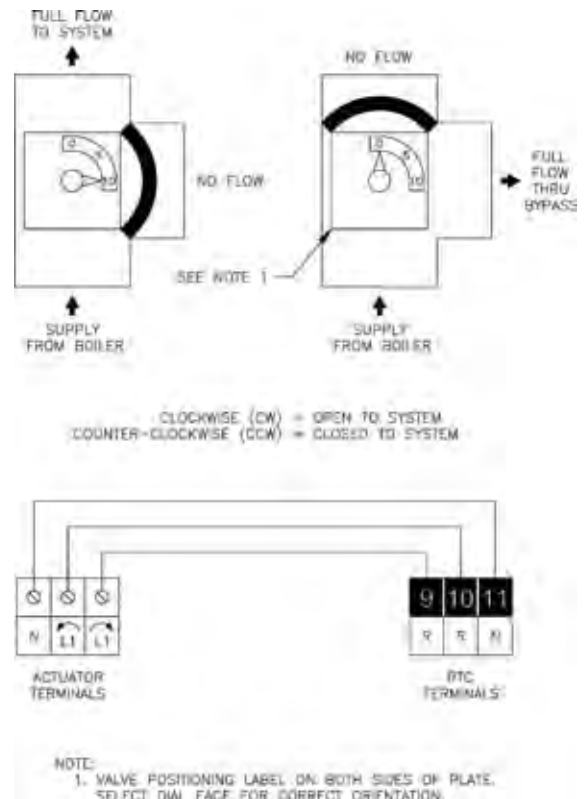
1. Valve Actuator – The valve actuator is mounted to the top of the diverting valve. Mount and connect the actuator as illustrated in Appendix C. The electrical connections depend on valve orientation. Use Figures 39a and 39b as a guide.
2. Return Sensor – A sensor has been included with the Return Temperature Control. The sensor must be mounted for proper operation. The sensor is mounted in the 3 inch NPT x 12 inch special return nipple. The sensor must be inserted into the ¼ NPT connection using pipe dope. The 3” nipple must be inserted with the sensor closest to the boiler, using the rear lower right connection. (Orientation based on viewing the boiler from the rear.) The sensor

shall be connected to the RTC through a junction box located above the nipple. Use grommets and conduit to protect the leads and connection back to the RTC controller.

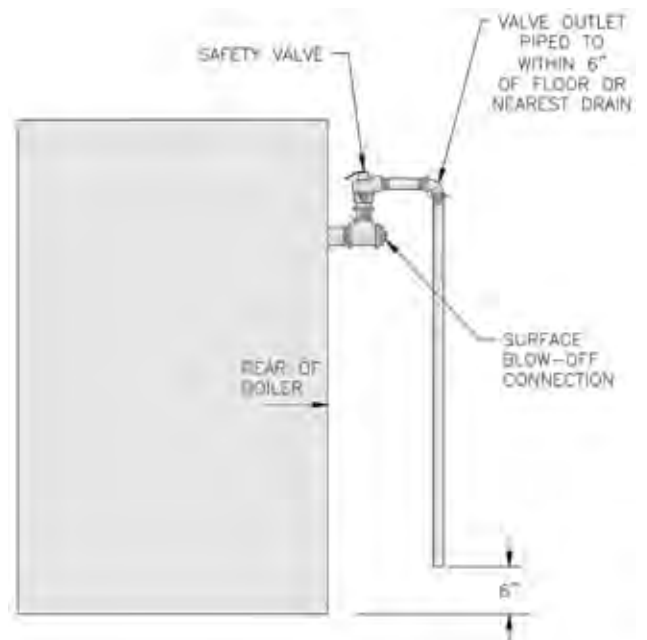
3. Knock Down Boiler Installations – The installation instructions above must be followed for all knockdown boilers as well. The controller is mounted on the front jacket panel at the top right. See Figures 41 and 42 for general component



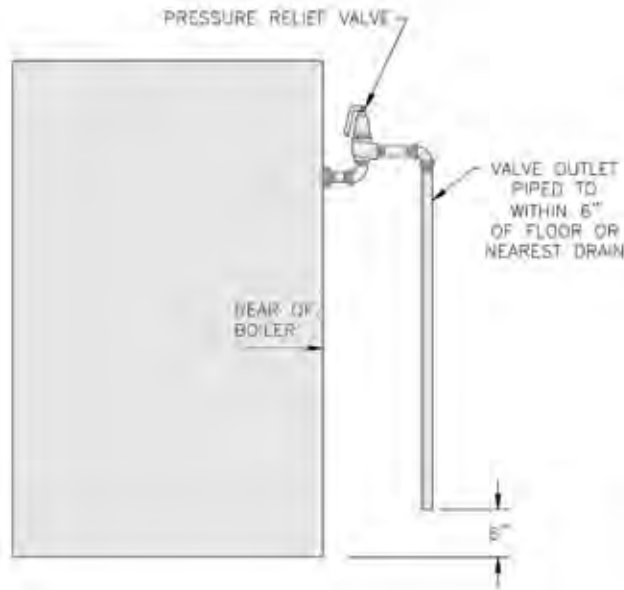
**Figure 39a: Diverting Valve/Actuator Wiring (CCW - Open to System)**



**Figure 39b: Diverting Valve/Actuator Wiring (CW - Open to System)**



**Figure 40a: Steam Boiler - Safety Valve Hook-Up**



**Figure 40b: Water Boiler - Pressure Relief Valve Hook-Up**

placement. The 14 gauge mounting bracket must be attached to the jacket first using four (4) #8 x 3/4" drill point sheet metal screws.

One may find it easier to install some of the conduit

connectors with their corresponding conduit runs onto the RTC back panel before mounting to the bracket. The actual controller can and should be removed from the back panel during the mounting process. This will eliminate the potential for accidental damage to the controller. The RTC back panel is mounted onto the bracket with (4) #8-32 x 1/2" type F, Phillips Pan head screws supplied with the controller. The middle 3 rear knockouts should be used before utilizing the 5 knockouts exiting the bottom of the control. Depending on the final configuration, most of the controller connections could be used. Typically, the return sensor, actuator control and boiler pump exit the rear of the controller.

Wire the RTC controller to the various components as shown below. The "Mix" and "Outdoor" sensor are optional and must be connected if outdoor reset function is desired. The outdoor reset function on this controller cannot be used in a multiple boiler application. A boiler sequencer must be used when an outdoor reset feature is required in a multiple boiler application.

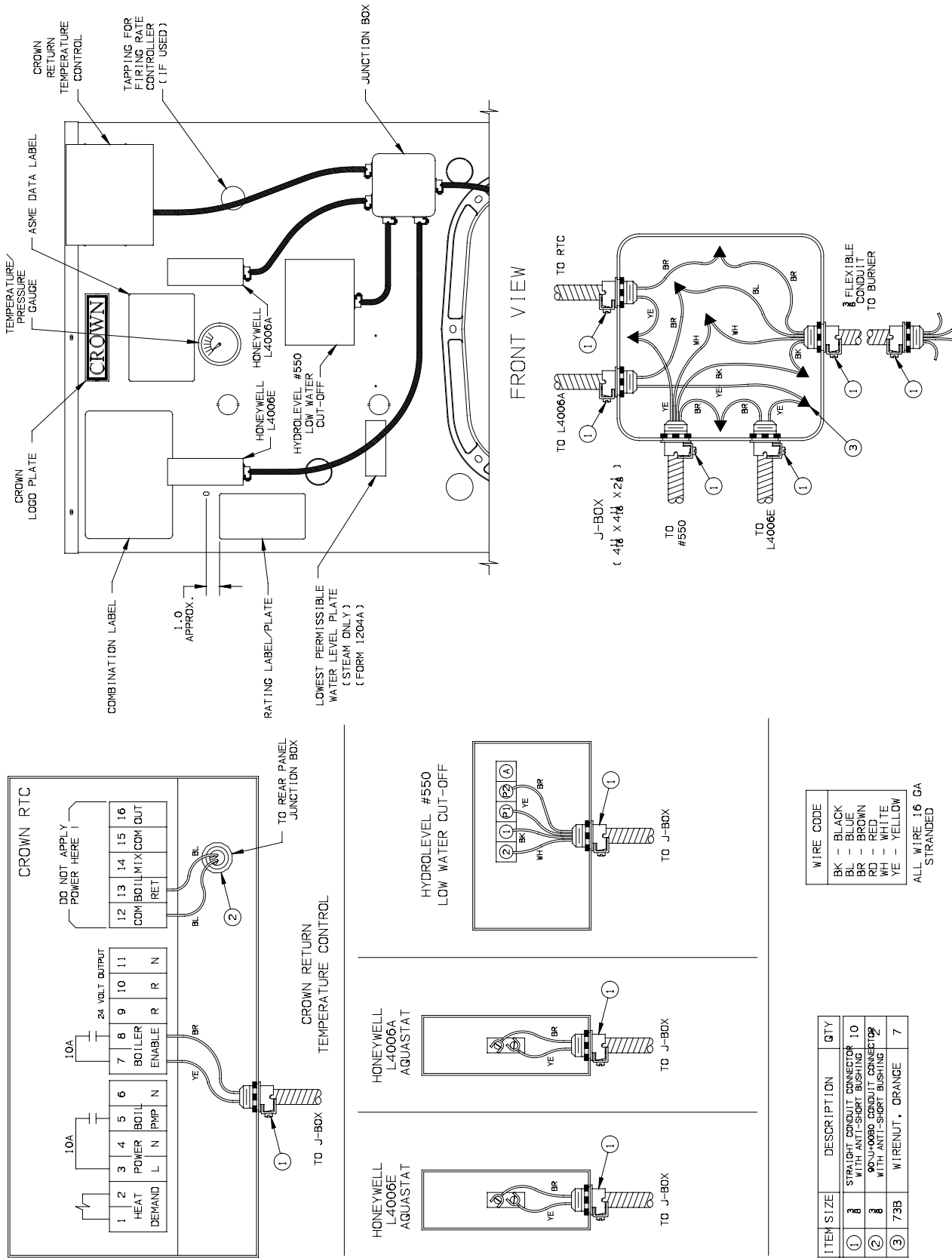
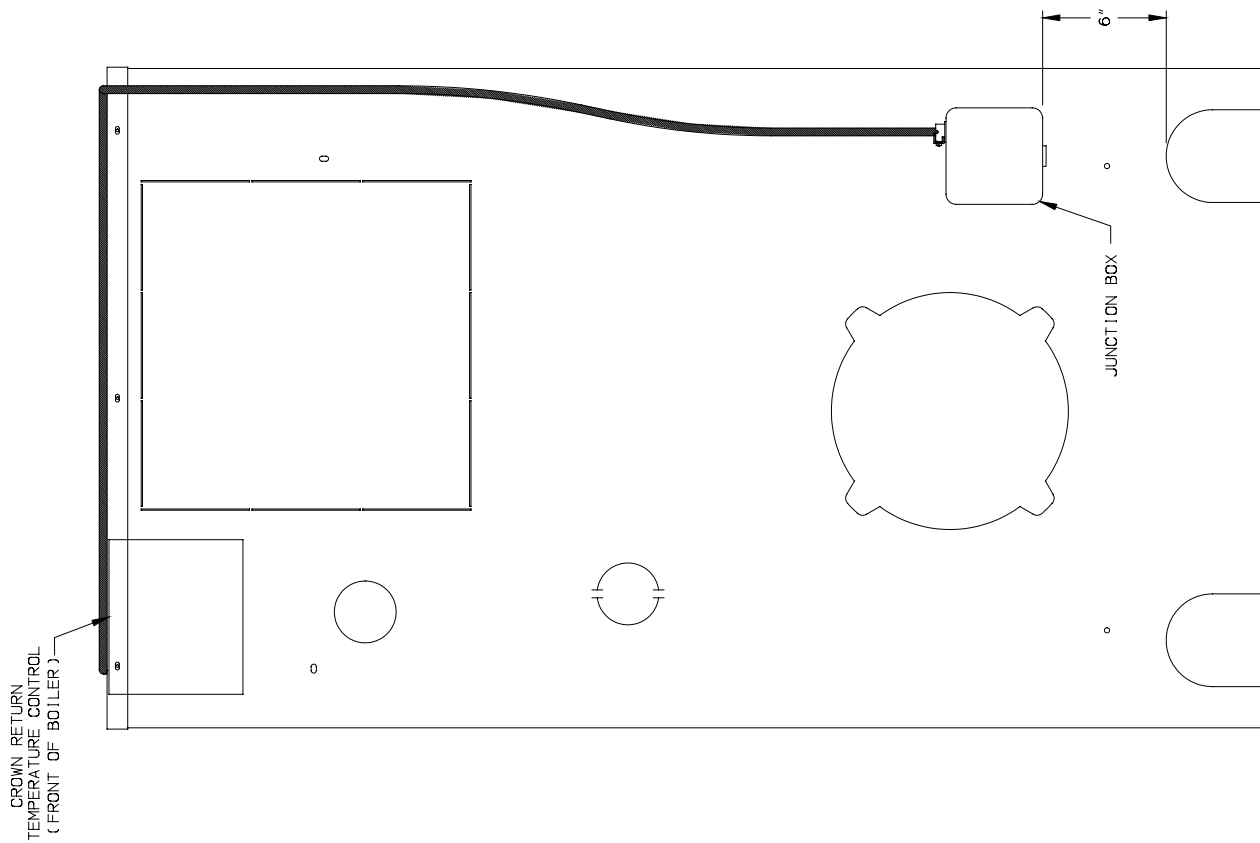


Figure 41: Typical Boiler Wiring with RTC (Front)



ITEM	SIZE	DESCRIPTION	QTY
①	3/8	STRAIGHT CONDUIT CONNECTOR WITH ANTI-SHORT BUSHING	1
②		GROMMET	1
③	73B	WIRENUT, ORANGE	2

WIRE CODE
BL - BLUE

ALL WIRE .16GA STRANDED

TO TERM. NO'S. 12 & 13 ON RTC CONTROL

J-BOX ( 4# X4# X2# )

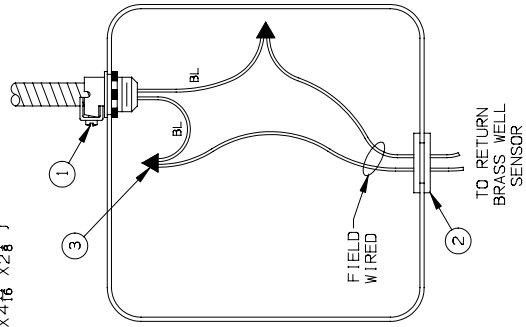


Figure 42: Typical Boiler with RTC Return Sensor (Rear)



## SECTION IV - OPERATING INSTRUCTIONS

### WARNING

**If you do not follow these instructions exactly, a fire or explosion may result causing property damage or personal injury.**

**If any unusual or improper operation or site conditions are observed, turn the boiler off and contact an experienced and skilled service agency.**

**Follow component manufacturer's instructions. Component manufacturer's instructions were provided with the boiler. Contact component manufacturer for replacement if instructions are missing. Do not install, start up, operate, maintain or service this boiler without reading and understanding all of the component instructions. Do not allow the boiler to operate with altered, disconnected or jumpered components. Only use replacement components identical to those originally supplied with the boiler and burner.**

**A. ALWAYS INSPECT INSTALLATION BEFORE STARTING BURNER.**

**B. FILL HEATING SYSTEM WITH WATER.**

Boiler must be cleaned and fully free of oil and dirt.

### CAUTION

**Failure to clean the system will result in erratic water lines and surging, and other improper system operations.**

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 step (K) for proper cleaning instructions for steam and water boilers.

1. STEAM BOILERS - Fill boiler to normal water line. As shown in Figure 1, the normal water line is 4 1/2" from the floor or bottom of casting. At the start of each heating season and once or twice during the season try SAFETY VALVE to be sure it is in working condition. To do this, fasten wire or cord to lever of valve and pull lever — standing safe distance away from valve.
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 to remove air from system when filling:

- a. Close isolation valve in boiler supply piping.
- b. Isolate all circuits by closing zone valves or balancing valves.
- c. Attach a hose to bib cock located just below isolation valve in boiler supply piping.  
(Note - Terminate hose in five gallon bucket at a suitable floor drain or outdoor area).
- d. Starting with one circuit, open zone valve.
- e. Open bib cock.
- f. Open fill valve (Make-up water line should be located directly above isolation valve in boiler supply piping).
- g. Allow water to overflow from bucket until discharge from hose is bubble free for 30 seconds.
- h. Open zone valve to the second zone to be purged, then close the first. Repeat this step until all zones have been purged, but always have one zone open. At completion, open all zone valves.
- i. Close bib cock, continue filling the system until the pressure gauge registers normal system design operating pressure. Close fill valve.  
(Note - If make-up water line is equipped with pressure reducing valve, system will automatically fill to normal system design operating pressure. Leave globe valve open.)
- j. Open isolation valve in boiler supply piping.
- k. Remove hose from bib cock.

**C. SET CONTROLS** with burner service switch turned "OFF".

### DANGER

**Do not operate boiler with pressure above maximum allowable working pressure listed on the Boiler Rating Label.**

**DO NOT draw water from boiler while in use. When adding water while boiler is in operation, do not open supply valve fully but add water slowly.**

1. PRESS RESET BUTTON on primary control and release.
2. On STEAM BOILERS set cut-in pressure on L404A Pressuretrol for three (3) PSI and differential pressure for two (2) PSI. These pressures may be varied to suit individual requirements of installation.
3. On STEAM BOILERS WITH TANKLESS DOMESTIC WATER HEATERS, set boiler water temperature dial on low limit operating control at 190°F (max.). Set differential at 10°.
4. ON WATER BOILERS WITHOUT TANKLESS HEATERS, set high limit dial on L4006A at 210°F. This temperature may be varied to suit requirements

of installation.

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

#### D. ADJUST BURNER according to the Burner Manual.

##### 1. FLAME FAILURE

The Series 24 boiler controls operate the burner automatically. If for unknown reasons the burner ceases to fire and the reset button on the primary control is tripped, the burner has experienced ignition failure. Before pressing the reset button, call your serviceman immediately.

### WARNING

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

#### E. RETURN TEMPERATURE CONTROL: Initial

**Set-Up and Operation** – The return temperature control (RTC) is an important part of the overall boiler system. The primary function of the RTC is to protect the boiler from thermal shock and sustained flue gas condensation. The RTC monitors the temperature of the water returning into the boiler through a return sensor. The RTC controls the 3-way diverting valve mounted on the supply of the boiler to prevent return water less than 135° F from entering the boiler. The boiler circulator provides constant and minimum flow through the boiler during every heat demand. Prior to the start of any boiler cycle, the diverting valve is closed to a full by-pass condition, forcing 100% boiler water re-circulation. The diverting valve opens and will continue to open provided the return sensor is satisfied. Conversely, large temperature drops will close the diverting valve to a position as to prevent low temperature return water. The RTC along with the ancillary components must be properly installed as identified in Section III, if there is any possibility of system return water temperature less than 135°F. A detailed description of the controller and its features can be found in the RTC Installation and Maintenance Manual.

1. Initial Start-up - Upon initial start-up, the control will be energized, identifying the control name and revision on the LED display. If wired properly, the control should be energized at all times. The RTC circuit should be supplied from a different source than the burner or boiler circuit. The RTC control should be energized at all times.
2. Testing – The RTC should be tested on initial start-up, as well as during any troubleshooting exercise.

Depressing the test button will activate a test sequence and energize the red test light on the front of the control. Each of the controllers outputs and relays will be energized and tested. One may pause the test sequence at any time by depressing the test button. See the RTC Installation & Maintenance Manual for a detailed description of the sequence and the potential error messages.

