INSTRUCTION MANUAL

FOR

INDOOR & OUTDOOR **RITE**
POWER BURNER FIRED*
BOILERS

70 Horsepower 125 PSi Hot Water Boiler

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Read instructions carefully before proceeding with installation and operation.
Post and maintain instructions in legible condition.

*Excludes Durafin Boilers. Please check website for updates and addendas to the manual.

09/2012

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SAFETY WARNING NOTICES:

Your physical safety and the safety of others is very important. Throughout this manual we have provided safety warning notices to alert you to potential safety hazards. A safety notice will be preceded by:

DANGER ***IT MEANS:*** You CAN be **KILLED** or **SERIOUSLY HURT** if you don't follow instructions.

EQUIPMENT WARRANTY NOTICES:

When properly installed, operated and maintained, Rite Boilers can easily offer forty or more years of service. Throughout this manual we have provided equipment warranty notices to alert you to potential practices that could lead to premature repairs. An equipment warranty notice will be preceded by:

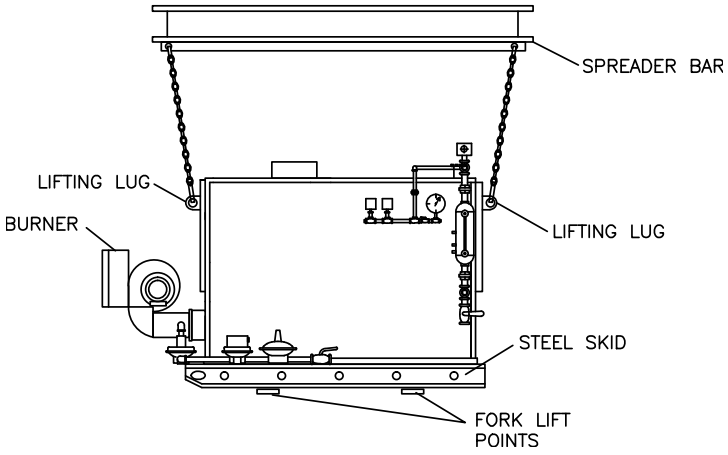
CAUTION ***IT MEANS:*** Failure to follow these instructions will void warranty and may lead to premature repairs.

RECEIVING

1. Before signing Bill of Lading, check for any signs of external damage. Be sure you have received all the pieces noted on the bill. Barometric Dampers are shipped loose.

2. **DANGER** Offload the boiler as shown in **Figure 1.** Follow safe rigging procedures and use load rated equipment.

Figure 1



CAUTION Forklift underneath base only if forks are long enough to extend rail-to-rail (Dimension B in catalogs).

3. **CAUTION** Place the boiler gently onto a firm, level surface. Hard drops, or rigging the boiler on its side unless pre-approved, can cause damage.

STORAGE

1. If the boiler is temporarily stored outdoors it must be completely protected from the elements by a tarp or other means.

2. Keep the Barometric Damper and any other equipment shipped loose with the boiler, otherwise they have a way of becoming lost.

3. Leave plastic cap plugs in place and keep debris from entering boiler stack(s) and plumbing connections.

PLACEMENT

1. Boiler may be placed directly onto pad as shown in **Figure 1** or moved on rollers as shown below in **Figure 2**:

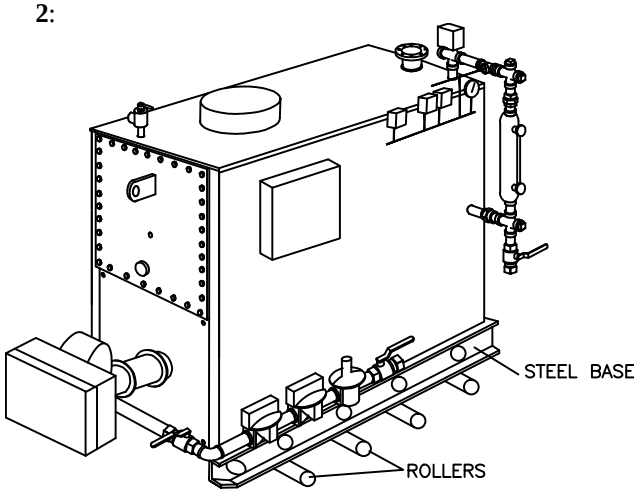


Figure 2

2. The boiler must be installed on a level, concrete housekeeping pad or other approved non-combustible surface that has been engineered to support the operating weight of the boiler.

3. If the boiler was shipped on a wooden skid, remove the skid prior to final placement on the pad.

4. When anchoring the boiler to the pad observe the following:

   4.1 See job specification for any special seismic anchorage requirements.

   4.2 If in doubt, contact your local Building & Safety Dept. or a qualified mechanical engineer for assistance.

   4.3 Refer to appropriate Rite brochure for boiler weights, water content and dimensions.

   4.4 Boilers not shipped on wooden skids will require anchor plates (by others).

5. When installing on a concrete pad be sure the pad is big enough in length and width. The minimum requirement is that the pad must extend beyond the anchor plate holes by at least six (6) times the anchor bolt diameter. (See **Figure 3** on the next page).

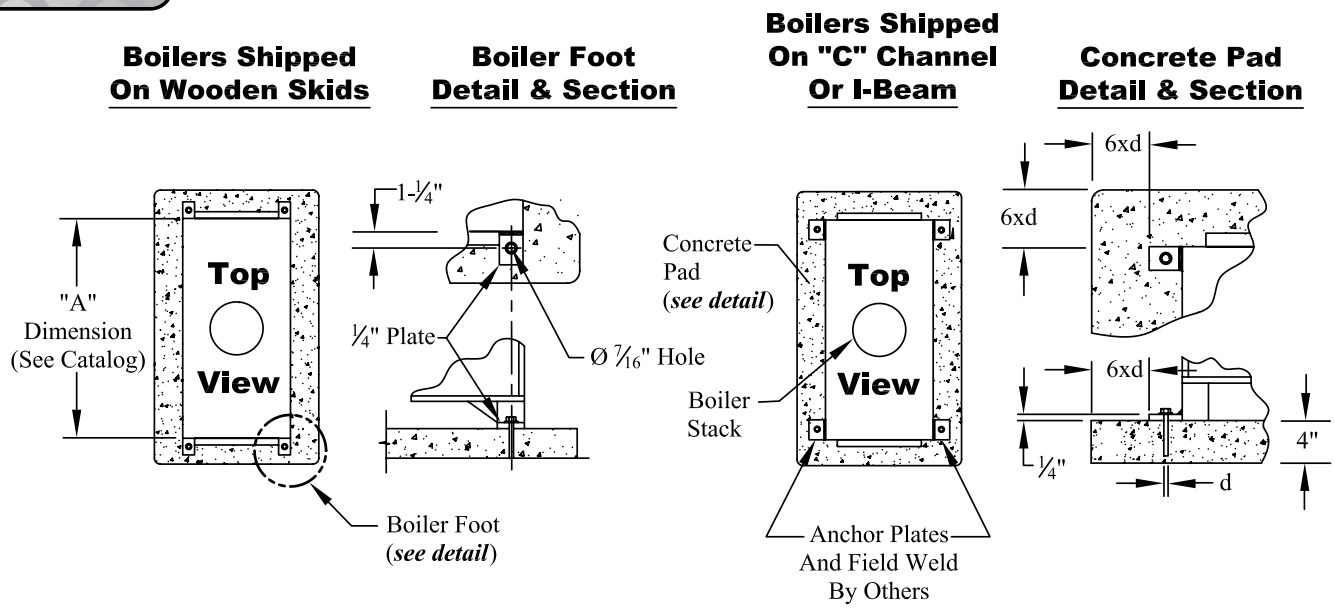


Figure 3

INSTALLATION

General

1. In most cases the installation will be carried out by a licensed contractor who must pull the required permits before starting the job. Before the boiler is started up, all the work permits should be signed off.

2. The installing contractor must carry out the work according to state and local codes which may exceed nationally recognized codes such as the Uniform Mechanical Code, Uniform Plumbing Code, National Fire Protection Agency, ASME CSD-1, National Electric Code, etc. Additional insurance requirements or job specifications may also be required. For example, it is mandatory that Section I Boilers are piped up in part by an ASME stamp holder in accordance with B31.1 of the ASME Power Piping Code.

3. Always lay out and install the largest components first. Start with the stack system and combustion air ducts, followed by the water or steam mains next and do the smallest diameter runs like water make-up and drain lines last. Plan carefully. The best installations are those where the largest components are run as straight and direct as possible.

Combustion / Ventilation Air

1. Provide at least 1/2 square feet of free air opening from outside for every 1 million btuh of maximum rated input for combustion. Check local codes for exceptions.

2. Provide the same size opening at a high point in the room for ventilation.

3. If additional ventilation is required it is better to force air into the room. Avoid exhaust fans whenever possible.

4. Louvers can significantly reduce free air openings. If the free area is not known, it shall be assumed that:

   4.1 Fixed wood louvers will have 20-25% free air opening.
   4.2 Fixed Metal louvers will have 60-70% free air opening.
   4.3 Metal mesh screen (minimum 1/4") will have 98% free air opening.
   4.4 Blade type motorized Combustion Air Dampers (CAD) will have 95% free air opening.

5. Doors and windows that can be closed *are not* considered to be a source for combustion or ventilation air.

6. When combustion air dampers are used, make sure an electrical interlock (end switch) proves the dampers are fully open before the boiler is allowed to fire.

7. **DANGER** Exercise caution anytime a fan is used to exhaust air from a boiler room. Negatively pressurized boiler rooms can cause poor combustion and products of combustion to spill out of the barometric damper into the boiler room. Be sure the air pressure in the boiler room is the same as it is outdoors under all operating conditions.

8. **CAUTION** Determine if the boiler room is next to another equipment room and the two share a common door. If the other equipment room contains air handling equipment, boiler room's air pressure can go negative if the connecting door is left open. In such cases, a door interlock switch must be used to prevent the boiler from firing unless the connecting door is closed.

Draft Control

1. Rite Power Burner Fired Boilers require a slightly negative firebox pressure (-.01" w.c.) at all firing rates. The burner blower motor is therefore required for combustion purposes only and not to force the products of combustion through the boiler and out the stack. Natural draft makes use of the leftover heat going up the stack to create all the draw necessary for proper operation. The barometric damper balances the draft at the vent connector as the stack heats and cools and firing rates change. A slightly greater negative pressure at the vent connector minus the pressure drop through the tube bundle yields the -.01" to -.03" w.c. negative firebox pressure.

2. **CAUTION** The Barometric Damper must be properly installed and adjusted at the jobsite. It should be located as close to the vent connector as practical with the proper offset (See Figure 4).

3. Barometric Dampers must have the right number of washer weights to produce a draft at the vent connector of between **–**.03" to **–**.09" w.c. when firing. Increasing the number of weights makes it harder for the damper gate to open. This results in less dilution air entering the stack, thus increasing the boiler's draft. Too much draft is better than no draft (which can cause sooting and overheating) but keep in mind that too much draft reduces heat transfer efficiency and can pull the flame off the burner head or diffuser to a point where the air/fuel mixture becomes so poor that the flame pulsates and becomes unstable.

4. Factory mounted draft gauges are standard on all boilers. They should be used for adjusting the barometric during start-up and then periodically checked during routine maintenance to make sure the draft stays within range. The fluid will slowly evaporate and must be replenished from time to time. Use only Dwyer .826 Specific Gravity Red gage oil and add with an eyedropper to prevent overfilling.

Stack Requirements

1. Natural gas or propane fired boilers are U .L. listed for use with Type B gas vent provided a barometric damper is installed as shown in Figure 4. Check local codes for exceptions. Type B is double wall stack, widely available from a number of different manufactures. It is relatively inexpensive, easy to install and available in 3" through 30" diameters. Type B vent is suitable for Category 1 appliances only - combustion equipment defined as having net stack temperatures less than 400º F., operating with negative draft to the stack termination and producing non-condensing flue gasses.

   Oil fired boilers, combination gas/oil fired boilers and digester gas boilers cannot use Type B vent. They must use a stack that has Type 316 Stainless Steel inner liner or better to prevent sulfuric acid corrosion. The barometric damper installation requirement is the same, however the red stop hardware on the barometrics for oil firing should not be removed.

2. Refer to gas vent manufacturers catalogs for detailed installation instructions. Most vent manufacturers offer free engineering support for specific job requirements as one of their selling tools. This can take the guesswork out of unconventional stack designs.

3. It is good practice to incorporate a vent support plate for independent stack support and an adjustable length (telescoping) section for future boiler/stack separation. This will facilitate fireside tube cleaning should it ever be required. Terminate Type B vent stack with a B vent rain cap except in those locations where frequent high winds may necessitate a Breidert type cap available from Rite.

4. **CAUTION** A horizontal stack run must not exceed 75% of the vertical stack height (NFPA 54 7.6.1d) without the addition of an engineered mechanical draft system (induced draft fan).

Stack Requirements *continued*

5. **CAUTION** Boiler installations with unavoidable negative air conditions - such as factories with exhaust fans - will generally require engineered mechanical draft systems.

6. **CAUTION** Never reduce the boiler vent connector diameter without written factory approval. Stack size can often be safely reduced at substantial cost savings but only after a review and written approval by either the vent manufacturer or Rite.

7. **CAUTION** If the stack diameter is reduced from the vent connector diameter, the draft gauge "Good" range (green) becomes meaningless because the smaller diameter stack requires a higher CFM and therefore a higher negative static pressure at the vent connector. In order to find the correct draft, remove the 1/8" pipe plus at the rear firebox view port and measure the firebox draft at high fire. It should be between -.01" to -.03 w.c. Adjust the washer weights on the barometric damper until this is achieved and then mark the draft gauge at the vent connector with the new correct setting.

8. Firebox pressure must always remain slightly negative when the boiler is firing. After setting up the burner and draft, always verify firebox pressure with a simple smoke test: Open the front viewport after the boiler has been at high fire for at least ten minutes and provide a smoke source (or something similar) and inch or so from the opening. If the smoke is gently pulled in, the draft is good. If the smoke is rapidly pulled in, the draft is too high. **CAUTION** If the smoke is unaffected then the firebox is at neutral pressure and needs a little more draft. Smoke blowing away from the opening means the firebox is under positive pressure and corrective action must be taken immediately.

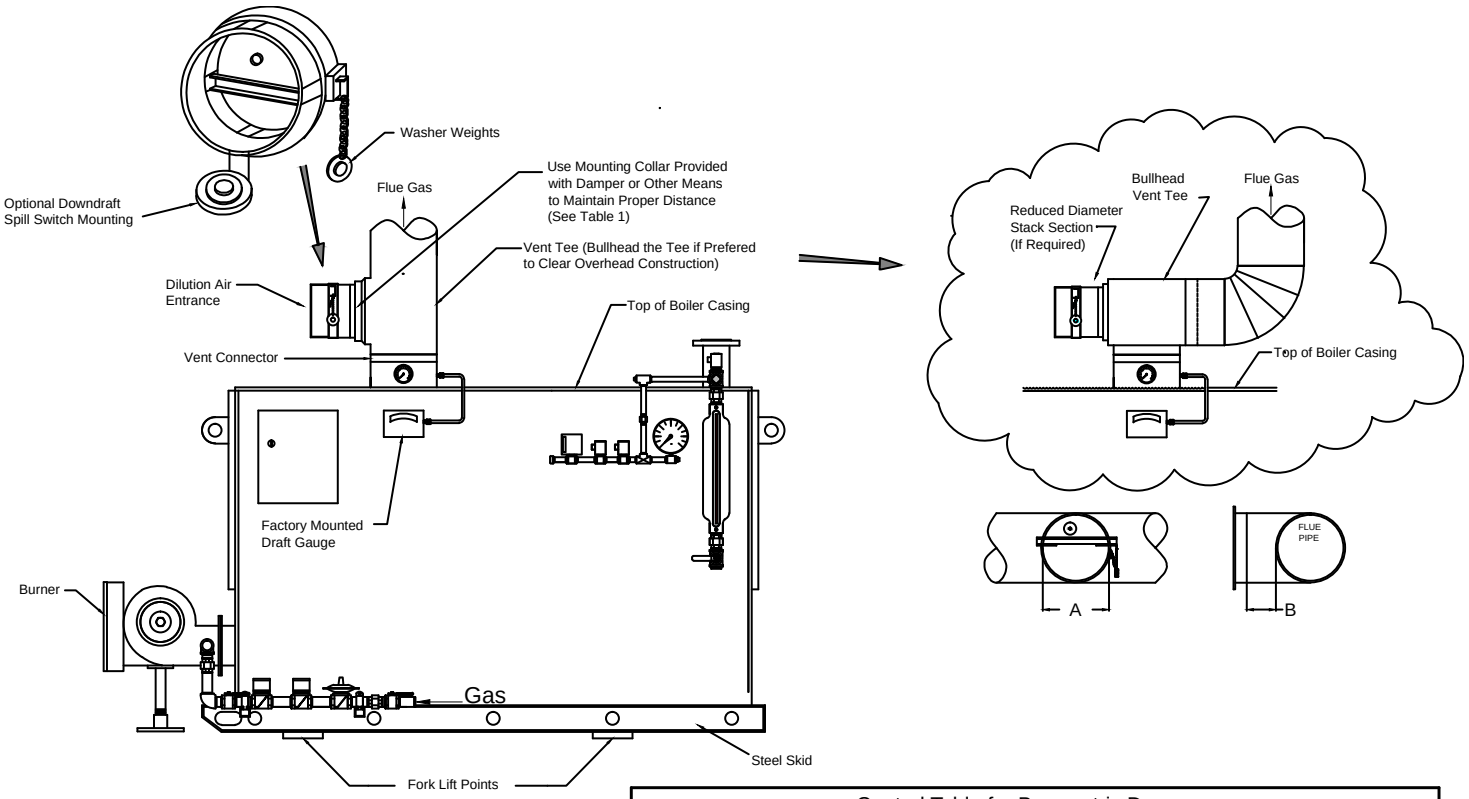


Figure 4

Control Table for Barometric Dampers									
Damper Size (A)	**10**	**12**	**14**	**16**	**18**	**20**	**24**	**28**	**32**
Collar Length (B)	4-3/8"	5-3/4"	7-1/8"	8-3/8"	8-1/4"	9-5/8"	12-3/8"	13-1/8"	15-3/4"

NOTE: BE SURE TO USE CORRECT COLLAR LENGTH. TOO SHORT OR TOO LONG MEANS A LESS EFFECTIVE CONTROL.

Barometric Damper Location For Indoor Boilers
(Barometric dampers cannot be installed on outdoor boilers)

Clearances

1. U.L. 795 requires the following minimum clearances to combustible construction from the boiler:

CLEARANCE TO COMBUSTIBLE MATERIALS

MODELS	FROM ABOVE	FROM FRONT	SIDES & REAR	VENT CONNECTOR
48W - 1250W (Water) 48S-1250S (15# Steam)	18”	48”	18”	18”
P9.5 - P250 (150# Steam) PW9.5-PW250 (Water)	48”	96”	36”	36”

2. For tube cleaning or replacement, leave an area in front of the boiler that is approximately the length of the boiler jacket and 24" or more at the rear. Codes typically require a minimum 24" clearance from the non-controls side of the boiler and 36" or more around the controls side. The National Board I-2330 clearances for Section I boilers(Rite "P" & "PW" Series) require minimum 36" clearance to any obstruction around the sides and back. Pennsylvania requires 30" clearance around *all* boilers. Always check state and local code clearances *before* laying out the boiler room.

3. Avoid blocking headplates with pipes or other obstructions. For boilers ordered with optional hinged headplates, leave room for the headplates to swing completely open 180º. See headplate swing dimension “T” in boiler catalog.

Piping - Water Boilers

1. See recommended piping diagrams at the back of this manual, pages 43 to 46.

2. **CAUTION** All Rite Boiler waterside surfaces are thoroughly cleaned prior to shipping so a boil-out procedure is not required. Taking a few extra minutes to remove thread cutting oil and other contaminants from the field piping as it is being assembled can reduce or eliminate the need for chemically flushing the system.

3. Always install the system pump so that the suction side is nearest the boiler hot water outlet. This lowers the risk of air entering the system and does not impose the system head on the boiler. Always pump away - not toward - the expansion tank system connection.

4. Rite Hot Water Boilers can be fired safely with the system pump off as long as there is water in the boiler and the low water cut-offs detect water. There is no required minimum or maximum flow rate through a Rite boiler and a flow switch is not a safety requirement.

5. **CAUTION** *Always use dielectric unions or dielectric flange kits when connecting copper pipe to the boiler to avoid galvanic electrolysis.*

6. An expansion tank must be installed in every hot water heating system. The tank can be bladder or compression type. Do not use open-to-atmosphere type. To order the correct size tank you must know: Total system volume in gallons; minimum anticipated system water temperature at start-up; maximum anticipated system operating temperature and minimum system operating pressure. Minimum system operating pressure can be calculated by dividing the overall height of the system piping above the boiler (in feet) by 2.31. For exceptions, see next paragraph.

7. Minimum system water pressure requirements for sea level to 3000 feet elevation are as follows:

Maximum Boiler Operating Temp. (ºF)	Minimum System Pressure (PSIG)
180	12
190	15
200	18
210	21
220	24
230	27
240	30

For elevations 4000' and higher, maintain a minimum 30 psi system pressure. For Section I High Temperature Hot Water boilers, refer to the steam tables to find the corresponding pressure to the maximum operating temperature and then add an additional 15 psi to that pressure to find the minimum system pressure.

8. It is a good idea to install a relatively inexpensive water meter in the water make-up line. On closed loop heating systems it is the best way to detect system water loss early on before harmful amounts of entrained solids and oxygen are introduced into the boiler system via water make-up.

9. **CAUTION** Never let chilled water from a cooling system circulate through the boiler under any circumstances.

10. **CAUTION** Reheat systems must not allow the chilled water loop to inadvertently cool down the heating loop inside the air handler(s).

11. **DANGER** Never use compressed air to test water system piping for leaks. Use water only.

Piping - Steam Boilers

1. See recommended piping diagrams at the back of this manual, pages 47 to 51.

2. Do not reduce the steam boiler outlet nozzle size. Reducing the diameter of the pipe of the boiler's outlet nozzle to the steam main may raise steam exit velocities to the point at which water is "lifted" or carried over from the boiler into the main.

