

# LENNOX

## PRODUCT LITERATURE

Lennox Industries Inc.  
Dallas, Texas



# INSTALLATION INSTRUCTIONS

GWB9-050IH-2

GWB9-075IH-2

GWB9-100IH-2

GAS-FIRED, DIRECT VENT,  
CONDENSING, HOT WATER BOILER

## RETAIN THESE INSTRUCTIONS FOR FUTURE REFERENCE

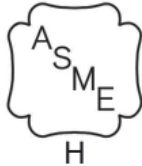
*These instructions must be affixed on or adjacent to the boiler.*

### **⚠ WARNING**

Improper installation, adjustment, alteration, service, or maintenance could result in death or serious injury. Refer to this manual for assistance. For additional information consult a qualified installer, service agency, or the gas supplier.

### **GAS-FIRED HOT WATER BOILERS**

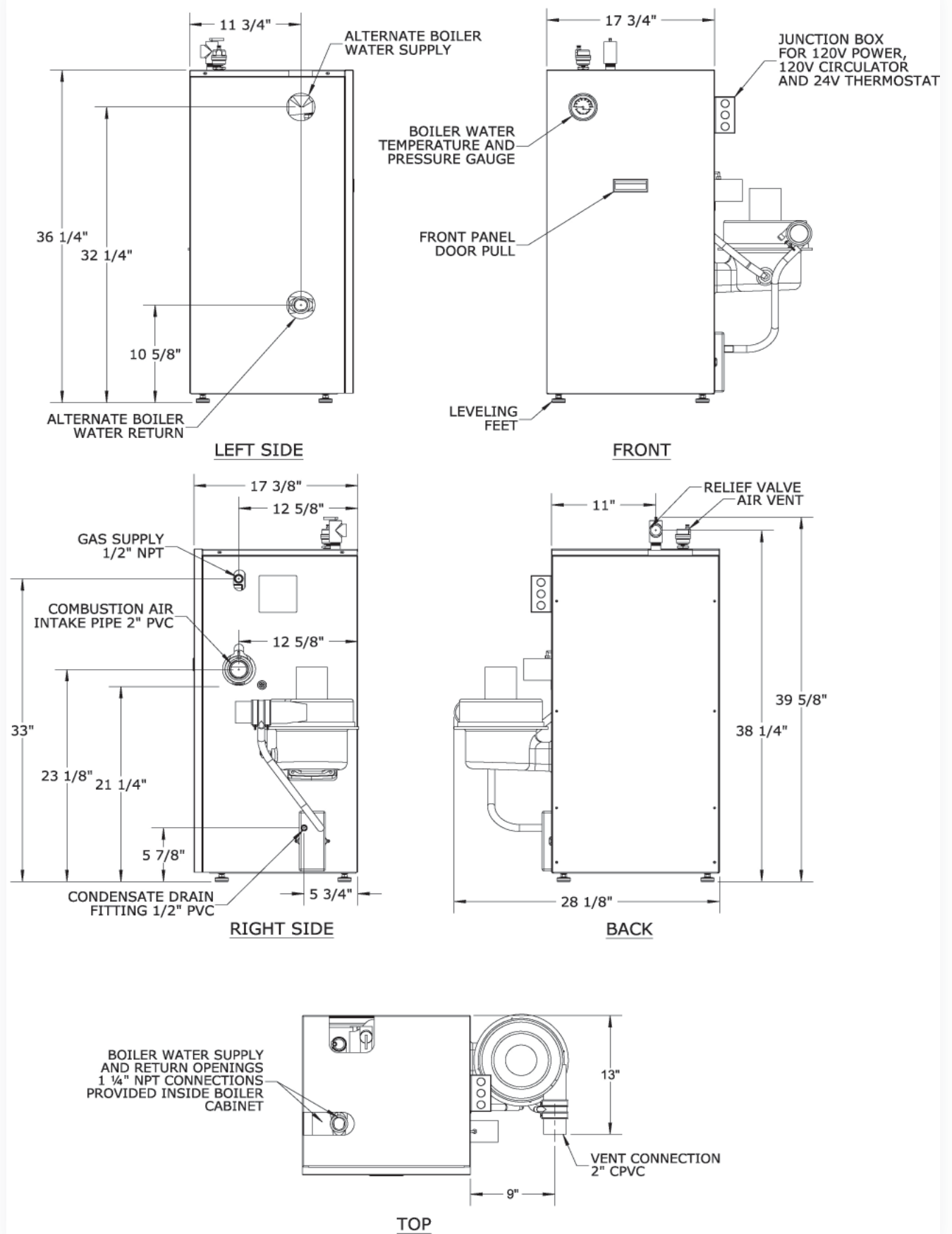
These low pressure gas fired hot water boilers are design certified by CSA (Canadian Standards Association) for use with natural and propane gases (100 MBH model is certified for natural gas only). They are constructed and hydrostatically tested for a maximum working pressure of 50 psi (pounds per square inch) in accordance with A.S.M.E. (American Society of Mechanical Engineers) Boiler and Pressure Vessel Code Section IV Standards for Heating Boilers.



This boiler cannot be used with all types of chimneys. Read these instructions carefully before installing.

# DIMENSIONS

**Figure 1 - Boiler Dimensions**



## INTRODUCTION

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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 and CPVC pipes.
- These low pressure gas-fired hot water boilers are design certified by CSA International for use with natural gas and propane gases (90-100 model is certified for natural gas only).
- 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. (American Society of Mechanical Engineers) 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.

**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.
- Canada
  - Natural Gas and Propane Installation Code, CAN/CSA B149.1.
  - Canadian Electrical Code, Part I, Safety Standard for Electrical Installations, CSA C22.1

**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 45.

## 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.)	Flue Diameter
90-50	50	45	39	220	2" CPVC & PVC
90-75	75	68	59	220	2" CPVC & PVC
90-100**	100	90	78	220	2" CPVC & PVC

\* 1 MBH = 1,000 Btuh *Btuh = British Thermal Units Per Hour*

\*\* 90-100 model is certified for natural gas only.

++ 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 are factory equipped for operation at altitudes ranging from 0-5,000 feet above sea level (4,500 feet in Canada).

### **Boilers for use at high altitude**

Canada - Contact Provincial authority having jurisdiction for installations above 4,500 feet (1,350m) above sea level.

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 27 and Figure 28, 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 number. For replacing orifice refer to specific instructions included with conversion kit.

**Table 2 - 90 - 50/75/100 SERIES 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	-	-	-	-	-
Manifold Pressure In W.C.	2.5	4	4	3.5	2.5	2.5
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	-	-	-	-	-
Manifold Pressure In W.C.	2.5	3.5	3.5	2.5	2.5	2.5
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	-	-	-	-	-
Manifold Pressure In W.C.	2.5	3.5	3.5	2.5	2.5	2.5
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 - 90 - 50/75 SERIES 2 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	-	-	-	-	-
Manifold Pressure In W.C.	2.5	3	3	2.5	2.5	2.5
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	-	-	-	-	-
Manifold Pressure In W.C.	2.5	3.5	3.5	3.5	3	3
Orifice	43331093	43331096*				
<i>* 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.</i>						
<i>++Contact local gas utility or distributor for Btu value of gas.</i>						

## 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 a 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 a suitable venting system to remove the hazardous products of gas combustion, refer to "Combustion Air and Vent Pipe" on page 22 for details.
- Connected to a suitable hot water heating system.
- Supplied with a suitable electrical supply for all boiler motors and controls.
- Connected to a properly located thermostat or operating control. Not included with boiler.
- Placed on level surface. DO NOT install on carpeting.
- Condensate drain line must be pitched down to floor drain or external condensate pump with reservoir at ¼" per foot (wood frame or blocks may be used to raise boiler).



## 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.
1. Select level location central to piping systems served and as close to vent and air intake terminals as possible.
2. 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.
3. Boiler is approved for installation in closets and on combustible floors. This boiler shall NOT be installed on carpeting.
4. 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. Maintain 18" clearance at side where passage is required to access another side for cleaning or servicing, inspection or replacement of parts. Allow 24" at front and left side and 8" at top for servicing. No clearances are required to venting or combustion air intake piping.
5. Install equipment in location which facilitates operation of venting and combustion air intake piping systems as described in this manual.
6. 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.
7. 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.).

### 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.

- Keep boiler area clean of debris and free of flammable and combustible materials, vapors and liquids.

- When vent pipe is exposed to temperatures below freezing, such as when it passes through an unheated space or when chimney is used as a raceway, vent pipe must be insulated with 1/2" Armaflex or equivalent. In extreme cold climate areas, use 3/4" Armaflex or equivalent.

### **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 these instructions could result in fire, personal 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)	24" (610mm)
Right Side	11" (280mm)	-
Base	1" (26mm)	-
Front	1" (26mm)	24" (610mm)
Back	1" (26mm)	-
Intake/Vent Piping	0 (0)	-
Near Boiler Hot Water Piping	1" (26mm)	-

*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.
- 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. Do 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 tables in Chapter 13 of the National Fuel Gas Code, NFPA-54/ANSI- Z223.1 and/or the Natural Gas and Propane Installation Code, CAN/CSA B149.1.

### Clean the 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.

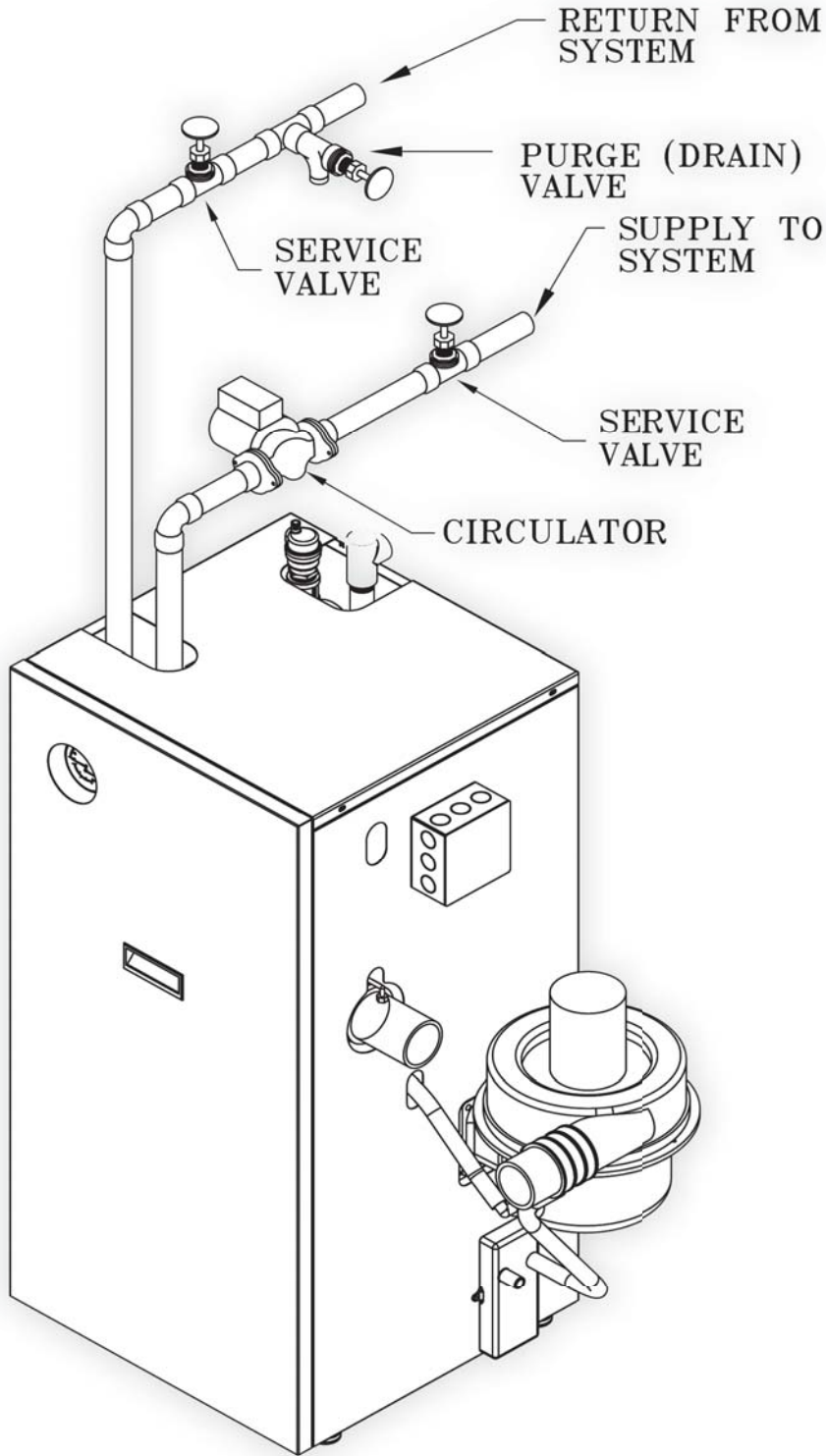
**DO NOT** mix different manufacturer's products.

- 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. A 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.