- a. Return Sensor - The return sensor must be properly connected or an error message will be displayed. Both a short and an open circuit in the sensor circuit will cause an error message to be displayed and the valve will be moved to a partially open position until the error is resolved.
  - b. Valve Actuator – During the valve actuator test sequence, confirm that the valve travels through 90 degrees of rotation from a full closed position to a full open position. The pointer on the shaft must rotate from “10” to “0” respectively.
3. Adjust Setpoints – The RTC must have a number of setpoints adjusted for proper operation. Below is a summary, however see the RTC Installation and Maintenance Manual for more details. To activate the ADJUST menu, simultaneously depress and hold the Item,  $\Delta$  and  $\nabla$  buttons. ADJUST will appear in the upper right hand corner of the LED display.
    - a. ROOM - Set desired room temperature. This will provide parallel shift to heating curve. OUTDR DESIGN OFF
    - b. MIX TARGET – This represents a fixed target supply temperature when the outdoor reset feature in NOT selected. (OUTDR DESIGN = OFF) Set the MIX TARGET temperature to the designed boiler supply temperature. Example: If the boiler loop is designed to supply hot water to the system at 180°F, set the MIX TARGET to 180°F. This is also the same as the operating aquastat set point. The mix target is adjustable from 60°F to 200°F. The default setting is 180°F. NOTE: This function is only for applications where the mix sensor is installed.
    - c. MIX DSGN – Mix design temperature represents the design heating system supply temperature when the outdoor reset feature is selected. (OUTDR DESIGN = ON) This represents the design of the system loop. If unsure of the original design temperature, set the MIX DSGN to the same temperature as the boiler operating aquastat, typically 180°F. The MIX DSGN is adjustable from 70°F to 210°F. The default setting is 180°F.
    - d. OUTDR DSGN – The outdoor design temperature represents the value used in the heat loss calculations, when the outdoor reset feature is selected. (OUTDR DESIGN = ON) If this value is unknown, use the value found in

ASHRAE Fundamentals for the area closest to the installation. This value has a default of 10°F, and is adjustable between –60°F to 32°F.

- e. WWSD – The Warm Weather Shut Down feature is used only when the outdoor reset feature is selected. (OUTDR DESIGN = ON) If the outdoor temperature rises above the WWSD value, WWSD will be displayed. If a demand for heat is generated when the control is in the WWSD mode, the boiler will be disabled. The default for the WWSD is 70°F, but is adjustable from 35°F to 100°F.
- f. MIX MIN – This represents the minimum mix target supply temperature when the outdoor reset feature is selected. (OUTDR DESIGN = ON) This is the lowest temperature the controller is allowed to use as a MIX TARGET temperature. During mild conditions, if the RTC calculates a MIX TARGET below the MIX MIN, the target will be adjusted to match the MIX MIN setting.
- g. MIX MAX – This represents the highest temperature allowed as the MIX TARGET temperature when the outdoor reset feature is selected. (OUTDR DESIGN = ON) If the RTC calculates a MIX TARGET higher than the MIX MAX, the MIX TARGET will take the value of the MIX MAX. Typically, this is set between 200°F and 220°F. The temperature must be set below the lowest permissible temperature for any system related component affected by boiler supply water.
- h. OPEN DELAY – This value represents the number of seconds required for the actuator to open through 90 degrees of rotation. Leave in default value of 50 seconds.
- i. BOIL MIN – This is the minimum boiler return temperature allowed. The minimum value has been set to 135°F, adjustable to as high as 230°F. The RTC will control the diverting valve while maintaining a minimum BOIL MIN temperature. Setting should remain at 135°F unless a higher minimum boiler temperature is required.
- j. BOIL MIN DELAY – This represents the time (in seconds) required for warm-up during an initial cold start. This prevents the counter from including cold start warm up time in the total boiler operation time below 135°F. This grace period is provided for every heat demand cycle until 135°F has been sensed at the return sensor. Once the return sensor has sensed a return temperature reading of 135°F, after the heat demand cycle has initiated, the grace period is terminated. The warm up time includes a 90 seconds of pre-purge time. Use the values in Table V for the correct application.
- k. PUMP DELAY – Pump delay represents the time (in seconds) for pump purge (boiler

**Table V: Boil Min Delay Settings**

Boiler Model	BOIL MIN DELAY (Seconds)
24-03	540
24-04	460
24-05	410
24-06	370
24-07	360
24-08	340
24-09	320
24-10	310
24-11	300
24-12	290

circulator purge) after a heat demand cycle. This minimizes the amount of boiler temperature overshoot at the end of a boiler cycle. During the pump purge the diverting valve will continue to operate and prevent low return water temperatures from entering the boiler. At the end of the pump purge period the diverting valve will be immediately closed. The default PUMP DELAY is set to 30 seconds.

- l. UNITS – The temperature units can be changed to either Fahrenheit or Celsius. The default temperature unit is Fahrenheit.
- 4. ERROR MESSAGES – Error messages are shown on the LED display. The function in error will be shown as a black background label in the LED. Most of the errors indicate an open or short circuit, connected to the RTC. The RTC Installation and Maintenance Manual identifies common errors. Cycle through the error messages and repair as required.
  - a. Return Sensor Error – If the return water temperature sensor has been damaged or omitted, the BOIL item will be displayed as either a “short” or “open” circuit. This will force the mixing device (i.e. 3-way valve) to run at a fixed 30% open position. The system may not receive enough heat nor will it be fully protected, however a significant change will be obvious to occupants and/or operators.
  - b. Operation Below Minimum – If the return sensor has been damaged or omitted, and the return water is allowed to return to the boiler below 135°F, the BOIL MIN field will be displayed along with ERR. The failure must be identified and repaired immediately since the boiler has been operating in a condition that fosters premature boiler failure.
- 5. COMPONENT EXERCISE - The RTC will exercise

both the boiler circulator and the diverting valve during periods of dormant activity provided power is supplied to the control.

**F. DIVERTING VALVE ACTUATOR** - A 3-way diverting valve is used to control the temperature of the water returning to the boiler. Proper operation is required to protect the boiler from thermal shock and sustained condensate production. Confirm the operation of the valve as shown above. See Figures 39a and 39b.

**G. BOILER OPERATING AQUASTAT** – The operating aquastat, L4006A, can be found on the front of the boiler, to the right of the temperature/pressure gauge. The operating aquastat should be set to the designed supply temperature, typically 180°F. The operating aquastat set point, the RTC MIX TARGET or the RTC MIX DESGN, should be set to the same value for 20°F ΔT applications. In 40°F ΔT applications, the operating aquastat (L4006A) must be set 20°F higher than the MIX TARGET and MIX DESIGN. Under no circumstances should the operating aquastat be set below 135°F plus (+) the designed boiler temperature drop, ΔT (°F).

Example: if the flow rate through the boiler corresponds to a 20°F ΔT design, the operating aquastat cannot be set lower than  $135 + 20 = 155^{\circ}\text{F}$ .

In reality, most systems are designed for a 180°F supply water and 160°F return water. The accuracy of the operating aquastat is less than the RTC accuracy, often requiring the operating aquastat temperature to be bumped upward a few degrees.

**H. BOILER HIGH LIMIT AQUASTAT** – If used, the high limit aquastat, L4006E, can be found on the front of the boiler, to the left of the temperature/pressure gauge. The high limit aquastat can be identified with a red manual reset button. Ideally, the high limit aquastat should be set 10 -15°F above the RTC MIX MAX setting, when the outdoor reset feature is selected. Typically, this is set between 200°F and 220°F. The temperature must be set below the lowest permissible temperature for any system related component affected by boiler supply water. Under no circumstances can the high limit aquastat be set higher than 250°F.

**I. BOILER MODULATING CONTROL** – Various controls are used to modulate burner firing rates. No attempt will be made to cover every possibility, however a general outline will be given. Most modulation controls require the entry of a boiler temperature identifying boiler operation at the maximum firing rate. A boiler operating temperature below that will also generate a full firing rate. When a boiler heat demand is generated the unit will initiate at either a low or high fire rate and quickly ramp up to the

high fire rate. The unit will continue to fire at the high fire rate until the boiler high fire modulating limit is reached.

Many modulation controls require the entry of a burner off or low fire setting. The burner will modulate between the high fire and low fire rate based on the absolute boiler temperature as well as the rate of change in boiler temperature.

If using a T991 Proportional Control or a similar modulating device in a traditional hydronic system, the minimum setting shall be the sum of the designed heating system return temperature + boiler ΔT + 10°F.

Example: System Supply	180°F
System Return	160°F
System ΔT	20°F
Boiler ΔT	40°F

Min. Setting =  $160^{\circ}\text{F} + 40^{\circ}\text{F} + 10^{\circ}\text{F}$   
= 210°F

\*NOTE: A higher flow through the boiler, achieving a 20°F ΔT would lower the minimum to 190°F.

If using the same control in a system where the designed return is less than 135°F, then the minimum becomes:

$135^{\circ}\text{F} + \text{Boiler } \Delta\text{T} + 10^{\circ}\text{F}$

## J. TEST CONTROLS

### WARNING

**Before installation of the boiler is considered complete, the operation of the boiler controls should be checked, particularly the low water cutoff and the high limit control.**

All controls must be checked prior to putting the boiler in service.

1. CHECK OPERATING CONTROL OPERATION.  
Raise and lower operating control setting as required to start and stop burner.
2. CHECK OPERATION OF HIGH LIMIT CONTROL —  
Jumper Operating Control Terminals. Allow burner to operate until shutdown by limit. Installation is not considered complete until this check has been made. REMOVE JUMPER.
3. CHECK LOW WATER CUTOFF control with water level at normal water line (see Figure 1). Raise operating control 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 cutoff.  
Close boiler drain and refill to normal water line. Burner should automatically restart during fill. RESET OPERATING CONTROL.



## CAUTION

**Probe and float type low water cutoff devices require annual inspection and maintenance.**

4. 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 shutdown.
5. CHECK RTC CONTROL - see the Test Section in the RTC Installation and Maintenance Manual.

### K. BOILER AND SYSTEM CLEANING - STEAM BOILER

## NOTICE

**A qualified water treatment chemical specialist should be consulted for recommendations regarding appropriate chemical compounds and concentrations which are compatible with local environmental regulations.**

## WARNING

**Chemicals used in treating boiler water are toxic and/or harmful. Always use protective clothing and equipment when working with/near chemicals. Contact local authorities to determine if treated boiler water can be discharged into local waste water system.**

1. 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 BLOWOFF connection. See Figure 40a.
  - a. Drain boiler until water is just visible in gauge glass. Run temporarily 1½" pipe line from the surface blowoff connection to an open drain or some other location where hot water may be discharged safely. Do not install valve in this line.
  - b. Add an appropriate amount of recommended boilout compounds.
  - c. 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 blowoff pipe. Continue this slow boiling and trickle of overflow for several hours until the water coming from the overflow is clear.

- d. Stop burner and drain boiler in a manner and to a location that hot water can be discharged with safety.
  - e. Refill boiler to normal water line. If water in gauge glass does not appear to be clear, repeat steps (a. thru e.), and boil out the boiler for a longer time.
2. Low pressure steam boilers such as the Series 24 should be maintained with appropriate water treatment compounds. After cleaning process has been completed, add water treatment compounds as recommended by your local qualified water treatment company.
  3. Remove temporary surface blowoff piping and replug tapping. Boil or bring water temperature to 180°F promptly in order to drive off the dissolved gases in the fresh water.
  4. If unsteady water line, foaming or priming persist, install gate valve in Hartford Loop and drain valves in return main and at boiler and proceed as follows:
    - a. Connect hoses from drain cocks to floor drain. Close gate valve in Hartford Loop and open drain cock in return main. Fill boiler to normal water level, turn on 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.
    - b. Draw about 5 gallons of hot water from boiler into a container and dissolve into it appropriate amount of a recommended boilout compound. Remove surface blowoff plug and pour this solution into boiler, then reinstall plug.
    - c. Turn on 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.
    - d. Stop feeding water to boiler but continue operating 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 burner. Drain boiler. Open all radiator valves. Reinstall all supply main air valves. Open gate valve in Hartford Loop.
    - e. When boiler has cooled down sufficiently (crown sheet of sections are not too hot to touch), close

the drain cocks at boiler and in return main and feed water slowly up to normal level in boiler. Turn on 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.

- f. 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 cock in return main, turn on 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 burner, drain boiler, open gate valve in Hartford Loop, then repeat step (1) above.

5. 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 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 appropriate water treatment chemicals, if necessary to bring the pH within the specified range.

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

## L. BOILER AND SYSTEM CLEANING - WATER BOILERS

1. Filling of Boiler and System --- General --- In a hot water heating system, the boiler and entire system (other than the expansion tank) must be full of water for satisfactory operation. Water should be added to the system until the boiler pressure gauge registers normal system design operating pressure. To insure that the system is full, water should come out of all air vents when opened.

2. Boiling Out of Boiler and System. The oil and grease which accumulate in a new hot water boiler can be washed out in the following manner.
  - a. Remove safety relief valve using extreme care to avoid damaging it.
  - b. Add an appropriate amount of recommended boilout compound.
  - c. Reinstall safety relief valve.
  - d. Fill the entire system with water.
  - e. Start firing the boiler.
  - f. Circulate the water through the entire system.
  - g. Vent the system, including the radiation.
  - h. Allow boiler water to reach operating temperature, if possible.
  - i. Continue to circulate the water for a few hours.
  - j. Stop firing the boiler.
  - k. Drain the system in a manner and to a location that hot water can be discharged with safety.
  - l. Remove plugs from all available returns and wash the water side of the boiler as thoroughly as possible, using a high-pressure water stream.
  - m. Refill the system with fresh water.

3. Add appropriate boiler water treatment compounds as recommended by your local qualified water treatment company.

4. Make pH or Alkalinity Test.

After boiler and system have been cleaned and refilled as previously described, test the pH of the water in the system. This can easily be done by drawing a small sample of boiler water and testing with 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 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.

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



## M. FREQUENT WATER ADDITION

### IMPORTANT

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)

24-03	16½	24-08	44
24-04	22	24-09	49½
24-05	27½	24-10	55
24-06	33	24-11	60½
24-07	38½	24-12	66

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. The maintenance of system integrity is the best method to prevent these types of failure.

## N. OXYGEN CORROSION:

### WARNING

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

There are many possible causes of oxygen contamination such as:

- Addition of excessive make-up water as a result of system leaks.
- Absorption through open tanks and fittings.
- Oxygen permeable materials in the distribution system.

In order to insure long product life, oxygen sources must be eliminated. This can be accomplished by taking the following measures:

- Repairing system leaks to eliminate the need for addition of make-up water.
- Eliminating open tanks from the system.
- Eliminating and/or repairing fittings which allow oxygen absorption.
- Use of non-permeable materials in the distribution system.
- Consult your local water treatment specialist for specific recommendations.

## SECTION V - SERVICE INSTRUCTIONS

### DANGER

This boiler uses flammable gas, high voltage electricity, moving parts, and very hot water under high pressure. Assure that all gas and electric power supplies are off and that the water temperature is cool before attempting any disassembly or service. More than one gas shut-off valve and electrical disconnect switch are used on the boiler. Assure that all gas valves and electrical disconnect switches are off before attempting any disassembly or service.

Do not attempt any service work if gas is present in the air in the vicinity of the boiler. Never modify, remove or tamper with any control device.

### WARNING

This boiler must only be serviced and repaired by skilled and experienced service technicians.

If any controls are replaced, they must be replaced with identical models.

Read, understand and follow all the instructions and warnings contained in all the sections of this manual.

If any electrical wires are disconnected during service, clearly label the wires and assure that the wires are reconnected properly.

NEVER operate boiler without all sight glasses and brackets in place and securely fastened and sealed. Very HOT combustion gas may cause burn injury.

Read, understand and follow all the instructions and warnings contained in ALL of the component instruction manuals.

Assure that all safety and operating controls and components are operating properly before placing the boiler back in service.

- A. **GENERAL** — Inspection should be conducted annually. Service as frequently as specified in paragraphs below. While service or maintenance is being done, electrical power to the boiler must be “off”.
- B. **CLEAN THE BOILER HEATING SURFACES & FLUE** at least once each year, preferably at the end of the heating season.
1. **CLEAN THE VENT SYSTEM** — Vent system should be checked annually for:
    - a. Obstructions.
    - b. Accumulations of soot.
    - c. Deterioration of vent pipe or vent accessories due to condensation or other reasons.
    - d. Proper support — no sags, particularly in horizontal runs.
    - e. Tightness of joints.
    - f. Remove the smoke pipe. Remove all accumulations of soot with wire brush and vacuum. Remove all obstructions. Replace all deteriorated parts and support properly. Seal all joints.
  2. **CLEAN THE BOILER FLUEWAYS**
    - a. Remove the jacket left side panels.
    - b. Loosen nuts securing the flue cleanout plates and remove the plates. The insulation should be removed with the plates taking care not to damage the insulation.
    - c. Using a 1¼” diameter wire or fibre bristle brush (36” handle) clean the flueways. Start at the top of each flueway opening and work down the pin rows using two or three horizontal strokes per row for best results.
  3. **CLEAN TOP OF BOILER SECTIONS**

Remove the jacket top panel. Remove the top flue canopy cover or outlet assembly. Use a flashlight to inspect the upper portion of the flueways and top of castings for soot and debris. Heavy accumulations over 1/16” thick must be removed. Remove the canopy being careful not to damage the cerafelt strips. Brush and vacuum the upper flueways and tops of castings.
  4. **CLEAN THE FIREBOX**
    - a. Disconnect fuel line(s) and remove burner and burner mounting plate.

- b. Using wire or fibre bristle brush clean crown of boiler and inside of water legs.
- c. Inspect target wall (903A only) for damage or deterioration. If target wall is damaged, replace.

#### 5. REASSEMBLE BOILER

### CAUTION

**Do not start the burner unless canopy, smokepipe, burner mounting plate and all flue plates are secured in place.**

- a. If removed, install the canopy taking care to align the cerafelt strips. If strips are damaged replace as needed.
- b. Reinstall burner mounting plate to front section making sure 3/16" diameter rope gasket is in place and forms gas tight seal. If gasket is damaged, replace.
- c. Bolt burner to burner mounting plate. Inspect gasket to assure adequate seal. Replace if damaged. Connect oil line(s) and/or gas line(s).
- d. Reinstall flue plates making sure gasket on each plate is in place and forms gas tight seal. If damaged, all edges of the cleanout plates should be sealed with Silastic sealant when reinstalled until insulation can be replaced.
- e. If removed, reinstall jacket top.
- f. Reinstall left side panels.
- g. Reinstall smokepipe.

#### C. MAINTENANCE OF LOW WATER CUTOFF DEVICES.

### NOTICE

**Probe and float type low water cutoff devices require annual inspection and maintenance.**

##### 1. PROBE TYPE LOW WATER CUTOFF

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

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

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

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

### DANGER

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

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

### WARNING

**Exercise caution when handling phosphoric acid and follow the instructions on container label. Always use protective clothing and equipment when working with/near chemicals.**

- h. Wire brushing of the probe is not recommended as the soft platinum guard ring sandwiched between the ceramic insulators may be damaged. Care must be taken not to damage this ring in any way or the useful life of the probe may be shortened.
- i. Clean the pipe threads of the probe to remove old, hardened pipe dope and other foreign matter.
- j. 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.
- k. Screw the probe into the boiler tapping.
- l. Mount the low water cutoff control on the probe.
- m. Reconnect the control to probe wiring.
- n. Fill the boiler to its normal waterline.
- o. Add boiler water treatment compound as needed.
- p. Restore electric service to the boiler.
- q. Fire burner to bring the water in the boiler to a boil to drive off free oxygen.
- r. **BEFORE RETURNING BOILER TO SERVICE** Follow the low water cutoff checkout procedure on Pages 46 and 47.

## 2. FLOAT TYPE LOW WATER CUTOFF

During the heating season, if an external low water cutoff 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 cutoffs 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.

**D. CHECK BURNER AND CONTROLS** at least once a year. See Section IV - Operating Instructions, Step J for control checks. See Burner Manual for burner tests and adjustments.

