



FSB SERIES 3

Gas-Fired Hot Water
Induced Draft Boilers

INSTALLATION, OPERATION & MAINTENANCE MANUAL

Models

- FSB-2
- FSB-3
- FSB-4
- FSB-5
- FSB-6



C.S.A. Certified
For Natural Gas Or Propane



Tested For 50 psi
ASME
Working Pressure

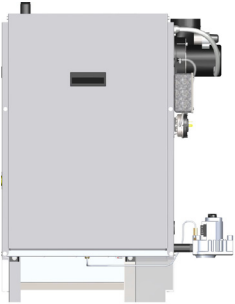

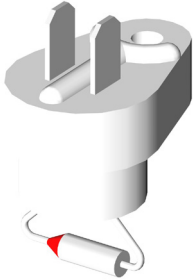
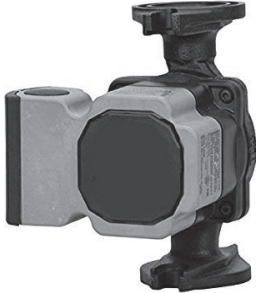
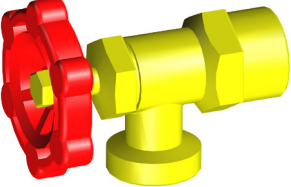
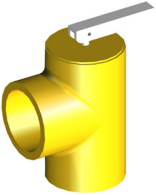
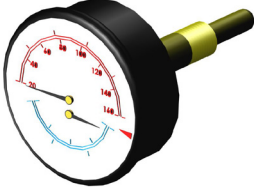
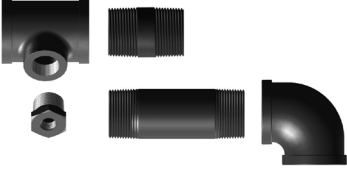


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PN 240013101 REV. B [08/08/2023]

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VERIFY CONTENTS RECEIVED

			
Fully Assembled Boiler	*Vent Adapter	*Fuse Link	Pump (Optional)
			
*Drain Valve	*ASME Safety Relief Valve	*Tridicator	*Black Iron Fittings (see parts list for sizes and use)
<p>Includes Essential Documents and Warranty 11x17 Wire Diagrams</p>			
Document Package			

* Items found in parts box included with your boiler.

**KEEP THIS MANUAL NEAR BOILER
RETAIN FOR FUTURE REFERENCE**

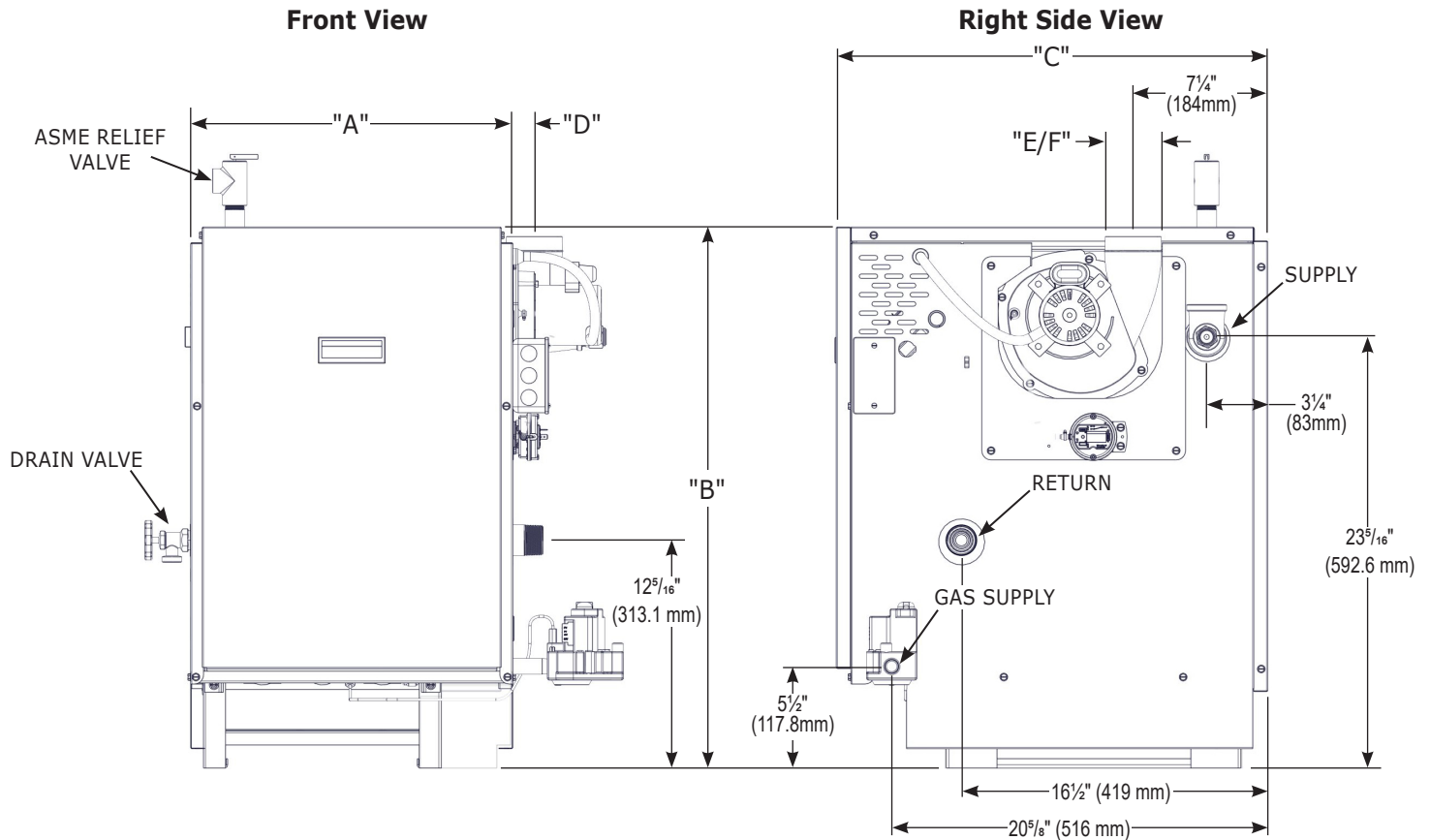
For Parts list see manual 240013102 included with your boiler literature package.

Check our website frequently for updates: www.ecrinternational.com

Information and specifications outlined in this manual in effect at the time of printing of this manual. ECR International reserves the right to discontinue, change, specifications or system design at any time without notice and without incurring any obligation, whatsoever.

1 - PHYSICAL DATA

Model	FSB-2	FSB-3	FSB-4	FSB-5	FSB-6
# Sections	2	3	4	5	6
A Width	11"	14- ¹ / ₄ "	17- ¹ / ₂ "	20- ³ / ₄ "	24"
	279 mm	362 mm	445 mm	527 mm	610 mm
B Height	29"	29"	29"	29"	29"
	737 mm	737 mm	737 mm	737 mm	737 mm
C Depth	23- ¹ / ₄ "	23- ¹ / ₄ "	23- ¹ / ₄ "	23- ¹ / ₄ "	23- ¹ / ₄ "
	591 mm	591 mm	591 mm	591 mm	591 mm
D Vent Location	2- ⁵ / ₁₆ "	2- ⁵ / ₁₆ "	2- ⁵ / ₁₆ "	2- ⁵ / ₁₆ "	2- ⁵ / ₁₆ "
	59 mm	59 mm	59 mm	59 mm	59 mm
E Flue Diameter (Sidewall)	3"	3"	3"	3"	4"
	76 mm	76 mm	76 mm	76 mm	102 mm
F Flue Diameter (Chimney)	4"	4"	4"	4"	4"
	102 mm	102 mm	102 mm	102 mm	102 mm
Supply & Return Tappings	1- ¹ / ₄ " NPT	1- ¹ / ₄ " NPT	1- ¹ / ₄ " NPT	1- ¹ / ₄ " NPT	1- ¹ / ₄ " NPT
Natural Gas Inlet	1/2" NPT	1/2" NPT	1/2" NPT	1/2" NPT	1/2" NPT
Relief Valve NPT	3/4" NPT	3/4" NPT	3/4" NPT	3/4" NPT	3/4" NPT
Drain Valve NPT	3/4" NPT	3/4" NPT	3/4" NPT	3/4" NPT	3/4" NPT
Heating Water Content, Gal (Liters)	1.75 (6.6)	3 (11.4)	4.25 (16.1)	5.5 (20.9)	6.75(25.6)
Boiler Weight, less pkg - Lbs (KG)	225 (102.1)	265 (120.2)	322 (146.1)	370 (167.8)	431 (195.5)



2 - SAFETY SYMBOLS AND WARNINGS

2.1. Safety Symbols & Warnings

Boiler installation shall be completed by qualified agency.

⚠ 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.

⚠ WARNING

Do not tamper with or use this boiler for any purpose other than its intended use. Failure to follow these instructions could result in death or serious injury. Use only manufacturer recommended parts and accessories.

⚠ WARNING

Adding water to a hot boiler may result in heat exchanger failure. Before filling boiler verify heat exchanger is not hot. Failure to follow these instructions could result in death or serious injury.

⚠ CAUTION

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

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.

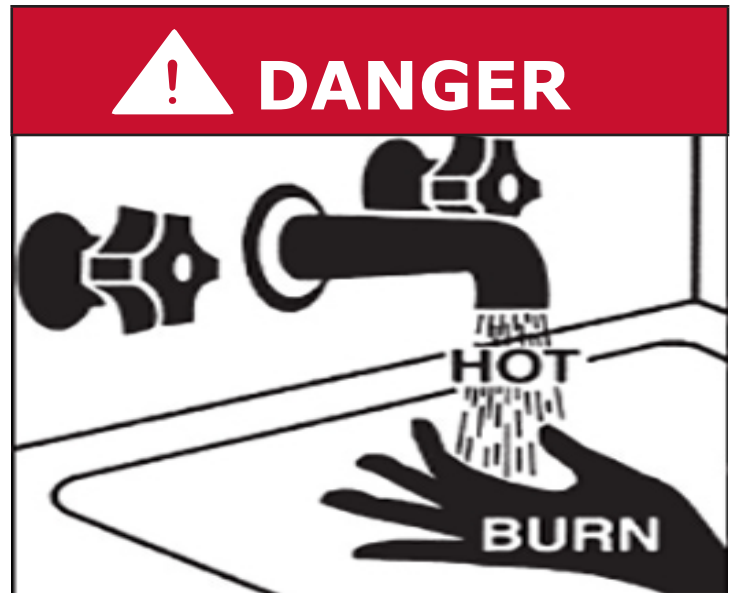
⚠ CAUTION

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.

FOR YOUR SAFETY READ BEFORE OPERATING



Hot Water Can Scald!

Water heated to temperature for clothes washing, dish washing and other sanitizing needs can scald and cause permanent injury.

Children, elderly, and infirm or physically handicapped persons are more likely to be permanently injured by hot water. Never leave them unattended in bathtub or shower. Never allow small children to use a hot water tap or draw their own bath.

If anyone using hot water in the building fits the above description, or if state laws or local codes require certain water temperatures at hot water taps, you must take special precautions:

- Use lowest possible temperature setting.
- Install some type of tempering device, such as an automatic mixing valve, at hot water tap or water heater. Automatic mixing valve must be selected and installed according to manufacturer's recommendations and instructions.
- Water passing out of drain valves may be extremely hot. To avoid injury:
 - Make sure all connections are tight.
 - Direct water flow away from any person.

Water Temperature Setting	1st Degree Burn Exposure Time For An Adult	2nd and 3rd Degree Burn Exposure Time For An Adult
120° F	1 minute	5 minutes
130° F	5 seconds	30 seconds
140° F	2 seconds	5 seconds
150° F	1 second	1.5 seconds
160° F	Instantaneous	0.5 seconds

Note: Warning for Infants, Children, and Elderly: Great care must be taken when exposing the aforementioned groups to warm or hot water as they can be badly burned in exposure times less than half of the time for an adult.

2 - SAFETY SYMBOLS AND WARNINGS

WARNING

This product contains Fibrous glass. Fibrous glass is a synthetic fiber made from tiny particles of glass. Fibrous glass has been classified as a possible human carcinogen. When disturbed as a result of servicing or repair, fibrous glass becomes airborne and, if inhaled, may be hazardous to your health. It can harm the eyes, skin, and the lungs. Airborne fibers from these materials have been listed by the State of California as a possible cause of cancer through inhalation. Adhere to the following precautions and procedures. Avoid breathing dust and contact with skin and eyes. Use NIOSH certified dust respirator (e.g., N95). Other types of respirators may be needed depending on the job site conditions. Current NIOSH recommendations can be found on the NIOSH website <https://www.cdc.gov/niosh/>. Approved respirators, manufacturers, and phone numbers are also listed on this website. Wear appropriate personal protective clothing to prevent skin contact, as well as gloves and eye protection. Wash skin daily at end of each work shift, and prior to eating, drinking, smoking, etc. Workers whose clothing may have been contaminated should change into uncontaminated clothing before leaving the work premises. Wash potentially contaminated clothes separately from other clothing. Rinse clothes washer thoroughly. Follow all Local, State and Federal guidelines for disposal.

NIOSH stated First Aid. Eye: Irrigate immediately.
Breathing: Fresh air.

WARNING

Fire, Explosion, Asphyxiation, Electrical shock hazard! Flooding will result in damages such as electrical problems, corrosion, inoperative parts, mold and other unforeseen issues which can occur over time. Any equipment determined by a professional as damaged by a flood, defined as excess of water or other liquid, shall be replaced. Failure to follow these directions will result in a Hazardous Situation.

WARNING

Combustion chamber insulation in this product contains ceramic fiber material. Ceramic fibers can be converted to cristobalite in very high temperature applications. The International Agency for Research on Cancer (IARC) has concluded, Crystalline silica inhaled in the form of quartz or cristobalite from occupational sources is carcinogenic to humans (Group1). Avoid breathing dust and contact with skin and eyes. Use NIOSH certified dust respirator (N95). This type of respirator is based on the OSHA requirements for cristobalite at the time this document was written. Other types of respirators may be needed depending on the job site conditions. Current NIOSH recommendations can be found on the NIOSH website <https://www.cdc.gov/niosh/topics/silica/>. NIOSH approved respirators, manufacturers, and phone numbers are also listed on this website. Wear long-sleeved, loose fitting clothing, gloves, and eye protection. Apply enough water to the combustion chamber lining to prevent dust. Wash potentially contaminated clothes separately from other clothing. Rinse clothes washer thoroughly.

NIOSH stated First Aid. Eye: Irrigate immediately.
Breathing: Fresh air.

WARNING

Keep boiler area clear and free from combustible materials, gasoline and other flammable vapors and liquids.
DO NOT obstruct air openings to the boiler room. Modification, substitution or elimination of factory equipped, supplied or specified components may result in personal injury or loss of life.
Installation and service of this boiler shall be performed by a qualified installer.
When this product is installed in the Commonwealth of Massachusetts the installation shall be performed by a Licensed Plumber or Licensed Gas Fitter.

2.2 For Your Safety

Installer shall verify that at least one carbon monoxide alarm has been installed within a residential living space or home, following the alarm manufacturer's instructions and applicable codes before putting the appliance into operation.

3 - LOCATING THE BOILER

⚠️ WARNING

Fire hazard. Do not install boiler on combustible flooring or carpeting. Refer to (Combustible Floor Addendum) included in literature envelope provide with boiler. Failure to follow these instructions could result in death or serious injury.

⚠️ CAUTION

Boiler weight exceeds 200 pounds (90.7 kg). Do not lift boiler without assistance.

NOTICE

Follow local regulations with respect to installation of CO detectors.