### Supply And Return Lines

- Boiler is set up to receive 1 ¼" 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.
- Furnished 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**

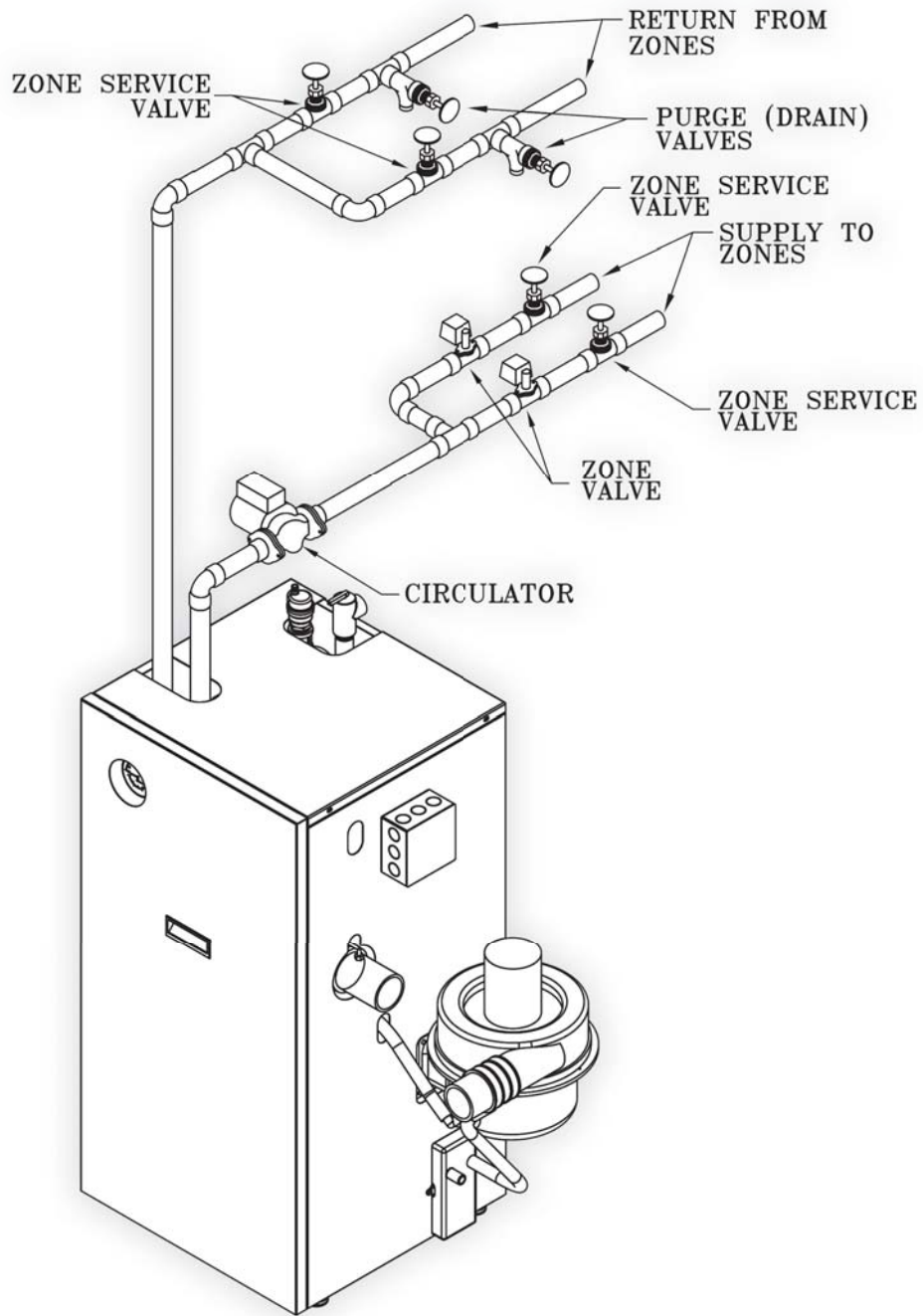
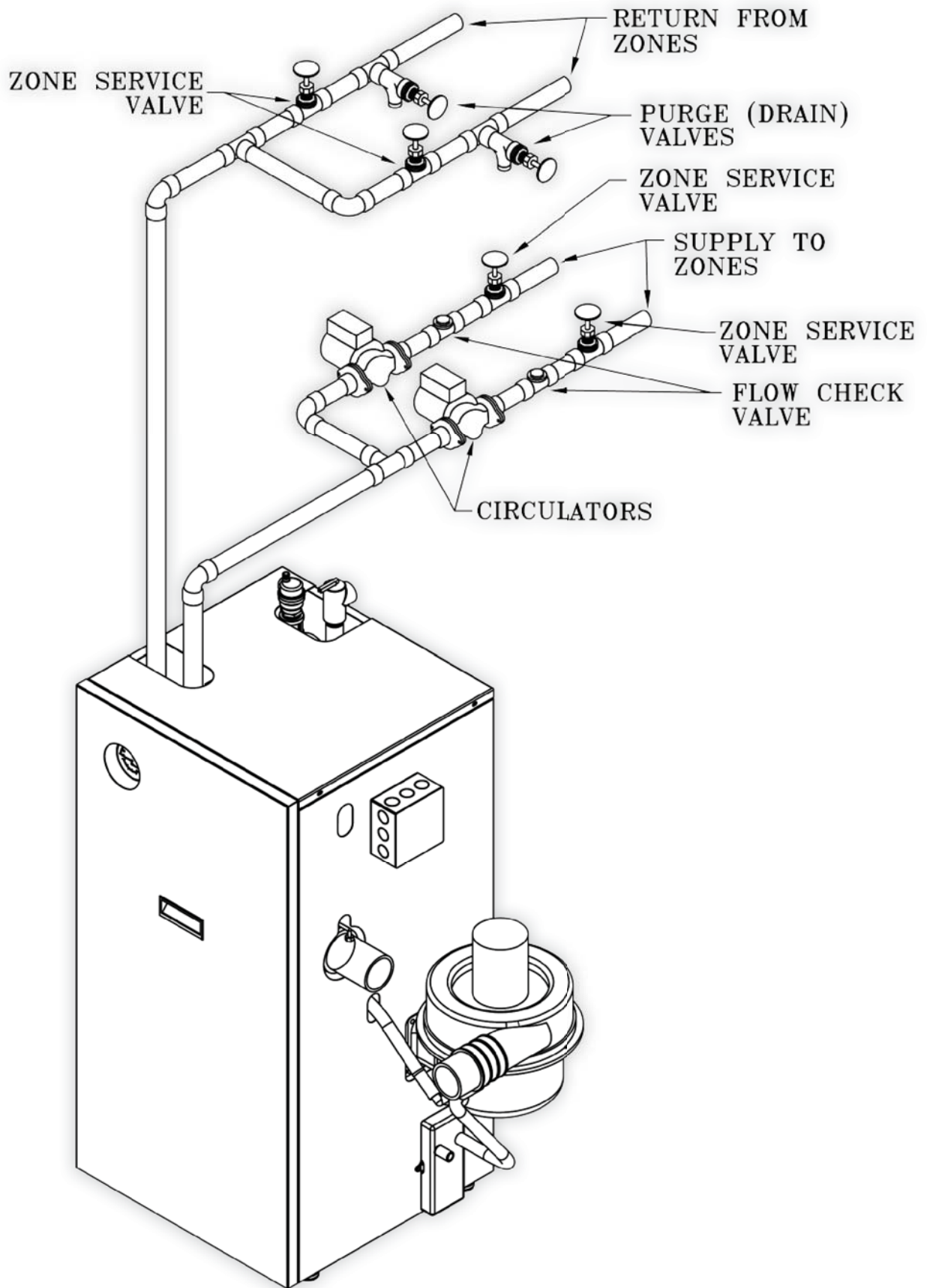
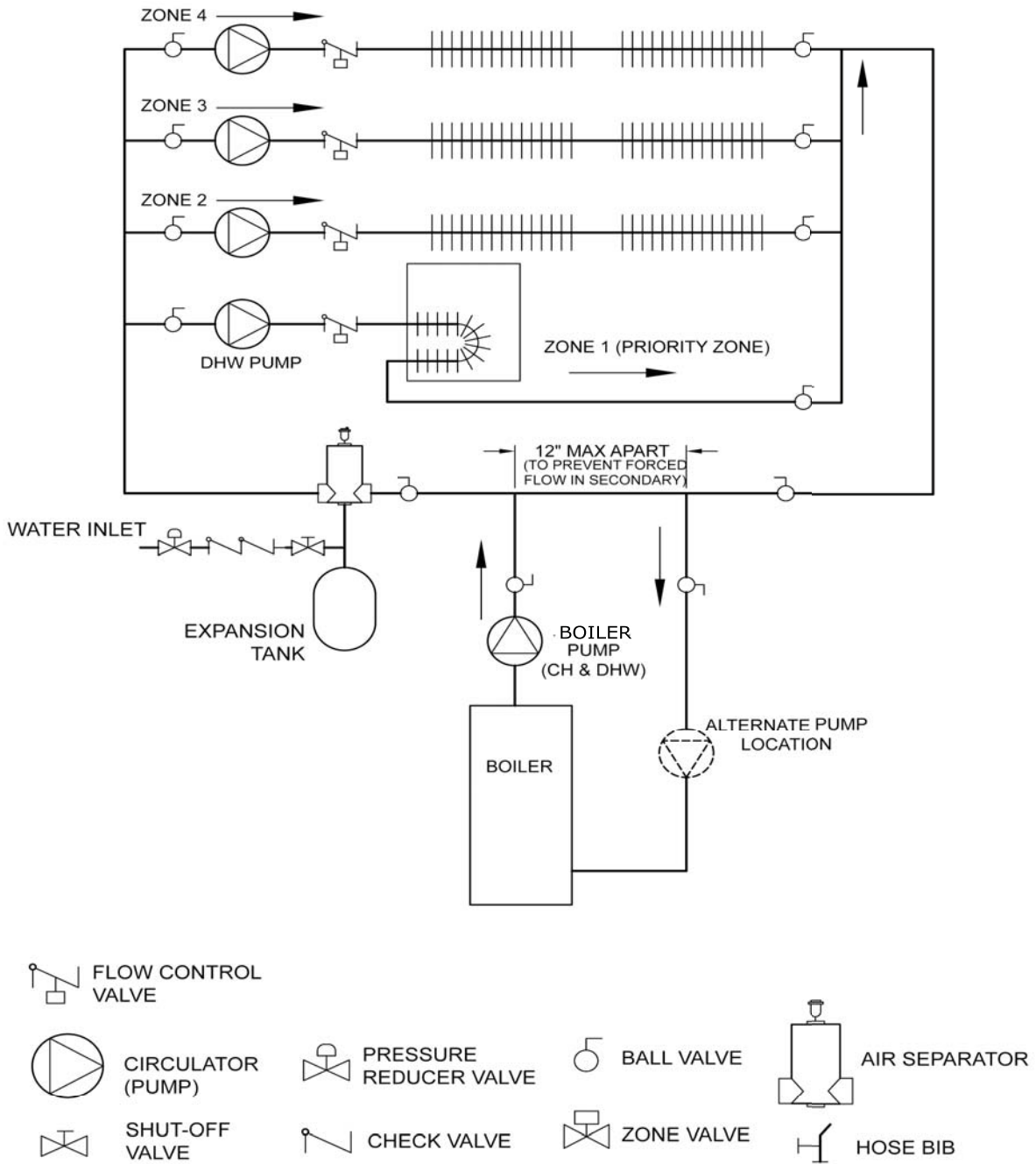


