



Q90-50/75/100 Series 4 GAS-FIRED, DIRECT VENT, CONDENSING, HOT WATER BOILER

INSTALLATION, OPERATION & MAINTENANCE MANUAL

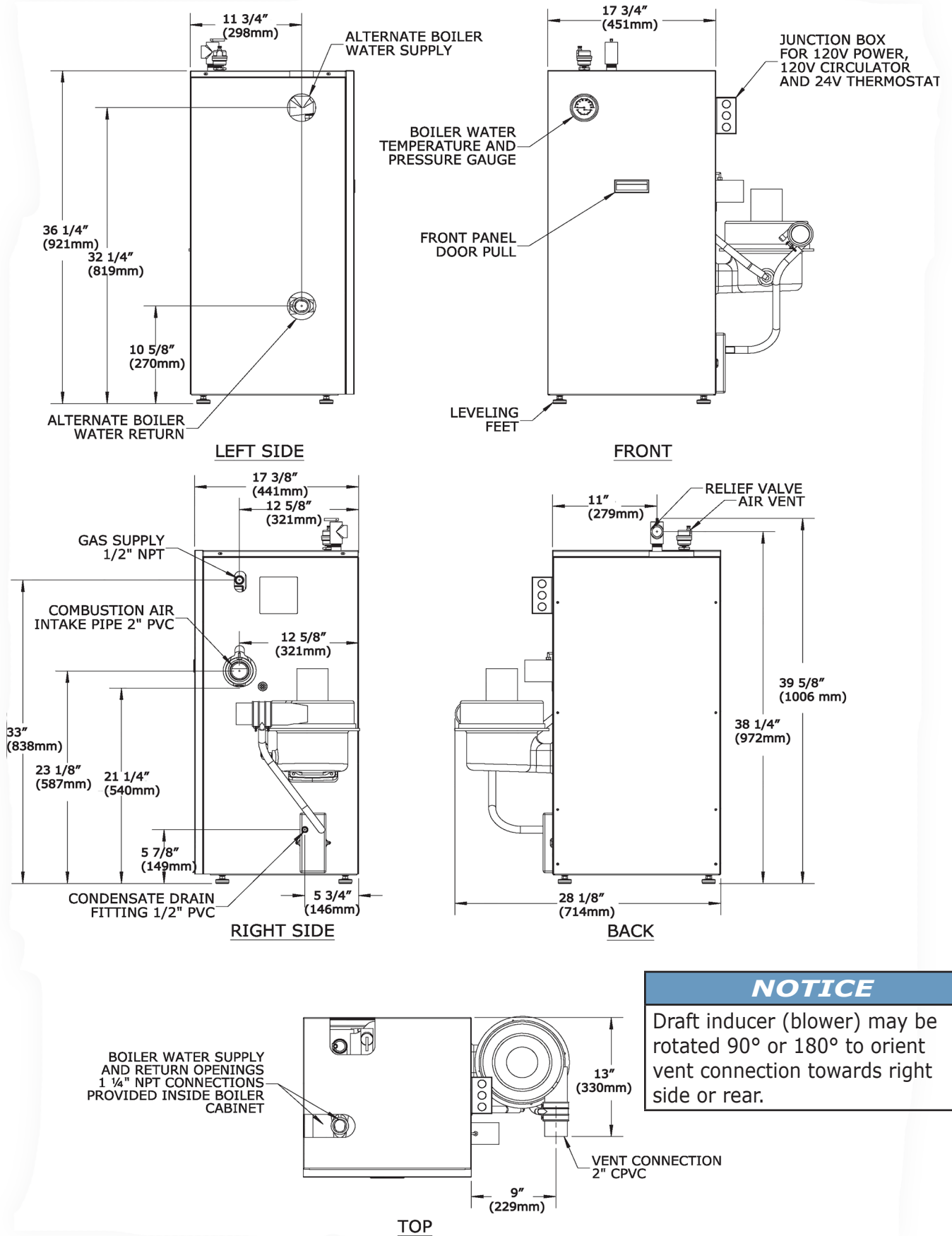
Models
Q90-50
Q90-75
Q90-100



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DIMENSIONS

Figure 1 - Boiler Dimensions



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Introduction

- This appliance is a gas-fired direct vent hot water boiler with cast aluminum boiler sections.
- The heating system water absorbs large amounts of heat from the cast aluminum heat exchanger, cooling flue gases and causing condensation.
- Sealed combustion, premix gas burner, and low flame temperature means reduced CO and NOx emissions, which contribute to cleaner and healthier environment.
- This appliance takes its combustion air directly from outdoors (sealed combustion) and does not compete with building occupants for fresh air.
- Sealed combustion (also known as "direct vent") is safest and best way to obtain plenty of clean combustion air.
- Induced draft fan draws in outside combustion air, takes cooler flue gases from boiler unit and provides positive removal of flue gases from the building through readily available PVC, CPVC and PP (Polypropylene) pipes.
- These low pressure gas-fired hot water boilers are design certified by CSA International for use with natural gas and propane gas.
- Boilers are constructed and hydrostatically tested for maximum working pressure of 50 psig (pounds per square inch gage) in accordance with A.S.M.E. Boiler and Pressure Vessel Code Section IV Standards for heating boilers.

IMPORTANT SAFETY INFORMATION

General

Boiler installation shall be completed by qualified agency. See glossary for additional information.

WARNING

Fire, explosion, asphyxiation and electrical shock hazard. Improper installation could result in death or serious injury. Read this manual and understand all requirements before beginning installation.

**Keep this manual near boiler
Retain for future reference**

Become familiar with symbols identifying potential hazards.



This is the safety alert symbol. Symbol alerts you to potential personal injury hazards. Obey all safety messages following this symbol to avoid possible injury or death.

DANGER

Indicates a hazardous situation which, if not avoided, WILL result in death or serious injury

WARNING

Indicates a hazardous situation which, if not avoided, could result in death or serious injury.

CAUTION

Indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.

NOTICE

Used to address practices not related to personal injury.

CAUTION

Laceration, burn hazard. Metal edges and parts may have sharp edges and/or may be hot. Use appropriate personal protection equipment to include safety glasses and gloves when installing or servicing this boiler. Failure to follow these instructions could result in minor or moderate injury.

Installation shall conform to requirements of authority having jurisdiction or in absence of such requirements:

- United States
 - National Fuel Gas Code, ANSI Z223.1/NFPA 54.
 - National Electrical Code, NFPA 70.

Where required by authority having jurisdiction, installation shall conform to Standard for Controls and Safety Devices for Automatically Fired Boilers, ANSI/ASME CSD-1.

Additional manual reset low water cutoff and/or manual reset high limit may be required.

Requirements for Commonwealth of Massachusetts:

Boiler installation must conform to Commonwealth of Massachusetts code 248 CMR which includes but is not limited to:

- Installation by licensed plumber or gas fitter.

Installers - Follow local regulations with respect to installation of CO (Carbon Monoxide) Detectors. Follow maintenance recommendations "Maintenance And Cleaning" on page 47.

BOILER RATINGS & CAPACITIES



Table 1 - SEA LEVEL RATINGS – NATURAL AND PROPANE GASES

Model	Input *(MBH)	++ Heating Capacity *(MBH)	Net AHRI Rating *(MBH)	Shipping Weight (lbs.)	AFUE
90-50	50	45	39	220	90.0
90-75	75	68	59	220	90.0
90-100	100	90	78	220	90.0
* 1 MBH = 1,000 Btuh		<i>Btuh = British Thermal Units Per Hour</i>			

++ AFUE (Annual Fuel Utilization Efficiency) and Heating Capacity is based on the D.O.E. (Department of Energy) test procedure.

Heating Capacity indicates the amount of heat available after subtracting losses up the stack. Most of this heat is available to heat water. A small portion is heat from jacket and surfaces of the boiler, and it is assumed that this heat stays in the structure.

Net AHRI rating represents portion of remaining heat that can be applied to heat radiation or terminal units (i.e. finned tube baseboard, cast iron radiators, radiant floor, etc.). The difference between Heating Capacity and Net AHRI Rating, called piping and pickup allowance, establishes reserve for heating volume of water in system and offsetting heat losses from piping.

Net AHRI ratings shown are based on piping and pickup factor of 1.15 in accordance with AHRI Standard as published by Hydronics Institute. Net AHRI rating of boiler selected should be greater than or equal to the calculated peak heating load (heat loss) for building or area(s) served by boiler and associated hot water heating systems. Consult manufacturer before selecting a boiler for installations having unusual piping and pickup requirements.

Boilers for use at high altitude

United States - See "Boilers For Use At High Altitude" on page 6.

BOILERS FOR USE AT HIGH ALTITUDE - UNITED STATES INSTALLATIONS

- Boilers (with exception of 90-75 propane (LP) product) are factory equipped for operation at altitudes ranging from 0-10,000 feet above sea level.
 - No changes to factory settings are required for installations from 0-5,000 feet above sea level.
 - For altitudes from 5,000-10,000 feet above sea level gas manifold pressure needs to be adjusted based upon calorific (Btu) value of supply gas (contact local gas utility or distributor for this value).
 - For specific settings refer to Table 2 for natural gas applications and Table 3, Page 7 for propane (LP) gas applications.
 - Instructions on how to adjust gas manifold pressure settings see Figure 25 and Figure 26, Page 44.
- Note 90-75 propane (LP) applications for 5,000 - 10,000 feet above sea level require orifice change as well as gas manifold pressure adjustment based upon calorific (Btu) value of supply gas.
- Refer to Table 2 and Table 3 for high altitude orifice part numbers. For replacing an orifice refer to specific instructions included with conversion kit.

Table 2 - NATURAL GAS

MODEL 90-50						
	Stock Factory	Btu Value of Natural Gas++				
	Settings	750	850	950	1000	1050
Altitude in Ft.	0-5,000	5,000-10,000				
Normal Input (MBH)	50	-	-	-	-	-
Orifice	43331094	43331094				
MODEL 90-75						
	Stock Factory	Btu Value of Natural Gas++				
	Settings	750	850	950	1000	1050
Altitude in Ft.	0-5,000	5,000-10,000				
Normal Input (MBH)	75	-	-	-	-	-
Orifice	43331092	43331092				
MODEL 90-100 /						
	Stock Factory	Btu Value of Natural Gas++				
	Settings	750	850	950	1000	1050
Altitude in Ft.	0-5,000	5,000-10,000				
Normal Input (MBH)	100	-	-	-	-	-
Orifice	43331090	43331090				
++Contact local gas utility or distributor for Btu value of gas.						

BOILERS FOR USE AT HIGH ALTITUDE - UNITED STATES INSTALLATIONS

Model 90-75 propane (LP) units only at altitudes above 5,000 ft., install 90-75 High Altitude Orifice Kit #550002629*.

For all other altitudes use sea level orifice

Table 3 - PROPANE GAS

MODEL 90-50						
	Stock Factory	Btu Value of Propane Gas++				
	Settings	2300	2350	2400	2450	2500
Altitude in Ft.	0-5,000	5,000-10,000				
Normal Input (MBH)	50	-	-	-	-	-
Orifice	43331095	43331095				
MODEL 90-75*						
	Stock Factory	Btu Value of Propane Gas++				
	Settings	2300	2350	2400	2450	2500
Altitude in Ft.	0-5,000	5,000-10,000				
Normal Input (MBH)	75	-	-	-	-	-
Orifice	43331093	43331096*				
* For model 90-75 Propane units only at altitudes above 5,000 ft., install 90-75 High Altitude Orifice Kit #550002629 For all other altitudes use sea level orifice.						
MODEL 90-100 **						
	Stock Factory	Btu Value of Propane Gas++				
	Settings	2300	2350	2400	2450	2500
Altitude in Ft.	0-5,000	5,000-10,000				
Normal Input (MBH)	100	-	-	-	-	-
Orifice	43331091	43331091				
++Contact local gas utility or distributor for Btu value of gas.						

BEFORE INSTALLING THE BOILER

1. Boiler is equipped for residential installations. If used for commercial applications, any additional code requirements must be adhered to for installation. This may require additional controls including but not limited to an additional low water cut off, a manual reset high temperature limit, and wiring and/or piping modifications.
2. Before servicing boiler - allow boiler to cool. Shut off electricity and gas supply connected to boiler prior to servicing.
3. Inspect gas line for leaks.
4. Verify gas input rate is correct. Over firing may result in early failure of boiler sections. This may cause dangerous operation. Under firing may result in too much air for pre-mix burner causing poor or loss of combustion.
5. Never vent products of combustion from this boiler to enclosed space. Always vent to outdoors. Never vent to another room or to inside building.
6. Be sure there is adequate outdoor air supply to boiler for complete combustion.
7. Follow regular service and maintenance schedule for efficient and safe operation.
8. Keep boiler area clean of debris and free of combustible and flammable materials.
9. Proper through wall or through roof combustion venting shall be in accordance with materials and methods described in this manual. Installation must comply with local codes.
10. Boiler and related hot water heating systems are not do it yourself items they must be installed and serviced by qualified professionals.

Boiler Sizing

Check to be sure you have selected boiler with proper capacity before starting installation. AHRI Rating of boiler selected should be greater than or equal to calculated peak heating load (heat loss) for building or area(s) served by boiler and associated hot water heating systems. See Table 1, Page 5.

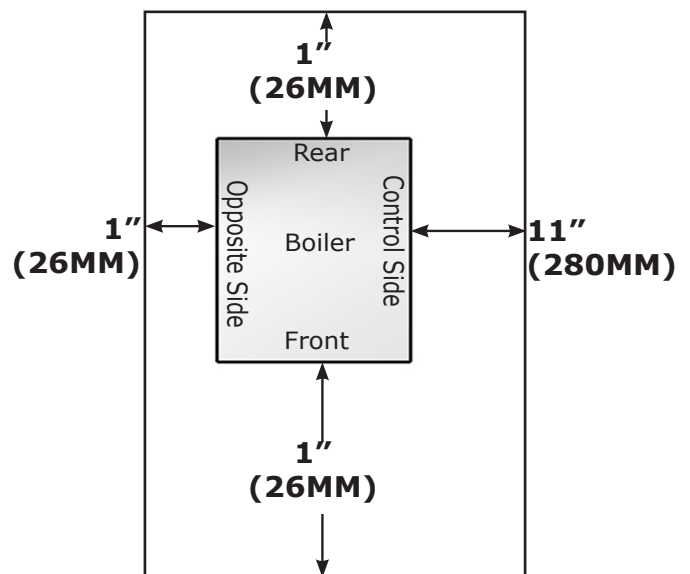
Heat loss calculations should be based on approved industry methods.

Boiler Location Considerations

Before selecting boiler location consider following.

- Supplied with correct type of gas (natural gas or propane).
- Connected to suitable combustion air intake piping system to supply correct amounts of fresh (outdoor) air for combustion, refer to "Combustion Air and Vent Pipe" on page 22 for details.
- Connected to suitable venting system to remove hazardous products of gas combustion, refer to "Combustion Air and Vent Pipe" on page 22 for details.
- Connected to suitable hot water heating system.
- Supplied with suitable electrical supply for all boiler motors and controls.
- Connected to properly located thermostat or operating control. Not included with boiler.
- Placed on level surface.
- Condensate drain line must be pitched down to floor drain or external condensate pump with reservoir at $\frac{1}{4}$ " per foot (wood frame or blocks may be used to raise boiler).

Minimum Clearances To Combustible Construction



BOILER INSTALLATION

Locating The Boiler

1. Place crated boiler as close to selected location as possible and un-crate boiler. Boiler may be moved into position with appliance dolly or 2 wheel hand truck. Insert dolly or hand truck under left hand side of boiler. It is possible to slide boiler for short distance on smooth floor or surface.
2. Select level location central to piping systems served and as close to vent and air intake terminals as possible.
3. Accessibility clearances, if more stringent (i.e. larger clearances) than required fire protection clearances, must be used for boiler installation. Accessibility clearances may be achieved with the use of removable walls or partitions.
4. Boiler is approved for installation in closets and on combustible floors. This boiler shall NOT be installed on carpeting.
5. Clearances shown in Table 4 indicate required clearances. Maintain minimum 1" clearance between combustible construction and each of left, top and back surfaces of the boiler. Minimum 11" clearance is required on right side, to allow room for induced draft blower. Allow 24" at front and 8" at top for servicing. No clearances are required to venting or combustion air intake piping.
6. Install equipment in location which facilitates operation of venting and combustion air intake piping systems as described in this manual. Draft inducer (blower) may be rotated 90° or 180° to orient vent connections towards right side or rear. Remove blower mounting screws. Orient blower and install mounting screws. Do not overtighten screws.
7. Advise owner to keep venting and combustion air intake passages free of obstructions. Both venting and combustion air intake piping systems connected to outdoors must permit flow through piping systems without restrictions for boiler operation.
8. Install boiler such that the automatic gas ignition system components are protected from water (dripping, spraying, rain, etc.) during operation and service (circulator replacement, condensate trap, control replacement, etc.).
9. Keep boiler area clean of debris and free of flammable and combustible materials, vapors and liquids.
10. Locate boiler where minimum possible room temperature where boiler is installed, assuming boiler is not in operation and therefore contributes no heat to space, is always at or above 32°F (0°C) to prevent freezing of liquid condensate.

Combustion Air And Vent Pipe Requirements

This boiler requires a dedicated direct vent system. In a direct vent system, all air for combustion is taken directly from outside atmosphere, and all flue products are discharged to outside atmosphere.

Terminate combustion air and vent pipe connections in same atmospheric pressure zone, through roof or sidewall (roof termination preferred). See Figure 12 thru Figure 14, pages 24 and 25 for required clearances.

WARNING

Solvent cements are combustible. Keep away from heat, sparks, and open flame. Use only in well ventilated areas. Avoid breathing in vapor or allowing contact with skin or eyes. Failure to follow these instructions could result in fire, serious injury, or death.

- Combustion air must be clean outdoor air. Combustion air must not be taken from inside structure because that air frequently is contaminated by halogens, which include fluorides, chlorides, phosphates, bromides and iodides. These elements are found in aerosols, detergents, bleaches, cleaning solvents, salts, air fresheners, paints, adhesives and other household products.
- Locate combustion air inlet as far away as possible from swimming pool and swimming pool pump house.
- All combustion air and vent pipes must be airtight and watertight. Combustion air and vent piping must also terminate as shown in "Combustion Air and Vent Pipe" section.
- Vent connections serving appliances vented by natural draft shall not be connected into any portion of mechanical draft systems operating under positive pressure.

Table 4 - Required Clearances

Unit	Combustible Clearance	Accessibility, Cleaning, and Servicing
Top	1" (26mm)	8" (204mm)
Left Side	1" (26mm)	-
Right Side	11" (280mm)	-
Base	1" (26mm)	-
Front	1" (26mm)	24" (610mm)
Back	1" (26mm)	-
Intake/Vent Piping	0 (0)	-

All distances measured from the cabinet of the boiler.

Condensate Drain Requirements

- Pitch condensate drain line down to floor drain at minimum of ¼" per foot. External condensate pump (not furnished) may be used if floor drain is not available. Installation shall conform to requirements of authority having jurisdiction, check local codes for requirements.
- Condensate pump must be designed for flue gas condensate application.
- Condensate trap provided with boiler, an additional trap is not required and should not be used.
- Wood frame or blocks may be used to raise boiler to maintain drain pitch or to be above external condensate pump reservoir.

Foundation Requirements

- Install boiler on level surface.

WARNING

Fire hazard. Shall not install boiler on carpeting. Failure to follow these instructions could result in death or serious injury.

- Boiler is NOT to be installed on carpeting.
- If boiler is not level condensate drain lines will not function properly. Adjustable feet are located on the boiler to make up for minor surface irregularities or tilt.
- Wood frame or blocks may be used to raise boiler to maintain drain pitch or to be above external condensate pump reservoir.

Removal of Existing Boiler From Common Vent System

When an existing boiler is removed from a common venting system, the common venting system is likely to be too large for proper venting of the appliances remaining connected to it. At the time of removal of an existing boiler, the following steps shall be followed with each appliance remaining connected to the common venting system placed in operation, while the other appliances remaining connected to the common venting system are not in operation.

1. Seal any unused openings in the common venting system.
2. Visually inspect the venting system for proper size and horizontal pitch and determine there is no blockage, or restrictions, leakage, corrosion and other deficiencies which could cause an unsafe condition.

3. In-so-far as is practical, close all building doors and windows and all doors between the space in which the appliances remaining connected to the common venting system are located and other spaces of the building. Turn on clothes dryer and any appliance not connected to the common venting system. Turn on any exhaust fans, such as range hoods and bathroom exhaust, so they will operate at maximum speed. Do not operate a summer exhaust fan. Close fire dampers.
4. Place in operation the appliance being inspected. Follow the lighting instructions. Adjust thermostat so appliances will operate continuously.
5. Test for spillage at the draft hood relief opening after 5 minutes of main burner operation. Use the flame of a match or candle, or the smoke from a cigarette, cigar or pipe.
6. After it has been determined that each appliance remaining connected to the common venting system properly vents when tested as outlined above, return doors, windows, exhaust fans, fire place dampers, and any other gas-burning appliance to their previous condition of use.
7. Any improper operation of the common venting system should be corrected so the installation conforms with the National Fuel Code, NFPA-54/ANSI -Z223.1 and/or the Natural Gas and Propane Installation Code, CAN/CSA B149.1. When re-sizing any portion of the common venting system, the common venting system should be re-sized to approach the minimum size as determined using the appropriate of the National Fuel Gas Code, NFPA-54/ANSI- Z223.1 and/or the Natural Gas and Propane Installation Code, CAN/CSA B149.1.

Near Boiler Piping

- When boiler installation is for new heating system, install all of radiation units (panels, radiators, baseboard, or tubing) and supply and return mains.
- After all heating system piping and components have been installed, make final connection of system piping to boiler. Hot water boiler installed above radiation level, or as required by the Authority having jurisdiction, must be equipped with low water cut off device.
- Periodic inspection is necessary for flushing of float type devices, per low water cut off manufacturers specific instructions.

Clean System First

Before connecting boiler to heating system, clean and flush system thoroughly. Verify system is free of sediment, flux and any residual boiler water additives.

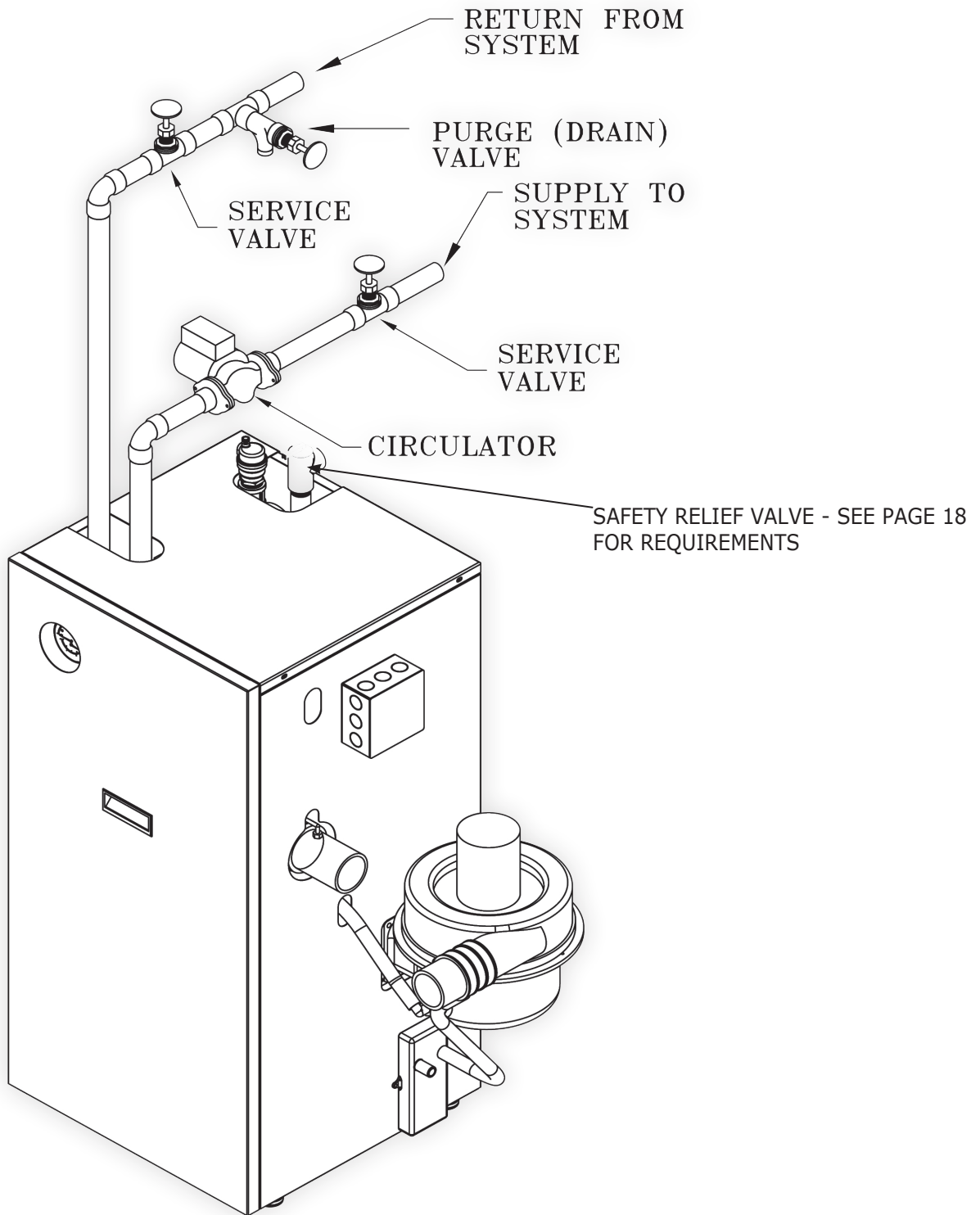
Systems having antifreeze not recommended must be completely flushed to insure no old antifreeze remains. In older systems obviously discolored, murky or dirty water; or pH reading outside acceptable range (between 7.0 and 8.0) are indications the system should be cleaned or treated. Thoroughly flush system with clean water to remove any sediment or contaminants. Sludge and iron oxide deposits can cause rapid breakdown of inhibitors.