**E. LUBRICATE BOILER COMPONENTS** according to manufacturer's instructions. Generally, this involves the oil burner and circulator. This includes the type of lubricant to use, frequency of lubrication, and points to lubricate.

## F. GENERAL MAINTENANCE CONSIDERATIONS

1. Keep radiators and convectors clean.
2. If a hot water radiator is hot at the bottom but not at the top, it indicates that air has accumulated inside and should be vented. To vent radiator, hold small cup under air vent (located near top of radiator), open vent until water escapes and then close.

3. If much water is added to system, it is advisable to heat system to a high temperature and vent again. This will make less venting necessary during the winter.
4. Where an expansion tank is used, make sure that neither the tank nor its drain pipe is exposed to freezing temperatures. Never place valves in piping leading to or from expansion tank.
5. Boiler and system cleaning will help assure trouble free operation. See Section IV - Operating Instructions, Steps K or L for procedure.

## G. ATTENTION TO BOILER WHILE NOT IN OPERATION

### WARNING

**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 when 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 IV - Operating Instructions, Steps B through L.

# SECTION VI - BURNER SPECIFICATIONS

## NOTICE

Series 24 boiler ratings and capacities are based upon the following burners, pump pressures, nozzle sizes and manifold pressures. Refer to instructions furnished with burner for additional information regarding proper installation, fuel piping, wiring details, burner adjustments, service instructions and burner start-up.

Table VI: Beckett Burner Specifications

### OIL BURNERS

BOILER MODEL	BURNER INPUT (GPH)	BURNER MFR.	BURNER MODEL	AIR TUBE COMB.	BURNER SETTINGS					PUMP PRESS. (PSI)		NOZZLE MAKE	NOZZLE DATA GPH X ANGLE-TYPE
					HEAD	AIR SHUTTER	AIR BAND	AIR DAMPER LOW	AIR DAMPER HIGH	LOW FIRE	HIGH FIRE		
24-03	3.1	BECKETT	CF-500	CF60KK	2	10	3	N/A	N/A	---	150	HAGO	2.50 X 45° - P
24-04	4.2	BECKETT	CF-800	CF80KH	1	8	0	N/A	N/A	---	150	HAGO	3.50 X 45° - P
24-05	5.6	BECKETT	CF-800	CF80KH	2	10	6	N/A	N/A	---	150	HAGO	4.50 X 45° - P
24-06	7.0	BECKETT	CF-1400	CF66KD	3	N/A	N/A	2.75	4.0	150	300	HAGO	4.00 X 60° - P
24-07	8.3	BECKETT	CF-1400	CF66KD	4	N/A	N/A	3.0	6.5	150	275	HAGO	5.00 X 45° - P
24-08	9.6	BECKETT	CF-1400	CF66KEE	1	N/A	N/A	3.5	8.5	150	300	HAGO	5.50 X 45° - P
24-09	11.6	BECKETT	CF-2300A	CF66KG	0	N/A	N/A	2.0	4.0	150	275	HAGO	7.00 X 45° - P
24-10	13.2	BECKETT	CF-2300A	CF66KG	1	N/A	N/A	2.0	6.0	150	275	HAGO	8.00 X 45° - P
24-11	14.8	BECKETT	CF-2500	CF66KP	0	N/A	N/A	0.5	3.0	275	275	HAGO	(L) 4.50 X 45° - P
													(H) 4.50 X 45° - P
24-12	16.4	BECKETT	CF-2500	CF66KP	0	N/A	N/A	0.5	4.0	275	275	HAGO	(L) 5.00 X 45° - P
													(H) 5.00 X 45° - P

### GAS BURNERS (Natural Gas)

Boiler Model	Gas Burner Model	Damper Settings				Manifold Pressure ("WC)		Rate Control	Minimum Inlet Pressure "WC <sup>1</sup> By Gas Train Pipe Size				
		Low Fire	High Fire	Shutter	Band	Low Fire (Start)	High Fire		1"	1 1/4"	1 1/2"	2"	2 1/2"
24-03	CG10.1S			10	1	(1.3)	2.5	On/Off	<b>3.24</b>	3.13	--	--	--
24-04	CG10.4S			5	2	(1.3)	2.6	On/Off	<b>3.64</b>	3.4	--	--	--
24-05	CG10.5S			7	1	(1)	3.3	On/Off	4.61	<b>4.26</b>	--	--	--
24-06	CG10.6S			10	6	(1.1)	3.64	On/Off	5.43	4.76	<b>4.38</b>	--	--
24-07	CG15.3S	18	43			0.9	3.1	Lo/Hi/Lo	5.31	4.44	<b>3.99</b>	--	--
24-08	CG15.4S	21	63			0.95	3.3	Lo/Hi/Lo	6.14	4.9	<b>4.41</b>	--	--
24-09	CG25.2S	23	47			0.8	3.43	Lo/Hi/Lo	--	4.69	<b>4.28</b>	3.86	--
24-10	CG25.3S	26	52			0.8	3.44	Lo/Hi/Lo	--	--	<b>4.94</b>	4.4	3.98
24-11	CG25.4S	28	58			0.8	3.0	Lo/Hi/Lo	--	--	<b>4.88</b>	4.21	3.68
24-12	CG50.2S	10	25			0.8	2.1	Lo/Hi/Lo	--	--	<b>3.87</b>	3.56	2.94

1. Standard burners are indicated with bold numbering in shaded boxes. The other burners shown are optional.

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## SECTION VII - REPAIR PARTS & CARTON CONTENTS

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The following parts may be obtained from any Crown distributor. To find the closest Crown distributor, consult the area Crown representative or the factory at:

Crown Boiler Co.  
Customer Service  
P.O. Box 14818  
Philadelphia, PA 19134  
[www.crownboiler.com](http://www.crownboiler.com)



## SERIES 24 MASTER PARTS LIST

DESCRIPTION	SECTIONS				SECTION JOINER CARTON	REAR FLUE OUTLET CARTON				FLAME OBS. CARTON	WATER TRIM CARTON	STEAM TRIM CARTON	TARGET WALL CARTON	BURNER MTG PLATE CARTON		BURNER ADAPTER PLATE CARTON	BURNER CARTON	CANOPY CARTON	JACKET CARTON	OIL BOILER CARTON	GAS BOILER CARTON	
	FRONT (KEY # 1)	BACK (KEY # 5)	CENTER <sup>1</sup> (KEY # 2)	"CX" (KEY # 4)		F	G	H	7					8	10							12
WATER	330000	330001	330002	330003	331200	331201	331202	330133	330134	330135	330136	330050	331210	331220	330025	1	1	1 EA.	1 EA.	1 EA.	1 EA.	1 EA.
	24-03W	1	1	1	1		1	1				1	1		1			330123	330203	331001	331101	331101
	24-04W	1	1	2		1	1	1				1	1					330124	330204	331002	331102	331102
	24-05W	1	1	3			1	1	1			1	1					330125	330205	331003	331103	331103
	24-06W	1	1	4		1	1	1	1			1	1					330126	330206	331004	331104	331104
	24-07W	1	1	5		2	1	1	1			1	1					330127	330207	331005	331105	331105
	24-08W	1	1	6		1	1	1		1		1	1					330128	330208	331006	331106	331106
	24-09W	1	1	7			2	1	1	1		1	1					330129	330209	331007	331107	331107
	24-10W	1	1	8		3			1		1	1	1					330130	330210	331008	331108	331108
	24-11W	1	1	9		2	1	1			1	1	1					330131	330211	331009	331109	331109
	24-12W	1	1	10		1	2	1			1	1	1					330132	330212	331010	331110	331110
	STEAM	24-03S	1	1		1		1					1	1	1				330123	330203	331011	331111
24-04S		1	1	2		1	1					1	1	1				330124	330204	331012	331112	331112
24-05S		1	1	3			1	1				1	1	1				330125	330205	331013	331113	331113
24-06S		1	1	4		1	1	1	1			1	1	1				330126	330206	331014	331114	331114
24-07S		1	1	5		2	1	1	1			1	1	1				330127	330207	331015	331115	331115
24-08S		1	1	6		1	1			1		1	1	1				330128	330208	331016	331116	331116
24-09S		1	1	7			2	1	1			1	1	1				330129	330209	331017	331117	331117
24-10S		1	1	8		3				1		1	1	1				330130	330210	331018	331118	331118
24-11S		1	1	9		2	1					1	1	1				330131	330211	331019	331119	331119
24-12S		1	1	9	1	1	2					1	1	1				330132	330212	331020	331120	331120

1) NOTE: IF TANKLESS HEATERS (\*PN 330020) ARE USED, REPLACE ONE INTERMEDIATE SECTION WITH COIL SECTION (\*PN 330004, KEY # 3) FOR EACH TANKLESS HEATER USED. SEE FIGURE 1 FOR MAX. NUMBER OF PERMITTED TANKLESS HEATERS

## SECTION VII - REPAIR PARTS (Continued)

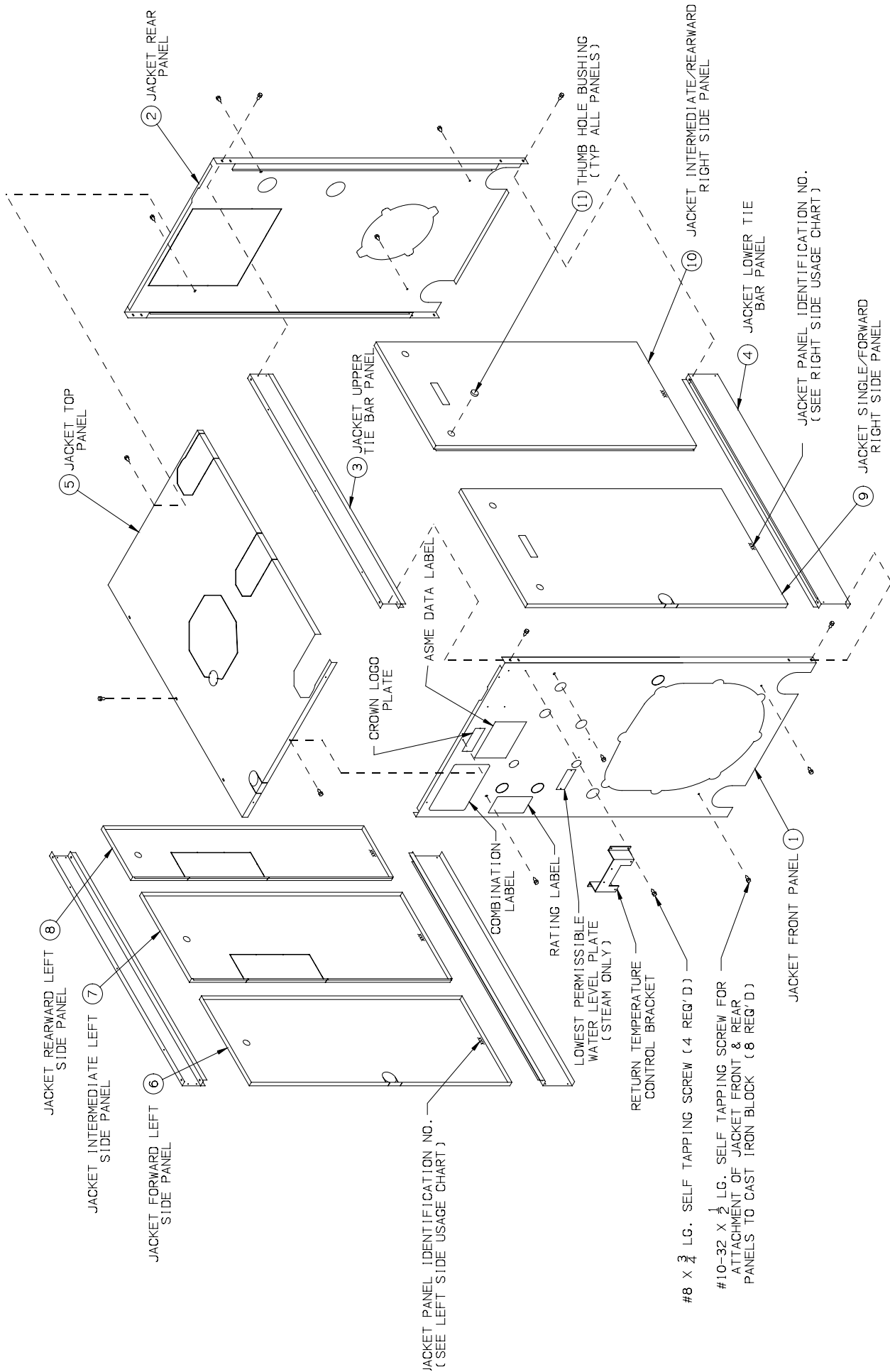


Figure 43: Series 24 Jacket Assembly (Boiler Models 24-03 thru 24-12)

## JACKET CARTON

CROWN CARTON PART #		330203	330204	330205	330206	330207	330208	330209	330210	330211	330212	
		QUANTITY										
KEY	DESCRIPTION	CROWN PART #	24-03	24-04	24-05	24-06	24-07	24-08	24-09	24-10	24-11	24-12
1	FRONT JACKET PANEL	330310	1	1	1	1	1	1	1	1	1	1
2	REAR JACKET PANEL	330320	1	1	1	1	1	1	1	1	1	1
3	UPPER TIE BAR ASSY, 3 SEC.	330333	2									
	UPPER TIE BAR ASSY, 4 SEC.	330334		2								
	UPPER TIE BAR ASSY, 5 SEC.	330335			2							
	UPPER TIE BAR ASSY, 6 SEC.	330336				2						
	UPPER TIE BAR ASSY, 7 SEC.	330337					2					
	UPPER TIE BAR ASSY, 8 SEC.	330338						2				
	UPPER TIE BAR ASSY, 9 SEC.	330339							2			
	UPPER TIE BAR ASSY, 10 SEC.	330340								2		
	UPPER TIE BAR ASSY, 11 SEC.	330341									2	
	UPPER TIE BAR ASSY, 12 SEC.	330342										2
4	LOWER TIE BAR ASSY, 3 SEC.	330343	2									
	LOWER TIE BAR ASSY, 4 SEC.	330344		2								
	LOWER TIE BAR ASSY, 5 SEC.	330345			2							
	LOWER TIE BAR ASSY, 6 SEC.	330346				2						
	LOWER TIE BAR ASSY, 7 SEC.	330347					2					
	LOWER TIE BAR ASSY, 8 SEC.	330348						2				
	LOWER TIE BAR ASSY, 9 SEC.	330349							2			
	LOWER TIE BAR ASSY, 10 SEC.	330350								2		
	LOWER TIE BAR ASSY, 11 SEC.	330351									2	
	LOWER TIE BAR ASSY, 12 SEC.	330352										2
5	TOP PANEL, 3 SEC.	330323	1									
	TOP PANEL, 4 SEC.	330324		1								
	TOP PANEL, 5 SEC.	330325			1							
	TOP PANEL, 6 SEC.	330326				1						
	TOP PANEL, 7 SEC.	330327					1					
	TOP PANEL, 8 SEC.	330328						1				
	TOP PANEL, 9 SEC.	330329							1			
	TOP PANEL, 10 SEC.	330330								1		
	TOP PANEL, 11 SEC.	330331									1	
	TOP PANEL, 12 SEC.	330332										1
6	LEFT SIDE PANEL, L5	330370	1			1			1			1
	LEFT SIDE PANEL, L10	330371	1	1	1	1	1	1	1	1	1	1
7	LEFT SIDE PANEL, L11	330372		1			1			1		
8	LEFT SIDE PANEL, L17	330373			1			1			1	
	LEFT SIDE PANEL, L18	330374				1	1	1	2	2	2	3
9	RIGHT SIDE PANEL, R15	330360	1				1					
	RIGHT SIDE PANEL, R21	330361		1				1				1
	RIGHT SIDE PANEL, R24	330362					1	1	1			2
	RIGHT SIDE PANEL, R27	330363			1				1	1		
	RIGHT SIDE PANEL, R30	330364								1	1	
	RIGHT SIDE PANEL, R33	330365				1					1	
11	THUMB HOLE BUSHING	330390	3	4	4	5	6	7	8	8	8	11
	10-32 X 1/2 SELF TAP MACH SCREW		9	9	9	9	9	9	9	9	9	9
	#8 X 3/4 SHEET METAL SCREW		34	34	34	34	34	34	34	34	34	34

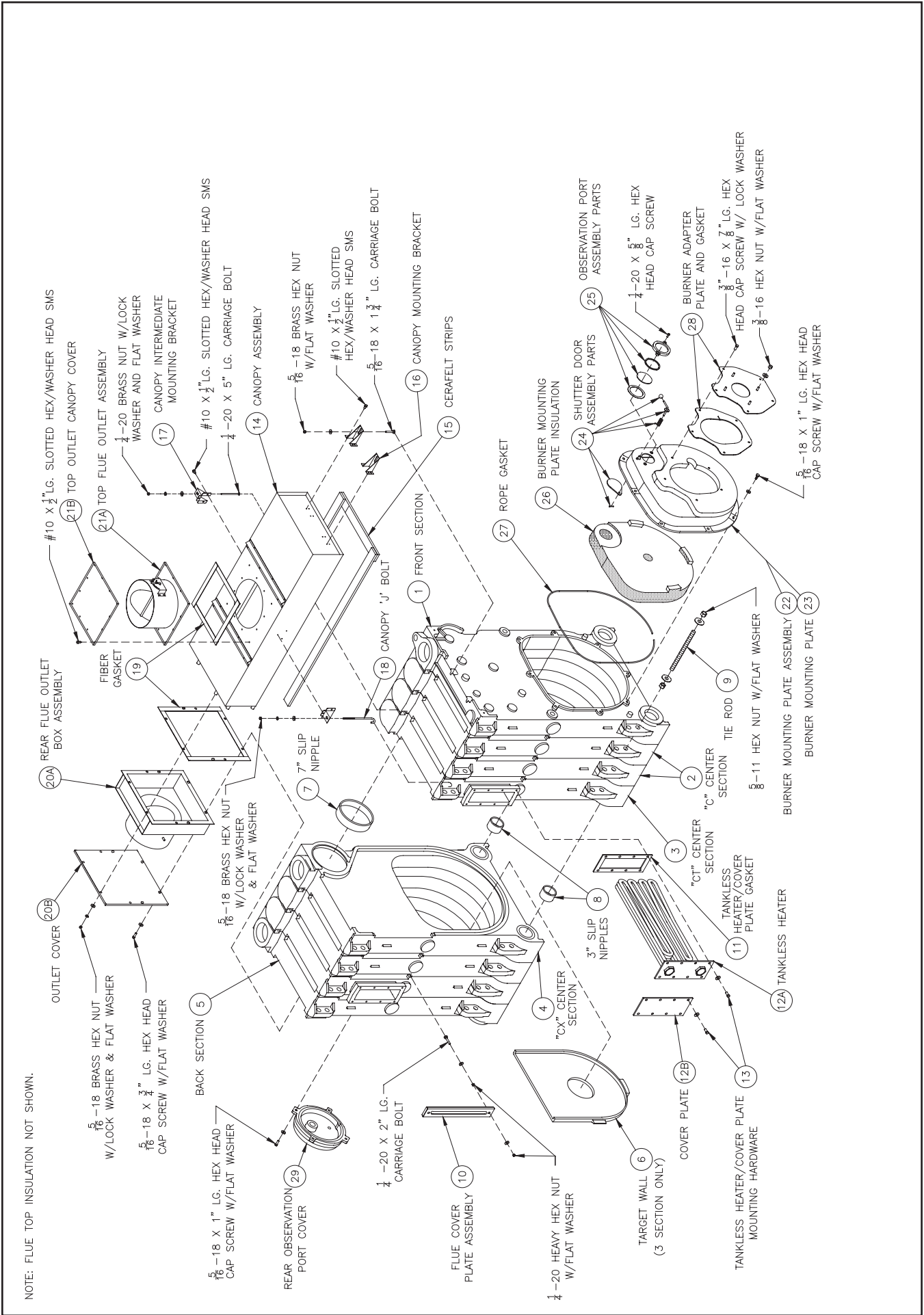


Figure 44: Bare Boiler Assembly

## SECTION JOINER CARTON ASSY

KEY	DESCRIPTION	CROWN PART #	QUANTITY		
			"F"	"G"	"H"
7	7" PUSHNIPPLE	310005	2	3	4
8	3" PUSHNIPPLE	310006	4	6	8
9	5/8 X 9 3/4 TIE ROD	900310	8	12	16
	5/8 HEAVY HEX NUT (GRADE 9)	900307	16	24	32
	5/8 HI-STRENGTH FLAT WASHER	900308	16	24	32
	LOCTITE # 592, 50 ml TUBE	900350	1	2	2
	GASKET ROPE, 3/8 DIA x 96"	330033	2 ft	3 ft	4 ft
	ROPE ADHESIVE	330032	1	1	1
	SIL-BOND, RTV 6500, 10.3 OZ TUBE	900046	2	3	3
10	FLUE CLEANOUT COVER ASSY.	330031	2	3	4
	1/4-20 X 2" CARRIAGE BOLT		4	6	8
	1/4 FLAT WASHER		8	12	16
	1/4-20 HEX NUT		4	6	8
	1/4-20 BRASS HEX NUT		4	6	8