(Combustible Floor Addendum) included in literature envelope provide with boiler and outlined in *National Fuel Gas Code*, ANSI Z223.1/NFPA 54. **Do Not Install Boiler on carpeting.**

11. Verify boiler is supplied with correct type of gas, fresh air for combustion, and suitable electrical supply.

3.1 Installation Requirements

1. Installation must conform to requirements of authority having jurisdiction or, in absence of such requirements, to the *National Fuel Gas Code*, ANSI Z223.1/NFPA 54
2. Where required by authority having jurisdiction, installation must conform to the Standard for Controls and Safety Devices for Automatically fired Boilers, ANSI/ASME CSD-1.
3. This boiler series is classified as Category I. Vent installation shall be in accordance with "Venting of Equipment", of the *National Fuel Gas Code*, ANSI Z223.1/NFPA 54, or applicable provisions of local building codes.
4. Boiler has met safe lighting and other performance criteria with gas manifold and control assembly on boiler per latest revision of ANSI Z21.13/CGA 4.9.
5. Install such that gas ignition system components are protected from water (dripping, spraying, rain, etc.) during appliance operation and service, (circulator replacement, condensate trap, control replacement, etc.).
6. Locate boiler on level, solid base as near chimney as possible and centrally located with respect to heat distribution system as practical.
7. Verify you have the right size boiler before starting installation. See rating and capacity table.
8. When installed in utility room, door should be wide enough to allow largest boiler part to enter, or to permit replacement of another appliance such as water heater.
9. Boiler installed in building under construction, take care to insure clean combustion air supply during construction process. Airborne particulates such as from drywall dust and from fiberglass insulation can clog burner ports and cause incomplete combustion and sooting.
10. **FOR INSTALLATION ON NON-COMBUSTIBLE FLOORS ONLY** - For installation on combustible flooring special base shall be used. Please refer to

Figure 1 - Minimum Clearances To Combustible Construction

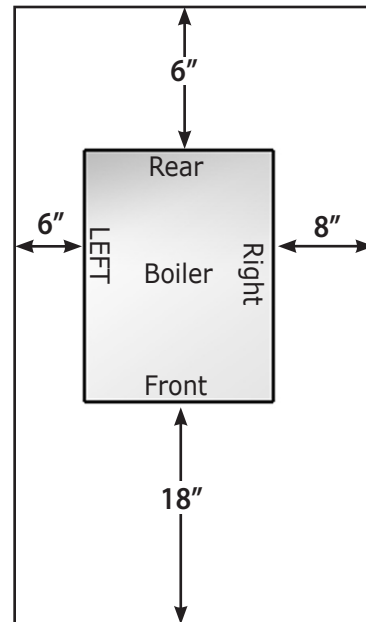


Table 1 - BOILER MINIMUM CLEARANCE TO COMBUSTIBLES

Unit	Minimum Clearances
Top	6" (152 mm)
Rear	6" (152 mm)
Right	8" (203 mm)
Left	6" (152 mm)
Front (Alcove)	18" (457 mm)
Flue/Vent Connector	6" (152 mm)
Near Boiler Piping	1" (24 mm)

Set unit on concrete or other noncombustible material base or floor. DO NOT INSTALL ON CARPETING.

* Definition of Alcove is three sided space with no wall in front of boiler. ANSI standard for alcove is 18 inches from front of appliance to leading edge of side walls as shown above.

3 - LOCATING THE BOILER

3.2 Boiler Location Considerations

- Ambient room temperature always above 32°F (0°C) to prevent the potential of freezing.
- Drainage of water (or water/ antifreeze solution) during boiler service or from safety relief valve discharge.
- Access to system water piping, gas supply, and electrical service.
- Boiler shall be installed on flat level surface which is capable of supporting the weight of the boiler, water, and equipment.
- Raise boiler above the floor on blocks if floor may get wet.
- Water, gas, and electrical connect to right side of boiler.
- Horizontal run to chimney shall be as short as possible.
- System piping exposed to freezing conditions: Use inhibited propylene glycol solutions certified by fluid manufacturer for use with closed water heating system. Do not use automotive or ethylene glycol.

Table 2 - CONTAMINANTS		
Items to Avoid	Products Which May Contain These Items	Areas Where These Items May Be Found
Chlorine, Fluorine, and Compounds	Spray cans containing chlorofluorocarbons Chlorinated waxes/cleaners Chlorine-based swimming pool chemicals Calcium chloride used for thawing Sodium chloride used for water softening Swimming pool or spa chemicals De-icing salts or chemicals Carbon Tetrachloride	Swimming pools and pool storage areas Laundry room (Note 2) Confined storage areas
Airborne Particulates	Drywall dust Road or gravel dust Dryer lint Cat litter	Construction or remodelling areas (Note 1) Laundry room (Note 2)
Acids, Solvents, etc.	Paint, Varnish, Turpentine, etc. Cleaning Solvents Hydrochloric acid/muriatic acid Cements, adhesives and glues	Photo processing plants Garages with workshops Furniture refinishing areas and establishments
Laundry Chemicals	Laundry detergents, bleaches, fabric softeners, etc. Antistatic fabric softeners (dryer sheets)	Dry cleaning/laundry areas and establishments
Other	Permanent wave solutions Refrigerants (Freon, etc) (only where the refrigerant may be leaking from the appliance)	Beauty shops Refrigeration repair shops
Notes:	<p>1. It is recommended the boiler be isolated and not operated during construction/ renovation. Excessive particles ingested by the boiler may accumulate in the flueway passages possibly resulting in unsafe operation. In this case, unit servicing shall include cleaning of flueway passages and burner ports.</p> <p>2. If locating boiler in laundry room is unavoidable, it is manufacturer recommended the room be generously ventilated (well in excess of combustible air requirements), and homeowner seal laundry supply containers, and minimize room vapors.</p> <p>3. Piping allowing fresh air in should also be considered. See Section 5-1.</p>	



⚠ WARNING

Burn and scald hazard! Safety relief valve shall be installed with spindle in ***upright position only***, following ASME BPV code. Failure to follow these instructions could result in death or serious injury.

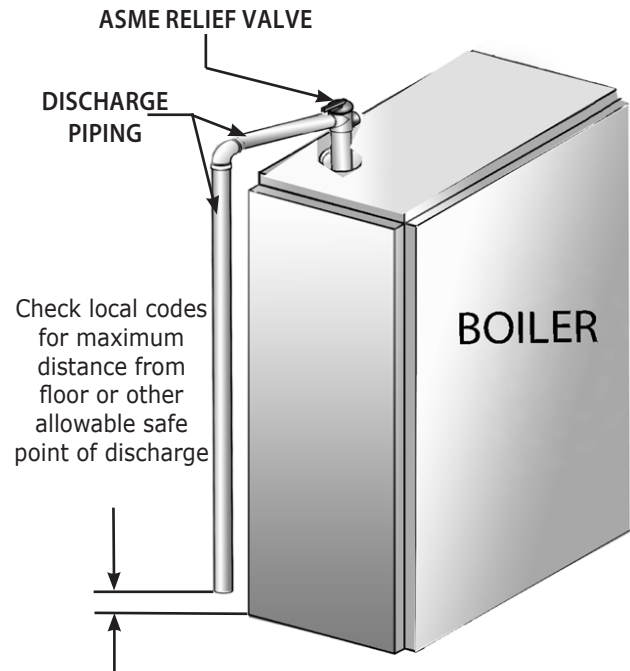
⚠ WARNING

Burn and scald hazard. Safety relief valve could discharge steam or hot water during operation. Install discharge piping per these instructions. Failure to follow these instructions could result in death or serious injury.

4.1 Safety Relief Valve Installation

1. Refer to local codes and appropriate *ASME Boiler and Pressure Vessel Code* for additional installation requirements. Install safety relief valve using pipe fittings provided with boiler. See Figure 2.
2. Install safety relief valve with spindle in vertical position.
3. Do not install shutoff valve between boiler and safety relief valve.
4. Install discharge piping from safety relief valve. See Figure 2.
 - Use $\frac{3}{4}$ " 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).

Figure 2 - Safety Relief Valve Discharge Piping



4 - CONNECTING SUPPLY AND RETURN PIPING

Figure 3 - Forced Hot Water Typical Piping

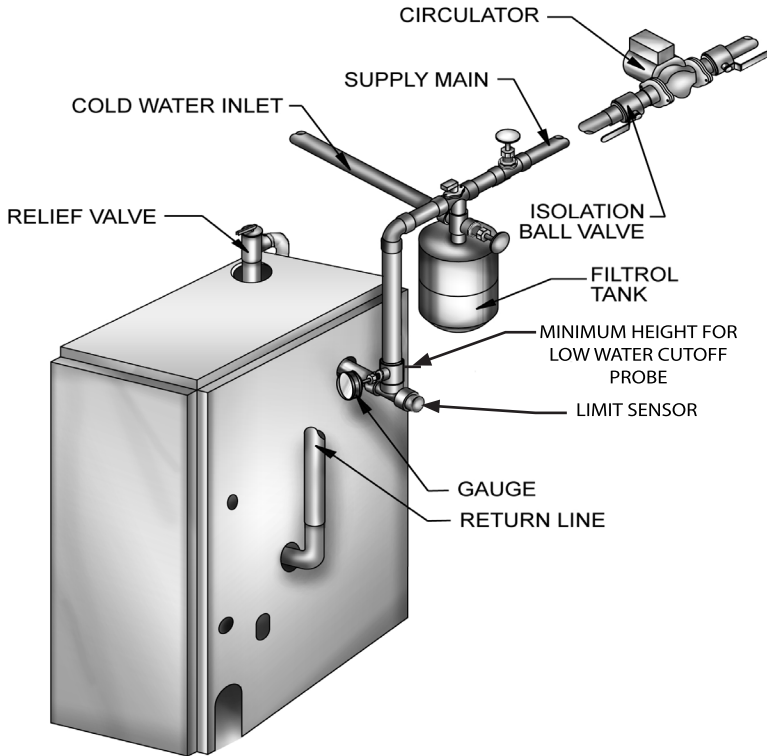
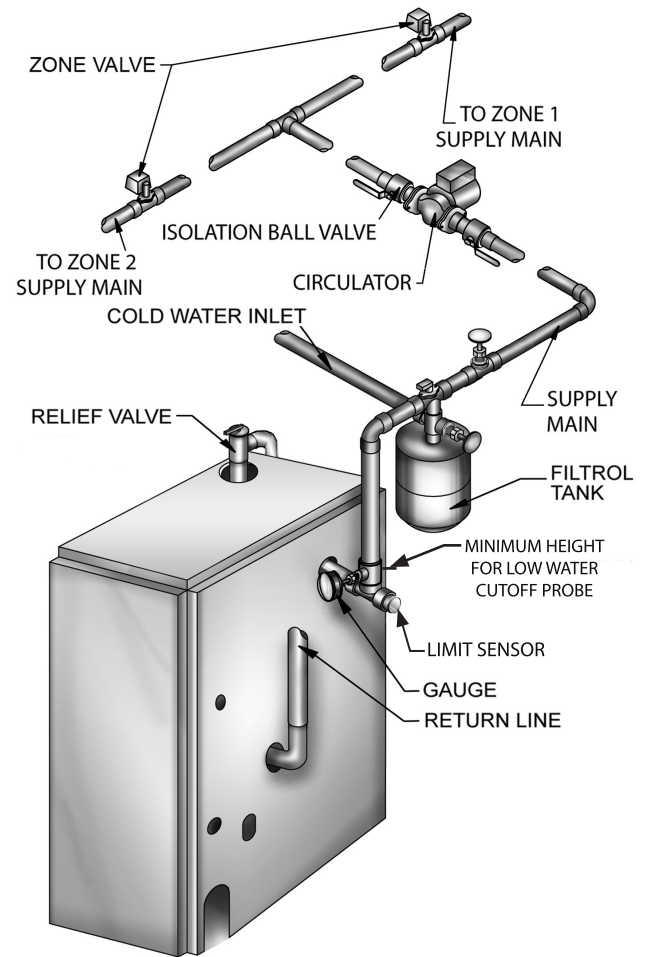


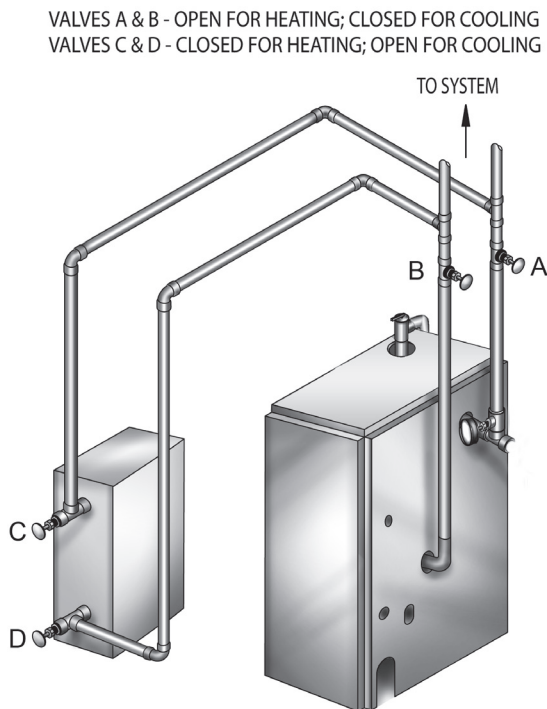
Figure 4 - Forced Hot Water Typical Piping With Zone Control Valve



4.2 Supply and Return Requirements

- Install radiation units (panels, radiators or cabinets) and supply and return mains first then make connections at boiler.
- Verify clean water supply is available when connecting cold water supply to water valve. Install sand strainer at pump when water supply is from well or pump.
- Provide low water cutoff device when boiler is installed above radiation level or as required by the Authority having jurisdiction, either provide as part of boiler or at time of boiler installation. Periodic inspection is necessary, as is flushing of float type devices, per manufacturers specific instructions. Refer to Figures 3 & 4 for minimum height for installation of LWCO. Refer to parts manual for LWCO kit. When using LWCO other than kit listed in parts manual follow specific LWCO manufacturer instructions.
- Boiler used in connection with refrigeration systems shall be installed so chilled medium is piped in parallel with heating boiler with appropriate valves to prevent chilled medium from entering heating boiler. See Figure 5.
- Boiler connected to heating coils located in air handling units exposed to refrigerated air circulation, piping system shall be equipped with flow control valves or other automatic means to prevent gravity circulation of boiler water during cooling cycle.

Figure 5 - Piping Arrangements For Boiler When Used In Connection With Refrigeration System



⚠ WARNING

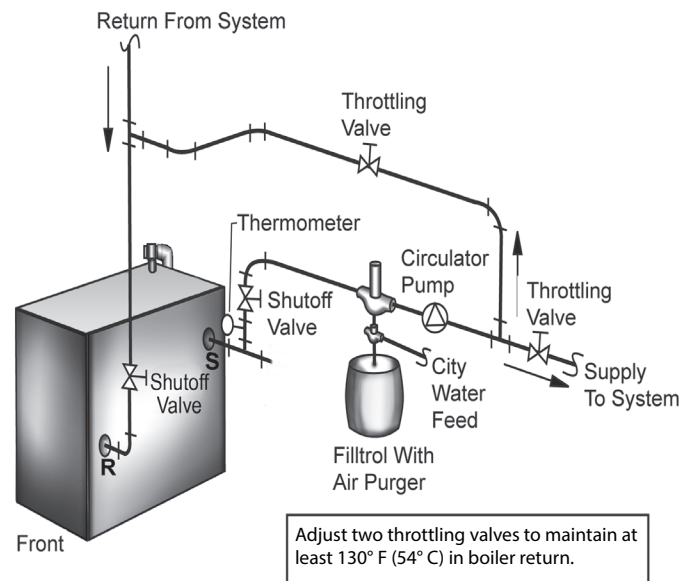
Asphyxiation hazard! Gradual flueway blockage resulting from condensate induced corrosion may block boiler passages, resulting in carbon monoxide and or flame rollout. Install bypass piping if return temperature is under 130°F. Failure to follow these instructions could result in death or serious injury.