Flushing with clean water. If chemical cleaners are used, use only those recommended for use with aluminum boilers. Follow chemical cleaner manufacturer's instructions completely. **DO NOT** mix different manufacturer's products.

Supply And Return Lines

- Boiler is set up to receive 1¼" NPT supply and return piping from top access.
- Boiler may be piped from left side by turning supply elbow.
- Install furnished dielectric unions at boiler supply and return lines prior to making system piping connections
- Do not install copper supply and return piping directly into aluminum boiler section casings due to galvanic corrosion between dissimilar metals.
- Must use provided dielectric unions between copper system piping and boiler to make final connection to boiler.
- Circulator pump can be installed at installer preferred location.

Figure 2 - Single Zone Boiler Piping



Multi-Zone Systems

Multi-zone systems with two zones are typically piped as shown in Figures 3 or 4. Multi-zone systems with more than two zones are likely to have small zones with very low heat and flow requirements compared to full heating capacity of the boiler. This can result in very low flow in the boiler if only one small zone is calling for heat.

Primary Secondary Piping is recommended for multi-zone systems with more than two zones to insure proper water flow through the boiler at all times. See Figures 5, 6 and 7 for typical primary secondary piping configurations.

Figure 3 - Two Zone Boiler Piping With Zone Valves

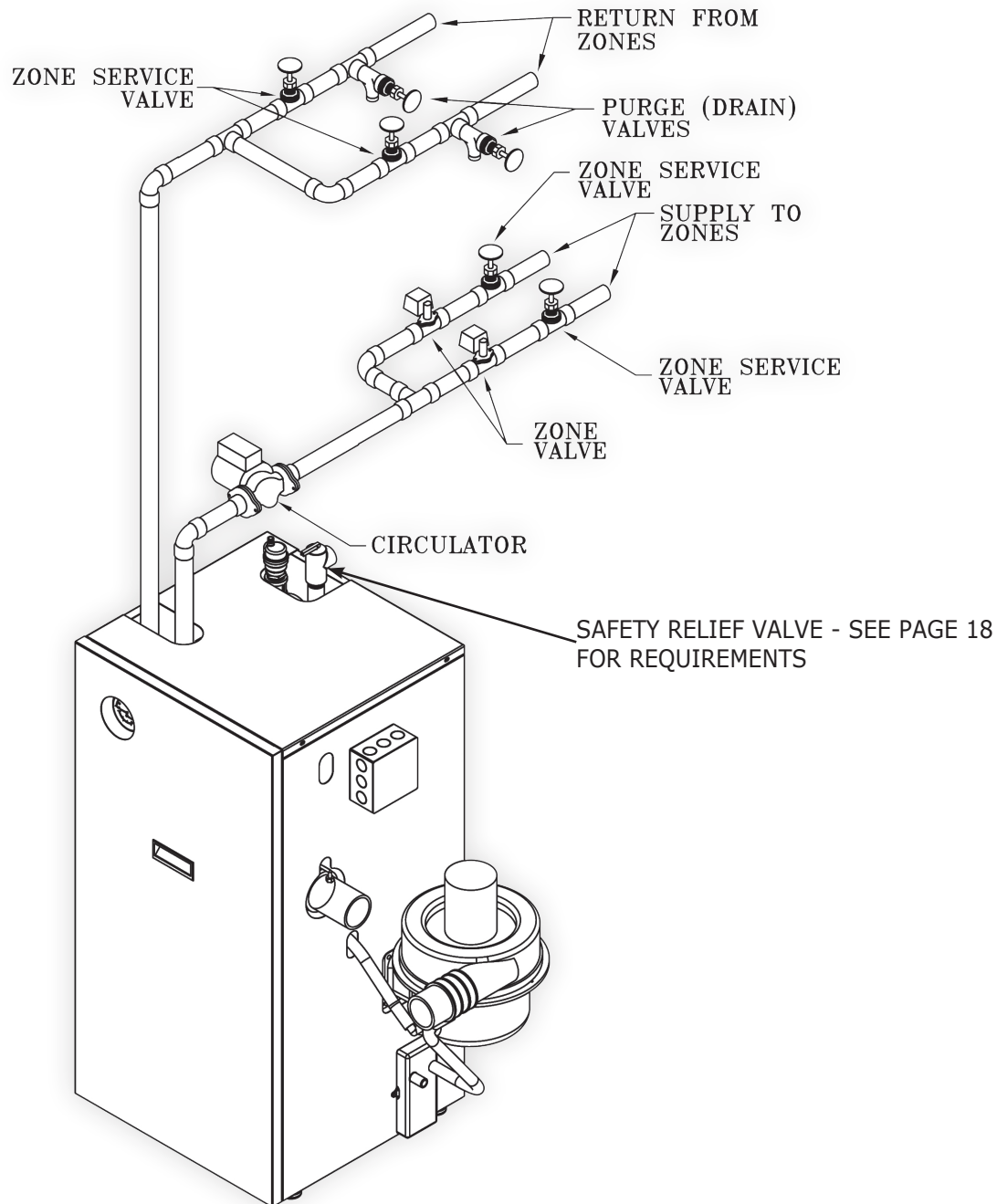
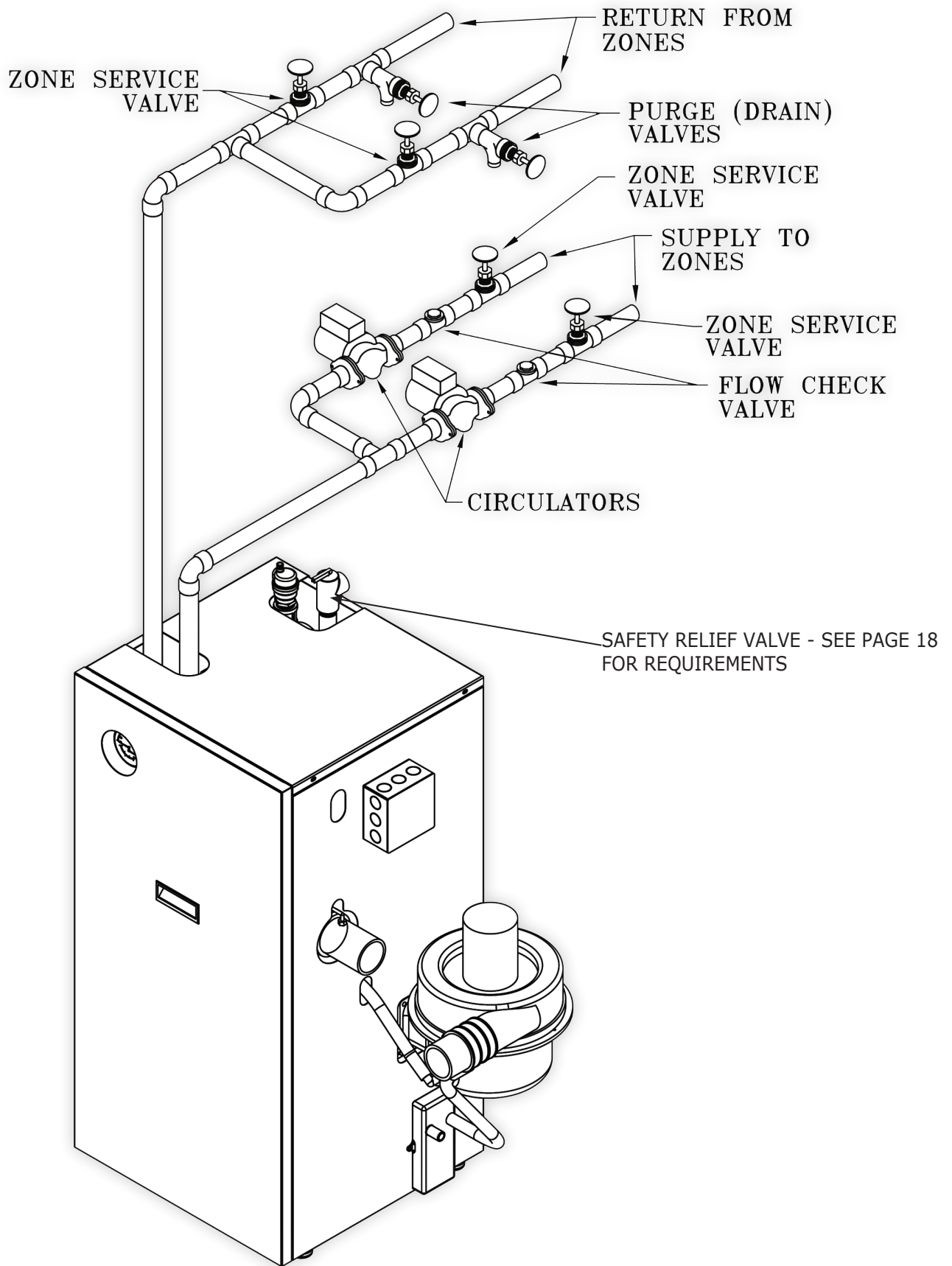
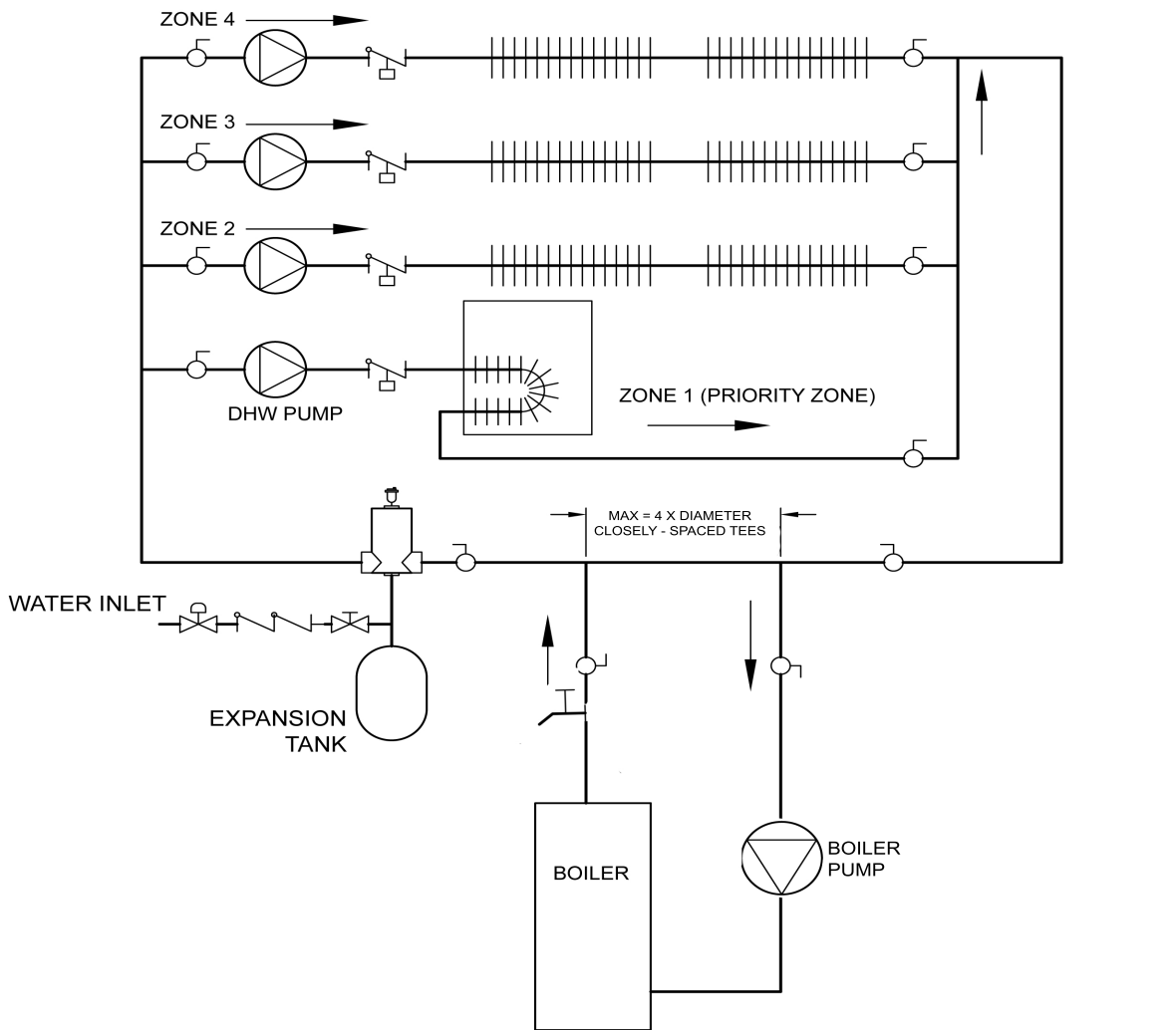





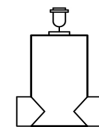






Figure 4 - Two Zone Boiler Piping With Circulators



NEAR BOILER PIPING

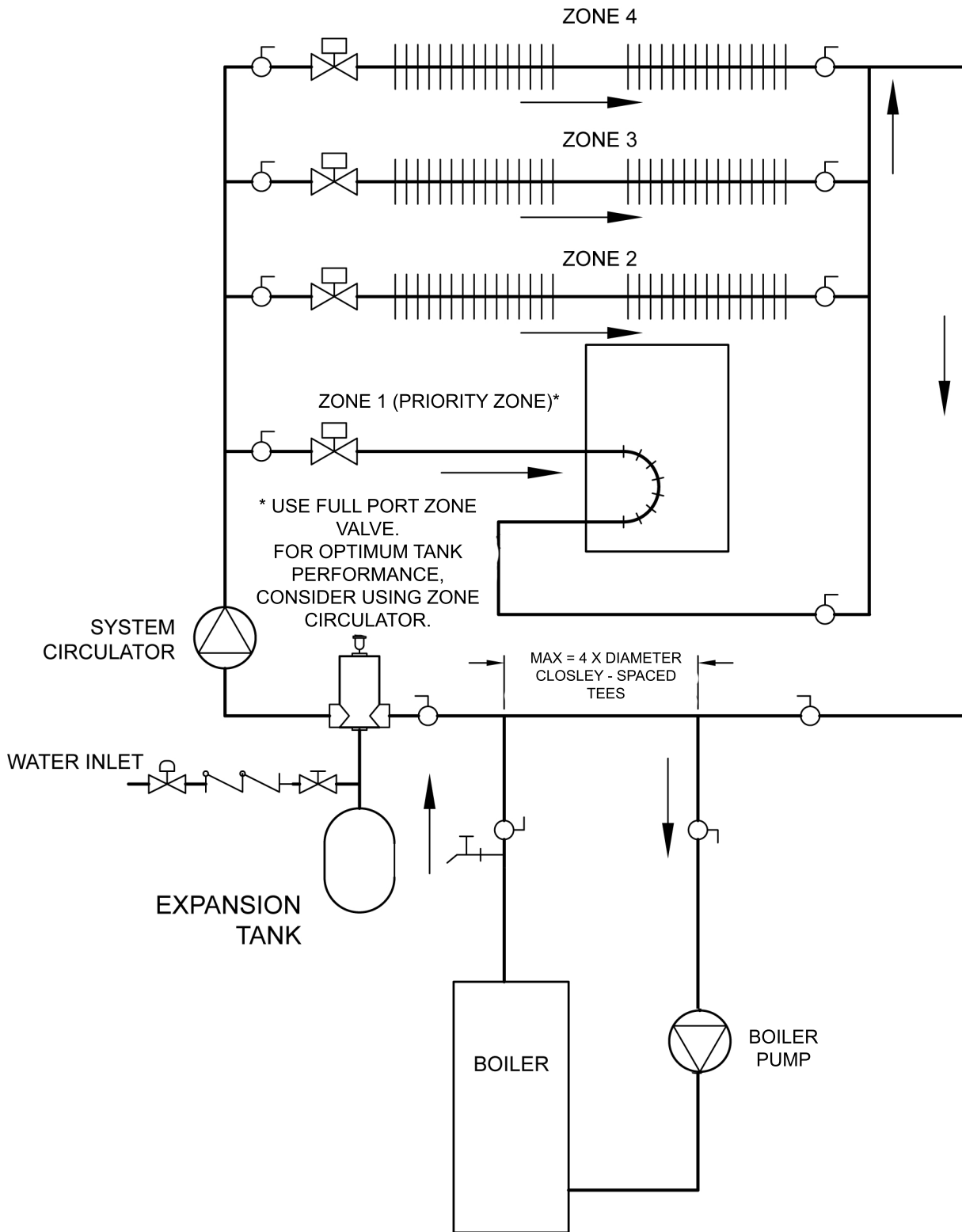
Figure 5 - Primary/Secondary Piping With Circulators And Domestic Hot Water



- | | | | | | | | |
|---|--------------------|---|------------------------|---|-------------|---|---------------|
|  | FLOW CONTROL VALVE |  | PRESSURE REDUCER VALVE |  | BALL VALVE |  | AIR SEPARATOR |
|  | CIRCULATOR (PUMP) |  | SHUT-OFF VALVE |  | CHECK VALVE |  | ZONE VALVE |
|  | SHUT-OFF VALVE |  | HOSE BIB | | | | |

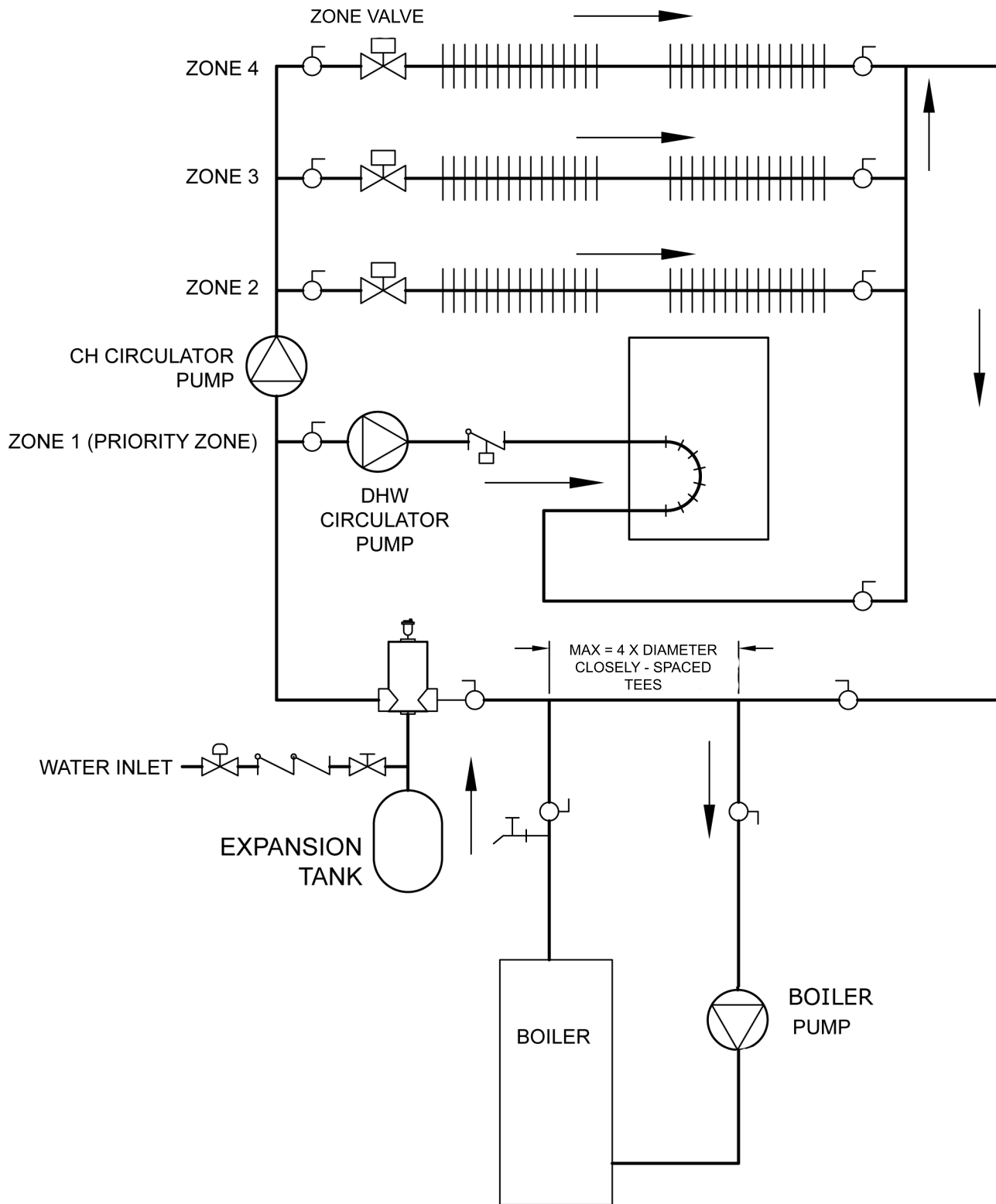
NEAR BOILER PIPING

Figure 6 - Piping Primary/Secondary Multi Zone System Piping With Zone Valves And Domestic Hot Water (With Zone Valve)



NEAR BOILER PIPING

Figure 7 - Piping Primary/Secondary Piping With Zone Valves And Domestic Hot Water (With Circulator)



⚠ WARNING

Burn and scald hazard. Safety relief valve could discharge steam or hot water during operation. Install discharge piping per these instructions.

Relief Valve

Installation of safety relief valve shall conform to ANSI/ASME Boiler and Pressure Vessel Code, Section IV.

- Install furnished safety relief valve using 3/4" x 4 1/2" pipe provided with boiler. See Figure 8.
- Install safety relief valve with spindle in vertical position.
- Do not install shutoff valve between boiler and safety relief valve.
- Install discharge piping from safety relief valve. See Figure 8.
- Use 3/4" or larger pipe.
- Use pipe suitable for temperatures of 375°F (191°C) or greater.
- Individual boiler discharge piping shall be independent of other discharge piping.
- Size and arrange discharge piping to avoid reducing safety relief valve relieving capacity below minimum relief valve capacity stated on rating plate.
- Run pipe as short and straight as possible to location protecting user from scalding and properly drain piping.
- Install union, if used, close to safety relief valve outlet.
- Install elbow(s), if used, close to safety relief valve outlet and downstream of union (if used).
- Terminate pipe with plain end (not threaded).

Expansion Tank And Make-Up Water

Determine required system fill pressure, system design temperature, and system water content.