## CANOPY CARTON

KEY	DESCRIPTION	CROWN PART #	QUANTITY										
			24-03	24-04	24-05	24-06	24-07	24-08	24-09	24-10	24-11	24-12	
14	3-SEC. CANOPY CARTON	330123	1										
	4-SEC. CANOPY CARTON	330124		1									
	5-SEC. CANOPY CARTON	330125			1								
	6-SEC. CANOPY CARTON	330126				1							
	7-SEC. CANOPY CARTON	330127					1						
	8-SEC. CANOPY CARTON	330128						1					
	9-SEC. CANOPY CARTON	330129							1				
	10-SEC. CANOPY CARTON	330130								1			
	11-SEC. CANOPY CARTON	330131										1	
	12-SEC. CANOPY CARTON	330132											1
15	1/2 X 2" CERAFELT GASKET	9206003	5	6	7	8	9	10	11	12	13	14	
19	TAPE GASKET, 1/8 X 1 X 11FT	7206024	1	1	1	1	1	1	1	1	1	1	
16	END CANOPY HOLD-DOWN BRKT	71129002	2	2	2	2	2	2	2	2	2	2	
	5/16 X 1 3/4 CARRIAGE BOLT		2	2	2	2	2	2	2	2	2	2	
	5/16 LOCK WASHER		5	5	5	5	6	6	6	7	7	7	
	5/16 FLAT WASHER		11	11	11	11	12	12	12	13	13	13	
	5/16 BRASS HEX NUT		5	5	5	5	6	6	6	7	7	7	
	5/16 LOCK NUT		2	2	2	2	3	3	3	4	4	4	
	#10 X 1/2 HWH SHEET METAL SCREW		24	24	24	24	30	30	30	36	36	36	
	5/16 X 3/4 CAP SCREW		4	4	4	4	4	4	4	4	4	4	
17	SIDE CANOPY HOLD DOWN BRACKET	71129007	0	0	0	0	1	1	1	2	2	2	
18	"J" BOLT	80861679	0	0	0	0	1	1	1	2	2	2	
	1/4-20 X 5" CARRIAGE BOLT		0	0	0	0	1	1	1	2	2	2	
	1/4-20 BRASS HEX NUT		0	0	0	0	1	1	1	2	2	2	
	1/4-20 LOCK WASHER		0	0	0	0	1	1	1	2	2	2	

## REAR FLUE OUTLET CARTON

KEY	DESCRIPTION	CROWN PART #	QUANTITY			
			7	8	10	12
20A	7" REAR OUTLET DAMPER ASSY	333007	1			
	8" REAR OUTLET DAMPER ASSY	333008		1		
	10" REAR OUTLET DAMPER ASSY	333010			1	
	12" REAR OUTLET DAMPER ASSY	333012				1
21B	TOP OUTLET COVER, 7"& 8" OPENING	333017	1	1		
	TOP OUTLET COVER, 10" OPENING	333020			1	
	TOP OUTLET COVER, 12" OPENING	333022				1

## BURNER MOUNTING PLATE CARTON

KEY	DESCRIPTION	CROWN PART #	QUANTITY	
			8"	4"
23	B.M.P., 4" CARTON COMPLETE*	330404	0	1
	B.M.P., 8" CARTON COMPLETE*	330408	1	0
	5/16 X 1" CAP SCREW	900410	8	8
	5/16" WASHER	900102	8	8
	3/8 X 7/8 CAP SCREW	900450	5	5
	3/8 FLAT WASHER	90-036	4	4
	3/8 LOCK WASHER		9	9
	FLEXROPE, 3/16" DENSE	333005	6.5 ft	6.5 ft

## BURNER ADAPTOR PLATE CARTON

KEY	DESCRIPTION	CROWN PART #	QUANTITY				
			920	921	922	923	924
28	BECKETT B.A.P. ASSY, 920	330400	1				
	BECKETT B.A.P. ASSY, 921	330401		1			
	BECKETT B.A.P. ASSY, 922	330402			1		
	BECKETT B.A.P. ASSY, 923	330403				1	
	BECKETT B.A.P. ASSY, 924	330404					1
	BURNER ADAPTOR PLATE GASKET	333405	1	1	1		

## REAR FLAME OBSERVATION PORT CARTON

KEY	DESCRIPTION	CROWN PART #	QUANTITY
29	REAR FLAME OBSERVATION PORT ASSY	333000	1
	5/16 X 1" CAP SCREW		4
	5/16" WASHER		4
	FLEXROPE, 3/16" DENSE	333005	2.83 ft

## REAR TARGET WALL CARTON

DESCRIPTION	CROWN PART #	QUANTITY
TARGET WALL	335025	1



## STANDARD STEAM TRIM CARTON ASSY.

DESCRIPTION	CROWN PART #	QUANTITY
LWCO, #67	400682	1
GLASS SET (11.25" CTR TO CTR)	950082	1
L404F1367	3503800	1
1/2 X 3 BR NIPPLES	95-116	2
1/2" BR. UNION	95-150	2
1/2 X CL BRASS NIPPLE	95-147	2
3/4 BLACK EXTENSION	95-090	1
3/4 X 1/4 BRASS BUSHING	950016	1
90 DEG. BRASS PIGTAIL	95-060B	1
PRESSURE GAUGE	95-070	1
1/2 X 1/4 BRASS BUSHING	95-146	1
3/4" RECESSED HEAD PLUG	950265	3
1" NPT RECESSED HEAD PLUG	950270	4
3" SQ. HD PLUG	950273	2
3 X 1 1/4 BLK BUSHING	950275	1
1-1/2 X 4 BLK NIPPLE	950124	1
1-1/2 BLK TEE	950180	1
1-1/2 BLK SQ. HD PLUG	95-143	1

## STANDARD WATER TRIM CARTON ASSY.

DESCRIPTION	CROWN PART #	QUANTITY
L4006A2015	35-3510	1
3/4 LONG WELL	35-1020	1
TRIDICATOR GAUGE	95-038	1
1/2 X 1/4 BLK BUSHING	95-053	1
3 X 3/4 BLK BUSHING	950035	1
1/2" NPT RECESSED HEAD PLUG	950260	2
3/4" NPT RECESSED HEAD PLUG	950265	3
1" NPT RECESSED HEAD PLUG	950270	4
3" PLUG	950273	2
4" PLUG	950274	1

**V Return Temperature Control (RTC) Packages**  
**(CONSULT APPENDIX B1, B2, B3 & B4 IN THE I/O MANUAL FOR VALVE SELECTION)**

DESCRIPTION	RTC Carton with Outdoor Reset	RTC Carton without Outdoor Reset	1" 3-Way Valve, MG25-12	1 1/4" 3-Way Valve, MG32-8	1 1/2" 3-Way Valve, G138	2" 3-Way Valve, G151	2 1/2" 3-Way Valve, F165-50	2 1/2" 3-Way Valve, F165	3" 3-Way Valve, F180
CROWN PART #	330800	330810	330850	330851	330852	330853	330854	330855	330856
1" VALVE WITH OUTDOOR RESET	1		1						
1" VALVE W/O OUTDOOR RESET		1	1						
1 1/4" VALVE WITH OUTDOOR RESET	1			1					
1 1/4" VALVE W/O OUTDOOR RESET		1		1					
1 1/2" VALVE WITH OUTDOOR RESET	1				1				
1 1/2" VALVE W/O OUTDOOR RESET		1			1				
2" VALVE WITH OUTDOOR RESET	1					1			
2" VALVE W/O OUTDOOR RESET		1				1			
2 1/2" VALVE (F165-50) WITH OUTDOOR RESET	1						1		
2 1/2" VALVE (F165-50) W/O OUTDOOR RESET		1					1		
2 1/2" VALVE (F165) WITH OUTDOOR RESET	1							1	
2 1/2" VALVE (F165) W/O OUTDOOR RESET		1						1	
3" VALVE WITH OUTDOOR RESET	1								1
3" VALVE W/O OUTDOOR RESET		1							1

**RTC CARTON WITH OUTDOOR RESET**

DESCRIPTION	CROWN PART #	QUANTITY
RETURN TEMPERATURE CONTROL (RTC) WITH BOILER SENSOR & MOUNTING SCREWS	332800	1
ACTUATOR (24V, 50 SECOND MOTOR)	332801	1
NIPPLE 3" X 12", (SPECIAL, SCH 40)	332802	1
MOUNTING BRACKET FOR RTC	332803	1
MIX SENSOR, TEKMAR #071, SURFACE MOUNT	332804	1
OUTDOOR AIR SENSOR, TEKMAR #070	332805	1

**RTC CARTON WITHOUT OUTDOOR RESET**

DESCRIPTION	CROWN PART #	QUANTITY
RETURN TEMPERATURE CONTROL (RTC) WITH BOILER SENSOR & MOUNTING SCREWS	332800	1
ACTUATOR (24V, 50 SECOND MOTOR)	332801	1
NIPPLE 3" X 12", (SPECIAL, SCH 40)	332802	1
MOUNTING BRACKET FOR RTC	332803	1

### Tankless Coil Components

KEY	DESCRIPTION	CROWN PART #	QUANTITY
	S24 TANKLESS HEATER CARTON INCLUDES:	330020	1
12A	S-24 TANKLESS HEATER		1
11	GASKET	330021	1
	3/8 X 7/8 "ASME BOLTS"		8
	3/8 WASHER		8

### CSD-1 Packages

#### A. WATER

DESCRIPTION	CROWN PART #	QUANTITY
HYDROLEVEL 550 LWCO	450560	1
L4006E1109	35-3100	1
3/4 LONG WELL	35-1020	1

#### B. STEAM GRAVITY RETURN

DESCRIPTION	CROWN PART #	QUANTITY
#64 LWCO	40-640	1
STEAM FITTING PACKAGE	332001	1

#### C. STEAM PUMPED RETURN

DESCRIPTION	CROWN PART #	QUANTITY
#150S-MD LWCO	40-160	1
STEAM FITTING PACKAGE	332001	1

#### D. STEAM FITTING PACKAGE

DESCRIPTION	CROWN PART #	QUANTITY
3/4 BLACK EXTENSION	95-090	1
3/4 X 1/4 BRASS BUSHING	950016	1
90 DEG. BRASS PIGTAIL	95-060B	1
L404C1147	35-3020	1
#11M SWITCH	400100	1

### Top Flue Outlet

DESCRIPTION	CROWN PART #	QUANTITY
TOP FLUE OUTLET CARTON, 7"	330133	1
TOP FLUE OUTLET CARTON, 8"	330134	1
TOP FLUE OUTLET CARTON, 10"	330135	1
TOP FLUE OUTLET CARTON, 12"	330136	1

### Miscellaneous Optional Components

DESCRIPTION	CROWN PART #	QUANTITY
BASE RAIL SET, 4-5 SEC.	330604	1
BASE RAIL SET, 6-7 SEC.	330606	1
BASE RAIL SET, 8-9 SEC.	330608	1
BASE RAIL SET, 9-10 SEC.	330610	1
BASE RAIL SET, 11-12 SEC.	330612	1
POLYETHYLENE BLOCK	330010	1
3-WAY VALVE FLANGE KIT: 2-1/2" FLG x 2-1/2" NPT	332950	1
3-WAY VALVE FLANGE KIT: 3" FLANGE x 3" NPT	332953	1

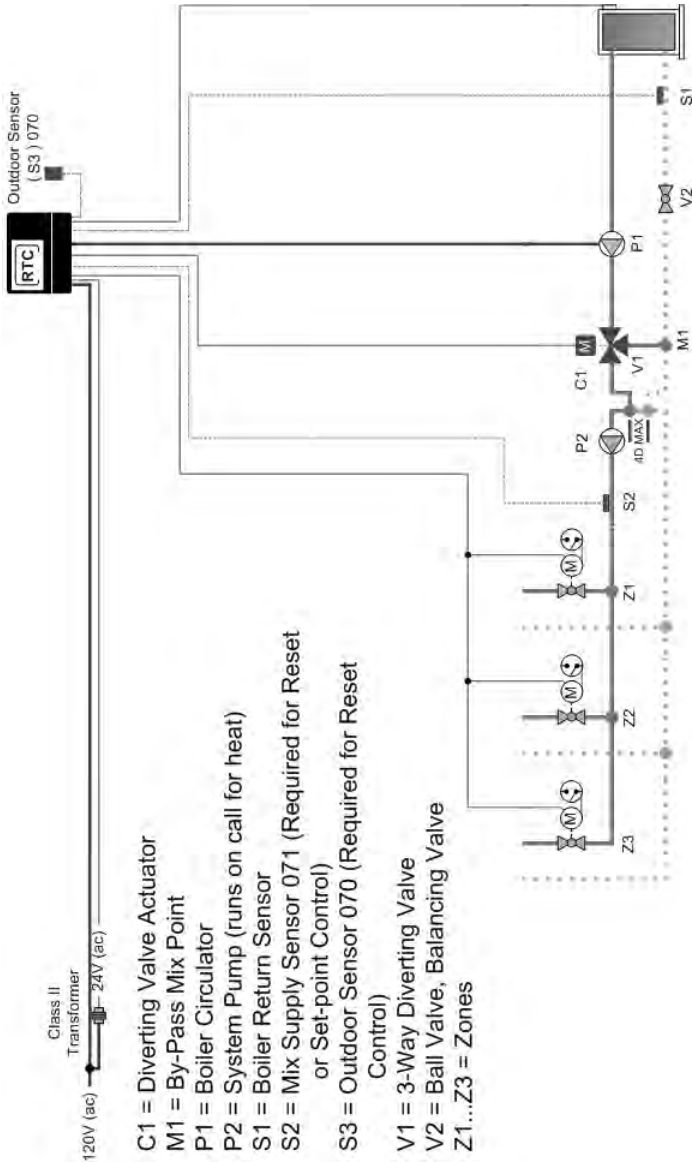
STEAM BOILER CARTON ASSY (BECKETT)

DESCRIPTION	RATING PLATE	INSTALLATION MANUAL	WARRANTY	NIPPLE GAUGE	MINIMUM SAFE WATER LEVEL PLATE	#10 X 1/2" SHEET METAL SCREWS	HAGO 4.50/45P NOZZLE	HAGO 5.00/45P NOZZLE	HAGO 8.00/45P NOZZLE	NOZZLE INSTRUCTIONS	1 1/4 X 3/4 BUSHING	1 1/4 X 1 BUSHING	4" BLACK PLUG	15 PSI SAFETY VALVE, CONBRACO 13-211	15 PSI SAFETY VALVE, CONBRACO 13-202	15 PSI SAFETY VALVE, CONBRACO 13-213	15 PSI SAFETY VALVE, CONBRACO 13-214	1-1/2 X 3/4 BLK BUSHING	1-1/2 X 1 BLK BUSHING	95-047
24-03SO	98-111	980417	980418	980920	980150	90-212	130185	13-074	130190	980419	950098	950192	950274	950510	950515	950520	950525	95-096	950185	
24-04SO	1	1	1	1	1	2					1	1	1	1	1	1		1	1	
24-05SO	1	1	1	1	1	2	1			1		1	1			1				1
24-06SO	1	1	1	1	1	2		1		1		1	1			1				1
24-07SO	1	1	1	1	1	2				1		1				1				1
24-08SO	1	1	1	1	1	2						1				1				1
24-09SO	1	1	1	1	1	2			1							1				
24-10SO	1	1	1	1	1	2				1						1				
24-11SO	1	1	1	1	1	2										1				
24-12SO	1	1	1	1	1	2		2		1							1			
24-03SG	1	1	1	1	1	2					1	1	1	1				1		
24-04SG	1	1	1	1	1	2					1	1	1		1				1	
24-05SG	1	1	1	1	1	2						1	1			1				1
24-06SG	1	1	1	1	1	2						1	1			1				1
24-07SG	1	1	1	1	1	2						1				1				1
24-08SG	1	1	1	1	1	2						1				1				1
24-09SG	1	1	1	1	1	2						1				1				1
24-10SG	1	1	1	1	1	2						1				1				1

WATER BOILER CARTON ASSY (BECKETT)

DESCRIPTION	CROWN PART #	RATING PLATE	INSTALLATION MANUAL	WARRANTY SHEET	NIPPLE GAUGE	HAGO 4.50/45P NOZZLE	HAGO 5.00/45P NOZZLE	HAGO 8.00/45P NOZZLE	NOZZLE INSTRUCTIONS	3" BLACK SQ. HD PLUG	30 PSI RELIEF VALVE, CONBRACO 10-408-05	30 PSI RELIEF VALVE, CONBRACO 10-614-05	30 PSI RELIEF VALVE, CONBRACO 10-615-05	30 PSI RELIEF VALVE, CONBRACO 10-616-05	95-096	95-027	95-057	95-105	950185	950114	950190	950110	95-047	95-033	95-058	95-031		
	24-03WO	1	1	1	1					1	1				1	1	1	1			1	1 X CL BLK NIPPLE	1-1/2 X 1-1/4 BLK BUSHING	1-1/4 X 4 BLK NIPPLE	1-1/4 ELBOW	1-1/4 X CL BLK NIPPLE		
	24-04WO	1	1	1	1					1	1				1	1	1	1										
	24-05WO	1	1	1	1	1			1						1	1	1	1										
	24-06WO	1	1	1	1					1					1	1	1	1										
	24-07WO	1	1	1	1	1			1						1	1	1	1										
	24-08WO	1	1	1	1										1	1	1	1										
	24-09WO	1	1	1	1										1	1	1	1										
	24-10WO	1	1	1	1			1	1	1																		
	24-11WO	1	1	1	1										1	1	1	1										
	24-12WO	1	1	1	1	2			1	0					1	1	1	1										
	24-03WG	1	1	1	1					1	1				1	1	1	1										
	24-04WG	1	1	1	1					1	1				1	1	1	1										
	24-05WG	1	1	1	1					1					1	1	1	1										
	24-06WG	1	1	1	1					1					1	1	1	1										
	24-07WG	1	1	1	1					1					1	1	1	1										
	24-08WG	1	1	1	1					1					1	1	1	1										
	24-09WG	1	1	1	1					1					1	1	1	1										
	24-10WG	1	1	1	1					1					1	1	1	1										
	24-11WG	1	1	1	1					1					1	1	1	1										