Low Design Water Temperature Systems (Below 150°F) And Large Water Content Systems

Condensation is corrosive and can eventually cause severe damage to boiler and venting system.

- Minimum design return water temperature to prevent condensation in boiler and venting is 130°F. Minimum high limit setting is 150°F.
- Boiler used in heating systems where design water temperatures below 150°F are desired (e.g. radiant floor heating), a 3-way or 4-way mixing valve or suitable alternative is required to prevent low temperature return water from entering boiler. When using mixing valve, follow manufacturer's installation instructions.
- Boiler connected to system having large water content (such as former gravity system), suggest use of bypass piping. See Figure 6.

Figure 6 - Bypass Piping



5.1 Requirements

⚠ WARNING

Asphyxiation Hazard! Provide enough air openings to boiler/combustion area to dilute flue gases and allow for consistent, quality combustion. Do not obstruct air openings. Follow instructions below, to maintain adequate combustion air. Failure to follow these instructions could result in ignition failure, overheating, carbon monoxide, and accumulation of flue gases.

Provide combustion air and ventilation air in accordance with the section "Air for Combustion and Ventilation," of the *National Fuel Gas Code*, ANSI Z223.1/NFPA 54. Provide make-up air where exhaust fans, clothes dryers, and kitchen ventilation equipment interfere with proper operation. If inadequate makeup air is suspected it is always acceptable to add additional ventilation.

National Fuel Gas Code recognizes several methods of obtaining adequate ventilation and combustion air. Requirements of the authority having jurisdiction may override these methods.

- Engineered Installations. Must be approved by authority having jurisdiction.
- Mechanical Air Supply. Provide minimum of 0.35 cfm per (Btu/hr)/1000 for all appliances located within space. Additional requirements where exhaust fans installed. Interlock each appliance to mechanical air supply system to prevent main burner operation when mechanical air supply system not operating.
- All Indoor Air. Calculate minimum volume for all appliances in space. Use a different method if minimum volume not available.
 - A. Standard Method. Cannot be used if known air infiltration rate is 0.40 air changes per hour. See Table 3 for space with boiler only. Use equation for multiple appliances.

$$\text{Volume} \geq 50 \text{ ft}^3 \times \text{Total Input (Btu/hr)}/1000$$
 - B. Known Air Infiltration Rate. See Table 5-1 for space with boiler only. Use equation for multiple appliances. Do not use an air infiltration rate (ACH) greater than 0.60.

$$\text{Volume} \geq 21 \text{ ft}^3/\text{ACH} \times \text{Total Input (Btu/hr)}/1000$$

- C. Refer to National Fuel Gas Code for opening requirements between connected indoor spaces.
- All Outdoor Air. Provide permanent opening(s) communicating directly or by ducts with outdoors.
 - A. Two Permanent Opening Method. Provide opening commencing within 12 inches of top and second opening commencing within 12 inches of bottom of enclosure.
 - Direct communication with outdoors or communicating through vertical ducts. Provide minimum free area of 1 in² per 4,000 Btu/hr of total input rating of all appliances in enclosure.
 - Communicating through horizontal ducts. Provide minimum free area of 1 in² per 2,000 Btu/hr of total input rating of all appliances in enclosure.
 - B. One Permanent Opening Method. Provide opening commencing within 12 inches of top of enclosure. Provide minimum clearance of 1 inch on sides/back and 6 inches on front of boiler (does not supersede clearance to combustible materials).
- Refer to National Fuel Gas Code for additional requirements for louvers, grilles, screens and air ducts.
- Combination Indoor and Outdoor Air. Refer to National Fuel Gas Code for application information.

National Gas and Propane Installation Code Requires providing air supply in accordance with:

- Section 8.2 and 8.3 when combination of appliances has a total input of up to and including 400,000 Btu/hr (120 kW).
- Section 8.4 when combination of appliances has total input exceeding 400,000 Btu/hr (120 kW).
- Refer to Natural Gas and Propane Installation Code for specific air supply requirements for enclosure or structure where boiler is installed, including air supply openings and ducts.

Table 3 - Air Infiltration (ft ³ /h)							
Input (Btu/hr)	Standard Method	Known Air Infiltration Rate Method (ACH - Air Changes Per Hour)					
		0.1	0.2	0.3	0.4	0.5	0.6
42,500	2125	6375	3188	2125	1594	1275	1063
75,000	3750	11250	5625	3750	2813	2250	1875
112,500	5625	16875	8438	5625	4219	3375	2813
150,000	7500	22500	11250	7500	5625	4500	3750
187,500	9375	28125	14063	9375	7031	5625	4688



6.1 Removal of Existing Boiler From Venting 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. If this occurs, follow this test procedure:

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 appliance 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 restriction, leakage, corrosion and other deficiencies which could cause an unsafe condition.
3. Insofar 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 dryers and any appliance not connected to the common venting system. Turn on any exhaust fans, such as range hoods and bathroom exhausts, so they will operate at maximum speed. Do not operate a summer exhaust fan. Close fireplace dampers.
4. Place in operation the appliance being inspected. Follow the lighting instructions. Adjust thermostat so appliance will operate continuously.
5. Test for spillage at the draft hood relief opening after 5 minutes of main burner operation. Use flame of a match or candle, or 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, fireplace dampers and any other gas-burning appliance to their previous conditions of use.
7. Any improper operation of the common venting system should be corrected so the installation conforms with the *National Fuel Gas Code, ANSI Z223.1/NFPA 54*. When re-sizing any portion of the common venting system, the common venting system should be re-sized to approach the minimum size determined using the appropriate tables in Chapter 13 of the *National Fuel Gas Code, ANSI Z223.1/NFPA 54*.
8. The existing venting system shall be checked to ensure it meets local codes.

7 - VENT INSTALLATION

⚠ WARNING

Boiler and venting installations shall be performed by a qualified expert and in accordance with the appropriate manual. Installing or venting boiler or other gas appliance with improper methods or materials may result in serious injury or death due to fire or to asphyxiation from poisonous gases such as carbon monoxide which is odorless and invisible.

⚠ WARNING

Do not connect boiler to any portion of mechanical draft system operating under positive pressure.

7.1 Chimney Venting (Category I)

Chimney must be clean, right size, properly constructed and in good condition. A chimney shall be lined in a manner acceptable to the authority having jurisdiction.

1. Installation must conform to requirements of the authority having jurisdiction or, in absence of such requirements, to the *National Fuel Gas Code*, ANSI Z223.1/NFPA 54, or applicable provisions of the local building codes.

NOTICE

Boiler installation for chimney venting is not complete unless increaser fitting is located and secured.

2. Boiler's induced draft blower has 3" outlet. 3" X 4" increaser fitting is included in parts bag. Locate increaser fitting on outlet of induced draft blower, and secure gas-tight with bead of furnished silicone sealant. Increaser fitting is required on this boiler for Category I venting, and 4" is minimum permissible vent diameter. This does not imply vent connector is intended to be 4" diameter pipe. Vent connector shall be sized according to appropriate venting tables in the National Fuel Gas Code and may be required to be larger than 4" diameter.
3. These are high efficiency boilers with low stack or exhaust temperature.
4. Venting into masonry chimney without liner, line chimney from top to bottom with either:
 - A. Listed Type B vent pipe
 - B. Listed flexible vent liner
 - C. Poured ceramic liner.

5. Outside chimneys should not be used unless they are (choose one of the following):
 - A. Enclosed in a chase
 - B. Lined with Type B vent pipe
 - C. Use listed flexible vent liner
 - D. Use certified chimney lining system
6. Vent connector from boiler to chimney should run as directly as possible with as few elbows as possible.
7. Where possible, it is recommended to common vent water heater and boiler. Consult appropriate Vent Sizing Tables in *National Fuel Gas Code* for specific requirements of multiple appliance venting.
8. When boiler is only appliance connected to vent, Type B vent pipe is recommended for vent connector.
9. For horizontal runs slope pipe up from boiler to vent terminal not less than 1/4" in/ft (21 mm/m).
10. End of vent pipe must be flush with inside face of chimney flue. Use sealed-in thimble for chimney connection.
11. Fasten sections of vent pipe with 3 sheet metal screws at each joint to make rigid.
12. Use stovepipe wires or metal strapping every 5' to support pipe from above.
13. Do not connect to fireplace flue.
14. Do not install damper on this boiler.

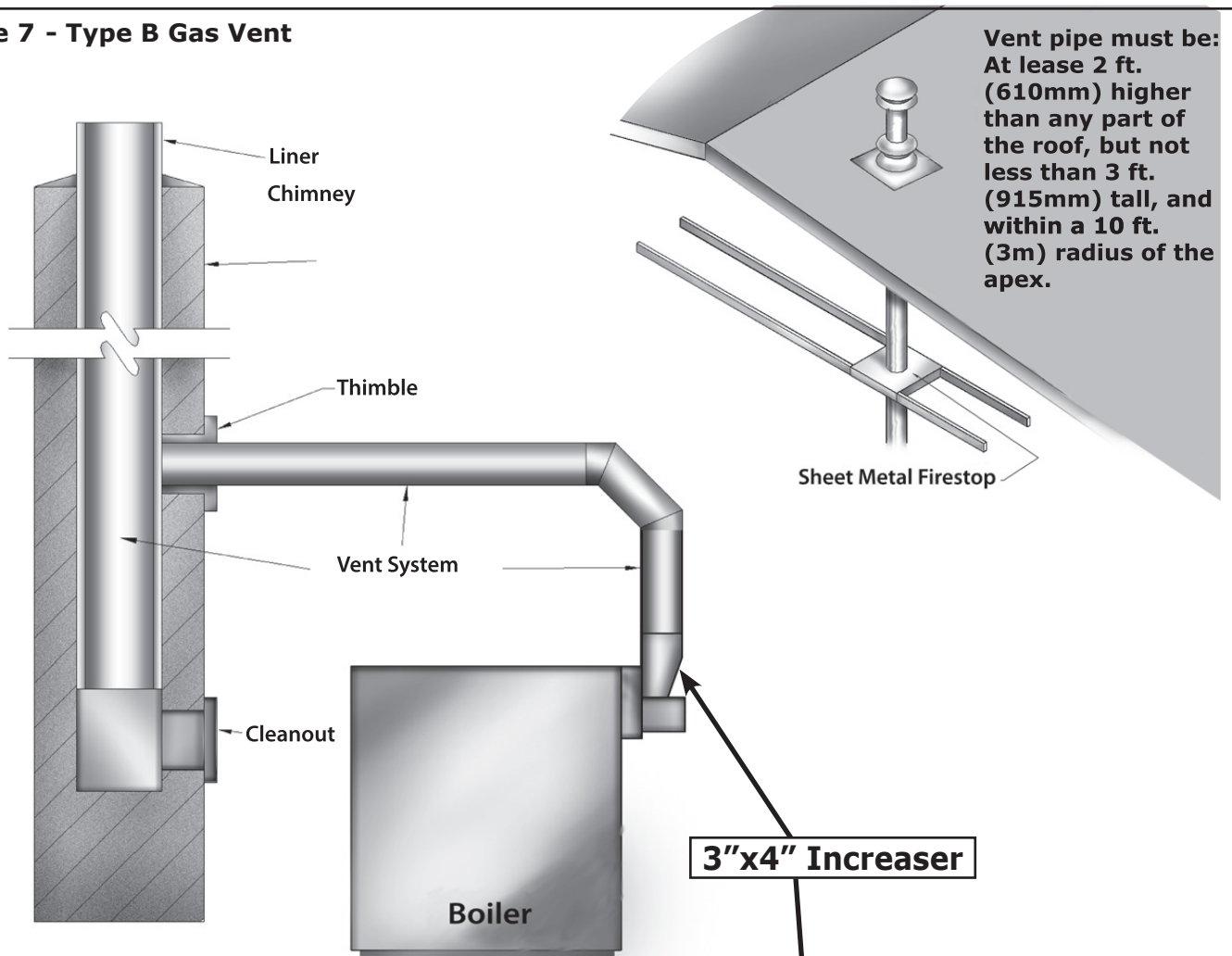
NOTICE

Minimum Vent Pipe Clearance - Wood and other combustible materials shall not be closer than 6" from any surface of single wall metal vent pipe. Listed Type B vent pipe or other listed venting systems shall be installed in accordance with their listing.

7.2 Requirements

- Use Type B vent pipe through crawl space. Where vent pipe passes through combustible wall or partition, use ventilated metal thimble. Thimble should be 4 inches larger in diameter than vent pipe.
- Boiler installed with single wall vent, must have 6" clearance between its surface and any combustible material. New Type B gas vent or flexible liner must be installed in accordance with instructions furnished with vent. Maintain clearances as specified for vent pipe.
- Verify vent pipe is fire-stopped where it goes through floor or ceiling. It should have approved vent cap with clearances from roof. If clearances are less than shown, have vent checked by local authorities. Figure 7.

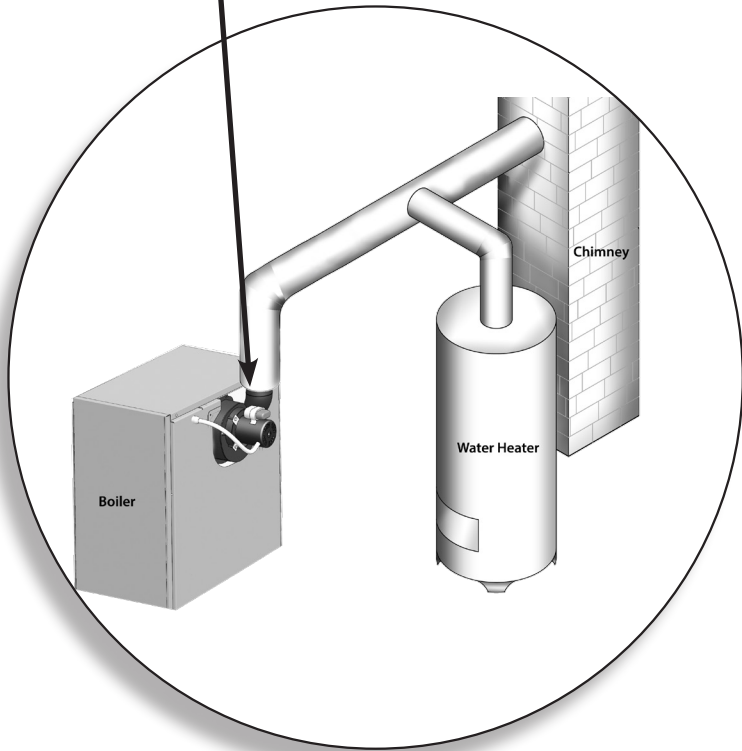
Figure 7 - Type B Gas Vent



⚠ WARNING
 3" x 4" increaser is required for Category I venting. Failure to follow these instructions could result in asphyxiation from poisonous gases such as carbon monoxide which is odorless and invisible and may result in serious injury or death.

CHECK YOUR CHIMNEY

For boilers connection to gas vents or chimneys, vent installations shall be in accordance with "Venting of Equipment", of the *National Fuel Gas Code*, ANSI Z223.1/NFPA 54, or applicable provisions of the local building codes.



INDUCED DRAFT HIGH EFFICIENCY BOILERS

8.1 Horizontal Venting (Category III)

Horizontal Requirements (Category III) venting systems must be installed in accordance with these instructions.

Maximum Horizontal Vent Length For Stainless Steel Vent Pipe - 30' Plus One 90° Elbow Plus Vent Terminal.

