EnduroTI®
Commercial Boilers

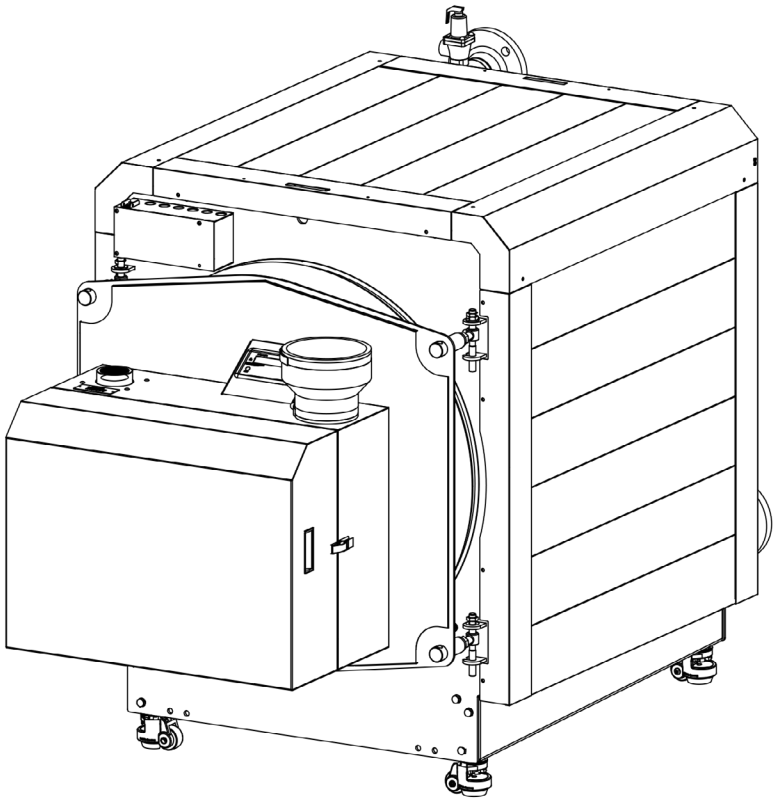
Installation

Start-Up

Maintenance

Parts

Warranty



ETI-750 / ETI-1000 Models*

***"HL" Denotes Installed High and Low Gas Pressure Switches**

Heat Exchanger Bears the ASME "H" Stamp

DANGER
This manual must only be used by a qualified installer / service technician. Read all instructions in this manual before installing. Perform steps in the given order. Failure to do so could result in substantial property damage, severe personal injury, or death.
WARNING
Improper installation, adjustment, alteration, service, or maintenance could void product warranty and cause property damage, severe personal injury, or death.
NOTICE
HTP reserves the right to make product changes or updates without notice and will not be held liable for typographical errors in literature.
NOTE TO CONSUMER: PLEASE KEEP ALL INSTRUCTIONS FOR FUTURE REFERENCE.

272 Duchaine Blvd. New Bedford, MA 02745 www.htproducts.com
LP-517 Rev. 000 Rel. 013 Date 3.8.18

⚠ WARNING

WARNING: If the information in these instructions is not followed exactly, a fire or explosion may result causing property damage, personal injury or death.

- Do not store or use gasoline or other flammable vapors and liquids in the vicinity of this or any other appliance.

WHAT TO DO IF YOU SMELL GAS

- Do not try to light any appliance.
- Do not touch any electrical switch; do not use any phone in your building.
- Immediately call your gas supplier from a neighbor's phone. Follow the gas supplier's instructions.
- If you cannot reach your gas supplier, call the fire department.
- Installation and service must be provided by a qualified installer, service agency or the gas supplier.

Improper installation, adjustment, alteration, service, or maintenance can cause injury, property damage, or death. Refer to this manual. Installation and service must be performed by a qualified installer, service agency, or gas supplier.

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.

A. This appliance does not have a pilot. It is equipped with an ignition device which automatically lights the burner. Do not try to light the burner by hand.

B. BEFORE OPERATING smell all around the appliance area for gas. Be sure to smell next to the floor because some gas is heavier than air and will settle on the floor.

WHAT TO DO IF YOU SMELL GAS

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

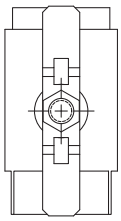
C. Use only your hand to turn the gas control knob. Never use tools. If the handle will not turn by hand, don't try to repair it, call a qualified service technician. Force or attempted repair may result in a fire or explosion.

D. Do not use this appliance if any part has been under water. Immediately call a qualified service technician to inspect the appliance and to replace any part of the control system and any gas control which has been under water.

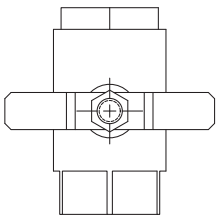
OPERATING INSTRUCTIONS

1. **STOP! Read the safety information above.**
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 try to light the burner by hand.**

GAS VALVE ON



GAS VALVE OFF



5. **Remove front cover.**
6. **Turn gas shutoff valve to "off". Handle will be across the piping, do not force.**
7. **Wait five (5) minutes to clear out any gas. If you then smell gas, STOP! Follow "B" in the safety information above on this label. If you don't smell gas, go to next step.**
8. **Turn gas shutoff valve to "on". Handle will be in line with piping.**
9. **Install Front Cover.**
10. **Turn on all electric power to appliance.**
11. **Set thermostat to desired setting.**
12. **If the appliance will not operate, follow the instructions "To Turn Off Gas To Appliance" and call your service technician or gas supplier.**

TO TURN OFF GAS TO APPLIANCE

1. **Set the thermostat to lowest setting.**
2. **Turn off all electric power to the appliance if service is to be performed.**
3. **Remove Front Cover.**
4. **Turn gas shutoff valve to "off". Handle will be across the piping. Do not force.**
5. **Install Front Cover.**

LP-175 Rev. 4 3-11-08

SPECIAL ATTENTION BOXES

The following defined terms are used throughout this manual to bring attention to the presence of hazards of various risk levels or to important product information.

⚠ DANGER

DANGER indicates an imminently hazardous situation which, if not avoided, will result in serious personal injury or death.

⚠ WARNING

WARNING indicates a potentially hazardous situation which, if not avoided, could result in personal injury or death.

⚠ CAUTION

CAUTION indicates a potentially hazardous situation which, if not avoided, may result in moderate or minor personal injury.

CAUTION

CAUTION used without the safety alert symbol indicates a potentially hazardous situation which, if not avoided, may result in property damage.

NOTICE

NOTICE is used to address practices not related to personal injury.

Foreword

This manual is intended to be used in conjunction with other literature provided with the boiler. This includes all related control information. It is important that this manual, all other documents included in this system, and additional publications including the *Code for the Installation of Heat Producing Appliances* and *National Fuel Gas Code - ANSI Z223.1* (latest versions), be reviewed in their entirety before beginning any work.

Installation should be made in accordance with the regulations of the Authority Having Jurisdiction, local code authorities, and utility companies which pertain to this type of water heating equipment.

Authority Having Jurisdiction (AHJ) – The AHJ may be a federal, state, local government, or individual such as a fire chief, fire marshal, chief of a fire prevention bureau, labor department or health department, building official or electrical inspector, or others having statutory authority. In some circumstances, the property owner or his/her agent assumes the role, and at government installations, the commanding officer or departmental official may be the AHJ.

NOTE: HTP, Inc. reserves the right to modify product technical specifications and components without prior notice.

For the Installer

This boiler must be installed by qualified and licensed personnel. The installer should be guided by the instructions furnished with the boiler, and by local codes and utility company requirements. In the absence of local codes, preference should be given to the *National Fuel Gas Code - ANSI Z223.1*, latest version.

Installations Must Comply With:

Local, state, provincial, and national codes, laws, regulations, and ordinances.

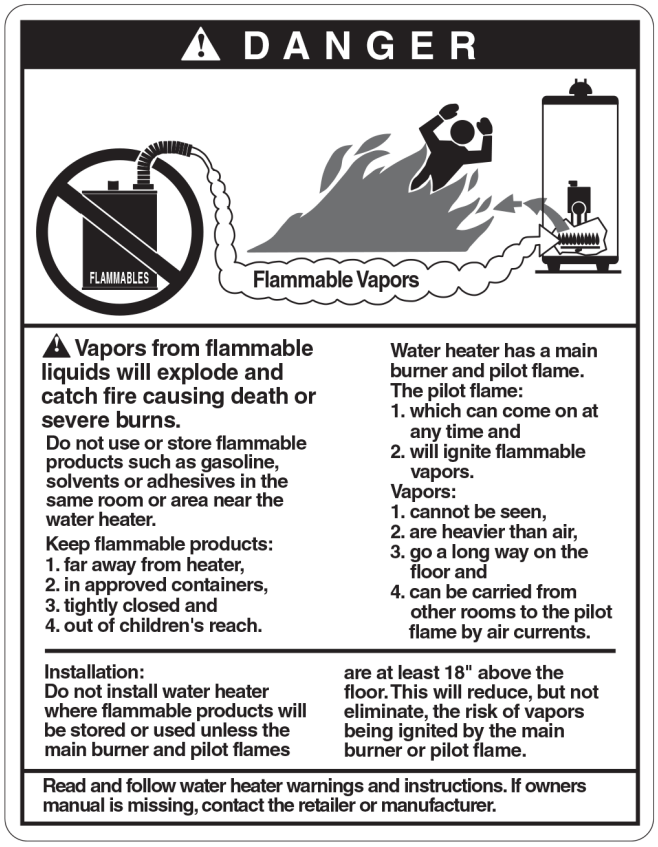
The latest version of the *National Fuel Gas Code, ANSI Z223.1*, from American Gas Association Laboratories, 8501 East Pleasant Valley Road, Cleveland, OH 44131.

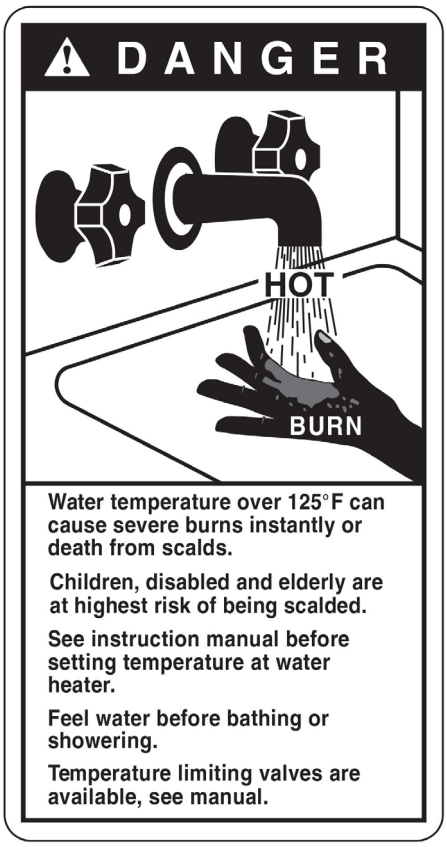
In Canada - *CGA No. B149* (latest version), from Canadian Gas Association Laboratories, 55 Scarsdale Road, Don Mills, Ontario, Canada M3B 2R3. Also, *Canadian Electrical Code, C 22.1*, from Canadian Standards Association, 5060 Spectrum Way, Suite 100, Mississauga, Ontario, Canada L4W 5N6.

Code for the Installation of Heat Producing Appliances (latest version) from American Insurance Association, 85 John Street, New York, NY 11038.

The latest version of the *National Electrical Code, NFPA No. 70*.

NOTE: The gas manifold and controls met safe lighting and other performance criteria when undergoing tests specified in *ANSI Z21.13* - latest edition.





NOTICE

The CSD-1 ASME Code, Section CW-400 requires that hot water heating and supply boilers have a) a UL 353 temperature control device, b) at least one (1) temperature-actuated control to shut off the fuel supply when system water reaches a preset operating temperature, c) a high temperature limit control that prevents the water temperature from exceeding the maximum allowable temperature by causing a safety shutdown and lockout, and d) its own sensing element and operating switch.

The temperature control system integrated into the 928 control provided with this heating appliance complies with the requirements of CSD-1 Section CW-400 as a temperature operation control. The control monitors the temperature difference between the inlet and the outlet sensor, which is affected by boiler water flow. If this temperature difference exceeds 55°F (typically because of low water flow or very low heat load), the control will reduce the maximum fan speed. If the temperature difference exceeds 60°F, the control will effectively sense there is little or no water flow or heat load and shut the boiler down. The controller will restart automatically once the temperature difference has dropped below 55°F and the minimum off time (anti-cycle time) has expired. In addition, if the control senses that the outlet water temperature has reached 210°F, the boiler is put into a hard lockout and requires manual reset to restart.

IMPORTANT

In accordance with Section 325 (f) (3) of the Energy Policy and Conservation Act, HTP, Inc. has provided this boiler with multiple features designed to save energy by reducing the boiler water temperature as heating load decreases.

These features include:

- **A modulating combustion system that adjusts firing rate based on heat demand.**
- **Adjustment of boiler set point based on inferred heat load as determined by an outdoor sensor. The outdoor sensor is supplied by HTP, Inc. with this boiler.**
- **This boiler does not include a standing pilot.**
- **This boiler is designed and shipped to assure the highest efficiency operation possible. Such high efficiency is achieved by limiting heating circuit water temperature to 140°F when there is no anticipated heat load, based upon the outdoor sensor and the Outdoor Reset Curve (sensor response curve) in the boiler software.**
- **This feature may be over-ridden as described below in specific installations:**
- **The boiler control is equipped with an outdoor sensor override for use with building management systems or in cascaded systems (for systems with total input of 300,000 BTU/hr or greater).**

See statement below for an important notice on the use of the override.

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 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.**

⚠ WARNING

The hydronic supply and return connections of these products are for installation in closed loop systems ONLY! Use of this product in any manner other than described in this manual may result in premature product failure, substantial property damage, severe personal injury, or death. Damage or failure of this product (or the system in which it is installed) due to unauthorized use **IS NOT COVERED BY WARRANTY.**

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Part 1 - General Safety Information

This boiler is approved for indoor installations only and is not intended for use as a pool heater. Clearance to combustible materials: 6" top, 0" sides, and 18" back. Boiler must have room for service: 45" front and 18" left side are minimum recommended service clearances. (A combustible door or removable panel is acceptable front clearance.) This boiler has not been approved for installation on combustible flooring. Do not install on carpeting. Install the boiler in a location where temperature and pressure relief valve discharge or a leak will not result in damage to the surrounding area. If such a location is not available, install an auxiliary catch pan. Use only Category IV vent systems.

⚠ WARNING

Installer - Read all instructions in this manual before installing. Perform steps in the given order.

User - This manual is for use only by a qualified heating installer / service technician. Have this boiler serviced / inspected annually by a qualified service technician.

FAILURE TO ADHERE TO THE GUIDELINES ON THIS PAGE CAN RESULT IN SUBSTANTIAL PROPERTY DAMAGE, SEVERE PERSONAL INJURY, OR DEATH.

DO NOT USE THIS BOILER IF ANY PART HAS BEEN SUBMERGED IN WATER. Immediately call a qualified service technician. The boiler MUST BE replaced if it has been submerged. Attempting to operate a boiler that has been submerged could create numerous harmful conditions, such as a potential gas leakage causing a fire and/or explosion, or the release of mold, bacteria, or other harmful particulates into the air. Operating a previously submerged boiler could result in property damage, severe personal injury, or death.
NOTE: Boiler damage due to flood or submersion is considered an Act of God, and IS NOT covered under product warranty.

NOTE: Obey all local codes. Obtain all applicable permits before installing the boiler.

NOTE: Install all system components and piping in such a manner that does not reduce the performance of any fire rated assembly.

Altering any HTP, Inc. boiler with parts not manufactured by HTP, Inc. WILL INSTANTLY VOID the boiler warranty and could result in property damage, personal injury, or death.

NOTE: If the boiler is exposed to the following, do not operate. Immediately call a qualified service technician.

1. Fire
2. Damage
3. Water

Failure to follow this information could result in property damage, severe personal injury, or death.

CAUTION

Do not use this boiler for anything other than its intended purpose (as described in this manual). Doing so could result in property damage and WILL VOID product warranty.

High heat sources (sources generating heat 100°F / 37°C or greater, such as stove pipes, space heaters, etc.) may damage plastic components of the boiler as well as plastic vent pipe materials. Such damages ARE NOT covered by warranty. It is recommended to keep a minimum clearance of 8" from high heat sources. Observe heat source manufacturer instructions, as well as local, state, provincial, and national codes, laws, regulations and ordinances when installing this boiler and related components near high heat sources.

CAUTION

Due to low water content of the boiler, improperly sizing the boiler in regard to potable water heating load will result in excessive boiler cycling and accelerated component failure. HTP DOES NOT warrant failures caused by improperly sized boiler applications. DO NOT oversize the boiler to the system. Modular boiler installations greatly reduce the likelihood of boiler oversizing.

A. Improper Combustion

⚠ WARNING

Do not obstruct the flow of combustion and ventilating air. Adequate air is necessary for safe operation. Failure to keep the exhaust vent and combustion air intake clear of ice, snow, or other debris could result in property damage, serious personal injury, or death.

B. Gas

Should overheating or gas supply fail to shut off, turn off the manual gas control valve to the boiler.

C. When Servicing the Boiler

⚠ WARNING

Be sure to disconnect electrical power before opening boiler cabinet or performing service. Failure to do so could result in electrical shock, property damage, serious personal injury, or death.

To avoid electric shock, disconnect electrical supply before performing maintenance.

NOTE: When inquiring about service or troubleshooting, reference the model and serial numbers from the boiler rating label.

To avoid severe burns, allow boiler and associated equipment to cool before servicing.

D. Boiler Water

- If you have an old system with cast iron radiators, thoroughly flush the system (without boiler connected) to remove sediment. The high-efficiency heat exchanger can be damaged by build-up or corrosion due to sediment. HTP recommends a suction strainer in this type of system.
- Do not use petroleum-based cleaning or sealing compounds in boiler system. Gaskets and seals in the system may be damaged, possibly resulting in substantial property damage.
- Do not use "homemade cures" or "boiler patent medicines". Substantial property damage, damage to boiler, and/or serious personal injury may result.
- Continual fresh make-up water will reduce boiler life. Mineral buildup in the heat exchanger reduces heat transfer, overheats the stainless steel heat exchanger, and causes failure. Addition of oxygen from make-up water can cause internal corrosion in system components. Leaks in the boiler or piping must be repaired at once.

E. Freeze Protection

NOTE: Consider piping and installation when determining boiler location.

CAUTION

Failure of the boiler due to freeze related damage IS NOT covered by product warranty.

⚠ WARNING

NEVER use any toxic chemical, including automotive, standard glycol antifreeze, or ethylene glycol made for hydronic (non-potable) systems. These chemicals can attack gaskets and seals in water systems, are poisonous if consumed, and can cause personal injury or death.

F. High Elevation Installations

⚠ WARNING

Natural gas at high elevation might contain less heating value than typical 1,000 BTU/cu ft and therefore can cause improper air / gas mix leading to improper combustion. For natural gas installations above 3,000 ft, call your gas provider to determine the heating value of the supplied natural gas.

Part 2 - Before You Start

NOTICE

UNCRATING THE BOILER - Any claims for damage or shortage in shipment must be filed immediately against the transportation company by the consignee.

A. What's in the Box

Remove all sides of the shipping crate of the boiler.
Components included with the boiler:

- Outdoor Sensor
- Condensate Trap and Installation Components
- Three (3) Stainless Steel Screens
- Installation Manual and Warranty
- User's Information Manual
- CSD-1 Form
- H-2 Data Sheet

B. How the Boiler Operates

Condensing technology intelligently delivers highly efficient hydronic heating while maximizing efficiency by measuring data from the heating system. The following are features of the system and how they operate.

Stainless Steel / Steel Heat Exchanger

The highly efficient heat exchanger is designed to use the cold water return from the system and extract the last bit of heat before it is exhausted.

Modulating Combustion System

The combustion system modulates the output of the burner during operation to match system demand and achieve the control set point while in operation. The set point can change by internal or external signals to enhance the overall performance of the system.

Control

The integrated control system monitors the system and regulates fan speed to control boiler output. This allows the boiler to deliver only the amount of heat energy required and nothing more. The system can be further enhanced by installing an indirect water heater to provide domestic hot water.

The control can regulate the output of multiple boilers through its cascade system function. The cascade system is capable of connecting up to eight boilers together in such a way that they function as one boiler system. This allows for greater turn down ratios and provides systematic control of the multiple boilers in an installation to minimize downtime and maximize efficiency.

The cascade system works by establishing one boiler as the master and the other connected boilers as followers. The master boiler requires a cascade system sensor and a cascade pump in addition to its own boiler pump. Each of the follower boilers will have its own pump to provide maximum flow and control heat exchanger flow rate.

System Display and Operational LED Light Indicators
The display allows the user to change system parameters and monitor system outputs.
Gas Valve
Senses suction from the blower, allowing gas to flow only if powered and combustion air is flowing.
Integrated Venturi
Controls air and gas flow into the burner.
Burner
The high grade stainless steel burner uses premixed air and gas to provide a wide range of firing rates.
Burner Sensor
Continually monitors the temperature of the burner to provide increased safety. Temperatures outside the allowable range will shut down the boiler before an unsafe condition occurs.
Spark Ignition
The burner is ignited by applying high voltage through the system spark electrode. The spark from the electrode ignites mixed gas off of the burner.
Dual Supply Water Temperature Sensor / High Limit Water ECO
This dual sensor monitors the boiler outlet water temperature (System Supply). The control adjusts boiler firing rate so the supply temperature will match the boiler set point. The dual sensor meets all requirements to function as a safety, eliminating the mechanical ECO and increasing safety and reliability.
Return Water Temperature Sensor
This sensor monitors boiler return water temperature (System Return).
Temperature and Pressure Gauge
Allows the user to monitor system temperature and pressure.
Electrical field connections with terminal strips
The electrical cover allows easy access to the clearly marked line voltage and low voltage terminal strips to facilitate wiring the boiler.
Supplied Condensate Collection System (Field Installed)
This boiler is a high efficiency appliance and will produce condensate. The condensate collection system has a float switch which monitors condensate level and prevents condensate from backing up into the combustion system. Inside the collection system is a built in trap which seals the combustion system from the connected drain. This condensate should be neutralized to avoid damage to the drainage system or piping.
Flow Protection
The optional flow switch is designed to protect the boiler during low flow conditions. The boiler control also monitors flow through the heat exchanger by monitoring the return and supply sensors and will shut down the burner before overheating occurs.
Outdoor Sensor
The control adjusts unit set point based on the outdoor temperature measured by this sensor to provide greater efficiency.
0-10 Volt Input
Allows the installer to connect a BMS (Building Management System) to control the boiler.
0-10 Volt Output A (Configured through Control System)
0-10 Volt Output A is configured through the boiler's control system. 0-10 Volt Output A is related to one of the following boiler values: boiler power, cascade power, fan speed, alarm status, or temperature setting based on outdoor reset curve.
UL 353 Internal Low Water Cutoff (LWCO)
The supplied internal Low Water Cutoff meets UL 353 requirements to function as a safety, locking out the boiler when water level is inadequate for safe operation. To test LWCO function, press and hold v and RESET simultaneously for five (5) seconds. Press RESET to clear the error code.
Boost Timer Function
This function temporarily overrides the outdoor reset curve in order to satisfy a thermostat setpoint in a short amount of time, especially during a relatively warm day.
Flue Temperature Modulation
As an additional safety feature, if the flue temperature exceeds 200°F, the control will modulate the boiler down based on the vent temperature, rather than the supply temperature. If the flue temperature exceeds 210°F the control will lock out the boiler.
System Sensor (Optional)
This sensor is designed to be used in a cascade system. The system pipe sensor measures the temperature of return water and communicates with the control system to modulate the firing rate of the connected boilers.
NOTE: When using a system sensor, pipe insulation must be wrapped around it to improve temperature measurement accuracy and increase overall system efficiency.
External Low Water Cutoff (Optional)
Connection points are provided on the Field Connection Board to install an external LWCO if required by local codes.
Indirect Tank Sensor (Optional)
Monitors storage tank temperature.

C. Optional Equipment
Optional equipment available from HTP (and Part #):
- System Sensor (7250P-324)
- Indirect Tank Sensor (7250P-325)
- High and Low Gas Pressure Switch Kit with Manual Reset (6300P-991)
- 6" Stainless Steel Outside Termination Vent Kit (V3000)
- Flow Switch Kit (6300P-990)
- Manual Reset High Temperature Limit (6300P-998)
- Alarm System Kit (to monitor any failure) (7350P-602)
- 928 PC Connection Kit with Software (7450P-330)
- Condensate Neutralizer (7350P-611)

Part 3 - Prepare the Boiler
Remove all sides of the shipping crate to allow the boiler to be moved into its installation location. The boiler is heavy. At least two individuals are needed to properly handle the boiler. The boiler is also equipped with leveling mechanisms on its casters that can be used to level the boiler properly on an uneven location surface. If surface flooring is rough, take care when moving the boiler into position, as catching the casters could damage the boiler.

CAUTION

COLD WEATHER HANDLING - If the boiler has been stored in a very cold location (BELOW 0°F) before installation, handle with care until the components come to room temperature. Failure to do so could result in damage to the boiler.

Carefully consider installation when determining boiler location. Please read the entire manual before attempting installation. Failure to properly take factors such as boiler venting, piping, condensate removal, and wiring into account before installation could result in wasted time, money, and possible property damage and personal injury.

A. Locating the Boiler

⚠ WARNING

This boiler is certified for indoor use only. DO NOT INSTALL OUTDOORS. Outdoor installations ARE NOT covered by warranty. Failure to install the boiler indoors could result in property damage, severe personal injury, or death.

Incorrect ambient conditions can lead to damage to the heating system and put safe operation at risk. Ensure that the installation location adheres to the information included in this manual. Failure to do so could result in property damage, serious personal injury, or death. Failure of boiler or components due to incorrect operating conditions IS NOT covered by product warranty.

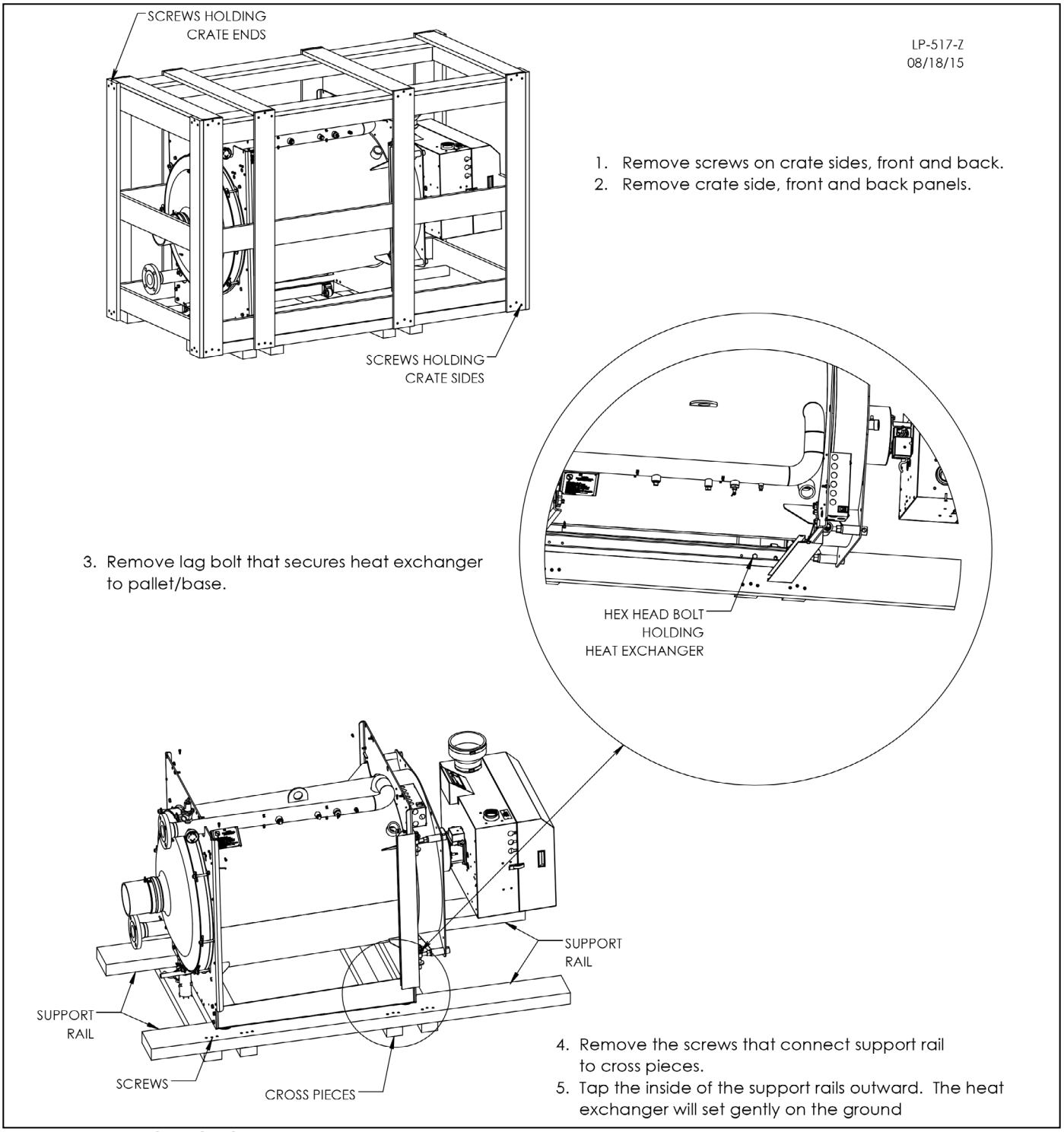


Figure 1 - Removing the Boiler Shipping Crate

⚠ WARNING

This boiler must be installed upright in the vertical position as described in this manual. DO NOT attempt to install this boiler in any other orientation. Doing so will result in improper boiler operation and property damage, and could result in serious personal injury or death.

1. Installation Area (Mechanical Room) Operating Conditions

- Ensure ambient temperatures are higher than 32ºF / 0ºC and lower than 104ºF / 40ºC
- Prevent the air from becoming contaminated by the products, places, and conditions listed in this manual
- Avoid continuously high levels of humidity
- Never close existing ventilation openings
- Ensure a minimum 1" clearance around hot water and exhaust vent pipes
- NOTE: To prevent condensing in the fan, it is recommended to avoid prolonged exposure to temperatures below 45ºF

⚠ WARNING

This boiler has a condensate disposal system that may freeze if exposed to sustained temperatures below 32°F. Precautions should be taken to protect the condensate trap and drain lines from sustained freezing conditions. Failure to take precautions could result in property damage, severe personal injury, or death.

2. Check for nearby connections to:

- System water piping
- Venting connections
- Gas supply piping
- Electrical power
- Condensate drain

3. Check area around boiler. Remove any combustible materials, gasoline, and other flammable liquids.

⚠ WARNING

Failure to keep the boiler area clear and free of combustible materials, liquids, and vapors can result in substantial property damage, severe personal injury, or death.

CAUTION

The service life of the boiler's exposed metallic surfaces, such as the casing, as well as internal surfaces, such as the heat exchanger, are directly influenced by proximity to damp and salty marine environments. In such areas higher concentration levels of chlorides from sea spray coupled with relative humidity can lead to degradation of boiler components. In these environments, boilers must not be installed using direct vent systems which draw outdoor air for combustion. Such boilers must be installed using room air for combustion. Indoor air will have a much lower relative humidity, and hence potential corrosion will be minimized.

Locate the boiler where any leakage from the relief valve, related piping, tank, or connections will not result in damage to surrounding areas or lower floors of the building. The boiler should be located near a floor drain or installed in a drain pan. Leakage damages ARE NOT covered by warranty.

High heat sources (generating heat 100°F / 37°C or greater, such as boiler flue pipes, space heaters, etc.) may damage plastic components of the boiler as well as plastic vent pipe materials. Such damages ARE NOT covered by warranty. It is recommended to keep a minimum clearance of 8" from high heat sources. Observe heat source manufacturer instructions, as well as local, state, provincial, and national codes, laws, regulations, and ordinances when installing this boiler and related components near high heat sources.

Failure of the boiler or components due to incorrect operating conditions IS NOT covered by product warranty.

4. Gas control system components must be protected from dripping water during operation and service.

5. If the boiler is to replace an existing boiler, check for and correct any existing system problems, such as:

- System leaks
- Location that could cause the system and boiler to freeze and leak
- Incorrectly sized expansion tank

6. Clean and flush system when reinstalling a boiler.

NOTE: When installing in a minimum clearance location, it may not be possible to read or view some product labeling. It is recommended to make note of the boiler model and serial number.

⚠ WARNING

Use extreme care not to drop the boiler or cause bodily injury while lifting the boiler. Failure to follow these instructions could result in property damage, severe personal injury, or death.

B. Flooring

⚠ WARNING

This boiler is approved for installation on combustible flooring, but must never be installed on carpeting. Installing this boiler on carpeting could result in fire, property damage, severe personal injury, or death.

Assure that the floor and structure of the installation location are sufficient to support the full installed weight of the boiler, including water content of the heat exchanger and related piping. Failure to ensure the floor and structure of the installation location are structurally sound before installation of the boiler can result in structural failure, substantial property damage, severe personal injury, or death.

C. Leveling

⚠ CAUTION

In order for the condensate to properly flow out of the collection system, the area where you locate the boiler must be level. Location must also fully support the weight of the filled boiler.

D. Clearances for Service Access

NOTE: If you do not provide the minimum clearances shown in Figure 4 it might not be possible to service the boiler without removing it from the space.

NOTE: A combustible door or removable panel is acceptable front clearance.

NOTE: In multiple boiler installations, ensure an 18" minimum clearance is maintained between boilers.

⚠ WARNING

The space must be provided with combustion / ventilation air openings correctly sized for all other appliances located in the same space as the boiler. The boiler cover must be securely fastened to prevent the boiler from drawing air from the boiler room. This is particularly important if the boiler is in a room with other appliances. Failure to comply with the above warnings could result in substantial property damage, severe personal injury, or death.

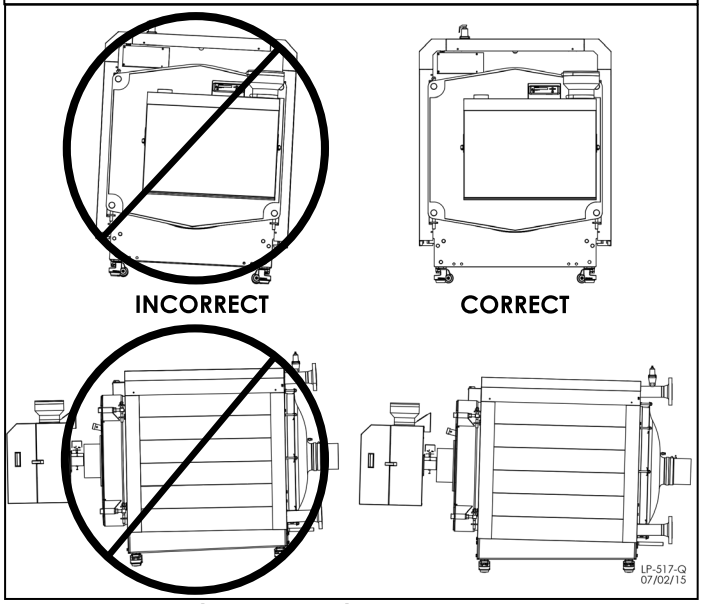


Figure 2 - Correct and Incorrect Leveling

CAUTION

All boilers eventually leak. It is recommended to install a catch pan beneath the boiler. This catch pan should be sized with a maximum depth of 2", and a minimum diameter 2" greater than the diameter of the boiler. The catch pan should empty into an open drain line. This drain line should be 3/4" ID minimum, piped to an open drain. Failure to follow these instructions could result in property damage. Such damages ARE NOT covered by product warranty.

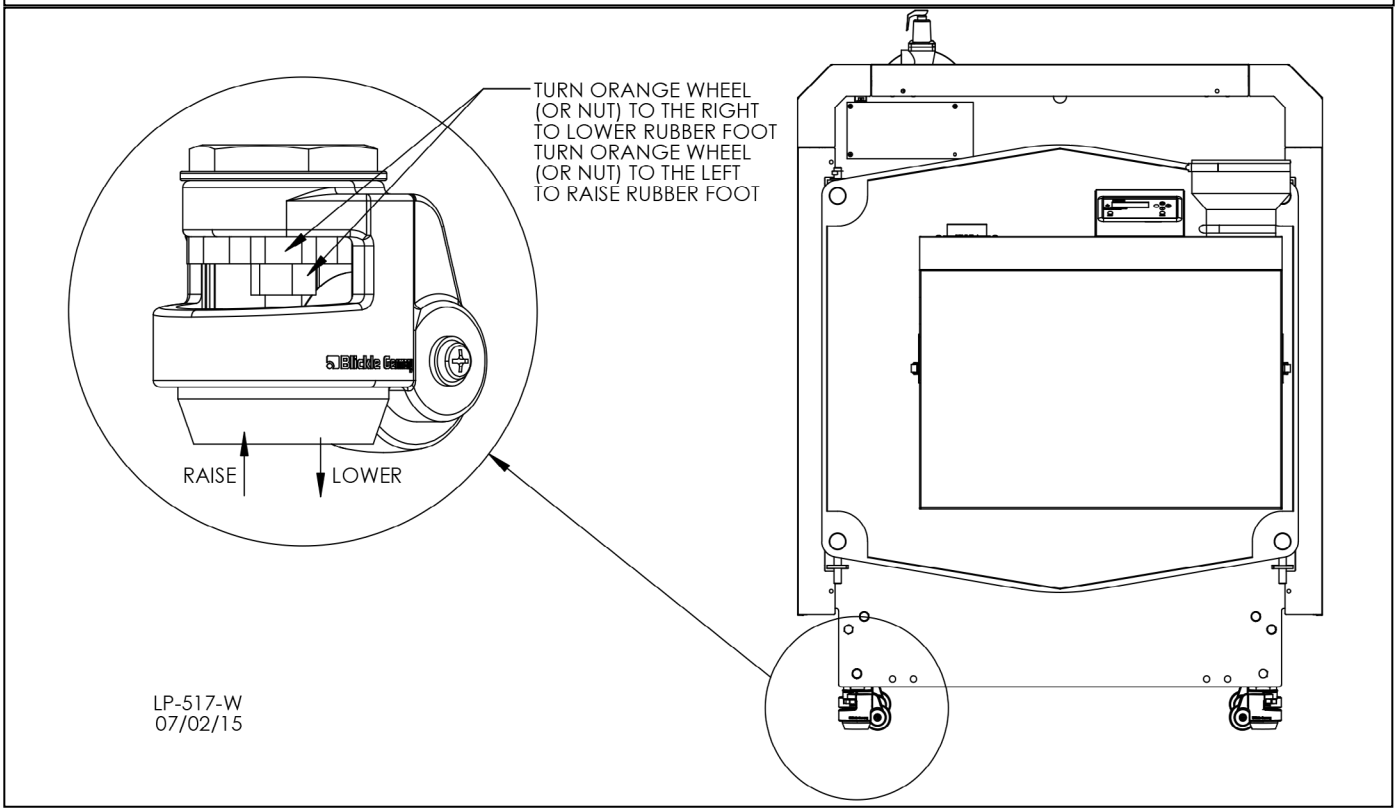


Figure 3 - Correct and Incorrect Leveling

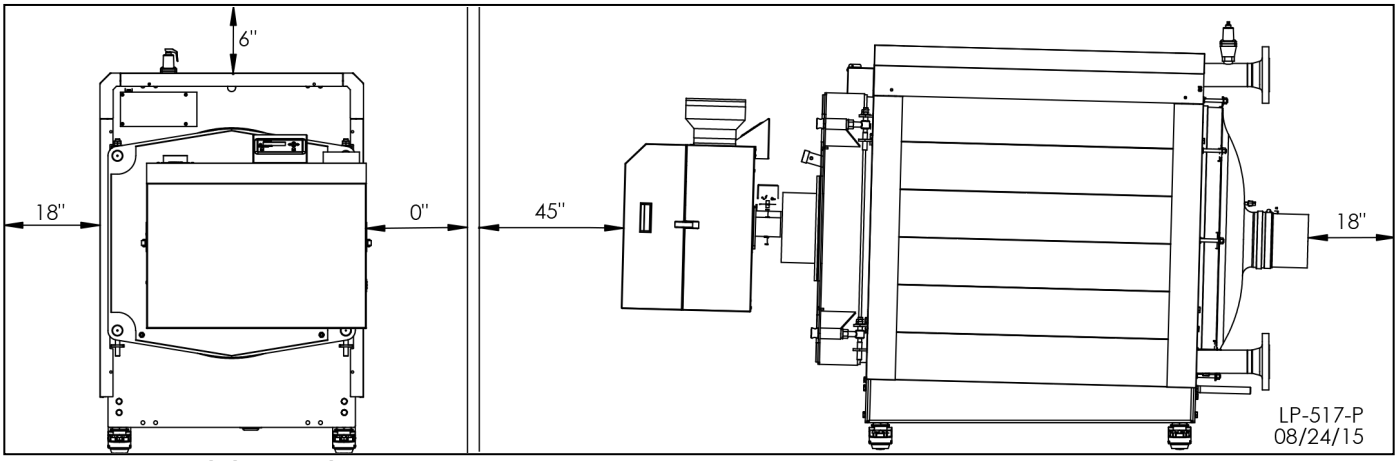


Figure 4 - Recommended Service Clearances

NOTE: In multiple boiler installations, ensure an 18" minimum clearance is maintained between boilers.