3. Use black pipe - never galvanized pipe - for steam mains and blow-down lines. Condensate return lines should be constructed of Schedule 80 pipe or Type K copper. If copper is used, be sure the fittings are silver soldered rather than soft soldered as condensate return temperatures are often at or near the soft solder melting point. Use dielectric unions or flange kits when connecting copper to steel.

4. It is a good idea to install a relatively inexpensive water meter in the make-up line to record the amount of make-up water you are using and help keep the water treatment program on track.

5. For Rite steam boilers (low and high pressure) the boiler feed pump should be sized to deliver the following GPM per boiler horsepower (BHP) at operating pressure as shown at the bottom of this page.

   - 1 BHP ≈ 34,000 BTU output.
   - .069 x BHP ≈ The actual GPM rate of evaporation. Recommended feed rate is 2.5 to 3 times this rate.

6. Section I Boilers with heating surface greater than 500 ft^2 (Rite P125 and larger) must have 2 feed water pumps each capable of supplying the required GPM at a head pressure 3% higher than the safety valve setting per PG 61.1 of the A.S.M.E. Code.

7. **DANGER** Never use compressed air to test steam system piping for leaks.

Gas Piping

1. The use of teflon tape is not recommended. Thoroughly clean all thread cutting oil and other debris such as metal chips, welding slag and pipe dope from inside the gas piping during assembly.

BOILER HORSEPOWER	INPUT MBH	STEAM LB/HR	RECOMMENDED GPM FEED RATE
9.5	398	328	2
10	419	345	2
12	502	414	2.5
15	628	518	3
20	838	690	4
30	1255	1035	6
40	1674	1380	8
50	2093	1725	10
60	2511	2070	12
70	2931	2415	14
80	3348	2760	17
100	4185	3450	21
125	5230	4313	26
150	6276	5175	31
200	8369	6900	41
225	9425	7762	47
250	10456	8625	52
275	11500	9487	57
300	12500	10350	62

Gas Piping *continued*

2. **CAUTION** A drip leg is recommended at or near the connection to the gas train. If an optional wye strainer is used it should have a 40 mesh screen.

3. Be sure the natural gas supply pipe is large enough to deliver the required CFH at the inlet pressure required. If in doubt, refer to the Uniform Mechanical Code or NFPA 54 gas line sizing tables.

4. **CAUTION** When pressure testing a new gas line with air, be sure the boiler's main and pilot cocks are in the closed position and disconnect the union or flange connection between the main gas cock and the drip leg. This will prevent over-pressurization damage to the gas train valves and controls.

5. If the gas train is supplied with a normally open vent valve, it is a good idea to install a full size sight-flow indicator on the discharge side of the valve for visual confirmation that the valve is closed when the boiler is firing. Regular checks can prevent the loss of natural gas out the vent valve should the valve fail to close when energized.

6. Per current U.L. 795 standards, the boiler's gas train will require that one or more separate vent lines be piped outdoors to a safe point of discharge.

   6.1 The following two types of valves *must be vented individually:*
   1. Gas pressure regulators (except those approved for use with vent limiter).
   2. Normally open vent valves.

   6.2 Diaphragm operated gas valves and diaphragm operated gas pressure switches that require venting (look for threaded vent pipe connection on valve or switch body) may be manifolded together into a single common line provided it has a cross sectional area not less than the area of the largest vent line plus 50% of the area of all additional vent lines.

   6.3 **DANGER** **DO NOT** pipe any gas vents into the combustion chamber or stack.

   6.4 **NOTICE** Always terminate vents away from air intakes or sources of ignition. Be sure that moisture and insects cannot enter the vent pipes. Always utilize a drip leg to keep moisture from traveling back down vent tubing and damaging the diaphragms. See **Figure 5**.

Burner & Electrical

1. **CAUTION** Most burners require support under the housing to reduce the cantilever effect. Screw a support pipe into the coupling underneath the burner and into the floor plate flange. Adjust or shim until burner is supported. See **Figures 4 and 5**.

2. The correct voltage must be supplied to the boiler/burner as per the nameplates and connected to the proper point of connection per the wiring diagram. If the burner door is hinged, run the supply power in flexible conduit from the *side* of the boiler so the door can be swung open without disconnecting the power or conduit. If three phase power is required and no stepdown transformer is provided, run a separate 120/60/1 control circuit or add a stepdown transformer sized per the burner manufacturer's recommendation. **CAUTION** Do not add additional loads to a stepdown transformer without burner manufacturer's approval. Power supply must be clean and all stepdown transformers must be grounded to neutral. Voltages over 132 VAC or under 102 VAC are out of range and can cause safety controls to fail or malfunction.

3. When connecting power to the boiler make sure the polarity is correct and that there is less than **.**5 VAC between the neutral supply wire and the ground conductor. Check that fan wheel rotation is correct and that separate oil pump motor rotation is also correct if supplied.

4. **CAUTION** A good electrical ground to the boiler service connection is essential for two reasons: Poor grounding may cause the flame safeguard control to malfunction and stray voltages may cause electrolysis within the pressure vessel.

5. **CAUTION** **Electrolysis** due to poor electrical grounding and/or stray voltages passing through the boiler to ground has been known to cause severe pressure vessel damage. The problem usually goes unnoticed until a tube leak occurs and the cause turns out to be a small crater on the inside of the tube - often underneath a small and otherwise insignificant looking mud deposit. While this problem is relatively rare, it should be checked for by a skilled electrician **before** the boiler is put into service in the following manner: Using a digital multimeter with sharp probes, check for the presence of millivoltage (AC) between any bare metal spot on the pressure vessel and the building ground. A reading of 2 millivolts or less is good and no corrective action is required. If over 2 millivolts, either find the cause and correct it or install a separate ground rod dedicated to the boiler. Annual testing will show if the ground rod needs to be turned in order to break off deposits that can insulate and inhibit its grounding effectiveness.

Building Automation Systems (BAS)

1. **CAUTION** Rite Hot Water Boilers must not be operated with return water temperatures continually less than 135° to 140º F (see pages 44 - 46 for low temperature supply systems). Outdoor reset controls must be carefully programmed not to reset boiler supply water temperatures so that return water temperatures could fall below 135º.

2. **CAUTION** For HVAC reheat systems, the heating system pump should be programmed to turn off no more than 10 minutes after an unscheduled boiler shutdown (such as a limit or flame failure) in order to prevent the heating water from getting chilled in the air handler and circulated back to the boiler where it will condense.

3. **CAUTION** Care must be taken when integrating Building Automation Systems (BAS) and associated Energy Management Systems (EMS) with the boiler control circuit. BAS and EMS systems - while well intentioned - have been known to override boiler control systems and inadvertently create poor or unsafe operating conditions. EMS and BAS systems may receive information from the boiler control system but signals sent by the BAS or EMS to the boiler control system should be limited to establishing load demand and initiating start/stop sequence. *BAS and EMS systems must be programmed not to allow return water temperature to the boiler below 135° to 140º F.*

4. **CAUTION** Do not use solid state Triac type relays to enable/disable boiler. Use only electro-mechanical or ice cube type relays. **The following operating recommendations for Rite Boilers should be part of any EMS Strategy:**

(PREFERRED)

4.1. Leave the boiler and primary loop pump on during the heating season while turning off all secondary loop pumps, air handlers, etc when heat is not required. Fuel consumption during "off hours" will be limited to boiler and primary loop piping radiant losses which are generally small. A night temperature setback control may also be used to reduce system water temperature to 135º to 140º F. - the minimum recommended return water temperature.

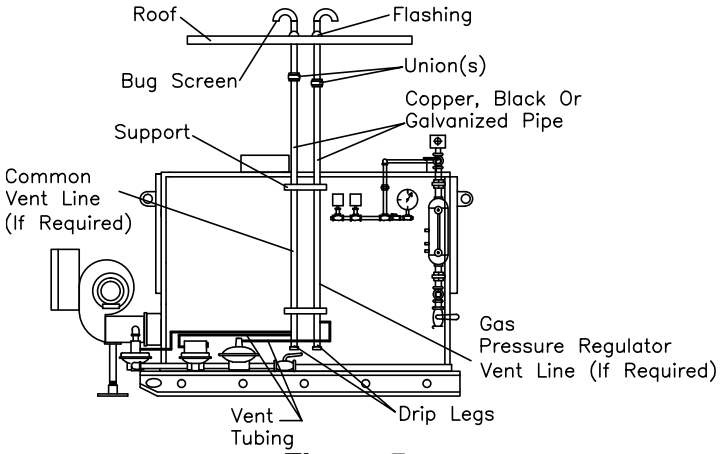


Figure 5

(ACCEPTABLE)

4.2 Leave the boiler on and turn the primary loop pump ***OFF***. Due to natural internal circulation, pumped water flow through a Rite Boiler is not required when firing. ***Important:*** When system heat is again required, the cool system water should be blended *slowly* back into the boiler so the boiler's water temperature doesn't fall below 135° F. This can be accomplished manually or with automatic controls.

5. While initial or infrequent cold start-ups are considered routine and will not harm the boiler - failure to follow the above strategies will cause repeated Thermal Stress Cycling. Although Rite Boilers are designed with floating heads to minimize the stresses of tube expansion and contraction, tube loosening (the "slippage" of the rolled portion of the tube in the tube sheet) **may** occur if the boiler is subjected to repeated cold start-ups or excessive on - off cycling.

6. Boilers owners and specifications engineers should take the following quote from the ABMA's *"Guideline for the Integration of Boilers and Automated Control Systems in Heating Applications"* into account: **"Automatic programmed de-energizing of boilers should be very closely examined. It is (also) questionable as to the real energy savings to be realized in cooling a boiler or a system on a regular basis only to reheat it in a short time later".**

WATER TREATMENT

1. **System Flush/Boilout Procedure:** Boiler tubes are typically coated on the outside with rust inhibitors. On fire-tube boilers, these and other contaminants are in contact with the water and should be removed or priming and foaming may result. This is generally done by the installing contractor following a boil-out procedure given by the boiler manufacturer. There are no such coatings inside a Rite watertube boiler. After the tubes are rolled, all traces of tube rolling grease are removed along with any other contaminants. A Rite boiler may therefore be put directly into service without a time consuming boil-out procedure.

   If the system piping recommendations in paragraph 2 on page 5 are followed by the installer, the need for a system flush can also be eliminated.

   For more information on what a boilout procedure and system flush entails, contact the factory.

2. **WATER TREATMENT FOR CLOSED HOT WATER SYSTEMS:** Closed hot water systems require some chemical treatment as no system is completely tight 100% of the time. These chemicals are introduced into the system via 2-5 gallon chemical pot feeders. The chemical treatment can vary depending on the systems operating temperature and pressure. Consult with a qualified water treatment specialist for further information. Regularly monitor that the expansion tank is working proper and the relief valve is not discharging water. Keep the system tight and free of leaks. Soft water make-up is not required. A pH level of no less than 9 should be maintained. **CAUTION** A pH level below 7 will cause an acidic attack of the pressure vessel and void the warranty.

3. **CAUTION** For metal finishing systems that use heat exchangers or coils, check the boiler water regularly for low pH which would indicate a breach between the boiler water and the acid baths.

4. **GLYCOL:** Glycols reduce heat transfer efficiency and can cause corrosion if the water quality is poor. If glycols are used, consider these tips and guidelines:

   4.1 Consult your glycol distributor. Rite is a steel watertube boiler.

   4.2 Use only enough glycol for "burst" protection, not "freeze" protection.

   4.3 Use only with good quality water defined as having less than 25 ppm of chloride and sulfate; less than 50 ppm of calcium and magnesium and less than 100 ppm (5 grains) of total hardness.

   4.4 Higher flow rates will reduce film coefficient of glycol and thus proportionally improve heat transfer.

   4.5 Higher operating temperatures will also improve heat transfer efficiency of glycols but not as much as higher flow rates.

   4.6 Never exceed more than 50% glycol in solution.

   4.7 Ethylene glycol is better at transferring heat than propylene glycol. Ethylene glycol is highly toxic if ingested.

4. **WATER TREATMENT FOR STEAM BOILERS:** **CAUTION** ***Failure to maintain an effective water treatment program as outlined below will void warranties and lead to premature pressure vessel failure.*** There are three basic components for effective scale and corrosion prevention in steam boilers.

   4.1 **SOFT WATER MAKE-UP:** All fresh water make-up must come through a softener 100% of the time **CAUTION** Avoid deionized or reverse osmosis systems that lower pH levels.

   4.2 **BLOW-DOWN:** It is recommended that a boiler be blown down a minimum of twice per 8 hour shift. The goal is to keep the TDS (Total Dissolved Solids) level between 2200 and 2600ppm. A uniform 15 second to 30 second blow-down is typical for most boilers when they are in proper control ranges. Subsequent boiler water analysis is required to properly determine exact length and frequency. To properly blow-down a boiler a washing action is recommended. This is achieved by slowly opening the blow-down valve for approximately 5 to 10 seconds, then slowly closing the valve and repeat again, until the recommended time has been achieved. This allows the solids to remain suspended for more uniform removal during the blow-down procedure. The water column also must be blown down at least once per shift; this helps to keep the column clear of debris and allows the operator to determine if the low water cut-offs and pump start controls are working. The blow-down tank should also be drained and flushed at least once every six months to help remove sludge and scale build up which can cause back pressure on the boiler leading to insufficient blow-downs.

   4.3 **CHEMICAL TREATMENT:** Use an automatic chemical metering pump to inject boiler chemicals into the boiler feed line. The metering pump should

WATER TREATMENT *continued*

be wired in series with the boiler feed pump and the point of connection should be a stainless steel tee down steam of the check valves and just before the shutoff valve at the feedwater inlet connection (see Page 48). Feeding chemicals directly into the feedwater tank is preferred by some water treat ment specialists. If so, be aware that these chemicals can be highly corrosive to feedwater tanks at the point of entry and the dispersal in the tank dilutes their effectiveness inside the boiler where they are intended. In addition, pump seals exposed to high concentrations of chemicals often fail prematurely.

5. **CAUTION** Annual or more frequent waterside inspections will confirm the effectiveness of your water treatment program. A successful program is one that keeps both scale and corrosion in check.

6. Some low pressure steam boilers are installed in gravity return heating systems that do not have a return tank or feed pump (*see pages 50 & 51*). In most of these systems there is no water treatment taking place. For these installations, use soft water make-up and install a water meter in the make-up line. Check the low water cut-offs once a month by performing a slow steam evaporation test as described on page 18. Blow-down these boilers only when the TDS exceeds 2600 ppm.

7. The pH of a steaming boiler should be between 10.5 to 11.5. P/Alkalinity: 200-400 ppm. M/Alkalinity: 400-800 ppm. Sulfite: 20-60 ppm. Hardness (soft water): 0-Trace. Chlorines: 5 to 7 times the supply soft water level.

Altitude Derations Above 2000'

CAUTION In most cases, power burners can be provided with larger fan wheels and motors to compensate for lower air densities at higher elevations. The required input/output at elevation should be agreed upon by all parties *before* an order is placed so there is no confusion as to the actual input/output that the boiler will do.

START - UP

1. **CAUTION / DANGER** Only highly qualified trained and licensed individuals should be asked to do boiler/burner start-ups.

2. It is the contractor or owner's responsibility to complete steps 3-11 below *before* requesting start-up in order to avoid the cost of more than one site visit.

3. Verify that the installation instructions have been followed and that all permits have been signed off.

4. Make sure the system pumps are running and most importantly that *there is a way to drop the load*.

5. **CAUTION** Make sure air has been bled from the natural gas supply line and that the supply pressure is within the range shown on the boiler shop sheet. A pipe tee with plug has been provided in the boiler's pilot gas line near the main gas cock for this purpose. If the supply gas pressure is over 28" w.c., make sure the boiler has been supplied with suitable high pressure regulators (main and pilot). If in doubt, consult factory ***before*** turning on the gas to the boiler.

6. For oil, make sure there is oil in the tank. Prime the oil pump and circulate the oil without the burner firing. Check the suction line to the oil pump and make sure it doesn't exceed 10 inches mercury of vacuum or more than 3 PSIG positive pressure. Bleed air from lines through bleed valve on integral pumps. Make sure teflon tape was not used on any oil line piping and check unions, packing glands strainer caps etc. for tight seal to prevent oil leaking out or air being sucked in. Make sure the oil storage tank foot valve (check) is holding when the pump is off.

7. **CAUTION** Make sure there is water in the boiler. For hot water boilers, make sure the system has been filled and air has been bled from all manual bleed valves.

8. For hot water boilers, verify that an expansion tank has been installed and that if a valve is installed between the tank and system *it must be open*. An elevated, compression type tank should have water in the lower third of the gauge glass when filled. The air pressure in bladder/diaphragm tanks should be slightly higher than the regulated make-up water pressure and the tank should be pressurized *before* the boiler and system is filled with water. If expansion tank is sized and operating properly, the boiler pressure gauge should show a negligible increase in pressure while going from a cold start-up to operating temperature. See page 13, paragraph 31 for exception.

9. For steam boilers, make sure the feedwater system is operating properly and that all make up water is coming through a water softener. Make sure that a blow-down tank or separator has been installed per code. Coordinate the chemical treatment start-up to overlap the boiler start-up.

10. Make sure any intake or exhaust fans or other equipment that can change air pressure conditions in the boiler room are operational and make sure the start-up person is aware of them.

11. Provide the start-up technician the "As Built" wiring diagram and the burner installation and instruction packet *before* site visit. In addition, burner O & M manuals that contain additional information can be found on-line at http://www.riteboiler.com/om-manuals.html.

12. **CAUTION / DANGER** Boiler/Burner start-up should be performed only by qualified technicians. If possible, the boiler operator(s) should witness the start-up.

13. Prior to going to the job site, the start-up technician should verify with the installing contractor that steps 3-10 have been completed. If on arrival you find any aspects of the installation incomplete, wrong or questionable - do not leave the site before making a complete survey of everything that needs to be reviewed or corrected. Go over this list with the installing contractor. Failure to provide a complete list of corrections can lead to back charges by the contractor.

14. **For hot water boilers, set aquastats as labeled in the following manner:**

    OPERATOR or LOW FIRE:
    Between 155º F. and 230º F.

    HIGH FIRE (if used):
    5 to 10 degrees less than low fire.

    MODULATION (if used):
    Set so that the burner reaches minimum firing rate prior to the operator aquastat turning off the burner.

    HIGH LIMIT:
    20 degrees or more above operator or low fire control.

15. **For low pressure steam boilers (15 PSI) set pressure controls as follows:**

    OPERATOR or LOW FIRE:
    Between 3 and 12 PSI.

    HIGH FIRE (if used):
    1 - 3 PSI less than low fire .

    MODULATION (if used):
    Set so that the burner reaches minimum firing rate prior to the operator pressuretroll turning off the burner.

    NIGHT SETBACK (if used):
    Usually 1 -2 PSI.

    HIGH LIMIT:
    13 - 14 PSI.

16. **For High Pressure Steam Boilers (M.A.W.P. 100-150 PSI) set pressure controls** using similar ratios to low pressure steam boilers. The high limit pressure control should be set at least 10 PSI less than the boiler's relief valve setting.

17. Rite power burner fired boilers manufactured after January 1, 2011 will be supplied with ceramic fiber side and rear panels instead of cast refractory. The burner door will still be cast refractory. If no refractory curing instructions are taped inside the burner panel cover then no cure time is required during start-up.
    CAUTION If curing instructions <u>are</u> provided then the instructions must be followed or refractory spalling could result.

18. Refer to the burner manufacturers O & M Manual and "As Built" specification sheet. Verify that the electrical and fuel supply requirements are met. Follow the burner manufacturer's start-up recommendations. If these cannot be obtained, steps 19-37 in this section provides a *general* outline of common power burner start-up procedures except for some low NOx and surface combustion type burners. For water boilers, record the boiler pressure when the system pump is both on and off prior to firing the boiler for future reference.

19. Bump the burner motor starter or contactor and check fan rotation. If backwards, change any 1 leg of 3 phase power supply. If there is excessive vibration the fan wheel may need to be balanced or replaced.

20. If the burner is straight gas or combination gas/#2 oil, set selector switch to gas. Turn the pilot gas cock off. Turn the downstream leak test cock off. Install a gas pressure gauge where it can sense the supply gas pressure to the inlet of the gas train. Open the upstream main gas cock *slowly*. Manually reset the high and low gas pressure switches if supplied, making sure the setpoints are properly set.

21. Turn the burner power switch on. Manually reset the low water cut-off and flame safeguard controls if required. The burner should sequence to a prepurge (fan on only) stage for 10 to 60 seconds depending on the size of the burner. The burner should then sequence to a pilot trial for ignition. On many straight oil fired burners, there is no PTFI and the spark ignition will directly light off the atomized oil. Some straight oil and combination gas/oil burners will use a natural or L.P. gas pilot to light off the oil. All gas pilot burners should lock out on flame failure due to the pilot cock being closed. **DANGER** It is important to check that the spark ignition alone does not cause any flame signal whatsoever. If this occurs, it must be corrected before proceeding to the next step.

22. Open the pilot gas cock and carefully bleed off any air in the pilot tubing. When you smell gas immediately tighten the tubing fitting back up. If the gas is L.P. (propane) make *sure* all piping is leak tested and tight. Propane is heavier than air and will accumulate on the ground if it leaks. Manually reset the flame safeguard control and allow the burner to sequence to a pilot trial for ignition. On burners with inputs 2.5 million BTU's and less, the pilot is usually *intermittent* which means the pilot valve (but not the spark) remains on all during the main flame cycle. On burners larger than 2.5 million BTU's, the pilot is *interrupted*, meaning both the ignition transformer spark and the pilot valve turn off approximately 10 seconds after the main flame lights.

23. For burners with *intermittent* pilots, the main fuel valves will open only after a pilot with sufficient flame signal strength is established. The flame scanner will not differentiate between seeing the pilot flame and the main flame. To bring on the main flame, slowly open the downstream leak test cock.

24. For burners with *interrupted* pilots, open the downstream leak test cock first. If the pilot establishes itself within 10 seconds, the main fuel valves will begin to open. If the main burner is not successfully lit before the pilot is extinguished, the flame scanner will see this and immediately shut off all the fuel valves and lock the burner control out.