- Boiler contains 2.6 gallons (U.S.). Size expansion tank accordingly. Consult expansion tank manufacturer for proper sizing information.
- Connect properly sized expansion tank (not furnished). Diaphragm type expansion tank see Figure 9, Page 19. See Figure 10, Page 20 for conventional closed type expansion tanks.
- For diaphragm type expansion tanks, adjust tank air pressure to match system fill pressure. Install furnished air vents shown for diaphragm type expansion tank system only.
- Install make-up water connections as shown per local codes.
- If pressure reducing valve is used, adjust to match system fill pressure.
- Verify clean water supply is available. When water supply is from well or pump, install sand strainer at pump

Figure 8 - Relief Valve Boiler Piping

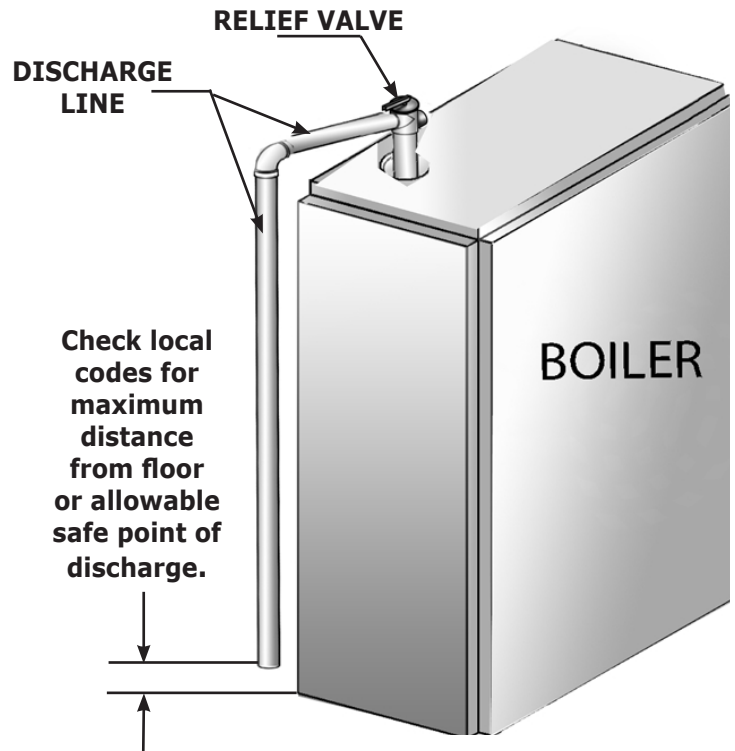


Figure 9 - Diaphragm Type Expansion Tank Piping

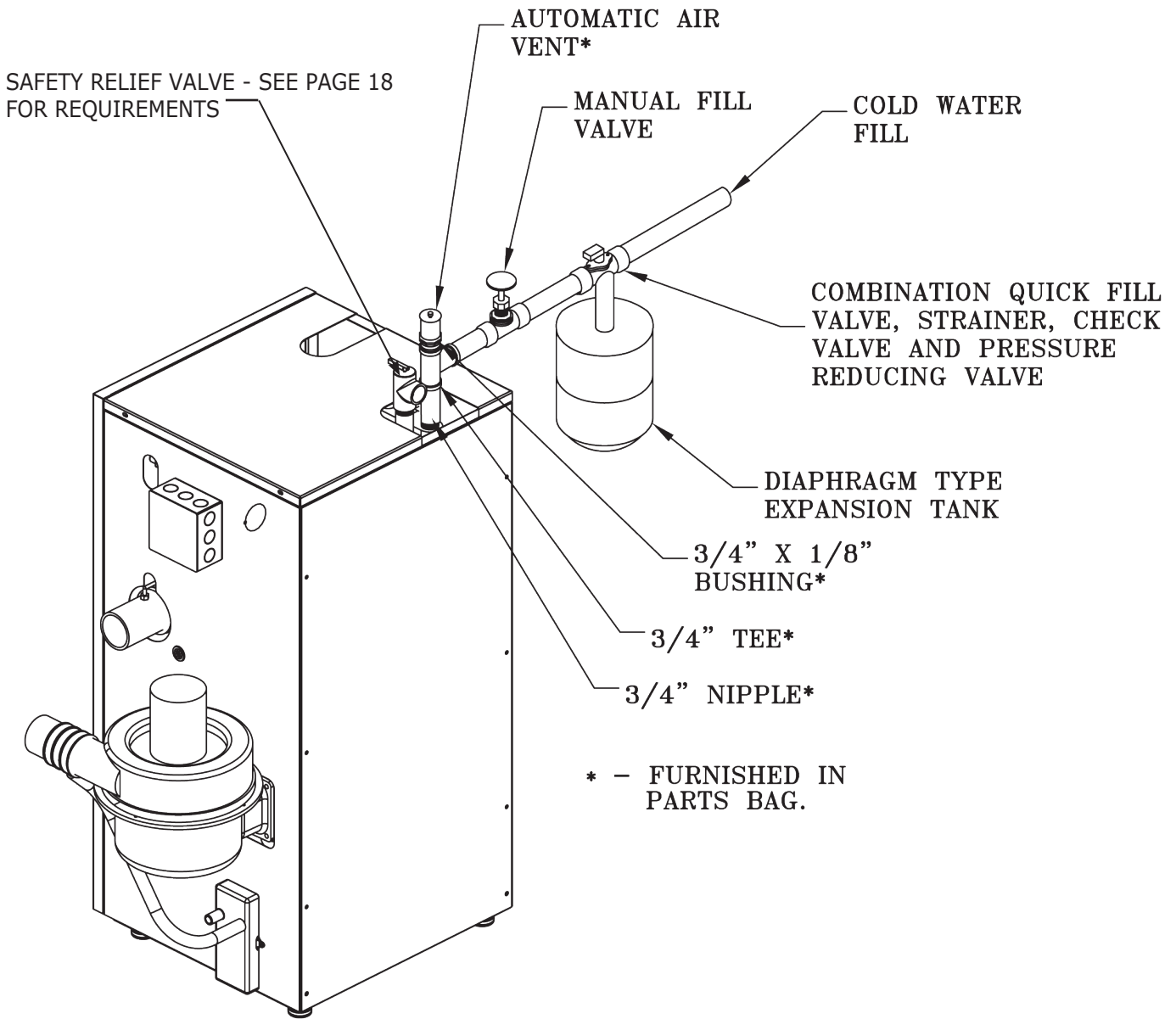
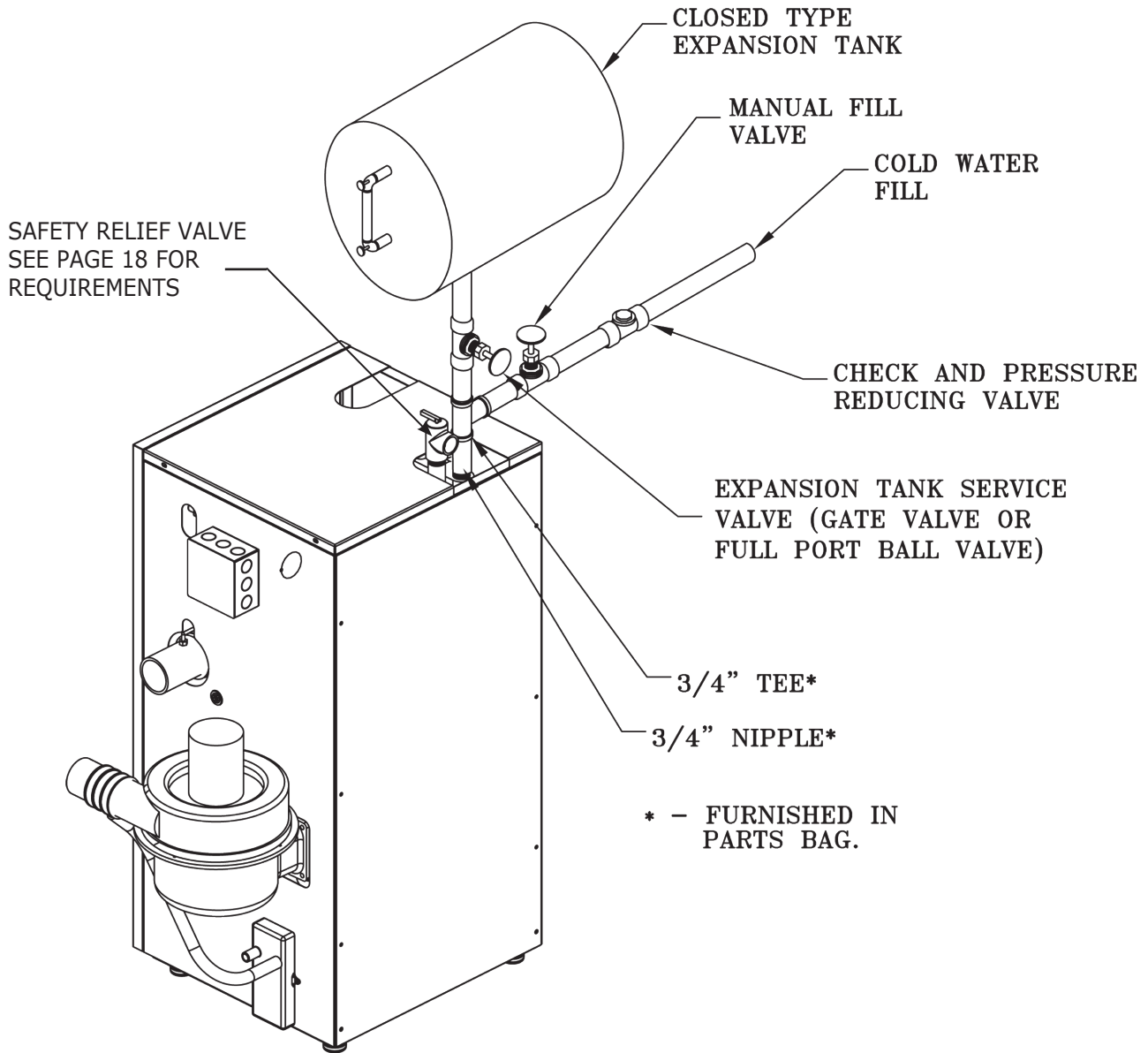


Figure 10 - Conventional (Closed Type) Expansion Tank Piping



Condensate Drain Piping

Boiler is factory equipped with a condensate trap. An additional trap is not required and should NOT be used.

1. Provide 1/2" PVC condensate drain and fittings.
Condensate drain to be pitched down to floor drain at a minimum of 1/4" per foot. Installation shall conform to requirements of authority having jurisdiction, check local codes for requirements.
2. Install 1/2" PVC tee to overflow fitting as shown in Figure 11.
3. The 1/2" diameter schedule 40 PVC or CPVC condensate drain and pipe fittings must conform to ANSI standards and ASTM D 1785 or D2846.
4. Schedule 40 PVC or CPVC cement and primer must conform to ASTM D2564 or F493.
5. In Canada, use CSA or ULC certified schedule 40 PVC or CPVC drain pipe cement.
6. Condensate pump with reservoir (not furnished) may be used to remove condensate to a drain line (sanitary line) above boiler if floor drain is not available or is not accessible.

Filling Condensate Trap With Water

On initial start up condensate trap must be manually filled with water.

Following are the steps required to initially fill condensate trap for start up. Steps are only required at initial start up or if maintenance requires draining of condensate trap.

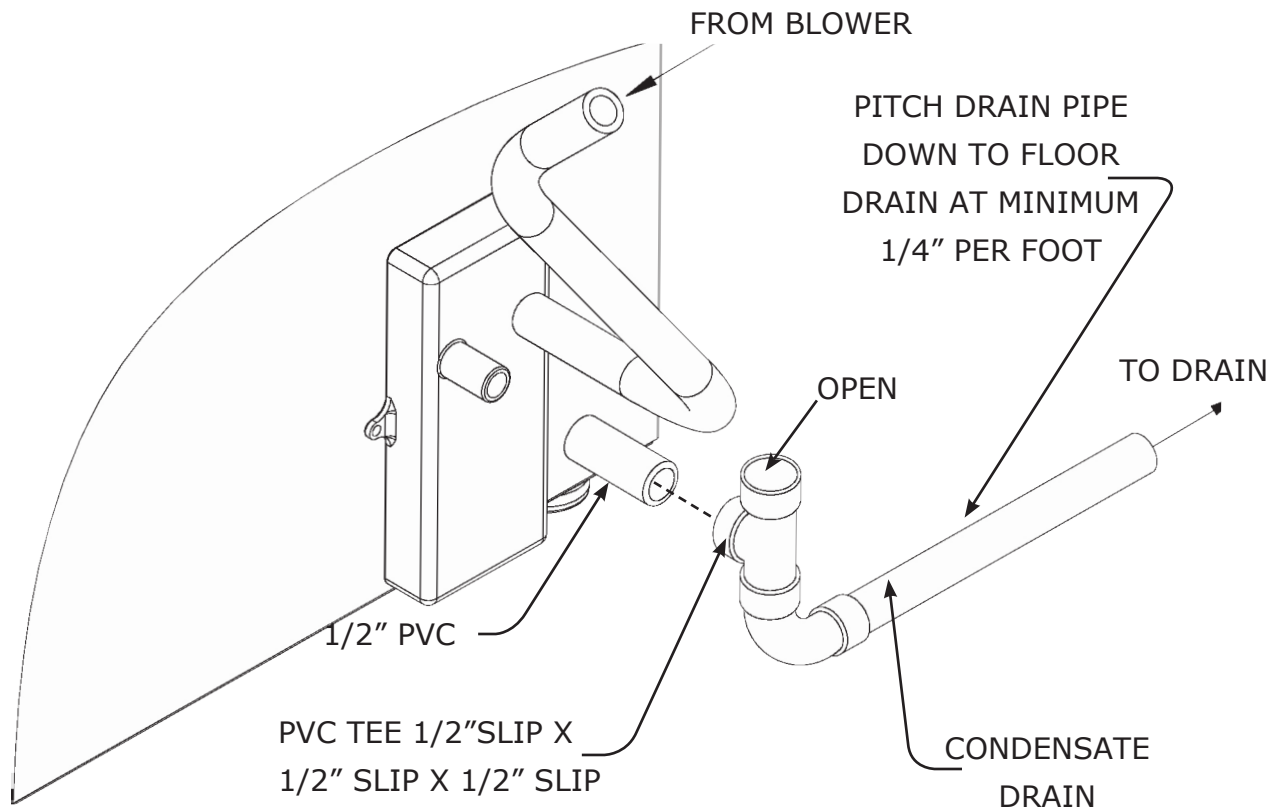
1. Disconnect vent condensate drain line from vent pipe connector on outlet of induced draft blower.
2. Pour about 1 cup of cold tap water into vent drain line with funnel.
3. Excess water should go through overflow and out through condensate drain line. Verify proper operation of drain line (or external condensate pump if used).
4. Reinstall vent drain line.

Chilled Water Piping

Install boiler, when used in connection with refrigeration system, so chilled medium is piped in parallel with boiler with appropriate valves to prevent chilled medium from entering boiler.

Boiler piping system of hot water boiler connected to heating coils located in air handling units where they may be exposed to refrigerated air circulation must be equipped with flow control valves or other automatic means to prevent gravity circulation of the boiler water during cooling cycle.

Figure 11 - Condensate Drain Piping



COMBUSTION AIR AND VENT PIPE

Connections And Termination

Provisions for combustion and ventilation air must be in accordance with section, Air For Combustion and Ventilation, of the National Fuel Gas Code, ANSI 2223.1/ NFPA54, or National Gas and Propane Installation Code, CAN/CGA-B 149.1, or applicable provisions of the local building code.

Boilers require dedicated direct vent system. All air for combustion is taken directly from outdoors through combustion air intake pipe. All flue products are discharged to outdoors through vent pipe.

1. Venting Materials:

WARNING

Use of cellular core PVC (ASTM F891), cellular core CPVC, or Radel® (Polyphenolsulfone) in venting systems could result in death, or serious injury.

WARNING

Covering non-metallic vent pipe and fittings with thermal insulation shall be prohibited. Use in venting system could result in death or serious injury.

Table 4 - Combustion air and vent pipe fittings must conform with the following:

Item	Material	Standards
Vent Pipe and Fittings	PVC schedule 40	ANSI/ASTM D1785
	PVC - DWV	ANSI/ASTM D2665
	CPVC schedule 40	ANSI/ASTM D1784/ F441
	SDR-21 & SDR-26 PVC	ANSI/ASTM D2241 NOT APPROVED FOR CANADA
	ABS-DWV	ANSI/ASTM D2661
	Schedule 40ABS	ANSI/ASTM F628
	PP (Polypropylene) Pipe and Components	UL 1738 ULC S636-08
Pipe Cement/ Primer	PVC	ANSI/ASTM D2564
	CPVC	ANSI/ASTM F493
	Schedule 40 ABS	ANSI/ASTM D2235

- IPEX is approved vent manufacturer in Canada listed to ULC-S636.
- IPEX System 636 Cements and Primers are approved in Canada listed to ULC-S636.

Use of cellular core PVC (ASTM F891), cellular core CPVC, or Radel®, (Polyphenolsulfone) in venting systems shall be prohibited.

NOTICE

Use of PP piping, follow manufacture's installation instructions and requirements.

2. Canadian installations:

- First 3 feet (900mm) of venting must be readily available for visual inspection.
- Specified primers and glues of certified vent system must be from single manufacturer, and not intermixed with other manufacturer's vent system parts.
- Components of the certified system must not be interchanged with other vent systems, or unlisted pipe and/or fittings.

NOTICE

Transition from 2" pipe to 3" pipe must be made in vertical run.

- Boiler combustion air and vent piping connections are sized for 2" pipe. Any pipe size change (to 3") must be made outside of boiler casing in vertical run of pipe to allow for proper drainage of vent condensate. Due to potential for flue gas temperatures over 155°F, first five (5) feet of vent pipe must be CPVC, the remaining vent pipe can be PVC. If any elbows are employed within the first 5 feet of vent, they must be CPVC also. Two (2) - 30" pieces of 2" CPVC pipe. 2½" piece of 2" CPVC pipe, a 2" CPVC elbow and 2" CPVC pipe coupling are furnished with the boiler. No requirement when using PP pipe.
- Combustion air and vent piping lengths. Table 5, Page 23. If vent exceeds 5 ft. first 5 ft. of vent piping run must be 2" CPVC:
Length of pipe is counted from boiler jacket (air intake pipe) or from vent pipe connector(vent pipe). Termination is not counted toward the "Total Equivalent Length".
For elbows, reduce maximum vent length as shown:
 - 2" 90° elbow - 2 ft. per elbow.
 - 3" 90° elbow - 3 ft. per elbow.

Example:

To add two (2) 90° elbows to a 3" pipe for a 75 boiler. Each elbow is 3 ft. per 90° elbow for a total of 6 ft.

(1 elbow @ 3 ft. + 1 elbow @ 3 ft. = 6 equivalent ft. of pipe)

Total additional pipe is then subtracted from maximum allowable pipe length to give new maximum length of 112-6=106 ft. with two (2), 90° elbows.

"TOTAL EQUIVALENT LENGTH":

Original 112 ft. max. - 6 equivalent ft. for 2 elbows = new 106 ft. maximum length.

COMBUSTION AIR AND VENT PIPE

Table 5 - Combustion Air And Vent Piping Lengths - Total Equivalent Length

BOILER SIZE	2" PIPE MINIMUM VENTING	2" PIPE MAXIMUM VENTING	3" PIPE MINIMUM VENTING	3" PIPE MAXIMUM VENTING
100	2 FEET	21 FEET	15 FEET	92 FEET
75 & 50	2 FEET	26 FEET	20 FEET	112 FEET

NOTE: Follow venting lengths strictly, to avoid nuisance pressure switch trips.

5. See Figure 12 thru Figure 17, Pages 24 thru 26 for combustion air and vent pipe roof and sidewall termination. Roof termination is preferred. Combustion air and vent pipes must terminate together in same atmospheric pressure zone as shown.
 6. Construction through which vent and air intake pipes may be installed is maximum 24 inches, minimum ¼" thickness.
 7. Optional- Rotate draft inducer (blower) 90° or 180° to orient vent connection towards right side or rear. Remove blower mounting screws, re-orient blower. Reinstall mounting screws. Do not overtighten screws.
 8. Pitch combustion air and vent piping back to boiler at minimum ¼" per ft. (21 mm/m) from intake and vent terminals so all moisture in combustion air and vent piping drains to boiler. Pitch pipes continuously with no sags or low spots where moisture can accumulate and block flow of air or flue gas. Combustion air and vent pipes must be airtight and watertight.
 9. Consider following when determining appropriate location for termination of combustion air and vent piping.
 - Position termination where vent vapors will not damage plants/shrubs or air conditioning equipment.
 - Position termination as to not be effected by wind eddy, air born leaves, snow, or recirculated flue gases.
 - Position termination where it will not be subjected to potential damage by foreign objects, such as stones, balls, etc..
 - Position termination should where vent vapors are not objectionable.
 - Place vent on wall away from prevailing wind. Locate or guard vent to prevent accidental contact with people or pets.
 - Terminate vent above normal snow line. Avoid locations where snow may drift and block vent. Ice or snow may cause boiler to shut down if vent becomes obstructed.
 - Under certain conditions, flue gas will condense, forming moisture, and may be corrosive. Take steps to prevent building materials at vent from being damaged by exhaust of flue gas.
 - Vent shall not terminate where it may cause hazardous frost or ice accumulations on adjacent property surfaces.
 10. Venting Requirements:
 - Venting system shall terminate at least 3 ft. (0.9m) above any forced air inlet (except boiler's combustion air inlet) within 10 ft.(3m).
 - Venting system shall terminate at least 12 in. from any air opening into any building.
 - Vent bottom shall be located at least 12 in. above grade.
 - Termination of the vent shall be not less than 7 ft. (2.1m) above adjacent public walkway or paved driveway.
 - Vent terminal shall not be installed closer than 3 ft. from inside corner of L shaped structure.
 - Vent termination should be kept at least 3 ft. away from vegetation.
 - Venting system shall terminate at least 4 ft. horizontally from, and in no case above or below, unless 4 ft. (1.22m) horizontal distance is maintained, from electric meters, gas meters, regulators, and relief equipment.
 - **Canada only.**
 - Venting system shall terminate at least 6 ft. (1.83m) horizontally from, in no case above or below, unless a 6 ft. (1.83m) horizontal distance is maintained, from electric meters, gas meters, regulators, and relief equipment.
 - Vent shall not terminate within 6 ft. (1.8m) of mechanical air-supply inlet to any building.
 - Vent shall not terminate above regulator within 3 ft. (900 mm) horizontally of vertical center line of regulator vent outlet to maximum vertical distance of 15 ft. (9.5m).
 - Vent shall not terminate within 1 ft (305mm) for inputs up to and including 100,000 btu/hr and 3 ft. (900mm) for inputs exceeding 100,000 btu/hr of window or door that can be opened in any building, or any non-mechanical air-supply inlet to any building, or of combustion air inlet of any other appliance.
 - Vent shall not terminate underneath veranda, porch or deck unless,
 - (a) veranda, porch or deck is fully open on minimum of two sides beneath floor, and
 - (b) distance between top of vent termination and underside of veranda, porch or deck is greater than 1 ft. (300mm).
- See figures 12 and 13 and 14 for two pipe terminations.
See figures 15, 16 and 17 for concentric vent terminations.

COMBUSTION AIR AND VENT PIPE

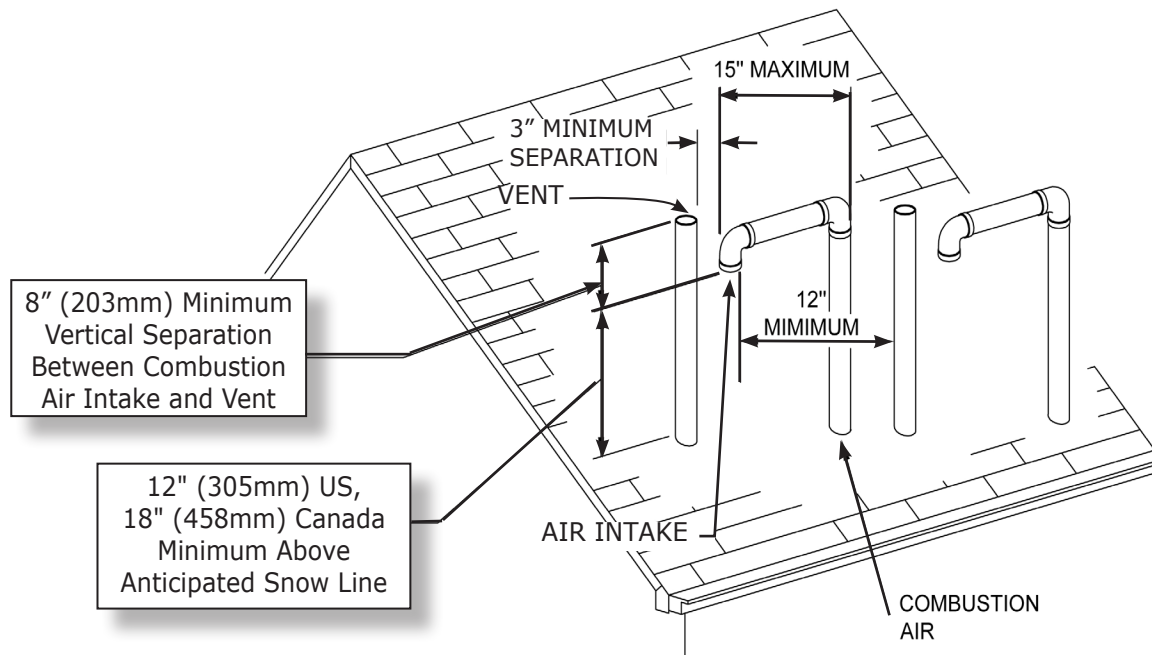
Installation

1. Attach combustion air intake piping using field supplied 2" flexible coupling. Attach vent piping to furnished 2" vent pipe connector on draft inducer outlet.
2. All pipe joints are to be water tight
3. Working from boiler to outside, cut pipe to required length(s).
4. Deburr inside and outside of pipe.
5. Chamfer outside edge of pipe for better distribution of primer and cement.
6. Clean and dry all surfaces to be joined.
7. Check dry fit of pipe and mark insertion depth on pipe.
8. After pipes have been cut and pre-assembled, apply cement primer to pipe fitting socket and end of pipe to insertion mark. Quickly apply approved cement to end of pipe and fitting socket (over primer). Apply cement in light, uniform coat on inside of socket to prevent buildup of excess cement. Apply second coat.
9. While cement is still wet, insert pipe into socket with $\frac{1}{4}$ turn twist. Be sure pipe is fully inserted into fitting socket.
10. Wipe excess cement from joint. Continuous bead of cement will be visible around perimeter of properly made joint.
11. Handle pipe joint carefully until cement sets.
12. Support combustion air and vent piping minimum of every 5 feet using pre-formed metal hanging straps. Do not rigidly support pipes. Allow movement due to expansion and contraction.
13. Slope horizontal portion of combustion air and vent pipes toward boiler minimum of $\frac{1}{4}$ " per linear ft. (21mm/m) with no sags between hangers.
14. Use appropriate methods to seal openings where vent and combustion air pipes pass through roof or side wall.

NOTICE

To avoid nuisance trips under high wind conditions, an inlet tee is required for side wall venting. See figures 13 and 14 page 25.