E. Residential Garage and Closet Installations

CAUTION

Check with your local Authority Having Jurisdiction for requirements when installing the boiler in a garage or closet. Please read the entire manual before attempting installation. Failure to properly take factors such as venting, piping, condensate removal, and wiring into account before installation could result in wasted time, money, and possible property damage and personal injury.

Precautions

If the boiler is located in a residential garage, per ANSI Z223.1:

- Install the boiler burner and ignition devices a minimum of 18" above the floor of the garage. This will ensure the burner and ignition devices are well off the floor.
- When raising the boiler ensure the entire bottom and fully filled weight of the boiler are fully supported.
- Locate or protect the boiler so it cannot be damaged by a moving vehicle.

⚠ WARNING

The space must be provided with correctly sized combustion/ventilation air openings for all other appliances located in the space with the boiler. For power venting installations using room air for combustion, refer to the venting section, this manual, for descriptions of confined and unconfined spaces. Do not install the boiler in an attic. Failure to comply with these warnings could result in substantial property damage, severe personal injury, or death.

F. Exhaust Vent and Intake Pipe

The boiler is rated ANSI Z21.13 Category IV (pressurized vent, likely to form condensate in the vent) and requires a special vent system designed for pressurized venting.

NOTE: The venting options described here (and further detailed in the Venting section, this manual) are the lone venting options approved for this boiler. Failure to vent the boiler in accordance with the provided venting instructions will void the warranty.

⚠ DANGER

Failure to vent the boiler properly will result in serious personal injury or death.

⚠ WARNING

Do not attempt to vent this boiler by any means other than those described in this manual. Doing so will void the warranty and may result in severe personal injury or death.

The exhaust discharged by this boiler may be very hot. Avoid touching or other direct contact with the exhaust gases of the vent termination assembly. Doing so could result in severe personal injury or death.

Vents must be properly supported. Boiler exhaust and intake connections are not designed to carry heavy weight. Vent support brackets must be within 1' of the boiler and the balance at 4' intervals. Boiler must be readily accessible for visual inspection for first 3' from the boiler. Failure to properly support vents could result in property damage, severe personal injury, or death.

1. Direct Vent of Exhaust and Intake

If installing a direct vent option, combustion air must be drawn from the outdoors directly into the boiler intake and exhaust must terminate outdoors. There are three basic direct vent options detailed in this manual: 1. Side Wall Venting, 2. Roof Venting, and 3. Unbalanced Venting.

Be sure to locate the boiler such that the exhaust vent and intake piping can be routed through the building and properly terminated. Different vent terminals can be used to simplify and eliminate multiple penetrations in the building structure (see Optional Equipment in Venting Section). The exhaust vent and intake piping lengths, routing, and termination methods must all comply with the methods and limits given in the Venting Section, this manual.

When installing a combustion air intake from outdoors, care must be taken to utilize uncontaminated combustion air. **To prevent combustion air contamination, see Table 1.**

2. Power Venting, Indoor Combustion Air in Confined or Unconfined Space

This boiler requires fresh, uncontaminated air for safe operation and must be installed in a mechanical room where there is adequate combustion and ventilating air. **NOTE: To prevent combustion air contamination, see Table 1.**

Combustion air from the indoor space can be used if the space has adequate area or when air is provided through a duct or louver to supply sufficient combustion air based on the boiler input. Never obstruct the supply of combustion air to the boiler. If the boiler is installed in areas where indoor air is contaminated (see Table 1) it is imperative that the boiler be installed as direct vent so that all combustion air is taken directly from the outdoors into the boiler intake connection.

Unconfined space is space with volume greater than 50 cubic feet per 1,000 BTU/hr (4.8 cubic meters per kW) of the total input rating of all fuel-burning appliances installed in that space. Rooms connected directly to this space through openings not furnished with doors are considered part of the space. See Venting Section for details.

Confined space is space with volume less than 50 cubic feet per 1,000 BTU/hr (4.8 cubic meters per kW) of the total input rating of all fuel-burning appliances installed in that space. Rooms connected directly to this space through openings not furnished with doors are considered part of the space.

When drawing combustion air from inside a conventionally constructed building to a confined space, such space should be provided with two permanent openings: one located 6" (15 cm) below the space ceiling, the other 6" (15cm) above the space floor. Each opening should have a free area of one square inch per 1,000 BTU/hr (22cm^2/kW) of the total input of all appliances in the space, but not less than 100 square inches (645cm^2).

If the confined space is within a building of tight construction, air for combustion must be obtained from the outdoors as outlined in the Venting section of this manual.

CAUTION

When drawing combustion air from the outside into the mechanical room, care must be taken to provide adequate freeze protection.

⚠ WARNING

Failure to provide an adequate supply of fresh combustion air can cause poisonous flue gases to enter the living space, resulting in severe personal injury or death. To prevent combustion air contamination, see Table 1.

G. Carbon Monoxide Detectors

In the Commonwealth of Massachusetts and As Required by State and Local Codes:

Installation of Carbon Monoxide Detectors: At the time of installation or replacement of the vented gas fueled appliance, the installing plumber or gas fitter shall observe that a hard wired carbon monoxide detector with an alarm and battery back-up is installed on the floor level where the gas appliance is installed, unless the appliance is located in a detached, uninhabitable structure separate from the dwelling, building, or structure used in whole or in part for residential purposes.

In addition, the installing plumber or gas fitter shall observe that a hard wired carbon monoxide detector with an alarm and battery back-up is installed on each additional level of the dwelling, building, or structure served by the vented gas appliance. It shall be the responsibility of the property owner to secure the service of qualified licensed professionals for the installation of hard wired carbon monoxide detectors.

a. In the event that the vented gas fueled appliance is installed in a crawl space or attic, the hard wired carbon monoxide detector with alarm and battery back-up shall be installed on the next adjacent floor level.

b. In the event that these requirements cannot be met at the time of completion of installation, the owner shall have a period of thirty (30) days to comply with the above requirements; provided, however, that during said thirty (30) day period, a battery operated carbon monoxide detector with an alarm shall be installed.

⚠ WARNING

Do not attempt to vent this appliance by any means other than those described in this manual. Doing so will void the warranty and may result in severe personal injury or death.

Approved Carbon Monoxide Detectors: Each carbon monoxide detector as required in accordance with the above provisions shall comply with NFPA 70 and be ANSI/UL 2034 listed and IAS certified.

H. Prevent Combustion Air Contamination

Install intake air piping for the boiler as described in the Venting Section, this manual. Do not terminate exhaust in locations that can allow contamination of intake air.

⚠ WARNING

Ensure that the intake air will not contain any of the contaminants in Table 1. Contaminated air will damage the boiler, resulting in possible substantial property damage, severe personal injury, or death. For example, do not pipe intake air near a swimming pool or laundry facilities. These areas always contain contaminants.

Products to Avoid	Areas Likely to Have Contaminants
Spray cans containing fluorocarbons	Dry cleaning / laundry areas and establishments
Permanent wave solutions	Swimming pools
Chlorinated waxes / cleaners	Metal fabrication plants
Chlorine-based swimming pool chemicals	Beauty shops
Calcium chloride used for thawing	Refrigeration repair shops
Sodium chloride used for water softening	Photo processing plants
Refrigerant leaks	Auto body shops
Paint or varnish removers	Plastic manufacturing plants
Hydrochloric or Muriatic acid	Furniture refinishing areas and establishments
Cements and glues	New building construction
Antistatic fabric softeners used in clothes dryers	Remodeling areas
Chlorine-type bleaches, laundry detergents, and cleaning solvents	Garages and workshops
Adhesives used to fasten building products	

Table 1 - Products and Areas Likely to Have Contaminants

NOTE: DAMAGE TO THE BOILER CAUSED BY EXPOSURE TO CORROSIVE VAPORS IS NOT COVERED BY WARRANTY. (Refer to the limited warranty for complete terms and conditions.)

I. Removing a Boiler from a Common Vent System

⚠ DANGER

Do not install the boiler into a common vent with any other appliance. This will cause flue gas spillage or appliance malfunction, resulting in possible substantial property damage, severe personal injury, or death.

⚠ WARNING

Failure to follow all instructions can result in flue gas spillage and carbon monoxide emissions, causing severe personal injury or death.

When removing an existing boiler, follow the steps below.

1. Seal any unused openings in the common venting system.
2. Visually inspect the venting system for proper size and horizontal pitch to determine if there is blockage, leakage, corrosion, or other deficiencies that could cause an unsafe condition.
3. If practical, close all building doors, windows, and doors between the space in which the boiler remains connected to the common venting system and other spaces in the building. Turn on clothes dryers and any appliances not connected to the common venting system. Turn on any exhaust fans, such as range hoods and bathroom exhausts, at maximum speed. Do not operate a summer exhaust fan. Close all fireplace dampers.
4. Place in operation the appliance being inspected. Follow the lighting instructions. Adjust the thermostat so the appliance will operate continuously.
5. Test for spillage at the draft hood relief opening after 5 minutes of main burner operation. Use the flame of a match or candle or smoke from a cigarette.
6. After it has been determined that each appliance remaining connected to the common venting system properly vents when tested as outlined, return doors, windows, exhaust fans, fireplace dampers, and any other gas burning appliances to their previous condition of use.
7. Any improper operation of the common venting system should be corrected to conform to the National Fuel Gas Code, ANSI Z223.1. When resizing any portion of the common venting system, the system should approach the minimum size as determined using the appropriate tables in Appendix G of ANSI Z223.1.

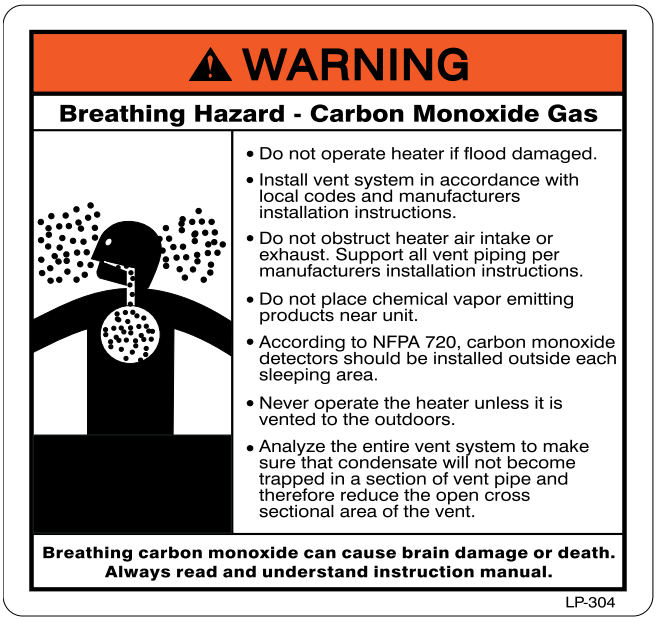


Figure 5 - CO Warning Label

J. Water Chemistry Requirements*

CAUTION

Chemical imbalance of the water supply may affect efficiency and cause severe damage to the appliance and associated equipment. It is important that the water chemistry on both the domestic hot water and central heating sides are checked before installing the appliance. Water quality must be professionally analyzed to determine whether it is necessary to treat the water. Various solutions are available to adjust water quality. Adverse water quality will affect the reliability of the system. In addition, operating temperatures above 135°F will accelerate the build-up of lime scale and possibly shorten appliance service life. Failure of an appliance due to lime scale build-up, low pH, or other chemical imbalance IS NOT covered by the warranty.

Closed loop water must be free of corrosive chemicals, sand, dirt, and other contaminates. It is up to the installer to ensure the water does not contain corrosive chemicals or elements that can damage the heat exchanger.

If you suspect that your water is contaminated in any way, discontinue use of the appliance and contact an authorized technician or licensed professional.

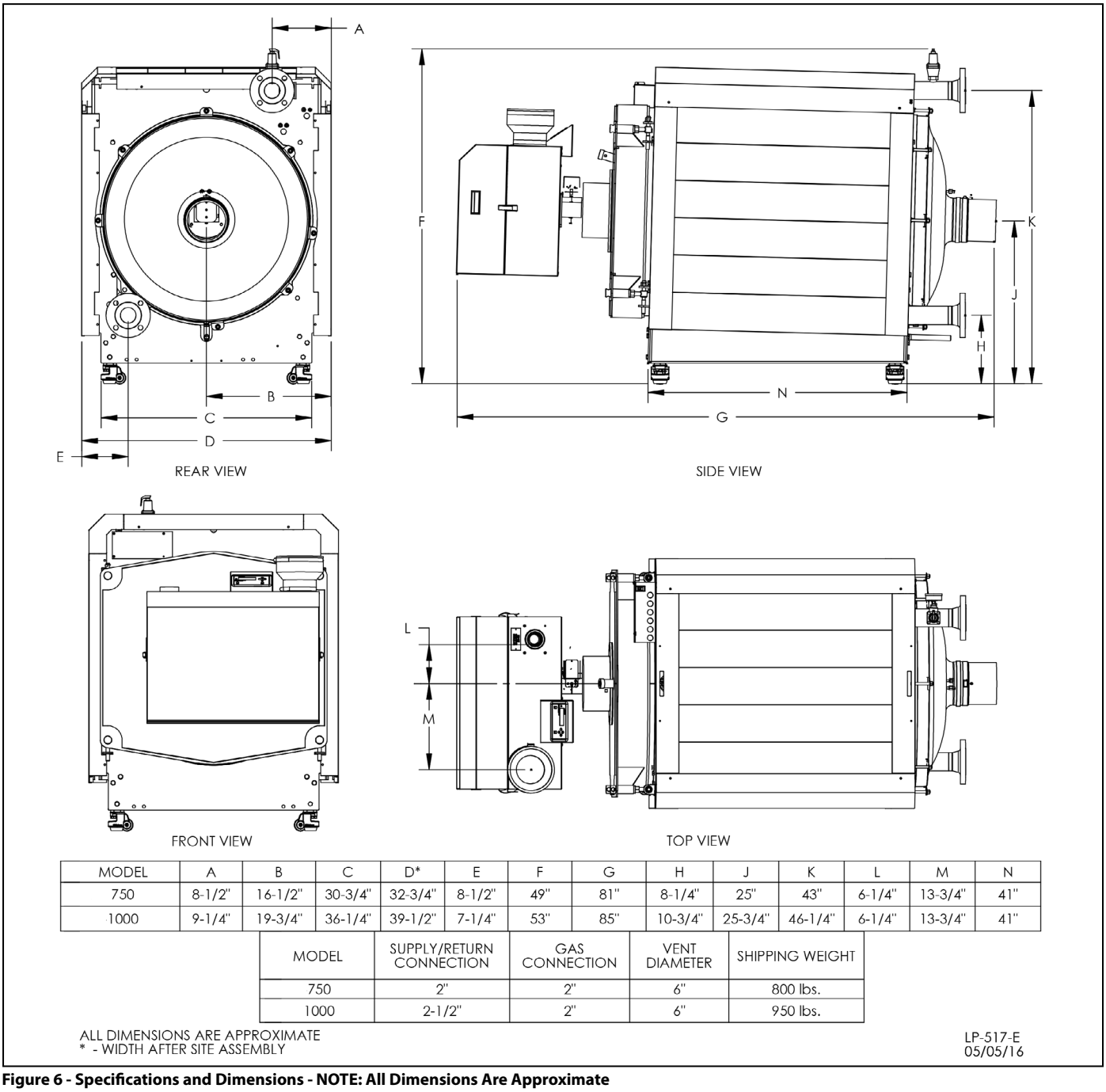
- **Water pH between 6.5 and 8.5**
  - pH levels below 6.5 can cause an increase in the rate of

corrosion. pH of 8.5 or higher can potentially cause lime scale build-up

- Maintain water pH between 6.5 and 8.5. Check with litmus paper or have it chemically analyzed by a local water treatment company.
- If the pH is not between 6.5 and 8.5, consult a local water treatment company for solutions.

- **Hardness less than 7 grains (120 mg/L)**
  - Hardness levels above the required amounts can lead to lime scale build-up throughout the system. Water below 5 grains/gallon (85 mg/L) may be over softened.
  - Consult local water treatment companies for unusually hard water areas (above the required amounts) or for other treatment solutions if water is being over softened (below 5 grains/gallon [85 mg/L]).
- **Chloride concentration less than 100 ppm (mg/L)**
  - Do not fill appliance or operate with water containing chlorides in excess of 100 ppm (mg/L).
  - Using chlorinated fresh water should be acceptable as levels are typically less than 5 ppm (mg/L).
  - Do not connect the appliance to directly heat swimming pool or spa water.
- **Total Dissolved Solids (TDS) less than 500 ppm (mg/L)**
  - Total dissolved solids are minerals, salts, metals, and charged particles that are dissolved in water.
  - The greater the amounts of TDS present, the higher the corrosion potential due to increased conductivity in the water.
  - If using softened water to fill the appliance, it is still possible to have high TDS. This water can be corrosive. Consult local water treatment companies for other treatment solutions to reduce this affect.

***NOTE:** It is recommended to clean the heat exchanger at least once a year to prevent lime scale buildup. To clean the heat exchanger, follow the maintenance procedure in this manual.



MODEL	A	B	C	D*	E	F	G	H	J	K	L	M	N
750	8-1/2"	16-1/2"	30-3/4"	32-3/4"	8-1/2"	49"	81"	8-1/4"	25"	43"	6-1/4"	13-3/4"	41"
1000	9-1/4"	19-3/4"	36-1/4"	39-1/2"	7-1/4"	53"	85"	10-3/4"	25-3/4"	46-1/4"	6-1/4"	13-3/4"	41"

MODEL	SUPPLY/RETURN CONNECTION	GAS CONNECTION	VENT DIAMETER	SHIPPING WEIGHT
750	2"	2"	6"	800 lbs.
1000	2-1/2"	2"	6"	950 lbs.

ALL DIMENSIONS ARE APPROXIMATE
* - WIDTH AFTER SITE ASSEMBLY

LP-517-E
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Figure 6 - Specifications and Dimensions - NOTE: All Dimensions Are Approximate

Part 4 - Piping

⚠ WARNING

Failure to follow the instructions in this section WILL VOID the warranty and may result in property damage, severe personal injury, or death.

CAUTION

Dielectric unions or galvanized steel fittings must not be used in a system with this boiler. Doing so WILL VOID the warranty. Use only copper, brass, or stainless steel fittings. Teflon thread sealant must be used on all connections.

Plumbing of this product should only be done by a qualified, licensed plumber in accordance with all local plumbing codes. The boiler may be connected to an indirect water heater to supply domestic hot water. HTP offers indirect water heaters in either stainless steel or glass-lined construction.

A. General Plumbing Information

CAUTION

The building piping system must meet or exceed the piping requirements in this manual.

The control module uses temperature sensors to provide both high limit protection and modulating temperature control. The control module also provides low water protection by sensing the water level in the heat exchanger. Some codes/jurisdictions may require additional external controls.

Use two wrenches when tightening water piping at boiler. Use one wrench to prevent the boiler return or supply line from turning. Failure to prevent piping connections from turning could cause damage to boiler components.

NOTE: The addition of a high temperature limiting device is important if the boiler is to be connected to a domestic hot water system.

B. Relief Valve

Connect discharge piping to a safe disposal location by following these guidelines.

⚠ WARNING

To avoid water damage or scalding due to relief valve operation:

- Discharge line must be connected to relief valve outlet and run to a safe place of disposal. Terminate the discharge line in a manner that will prevent possibility of severe burns or property damage should the relief valve discharge.
- Discharge line must be as short as possible and the same size as the valve discharge connection throughout its entire length.
- Discharge line must pitch downward from the valve and terminate at least 6" above the floor drain, making discharge clearly visible.
- The discharge line shall terminate plain, not threaded, with a material serviceable for temperatures of 375^{O}F or greater.
- Do not pipe discharge to any location where freezing could occur.
- No valve may be installed between the relief valve and boiler or in the discharge line. Do not plug or place any obstruction in the discharge line.
- Test the operation of the relief valve after filling and pressurizing the system by lifting the lever. Make sure the valve discharges freely. If the valve fails to operate correctly, immediately replace with a new properly rated relief valve.
- Test relief valve at least once annually to ensure the waterway is clear. If valve does not operate, turn the boiler "off" and call a plumber immediately.
- Take care whenever operating relief valve to avoid scalding injury or property damage.

FAILURE TO COMPLY WITH THE ABOVE GUIDELINES COULD RESULT IN FAILURE OF RELIEF VALVE OPERATION, RESULTING IN POSSIBILITY OF SUBSTANTIAL PROPERTY DAMAGE, SEVERE PERSONAL INJURY, OR DEATH.

⚠ WARNING

Do not thread a cap or plug into the relief valve or relief valve line under any circumstances! Explosion and property damage, serious injury, or death may result.

RE-INSPECTION OF RELIEF VALVES: Valves should be inspected AT LEAST ONCE EVERY THREE YEARS, and replaced if necessary, by a licensed plumbing contractor or qualified service technician to ensure that the product has not been affected by corrosive water conditions and to ensure that the valve and discharge line have not been altered or tampered with illegally. Certain naturally occuring conditions may corrode the valve and its components over time, rendering the valve inoperative. Such conditions can only be detected if the valve and its components are physically removed and inspected. **Do not attempt to conduct an inspection on your own.** Contact your plumbing contractor for a re-inspection to assure continued safety.

FAILURE TO RE-INSPECT THE RELIEF VALVE AS DIRECTED COULD RESULT IN UNSAFE TEMPERATURE AND/OR PRESSURE BUILD-UP WHICH CAN RESULT IN PROPERTY DAMAGE, SERIOUS PERSONAL INJURY, OR DEATH.

C. Backflow Preventer

Use a backflow preventer specifically designed for hydronic boiler installations. This valve should be installed on the cold water fill supply line per local codes.

CAUTION

All piping methods in this manual use primary / secondary connections to the boiler loop. This is to avoid the possibility of inadequate flow through the boiler. For other piping methods, consult your local HTP representative or refer to Applications in this manual.

D. Expansion Tank

Expansion Tank and Make-Up Water

1. Ensure that the expansion tank is sized to correctly handle boiler and system water volume and temperature.

⚠ WARNING

Expansion tanks must be sized according to total system volume. This includes all length of pipe, all fixtures, boilers, etc. Failure to properly size for system expansion could result in wasted time, money, possible property damage, serious injury, or death.

CAUTION

Undersized expansion tanks cause system water to be lost from the relief valve, causing make-up water to be added. Eventual boiler failure can result due to excessive make-up water addition. **SUCH FAILURE IS NOT COVERED BY WARRANTY.**

DO NOT install automatic air vents on closed type expansion tank systems. Air must remain in the system and return to the tank to provide an air cushion. An automatic air vent would cause air to leave the system, resulting in improper operation of the expansion tank.

Model	Heat Exchanger Volume (Gallons)
750	38
1000	61

Table 2 - Heat Exchanger Volume

2. The expansion tank must be located as shown in Applications, this manual, or following recognized design methods. See expansion tank manufacturer's instructions for details.

3. Connect the expansion tank to the air separator only if the separator is on the suction side of the circulator. Always install the system fill connection at the same point as the expansion tank connection to the system.

4. Most chilled water systems are piped using a closed type expansion tank.

E. Circulators

CAUTION

DO NOT use the boiler circulator in any location other than the ones shown in this manual. The boiler circulator location is selected to ensure adequate flow through the boiler. Failure to comply with this caution could result in unreliable performance and nuisance shutdowns from insufficient flow.

SIZING SPACE HEAT SYSTEM PIPING

Size the piping and components in the space heating system using recognized design methods.

F. Hydronic Piping with Circulators, Zone Valves, and Multiple Boilers

The boiler is designed to function in a closed loop hydronic system. The included temperature and pressure gauge allows the user to monitor system pressure and outlet temperature from the boiler. It is important to note that the boiler has a minimal amount of pressure drop that must be calculated when sizing the circulators. Each boiler installation must have an air elimination device that will remove air from the system.

Install the boiler so the gas ignition system components are protected from water (dripping, spraying, etc.). Allow clearance for basic service of the boiler circulator, valves, and other components. Observe minimum 1" clearance around all uninsulated hot water pipes when openings around pipes are not protected by non-combustible materials.

On a boiler installed above radiation level, some states and local codes require a low water cut off device. This is provided standard on the boiler. Check with local codes for additional requirements. If the boiler supplies hot water to heating coils in air handler units, flow control valves or other devices must be installed to prevent gravity circulation of boiler water in the coils during the cooling cycle. Chilled water medium must be piped in parallel with the boiler.

Freeze protection for new or existing systems must use glycol specifically formulated for this purpose. This glycol must include inhibitors that will prevent it from attacking metallic system components. Make certain that the system fluid is checked for the correct glycol concentration and inhibitor level. The system should be tested at least once a year and as recommended by the producer of the glycol solution. Allowance should be made for the expansion of the glycol solution in the system piping. Example: 50% by volume glycol solution expands 4.8% in volume for the temperature increase from 32°F to 180°F, while water expands 3% over the same temperature rise.

CAUTION

Never use dielectric unions or galvanized steel fittings when connecting to a stainless steel storage tank or boiler. Failure to follow this instruction can lead to premature failure of the boiler system. Such failures ARE NOT covered by warranty.

The boiler should not be operated as a potable hot water heater. The boiler should not be used as a direct hot water heating device.

G. Circulator Sizing

In addition, the boiler heat exchanger has a minimum total water volume that must be taken into account when sizing the circulator. Minimum boiler flow rates are listed in the table below.

Minimum Boiler Flow Rates	
Model	Minimum Flow (GPM)
750	7.5
1000	10

Table 3 - Minimum Flow Rates

The boiler heat exchanger does have a pressure drop which must be considered in system design. Refer to the graph in Table 4 for pressure drop through the boiler heat exchanger.

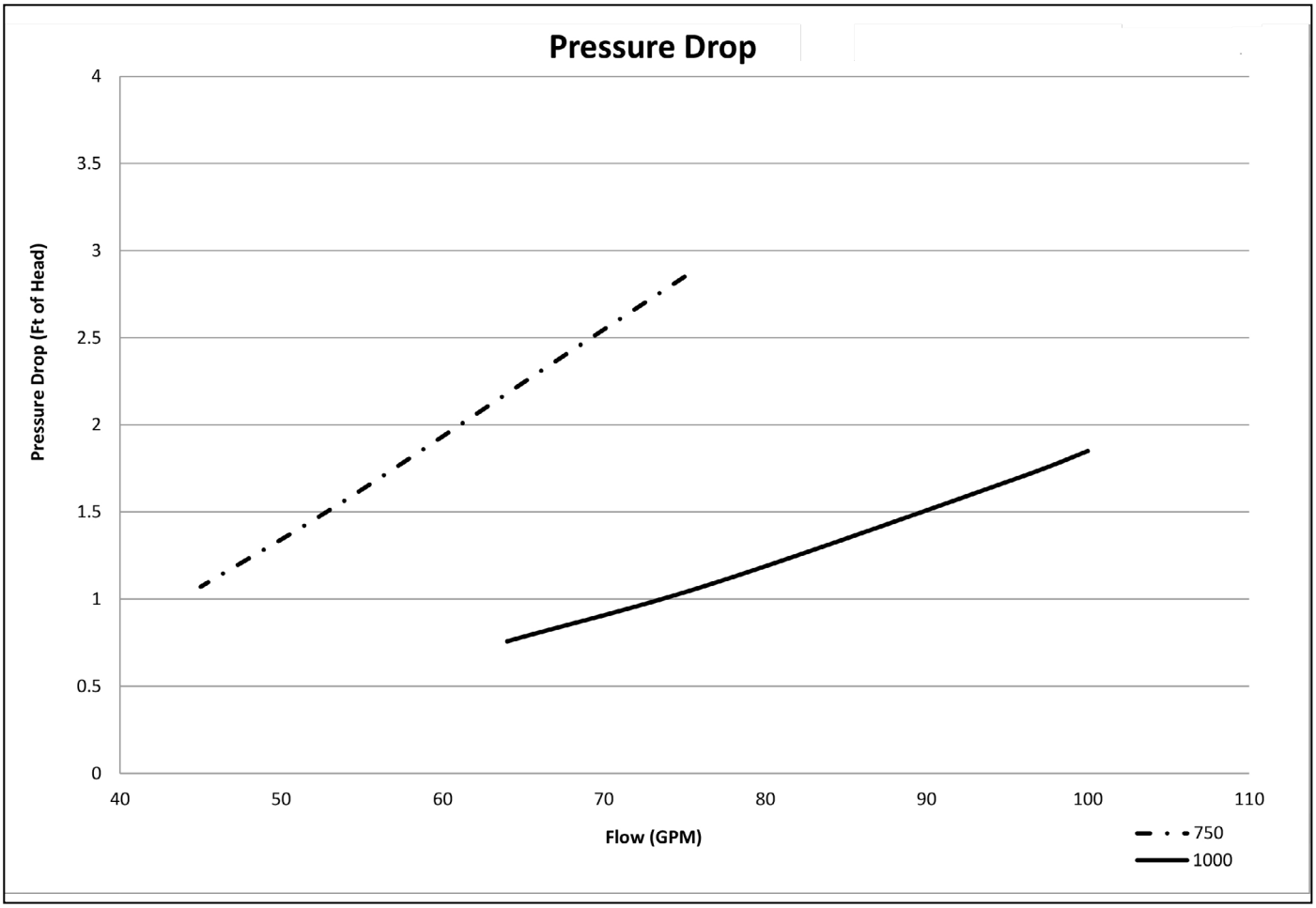


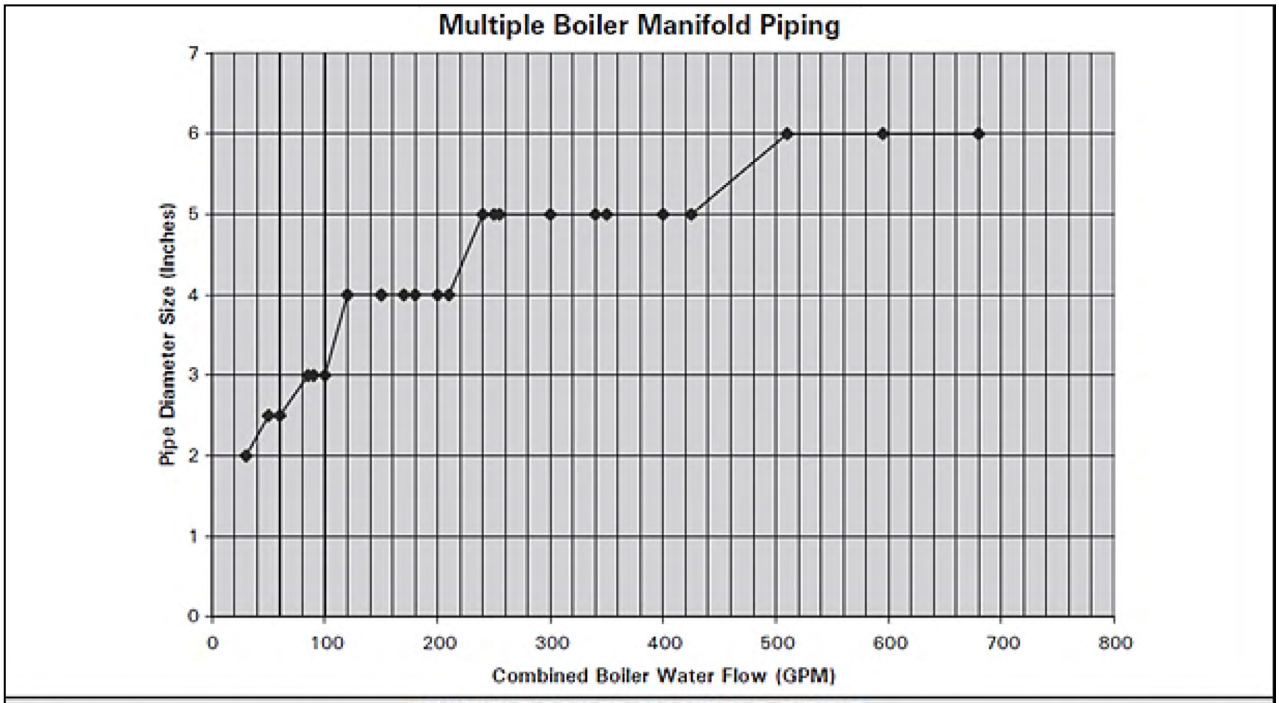
Table 4 - Heat Exchanger Pressure Drop

The chart below represents various system design temperature rise through the boiler along with respective flows and friction loss. This is provided to aid in circulator selection.

System Temperature Rise Chart						
	20°Δt		25°Δt		30°Δt	
Model	Friction Ft	Flow Rate (GPM)	Friction Ft	Flow Rate (GPM)	Friction Ft	Flow Rate (GPM)
750	2.85′	75	1.8′	60	1.3′	50
1000	1.85′	100	1.25′	80	0.8′	66.6

Table 5 - Temperature Rise, Friction Ft and Flow Rate

The chart below represents the combined flow rates and pipe sizes when using multiple boilers to design the manifold system for the primary circuit. To size, simply add up the number of boilers and the required flow rates for the system design temperature.
Example: (5) 750 boilers with a design of 30ºF temperature rise with each boiler having an individual flow rate of 50 GPM. To correctly size the manifold feeding these boilers, you would need a pipe size of 5".



MULTIPLE BOILER MANIFOLD PIPING

Flow rate	30	50	60	85	90	100	120	150	170	180	200	210	240	250	255	300	340	350	400	425	510	595	680
Pipe Dia.	2"	2½"	2½"	3"	3"	3"	4"	4"	4"	4"	4"	4"	5"	5"	5"	5"	5"	5"	5"	5"	6"	6"	6"

Table 6 - Multiple Boiler Manifold Piping

H. Check / Control Water Chemistry

NOTE: Boiler failure due to improper water chemistry is not covered by warranty.

- **Water pH between 6.5 and 8.5**
- **Hardness less than 7 grains (120 mg/L) (Water temperatures of 140ºF and greater)**
- **Chloride concentration less than 100 ppm (mg/L)**
- **Total Dissolved Solids (TDS) less than 500 ppm (mg/L)**

***NOTE:** It is recommended to clean the heat exchanger at least once a year to prevent lime scale buildup. To clean the heat exchanger, follow the maintenance procedure in this manual.

Clean system to remove sediment*

1. You must thoroughly flush the system (without boiler connected) to remove sediment. The high-efficiency heat exchanger can be damaged by buildup or corrosion due to sediment.
2. For zoned systems, flush each zone separately through a purge valve. (If purge valves and isolation valves are not already installed, install them to properly clean the system.)
3. Flush system until water runs clean and you are sure piping is free of sediment.

***NOTE:** It is recommended you clean heat exchanger at least once a year to prevent lime scale buildup. Follow the maintenance procedure to clean the heat exchanger in the Maintenance Section of this manual.

Test/replace freeze protection fluid

1. For systems using freeze protection fluids, follow fluid manufacturer's instructions to verify inhibitor level and that other fluid characteristics are satisfactory.
2. Freeze protection fluid must be replaced periodically due to degradation of inhibitors over time. Follow all fluid manufacturer instructions.

Piping Components

Heating System Piping

System piping MUST be sized per technical pipe requirements listed in Tables 6 and 7. Reducing pipe size can restrict flow rate through the boiler, causing inadvertent short cycling and poor system performance.

Check Valves

Field supplied. Check valves are recommended for installation as shown in Applications.

Isolation Valves

Field supplied. Full port ball valves are required. Failure to use full port ball valves could result in a restricted flow rate through the boiler.

Anti-Scald Mixing Valve

Field supplied. An anti-scald mixing valve is recommended when storing domestic hot water above 115°F.

Steel Flanges

Field supplied. Recommended for unit serviceability.

Pressure Relief Valve

Factory supplied on boiler. The pressure relief valve is sized to ASME specifications. Storage tank may require additional relief valves depending on local codes.

I. Plumbing

CAUTION

This boiler should not be operated as a potable hot water heater. It should not be used as a direct hot water heating device.

Basic steps are listed below that will guide the installation of the boiler.

1. Connect the system return marked "Inlet".
2. Connect the system supply marked "Outlet".

3. Install purge and balance valve or shut off valve and drain on system return to purge air out of each zone.
4. Install a back flow preventer on the cold feed make-up water line.
5. Install a pressure reducing valve on the cold feed make-up water line (15 PSI nominal on the system return). Check temperature and pressure gauge when operating. It should read a minimum pressure of 12 PSI.
6. Install a circulator as shown in piping details (this section). Make sure the circulator is properly sized for the system and friction loss.
7. Install an expansion tank on the system supply. Consult the tank manufacturer's instructions for specific information relating to expansion tank installation. Size the expansion tank for the required system volume and capacity.
8. Install an air elimination device on the system supply.
9. The relief valve is installed at the factory. A pipe discharge line should be installed to discharge 6" above the drain in the event of pressure relief. The pipe size must be the same size as the relief valve outlet. **NEVER BLOCK THE OUTLET OF THE SAFETY RELIEF VALVE.**

Minimum Pipe Size	
Model	**Size**
750	2" NPT
1000	2 1/2" NPT

Table 7 - Minimum Pipe Size

J. Fill and Purge Heating System

- Attach the hose to balance and purge hose connector or drain valve and run hose to nearest drain.
- Close the other side of the balance and purge valve or the shut off valve after the drain.
- Open first zone balance and purge or drain valve to let water flow out the hose. If zone valves are used, open the valves one at a time manually. (NOTE: You should check the valve manufacturer's instructions prior to opening valves manually, so as not to damage the valves.)
- Manually operate fill valve regulator. When water runs out of the hose, you will see a steady stream of water (without bubbles). Close balance and purge valve or drain to stop the water from flowing. Disconnect the hose and connect it to next zone to be purged.
- Repeat this procedure for additional zones (one at a time).