25. **CAUTION / DANGER** A pilot turndown test must be performed. This involves reducing the size of the pilot flame to a point that is at the minimum detectable flame safeguard level but can still light off the main flame reliable. Do not proceed until this is done.

26. Sequence the boiler to main flame. For modulating or high-low firing burners, hold the burner at low fire and then adjust the air/fuel ratio to the burner manufacturers recommended settings. Leave the burner on for 30 minutes then turn the burner off for at least twenty-five minutes. Use this time to check the following: gas leaks on the gas train; water leaks around the headplates and boiler piping; control voltage supply in range (not less than 102 and not more than 132 VAC.); loose electrical and conduit connections.

27. For hot water boilers, check the low water cut-off(s) to verify that they will shut the burner off in the event of low water. If two low water cut-offs are used, *temporarily* jumper the primary LWCO after it has turned the burner off in order to test the auxilary. **CAUTION** Do not use "Test" buttons on probe low water cut-offs for this test but do an actual slow drain test by closing off the water supply and return valves on the boiler, lifting the relief valve handle to relieve pressure and break the vacuum and cracking open the drain valve at the back of the boiler. The burner should cut off when the water level drops 4-5 inches below the top of the headplate. When finished, close the drain valve, crack open the return water valve and raise the relief valve handle until all the air is purged out. Make sure the relief valve reseats tightly then open the supply and return water valves to their original position.

28. **CAUTION** For steam boilers, let the feed pump or feedwater valve fill the boiler to normal operating level and then perform a slow steam evaporation test as described on page 18.

29. As the boiler heats up, re-tighten the headplate bolts uniformly. Work from the centers to the corners as you go: center left bolt, center right bolt, center top bolt, center bottom bolt, etc. Make sure all bolts are *moderately* tight when finished. If hand holes are supplied make sure the crab nut is snug as well. If insulated headplate covers are provided, leave them off until the very end of start-up. **CAUTION** Tightening headplate bolts beyond what is required to prevent leaks will reduce gasket service life.

30. After the 25 minute standby (burner off) as described in step 26, remove the low fire hold if applicable and allow the burner to sequence to high fire. Check fuel input rate and make sure it is *below* the *boiler* nameplate (not the burner) maximum input rating. Adjust the burner air damper to meet the burner manufacturers recommendation for excess air (or O_2) at high fire. Make sure the boiler draft stays in the green range at high fire: If not, adjust the number of washer weights on the barometric damper or recalibrate auto draft fan system (if supplied) until it is. If flue gas recirculation is installed, make sure the FGR butterfly damper is open just enough to achieve the NOx requirement, but not so open that the flame becomes unstable and

the burner rumbles. Excess rumbling indicates too much flue gas is being introduced into the air/fuel mix. It is important to check this when the firebox is both hot *and* cold to find a setting that satisfies both conditions. It is also important to remember that excess air (O_2) will change with the density of air. At cooler air temperatures, there will be more air (and O_2) per cubic foot than at warmer temperatures. O_2 trim sensors automatically adjust for this but are generally to costly for boilers below 300 horsepower. It is therefore advisable that when tuning a burner on a warm day, adjust the excess air (O_2) on the low side and on a cold day adjust to the high side of the manufacturers recommended range. For modulating burners, make air/fuel ratio adjustments throughout the curve to maintain good combustion readings between previous established minimum and maximum firing rates.

31. For hot water boilers, check the boiler pressure at the P&T gauge with the system pump on and when the boiler is at or near the system maximum operating temperature. Compare the pressure with the pressure noted on Page 11, step 18. If the expansion tank was correctly sized (and pressurized if bladder type) and working properly, then the pressure should have risen only slightly from when the system was cold. In some cases the tank will be sized to allow larger pressure differentials. If so, the differential should be documented and made known to the start-up person and in all cases must be well below the boiler relief valve setting. The pump when operating at full RPM should also have little or no effect on the pressure in the boiler. **CAUTION** Any deviation from this must be corrected at once.

32. **CAUTION** For hot water boilers, check the return water temperature to the boiler and make sure that the return water temperature is at least 135º to 140º F. for natural gas and propane fired boilers. For #2 oil (diesel) and digester gas fired boilers, the return water temperatures should be significantly higher to avoid condensation in both the boiler and especially the stack. Check with the factory for recommendations if in doubt. Failure to do so can lead to condensing which is not covered by warranty. If indoor - outdoor reset is used, make sure that it is programmed to avoid condensing return water temperatures to the boiler under all outside air reset conditions.

33. For water boilers in systems with *fixed* speed system pumps and P.I.D. temperature controls, auto tune the P.I.D. loop after the system is up and operating normally. On systems with variable speed pumps, do not auto tune P.I.D. controls. For boilers without P.I.D. controls, adjust aquastat set points and differentials to minimize excessive burner cycling while still satisfying the system design temperature demands.

34. For steam boilers, make sure the feedwater system is working properly. If a chemical feed pump is used, be sure it is wired in series with the feedwater pump. **CAUTION** Chemicals fed directly into condensate return/ feedwater tanks have been known to damage feedwater pump seals. Chemical Treatment and blow-down procedure should be established and monitored by a water treatment specialist. Steam boilers operated without chemical treatment will not be covered by warranty against failure from scale or corrosion of the tubes or heat exchanger.

35. Check steps 6-8 on page 4. Make sure burner linkage assemblies or servo motor actuators run smoothly and don't bind throughout the firing range. Make sure all linkages and servo motor fasteners are *tight*. Consider marking final ball joint locations and other air-fuel-FGR settings with tamper proof paint.

36. Secure all guards, covers etc. and reinstall insulated headplate covers if supplied.

37. Be sure the owner/operator receives a copy of this O & M manual, the burner manual, cut sheets of all safety and operating devices furnished with this boiler along with a copy of your start-up report. See next page for suggested start-up form.

Notes:

BOILER / BURNER START UP INFORMATION & TEST DATA *(page 1 of 2)*

The following information shall be recorded for each boiler/burner start up:

Job Name _____ Job Location _____
Rite Model & Serial # _____ Burner Mfg Make/Model & Job or Serial # _____
Burner MFG. Job or S.O.# _____ Start Up Date _____
Start Up Contractors Name _____ Phone _____
Name of Technician Performing Start Up _____
Type of Gas Natural ❑ LP ❑ Other _____ Fuel Oil Grade No _____

Gas Firing

Gas Pressure at Train Inlet
Burner in Off Position _____ " W.C.

Gas Pressure at Train Inlet
Low Fire _____
High Fire _____

Gas Pressure at Firing Head
Low Fire _____
High Fire _____

Gas Pressure at Pilot Test Tee
_____

Power Supply
Volts _____ Ph _____ Hz _____
Control Circuit Volts _____
Blower Motor amps at high fire _____
_____

Flame Signal Readings
Pilot _____
Low Fire _____
High Fire _____

O_2 & CO_2
Low Fire _____
High Fire _____

CO
Low Fire _____
High Fire _____

Input Rate BTU/HR
Low Fire _____
High Fire _____

Over Fire Draft (Combustion Chamber)
Low Fire _____
High Fire _____

Vent Connector Draft Gauge
Low Fire _____
High Fire _____

Net Stack Temperature
(at vent connector, less ambient)
Low Fire _____
High Fire _____

Combustion Efficiency
Low Fire _____ %
High Fire _____ %

NOx Measured (Corrected to 3% O_2)
Low Fire _____
High Fire _____

Low Gas Pressure Switch
Setpoint _____ " W.C.
High Gas Pressure Switch
Setpoint _____ " W.C.

Oil Firing

High Fire Vacuum Reading at Oil
Pump Inlet _____ " H.G.

Gas Pressure at Pilot Train Inlet
(if applicable) _____

Gas Pressure at Pilot Test Tee
(if applicable) _____

Oil Nozzle Supply Pressure
Low Fire _____
High Fire _____

Oil Nozzle Bypass Pressure
Low Fire _____
High Fire _____

Power Supply
Volts _____ Ph _____ Hz _____
Control Circuit Volts _____
Blower Motor amps at high fire _____

Remote Oil Pump Motor Amps at
High Fire _____

Flame Signal Reading
Pilot (if applicable) _____
Low Fire _____
High Fire _____

GPH Firing Rate
Low Fire _____
High Fire _____

O_2 & CO_2
Low Fire _____
High Fire _____

Bachrach Scale Smoke Number
Low Fire _____
High Fire _____

Low oil pressure switch (PSI)
Settings: cut in _____ cut out _____

Over Fire Draft (Combustion Chamber)
Low Fire _____
High Fire _____

Vent Connector Draft Gauge
Low Fire _____
High Fire _____

Net Stack Temperature
(at vent connector, less ambient)
Low Fire _____
High Fire _____

Combustion Efficiency
Low Fire _____ %
High Fire _____ %

NOx Measured (Corrected to 3% O_2)
Low Fire _____
High Fire _____

High oil pressure switch (PSI)
Settings: cut in _____ cut out _____

Control Settings

General
Operating control cut out setting _____

Operating control cut in setting _____

Limit control setpoint _____

BOILER / BURNER START UP INFORMATION & TEST DATA *(page 2 of 2)*

Operation Checklist

Checked for Proper Operation of:	Yes	No	N/A	(N/A Not Applicable)	Yes	No	N/A
Low water cut off	( )	( )		Barometric damper	( )	( )	( )
High Limit	( )	( )		Boiler room combustion air and ventilation	( )	( )	( )
Operator control	( )	( )		provisions correct			
Modulation or high-low control	( )	( )		Oil tank vent system checked	( )	( )	( )
Flame safeguard control ignition failure	( )	( )		All oil lines checked for leaks	( )	( )	( )
Flame safeguard control main flame failure	( )	( )		All gas lines checked for leaks	( )	( )	( )
Burner air flow switch	( )	( )		Gas lines and controls properly vented	( )	( )	( )
Induced draft fan controls	( )	( )	( )	Expansion tank	( )	( )	( )
Over fire draft controls	( )	( )	( )	Relief valve	( )	( )	
Fresh air damper end switch	( )	( )	( )	BAS, EMS or DDC system integration	( )	( )	( )
Feed water system	( )	( )		Other system components (specify)	( )	( )	

Notes:

Starting (cold) water boiler pressure _____. Water boiler pressure at operating temperature _____.

Notified _____ of the following system deficiencies:_____

_____

_____

_____

_____

_____

_____

SEQUENCE OF OPERATION:

The following is intended to provide a general overview as to how most power burners work. Given the variety of manufacturers and changing technologies, always refer to the burner O & M manual specific to the job for more complete and accurate sequence of operation than the following generic outline below:

When there is a call for heat, the burner fan motor will come on and initiate approximately 4 combustion chamber air changes during what is called prepurge. The purpose of this is to force any unburned fuel in the combustion chamber out of the stack prior to pilot ignition if fuel valves are not tightly closing off when the boiler is in standby.

Except for on-off fired boilers, following prepurge the burner will modulate to a low fire position prior to light-off. A pilot trial for ignition will then occur during which a pilot flame of sufficient strength must be established before main fuel valves are energized. On some #2 oil fired burners, direct spark ignition of the main fuel may occur in lieu of a gas pilot.

If the pilot signal is too weak, the burner control will lock out on pilot flame failure. Otherwise the main fuel valves will be energized within 10 seconds of an established pilot. On boilers 2.5 million BTU's and less, the pilot valve may remain on (intermittent pilot) during the main fuel on period. On boilers over 2.5 million BTUH, the pilot valve will be de-energized (interrupted) after the main flame establishing period (usually 10 seconds) in order that the scanner or flame rod "prove" main flame.

Once main flame is established, the burner (except for on-off fired models) will respond to load demand and modulate accordingly. When the low fire or operator setpoint is reached, the fuel valves will close and following a short post purge, the blower motor will turn off. This constitutes one full burner cycle. The boiler/burner is now in standby mode waiting for the next call for heat.

OPERATION, MAINTENANCE AND SERVICE

General

1. Maintaining a boiler log and following the recommendations in this section will help your boiler operate at peak efficiency and reduce service calls. It is impossible to cover all potential problems or questions when it comes to operation, maintenance and service. Detailed cut sheets of various components provided with your boiler and burner O & M Manuals should be referred to when necessary. Retubing and refractory replacement instructional videos are available on line at *www.riteboilers.com*. Unless you are a skilled technician, we highly recommend you call one when you spot a problem rather than attempt to repair it yourself. ***Above all else, use common sense.***

2. The combustion chamber and insulation should last many years provided the boiler has:
   a) *Operated with return water temperatures above 135ºF,*
   b) *not been overfired*
   c) *operated with ample draft (minimum -.01" W.C. in combustion chamber)*
   d) *Not been subjected to negative room conditions.*

3. Small cracks in the burner door refractory are considered normal. Check the condition of the ceramic fiber combustion chamber panels once a year. Pack 2600º F. rated fiber into any voids or areas where the fiber has shrunk or is no longer tight. If exterior boiler jacket shows signs of heat discoloration, check firebox pressure at high fire for positive pressure and check input and draft. Turn the burner off and after cool down period, access the inside of the combustion chamber. Check for soot in the tube bundle and/or gaps in the ceramic fiber panels that correspond to hot spots on the jacket.

4. Gas train components are maintenance-free. Two or three times a year check all ball joint linkages on the burner for tightness. Check fan wheel for excessive vibration or blade loading, especially in dirty air environments. The flame scanner glass should be wiped clean from time to time. Oil filters will need to be cleaned or changed if supply pressure to the pump begins to decline.

5. Most unscheduled shutdowns can be traced by referring to the burner wiring diagram. On most burners a keyboard display module can be plugged into the flame safeguard control to provide a fault history. If the boiler is off due to an open limit switch, remove the cover from each limit beginning with the first limit shown on the diagram and check with a voltmeter until you find the one that is locked out (open). After correcting the problem, manually reset the switch or control. **DANGER** Electrical work should be carried out by qualified technicians only.

6. If you notice flue gas temperatures going up over time, it is usually an indication that the tubes need cleaning. It is neither difficult nor expensive to waterside clean a Rite Boiler and doesn't require chemicals. You will need a couple of headplate gaskets and one or two heavy duty tube brushes which can be purchased from your Rite Representative. You will need to remove the front and rear headplates, or simply swing them open if they are hinged from the factory to attain complete waterside access. Most boilers can be cleaned and put back into operation in half a day. **See steps 1-4 on the next page.**

7. The following efficiency loss due to scale in tubes applies to <u>all</u> boilers:

SCALE THICKNESS (IN INCHES)	EFFICIENCY LOSS
1/64"	4%
1/32"	8%
1/16"	12%
1/8"	18%
3/16"	27%

It pays to have a clean boiler. It pays to have a boiler that's easily cleaned!

Waterside Tube Cleaning Procedure For Rite Boilers with Standard Pilley Brush*

STEP 1

Remove (or swing open if hinged) both headplates. Install temporary splash/mud shields as shown.

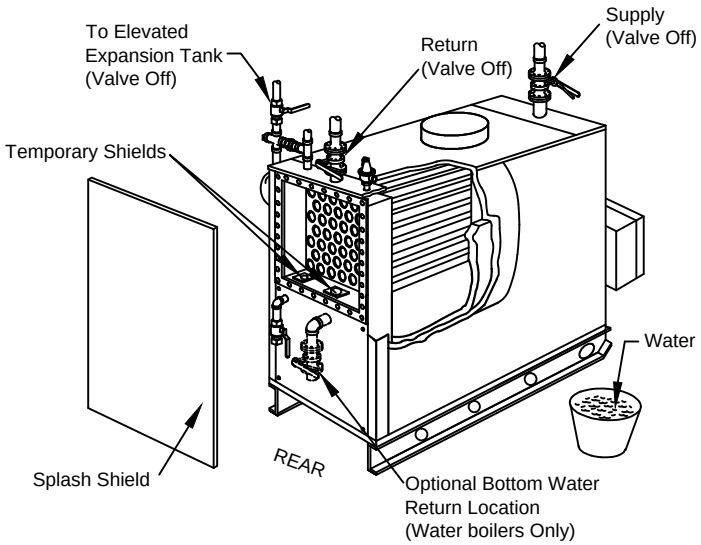


Figure 6

STEP 2

Use a standard hose with a gun type nozzle that will deliver a sharp stream of water. Begin by rinsing out all the tubes starting from the top and working down.

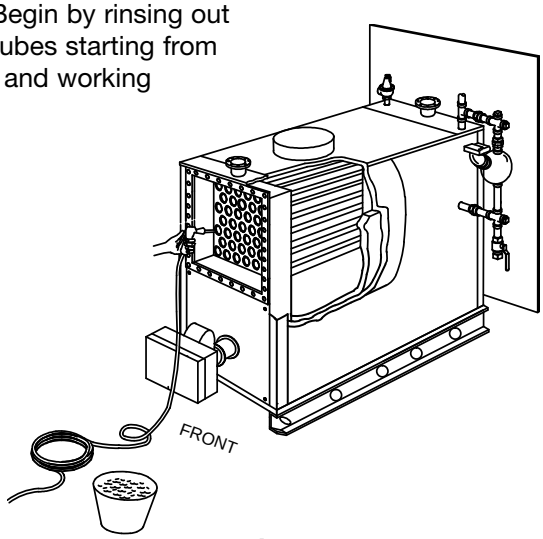


Figure 7

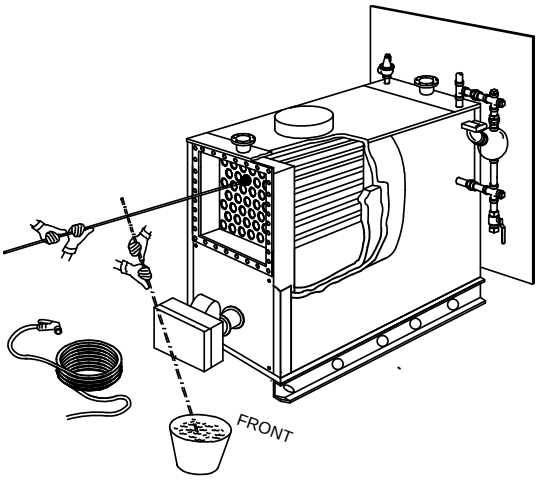


Figure 8

STEP 3

Brush out the top row of tubes, making two full passes per tube. Because mud or scale will load up the brush, dip the brush into a bucket of water after each pass. Tube brush has 1/4” female pipe thread connection. Mount onto a 1/4” pipe or 1/2” pipe using a bell reducer and 1/4” NPT nipple. The pipe handle should be approximately as long as the boiler. Where space between the boiler and an obstruction does not permit the use of a single length of pipe, use shorter threaded and coupled lengths that you can join together and take apart.

STEP 4

Thoroughly rinse the top row of tubes out after brushing. Repeat this process one row at a time, top to bottom, until all tubes are clean.

*For more aggressive tube cleaning solutions, see our video showing our electrically operated tube cleaning machine that is available for rent.

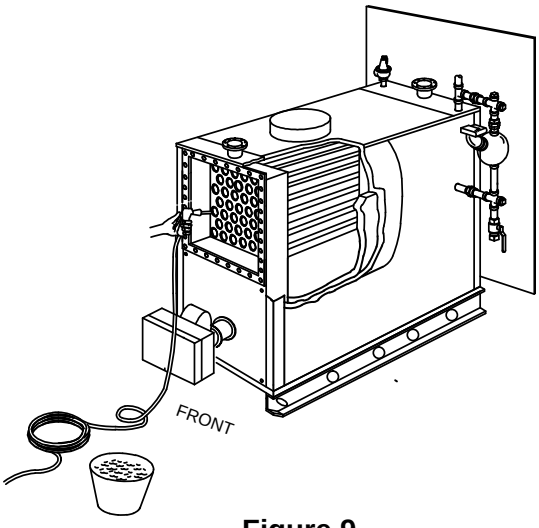
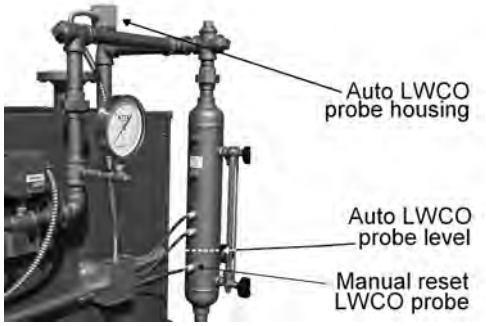
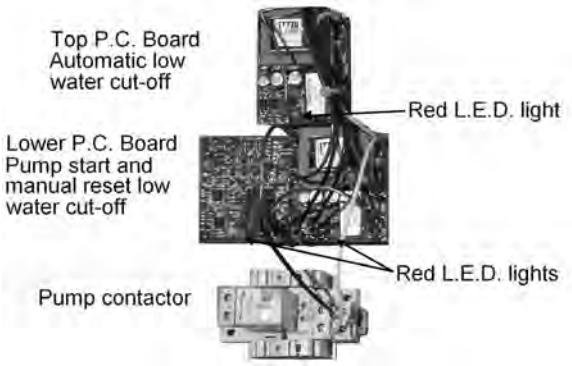


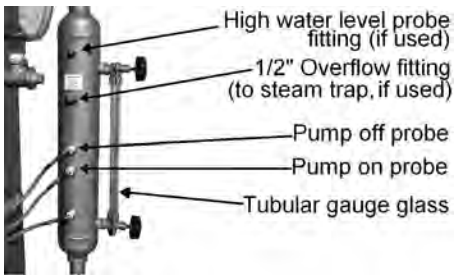
Figure 9



8. **CAUTION** **On steam boilers it is necessary to check the feedwater and low water cut off devices once a month by performing a slow steam evaporation test:** With the boiler under load and the water level between the top and middle probes on the water column, shut off the electrical disconnect(s) to the boiler feed pump(s). Open the electrical panel marked "Boiler Feed Pump Controls and Low Water Cut-Offs" and look for a red L.E.D. light (illuminated) on the top P.C. Board and two red L.E.D. lights (right hand illuminated, left hand not illuminated) on the lower P.C. Board.



8.1 The following should happen as the water slowly drops in the gauge glass: Approximately 5 seconds after the water drops below the level of the middle probe, the left hand light on the lower P.C. Board should illuminate and the bottom relay (labeled "pump contactor") should pull in. To verify, momentarily restore pump disconnect to the "on" position and make sure the pump starts, then turn the pump disconnect off again.