**A1. 3-way RTC in Primary/Secondary – Heating Only/No DHW; with/without Outdoor Reset (MECHANICAL)**



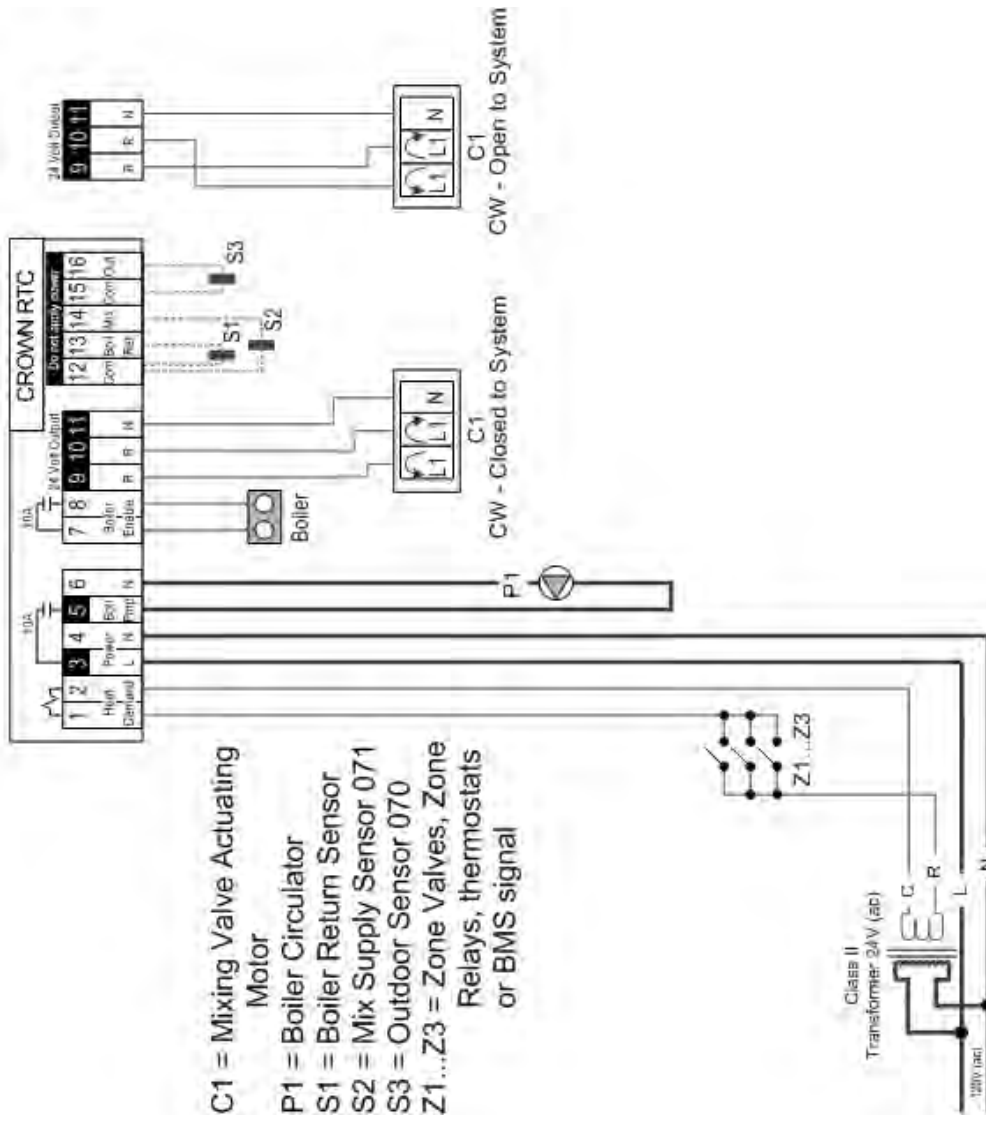
**NOTES:**

- 1) Install the boiler as indicated above for systems where return temperatures may be less than 135F and heating application only.
- 2) The Outdoor Sensor (S3) and the Mix Supply Sensor (S2) are required when the Outdoor Reset feature is selected. The mix sensor must be installed 10 pipe diameters downstream of the system pump, in the primary loop. The mix sensor must be secured to the surface of the pipe using a wire tie or similar device.
- 3) The by-pass piping, diverting valve and boiler circulator must be sized using the sizing charts found in Appendix B.
- 4) Closely spaced tees must connect the branch to the larger header. The Tee centerlines must be no greater than 4 times the larger header pipe diameter.
- 5) The diverting valve, V1, must be no greater than 11 linear feet of pipe from the Return Sensor, S1.
- 6) There shall be a **MINIMUM** of 4 linear feet of pipe between the By-pass Mix Point, M1, and the Return Sensor, S1.
- 7) The balancing valve in the boiler return line, V2, may be necessary in low head by-pass loop applications.
- 8) Expansion tanks, air scoops and other components left out for clarity.
- 9) Observe all applicable plumbing and electrical codes.

***This diagram is for reference only. The installer or designer is responsible for the proper selection and design of the system.***



### A1. 3-way RTC in Primary/Secondary – Heating Only/No DHW; with/without Outdoor Reset (ELECTRICAL)

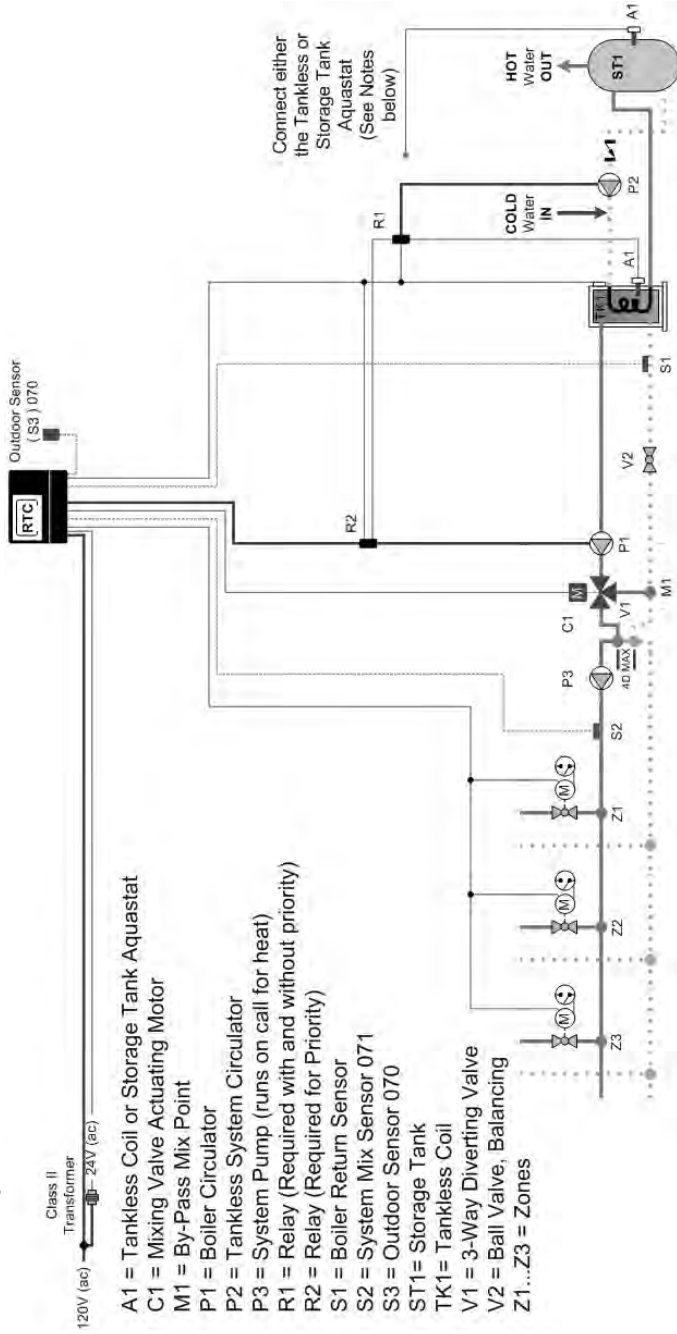


#### NOTES:

- 1) Refer to the I&O to determine correct valve orientation and actuator wiring.
- 2) 120 VAC supplying the RTC should be separate from the burner/boiler circuit.
- 3) Heat demand can be any electrical signal consisting of 24 – 240 VAC.
- 4) Use isolation relays for circulators greater than 1/3 HP. Use motor starters for 3 phase circulators.
- 5) The Outdoor Sensor (S3) and the Mix Supply Sensor (S2) are required if the Outdoor Reset feature is selected.
- 6) System Pump (P2) to be operated by zone relay or other installer supplied device.

***This diagram is for reference only. The installer or designer is responsible for the proper selection and design of the system.***

## A2. 3-way RTC in Primary/Secondary – Heating and DHW using Tankless Coils; with/without Outdoor Reset (MECHANICAL)

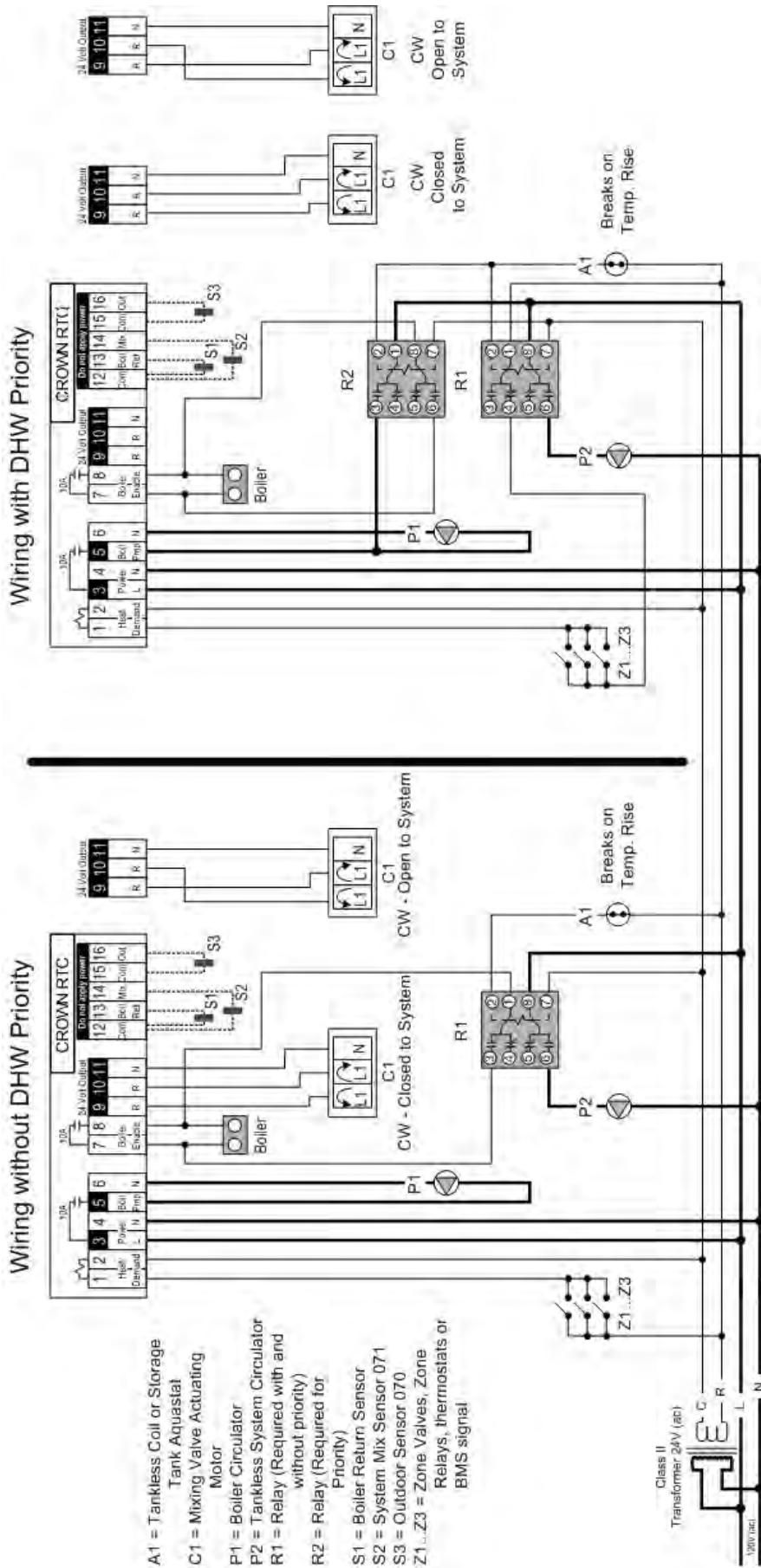


### NOTES:

- 1) Install the boiler as indicated above for systems where return temperatures may be less than 135F and heating/DHW with tankless coils.
- 2) The Outdoor Sensor (S3) and the Mix Supply Sensor (S2) are required when the Outdoor Reset feature is selected. The mix sensor must be installed 10 pipe diameters downstream of the system pump, in the primary loop. The mix sensor must be secured to the surface of the pipe using a wire tie or similar device.
- 3) The by-pass piping, diverting valve and boiler circulator must be sized using the sizing charts found in Appendix B.
- 4) Closely spaced tees must connect the branch to the larger header. The Tee centerlines must be no greater than 4 times the larger header pipe diameter.
- 5) The diverting valve, V1, must be no greater than 11 linear feet of pipe from the Return Sensor, S1.
- 6) There shall be a **MINIMUM** of 4 linear feet of pipe between the By-pass Mix Point, M1, and the Return Sensor, S1.
- 7) The balancing valve in the boiler return line, V2, may be necessary in low head by-pass loop applications.
- 8) Domestic Hot Water must be tempered for safe usage. The tankless aquastat and/or a storage tank aquastat (A1) are normally closed switches. Circuit breaks on temperature rise.
- 9) Expansion tanks, air scoops and other components left out for clarity.
- 10) Observe all applicable plumbing and electrical codes.

***This diagram is for reference only. The installer or designer is responsible for the proper selection and design of the system.***

## A2. 3-way RTC in Primary/Secondary – Heating and DHW using Tankless Coils; with/without Outdoor Reset (ELECTRICAL)

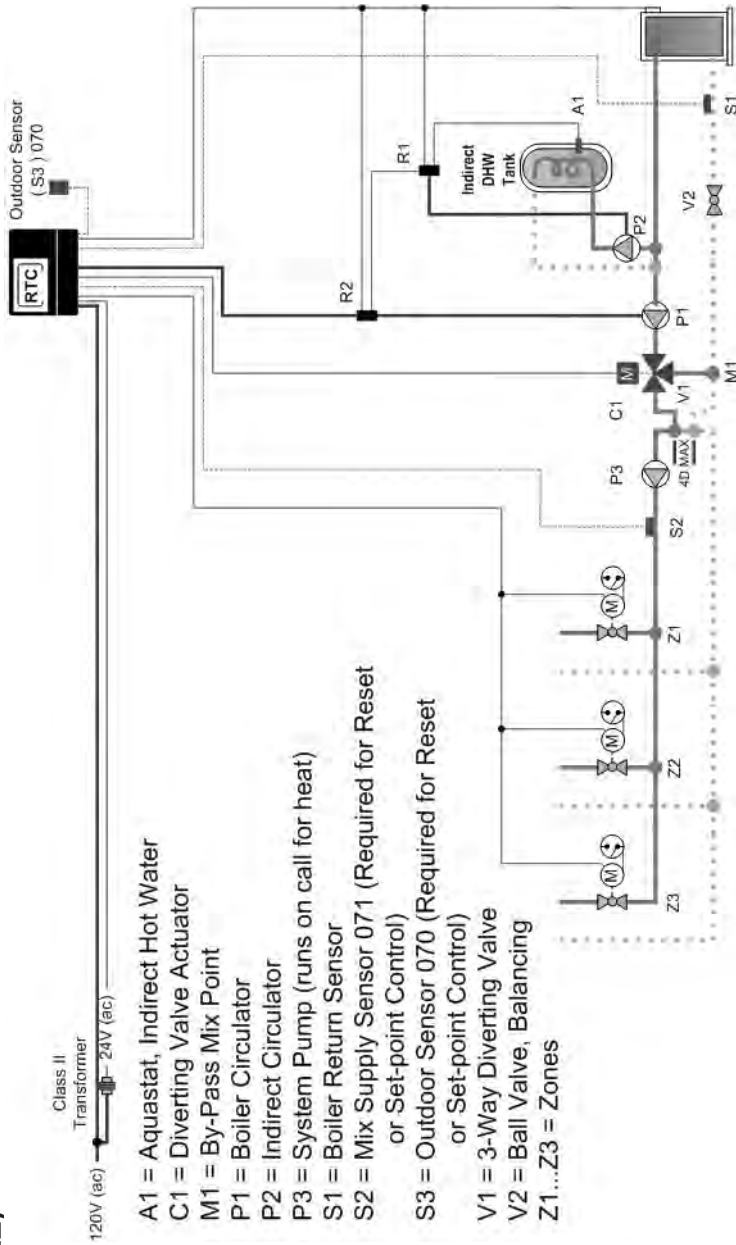


### NOTES:

- 1) Refer to the I&O to determine correct valve orientation and actuator wiring.
- 2) 120 VAC supplying the RTC should be separate from the burner/boiler circuit.
- 3) Heat demand can be any electrical signal consisting of 24 – 240 VAC.
- 4) The Outdoor Sensor (S3) and the Mix Supply Sensor (S2) are required if the Outdoor Reset feature is selected.
- 5) Use isolation relays for circulators greater than 1/3 HP. Use motor starters for 3 phase circulators.
- 6) Connect the Tankless Aquastat (A1) if you are not using a storage tank. If you are using a storage tank with the tankless heater than using the storage tank aquastat (A1).
- 7) System Pump (P3) to be operated by zone relay or other installer supplied device.