CAUTION

For installation that incorporates standing iron radiation and systems with manual vents at the high points, follow previous section and, starting with the nearest manual air vent, open until water flows out. Then close vent. Repeat procedure, working your way toward the furthest air vent. It may be necessary to install a basket strainer in an older system where larger amounts of sediment may be present. Annual cleaning of the strainer may be necessary.

Upon completion, make sure that the fill valve is in the automatic position and each zone balance and purge or shut off is in an open position and zone valves are positioned for automatic operation.

K. Freeze Protection Fluids

CAUTION

Use only inhibited glycol solutions which are specially formulated for hydronic systems. Ethylene glycol is toxic and can attack gaskets and seals used in hydronic systems. Glycol mixtures should not exceed 50%.

1. Glycol in hydronic applications is specially formulated for this purpose, and includes inhibitors that prevent the glycol from attacking metallic system components. Make certain that the system fluid is checked for the correct glycol concentration and inhibitor level.
2. The glycol solution should be tested at least once a year and as recommended by the glycol manufacturer.
3. Anti-freeze solutions expand more than water. For example: A 50% by volume solution expands 4.8% in volume for a temperature increase from 32oF to 180oF, while water increases 3% over the same temperature rise. Allowances must be made for this expansion in the system design.
4. A 30% mixture of glycol will result in a BTU output loss of 15% with a 5% increase in head against the system circulator.
5. A 50% mixture of glycol will result in a BTU output loss of 30% with a 50% increase in head against the system circulator.

CAUTION

It is highly recommended that you carefully follow the glycol manufacturer's recommended concentrations, expansion requirements, and maintenance recommendations (pH additive breakdown, inhibitor reduction, etc.). Carefully figure the additional friction loss in the system as well as the reduction in heat transfer coefficients.

L. Zoning with Zone Valves

1. When zoning with zone valves, connect the boiler to the system as shown in Applications. The primary/secondary piping shown ensures the boiler loop will have sufficient flow. It also avoids applying the high head of the boiler circulator to the zone valves.
2. Connect DHW (domestic hot water) piping to indirect storage water heater as shown in Applications.

M. Zoning with Circulators

1. When using circulator zoning, connect the boiler to the system as shown in Applications. NOTE: The boiler circulator cannot be used for a zone. It must only supply the boiler loop.
2. Install a separate circulator for each zone.
3. Connect DHW (domestic hot water) piping to indirect storage water heater as shown in Applications.

N. Multiple Boilers

1. Connect multiple boilers as shown in Applications.
2. All piping shown is reverse return to assure balanced flow throughout the connected boilers.
3. Each connected boiler must have its own circulator pump to assure adequate flow.
4. Connect DHW (domestic hot water) piping to indirect storage water heater as shown in Applications.
5. The system flow (secondary loop) must be greater than the boiler's primary loop flow.

O. Applications*

***NOTE:** Systems shown are primary/secondary piping systems. These recommended systems have a primary (boiler) loop, and secondary circuits for heating. The primary loop and secondary circuits have separate circulators. The use of other near boiler piping configurations could result in improper flow rates, leading to inadvertent boiler high limit shutdowns and poor system performance.

NOTE: In piping applications utilizing a single zone, it is recommended that the installer use flow / check valves with weighted seats at or near the appliance to prevent gravity circulation.

FIGURE NOTES:

1. This drawing is meant to demonstrate system piping concept only.
2. A mixing valve is recommended if the DHW temperature is set above the factory setting of 119°F.
3. Install a minimum of 12 diameters of straight pipe upstream of all circulators.
4. Install a minimum of 6 diameters of straight pipe up and downstream of all closely spaced tees.
5. Piping shown is Primary/ Secondary.
6. The minimum pipe size for connecting an HTP indirect fired water heater is 1".
7. The minimum pipe size for connecting a 750 boiler is 2". The minimum pipe size for connecting a 1000 boiler is 2 1/2".
8. System flow (Secondary Loop) must be greater than the boiler's Primary Loop flow.
9. Installations must comply with all local codes.
10. In Massachusetts, a vacuum relief valve must be installed on the cold water line per 248 CMR.
11. See Multiple Boiler Manifold Piping chart, this manual, when sizing and installing a multiple boiler system.

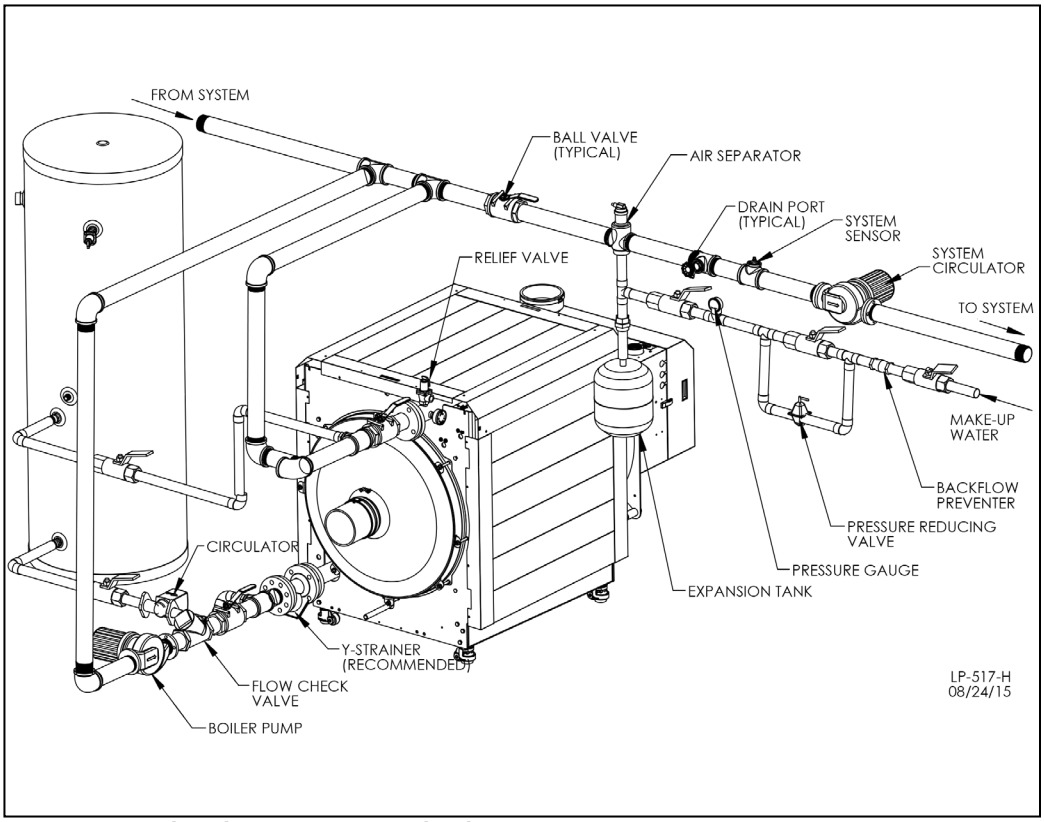


Figure 7 - Single Boiler Space Heating with Indirect Priority

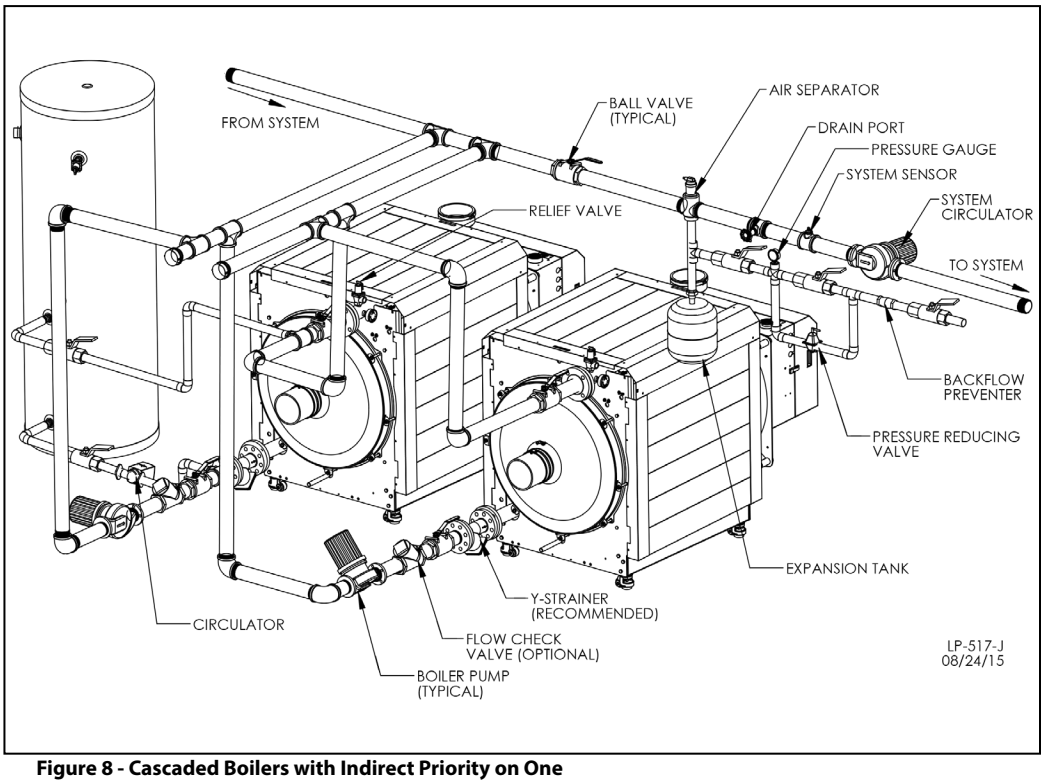


Figure 8 - Cascaded Boilers with Indirect Priority on One

⚠WARNING

An ASSE 1017 thermostatic mixing valve is recommended on all indirect water heaters if the hot water temperature leaving the heater is above 119°F. Failure to do so could result in substantial property damage, serious injury, or death.

The piping will not support the weight of the circulators. Refer to the circulator manufacturer's instructions to properly support the circulator. Failure to comply with these instructions could result in property damage, severe personal injury, or death.

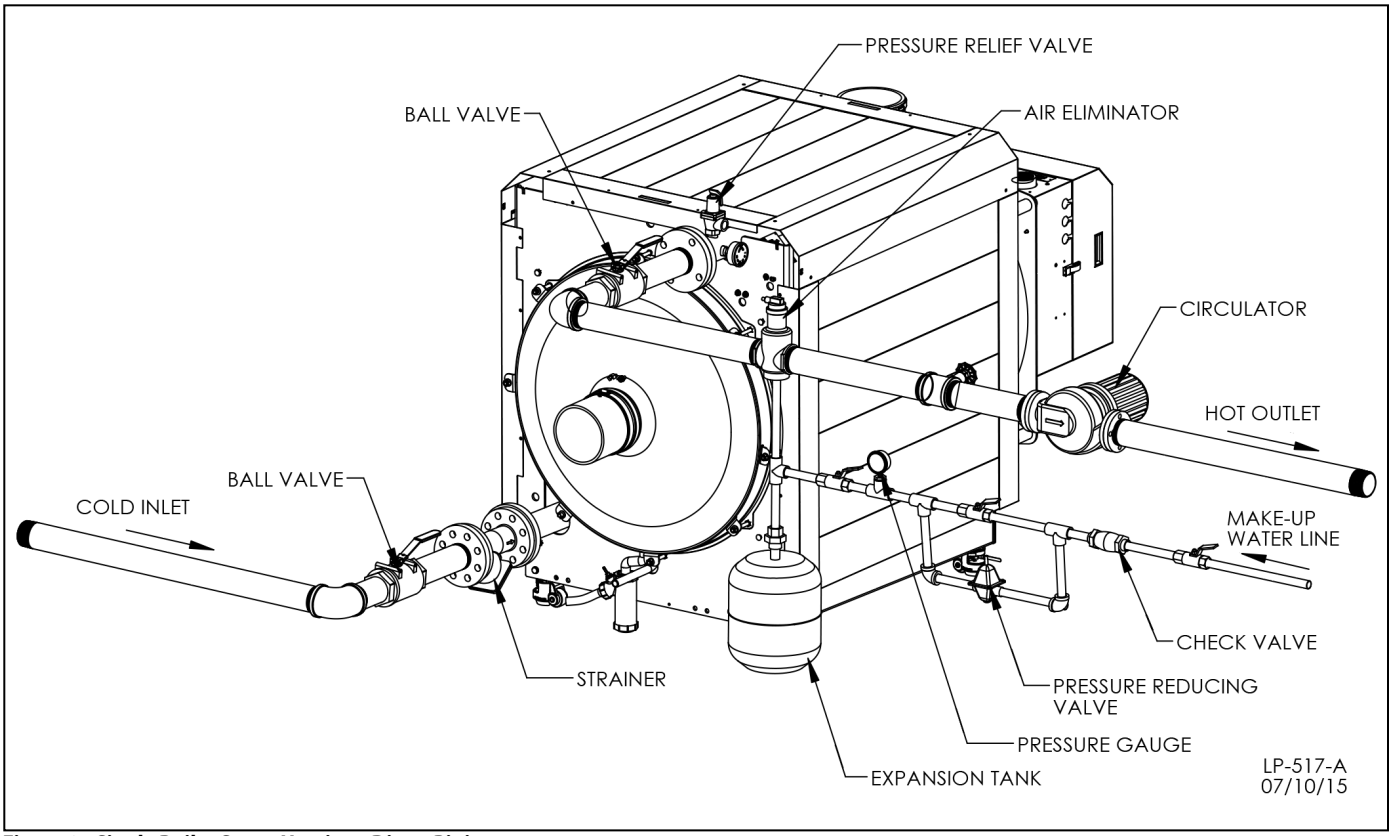


Figure 9 - Single Boiler Space Heating - Direct Piping

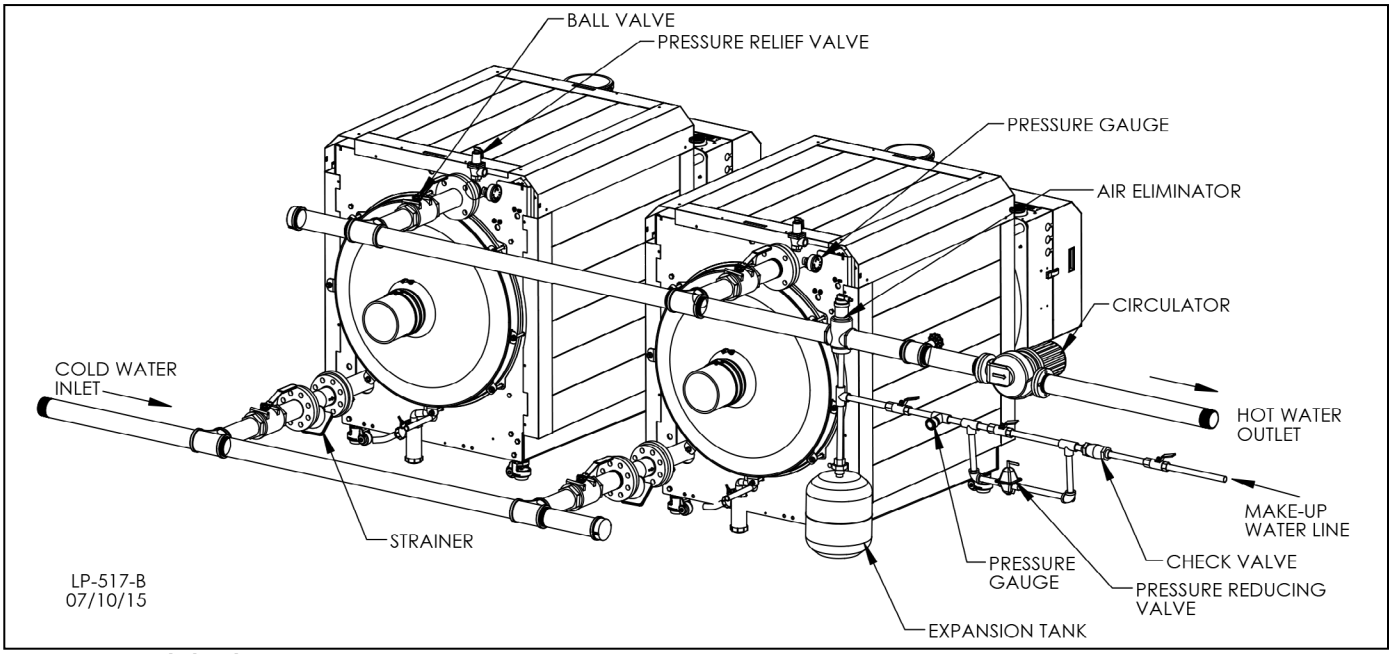


Figure 10 - Cascaded Boilers Space Heating - Direct Piping

FIGURE NOTES:

1. This drawing is meant to demonstrate system piping concept only.
2. Install a minimum of 12 diameters of straight pipe upstream of all circulators.
3. Install a minimum of 6 diameters of straight pipe up and downstream of all closely spaced tees.
4. The minimum pipe size for connecting a 750 boiler is 2". The minimum pipe size for connecting a 1000 boiler is 2 1/2".
5. Installations must comply with all local codes.
6. Direct piping is shown. VERY IMPORTANT: Minimum flow rates outlined in the manual must be maintained to minimize short cycling.
7. See Multiple Boiler Manifold Piping chart, this manual, when sizing and installing a multiple boiler system.

⚠ WARNING

The piping will not support the weight of the circulators. Refer to the circulator manufacturer's instructions to properly support the circulator. Failure to comply with these instructions could result in property damage, severe personal injury, or death.

Part 5 - Venting

⚠ DANGER

The boiler must be vented as detailed in this section. Ensure exhaust vent and intake piping complies with these instructions regarding vent system. Inspect finished exhaust vent and intake piping thoroughly to ensure all joints are well secured, airtight, and comply with all applicable code requirements, as well as the instructions provided in this manual. Failure to properly install the vent system will result in severe personal injury or death.

A. General

⚠ DANGER

This boiler is certified as a "Category IV" appliance and requires a special venting system. The vent system will operate with a positive pressure in the pipe. Exhaust gases must be piped directly outdoors using the vent materials and rules outlined in these instructions. Do not connect vent connectors serving appliances vented by natural draft into any portion of mechanical draft systems operating under positive pressure. Follow the venting instructions carefully. Failure to do so will result in substantial property damage, severe personal injury, or death.

1. Installation should be made in accordance with the regulations of the Authority Having Jurisdiction, local code authorities, and utility companies which pertain to this type of water heating equipment.
2. Install the venting system in accordance with these instructions and with the National Fuel Gas Code, ANSI Z223.1/NFPA 54, CAN/CGA B149, and / or applicable provisions of local building codes.
3. This boiler must be vented with materials, components, and systems listed and approved for Category IV appliances.

⚠ DANGER

Exhaust and intake are to be piped separately. This boiler cannot share a common exhaust or intake with multiple appliances. Failure to follow these instructions will result in substantial property damage, severe personal injury, or death.

NOTE: To avoid contamination often contained in indoor air, it is best to pipe all intake combustion air directly to the outdoors.
NOTE: If exhaust vent pipe system passes through an unheated space such as an alcove or attic, the space must be heated.

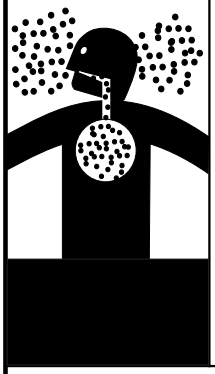
⚠ WARNING

Improper seating of vent pipe gaskets can cause eventual gasket failure and exhaust gas leakage. Ensure the exhaust vent pipe is properly beveled and seated before insertion into the flue adapter. Failure to do so could result in property damage, severe personal injury, or death.

Exhaust vent adaptors are not designed as load-bearing devices, and must not be used to support exhaust vent piping. All vent pipes must be properly connected, supported, and the exhaust vent must be pitched a minimum of 1/4" per foot back to the boiler to allow drainage of condensate. Failure to properly support vent piping and follow the information in this statement could result in product damage, severe personal injury, or death.

⚠ WARNING

Breathing Hazard - Carbon Monoxide Gas



- Do not operate heater if flood damaged.
- Install vent system in accordance with local codes and manufacturers installation instructions.
- Do not obstruct heater air intake or exhaust. Support all vent piping per manufacturers installation instructions.
- Do not place chemical vapor emitting products near unit.
- According to NFPA 720, carbon monoxide detectors should be installed outside each sleeping area.
- Never operate the heater unless it is vented to the outdoors.
- Analyze the entire vent system to make sure that condensate will not become trapped in a section of vent pipe and therefore reduce the open cross sectional area of the vent.

Breathing carbon monoxide can cause brain damage or death. Always read and understand instruction manual.

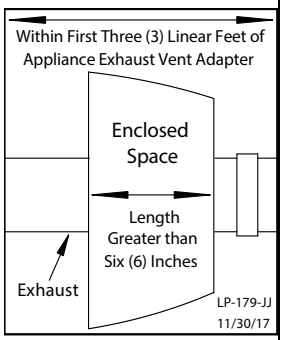
LP-304

⚠ DANGER

Due to the extreme flammability of most glues, cements, solvents, and primers used to join plastic exhaust vent and intake pipes, explosive solvent vapors must be cleared from all vent piping before start-up. Avoid using excess cement or primer, as this may pool in the vent pipes. Vent assemblies should be allowed to cure for a period of at least 8 hours before powering a connected appliance. Failure to follow these instructions will result in substantial property damage, severe personal injury, or death. It is the installers' responsibility to understand the hazards associated with explosive solvents and take the necessary precautions to avoid these risks.

⚠ WARNING

- DO NOT insulate the first three (3) linear feet of the exhaust vent run.
- CPVC, Polypropylene, or Stainless Steel pipe material MUST be used if the first three (3) linear feet of the exhaust vent run is insulated or passes through an enclosed space greater than 6" in length, such as a wall.
- If CPVC is used to meet these requirements, the balance may be installed with approved PVC pipe.
- If Polypropylene or Stainless Steel is used to meet these requirements, the balance of the vent run must be installed with the same material.
- Failure to comply with this warning could result in property damage, severe personal injury, or death.



B. Approved Materials for Exhaust Vent and Intake Pipe

Item	Material	Standards for Installation In:	
		United States	Canada
Pipe and Fittings Approved for Intake ONLY	ABS*	ANSI/ASTM D2661	NOT PERMITTED
Pipe Approved for Intake OR Exhaust Vent	PVC Schedule 40/80	ANSI/ASTM D1785	PVC, CPVC, and PP Venting Must be ULC-S636 Certified. IPEX is an approved manufacturer in Canada.
	PVC-DWV Schedule 40/80	ANSI/ASTM D2665	
	CPVC Schedule 40/80	ANSI/ASTM F441	
	Polypropylene	UL-1738 or ULC-S636	
	Stainless Steel AL29-4C	Certified for Category IV and Direct Vent Appliance Venting	
Pipe Fittings	PVC Schedule 40	ANSI/ASTM D2466 or D2665	PVC, CPVC, and PP Venting Must be ULC-S636 Certified. IPEX is an approved manufacturer in Canada.
	PVC Schedule 80	ANSI/ASTM D2467 or D2665	
	CPVC Schedule 40	ANSI/ASTM F438	
	CPVC Schedule 80	ANSI/ASTM F439	
Pipe Cement	ABS*	ANSI/ASTM D2235	NOT PERMITTED
	PVC	ANSI/ASTM D2564	IPEX System 636 Cements and Primers
	CPVC	ANSI/ASTM F493	
Pipe Primer	PVC / CPVC	ASTM F656	

⚠ DANGER

- The exhaust and intake components installed with this boiler must be used for near boiler piping BEFORE transitioning to the approved materials listed above. DO NOT REMOVE these installed components. Doing so WILL VOID boiler warranty.
- PVC / CPVC pipe and fittings of the same diameter are considered interchangeable.
- DO NOT use Foam Core Pipe in any portion of the exhaust piping from this boiler.
- DO NOT connect PVC/CPVC to Polypropylene without an approved vent connector.
- Any transition to Polypropylene MUST be done in the vertical within five (5) feet of the appliance.
- When installing AL29-4C vent piping, install a PVC-to-stainless adapter at the boiler vent connection, and at the termination when using a PVC termination kit. DO NOT mix AL29-4C piping from different manufacturers unless using adapters specifically designed for the purpose by the manufacturer.
- A double wall vent may be used when using stainless steel vent material in a freezing climate.
- *ABS and PVC-DWV may be used for air intake applications ONLY. ABS is NOT PERMITTED for use in Canada.
- Contact the venting material manufacturer if there is any question about the applicability of the proposed venting material.

Failure to follow these directions will result in substantial property damage, severe personal injury, or death.

Table 8 - Approved Materials for Exhaust Vent and Intake Pipe

⚠ WARNING

DO NOT mix components from different venting systems without proper adapters. The vent system could fail, causing leakage of flue products into the living space. Use only the approved pipe and fitting materials, and primer and cement specifically designed for the material used, as listed in the above table. Failure to do so could result in property damage, serious injury, or death.

CAUTION

High heat sources (generating heat 100°F / 37°C or greater, such as boiler flue pipes, space heaters, etc.) may damage plastic components of the boiler as well as plastic vent pipe materials. Such damages ARE NOT covered by warranty. It is recommended to keep a minimum clearance of 8" from high heat sources. Observe heat source manufacturer instructions, as well as local, state, provincial, and national codes, laws, regulations, and ordinances when installing this boiler and related components near high heat sources.

NOTE: The use of double-wall vent or insulated material for the combustion air intake pipe is recommended in cold climates to prevent the condensation of airborne moisture in the incoming combustion air.

⚠ DANGER

You must not use "B" vent in an exhaust application. "B" vent is for intake applications ONLY. Using "B" vent in an exhaust application will result in serious injury or death.

⚠ WARNING

It is required to insert exhaust and intake screens into the vent terminations to prevent blockage caused by debris or birds. Failure to keep terminations clear could result in property damage, severe personal injury, or death.

C. Additional Requirements for Installation in Canada

1. Installations must be made with a vent pipe system certified to ULC-S636. IPEX is an approved vent manufacturer in Canada supplying vent material listed to ULC-S636. Additionally, you may use AL29-4C stainless steel venting to comply with Canadian requirements.

2. The first three (3) feet of vent pipe from the boiler flue outlet must be readily accessible for visual inspection. 3. The components of the certified vent system must not be interchanged with other vent systems or unlisted pipe / fittings.

Cellular foam core piping may be used on air inlet piping **only**.

D. Exhaust Vent and Intake Pipe Location

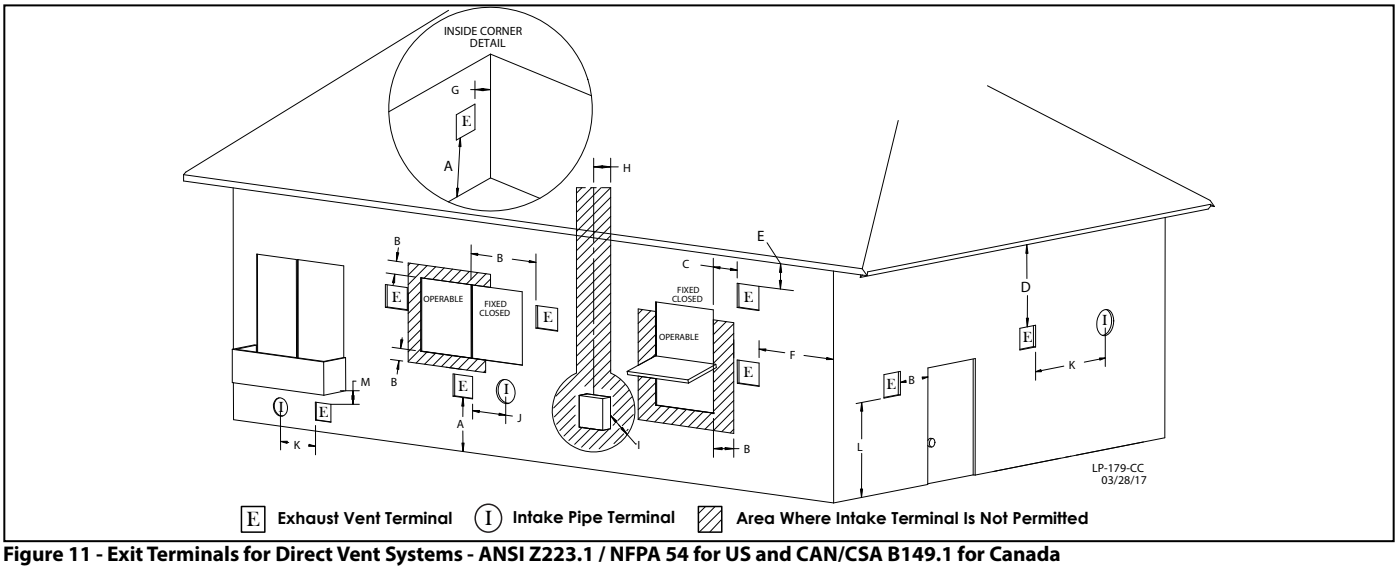


Figure 11 - Exit Terminals for Direct Vent Systems - ANSI Z223.1 / NFPA 54 for US and CAN/CSA B149.1 for Canada

	DESCRIPTION		US	CANADA
A	Clearance above grade, veranda, porch, deck, or balcony		1 foot (30 cm)	
B	Clearance to window or door that may be opened	Direct Vent	1 foot	3 feet (91 cm)
		Power Vent	4 ft below or to side of opening; 1 ft above opening	
C	Clearance to permanently closed window		*	
D	Vertical clearance to ventilated soffit located above the terminal within a horizontal distance 2 feet (61 cm) from the center line of the terminal		*	
E	Clearance to unventilated soffit		*	
F	Clearance to outside corner		*	
G	Clearance to inside corner		*	
H	Clearance to each side of center line extended above meter / regulator assembly		*	
I	Clearance to service regulator vent outlet		*	Above a regulator within 3 feet (91 cm) horizontally of the vertical center line of the regulator vent outlet to a maximum vertical distance of 15 ft (4.5 m)
J	Clearance to nonmechanical air supply inlet to building or the combustion air inlet to any other appliance	Direct Vent	1 foot	3 feet (91 cm)
		Power Vent	4 ft below or to side of opening; 1 ft above opening	
K	Clearance to mechanical air supply inlet		3 feet above if within 10 feet horizontally	6 feet (1.83 m)
L	Clearance above paved sidewalk or paved driveway located on public property	Direct Vent	*	7 feet (2.13 m)
		Power Vent	7 feet (2.13 m)	
M	Clearance under veranda, porch deck, or balcony		*	1 foot (30 cm)

Table 9 - Vent Termination Clearances - *NOTE: For clearances not specified in ANSI Z223.1 / NFPA 54 for US and CAN/CSA B149.1 for Canada, please use clearances in accordance with local installation codes and the requirements of the gas supplier.

⚠ WARNING

The building owner is responsible for keeping the exhaust and intake terminations free of snow, ice, or other potential blockages, as well as scheduling routing maintenance. Failure to keep the vent piping terminations clear and properly maintain the heater could result in property damage, severe personal injury, or death.

⚠ WARNING

For each floor containing bedroom(s), a carbon monoxide detector and alarm shall be placed in the living area outside the bedrooms, as well as in the room that houses the heater. Detectors and alarms shall comply with NFPA 720 (latest edition). Failure to comply with these requirements could result in product damage, severe personal injury, or death.

E. Exhaust Vent and Intake Pipe Sizing

1. The exhaust vent and intake pipe size is 6".
2. The maximum total equivalent length of exhaust vent and intake pipe **should not exceed 140 feet**.
   a. The equivalent length of elbows, tees, and other fittings are listed in the Friction Loss Table.

Friction Loss Equivalent in Piping and Fittings		
Fittings or Piping	**Equivalent Feet**	
	6"	8"
90 Degree Elbow*	3'	3'
45 Degree Elbow	1'	1'
Coupling	0'	0'
Air Inlet Tee	0'	0'
Straight Pipe	1'	1'
V Series Vent Kit	1'	1'
AL29 4c Vent Terminal	1'	1'

Table 10 - *Friction loss for long radius elbow is 1 foot less. NOTE: Consult Polypropylene venting instructions for friction loss and pressure drop equivalents.

   b. For example: If the exhaust vent is 6" in diameter, has two 90° elbows, and 10 feet of PVC pipe we will calculate:
   Exhaust Vent Equivalent Length = (2x3) + 10 = 16 feet.
   Further, if the 6" intake pipe has two 90° elbows, one 45° elbow, and 10 feet of PVC pipe, the following calculation applies:
   Intake Pipe Equivalent Length = (2x3) + 1 + 10 = 17 feet.
   The total equivalent length is 33 feet, well below the maximum of 140 feet.
   c. Effort should be made to keep a minimum difference in equivalent length between the exhaust vent and intake pipe.
3. The minimum total equivalent length is 16 feet.

CAUTION

Do not exceed the maximum lengths for vent pipes. Excessive length could result in boiler shutdown and property damage.

Failure to provide a minimum total vent length of 16 equivalent feet could result in property damage and improper product operation.

⚠ DANGER

Total maximum equivalent length of exhaust vent and intake pipe must not exceed the lengths defined in this manual. Failure to keep the total equivalent length below the maximum lengths determined in this manual will result in faulty boiler operation, substantial property damage, serious personal injury, or death.

F. Exhaust Vent and Intake Pipe Installation

⚠ WARNING

All joints of positive pressure vent systems must be sealed completely to prevent leakage of flue products into the living space. Failure to do so could result in property damage, serious injury, or death.

1. Use only solid PVC, CPVC, or stainless steel pipe or a Polypropylene vent system approved for use with Category IV appliances.
FOAM CORE PIPING IS NOT APPROVED FOR EXHAUST VENT APPLICATIONS. Foam core piping may be used on air inlet piping **only**.
2. Remove all burrs and debris from joints and fittings.
3. When using PVC or CPVC pipe, all joints must be properly cleaned, primed, and cemented. Use only cement and primer approved for use with the pipe material. Cement must conform to ASTM D2564 for PVC and ASTM F493 for CPVC pipe. **NOTE: DO NOT CEMENT POLYPROPYLENE PIPE.**
4. Ensure the vent is located where it will not be exposed to prevailing winds.
5. In all roof venting applications, exhaust discharge must point away from the pitch of the roof.
6. If the exhaust vent is to be terminated in a walled off area (such as a roof with a parapet wall), ensure the exhaust vent terminates a minimum of 10' from nearest wall and extends level with or above the top of the wall. This will ensure flue gas does not get trapped and possibly recirculated into the intake air pipe, which could contaminate the combustion air.
7. To prevent water leakage, install adequate roof flashing where the pipe enters the roof.
8. Do not locate vent over public walkways, driveways, or parking lots. Condensate could drip and freeze, resulting in a slip hazard or damage to vehicles and machinery.
9. Due to potential moisture build-up, sidewall venting may not be the preferred venting option. To save time and cost, carefully consider venting installation and location.
10. Horizontal lengths of exhaust vent must slope back towards the boiler not less than ¼" per foot to allow condensate to drain from the vent pipe.
11. The exhaust vent must terminate where vapors cannot make accidental contact with people or pets, or damage shrubs or plants.
12. In vacant chimney applications, install and seal a rain cap over existing chimney openings.
13. All piping must be fully supported. Use pipe hangers at a minimum of 4 foot intervals to prevent sagging of the pipe where condensate may form.
14. Do not use the boiler to support any piping.
15. Ensure the outdoor exhaust vent termination is screened to prevent blockage caused by debris or birds.
16. Ensure the outdoor intake pipe termination is screened to prevent blockage caused by debris or birds.
17. Maximum Snow Level Determination: These installation instructions reference snow levels in establishing a minimum height for the installation of exhaust vent or air intake terminations. Snow levels shall be determined as follows:
   a. The installation location may, by ordinance, designate how snow levels are calculated in that location; or
   b. In the absence of specific ordinances, snow levels shall be calculated from the average monthly maximum depth of snow accumulation as indicated by the National Weather Service's 10 year statistics for the installation location/geographical area.

In addition:

- Total length of vent piping shall not exceed the limits specified in this manual.
- The vent piping for this direct vented appliance is approved for zero clearance to combustible construction.
- The flue products coming from the exhaust vent will create a large plume when the heater is in operation. Avoid venting in areas that will affect neighboring buildings or be considered objectionable.
- DO NOT locate exhaust vent or intake pipe in a parking area where machinery may damage the pipe.
- DO NOT vent near soffit vents, crawl space vents, or other areas where condensate or vapor could create a nuisance or hazard or cause property damage.
- DO NOT vent where condensate vapor could cause damage or could be detrimental to the operation of regulators, relief valve, or other equipment.

In the Commonwealth of Massachusetts and as Required by State and Local Codes:

- The vented gas fueled appliance shall not be installed so its combustion, ventilation, or dilution air is obtained from a bedroom or bathroom.
- Signage: Whenever any through-the-wall (horizontal or

sidewall) vent is installed less than seven feet above the finished grade, a metal or plastic identification plate shall be permanently mounted to the exterior of the building at a minimum height of eight feet above grade directly in line with the exhaust vent terminal. The sign shall read, in print no less than 0.5 inches in size, "GAS VENT DIRECTLY BELOW. KEEP CLEAR OF ALL OBSTRUCTIONS".

- Marking of Exhaust Vent and Intake Pipe: Piping used for ventilation, make-up, or combustion air intake shall be labeled as follows:
  a. Throughout the entire developed length:
  i. Labels must be placed every ten feet for exposed/visible piping; or
  ii. Labels must be placed every three feet for concealed piping.
  b. At all changes of direction;
  c. On each side of a penetration through a partition, wall or ceiling; and
  d. The labels shall be black lettering that:
  i. Indicates that the piping is used for ventilation, make-up, or combustion air intake, and
  ii. The letters shall be sized equal to a minimum of the pipe diameter. However, for piping with a diameter exceeding two inches, said lettering does not need to be larger than two inches.

G. Applications

1. Direct Vent Installation of Exhaust and Intake

If installing a direct vent option, combustion air must be drawn from the outdoors directly into the boiler intake, and exhaust must terminate outside. There are three basic direct vent options detailed in this manual: 1. Side Wall Venting, 2. Roof Venting, and 3. Unbalanced Venting.

Be sure to locate the boiler such that the exhaust vent and intake pipe can be routed through the building and properly terminated. Different vent terminals can be used to simplify and eliminate multiple penetrations in the building structure (see Optional Equipment in Venting Section). The exhaust vent and intake pipe lengths, routing and termination methods must all comply with the methods and limits given in the Venting section of this manual.

When installing a combustion air intake from outdoors, care must be taken to utilize uncontaminated combustion air. **NOTE:** To prevent combustion air contamination, see Table 1.

