INSTALLATION & OPERATING MANUAL



Residential Condensing Boiler

Boiler 85
RHBH-FTS85 RUHBH-FTS85

Boiler 115
RHBH-FTS115 RUHBH-FTS115

Boiler 160
RHBH-FTS160 RUHBH-FTS160

Boiler 199
RHBH-FTS199 RUHBH-FTS199

WARNING

If the information in this manual is not followed exactly, a fire or explosion may result causing property damage, personal injury, or loss of life.

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

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 nearby phone. Follow the gas supplier's instructions.
- If you cannot reach your gas supplier, call the fire department.

Installation and service must be performed by a qualified installer, service agency or the gas supplier.

Intertek AHRI CERTIFIED ASME H ENERGY STAR

Water quality

Warning

Water quality has a significant impact on the lifetime and performance of a boiler's heat exchanger. Improperly prepared water in a heating circuit may cause damage to the heat exchanger through fouling or corrosion.

Dissolved solids or minerals precipitate onto the hottest part of the heat exchanger, impairing heat transfer and service life. A large volume of water with a low hardness may cause as much damage as a small volume with high hardness, so for systems over 40 gallons it is recommended to reduce total dissolved solids (TDS) to 10–30 ppm (before the introduction of inhibitors or glycol).

Water Chemistry Limits	Site Volume:
Hardness between 1 and 9 grains	grains
TDS between 10 and 150 ppm	TDS
Acidity pH between 6.6 and 8.5	pH
Chloride less than 125 mg/l	mg/l
Iron less than 0.3 mg/l	mg/l
Copper less than 0.1 mg/l	mg/l
Conductivity between 20 and 300 µS/cm at 77°F (25°C)	µS/cm

Important: Ensure that these limits are acceptable for the other water-side components in the system.
Uncontrolled water fills are not permitted.

Shipped with the boiler:

- 1 x Wall mounting bracket, P-9092
- 1 x Condensate trap assembly, P-115
- 1 x 30 psig pressure relief valve, P-9009
- 1 x Outdoor temperature sensor, P-9067
- 6 x ¼" x 2 ½" Lag screws w/ flat washers
- 1 x Propane fuel conversion kit

Safety information

Manual safety markings

Danger
Points out an immediate hazardous situation that must be avoided to prevent serious injury or death.

Warning
Points out a potential hazardous situation that must be avoided to prevent serious injury or death.

Caution
Points out a potential hazardous situation that must be avoided to prevent possible moderate injury and/or property damage.

Note
Points out installation, maintenance and operational notes to enhance efficiency, longevity and proper operation of the boiler.

Important safety instructions

Installation, start-up and servicing of these boilers must be performed by competent, qualified, licensed and trained heating technicians.

Failure to read and comply with all instructions and applicable national and local codes may result in hazardous conditions that could result in property damage and injury to occupants, and in extreme cases to death. Keep instructions near the air handling appliance for future reference.

Danger
Should overheating occur or the gas supply fails to shut off, do not turn off or disconnect the electrical supply to the pump. Instead shut off the gas supply at a location external to the appliance.

Danger
Do not store or use gasoline or other flammable vapors or liquids in the vicinity of this or any other appliance. If you smell gas vapors, do not try to operate any appliance - do not touch any electrical switch or use any phone in the building. Immediately, call the gas supplier from a phone located remotely. Follow the gas supplier’s instructions, or if the supplier is unavailable, contact the fire department.

Warning
If the boiler is likely to be exposed to fluid temperatures below 34°F (1°C), use a method to prevent freezing of condensate. Contact the factory for further information.

Warning

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 under water.

Warning

Improper installation, adjustment, alteration, service or maintenance can cause property damage, personal injury, or loss of life. Read and understand the entire manual before attempting installation, start-up, operation, or service. Installation and service must be performed only by an experienced, skilled installer or service agency.

Failure to follow all instructions in the proper order can cause personal injury or death. Read all instructions, including all those contained in component manufacturers' manuals before installing, starting up, operating, maintaining, or servicing the appliance.

Warning

Disconnect power supply before any wiring/service is performed. Failure to do so could result in damage to appliance and/or electric shock.