8.2 When the water drops to a level approximately 1" to 1 1/2" above the bottom of the gauge glass, the top P.C. board's light should go out. This indicates the primary low water cut-off (probe is located in pipe cross on top of the rear header drum) senses a low water condition. This should cause the burner to shut off. ***Temporarily jumper the automatic low water cut-off common and normally open terminals to bring the burner back on.***

8.3 The water level should continue to drop slowly as the burner continues to fire. After the water level reaches the bottom of the glass and falls below the bottom probe on the water column, the lower P.C. Board's right hand light should go out and the burner should shut off. Note that there are time delays of a few seconds built into both P.C. Boards so the switching action occurs shortly after the water crosses a probe in either direction. **CAUTION** ***Do not allow the boiler to keep firing if the water disappears from the gauge glass for longer that 15 seconds. Turn the power switch off.***

8.4 If everything works correctly as described, above, ***remove the temporary jumper on the automatic low water cut off*** and turn boiler feed pump disconnect(s) back on. When the water level rises above the bottom probe on the water column, reset the low water cut-off push button switch. The middle P.C. Board's right hand light should come on. As the water level approaches the middle probe, the top P.C. Board's light should automatically come on. At this point both low water cut-offs have "remade" and the boiler should attempt a PTFI and light-off with the feed pump continuing to run. When the water level reaches the top probe, the middle P.C. Board's left hand light and the feed pump should both turn off. This completes the slow steam evaporation test for probe style low water cut-off and pump start controls.

8.5 Failure of any of the relays or controls to operate as described above requires immediate attention: Turn burner switch off and let boiler pressure drop to zero. **DANGER** Only when you are certain there is no pressure in the boiler, remove the three column probes (and the vertical probe in the rear header drum by removing the entire probe housing from the pipe cross ***if*** the test proved it defective). Clean probes thoroughly using a shop cloth, wire brush or wire wheel. If there is a build-up of scale or mud on the probes, contact your water treatment company to review the water treatment program. The solution may be as simple as blowing down the steam column more often. For process steam boilers, blow-down the column once every eight hours. For low pressure steam heating boilers, blow-down the column once a day. Reinstall probes and corresponding "top", "middle" and "bottom" probe wires labeled accordingly. Check ground wires and all other wiring to the P.C. Boards for loose connections, shorts or other defects. Repeat the test. If problems persist, contact the factory.

Steam Boilers *continued*

9. On a steam boiler equipped with optional float operated pump start / low water cut-offs or float operated feeder / low water cut-offs, the same slow steam evaporation test should be carried out. Prior to testing, review the control manufacturer's cut-sheets (provided with this O & M Manual) for determining normal operating levels and detailed cleaning and repair procedures.


Float Type Pump Start/LWCO

10. On steam boilers, the gauge glass, trycock(s) and water column must be clean and in good working order at all times. Steam or water seepage around the gauge glass packing nuts will cause the glass to erode and weaken. Extra gauge glass, brass friction washers and packing gaskets should be kept on hand. Your Rite Representative can supply these items to ensure proper gauge glass length and pressure rating. If tubular gauge glass breakage or erosion becomes an issue, consider replacing with a Rite reflex type water gage.

11. When replacing gauge glass, it is imperative that the water gauge valves be in near perfect alignment to prevent stress on the glass. **DANGER** Never attempt to replace the gauge glass on a boiler that is operating under pressure unless qualified to do so. Always wear safety glasses when working around gauge glass.

12. The trycock is a back up valve for verifying water level in the boiler and should be used only when the gauge glass is temporarily inoperable or if the boiler operator suspects that the water level in the gauge glass might not be reading true. Constant leakage out the trycock can eventually cause it to plug up with scale and become inoperable.

13. **CAUTION** The equalizing piping that connects the steam column to the boiler must be kept free of mud and sludge. To access and clean, remove pipe plugs in the crosses that connect the column to the boiler and rod out with a stiff wire bottle brush. The bottom equalizing pipe is generally the most susceptible to mud accumulation. The steam column itself should be checked at least once a year. Mud or sludge in the steam column is an indication that the column is not being blown down often enough and/or the water softener is not working properly.

14. On steam boilers, sometimes the feed pump is on but the water level won't rise in the sight glass until the steam pressure drops. If this happens, chances are the check valve(s) between the boiler and the pump have failed. For this reason Rite recommends two spring loaded check valves piped in series in the boiler feed line (See page 48).

15. A steam boiler that is shut off and cooling down will eventually draw a vacuum. Usually this vacuum is broken by air seeping in through the gauge glass gasket. If not, the vacuum can be strong enough to pull water out of the condensate return tank and flood the boiler. A full gauge glass in the morning is an indication of this. If this causes more water carry-over than the steam main's trap can handle on restart, here are a few suggestions: 1. Install a larger capacity float & thermostatic trap at the end of the steam main. 2. Leave boiler "on" during off hours with the steam supply valve closed and operating pressuretroll in night set-back mode. 3. A vacuum breaker of the proper rating can be installed by adding a tee in the boiler's control piping, but be aware that this will introduce the same unwanted oxygen into the boiler as the seepage through the gauge glass gasket and may require a modification to the chemical treatment program.

16. Check steam traps regularly. Steam loss through traps that are stuck open can waste vast amounts of steam to atmosphere without notice. If the end of the vent pipe from the condensate return tank to outdoors is blowing a ***continuous plume*** of steam, chances are one or more traps have failed open.

Water Boilers

1. For closed hot water heating systems the most important thing to avoid is losing system water. At least once a month check the discharge piping from the boiler relief valve(s) and the drain valve for any sign of leaks as well as around the boiler head gaskets, pump seal(s), valve packing(s), piping, etc. A water meter installed in the fresh water make-up line is a very cheap and simple way to tell whether or not the heating loop is losing (and therefore making-up) water.

2. On hot water heating boilers, verify the following when the system is at or near operating temperature: The boiler pressure gauge should read well below the boiler's relief valve set pressure. The boiler supply temperature gauge should not read below 155º F for systems operating with delta T's of 20° F or less. Return water temperature should be 135º to 140º F or above to avoid the possibility of condensing.

3. On hot water heating boilers check the low water cut-off operation once a month. If you have a float type low water cut-off installed with *Test 'N' Check* valves, open the drain valve beneath it while the burner is firing. The burner should turn off. Close the drain valve and manually reset the low water cut-off if required. The burner should attempt to relight. If you have a probe type low water cut-off, hold in the "test" button for about six seconds while the boiler is firing. The burner should go off during this time and not attempt to relight until you push the reset button.

DAILY MAINTENANCE SCHEDULE:

	TYPE OF SERVICE REQUIRED	BOILER TYPE	BY WHOM	SERVICE RESPONSE	BOILER STATUS
1.	Check the water level in the boiler gauge glass.	Steam	Operator	Immediate if the water level is unusually low or not visible.	On
2.	Blow-down boiler and steam column per water treatment program recommendations. Confirm that both low water cut-offs and the pump control function properly.	Steam	Operator	Immediate if any of the water level controls fail to respond properly or if the blow-down valves or piping seem restricted or blocked.	On during low demand.
3.	Check condensate return/feedwater tank for: (1) water level (2) overflow (3) water make-up valve operation from high level (make-up off tight) to low level (make-up keeping up with pump demand) (4) feedwater temperature (5) constant steam plume coming out of the vent pipe.	Steam	Operator	Immediate if no water in tank or float valve rod linkage hangs up when water level in tank drops. Otherwise A.S.A.P.	
4.	Check chemical feed and softener systems.	Steam	Operator	A.S.A.P. if not working.	On
5.	Visually check main flame through the firebox view port at the rear of the boiler.	Steam Water	Operator	Notify qualified service company if flame is too rich (all yellow), too lean or unstable (pulsating).	On
6.	Confirm that boiler is drafting properly by checking for a slight negative draft entering the front firebox view port cover (A small amount of smoke is one way to do this).	Steam Water	Operator	Immediate if there is any indication of back pressure in the firebox.	On High Fire
7.	Check for residual flame in the firebox after the burner has cycled off.	Steam Water	Operator	Immediate if gas valves fail to close.	At the end of a burner “on” cycle
8.	Check for simmering or discharging relief valves.	Steam Water	Operator	Immediate if boiler pressure is within 10% of relief valve setting.	On
9.	Check boiler pressure gauge.	Steam Water	Operator	Immediate or A.S.A.P. if pressure is above normal or closer than 10-15% of relief valve set pressure	On
10.	Check boiler draft gauge.	Steam Water	Operator	A.S.A.P. if the draft reading is in the red zone.	On
11.	Check boiler stack thermometer.	Steam Water	Operator	A.S.A.P. if baseline stack temp-erature goes up by 40° or more.	On
12.	Check for water leakage: (1) under boiler (2) around boiler headplate gaskets (3) low water cut-off gaskets (4) pump seals (5) system piping.	Steam Water	Operator	Immediate or A.S.A.P.	On
13.	Continue to eliminate entrained air from a new or freshly filled system.	Water	Operator	Manually vent air from high points in the system.	On or Off
14.	Check boiler return water temperature.	Water	Operator	Immediate if return is less than 135° F.	On

WEEKLY MAINTENANCE SCHEDULE:

	TYPE OF SERVICE REQUIRED	BOILER TYPE	BY WHOM	SERVICE RESPONSE	BOILER STATUS
15.	Check make-up water meter and record the number of gallons in water treatment log or boiler log.	Steam	Operator	Make sure your water treat-ment company receives a copy. Highlight any significant changes in water usage and investigate the cause.	On or Off
16.	Ditto	Water	Operator	Immediate if you are making up water.	On or Off
17.	Check water level in elevated compression type expansion tank.	Water	Operator	Immediate if gauge glass is full of water.	On

MONTHLY:

	TYPE OF SERVICE REQUIRED	BOILER TYPE	BY WHOM	SERVICE RESPONSE	BOILER STATUS
18.	Slow steam evaporation test (see pages 18 and 19)	Steam	•Operator •Boiler Tech	Immediate if level controls fail to respond properly.	(See page 18)
19.	Probe low water cut-off test and reset check.	Water	Operator	Immediate if control does not respond to test and reset buttons	On Low Fire
20.	Blow-down float low water cut-offs that are equipped with McDonnell Miller Test ‘N’ Check valves.	Water	Operator	Immediate if low water cut-offs do not shut the burner off.	On Low Fire
21.	Check float low water cut-off that are not equipped with Test ‘N’ Check valves by externally manipulating linkages or bellows to force the float ball down (simulating low water) and then releasing in order to confirm that the float and linkages respond freely. This can be accomplished on most McDonnell Miller low water cut-offs except for #64.	Water	Operator	Immediate if the low water cut off does not shut the burner off or if the float fails to bounce back up quickly (indicating that it is sticking to mud at the bottom of the float chamber).	On Low Fire
22.	Check one complete sequence of operation (see page 16).	Steam Water	Operator	Immediate or A.S.A.P. if actual sequence does not follow written description.	Start when there is a call for heat.

AFTER THE FIRST THREE MONTHS OF OPERATION:

	TYPE OF SERVICE REQUIRED	BOILER TYPE	BY WHOM	SERVICE RESPONSE	BOILER STATUS
23.	Internal waterside inspection to check for scale, corrosion, and electrolysis, the latter sometimes indicated by reddish rust primer looking steel.	Steam Water*	•Operator •Boiler Tech •Water Treatment Company Representative	Immediate or A.S.A.P. depending on condition of tubes and header boxes.	Off
24.	Open the burner door if it is hinged, or the combustion chamber access panel on side of boiler if it's not. Inspect bottom row of tubes (fireside) and slide yardstick back and forth diagonally up between the tubes to check for soot. Inspect entire combustion chamber, including floor brick, for gaps, voids or deterioration of the ceramic fiber panels or cast refractory.	Steam Water	•Operator •Boiler Tech	Immediate or A.S.A.P. if: (1) Rust or water marks indicate chronic condensing problems (2) Ceramic fiber or refractory deterioration indicates overheating due to draft or overfiring problems (3) You discover any soot in the tube bundle (4) Any of the bottom tubes are leaking, sagging, or have “blisters” or bulges.	Off Locked Out/ Tagged Out
25.	Open drip/dirt legs to all vent lines. Disconnect vent lines at all diaphragm valves and switches as well as the main gas pressure regulator and NOVV if supplied.	Steam Water	•Operator •Boiler Tech	Immediate if water or moisture is discovered. These lines must be completely dry and open to atmosphere.	Off
26.	Inspect stack internally for soot near the draft control and at the stack cap.	Steam Water	•Operator •Boiler Tech	Immediate or A.S.A.P. If soot is found.	Off

ANNUAL:

	TYPE OF SERVICE REQUIRED	BOILER TYPE	BY WHOM	SERVICE RESPONSE	BOILER STATUS
27.	Follow step 23-26 above.	See above	See above	See above	Off Locked Out/ Tagged Out
28.	Inspect feedwater, blow-down and equalizing valves and piping for sludge restrictions or obstructions.	Steam	•Operator •Boiler Tech	Clean or replace piping and valves as necessary.	Off
29.	Check all wye strainer screens.	Steam Water	Operator	Clean or replace as necessary.	Off
30.	Check boiler water pH with sample pulled from boiler before draining for internal inspection.	Steam Water	•Operator •Boiler Tech •Water Treatment Company Representative	Adjust with chemical treatment as required to bring into proper pH range.	Off
31.	Flush out and clean blow-down tanks and condensate return tanks. ***Twice a year is recommended.***	Steam	Operator Boiler Tech	As required.	Off
32.	Open all float type low water cut-offs used on steam boilers and McDonnell MIller #64 or 150 s (m) low water cut-off on water boilers.	Steam Water	•Operator •Boiler Tech	Immediate if float bowls or float arm guides have any mud or scale buildup.	Off
33.	Check for electrolysis due to stray electrical currents or improper boiler-to-copper pipe connections.	Steam Water	•Electrician •Operator	See pages 7 and 34	On
34.	Check high limit control operation.	Steam Water	Operator	Immediate if lowering high limit setting to pressure or temperature reading in boiler does not cause burner to shutdown and high limit to lockout.	On low fire
35.	Check high limit control, operator control and pressure/temperature gauge for nominal accuracy.	Steam Water	•Operator •Boiler Tech	Immediate if the controls and pressure/temperature gauge are not within reasonable accuracy of each other.	On
36.	Replace gauge glass and glass packing gaskets on steam column.	Steam	•Operator •Boiler Tech		Off
37.	Replace gauge glass and glass packing gaskets on elevated compression type expansion tanks.	Water	Operator	Do only if expansion tank has become waterlogged during the year.	Off
38.	Lubricate (if necessary) and do amperage test on all pump and fan motors associated with boiler system.	Steam Water	•Operator, •Boiler Tech •Electrician	A.S.A.P. If full load amperage draw is higher than motor name-plate rating, check motor starter contacts for wear and replace as necessary.	Off
39.	If supplied, check normally open vent valve on boiler gas train for proper operation.	Steam Water	•Operator •Boiler Tech	Immediate if NOVV stays open when boiler is firing.	Firing
40.	Check that washer weights have remained in place on the barometric damper.	Steam Water	Operator	Replace weights if they have fallen off. Recheck draft when finished.	On or Off
41.	Relief valve test: With boiler pressure at 75% of relief valve set pressure- use relief valve lever to manually open the valve. Leave open about 5 seconds and then close again. **DANGER:** Relief valve discharge piping must be piped to a safe point of discharge. Ear and eye protection is recommended for this test.	Steam Water	Boiler Tech	Immediate if valve fails to open or if water or steam is not discharged under pressure. If valve fails to reseat tightly, open a few more times to dislodge any foreign material on the valve seat. Replace valve if it does not reseat.	On
42.	Check draft gauge calibration	Steam Water	Operator	Temporarily remove the plastic tubing to the draft gauage. If red gauge oil does not return to “O”, try adjusting it with the zero set knob. Add oil as needed. See page 3 Para 4	On

* The 3 month internal inspection may be waived for water boilers provided they are opened up after one year. Subsequent inspections are discretionary but should not be more than 5 years apart.

Outdoor Boilers

1. Weatherproof boilers for outdoor installation come with sheet metal covers over the burner and gas train. Controls are covered or installed in Nema 3R or 4 panels and sealtite conduit is used.

2. A storm collar is provided around the vent connector. Sheet metal seams are caulked to prevent rain from entering the jacket. The RTV caulking (Dow #732) should be inspected once a year and repaired or replaced as necessary.

3. Barometric damper draft controls are not supplied with outdoor boilers because they do not work properly in windy conditions.

4. To maintain proper draft, gas fired boilers should use 8 to 10 feet of stack straight up from the top of the boiler the same diameter as the vent connector. For #2 oil fired boilers, the height should be increased to 13 to 15 feet and the use of an in-line condensate drain trap is recommended in the first stack section.

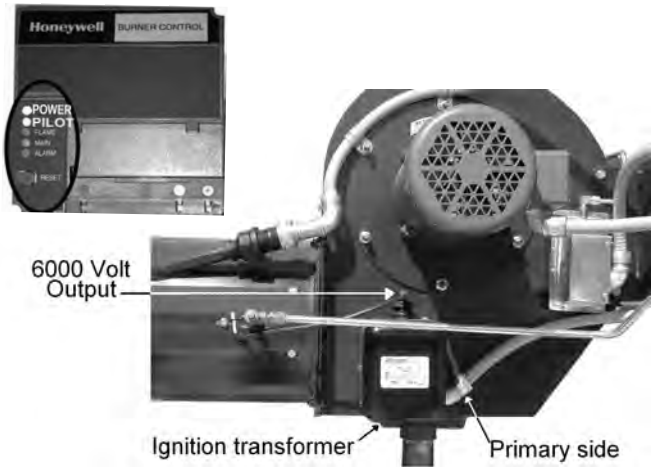
5. The stack must be guy wired to the boiler or adjacent construction and terminated with a rain cap. In areas with moderate to strong winds, a breidert type cap - available from Rite - should be used.

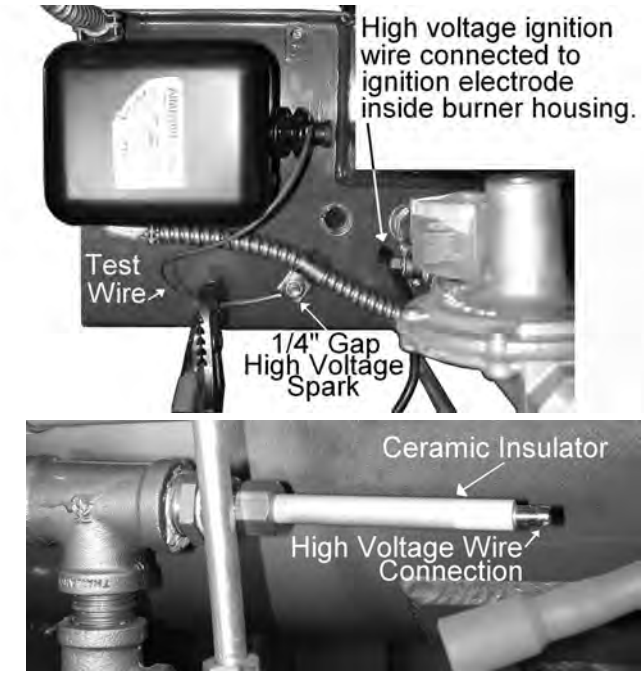
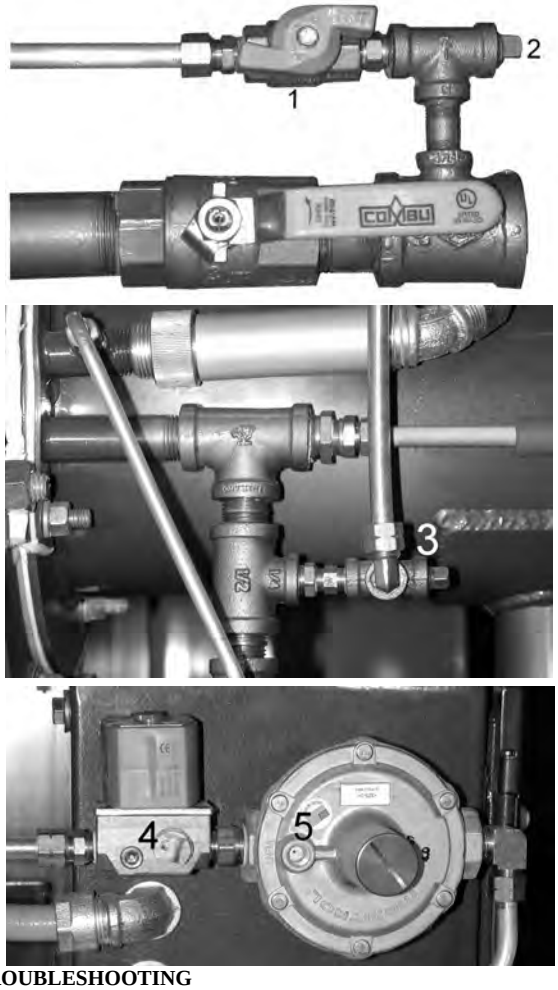
6. If stack height must be increased beyond the heights in paragraph 4, it might be necessary to add a baffle across the vent connector to slow the draft down. When firing, the overfire (firebox) pressure should be –.01" to –.03" water column. The measurement can be taken through the tapping located in the rear viewport pipe on boilers manufactured after June 2007. Draft measurement can also be taken at the vent connector. (below the stack baffle if installed) and the range should be –.03" to –.09" maximum w.c. when firing.

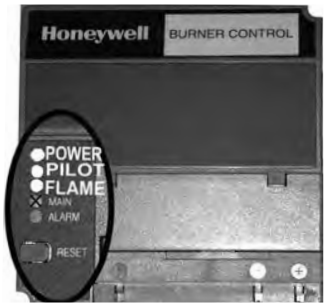
DANGER **TROUBLESHOOTING SHOULD BE CARRIED OUT BY QUALIFIED PERSONNEL ONLY**

SECTION I. HONEYWELL RM7800 SERIES FLAME SAFEGUARD CONTROLS

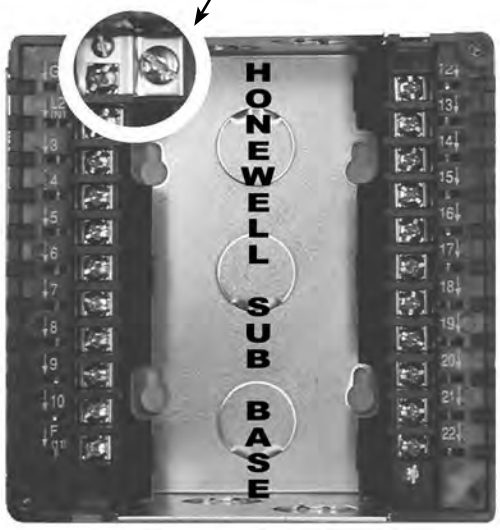
SEE APPROPRIATE FSG BULLETIN FOR OTHER FLAME SAFEGUARD CONTROLS AND MORE COMPLETE OPERATION & TROUBLESHOOTING INFORMATION.