***This diagram is for reference only. The installer or designer is responsible for the proper selection and design of the system.***

### A3. 3-way RTC in Primary/Secondary – Heating and DHW using Indirect Water Heater; with/without Outdoor Reset (MECHANICAL)



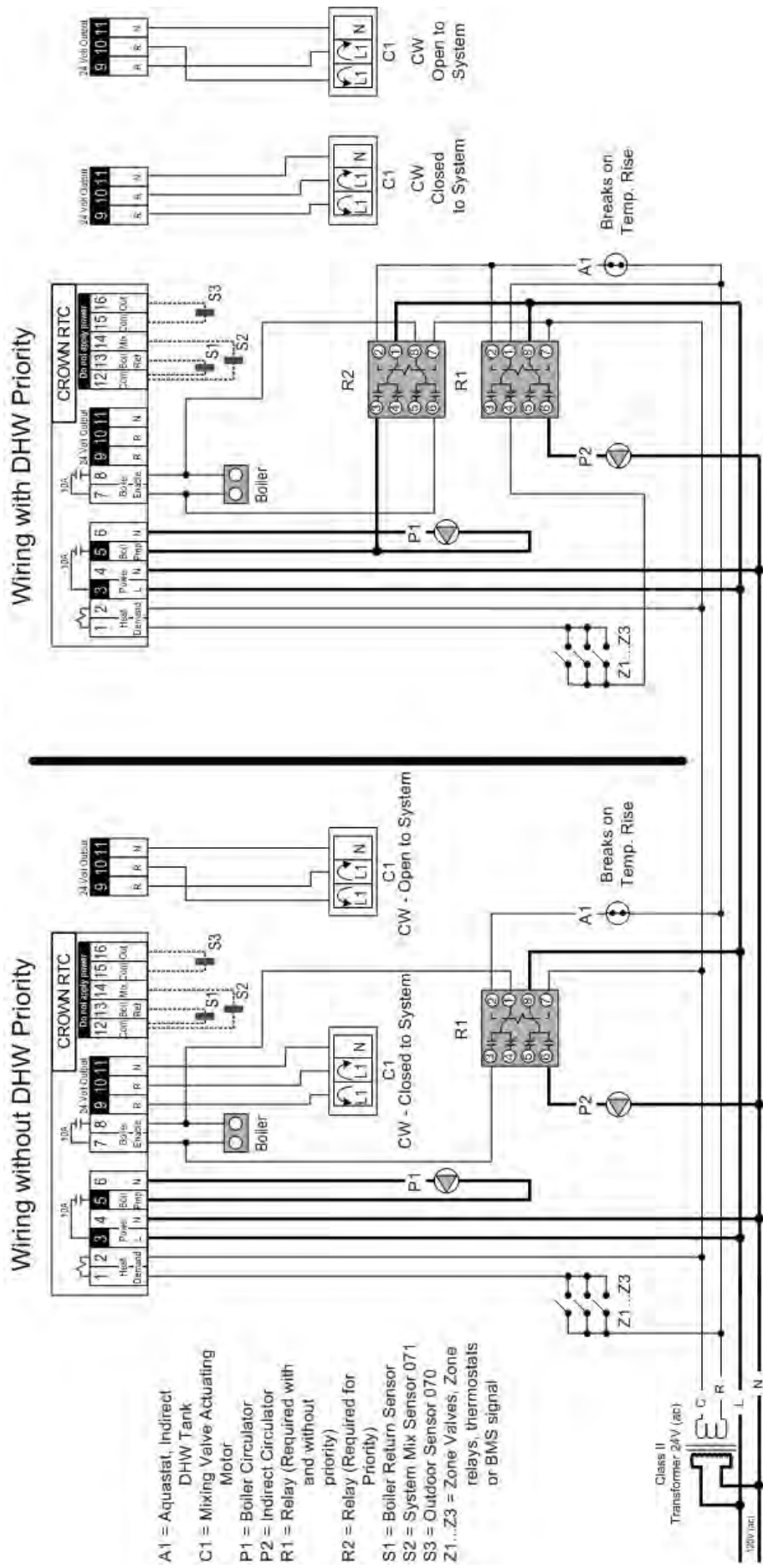
#### NOTES:

- 1) Install the boiler as indicated above for systems where return temperatures may be less than 135F and heating/DHW with an indirect water heater.
- 2) The Outdoor Sensor (S3) and the Mix Supply Sensor (S2) are required when the Outdoor Reset feature is selected. The mix sensor must be installed 10 pipe diameters downstream of the system pump, in the primary loop. The mix sensor must be secured to the surface of the pipe using a wire tie or similar device.
- 3) The by-pass piping, diverting valve and boiler circulator must be sized using the sizing charts found in Appendix B.
- 4) Closely spaced tees must connect the branch to the larger header. The Tee centerlines must be no greater than 4 times the larger header pipe diameter.
- 5) The diverting valve, V1, must be no greater than 11 linear feet of pipe from the Return Sensor, S1.
- 6) There shall be a **MINIMUM** of 4 linear feet of pipe between the By-pass Mix Point, M1, and the Return Sensor, S1.
- 7) The balancing valve in the boiler return line, V2, may be necessary in low head by-pass loop applications.
- 8) The indirect heater aquastat (A1) is a normally closed switch. Circuit breaks on temperature rise.
- 9) Expansion tanks, air scoops and other components left out for clarity.
- 10) Observe all applicable plumbing and electrical codes.

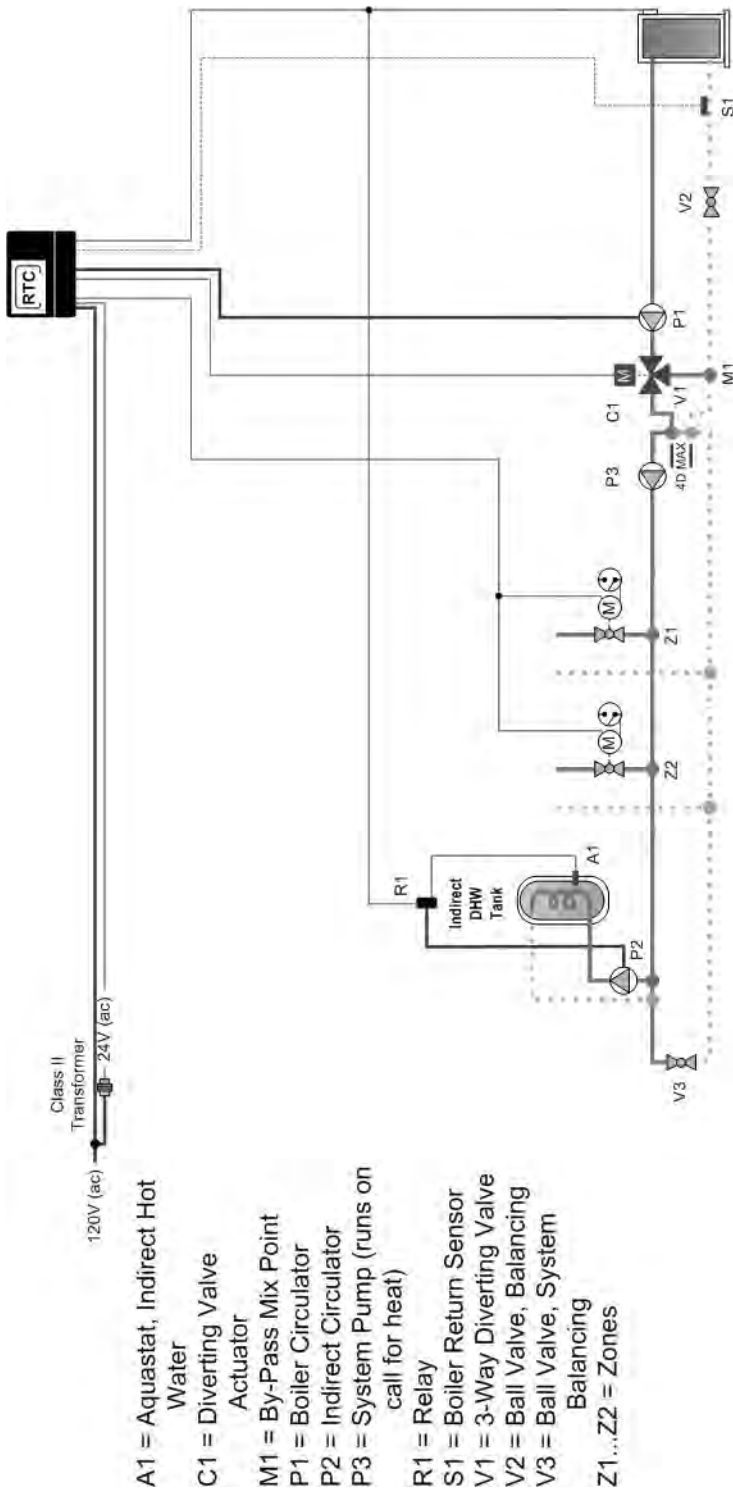
***This diagram is for reference only. The installer or designer is responsible for the proper selection and design of the system.***



### A3. 3-way RTC in Primary/Secondary – Heating and DHW using Indirect Water Heater; with/without Outdoor Reset (ELECTRICAL)



#### A4. 3-way RTC in Primary/Secondary – Heating and DHW using Indirect Water Heater on Primary Loop; without Outdoor Reset (MECHANICAL)



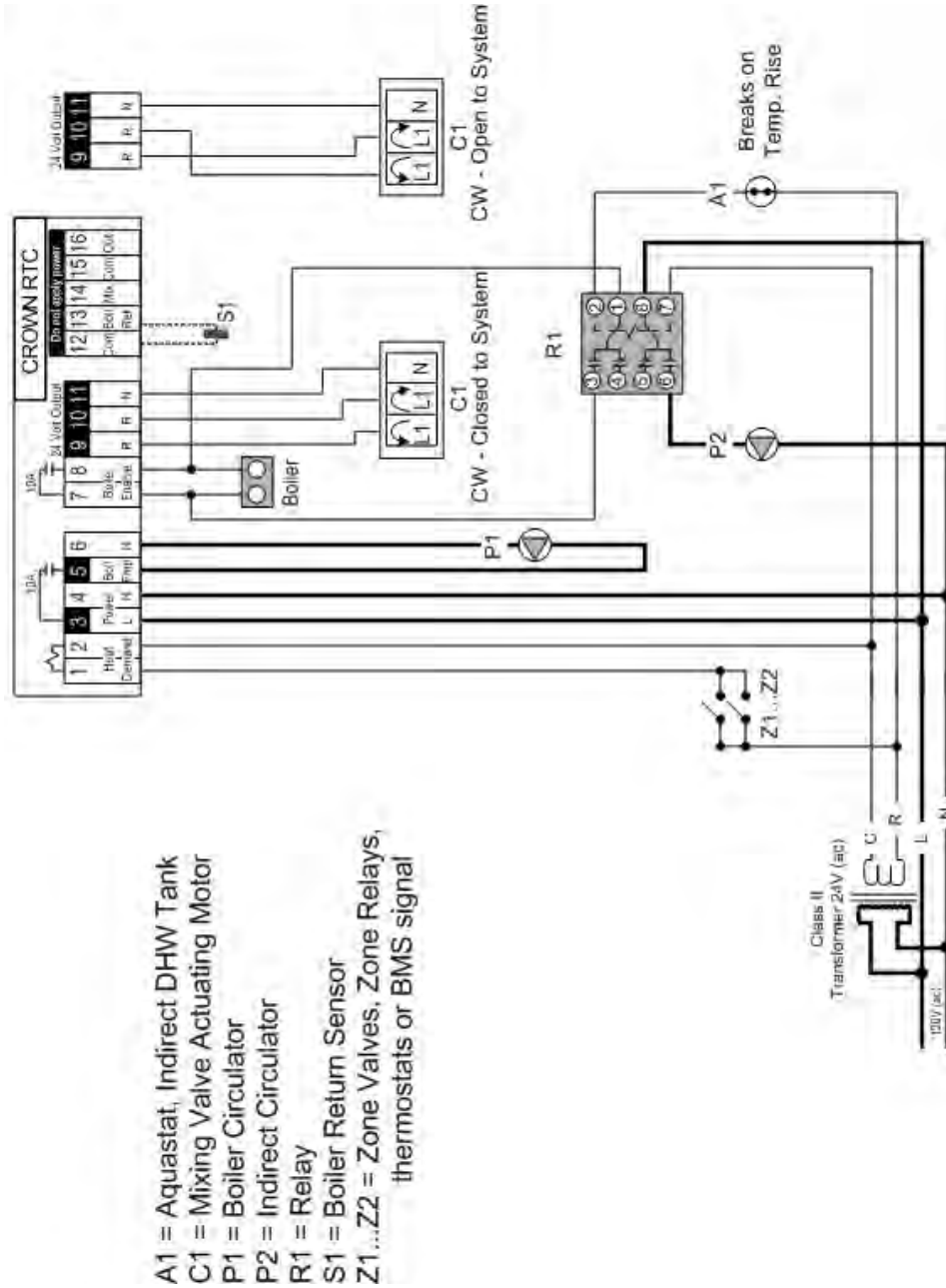
#### NOTES:

- 1) Install the boiler as indicated above for systems where return temperatures may be less than 135F and heating/DHW with an indirect water heater.
- 2) This arrangement is **NOT** recommended for outdoor reset applications. The reset temperature will constantly change DHW water performance.
- 3) The by-pass piping, diverting valve and boiler circulator must be sized using the sizing charts found in Appendix B.
- 4) A domestic hot water priority could be used provided the diversion from the heating system loop does not impact the system heater's performance.
- 5) Closely spaced tees must connect the branch to the larger header. The Tee centerlines must be no greater than 4 times the larger header pipe diameter.
- 6) The diverting valve, V1, must be no greater than 11 linear feet of pipe from the Return Sensor, S1.
- 7) There shall be a **MINIMUM** of 4 linear feet of pipe between the By-pass Mix Point, M1, and the Return Sensor, S1.
- 8) The balancing valve in the boiler return line, V2, may be necessary in low head by-pass loop applications.
- 9) The indirect heater aquastat (A1) is a normally closed switch. Circuit breaks on temperature rise.
- 10) Expansion tanks, air scoops and other components left out for clarity.
- 11) Observe all applicable plumbing and electrical codes.

***This diagram is for reference only. The installer or designer is responsible for the proper selection and design of the system.***



#### A4. 3-way RTC in Primary/Secondary – Heating and DHW using Indirect Water Heater on Primary Loop; without Outdoor Reset (ELECTRICAL)

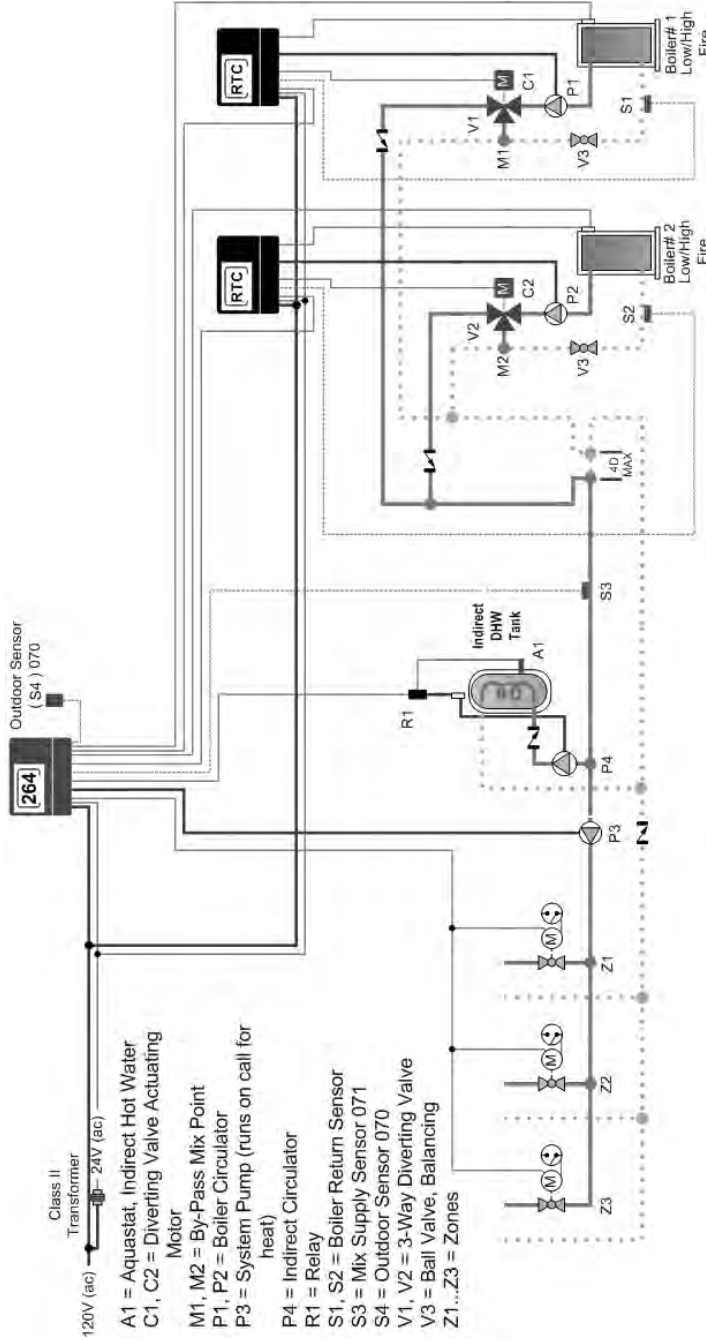


#### NOTES:

- 1) Refer to the I&O to determine correct valve orientation and actuator wiring.
- 2) 120 VAC supplying the RTC should be separate from the burner/boiler circuit.
- 3) Heat demand can be any electrical signal consisting of 24 – 240 VAC.
- 4) Use isolation relays for circulators greater than 1/3 HP. Use motor starters for 3 phase circulators.
- 5) System Pump (P3) to be operated by zone relay or other installer supplied device.

***This diagram is for reference only. The installer or designer is responsible for the proper selection and design of the system.***

### A5. 3-way Multiple Boiler RTC in Primary/Secondary – Heating and DHW using Indirect Water Heater on Primary Loop; Using Sequencer with & without Outdoor Reset (MECHANICAL)

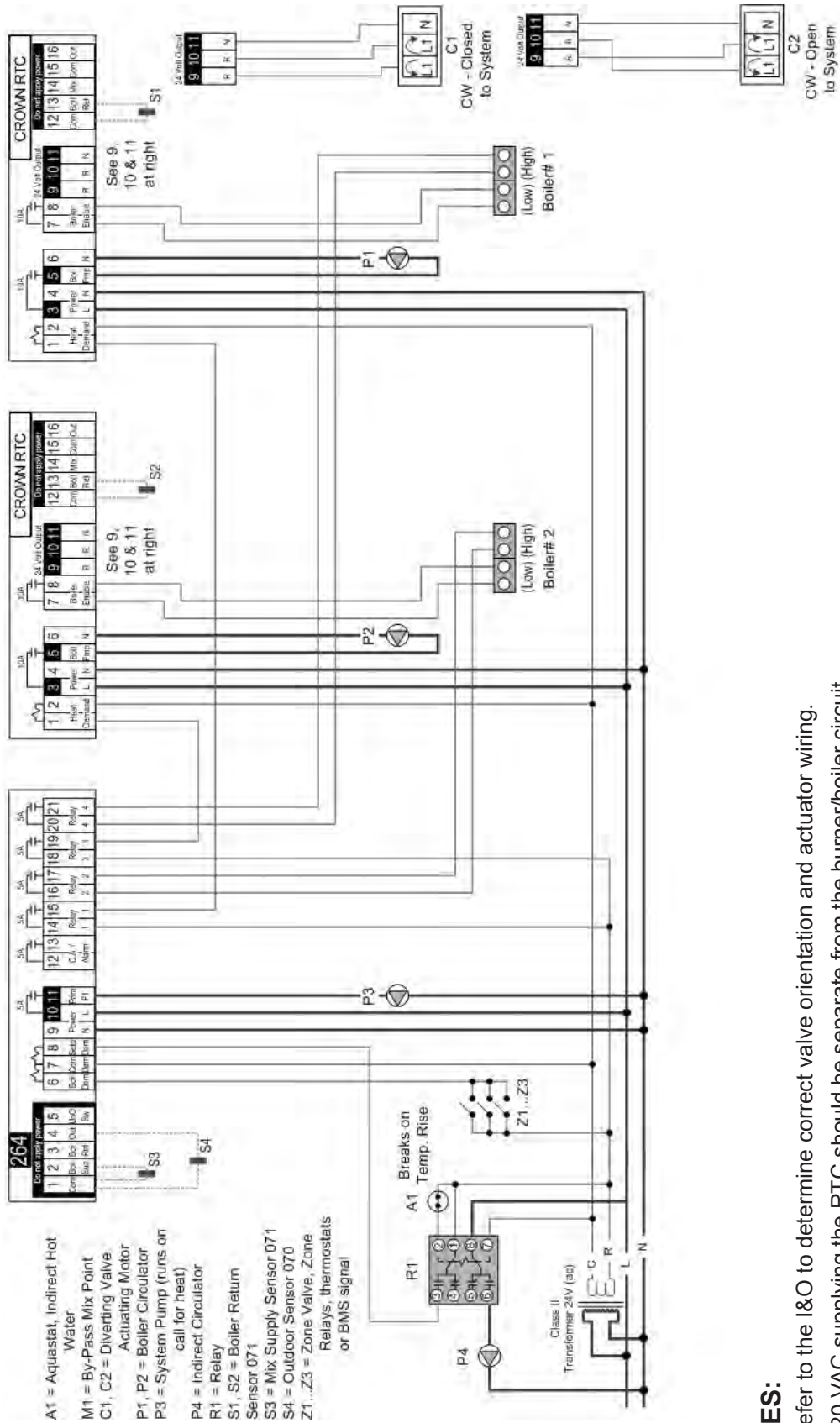


#### NOTES:

- 1) Install the boiler as indicated above for systems where return temperatures may be less than 135F and heating/DHW with an indirect water heater.
- 2) The Outdoor Sensor (S4) and the Mix Supply Sensor (S3) are required when the Outdoor Reset feature is selected. An appropriate sequencer must also be selected. The mix sensor must be installed 10 pipe diameters downstream of the system pump, in the primary loop. The mix sensor must be secured to the surface of the pipe using a wire tie or similar device.
- 3) The by-pass piping, diverting valve and boiler circulator must be sized using the sizing charts found in Appendix B.
- 4) A domestic hot water priority could be used provided the diversion from the heating system loop does not impact the system heater's performance.
- 5) Closely spaced tees must connect the branch to the larger header. The Tee centerlines must be no greater than 4 times the larger header pipe diameter.
- 6) The diverting valves, V1 & V2, must be no greater than 11 linear feet of pipe from the Return Sensors, S1 & S2.
- 7) There shall be a **MINIMUM** of 4 linear feet of pipe between the By-pass Mix Points, M1 & M2, and the Return Sensors, S1 & S2.
- 8) The balancing valves in the boiler return lines, V3, may be necessary in low head by-pass loop applications.
- 9) The indirect heater aquastat (A1) is a normally closed switch. Circuit breaks on temperature rise.
- 10) Expansion tanks, air scoops and other components left out for clarity.
- 11) Observe all applicable plumbing and electrical codes.