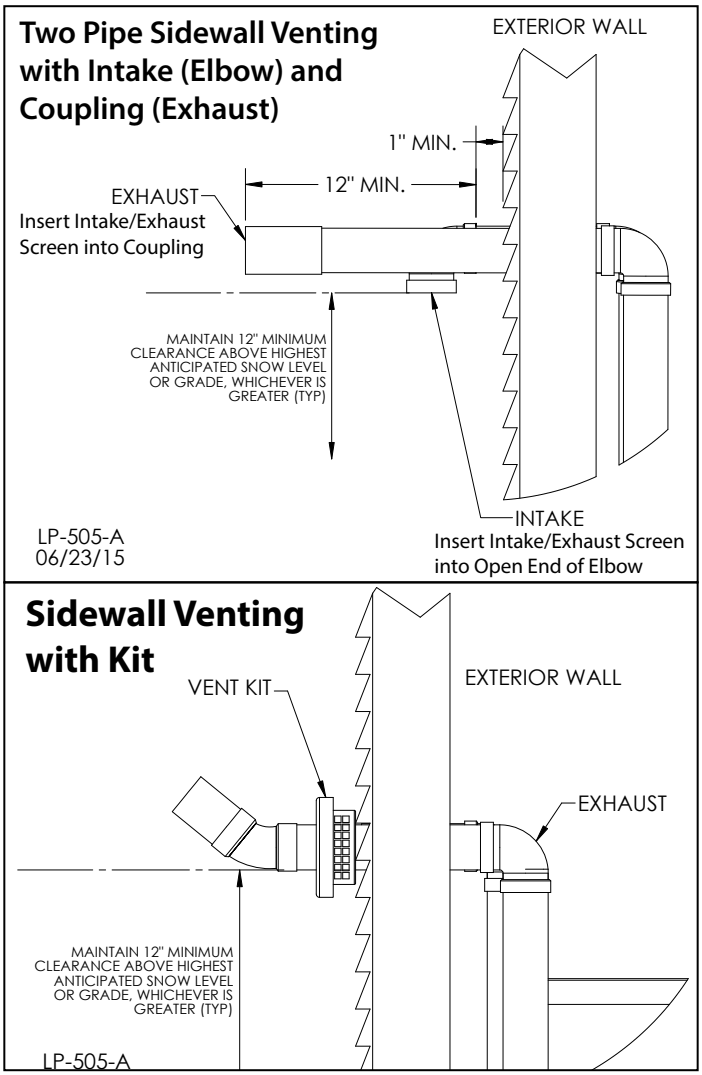


Figure 12 - Sidewall Venting with Tee and Coupling and Optional Kit

NOTE: These drawings are meant to demonstrate system venting only. The installer is responsible for all equipment and detailing required by local codes.

Ensure the terminations are screened to prevent blockage caused by debris or birds.

⚠ WARNING

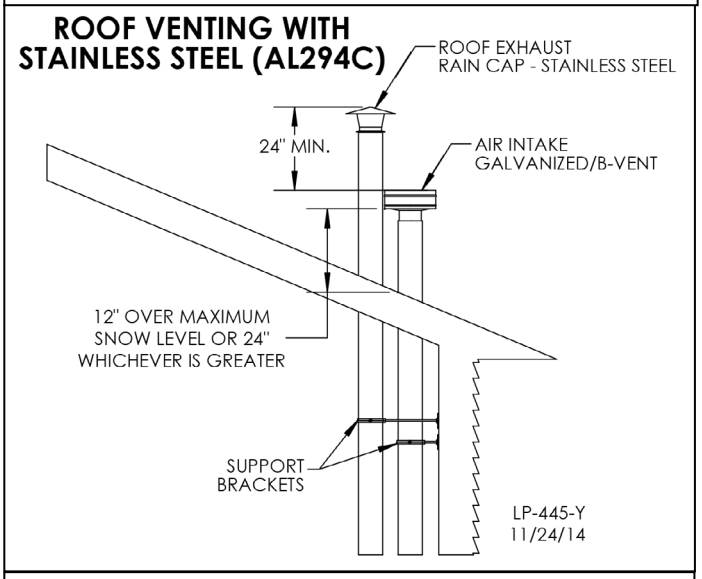
All vent pipes must be glued, properly supported, and the exhaust pitched a minimum of 1/4" per foot back to the boiler to allow drainage of condensate. When placing support brackets on vent piping, the first bracket must be within 1 foot of the boiler and the balance of 4 foot intervals on the vent pipe. Venting must be readily accessible for visual inspection from the first three feet from the boiler.

Take extra precaution to adequately support the weight of vent pipes terminating through the roof. Failure to properly support roof terminated vent piping could result in property damage, serious personal injury, or death due to flue gas leakage.

An unbalanced vent system can be installed ONLY when the exhaust is in the vertical position. Failure to do so could result in serious personal injury or death.

WARNING

Take extra precaution to adequately support the weight of vent pipes terminating through the roof. Failure to properly support roof terminated piping could result in property damage, serious injury, or death.



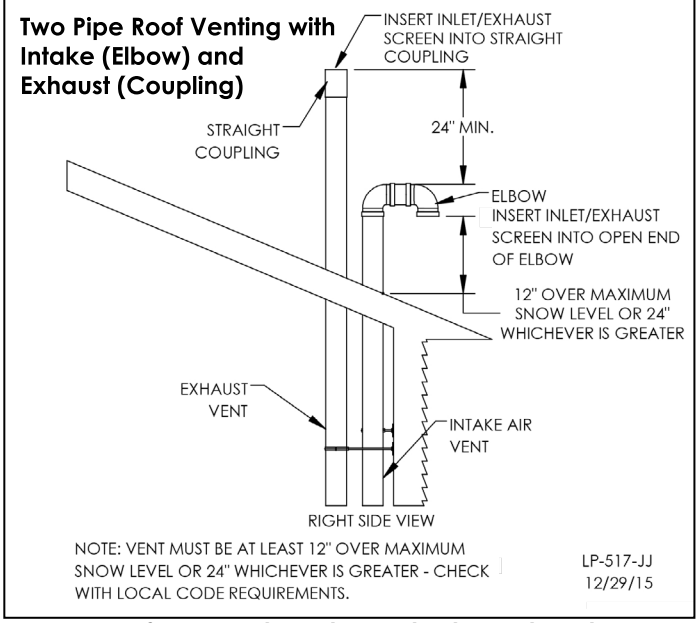


Figure 13 - Roof Venting with Stainless Steel and Tee and Coupling

WARNING

All vent pipes must be glued, properly supported, and the exhaust pitched a minimum of 1/4" per foot back to the boiler to allow drainage of condensate. When placing support brackets on vent piping, the first bracket must be within 1 foot of the boiler and the balance of 4 foot intervals on the vent pipe. Venting must be readily accessible for visual inspection from the first three feet from the boiler.

Take extra precaution to adequately support the weight of vent pipes terminating through the roof. Failure to properly support roof terminated vent piping could result in property damage, serious personal injury, or death due to flue gas leakage.

An unbalanced vent system can be installed ONLY when the exhaust is in the vertical position. Failure to do so could result in serious personal injury or death.

NOTE: This drawing is meant to demonstrate system venting only. The installer is responsible for all equipment and detailing required by local codes.

Ensure the terminations are screened to prevent blockage caused by debris or birds.

WARNING

All vent pipes must be glued, properly supported, and the exhaust pitched a minimum of 1/4" per foot back to the boiler to allow drainage of condensate. When placing support brackets on vent piping, the first bracket must be within 1 foot of the boiler and the balance of 4 foot intervals on the vent pipe. Venting must be readily accessible for visual inspection from the first three feet from the boiler.

Take extra precaution to adequately support the weight of vent pipes terminating through the roof. Failure to properly support roof terminated vent piping could result in property damage, serious personal injury, or death due to flue gas leakage.

An unbalanced vent system can be installed ONLY when the exhaust is in the vertical position. Failure to do so could result in serious personal injury or death.

2. Power Venting, Room and Indoor Combustion Ventilation Requirements

When using an indoor combustion air installation, the mechanical room MUST be provided with properly sized openings, and/or be of sufficient volume to assure adequate combustion air and proper ventilation for all gas fired appliances in the mechanical room to assure adequate combustion air and proper ventilation. The requirements shown here are for the boiler only. Additional gas fired appliances in the mechanical room will require an increase in the net free area and/or volume to supply adequate combustion air for all appliances. This must be done in accordance with the National Fuel Gas Code, NFPA 54 / ANSI Z223.1.

This boiler can be vented using mechanical room air only for combustion. No combustion air openings are needed when the boiler is installed in a space with a volume NO LESS than 50 cubic feet per 1,000 BTU/hr of all installed gas fired appliances and the building MUST NOT BE of "Tight Construction".

TIGHT CONSTRUCTION: A building with less than .4 ACH (air changes per hour). For buildings of "Tight Construction", provide air openings into the building from the outside.

Indoor and outdoor combustion air may be combined by applying a ratio of available volume to required volume times the required outdoor air opening(s) size(s). This must be done in accordance with the National Fuel Gas Code, NFPA 54 / ANSI Z223.1.

1. If air is taken directly from outside the building with no duct, provide two permanent openings to the mechanical room each with a net free area of one square inch per 4000 BTU/hr input. See Figure 15.

2. If combustion and ventilation air is taken from the outdoors using a duct to deliver the air to the mechanical room, each of the two openings should be sized based on a minimum free area of one square inch per 2000 BTU/hr input. See Figure 16.

3. If air is taken from another interior space combined with the mechanical room:

   a. Two spaces on same story: Each of the two openings specified should have a net free area of one square inch for each 1000 BTU/hr input, but not less than 100 square inches.

   b. Two spaces on different stories: One or more openings should have a net free area of two square inches per 1000 BTU/hr.

See Figure 17 for reference.

4. If a single combustion air opening is provided to bring combustion air in directly from the outdoors, the opening must be sized based on a minimum free area of one square inch per 3000 BTU/hr. This opening must be located within 12" of the top of the enclosure. See

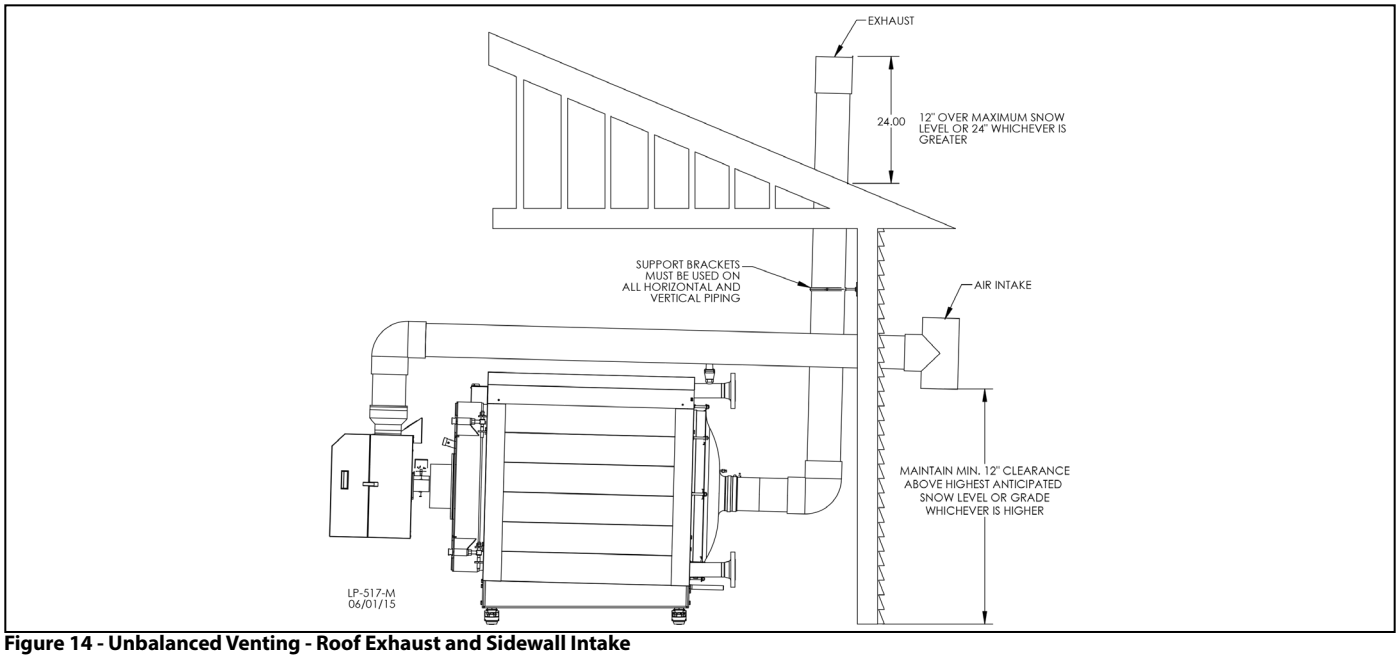


Figure 14 - Unbalanced Venting - Roof Exhaust and Sidewall Intake

Figure 18.

Combustion air requirements are based on the latest edition of the National Fuel Gas Code, NFPA 54 / ANSI Z223.1, CGA Standard CAN/CSA B149.1 in Canada. Check all local code requirements for combustion air.

All dimensions based on net free area in square inches. Metal louvers or screens reduce the free area of a combustion air opening a minimum of approximately 25%. Check with louver manufacturers for exact net free area of louvers.

Where two openings are provided, one must be within 12" of the ceiling, and one must be within 12"of the floor of the mechanical room. Each opening must have a net free area as specified in Table 10. Single openings shall commence within 12" of the ceiling. The minimum dimension of air openings should not be less than 3".

⚠ CAUTION

Under no circumstances should the mechanical room ever be under negative pressure. Particular care should be taken where exhaust fans, attic fans, clothes dryers, compressors, air handling units, etc., may take away air from the unit. Failure to follow these instructions could result in property damage or personal injury.

Combustion air supply must be completely free of any flammable vapors that may ignite, or chemical fumes which may be corrosive to the boiler. See Table 1 for a list of combustion air contaminants. These chemicals, when burned, form acids which quickly attack the stainless steel heat exchanger, headers, flue connectors, and the vent system. The result is improper combustion and premature boiler failure. Such failure IS NOT covered under warranty.

EXHAUST FANS: Any fan or appliance which exhausts air from the mechanical room may deplete the combustion air supply and/or cause a downdraft in the venting system. Spillage of flue products from the venting system into an occupied living space can cause a very hazardous condition that must be corrected immediately.

Minimum Recommended Combustion Air Supply to Mechanical Room

Model	Figure 15		Figure 16	
	*Outside Air from 2 Openings Directly from Outdoors[1]		*Outside Air from 2 Ducts Delivered from Outdoors[1]	
	Top Opening, in^2	Bottom Opening, in^2	Top Opening, in^2	Bottom Opening, in^2
750	188	188	375	375
1000	250	250	500	500

Model	Figure 17			Figure 18
	Inside Air from 2 Ducts Delivered from Interior Space[2]			*Outside Air from 1 Opening Directly from Outdoors, in^2 [1]
	Same Story		Different Stories	
	Top Opening, in^2	Bottom Opening, in^2	Top Opening, in^2	
750	750	750	1500	250
1000	1000	1000	2000	335

Table 11 - Indoor Combustion Air Sizing

The above requirements are for the boiler only; additional gas fired appliances in the mechanical room will require an increase in the net free area and/or volume to supply adequate combustion air for all appliances.

No combustion air openings are needed when the boiler is installed in a space with a volume NO LESS than 50 cubic feet per 1,000 BTU/hr of all installed gas fired appliances. Buildings MUST NOT be of *"Tight Construction".

[1]Outside air openings shall communicate with the outdoors.

[2]Combined interior space must be 50 cubic feet per 1,000 BTU/hr input. Buildings MUST NOT be of *"Tight Construction".

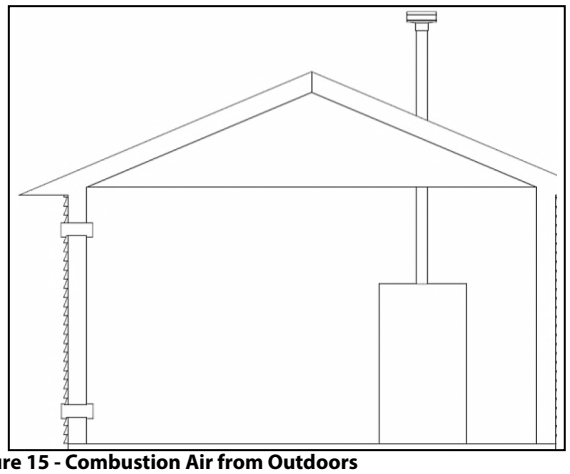


Figure 15 - Combustion Air from Outdoors

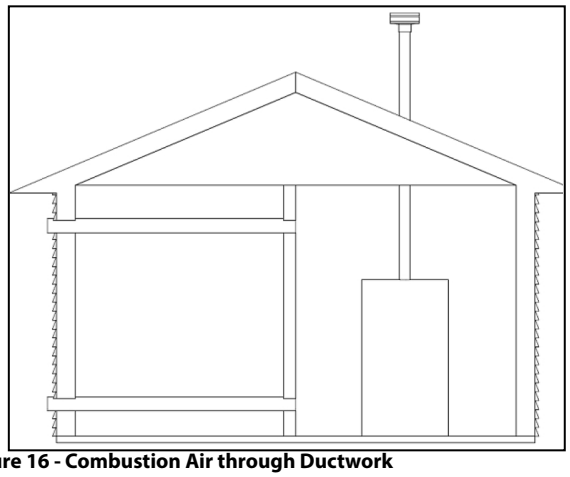


Figure 16 - Combustion Air through Ductwork

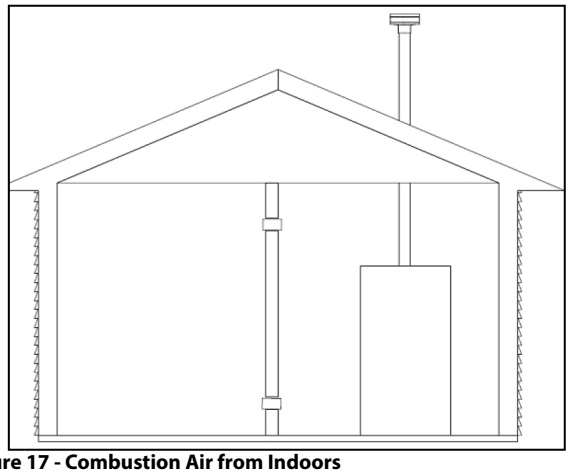


Figure 17 - Combustion Air from Indoors

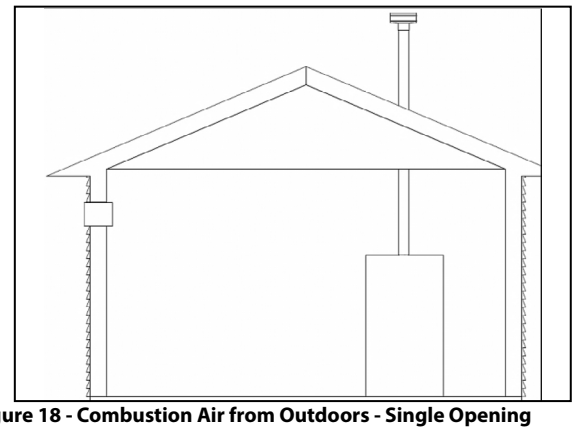
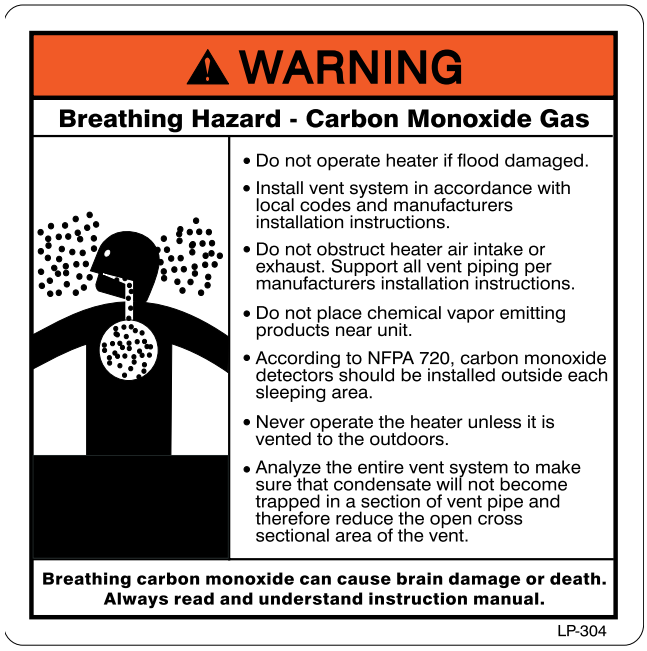


Figure 18 - Combustion Air from Outdoors - Single Opening



Part 6 - Condensate Removal

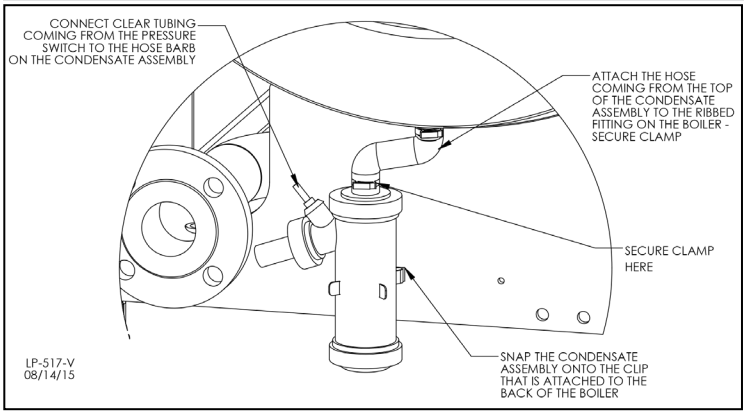


Figure 19 - Installing the Condensate Trap and Pressure Switch Tubing

NOTE: Check with your local gas company to determine if combustion condensate disposal is permitted in your area. In the state of Massachusetts, condensate must be neutralized before entering a drain.

This boiler is a high efficiency appliance, and therefore produces condensate: a by-product of the combustion process. A condensate collection system with an internal float switch monitors condensate level to prevent it from backing up into the combustion system.

Condensate from the boiler is slightly acidic with a pH of 3.2 - 4.5. To avoid long term damage to the drainage system and to meet local code requirements, HTP recommends neutralizing condensate with a Condensate Neutralizer Kit (Part # 7350P-611). The neutralizer kit connects to the drain system and contains limestone chips that neutralize the pH level of the condensate. The neutralizer kit should be checked annually and the limestone chips replenished if necessary. When replacing the limestone chips, take care to ensure chips are no smaller than ½" to avoid blockage in condensate piping (refer to figure below for piping of the condensate neutralizer.)

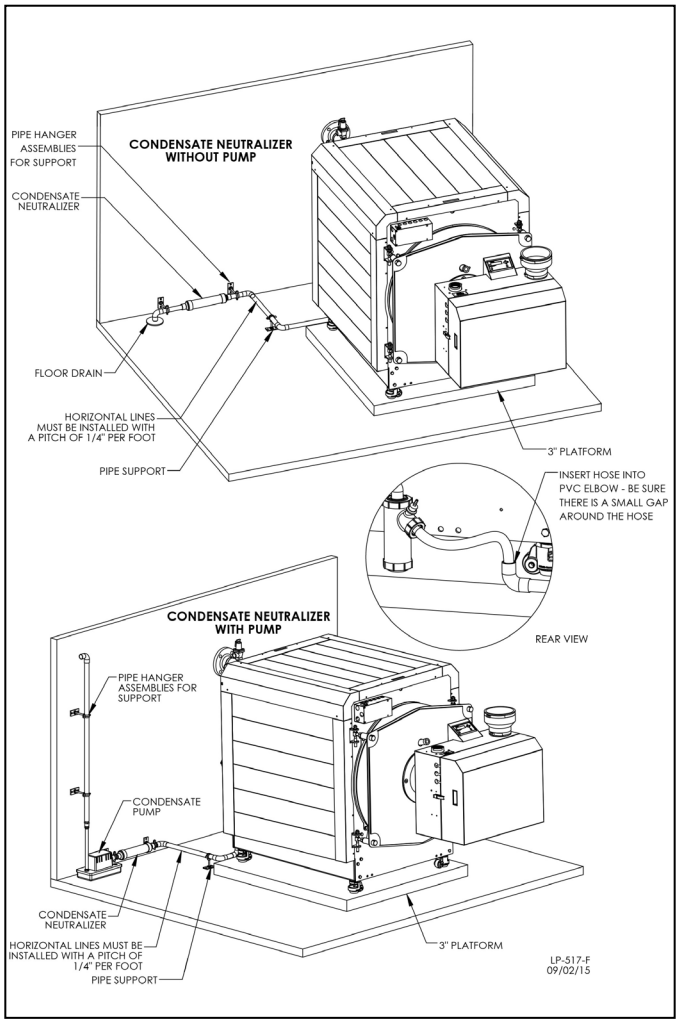


Figure 20 - Condensate Piping

NOTES:

1. Condensate line must be pitched at least ¼" per foot to properly drain. If this cannot be done, or a very long length of condensate hose is used, increase the condensate line to a minimum of 1" ID and place a tee in the line before the condensate neutralizer to properly reduce vacuum lock in the drain line.
2. PVC or CPVC pipe should be the only material used for condensate line. Steel, brass, copper, and other metals will be subject to corrosion or deterioration.
3. A frozen condensate line could result in a blocked vent condition. It is very important to protect the condensate line from freezing temperatures or any type of blockage. In installations that may encounter sustained freezing conditions, the use of heat tape is recommended to avoid freezing of the condensate line. It is also recommended to bush up the condensate line size to 1" and terminate condensate discharge as close to the unit as possible. Longer condensate runs are more prone to freezing. Damages due to frozen or blocked condensate lines ARE NOT covered by warranty.
4. Support of the condensate line may be necessary to avoid blockage of the condensate flow.
5. To allow proper drainage on longer horizontal condensate runs, tubing size may need to increase to 1" and a second line vent may be required.

NOTE: To clean out condensate trap, see Maintenance section.

CAUTION

The condensate line must remain unobstructed. If allowed to freeze in the line or obstructed in any other manner, condensate can exit from the boiler tee, resulting in potential water damage to property. When installing a condensate pump, select one approved for use with condensing boilers and furnaces. The condensate pump should have an overflow switch to prevent property damage from spillage. Condensate from the boiler will be slightly acidic (pH from 3.2 to 4.5). Install a neutralizing filter if required by local codes.

Is is very important that condensate piping be no smaller than 3/4". Use a tee at the condensate connection with a branch vertically up and open to the atmosphere to prevent a vacuum that could obstruct the flow of condensate from the boiler. To prevent sagging and maintain pitch, condensate piping should be supported with pipe supports.

When installing a condensate pump, select one approved for use with condensing boilers and furnaces. The pump should have an overflow switch to prevent property damage from condensate spillage.

⚠ WARNING

Power to the optional condensate pump is continuous. When the boiler is powered off the condensate pump will remain on. It is important to remember to turn off the condensate pump when powering down the boiler. Failure to do so could result in property damage, severe personal injury, or death.

Part 7 - Wiring

⚠ WARNING

To avoid electrical shock, turn off all power to the boiler prior to opening an electrical box within the unit. Ensure the power remains off while any wiring connections are being made. Failure to follow these instructions could result in component or product failure, serious injury, or death. Such product failure IS NOT covered by warranty.

Jumping out control circuits or components WILL VOID product warranty and can result in property damage, personal injury, or death.

It is of extreme importance that this unit be properly grounded. It is very important that the building system ground is inspected by a qualified electrician prior to making this connection. Electrical power must only be turned on when the boiler is completely filled with cold water. Failure to follow these instructions could result in component or product failure, serious injury, or death.

Electrical Shock Hazard - Turn off electrical power supply at service entrance panel before making any electrical connections. Failure to follow to do so could result in serious injury, or death.

⚠ CAUTION

Label all wires prior to disconnecting them when servicing the boiler. Wiring errors can cause improper and dangerous operation. Failure to follow these instructions may result in property damage or personal injury.

CAUTION

Wiring must be NEC Class 1. If original wiring supplied with the boiler must be replaced, use only TEW 105 ^{o}C wire or equivalent. Boiler must be electrically grounded as required by the National Electrical Code, ANSI/NFPA 70 - Latest Edition.

A. Installation Must Comply With

1. National Electrical Code and any other national, state, provincial, or local codes or regulations.
2. In Canada, CSA C22.1, Canadian Electrical Code Part 1, and any local codes.

B. Field Wiring

All connections made to the boiler in the field are done inside the electrical junction box located on the side of the unit. The electrical junction box is located on the left side of the boiler. Multiple knockout locations are available to route field wires into and out of the electrical junction box.

The control used in the boiler is capable of directly controlling 2 pumps in standard mode and 3 pumps when configured as a cascade master boiler. As a standard unit, each pump can provide a maximum of 2 amps at 120 volts. If a pump requires more than this amount of power, an external contactor or motor starter is needed.

The electrical junction box has separate, clearly marked terminal strips for line voltage and low voltage wiring. Special jacks are provided for trouble-free cascade system wiring using standard CAT3 or CAT5 patch cables.

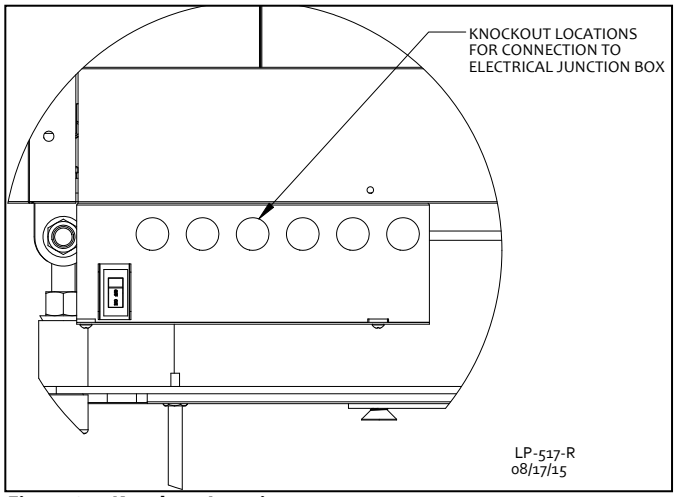


Figure 21 - Knockout Locations

C. Line Voltage Wiring for Standard Boiler

NOTE: A termination plug is included in the CAT 3 / CAT 5 Bus Connection Point, labeled J3 in Figure 22. DO NOT REMOVE THIS PLUG! Doing so will affect boiler operation and void warranty.

1. Connect the incoming power wiring to the line voltage terminal strip in the electrical junction box at terminals 120V, NEUT, and GND (shown in Figure 22).
2. A line voltage fused disconnect switch may be required to be externally mounted and connected according to local wiring codes.
3. Connect the boiler pump as shown in Figure 22 to the terminals marked 1 – (HOT), 2 – (NEUT), and 3 – (GND). The connections shown are suitable for a maximum continuous pump draw of 2 amps at 120 volts. If the pump requires more current or voltage than the 120 volts supplied, an external motor starter or contactor will be required.
4. If using DHW, connect the domestic hot water pump to the terminals marked 4 (DHW HOT), 5 (DHW NEUT), 6 (DHW GND). The connections shown are suitable for a maximum continuous pump draw of 2 amps at 120 volts. If a pump requires more current or voltage than the 120 volts supplied, an external motor starter or contactor will be required.

D. Alarm Connections

The control includes a dry contact alarm output. This is an SPDT circuit, rated at 5 amps at 120 volts. This contact can be used to activate an alarm light or bell or notify a building management system if the boiler goes into a lockout condition. The circuit between the ALARM COM and NC terminals is closed during normal operation and the circuit between ALARM COM and NO is open during normal operation. The connections depicted in Figure 22 show two 120 volt lights connected to the alarm terminals. One light will be on when the boiler is in normal mode and the other light will be on when the boiler is in lockout mode. HTP offers an Alarm System Kit (part # 7350P-602).

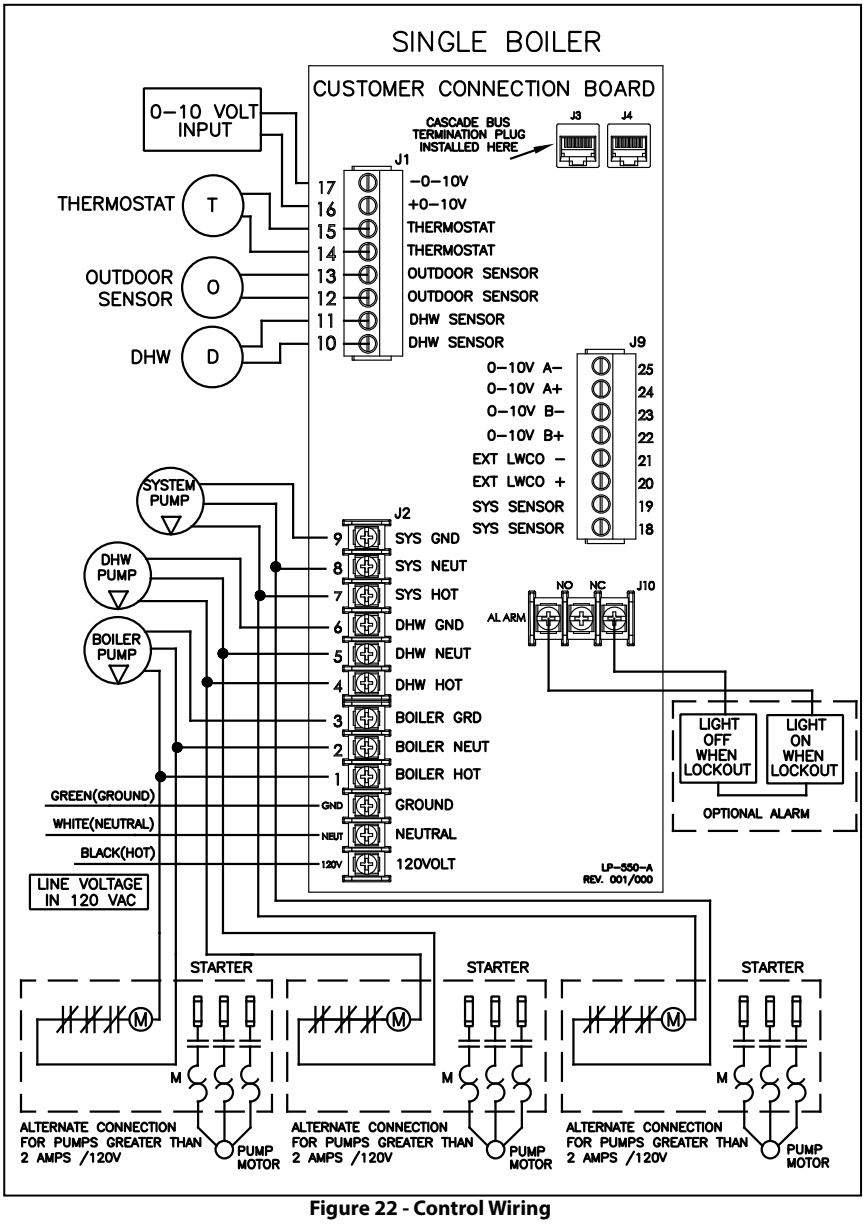


Figure 22 - Control Wiring

E. Low Voltage Connections for Standard Boiler

1. All low voltage cables should enter the electrical junction box through the provided knock out holes as shown in Figure 22.
2. Connect all low voltage field devices to the low voltage terminal strip located in the electrical junction box.

F. Thermostat

1. Connect the room thermostat to the terminals marked 14 and 15 (THERMOSTAT) in the electrical junction box (shown in Figure 22). Alternately, any dry contact closure across these terminals will cause the boiler to run. Caution should be taken to ensure neither of the terminals becomes connected to ground.

2. Mount the thermostat on an inside wall as centrally as possible to the area being heated, but away from drafts or heat producing devices such as television sets that could influence the ability of the thermostat to measure room temperature.
3. If the thermostat is equipped with an anticipator and it is connected directly to the boiler, the anticipator should be set at .1 amps. If the thermostat is connected to other devices, the anticipator should be set to match the power requirements of the device it is connected to. See the instruction manual of the connected devices for further information.

G. Outdoor Sensor

NOTE: There is no connection required if an outdoor sensor is not used in this installation.
1. If using an outdoor sensor, connect wires for sensor to the terminals marked 12 and 13 (OUTDOOR SEN, shown in Figure 22) in the electrical junction box. Caution should be used to ensure neither of these terminals becomes connected to ground.
2. Use a minimum 22 AWG wire for runs of 100 feet or less and minimum 18 AWG wire for runs of up to 150 feet.
3. Mount the outdoor sensor on an exterior surface of the building, preferably on the north side in an area that will not be affected by direct sunlight and will be exposed to varying weather conditions.

H. Indirect Sensor

NOTE: There is no connection required if an indirect water heater is not used in this installation.
1. The boiler will operate an indirect fired water heater with either a thermostat type aquastat installed in the indirect tank, or an HTP 7250P-325 tank sensor. When a tank sensor is used, the control will automatically detect its presence and a demand for heat from the indirect water heater will be generated when the tank temperature falls below the user selected set point by more than the user selected offset. The demand will continue until the sensor measures that the indirect water heater temperature is above the set point.
2. Connect the indirect tank sensor (7250P-325) to the terminals marked 10 and 11 (DHW SENSOR, shown in Figure 22) in the electrical junction box.

⚠ WARNING

Failure to use the correct sensor may result in tank temperature being either above or below set point, and could result in decreased performance, substantial property damage, or heightened risk of injury or death due to scalds.

Caution should be used to ensure neither of these terminals becomes connected to ground.

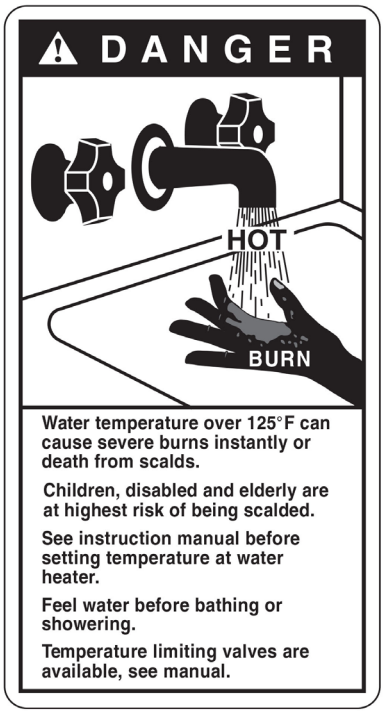
NOTE: If sensor wires are located in an area with sources of potential electromagnetic interference (EMI), the sensor wires should be shielded, or the wires routed in a grounded metal conduit. If using shielded cable, the shielding should be connected to the common ground of the boiler.

I. Optional 0-10 Volt Building Control Signal

1. A signal from a building management system may be connected to the boiler to enable remote control. This signal should be a 0-10 volt positive-going DC signal. When this input is enabled using the installer menu, a building control system can be used to control the set point temperature of the boiler. The control interprets the 0-10 volt signal as follows; when the signal is between 0 and 1 volts, the boiler will ignite. As the signal continues to rise towards its maximum of 10 volts, the boiler will increase in either set point temperature or firing rate depending on the setting of function 17 in the Installer Menu. See this manual for details on the setting of function 16 and 17 for this option.
2. Connect a building management system or other auxiliary control signal to the terminals marked 17, 0-10 VOLT + and 16, 0-10 VOLT – in the electrical junction box (shown in Figure 22). Caution should be used to ensure that the 0-10 VOLT + connection does not become connected to ground.

J. Optional High Gas Pressure Switch

1. If an optional high gas pressure switch is used, it should be installed on the outlet side of the gas valve. This is normally closed and will open if the pressure goes above 20" w.c. on the outlet side.
2. Locate the two pigtails hanging from the electrical box inside of the boiler cabinet. Remove and discard the jumper plug from one of the unused pigtails.
3. Connect the high gas pressure switch to the pigtail that you removed the jumper plug from.