Figure 12 - Roof Vent / Intake Terminations



COMBUSTION AIR AND VENT PIPE

Figure 13 - Side Wall Vent / Intake terminations - Less Than 12" Clearance Above Grade

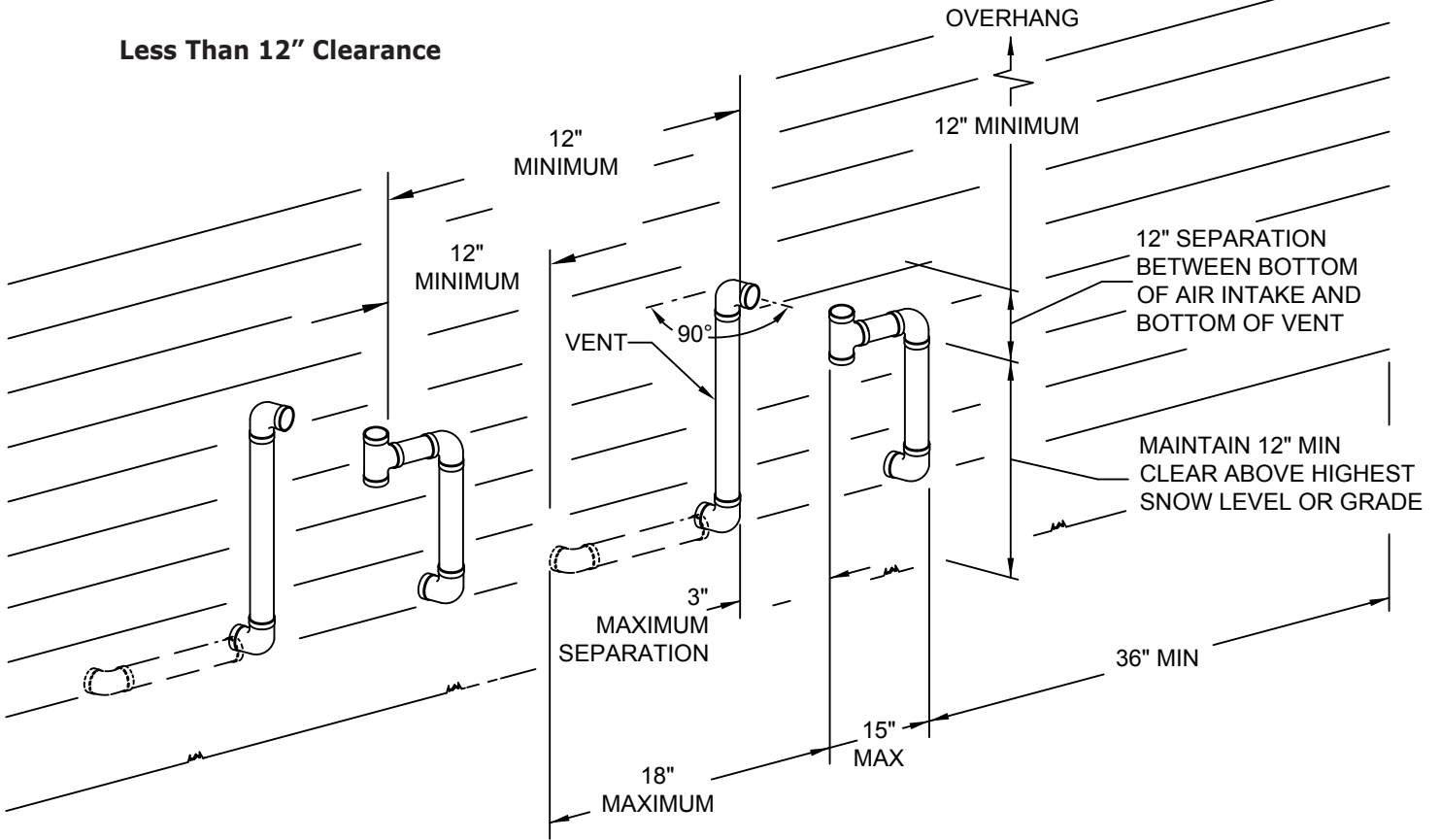


Figure 14 - Side Wall Vent/Intake Terminations - 12" Or More Clearance Above Grade

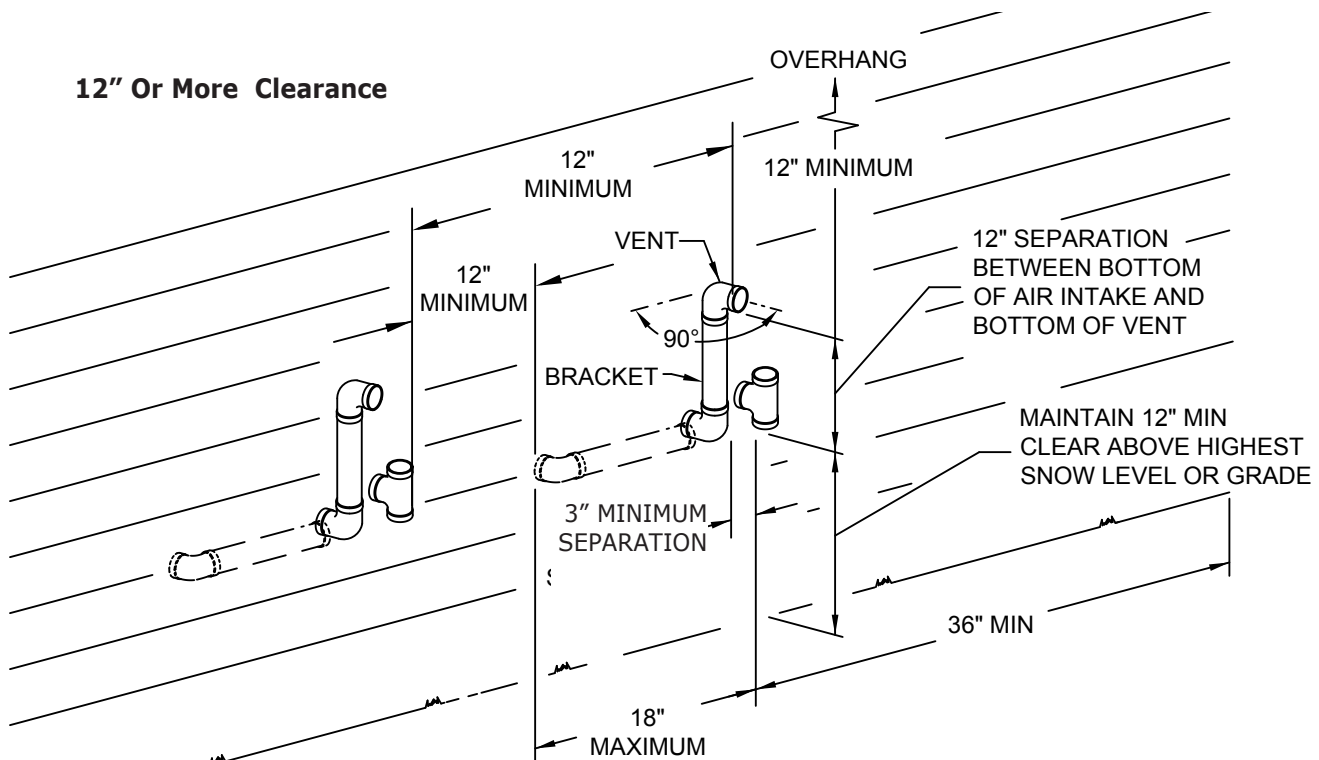
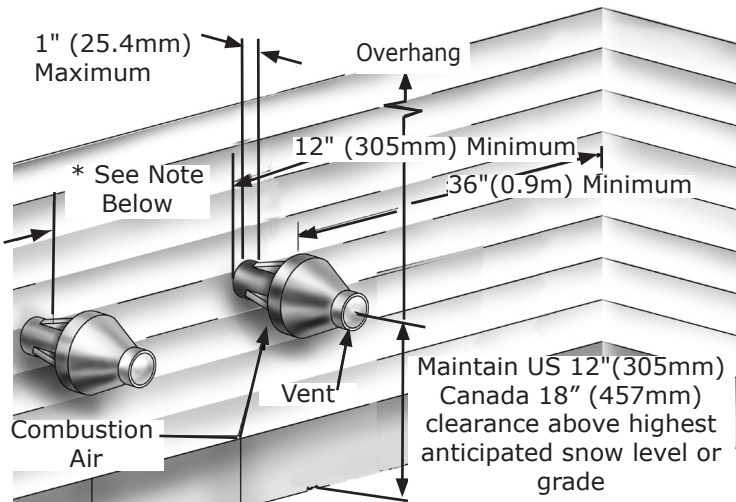
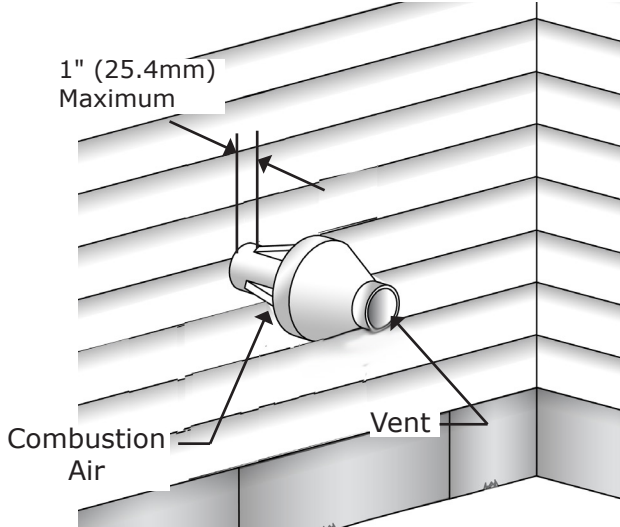


Figure 15 - Concentric Vent Terminations



*Must be less than 4" (102mm) or greater than 24" (610mm) Horizontal distance between end bells of each air intake to prevent flue gas recirculation.

Figure 16 - Concentric Vent

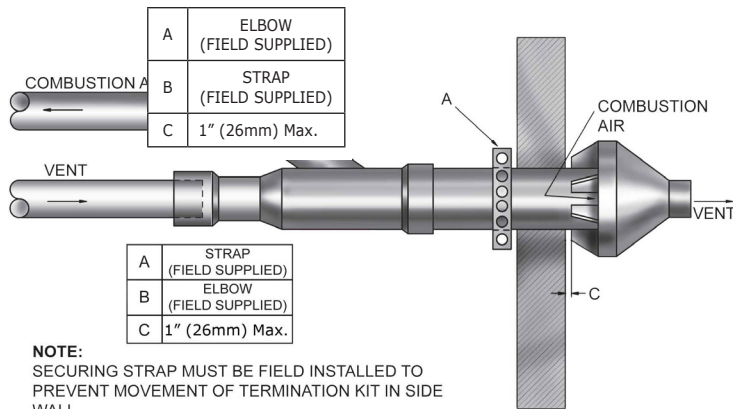
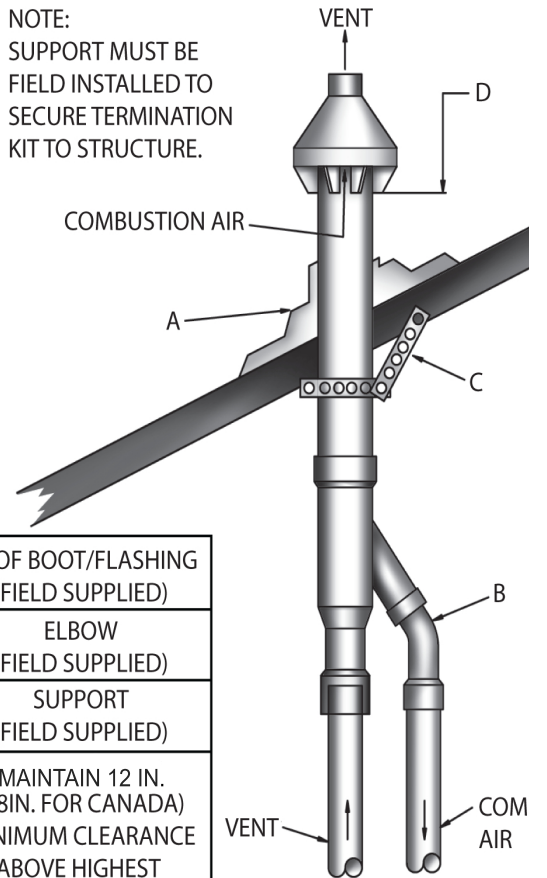


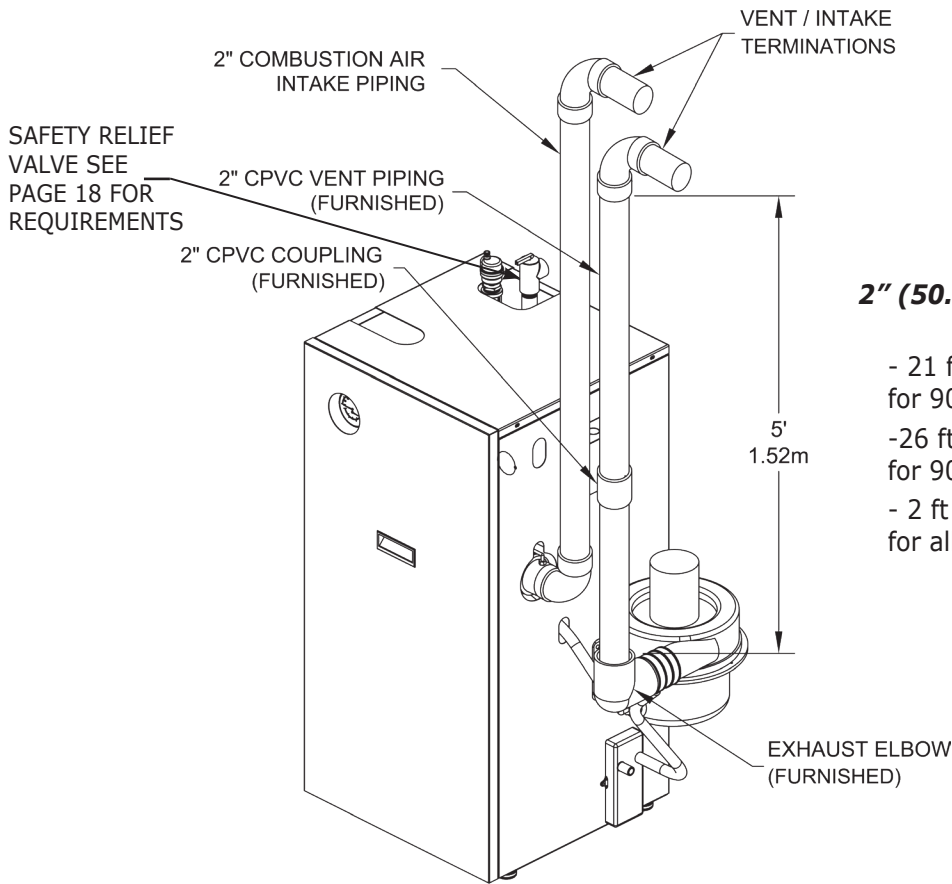
Figure 17 - Concentric Vent Roof Installation

NOTE:
SUPPORT MUST BE FIELD INSTALLED TO SECURE TERMINATION KIT TO STRUCTURE.



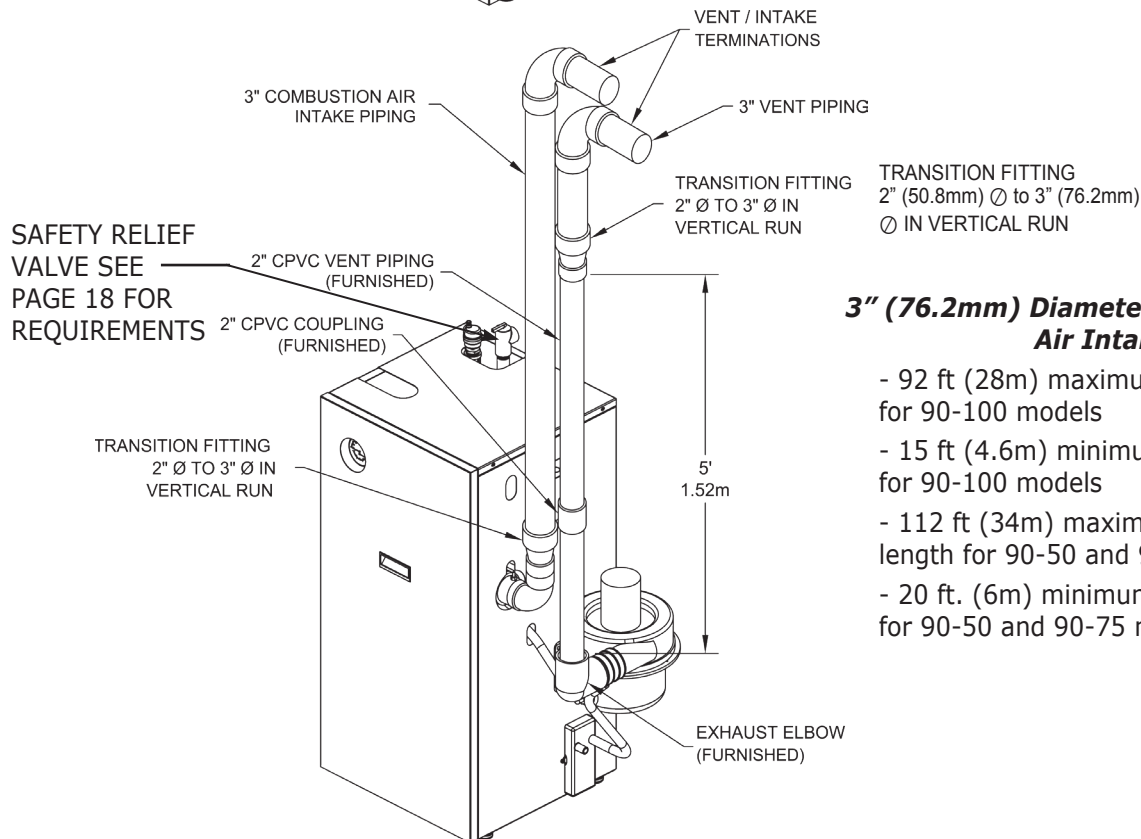
A	ROOF BOOT/FLASHING (FIELD SUPPLIED)
B	ELBOW (FIELD SUPPLIED)
C	SUPPORT (FIELD SUPPLIED)
D	MAINTAIN 12 IN. (18IN. FOR CANADA) MINIMUM CLEARANCE ABOVE HIGHEST ANTICIPATED SNOW LEVEL. MAXIMUM OF 24 IN. ABOVE ROOF

Figure 18 - Combustion Air and Vent Piping - Boiler Connections



2" (50.8mm) Diameter Vent And Combustion Air Intake Piping

- 21 ft (6.4m) maximum total equivalent length for 90-100 models
- 26 ft (7.9m) maximum total equivalent length for 90-50 and -90-75 models
- 2 ft (0.6m) minimum total equivalent length for all models



3" (76.2mm) Diameter Vent And Combustion Air Intake Piping

- 92 ft (28m) maximum total equivalent length for 90-100 models
- 15 ft (4.6m) minimum total equivalent length for 90-100 models
- 112 ft (34m) maximum total equivalent length for 90-50 and 90-75 models
- 20 ft. (6m) minimum total equivalent length for 90-50 and 90-75 models

⚠ CAUTION

WHAT TO DO IF YOU SMELL GAS

- Do not try to light any appliance.
- Do not touch any electrical switch; do not use any phone in your building.
- Immediately call your gas supplier from a neighbor's phone. Follow gas supplier's instructions.
- If you cannot reach your gas supplier, call the fire department.

Check Gas Supply

Gas pipe to your boiler must be correct size for length of run and for total Btu per hour input of all gas utilization equipment connected to it. See Table 7, Page 29.

Boiler and its individual shutoff valve must be disconnected from gas supply piping system during any system pressure testing at test pressures in excess of ½ psig (3.5kpa).

Boiler must be isolated from gas supply piping system by closing its individual manual shutoff valve during any pressure testing of gas supply piping system at test pressures equal to or less than ½ psig (3.50ka).

Connecting The Gas Piping

See Figure 19, Page 29 for general layout at boiler.

Gas line enters boiler from right side jacket panel.

Boiler is equipped with ½" NPT connection on gas valve for supply piping.

Following rules apply:

1. Use piping materials and joining methods acceptable to authority having jurisdiction. In absence of such requirements:
 - USA - National Fuel Gas Code, ANSI Z223.1/NFPA 54
 - Canada - Natural Gas and Propane Installation Code, CAN/CSA B149.1
2. Size and install gas piping system to provide sufficient gas supply to meet maximum input at not less than minimum supply pressure. See Table 7, Page 29
3. Use ground joint unions.
4. Provide sediment trap up stream of gas valve.
5. Use two pipe wrenches when making the connection to gas valve to keep it from turning.
6. Install a manual shutoff valve in the vertical pipe about 5 feet above floor.
7. Tighten all joints securely.
8. Propane gas connections should only be made by licensed propane installer.
9. Two stage regulation should be used by propane installer.
10. Propane gas piping should be checked out by propane installer.

⚠ DANGER

Fire Hazard. Do not use matches, candles, open flames, or other methods providing ignition source. Failure to comply will result in death or serious injury.

Leak Check Gas Piping

Pressure test boiler and gas connection before placing boiler in operation.

- Disconnect boiler and its individual gas shutoff valve from gas supply system.
- Isolate boiler from gas supply system by closing manual gas shutoff valve. See Figure 19, Page 29.
- Locate leakage using gas detector, noncorrosive detection fluid, or other leak detection method acceptable to authority having jurisdiction. Do not use matches, candles, open flames, or other methods providing ignition source.
- Correct leaks immediately and retest.

Table 6 - Gas Supply Pressure

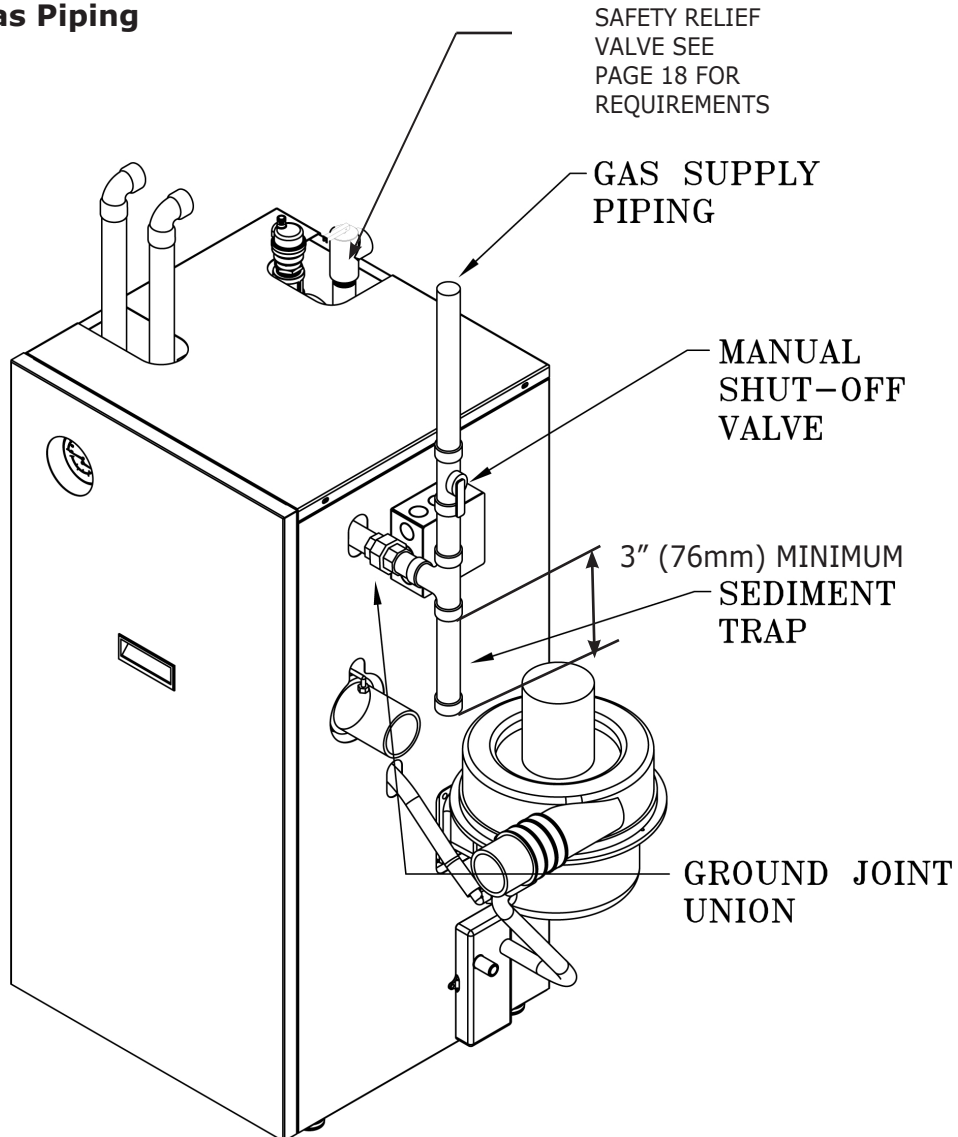
	NATURAL GAS	PROPANE GAS
Maximum Gas Supply Pressure	10" w.c.	14" w.c.
Minimum Gas Supply Pressure	4" w.c.	10" w.c.

GAS SUPPLY PIPING

Table 7 – Gas Pipe Sizes				
NATURAL GAS				
Length of Pipe - Ft.	Pipe Capacity - BTU Per Hour Input Includes Fittings			
	1/2"	3/4"	1"	1 1/4"
20	92,000	190,000	350,000	625,000
40	63,000	130,000	245,000	445,000
60	50,000	105,000	195,000	365,000
PROPANE GAS				
Length of Pipe - Ft.	Pipe Capacity - BTU Per Hour Input Includes Fittings			
	Copper Tubing*		Iron Pipe	
	5/8"	3/4"	1/2"	3/4"
20	131,000	216,000	189,000	393,000
40	90,000	145,000	129,000	267,000
60	72,000	121,000	103,000	217,000

* Outside diameter

Figure 19 - Gas Piping



⚠ WARNING

Electrical shock hazard. Turn OFF electrical power supply at service panel before making electrical connections. Failure to do so could result in death or serious injury.

Electrically bond boiler to ground in accordance with requirements of authority having jurisdiction. Refer to:

- USA- National Electrical Code, ANSI/NFPA 70.
- Canada - Canadian Electrical Code, Part I, CSA C22.1: Safety Standard for Electrical Installations.

Electric Power Supply

Prior to making any line Voltage connections, turn OFF electrical power at fuse box.

1. Run separate 115 Volt circuit from separate over current protection device in electrical service entrance panel. This should be 15 ampere circuit.
2. See Figure 20, Page 31 for diagram showing service switch junction box and power supply connection points.
3. Locate service switch in vicinity of boiler. Verify it is turned OFF during service or maintenance.
 - Connect black (hot) lead from power supply to black wire labeled L 120 VAC.
 - Connect white (neutral) lead from power supply to white wire labeled N 120 VAC.
 - Connect green (ground) lead from power supply to green wire labeled G 120 VAC.
4. Run 14 gauge or heavier copper wire from boiler to grounded connection in service panel or properly driven and electrically grounded ground rod.