Minimum Horizontal Vent Length - 2' Plus One 90° Elbow Vent Termination.

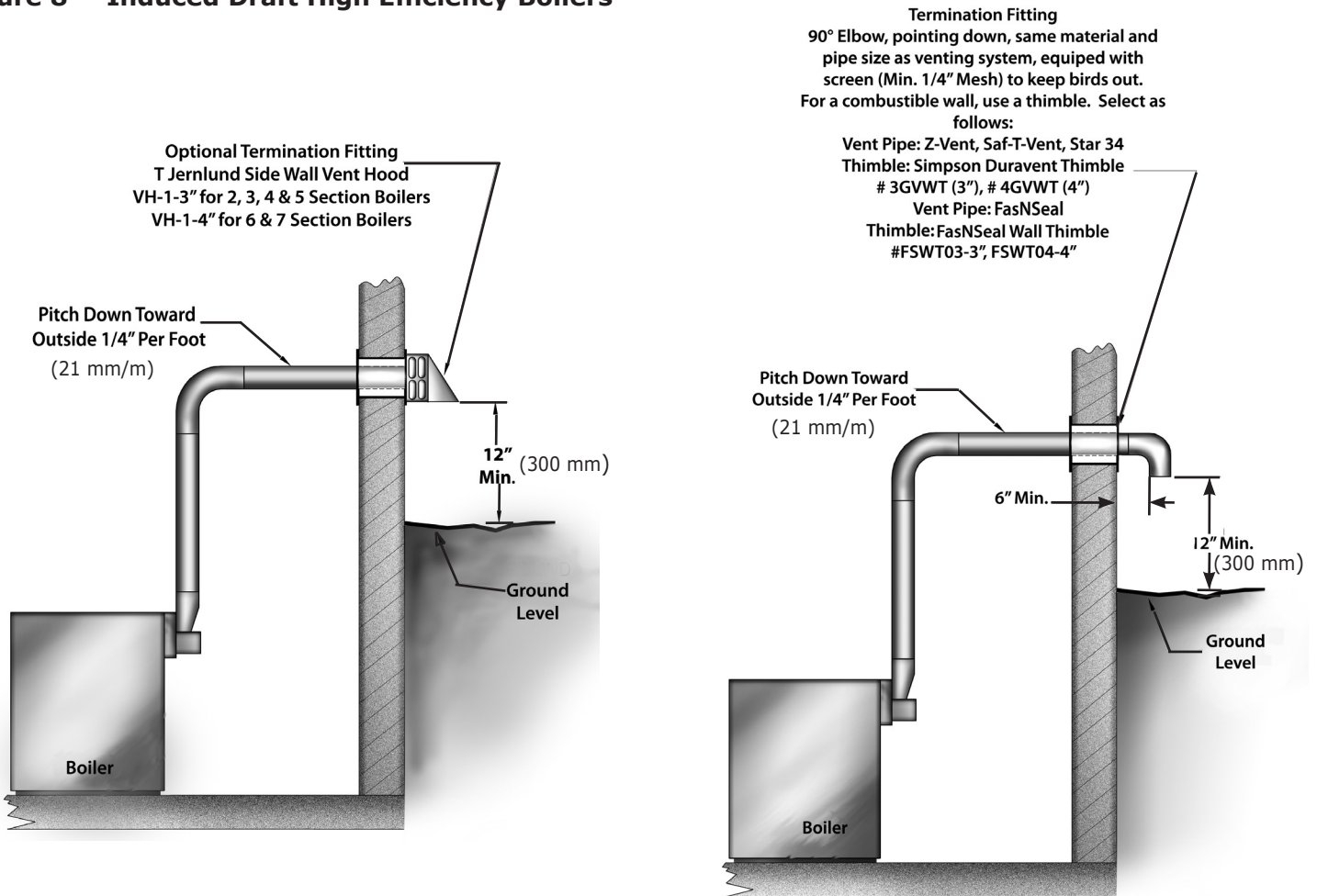
Additional elbows are equivalent to 6 feet of straight pipe for 4" diameter 90° elbow or 3 feet of straight pipe for 3" diameter 90° elbow. 2, 3, 4, 5, Section Boilers use 3" vent pipe; for 6 Section Boilers use 4" vent pipe.

For appliance adapter and terminations, that fit your specific installation needs, contact the approved vent material manufacturer listed under **CHOICE OF VENT PIPE MATERIAL**.

CHOICE OF VENT PIPE MATERIAL

- U. L. Listed Z-Flex Z-Vent Stainless Steel Vent Pipe.
- U. L. Listed Heat-Fab Saf-T-Vent Stainless Steel Vent Pipe.
- U. L. Listed Flex-L Star-34 Stainless Steel Vent Pipe.
- U. L. Listed ProTech Systems FasNSeal Stainless Steel Vent Pipe.

Figure 8 - Induced Draft High Efficiency Boilers



8 - HORIZONTAL VENTING INSTRUCTIONS

1. Boilers may be vented horizontally as shown in Figure 8. Vent pipe is pitched **down** from boiler to vent termination. Do not connect other appliances to this vent.
2. Vent Pipe Material:
 - A. UL Listed Z-Flex Z-Vent stainless steel vent pipe from boiler to vent termination,
-or-
 - B. UL Listed Heat-FabSaf-T-Vent stainless steel vent pipe from boiler to vent termination,
-or-
 - C. UL Listed Flex-L StaR-34 stainless steel vent pipe from boiler to vent termination,
-or-
 - D. UL Listed ProTech FasNSeal stainless steel vent pipe from boiler to vent termination.
3. Clearance to Combustible Materials: For stainless steel vent pipe maintain 6" minimum air space clearance to combustible materials.
4. Vent Pipe Size:
 - A. 2, 3, 4 and 5 section boilers use 3" vent pipe connected directly to the outlet of the induced draft blower.
 - B. 6 section boilers use 4" vent pipe, starting with a 3" to 4" stainless steel vent pipe transition that is connected directly to the outlet of the induced draft blower. Do not use 3" vent pipe on 6 section boilers.
5. Vent Pipe Length:
 - A. For stainless steel vent pipe, the maximum horizontal vent length is 30 feet plus one 90° elbow plus termination fitting.
 - B. Minimum horizontal vent length for all vent materials is 2 feet plus one 90° elbow plus termination fitting.
 - C. For additional elbows reduce the maximum vent length as shown:
 - 3" - 90° elbow - reduce vent length 3 feet per each 3" elbow
 - 4" - 90° elbow - reduce vent length 6 feet per each 4" elbow
6. Vent Termination Fitting: For all vent pipe materials, you may use either:
 - A. A 90° elbow pointing down, fitted with a minimum 1/4" mesh screen to keep out rodents and birds. The elbow shall be of the same material and size as vent pipe. The elbow exit should be at least 6" away from exterior wall as shown in Figure 8.
-or-
 - B. Tjernlund VH-1 Series side wall vent hood. For 2, 3, 4, 5 section boilers use VH-1-3". For 6 section boilers use VH-1-4".
7. Vent Pipe Termination Location See Figure 9:
 - A. When venting through combustible walls, combustible clearances must be considered. The VH-1 Side wall vent hood provides both the outside vent termination and a double wall pipe for passing through a combustible wall up to 8" thick (VH-1-4") or 9" thick (VH-1-3"). The hole in the wall must be 6 1/4" square for 3" vent pipe and 7 1/2" square for 4" vent pipe, in order to insert the VH-1 side wall vent hood. The VH-1 may also be used in noncombustible walls.
 - B. If the 90° elbow is the termination fitting of choice, then the single wall pipe will be passing through the side wall. For combustible walls, a UL listed thimble shall be used where the single wall pipe passes through the wall. For combustible walls using Z-Vent, Saf-T-Vent, or StaR-34 vent pipe, use the following:
 - 3" vent pipe - use Simpson's Duravent 3" thimble
 - 4" vent pipe - use Simpson's Duravent 4" thimble. Maximum wall thickness with this thimble is 7 inches.

For combustible walls using ProTech FasNSeal where the single wall vent pipe must pass through the side wall, a UL Listed FasNSeal wall thimble shall be used.

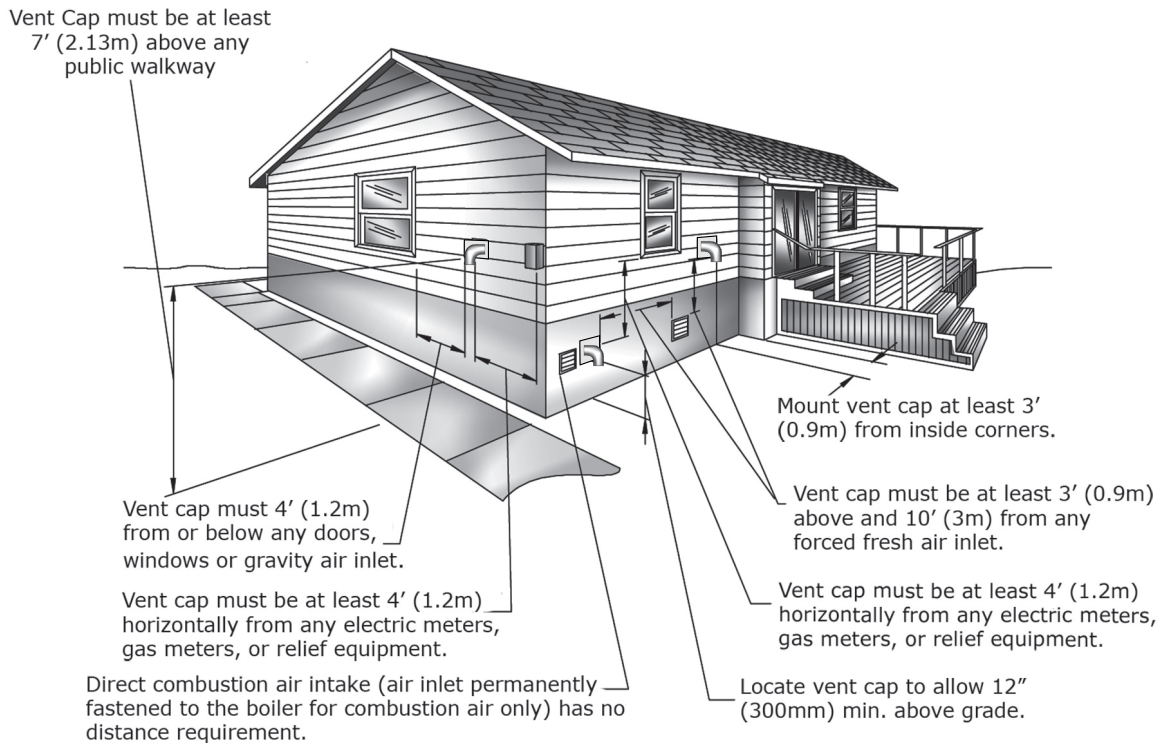
The thimble is adjustable for different wall thickness, with a maximum wall thickness of 7 inches. Seal the thimble along the outside edge of the plate with caulk or silicone and fasten to the wall with screws or nails.

- C. For single wall pipe through non-combustible walls, the hole through the wall need only be large enough to maintain the pitch of the vent pipe, and provide proper sealing. A thimble is not required for single wall pipe passing through noncombustible walls.

Example: 6 section boiler has 3 elbows plus the termination fitting. This means 2 additional 4" elbows will be used, at 6 feet per elbow. This is equivalent to 12 feet of pipe ($2 \times 6 = 12$), therefore maximum vent length is now 18 feet ($30 - 12 = 18$).

Figure 9 - Horizontal Venting Clearances

Note: If there is a potential for excessive winds, special consideration should be given to locate the vent termination away from the windward side of the building.



D. Vent Termination

- o Venting system shall terminate at least 3 feet (0.9 m) above any forced air inlet located within 10 feet (3 m).
- o Venting system shall terminate at least 4 feet (1.2 m) below, 4 feet (1.2 m) horizontally from, or 1 foot (300 mm) above any door, window, or gravity air inlet into any building.
- o Bottom of vent shall be located at least 12 inches (300 mm) above grade.
- o Termination of vent shall be not less than 7 feet (2.13 m) above adjacent public walkway.
- o Vent terminal shall not be installed closer than 3 feet (0.9 m) from inside corner of L shaped structure.
- o Termination of vent should be kept at least 3 feet (0.9 m) away from vegetation.
- o Venting system shall not terminate underneath any deck, patio, or similar structure.
- o **United States** - Terminate vent system at least 4 feet (1.22 m) horizontally from, and in no case above or below, unless a 4 feet (1.22m) horizontal distance is maintained, from electric meters, gas meters, regulators and relief equipment. See Figure 9.
- o **Canada** - Terminate vent system at least 6 feet (1.83 m) horizontally from, and in no case above or below, unless 6 feet (1.83 m) horizontal distance is maintained, from gas and electric meters, regulators and relief equipment.
- o Venting system shall terminate at least 4 feet below any eave, soffit, or roof overhang.
- o Place vent on wall away from prevailing winter wind. Locate or guard vent to prevent accidental contact with people or pets.
- o Terminate vent above normal snow-line. Avoid locations where snow may drift and block vent. Ice or snow may cause boiler to shut down if vent becomes obstructed.
- o Under certain conditions, flue gas will condense, forming moisture. Take steps to prevent building materials at vent terminal from being damaged by exhaust of flue gas.

8 - HORIZONTAL VENTING INSTRUCTIONS

8. Joining and Sealing the Vent Pipe:

The vent pipe needs to be both watertight and gas tight. Seal all joints and seams as follows:

- A. For Z-Flex Z-Vent stainless steel vent pipe use a high temperature silicone sealant rated for 550°F. The outside of the male end and inside of the female end of the pipe must be cleaned with brake cleaner before applying silicone bead. For 3" vent pipe runs begin with the male end of the vent pipe over the boiler's induced draft blower outlet. For 4" vent pipe runs begin with a 6" length of 3" Z-Vent over the boiler's induced draft blower outlet, to which an even bead of high temperature silicone sealant should be applied. Then connect the 3" Z-Vent to a Z-Vent 3" to 4" reducer. Then continue the 4" Z-Vent pipe run by connecting the 4" male end of the Z-Vent to the reducer. (A locking band may be used around this joint for additional support.) Then following the sealing instructions, push the 4" male end of the Z-Vent over the 4" increaser fitting. When using the Tjernlund VH-1 vent hood, the female end (flared end) of the vent pipe will be connected to the termination hood. The male end of the vent hood must be crimped before pushing the Z-Vent over the vent hood's connecting pipe. Before the pipes are joined, apply a ¼" bead of silicone one inch from the end of the male end. Then push the pipes together as far as they will go making sure any seams are aligned and oriented upward. Now apply another bead of silicone around this joint and smooth out. Then use a Z-Flex locking band around the center of the joint.
1. Apply the high temperature silicone approximately one inch from the end, around the male end of the pipe in an even ¼" bead.
 2. Pipes can now be pushed together as far as they will go. The seams on pipe should be aligned and oriented upward in all horizontal appliances. Apply another bead of silicone around this joint and smooth out.
 3. Slide locking band over center of joint and tighten gear clamps. Make sure locking band is centered on joint.
 4. Check all joints and seams for gas tightness.
 5. Horizontal venting shall have slope not less than ¼" every 12 inches (21 mm/m) downward away from the boiler to prevent collection of condensate throughout the assembly.
 6. Allow sealant to cure for 24 hours before operating appliance.