K. Optional Low Gas Pressure Switch

1. If an optional low gas pressure switch is used, it should be installed on the inlet side of the gas valve. This is normally closed and will open if the pressure goes below 1" w.c. on the inlet side.
2. Locate the two pigtails hanging from the electrical box inside of the boiler cabinet. Remove and discard the jumper plug from one of the unused pigtails.
3. Connect the low gas pressure switch to the pigtail that you removed the jumper plug from.

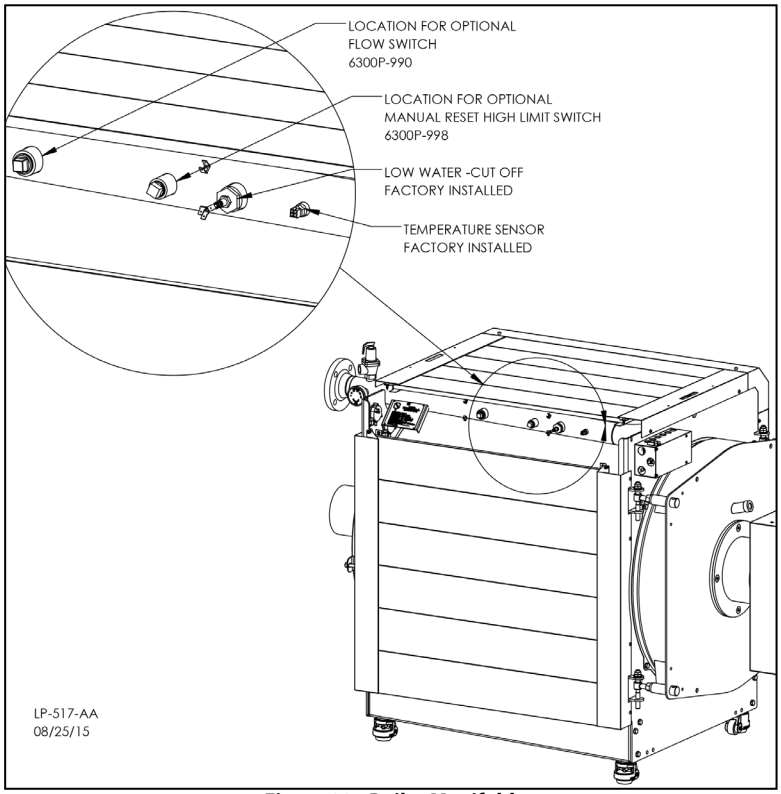


Figure 23 - Boiler Manifold

L. Optional Flow Switch

NOTE: Follow the more detailed instructions included with the flow switch kit for proper installation steps.

1. Attach the correct flow paddle to the flow switch.
2. Thread flow switch into the fitting provided on the manifold using teflon thread tape. **Make certain the FLOW arrow points in the correct direction.**
3. Locate the two red wires at the boiler and connect them to the flow switch as described in the flow switch instructions.
4. When installation is complete, power up the boiler and use the control to access installer parameter #20 and change the default value to FLOW SWITCH. When done, create a demand and observe boiler function to verify the installation is working properly.

NOTE: The flow switch requires a minimum flow rate of 21 GPM to activate the boiler. The sensitivity of the flow switch can be adjusted. See manufacturer's instructions for details.

M. UL353 Internal Low Water Cut-Off (Factory Installed)

The supplied internal Low Water Cutoff (LWCO) meets UL 353 requirements to function as a safety, locking out the boiler when water level is inadequate for safe operation.

To test, press the **RESET** and **v** buttons together for 3 - 5 seconds. The LWCO will trip and indicate an F21 or F22 fault code on the display. To clear the error, press **RESET**.

N. Optional High Limit Manual Reset

NOTE: Follow the more detailed instructions included with the high limit manual reset kit for proper installation steps.

1. Thread the control well into the fitting provided on the manifold using teflon thread tape.
2. Insert the control probe into the control well.
3. Secure the high limit manual reset box to the control well.
4. Locate and disconnect the red high limit manual reset wires. Connect the two red wires to the manual reset box.
5. When installation is complete, power up the boiler and test the reset according to the provided instructions. If the reset operates properly, set the high limit temperature as described in the provided instructions. When done, create a demand and observe boiler function to verify the installation is working properly.

P. Wiring of Cascade System Communication Bus

1. A Cascade Bus Termination Plug has been installed on the customer connection board of this boiler. The purpose of this plug is to stabilize communication between multiple boilers and reduce electrical "noise". See Figure 22 for Cascade Bus Termination Plug installation detail.

NOTE: It is important that the termination plug in multiple boilers (cascaded units) be installed as depicted in Figure 22. Leave the plug installed in the J3 port on the Master boiler. Remove the plug on intermediate Follower boilers. Move the plug to the J4 port on the final Follower boiler.

2. Use standard CAT3 or CAT5 computer network patch cables to connect the communication bus between each of the boilers. These cables are readily available at any office supply, computer, electronic, department or discount home supply store in varying lengths. If you possess the skills you can also construct custom length cables.
3. It is recommended to use the shortest length cable that will reach between the boilers and create a neat installation. Do not run unprotected cables across the floor where they may become wet or damaged. Avoid running communication cables parallel and close to or against high voltage (120 volt or greater) wiring. HTP recommends that the maximum length of communication bus cables not exceed 200 feet.
4. Route the communication cables through one of the knockouts in the cabinet.
5. Connect the boilers in a daisy chain configuration as shown below. It is best to wire the boilers using the shortest wire runs rather than trying to wire them in the order that they are addressed. The communication bus jacks on the customer connection panel are interchangeable so you can use either one or both in any order to connect the cable.

If you have connected the boilers to each other properly, there will be no open communication connection ports.

Q. Cascade Master Pump and Sensor Wiring

1. Connect the system pump hot wire to the terminal marked 7 (SYS PUMP).
2. Connect the system pump neutral to the 8 (SYS NEUT) terminal and the pump ground wire to the 9 (SYS GND) terminal.
3. Connect the boiler pump to the terminals marked 1 (BOILER HOT), 2 (BOILER NEUT), and 3 (BOILER GND).
4. Connect the system pipe sensor to the terminals marked 18 and 19 (SYS SENSOR).
5. Connect the outdoor sensor (if used) to the terminals marked 12 and 13 (OUTDOOR SEN).
6. Connect the signal to start the system to the terminals marked 14 and 15 (THERMOSTAT).

NOTE: This signal can come from a room thermostat or a dry contact closure. No power of any voltage should be fed into either of these terminals.

R. Cascade Follower Pump and Sensor Wiring

1. If it is desired to have the boiler control the boiler pump, connect the boiler pump to the 1 (BOILER HOT), 2 (BOILER NEUT), and 3 (BOILER GND) terminals.
2. If you are using an indirect fired water heater connected directly to the follower boiler, connect the pump for it to the 4 (DHW HOT), 5 (DHW NEUT), and 6 (DHW GND) terminals.

If desired, an alarm bell or light can be connected to the alarm contacts of the boiler. The normally closed alarm contact may be used to turn a device off if the boiler goes into lockout mode. The alarm contacts are rated 5 amps at 120 VAC.

To connect an alarm device, connect the power for the device to the J10-2 (ALARM COM) terminal. Connect the alarm device hot wire to the J10-1 (ALARM NO) terminal. Connect the neutral or return of the alarm device to the neutral or return of the power for the alarm device.

To connect a device that should be powered off during a boiler lockout condition, follow the same instructions as above and use the J10-3 (ALARM NC) terminal rather than the ALARM NO terminal.

NOTE: In a cascade system, the alarm output of the boiler addressed as #1 will also be active if the master boiler has a lockout condition. The alarm output of boilers addressed #2-15 will only sound if a lockout condition occurs on that specific boiler.

S. Variable Speed Pumping

Variable speed pump support is available on the primary loop of all models manufactured after 11/15/2016. This feature controls pump speed via an analog 0-10VDC signal supplied via the 0-10VA connection on the Customer Connection Board.

When this feature is in use, an installer selected Delta T is maintained with the Supply and Return sensors, increasing efficiency and providing better system temperature control. When the difference between the Supply and Return temperatures is greater than the desired setting, the pump will increase speed and flow to compensate. Conversely, if the Delta T is less than the desired setting, the pump will decrease speed and flow to compensate.

NOTE: This feature may be used in Primary / Secondary piping arrangements ONLY!

Variable Speed Pumping Wiring:

1. Connect the boiler pump as shown in Figure 22 to the terminals marked 1 – (HOT), 2 – (NEUT), and 3 – (GND). The connections shown are suitable for a maximum continuous pump draw of 2 amps at 120 volts. If the pump requires more current or voltage than the 120 volts supplied, an external motor starter or contactor will be required.
2. Connect the 0-10v input wires on the variable speed pump to the

0-10vA output on J9 of the customer connection board. Connect the positive pump input wire to J9-24, and the negative wire to J9-25.
NOTE: When making wiring connections, ensure proper polarity or the system will not operate properly.

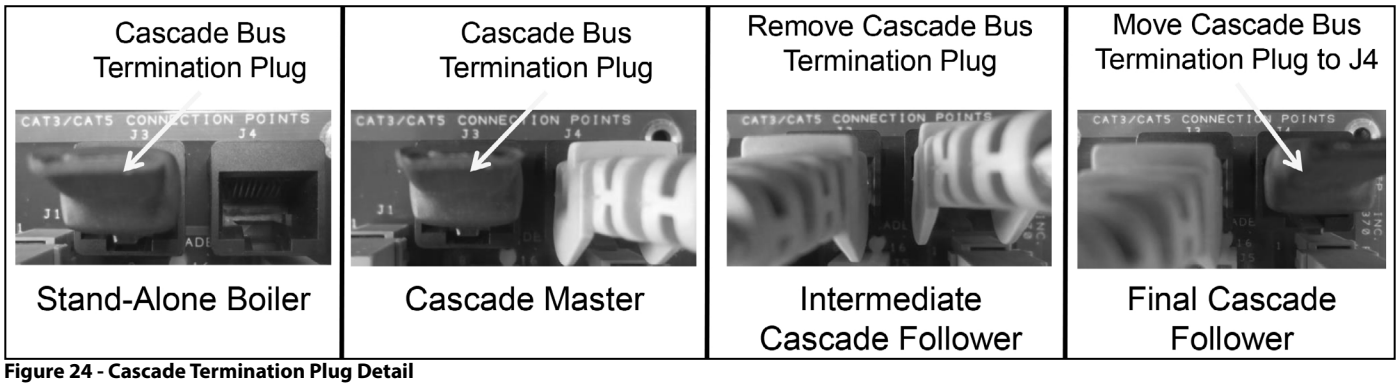


Figure 24 - Cascade Termination Plug Detail

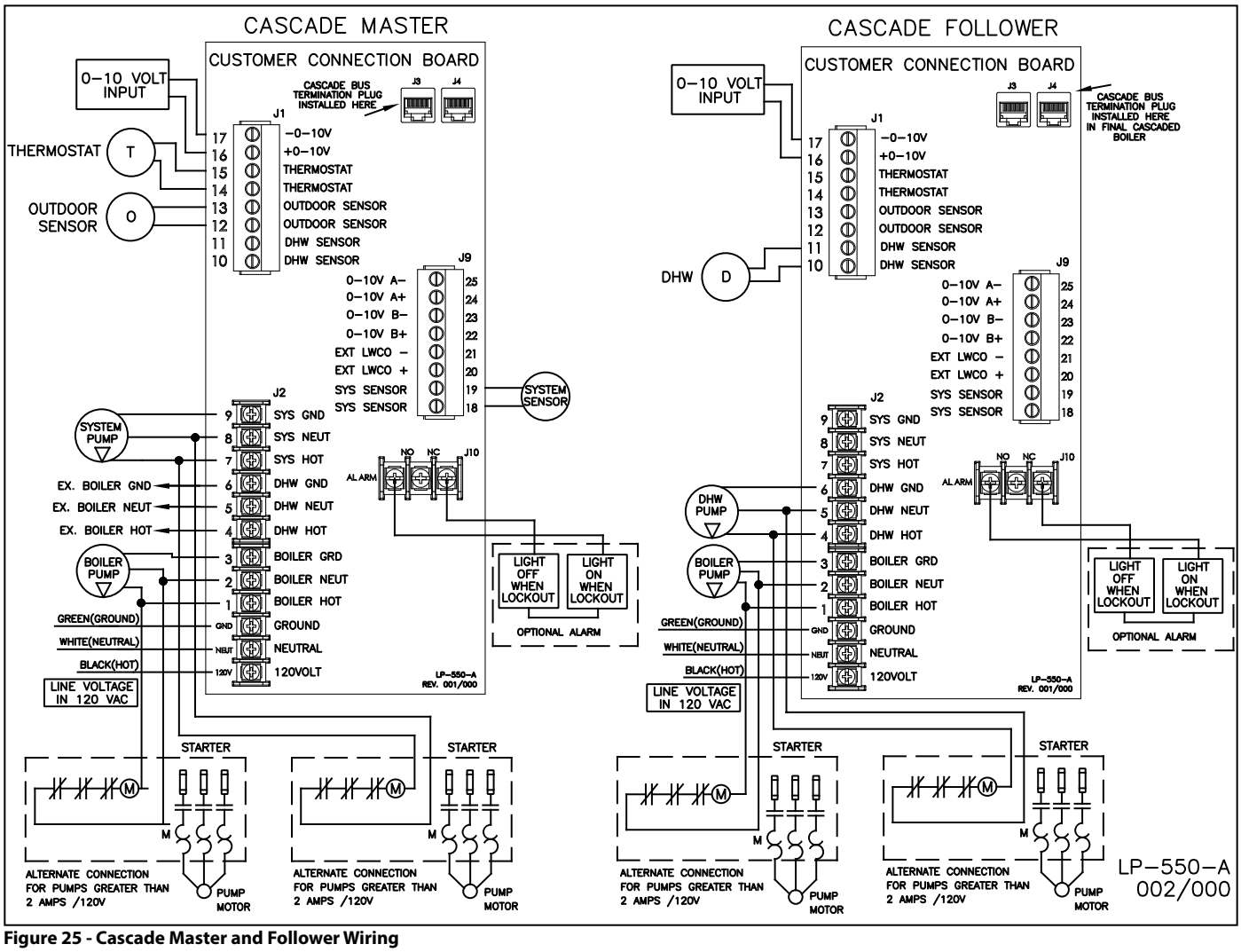


Figure 25 - Cascade Master and Follower Wiring

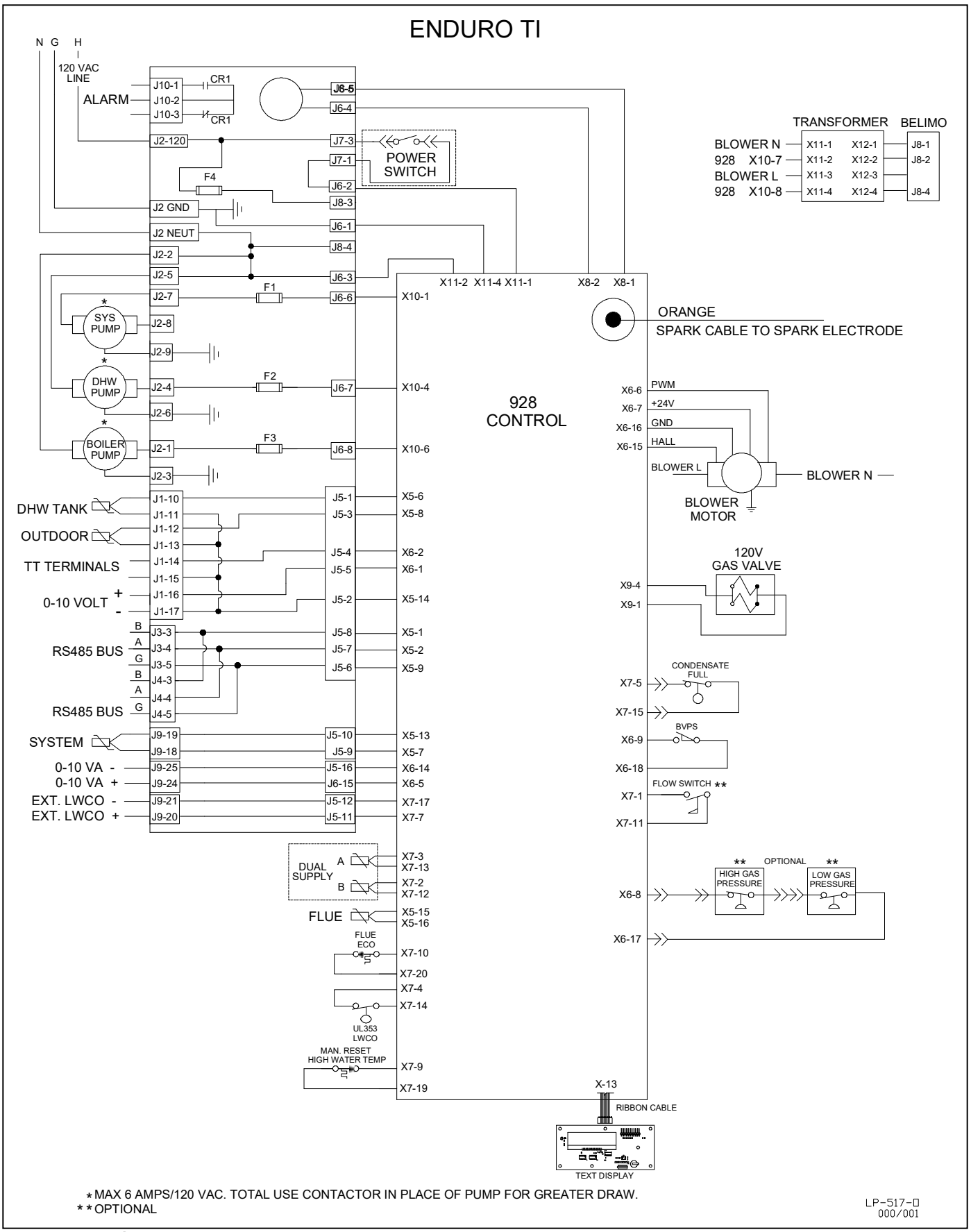


Figure 26 - Internal Connection Diagram

Part 8 - Gas Connections

⚠ WARNING

Failure to follow all precautions could result in fire, explosion, severe injury, or death.

It is very important that you are connected to the type of gas noted on the rating plate. "NG" for natural or city gas. Prior to turning the gas on, all gas connections must be approved by the local gas supplier or utility, in addition to the governing authority.

The gas supply shall have a minimum of no less than 3.5" water column, a maximum inlet pressure of no greater than 14" water column (350 mm), and ½ pound pressure (3.5 kPa). The entire piping system, gas meter, and regulator must be sized properly to prevent excessive pressure drop (greater than 0.5" WC) as stated in the National Fuel Gas Code. This information is listed on the rating plate.

⚠ WARNING

UL recognized fuel gas detectors are recommended in all enclosed natural gas applications where there is a potential for an explosive mixture of fuel gas to accumulate. The installation of these detectors should be made in accordance with the detector manufacturer's recommendations, and/or local laws. Failure to install fuel gas detectors in these applications could result in fire, explosion, property damage, severe personal injury, or death.

The gas connection on the boiler is 2". It is mandatory that this fitting is used for connection to a field fabricated drip leg as shown in the illustration per the National Fuel Gas Code. You must ensure that the entire gas line to the connection at the boiler is no smaller than the unit supplied connection.

Once all inspections have been performed, the piping must be leak tested. If the leak test requirement is a higher test pressure than the maximum inlet pressure, you must isolate the boiler from the gas line. In order to do this, shut the gas off using factory and field-installed gas cocks. This will prevent high pressure. Failure to do so may damage the gas valve. In the event the gas valve is exposed to a pressure greater than ½ PSI, 14" w.c. (3.5 kPa), the gas valve must be replaced. Never use an open flame (match, lighter, etc.) to check gas connections.

A. Gas Piping

1. Run the gas supply line in accordance with all applicable codes.
2. Locate and install manual shutoff valves in accordance with state and local requirements.
3. In Canada, the Manual Shutoff must be identified by the installing contractor.
4. It is important to support gas piping as the unit is not designed to structurally support a large amount of weight.
5. Purge all gas lines thoroughly to avoid start up issues with air in the lines.
6. Sealing compound must be approved for gas connections. Care must be taken when applying compound to prevent blockage or obstruction of gas flow which may affect the operation of the unit.

⚠ WARNING

Support gas supply piping with hangers, not by the boiler or its accessories. The boiler gas valve and blower will not support the weight of the piping. Make sure the gas piping is protected from physical damage and freezing, where required. Failure to follow these instructions could result in gas leakage, and result in fire, explosion, property damage, severe personal injury, or death.

⚠ WARNING

Do not use Teflon tape on gas line pipe thread. Use a pipe compound rated for use with natural gases. Apply sparingly on male pipe ends, leaving the two end threads bare and flow unobstructed. Failure to follow these instructions could result in gas leakage or blockage, and result in fire, explosion, property damage, severe personal injury, or death.

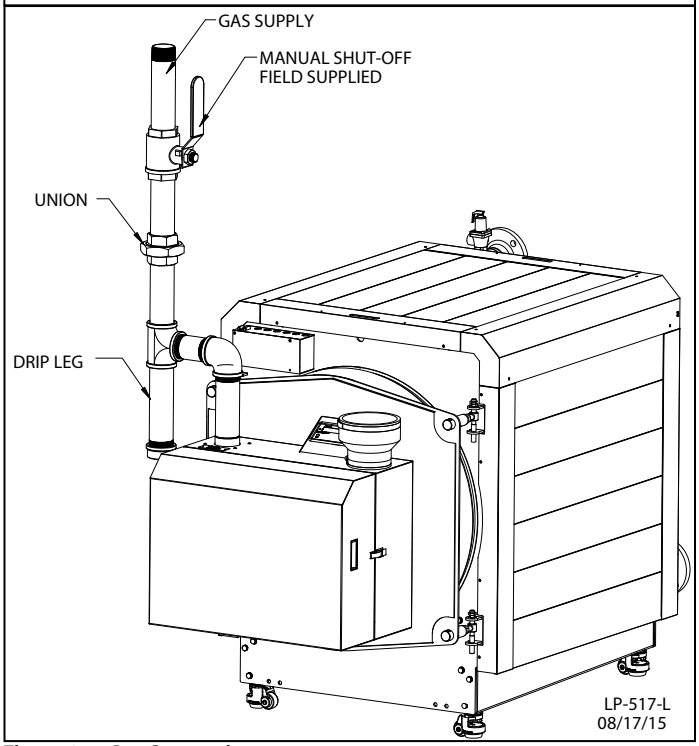
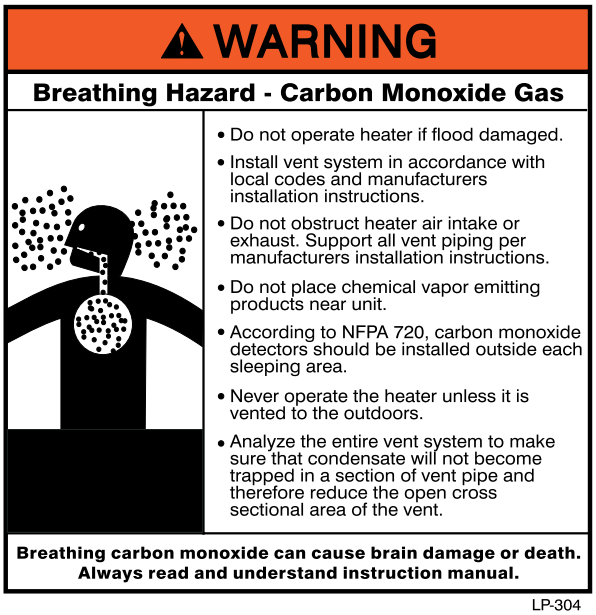


Figure 27 - Gas Connection



⚠ WARNING

Never use an open flame (match or lighter) to check for gas leaks. Use a soapy solution to test connection. Failure to use a soapy solution test or check gas connection for leaks can result in substantial property damage, severe personal injury, or death.

CAUTION

Use two wrenches when tightening gas piping at the boiler: One to prevent the boiler gas line from turning. Failure to prevent the boiler gas connection from turning could result in damage to the gas line components, substantial property damage, severe personal injury, or death.

CSA or UL listed flexible gas connections can be used when installing the boiler. Flexible gas connections have different capacities and must be sized correctly for the connected boiler firing rates. Consult with the flex line supplier to assure the line size is adequate for the job. Follow local codes for proper installation and service requirements.

B. Gas Table

Refer to Table 12 to size the supply piping to minimize pressure drop between the meter or regulator and unit. Maximum capacity of pipe in cubic feet of gas per hour cannot have a pressure drop greater than .5 w.c.

The gas piping must be sized for the proper flow and length of pipe to avoid pressure drop. The gas meter and regulator must be properly sized for the total gas load. If you experience a pressure drop greater than 1" w.c. (.87 kPa), the meter, regulator or gas line may be undersized or in need of service. You can attach a manometer to the incoming gas drip leg after removing the cap. The gas pressure must remain between 3.5" (.87 kPa) and 14" (3.5 kPa) during stand-by (static) mode and while in operating (dynamic) mode.

If an in-line regulator is used, it must be a minimum of 10 feet from the boiler. It is very important that the gas line is properly purged by the gas supplier or utility. Failure to properly purge the lines, or improper line sizing, will result in ignition failure. This problem is especially noticeable in NEW installations and empty tank situations. This situation can also occur when a utility company shuts off service to an area to provide maintenance to their lines. This gas valve must not be replaced with a conventional gas valve under any circumstances.

Natural Gas Supply Piping Capacity Chart								
(0.6 Specific gravity gas; 0.5" WC pressure drop) ***Schedule 40 iron pipe size in nominal inches**								
Cubic Ft. Hr.	**750**	**1500**	**2250**	**3000**	**3750**	**4500**	**5250**	**6000**
Model	**1 Boiler**	**2 Boilers**	**3 Boilers**	**4 Boilers**	**5 Boilers**	**6 Boilers**	**7 Boilers**	**8 Boilers**
750 @ 100' of Pipe	2"	2 1/2"	3"	3"	3 1/2"	3 1/2"	4"	4"
750 @ 250' of Pipe	2 1/2"	3"	3 1/2"	4"	4"	5"	5"	5"
Cubic Ft. Hr.	**1000**	**2000**	**3000**	**4000**	**5000**	**6000**	**7000**	**8000**
Model	**1 Boiler**	**2 Boilers**	**3 Boilers**	**4 Boilers**	**5 Boilers**	**6 Boilers**	**7 Boilers**	**8 Boilers**
1000 @ 100' of Pipe	2"	3"	3"	3"	4"	4"	5"	5"
1000 @ 250' of Pipe	2 1/2"	4"	4"	4"	5"	5"	5"	6"

Table 12 - Gas Supply Piping Size Chart for Boilers

C. Check Inlet Gas Pressure

The gas valve is equipped with an inlet gas pressure tap that can be used to measure the gas pressure to the unit. To check gas pressure, perform the steps listed below:

1. **IMPORTANT!** Before you connect to the inlet pressure, shut off the gas and electrical power to unit.
2. Loosen the pressure tap with a small screwdriver. Refer to Figure 28 for location.
3. Each unit is equipped with a needle valve that will accept a 5/16 ID hose to connect to a digital manometer or liquid gauge to measure incoming pressure from 0-35" w.c.
4. Turn on the gas and power up the unit.
5. Put the unit into manual test mode. In test mode, monitor pressure to assure it does not drop below 1 inch from its idle reading. If gas pressure is out of range or pressure drop is excessive, contact the gas utility, gas supplier, qualified installer, or service agency to determine correct action that is needed to provide proper gas pressure to the unit. If Gas Pressure is within normal range proceed to Step 6.
6. Exit test mode, then turn power off and shut off gas supply at the manual gas valve before disconnecting the hose from the gas monitoring device. Tighten screw on the pressure tap and turn gas on. Check for leaks with soapy solution. Bubbles will appear on the pipe to indicate a leak is present.

⚠ WARNING

Ensure the pressure tap screw is properly tightened to prevent gas leaks. Failure to do so could cause substantial property damage, severe personal injury, or death.

⚠ WARNING

DO NOT adjust or attempt to measure gas valve outlet pressure. The gas valve is factory-set for the correct outlet pressure and requires no field adjustment. Attempts by the installer to adjust or measure the gas valve outlet pressure could result in damage to the valve and cause substantial property damage, severe personal injury, or death.

Strain on the gas valve and fittings may result in vibration, premature component failure and gas leakage, and result in fire, explosion, property damage, severe personal injury, or death.

Adjustments to the throttle screw or offset may only be made by a qualified gas technician using a calibrated combustion analyzer capable of measuring CO2 and CO. Failure to follow this instruction could result in fire, explosion, property damage, severe personal injury, or death.

Natural or LP Gas	
Minimum Pressure	3.5"WC
Maximum Pressure	14"WC

Table 13 - Gas Pressure Requirements

NOTICE

Do not fire (operate) the boiler until all connections have been completed and the heat exchanger is filled with water. Doing so will damage the boiler and void the warranty.

D. Boiler Gas Valve

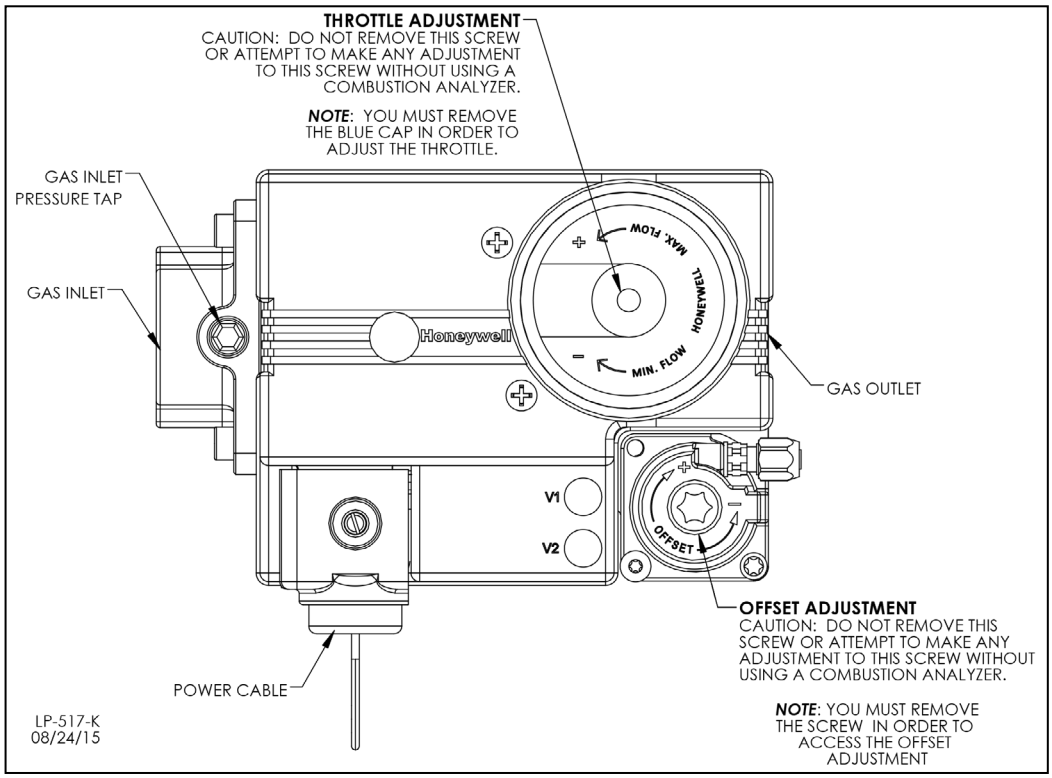


Figure 28 - Gas Valve - If Necessary, Use #40 Torx to Adjust Offset and Hex to Adjust the Throttle

⚠ WARNING

Ensure that the high gas pressure regulator is as least 6 – 10 feet upstream of the appliance. Failure to do so could result in substantial property damage, severe personal injury, or death.

The boiler is equipped with a damper actuator. This actuator is modulated by the system control to manage boiler combustion. It is important that the damper actuator selector switch is set to "0". See Figure 29 for correct positioning.

CAUTION

Ensure the damper actuator selector switch is set to "0". Turning the damper actuator selector switch to "1" will result in improper boiler operation. Service calls to repair this condition ARE NOT covered by warranty.

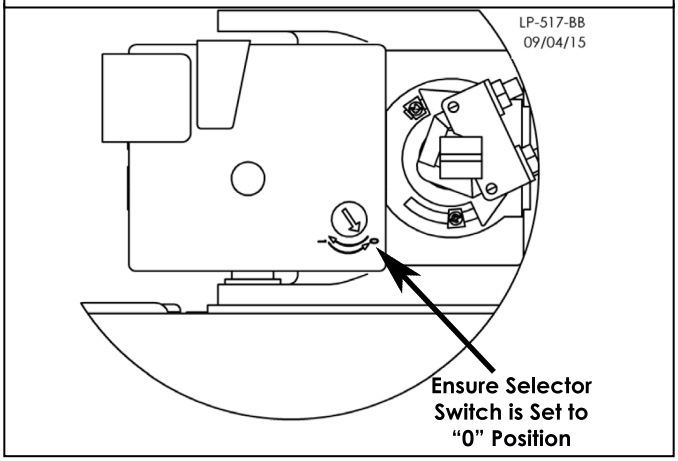


Figure 29 - Ensure the Damper Actuator is Set to "0" Position

Part 8 - Start-Up Preparation

⚠ WARNING

Thoroughly clean and flush any system that has used glycol before installing the boiler. Provide the customer with a material safety data sheet (MSDS) on the fluid used.

A. Check / Control Water Chemistry

CAUTION

Chemical imbalance of your water can cause severe damage to your boiler and associated equipment, and may also affect efficiency. You may have to have your water quality professionally analyzed to determine whether you need to install a water softener. It is important that the water chemistry on both the domestic hot water and central heating sides are checked before installing the boiler, as water quality will affect the reliability of the system. Outlined below are those water quality parameters which need to be met in order for the system to operate efficiently for many years. Failure of a heat exchanger due to lime scale build-up on the heating surface, low pH or other imbalance IS NOT covered by the warranty.

To assure extended service life, it is recommended to test water quality prior to installation. Listed below are some guidelines.

CAUTION

Do not use petroleum-based cleaning or sealing compounds in the boiler system. Damage to elastomer seals and gaskets in the system could occur, resulting in substantial property damage.

Closed loop water must be free of corrosive chemicals, sand, dirt, and other contaminates. It is up to the installer to ensure the water does not contain corrosive chemicals or elements that can damage the heat exchanger.

If you suspect that your water is contaminated in any way, discontinue use of the appliance and contact an authorized technician or licensed professional.

- **Water pH between 6.5 and 8.5**
- **Hardness less than 7 grains (120 mg/L) (Water temperatures of 140ºF and greater)**
- **Chloride concentration less than 100 ppm (mg/L)**
- **Total Dissolved Solids (TDS) less than 500 ppm (mg/L)**

***NOTE:** It is recommended to clean the heat exchanger at least once a year to prevent lime scale buildup. To clean the heat exchanger, follow the maintenance procedure in this manual.

Clean system to remove sediment*

1. You must thoroughly flush the system (without boiler connected) to remove sediment. The high-efficiency heat exchanger can be damaged by buildup or corrosion due to sediment.
2. For zoned systems, flush each zone separately through a purge valve. (If purge valves and isolation valves are not already installed, install them to properly clean the system.)
3. Flush system until water runs clean and you are sure piping is free of sediment.

***NOTE:** It is recommended you clean heat exchanger at least once a year to prevent lime scale buildup. Follow the maintenance procedure to clean the heat exchanger in the Maintenance Section of this manual.

Test/replace freeze protection fluid

1. For systems using freeze protection fluids, follow fluid manufacturer's instructions to verify inhibitor level and that other fluid characteristics are satisfactory.
2. Freeze protection fluid must be replaced periodically due to degradation of inhibitors over time. Follow all fluid manufacturer instructions.

NOTE: Boiler failure due to improper water chemistry is not covered by warranty.

B. Check for Gas Leaks

⚠ WARNING

Before starting the boiler, and during initial operation, smell near the floor and around the boiler for gas odorant or any unusual odor. Remove boiler front door and smell interior of boiler enclosure. Do not proceed with startup if there is any indication of a gas leak. Repair any leaks at once.

C. Freeze Protection (When Used)

⚠ WARNING

NEVER use automotive or standard glycol antifreeze. Do not use ethylene glycol made for hydronic systems. Use only freeze-protection fluids certified by fluid manufacturer as suitable for use with stainless steel boilers, verified in the fluid manufacturer's literature. Thoroughly clean and flush any system that has used glycol before installing the new boiler. Provide the boiler owner with a material safety data sheet (MSDS) on the fluid used.

1. Determine the freeze protection fluid quantity using total system water content following the fluid manufacturer's instructions. Remember to include expansion tank water content.
2. Local codes may require back flow preventer or actual disconnect from city water supply.
3. When using freeze protection fluid with automatic fill, install a water meter to monitor water makeup. Freeze protection fluid may leak before the water begins to leak, causing concentration to drop, reducing the freeze protection level.

D. Fill and Test Water System

⚠ WARNING

Ensure the boiler is full of water before firing the burner. Failure to do so will damage the boiler. Such damage IS NOT covered by warranty, and could result in property damage, severe personal injury, or death.

1. Fill the system only after ensuring water chemistry meets the requirements listed in this manual.
2. Close the manual and automatic air vents and boiler drain valve.
3. Fill to the correct system pressure. Correct pressure will vary with each application.
   a. Typical cold water fill pressure for a residential system is 12 psi.
   b. Pressure will rise when boiler is turned on and system water temperature increases. Operating pressure must never exceed the relief valve pressure setting.
4. At initial fill and during boiler startup and testing, check system thoroughly for leaks. Repair all leaks before proceeding further.

CAUTION

Eliminate all system leaks. Continual fresh make-up water will reduce boiler life. Minerals can build up in the heat exchanger, reducing heat transfer, overheating the heat exchanger and causing heat exchanger failure.

5. The system may have residual substances that could affect water chemistry. After the system has been filled and leak tested, verify that water pH and chloride concentrations are acceptable by sample testing.

CAUTION

It is important to purge the system of air to avoid damage to the boiler.

E. Purge Air from Water System

Purge air from the system:

a. Connect a hose to the purge valve and route hose to an area where water can drain and be seen.
b. Close the boiler or system isolation valve between the purge valve and fill connection to the system.
c. Close zone isolation valves.
d. Open quick-fill valve on cold water make-up line.
e. Open purge valve.
f. Open the isolation valves one zone at a time. Allow water to run through the zone, pushing out the air. Run water until no noticeable air flow is present. Close the zone isolation valves and proceed with the next zone. Follow this procedure until all zones are purged.
g. Close the quick-fill water valve and purge valve and remove the hose. Open all isolation valves. Watch the system pressure rise to correct cold-fill pressure. It is recommended that you put the pumps into manual operation to assist in purging the circuits.
h. Disconnect the wires that are connected to the THERMOSTAT terminals of the customer connection board. Apply power to the boiler. The display will show READY. Press the **v** and **ENTER** keys simultaneously and hold for 1 second. The display will read:

```
SERVICE PUMP CH
PUMP ON        11:47A
```

The central heating pump will come on. If you then press the ^ key, the central heating pump will shut off, the DHW pump will come on, and the display will read:

```
SERVICE PUMP DH
PUMP ON        11:47A
```

If the boiler is set up as a cascade master and you then press the ^ key again, the DHW pump will shut off, the system pump will come on, and the display will read:

```
SERVICE PUMP SH
PUMP ON        11:47A
```

NOTE: The boiler must be programmed as a cascade master for the Service Pump SH screen to display.