Thermostat Installation

- Thermostat location has important effect on operation of boiler system.
- Follow instructions included with your thermostat.
- Locate thermostat about five feet above floor on inside wall.
- Mount directly on wall or on vertical mounted outlet box.
- It should be sensing average room temperature.

Set heat anticipator (where applicable) at 0.7 amps. Connect 24 Volt thermostat leads to two(2) yellow wires located in junction box, located on outer jacket of boiler. See Figure 20, Page 31 for junction box and thermostat field wiring connections.

Connect Circulator Pump Wiring

See Figure 20, Page 31 for circulator pump field wiring connections.

Supplied 5 foot wiring harness with flexible metal conduit for connection from circulator pump to junction box.

If two 120 Volt circulator wire terminals inside junction box are not used, leave two wire nuts to prevent short circuit.

NOTICE

Label all wires prior to disconnection when servicing controls. Wiring errors can cause improper and dangerous operation. Verify proper operation after servicing.

Things to Avoid when Locating Thermostats	
DEAD SPOTS:	
Corners and alcoves	Behind doors
COLD SPOTS:	
Concealed pipes or ducts	Concealed pipes
	Fireplace
Stairwells - drafts	TV sets
	Radios
HOT SPOTS:	
Unheated rooms on other side of wall	Lamps
	Direct sunlight
	Kitchens

Figure 20 - Field Wiring Connections

SAFETY RELIEF VALVE
SEE PAGE 18 FOR
REQUIREMENTS

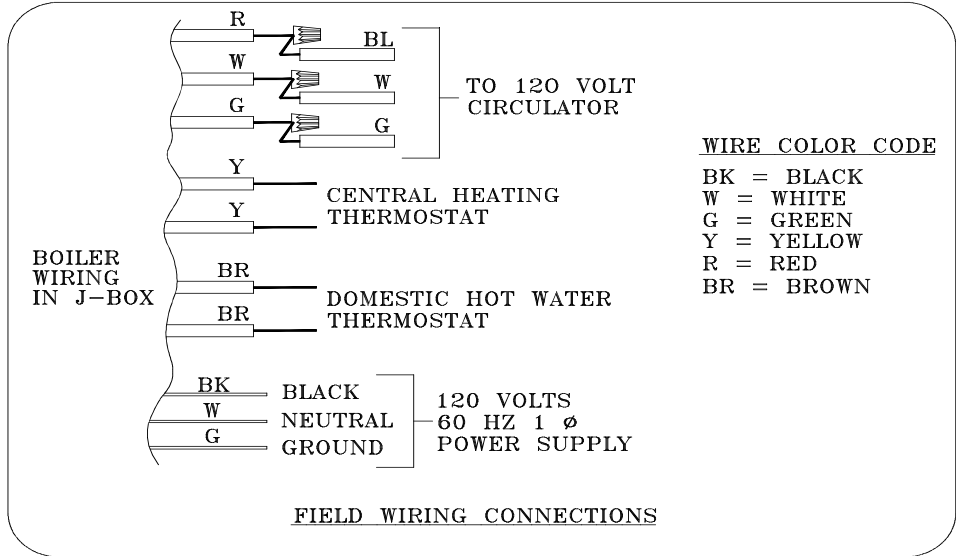
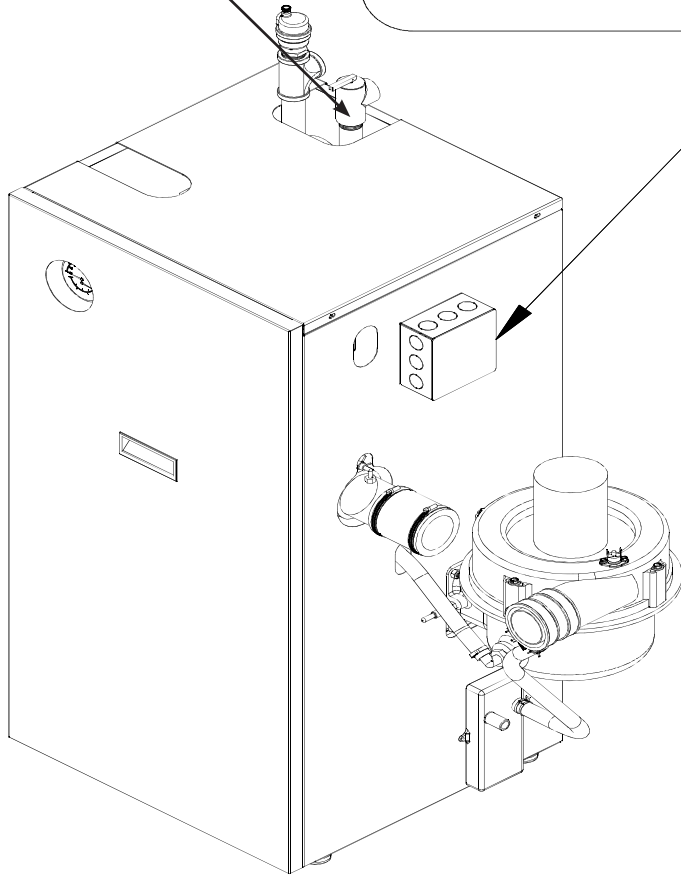
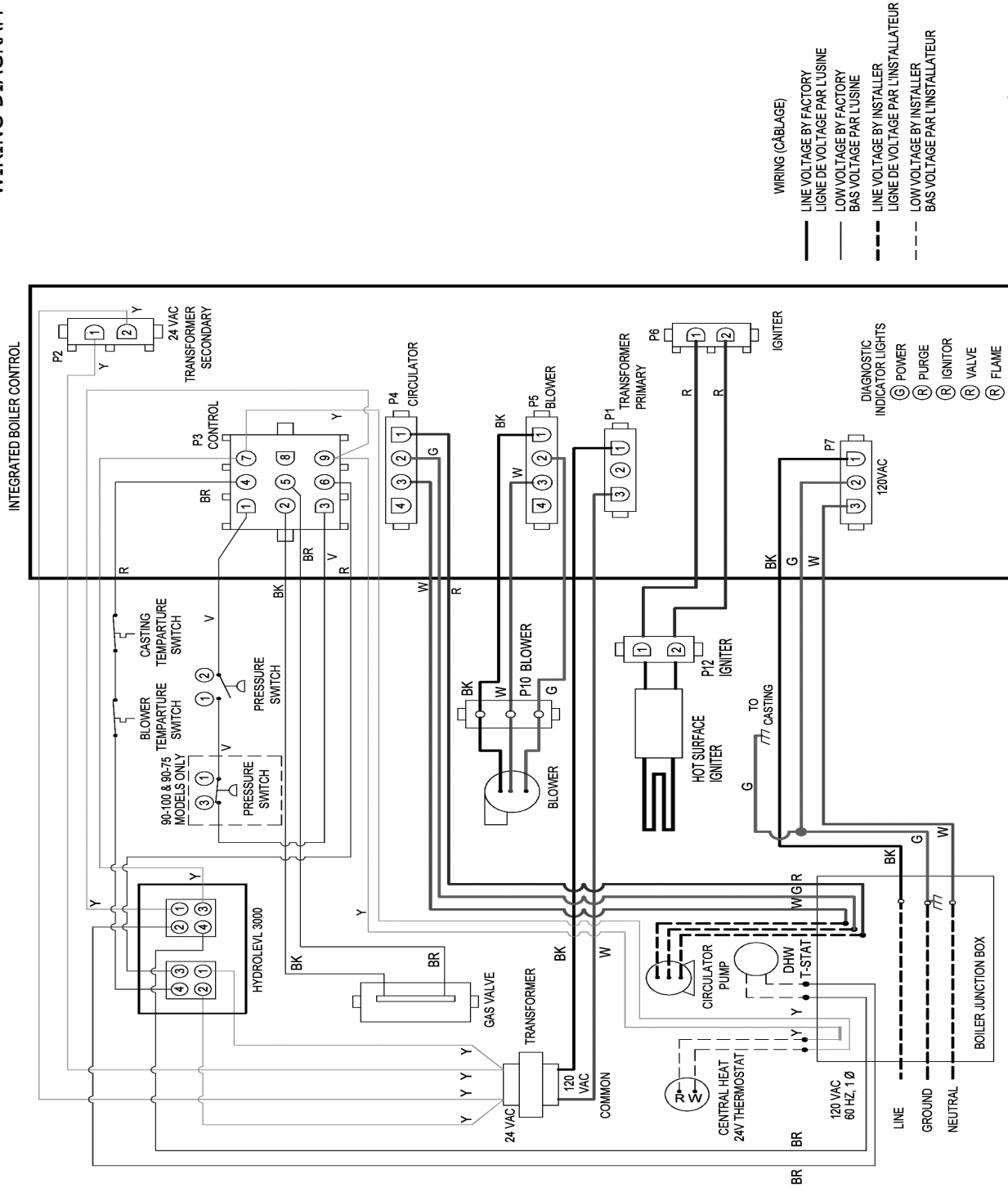


Figure 21 - Wiring Schematic

WIRING DIAGRAM

NOTICE

If any of original wire as supplied with this appliance must be replaced, it must be replaced with type 105°C Thermoplastic wire or its equivalent



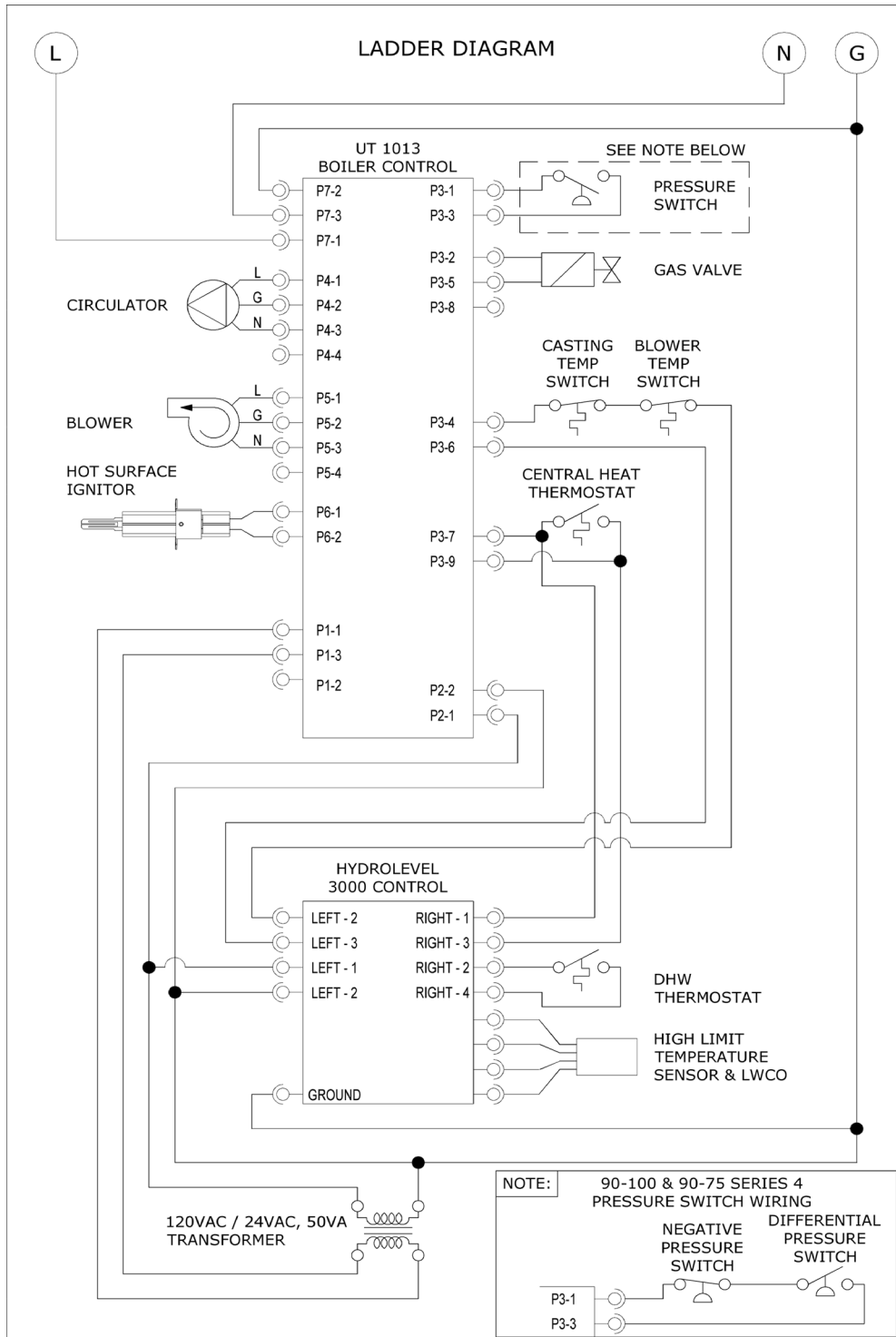
WIRING (CÂBLAGE)
 LINE VOLTAGE BY FACTORY
 LIGNE DE VOLTAGE PAR L'USINE
 LOW VOLTAGE BY FACTORY
 BAS VOLTAGE PAR L'USINE
 LINE VOLTAGE BY INSTALLER
 LIGNE DE VOLTAGE PAR L'INSTALLATEUR
 LOW VOLTAGE BY INSTALLER
 BAS VOLTAGE PAR L'INSTALLATEUR

DIAGNOSTIC INDICATOR LIGHTS
 (C) POWER
 (R) PURGE
 (R) IGNITOR
 (R) VALVE
 (R) FLAME

P/N: 240010137
 REVISION: C

(NOTE: USE COPPER CONDUCTORS ONLY)

Figure 22 - Ladder Diagram for Figure 21



1 - Integrated Boiler Control (IBC)

- Integrated Boiler Control (IBC) is a microprocessor based controller for high efficiency gas boilers.
- Controller monitors all safety controls which control operation of combustion air blower, circulator pump, burner, and combination hot surface igniter/flame sensor.
- Controller is not intended for use with vent damper. Controller is mounted on control panel inside boiler. Contains five diagnostic indicator lights.

2 - High Limit Control

NOTICE

Maximum set-point of limit control must not exceed 190°F.

- High limit control determines maximum boiler water temperature and provides means for protecting boiler and heating system from unsafe operating conditions which could damage boiler.
- Control is mounted in 3/4" NPT control well on top of front boiler section at hot water outlet.
- Control is tied in with IBC and factory set at 190°F water temperature.
- High limit set-point is field adjustable and may be set between 100°F and 190°F.
- Field set-point adjustment for each installation depends on heating system requirements.
- Differentials are automatic, vary based on control settings and boiler temperature.
- Refer to limit manufacturer instructions provided with limit control.

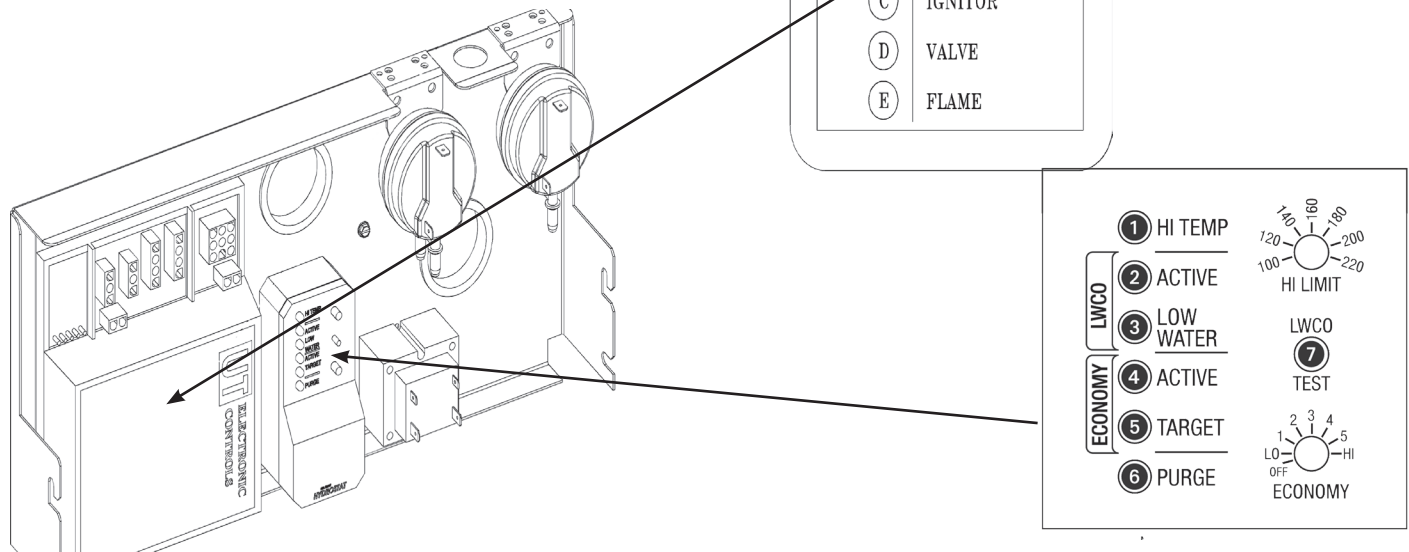
A - Setting High Limit

To adjust, turn HI TEMP dial **1** until desired setting is displayed. Overall range of High limit setting is from 100°F to 190°F (38° C to 88° C). High limit (HL) on limit control is factory set at 190°F. Temperature setting may be varied to suit requirements of installation. Differentials are automatic and will vary based on control settings and boiler temperature. See Figure 23.

B - Setting Economy Feature

- Economy feature is factory set for 1 zone heating system. To adjust, turn ECONOMY dial until number displayed equals number of heating zones.
- Do not include indirect water heaters in number of heating zones.
- Economy feature conserves fuel by reducing boiler temperature. If heating system is unable to supply needed heat to house, ECONOMY dial should be turned to lower setting. (example: in a three zone house, turn dial to 2 or 1).
- Conversely, if boiler provides adequate heat, added fuel savings can be achieved by selecting higher setting (example: 4 or 5).
- If heating and indirect water heater signals were not separated when wiring the control, Economy feature should be turned off to ensure the boiler supplies adequate temperature to heat indirect tank.

Figure 23 - Indicator Lights



CONTROLS AND ACCESSORIES

SETTING	
OFF	Disables economy function. Will allow boiler to fire until hi-limit temp is reached and re-fire with a 10° subtractive differential.
LO	Provides lowest level of fuel savings. Use this setting only if the house does not stay warm at higher settings.
1	Recommended setting for single zone systems.
2	Recommended setting for Two zone systems.
3	Recommended setting for Three zone systems.
4	Recommended setting for Four zone systems.
5	Recommended setting for Five zone systems.
HI	Provides highest level of fuel savings.

C - Differentials

Differentials are automatic and will vary based on the control settings and boiler temperature.

3 - Gas Control Valve

Electrically controlled Combination Gas Control Valve is designed to meet requirements for use with hot surface ignition found in this boiler. Valve is piped to gas/air mixer.

4 - Hot Surface Igniter

Igniter is mounted next to burner through gas/air mixer. The igniter also serves as means for proving main burner flame by flame rectification. In the event of a lack of flame signal on three (3) consecutive trials for ignition, IBC will flash the VALVE light when locked out due to failed ignition.

5 - Draft Inducer Temperature Safety Switch

Draft Inducer Temperature Safety Switch is a disc thermostat (180°F setpoint) located on induced draft fan outlet port. Switch protects inducer and vent pipe from potential high temperature condition for discharging flue gases. Condition would typically be result of higher high limit control setting or over firing. Temperature safety switch automatically resets when the vent temperature decreases. (15°F switch differential).

6 - Casting Temperature Safety Switch

In event of lack of or loss of water in boiler, Casting Temperature Safety Switch (300 °F setpoint) installed on top of the aluminum boiler section shuts off boiler by shutting off power to Integrated Boiler Control (IBC). This fault requires manual reset of casting temperature safety switch to restart the boiler. Verify that boiler is properly filled with water before resetting this switch.

Never run cold water into a hot empty boiler.

7 - Differential Pressure Air Proving Switch/ Blocked Vent Safety Shutoff

Differential pressure switch monitors air flow by sensing differential pressure measured in inches of water (" w.c.). Pressure switch contacts close when draft inducer is running. Closed switch indicates there is adequate air flow for combustion. Pressure switch shuts off main burner if differential pressure is inadequate due to blocked vent pipe, blocked air intake, blocked boiler sections, or blocked draft inducer. If pressure switch does not close within 5 minutes of blower being turned on, control locks out with PURGE light flashing to indicate pressure switch fault.

8 - Draft Inducer

Draft inducer (blower) provides means for pulling combustion air into and through the mixer, burner, flue ways of cast aluminum boiler sections and flue adapter before being discharged through vent piping to outdoors. See applicable sections for proper sizing and installation of combustion air and vent piping in this manual.

9 - Circulator Pump (Optional)

Every forced hot water system requires at least one circulating pump. Circulating pump imparts the necessary energy to move water through closed loop supply and return piping systems, terminal heating equipment (i.e. finned tube radiators, etc.) and back through boiler for reheating. To provide required hot water flow rates, circulator pump must be properly sized to overcome frictional losses (usually measured in feet of water, also referred to as "pump head loss") of supply and return piping systems and boiler. The circulator pump is furnished for single zone or zone valve controlled heating system and should be located on downstream (i.e., pumping away) side of expansion tank. For pump controlled system (where there is a circulator for each zone) circulator provided with boiler can work for one zone. For more details on piping and circulators, see "Near Boiler Piping" on page 11.

10 - Drain Valve

Manual drain valve provides means of draining water in heating system, including boiler and hot water supply and return piping systems installed above drain valve. This drain valve is installed in ¾" tapping at bottom of front boiler section. Any piping installed below elevation of this drain valve will require additional drain valves to be installed at low points in piping systems in order to drain entire system.

Water Quality, Water Treatment and Freeze Protection - see Appendix A

Filling Boiler With Water And Purging Air For Systems With Diaphragm Type Expansion Tanks

Refer to the appropriate diagrams, "Near Boiler Piping" on page 11 for more information.

1. Close all zone service valves on the supply and return piping. Open the feed valve and fill boiler with water. Make sure air vent is open. Hold relief valve open until water runs air free for five seconds to rapidly bleed air from boiler, then let the relief valve snap shut.
2. Open the zone service valve on the supply pipe for the first zone. Open the purge valve on the first zone. Feed water will fill the zone, pushing air out the purge valve. Close the purge valve when the water runs air free. Close the zone service valve.
3. Repeat step 2 for all remaining zones.
4. Open all service valves. Any air remaining trapped in the return lines between the service valves and the boiler will be pushed towards the air vent when the boiler is placed in operation.
5. Inspect piping system. Repair any leaks immediately.

Purging Air For Systems With Conventional Closed Type Expansion Tanks:

Refer to the appropriate diagrams "Near Boiler Piping" on page 11 for more information.

1. Close all zone service valves on the supply and return piping and close the expansion tank service valve. Drain expansion tank. Open the feed valve and fill boiler with water. Hold relief valve open until water runs air free for five seconds to rapidly bleed air from boiler, then let the relief valve snap shut.
2. Open the zone service valve on the supply pipe for the first zone. Open the purge valve on the first zone. Feed water will fill the zone, pushing air out the purge valve. Close the purge valve when the water runs air free. Close the zone service valve.
3. Repeat step 2 for all remaining zones.
4. Open the expansion tank service valve and the tank vent. Fill the tank to the proper level and close the tank vent. Remove the handle from the expansion tank service valve so the homeowner doesn't accidentally close it.
5. Open all service valves. Any air remaining trapped in the return lines between the service valves and the boiler will be pushed towards the expansion tank when the boiler is placed in operation.
6. Inspect piping system. Repair any leaks immediately.

Control - System Startup

At initial start up, with the Economy feature active, the control establishes a 145°F target temperature. To test the high limit shut-off function, the Economy dial must be turned to OFF. Once tested, restore the Economy setting. If the heating demand is high, the target will increase over time to satisfy the heat load.

How Thermal Targeting Works

Thermal targeting technology analyzes thermostat activity and continually evaluates how much heat the house requires.

When it is very cold outside, heat demand is high and limit control will raise boilers target temperature to provide heat.

When outside temperature is mild, heat demand is low. Limit control will lower boiler's target temperature saving fuel.

⚠ WARNING

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

- This appliance is equipped with an ignition device which automatically lights burner. **Do NOT try to light this burner by hand.**
- Before operating smell all around appliance area for gas. Be sure to smell next to floor because some gas is heavier than air and will settle to the floor.
- **Use only your hand to turn the gas shutoff valve.** Never use tools. If valve will not turn by hand, do not try to repair it, call a qualified service technician. Force or attempted repair may result in fire or explosion.
- **Do not use this appliance if any part has been under water.** Immediately call a qualified service technician to inspect appliance and to replace any part of control system and any gas control which has been under water.

Stop! Read Safety information above.

1. Set thermostat to lowest setting.
2. Turn off all electric power to the appliance.
3. This appliance is equipped with an ignition device which automatically lights the burner. **DO NOT** try to light the burner by hand.
4. Remove the front jacket panel.
5. Turn the gas control knob clockwise ↻ to "OFF".
6. Wait five (5) minutes to clear out any gas. Then smell for gas, including near the floor. If you smell gas, **STOP!** Follow "B" in the safety information above on this label. If you don't smell gas go on to next step.
7. Turn the gas control knob counterclockwise ↻ to "ON".
8. Replace front jacket panel.
9. Turn on all electrical power to the appliance.
10. Set the thermostat to desired setting.
11. If the appliance will not operate, follow the instructions "To Turn Off Gas To Appliance" and call your service technician or gas supplier.