- B. For Heat-Fab Saf-T-Vent stainless steel vent pipe use a high temperature silicone sealant rated for 550°F The outside of the male end and inside of the female end of the pipe must be cleaned before applying the silicone bead. For 3" vent pipe runs, the male end of the vent pipe which goes over the outlet of the boiler's induced draft blower must be crimped. The vent pipe should be crimped as minimal as possible to provide a tight fit over the outlet. After crimping is completed follow the instructions for applying silicone sealant. For 4" vent pipe runs, begin with a Saf-T-Vent 3" to 4" increaser fitting over the boiler's induced draft blower outlet, to which an even bead of high temperature silicone sealant should be applied. Then continue the 4" Saf-T-Vent pipe run by connecting the 4" male end of the Saf-T-Vent to the increaser. (A locking band may be used around this joint for additional support.) The vent flow must be in the direction indicated on the vent pipe. When using the Tjernlund VH-1 vent hood, the female end (flared end) of the vent pipe will be connected to the termination hood. Apply high temperature silicone in an even ¼" bead approximately ¼" to ⅜" from the end of the vent hood's connecting vent pipe. Also, run a similar size bead of silicone sealant down the seam weld of the vent pipe. Then push the female end over the vent hood's connecting vent pipe.
1. Apply the high temperature silicone around the male end of the pipe (without the tabs) in an even ¼" bead. Silicone bead should be approximately ¼" to ⅜" from the end of the male end. Also, run a similar size bead of silicone sealant down the seam weld at the end of each joint.
 2. Pipes can now be pushed together as far as they will go. The seams on the vent pipe should be aligned and oriented upward in all horizontal appliances. With a moistened finger or flat tool, spread any sealant that squeezes out around the circumference of the joint.
 3. Attach the sections together with the locking rings and tabs (except at the blower outlet where no locking ring exists.) Inspect the joint to ensure that flue gases will not leak. If necessary apply additional sealant around the joint.
 4. Horizontal venting shall have a slope not less than ¼" every 12 inches (21 mm/m) downward away from the boiler to prevent collection of condensate throughout the assembly.
 5. Allow the sealant to cure for 24 hours before operating the appliance.

8 - HORIZONTAL VENTING INSTRUCTIONS

- C. For Flex-L StaR-34 stainless steel vent pipe use a high temperature silicone sealant rated for 550°F. Before applying silicone, the outside of the male end and inside of the female end of the pipe must be cleaned using a cleaner, such as methyl ethyl ketone (MEK) or naphtha. For 3" vent pipe runs, begin with the male end of the vent pipe over the boiler's induced draft blower outlet. For 4" vent pipe runs begin with a StaR-34 3" to 4" increaser fitting over the boiler's induced draft blower outlet. For both 3" and 4" vent pipe runs, apply a bead of silicone sealant around the blower outlet and around the inside of the male end of vent pipe going over the blower's outlet. When using the Tjernlund VH-1 vent hood, the female end (flared end) of the vent pipe will be connected to the termination hood. Apply high temperature silicone in an even ¼" bead approximately ¼" from the end of the vent hood's connecting vent pipe. Also, run a similar size bead of silicone sealant down the seam weld of the vent pipe. Then push the female end over the vent hood's connecting vent pipe. Now fill in the channel inlet with silicone sealant. Do not try to insert the joiner band, instead fasten the vent pipe to the vent hood's pipe with a steel gear clamp.
1. Apply the high temperature silicone around the male end of the pipe in an even ¼" bead. Silicone bead should be approximately ¼" from the end of the male end. Also, run a similar size bead of silicone sealant down the seam weld at the end of each joint.
 2. The seams on the vent pipe should be aligned and oriented upward in all horizontal vent pipe runs.
 3. Insert the male end of one into the female end of the other. Push the pipe together so the female end rests up against the stop bead of the male end.
 4. Insert a StaR-Joiner Band into the inlet of the beaded channel. Feed the Joiner Band in so it makes its way around the pipe, back to the channel inlet and it overlaps itself by about ½".
 5. Cut the excess Joiner Band so it lays flat in the beaded channel. Fill the inlet of the beaded channel with high temperature silicone. Smooth out the silicone over the channel inlet and the silicone between the female end and the stop bead of the male end.
 6. Horizontal venting shall have a slope not less than ¼" every 12 inches (21 mm/m) downward away from the boiler to prevent collection of condensate throughout the assembly.
 7. Allow the sealant to cure for 24 hours before operating the appliance.
- D. For ProTech Systems FasNSeal stainless steel vent pipe no cleaning fluid is required. For 3" vent pipe runs on 2, 3, 4 and 5 section boilers, begin by locating the FasNSeal Ametek Adapter over the boiler's induced draft blower. Continue the vent pipe run with 3" FasNSeal vent pipe. For 6 section boilers, begin by locating the FasNSeal Ametek Adapter over the boiler's induced draft blower. Then connect a FasNSeal 3" to 4" increaser to the 3" adapter outlet. Continue the vent pipe run with 4" FasNSeal vent pipe. Other than the Ametek Adapter and increaser fitting, DO NOT use 3" vent pipe on 6 section boilers. FasNSeal vent pipe is joined and sealed by the use of an internal sealing gasket and a locking band on the female end of each vent pipe. All components should be examined for possible shipping damage prior to installation. Align all vent pipe seams and orient upward in all horizontal applications. Adjustable vent lengths are available for 4" diameter vent piping. For 3" diameter vent piping, square cut male end at the desired length. For 2, 3, 4 and 5 section boilers using the VH-1-3" vent hood, connect the FasNSeal Vent to the VH-1-3" vent hood using FasNSeal Adapter #FSC-DUN-3. This adapter has no internal sealing gasket. To attach the adapter to the vent hood, crimp the 3" vent hood pipe, apply a ¼" bead of high temperature silicone sealant around the outside of the vent hood's crimped connecting pipe and a similar bead of high temperature silicone around the inside of the FasNSeal adapter. After pressing the two pipes together and tightening the locking band, finish creating a complete seal by filling the FasNSeal adapter's notched hole with high temperature silicone. For 6 section boilers using the VH-1 - 4" vent hood, an adapter is not required. The 4" FasNSeal vent pipe connects directly to the VH-1- 4" vent hood, and is joined and sealed by the internal gasket and locking band.
- To join and seal the FasNSeal vent pipe:
1. Insert male end into female section.
 2. Push the units together as far as possible.
 3. Firmly tighten locking band with a nut driver.
 4. DO NOT penetrate the FasNSeal vent pipe with fasteners.
 5. Horizontal venting shall have a slope of not less than ¼" every 12 inches (21 mm/m) downward away from the boiler to prevent the collection of condensate throughout the assembly.

8 - HORIZONTAL VENTING INSTRUCTIONS

9. Support Spacing:

Do not restrict thermal expansion movement of the vent. Vent pipe must expand and contract freely with temperature change. Each run of vent piping shall be supported as follows:

- A. Z-Flex stainless steel vent piping requires a loose fitting metal strap or similar support at each joint at a maximum of 4 feet between supports.
- B. Heat-Fab stainless steel vent piping requires a support for every 6 feet of horizontal piping run. The support must be secured using at least #10 fasteners to a solid material (solid masonry or wood framing or blocking.) Do not fasten to drywall sheathing using hollow wall anchors. Each support will be 1½ inch lower than the previous support when spaced 6 feet apart.
- C. Flex-L stainless steel vent piping requires a loose fitting metal strap or similar support at each joint at a maximum of 4 feet between supports.
- D. ProTech stainless steel vent piping requires one loose fitting FasNSeal support strap for every 6' of horizontal vent.

10. If horizontal vent must go through a crawl space or other unheated space, cool temperatures will cause flue gases to continuously condense inside the vent pipe. Do not insulate the vent pipe. It must be visible for monthly inspection. Insure that the vent pipe is properly pitched away from the boiler, with no low spots, so that condensate in the vent will drain away from the boiler. An insulated enclosure or chase, with access for inspection and servicing of the vent, may be required to prevent freezing of liquid condensate. Consult the vent pipe manufacturer's instructions for specific guidelines.
11. At beginning of each heating season and monthly during the heating season, check all vent pipes and vent terminal to make sure there are no obstructions. Periodically clean the screen in the vent terminal.

9 - OPTIONAL HORIZONTAL VENTING INSTRUCTION

9.1 Optional Horizontal Venting

Horizontal venting with a power venter is an alternate method of sidewall venting. This boiler is CSA listed for sidewall venting with standard single wall galvanized or Type B vent pipe when using the following power venter kits, which were specifically sized for these boilers:

Table 4 - Field Controls	
Number Of Boiler Sections	Field Controls Power Venter
2, 3, 4, 5	SWG-4
6	*SWG-5

* SWG-5 requires purchase of CK-43F control kit.

Reasons for the use of a power venter for sidewall venting:

1. Preferred by some local codes.
 2. Installation requires a vent piping run more than 30' (9.1 m) (less than 50' (15.2 m)).
 3. Boiler installation site experiences gusting or high winds. Power venter can prevent boiler from short cycling due to gusting or high winds, by providing vent exhaust pressures greater than boiler's induced draft blower alone.
 4. Installers or homeowners prefer negative pressure vent system instead of positive pressure vent system.
 5. May be more cost effective than stainless steel venting, particularly at longer vent length. Field control SWG-4 Power Vent Kit includes: SWG-4HD Power venter, MG-1 4" barometer draft controller and CR-43F controls kit. Purchase SWG-5 field controls power venter with purchase of CR-43F control kit.
- Confirm installation of a power venter is allowed by local codes.
 - Follow power venter manufacturer installation instructions supplied with power venter kits.
 - Although power venter is equipped with a fan, the fan on boiler remains and unaltered when using a power venter.
 - When sidewall venting, flue gases shall be vented to point in relation to the prevailing wind to disperse flue gas into the air without being blown back at the building causing discoloration, or into the building through doors or windows causing odors.
 - Under certain conditions flue gases will condense forming moisture. Take steps to prevent building materials at the vent terminal from being damaged by exhausted flue gas.
 - When installing single wall galvanized vent pipe for power venting follow manufacturer's power venter installation instructions for layout, and location of barometric draft control and termination connections.
 - When joining and sealing single wall galvanized or Type B vent piping, use RTV silicone sealant with minimum temperature rating of 400°F.
 - A. 3" vent pipe runs, start with female end of the vent pipe over boiler's induced draft blower outlet.
 - B. 4" vent pipe runs start with supplied galvanized 3" to 4" increaser fitting over the induced draft blower outlet. Place female end of 4" vent pipe over the increaser fitting.
 - When joining pieces of single wall galvanized vent pipe, use a large bead of silicone at the joint to ensure leak proof connection.



⚠ 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.

⚠ WARNING

Fire, explosion, asphyxiation and burn hazard. Boiler piping and gas connections shall be leak tested before placing boiler in operation. Failure to follow these instructions and or improper installation could result in death or serious injury.

⚠ CAUTION

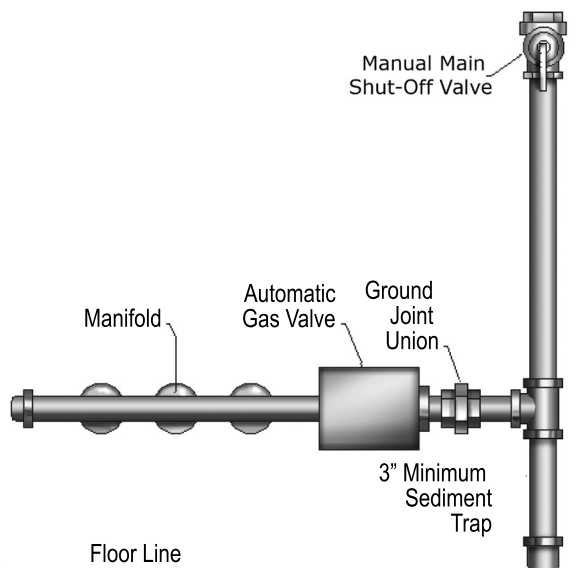
WHAT TO DO IF YOU SMELL GAS

- 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.

NOTICE

Use of CSA approved corrugated, semi-rigid stainless steel tubing with polyethylene jacketing is approved for use with boilers following tubing manufacturer's instructions. Use of flexible appliance gas tubing also known as a "whip" is not allowed per NFPA 54.

Figure 10 - Gas Piping At Boiler



10.1 Connecting Gas Piping

Gas line enters boiler from right side. Flexible gas connectors must never breach any boiler openings.

- Use piping materials and joining methods acceptable to authority having jurisdiction. In absence of such requirements *National Fuel gas Code, ANSI Z223.1/ NFPA 54*.
- All pipe compound must be resistant to liquefied petroleum gas.
- Install ground joint union in gas supply line between shut-off valve and boiler controls.
- Install sediment trap upstream of gas controls.
- Use two pipe wrenches when making connection to gas valve to keep it from turning.
- Install manual shut-off valve in vertical pipe about 5 feet (1.5 m) above floor. See Figure 10.
- Tighten all joints securely.
- Propane gas connections should only be made by licensed propane installer.
- Two-stage regulation should be used by propane installer.
- Propane gas piping should be check by propane installer.

Check Gas Supply

Gas pipe must be correct size for length of run and for total BTU per hour input of all gas utilization equipment connected to it. See Gas Table 5 & 6 for proper size. Be sure your gas line complies with local codes and gas company requirements.

Check Gas Piping

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

- Pressure test over 1/2 psig (3.5 kPa). Disconnect boiler and its individual gas shutoff valve from gas supply system.
- Pressure test at 1/2 psig (3.5 kPa) or less. Isolate boiler from gas supply system by closing manual gas shutoff valve. See Figure 10.
- Locate leakage using gas detector, noncorrosive detection fluid, or other leak detection method acceptable to authority having jurisdiction.
- Correct leaks immediately and retest.

10 - GAS SUPPLY PIPING

Table 5 - 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

Table 6 - 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:**

Measure length of pipe or tubing from gas meter or propane second stage regulator.

Table 7 - Gas Pressure		
PRESSURE	GAS	
	NATURAL	PROPANE
MIN. SUPPLY	5" w.c.	11" w.c.
MAX. SUPPLY	13.5" w.c.	13.5" w.c.
MANIFOLD	3.5" w.c.	10" w.c.

Verify minimum pressure while boiler is operating.
Verify maximum pressure when boiler is not operating



11 - ELECTRICAL WIRING

⚠ 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.

11.1 Electrical Wiring Requirements

See wiring diagram Figure 12 for details. Refer to Ladder Diagram from document envelope received with boiler.

Electrically bond boiler when installed to ground in accordance with requirements of authority having jurisdiction or in the absence of such requirements, with the *National Electrical Code*, ANSI/NFPA 70

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

Circulator harness is factory wired to control module. Connect harness to circulator in field. See Figure 11.

Electric Power Supply

Run a separate 115 volt circuit from separate over current protective device 15 ampere circuit in electrical service entrance panel.

Refer to parts manual for LWCO kit. When using LWCO other than kit listed in parts manual follow specific LWCO

manufacturer instructions.