PROBLEM	CAUSE / REMEDY
1. On FSG, the top light does not come on: 	1. Circuit breaker or fuse to the boiler is off. 2. Boiler power switch is off.
2. FSG does not sequence to PTFI (Pilot Trial for Ignition). The second light down does <u>not</u> come on:  Honeywell FSG Run/Test switch (On boilers over 2500 MBH)	1. One or more of the limit switches are not "made" (closed). Correct problem and then manually reset the switch(es). 2. The operator or low fire control is not calling for heat. 3. Burner control circuit fuse is blown. 4. Building Automation System is not calling for heat. 5. Burner fan proving switch not made. Check blower motor rotation, check fan wheel, check fan proving switch adjustment. 6. "End" or proving switches attached to the following devices may not be made: combustion air damper, induced draft fan, supply air fan, automatic stack damper.
3. The top two lights come on but there is no ignition spark as seen through the boiler rear viewport. 	1. Make sure primary side of ignition transformer is getting 120 VAC during PTFI. If not, check wiring to the primary side. If wiring is good, the Flame Safeguard is probably bad. 2. To test the ignition transformer, temporarily remove the high voltage wire from the output post. Install a piece of insulated 16 awg wire long enough to reach grounded bare metal. Strip a 1/4" off the end of the wire and holding the wire with insulated pliers, maintain a 1/4" gap between the end of the wire and the bare metal as shown on the next page. If a spark jumps when 120 VAC is applied to the primary side, the ignition transformer is good. Continued →

PROBLEM	CAUSE / REMEDY
3. Honeywell “Pilot” light is on but there is no ignition spark for the pilot (continued from previous page): 	3. High voltage ignition wire could be defective. To test temporarily replace with a piece of 12 or 14 gauge <u>insulated</u> wire, TFFN solid or stranded. The wire may have to be manually held onto the ignition electrodes point of connection. If spark occurs when 120 VAC is supplied to the primary side, replace defective ignition wire. 4. Locate ignition electrode. Check high voltage wire connection for tightness and continuity. Check ceramic insulator for defects. Replace insulator if cracked or broken. 5. Check ignition electrode spark gap distance per burner manufacturer's recommendations. The electrode will not spark if it is in direct contact with metal or too far away.
4. During PTFI there is ignition spark but no pilot flame: 	1. Make sure air has been bled from the gas line and pilot tubing for all new installations. 2. Make sure the manual pilot gas cock (**1**) is open. 3. Check the gas pressure to the pilot line at the 1/4” tee test port (**2**) and make sure it is within the range specified by the burner manufacturer. 4. During PTFI, check for gas pressure downstream of the pilot valve at a plugged tee port or by disconnecting the pilot tubing (**3**). If there is no gas flow: a) Check to see if the pilot valve (**4**) is receiving 120 VAC (if not, the FSG may be bad or the wiring from the FSG’s pilot terminal sub base to the pilot valve may be faulty). b) The pilot valve may be defective c) The pilot regulator (**5**) vent port may be plugged which may prevent the regulator from opening. 5. Check the pilot tubing for kinks, breaks or internal obstruction. 6. Check the pilot burner orifice opening for debris blockage or reduced diameter due to corrosion. Do not enlarge the orifice opening beyond original size.

PROBLEM	CAUSE / REMEDY
5. During PTFI there is a pilot flame but the third light down does not come on: 	1. Put the F.S.G. run-test switch in test position. 2. Using a multimeter (or the FSG's optional key-board display module) make sure the pilot flame signal strength is in the proper range. 3. If there is no signal, UV scanner (or flame rod) may not be sighting the flame. Scanner may be mis-wired. The amplifier, scanner or flame rod might be defective. 4. If the flame signal is too low, pilot gas pressure might be too low, the boiler draft might be too high or too much combustion air is affecting the pilot flame.
6. There is a pilot flame and the third light down is on but the fourth light is not on. 	1. F.S.G. run-test position is in the test position. Move to run position. 2. F.S.G. chassis might be defective. 3. Install keyboard display module on F.S.G. to help troubleshoot.
7. The fourth light down comes on but the main flame does not come on.  	1. Upstream or downstream manual gas train shut-off valves might be off. 2. Check that the electrically operated safety shut-off valves are opening, either visually in the case of motorized valves or by listening for the click of the solenoid or diaphragm gas valves when they open. Gas pressure taps are also available on the upstream and downstream side of most gas valve bodies. 3. The main gas pressure regulator vent or vent line may be plugged, blocked or corroded shut, causing the regulator not to open. 4. The bleed vent port or vent line to diaphragm gas valve might be plugged, blocked or corroded shut and not allowing the valve to open

PROBLEM	CAUSE / REMEDY
6. Intermittent flame failure requiring manual reset of FSG:	1. Poor electrical ground. Verify that a solid earth ground wire has been brought to the F.S.G.'s sub base earth grounding screw. 2. Wrong electrical polarity: Check that the 120 VAC supply hot leg goes to the burner switch and that the neutral leg (L2) has less than .5 VAC potential to earth ground. 3. Transient voltage problems with the main power supply. To verify, run a temporary ground wire from the pilot burner to the F.S.G. sub base earth grounding screw. 4. Power supply less than 102 VAC or greater than 132 VAC. 5. Ambient temperature at the F.S.G. is over 140 degrees F or less than -40 degrees F. 6. Pilot valve is sticking open after a burner firing cycle and creating a false flame signal during standby. Honeywell's "MAIN" and "ALARM" LED lights will be on. 7. Energy Management System's enable-disable relay is "Triac" type (i.e., voltage leaks through before relay contacts fully make). Replace with "ice cube" or similar definite purpose relay. 8. VFD (variable frequency drive) motors are operating nearby. Install a power line "noise" filter (such as Corcom 10VS1 or Schaffner FN 660-16-03) at the supply side of the boiler's power-on switch.

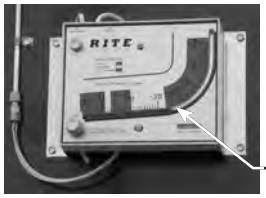


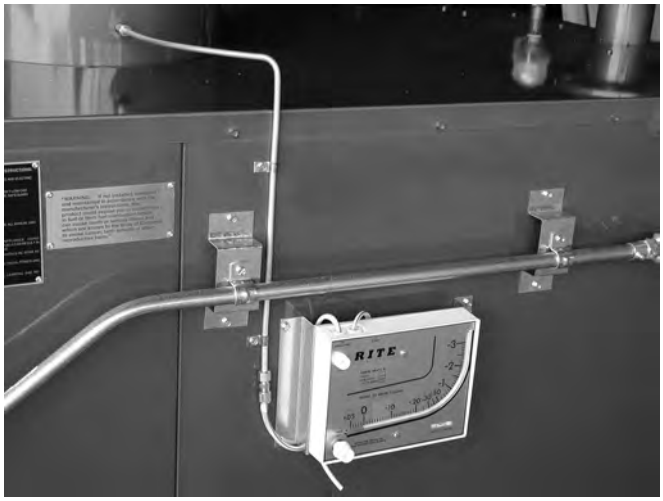
6. Intermittent flame failure requiring manual reset of FSG (continued from previous page):

Honeywell Chassis and Modules

Amplifier

Purge Timing Card





9. Fluttering draft proving switch. If an induced draft fan is used, be sure the draft proving switch is properly installed and calibrated so that the switch does not "flutter" on and off.

10. Gas pressure "droop". Make sure the gas supply piping to the boiler is properly sized to prevent the gas pressure from decreasing below minimum supply requirements when the boiler and any other gas burning equipment connected to the same meter are on line. This can be checked by installing a gas pressure gauge of the proper range at the gas train's supply gas pressure test port and seeing if the pressure drops appreciably between static (burner not firing) and flow conditions.

11. Intermittent F.S.G. control component failure. The best way to check this is if there is a second boiler operating nearby with the exact same F.S.G. control. Swap the controls and see if the problem stays with the boiler or follows the control. If the problem follows the control, you may then want to swap the F.S.G.'s control modules to further pinpoint the defective component. If you do not have another F.S.G. to swap, check with a local authorized distributor to see if they can bench test the unit.

12. A poor main or pilot flame can lead to deterioration of flame ionization and thus a weak flame signal. Typical causes of this are temporary negative boiler room pressure conditions or stack downdrafts.

13. Too high a draft can pull the flame away from the UV scanner or flame rod. Check draft gauge and draft control to assure that draft is not over –.1" w.c., especially on boilers with vertical stacks over 40 feet tall or operating with an induced draft fan.

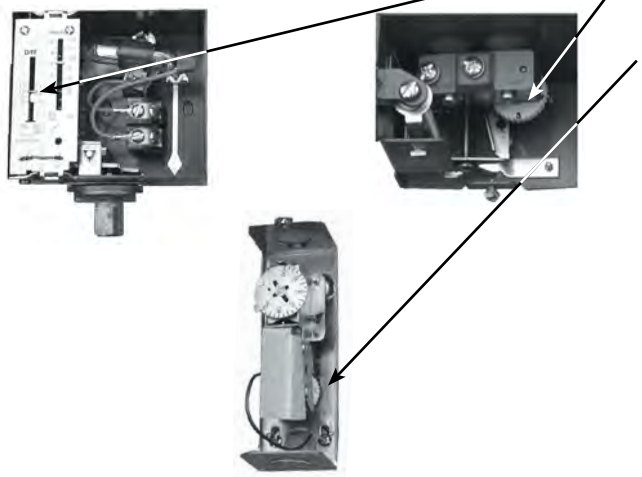
PROBLEM	CAUSE / REMEDY
6. Intermittent flame failure requiring manual reset of FSG (continued from previous page):	14. F.S.G. control sub base is defective. In some rare cases, there have been hidden defects in the F.S.G. sub base. If all else fails, the F.S.G. sub base should be changed out (see page 26).
	15. The following F.S.G. plug-in diagnostic display module will provide flame signal read-out as well as other useful burner monitoring and troubleshooting information: Honeywell: S7800A1001 or S7800A1142.
	16. Some Honeywell flame safeguards have a "run-test" switch that holds the sequence in the test position. This can be useful for checking flame signals and troubleshooting the burner at various stages of operation.

SECTION II. MAIN FLAME

1. Main flame "pulsates":	1. Too much draft. Check draft gauge on side of boiler.
 **Barometric Damper**	2. Barometric damper not installed.
	3. Barometric damper is installed too far away from the boiler. Install damper in stack tee as close to the boiler as possible (see page 4, figure 4).
	4. Barometric damper is installed in a Tee or collar that doesn't provide enough offset, causing the bottom of the damper gate to get caught in the stack's exhaust flow while operating.
	5. Barometric damper gate is not opening up enough. Remove some washer weights.

SECTION III. GAS VALVE AND BURNER OPERATION

1. Boiler cycles on/off too frequently:



1. On steam boilers, adjust the differential setpoint higher.
2. On water boilers, replace aquastats with fixed differentials to adjustable type.
3. Check energy management system's remote start/stop relay.
4. Check sequence of operation (see pages 16) to make sure the burner has returned to low fire long before a call for heat has been satisfied.

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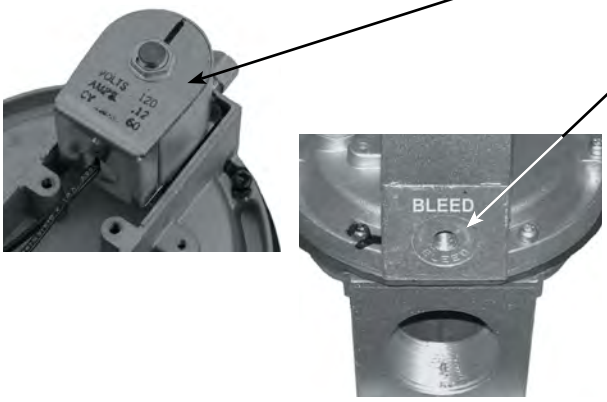
2. Diaphragm gas valve does not open when energized:



1. Coil defective. Replace with new coil (part #116931) for all Honeywell V48A valves.
2. Bleed port is plugged, blocked or corroded shut.
3. Valve defective. Replace.

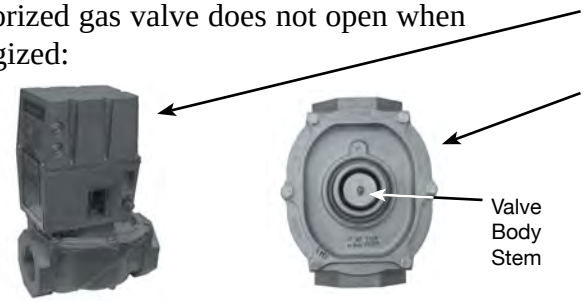
---

3. Solenoid gas valve does not open when energized:

1. Coil defective. For Honeywell V4295A valves, replace with new coil (see chart below).

Valve Size (inch)	Type	Coil Part Number 120 Vac, 50/60 Hz	
		2 psi	5 psi
3/8, 1/2	N.C.	BBA51302	BBA51302
3/4	N.C.	BBA51302	BBA51314
1	N.C.	BBA51302	BBA51309
1-1/4	N.C.	BBA51303	BBA51310
1-1/2	N.C.	BBA51301	BBA51310
2	N.C.	BBA51304	BBA51311
2-1/2	N.C.	BBA51305	N/A
3	N.C.	BBA51306	N/A
3/4, 1	N.C.	BBA51307	N/A
1-1/4	N.C.	BBA51308	N/A

2. Valve defective. Replace.

PROBLEM	CAUSE / REMEDY
4. Motorized gas valve does not open when energized:  Actuator and Valve Body Valve Body Only	1. Check actuator for leaking hydraulic oil fluid. 2. Remove actuator and make sure valve body stem is not jammed and can be forced down against closing spring pressure. 3. Replace actuator or valve body as required.

5. Safety shut-off gas valves fail to close completely when de-energized:

Valve Leak Test (see Figure 10 on next page)

This is a test for checking the closure tightness of a gas safety shutoff valve. It should be performed by qualified personnel during the initial startup of a burner system, or whenever the valve or valve bonnet is replaced. It is recommended that this test also be included in the scheduled inspection and maintenance procedures. For a periodic inspection test, follow steps ***1-12 below and refer to figure 10 on page 31.***

1. Shut the burner power switch off.

2. Close the downstream leak test cock “E”

3. Open manual gas shutoff cock “A”

4. Remove the plug from the petcock “F” and connect the test apparatus.

5. Submerse the 1/4” tubing vertically 1/2” into a jar of water.

6. Slowly open test petcock “F”.

7. When the rate of bubbles coming through the water stabilizes, count the number of bubbles appearing during a ten second period. Each bubble appearing during a ten second period represents a flow rate of approximately .001 CFH (23.32 cc/hr).

8. If the leakage rate for the SSOV “B” does not exceed the allowable rate, close the test petcock “F” and reinstall plug.

9. Temporary hot-wire SSOV “B” to the open position.

10. Use test petcock “G” to test SSOV “C” in the same manner.

11. If the leakage rate for SSOV “C” does not exceed the allowable rate, close the test petcock “G” and reinstall plug.

12. Rewire all valves and wiring to pre-test conditions and check the burner gas train operation for at least two complete firing sequence.

To Meet U.S. requirements, leakage must not exceed the following values:

V48A Pipe Size *(in)*	Allowable Leakage *(cc/hr NatGas)*	Number of Bubbles per 10sec *(Nat Gas)*
3/4"	332.5	8
1"	377.5	9
1-1/4" & 1-1/2"	552.5	13
2" & 2-1/2"	812.5	20

V5055 Pipe Size *(in)*	Allowable Leakage *(cc/hr)*	Number of Bubbles per 10sec *(Nat Gas)*
3/4, 1, 1-1/4, 1-1/2	573	14
2, 2-1/2, 3	940	24
4	1254	33

V4295A Pipe Size *(in)*	Allowable Leakage *(cc/hr)*	Number of Bubbles per 10sec *(Nat Gas)*
3/8" & 1/2"	235	6
3/4" & 1"	241	6
1-1/4 & 1-1/2"	444	11
2"	532	14
2-1/2”	629	16
3	768	20

NOTE: For international leak test requirements, contact the office of the appropriate approval agency.

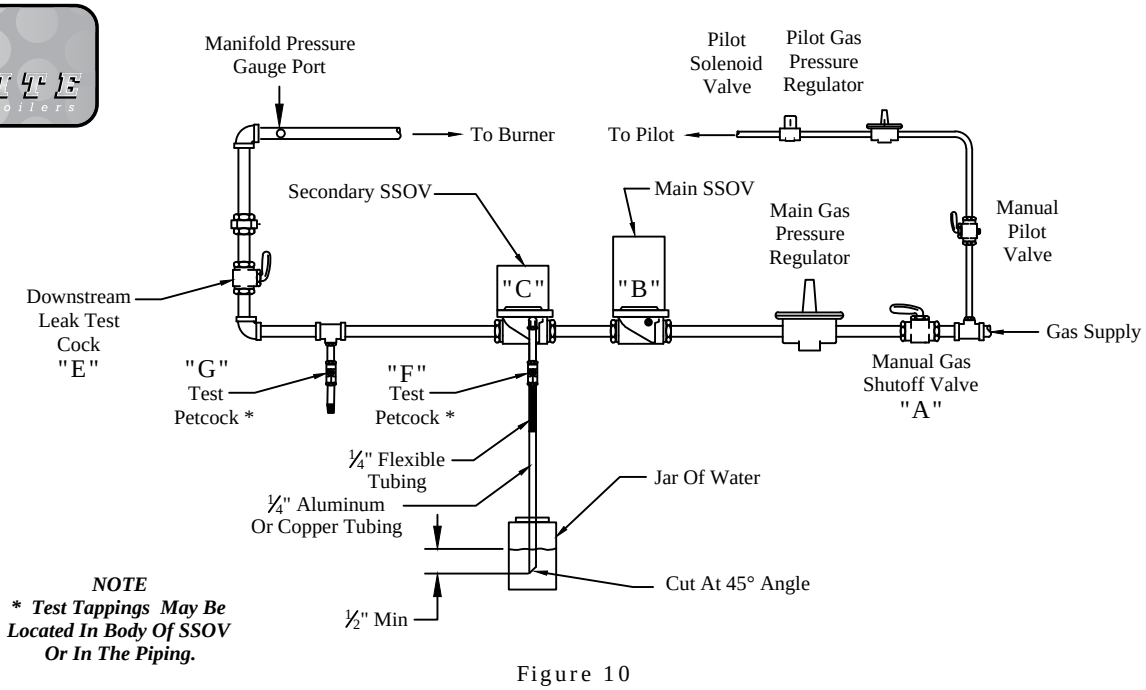
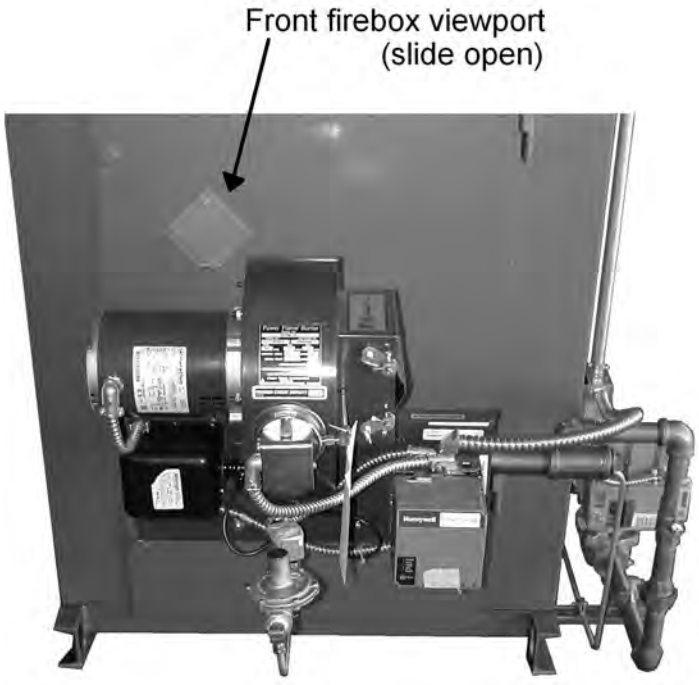


Figure 10

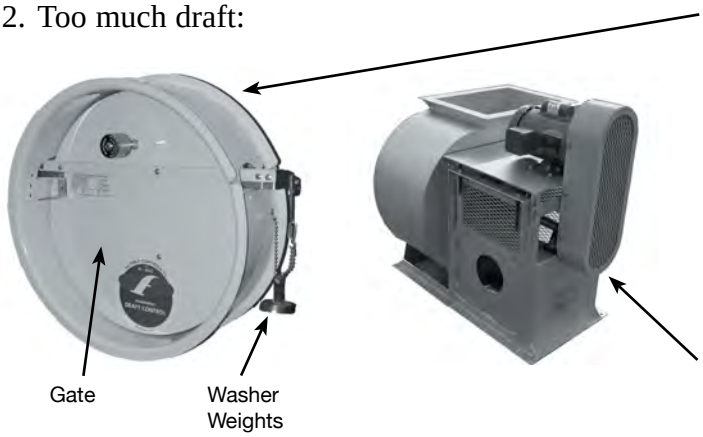
PROBLEM	CAUSE / REMEDY

SECTION IV. DRAFT OR HIGH STACK TEMPERATURE

1. Not enough draft: Positive pressure at firebox door peepsight opening when firing and/or draft gauge is reading positive pressure.



1. Tube bundle (heat exchanger) sooted.
2. Boiler room is under negative pressure.
3. Washer weights have fallen off barometric damper.
4. Downdraft condition due to wind or poor stack termination location. If winds are a constant problem, consider replacing standard stack cap with Breidert type.
5. Boiler is condensing.
6. Improper stack design such as long horizontal run or stack diameter reduction.