***This diagram is for reference only. The installer or designer is responsible for the proper selection and design of the system.***

## A5. 3-way Multiple Boiler RTC in Primary/Secondary – Heating and DHW using Indirect Water Heater on Primary Loop; Using Sequencer with & without Outdoor Reset (ELECTRICAL)



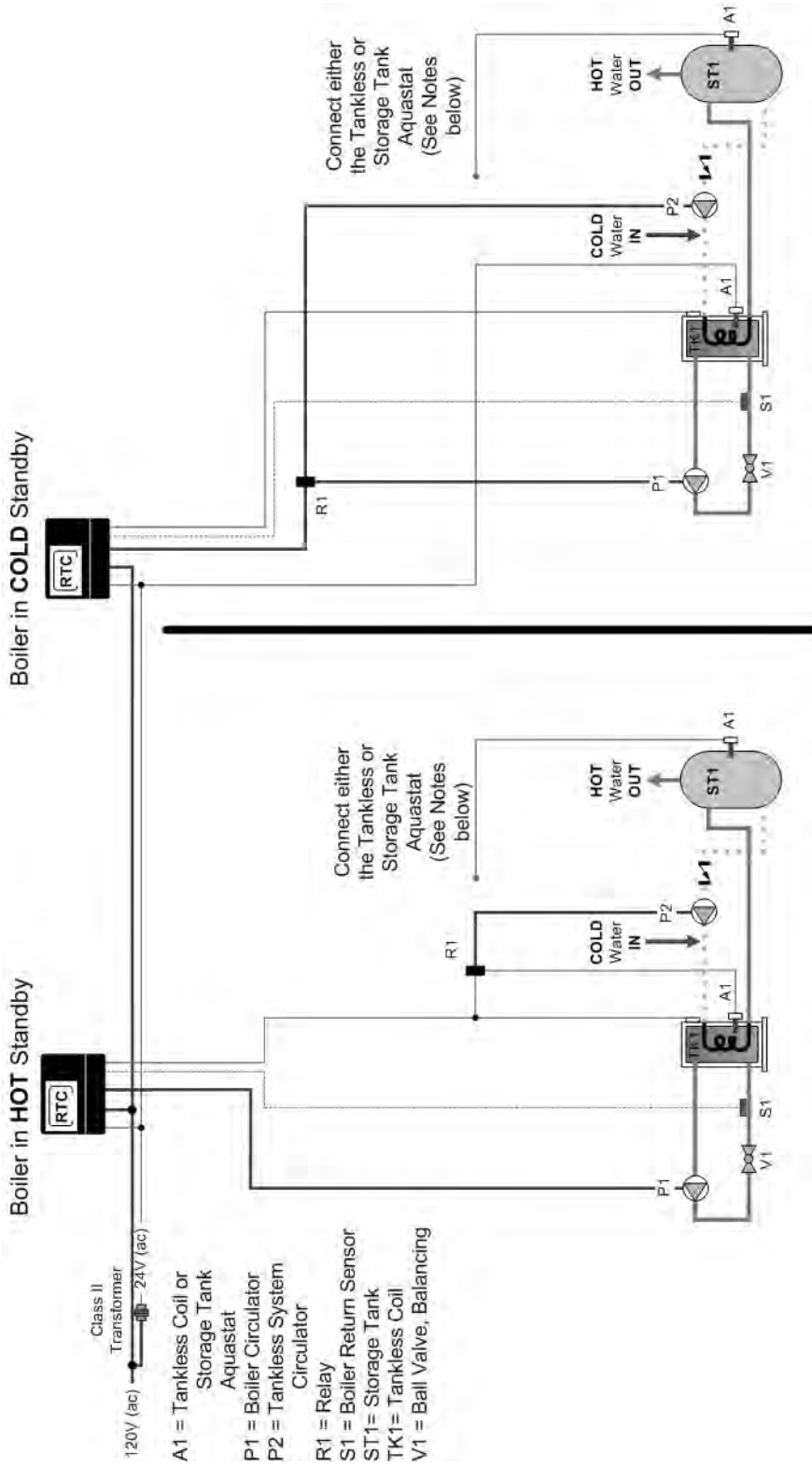
A1 = Aquastat, indirect Hot Water.  
 M1 = By-Pass Mix Point  
 C1, C2 = Diverting Valve  
 P1, P2 = Actuating Motor  
 P3 = System Pump (runs on call for heat)  
 P4 = Indirect Circulator  
 R1 = Relay  
 S1, S2 = Boiler Return Sensor 071  
 S3 = Mix Supply Sensor 071  
 S4 = Outdoor Sensor 070  
 Z1...Z3 = Zone Valve, Zone Relays, thermostats or BMS signal

### NOTES:

- 1) Refer to the I&O to determine correct valve orientation and actuator wiring.
- 2) 120 VAC supplying the RTC should be separate from the burner/boiler circuit.
- 3) Heat demand can be any electrical signal consisting of 24 – 240 VAC.
- 4) Use isolation relays for circulators greater than 1/3 HP. Use motor starters for 3 phase circulators.
- 5) System Pump (P3) to be operated by zone relay or other installer supplied device.

***This diagram is for reference only. The installer or designer is responsible for the proper selection and design of the system.***

## A6. Tankless Application Only with RTC – NO Building Heat; with and without storage tank (MECHANICAL)



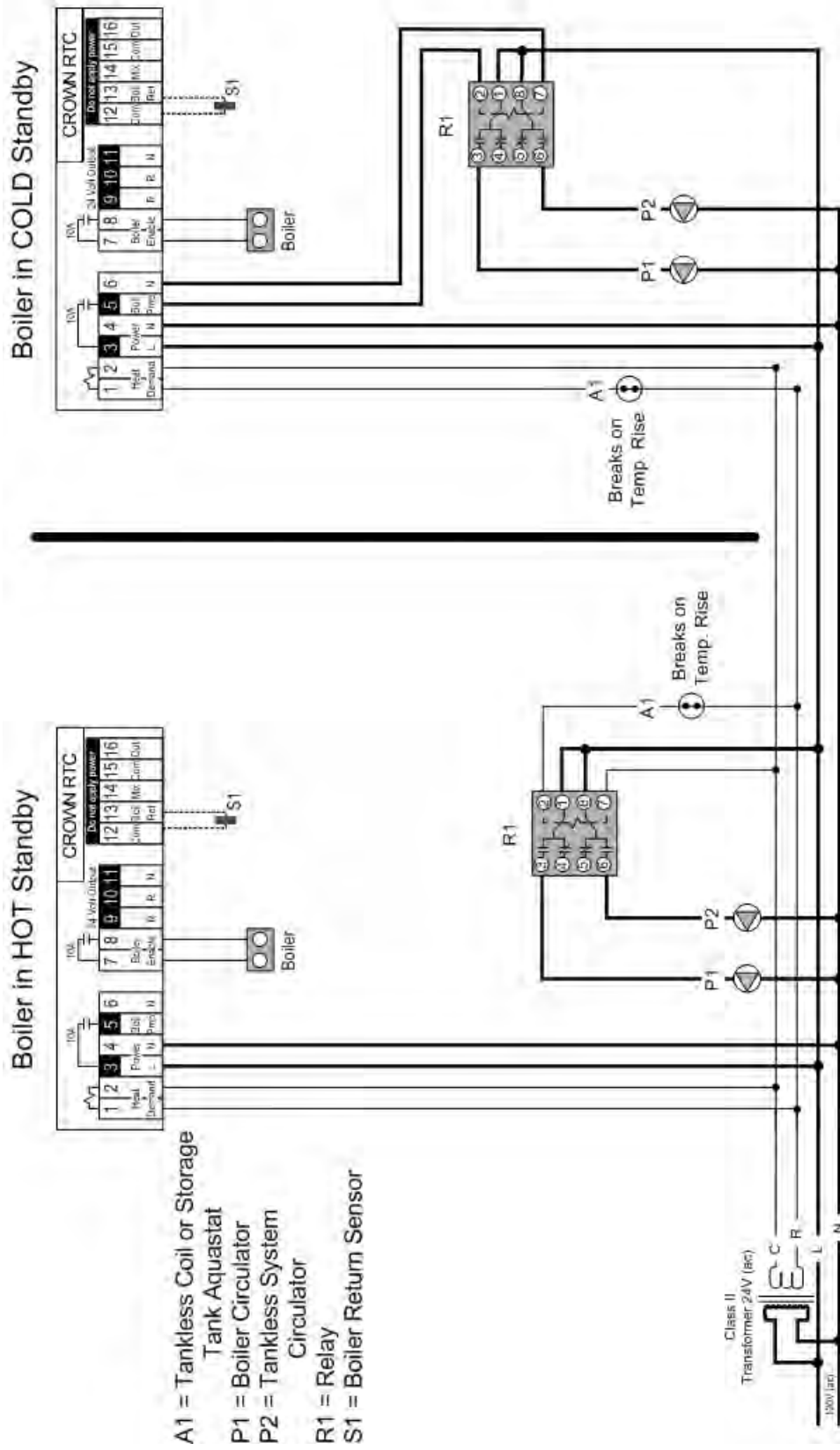
### NOTES:

- 1) Install the boiler as indicated above for systems where the boiler return temperatures may be less than 135F and heating DHW with a tankless coil.
- 2) The boiler circulator must be sized using the sizing charts found in Appendix B.
- 3) The return sensor, S1, shall be installed at the return of the boiler. The boiler circulator may be located anywhere within the recirculation loop.
- 4) The balancing valve in the boiler return line, V1, may be necessary in low head by-pass loop applications.
- 5) Domestic Hot Water must be tempered for safe usage. The tankless aquastat and/or a storage tank aquastat (A1) are normally closed switches. Circuit breaks on temperature rise.
- 6) Expansion tanks, air scoops and other components left out for clarity.
- 7) Observe all applicable plumbing and electrical codes.

***This diagram is for reference only. The installer or designer is responsible for the proper selection and design of the system.***



## A6. Tankless Application Only with RTC – NO Building Heat; with and without storage tank (ELECTRICAL)

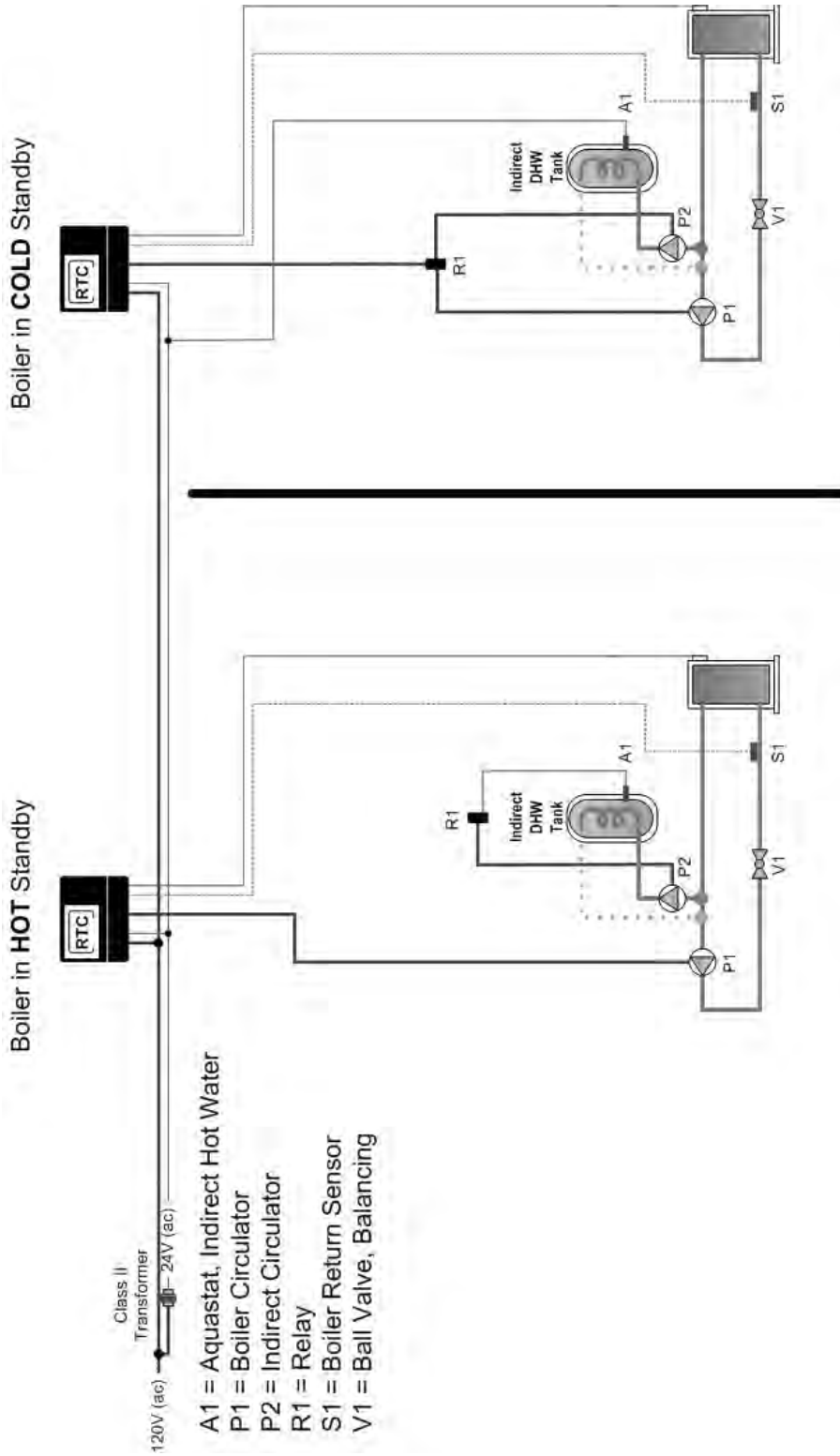


### NOTES:

- 1) Refer to the I&O to determine correct valve orientation and actuator wiring.
- 2) 120 VAC supplying the RTC may or may not be separate from the burner/boiler circuit.
- 3) Heat demand can be any electrical signal consisting of 24 – 240 VAC.
- 4) Use isolation relays for circulators greater than 1/3 HP. Use motor starters for 3 phase circulators.
- 5) In COLD STANDBY applications, set the "OPEN DELAY" variable to 30 seconds.

***This diagram is for reference only. The installer or designer is responsible for the proper selection and design of the system.***

## A7. Indirect Application Only with RTC – NO Building Heat (MECHANICAL)



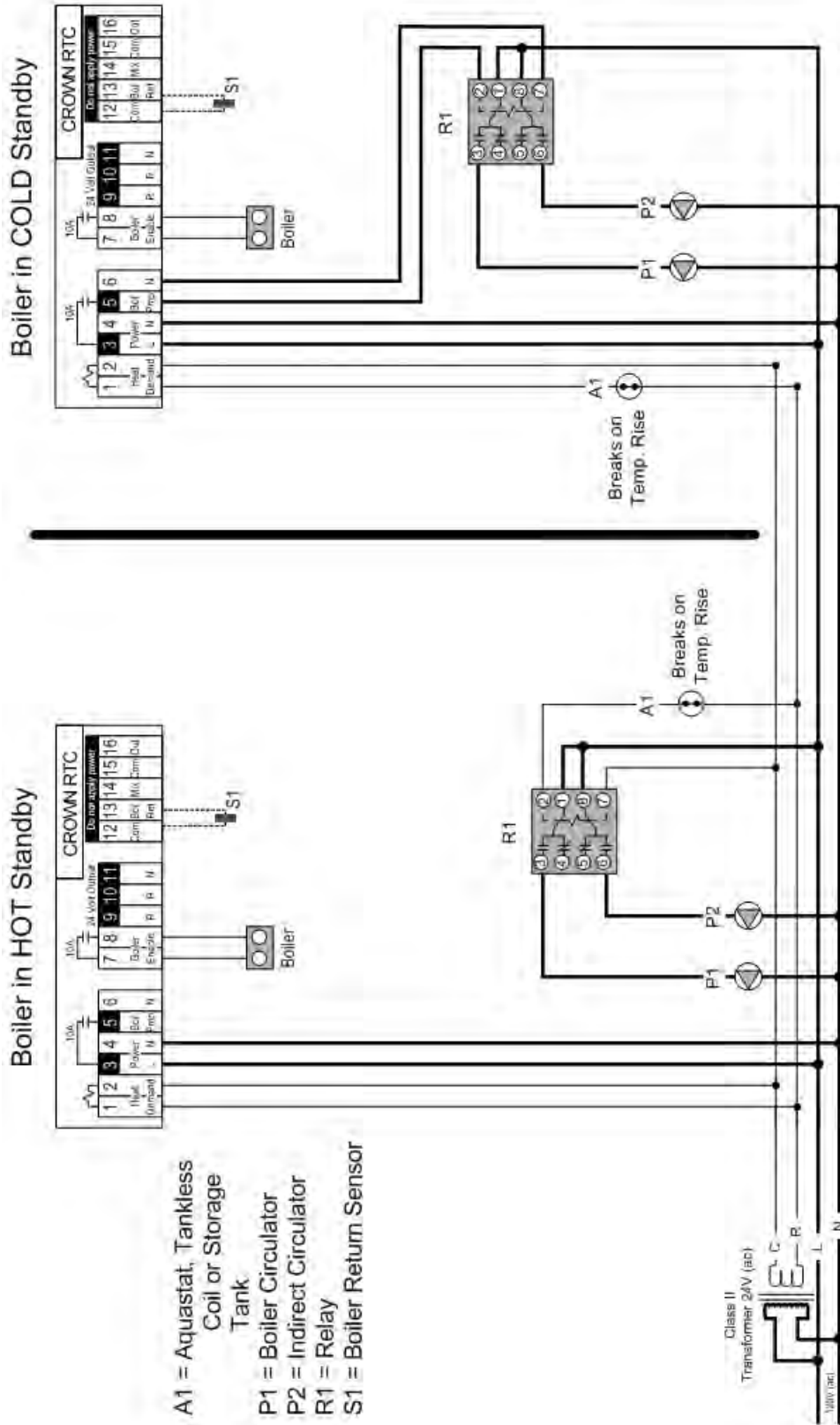
### NOTES:

- 1) Install the boiler as indicated above for systems where the boiler return temperatures may be less than 135F and heating DHW with an indirect water heater or heat exchanger.
- 2) The boiler circulator must be sized using the sizing charts found in Appendix B.
- 3) The return sensor, S1, shall be installed at the return of the boiler. The boiler circulator may be located anywhere within the recirculation loop.
- 4) The balancing valve in the boiler return line, V1, may be necessary in low head by-pass loop applications.
- 5) The indirect heater aquastat (A1) is a normally closed switch. Circuit breaks on temperature rise.
- 6) Expansion tanks, air scoops and other components left out for clarity.
- 7) Observe all applicable plumbing and electrical codes.