Use the **^** and **v** keys to toggle between running each pump in the system as required to help bleed out all entrapped air. Some good indicators that air is removed include the absence of gurgling noises in the pipes and pump operation becoming very quiet. Pressing **^** and **v** together at any time will return the boiler to normal operation.

i. After the system has operated for five minutes, eliminate any residual air by using the manual air vents located throughout the system.

j. If purge valves are not installed in the system, open manual air vents in the system one at a time, beginning with the lowest floor. Close vent when water squirts out. Repeat with remaining vents.

k. Refill to correct pressure.

F. Check Thermostat Circuit(s)

1. Disconnect the two external wires connected to the boiler thermostat terminals (low voltage terminal strip).
2. Connect a voltmeter across these two incoming wires with power supplied to the thermostat circuits. Close each thermostat, zone valve and relay in the external circuit one at a time and check the voltmeter reading across the incoming wires.
3. There should NEVER be a voltage reading.
4. If a voltage reading does occur under any condition, check and correct the external wiring. (This is a common problem when using 3-wire zone valves.)
5. Once the external thermostat circuit wiring is checked and corrected if necessary, reconnect the external thermostat circuit wires to the boiler low voltage terminal strip. Allow the boiler to cycle.

G. Condensate Removal

1. The boiler is a high efficiency condensing boiler. Therefore, the unit has a condensate drain. Condensate fluid is nothing more than water vapor, derived from combustion products, similar to that produced by an automobile when it is initially started.

Condensation is slightly acidic (typically with a pH of 3 to 5) and must be piped with the correct materials. Never pipe the condensate using steel, copper, brass or other materials that will be subject to corrosion. Plastic PVC or CPVC pipe are the only approved materials. A condensate neutralizer, if required by local authorities, can be made up of lime crystals, marble or phosphate chips that will neutralize the condensate. This may be done by the installer or you may purchase a condensate neutralizer from HTP (7350P-611).

2. The boiler is equipped with a ¾ female socket weld fitting connection that must be piped to a local drain. It is very important that the condensate line is sloped downward away from the boiler to a suitable inside drain. If the condensate outlet on the appliance is lower than the drain, you must use a condensate removal pump, available from HTP (554200). This pump is equipped with two leads that can be connected to an alarm or another type of warning device to alert the user of a condensate overflow, which, if not corrected, could cause property damage.
3. If a long horizontal run is used, it may be necessary to create a vent in the horizontal run to prevent a vacuum lock in the condensate line.
4. Do not expose the condensate to freezing temperatures.
5. It is very important you support the condensation line to assure proper drainage.

H. Final Checks Before Starting Boiler

1. Read Startup Procedures within this manual for proper steps to start boiler. (See Startup Report to record steps for future reference.)
2. Verify the boiler and system are full of water and all system components are correctly set for operation.

⚠ WARNING

Ensure the boiler is full of water before firing the burner. Failure to do so will damage the boiler. Such damage IS NOT covered by warranty, and could result in property damage, severe personal injury, or death.

3. Fill condensate trap with water.
4. Verify electrical connections are correct and securely attached.
5. Inspect exhaust vent and intake piping for signs of deterioration from corrosion, physical damage or sagging. Verify exhaust vent and intake piping are intact and correctly installed per Venting Section and local codes.

I. Setting Up a Single Boiler

When power is applied to the boiler, the control first completes a power-up systems check. During this time the combustion fan may run. The display will initially show the current boiler supply temperature. If a fault is detected during the power-up test, the control will display the appropriate fault code. Otherwise, the display will continue to show the boiler supply temperature and stand-by, waiting for a demand for heat.

When a demand for heat is received, the control begins the following demand sequence. The boiler first turns on the pump. The control will measure the supply temperature. If it is below the set point temperature minus the ignition differential the control will ignite the burner.

After the burner is lit, the control modulates the firing rate to control the supply water temperature and meet the heat demand. When the thermostat or indirect water heater temperature is met, the control will extinguish the burner and run the combustion fan to purge gasses from the combustion chamber. In addition, the pump will run for a pump post purge interval. The control will then be in standby, waiting to process the next demand for heat.

During this process, the control will extinguish the burner if it senses a dangerous or unsafe condition. If the control determines that a dangerous or unsafe condition has occurred, the control may lock out the boiler and prevent it from igniting until a maintenance person diagnoses the problem, repairs it, and resets the control. In the event that the control goes into lockout, it will show a diagnostic code on the display, illuminate the LED fault indicator, and close the alarm relay contacts to aid in recognition of the condition, diagnosis, and repair.

J. Setting Up a Cascaded System

If the boiler is part of a cascaded system the operation is somewhat different. The control of each boiler in a cascaded system completes its own power up system check. One of the boilers in the cascade system is designated as the master boiler. After the master boiler completes its power up sequence, it checks the communication bus to see if any other boilers are present. If other boilers are present, the master control determines these follower boiler addresses. The master boiler control will recheck the bus every few seconds as long as it is powered up to update the status of the connected boilers. The control in the master boiler processes all heat demands and dictates which of the follower boilers should light and what firing rate the followers should try to achieve.

When the master boiler receives a demand for heat, it determines which boiler is first in the firing sequence and sends that boiler a command to begin a demand sequence. That boiler will then begin a demand sequence as described above. Once the boiler ignites, the master boiler control will increase the firing rate command to that boiler until the system sensor temperature is at the set point temperature plus the differential, or that boiler is at high firing rate. If the command from the master boiler control gets to the high firing rate of the follower boiler, but the system sensor is below the required temperature, the master boiler control will then tell the next boiler in the firing sequence to begin its demand sequence. The master boiler control will then begin to ramp up the firing rate command of that boiler. This process will

continue while there is a demand until all boilers in the cascade system are at high fire or the desired temperature of the system sensor is reached. If the system sensor temperature reaches tank set point and differential before all boilers are at high fire, the master control will modulate the cascade command signal to maintain the system sensor at set point and differential until the demand is complete. When the system sensor is equal to the set point temperature, demand is complete, and the master boiler control will extinguish all boilers that may be lit. If the demand decreases, the firing rate command and amount of boilers lit will decrease exactly opposite as described above. Whenever the master boiler control needs to fire a follower boiler, it sends a firing rate command to that boiler. The follower boiler will respond to the command until its supply sensor temperature gets to be 5ºF above the set point temperature plus the differential, at which point the individual boiler will modulate on its own so as not to overheat. As a result, it is not uncommon to see the cascade output at maximum but individual boilers firing at less than their maximum firing rate.

K. Lockout Condition

If any boilers, including the master boiler in the cascade system, are in a lockout condition, the master control will recognize the lockout condition and skip over the boiler in the firing sequence. Each boiler in the cascade system is responsible for its own safety functions. So, if any individual boiler control senses an unsafe condition, it will extinguish the burner and, if necessary, go to a lockout condition. In this way, every boiler in the system has its individual safety controls intact and operational, even if the firing of the boiler is under control of the master boiler.

In the event that the system sensor fails, all boilers in the system will ignite simultaneously when there is a demand, and each boiler will individually regulate firing rates to maintain the master set point temperature (tank set point + installer #4) at the individual supply sensors built into the boiler. If this should happen, the master boiler will display an E03 fault code, indicating that the supply sensor has failed.

L. Cascade System Programming

1. If the boiler is used alone, skip this section.

2. Programming the Master Boiler:

a. Make sure there is no demand for heat being supplied to the boiler.

b. Apply power to the boiler.

c. Enter the system setting program navigation following instructions in this manual.

d. Verify that cascade address function 15 is set to 0. This makes the master boiler address 0. NOTE: The Master Boiler MUST be addressed as 0.

e. Change CASCADE MODE Function 23 to 928 BOILERS.

f. Exit the installer menu.

3. Programming Follower Boilers:

NOTE: READ THE NOTES BELOW BEFORE PROGRAMMING FOLLOWER BOILERS

- The master boiler will share its alarm output with the boiler addressed as 1.
- If one of the follower boilers has an indirect fired water heater connected to it, the address of this boiler must be 2 or greater.
- It is recommended but not necessary to address boilers in the order that they are wired.
- No two boilers can have the same address.
- It is not required to use all consecutive address numbers. Example: In a 2 boiler system with an indirect connected to the follower, the follower address would be 2 (address 1 is not used).
- Maximum amount of boilers in a cascaded system is eight (8).

a. Make sure there is no demand for heat being supplied to the master boiler.

b. Apply power to the follower boiler you are working on.

c. Enter system settings following instructions in this manual.

d. Set cascade address parameter 15 to 1 for the first follower, 2 for the second follower, etc. depending on which boiler you are programming based on the above notes. This establishes the boiler as a follower in a cascaded system and enables data to be transferred as needed for the system to function at full capability.

e. Change CASCADE MODE Function 23 to 928 BOILERS.

f. Exit the installer menu.

M. Initial Operation - Boiler Door and Seal

⚠ WARNING

It is important to ensure that the combustion chamber door is properly sealed and installed BEFORE attempting to start the boiler. Failure to do so could result in property damage, severe personal injury, or death.

NOTE: During initial start-up, the sealing rope may burn off. During this period a burning smell may come from the boiler. This is normal and will pass when the sealing rope has completed burning off.

After the boiler has operated for 12 - 16 hours, the door will have to be closed again to accommodate any burn-off of the organic starch sealing rope. Retightening the door after 12 - 16 hours will ensure a proper seal.

Part 9 - Start-Up Procedure

⚠ WARNING

FOR YOUR OWN SAFETY READ BEFORE OPERATING

1. This boiler does not have a pilot. It is equipped with an ignition device which automatically lights the burner. Do not try to light the burner by hand.

2. BEFORE OPERATING: Smell all around the boiler area for gas. Be sure to smell next to the floor because some gas is heavier than air and will settle on the floor.

3. WHAT TO DO IF YOU SMELL GAS

- Do not try to light any boiler.
- Do not touch any electric switch, do not use any phone in your building.
- Immediately call your gas supplier from a neighbor's phone. Follow the gas suppliers' instructions.
- If you cannot reach your gas supplier, call the fire department.
- Turn off the gas shutoff valve (located outside the boiler) so that the handle is crosswise to the gas pipe. If the handle will not turn by hand, don't try to force or repair it, call a qualified service technician. Force or attempted repair may result in a fire or explosion.

4. Do not use this boiler if any part has been under water. Immediately call a qualified service technician to inspect the boiler and to replace any part of the control system and any gas control that has been damaged.

5. The boiler shall be installed so the gas ignition system components are protected from water (dripping, spraying, rain, etc.) during boiler operation and service (circulator replacement, condensate trap, control replacement, etc.)

Failure to follow these instructions could result in property damage, serious personal injury, or death.

If you discover any evidence of a gas leak, shut down the boiler at once. Find the leak source with a bubble test and repair immediately. Do not start the boiler again until the leak is repaired. Failure to comply could result in substantial property damage, severe personal injury, or death.

A. Control Overview

The control is one of the primary safety devices of the boiler. It monitors the safety sensors of the boiler to assure safe and efficient operation.

The control has many features associated with system design. This section addresses programming features, including Boiler Settings / System Settings / Maintenance Settings and System Diagnostics, to help in customizing your control. It is important to fully understand control capabilities before customization, as its factory defaults may already fit your system design and not require any adjustment at all.

B. Navigation of the Display

The display includes a two line backlit LCD readout to provide informative messages about the operation of the boiler. Many operating parameters can be viewed and adjusted by using the six buttons on the display. The function of each button is described below.

RESET – The RESET button has two functions.
- – Resets any lockout error code
- – Returns the user to the default display screen.

ENTER – The ENTER key is used to access parameter programming mode. To access this mode, hold down the ENTER key for more than 4 seconds. The readout will change to:

ENTER MENU CODE 000

One of the zeroes will be blinking. Use the **^ v** arrow keys to change the blinking digit to the correct value. Use the **< >** arrow keys to select the next digit to change and again use the **^ v** keys to change the value. Repeat until the correct code is entered. Press the **ENTER** key to accept the code entered. If the code is correct, the readout will change to the appropriate screen. If the programming code is not accepted, the readout will continue to display as shown above.

ENTER is also used to enable a function for editing. After the user navigates to the desired function, the user holds down **ENTER** for one second. When **ENTER** is released, the function value will begin to blink. The function can now be changed using the **^ v** keys. After the new value is displayed, the user then presses **ENTER** for 1 second to lock the new value of the function. The value will then stop blinking.

LEFT AND RIGHT ARROW KEYS – **< >** are used to navigate between the default display, status display, analog and cascade displays if they are enabled. The **< >** keys are also used in programming modes to change between programmable functions. It is recommended you use the Menu Maps in the back of this manual and the detailed menu instructions printed in this section to help in menu navigation.

UP AND DOWN ARROW KEYS – **^ v** are used to navigate between the various functions displayed in the menu. After the function is enabled for editing by pushing the **ENTER** key, the **^ v** keys are used to adjust the function upward or downward to the desired value.

C. Operating Instructions

Before operating the unit, it is important to verify that the gas line and water lines are connected to the boiler and fully purged. If you smell gas, STOP; Follow the safety instructions listed in the first part of this section. If you do not smell gas, follow the next steps.

1. Turn down the thermostats before applying power to the boiler. If 0–10 volt or other inputs are used, make sure that they are set so there is no call for heat while programming.
2. Turn on the power to the boiler or boilers if a cascade system is used.
3. Next, check the boiler settings. Adjustment and factory defaults are outlined within this section. If a cascade system is used, it is important that all the boilers have the same boiler settings.
4. Next, check the system settings. Adjustments and factory defaults are outlined within this section. If a cascade system is used, it is important that the Master Boiler is programmed with the correct system settings.
5. Create a demand on the boiler or boilers if a cascade system is used. The user can monitor system functions when the boilers are operational.
6. If the boilers fail to start, refer to the troubleshooting section in the back of this manual.

D. Programming Boiler Settings

Boiler Setting Program Access

Note: Programming the boiler control is not possible when the boiler is firing. Make sure any input which can create a demand on the boiler, such as the tank thermostat, is turned off, so the boiler will remain idle to allow programming.

Screen	Description
ENTER MENU CODE 000	To access the boiler setting program, press and hold **ENTER** for 4 seconds until the display shows the screen at left.
ENTER MENU CODE 600	Use the arrow keys to log in the **Boiler Menu Access Code - 600**. Press **ENTER** to confirm the code and access the **Boiler Setting Program** navigation menu.

Table 14 - Boiler Setting Access

Boiler Setting Program Navigation

Once the code is confirmed, the user can start to set the **Boiler Settings**. Use the arrow keys on the display to navigate through the **Boiler Settings**. A blinking setting indicates the setting can be changed. To change a setting, press **ENTER**. Boiler settings can be increased by pressing **^** and decreased by pressing **v** on the display. When done, press **ENTER**. The setting will stop blinking and the user can move on to next setting by pressing the **<** or **>** arrow keys. Press **RESET** to exit programming and store settings. Listed below are the boiler settings that can be programmed into the control.

Screen	Description
CENTRAL HEAT 180 °F	Allows the user to adjust the boiler set point from 50F to 190°F (Factory Default 180°F).
CENTRAL DIFF SET 30 °F	Adjusts the boiler differential set point from 5°F to 30°F (Factory Default 30°F).
DHW SETPOINT 119 °F	Adjusts the indirect tank set point from 70°F to 185°F (Factory Default 119°F).
DHW DIFF SETPOINT 7 °F	Adjusts the DHW differential set point from 1°F to 30°F (Factory Default 7°F).
TEMP DISPLAY C OR F °F	Adjusts the temperature measurement in F = Fahrenheit to C = Celsius (Default is Fahrenheit).

Table 15 - Boiler Setting Program Navigation

Clock Settings

(**NOTE:** The clock will reset if the boiler is powered off for more than a week.)

Screen	Description
CLOCK MODE (12/24) 08/28/2009 Fr 9:42A	Changes the clock from 12 hour mode (8:45 PM) to 24 hour mode (20:45). To change to 24 hour mode, press **ENTER**. The letter (A or P) after the time will blink. Press the up or down arrow key once and the letter will disappear. Press **ENTER** to save the new setting.
CLOCK HOUR 08/28/2009 Fr 10:01A	Allows the user to adjust the hour setting.
CLOCK MINUTE 08/28/2009 Fr 10:01A	Adjusts the minute setting.
CLOCK DAY OF WEEK 08/28/2009 Fr 10:01A	Adjusts the day of the week.

CLOCK DATE MODE 08/28/2009 Fr 10:01A	Allows the user to switch to European date format (2009/08/28) from US format (08/28/2009).
CLOCK YEAR 08/28/2009 Fr 10:01A	Adjusts the year setting.
CLOCK MONTH 08/28/2009 Fr 10:01A	Adjusts the month setting.
CLOCK DATE 08/28/2009 Fr 10:01A	The clock is set.

Table 16 - Clock Setting Screens

NOTE: The internal clock does not adjust for daylight savings time and requires manual adjustment.

E. Programming the System Setting

System Setting Program Access

Note: Programming the boiler control is not possible when the boiler is firing. Make sure any input which can create a demand on the boiler, such as the tank thermostat, is turned off, so the boiler will remain idle to allow programming.

Screen	Description
ENTER MENU CODE 000	To access the boiler setting program, press and hold **ENTER** for 4 seconds until the display shows the screen at left.
ENTER MENU CODE 925	Use the arrow keys to log in the **Boiler Menu Access Code - 925**. Press **ENTER** to confirm the code and access the **System Setting Program** navigation menu.

Table 17 - System Setting Access

F. System Setting Program Navigation

Once the **System Menu Access Code** is confirmed, the user can begin to set the system setting menu. Use the **< >** keys on the display to navigate through the System Settings. To change a setting, press **ENTER**. System settings can be **increased** by pressing **^** and **decreased** by pressing **v** on the display. When done, press **ENTER**. The setting will stop blinking and you can move on to next setting. Press **RESET** to exit programming and store settings. Listed below are the boiler settings that can be programmed into the control.

Screen	Description
Function 1	**Factory Program Mode**
MODE INDIRECT 1	This indicates that the control is configured correctly. Do not change this setting.
Function 3	**DHW Tank Max Temp**
DHW TANK MAX TEMP 180 ºF 3	This is the maximum temperature that can be selected in boiler settings for the DHW tank. Factory Default is 180ºF. (Range: 95ºF to 180ºF)
Function 6	**DHW Post Pump Time**
DHW POST PUMP TIME 0 MINUTES 6	The indirect pump has the ability to post purge energy from the boiler to run the pump after the set point has been achieved. Please note that running the pump for a time greater than 5 minutes may cause tank energy to be released back to the heat exchanger. Factory Default of 0 Minutes. (Range: 0 – 10 minutes)
Function 7	**Warm Weather Shutoff**
WARM WEATHER OFF 68 ºF 7	When used with an outdoor sensor, warm weather shut down will disable the boiler if the programmed outdoor temperature is exceeded. Default: 68ºF (Range: 41ºF to 122ºF).
Function 8	**Min Outdoor Temp**
MIN OUTDOOR TEMP 5 ºF 8	Sets the minimum outdoor design temperature for the system. Default: 5ºF (Range: -49ºF to 32ºF).
Function 9	**Max Supply Temp**
MAX SUPPLY TEMP 180 ºF 9	Sets the maximum design supply temperature based on the minimum outdoor design temperature. Default: 180ºF (Range: 77ºF to 190ºF).
Function 10	**Max Outdoor Temp**
MAX OUTDOOR TEMP 68 ºF 10	Sets the maximum outdoor design temperature for the system design. Default: 68ºF (Range 32ºF to 190ºF).
Function 11	**Min Supply Temp**
MIN SUPPLY TEMP 95 ºF 11	Sets the design supply water temperature based on the maximum outdoor design temperature. Default: 95ºF (Range: 32ºF to 190ºF).
Function 12	**Min Boiler Temp**
MIN BOILER TEMP 68 ºF 12	Sets the design minimum heat curve temperature for central heat. Default: 68ºF (Range: 32ºF to 190ºF).
Function 13	**CH Post Pump Time**
CH POST PUMP TIME 0 MINUTES 13	Allows the user to set the boiler pump post purge time once the thermostat is satisfied. Default: 0 minutes (Range: 0 – 10 minutes).
Screen	**Description**
Function 14	**DHW Priority**
DHW PRIORITY 30 MINUTES 14	Allows the user to set the maximum run time for the indirect fired water heater and the minimum run time for central heating. Default: 30 minutes (Range: 0 – 60 minutes).
Function 15	**Cascade Address**
CASCADE ADDRESS 0 15	Bus addressing boilers (maximum boilers allowed is eight (8) in a cascade system). Master Boiler address is 0 and Follower Boilers are addressed 1 thru 7. Default: 0 (Range: 0 – 15). NOTE: DO NOT USE ADDRESSES 8 - 15.
Function 16	**Optional Inputs**
OPTIONAL INPUT OFF 16	Allows the user to select optional inputs to control or monitor the system. Default: OFF (Range: Off / Booster Board / 0-10 Volt).
Function 17	**0-10 Volt Function**
0-10 VOLT FUNCTION TEMPERATURE 17	Controls boiler modulation through temperature control. Factory Default = Temperature (Range: Temperature or Fan Speed).

Function 18	Step Modulation Mode
STEP MODULATE MODE ON 18	Allows the user to turn ON step modulation, which regulates burner output in six steps at one minute intervals. Step modulation will start at the last modulation rate of the boiler and work up one minute at a time. Default: ON (Selection: OFF or ON).
Function 19	**Boiler DHW Temp**
BOILER SUPPLY DHW 180 °F 19	Allows the user to program the boiler supply water temperature to the indirect heat exchanger during a demand cycle. Default: 180°F (Range: 119°F to 190°F).
Function 20	**Water Safety Input**
WATER SAFETY INPUT NONE 20	The user can select various water safety inputs used in the boiler system. Default: NONE (Range: NONE / Flow Switch / Water Pressure).
Function 21	**Error Outdoor Sensor**
ERROR OUTD SENSOR OFF 21	Allows the user to set the control to display an error message if an outdoor sensor is open or shorted. NOTE: This error does not stop the boiler from running. Factory Default: OFF (Range: ON / OFF / PHOEN ON).
Function 22	**Adjust Boiler Output %**
ADJ BOILER OUTPUT 100% 22	Adjusts the boiler output down from 100% to 50%. Factory Default: 100%. (Range: 100% – 50%)
Screen	**Description**
Function 23	**Cascade Mode**
CASCADE MODE OFF 23	Allows the user to select cascade mode. Select OFF if boiler is operating alone. Select 928 BOILRS to establish a cascaded system. Factory Default: OFF (Range: OFF / 928 BOILRS). **NOTE:** Select OFF if boiler is operating alone or with Vision 3 panel.
Function 24	**Cascade Rotation**
CASCADE ROTATION 48 HOURS 24	Sets the amount of hours before the first boiler in the cascade firing rotation will be changed. NOTE: If this is set to 0, the firing order of the boilers will not rotate. Default: 48 hours (Range: 0 – 240 hours).
Function 25	**Cascade DHW Mode**
DHW CASCADE MODE ENTIRE CASCADE 25	**NOTE:** "SYS PMP OFF W/DHW" has been added to Function 25. This new setting only applies to a single boiler cascade. Depending on system piping, this option allows you to run both the CH and DHW pumps during a DHW call, but the SYS pump will NOT be energized during the DHW call. ENTIRE CASCADE (Range: ENTIRE CASCADE / DHW ON LOOP / ONLY MASTER / SYS PMP OFF W/DHW).

Function 26	System Freeze Protection
SYS FREEZE PROT PROTECT OFF 26	**NOTE:** This parameter is only present if the boiler is a cascade master. Allows the user to set the freeze protection when a system pump is used. Factory Default: OFF. Selection of temperature activates freeze protection. (Range: OFF, -40°F – 104°F).
Function 27	**Error System Sensor**
ERROR SYSTEM SENS ON 27	Sets the control to display an error message if the system sensor is open or shorted. NOTE: This error does not stop the boiler (or boilers) from running. Factory Default: ON (Range: ON / OFF).
Function 28	**Freeze Protection**
FREEZE PROTECTION ON 28	Allows the user to set freeze protection on the boiler. Factory Default: ON (Range: ON / OFF).
Function 29	**DHW Modulation Mode**
DHW MODULATE MODE NORMAL MOD 29	This parameter controls how the boiler modulates for a DHW demand. In NORMAL MOD mode, the boiler will modulate down from high fire when there is a DHW demand. In LOW MOD mode, the boiler will modulate up from low fire when there is a DHW demand. This mode is useful to minimize short cycling when a large boiler and small indirect tank are used together. Factory Default: NORMAL MOD (Range: NORMAL MOD / LOW MOD).
Function 30	**Extra Boiler Mode**
EXTRA BOILER MODE OFF 30	Allows for a non HTP boiler to be controlled when the cascade output has risen above the percent of the cascade firing rate set in this parameter. Factory Default: OFF (Range: 50% - 100%).
Function 31	**System Sensor Mode**
SYSTEM SENSOR MODE OFF 31	Suppresses the 'NO FOLLOWER' display message if the boiler is used as a cascade master boiler with no follower boilers connected. Factory Default: OFF (Range: ON / OFF).
Function 32	**Service Schedule**
SERVICE SCHEDULE OFF 32	Selects a service date or time based on the boiler run hours to program the boiler maintenance schedule. Factory Default: OFF (Range: Date or Run Hours). NOTE: Without setting this function, Functions 33/34/35/36 will not display.

Function 37	Modbus Mode
MODBUS MODE OFF 37	Enables Modbus Mode on the appliance. Factory Default: OFF (Range: OFF, ON, AUTO). NOTE: Turning Modbus Mode "ON" will open a number of additional parameters to customize Modbus installation. See Modbus Instructions (lp-372) for details. NOTE: Turning this Mode "ON" without a connected and powered Modbus communication adapter (p/n 7350P-629) will result in improper appliance operation. Service calls associated with this ARE NOT covered by warranty.
Function 54	**Boost Time**
BOOST TIME 0 54	Temporarily overrides the Outdoor Reset Curve to bring the boiler up to the maximum setpoint to satisfy a thermostat call in less time. Factory Default: 0 min (Range: 0-762 min in increments of 6 minutes.) EXAMPLE: If 6 minutes is selected, and there has been a call for heat for 6 minutes, the boiler will override the Outdoor Reset Curve and boost to the maximum setpoint until the call for heat is satisfied. The boiler will then continue to boost for 6 additional minutes before returning to the Outdoor Reset Curve.
Function 55	**CH Pump Priority**
PUMP CH PRIO OFF 55	**NOTE:** This function applies only to boilers with a Cascade Address of 0. Controls whether the CH pump will meet a call for heat while also meeting or answering a DHW call. A setting of OFF will not run the CH pump while running the DHW pump; an ON setting will run the CH pump while simultaneously running the DHW pump. Factory Default: OFF (Range OFF/ON)
Function 56	**OA1 Configuration**
O-10V A OUTPUT CONFIG POWER BOIL 56	Controls the operation of the 0-10V A output on the Field Connection Board. Factory Default: BOIL POWER (Range: BOIL POWER / CASC POWER / FAN SPEED / ALARM / TEMPERATUR / FLAME / PUMP dT).

The following information details the 0-10V output parameters described in Function 56 that can be read at a Building Management System.

BOIL POWER - 0-10V output is proportional to boiler firing rate. 0V = Not Firing, 1.5V = Minimum Firing Rate, 10V = Maximum Firing Rate

CASC POWER - When configured on the Cascade Master, 0-10V is proportional to the firing rate of the Cascaded System. 0V = Not Firing, 1.5V = Minimum Firing Rate (One Boiler Lit), 10V = Maximum Firing Rate of all Connected Boilers

FAN SPEED - Output is proportional to boiler fan speed. 0V = Fan is Off, 1.5V = Minimum Fan Speed, 10V = Maximum Fan Speed

ALARM - 0V = Alarm is Off, 10V = Alarm is On

TEMPERATUR - Output follows boiler temperature setting based on outdoor reset. 0V = Minimum Boiler Temperature for Maximum Outdoor Temperature Setting. 10V = CH (or cascade) temperature setting. This number will vary with the outdoor temperature so that the user can know what setpoint temperature the boiler is trying to achieve.

FLAME - Equals boiler Flame Current. 0V = 0ua, 10V = 10ua.

PUMP dT - This output controls pump speed to maintain the desired Delta T. 0V = OFF, 2V (or output offset value greater than 2) = Minimum Pump Speed, 10V = Maximum Pump Speed.

Function 57	OA1 Offset
O-10V A OUTPUT OFFSET 1.5 57	This value is added to the OFFSTATE VOLT OA1 value, to determine the total voltage output required at the minimum case. Factory Default: 1.5 (Range: 0.0 to 9.9)
Function 60	**CH dT Setting**
CH dT SETTING 20F 60	This parameter is only available when PUMP dT is selected in Function 56. Determines the desired temperature difference between the SUPPLY And RETURN temperatures. Factory Default: 20F (Range: 0 - 47F)
Function 61	**Offstate Voltage OA1**
OFFSTATE VOLT 0-10V A 0.0V 61	This parameter is only available when PUMP dT is selected in Function 56. Determines the voltage present in OA1 when the pump is supposed to be OFF. Factory Default: 0.0 (Range: 0.0 to 9.9)

Table 18 - System Setting Program Navigation

NOTE: For the following functions, you must have your Service Schedule set on either Date or Run Hours.

To change these functions, press **ENTER**. The left most digit will begin to blink. Use the **^** or **v** arrows to change the digit. Use the **< >** arrow keys to switch between digits. When you've made your selection, press **ENTER** again.

Screen	Description
Function 33	**Year**
SERVICE SCHEDULE YEAR 00/00/2000 33	If the date function was selected, allows the user to set the year of the next service reminder.
	Hours
SERVICE SCHEDULE 10000s 00000 33	If the run hour function was selected, allows the user to set the tens of thousands of run hours before next service reminder.
Function 34	**Month**
SERVICE SCHEDULE MONTH 00/00/2000 34	Programs the month of the next service reminder.
	Hours
SERVICE SCHEDULE 10000s 00000 34	Sets the thousands of run hours before next service reminder.
Function 35	**Day**
SERVICE SCHEDULE DAY 00/00/2000 35	Sets the day of next service reminder.
	Hours
SERVICE SCHEDULE 10000s 00000 35	Sets the tens of run hours for the next service reminder.

Function 36	Telephone
TELEPHONE # 000 000 0000 36	Allows the user to input a telephone number that will display when maintenance is required.

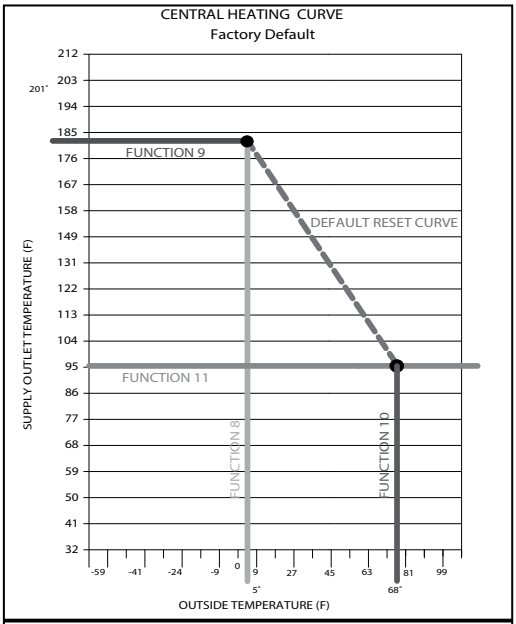
Table 19 - Maintenance Reminder Function Screens

G. Resetting the Maintenance Schedule

When the system control flashes MAINTENANCE REQUIRED, it is advisable that you call for service. After the service is performed, reset the schedule for the next required service by using the following steps.

Press **ENTER** on the display for 3 seconds. The Menu code will appear as 000. This does not change. Press **ENTER** again. SERVICE SCHEDULE RESET will be displayed. Using the **>** key scroll to the selection of year or hours. Press **ENTER** to reset the selected Service Schedule. Press the **^** and **v** keys to make adjustments. Press **ENTER** when reset is complete.

Part 10 - Start-Up Procedures for the Installer



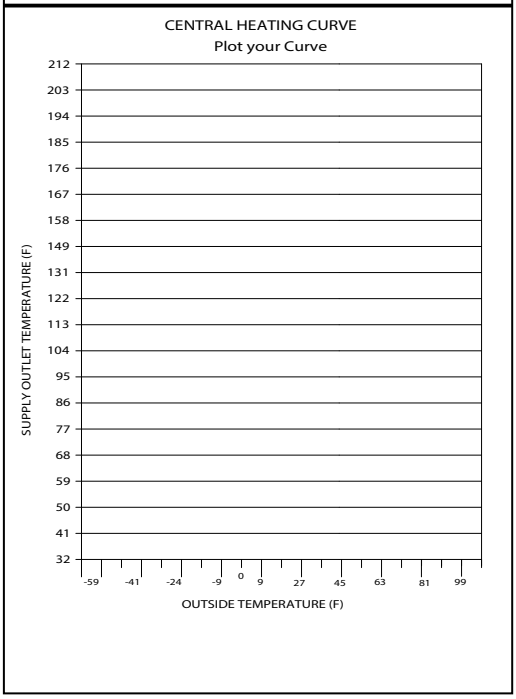


Table 20 - Heating Curve - NOTE: The user can adjust the heat curve down by lowering the central heating temperature.

A. Boiler Control Status Menu

The boiler control also has the ability to review system status. To access the status screens, press **>**. Once the first value is displayed, press **^** and **v** to scroll through additional information. At any point press **RESET** to exit the status screens.

Screen	Description
SUPPLY 180ºF RETURN 150ºF	This is the first screen that appears after pressing **>**, and shows the actual temperatures measured by the supply and return sensors. NOTE: If the boiler is configured to use a 0 – 10 volt input, the return sensor is disabled and the second line of the display will be blank.
Press v once.	
CH SET 180ºF BURNER 120ºF	The screen displays the current central heating temperature set point on the top line. NOTE: This temperature set point may vary from what was set in the boiler settings if an outdoor sensor is used. The actual temperature measured by the burner sensor is displayed on the bottom line.
Press v once.	
CH DEMAND OFF BOILER	This screen displays the central heat demand set for the cascade system.
Press v once.	**This screen appears only when the boiler is set as a Master Boiler.**
CAS SET 180ºF SYSTEM 112ºF	This screen displays the cascade set point (maximum 190ºF) on the top line. The system sensor reading is on the second line. The control will cascade the boilers up to this set point depending on demand.
Press v once.	
DHW SET 119ºF DHW 117ºF	Displays the current tank temperature set point on the top line. The actual temperature measured by the tank or return sensor (HTP 7250P-325) is displayed on the bottom line. If a mechanical aquastat is used in place of the recommended sensor, the second line will display 'OFF' in place of the temperature if the aquastat measures close to its set temperature, or 'ON' if the aquastat temperature is too low.
Press v once.	
OUTDOOR 11ºF FLUE 95ºF	The current outdoor temperature is displayed on the top line. If there is no outdoor sensor connected to the boiler, this line will display "OFF" in place of the temperature. If the outdoor sensor is shorted, this line will display "ON" in place of the temperature. The second line displays the current boiler flue temperature.

Press v once.	
FLAME 0.0uA FAN SPEED 3497 RPM	This screen displays boiler flame current on the top line. The second line displays boiler fan speed.
Press v once.	
0-10 V 0.0V BOILER	The top line displays the voltage on the optional input. This voltage is only relevant if an external 0-10 volt signal is being used to control the boiler.
Press v once.	
BUS COMM NO CONN	This display shows the status of the communication bus between multiple boilers. If in a single boiler configuration, the display will show 'NO CONN'. In a multiple boiler configuration, if this is the Master Boiler and other boilers are connected to the communication bus and powered, this screen will show the address of each boiler connected to the bus.
Press v once.	
POWER ON 0H CH ON 0H	The top line indicates the amount of hours the boiler has been powered over its life. The second line indicates how many hours the burner has been on for central heat demand over its life.
Press v once.	
DHW ON 0H GOOD IGNIT 1X	The top line indicates the hours the burner has been on for hot water demand over the boiler's life. The second line indicates how many times the burner has successfully ignited over the boiler's life.
Press v once.	**This screen appears only when the boiler is set as a Master Boiler.**
SYS CH ON 0H SYS DHW ON 0H	This screen displays how many hours the boiler has run to meet central heat and DHW demand.
Press > once at any status screen.	
TEMPERATURE CONTROL ANALOG SIG 0.2 V	Displays 0-10V status when 0-10V is connected.

Table 21 - Boiler Control Status Menu Screens

The next ten screens display the last ten boiler lockout faults. Press **v** to scroll through the faults from most recent to oldest.

Screen	Description
FAULT HISTORY 1 07/27/2009 Mo 5:19A	This screen displays the most recent boiler control lockout fault. The top line will alternate between the words 'FAULT HISTORY' and the fault code encountered. The bottom line displays the date and time the fault occurred.
Press v once.	
FAULT HISTORY 2 08/28/2009 Fr 5:19A	The second oldest boiler control lockout fault. The top line will alternate between the words 'FAULT HISTORY' and the actual fault encountered. The bottom line will display the date and time that the fault occurred.
Press v once.	
FAULT HISTORY 3 08/28/2009 Fr 5:19A	The third oldest boiler control lockout fault. The top line will alternate between the words 'FAULT HISTORY' and the actual fault encountered. The bottom line will display the date and time that the fault occurred.
Press v once.	
FAULT HISTORY 4 08/28/2009 Fr 5:19A	The fourth oldest boiler control lockout fault. The top line will alternate between the words 'FAULT HISTORY' and the actual fault encountered. The bottom line will display the date and time that the fault occurred.
Press v once.	
FAULT HISTORY 5 08/28/2009 Fr 5:19A	The fifth oldest boiler control lockout fault. The top line will alternate between the words 'FAULT HISTORY' and the actual fault encountered. The bottom line will display the date and time that the fault occurred.
Press v once.	
FAULT HISTORY 6 08/28/2009 Fr 5:19A	The sixth oldest boiler control lockout fault. The top line will alternate between the words 'FAULT HISTORY' and the actual fault encountered. The bottom line will display the date and time that the fault occurred.
Press v once.	
FAULT HISTORY 7 08/28/2009 Fr 5:19A	The seventh oldest boiler control lockout fault. The top line will alternate between the words 'FAULT HISTORY' and the actual fault encountered. The bottom line will display the date and time that the fault occurred.
Press v once.	
FAULT HISTORY 8 08/28/2009 Fr 5:19A	The eighth oldest boiler control lockout fault. The top line will alternate between the words 'FAULT HISTORY' and the actual fault encountered. The bottom line will display the date and time that the fault occurred.
Press v once.	

FAULT HISTORY 9 08/28/2009 Fr 5:19A	The ninth oldest boiler control lockout fault. The top line will alternate between the words 'FAULT HISTORY' and the actual fault encountered. The bottom line will display the date and time that the fault occurred.
Press v once.	
FAULT HISTORY 10 08/28/2009 Fr 5:19A	The tenth oldest boiler control lockout fault. The top line will alternate between the words 'FAULT HISTORY' and the actual fault encountered. The bottom line will display the date and time that the fault occurred.