PROBLEM	CAUSE / REMEDY
2. Too much draft:  	1. Excess washer weights on Barometric Damper keeps the gate from opening and lowering the draft through the boiler. 2. Stack is over 25’ tall and with Barometric Damper wide open, the draft is still too high. Increase the damper size or add a second Barometric Damper in the stack. 3. Induced draft fan (if used) R.P.M. too high. Reduce fan speed.
3. High stack temperature. Over 400º F net or 500º F gross - except high pressure steam or high temperature hot water boilers which will have higher stack temperatures due to higher fluid saturation temperatures.	1. Excessive draft. 2. Boiler tubes require internal waterside cleaning. 3. Boiler tubes sooted (external). 4. Boiler overfiring. 5. Glycol in system (water boilers only) will result in higher operating stack temperatures than systems without glycol (see page 9).

SECTION V. WATER LEAKS

1. Headplate gasket leak

Typical headplate cap screw markings, ASME SA grade, and ***maximum*** bolt torque values. Typical bolt torque for Rite Boilers will be less than the following values:

5/8”-11 N.C. Thread
SA 307B
Maximum 50 foot pounds.

5/8”-11 N.C. Thread
SA 325-1
Maximum 100 foot pounds.

5/8”-11 N.C. Thread
SA 354BD-1
Maximum 100 foot pounds.

3/4”-10 N.C. Thread
SA 307B
Maximum 85 foot pounds.

3/4”-10 N.C. Thread
SA325-1
Maximum 160 foot pounds.

3/4”-10 N.C. Thread
SA354BD-1
Section IV Boilers: ***Maximum*** 180 foot-pounds.
Section I Boilers: ***Maximum*** 200 foot-pounds.

1. Make sure the boiler flange and headplate gasket mating surfaces are clean and not pitted or wire-drawn.

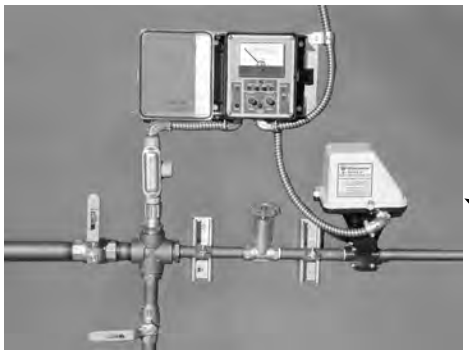
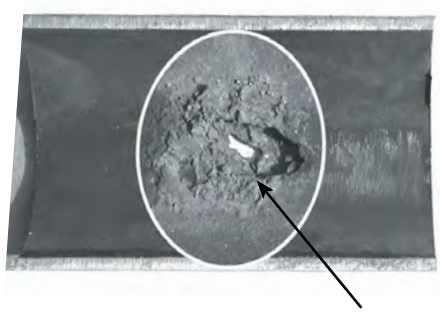
2. Use new authorized factory gaskets as supplied without additional sealant.

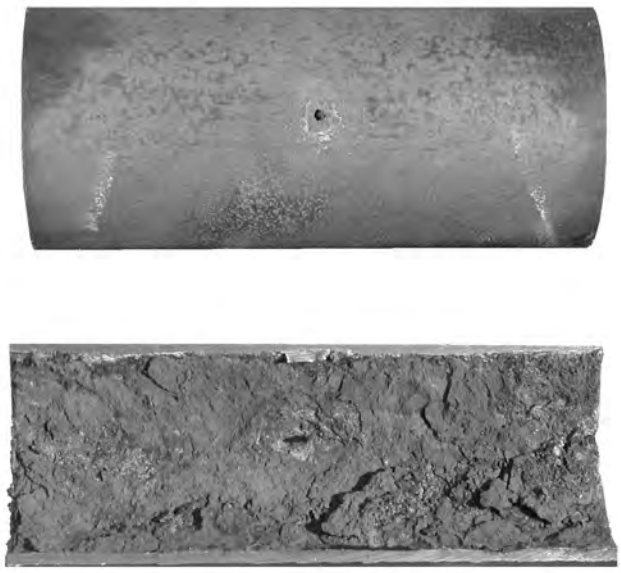
3. Use new or like new cap screw bolts with undamaged threads, lubricated with anti-seize rated for 1800º F.

4. Make sure threaded thru-holes in header box flanges are not galled or damaged. To “chase” threads, use 5/8”-11 or 3/4”-10 hand tap with H5 ground thread limits. Bolts should go in finger tight until the bolt heads engage the headplates.

5. After finger tightening all the bolts, tighten the cap screws ***SNUGLY*** in an alternating pattern starting at the centers (top, bottom, left and right) and work toward the corners. Repeat this pattern a second time. The third time just start at one center bolt and go around the headplate in one direction without alternating. All bolts should be uniformly snug when finished.

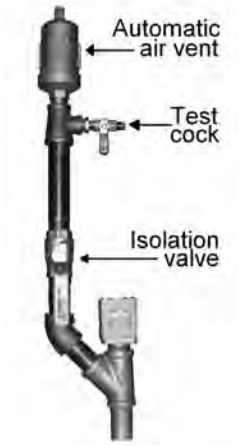
6. After bringing boiler up to operating pressure/ temperature, snug all bolts one more time.

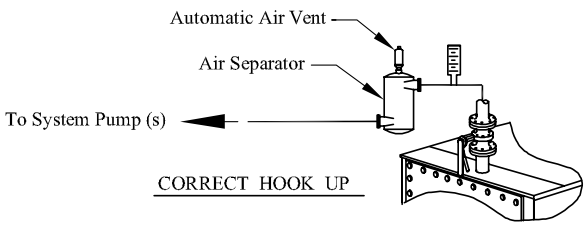
PROBLEM	CAUSE / REMEDY
2. One or more boiler tubes leak at the tubesheet(s):	1. Boiler may have been dry-fired. Tubes that are sagging or warped must be replaced. If tubesheets are warped and cannot be re-straightened, the entire heat exchanger may have to be replaced. Identify and correct the cause of the dry-fire before putting the boiler back into service.
3. One or more boiler tubes leak above the burner bed, usually from the bottom or second row. (External wastage from long term leakage is usually visible): 	1. Problem is usually a long term overheated area of the tube caused by a buildup of mud or lime deposits. Replacement of leaking tube(s) is required. Find cause of the water makeup before putting boiler back into service and make appropriate repairs. 2. For steam boilers operating with water make-up, find out why the water treatment program - especially the bottom blow-down, water softener and chemical treatment - has not been more successful at reducing scale. 3. Consider installing an automatic timed surface blow-down system to reduce scale.
4. Water Boiler: one or more tubes leak from above the second row:  Sectioned boiler tube showing underdeposit corrosion. (Enlarged for clarity).	1. The leak might be due to longterm overheating from internal scale but the higher up in the tube bundle the less likely a tube burnout becomes. Check the boiler water pH before you drain the boiler. It should be at or near 8.5. If below 7, the water is acidic and is eating the steel. 2. Test for electrolysis due to stray voltage and correct as necessary (see page 7 paragraph 5).

PROBLEM	CAUSE / REMEDY
4. Water Boiler: one or more tubes leak from above the second row (continued from previous page):	3. If copper piping was used on *any of the lines* to the boiler, make sure dielectric flange kits (or unions) are installed and working to keep the copper (cathode) isolated from the steel (anode). Note that a copper ground rod used to fix stray voltage electrolysis *will not solve* a galvanic electrolysis (dissimilar metals) problem even though galvanic electrolysis will also show up as AC millivoltage.
5. Steam Boiler: One or more tubes leak from above the second row: 	1. The problem might be due to longterm overheating from scale (easily confirmed by visual evidence) but the higher up in the tube bundle the less likely a tube burnout becomes. Check the boiler water pH before draining the boiler. It should be between 10.5 and 11.5. If below 7, the water is acidic and corroding the steel. 2. Remove the leaking tube(s) and section the tube near the failure. If the tube that failed came from below the normal water line, it could be due to oxygen corrosion or carbonic acid. Oxygen corrosion will appear as pitting in the steel, while carbonic acid attack will appear as channeling or grooving. 3. If the tube failed above the water line, it is usually the result of oxygen corrosion. Reasons include: a) Not enough oxygen scavenger in the chemical treatment. b) Boiler is frequently shut down at night or over weekend - causing a vacuum as it cools and sucking in oxygen laden air through the gauge glass packing gaskets. c) Out-of service oxygen corrosion due to improper boiler lay-up (see page 40).
6. One or more tubes have “split” or ruptured during cold weather shutdown:	1. Indicates that water in boiler reached freezing temperature. To help prevent this from occurring again: a) Install an automatic stack vent damper in the stack. b) Maintain enough glycol in the system (hot water boilers only) to stay above the freeze point. c) Leave the boiler and the system pump(s) on.

SECTION VI - Miscellaneous Water Boiler Problems

1. Water boiler "Knocks or Bangs" when firing:





1. The cause is almost always air in the system.
2. When filling the system, or re-filling the boiler after an internal inspection, always manually vent air from high points and other natural air trap locations before turning the system pump on.
3. Make sure automatic air vents are installed at highpoints in the system and that they meet or exceed the M.A.W.P. of the boiler.
4. Where compression type expansion tanks are used and the boiler is turned off regularly during heating season, the air in the tank can migrate down to the boiler when the water cools. To fix this, either leave the boiler on or replace the tank with a larger one (either compression or bladder) that has more acceptance volume. Sizing a new tank will require an engineering review.
5. Never mix compression tanks and bladder/ diaphragm tanks in the same system.
6. System pressure may be to low. If the operating temperature is above the boiling point, make sure the boiler pressure safely exceeds the equivalent steam pressure at that temperature to avoid flashing to steam.

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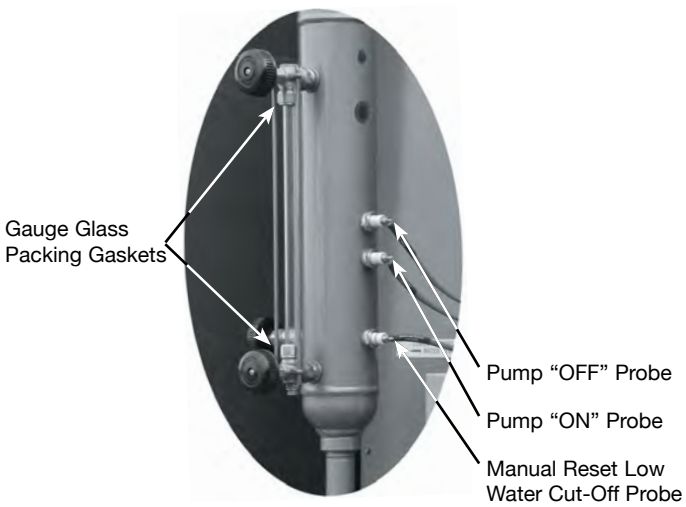
2. Boiler pressure goes up higher than normal.

1. If the system pressure rises when the boiler is not firing there might be dirt under the seat of the pressure reducing make-up valve, allowing city water pressure to continue entering the boiler system.
2. If the system pressure goes up when the boiler is firing, the expansion tank might be waterlogged (compression type) or the bladder/diaphragm might be ruptured or the tank may have lost its air charge (bladder/diaphragm type). The valve that isolates the expansion tank from the system may also be closed.

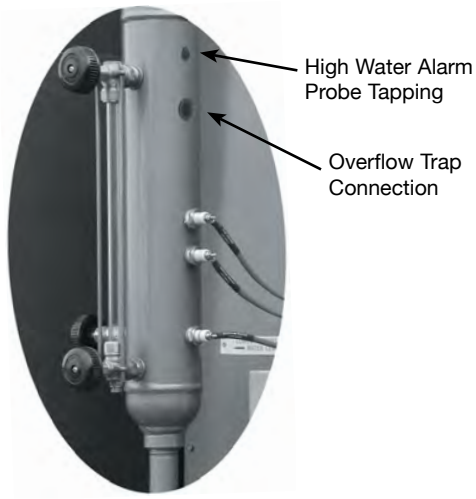
SECTION VII - Miscellaneous Steam Boiler Problems

1. Flooded gauge glass:



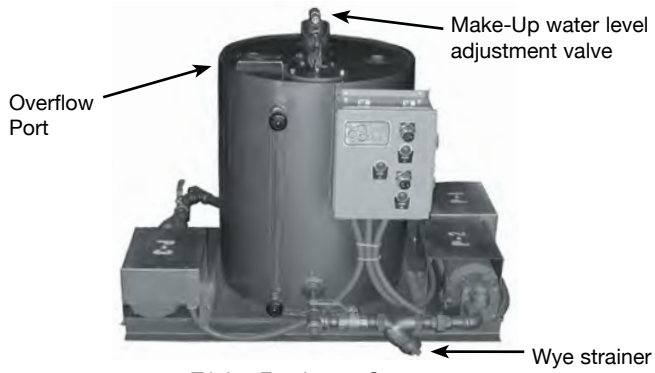
1. If this occurs only after the boiler has been turned off and cooled down, it's due to the boiler drawing a vacuum and pulling water out of the condensate return/feedwater tank. Adding a vacuum breaker on to the boiler external piping can solve this problem, but also creates another problem as well: by introducing air into the boiler, you are introducing oxygen into the boiler which will require more chemical treatment (especially oxygen scavengers) to compensate. As an alternative, consider leaving the boiler "on" in a night or weekend "set back" mode (1-2 psi) with the boiler stop valve closed.

2. If flooded glass occurs when the boiler is operating, see if the boiler feed pump is running.



3. If the feed pump system is designed to run continuously and multiple boilers are fed by individual electrically operated valves, see if the valves are energized open. In either case, if there is a call for water when there shouldn't be, you will have to troubleshoot the feed pump circuit until you find the problem. If solenoid feed valves are used, there might be foreign material under the seat preventing a tight shut-off.

4. If two or more boilers are piped in battery, make sure that the swing check valve (low pressure steam only) is closing tightly to prevent steam in the main header from condensing back into the boilers that are off line. On high pressure steam boilers piped in battery, the same thing can occur through the spring loaded check valves or the stop/check valves from each boiler's steam supply. On low pressure steam boilers piped in battery, it might be just as effective to install a steam trap just above the level in the boiler where the feed pump normally cuts off in lieu of installing a large swing check valve. See page 48 for recommended steam boiler battery piping.

PROBLEM	CAUSE / REMEDY
2. Steam boiler off on low water:	1. Follow steps in slow steam evaporation test (see page 18). 2. If water level in boiler rapidly drops when feed water pump comes on, the gpm rate might be too high, the feedwater temperature too low or a both. See page 6 for recommended feed rates. Ideal feedwater temperature is 180º to 190º F.
3. "Slow" feedwater pump. Water level in gauge glass starts to rise only after pressure in boiler drops:	1. Check valve(s) in feed water line have failed and boiler water has reached pump volute where it's flashing to steam. Replace or repair check valves (see page 48 for recommended check valve type and location). 2. Check feed pump discharge pressure with a gauge and make sure it is above boiler operating pressure. If not, on Burks pumps only, try adjusting impeller clearance. 3. Feedwater tank temperatures over 200° F may be causing steam vapor lock in pump volute. Lower feedwater temperature to 180° - 190° F.
4. Feedwater pump sluggish under most operating conditions:  Triplex Feedwater System shown	1. Feed pump wye strainer screen is clogged. 2. Feedwater inlet port at the boiler is partially blocked by scale or sludge. 3. Feedwater pumps "vortexing" due to low Net Suction Positive Head (NSPH). Raise make-up water level in tank before it reaches the 1" overflow port.

PROBLEM	CAUSE / REMEDY
5. Water carryover (“wet steam”):	1. Reducing the steam stop valve size and associated piping from the steam outlet nozzle can raise steam exit velocities out of the boiler and cause water lift. The exception to this is on larger high pressure steam boilers where stop/check valves are almost always sized smaller than the boiler outlet nozzle. 2. Instantaneous high steam demand. Correct by using slower opening valves such as motorized ball type in lieu of solenoid snap-acting type valves to feed steam equipment. 3. Boiler water T.D.S. levels above 2600 ppm will promote water carry-over. Lower T.D.S. level. 4. Make sure the steam main is properly pitched and trapped at the end. Make sure the risers from the steam main come off at or near the top of the pipe.
5. Not enough steam:	1. Boiler not sequencing to high fire (see page 16). 2. One or more steam traps have failed open, causing steam to continually blow by the traps. A steady plume of steam coming out of the condensate return tank vent line is a telltale sign of this; normal trap operation will be indicated by wisps of steam coming out the vent as various traps open intermittently. 3. Boiler is undersized for the load. Fix this problem by purchasing another Rite Boiler.

Removing Boilers From Service (Lay-up)

1. There are two types of lay-ups: short term and long term. A short term lay-up could be considered anywhere from a few weeks up to the 3 to 6 month warm season that comfort heating boilers are off-line. A long term lay-up could be considered any time period longer that 6 months. The two main goals of short and long term lay-ups is to prevent corrosion (oxygen or acidic) from attacking the boilers waterside steel surfaces and to prevent freeze-ups if the boiler is layed-up wet (full of water).

2. A water boiler wet lay-up is generally recommended for short term removal from service for two reasons: the boiler can be brought back on-line relatively quickly and it is also less labor intensive than a "dry" (no water in the boiler) lay-up. If the boiler to be layed-up wet in potentially freezing weather, add glycol to the boiler and system in concentrations recommended on page 9, or consider laying the boiler up dry instead. To combat corrosion in a wet lay-up, it is common to add a blend of oxygen scavenging and corrosion inhibiting chemicals to the boiler and system, but it is highly recommended that you do so under the guidance of your water treatment specialist.

3. While wet lay-ups of water boilers are fairly straight forward because the boiler and system are full of water and all the air has been vented out of the system, steam boilers are another matter. Steam boilers normally operate with a water line approximately 2/3 full. Steam boilers *must not* be layed-up in this manner because the air in the upper portion of the boiler will attack the exposed steel above the water line. Steam boilers must therefore be completely flooded up to the steam outlet's stop valve. The water used to flood the boiler should be softened and chemically treated. Returned condensate from the system is ideal for this purpose. The boiler should also be kept under slight pressure (3 to 5 p.s.i.) to prevent air (oxygen) from entering the boiler. Again, it is prudent to follow recommendations from your water treatment specialist when laying up a steam boiler wet. Their recommendations may include weekly testing of the water for maintaining pH levels above 8 and sulfite (oxygen scavenging) residual. Test results should be a minimum of 20 ppm sodium sulfite (as SO_3) and 400 ppm phenolphthalein alkalinity (as $CaCO_3$). In some cases they may recommend nitrogen blankets for your particular installation.

4. In a dry lay-up, you must be sure that the water is not only drained from the boiler, but from all external boiler piping as well. This includes low water cut-off float bowls and the anti-siphon line to the steam boiler pressuretrolls. After draining all the water out of the boiler with the water temperature between 120-135°F, remove the headplates. Next, the boiler tubes should be thoroughly brushed clean to remove any mud or sludge that could promote underdeposit corrosion (see page 17 and the bottom of page 34). Thoroughly dry all waterside surfaces using a warm air fan, towels, etc. Place quick lime (not hydrated) or commercial grade silica gel on elevated non-metallic trays inside each header box. If you are in an area subject to warm humid air, reinstall the headplates. Consult your desiccant supplier or water treatment company regarding the best type and amount of desiccant to use for your area. Generally, 5 lbs. of quick lime or 8 lbs. of silica gel should be used for every 30 BHP. Open the headplates up every 1-2 weeks to check results. In some cases, nitrogen blankets are used in dry lay-ups but always exercise caution when working nitrogen in confined spaces as pure nitrogen does not support life.

GLOSSARY

ABMA American Boiler Manufacturers Association

Air Handler A system consisting of heating and cooling coils with large fans blowing air across the coils for heating and cooling buildings.

Aquastat A water temperature controller.

ASME American Society of Mechanical Engineers

BAS Building Automation System (same as EMS)

BHP Boiler Horsepower (1BHP ≈ 33,500 BTUH Output)

BTUH British Thermal Unit per hour (input or output)

CAD Combustion Air Damper

Category 1 Appliance Vent stack not pressurized and non-condensing.

Category 2 Appliance Vent stack not pressurized and condensing.

Category 3 Appliance Vent stack pressurized and non-condensing.

Category 4 Appliance Vent stack pressurized and condensing.

CSD-1 Controls and safety devices rules for boilers per AMSE code.

DDC Direct Digital Control

Delta T or △T Temperature difference between inlet and outlet of a hot water boiler

Differential The difference between a boiler operators cut-out pressure or temperature and restart pressure or temperature.

Efficiency AFUE Annual Fuel Use Efficiency is the average fuel efficiency of a boiler over one year.

Efficiency Combustion 100% of fuel burned less % of heat loss out stack. Also called stack efficiency as determined by a stack analyzer.

Efficiency Thermal 100% of fuel burned less % of heat loss out stack plus % of heat radiation loss from boiler jacket. Also called true efficiency or fuel-to-water (or steam) efficiency.

EMS Energy Management System (same as BAS)

FGR Flue Gas Recirculation (as in piping or duct used to return flue gasses to the burner to lower NOx)

FSG Flame Safeguard Control. Also called burner management system.

FM Factory Mutual Insurance that recommends and approves various boiler controls and gas valves.

HGPS High Gas Pressure Switch

HTHW High Temperature Hot Water boilers built to Section I of ASME Code.

High Pressure Steam Boiler A boiler designed for making steam over 15 psi. A Section I Steam Boiler

Indirect Heating Surface Heating surfaces in a boiler that do not directly see visible flame. Also called convective heating surface.

IRI Industrial Risk Insurers (formerly FIA). Now called GE GAP. Accepts CSD-1 requirements.

LGPS Low gas pressure switch.

Low Pressure Steam Steam pressure at or less than 15 psi. A Section IV Steam Boiler.

LWCO Low Water Cut-Off: probe (conductance) or mechanical float type.

MAWP Maximum Allowable Working Pressure (of boiler, stamped on ASME nameplate).

MBH or MBTUH 1000 BTU per hour input or output.

Motorized Gas Valve A fluid powered or hydromotor SSOV consisting of an actuator and separate valve body.

MR Manual Reset

NB National Board: agency responsible for boilers and other pressure vessels in service.