Figure 4 - Two Zone Boiler Piping With Circulators



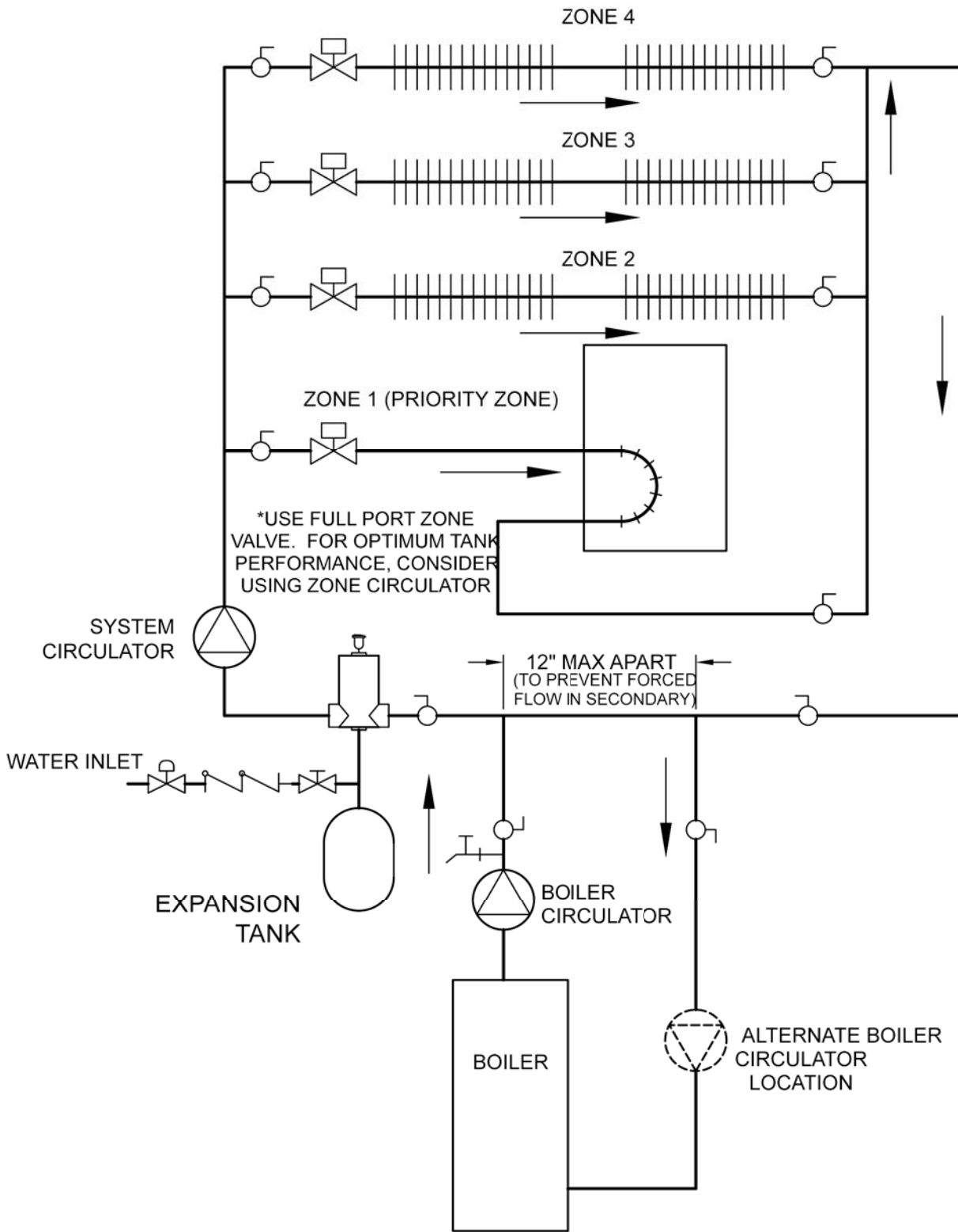
# NEAR BOILER PIPING

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



# NEAR BOILER PIPING

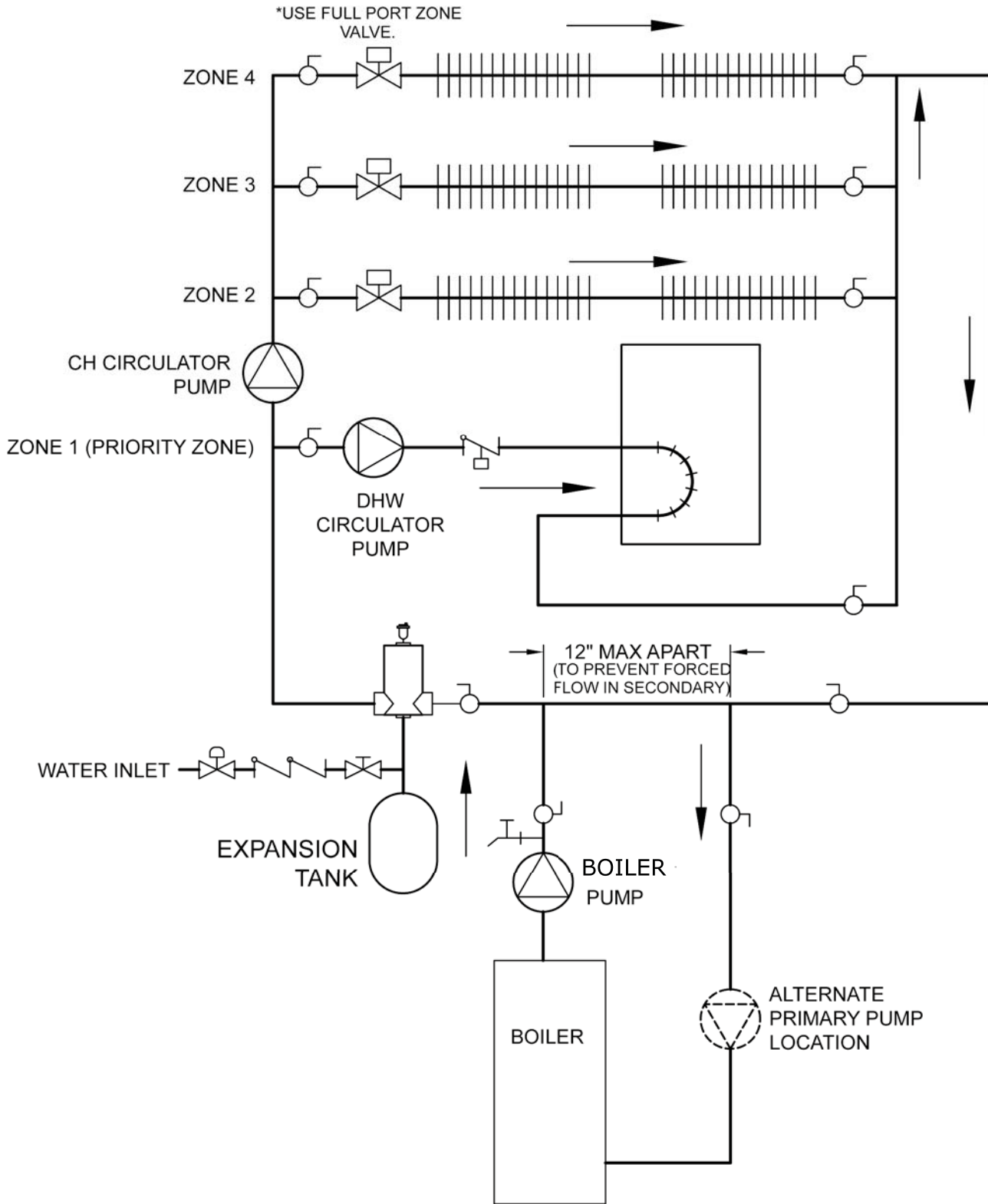
**Figure 6 - Piping and Wiring Primary/Secondary Multi Zone System Piping With Zone Valves And Domestic Hot Water (With Zone Valve)**





NEAR BOILER PIPING

Figure 7 - Piping And Wiring 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.

#### **Safety 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**

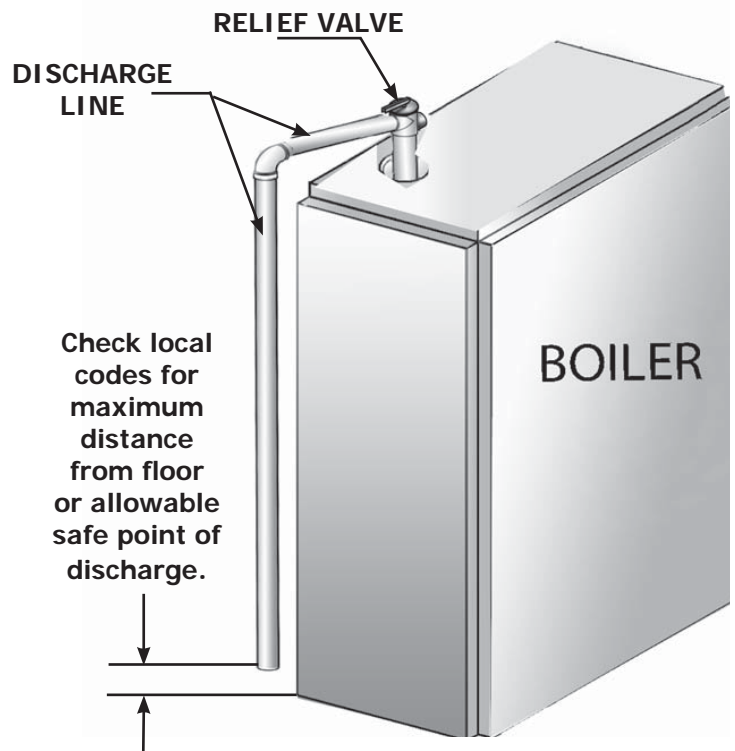


Figure 9 - Diaphragm Type Expansion Tank Piping

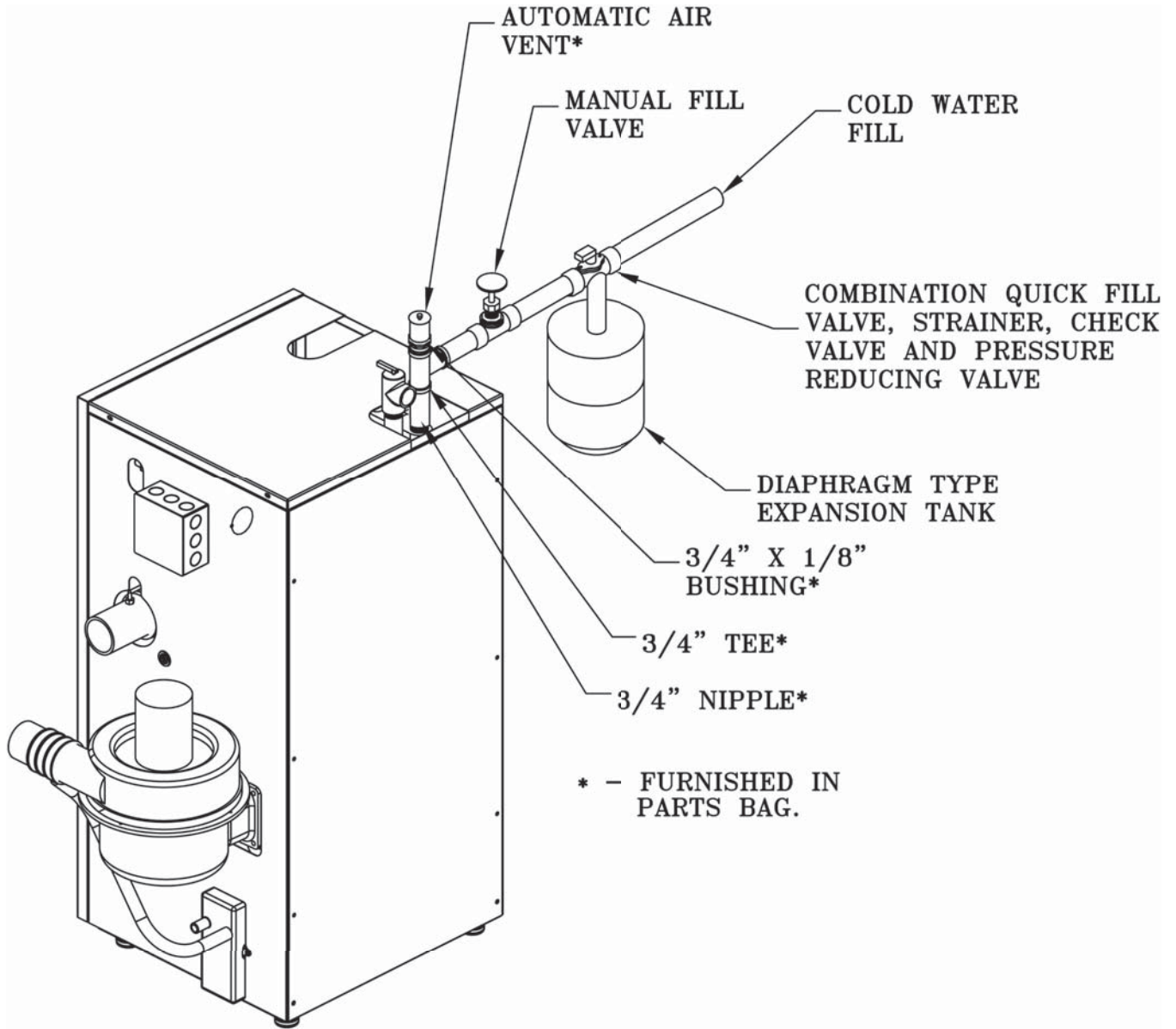
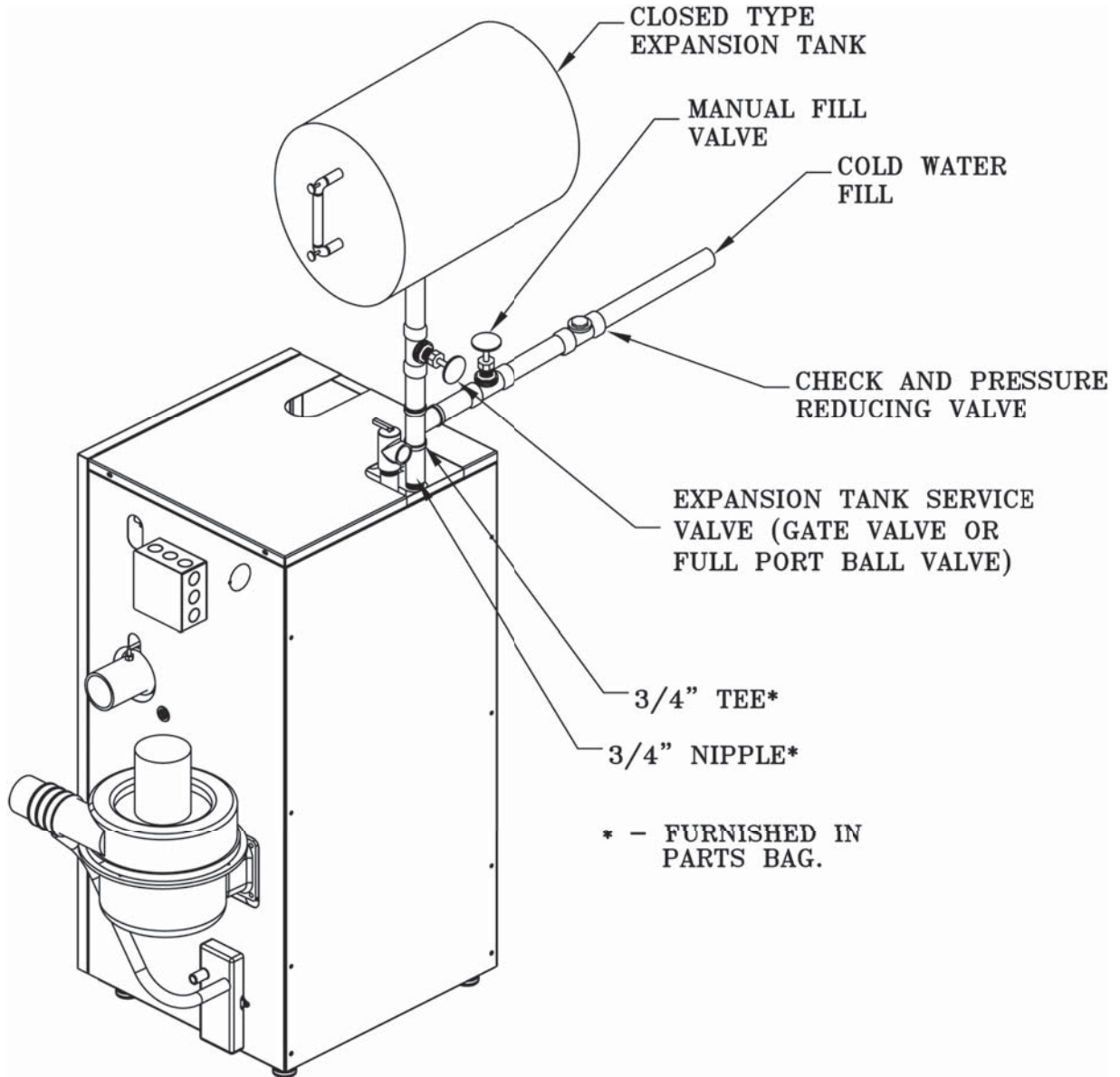