Table 22 - Boiler Fault Screens

The next ten screens display the last ten boiler blocking faults. Press **v** to scroll through the faults from most recent to oldest.

Screen	Description
BLOCKING HISTORY 1 08/28/2009 Fr 5:19A	This screen displays the most recent boiler control blocking error. The top line will alternate between the words 'BLOCKING HISTORY' and the blocking code encountered.
Press v once.	
BLOCKING HISTORY 2 08/28/2009 Fr 5:19A	The second oldest boiler control blocking error. The top line will alternate between the words 'BLOCKING HISTORY' and the actual blocking code encountered.
Press v once.	
BLOCKING HISTORY 3 08/28/2009 Fr 5:19A	The third oldest boiler control blocking error. The top line will alternate between the words 'BLOCKING HISTORY' and the actual blocking code encountered.
Press v once.	
BLOCKING HISTORY 4 08/28/2009 Fr 5:19A	The fourth oldest boiler control blocking error. The top line will alternate between the words 'BLOCKING HISTORY' and the actual blocking code encountered.
Press v once.	
BLOCKING HISTORY 5 08/28/2009 Fr 5:19A	The fifth oldest boiler control blocking error. The top line will alternate between the words 'BLOCKING HISTORY' and the actual blocking code encountered.
Press v once.	
BLOCKING HISTORY 6 08/28/2009 Fr 5:19A	The sixth oldest boiler control blocking error. The top line will alternate between the words 'BLOCKING HISTORY' and the actual blocking code encountered.
Press v once.	
BLOCKING HISTORY 7 08/28/2009 Fr 5:19A	The seventh oldest boiler control blocking error. The top line will alternate between the words 'BLOCKING HISTORY' and the actual blocking code encountered.
Press v once.	
BLOCKING HISTORY 8 08/28/2009 Fr 5:19A	The eighth oldest boiler control blocking error. The top line will alternate between the words 'BLOCKING HISTORY' and the actual blocking code encountered.
Press v once.	
BLOCKING HISTORY 9 08/28/2009 Fr 5:19A	The ninth oldest boiler control blocking error. The top line will alternate between the words 'BLOCKING HISTORY' and the actual blocking code encountered.
Press v once.	
BLOCKING HISTORY 10 08/28/2009 Fr 5:19A	The tenth oldest boiler control blocking error. The top line will alternate between the words 'BLOCKING HISTORY' and the blocking code encountered.
Press v once.	
OA1 0.0V OA2 0.0V	Displays the voltage level present on the 0-10VA and 0-10VB inputs.
Press v once.	
ARBA-P 160831 ASBA-P 150806	Displays the Comfort and Safety firmware revisions programmed into the control.

Table 23 - Boiler Blocking Screens

B. Cascade Menu

This menu is accessed by pressing **<** at the default menu or **>** at the status menu when the boiler is configured for cascade operation.

Screen	Description
CASCADE MASTER READY SYS PUMP OFF	This screen displays when the boiler is configured as a Cascade Master and the system is ready to accept a demand for heat. The second line indicates the cascade system pump output status. This screen alternates with the default screen every 5 seconds or can be accessed by pressing the **<** key from the default screen.
CASCADE NO FOLLOWER SYS PUMP OFF	This screen displays when the boiler is configured as a Master Boiler and there are no connected follower boilers, or the follower boilers are not powered. The second line indicates cascade system pump output status. This screen alternates with the default screen every 5 seconds or can be accessed by pressing the **<** key from the default screen.
CASCADE NO SENSOR SYS PUMP OFF	This screen displays when the boiler is configured as a Master Boiler and there is no system temperature sensor connected or the system sensor is defective. The cascade system will still function in this situation with reduced efficiency. All boilers will run simultaneously rather than in a staged fashion. The second line indicates cascade system pump output status. This screen will alternate with the default screen every 5 seconds or can be accessed by pressing the **<** key from the default screen.

CASCADE TT 0123 567 SYS PUMP ON 12:47P	This screen displays information about cascade status. The TT in the center of the top line shows that cascade demand is coming from TT contact being closed. You may also see DHW if the demand is from a DHW sensor, or 0-10 if the demand is from a 0-10 volt input. The following numbers show which boiler addresses are currently communicating to the master. If a boiler address is not used or communicating, the number will not display. In the example to the left, boiler address #4 is not communicating. When a boiler in the system is firing, its address number will alternate with a ". to signify it is firing. The bottom line shows the status of the system pump output contacts.
Press v once.	
CASCADE PWR 100% PRESENT 01234567	This screen displays overall cascade power output. The range of this value is the number of boilers communicating with the Master x 100. For example, if 8 boilers are connected and firing, the maximum cascade power is 800%. The second line shows which boiler addresses are communicating with the Master.
Press v once.	
CASCADE SYST 118ºF CASCADE SET 190ºF	This screen displays current system temperature sensor reading on the top line and the cascade system temperature setting on the bottom.
Press v once.	
BOILER 0 100% BOILER 1 56%	This screen displays the current cascade power demand output on a per connected boiler basis for boilers addressed as 0 and 1. In the example, boiler 0 is being commanded to fire at 100% and boiler 1 at 56%. If this were a 2 boiler system, the 'CASCADE PWR' screen above would read 156%.
Press v once.	
BOILER 2 0% BOILER 3 0%	This screen displays the current cascade power demand output on a per connected boiler basis for boilers addressed as 2 and 3.
Press v once.	
BOILER 4 0% BOILER 5 0%	This screen displays the current cascade power demand output on a per connected boiler basis for boilers addressed as 4 and 5.
Press v once.	
BOILER 6 0% BOILER 7 0%	This screen displays the current cascade power demand output on a per connected boiler basis for boilers addressed as 6 and 7.
Press v once.	
BOILER 8 N/A BOILER 9 N/A	This screen is not applicable.
Press v once.	
BOILER A10 N/A BOILER B11 N/A	This screen is not applicable.
Press v once.	
BOILER C12 N/A BOILER D13 N/A	This screen is not applicable.
Press v once.	
BOILER E14 N/A BOILER F15 N/A	This screen is not applicable.

Table 26 - Cascade Menu

C. Boiler Test Mode

This function is intended to simplify gas adjustment. The following tables include recommended combustion settings by fuel type and boiler fan speeds. Automatic modulation does not take place while the controller is in Test Mode. However, the boilers will modulate down if the program set point is reached while running in Test Mode. It is recommended to enter Test Mode with the largest load possible to create such a heat demand that Test Mode will not be interrupted. To enter Test Mode press **^** and **ENTER** simultaneously.
NOTE: The boiler will automatically exit Test Mode after 20 minutes of operation.
Press **^** to increase and v to decrease fan speed ten (10) RPM. Press **^** and ENTER simultaneously to go directly to max fan speed. Press v and ENTER simultaneously to go directly to min fan speed.
To leave Test Mode press **^** and **v** simultaneously.

SERVICE RUN 3400 RPM PUMP ON 4:49P

Combustion Settings on All Models			
Fan Speed	**Natural Gas (NG)**		
	Low	Ignition	High
Carbon Monoxide (CO) PPM	0-10		0-30
Carbon Dioxide (CO_2) %	7 1/2 - 8 1/2	8 1/2 - 9 1/2	

Table 24 - Combustion Settings - All Models

Fan Speeds			
Model	**Ignition**	**Min**	**Max**
750	3800	3600	5200
1000	4100	3950	6400

Table 25 - Fan Speeds

Part 11 - Troubleshooting

A. Boiler Error and Fault Codes

If any of the sensors detect an abnormal condition, or an internal component fails during the operation of the boiler, the display may show an error message and error code. This message and code may be the result of a temporary condition, in which case the display will revert to its normal readout when the condition is corrected, or it may be a condition that the controller has evaluated as not safe to restart the boiler. In this case, the boiler control will be locked out, the red FAULT light will be lit, and the message "LOCKOUT" will be displayed on the readout in the lower line.
The boiler will not start until a qualified technician has repaired the boiler and pressed the RESET button for more than 1 second. If there

is an error message displayed on the readout, and the message "LOCKOUT" is not displayed and the FAULT light is not lit, then the message is the result of a temporary condition and will disappear when the problem corrects itself.

IMPORTANT NOTE: If you see error messages on your display readout, call a technician immediately, since the message may indicate a more serious problem will occur soon.

B. Boiler Error

The controller will display an error code and message when an error condition occurs. These error codes, descriptions, and recommended corrective actions are described in Section D.

C. Boiler Fault

1. The controller will illuminate the red "FAULT" indication light and display a fault code and message when a fault condition occurs. The alarm output will also activate. Most fault conditions cause the CH pump to run in an attempt to cool the boiler.
2. Note the displayed fault code and refer to Section D for an explanation of the message along with several suggestions for corrective actions.
3. Press **RESET** to clear the fault and resume operation. Be sure to observe the operation of the unit for a period of time to assure correct operation and no reoccurrence of fault message.

⚠ WARNING

If overheating occurs or the gas supply fails to shut off, do not turn off electrical power to the circulating pump. This may aggravate the problem and increase the likelihood of boiler damage. Instead, shut off the gas supply to the boiler at the gas service valve. Failure to do so may result in property damage, personal injury, or death.

⚠ WARNING

When servicing or replacing components that are in direct contact with boiler water, be certain that:

- There is no pressure in the boiler. (Pull the release on the relief valve. Do not depend on the pressure gauge reading.
- The boiler water is not hot.
- The electrical power is disconnected.
- The gas is shut off.

Failure to make these checks could result in substantial property damage, serious personal injury, or death.

DO NOT USE THIS APPLIANCE IF ANY PART HAS BEEN SUBMERGED IN WATER. Immediately call a qualified service technician. The appliance MUST BE replaced if it has been submerged. Attempting to operate an appliance that has been submerged could create numerous harmful conditions, such as a potential gas leakage causing a fire and/or explosion, or the release of mold, bacteria, or other harmful particulates into the air. Operating a previously submerged appliance could result in property damage, severe personal injury, or death.

NOTE: Appliance damage due to flood or submersion is considered an Act of God, and IS NOT covered under product warranty.

⚠ CAUTION

Label all wires prior to disconnecting them when servicing the boiler. Wiring errors can cause improper and dangerous operation. Failure to follow these instructions may result in property damage or personal injury.

NOTE: If system return temperatures are maintained below the dew point, condensation will form on the boiler cabinet and cause some components to rust.

D. User Interface Display

Cascade Control Fault Codes

Screen	Description	Possible Remedy
SYS SUPPLY SENSOR E03 PUMP OFF 12:56P	E03 indicates a problem with the system sensor circuit. The circuit could be open or shorted. Possible reasons for this error are: There is no system sensor connected to the Master Boiler. The system sensor is faulty. There is a short circuit in the system sensor wiring; possibly from a staple placed through the wire, or damage to the wire causing both conductors to touch. The system sensor wiring is open due to defect or damage.	Disconnect the system sensor from the wiring and measure it's resistance. Compare the measured resistance to the table in this manual to see if it corresponds to the temperature of the sensor. If the resistance does not agree with the sensor, replace the sensor. If the sensor is OK, disconnect the sensor wiring from both the boiler and the sensor and check continuity using an ohmmeter. Repair or replace as necessary. If this error is present, the boilers in the cascaded group will run and ignite simultaneously when there is a heat demand. Each boiler will modulate to maintain set point temperature on its own supply sensor. This code automatically resets when repair is complete. This code will not display if system setting function ERROR SYSTEM SENS is set to OFF.
FLUE TEMP ECO F01 PUMP ON 1:47P	This code indicates that the Flue ECO has tripped because the flue temperature has exceeded 190ºF. This switch has to be manually reset.	1. Push the reset button in the center of the switch body to reset the switch. 2. Monitor the actual surface temperature of the heat exchanger near the switch. If the switch trips again, proceed with the steps below. 3. Disconnect the flue ECO on the rear of the heat exchanger from the wiring and measure it's resistance. Resistance should be at or near zero (0) ohms. If there is infinite resistance (open circuit), replace the ECO. 4. If the ECO is OK, disconnect the switch wiring from both the boiler and the ECO and check continuity of the wiring using an ohmmeter. Repair or replace as necessary. NOTE: The common reasons for temperature switches to trip are a) low water flow through the boiler, b) poor heat transfer from water to the load, or c) flue blockage. 5. Push RESET on the boiler. If the boiler tries to ignite or ignites and only runs for a short time and the F01 code returns, investigate the flue for blockage.

Screen	Description	Possible Remedy
SUPPLY SENSOR F02 PUMP ON TIME	The dual supply sensor contains two sensing elements within a single body. F02 indicates that one or both halves of the supply temperature sensor has failed OR the difference between the dual sensor readings is greater than 18ºF. This is a serious safety issue and the boiler will not restart until the sensor is replaced by a technician and he pushes the RESET button on the display. This situation is indicated by the red light on the display and the flashing word LOCKOUT. During this lockout fault, the pump will be on as indicated on the second line of the display.	1. Check the electrical connections to each half of the thermistor on the outlet manifold. Verify 5 VDC by checking in Molex connector. If there is not 5 VDC, check the harness. If harness and sensors are OK, replace control. NOTE: The boiler will reset automatically. Verify thermistor resistance values of each half of the dual sensor by referencing chart in this manual. 2. Replace thermistor if necessary.
RETURN SENSOR F03 PUMP ON TIME	F03 indicates the return temperature sensor of the boiler has failed. The boiler will not restart until a technician replaces the sensor and pushes **RESET** on the display. This is a serious safety issue as indicated by the illuminated red light and the word LOCKOUT flashing on the display. During this lockout fault, the pump will be on.	1. Check circulator pump operation. 2. Ensure adequate flow through the boiler by accessing the status menu and determining there is less than a 50ºF rise from the return thermistor to the supply thermistor. 3. Troubleshoot thermistor by following the steps in F02.
FLUE SENSOR F04 PUMP ON TIME	F04 indicates that the flue temperature sensor of the boiler has failed. The boiler will not restart until a technician replaces the sensor and pushes **RESET** on the display. This is a serious safety issue as indicated by the illuminated red light and the word LOCKOUT flashing on the display. During this lockout fault, the pump will be on.	Inspect the flue sensor for physical damage or corrosion and replace it if necessary. Check the electrical connection to the flue sensor and repair as necessary. Measure the resistance of the sensor and refer to the sensor resistance table in this manual. The temperature on the chart should be close to the temperature in the flue. If not, replace the flue sensor.
SUPPLY HIGH F05 PUMP ON TIME	F05 indicates the boiler supply temperature is excessive. When accompanied by the red FAULT light and LOCKOUT flashing on the display, this code indicates the supply sensor temperature has exceeded 210ºF and a serious safety issue exists. The boiler will not restart until a technician determines and repairs the cause of excessive temperature and pushes **RESET** on the display. If the FAULT light is not illuminated and this message is displayed, the supply temperature of the boiler is at or above 199ºF. The message will clear automatically when the temperature drops below 194ºF. During the time that this fault is displayed, the pump will be on.	1. Check circulator pump operation. 2. Ensure adequate flow through the boiler by accessing the status menu and determining there is less than a 50°F rise from the return thermistor to the supply thermistor. 3. Check the direction of flow off the boiler circulator. (See Piping Details in this manual.) 4. Troubleshoot the dual supply thermistor by following steps in F02.

RETURN TEMP HIGH F06 PUMP ON TIME	This display indicates that the boiler return temperature is excessive. When accompanied by the red FAULT light and LOCKOUT flashing on the display, this code indicates that the return sensor temperature has exceeded 210ºF and a serious safety issue exists. The boiler will not restart until a technician determines and repairs the cause of excessive temperature and pushes **RESET** on the display. If the red FAULT light is not illuminated and this message is displayed, then the return temperature of the boiler is at or above 199ºF. The message will clear automatically when the temperature drops below 194ºF. During the time that this message or lockout fault is displayed, the pump will be on.	1. Check circulator pump operation. 2. Ensure adequate flow through the boiler by accessing the status menu and determining there is less than a 50°F rise from the return thermistor to the supply thermistor. 3. Check the direction of flow on boiler circulator. (See Piping Details in this manual.) 4. Troubleshoot thermistor by following steps in F02.
Screen	**Description**	**Possible Remedy**
NO FLAME ON IGN F09 PUMP ON TIME	The boiler tried to ignite four times during one heat call and failed. This is a serious safety issue as indicated by the illuminated red light and the word LOCKOUT flashing on the display. The boiler will not restart until a technician determines and repairs the cause of ignition failure and pushes **RESET** on the display. During this lockout fault, the pump will remain on.	1. Watch the igniter through the observation window. 2. If there is no spark, check the spark electrode for the proper 1/4" gap between the burner. 3. Remove any corrosion from the spark electrode. 4. If there is a spark but no flame, check the gas supply to the boiler. 5. If there is a flame, check the flame current. 6. Check any flue blockage or condensate blocks. 7. Replace the ignitor.
FLAME LOSS F10 PUMP ON TIME	The flame was lost 3 times while the boiler was firing during 1 demand call. This is a serious safety issue as indicated by the illuminated red light and the word LOCKOUT flashing on the display. The boiler will not restart until a technician determines and repairs the cause of flame loss and pushes **RESET** on the display. During this lockout fault, the pump will be on.	1. Monitor gas pressure to the unit while in operation. 2. Assure the flame is stable when lit. 3. Check if the display readout changes from "GAS VALVE ON" to "RUN" within a few seconds of boiler ignition. 4. Check the FLAME signal on the display. It should be above 2.5uA when the boiler is firing. 5. If the signal reads less than 2.5uA, clean the spark probe. 6. If the problem persists and the 'FLAME" signal is still less than 2.5uA, replace the spark igniter probe. 7. The flame signal should be steady after the boiler has been firing for 1 minute and is normally at 5.0 to 9.0. If the flame signal is not steady, disassemble the burner door and check the burner and its sealing gaskets.
FALSE FLAME SIG F11 PUMP ON TIME	There is flame when the control is not telling the boiler to run. This is a serious safety issue as indicated by the illuminated red light and the word LOCKOUT flashing on the display.The boiler will not restart until a technician determines and repairs the cause and pushes **RESET** on the display. During this lockout fault, the pump will be on.	1. Look into window. If there is flame, turn the gas off to the unit at the service valve and replace the gas valve. 2. If the flame signal on the status menu is greater than 2.5uA when the burner is not lit, replace the spark ignitor. 3. If the flame signal is not present after turning off the gas supply, check the gas valve electrical connection. 4. Check for condensate backup. Repair condensate system as necessary. If condensate has partially filled the combustion chamber, the refractory wall may be damaged and should be replaced. 5. Turn the gas on at the service valve after corrective action is taken. 6. If the refractory wall falls against the spark ignitor, it may conduct the signal to ground, giving a false reading.

FAN SPEED ERROR F13 PUMP ON TIME	The fan is not running at the speed determined by the control. Fan speed has been more than 30% faster or slower than the commanded speed for more than 10 seconds. This is a serious safety issue as indicated by the illuminated red light and the word LOCKOUT flashing on the display .This boiler will not restart until a technician determines and repairs the cause and pushes **RESET** on the display. During this lockout fault, the pump will be on.	1. Check the combustion fan wiring. 2. Measure DC voltage from the red fan wire to ground while it is connected to the fan. It should be between 24 and 40 volts. If it is lower than 24 volts, check for excessive external loads connected to the boiler sensor terminals 3. Disconnect the 5 pin plug from the fan and check the voltage on the red wire again. If it is now between 24-40 volts, replace the fan. If it is still below 24 volts replace the boiler control board.
CONDENSATE FULL F20 PUMP OFF TIME	The condensate trap is full. This is a serious safety issue as indicated by the illuminated red light and the word LOCKOUT flashing on the display. The boiler will not restart until a technician determines and repairs the cause and pushes **RESET** on the display. During this lockout fault, the pump will be off.	1. Check condensate lines for obstructions. 2. Check float switch in condensate reservoir. 3. Check wiring from condensate reservoir to 928 control and repair as necessary.
Screen	**Description**	**Possible Remedy**
LWCO FAULT F21 PUMP OFF TIME	Water level in the boiler is low. To test LWCO function, press and hold v and RESET simultaneously for five (5) seconds. Press RESET to clear the error code.* *This procedure applicable to models with 928 control firmware ARBA-P 170426 or later or ASAA-P 170412 or later ONLY. NOTE: The date code is in YYMMDD format.	1. Check boiler feed water system to be sure it is supplying make-up water to the boiler system. 2. Ensure all air is bled from the system. 3. Check for leaks in the boiler and system piping and repair as necessary. 4. Inspect low water cutoff probe and wiring for damage and repair and replace as necessary.
EXTERNAL LWCO F22 PUMP ON TIME	This error is generated when the External Low Water Cutoff is installed and the water level in the boiler is low. When this code is displayed, the boiler will not respond to a demand for heat. The bottom line of the display indicates the status of the pump. The pump will remain on when this error is displayed.	IF EXT LWCO is installed: 1. Check boiler feed water system. Ensure it is supplying make-up water to the boiler system. 2. Be sure all air is bled from the system. 3. Check for leaks in the boiler and system piping and repair as necessary. 4. Inspect low water cutoff wiring for damage and repair as necessary. 5. Ensure EXT LWCO has power applied to the power input terminals. 6. Press Reset button on LWCO. If error reoccurs, replace EXT LWCO. IF EXT LWCO is NOT installed: Inspect the jumper from terminals 20 and 21 on the Field Connection Board for damage or loose connections.
GAS PRESSURE F26 PUMP ON TIME	The following switches are optional equipment that may be installed on boiler. These devices have indicator lights that illuminate if tripped. High gas pressure switch – Trips if there is excessive gas pressure on the outlet side of the gas valve and must be manually reset. Low gas pressure switch – Trips if there is low gas pressure on the inlet side of the gas valve and must be manually reset.	1. If an indicator light is illuminated, investigate the source of the error for that particular switch. 2. With boiler in service mode, measure the gas pressure in the supply line with a gas pressure meter. Monitor the gas pressure during both low and high fire conditions for correct pressure range. 3. If there are no optional switches or none of the indicator lights is illuminated on the optional switches, use an ohmmeter to test each of the switches one at a time. Turn the power off to the boiler and disconnect the switch to be tested from the boiler to determine which has tripped. When you find the tripped switch investigate the cause of the fault based on the purpose of the switch.

BURNER TEMP ERR F28 PUMP ON TIME	The boiler has generated a "BURNER TEMP BLOCK E28" more than five times in ten minutes during a single demand. When this code is displayed, the boiler will not respond to a demand for heat. The bottom line indicates the status of the pump. The pump will remain on when this error is displayed.	1. Check sensor by turning off the gas and allowing the unit to go through pre-purge and post purge cycles. While air is flowing through the burner check the burner sensor value on the display. This value should similar to the current intake air temperature. If this value is much different than the current intake air, check sensor resistance and wiring. If resistance values are out of range replace sensor. 2. If sensor is ok, check combustion, often a rich combustion setting elevates burner temperatures. Ensure there are no blockages on either the intake or the exhaust. Confirm the combustion is set to proper CO2 numbers, especially on low fire. After adjusting combustion, re-start the boiler and observe the burner temperature on the display. This should be done both on high and low fire.
BURNER SENSORERR F30 PUMP ON TIME	1. Burner Sensor has exceeded 330°F or is shorted. 2. Burner Sensor temperature is less than -31°F, or is open.	Inspect the burner sensor for physical damage or corrosion and replace it if necessary. Check the electrical connection to the burner sensor and repair as necessary. Measure the resistance of the sensor and refer to the sensor chart in this manual. The temperature on the chart should be close to the same as the temperature in the burner. If not, replace the burner sensor.
PROGRAM ERROR F31 PUMP OFF	There was an error while programming the control and the memory is corrupt. The boiler control will not function in this state and the pump will be off as indicated on the bottom line. This error only occurs if a technician is programming the control and the programming function fails. The only way to recover from this error is to reprogram the control. If this error occurs at any time other than when a technician is servicing the boiler, the control has failed and must be replaced by a qualified technician.	The control must be reprogrammed. If programming does not solve the problem, the control must be replaced.
HARD FAULT COND F41	This error indicates there is an internal fault in the circuit within the control connected to the condensate switch.	1. Inspect the ground wires for damage or loose connections. 2. Inspect the condensate wiring for damage and repair as necessary. 3. Ensure no high voltage wires are routed in parallel with the condensate low voltage wiring. 4. Replace control.
HARD FAULT LWCO F42	This error indicates there is an internal fault in the LWCO circuit.	1. Inspect the ground wires for damage or loose connections. 2. Inspect the LWCO wiring for damage and repair as necessary. 3. Ensure no high voltage wires are routed in parallel with the LWCO low voltage wiring. 4. Replace control.
AD SAFT FAULT F43	The temperature of either the burner, flue, or supply sensors has risen nine degrees in 100 milliseconds and not returned to normal within 1 second.	Ensure the connections to the burner, flue, and supply sensors are intact. If wires are intact, check sensor resistance. If the problem persists or the sensors are out of normal resistance range, replace the sensors.
CONTROL PROGRAMED PP	The control has been programmed by a technician or the factory. After programming, the control is left in a locked out mode.	Press **RESET** for at least 1 second to use the control.
OUTDOOR SENSOR FOU PUMP ON 1:45P	There is an issue with the outdoor sensor. It is shorted, damaged, or disconnected from the boiler.	1. Check outdoor sensor connections and wiring. Ensure the sensor and wiring are intact and that the sensor is connected to the boiler. 2. Check the outdoor sensor resistance with an ohmmeter. See table in this manual for correct outdoor sensor resistance. 3. Replace the outdoor sensor.

The following blocking codes will block operation until the control determines the situation safe for boiler operation.		
LOW WATER FLOW FL PUMP OFF 4:32P	This indicates the flow switch is not activated.	1. Ensure boiler contains water and all valves are open. 2. Check the boiler circulator and ensure it is in good operating condition (operating, wiring intact, etc.). 3. Inspect the wiring to the flow switch for damage and repair as necessary. 4. Disconnect one wire from the flow switch and test for continuity across the switch while flow is confirmed to be present. 5. Remove flow switch and inspect switch paddle for proper operation.
FLUE TEMP HIGH E07 PUMP ON TIME	This display indicates that the flue sensor temperature is above 210ºF. When this code is displayed, the boiler will not respond to a demand for heat. When the flue temperature decreases below 194ºF, the display will return to normal and allow the boiler to respond to a heat demand. The bottom line indicates the status of the pump. The pump will remain on when this error is displayed.	Check the flue for obstructions or any sign of damage, especially signs of excessive heat. Repair as necessary. Run the boiler and check the flue temperature with an external thermometer. If the flue temperature on the thermometer does not agree with the flue temperature displayed in the status menu, inspect the wiring to the flue temperature sensor in the boiler and repair as necessary. If the wiring is intact, replace the flue sensor. If the flue temperature is excessive on the status menu and the test thermometer reads the same, check and adjust combustion controls on the boiler.
TEMPER BLOCKING TT PUMP ON	TT indicates there is a demand for heat on the boiler, the pump is powered on, and the supply sensor temperature is too high for the boiler to ignite. This occurs because the water temperature measured by the supply sensor is higher than the tank temperature – ignition diff setting.	This message will stay present until the water temperature measured by the supply sensor is less than the tank temperature – ignition diff setting.
TEMPER BLOCKING PUMP ON	This screen indicates a demand for heat from the DHW circuit. The pump is powered on and the supply sensor temperature is too high for the boiler to ignite. This occurs because the water temperature measured by the supply sensor is higher than the tank temperature – ignition diff setting. **NOTE:** If there is a CH demand while this screen is displayed, the screen may read: TEMPER BLOCKING PRIO	This message will stay present until the water temperature measured by the supply sensor is less than the BOILER SUPPLY – boiler supply differential (5ºF) or DHW SETPOINT is satisfied and no longer calls for heat.
HIGH FLUE PRESS FLU PUMP ON	FLU indicates excessive flue pressure. This code resets automatically after the high pressure condition is resolved. The second line indicates pump status.	1. Assure the flue is not blocked. 2. Check the switch wiring by applying a jumper in place of the switch. If the code clears with the jumper in place, REPLACE the flue switch and connect the wires to the new switch BEFORE running boiler.
WARNING: Do not use jumper to remedy an FLU error. Faulty switch MUST be replaced. Failure to follow this instruction could result in serious personal injury or death.		
FLUE TEMP HIGH E07 PUMP OFF TIME	E07 indicates the flue sensor temperature is excessive and above 210ºF. When E07 is displayed the boiler will not respond to a demand for heat and begin to modulate down on vent temp rather than supply temp. During reduced modulation, the display will show VENT RED MODULATION, and the second line will alternate between PUMP ON TIME and the actual vent temperature. When the flue temperature decreases below 194ºF, the display will return to normal and allow the boiler to respond to a heat demand.	1. Check the flue for obstructions and any sign of damage, especially signs of excessive heat. Repair as necessary. 2. Run the boiler and check the flue temperature with an external thermometer. If the flue temperature on the thermometer does not agree with the flue temperature displayed in the status menu, inspect the wiring to the flue temperature sensor in the boiler and repair as necessary. If the wiring is intact replace the flue sensor. 3. If the flue temperature is excessive on the status menu and the test thermometer reads the same, check and adjust combustion controls on the boiler.

LINE VOLTAGE E19 PUMP OFF	E19 indicates the line voltage frequency is out of range. This could happen if the boiler is being powered from a small gasoline powered generator that is overloaded or not functioning correctly.	Inspect power wiring to the boiler and repair as necessary. If connected to line voltage, notify the power company. If connected to an alternate power source such as a generator or inverter, make sure the line voltage frequency supplied by the device is 47 - 62.5 Hz.
BURNERTEMPBLOCK E28 PUMP ON TIME	This error indicates the burner sensor has exceeded 199°F. The burner will re-fire once the burner temperature drops below 181°F. If this occurs more than five times in ten minutes during a single heat demand, an F28 lockout code is generated.	1. Check sensor by turning off the gas and allowing the unit to go through pre-purge and post purge cycles. While air is flowing through the burner check the burner sensor value on the display. This value should similar to the current intake air temperature. If this value is much different than the current intake air, check sensor resistance and wiring. If resistance values are out of range replace sensor. 2. If sensor is ok, check combustion, often a rich combustion setting elevates burner temperatures. Ensure there are no blockages on either the intake or the exhaust. Confirm the combustion is set to proper CO2 numbers, especially on low fire. After adjusting combustion, re-start the boiler and observe the burner temperature on the display. This should be done both on high and low fire.

Table 27 - Boiler Error and Fault Codes

Outdoor Sensor (7250P-319)		Supply Temperature Sensor (7250P-324)	Indirect Sensor (7350P-325)	Boiler Sensor (7700P-073)	Flue Temperature Sensor (6300P-023)	Burner Temperature Sensor (6300P-036)
Temperature (°F)	**Resistance (ohms)**	**Temperature (°F)**	**Resistance (ohms)**			
-22	171800	32	32624			
-13	129800	41	25381			
-4	98930	50	19897			
5	76020	59	15711			
14	58880	68	12493			
23	45950	77	10000			
32	36130	86	8056			
41	28600	95	6530			
50	22800	104	5324			
59	18300	113	4365			
68	14770	122	3599			
77	12000	131	2982			
86	9804	140	2483			
95	8054	149	2079			
104	6652	158	1748			
113	5522	167	1476			
		176	1252			
		185	1066			
		194	912			
		203	782			
		212	674			

Table 28 - Sensor Temperature Resistance

Part 12 - Maintenance

A. Procedures

Periodic maintenance should be performed once a year by a qualified service technician to assure that all the equipment is operating safely and efficiently. The owner should make necessary arrangements with a qualified heating contractor for periodic maintenance of the boiler. The installer must also inform the owner that a lack of proper care and maintenance of the boiler may result in a hazardous condition.

⚠ WARNING

BEFORE EACH HEATING SEASON a trained and qualified service technician should perform the inspections as per the boiler inspection and maintenance schedule in this manual. Failure to do so could result in death or serious injury.

The 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 (Group 1)."

- Avoid breathing dust and contact with skin and eyes.
- Use a 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 job site conditions. Current NIOSH recommendations can be found on the NIOSH website: http://www.cdc.gov/niosh/homepage.html. 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.

Do not use solvents to clean any of the burner components. The components could be damaged, resulting in unreliable or unsafe boiler operation, substantial property damage, severe personal injury, or death.

B. Closing the Combustion Chamber Door

The boiler door can be opened to aid in mounting the burner and other combustion components, and to clean the combustion chamber. It should be closed with the proper torque before starting the boiler.

NOTE: Whenever opening or closing the combustion chamber door, (ensure you have personal protective equipment (PPE) in place. Wear an N95 certified dust respirator, eye protection, and gloves.

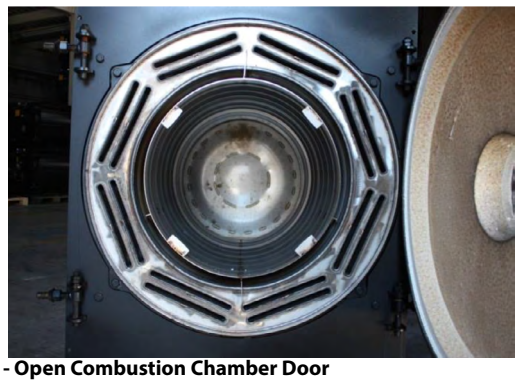


Figure 30 - Open Combustion Chamber Door

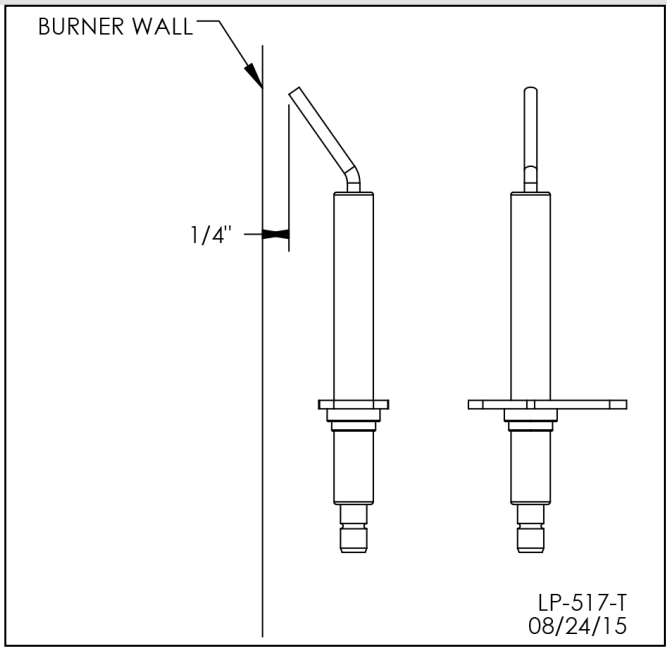


Figure 34 - Igniter Detail

Figure 31 - Combustion Chamber Door Hinge

The recommended torque for closing the door should be between 14 and 22 ft/lb. Use an appropriate torque wrench to control that value. Otherwise use the standard door handle (whose length is 220 mm) with a force between 66 and 100 ft/lb.

Tighten the hinges in a pattern (top left, bottom right, top right, bottom left) to ensure a proper seal.

Figure 32 - Setting the Torque Wrench

Figure 33 - Closing the Combustion Chamber Door

After the boiler has operated for 12 - 16 hours, the door will have to be closed again to accommodate any burn-off of the organic starch sealing rope. Retightening the door after 12 - 16 hours will ensure a proper seal.

NOTE: During initial start-up, the sealing rope may burn off. During this period a burning smell may come from the boiler. This is normal and will pass when the sealing rope has completed burning off.

⚠ WARNING

It is important to ensure that the combustion chamber door is properly sealed and installed. Failure to do so could result in a flue gas leak, property damage, severe personal injury, or death.

C. Replacing the Door Seal

NOTE: BEFORE replacing the door seal, ensure the door is completely and properly shut as described in this manual. An improperly closed door could lead to exhaust leaks.

1. Make sure power is turned off to the boiler.
2. Turn off and remove any piping and electrical connections connected to the combustion system cabinet (gas pipe line, intake pipe, etc.) that could hinder opening the boiler door.
3. Before opening the door, ensure you have personal protective equipment (PPE) in place. Wear an N95 certified dust respirator, eye protection, and gloves. Spray down the perimeter of the door to avoid the formation of dust during the procedure.

Figure 35 - Personal Protective Equipment (PPE)

4. Use the handle to open the door. Open the door slowly to avoid spreading of dust.

Figure 36 - Opening / Closing the Combustion Chamber Door

5. Gently remove the used seal. Take care not to damage the door's ceramic insulation.
6. Carefully wash out the seal pit and rebead with new high temperature silicon (rated to at least 300ºC).

Figure 37 - Removing the Combustion Chamber Door Seal

7. Replace the old seal with a new seal identical to the removed one. The seal must be a little bit longer than the door diameter in order to let the terminal sides remain compressed and ensure a tight seal. Ensure the ends of the seal are covered with scotch tape to prevent any fraying.
8. Place the new seal on the fresh silicon bead starting at the 5 o' clock position and insert it into the seal pit following the door circumference.

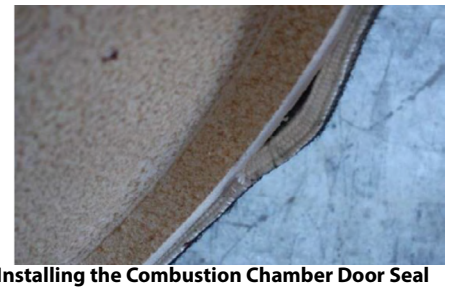


Figure 38 - Installing the Combustion Chamber Door Seal

Figure 39 - Meeting the Taped Ends of the Seal

9. Close the door. Verify that the boiler plate presses exactly in the middle of the seal. It may be necessary to readjust the door joints due to the new seal's plasticity.

Figure 40 - Combustion Chamber Door With Installed Seal

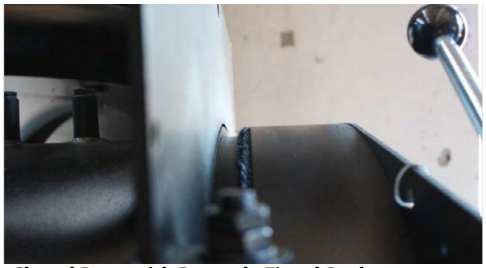


Figure 41 - Closed Door with Properly Fitted Seal

D. Maintaining the Condensate System

1. Ensure the boiler is powered off and has had time to cool.
2. Remove the hose clamp attaching the condensate trap to the condensate hose from the heat exchanger. Remove the clear plastic hose from the hose barb. Remove the condensate hose clamp to detach the condensate trap from the drain tube. Remove the condensate trap from the boiler.
3. Remove the bottom cap from the condensate trap.
4. Flush trap with fresh water to remove debris from the trap.

NOTE: Ensure the float moves freely within the trap. If the float does not move, DO NOT reinstall the trap.

5. When the condensate trap is sufficiently clean, reinstall the bottom cap on the trap.

NOTE: Ensure all parts shown in Figure 29, Condensate Detail, are installed with the condensate trap. If any parts are missing, DO NOT reinstall the trap. Replace the entire assembly.

⚠ DANGER

The condensate trap assembly MUST BE PROPERLY INSTALLED according to these instructions when operating the boiler. Operating the boiler without the condensate trap assembly will cause flue gases to leak and result in serious personal injury or death.

When servicing is complete, make sure the condensate collector cap is replaced securely. Failure to do so will cause venting issues that will result in serious injury or death.