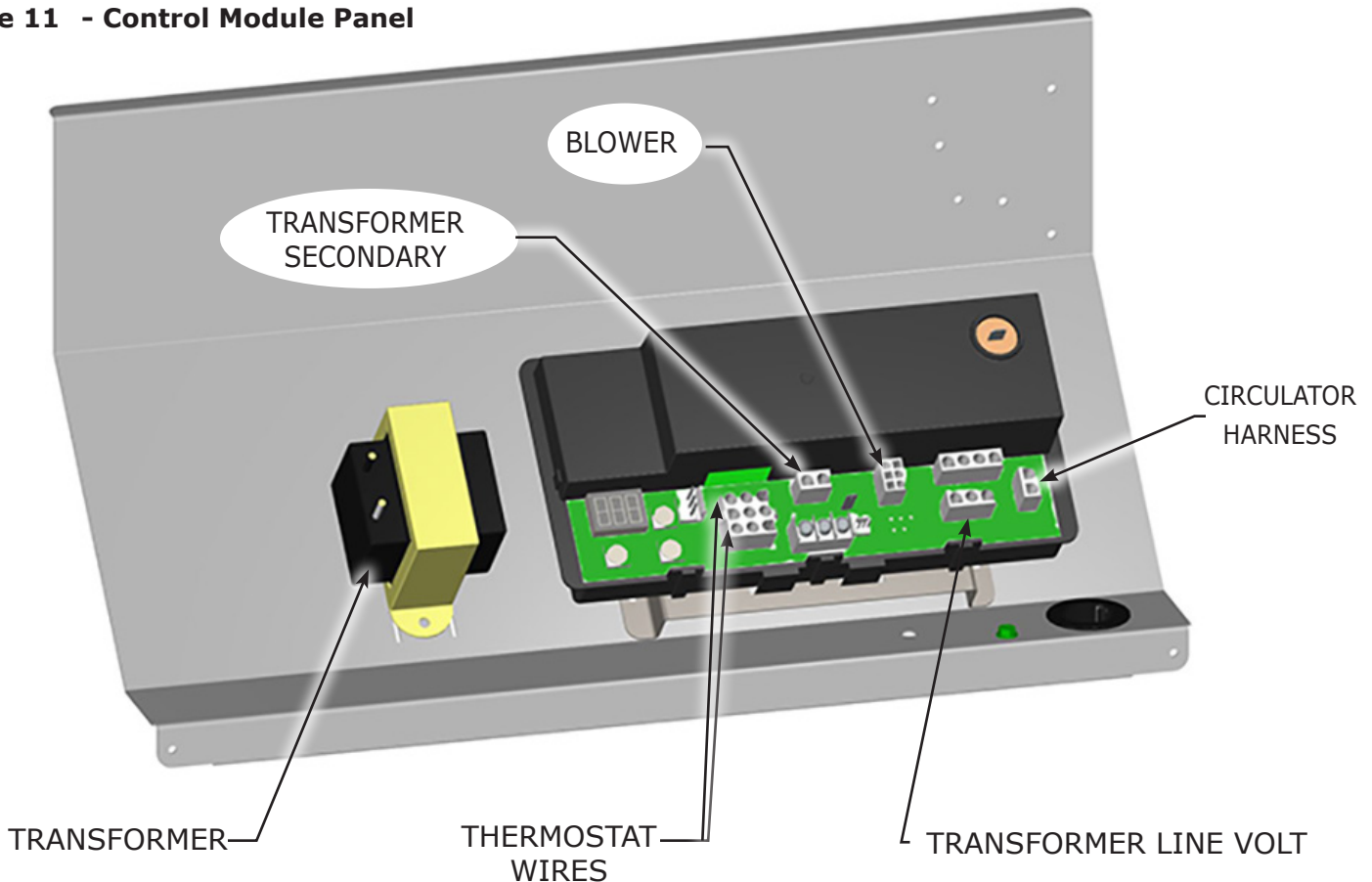
Connect 115 volt power supply to terminals L1 (HOT) and L2 inside J box on right side panel.

Run 14 gauge or heavier copper wire from boiler to grounded connection in service panel or properly driven and electrically grounded ground rod.

11.2 Thermostat Installation

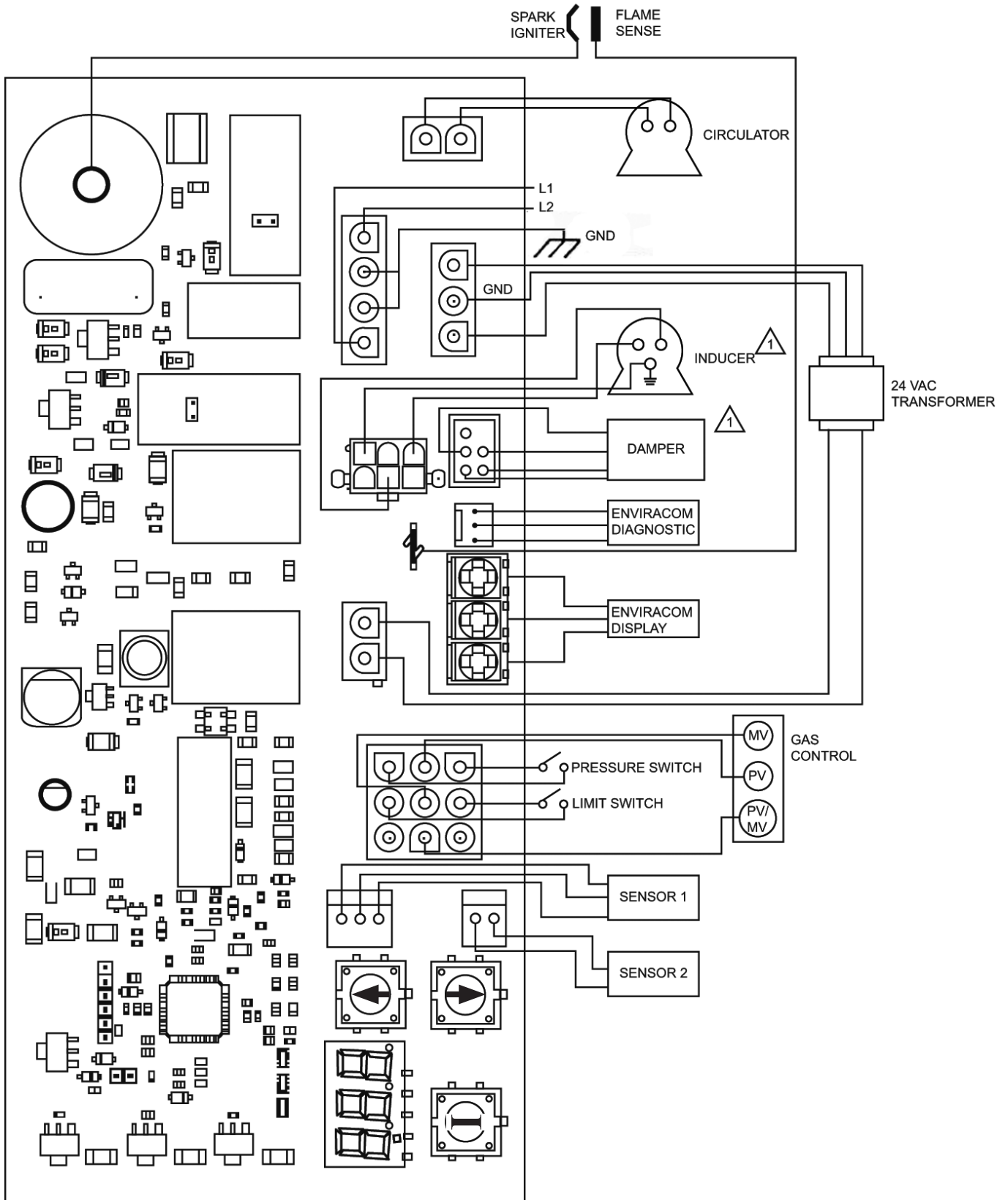
1. Thermostat should be installed on an inside wall about four feet above the floor.
2. NEVER install a thermostat on an outside wall.
3. Do not install a thermostat where it will be affected by drafts, hot or cold pipes, sunlight, lighting fixtures, televisions, a fireplace, or a chimney.
4. Check thermostat operation by raising and lowering thermostat setting as required to start and stop the burners.
5. Instructions for the final adjustment of the thermostat are packaged with the thermostat (adjusting heating anticipator, calibration, etc.)
6. Set heat anticipator at .2 amps. 24 volt thermostat connects to yellow low voltage wires labeled T-T.


Figure 11 - Control Module Panel



12 - WIRING DIAGRAM

Figure 12 - Control Module - Wiring Diagram



 OPTIONAL DEPENDING ON CONFIGURATION
 Damper is not an option.



13.1 Sequence of Operation

1. Thermostat calls for heat, control relay contacts.
2. Circulator pump is powered through terminals C1 and C2. Control holds off burner and attempts to satisfy thermostat with residual boiler heat.
3. Induced draft blower is powered.
4. When blower gets up to speed and blower suction pressure reaches pressure switch set point, pressure switch contacts close sending 24 volts to pilot control from transformer secondary.
5. Pilot gas valve opens and spark initiates to light pilot burner.
6. When pilot flame is proven, spark drops out.
7. Main gas valve opens and pilot burner ignites main burners.
8. If boiler water temperature reaches high limit set point, high limit contacts open, cutting power to blower and pilot control. Burners extinguish and blower stops. Circulator pump continues to run as long as the thermostat continues to call for heat. When boiler water temperature drops past the high limit set point and through the differential, high limit contacts close, repeating steps 3-7.
9. If venting system becomes blocked, blower suction pressure will drop below pressure switch set point, opening pressure switch contacts and cutting power to pilot control. Burners will extinguish, but blower will remain powered as long as thermostat continues to call for heat. If venting system clears, steps 4-7 will repeat.
10. Thermostat is satisfied, ending call for heat. Relay coil is de-energized, opening contacts. Burners extinguish. Blower and circulator pump stop.

14.1 Filling System

- Close air vents on all radiation units. Open valves to these units.
- Verify boiler and expansion tank drain valves are closed. Air bleed screw on tank drain fitting should be closed.
- Open valve in line from boiler to expansion tank.
- Open water inlet to your boiler and leave open.
- Start with lowest radiation unit. Open air vent on this unit. When all air has escaped and water starts to flow from vent, close it.
- Go to next radiation unit, and repeat this process.
- Repeat until you have covered every radiation unit in system. End at highest unit in system.
- If units have automatic vents, manual venting is unnecessary but it will speed up proper filling of system.
- If system is closed expansion tank system, you may have automatic fill valve. Leave it open to refill system automatically as needed.
- Check temperature-pressure gauge. Note position of hand indicating pressure. This should be between 10 and 15 psi. Any lowering of this movable hand below 10 psi indicates loss of water due to leakage. Automatic fill valve should compensate for this. Instructions are packaged with valve.

LIGHTING PROCEDURE FOR BOILER WITH INTERMITTENT PILOT SYSTEM

For Your Safety, Read Before Operating!!

⚠ 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.

⚠ CAUTION

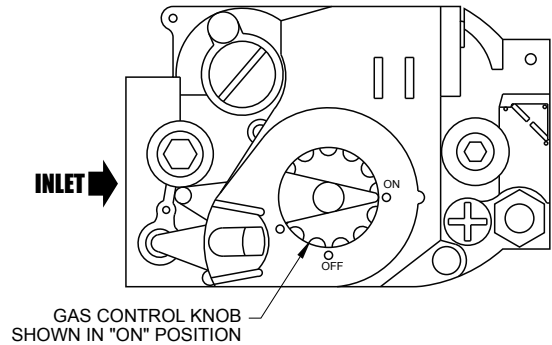
WHAT TO DO IF YOU SMELL GAS

- Do not try to light any appliance.
- Do not touch any electrical switches; 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.

14.2 Operating Instructions

1. **STOP! Read Safety Information on previous page.**
2. Set the thermostat to lowest setting.
3. Turn off all electric power to the appliance.
4. This appliance is equipped with an ignition device which automatically lights the burner. Do not attempt to light pilot by hand.
5. Remove front panel, if necessary.

Figure 13 - Gas Control Knob



6. Turn gas control knob clockwise ↻ to "OFF".
7. Wait five (5) minutes to clear out any gas. Then smell for gas, including near floor. If you smell gas, STOP! Follow WHAT TO DO IF YOU SMELL GAS found on operating instruction label. If you don't smell gas, go to next step.
8. Turn gas control knob counterclockwise ↻ to "ON."
9. Replace front panel, if removed.
10. Turn on all electric power to the appliance.
11. Set thermostat to desired setting.
12. If appliance will not operate after several tries, turn gas control knob to "OFF" and call your service technician or gas supplier.

14.3 Turn Off Gas To Appliance

1. Turn off all electric power to the appliance if service is to be performed.
2. Set the thermostat to lowest setting.
3. Remove front panel, if necessary.
4. Turn gas control knob clockwise ↻ to "OFF". Do not force.
5. Replace front jacket panel, if removed.





15.1 Gas Valve Safety Shutdown Test

WARNING

Electrical shock hazard. Follow instructions to turn off electric power. Failure to do so could result in death or serious injury.

Ignition system safety shutoff device must be tested after placing boiler in operation. With main burners firing, disconnect ignition cable from intermittent pilot control box. Gas valve should shut off main burners. **TURN OFF ELECTRIC POWER** to boiler before reconnecting ignition cable, to prevent electric shock.

15.2 Pilot Burner Adjustment

1. Remove screw cover over pilot adjusting screw.
2. Insert small screwdriver and adjust flame as needed See Figure 14 & 15. Turn screw counterclockwise  to increase flame, clockwise  to decrease. Replace screw cover over pilot adjusting screw.

15.3 Main Burner(s) Inspection

Main burners do not require primary air adjustment and are not equipped with primary air shutters.

Main burner flames form sharp blue inner cones in softer blue outer mantel, with no yellow. Puffs of air from blowing on flame or stamping on floor will cause flames to turn orange momentarily. *This is not unusual.* Remain still when observing main burner flames. See Figure 16.

If flame appearance is not correct, check main burner orifices, burner throat and flame ports for dust and lint obstruction. It may be necessary to remove rollout shield to observe main burner flames. Replace rollout shield after observation.

15.4 Adjusting Limit Controls

Instructions for each control are included with the controls. See Appendix A.3.

Recommended Boiler Water Temperatures

Settings can be changed after you have had some idea how the system works. **Example:** *If your system does not give quite enough heat in very cold weather, you can raise limit setting to 190°F.*

Instruction for final adjustment of thermostat are packaged with thermostat.

Figure 14 - Automatic Gas Valve

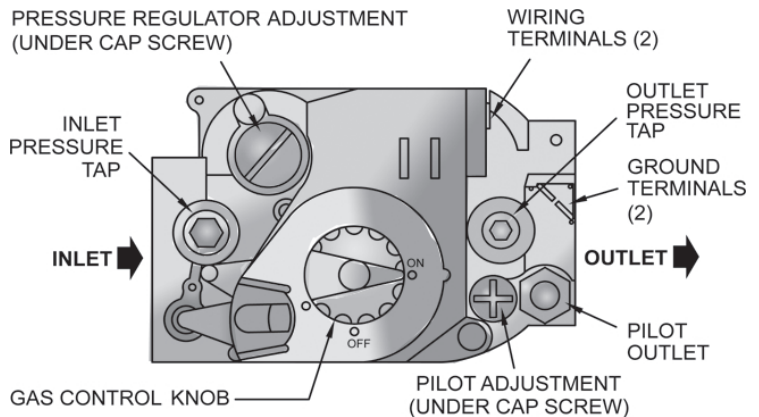


Figure 15 - Pilot Flame Adjustment

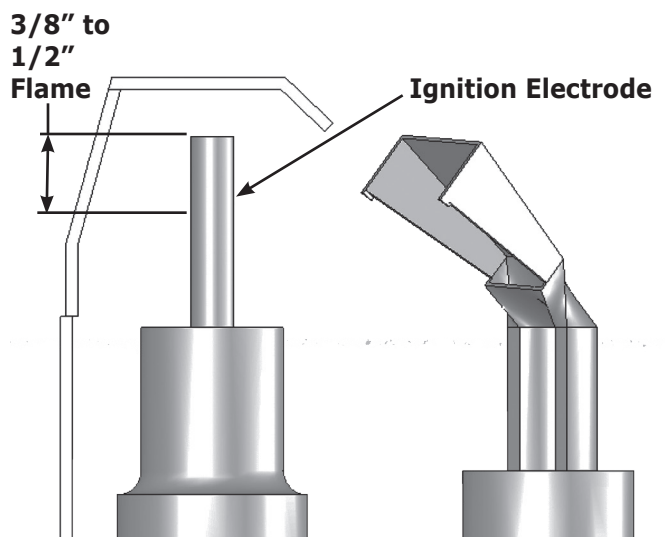
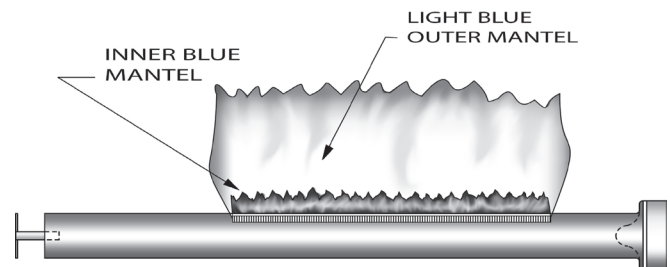


Figure 16 - Main Burner Adjustment



Main burner flame should form sharp blue inner mantel with no yellow.