***This diagram is for reference only. The installer or designer is responsible for the proper selection and design of the system.***



## A7. Indirect Application Only with RTC – NO Building Heat (ELECTRICAL)



A1 = Aquastat, Tankless Coil or Storage Tank  
P1 = Boiler Circulator  
P2 = Indirect Circulator  
R1 = Relay  
S1 = Boiler Return Sensor

### NOTES:

- 1) Refer to the I&O to determine correct valve orientation and actuator wiring.
- 2) 120 VAC supplying the RTC may or may not be separate from the burner/boiler circuit.
- 3) Heat demand can be any electrical signal consisting of 24 – 240 VAC.
- 4) Use isolation relays for circulators greater than 1/3 HP. Use motor starters for 3 phase circulators.
- 5) In COLD STANDBY applications, set the "OPEN DELAY" variable to 30 seconds.

***This diagram is for reference only. The installer or designer is responsible for the proper selection and design of the system.***

**APPENDIX B1 - Series 24 Boiler Circulator and Diverting Valve Selection Chart, 20°F & 40°F DT, TACO**

Series 24 Boiler Circulator Selection - TACO (20°F Differential)									
SIZE	IBR GROSS OUTPUT (MBH)	TOTAL GPM	Pipe Size	Boiler Recirculation 3-Way		TACO Circulating Pump			
				Valve Size	Valve Part Number	Model No.	Imp "	HP	RPM
24-03	342	35	2.0"	1.5" NPT	330852	IL 111	N/A	1/8	1725
24-04	471	48	2.0"	1.5" NPT	330852	1615	4.7"	1/3	1750
24-05	634	65	2.0"	2" NPT	330853	1611	4.5"	1/3	1750
24-06	797	81	2.5"	*2.5" Flange	330854	KV2006	4.3"	**1	1750
24-07	937	96	2.5"	*2.5" Flange	330854	1635	4.5"	**1/2	1750
24-08	1087	111	2.5"	*2.5" Flange	330854	1635	4.9"	**3/4	1750
24-09	1316	134	3.0"	2.5" Flange	330855	KV3006	4.7"	**1	1750
24-10	1505	153	3.0"	2.5" Flange	330855	KV3006	5.0"	**1	1750
24-11	1690	171	3.0"	2.5" Flange	330855	KV3006	5.3"	**1	1750
24-12	1852	190	4.0"	3.0" Flange	330856	KV3007	5.6"	**1	1750

\*Model F165-50 2½" 3-way valve.

\*\*Use Additional Relay for Single Phase Power. Use Motor Starter for 3 Phase Power.

Series 24 Boiler Circulator Selection - TACO (40°F Differential)									
SIZE	IBR GROSS OUTPUT (MBH)	TOTAL GPM	Pipe Size	Boiler Recirculation 3-Way		TACO Circulating Pump			
				Valve Size	Valve Part Number	Model No.	Imp "	HP	RPM
24-03	342	17	1.5"	1.0" NPT	330850	007	N/A	1/25	3250
24-04	471	24	1.5"	1.25" NPT	330851	0010	N/A	1/8	3250
24-05	634	32	1.5"	1.5" NPT	330852	111C	N/A	1/8	1725
24-06	797	40	1.5"	1.5" NPT	330852	121C	N/A	1/4	1725
24-07	937	48	2.0"	2.0" NPT	330853	120C	N/A	1/6	1725
24-08	1087	56	2.0"	2.0" NPT	330853	1611	4.1"	1/4	1750
24-09	1316	67	2.0"	2.0" NPT	330853	122C	N/A	1/4	1725
24-10	1505	76	2.5"	*2.5" Flange	330854	121C	N/A	1/4	1725
24-11	1690	86	2.5"	*2.5" Flange	330854	131	N/A	1/3	1725
24-12	1852	95	2.5"	*2.5" Flange	330854	1635	4.5"	**1/2	1750

\*Model F165-50 2½" 3-way valve.

\*\*Use Additional Relay for Single Phase Power. Use Motor Starter for 3 Phase Power.

**APPENDIX B2 - Series 24 Boiler Circulator and Diverting Valve Selection Chart, 20°F & 40°F ΔT, Grundfos**

Series 24 Boiler Circulator Selection - Grundfos (20°F Differential)									
SIZE	IBR GROSS OUTPUT (MBH)	TOTAL GPM	Pipe Size	Boiler Recirculation 3-Way		Grundfos Circulating Pump			
				Valve Size	Valve Part Number	Model No.	Imp "	HP	RPM
24-03	342	35	2.0"	1.5" NPT	330852	UPS32-40/4	3.39	1/3	1667
24-04	471	48	2.0"	1.5" NPT	330852	UPS32-80/2	2.52	**1/2	3400
24-05	634	65	2.0"	2" NPT	330853	UPS40-80/4	4.86	**1/2	1587
24-06	797	81	2.5"	*2.5" Flange	330854	UPS40-80/4	4.86	**1/2	1587
24-07	937	96	2.5"	*2.5" Flange	330854	UPS50-80/4	4.97	**3/4	1607
24-08	1087	111	2.5"	*2.5" Flange	330854	UPS50-80/2	2.91	**3/4	3426
24-09	1316	134	3.0"	2.5" Flange	330855	TP80-40/4	3.73	**1/2	1750
24-10	1505	153	3.0"	2.5" Flange	330855	TP100-40/4	4.10	**1	1750
24-11	1690	171	3.0"	2.5" Flange	330855	TP100-40/4	4.10	**1	1750
24-12	1852	190	4.0"	3.0" Flange	330856	TP100-80/4	5.24	**2	1750

\*Model F165-50 2½" 3-way valve.

\*\*Use Additional Relay for Single Phase Power. Use Motor Starter for 3 Phase Power.

Series 24 Boiler Circulator Selection - Grundfos (40°F Differential)									
SIZE	IBR GROSS OUTPUT (MBH)	TOTAL GPM	Pipe Size	Boiler Recirculation 3-Way		Grundfos Circulating Pump			
				Valve Size	Valve Part Number	Model No.	Imp "	HP	RPM
24-03	342	17	1.5"	1.0" NPT	330850	UPS32-40/4	3.39	1/3	1594
24-04	471	24	1.5"	1.25" NPT	330851	UPS32-40/4	3.39	1/3	1667
24-05	634	32	1.5"	1.5" NPT	330852	UPS32-40/4	3.39	1/3	1712
24-06	797	40	1.5"	1.5" NPT	330852	UPS32-80/2	2.52	**1/2	3400
24-07	937	48	2.0"	2.0" NPT	330853	UPS32-80/2	2.52	**1/2	3400
24-08	1087	56	2.0"	2.0" NPT	330853	UPS40-80/4	4.86	**1/2	1450
24-09	1316	67	2.0"	2.0" NPT	330853	UPS40-80/4	4.86	**1/2	1587
24-10	1505	76	2.5"	*2.5" Flange	330854	UPS40-80/4	4.86	**1/2	1587
24-11	1690	86	2.5"	*2.5" Flange	330854	UPS40-80/4	4.86	**1/2	1688
24-12	1852	95	2.5"	*2.5" Flange	330854	UPS50-80/4	4.97	**3/4	1607

\*Model F165-50 2½" 3-way valve.

\*\*Use Additional Relay for Single Phase Power. Use Motor Starter for 3 Phase Power.

**APPENDIX B3 - Series 24 Boiler Circulator and Diverting Valve Selection Chart, 20°F & 40°F ΔT, Bell and Gossett**

Series 24 Boiler Circulator Selection - Bell and Gossett (20°F Differential)									
SIZE	IBR GROSS OUTPUT (MBH)	TOTAL GPM	Pipe Size	Boiler Recirculation 3-Way		Bell and Gossett Circulating Pump			
				Valve Size	Valve Part Number	Model No.	Imp "	HP	RPM
24-03	342	35	2.0"	1.5" NPT	330852	PL-36 - 1.5"	Std.	1/6	3300
24-04	471	48	2.0"	1.5" NPT	330852	PL-75 - 2"	Std.	1/6	3400
24-05	634	65	2.0"	2" NPT	330853	PL-130 - 2"	Std.	**2/5	3200
24-06	797	81	2.5"	*2.5" Flange	330854	PL-130 - 2"	Std.	**2/5	3200
24-07	937	96	2.5"	*2.5" Flange	330854	PL-130 - 2"	Std.	**2/5	3200
24-08	1087	111	2.5"	*2.5" Flange	330854	Ser. 60, Mod. 610 - 2"	4"	**1/2	1750
24-09	1316	134	3.0"	2.5" Flange	330855	Ser. 60, Mod. 610 - 2"	4"	**1/2	1750
24-10	1505	153	3.0"	2.5" Flange	330855	Ser. 80, Mod. 3x3x7B	5"	**1	1750
24-11	1690	171	3.0"	2.5" Flange	330855	Ser. 80, Mod. 3x3x7B	5"	**1	1750
24-12	1852	190	4.0"	3.0" Flange	330856	Ser. 80, Mod. 3x3x7B	5"	**1	1750

\*Model F165-50 2½" 3-way valve.

\*\*Use Additional Relay for Single Phase Power. Use Motor Starter for 3 Phase Power.

Series 24 Boiler Circulator Selection - Bell and Gossett (40°F Differential)									
SIZE	IBR GROSS OUTPUT (MBH)	TOTAL GPM	Pipe Size	Boiler Recirculation 3-Way		Bell and Gossett Circulating Pump			
				Valve Size	Valve Part Number	Model No.	Imp "	HP	RPM
24-03	342	17	1.5"	1.0" NPT	330850	NRF-33	Std.	1/15	2950
24-04	471	24	1.5"	1.25" NPT	330851	PL-36	Std.	1/6	3300
24-05	634	32	1.5"	1.5" NPT	330852	PL-36	Std.	1/6	3300
24-06	797	40	1.5"	1.5" NPT	330852	PL-45	Std.	1/6	3300
24-07	937	48	2.0"	2.0" NPT	330853	PL-75	Std.	1/6	3400
24-08	1087	56	2.0"	2.0" NPT	330853	PL-75	Std.	1/6	3400
24-09	1316	67	2.0"	2.0" NPT	330853	PL-130 - 2"	Std.	**2/5	3200
24-10	1505	76	2.5"	*2.5" Flange	330854	PL-130 - 2"	Std.	**2/5	3200
24-11	1690	86	2.5"	*2.5" Flange	330854	PL-130 - 2"	Std.	**2/5	3200
24-12	1852	95	2.5"	*2.5" Flange	330854	PL-130 - 2"	Std.	**2/5	3200

\*Model F165-50 2½" 3-way valve.

\*\*Use Additional Relay for Single Phase Power. Use Motor Starter for 3 Phase Power.

**APPENDIX B4 - Series 24 Boiler Circulator and Diverting Valve Selection Chart, 20°F & 40°F ΔT,  
Armstrong**

Series 24 Boiler Circulator Selection - Armstrong (20°F Differential)									
SIZE	IBR GROSS OUTPUT (MBH)	TOTAL GPM	Pipe Size	Boiler Recirculation 3-Way		Armstrong Circulating Pump			
				Valve Size	Valve Part Number	Model No.	Imp "	HP	RPM
24-03	342	35	2.0"	1.5" NPT	330852	E-10	Full	1/6	---
24-04	471	48	2.0"	1.5" NPT	330852	S-45	3.875	1/4	1800
24-05	634	65	2.0"	2" NPT	330853	S-46	4.25	1/3	1200
24-06	797	81	2.5"	*2.5" Flange	330854	S-46	4.25	1/3	1200
24-07	937	96	2.5"	*2.5" Flange	330854	4380 3 x 3 x 6	5.04	1/3	1200
24-08	1087	111	2.5"	*2.5" Flange	330854	4380 3 x 3 x 6	5.567	**1/2	1200
24-09	1316	134	3.0"	2.5" Flange	330855	4380 3 x 3 x 6	5.23	1/3	1200
24-10	1505	153	3.0"	2.5" Flange	330855	4380 4 x 4 x 6	4.971	**1/2	1200
24-11	1690	171	3.0"	2.5" Flange	330855	4380 4 x 4 x 6	5.371	**1/2	1200
24-12	1852	190	4.0"	3.0" Flange	330856	4380 4 x 4 x 6	4.891	**1/2	1200

\*Model F165-50 2½" 3-way valve.

\*\*Use Additional Relay for Single Phase Power. Use Motor Starter for 3 Phase Power.

Series 24 Boiler Circulator Selection - Armstrong (40°F Differential)									
SIZE	IBR GROSS OUTPUT (MBH)	TOTAL GPM	Pipe Size	Boiler Recirculation 3-Way		Armstrong Circulating Pump			
				Valve Size	Valve Part Number	Model No.	Imp "	HP	RPM
24-03	342	17	1.5"	1.0" NPT	330850	S-25	2.75	1/6	1800
24-04	471	24	1.5"	1.25" NPT	330851	S-25	2.75	1/12	1800
24-05	634	32	1.5"	1.5" NPT	330852	E-8	Full	1/6	3600
24-06	797	40	1.5"	1.5" NPT	330852	S-35	3.375	1/6	1800
24-07	937	48	2.0"	2.0" NPT	330853	S-46	3.375	1/4	1800
24-08	1087	56	2.0"	2.0" NPT	330853	S-45	3.875	1/4	1800
24-09	1316	67	2.0"	2.0" NPT	330853	S-46	3.875	1/3	1800
24-10	1505	76	2.5"	*2.5" Flange	330854	4380 3 x 3 x 6	4.998	1/3	1200
24-11	1690	86	2.5"	*2.5" Flange	330855	4380 3 x 3 x 6	4.677	1/3	1200
24-12	1852	95	2.5"	*2.5" Flange	330856	4380 3 x 3 x 6	5.019	1/3	1200

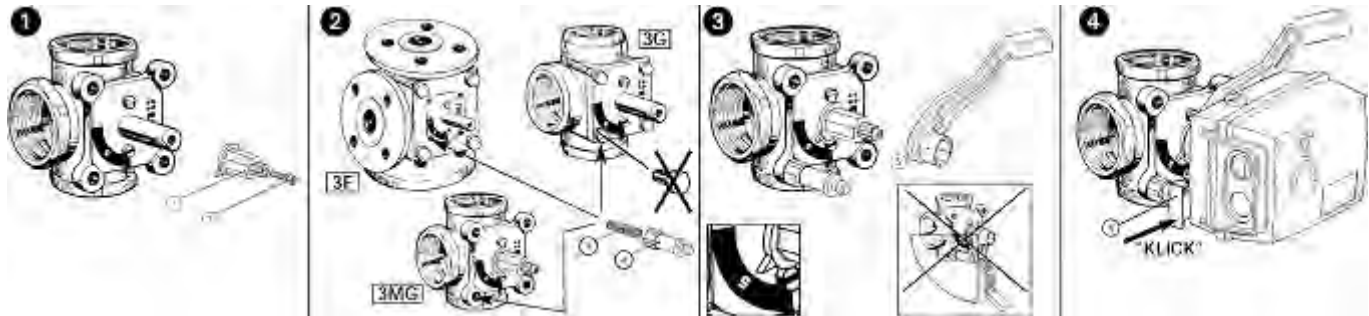
\*Model F165-50 2½" 3-way valve.

# APPENDIX C – VALVE AND ACTUATOR MOUNTING INSTRUCTIONS

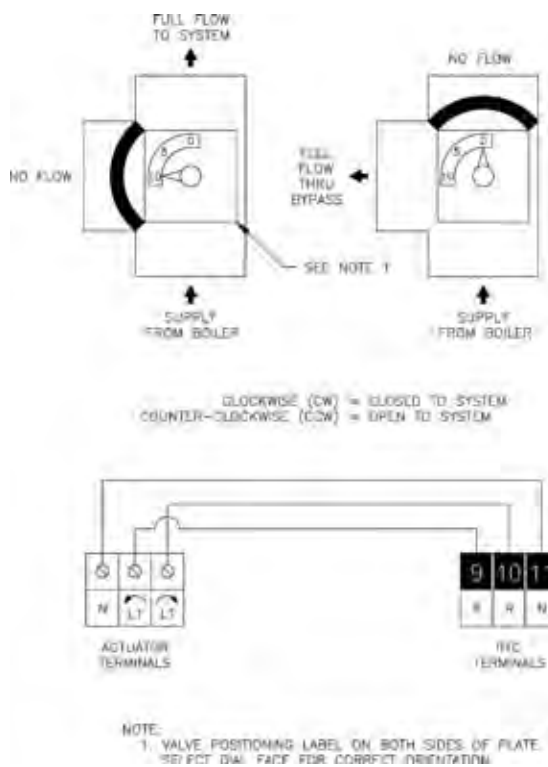
## Application

For use with ESBE 1/2" to 6" 3-Way and 4-Way rotary valves for mixing and diverting applications. Use with 24Vac 3-point "floating" signal controller.

## Mounting the Motor

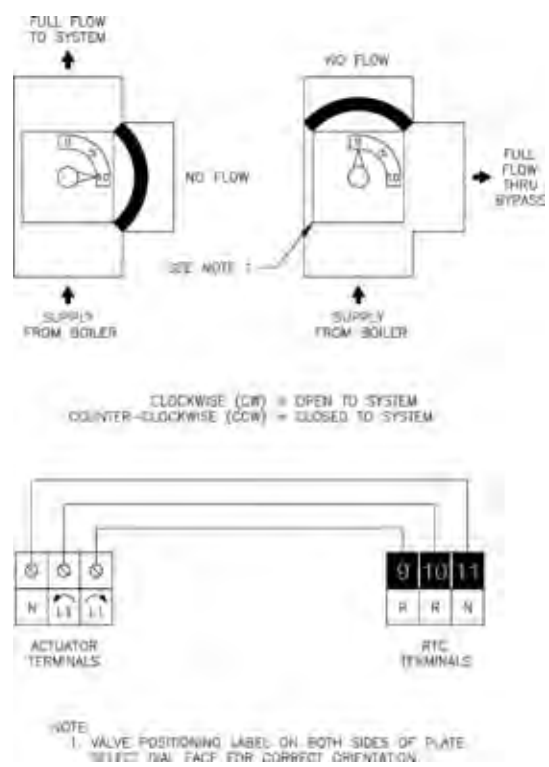


1. Place drive sleeve ① onto shaft and secure with bolt ②. Check that the valve is in mid-position (sleeve pointer set to position 5 on scale plate).
2. Mount threaded stud ③ in one of the threaded holes. For 1½" and 2" valves replace one of the cover bolts with the threaded rod. Tighten mounting piece ④ onto threaded rod.
3. Mount handle ⑤ over drive sleeve set pointer to 5 on the scale plate. Handle must be mounted opposite to the pointer of the drive sleeve.
4. Mount motor onto sleeve so that the mounting piece m fits into the locking piece o. Push locking piece to lock in place. Labels are supplied to indicate the direction of rotation. Determine the direction of rotation and mount the correct label under the plastic front cover of motor.



## Manual Operation

**Always disconnect power before operating by hand.** Note position of drive sleeve pointer to be returned to. Depress the gray button, "A", on the side to release the handle. The valve can now be operated manually. **Never manually operate when gears are engaged.**



## Adjusting Cams

The position of the cams is changed by fitting a screwdriver in the slot and moving the cam to the desired position. The topmost cam operates the auxiliary switch (upper switch – NOT USED). The middle and lower cams determine the degree of rotation (30° to 180°). To access, remove the actuator cover to gain access to the middle and lower cams. The valve rotation must be set before operation can begin. Adjust the cam so that each end switch is made when the valve is fully open (pointer towards "0") and when the valve is fully closed (pointer towards "10"). Depress the "Test" switch on the RTC control to test for proper valve operation.







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