Figure 10 - Conventional (Closed Type) Expansion Tank Piping



### 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.
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.

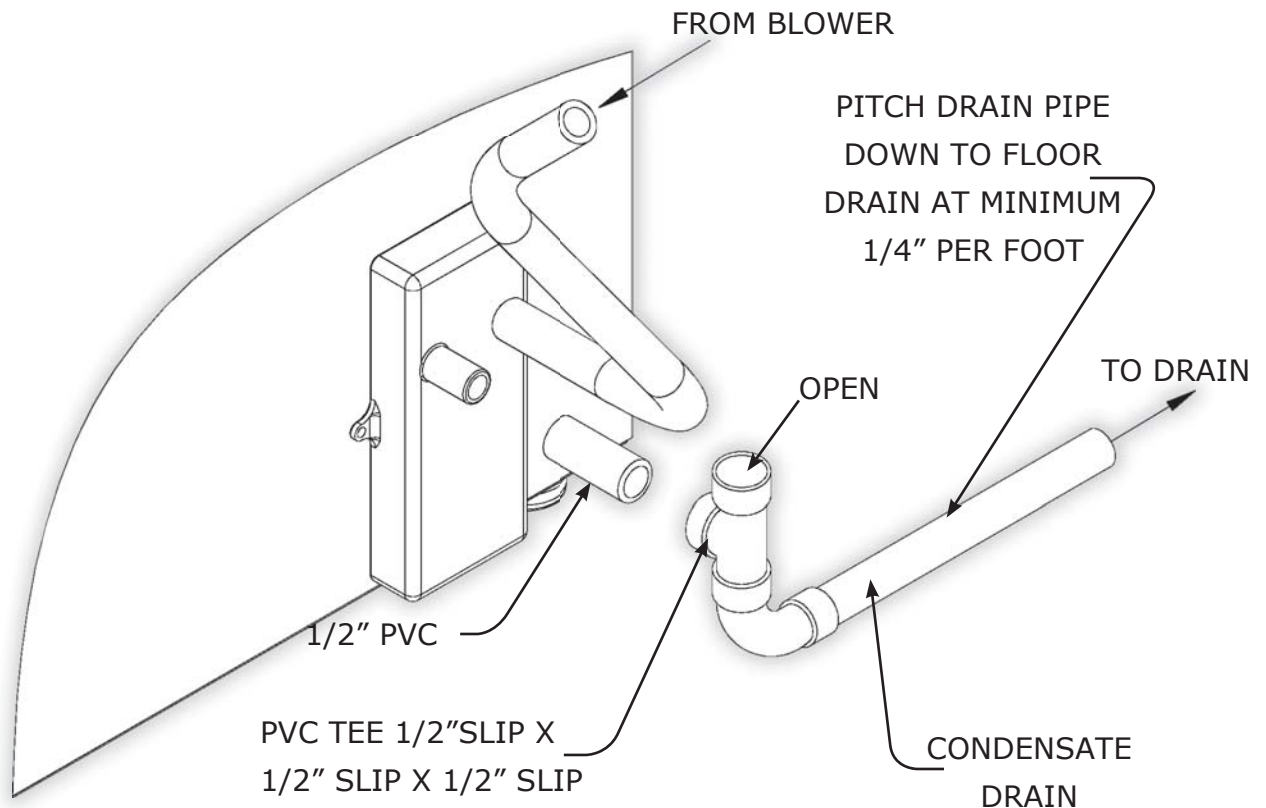
1. Disconnect vent condensate drain line from vent pipe connector on outlet of induced draft blower.
2. Pour about 1 cup of cold tap water into vent drain line with funnel.
3. Excess water should go through overflow and out through condensate drain line. Verify proper operation of drain line (or external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



### 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 Sections 8.2, 8.3 or 8.4 of 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. See Figure 12 thru Figure 14, Pages 24 and 25 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.
2. Construction through which vent and air intake pipes may be installed is maximum 24 inches, minimum ¼" thickness.
3. Combustion air and vent pipe fittings must conform to American National Standards Institute (ANSI) standards and American Society for Testing and Materials (ASTM) standards D1784 (schedule-40 CPVC), D1785 (schedule-40 PVC), D2665 (PVC-DWV), D2241 (SDR-21 and SDR-26 PVC), D2661 (ABS-DWV), or F628 (schedule-40 ABS). Pipe cement and primer must conform to ASTM standards D2564 (PVC) or D2235 (ABS).
4. **Canada** construct all combustion air and vent pipes for this unit of ULC S636 listed schedule-40 CPVC, schedule-40 PVC, PVC-DWV or ABS-DWV pipe and pipe cement. SDR pipe is not approved in Canada.
  - 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.

5. 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 too. 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.

6. Combustion air and vent piping lengths. Table 5, Page 23. 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 -1 ½ 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 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.

7. 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.
8. 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 snowline. Avoid locations where snow may drift and block vent. Ice or snow may cause boiler to shut down if vent becomes obstructed.

## 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
<b>100</b>	2 FEET	21 FEET	15 FEET	92 FEET
<b>75 &amp; 50</b>	2 FEET	26 FEET	20 FEET	112 FEET

- 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.
- 9. 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.
- **USA only.** 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 3 ft. (900mm) 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.

### 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 ¼ 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 ¼" 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.

Figure 12 - Roof Vent / Intake Terminations

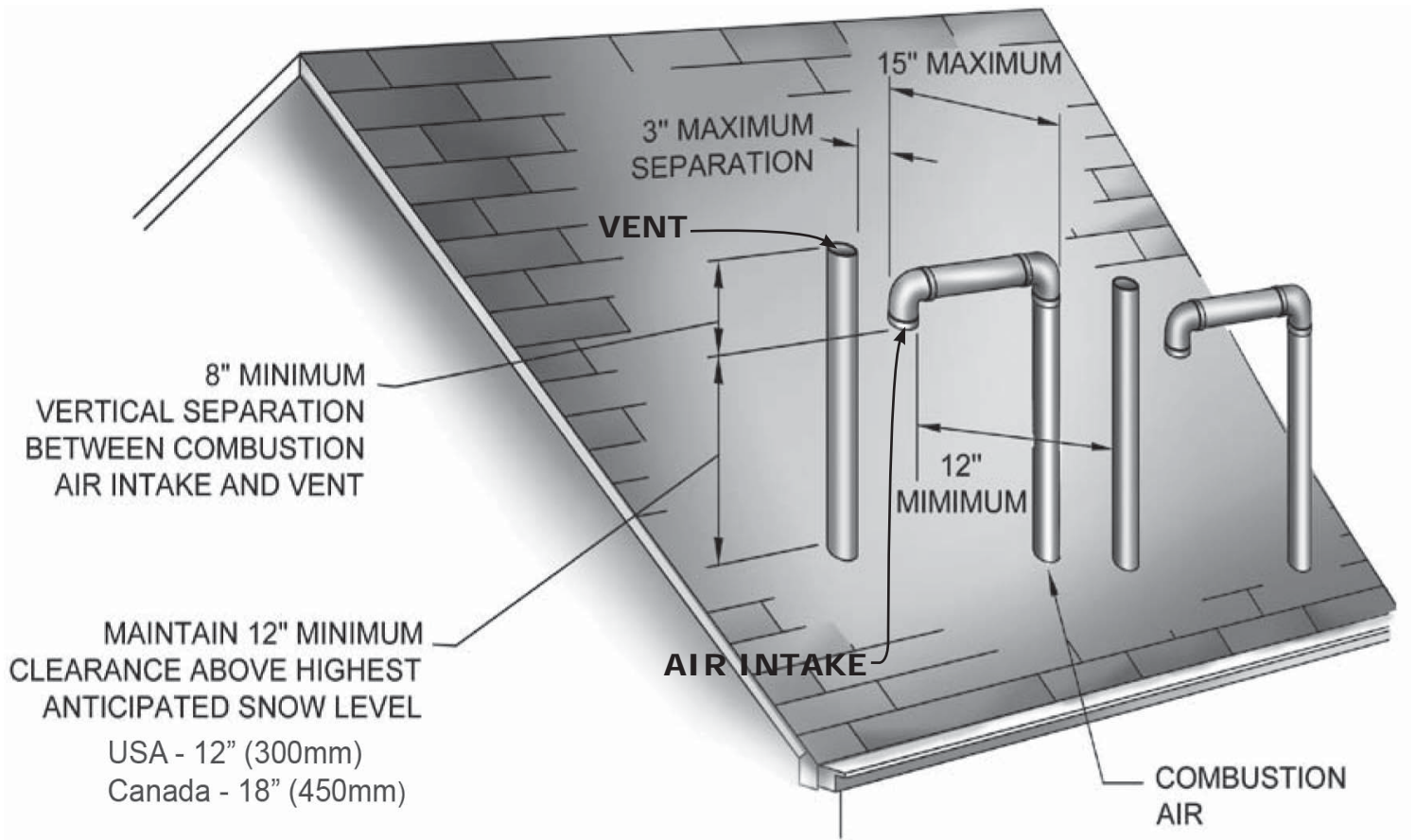




Figure 13 - Side Wall Vent / Intake terminations - Less Than 12" Clearance Above Grade

Less Than 12" Clearance

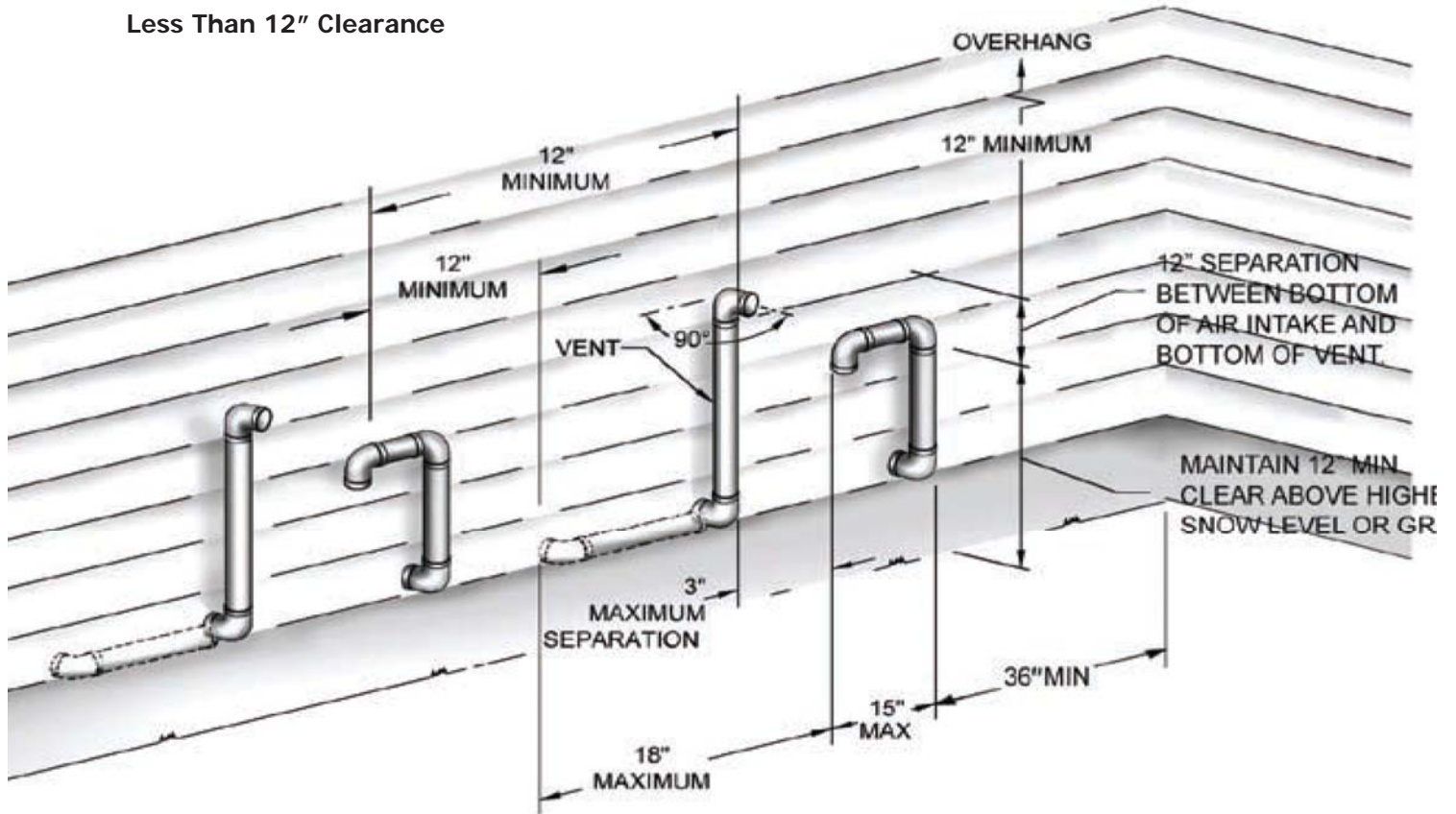


Figure 14 - Side Wall Vent/Intake Terminations - 12" Or More Clearance Above Grade