⚠ CAUTION

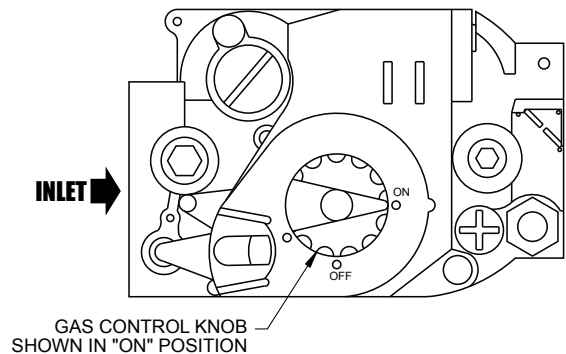
WHAT TO DO IF YOU SMELL GAS

- Do not try to light any appliance.
- Do not touch any electrical switch; do not use any phone in your building.
- Immediately call your gas supplier from a neighbor's phone. Follow the gas supplier's instructions.
- If you cannot reach your gas supplier, call the fire department.

To Turn Off Gas To Appliance

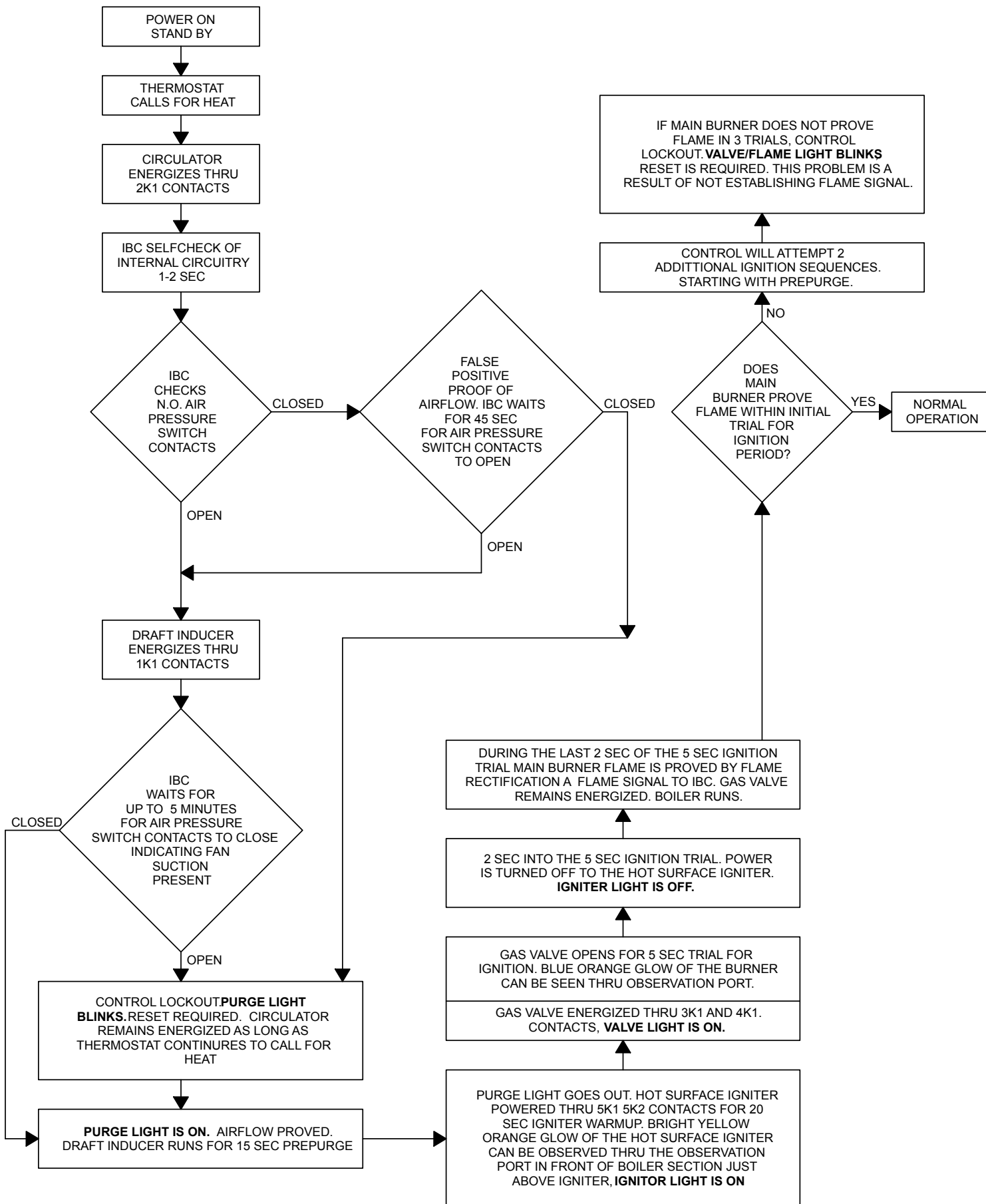
1. Set the thermostat to lowest setting.
2. Turn off all electric power to the appliance if service is to be preformed.
3. Remove the front jacket panel.
4. Turn gas control knob clockwise ↻ to "OFF".
5. Replace the front jacket panel.

Figure 24 - Gas Valve



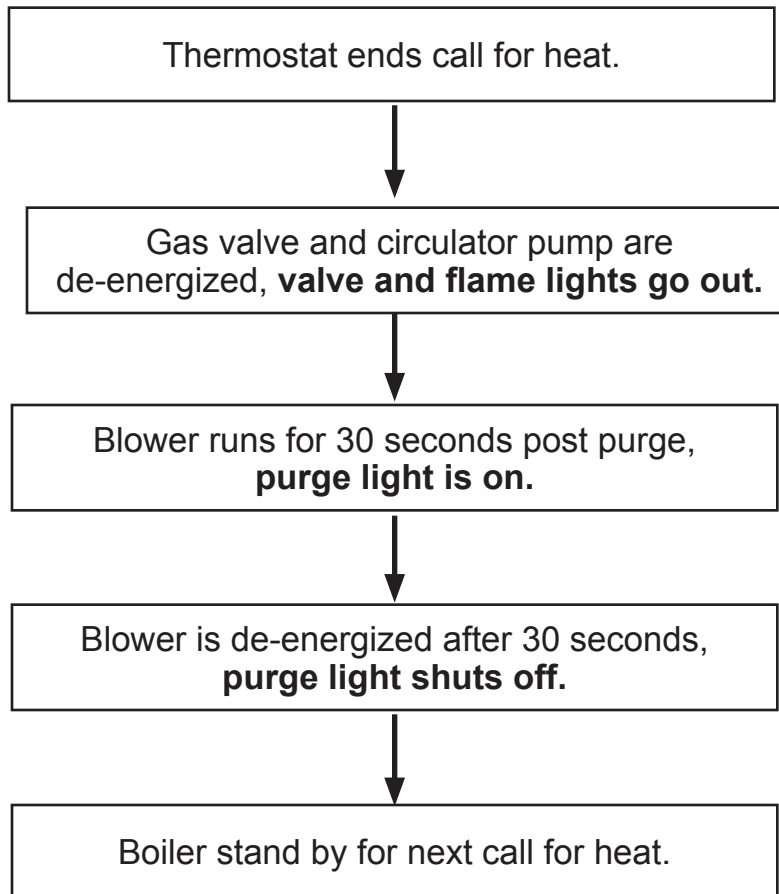
DETAILED SEQUENCE OF OPERATION

SERVICE HINTS



DETAILED SEQUENCE OF OPERATION

End Of Normal Sequence Of Operation



DETAILED SEQUENCE OF OPERATION

Sequence Of Operation Diagnostics

Follow sequence using the diagnostic indicator lamps on Integrated Boiler Control (IBC). See "Controls And Accessories" on page 34 for normal sequence of operation. Detailed sequence of operation containing potential faults can be found in service hints section.

A - Power, B - Purge, C - Igniter, D - Valve, E - Flame

SEQUENCE OF OPERATION	DIAGNOSTIC INDICATOR LAMPS	
(1) Lamp A is illuminated, indicating integrated control is receiving 24 volts and is in standby waiting for thermostat call for heat.	A.	●
(2) Thermostat calls for heat, energizing system circulator.	B.	○
(3) Integrated boiler control performs self check of internal circuitry, approximately two seconds, energizing draft inducer.	C.	○
	D.	○
	E.	○
(4) Draft inducer comes up to speed and establishes combustion airflow, causing normally open differential pressure air proving switch contacts to close. When combustion airflow is proved, Lamp B illuminates indicating 15 second pre-purge cycle has begun.	A.	●
	B.	●
	C.	○
	D.	○
	E.	○
(5) After pre-purge completion, Lamp B is extinguished and Lamp C is illuminated, indicating power is being delivered to hot surface igniter for 20 second igniter warm-up period. Observe bright yellow-orange glow of hot surface igniter through observation port on boiler.	A.	●
	B.	○
	C.	●
	D.	○
	E.	○
(6) After igniter warm-up period, integrated boiler control energizes gas valve, initiating 6 second trial for ignition mode, indicated by illumination of Lamp D. Lamp C extinguishes after 2 second delay. Integrated boiler control stops sending power to hot surface igniter.	A.	●
	B.	○
	C.	●
	D.	●
	E.	○
(7) Low level illumination of Lamp E indicates initiation of flame proving. During last 2 seconds of trial for ignition mode, main burner flame is proven by flame rectification through hot surface igniter, providing flame signal is relayed to integrated boiler control, fully illuminating Lamp E.	A.	●
	B.	○
	C.	○
	D.	●
	E.	●
(8) Thermostat ends its call for heat. Integrated boiler control de-energizes gas valve and system circulator. Lamp D is extinguished while unit enters 30 second post purge mode, indicated by illumination of Lamp B. Lamp E will remain illuminated as remainder of gas in blower is burned off (approximately 2 seconds). During post purge blower remains powered and clears out any residual products of combustion.	A.	●
	B.	●
	C.	○
	D.	○
	E.	○
(9) After post purge mode draft inducer is de-energized. Unit goes into standby mode until next call for heat from thermostat.	A.	●
	B.	○
	C.	○
	D.	○
	E.	○

NOTE: First one or two cold starts may be rough due to gas line not being completely purged of air, causing low firing rate and high excess air levels.

DETAILED SEQUENCE OF OPERATION

DRAFT INDUCER TEMPERATURE SAFETY SWITCH

If draft inducer temperature reaches temperature safety switch set-point, safety switch contacts open immediately, closing gas valve (**light goes out**).

Draft inducer runs through 30 second post purge and switches OFF.

Circulator runs with thermostat on call for heat.

When temperature safety switch contacts connect before end of call for heat, control goes in normal light-off sequence.

CASTING TEMPERATURE SAFETY SWITCH

If burner operates when boiler has no water, aluminum boiler sections heat up rapidly.

Casting temperature safety switch contacts will open, breaking 24 volt power to IBC. Power indicator light goes out. Requires manual reset to re-close contacts. **Power light goes out.**

LOSS OF FLAME SIGNAL

If established flame signal is lost while control expects burner is operating, control immediately de-energizes gas valve.

Valve and flame lights go out.

Draft inducer runs through 30 second post purge.

Control attempts to light boiler 3 times. If flame is not proven, control lockout problem establishing flame signal.

Valve light is blinking.

Control automatically resets after 1 hour.

HIGH LIMIT CONTROL

If boiler water temperature reaches high limit setpoint, high limit n.c. contacts open immediately, closing gas valve. **Valve and flame lights go out.**

Draft inducer continues to run for 30 second post purge and switch OFF.

Circulator runs as long as thermostat calls for heat.

When high limit contacts connect before end of call for heat - control goes into normal light-off sequence.

LOSS OF COMBUSTION AIRFLOW

If combustion airflow is lost while burner is firing (Differential air pressure switch contacts open) gas valve is de-energized.

Valve and flame lights go out.

Draft inducer runs through 30 second post purge.

If call for heat remains, IBC waits 5 minutes for airflow to be re-established.

If airflow does not re-establish control lockout problem with combustion airflow.

Purge light blinks.

Control automatically reset after 15 minutes.

CIRCULATOR PUMP

Circulator is energized as long as thermostat calls for heat during lockout.

Recovery from any lockout requires reset, which can be accomplished by:

- (a) Removing and re-establishing thermostat's call for heat or turning service switch off and back on;
- or
- (b) Waiting for control to automatically reset after 15 minutes for loss of combustion airflow or one hour for loss of flame.

VERIFICATION PROCEDURE AND ADJUSTMENT

Verify Proper Sequence Of Operation

Place boiler into operation and observe operation through several cycles. Follow remaining steps in this section to insure boiler is operating correctly.

First couple of cold starts may be rough due to gas line not being completely purged of air, causing low firing rate and high excess air levels.

Inspect Venting And Air Intake System

Operate boiler and verify all vent/air intake connections are gas-tight and watertight. Repair any leaks immediately.

Inspect Condensate Drain

Verify all connections are watertight, and that condensate flows freely. Repair any leaks immediately.

Inspect System Piping

Verify all connections are watertight. Repair any leaks immediately.

Test High Limit Control And Adjust

While burner is operating, adjust high limit setpoint below actual boiler water temperature. Burner should go off while circulator continues to operate. Raise limit setting above boiler water temperature and burner should reignite after inter-purge (retry delay). Set high limit control to design temperature requirements of system. Maximum high limit setting is 190°F. Minimum high limit setting is 100°F.

Test Other Safety Controls

If boiler is equipped with low water cut off, manual reset high limit, or additional safety controls, test for operation as outlined by control manufacturer. Burner should be operating and should go off when controls are tested. When safety controls are restored, burner should reignite.

Set Thermostat Heat Anticipator (If Used) And Verify Thermostat Operation

For single thermostat connected to yellow thermostat lead wires in furnished field wiring junction box, heat anticipator should be set at 0.7 amps. For other wiring configurations, refer to instructions provided by thermostat manufacturer regarding adjustment of heat anticipator. Cycle boiler with thermostat. Raise thermostat to highest setting and verify boiler goes through normal start up cycle. Lower thermostat to lowest setting and verify boiler goes off.

Measure Natural Gas Input Rate

Correct input rate is essential for proper and efficient operation of the burner and boiler.

1. Determine elevation at installation site.
2. Table 1 and Table 2, Page 6 to determine correct input rate for the local elevation.
3. Obtain yearly average heating value of local gas supply from gas utility. At sea level elevation, it should be approximately 1000 Btu's per standard cubic foot.
4. Operate boiler for 5 minutes.
5. Turn off all other gas appliances, extinguishing standing pilots where applicable.
6. At gas meter, measure time in seconds required to use one cubic foot of gas.
7. Calculate input rate according to the following formula:
$$3600 \times \text{heating value from step 3}$$
$$\text{Btuh in put rate} = \text{time from step 6}$$
8. Measured input rate should be within +/-2% of input rating from step 2. If within 2%, go to step 9. If not, adjustment is required, proceed as follows:
 - A. Turn boiler off
 - B. Set up U-tube manometer or differential pressure gauge for measuring manifold pressure. See Figure 25, Page 44.
 - C. Manometer or gauge must be able to read at least 0.0 to 3.0 inches water column of pressure, and resolve to at least 0.1 inches water column.
 - D. Turn boiler on.
 - E. Manifold pressure has been nominally set at 2.5 inches w.c. Manifold pressure and input rate must always be measured with pressure regulator cover screw installed. Cover screw must be removed for adjustment. Manifold pressure reading will change (increase) when cover screw is removed.
 - F. After adjusting input rate, turn boiler off, remove manometer or pressure gauge, reinstall $\frac{1}{8}$ " plug on gas valve. Turn boiler on.
 - G. Boiler should typically operate between:
 - 7 - 9.5% CO₂ on Natural Gas
 - 8% -11.0% CO₂ on Propane Gas

Note: CO₂ level is not adjustable on this model without changing manifold pressure or rate.

 - Under all conditions CO level should not exceed 100 ppm.

VERIFICATION PROCEDURE AND ADJUSTMENT

9. Restore all gas appliances that may have been shut off (while measuring boiler input rate) to normal operating conditions.
 - I. Remove regulator cover screw on top of gas valve, and insert an appropriate screwdriver into adjustment screw.
 - II. Turn adjustment screw clockwise to increase input rate, or counter clockwise to decrease input rate.
 - III. Replace cover screw, or cover hole temporarily with your finger to check new manifold pressure setting. Do not set manifold pressure lower than 2.0 inches w.c. or higher than 3.0 inches w.c. when adjusting input rate.
 - IV. Measure new input rate (cover screw must be installed). Repeat steps I.-IV until the input rate is within +/-2% of the nameplate input rating.
 - V. If the actual input rate can not be set to within 2% of the correct input rating by adjusting manifold pressure, a change in gas orifice size is required. Consult the boiler manufacturer for information on correct orifice sizing. The specific gravity (G) and the higher heating value (HHV) of the local natural gas must be obtained from the local gas utility in order to determine the proper orifice size.

Set Thermostat To Desired Room Temperature

Observe several operating cycles to verify proper operation.

Review All Instructions

Review all instructions shipped with this boiler with owner or maintenance person. Instructions must be affixed on or adjacent to the boiler.

Complete and sign the "Installation and Check-Out Certificate" on page 62.

Figure 25 - Manifold Pressure Measurement Detail

Following steps and diagram indicate location of the connection points required to measure manifold pressure. Manifold pressure may be measured using a U-Tube Manometer or Differential Pressure Gauge. Diagram shows connection of both measuring devices. Only ONE DEVICE IS REQUIRED to measure manifold pressure. Remove plug. Install appropriate barbed fitting and connect pressure side line from U-Tube Manometer or Differential Pressure Gauge.

Refer to "Differential Air Pressure Switch Check - all models" on page 45 when reading manifold pressure. When measurement is complete, disconnect U-Tube Manometer or Differential Pressure Gauge. Be sure to reinstall 1/8" plug, using appropriate pipe thread sealant approved for use with natural and liquefied Petroleum gases.

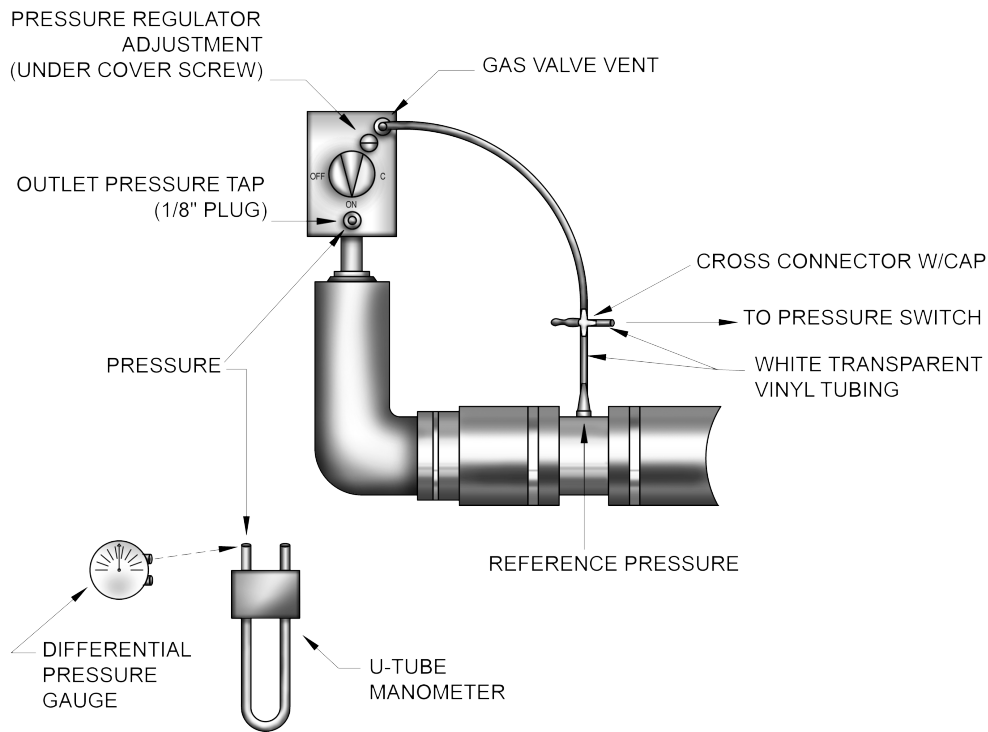
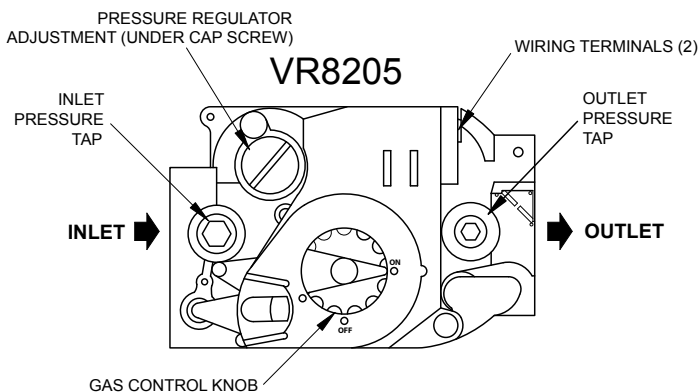


Figure 26 - Gas Valve



NOTICE

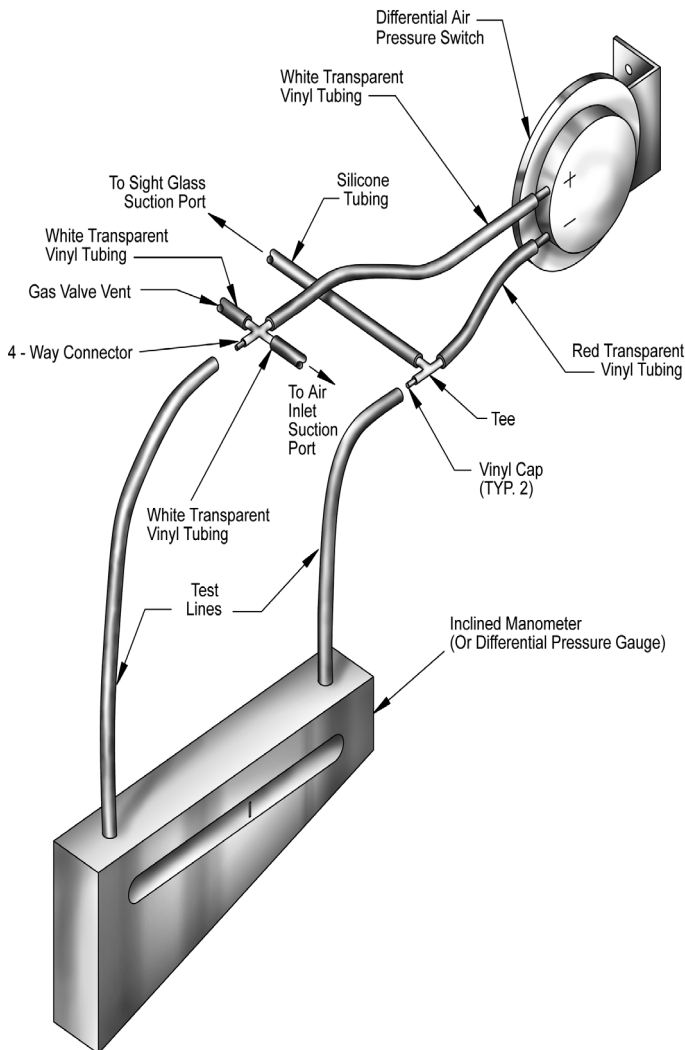
Regulator cover screw must be installed at all times unless adjusting manifold pressure. Firing rate and manifold pressure must only be measured with cover screw firmly installed.

DIFFERENTIAL AIR PRESSURE SWITCH CHECK - ALL MODELS

- Following steps and diagram indicate locations of connection points required to check differential air pressure.
- Differential air pressure switch is safety device which prevents boiler from firing if there is air intake, boiler heat exchanger or vent blockage.
- Turn off service switch, or lower thermostat setting.
- Remove vinyl caps from Tee and 4-way connector.
- Install testing lines as shown to inclined manometer or differential pressure gauge with ability to read 0.01" to 5.0" w.c.
- Turn on service switch and set thermostat to call for heat.

BOILER STATUS	DIFFERENTIAL PRESSURE (W.C.)	PRESSURE SWITCH CONTACTS
Not Running	0"	Normally Open
	1.80" for Model -100	
	1.80" for Model-75	
	2.10" for Model-50	
Running Without Blockage	Greater Than Setpoints	Closed
Running With Blockage	Less Than or Equal to Setpoints	Open

Model 050



If manometer readings do not correspond to chart above, check for possible causes:

- - Blockage or moisture in suction lines
- - Blockage in air intake or vent pipes
- - Undersized air intake or vent pipes
- - Loose blower wheel or motor shaft
- - Incorrect pressure switch or pressure switch setpoint

When pressure reading is proper and the pressure switch is operating properly, remove testing lines and reinstall vinyl caps to Tee and 4-way connector.