15.5 Thermostat Heat Anticipator Setting

1. Set Heat anticipator at .2.
2. Check thermostat operation. When set above temperature indicated on thermometer, boiler burners should ignite. Verify thermostat turns off boiler when room temperature reaches selected setting and starts boiler operating when room temperature falls few degrees. After setting limit control to desired setting, check to see if it shuts off gas supply to burners.
3. Turn your thermostat up to call for heat and let your boiler run until temperature of water reaches limit setting. Gas valve shuts off and circulator keeps running until thermostat is satisfied, or water cools enough to restart burners through limit control.
4. To check operation of contacts in pressure switch, disconnect rubber tubing (located between blower and pressure switch) from pressure switch, while boiler is operating. Burners extinguish and blower keeps running. When tubing is reconnected to pressure switch, ignition sequence begins, resulting in ignition of main burners.
5. Set thermostat for desired temperature.

Safe lighting and other performance criteria were met with gas manifold and control assembly provided on boiler when boiler underwent tests specified in ANSI Z21.13.

16.1 General Maintenance

Burners

Beginning of heating season visually check pilot and main burner flames. See Figures 15 & 16.

Safety Relief Valve

Test safety relief valve for proper operation. Refer to valve manufacturer's instructions packaged with relief valve.

Expansion Tank (Non-diaphragm)

Tank may become waterlogged, or may receive excess of air. Frequent automatic opening of safety relief valve indicates water logging. High boiler temperature accompanied by unusually low radiation unit temperature (and "knocking") indicates excess air in tank.

To correct:

1. Close valve between boiler and tank. Drain tank until empty.
2. Check all tank plugs and fittings. Tighten as necessary.
3. Open valve between boiler and tank. Water will rise to normal height in tank if you have automatic fill valve (otherwise, manually refill system).

Boiler Flue Passages

Recommend following checked annually by qualified service agent.

- flue passages
- burner adjustment
- operation of controls

Before start of each season (or whenever system has been shut down for some time) recheck whole system for leaks and recheck boiler and vent pipe for leaks. Replace or patch any boiler seals that are faulty. Before start of each season (or whenever system has been shut down for some time) recheck the whole system for leaks . . . and recheck the boiler and vent pipe for leaks. Replace or patch any boiler seals that are faulty.

Vent Pipe

Venting and piping should be checked at least monthly. If vent piping shows any sign of leaking, replace immediately.

Water System

If system is to remain out of service during freezing weather, always **drain it** completely (water left in to freeze will crack pipes and/or boiler).

Cleaning Your Boiler And Burners

Flue passages between sections should be examined yearly and cleaned if necessary.

To clean:

- Remove burners, pilot, and vent pipe.
- Remove top and front jacket panels.
- Remove two screws attaching intermediate front panel to left and right side jacket panels.
- Remove control panel as a unit.
- Remove draft diverter and intermediate front panel.
- Carefully remove cerafelt gasket strips.
- Clean passageways between sections with flexible handle wire brush. Remove dirt from bottom of boiler and from between sections by vacuuming.
- Verify all flame ports in burners are open and clear. Shake out or blow out all loose dirt in burners.
- Reseal seams between adjacent sections as necessary with 400°F RTV silicone sealant.
- Reassemble all parts.
- Verify tightness of pilot connections and condition of burner flames after reassembly. See Figures 15 & 16.
- Verify vent pipe connections to chimney are secure and no obstructions are present.

Blower

Blower motor features permanently lubricated ball bearing construction. Lubrication is not required.

Circulator Pump Isolation Valves

Operate isolation valves in circulator pump flanges manually once or twice per year to prevent valves from becoming stuck in open position

Rotate valves from open position to closed position and back to open position.

Low Water Cutoff(s)

Inspect field sourced low water cutoffs annually or as recommended by low water cutoff manufacturer. Flush float type low water cutoff(s) per manufacturer's instructions.

Housekeeping

- Keep boiler area clear and free from combustible materials, gasoline and other flammable vapors and liquids.
- Keep boiler area clear of debris and other materials obstructing flow of combustion and ventilation air.

17 - SERVICE HINTS

You may avoid inconvenience and service calls by checking these points before you call for service:

CAUTION
WHAT TO DO IF YOU SMELL GAS
<ul style="list-style-type: none"> 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.

IF YOUR SYSTEM IS NOT HEATING OR NOT GIVING ENOUGH HEAT . . .	
POSSIBLE CAUSE	WHAT TO DO
Thermostat is not set correctly	Reset thermostat
Burner is not operating properly	Check flame. If it is yellow, the burner is not getting enough air. Or, if flame is blue and noisy and seems to lift off the burner, the burner is getting too much air. Contact your service technician.
No electric power to boiler	Check over-current protection. Check to be sure electric power supply circuit is "ON".
Controls out of adjustment	Reset according to instructions.
Radiators not heating	Open radiator vents to excess air. Check flow control valve (if used). It may be in closed position.
Circulating pump not running	Check over-current protection. Check relay operation.
Poor electrical contact	Check all control terminals and wire joints.
Chimney flue is blocked	Pressure switch will not close and pilot spark will not operate to start pilot. Have your service technician check and correct, if necessary.
Rollout switch blown	Have your service technician check heat exchanger for blockage. Replace rollout switch with exact replacement.
IF BURNER IS NOISY . . .	
POSSIBLE CAUSE	WHAT TO DO
Gas input amount is incorrect	Contact your service technician.
RELIEF VALVE LEAKING . . .	
POSSIBLE CAUSE	WHAT TO DO
Dirt on seat	Open valve manually. Allow water to run and clear valve seat.
Water logged expansion tank	Drain tank, see manufacturer instructions.
HAVE YOUR SERVICE TECHNICIAN CHECK ANY PROBLEM YOU ARE UNABLE TO CORRECT.	



18 - BOILER RATINGS & CAPACITIES



Table 8 - RATINGS NATURAL AND PROPANE GASES

Model	(1) Input Btu/hr	(1) Heating Capacity Btu/hr	(2) Net AHRI Rating Water Btu/hr	AFUE	Vent Diameter (Inches)	
					To Chimney (Category I)	Horizontal Vent (Category III)
FSB-2	42,500	36,000	31,000	84.4	4	3
FSB-3	75,000	63,000	55,000	84.0	4	3
FSB-4	112,500	95,000	83,000	84.0	4	3
FSB-5	150,000	127,000	110,000	84.0	4	3
FSB-6	187,500	158,000	137,000	84.0	4	4

EXPLANATORY NOTES

- This boiler cannot be used with all types of chimneys. Read these instructions carefully before installing.
- These Gas-Fired Hot Water Boilers are low pressure, sectional cast iron boilers Design Certified by C.S.A. (*Canadian Standards Association*) for use with Natural and Propane Gases.
- Constructed and hydrostatically tested for maximum working pressure of 50 psi in accordance with A.S.M.E. *Boiler and Pressure Vessel Code* Section IV Standards for cast iron heating boilers.
- Boilers must stand on noncombustible floor. If installed on combustible floor, please refer to (Combustible Floor Addendum) included in literature envelope provide with boiler and outlined in *National Fuel Gas Code, ANSI Z223.1/NFPA 54*.
- The MEA number for this boiler is **484-84-E Vol. IV**.

(1) Input rating for sea level to 2,000 feet. (610 m) above sea level.

(2) Net AHRI Water Ratings shown based on piping and pickup allowance of 1.15. Consult Manufacturer before selecting boiler for installations having unusual piping and pickup requirements, such as intermittent system operation, extensive piping systems, etc.
For forced hot water systems where boiler and all piping are within area to be heated, boiler may be selected on basis of its heating capacity.

Boilers For Use At High Altitude

Boiler is factory equipped for use at altitudes of 0-2,000 feet above sea level. For use at altitudes above 2,000 feet above sea level, reduced input rate 4% for every 1,000 feet above sea level.

U.S.A. Only - For altitudes above 2,000 feet above sea level, input ratings should be reduced at rate of 4% for each 1,000 feet above sea level. Consult *National Fuel Gas Code (NFPA54/ANSI Z223.1)*, or manufacturer for correct orifice sizing information. High altitude orifices are available from boiler manufacturer.



A.1 Installation Environment Considerations

⚠ WARNING

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

- **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.
- Do not allow water to drip on controls. Prevent condensation by allowing air circulation around module and gas control.
- Do not use corrosive chemicals around or on module or gas control.

- Install plastic cover. Limits contamination from accumulation of dust or grease.
- Controls can be damaged by excessively high temperatures. Verify adequate air circulation around louvers is maintained when installing boiler.

A.2 Electrical Connections

- Connect L1, L2 and ground leads connect inside J box using wire nuts. Secure J box cover. (J box located on right side panel.)
- Connect Circulator harness to circulator. Harness comes plugged into module with Molex® plug.
- Connect thermostat connection to yellow wires marked T-T using wire nuts.
- Ensure remaining Molex® plug connectors have not worked loose during transit.
- Check sensing bulb is fully inserted in well and is not loose.
- Verify pressure switch connection is made.

A.3 Adjusting Settings

To discourage unauthorized changing of settings, procedure to enter adjustment mode is required.

To enter adjustment mode, press UP, DOWN, and I buttons simultaneously for three seconds. Press and release I button until parameter requiring adjustment is displayed. See Figures A-1 & A-2.

- "SP_" Setpoint (180 °F default setting; adjustable between 130 and 220 °F). **Note: on some models this is "HL" High Limit.**
- "Df_" Setpoint Differential (15 °F default setting; adjustable between 10 and 30 °F). **Note: on some models this is "HdF" High Limit.**
- "°F_" Degrees Fahrenheit

Press UP or DOWN button until parameter has reached desired value. After 60 seconds without any button inputs, control automatically returns to READ mode.

A.4 Display

In RUN mode, status items and parameters are viewable. See Figure A-3.

Example, to display setpoint, control flashes "sp" (setpoint) followed by temperature (i.e., 135), followed by °F or °C.

To read settings, press and release I key to find parameter of interest.

Example, press and release I until setpoint (sp) is displayed, followed by three-digit number, i.e., 190, followed by °F or °C. Press I button again will display (S1T), Sensor 1 Temperature followed by three-digit number and corresponding degree designator.

Figure A-1 - Display

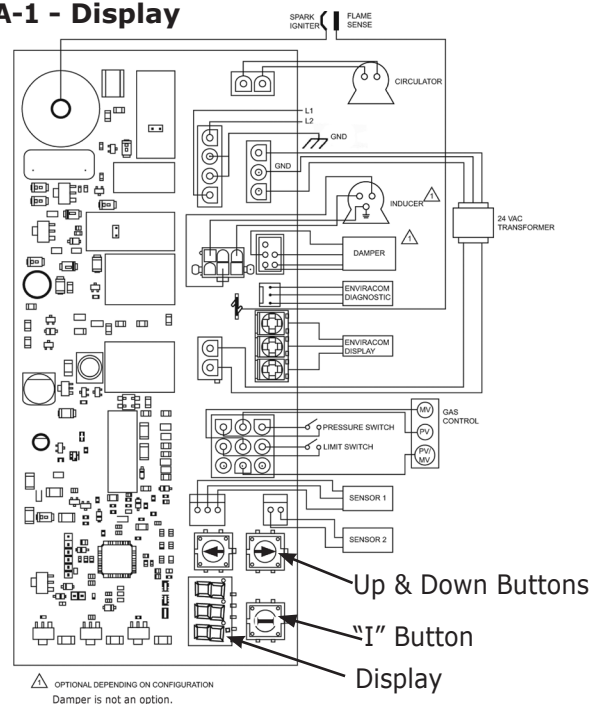


Figure A-2 Segment LED Display - Installer Mode Options

1st Screen	2nd Screen	3rd Screen	Default	Range	Description
HL_	<High Limit>	°F or °C	180	130 to 220 °F	Adjust High Limit setting SP=HL Note: Also changes SP setpoint
HdF	<High Limit Differential>	°F or °C	15	10 to 30 °F	Adjust High Limit Differential
Or_	<Pump Overrun Time>	SEC	60	0 to 120	Pump Overrun Time DO NOT CHANGE DEFAULT SETTING
otH	<ODR maximal temp.>	°F or °C	55	40 to 70°F	Maximal outdoor temperature (Use With Outdoor Reset)
otL	<ODR minimal Temp>	°F or °C	0	-40 to 40°F	Minimal outdoor temperature (Use With Outdoor Reset)
btL	<minimal water temp.>	°F or °C	140	130 to 150 °F	Minimal boiler temperature (Use With Outdoor Reset)
tPL	<minimal boiler temp.>	°F or °C	140	OFF, 120 to 160°F	Thermal purging minimal temperature DO NOT CHANGE DEFAULT SETTING
tPt	<maximal delay>	Min	2	1 to 10 minutes	Maximal Thermal Purge time DO NOT CHANGE DEFAULT SETTING
rSt	On or OFF		OFF	NA	Reset Lockout DO NOT CHANGE DEFAULT SETTING
F-C	°F or °C		F	F or C	Select degrees F or C Mode

Figure A-3 - Display Readout

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

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APPENDIX A - CONTROL MODULE

A.5 Display

Module continuously monitors boiler water temperature and fires or shuts off burner based on this temperature data.

1. When "Call for Heat" occurs, control enables circulator and monitors boiler water temperature to determine whether thermostat can be satisfied without firing burners. This may delay burner up to two (2) minutes or less.
2. Control determines burner operation is required, module proceeds to start burner (see state codes list) and heats water in boiler until setpoint temperature is achieved or thermostat is satisfied.
3. Burner is de-activated, ignition module completes heating cycle, returns to idle and waits for temperature to drop again.
4. Circulator remains on during, and throughout "Call for Heat."

Table A-1 - Operation State Codes

Order	State Code Number	Definition	Explanation
a	1	Idle	There is no call for heat; and/or:
b	1	Circulator	The thermostat has called for heat. The control has activated the system circulator pump and is waiting to see if there is enough heat stored in the boiler to satisfy the t'stat without firing the burners. This may last as long as 2 minutes, but will typically be much less.
c	17	Diagnostics	Pilot valve diagnostics/current leakage detection. Typically a few seconds.
d	2	Wait for pressure switch to open	The inducer motor should be off while the boiler is off to conserve energy. The control is verifying the motor is indeed off (a switch must be open). If the switch is not open ERR 2 will be displayed.
e	3	Wait for pressure switch to close	The control starts the inducer (vent motor) A pressure switch must close to verify the motor is running and the vent to outside is not obstructed. If this does not occur after one minute, the control will go into ERR29. Should the switch eventually close, the control will resume normal operation.
f	4	Pre-purge	Control is clearing gases out of the heat exchanger. Also, an internal electronic diagnostic check is performed.
g	6	Spark	Spark for ignition. There should be an audible sparking (buzzing) noise. This will last until the control detects a pilot flame, but not more than 30 seconds. (If no flame is detected after trial period, sparking will cease, and a 5 minute delay will occur before the control tries again. STA10 will be displayed during this period).
h	7	Flame stabilization	The pilot flame must be strong enough (1 uA) for the control to release the main burners. This will last up to 10 seconds. (If the flame is still not strong enough after 10 seconds, the control will shut off the pilot, wait 5 minutes, then try again. STA10 will be displayed during this 5 minute period).
i	8	Running	Main burners are providing heat. This will continue as long as the thermostat requires. During this period, the control will monitor the pilot signal, boiler temperature, damper, and limit switches to assure safe operation.
j	9	Post-Purge	Inducer motor is purging gases after heat cycle.
k	1	Post operation	The circulator pumps will continue for a short time to deliver stored heat to the house before it has a chance to escape during the coming off period.