12" Or More Clearance

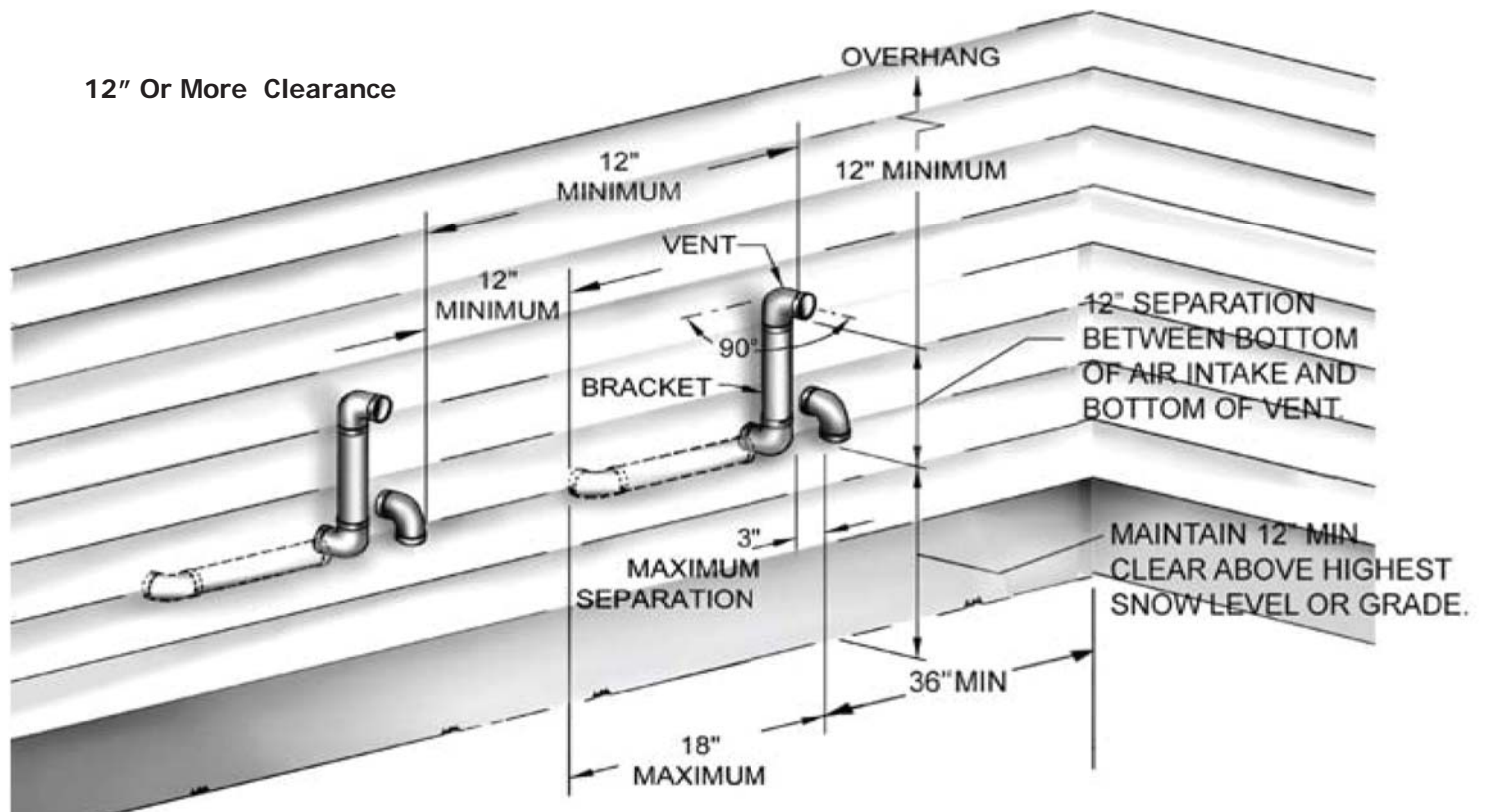
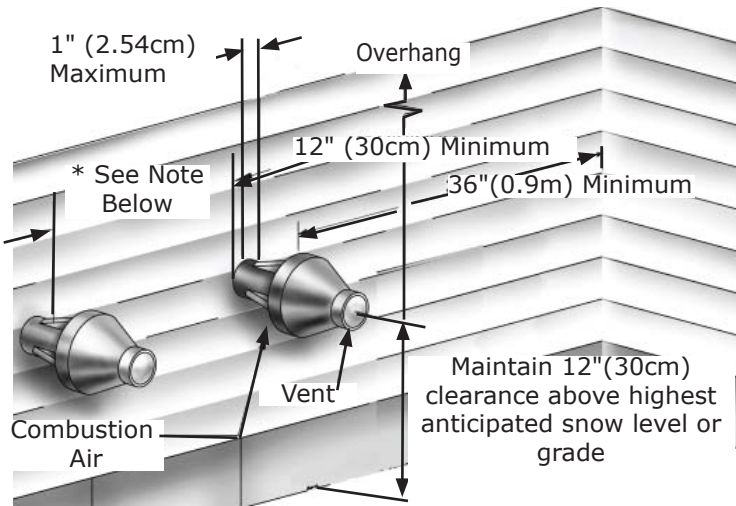
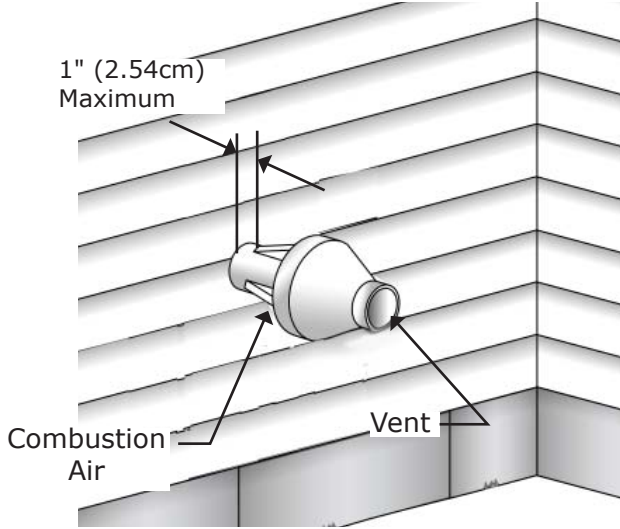


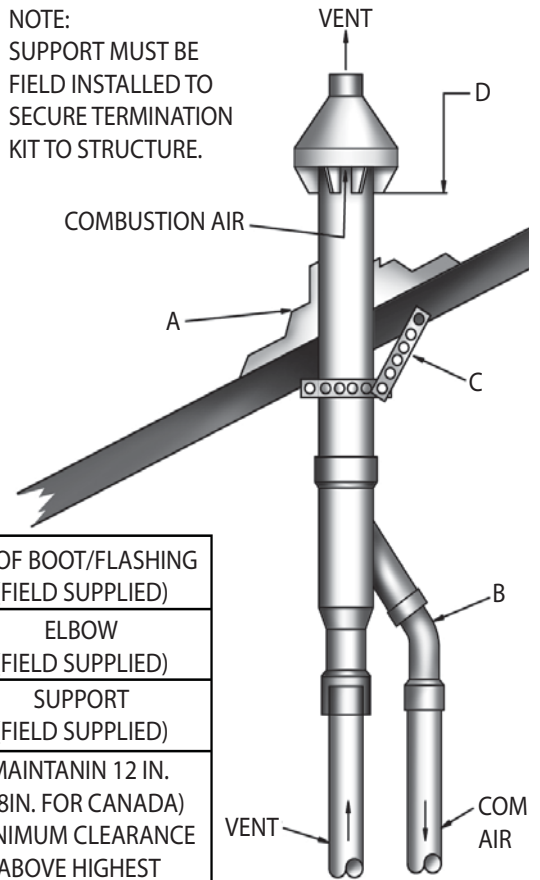
Figure 15 - Concentric Vent Terminations



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

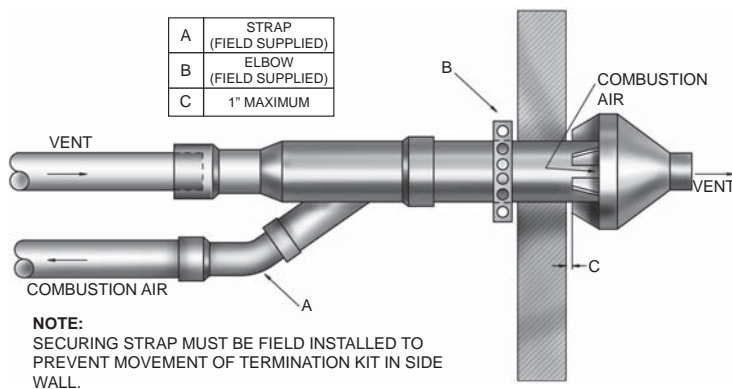
Figure 17 - Concentric Vent Roof Installation

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



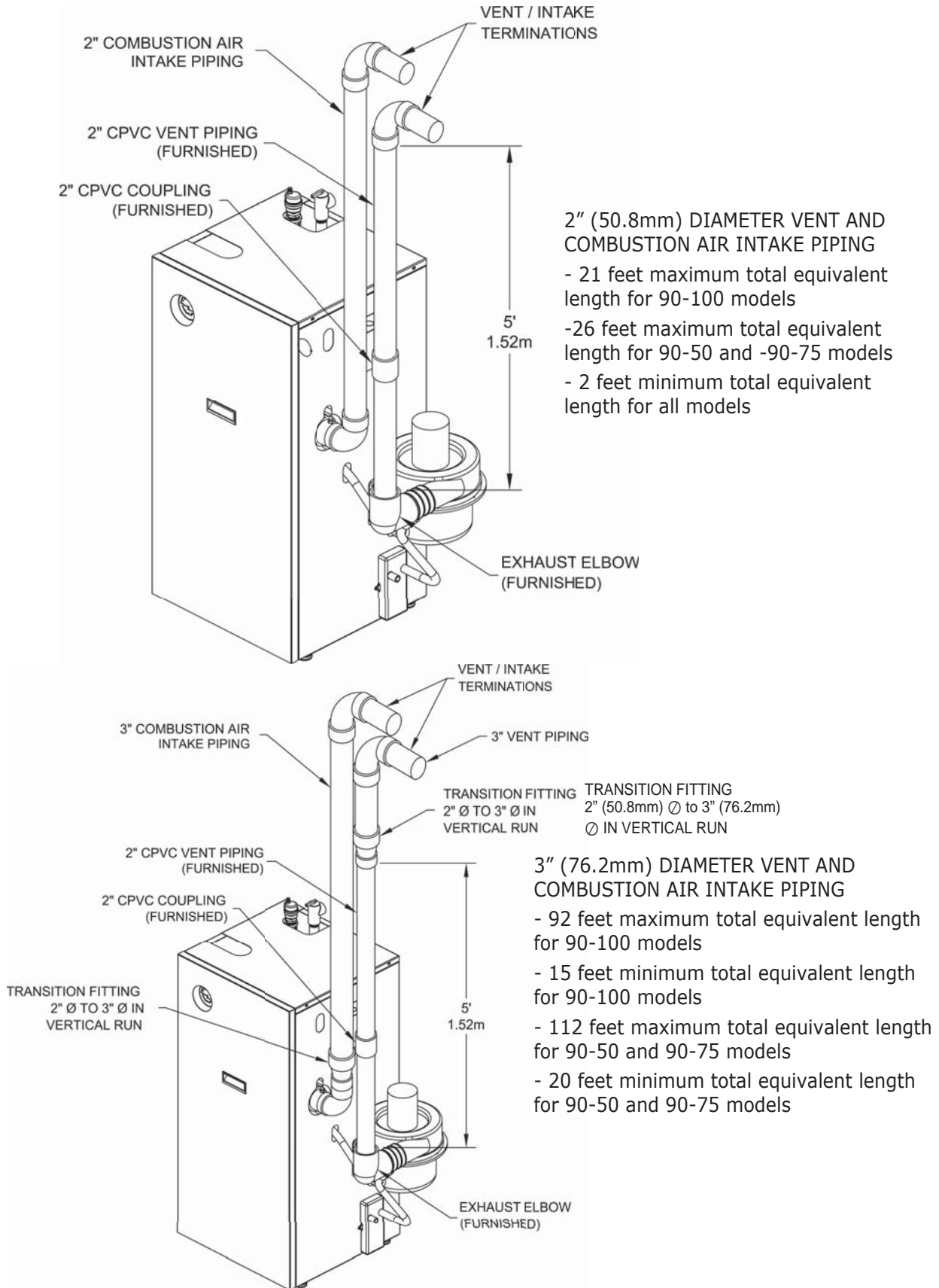
A	ROOF BOOT/FLASHING (FIELD SUPPLIED)
B	ELBOW (FIELD SUPPLIED)
C	SUPPORT (FIELD SUPPLIED)
D	MAINTAIN 12 IN. (18IN. FOR CANADA) MINIMUM CLEARANCE ABOVE HIGHEST ANTICIPATED SNOW LEVEL. MAXIMUM OF 24 IN. ABOVE ROOF

Figure 16 - Concentric Vent



NOTE:  
SECURING STRAP MUST BE FIELD INSTALLED TO  
PREVENT MOVEMENT OF TERMINATION  
KIT IN SIDE  
WALL.

Figure 18 - Combustion Air and Vent Piping - Boiler Connections



### 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**

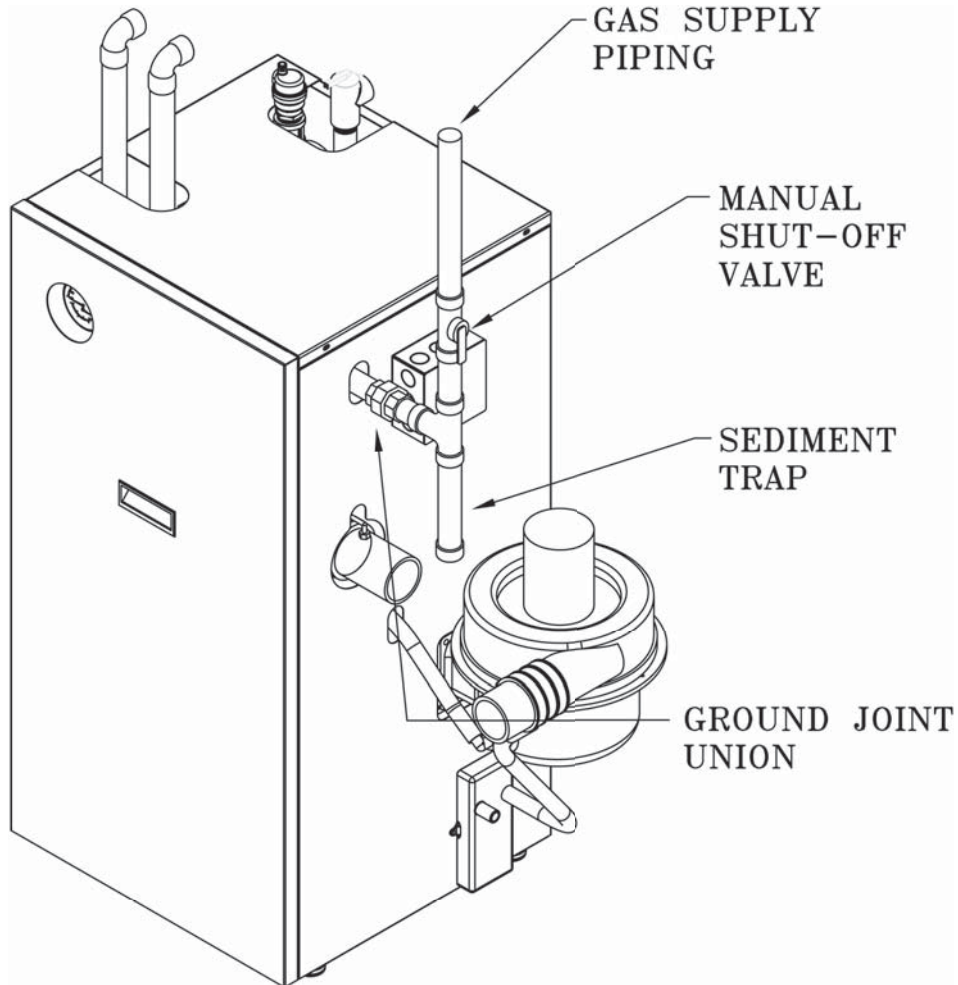
	NATURAL GAS	PROPANE GAS
<b>MAXIMUM GAS SUPPLY PRESSURE</b>	10" w.c.	14" w.c.
<b>MINIMUM GAS SUPPLY PRESSURE</b>	4" w.c.	10" w.c.