NEGATIVE PRESSURE SWITCH CHECK

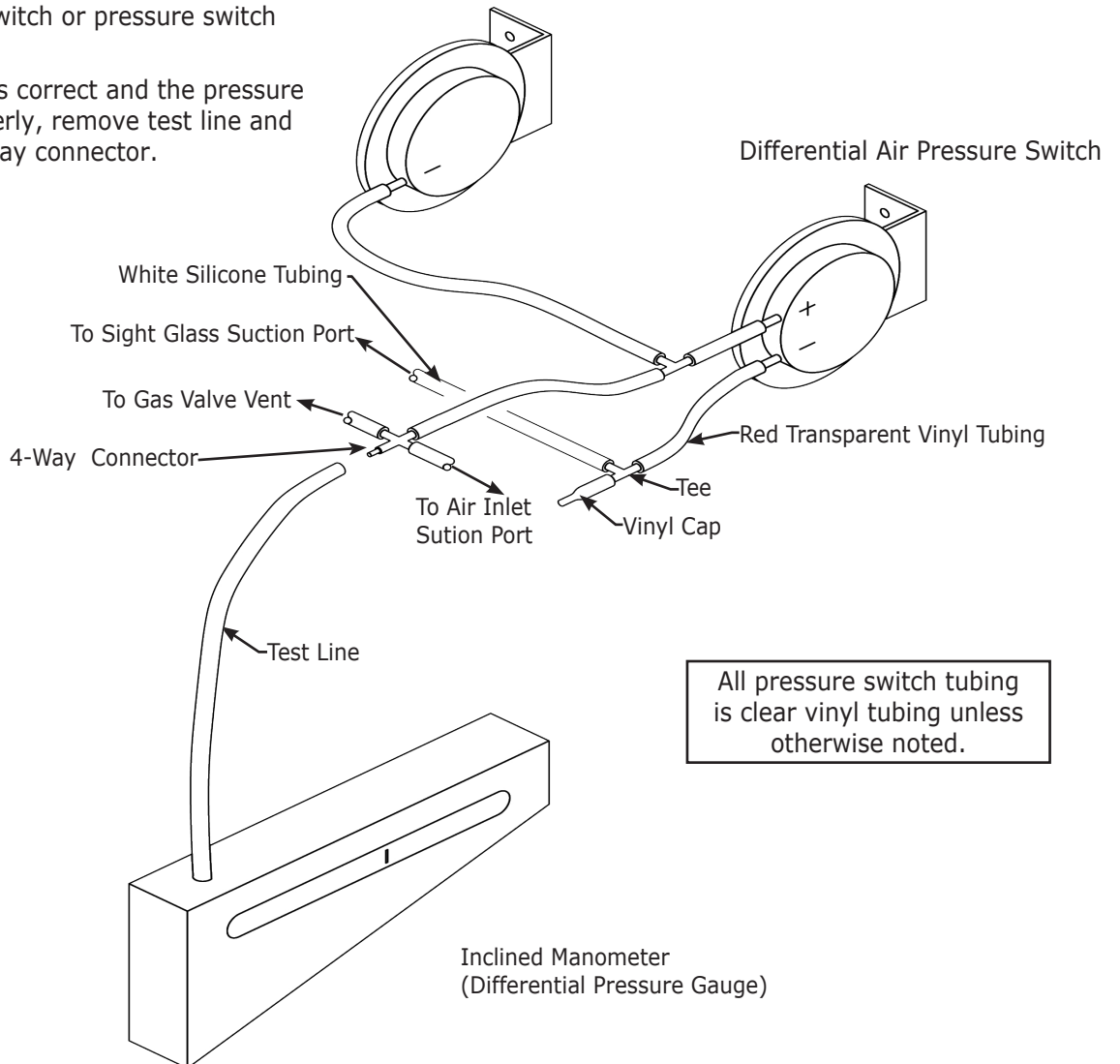
For use on Model - 100 boilers only.

- Following steps and diagram indicate locations of connection points required to check negative pressure.
- Negative pressure switch is safety device which prevents boiler from firing if there is air intake blockage.
- Turn off service switch, or lower thermostat setting.
- Remove vinyl cap from 4-way connector.
- Install test line as shown to inclined manometer or differential pressure gauge with ability to read 0.01" to 5.0" w.c.
- Turn on service switch and set thermostat to call for heat.
- If manometer readings do not correspond to chart, check for possible causes:
 - A. Blockage in air intake
 - B. Undersized air intake
 - C. Loose blower wheel or motor shaft
 - D. Incorrect pressure switch or pressure switch setpoint
- When pressure reading is correct and the pressure switch is operating properly, remove test line and reinstall vinyl cap to 4-way connector.

BOILER STATUS	NEGATIVE PRESSURE (W.C.)	PRESSURE SWITCH CONNECTS
Not Running	0"	Normally Closed
Setpoint	-0.50" for Models 100 & 075	
Running Without Blockage	Less Negative than Setpoint	Closed
Running With Blockage	More Negative than Setpoint	Open

Models 075 and 100

Negative Pressure Switch



Maintenance As Outlined Below Can Be Performed By Owner Unless Otherwise Noted.

- The acidic nature of flue gasses condensing on aluminum boiler sections may cause formation of aluminum oxide. This oxide formation is normal, is generally uniform throughout boiler sections, and represents negligible mass of aluminum that is consumed by oxidation during life of the boiler.
- If left unchecked, this buildup may eventually cause blockage of flue gas passages in boiler sections, reducing efficiency, and ultimately shutting down the boiler due to lack of combustion air flow.
- Regular service and maintenance by a qualified service agency must be performed to assure safe trouble free operation and maximum efficiency.

Beginning Of Each Heating Season

1. Annual service call by qualified service agency, which includes:
 - A. Examine flue passages between boiler sections, burner, and condensate lines, and clean if necessary following "Annual Examination And Cleaning Of Boiler Components" on page 48.
 - B. Visually inspect venting and air intake system for proper function, deterioration or leakage. If vent or air intake show any signs of deterioration or leakage, repair or replace them, immediately. Insure proper reassembly and resealing of vent and air intake system
 - C. Check for and remove any obstruction to flow of combustion air or venting of flue gases. Check air baffle located inside 1½" x 2" flexible coupling on mixer, clean if necessary and make sure to put it back. Refer to repair parts diagram of mixer and pressure switch assembly for exact location.
 - D. Follow instructions for "Operating Instructions" on page 37.
 - E. Follow instructions for "verification Procedure and Adjustment" on page 42.
 - F. Visually inspect condensate drain lines for proper operation and deterioration. Check for plugged condensate drain lines.
 - G. Check silicone rubber seals between boiler sections. Insure that there are no leaks. Use RTV silicone rubber adhesive sealant rated for at least 400° F to replace or repair seals in locations where original seals have deteriorated.
 - H. Check all gasketed joints for leakage, and tighten bolts or replace gaskets if necessary.
 - I. Remove jacket front and top panels and check for piping leaks around relief valve and other fittings. Repair, if found. DO NOT use stop leak compounds.
 - J. Check igniter for cracks and deterioration. Replace if necessary.
 - K. Check for water in pressure switch tubing. Drain if necessary.

2. Check boiler area is free from combustible materials, gasoline, and other flammable vapors and liquids.
3. Circulator pump and blower motor furnished with boiler are permanently lubricated from factory and require no further lubrication. Additional or non-factory supplied pumps and/or motors should be lubricated according to the pump and/or motor manufacturer's instruction.

Daily During Heating Season

1. Check for and remove any obstruction to the flow of combustion air or venting of flue gases.
2. Check boiler area is free from combustible materials, gasoline, and other flammable vapors and liquids.

Monthly During Heating Season

1. Remove jacket front and top panels and check for piping leaks around relief valve and other fittings. If found, contact qualified service agency to repair. DO NOT use stop leak compounds.
2. Test relief valve. Refer to valve manufacturers instructions packaged with relief valve.
3. Visually inspect venting and air intake system for proper function, deterioration, or leakage. If vent or air intake show any signs of deterioration or leakage, contact a qualified service agency to repair or replace immediately and to insure proper reassembly and resealing of vent and air intake system.
4. Visually inspect clear vinyl condensate lines and PVC condensate drain pipe for proper operation, leakage, and deterioration. If condensate lines or drain pipe show any signs of blockage, leakage, or deterioration contact a qualified service agency to clean, repair, or replace them immediately.

Periodically During Heating Season

Where low water cutoffs are used, periodic inspection of low water cut off is necessary, including flushing of float type devices. Refer to low water cut off manufacturer's specific instructions.

End of Each Heating Season - Annual Shutdown Procedure

Follow instructions "To Turn Off Gas To Appliance" on page 37.

If heating system is to remain out of service during freezing weather, and does not contain antifreeze, drain system completely. If boiler will be exposed to freezing temperatures, drain condensate lines. Otherwise, do not drain system or boiler.

Annual Examination And Cleaning Of Boiler Components

⚠ DANGER

Before servicing, turn off electrical power to boiler at service switch. Close manual gas valve to turn gas supply OFF to boiler. Failure to comply will result in death or serious injury.

NOTICE

Have qualified service agency perform the following service procedures. Boiler owner should not attempt these procedures.

1. Before Servicing, turn off electrical power to boiler at service switch. Close manual gas valve to turn off gas supply to boiler.
2. Cleaning Flue passages between boiler sections.
 - A. Any buildup of sediment or aluminum oxide (white powdery or flaky substance) in flue passages must be cleaned as follows.
 - B. Remove jacket front and top panels. Disconnect condensate drain line from barbed fitting on bottom of boiler. Keep open end of drain line above water level in condensate trap to prevent trap from draining. Disconnect pressure switch hose from barbed fitting on gas valve. Disconnect 1½ x 2" flexible coupling from air inlet. Disconnect air by-pass (½" transparent vinyl tube) from bottom of mixer.
 - C. Remove air baffle from ½" x 2" flexible coupling and clean air baffle if necessary. Refer to repair parts diagram, mixer and pressure switch assembly.
 - D. Confirm manual gas valve is closed and disconnect gas line to gas valve at union. Disconnect wires to gas valve and igniter.
 - E. Loosen but do not remove five (5) nuts attaching mixer assembly to boiler. Remove two (2) igniter screws and remove igniter.
 - F. Remove five (5) nuts and remove mixer assembly. Remove burner and mixer gasket.
 - G. Aluminum oxide deposits are water soluble and may be rinsed away with spraying or running water. Before rinsing, connect a ½" I.D. hose to barbed fitting on bottom of boiler and run hose to bucket or drain.
 - H. After rinsing, remove any remaining loosened sediment using shop vacuum with snorkel attachment.
 - I. Inspect burner for any foreign matter in flame ports or inside burner. Any foreign matter should be removed by blowing with compressed air or vacuuming.
 - J. Inspect interior of mixer for any signs of sediment or aluminum oxide and clean if necessary.
- K. Reinstall burner and mixer gasket and position mixer assembly over studs. Install five (5) nuts but do not tighten. Reinstall igniter and igniter gasket and fasten with two (2) screws. Use care when installing the igniter. Tighten five (5) nuts holding mixer assembly.
- L. Connect:
 - Gas line to gas valve
 - Condensate drain line to boiler
 - Pressure switch hose to gas valve
 - Air by-pass to mixer
 - 1 ½" x 2" flexible coupling to air inlet and make sure to put air baffle back to correct position
 - Igniter wires
 - Gas valve wires
3. Visually inspect condensate lines leading from boiler sections and vent pipe connector to condensate trap. Refer to repair parts diagrams. Any foreign material or debris visible in condensate lines needs to be cleaned out as follows:
 - A. Disconnect condensate drain lines from condensate trap.
 - B. Remove condensate trap and drain all water from trap.
 - C. Disconnect condensate lines from fitting on bottom of boiler and vent pipe connector.
 - D. Run cold water through condensate lines and trap to thoroughly flush out any sediment or debris.
 - E. Reinstall condensate trap and condensate lines.
 - F. Follow instructions under "Near Boiler Piping" for filling condensate trap with water.
4. Inspection of flue connector requires following steps. Refer to repair parts diagram.
 - A. Loosen the clamp on the draft inducer end of the 2" vent pipe connector that connects the vent to the draft inducer. Disconnect (unplug) wiring harness from draft inducer motor and draft inducer temperature safety switch. Remove four (4) bolts that attach draft inducer to flue connector.
 - B. Remove draft inducer and gasket from top of flue connector.
 - C. Inspect interior of flue connector. Any buildup of sediment or aluminum oxide on inside surface must be cleaned. Position draft inducer gasket and draft inducer and fasten with four (4) screws. Be sure to connect ground wire from draft inducer motor to one of four mounting screws.
 - D. Connect wiring harness leads to draft inducer motor and draft inducer temperature safety switch.
 - E. Connect vent pipe connector to draft inducer outlet.

NOTICE

Verify proper operation after servicing.

TROUBLESHOOTING

WARNING

Fire, explosion or shock hazard. Do not attempt to modify the physical or electrical characteristics of this boiler in any way. Failure to comply could result in death or serious injury.

Important

1. In reset from lockout condition, all electrical meter readings at the gas control valve (24 vac) must be taken within trial for ignition period.
2. If any component does not function properly, make sure it is correctly installed and wired before replacing it.
3. Static electricity discharge can damage integrated boiler control (IBC). Touch metal surface to discharge static electricity before touching IBC.
4. IBC cannot be repaired. If it malfunctions it must be replaced.
5. Only trained service technicians should service IBC systems. Following troubleshooting, check out system following sequence of operation for a normal light off sequence.
6. All controls are factory tested in the assembly process and a defective control is generally the least likely cause. If you suspect you have a defective control, read through this section before you replace it.
7. It is extremely unlikely that the two consecutive controls are defective. If it seems to be happening, chances are that either there is nothing wrong with the control or it is being damaged by some other problem (an electrical short burning out a transformer, for example).

Initial Service Checks

1. Before troubleshooting:
 - A. Make sure that circuit breaker is on or fuse is ok at electrical panel.
 - B. Make sure that service switch is on.
 - C. Make sure that gas is on at the gas meter, at all appropriate manual shutoff valves and at the gas control valve.
 - D. Make sure that the thermostat is calling for heat.
 - E. Check that wire connectors at the integrated boiler control and at the originating control are securely plugged in or connected.
 - F. Check that hoses are securely connected and are not plugged or damaged.

2. Troubleshooting tools:
 - A. Voltmeter to check 120 vac and 24 vac
 - B. Continuity tester.
 - C. Inclined manometer or pressure gauge with 0-3.0" Range (0.01" Scale) for measuring suction pressures at pressure switch.
 - D. U-tube manometer or differential pressure gauge with 0-14" range (0.1" Scale) for measuring inlet and manifold gas pressures.
3. System Status:
 - A. Consult "System Status" on pages 40 and 50.
 - B. See Figure 23, Page 34, for location of boiler Diagnostic Indicator Lamps.

LED Legend and LWCO Test Button

1 HI TEMP Illuminates when boiler water temperature reaches high limit setting. Remains lit until water temperature falls 10°F below high limit setting. Limit prevents burner operation while this LED is on.

2 ACTIVE Indicates low water cut-off function is active. When control is installed with Electro-well, LED is on at all times when control is powered. If the control is installed with a well other than Electro-well, LED will not illuminate indicating the control is not providing low water cutoff functionality.

⚠ WARNING

Burn and scald hazard. Do not add water until boiler has fully cooled. Failure to follow these instructions could result in death or serious injury.

3 LOW WATER Illuminates if boiler is in low water condition. Control will prevent burner operation during this condition.

Important: System must be checked by qualified service agency prior to resuming operation.

4 ACTIVE Indicates that thermal targeting function is active and control reduces boiler temperature to conserve fuel. Economy feature is activated using the ECONOMY dial.

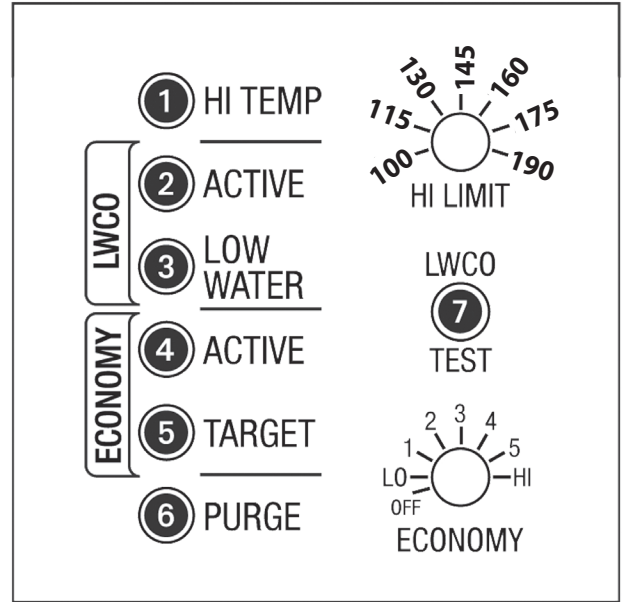
5 TARGET When feature is active, control continually sets target temperatures below high limit setting to maximize fuel efficiency. When boiler reaches target temperature, LED illuminates and burner shuts down. Boiler water continues to circulate and heat the house as long as thermostat call continues. LED stays lit until boiler temperature drops below differential at which point boiler will be allowed to fire again.

Note: LED illuminates regularly during normal boiler operation.

6 PURGE Control is purging latent heat from boiler and will not fire until temperature drops to 135°F.

7 TEST/SETTING to Test LWCO: Press and hold TEST button. Red Low Water light will illuminate and burner circuit will de-energize.

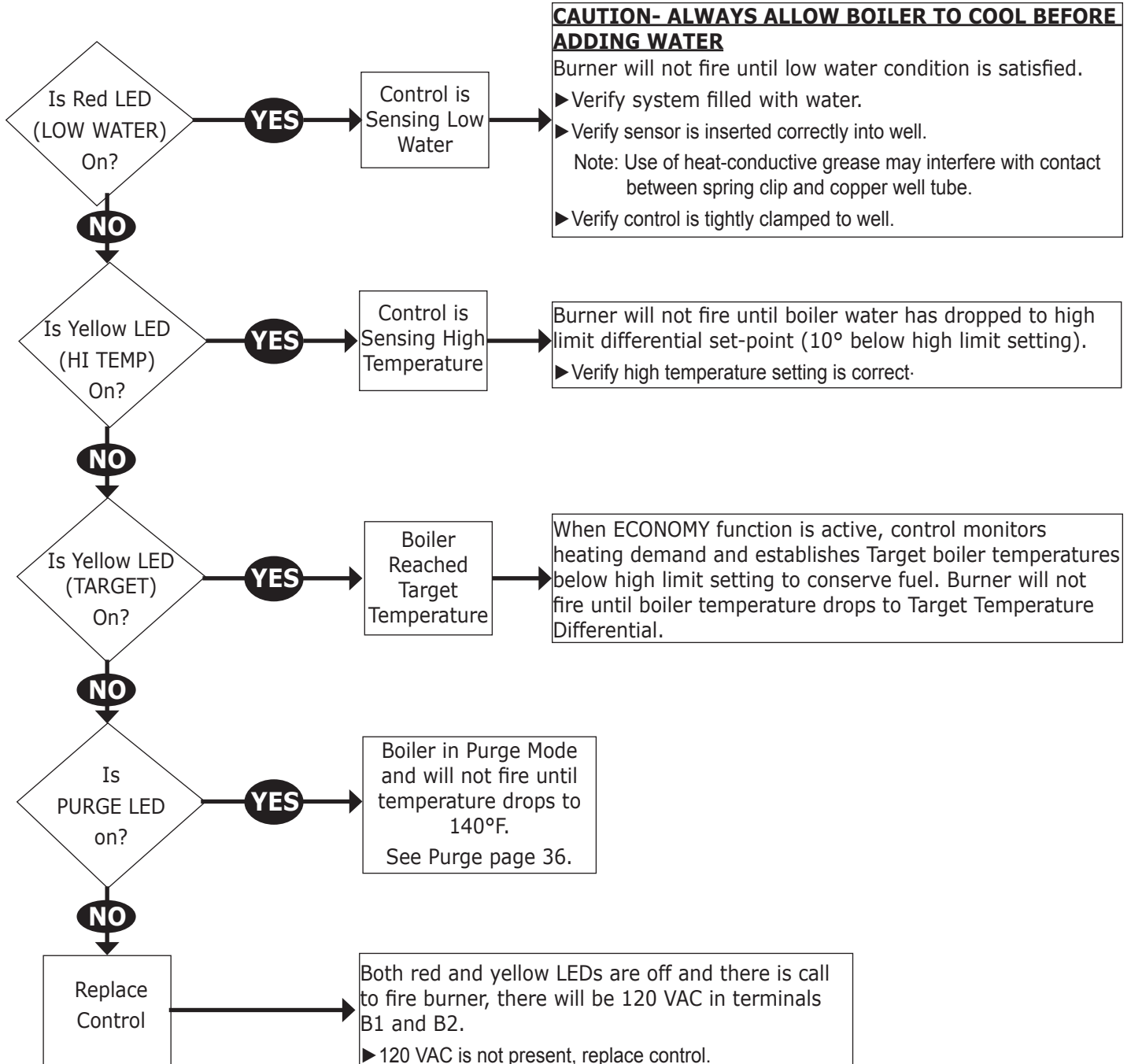
Figure 27 - LED Legend



TROUBLESHOOTING -HYDROSTAT HIGH LIMIT CONTROL AND LWCO

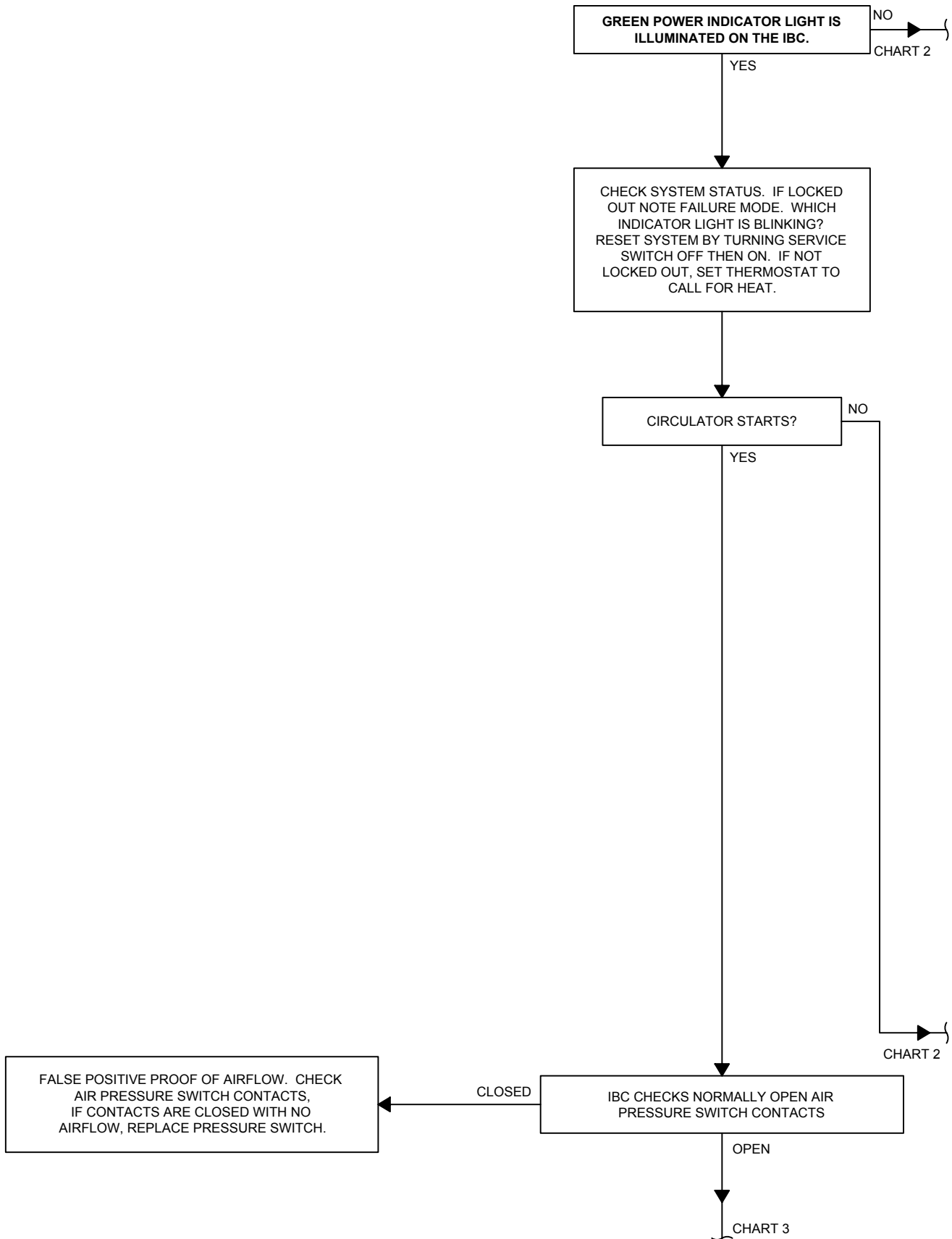
Troubleshooting Flow Chart

Burner Will Not Fire	See Flow Chart, this page.
No or Insufficient Domestic Hot Water	If installed with indirect water heater, insure end switch in relay box controlling indirect water heater is properly connected to Cable 2. This will insure domestic water calls are prioritized. If Cable 2 is not used, turn Economy Feature OFF.
House Will Not Get or Stay Warm	<ol style="list-style-type: none"> 1. Check for air-bound radiators. 2. Check thermostat settings including heat anticipator settings (common on non-digital thermostats). 3. Check Economy setting. Economy feature, like outdoor reset controls, lowers average boiler temperature and can slow or, in some cases, prevent the house from coming up to temperature. Move to lower setting.