⚠ WARNING

Do not install the condensate assembly if a component is lost or missing. Replace the entire assembly. Failure to follow this warning could result in property damage, serious personal injury, or death.

6. Fill the condensate trap with fresh water prior to reassembly on the boiler.
7. Install the condensate trap on the condensate hose from the heat exchanger. Use the hose clamp to secure the trap. Attach the clear plastic hose onto the hose barb. Reinstall the condensate hose clamp to detach the condensate trap from the drain tube.
8. If a condensate neutralizer kit is installed with the boiler, check the assembly when cleaning the condensate trap, and replenish the limestone chips if necessary. When replacing limestone chips, take care to ensure chips are no smaller than ½" to avoid blockage in condensate piping (for piping details, refer to condensate neutralizer installation instruction.)
9. Check condensate piping for sagging and/or leakage. Repair any sags or leaks before restoring power to the boiler.

⚠ WARNING

Do not operate the boiler without the clear hose attached from the hose barb to the pressure switch. Failure to follow this warning could result in property damage, serious personal injury, or death.

CAUTION

It is very important that the condensate piping be no smaller than ¾". To prevent sagging and maintain pitch, condensate piping should be supported with pipe supports, and pitched ¼" per foot to allow for proper drainage. Failure to maintain proper pipe size and pitch could result in condensate leakage and potential water damage to property.

The condensate line must remain unobstructed, allowing free flow of condensate. If condensate freezes in the line, or if line is obstructed in any other manner, condensate can exit from the tee, resulting in potential water damage to property.

10. If the boiler has a condensate pump, ensure the pump operates properly before considering maintenance complete.

Part 13 - Shutdown

A. Shutdown Procedure

If the burner is not operating, disconnect the electrical supply.
If the burner is operating, lower the set point value to 70°F and wait for the burner to shut off. Continue to wait for the combustion blower to stop, so all latent combustion gases are purged from the system. This should take a maximum of 40 to 90 seconds.

B. Vacation Procedure

If there is danger of freezing, change the set point to 70°F. DO NOT turn off electrical power. If there is no danger of freezing, follow "Shutdown Procedure".

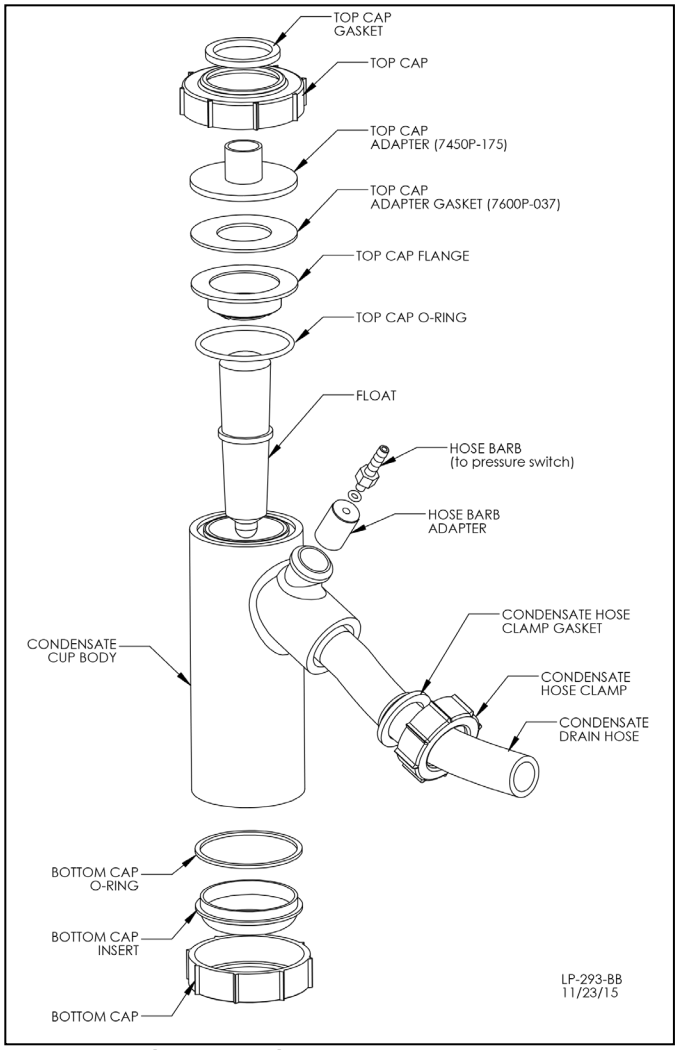
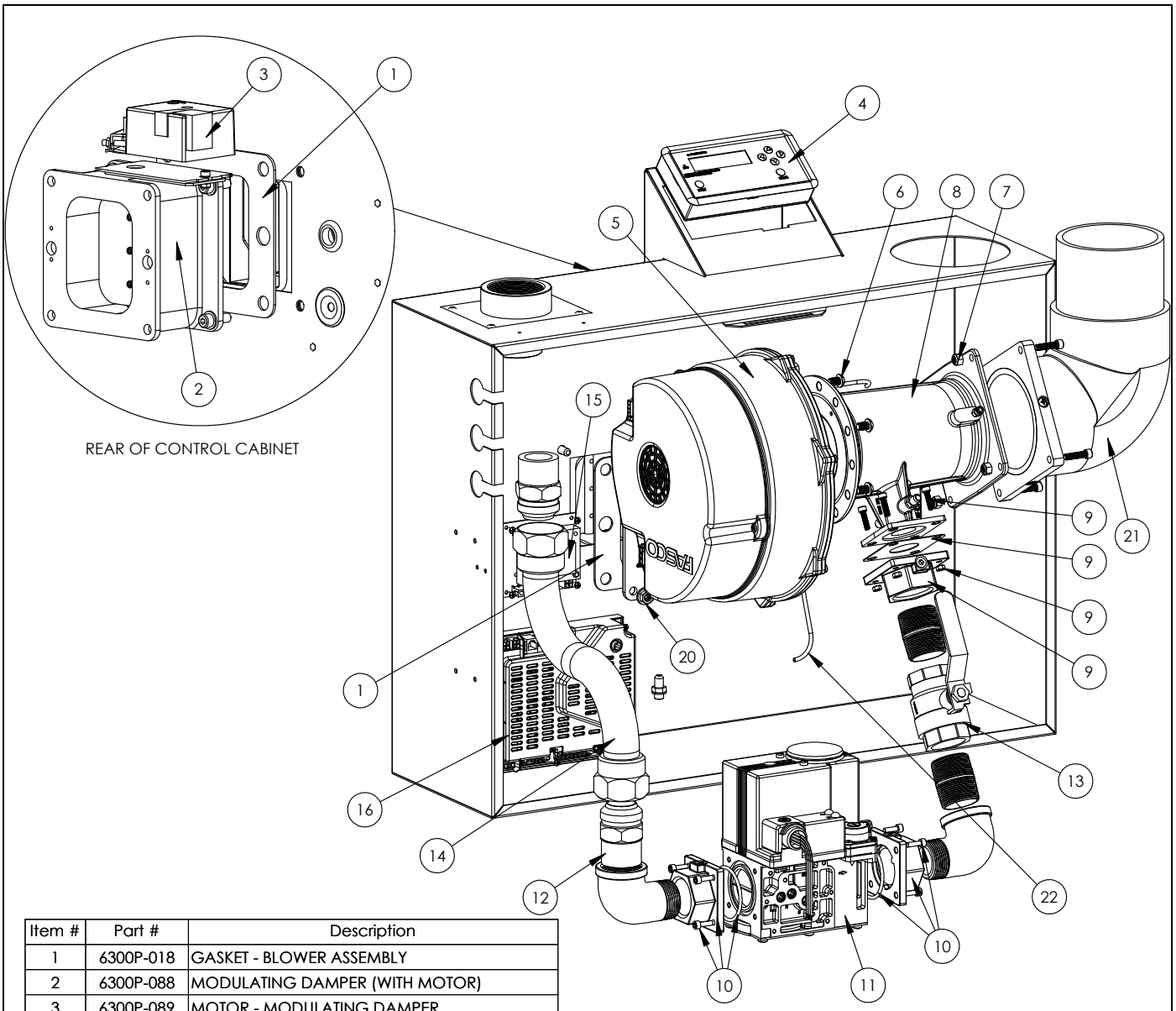


Figure 42 - Condensate Detail

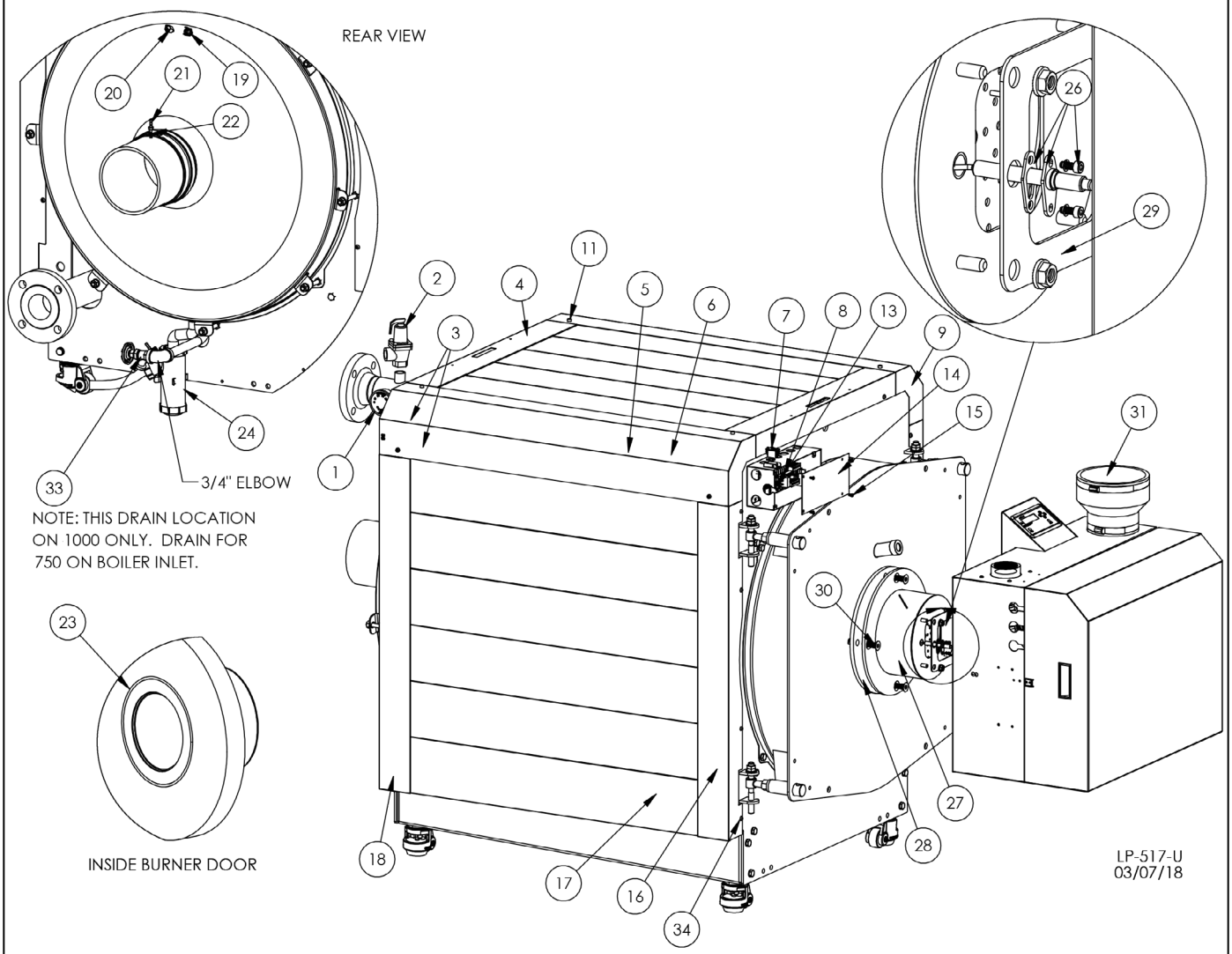
C. Failure to Operate

Should the burner fail to light, the control will perform two more ignition trials prior to entering a lockout state. Note that each subsequent ignition trial will not occur immediately. After a failed ignition trial, the blower must run for approximately 10 seconds to purge the system. Therefore, a time period of approximately 40 to 90 seconds will expire between each ignition trial.
If the burner lights during any one of these three ignition trails, normal operation will resume. If the burner lights, but goes off in about 4 seconds, check the polarity of the wiring. See electrical connection section.
If the burner does not light after the third ignition trial, the control will enter a lockout state. This lockout state indicates that a problem exists with the boiler, the controls, or the gas supply. Under such circumstances, a qualified service technician should be contacted immediately to properly service the boiler and correct the problem. If a technician is not available, depressing and holding the **RESET** button for more than 1 second will remove the lockout state so additional trials for ignition can be performed. The unit will try to re-light once every 6 minutes.



Item #	Part #	Description
1	6300P-018	GASKET - BLOWER ASSEMBLY
2	6300P-088	MODULATING DAMPER (WITH MOTOR)
3	6300P-089	MOTOR - MODULATING DAMPER
4	7100P-266	TEXT DISPLAY ASSEMBLY
5	6300P-030	BLOWER
6	N/A	SCREWS - AIR/GAS MIXER (M8 X 15MM)
7	6300P-075	NUTS - AIR SHUTTER (1/4-20)
8	6300P-008	AIR/GAS MIXER
9	6300P-996	VALVE FLANGE (w/GASKET, SCREWS & NUTS)
10	6300P-015	VALVE FLANGE (w/SCREWS, O-RING)
11	6300P-009	GAS VALVE
12	6300P-071	ADAPTER FITTING
13	6300P-017	BALL VALVE
14	6300P-020	FLEXIBLE TUBE
15	7250P-580	RELAY BOARD
16	7450P-322	CONTROL BOARD
17	6300P-995	LOW VOLTAGE WIRE HARNESS (NOT SHOWN)
18	6300P-994	HIGH VOLTAGE WIRE HARNESS (NOT SHOWN)
19	6300P-993	BLOWER WIRE HARNESS (NOT SHOWN)
20	N/A	M8 X 1.25 LOCK NUT
21	6300P-989	INTAKE ASSEMBLY
22	6300P-033	GAS VALVE SIGNAL TUBE w/FITTINGS

Figure 43 - Combustion System Replacement Parts

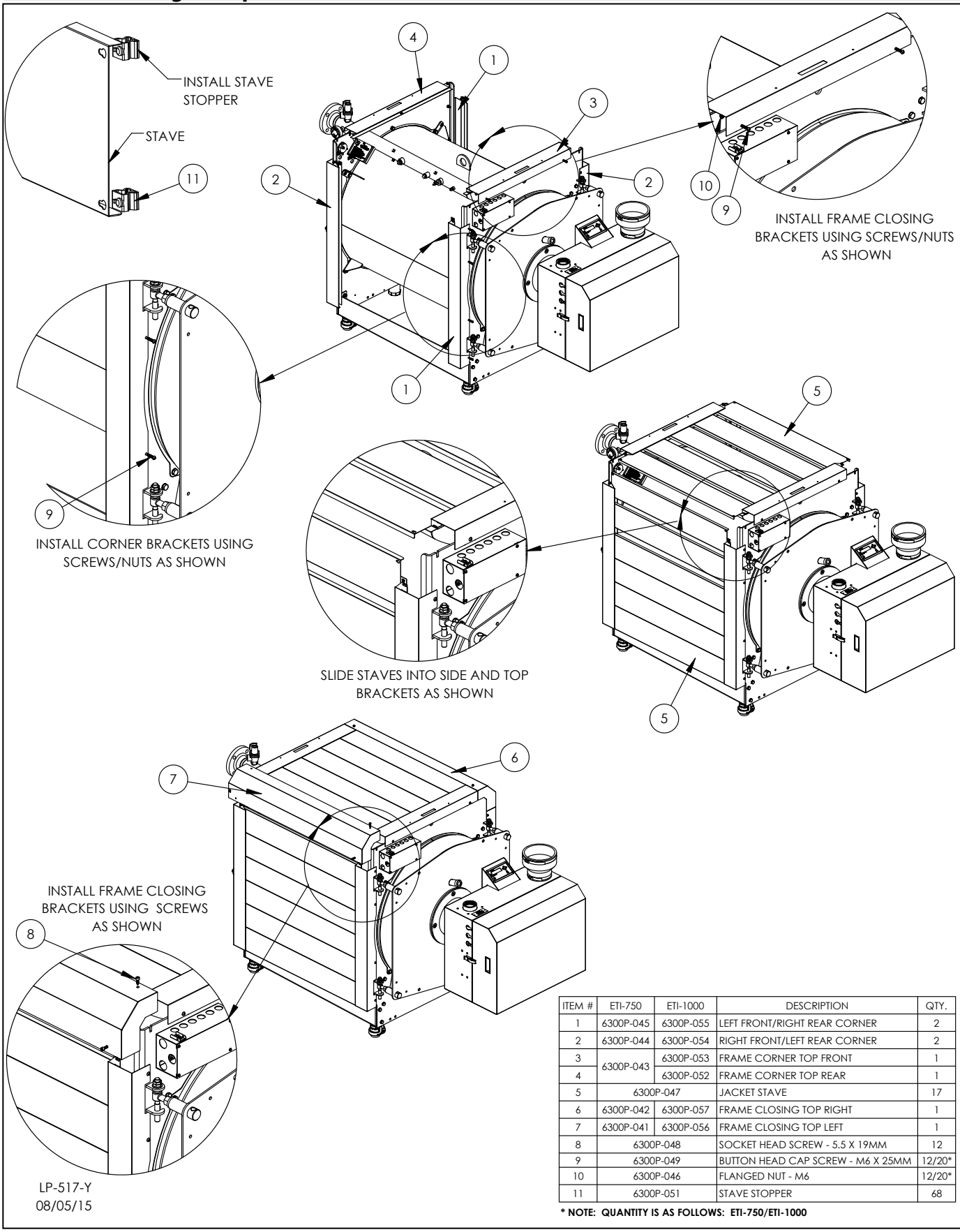


ITEM#	750	1000	DESCRIPTION
1	7250P-499		TEMP/PRESSURE GAUGE
2	7350P-223		T&P RELIEF VALVE
3	7250P-150		PRESSURE SWITCH
4	6300P-043	6300P-053	FRAME CORNER TOP FRONT
	6300P-043	6300P-052	FRAME CORNER TOP REAR
5	7350P-089		LOW WATER CUT-OUT
6	7700P-073		TEMPERATURE SENSOR
7	7500P-087		POWER SWITCH
8	7350P-370		CUSTOMER CONNECTION BOARD
9	6300P-042	6300P-057	FRAME CLOSING - TOP RIGHT
10	6300P-041	6300P-056	FRAME CLOSING - TOP LEFT (NOT SHOWN)
11	6300P-048		SCREW - 5.5MM X 19MM - TOP RIGHT, LEFT
12	6300P-992		POWER SWITCH WIRE HARNESS (NOT SHOWN)
13	6300P-037		FUSES - 2.0 AMP
14	6300P-062		COVER - CUSTOMER CONNECTION BOX
15	7500P-047		SCREW - CUSTOMER CONNECTION BOX
16	6300P-045	6300P-055	FRAME CORNER - LEFT FRONT & RIGHT REAR
17	6300P-047		JACKET STAVE
18	6300P-044	6300P-054	FRAME CORNER - RIGHT FRONT & LEFT REAR

ITEM#	750	1000	DESCRIPTION
19	7500P-002		FLUE ECO
20	6300P-023		VENT TEMPERATURE SENSOR
21	7250P-154		HOSE BARB
22	7250P-152		O-RING - HOSE BARB
23	7450P-280		TEMPERATURE SENSOR (NOT SHOWN) INSIDE UNIT
24	7450P-094		CONDENSATE KIT
25	6300P-999		PLASTIC TUBING - PRESSURE SWITCHES (NOT SHOWN)
26	6300P-004		SPARK ELECTRODE (W/GASKET, SCREWS, WASHERS)
27	6300P-005		BURNER (W/REFRACTORY) - ETI-750
	6300P-006		BURNER (W/REFRACTORY) - ETI-1000
28	6300P-003		REFRACTORY - BURNER DOOR
29	6300P-018		GASKET - BLOWER ASSEMBLY
30	6300P-007		SCREWS - BURNER ASSEMBLY (M12 X 25MM)
31	6300P-016		COUPLING - AIR INLET
32	6300P-036		BURNER SENSOR (NOT SHOWN)
33	7350P-277		BOILER DRAIN
34	6300P-049		SCREWS - 6MM X 25MM FRONT/REAR SIDE AND TOP
35	6300P-046		FLANGED NUT M6 - FRONT/REAR SIDE AND TOP (NOT SHOWN)
36	6300P-051		STAVE STOPPER (NOT SHOWN)
37	6100P-043		ROPE GASKET

Figure 44 - Exterior Replacement Parts

Part 14 - Installing the Optional Jacket



ITEM #	ETI-750	ETI-1000	DESCRIPTION	QTY.
1	6300P-045	6300P-055	LEFT FRONT/RIGHT REAR CORNER	2
2	6300P-044	6300P-054	RIGHT FRONT/LEFT REAR CORNER	2
3	6300P-043	6300P-053	FRAME CORNER TOP FRONT	1
4		6300P-052	FRAME CORNER TOP REAR	1
5	6300P-047		JACKET STAVE	17
6	6300P-042	6300P-057	FRAME CLOSING TOP RIGHT	1
7	6300P-041	6300P-056	FRAME CLOSING TOP LEFT	1
8	6300P-048		SOCKET HEAD SCREW - 5.5 X 19MM	12
9	6300P-049		BUTTON HEAD CAP SCREW - M6 X 25MM	12/20*
10	6300P-046		FLANGED NUT - M6	12/20*
11	6300P-051		STAVE STOPPER	68

*** NOTE: QUANTITY IS AS FOLLOWS: ETI-750/ETI-1000**

Table 29 - Optional Jacket Replacement Parts

Part 15 - Installation Checklist

Light Off Activities		Date Completed:	
1. Fill the Heating System	Check all piping and gas connections. Verify all are tight.		
	Pressurize system (12 - 15 psi).	PSI	
	Add water to prime condensate cup.		
	Verify near boiler piping is properly supported.		
	Percentage of glycol in system (0 - 50%)		
2. Check Gas Pipe	Leak test using locally approved methods (consult jurisdictional code book).		
	Check incoming gas pressure (3.5 to 14" WC).	Static WC	
	Check the "drop" on light off (less than 1" WC).	Dynamic WC	
3. Check Combustion	Check and adjust (if necessary) carbon dioxide content.	%CO2 High Fire	%CO2 Low Fire
	Check and adjust (if necessary) carbon monoxide content.	ppm CO High Fire	ppm CO Low Fire
4. Check Electrical Connections	Ensure all electrical connections of line voltage (pumps, etc.) and low voltage circuits (system sensor, outdoor sensor, etc.) are properly wired.		
5. Verify System Operation	Turn up thermostat to verify wiring connections.		
6. Record Ionization Current	Check uA reading in the status menu (see Start-Up section, this manual).	uA High Fire	uA Low Fire
7. System Setting	Verify system settings.	CH Setpoint	CH Differential
8. Indirect Water Heater	Verify safety and operation of the indirect water heater. Record settings.	DHW Setpoint	DHW Differential
Notes:			

Table 30 - Installation Checklist

Part 16 - Maintenance Report

CAUTION

In unusually dirty or dusty conditions, care must be taken to keep boiler cabinet door in place at all times. Failure to do so VOIDS the warranty.

⚠ WARNING

Allowing the boiler to operate with a dirty combustion chamber will hurt operation. Failure to clean the heat exchanger as needed by the installation location could result in boiler failure, property damage, personal injury, or death. Such product failures ARE NOT covered under warranty.

The boiler requires minimal periodic maintenance under normal conditions. However, in unusually dirty or dusty conditions, periodic vacuuming of the cover to maintain visibility of the display and indicators is recommended.

Periodic maintenance should be performed once a year by a qualified service technician to assure that all the equipment is operating safely and efficiently. The owner should make necessary arrangements with a qualified heating contractor for periodic maintenance of the boiler. Installer must also inform the owner that the lack of proper care and maintenance of the boiler may result in a hazardous condition.

Inspection Activities		Date Last Completed			
Piping		**1st Year**	**2nd Year**	**3rd Year**	**4th Year***
Near boiler piping	Check boiler and system piping for any sign of leakage; make sure pipes are properly supported.				
Vent	Check condition of all vent pipes and joints. Ensure the vent piping terminations are free of obstructions and blockages.				
System		**1st Year**	**2nd Year**	**3rd Year**	**4th Year***
Visual	Do a full visual inspection of all system components.				
Functional	Test all functions of the system (Heat, Safeties).				
Temperatures	Verify safe settings on boiler or anti-scald valve.				
	Verify programmed temperature settings.				
Electrical					
Connections	Check wire connections. Make sure connections are tight.				
Smoke and CO Detector	Verify devices are installed and working properly. Change batteries if necessary.				
Circuit Breakers	Check to see that the circuit breaker is clearly labeled. Exercise circuit breaker.				
Switch and Plug	Verify ON/OFF switch and convenience plug are both functional.				
Chamber / Burner		**1st Year**	**2nd Year**	**3rd Year**	**4th Year***
Combustion Chamber	Check burner tube and combustion chamber coils. Clean according to maintenance section of manual. Vacuum combustion chamber. Replace any gaskets that show signs of damage.				
Spark Electrode	Clean. Set gap at 1/4" Clean probe with plumbers cloth to remove oxides.				
Combination Ignitor and Flame Probe	Check ionization in uA (d7 in Status Menu in Start-Up Procedures). Record high fire and low fire. Clean probe with plumbers cloth to remove oxides.				
Condensate		**1st Year**	**2nd Year**	**3rd Year**	**4th Year***
Neutralizer	Check condensate neutralizer. Replace if necessary.				
Condensate Pipe	Disconnect condensate pipe. Clean out dirt. Fill with water to level of outlet and reinstall. (NOTE: Verify the flow of condensate, making sure that the hose is properly connected during final inspection.)				
Gas		**1st Year**	**2nd Year**	**3rd Year**	**4th Year***
Pressure	Measure incoming gas pressure (3.5 to 14"WC).				
Pressure Drop	Measure drop in pressure on light off (no more than 1"WC).				
Check Gas Pipe for Leaks	Check gas piping. Test for leaks and signs of aging. Make sure all pipes are properly supported.				
Combustion		**1st Year**	**2nd Year**	**3rd Year**	**4th Year***
CO / CO2 Levels	Check CO and CO2 levels in exhaust. See Start-Up Procedures for ranges. Record at high and low fire.				
Safeties		**1st Year**	**2nd Year**	**3rd Year**	**4th Year***
ECO (Energy Cut Out)	Check continuity on flue and water ECO. Replace if corroded.				
Sensors	Check wiring. Verify through ohms reading.				
Final Inspection		**1st Year**	**2nd Year**	**3rd Year**	**4th Year***
Check List	Verify that you have completed entire check list. WARNING: FAILURE TO DO SO COULD RESULT IN SERIOUS INJURY OR DEATH.				
Homeowner	Review what you have done with the homeowner.				

Table 31 - *Continue annual maintenance beyond the 4th year as required.

EnduroTi® Boiler
Limited Warranty
Ten year warranty to assure your complete satisfaction.

HTP warrants this boiler and its components to be free from defects in material and workmanship according to the following terms, conditions, and time periods. UNLESS OTHERWISE NOTED THESE WARRANTIES COMMENCE ON THE DATE OF INSTALLATION. This limited warranty is only available to the **original consumer purchaser** (herinafter "Owner") of this boiler, and is non-transferable.

COVERAGE

Heat Exchanger	Components
Ten (10) Years Prorated	One (1) Year*

***The Blower Motor will have a limited warranty of three (3) years.**

A. During the first year after the date of installation, HTP warrants that it will repair or replace, at its option, any defective or malfunctioning component of the boiler that is found to have failed due to manufacturer's defect. Replacement components will be warranted for ninety (90) days. No other component of the boiler will be replaced after this period (with exception to the blower motor, which will have a limited warranty of three [3] years).
B. During the first through fifth year after the date of installation, should a defect or malfunction result in a leakage of water from the boiler due to defective material or workmanship, malfunction, or failure to comply with the above warranty, with such defect or malfunction having been verified by an authorized HTP representative, HTP will repair or replace, at its option, the defective or malfunctioning boiler. Replacements will be of the nearest comparable model available at the time of replacement. The replacement boiler will be warranted for the unexpired portion of the applicable warranty period of the original boiler.
C. During the sixth through tenth year after the date of installation, should a defect or malfunction result in a leakage of water from the boiler due to defective material or workmanship, malfunction, or failure to comply with the above warranty, with such defect or malfunction having been verified by an authorized HTP representative, HTP will repair or replace, at its option, the defective or malfunctioning boiler at a cost to the Owner equal to the following percentages of the manufacturer's list price in effect at the date of replacement:

Year of Claim	6	7	8	9	10
Percentage to be Paid by Purchaser	25 %	50 %	75%	80 %	90 %

Replacements will be of the nearest comparable model available at the time of replacement. The replacement boiler will be warranted for the unexpired portion of the applicable warranty period of the original boiler.
D. In the event of a leakage of water of a replacement boiler due to defective material or workmanship, malfunction, or failure to comply with the above warranty, HTP reserves the right to refund to the Owner the published wholesale price available at the date of manufacture of the original boiler.
E. If government regulations, industry certification, or similar standards require the replacement boiler or component(s) to have features not found in the defective boiler or component(s), the Owner will be charged the difference in price represented by those required features. If the Owner pays the price difference for those required features and/or to upgrade the size and/or other features available on a new replacement boiler or component(s), the Owner will also receive a complete new limited warranty for that replacement boiler or component(s).
F. If at the time of a request for service the Owner cannot provide a copy of the original sales receipt or the warranty registration, the warranty period for the boiler shall then be deemed to have commenced thirty (30) days after the date of manufacture of the boiler and NOT the date of installation of the boiler, and be covered by the unexpired portion of the warranty detailed above.
G. This warranty extends only to boilers utilized in closed loop heating applications that have been properly installed based upon the manufacturer's installation instructions.
H. It is expressly agreed between HTP and the Owner that repair, replacement, or refund are the exclusive remedies of the Owner.
I. HTP will not accept claims from the Owner for labor costs incurred by any person as a result of the repair, replacement, removal, or reinstallation of a boiler or any component thereof.

OWNER RESPONSIBILITIES

The Owner or Qualified Installer / Service Technician must:
1. Have a relief valve bearing the listing marks of the American Society of Mechanical Engineers (ASME) installed with the boiler assembly in accordance with federal, state, and local codes.
2. Maintain the boiler in accordance with the maintenance procedure listed in the manufacturer's provided instructions. Preventive maintenance can help avoid any unnecessary breakdown of the boiler and keep it running at optimum efficiency.
3. Maintain all related system components in good operating condition.
4. Check all condensate lines to confirm that all condensate drains properly from the boiler.
5. Use the boiler in a closed system with a properly sized and installed thermal expansion tank.
6. Use the boiler at water pressures not exceeding the working pressure shown on the rating plate.
7. Keep the boiler free of damaging scale deposits.
8. Make provisions so if the boiler or any component or connection thereto should leak, the resulting flow of water will not cause damage to the area in which it is installed.

WARRANTY EXCLUSIONS

This limited warranty will not cover:
1. Any boiler purchased from an unauthorized dealer.
2. Any boiler not installed by a qualified heating installer/service technician, or installations that do not conform to ANSI, CSA, and/or UL standards, as well as any applicable national or local building codes.
3. Service trips to teach the Owner how to install, use, maintain, or to bring the boiler installation into compliance with local building codes and regulations.
4. Failure to locate the boiler in an area where leakage of the boiler or water line connections and the relief valve will not result in damage to the area adjacent to the boiler or lower floors of the structure.
5. Any failed components of the system not manufactured by HTP as part of the boiler.
6. Boilers repaired or altered without the prior written approval of HTP.
7. Damages, malfunctions, or failures resulting from failure to install the boiler in accordance with applicable building codes/ordinances or good plumbing and electrical trade practices.
8. Damages, malfunctions, or failures resulting from improper installation, failure to operate the boiler at firing rates or pressures not exceeding those on the rating plate, or failure to operate and maintain the boiler in accordance with the manufacturer's provided instructions.
9. Failure to operate the boiler in a closed system with a properly sized and installed thermal expansion tank.
10. Failure or performance problems caused by improper sizing of the boiler, expansion device, piping, or the gas supply line, the venting connection, combustion air openings, electric service voltage, wiring

or fusing.
11. Damages, malfunctions, or failures caused by improper conversion from natural gas to LP gas or LP gas to natural gas.
12. Damages, malfunctions, or failures caused by operating the boiler with modified, altered, or unapproved components, or any component / attachment not supplied by HTP.
13. Damages, malfunctions, or failures caused by abuse, accident, fire, flood, freeze, lightning, acts of God and the like.
14. Failures (leaks) caused by operating the boiler in a corrosive or contaminated atmosphere.
15. Damages, malfunctions, or failures caused by operating an empty or partially empty boiler ("dry firing"), or failures caused by operating the boiler when it is not supplied with water, free to circulate at all times.
16. Any damage or failure of the boiler due to the accumulation of solid materials or lime deposits.
17. Any damage or failure resulting from improper water chemistry. WATER CHEMISTRY REQUIREMENTS – Water pH between 6.5 and 8.5. Hardness less than 7 grains (120 mg/L). Chloride concentration less than 100 ppm (mg/L). TDS less than 500 ppm (mg/L).
18. Any damages, malfunctions, or failures resulting from the use of dielectric unions.
19. Boilers replaced for cosmetic reasons.
20. Components of the boiler that are not defective, but must be replaced during the warranty period as a result of reasonable wear and tear.
21. Components of the boiler that are subject to warranties, if any, given by their manufacturers; HTP does not adopt these warranties.
22. Damages, malfunctions, or failures resulting from the use of any attachment(s) not supplied by HTP.
23. Boilers installed outside the fifty states (and the District of Columbia) of the United States of America and Canada.
24. Boilers moved from the original installation location.
25. Boilers that have had their rating labels removed.
26. Any labor charges incurred by any person in connection with the examination or replacement of a boiler or parts claimed by the Owner to be defective.

PROCEDURES FOR WARRANTY SERVICE REQUESTS

Any claim for warranty assistance must be made immediately upon finding the issue. First, please consult the HTP Warranty Wizard (http://www.htproducts.com/Warranty-Wizard.html) to check warranty eligibility. You may also contact HTP Technical Support at 1-800-323-9651 for questions or assistance. Warranty coverage requires review and approval of the issue with HTP Technical Support or through the Warranty Wizard prior to a full unit replacement. Any claim for warranty reimbursement will be rejected if prior approval from HTP is not obtained in advance of a full unit replacement. Final determination will be made as part of the warranty claim process.

When submitting a warranty claim the following items are required:

1. Proof of purchase or installation of the product – Typically a copy of the invoice from the installing contractor, the receipt of the purchase of the product, or an original certificate of occupancy for a new home.

2. Clear pictures (or video) of the following:
   a. Serial number tag (sticker)
   b. The product
   c. The product issue / failure whenever possible
   d. A picture of the piping near the product
   e. For gas fired products, a picture of the venting, including how it exits the building

All claims will be reviewed by HTP within three (3) business days. If additional information is required and requested by the HTP Claims Department you will have thirty (30) days to provide it. When all requested information is provided HTP will respond within three (3) business days. The claim will be automatically closed if requested information is not provided within thirty (30) days. Claims will not be reopened without HTP Warranty Supervisor approval.

During the claims process a product that must be replaced will be given a designation of either a) field scrap, or b) return to HTP. If the product must be returned to HTP, the returned product must arrive at HTP within thirty (30) days of the date of our request to return the product. After receipt of the returned product HTP may require as many as thirty (30) additional days for product testing. **NOTE: Any components or heaters returned to HTP for warranty analysis will become the property of HTP and will not be returned, even if credit is denied.**

If you have questions about the coverage of this warranty, please contact HTP at the following address or phone number: HTP, 272 Duchaine Blvd., New Bedford, MA, 02745, Attention: Warranty Service Department, 1(800) 323-9651.

SERVICE, LABOR AND SHIPPING COSTS

This limited warranty does not extend to any shipping charges, delivery expenses, or administrative fees incurred by the Owner in repairing or replacing the boiler or component(s). This warranty does not extend to any labor costs incurred by any person as a result of the repair, replacement, removal, or reinstallation of a boiler or any component thereof. All such expenses are the Owner's responsibility.

LIMITATIONS OF THIS HTP WARRANTY AND REMEDIES

THE FOREGOING WARRANTIES ARE EXCLUSIVE AND ARE GIVEN AND ACCEPTED TO THE FURTHEST EXTENT UNDER APPLICABLE LAW IN LIEU OF ANY AND ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING WITHOUT LIMITATION THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE AND ANY OBLIGATION, LIABILITY, RIGHT, CLAIM OR REMEDY IN CONTRACT OR TORT, WHETHER OR NOT ARISING FROM HTP'S NEGLIGENCE, ACTUAL OR IMPUTED. THE REMEDIES OF THE OWNER SHALL BE LIMITED TO THOSE PROVIDED HEREIN TO THE EXCLUSION OF ANY OTHER REMEDIES INCLUDING WITHOUT LIMITATION, INCIDENTAL OR CONSEQUENTIAL DAMAGES, SAID INCIDENTAL AND CONSEQUENTIAL DAMAGES INCLUDING, BUT NOT LIMITED TO, PROPERTY DAMAGE, LOST PROFIT OR DAMAGES ALLEGED TO HAVE BEEN CAUSED BY ANY FAILURE OF HTP TO MEET ANY OBLIGATION UNDER THIS AGREEMENT INCLUDING THE OBLIGATION TO REPAIR AND REPLACE SET FORTH ABOVE. NO AGREEMENT VARYING OR EXTENDING THE FOREGOING WARRANTIES, REMEDIES OR THIS LIMITATION WILL BE BINDING UPON HTP. UNLESS IN WRITING AND SIGNED BY A DULY AUTHORIZED OFFICER OF HTP. THE WARRANTIES STATED HEREIN ARE NOT TRANSFERABLE AND SHALL BE FOR THE BENEFIT OF THE ORIGINAL OWNER ONLY.

NO OTHER EXPRESS WARRANTIES

This warranty gives the Owner specific legal rights. The Owner may also have other rights that vary from state to state. Some states do not allow the exclusion or limitation of incidental or consequential damages so this limitation or exclusion may not apply to the Owner. These are the only written warranties applicable to this boiler manufactured and sold by HTP. HTP neither assumes nor authorizes anyone to assume for it any other obligation or liability in connection with said boilers.

HTP reserves the right to change specifications or discontinue models without notice.

Maintenance Notes

Customer Installation Record Form	
The following form should be completed by the qualified installer / service technician for you to keep as a record of the installation in case of a warranty claim. After reading the important notes at the bottom of the page, please also sign this document.	
Customer's Name	
Date of Installation	
Installation Address	
Product Name / Serial Number(s)	
Comments	
Installer's Code / Name	
Installers Phone Number	
Signed by Installer	
Signed by Customer	
Installation Notes	

IMPORTANT

Customer: Please only sign after the qualified installer / service technician has fully reviewed the installation, safety, proper operation, and maintenance of the system. If the system has any problems please call the qualified installer / service technician. If you are unable to make contact, please call your sales representative.

Distributor / Dealer: Please insert contact details.