## 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 - Wiring Schematic

**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

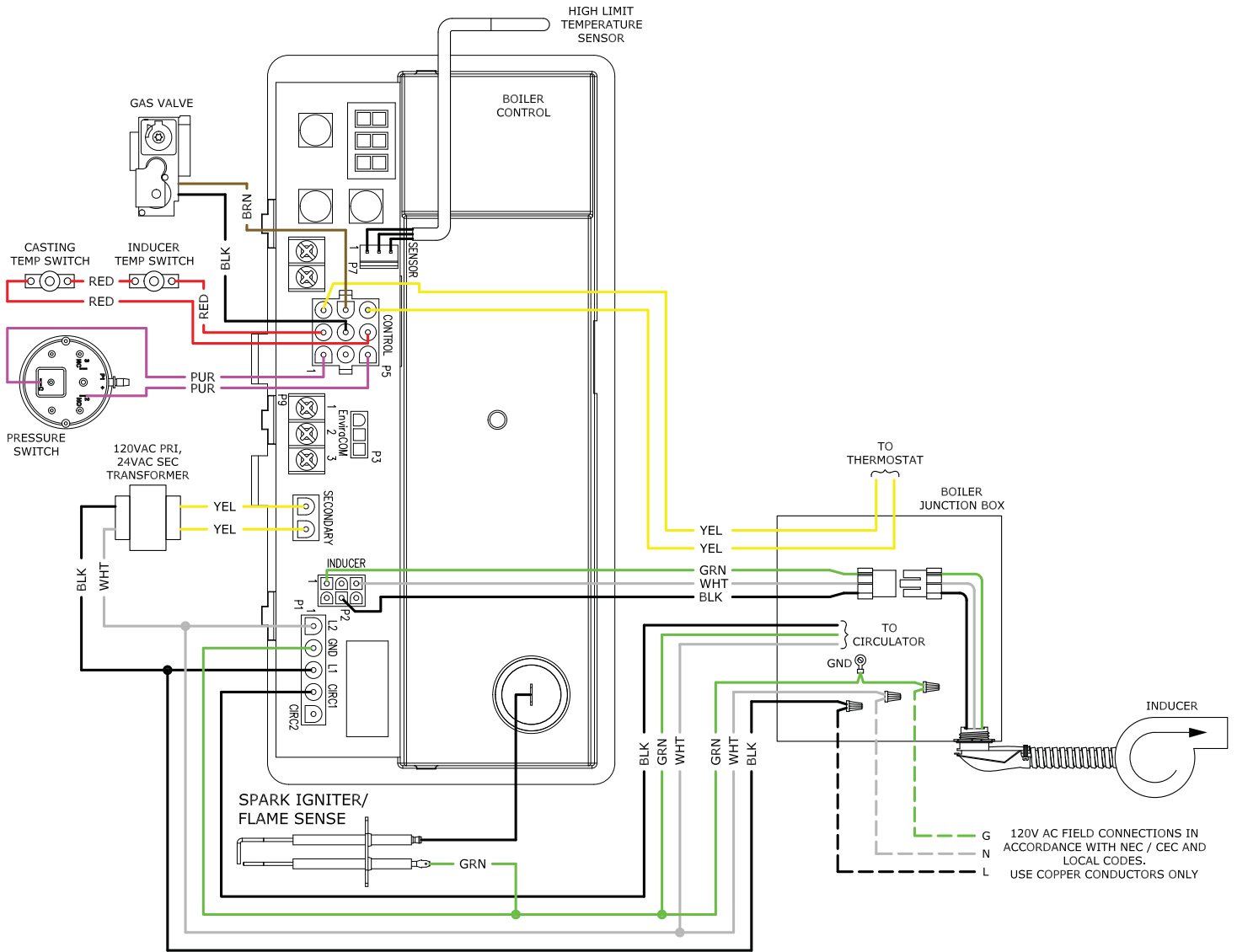


Figure 21 - Ladder Wiring Diagram

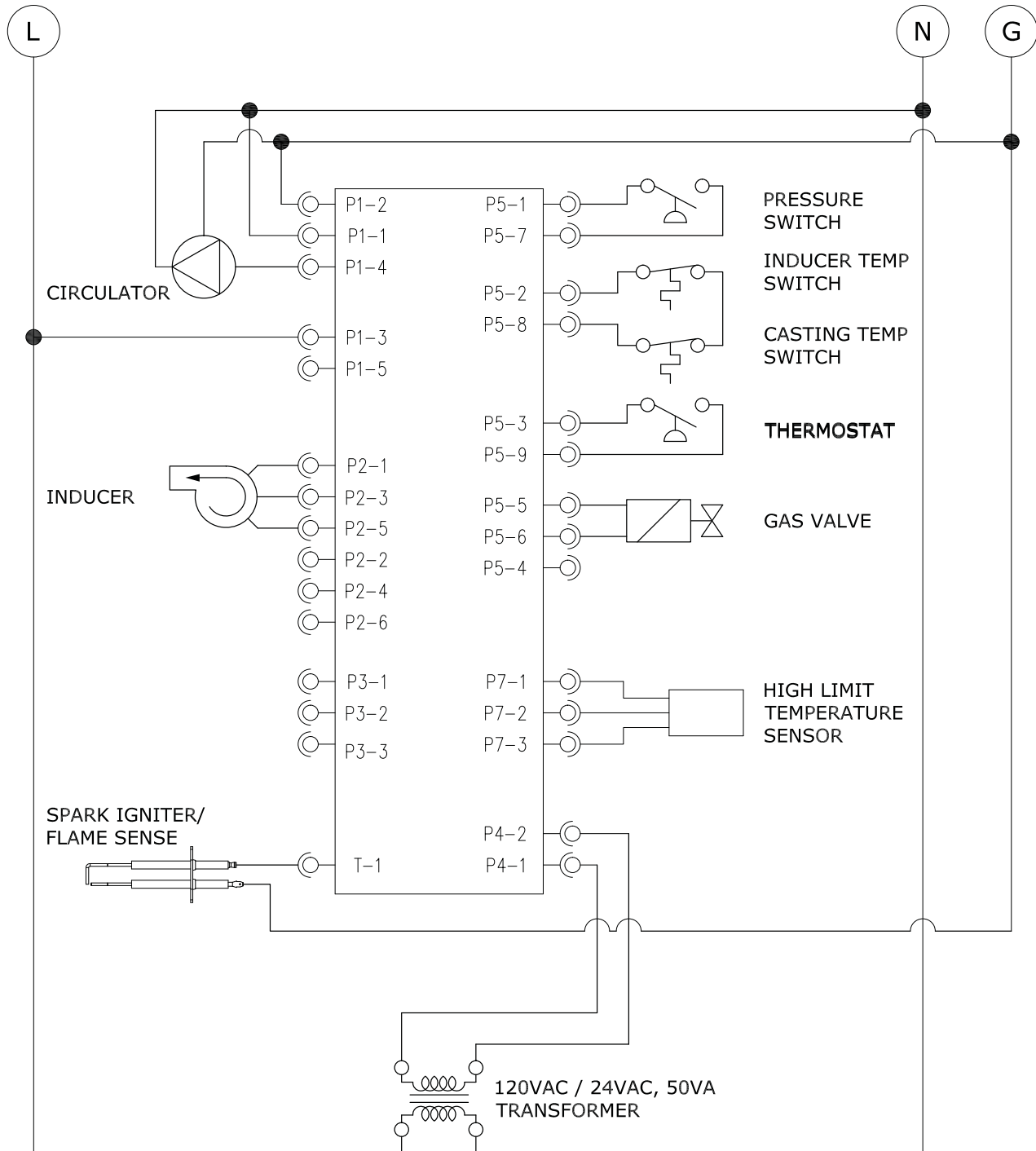
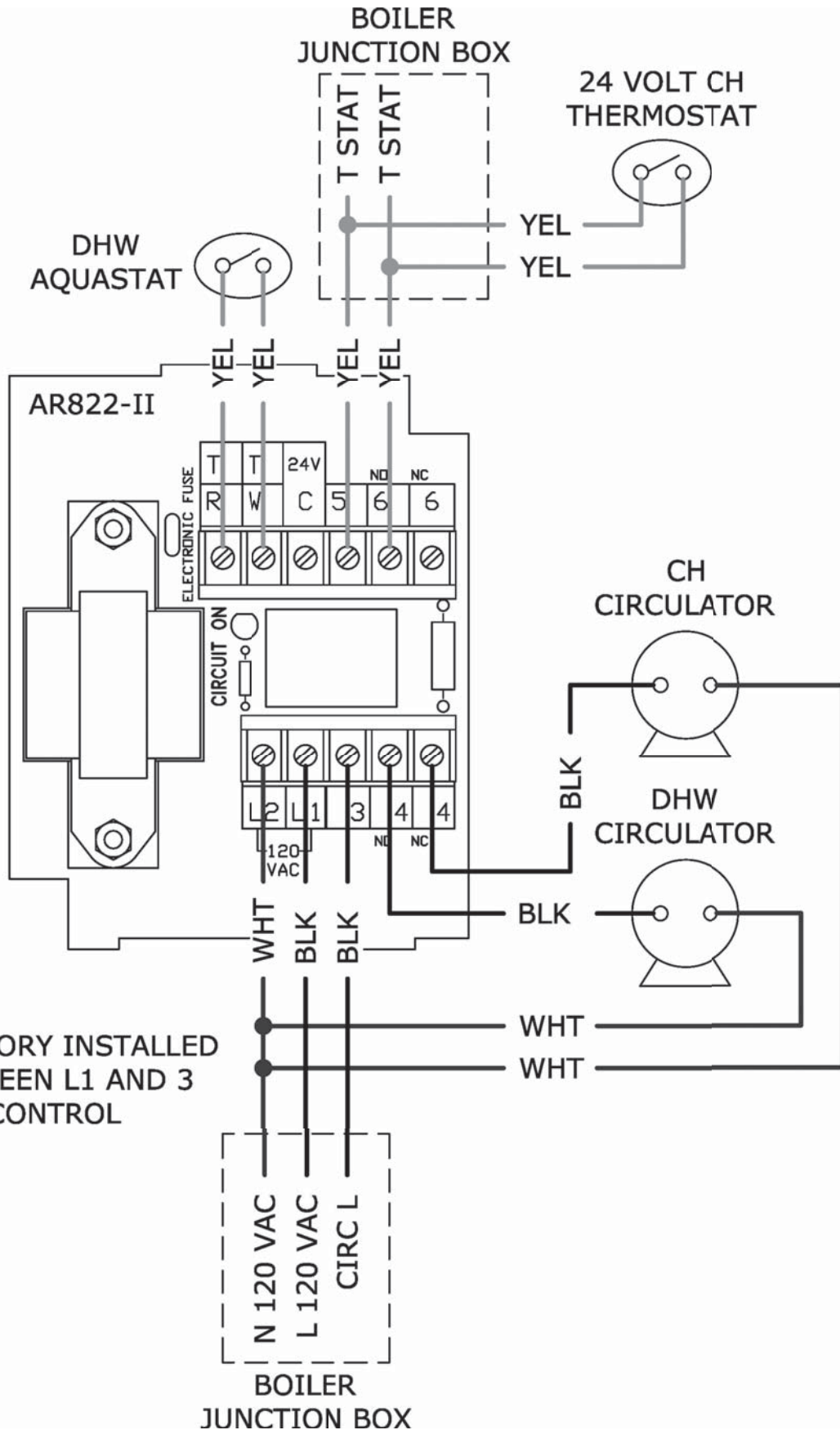