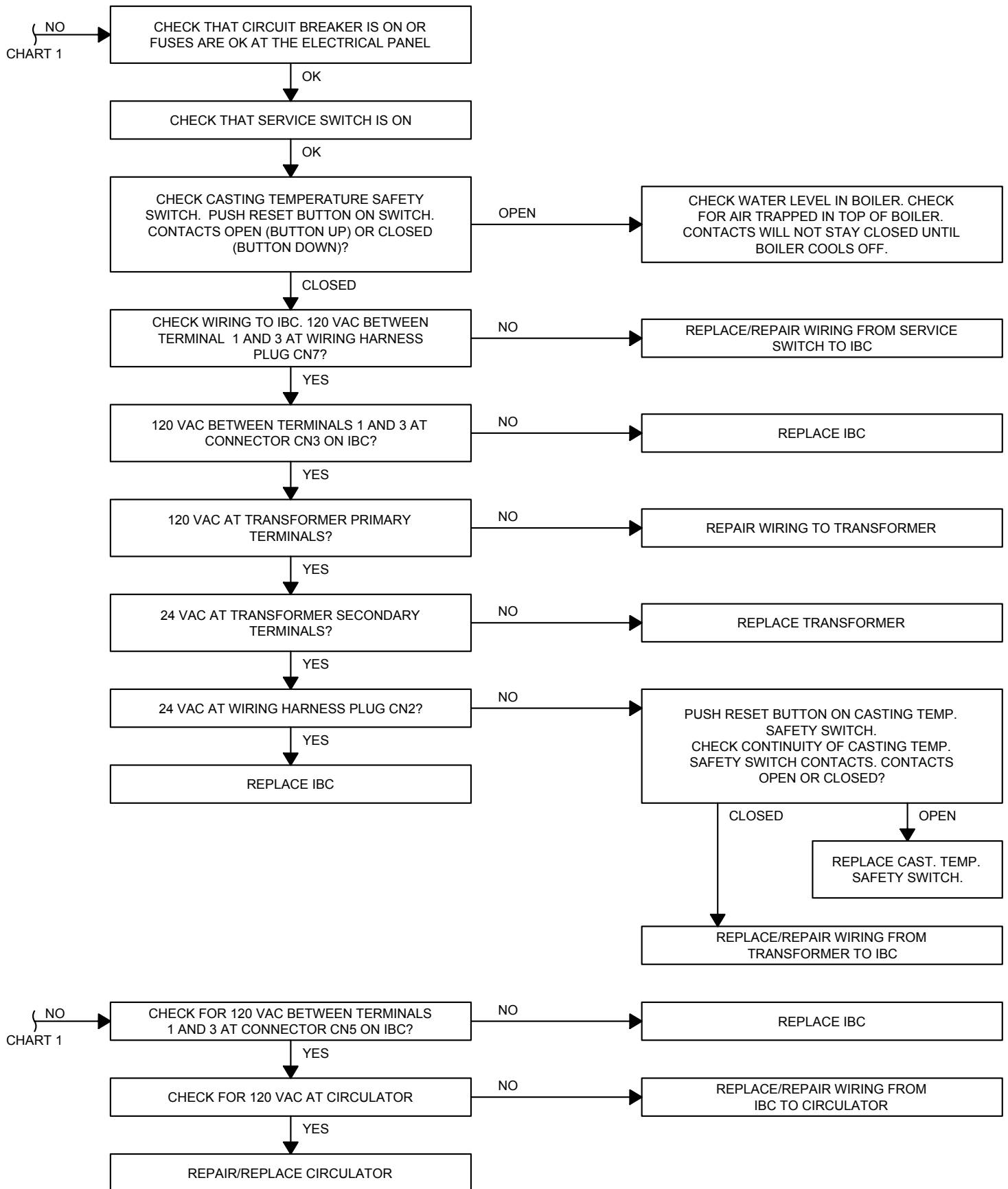
TROUBLESHOOTING

Troubleshooting Chart 1



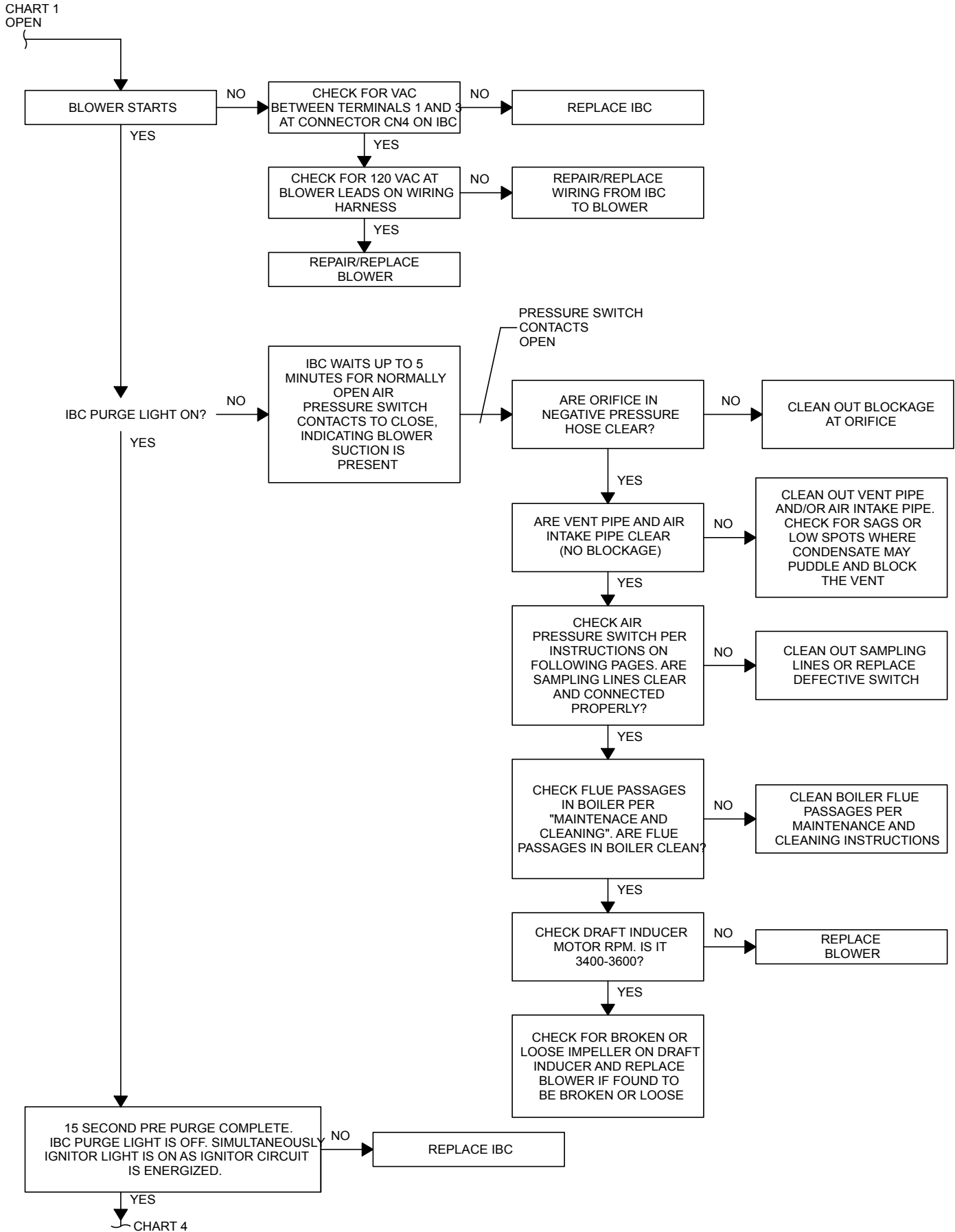
TROUBLESHOOTING

Troubleshooting Chart 2

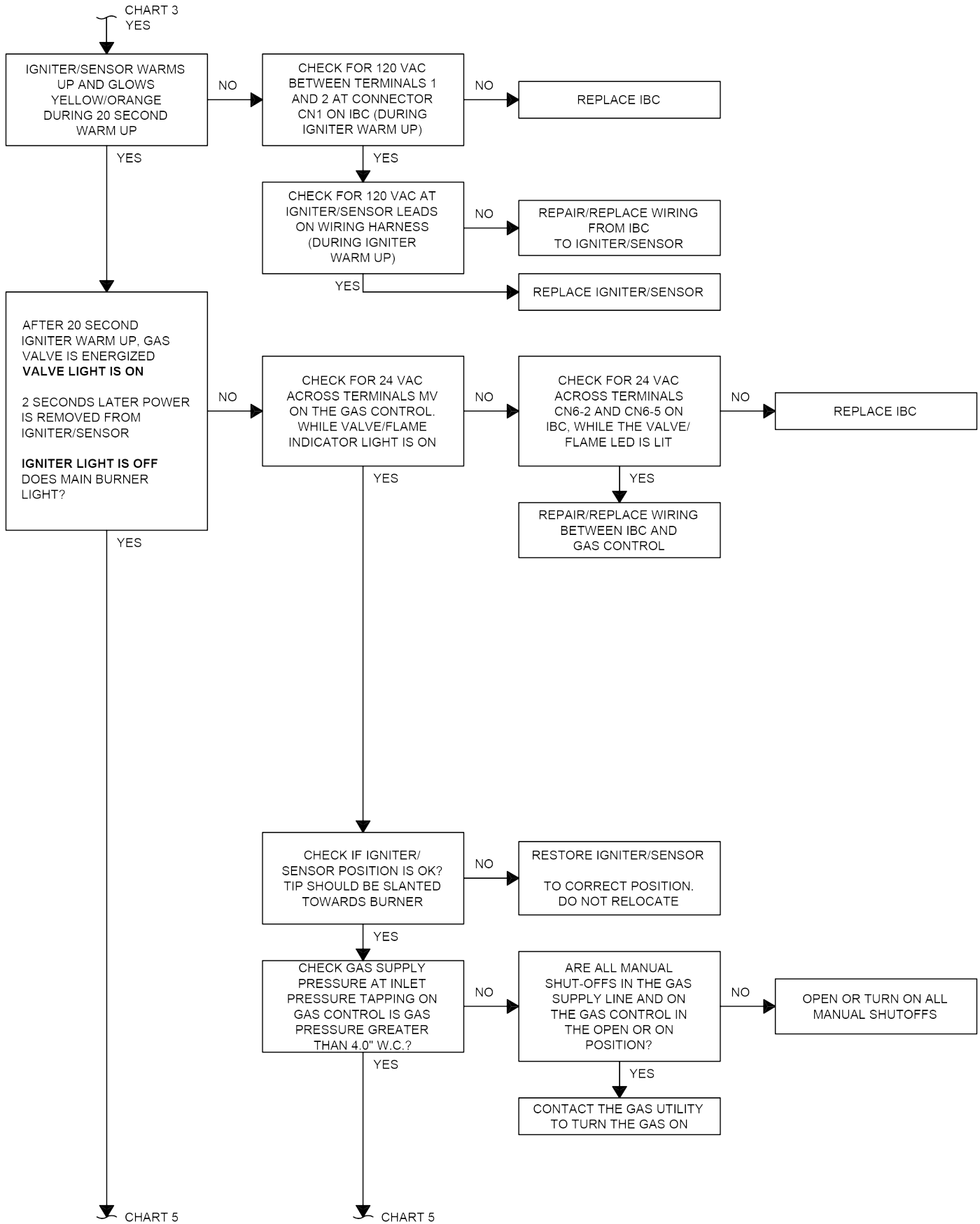


TROUBLESHOOTING

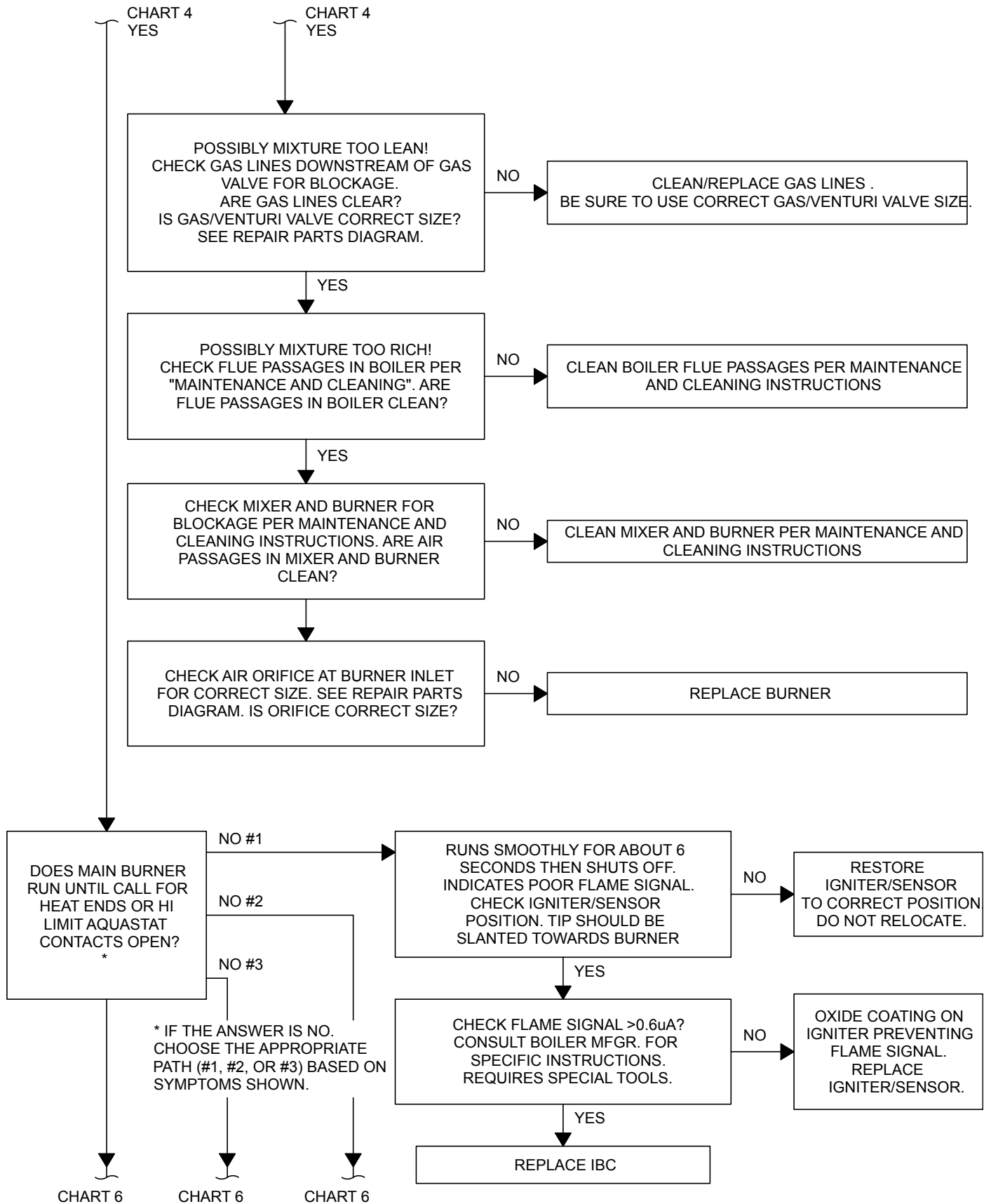
Troubleshooting Chart 3



Troubleshooting Chart 4

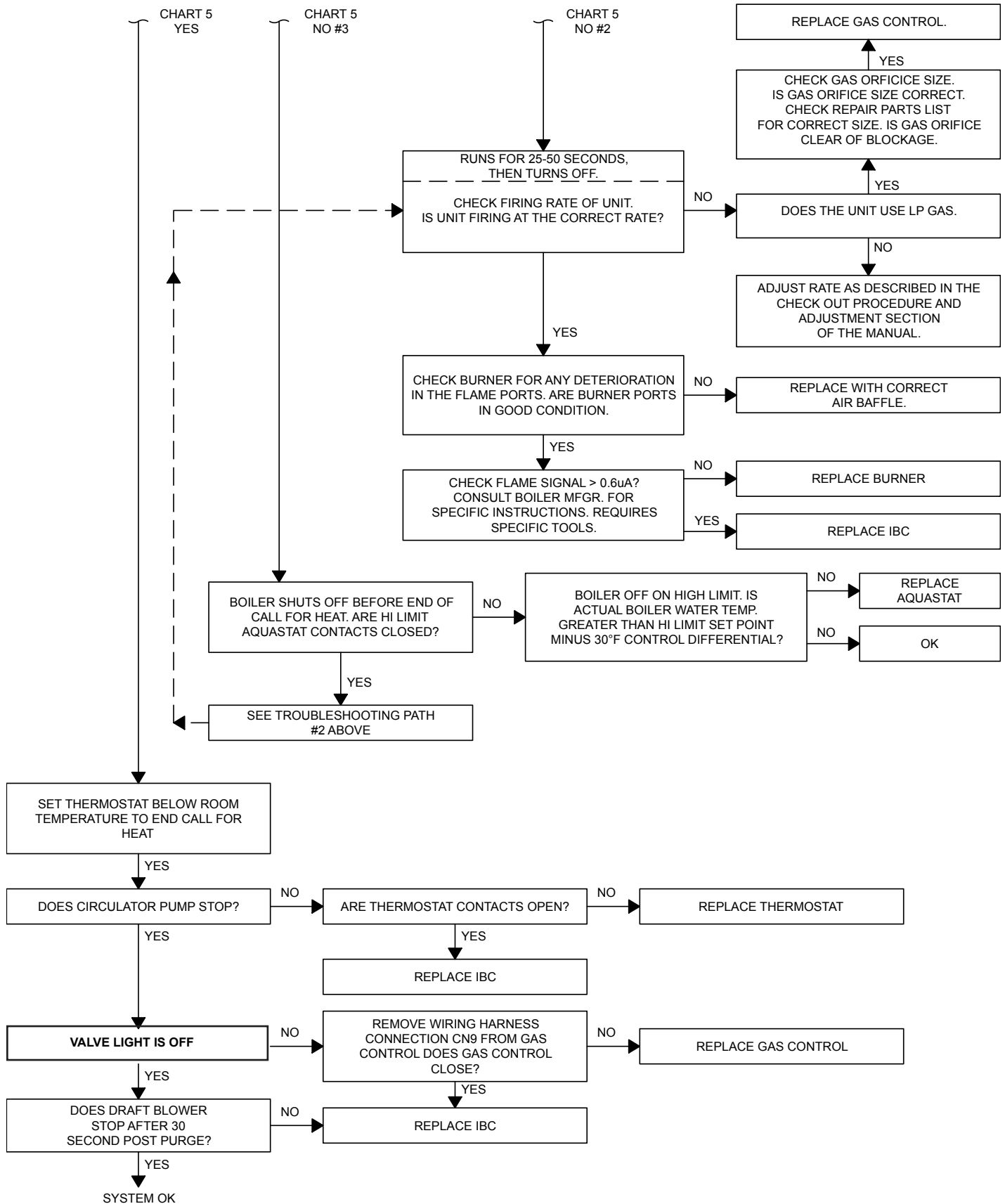


Troubleshooting Chart 5



TROUBLESHOOTING

Troubleshooting Chart 6



Aluminum Series

High Efficiency Gas-Fired Boiler

DIELECTRIC ISOLATION & ANTIFREEZE PROTECTION

WARNING

Follow these instructions to prevent damage to boiler's heat exchanger caused by inadequate dielectric isolation, incorrect water treatment or antifreeze application. Failure to comply could result in death or serious injury.

- Install boiler so gas ignition system components are protected from water (dripping, spraying, rain, etc) during appliance operation and service (circulator replacement, etc).

- **DIELECTRIC ISOLATION**

Two (2) 1-1/4" X 1-1/4" Female to female dielectric isolation unions are shipped loose in boiler parts bag. Install Dielectric Isolation unions at boiler supply line and return line. Install isolation fittings nearest boiler prior to system piping connections.

- **WATER TREATMENT and ANTIFREEZE PROTECTION**

MUST be applied for ALL aluminum series high efficiency gas-fired boilers using antifreeze protection.

System and Operating Precautions

Applies to ALL Aluminum High Efficiency Gas-Fired Water Boilers

Clean System First

BEFORE connecting boiler to heating system, clean and flush system thoroughly. Verify system is free of sediment, flux and any residual boiler water additives.

Systems having antifreeze not recommended must be completely flushed to ensure no old antifreeze remains. In older systems obviously discolored, murky or dirty water; or pH reading outside acceptable range (between 7.0 and 8.0) are indications the system should be cleaned or treated. Thoroughly flush system with clean water to remove any sediment or contaminants. Sludge and iron oxide deposits can cause rapid breakdown of inhibitors.

Flushing with clean water. If chemical cleaners are used, use only those recommended for use with aluminum boilers. Follow chemical cleaner manufacturer's instructions completely.

DO NOT mix different manufacturer's products.

Fill Water and Chemistry

Verify water used to fill system meets these requirements:

System fluid pH maintained between 7.0 and 8.0.

Maintain water hardness below 7 grains hardness.

Filling with chlorinated potable water is acceptable. DO NOT fill boiler with water containing chlorine in excess of 100 ppm.

DO NOT use inhibitors or other additives that are not listed in this addendum.

Consult local water treatment specialist for recommendations if any of above requirements is outside stated ranges.

Eliminate System Leaks

Continuous addition of make-up water will constantly add oxygen to system. Eliminate all system leaks. All system leaks must be repaired immediately.

DO NOT use stop leak compounds. Leaks in threaded connections in aluminum boiler sections must be repaired immediately. Aluminum threads will not seal themselves.

Verify expansion tank is operational and properly sized. Undersized expansion tanks cause relief valve weeping and substantial make-up water addition.

Operation of this boiler in system containing significant amounts of dissolved oxygen can cause severe heat exchanger corrosion damage.

This boiler is not designed for use in systems containing regular additions of make-up water. Regular additions of make-up water may cause severe heat exchanger damage. System leaks may not always be visible. An unseen system leak will become obvious if boiler pressure decreases when make-up valve is closed.

This boiler is designed for closed loop hydronic heat system **ONLY!** This boiler is not suitable for natural gravity type installations, or any other open type system.

System and Operating Precautions

Applies to ALL Aluminum High Efficiency Gas-Fired Water Boilers

General Guidelines When Using Antifreeze

- **Use only antifreeze products recommended for use with aluminum boilers, as listed in this addendum. See Table 8.**
- Continuous addition of make-up water will dilute power of antifreeze and change buffers ability to maintain pH.
- Flush old antifreeze from system. Flush boiler and system separately.
- Do not use antifreeze unless required.
- Antifreeze, if needed, must be of type listed on next page due to their operational characteristics of : type 356 T6 aluminum at operating temperatures between 20°F (-6.7°C) and 250°F (121°C). (See Table 8 for allowable products.)
- Always clean system prior to using antifreeze as stated in this supplement.
- Follow antifreeze manufacturer's instructions for use, safe handling and storage of their products. Refer to SDS (Safety Data Sheets) provided by antifreeze manufacturer for potential hazards and first aid procedures for exposure or ingestion.
- Antifreeze will raise pH of hydronic solution in heating system above recommended level due to corrosion inhibitors. Solution must be treated to maintain a pH within recommended level. Follow antifreeze manufacturer's instructions to adjust pH.
- If system has leaked, water and antifreeze chemistry will need to be adjusted. To avoid damage to boiler, check pH and chemistry of boiler solution and consult the antifreeze manufacturer for recommendations.
- Recommend taking pH reading annually, and adjusted as necessary. Follow antifreeze/inhibitor manufacturer's instructions for details on how to adjust pH.
- Antifreeze solutions can break down over time. Failure to check antifreeze chemistry on annual basis may result in accelerated corrosion of boiler and other system components. Consult with antifreeze manufacturer for recommendations.
- Use of antifreeze in any boiler will reduce heating capacity as much as 10-20%. Take into consideration when sizing heating system, pumps and expansion tank. Consult antifreeze manufacturer's literature for specific information on reduced capacity.
- Using antifreeze manufacturer's instructions, determine freezing temperature needed and use correct amount of antifreeze. Never exceed 50% antifreeze by volume.
- Boiler operating pressure must remain below 15 psi for antifreeze solutions that specify a maximum of 250°F (121°C). Otherwise, increase system operating/tank pressure to 20 psig. **Note: Refer to expansion tank manufacturer instructions for adjusting tank pressure.**

System and Operating Precautions
Applies to ALL Aluminum High Efficiency Gas-Fired Water Boilers

Table 8 - Antifreeze Products

Compatible Aluminum Antifreeze & Inhibitor Suppliers	
Noburst AL Antifreeze	Noble Company P. O. Box 350 Grand Haven, MI 49417 www.noblecompany.com Tel: 800-878-5788 Fax: 231-799-8850
Rhogard Antifreeze & Pro-Tek 922 Inhibitor*	Rhomar Water Management, Inc. P. O. Box 229 Springfield, MO 65801 www.rhomarwater.com Tel: 800-543-5975 Fax: 417-862-6410
* Pro-Tek 922 Inhibitor may be used to adjust the pH level of the hydronic system, but on occasion may not resolve the pH issue. In these cases, flush the system and refill with untreated water and antifreeze suitable for aluminum heat exchangers, as listed in this supplement.	
Alphi-11	Hydronic Agencies, Ltd. (Fernox North Distributor) 15363 117 Avenue Edmonton, AB T5M 3X4 Canada www.hydronicagencies.com Tel: 780-452-8661 Fax: 780-488-2304 Fernox www.fernox.com
Intercool NFP-30,40,50 AA Intercool RPH-15*	Interstate Chemical 2797 Freedland Road P.O. Box 1600 Hermitage, PA 16148-0600 www.interstatechemical.com Tel: 800-422-2436 Fax: 724-981-8383
Hercules Cryo-tek™-100/Al	Hercules Chemical Company, Inc. 111 South Street Passaic, NJ 07055 www.herchem.com Tel: 800-221-9330 Fax: 800-333-3456
* This product may be used to adjust pH level of hydronic system, but on occasion may not resolve pH issue. In these cases it is recommended to flush system and refill with untreated water and new boiler manufacturer approved antifreeze suitable for Aluminum heat exchangers.	

INSTALLATION AND CHECK-OUT CERTIFICATE

Boiler Model _____ **Serial #** _____ **Date Installed** _____

Measured BTU/HR input _____

- Installation instructions have been followed**
- Checkout procedure and adjustments performed**
- Maintenance and Service issues reviewed with owner/ maintenance person**
- Installation booklet affixed on or adjacent to boiler**

Installer (Company) _____

Address _____

Phone _____

Installer's Name _____

Signature _____

IMPORTANT

In accordance with Section 325 (f) (3) of the Energy Policy and Conservation Act, this boiler is equipped with a feature that saves energy by reducing the boiler water temperature as the heating load decreases.

This feature is equipped with an override which is provided primarily to permit the use of an external energy management system that serves the same function.

THIS OVERRIDE MUST NOT BE USED UNLESS AT LEAST ONE OF THE FOLLOWING CONDITIONS IS TRUE:

- An external energy management system is installed that reduces the boiler water temperature as the heating load decreases.
- This boiler is not used for any space heating
- This boiler is part of a modular or multiple boiler system having a total input of 300,000 BTU/hr or greater.
- This boiler is equipped with a tankless coil.



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All specifications subject to change without notice.

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