2. Other possible state codes

j	10	Retry Recycle Delay	5 minute delay after pilot signal is lost. EITHER: 1. Control failed to detect pilot flame after spark period. Check pilot for contamination; check ignition wire; check electrical ground; Check pilot flame. 2. Control lost pilot flame signal AFTER main burners were lit. Check for adequate draft and combustion air. Check gas line for adequate pressure.
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APPENDIX A - CONTROL MODULE

Table A-1 - Operation State Codes - Conti.

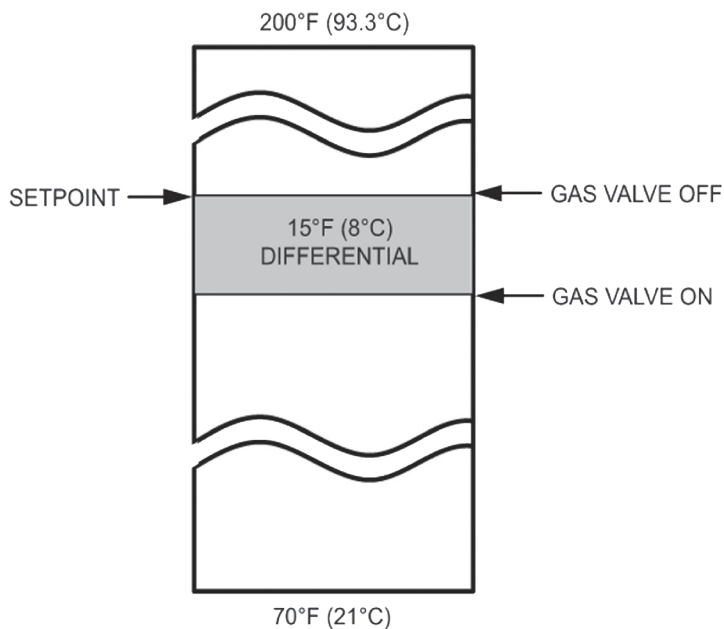
Order	State Code Number	Definition	Explanation
k	11	Wait for pressure switch to open - failed closed	The inducer is still off, but the pressure switch has not opened at the beginning of the heat cycle. An alarm is sent, but no lockout occurs.
l	12	Wait for pressure switch to close - failed open	The inducer is on but the pressure switch has not closed yet at the beginning of the heat cycle. An alarm message is sent but no lockout occurs.
m	13	Soft lock out	Soft lockout duration is one hour, may override with manual reset. Appropriate error code will flash alternately.
n	14	Hard lock out	Requires manual reset. Unacceptable high water temperature (err 65) and onboard electronics failure (err 18) are the only hard lockouts on this model.
o	15	Wait for limit to close	One of the safety limits - rollout, or Low water cutoff (if one is field installed on the 24V safety circuit) has been activated. Control will resume normal operation once limit is reset. Underlying cause why the limit switch opened MUST be investigated.
p	16	Flame out of sequence	Flame signal sensed before trial for ignition. Appropriate error code displayed. OR Flame signal sensed out of sequence during post purge OR Flame signal present when not expected. Appropriate error code displayed.
q	17	Diagnostics	Onboard self check performed at various points during the operation sequence.



A.6 Operation

- When water temperature reaches setpoint, controller ends heating cycle.
- When water temperature drops below setpoint minus differential, controller restarts heat cycle to re-heat boiler water.
- If water temperature exceeds maximum allowed temperature (220°F or 104°C), controller enters manual reset lockout state.
- For models having reset capability, press any onboard button or cycle power to reset.

Figure A-4 - Basic Control Algorithm Example



A.7 Boiler High Limit Temperature Controller

- Following service procedures are provided as general guide.
- On lockout and retry models, meter readings between gas control and ignition module must be taken within trial for ignition period. Once ignition module shuts off, lockout models must be reset through key buttons and display. On retry models, wait for retry or reset at thermostat.
- Check for correct installation and wiring before replacing any component.
- Control module cannot be repaired. If it malfunctions, it must be replaced.
- Use only qualified service agent to service ignition systems.

1. Perform checkout as first step in troubleshooting.
2. Check troubleshooting guide to pinpoint cause of problem. See Table A-1.
3. If troubleshooting indicates ignition problem, see Ignition System Checks to isolate and correct the problem.
4. Perform checkout procedure following troubleshooting guide again to verify system is operating normally.

A.8 Troubleshooting

Integrated boiler control uses advanced diagnostic capability to assist in troubleshooting error conditions. Figure A-2 shows codes that could arise on integrated display during fault.

Suggestions are provided in Table A-2 for servicing these potential errors.



APPENDIX A - CONTROL MODULE

Table A-2 - Operation Error Codes

Error Code	Error Description	Error display clearing (once error condition has been corrected)					Explanation	Things to look for
		Clears itself when root problem resolved	Cycle Power OFF	Push any key	Up/down key when status is displayed			
2	Pressure switch failed to open (stuck closed)	x	x				Control relies on pressure switch to verify inducer motor is running and vent is clear. Switch should open at end of heat cycle, but this did not occur	<ol style="list-style-type: none"> 1. Check pressure switch 2. Check tubes going to pressure switch, verify no obstruction. 3. Check wiring to pressure switch 4. Remove wire connections to pressure switch. If code persists, replace control.
4	Flame current lower than threshold	x	x				Control requires strong enough signal 1 (uA) to verify flame is present. Signal is too low.	<ol style="list-style-type: none"> 1. Check pilot flame sense is clean 2. Check for proper ground 3. Check wiring 4. Check for correct pilot orifice 5. Check there are no gas leaks in pilot tubing.
6	Flame sensed out of normal sequence		x		x		Control circuit is sensing flame rectification when there should be none.	<ol style="list-style-type: none"> 1. Check gas valve 2. Check all electrical connections are tight
18	Electronic failure		x				Control believes it is defective.	<ol style="list-style-type: none"> 1. Try reset by cycling power or push any key. 2. Check wiring to pilot and main valve. 3. Otherwise, control will require replacement
23	Flame sensed during Pre-purge		x		x		Primarily for induced draft models although present in vent damper software. Pilot is being sensed too soon in ignition sequence.	<ol style="list-style-type: none"> 1. Check gas valve - manifold pressure should be 0 when no voltage to either gas valve circuit. 2. Check all electrical connections are tight
24	Flame sensed during Post-purge		x		x		Primarily for induced draft models although present in vent damper software. Pilot is being sensed too late in shutdown sequence.	<ol style="list-style-type: none"> 1. Check gas valve - manifold pressure should be 0 when no voltage to either gas valve circuit. 2. Check all electrical connections are tight
29	Pressure switch failed to close (switch stuck open)	x	x				Control relies on pressure switch to verify inducer motor is running and vent is clear. Switch must close at start of heat cycle, but this did not occur	<ol style="list-style-type: none"> 1. Check pressure switch 2. Check venting, verify no obstructions 3. Check tubes going to pressure switch, verify no obstruction. 4. Check wiring to pressure switch 5. Jumper wire connections to pressure switch. If code persists, replace control. Be sure to remove jumper.
32	Temperature sensor failure	x	x				Temperature sensor is not providing an expected reading	<ol style="list-style-type: none"> 1. Check sensor is plugged into control board 2. Check sensor wiring is not damaged 3. Scroll display reading to ""bt"", and hold sensor bulb securely in your hand. It should read temperature close to body temperature. If not, replace sensor.
57	Flame rod shorted to burner ground	x	x				Control did not detect voltage difference between flame sense wire and ground	<ol style="list-style-type: none"> 1. Check flame sense wire on pilot assembly is not frayed or otherwise damaged. If so, replace pilot assembly. Note! These are high temperature wires. Do not attempt field repair. 2. Check there is not moisture collecting on control board
58	AC line frequency error	x	x				AC frequency is incorrect or noisy	<ol style="list-style-type: none"> 1. Some electric or electronic devices may generate electromagnetic interference. Verify none is present. 2. Check thermostat connection
59	Line voltage error	x	x				Line voltage (or, possibly thermostat) is either too high or too low	Source problem is likely in electrical external to boiler. Control will clear itself and resume normal operation once the situation is resolved. Check BOTH line power and thermostat wiring.
60	Thermostat input higher than threshold	x	x				Certain types of thermostat may not be compatible with control circuitry	Verify boiler works properly by jumping yellow thermostat wires. If so, replace thermostat (or possible thermostat wires)
61	Line voltage unstable	x	x				Unstable line voltage - possibly too many heavy loads switching on and off	<ol style="list-style-type: none"> 1. Check if current draw on this branch circuit from house breaker box might have very heavy loads switching on or off 2. Check power coming into house Source problem is likely in electrical external to boiler. Control will clear itself and resume normal operation once situation is resolved.
62	Soft Lockout-Max retries exceeded		x	x			Control has sensed consecutive instances of no flame signal while trying to light pilot. NOTE: not present on S9361A2095	<ol style="list-style-type: none"> 1. Check control ground connection 2. Check pilot ignition wire for good condition and connection 3. Clean pilot tip 4. Check pilot tube; assure no gas leaks 5. Check correct pilot orifice is being used 6. Check gas line pressure
63	Soft Lockout-Max recycles exceeded		x	x			Control has sensed consecutive instances of loss of pilot flame signal AFTER main burners are lit. Note: Not present on S9361A2095.	<ol style="list-style-type: none"> 1. Check gas valve 2. Check all electrical connections are tight 3. Check pilot rod is clean 4. Check gas line pressure 5. Check for adequate draft 6. Check for adequate combustion air.
64	Soft Lockout-Internal Failure		x	x			Control is sensing something wrong with electrical circuitry	<ol style="list-style-type: none"> 1. Check all wiring is correct. Refer to wiring diagram 2. Check there is good ground to pilot bracket.
65	Hard Lockout-Temperature above limit		x	x			Control sensed water temperature which is too high for safe boiler operation.	<ol style="list-style-type: none"> 1. Check water is circulating properly through boiler. 2. Check there is not air in system 3. If pressure relief valve opened, there is definitely a problem with water circulation! 4. If any of the above 3 are true, the root problem is in hot water circulation. 5. Scroll display reading to ""bt"", and hold sensor bulb securely in your hand. It should read temperature close to body temperature. If not, replace sensor.

Note: In event of multiple errors, the highest error number is displayed first.

Note: Error codes 18 and 65 - Hard Lockout will not expire. Requires operator reset. Nonvolatile memory (error will not be remembered if power is off).

Error codes 6, 23, 62, 63 and 64 - Soft Lockout of 1 hour duration if not reset. Control will then resume normal operation. If source error is still present a second soft lockout is possible.

All other codes - No lockout. Control will resume normal operation immediately when source error is resolved.



A.9 Intermittent Pilot

Ignition System Checks

STEP 1: Check ignition cable.

- Verify ignition cable does not run in contact with metal surfaces.
- Verify only factory supplied Ignition cable (or approved replacement) is used.
- Verify connections to ignition module and igniter or igniter-sensor are clean and tight.
- Verify ignition cable provides good electrical continuity.

STEP 2:

Verify ignition system grounding. Nuisance shutdowns are often caused poor or erratic grounding.

Common ground is required for module and pilot burner/igniter sensor.

- Check for good metal-to-metal contact between pilot burner bracket and the main burner.
- Check ground lead from GND (BURNER) terminal on module to pilot burner. Verify connections are clean and tight. If wire is damaged or deteriorated, replace with No. 14-18 gauge, moisture-resistant, thermoplastic insulated wire with 105°C [221°F] minimum rating.
- Check ceramic flame rod insulator for cracks or evidence of exposure to extreme heat, which can permit leakage to ground. Replace pilot burner/igniter sensor and provide shield if necessary.
- If flame rod or bracket is bent out of position, restore to correct position.

STEP 3: Check spark ignition circuit.

WARNING

Electrical shock hazard. Ignition circuit generates over 10,000 volts. Turn OFF electrical power supply at service panel before making electrical connections. Failure to do so could result in death or serious injury.






Disconnect ignition cable at SPARK terminal on module. Energize module and listen for audible sparking noise. When operating normally, there should be buzzing noise turns on and off twice per second for duration of 1–7 seconds, depending on model.

STEP 4: Verify pilot and main burner light-off.

1. Initiate call for heat. Turn thermostat above room temperature. Ignition sequence may be delayed by thermal purge until boiler water temperature is below 140°F (60°C)
2. Watch pilot burner during ignition sequence.
 - Verify ignition spark continues after pilot is lit.
 - Verify pilot lights and spark stops, verify main burner does not light.
 - a. Check pilot flame. Verify it is blue, steady and envelopes 3/8 to 1/2 in. [10 to 13 mm] of flame rod. See Figure A-5 for possible flame problems.
 - b. If necessary, adjust pilot flame by turning pilot screw on gas control clockwise to decrease or counter-clockwise to increase pilot flame. Following adjustment, always replace pilot adjustment cover screw and tighten firmly to assure proper gas control operation. See Figure 14.
3. If pilot does not stay lit, ensure adequate flame current as follows.
 - Turn off boiler at circuit breaker or fuse box.
 - Clean flame rod with emery cloth.
 - Verify electrical connections are clean and tight. Replace damaged wire..
 - Check for cracked ceramic insulator, which can cause short to ground, and replace igniter-sensor if necessary.

Set temperature below room set-point to end call for heat.
4. Recheck ignition sequence as follows.
 - Adjust thermostat above room temperature.
 - Verify ignition sequence at burner.

Figure A-5- Pilot Flame

APPEARANCE	CAUSE
<p>SMALL BLUE FLAME</p> 	<p>CHECK FOR LACK OF GAS FROM:</p> <ul style="list-style-type: none"> • CLOGGED ORIFICE FILTER • CLOGGED PILOT FILTER • LOW GAS SUPPLY PRESSURE • PILOT ADJUSTMENT AT MINIMUM
<p>LAZY YELLOW FLAME</p> 	<p>CHECK FOR LACK OF AIR FROM:</p> <ul style="list-style-type: none"> • DIRTY ORIFICE • DIRTY LINT SCREEN, IF USED • DIRTY PRIMARY AIR OPENING, IF THERE IS ONE • PILOT ADJUSTMENT AT MINIMUM
<p>WAVING BLUE FLAME</p> 	<p>CHECK FOR:</p> <ul style="list-style-type: none"> • EXCESSIVE DRAFT AT PILOT LOCATION • RECIRCULATING PRODUCTS OF COMBUSTION
<p>NOISY LIFTING BLOWING FLAME</p> 	<p>CHECK FOR:</p> <ul style="list-style-type: none"> • HIGH GAS PRESSURE
<p>HARD SHARP FLAME</p> 	<p>THIS FLAME IS CHARACTERISTIC OF MANUFACTURED GAS</p> <p>CHECK FOR:</p> <ul style="list-style-type: none"> • HIGH GAS PRESSURE • ORIFICE TOO SMALL

Correct Pilot Flame: 3/8 to 1/2 inch in flame.



INSTALLATION AND CHECK-OUT CERTIFICATE

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

Measured BTU/HR input _____

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

Installer (Company) _____

Address _____

Phone _____

Installer's Name _____

Signature _____



IMPORTANT

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

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

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

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