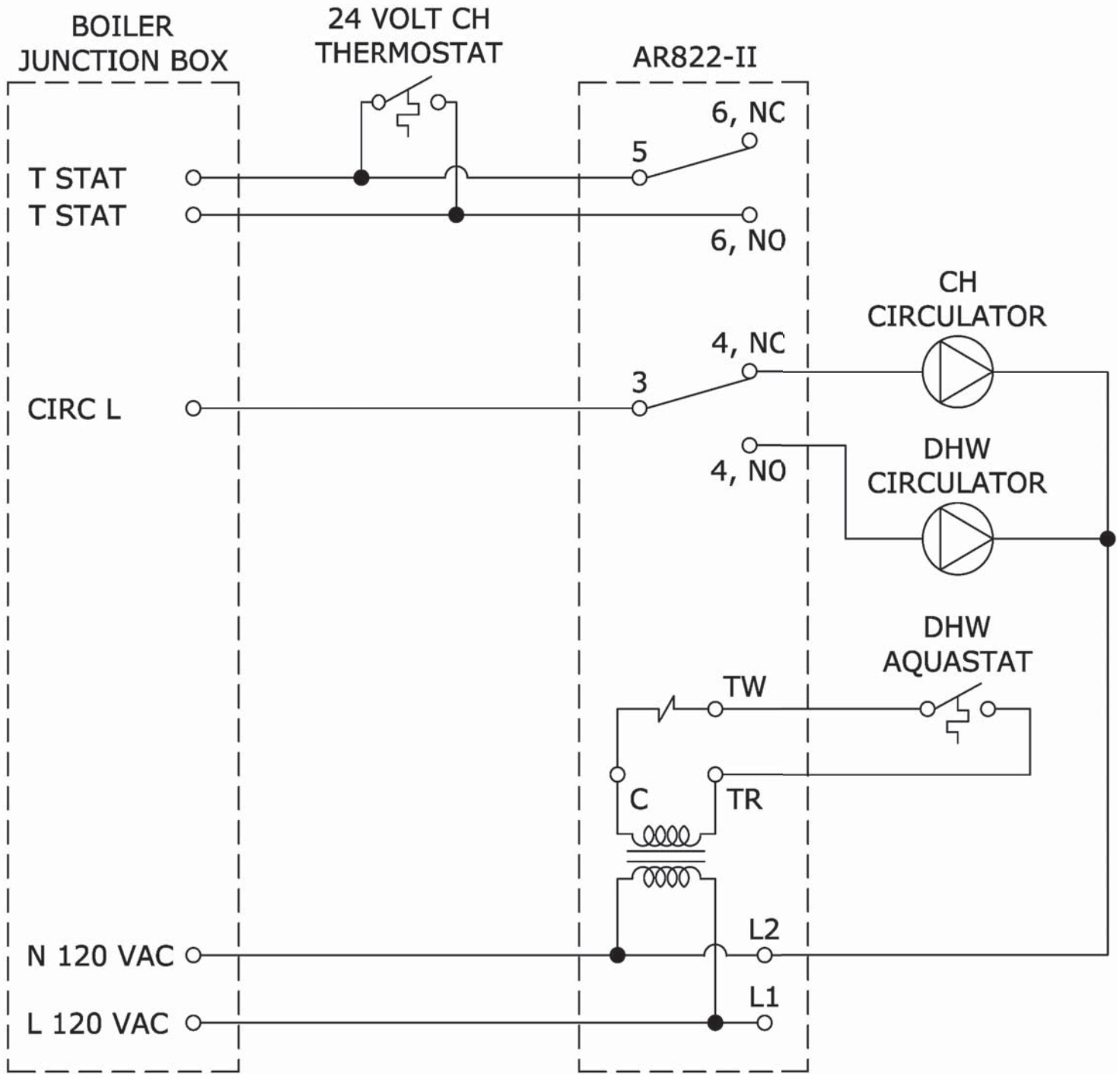


Figure 22 - Suggested Wiring Schematic for Domestic Hot Water Priority Two Zone System with Circulators Using Argo AR822II Pump Relay



**NOTE:**  
REMOVE FACTORY INSTALLED  
JUMPER BETWEEN L1 AND 3  
ON AR822-II CONTROL

Figure 23 - Ladder Diagram for Figure 22



This section provides a brief description of the key controls and accessories found in this boiler.

See Figure 26, Page 41 for detailed sequence of operation. See the Repair Parts Manual for locations of all control components and accessories described.

### Integrated Boiler Control (IBC)

Integrated Boiler Control (IBC) is a microprocessor based controller for high efficiency gas boiler that monitors all safety controls and which controls operation of the combustion air blower, circulator pump, burner, and a combination direct spark igniter/flame sensor. This controller is not intended for use with a vent damper. Controller is mounted on control panel inside of boiler and contains a three character user interface display.

### High Limit Control

High Limit Control determines maximum boiler water temperature and also provides means for protecting boiler and heating system from unsafe operating conditions which could damage boiler.

Limit control sensor is mounted in 3/4" NPT control well on top of the front boiler section at hot water outlet.

Limit control is incorporated in IBC and is field adjustable between 80°F and 190°F.

Field setpoint adjustment for each installation depends on heating system requirements.

Limit Control automatically resets when boiler water temperature decreases (10-30°F adjustable differential).

Differential can be adjusted to provide flexibility for boiler operation. Larger the differential, longer run cycle of boiler.

### Thermal Purge Operation

1. Thermal purge feature complies with 2012 DOE and NRCan requirements that boiler control must incorporate automatic means to adjust water temperature.
2. Intent of thermal purge is to insure usable residual heat in the boiler is circulated until it is sufficiently depleted from the system before the burner is allowed to fire. To that end, on call for heat, burner is held off while circulator runs until boiler temperature drops to thermal purge temperature limit or time delay is exceeded. Both of these parameters are adjustable.
3. When boiler temperature falls below thermal purge temperature limit or time delay expires, burner is allowed to fire.

In addition to thermal purge temperature and thermal purge time delay parameters, two other conditions release integrated boiler controller from thermal purge and allow burner to run in order to maintain comfort in the space.

- Boiler temperature has dropped 10°F from boiler water temperature measured at beginning of the call for heat.

- Boiler temperature is cooling at a rate greater than 5°F/minute while circulator is running.

### 4. For Installations using Indirect Hot Water Heater

Depending on the specific installation, thermal purge delay might or might not affect end user's expectation for domestic hot water delivery. In event the customer has a concern that it takes too long for hot water, the situation may be resolved in three ways.

- A. Add a Domestic Hot Water Module, ECR part Number 240009562 (Honeywell part number W8375s1008). This control senses when hot water is being drawn, and instructs the integrated boiler control to bypass the thermal purge operation until domestic hot water draw ends. Thermal purge will then be re-enabled.  
  
DHW module incorporates a temperature sensor installed at the indirect water heater's hot water supply fitting ( Note - this sensor is in addition to, not in place of, the limit control on the hot water tank.) The Module is connected to the Enviracom terminals in the Integrated Boiler Control.
- B. Thermal purge parameters may be adjusted (higher thermal purge temperature limit and/or shorter thermal purge time delay) to bring the burner on sooner.
- C. Thermal purge function can be disabled.

### Gas Control Valve

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

### Direct Spark Igniter

Direct spark igniter utilizes a spark gap to initiate gas combustion in the burner. 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 lockout and display Error Code 62.

### 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).

### 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.***

### 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 contacts fail to close control will display Error Code 29.

### 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.

### Circulator Pump

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.

### 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.

### A.S.M.E. Rated Pressure Relief Valve

Each boiler must have a properly sized and installed American Society of Mechanical Engineers rated pressure relief valve. Water expands as it is heated by burner/boiler sections. If there is no place for water to expand its volume, (i.e. a properly sized and properly functioning expansion tank) pressure on inside of boiler and heating system will increase. Furnished relief valve automatically opens at 30 psig pressure to relieve strain on boiler and heating system from increasing pressure. Pressure relief valve discharge must be piped with piping same size as valve discharge opening to open drain, tub or sink, or other suitable drainage point not subject to freezing, in accordance with A.S.M.E. specifications and requirements of local jurisdiction.

### External Condensate Pump (Optional)

For installations where there is no floor drain or other appropriate drainage receptacle available to receive condensate from the boiler, an external float activated condensate pump with integral sump is required. This unit can be installed to pump the condensate to a remote tie in point to a sanitary sewer system. For this application, the boiler must be installed so that proper pitch of piping to the external condensate reservoir (sump) can be accomplished. Use wood frame or blocks to raise boiler as required for proper installation.

### 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.

### ⚠ 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

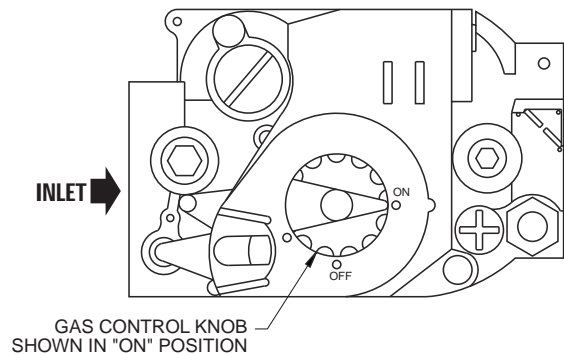
WHAT TO DO IF YOU SMELL GAS

- 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**



## S9381A INTEGRATED BOILER CONTROL OPERATION AND ADJUSTMENTS

S9381A control has a number of user adjustable parameters as shown in Table 8.

**Table 8 - User Parameters**

3-Digit 7-Segment Display			Default	Range	Description
1st Screen	2nd Screen	3rd Screen			
HL_	<High Limit>	°F or °C	180	130 to 220 °F	Adjust High Limit Setting
HdF	<High Limit Differential>	°F or °C	15	10 to 30 °F	Adjust High Limit Differential
Or_	<Pump Overrun Time>	SEC	60	0-120 seconds	Pump Overrun Time
atH	<ODR maximal temp.>	°F or °C	55	40 to 70 °F	Maximal outdoor temperature
atL	<ODR minimal temp.>	°F or °C	0	-40 to 40 °F	Minimal outdoor temperature
btL	<minimal water temp.>	°F or °C	140	130 to 150 °F	Minimal boiler temperature
tPL	<minimal boiler temp.>	°F or °C	140	OFF, 120 to 160 °F	Thermal purging minimal temperature (Parameter is available only if outdoor temperature is invalid)
tPt	<maximal delay>	Min	2	1 to 10 minutes	Maximal Thermal Purge time (Parameter is available only if outdoor temperature is invalid)
rSt	On or OFF		NA	NA	Reset Lockout
F-C	°F or °C		F	F or C	Select degrees F or C Mode

### Adjusting Settings

To discourage unauthorized changing of settings, a procedure to enter the adjustment mode is required. To enter the adjustment mode, press the UP, DOWN, and I buttons simultaneously for three seconds. Press and release the I button until the parameter requiring adjustment is displayed.

Then press the UP or DOWN button until the parameter has reached the desired value. After 60 seconds without any button inputs, the control will automatically return to the READ mode.

### Display

In RUN mode, status items and parameters are viewable. To read settings, press and release the I Key to find the parameter of interest. For example, press and release I until setpoint (sp) is displayed, followed by a three-digit number, i.e., 220, followed by °F or °C. See Display Readout, Figure 25.

**Figure 25 - Display**

TEXT	DESCRIPTION	DISPLAY SHOWS
STA	STATUS (SEE STATUS NUMBERS)	StA
BT	BOILER TEMPERATURE	bt
SP	OPERATING SETPOINT	SP
HL	HIGH LIMIT SETPOINT	HL
HdF	DIFFERENTIAL SETPOINT	HdF
FLA	FLAME CURRENT	FLA
RUN	RUN TIME HOURS	run
CYC	BOILER CYCLES	CYC
ERR	ERROR (SEE ERROR NUMBERS)	Err