NBBI National Board of Boiler and Pressure Vessel Inspectors

NOVV Normally Open Vent Valve - required on IRI gas trains between 2 motorized SSOV.

NOx Oxides of nitrogen in exhaust gasses usually expressed in ppm. Caused by fusion of oxygen and nitrogen molecules during combustion process. A component of smog and acid rain.

PFEP Pilot Flame Establishing Period

pH The measure of the alkalinity or acidity of a liquid.

GLOSSARY

PID Proportion Integral Derivative - A temperature or pressure control with the ability to anticipate load swings and modulate the burner so it cycles on and off less frequently.

PPM Parts Per Million

Pressuretroll A steam pressure controller.

PSI (G) Pounds Per Square Inch (Gauge pressure)

PTFI Pilot Trial For Ignition

Radiant Heating Surface Boiler heating surfaces that are exposed to visible flame.

Reheat System using hot water to raise the temperature of dehumidified chilled air up to human comfort level.

Section I Boiler An ASME Code Boiler stamped for over 15 psi steam, or over 160 psi or 250° F water.

Section IV Boiler An ASME Code Boiler stamped for a maximum 15 psi steam, or up to 160 psi and/or 250° F water.

Short Cycling Burner fires and then turns off after a short run time.

Static Pressure The pressure inside a boiler caused by the height of the water in the piping above it.
Every 2.3 feet = 1 psi.

SSOV Safety shut-off gas or oil valve that is electically operated.

TDS Total Dissolved Solids in water

Thermal Shock Metallurgical stresses inside a boiler created by heating (expansion) and cooling (contraction). Also known as thermal stress cycling.

Throttling Range The number of degrees (or pounds of pressure) below a modulation control setpoint that the control will begin to modulate at.

UL 726 Underwriters Laboratories code for oil fired burners.

UL 795 Underwriters Laboratories code for boilers.

VAV Variable Air Volume boxes for disseminating heat inside a building.

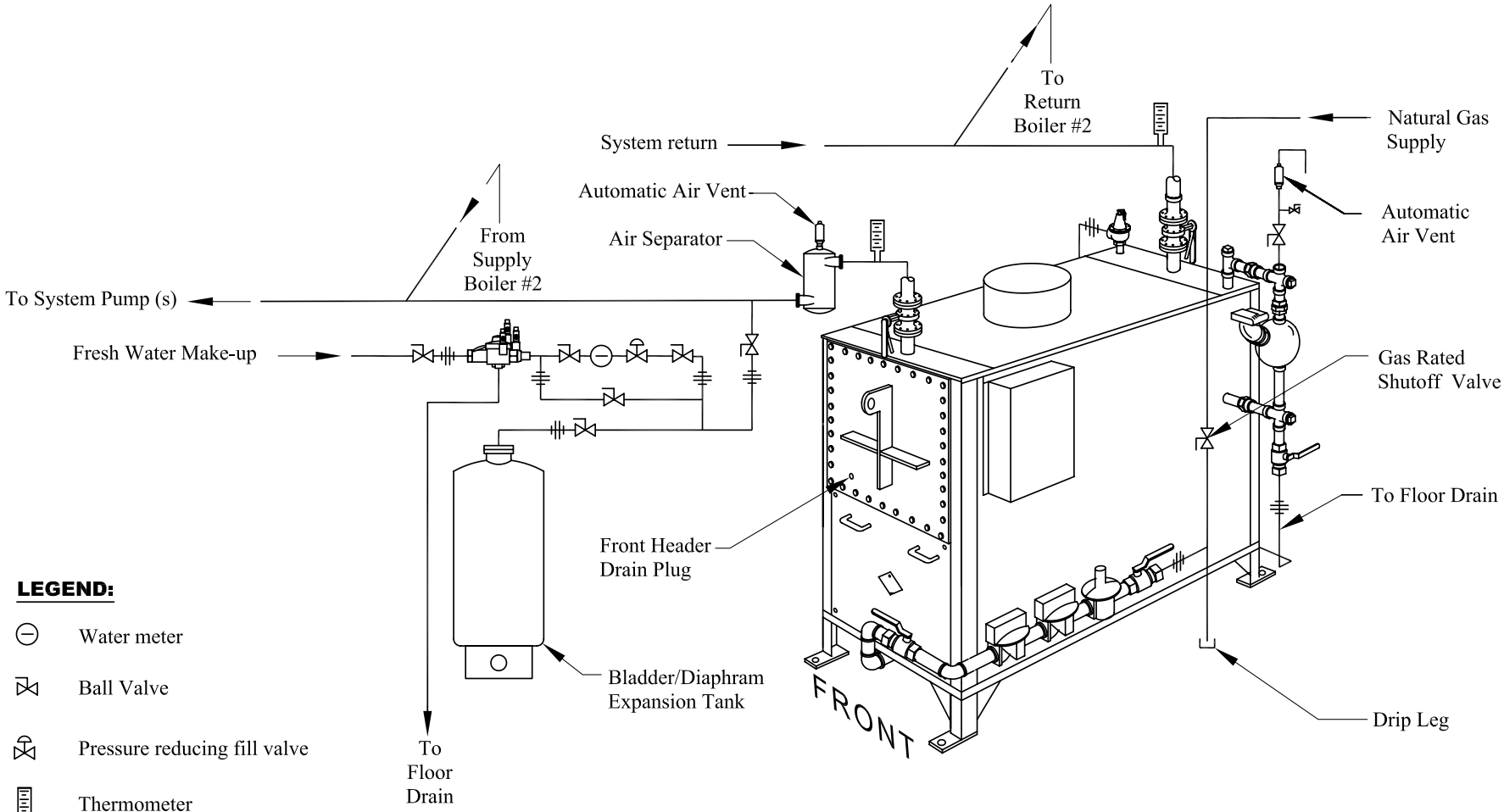
VAC Voltage Alternating Current

VDC Voltage Direct Current

WC Inches of Water Column pressure
28” ≈ 1 psi

WSHP Water Source Heat Pump

Rite Hot Water Boilers
Suggested Piping Diagram For Closed Hydronic Heating System
Featuring Conventional 135° To 235° F Return Water Temperature



LEGEND:

- Water meter
- Ball Valve
- Pressure reducing fill valve
- Thermometer
- Threaded Pipe Cap Or Plug
- Union or Flange
- Reduced Principal (R.P.) Backflow Preventer

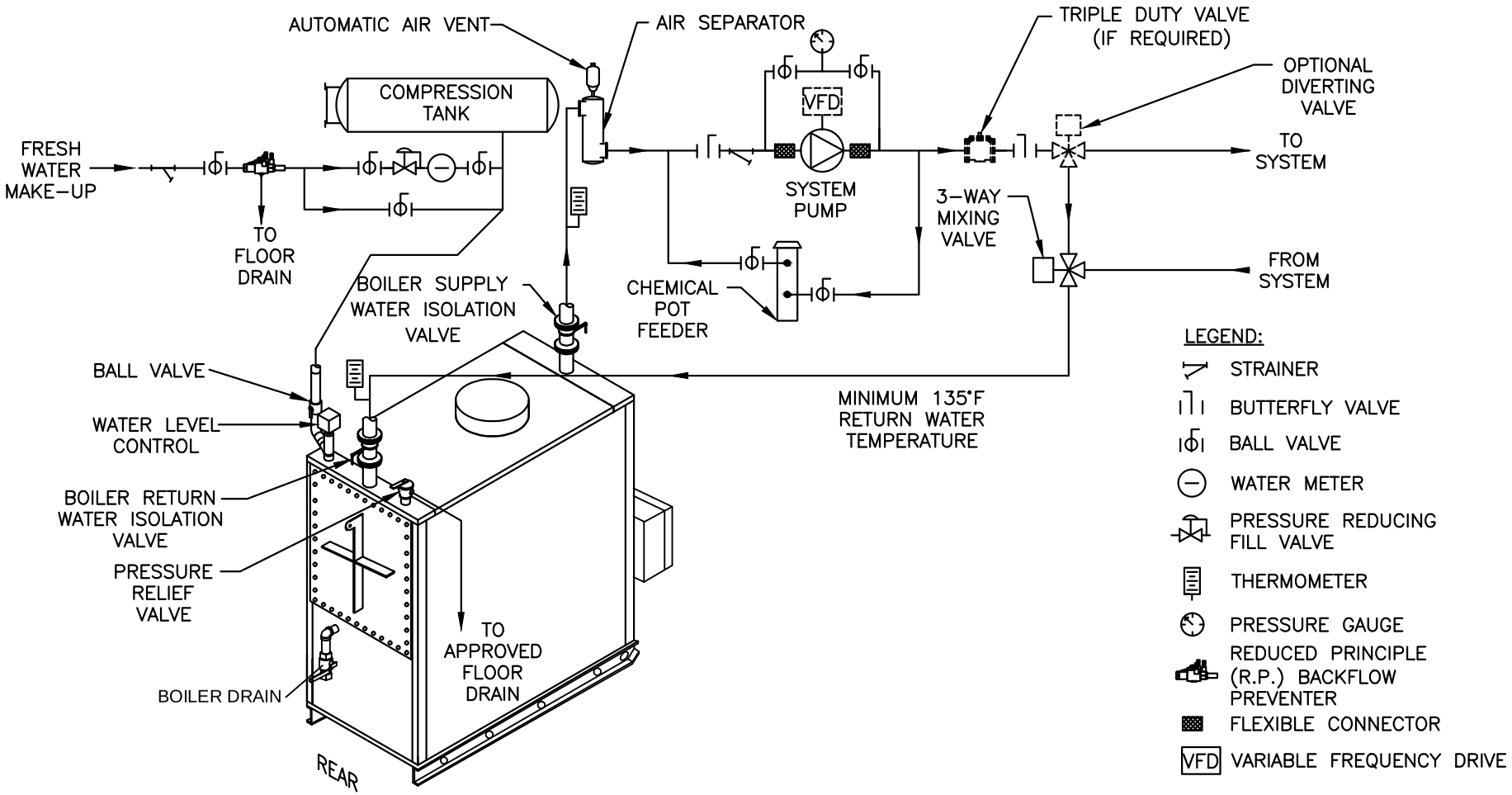
GENERAL NOTE:

This system may be used with a factory installed boiler indoor/outdoor temperature reset control provided the control is programmed to never return less than 135° F to the boiler.

Figure 11

RITE HOT WATER BOILERS
SUGGESTED PIPING DIAGRAM FOR CLOSED LOOPED HYDRONIC HEATING SYSTEM
FEATURING 3–WAY VALVE FOR BOILER PROTECTION

IMPORTANT
THESE ARE CONCEPT DRAWINGS ONLY – NOT ENGINEERED DRAWINGS. SPACE LIMITATIONS PRECLUDE SHOWING VALVES, CONTROL SYSTEM DETAILS AND OTHER APPURTENANCES. PIPING CONFIGURATION FOR REFERENCE ONLY AND PUMPING SYSTEM SHALL BE DESIGNED FOR THE PROPER APPLICATION.



GENERAL NOTES:

1. THE 3–WAY VALVE ACTUATOR SHOULD REMAIN IN FULL SYSTEM BYPASS POSITION UNTIL BOILER LOOP TEMPERATURE REACHES 190°F.
2. AFTER THE 3–WAY VALVE IS RELEASED TO PROVIDE THE SYSTEM HOT WATER, THE 3–WAY VALVE SHALL MAINTAIN A MINIMUM HOT WATER RETURN TEMPERATURE TO THE BOILER OF 135°F.
3. "CONDENSING" FLOW THROUGH A STANDBY BOILER CAN BE PREVENTED BY CLOSING EITHER THE SUPPLY OR RETURN VALVE (SEE ISOLATION VALVES SHOWN ON BOILER).

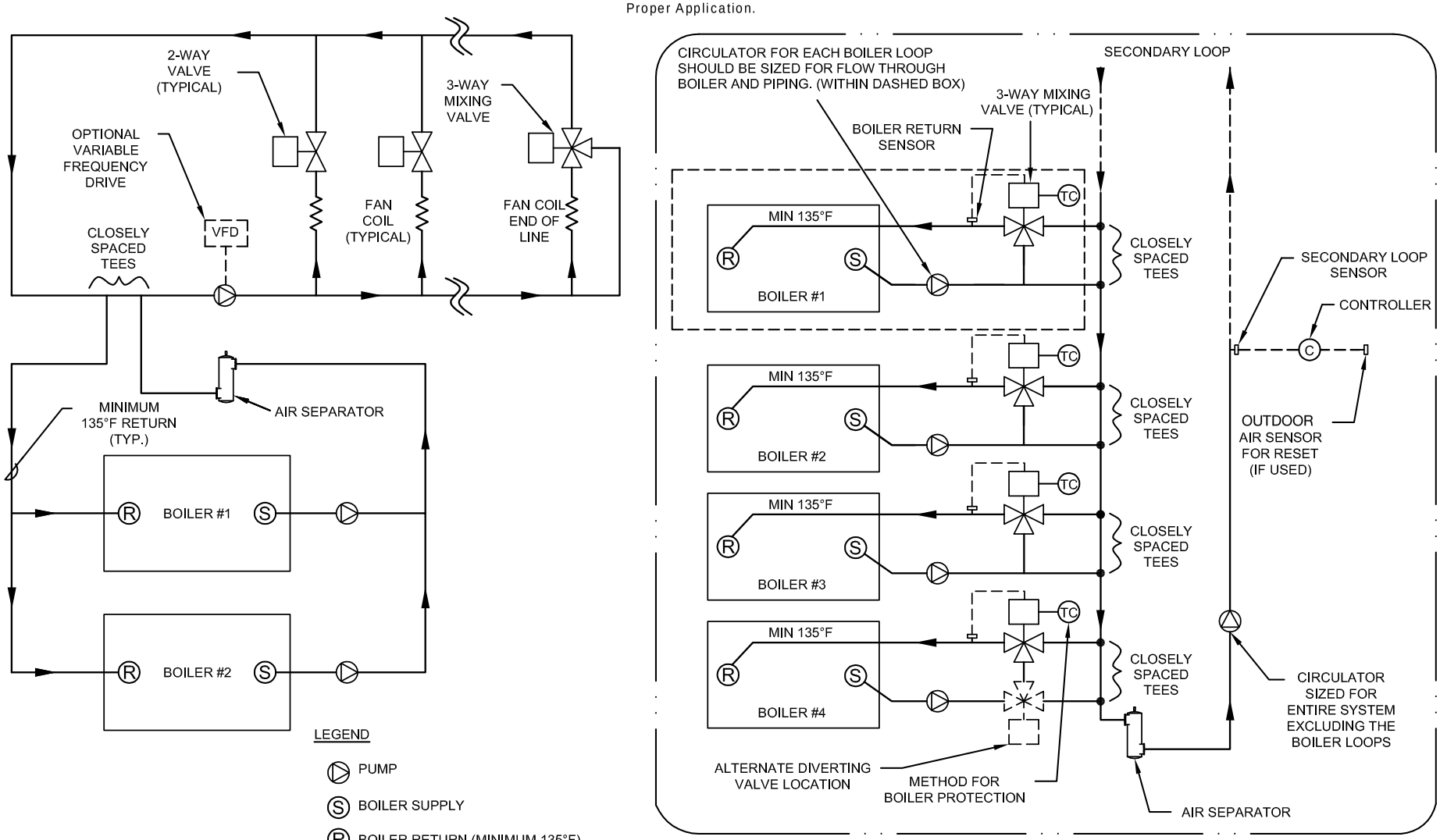
Figure 12

Rite Hot Water Boilers

Suggested Piping Examples for Closed Looped Hydronic Heating System
Featuring Primary-Secondary Piping with 2-way and/or 3-way Control Valves

IMPORTANT

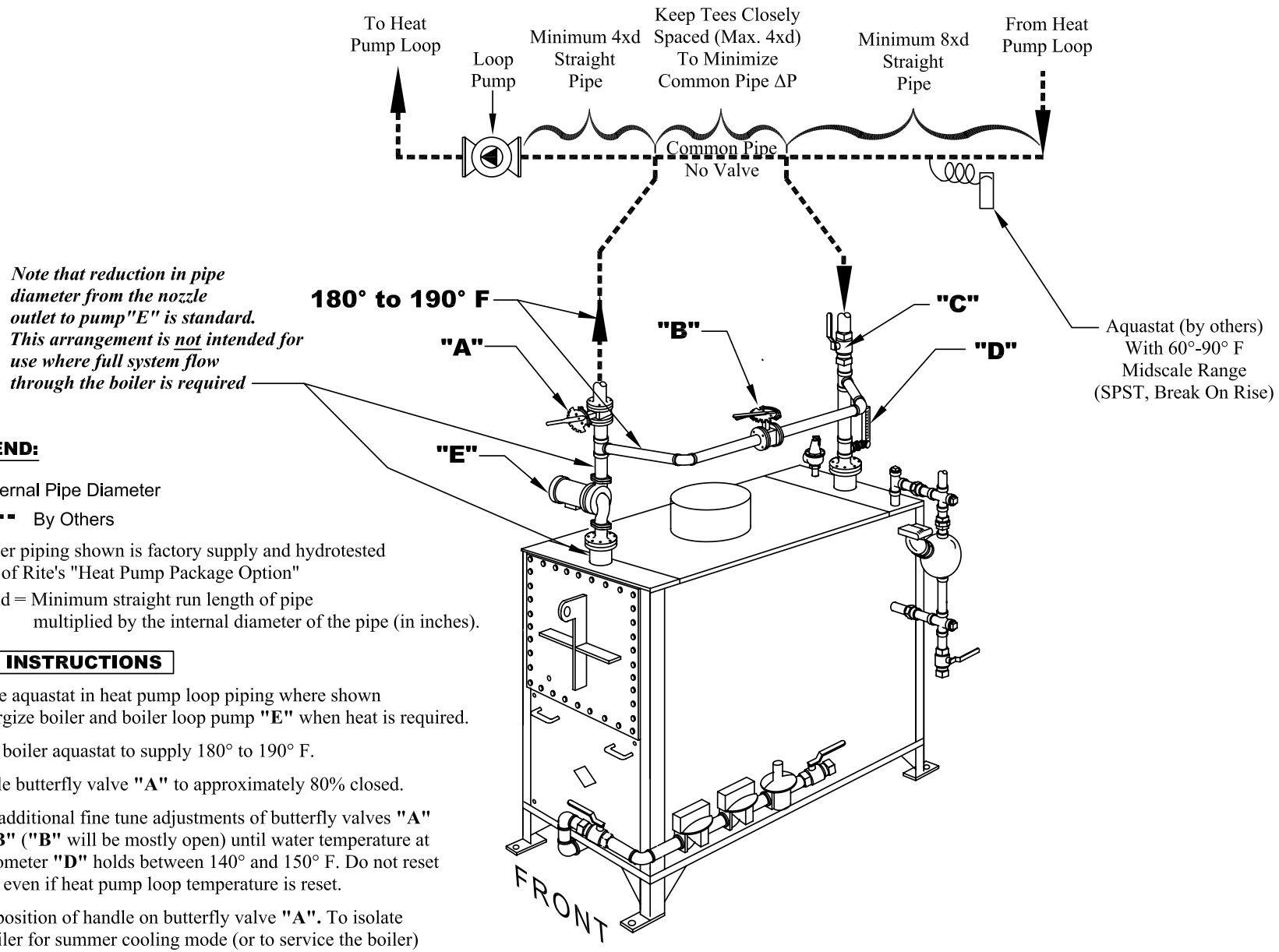
These Are Concept Drawings Only - Not Engineered Drawings. Space Limitations Preclude Showing Valves, Control System Details and Other Appurtenances. Piping **Configuration for Reference Only and Pumping System Shall Be Designed for The** Proper Application.



CLOSELY SPACED TEES = MAXIMUM DISTANCE BETWEEN TEE OUTLETS SHOULD NOT EXCEED 4X PIPE DIAMETER

Figure 13

Rite Water Heating Boilers Heat Pump Package
Suggested Piping For 60° To 90° F Water Source Heat Pump Systems*Only*



LEGEND:

d = Internal Pipe Diameter

- - - - - - By Others

All other piping shown is factory supply and hydrotested as part of Rite's "Heat Pump Package Option"

4 or 8xd = Minimum straight run length of pipe multiplied by the internal diameter of the pipe (in inches).

SET-UP INSTRUCTIONS

1. Provide aquastat in heat pump loop piping where shown to energize boiler and boiler loop pump **"E"** when heat is required.
2. Set up boiler aquastat to supply 180° to 190° F.
3. Throttle butterfly valve **"A"** to approximately 80% closed.
4. Make additional fine tune adjustments of butterfly valves **"A"** and **"B"** (**"B"** will be mostly open) until water temperature at thermometer **"D"** holds between 140° and 150° F. Do not reset valves even if heat pump loop temperature is reset.
5. Mark position of handle on butterfly valve **"A".** To isolate the boiler for summer cooling mode (or to service the boiler) simply close valves **"A"** and **"C".** To restore to heat mode, return **"A"** to marked position and open **"C"** fully.