## S9381A INTEGRATED BOILER CONTROL OPERATION AND ADJUSTMENTS

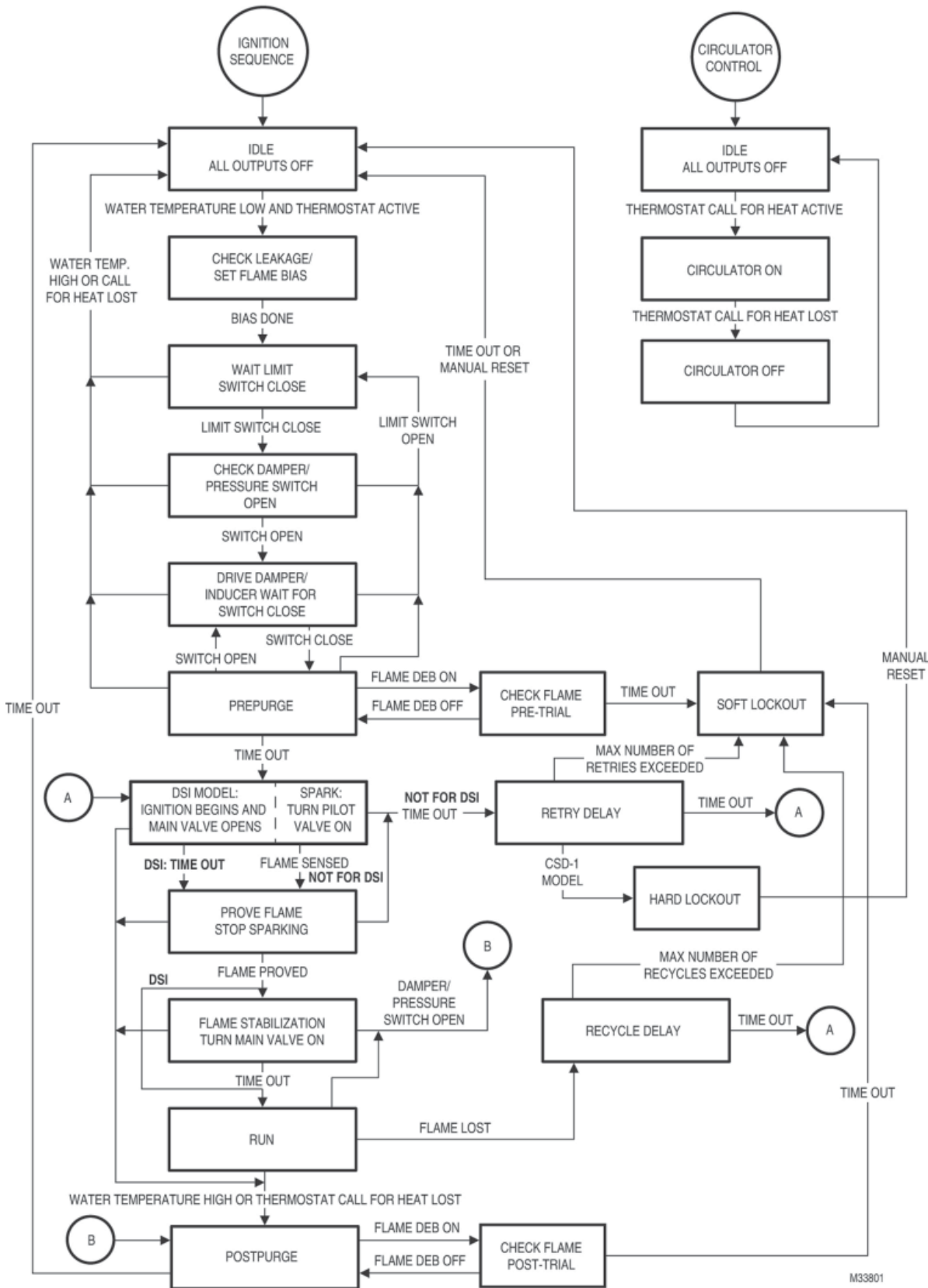
**Table 9 - State Code Definitions**

State	State code	Specific Description	General Description
Idle	1	The boiler is in standby-no call for heat	Standby
Run circulator		Heat request present but boiler temp sufficiently high to run circulator pump only (no ignition sequence)	
Wait for pressure switch to open	2	The inducer is off and the control waits for the pressure switch to open. This is checked at the beginning of a heat cycle before turning on the inducer. If the pressure switch doesn't open in 60 seconds, the control goes to state 11.	
Wait for pressure switch to close	3	The inducer is turned on. The control is waiting for the pressure switch to close at the beginning of a cycle. If the pressure switch doesn't close within 60 seconds, the control goes to state 12	
		3secs safety relay test delay time when status 4 or 6 is interrupted pressure switch to open. Then control goes to state 12	
Prepurge (includes PV short diagnostics)	4	System is purging before ignition trial-safety relay diagnostics followed safety relay switch-on during last 2 secs this state	
Spark, Ignition activation	6	System is sparking permanently 13 seconds whilst main valve relay is turned on	
Prove Flame	7	System is proving flame signal, typically 2 seconds	
Running	8	System is in running mode, flame signal must be present.	
Postpurge	9	System is purging at the end of a call for heat	
Inter-purge (Retry/ Recycle Delay)	10	If the control loses flame signal during state 7 or 8, it will recycle through the 30 seconds purge time and last 2secs.part of prepurge time	Re-Start delay due to flame failure
Wait for pressure switch to open - failed closed	11	The inducer is still off, and the pressure switch has not opened at the beginning of the heat cycle. An alarm message is sent but the control is not in lockout.	
Wait for pressure SW to close - failed open	12	The inducer is still on, waiting time for pressure switch to close expired. An alarm message is sent but the control is not in lockout.	
Soft Lockout	13	System is shutdown and will re-start following an enforced delay	
Hard Lockout - non-volatile	14	System is locked out. A manual reset is required to be able to light off again	
Wait for Limit to Close	15	There may be a call for heat from the thermostat, but the limit switch is open.	
flame out of sequence - before trial	16	Flame signal sensed before trial for ignition. Appropriate alarm is sent	Flame present out of sequence
flame out of sequence - after trial		Flame out of sequence during postpurge. Appropriate alarm is sent	
Wait for flame loss		Flame signal still present when not expected. Appropriate alarm is sent	
Leakage Detection	17	HW self check, check of connected periphery, it is performed at start up, in the beginning of the heat cycle and in the "Wait For Recovery" state	Self Test
Wait For Recovery		There is an external error and the control is waiting to recover, no lockout	Self Test



# S9381A INTEGRATED BOILER CONTROL OPERATION AND ADJUSTMENTS

Figure 26 - Sequence of Operation



## CHECK OUT 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 Ignition System Safety Shutoff Device

1. Turn off manual gas valve
2. Set thermostat to call for heat
3. Boiler begins normal sequence of operation
4. After approximately 20 seconds (pre purge, state code 4) gas valve is powered (state code 6).
5. After 13 second trial for ignition, gas valve closes, (state code 10) as integrated boiler control senses that flame is not present.
6. After about 30 seconds, control will go back to step 4 and make two more attempts to light the burner, then go into soft lockout and display Error code 62.
7. To restart system, open manual gas valve that was closed in Step 1. Reset lockout by breaking and restoring power to boiler. Observe normal operation.

### 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 80°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 27, 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.

## CHECK OUT PROCEDURE AND ADJUSTMENT

- 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:
- 8.5% -10.0% CO<sub>2</sub> on Natural Gas
  - 9.5% -11.0% CO<sub>2</sub> on Propane Gas
- Under all conditions CO level should not exceed 100 ppm.
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 54.**

**Figure 27 - Manifold Pressure Measurement Detail**

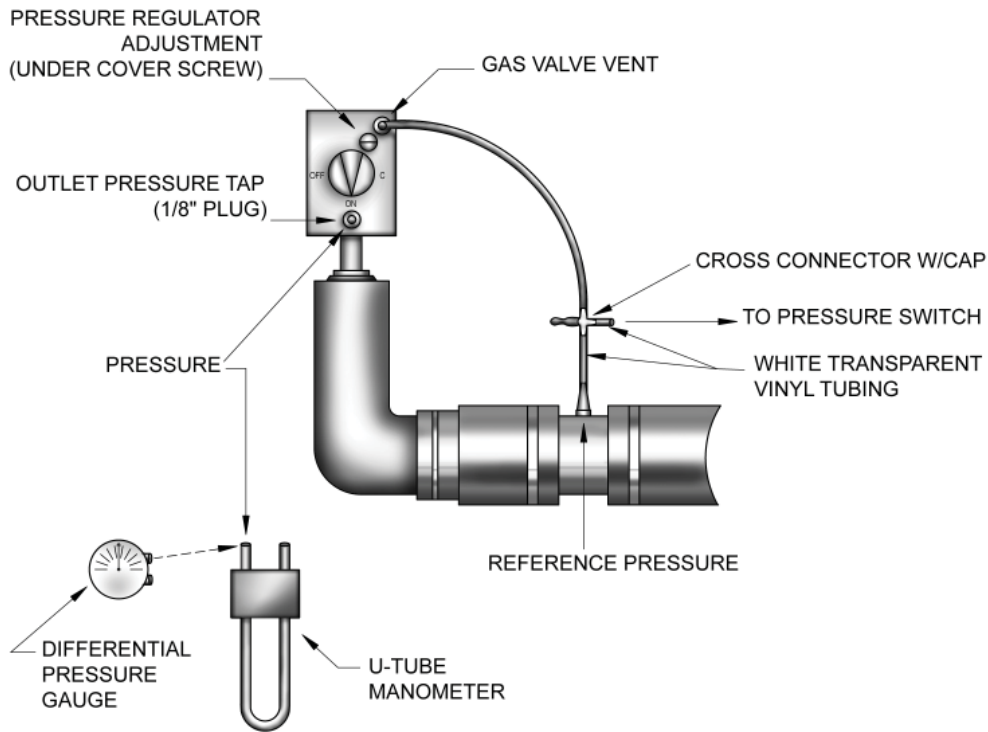
Following steps and diagram indicate location of the connection points required to measure manifold pressure.

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.

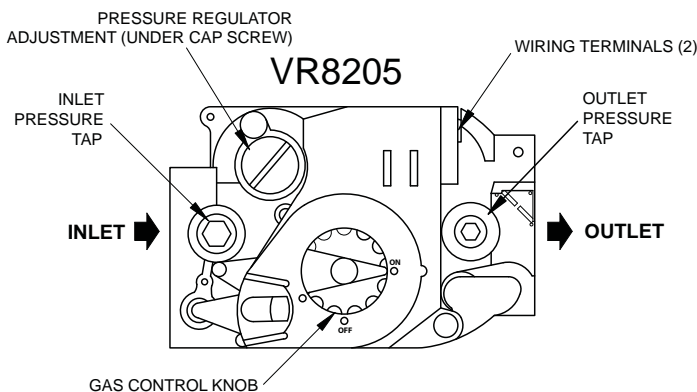
Remove plug. Install appropriate barbed fitting and connect pressure side line from U-Tube Manometer or Differential Pressure Gauge.

Refer to "Differential Air Pressure Switch Check" on page 49 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 28 - 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.

### 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 46.
  - 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 38.
  - E. Follow instructions for "Check Out 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.

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 38.

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. IBC Error Codes.
  - A. IBC uses advanced diagnostic capability to assist in troubleshooting error conditions. Table 10, Page 48 shows error codes that may arise during fault condition.
  - B. State Conditions shown in Table 9, Page 40 provide suggestions for servicing these potential errors.

## TROUBLESHOOTING

**Table 10- Error Codes**

Segment Display	Definition
Err 2	Pressure Switch failed to open (contacts stuck closed).
Err 4	Low flame current
Err 6	Flame sensed out of normal sequence (before opening gas valve or after closing gas valve).
Err 18	Gas valve relays welded 5 consecutive soft lockouts. A manual reset is required.
Err 23	Flame sensed during prepurge (before gas valve signaled opened).
Err 24	Flame sensed during postpurge (before gas valve signaled closed).
Err 29	Pressure Switch failed to close (contacts stuck open).
Err 32	Sensor 1 Error. Temperature sensor or interface failure (open or short connection, increased connection resistance, dual sensor mismatch) or failure of A/D conversion (invalid offset or gain, too many failures during A/D conversion).
Err 55	Atmospheric Damper End Switch failed to close (end switch contacts stuck open).
Err 56	Atmospheric Damper End Switch failed to open (end switch contacts stuck closed).
Err 57	Flame Rod shorted to burner ground.
Err 58	AC line frequency error—signal is too noisy or frequency is incorrect.
Err 59	Line voltage error—voltage out of spec high or low.
Err 60	Thermostat input higher than threshold.
Err 61	Line voltage unstable—possibly too many heavy loads switching on and off cause erratic supply voltage.
Err 62	Soft Lockout—maximum number of retries exceeded. Hard lockout on CSD-1 models.
Err 63	Soft Lockout—maximum number of recycles exceeded.
Err 64	Soft Lockout—electronics failure. Caused by general electronics failure such as relay open or shorted contacts, flame sensing circuit error, or A to D error. Hard lockout on CSD-1 models.
Err 65	Over temperature error. Sensors measured temperature in excess of ECO limit. Hard lockout on CSD-1 models.



## DIFFERENTIAL AIR PRESSURE SWITCH CHECK

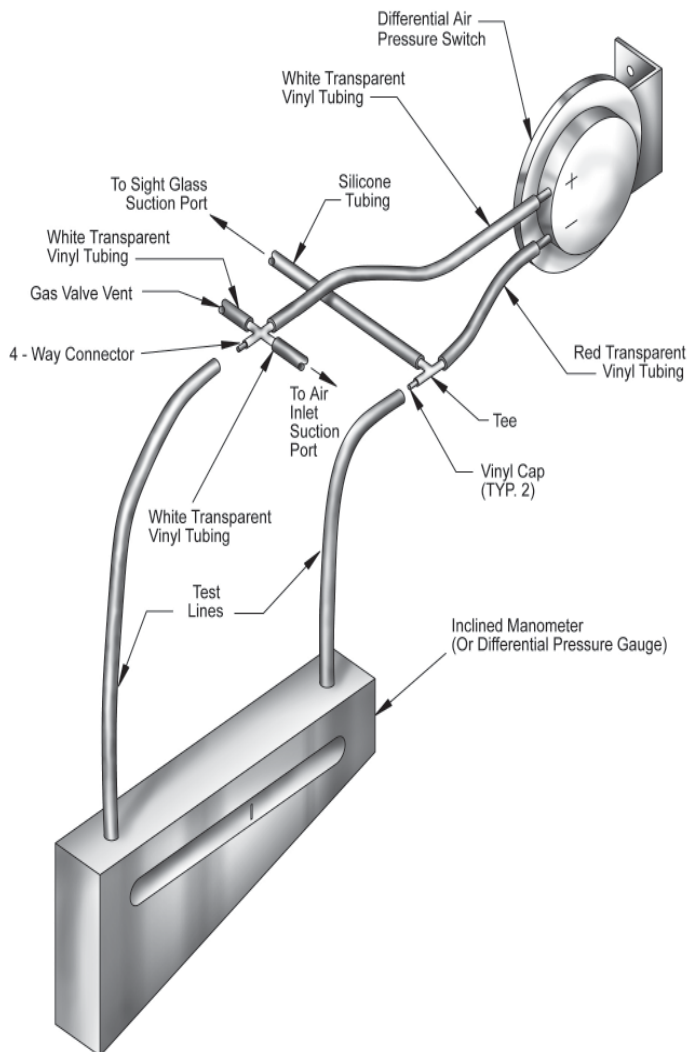
- Following steps and diagram indicate locations of connection points required to check differential air pressure.
- Differential air pressure switch is safety device which prevents boiler from firing if there is air intake, boiler heat exchanger or vent blockage.
- Turn off service switch, or lower 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 3.0" w.c.
- Turn on service switch and set thermostat to call for heat.

BOILER STATUS	DIFFERENTIAL PRESSURE (W.C.)	PRESSURE SWITCH CONNECTS
Not Running	0"	Normally Open
Setpoint	1.00" for Model-100	
	1.60" 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

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.



# Aluminum Series

## High Efficiency Gas-Fired Boiler

### DIELECTRIC ISOLATION & ANTIFREEZE PROTECTION ADDENDUM

#### **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 11.**
- 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 11 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 MSDS (Material 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 11 - Antifreeze Products**

<b>Compatible Aluminum Antifreeze &amp; Inhibitor Suppliers</b>	
<b>Noburst AL Antifreeze</b>	Noble Company P. O. Box 350 Grand Haven, MI 49417 <a href="http://www.noblecompany.com">www.noblecompany.com</a> Tel: 800-878-5788 Fax: 231-799-8850
<b>Rhogard Antifreeze &amp; Pro-Tek 922 Inhibitor*</b>	Rhomar Water Management, Inc. P. O. Box 229 Springfield, MO 65801 <a href="http://www.rhomarwater.com">www.rhomarwater.com</a> 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.	
<b>Alphi-11</b>	Hydronic Agencies, Ltd. (Fernox North Distributor) 15363 117 Avenue Edmonton, AB T5M 3X4 Canada <a href="http://www.hydronicagencies.com">www.hydronicagencies.com</a> Tel: 780-452-8661 Fax: 780-488-2304 Fernox <a href="http://www.fernox.com">www.fernox.com</a>
<b>Intercool NFP-30,40,50 AA Intercool RPH-15*</b>	Interstate Chemical 2797 Freedland Road P.O. Box 1600 Hermitage, PA 16148-0600 <a href="http://www.interstatechemical.com">www.interstatechemical.com</a> Tel: 800-422-2436 Fax: 724-981-8383
<b>Hercules cryo-tek™-100/AI</b>	Hercules Chemical Company, Inc. 111 South Street Passaic, NJ 07055 <a href="http://www.herchem.com">www.herchem.com</a> 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

\_\_\_\_\_





**PRODUCT LITERATURE**

Lennox Industries Inc.  
Dallas, Texas

**Manufactured by:**

**ECR International, Inc.**

2201 Dwyer Avenue, Utica NY 13501

web site: [www.ecrinternational.com](http://www.ecrinternational.com)