Figure 14

Rite Steam Boilers

Suggested Piping for High Pressure Steam Boilers (150 psi)
Featuring Blowdown & Safety Relief Valve Piping

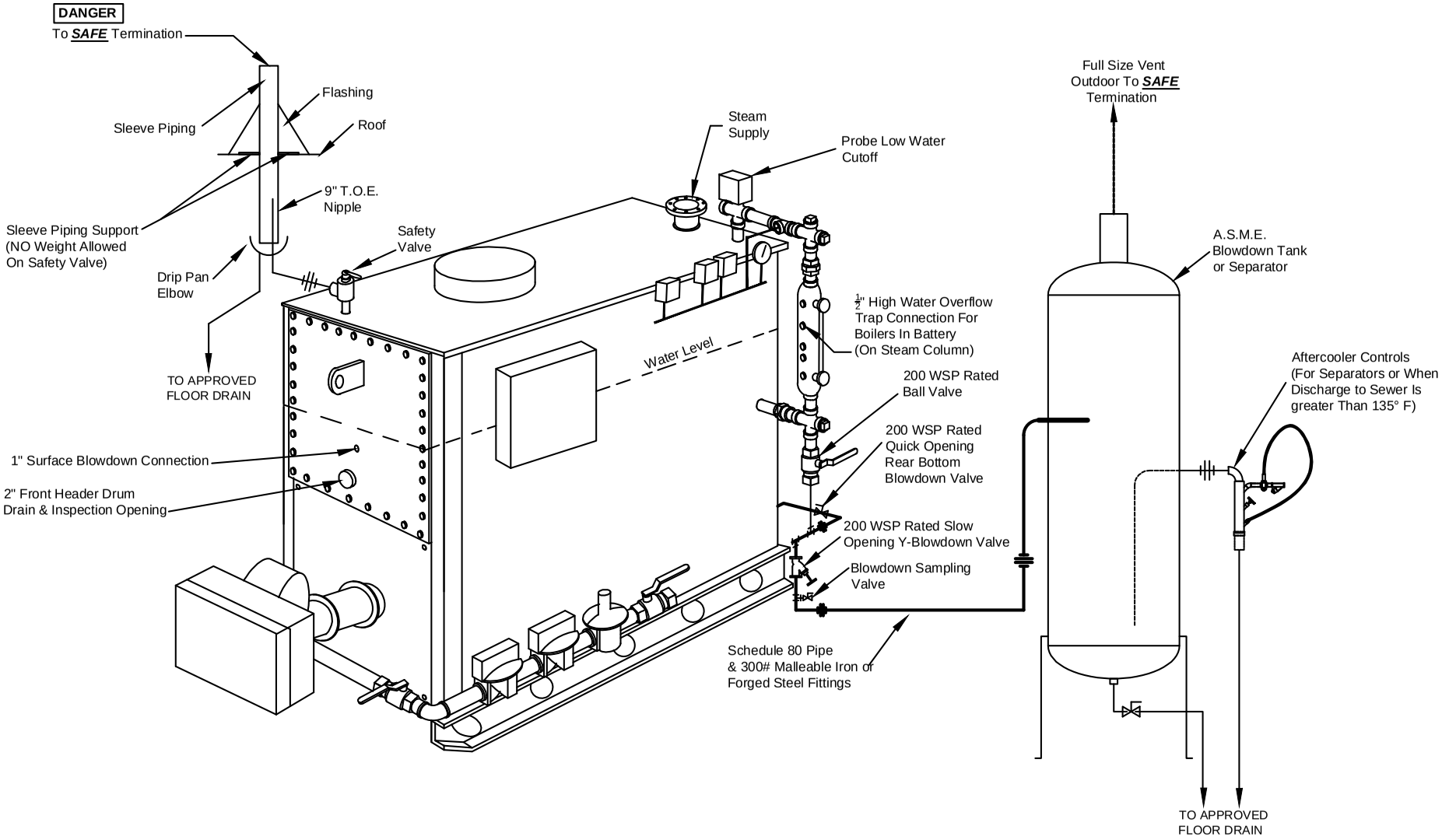
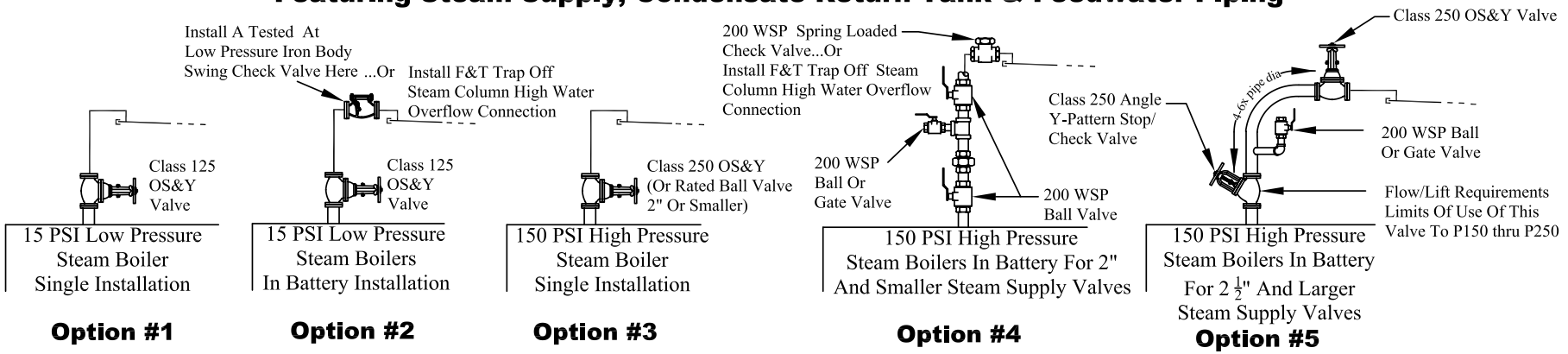


Figure 15

Rite Steam Boilers

Suggested Piping For Low & High Pressure Steam Boilers
Featuring Steam Supply, Condensate Return Tank & Feedwater Piping



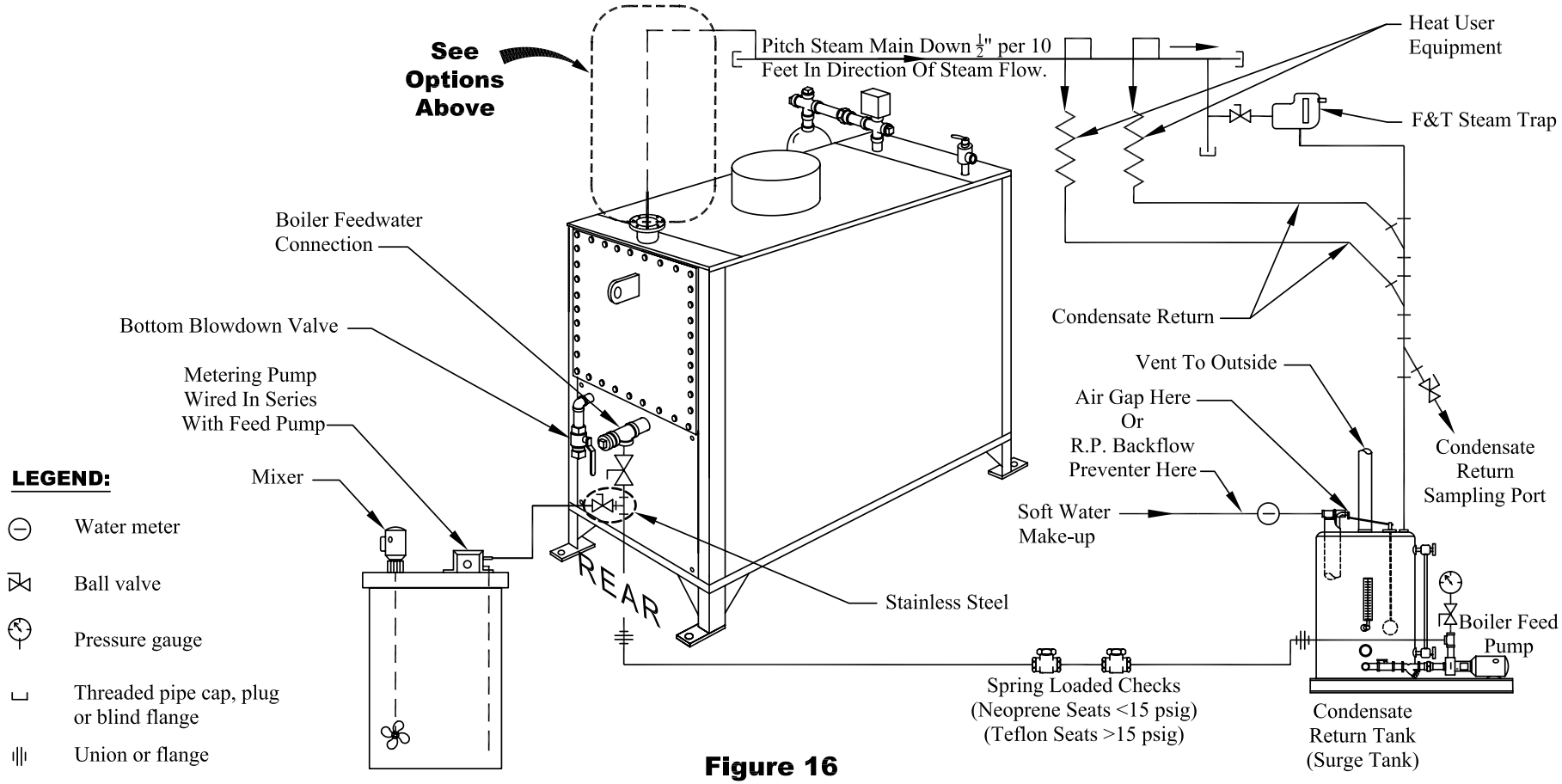
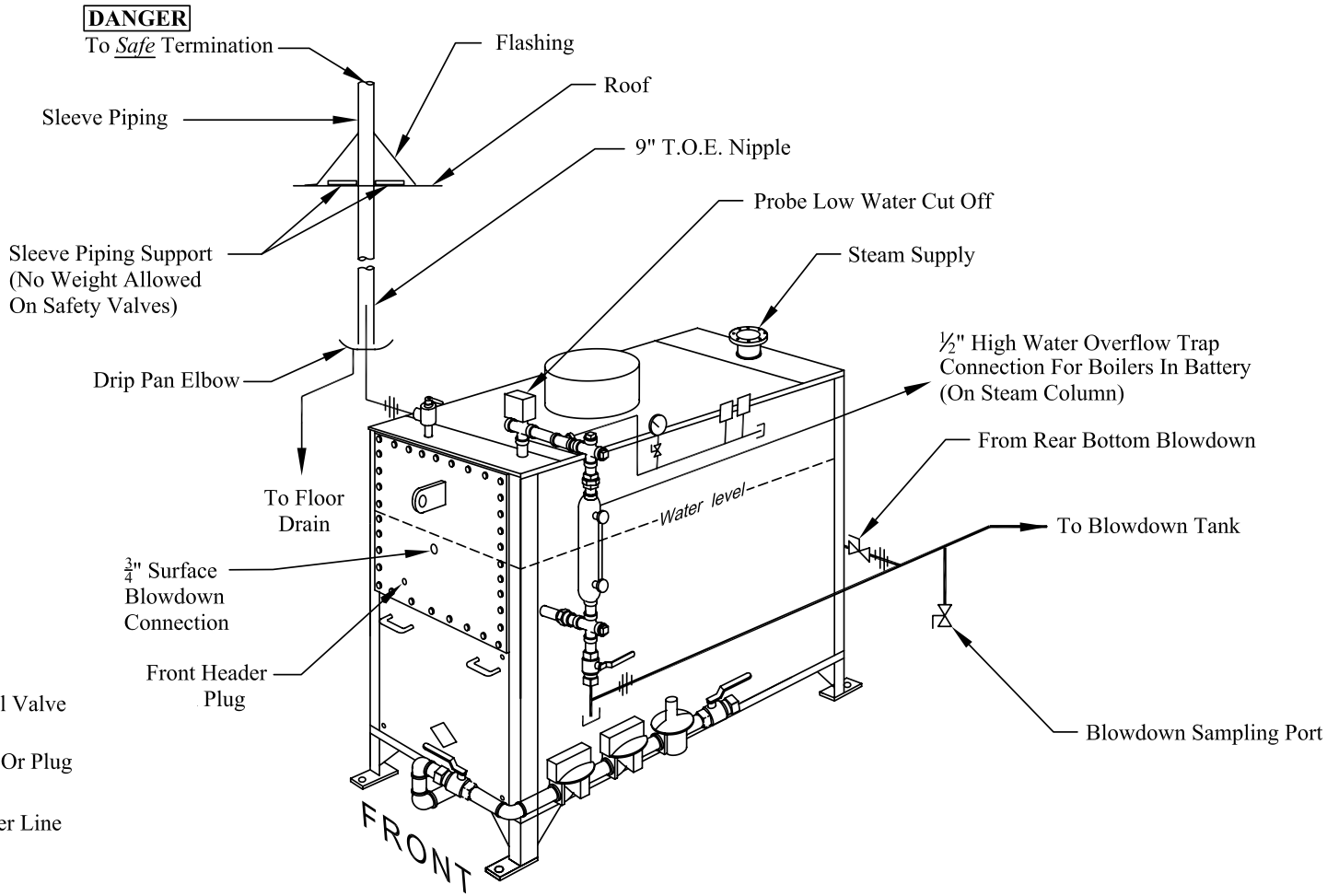


Figure 16

Rite Steam Boilers
Suggested Piping For Low Pressure Steam Boilers (15 psi)
Featuring Blowdown & High Water Overflow Valve Piping



LEGEND:

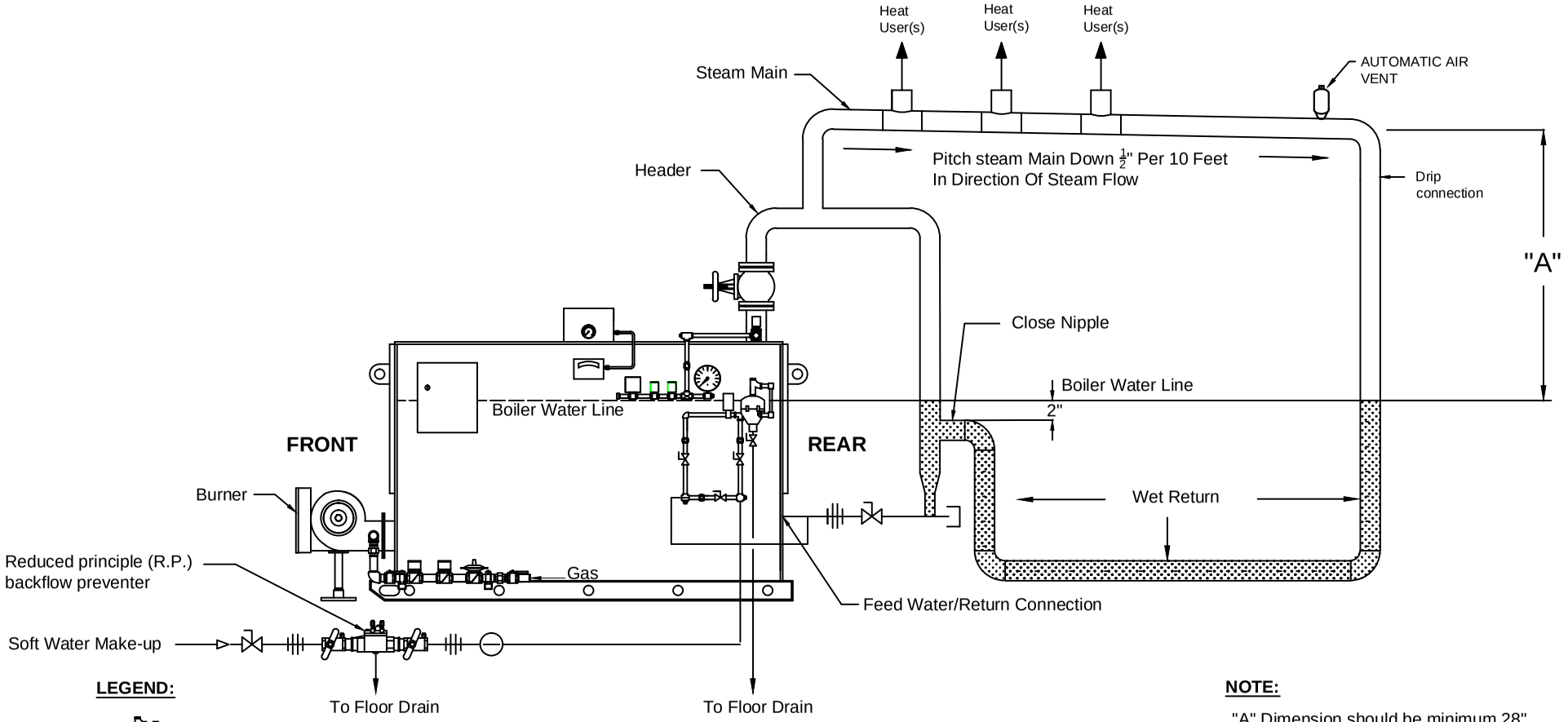
- 150 WSP Rated Ball Valve
- Threaded Pipe Cap Or Plug
- Boiler Normal Water Line
- Schedule 80 Pipe & 300# Malleable Or Forged Steel Fittings
- Union or Flange
- Safety Relief Valve

Figure 17

Rite Steam Boilers

Suggested Piping of 15 PSI Low Pressure Steam Boilers

For One Pipe Systems, Wet Gravity Return, Hartford Loop, Operating at 2 PSI or less



LEGEND:

- Combination water feeder/low water cut-off
- Water meter
- 150 WSP rated ball valve
- 125 WSP rated OS&Y stop valve
- Threaded pipe cap or plug
- Union or flange
- Boiler pressure gauge

NOTE:

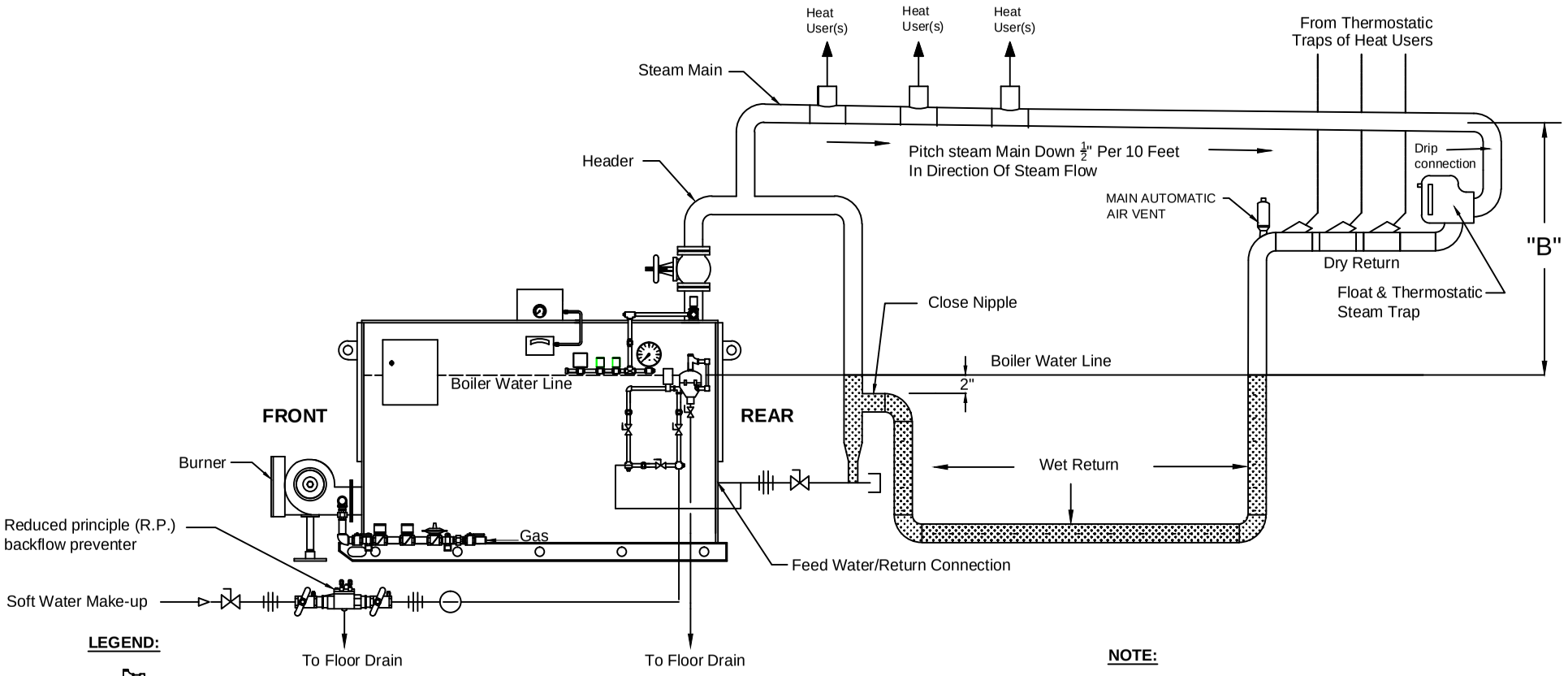
"A" Dimension should be minimum 28"

Figure 18

Rite Steam Boilers

Suggested Piping of 15 PSI Low Pressure Steam Boilers

For Two Pipe Systems, Wet Gravity Return, Hartford Loop, Operating at 2 PSI or less



LEGEND:

- Combination water feeder/low water cut-off
- Water meter
- 150 WSP rated ball valve
- 125 WSP rated OS&Y stop valve
- Threaded pipe cap or plug
- Union or flange
- Boiler pressure gauge

NOTE:

"**B**" Dimension should be 30" for every 1 PSI of Boiler Operating Pressure.

Figure 19

NOTES

25 Year Non Pro-rated Thermal Shock Warranty

Rite engineering & Manufacturing Corp. warrants its Boilers against pressure vessel cracks and broken welds caused by thermal stress cycling (“thermal shock”) for a period of 25 years from the date of manufacture. The Warranty - non pro-rated - is limited to the replacement or repair of the pressure vessel when such damage is determined by Rite Engineering or an authorized Rite Representative to have occurred during normal operation*. The Warranty shall not cover damage due to freezing, dry firing, or excessive scale build-up. The Warranty is limited to damage to the boiler itself and expressly excludes all other consequential damage.

25 Year Non Pro-rated Tube Erosion Warranty

Rite Engineering & Manufacturing Corp. warrants its Boilers against waterside tube erosion for a period of 25 years from the date of manufacture. Waterside tube erosion - defined as the result of scrubbing action caused by high velocity water flow through a limited number of boiler tubes such as copper finned - will not occur to Rite Boilers because of our greater number of tubes and low pressure drop heat exchanger construction. The Warranty shall not cover damage due to oxygen, electrolysis or acidic corrosion. The Warranty is limited to damage to the boiler itself and expressly excludes all other consequential damage.

Additional Warranty Coverage

Rite Engineering & Manufacturing Corp. warrants its Boilers against defective parts and poor workmanship for a period of 18 months from date of shipment or 12 months from date of start-up - whichever occurs first. Controls, valves and instruments made by other manufacturers and installed on Rite Boilers are generally covered by the same warranty period. Misuse, neglect or exposure shall not be considered grounds for warranty claims. In no case shall Rite Engineering be held liable for any consequential damage including product loss, freight or replacement labor.

**Operating instructions specific to limiting thermal stress cycling may be found on page 8 of this instructional manual.*