Caution

The boiler must be installed so that electrical components are not exposed to water during operation.

Known Contaminants

Known Corrosive Contaminants to Avoid	
Cements and glues	Refrigerant leaks from cracks in coils
Paint or varnish removers	Sodium chloride or potassium chloride used for water softening
Adhesives used to fasten building products and other similar products	Chemicals in perming solutions
Chlorinated waxes or cleaners	Chlorofluorocarbon chemicals found in spray cans
Chlorine-based swimming pool chemicals	Antistatic dryer sheets in clothes dryers
Hydrochloric acid or muriatic acid used in household cleaning and stain removal	Chlorine-type bleaches, detergents, and cleaning solvents found in household laundry rooms
Calcium chloride used for snow clearing	

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1.0 Specifications

Boiler Specification	Boiler 85	Boiler 115	Boiler 160	Boiler 199
CSA Input - MBH (NG or LP)	10.6 - 85 MBH	14 - 115 MBH	20 - 160 MBH	32 - 199 MBH
CSA Input -kW (NG or LP)	3.1 - 24.9 kW	4.1 - 33.7 kW	5.86 - 46.9 kW	9.37 - 58.3 kW
CSA Output - MBH	10.1 - 79 MBH	13.3 - 109 MBH	19 - 147 MBH	30 - 181.3 MBH
CSA Output - kW	2.96 - 23.1 kW	3.9 - 32 kW	5.57 - 43.1 kW	8.8 - 53.1 kW
A.F.U.E	96%	95%	95%	95%
Minimum gas supply pressure (NG or LP)	4 inch w.c.	4 inch w.c.	4 inch w.c.	4 inch w.c.
Maximum gas supply pressure (NG or LP)	14 inch w.c.	14 inch w.c.	14 inch w.c.	14 inch w.c.
Power use (120Vac/60Hz) @ full fire - (less pumps)	54 Watts	72 Watts	82 Watts	100 Watts
Weight (empty)	85 lbs/ 39 Kg	85 lbs/ 39 Kg	102 lbs/ 46 Kg	152 lbs/ 69 Kg
Pressure vessel water content	2.47 USG/ 9.35 Litres	2.47 USG/ 9.35 Litres	1.72 USG/ 6.51Litres	5.09 USG/ 19.3 Litres
Maximum boiler flow rate	14 USgpm	14 USgpm	19 USgpm	22 USgpm
Minimum boiler flow rate	2 USgpm	2 USgpm	4 USgpm	6 USgpm
Maximum operating water pressure[1]	30 psig	30 psig	30 psig	30 psig
Minimum water pressure	8 psig	8 psig	8 psig	8 psig
Approved installation altitude - ASL	0 - 12,000’	0 - 12,000’	0 - 12,000’	0 - 12,000’
Ambient temperature Low Ambient temperature High	32°F / 0°C 122°F / 50°C	32°F / 0°C 122°F / 50°C	32°F / 0°C 122°F / 50°C	32°F / 0°C 122°F / 50°C
Max. relative humidity (non-condensing)	90%	90%	90%	90%
Minimum water temp.	34°F / 1°C	34°F / 1°C	34°F / 1°C	34°F / 1°C
Maximum water temp. (electronic hi-limit)	190°F / 88°C	190°F / 88°C	190°F / 88°C	190°F / 88°C
Max. Water Temperature Lockout Limit	201°F / 94°C	201°F / 94°C	201°F / 94°C	201°F / 94°C
Max. ΔT - supply/return (electronic fence)	40°F	40°F	40°F	40°F

[1] Boilers are shipped with a 30 psig pressure relief valve

Boiler Specification	Boiler 85	Boiler 115	Boiler 160	Boiler 199
Maximum equivalent vent length exhaust & air intake (each)[1]	100’ (2") 240’ (3")	100’ (2") 240’ (3")	35’ (2") 170’ (3")	N/A (2") 150’ (3")
Heating surface area	9.46 ft^2 / 0.88 m^2	9.46 ft^2 / 0.88 m^2	14.19 ft^2 / 1.32m^2	16.34 ft^2 / 1.52 m^2
CRN	A7281.3CL	A7281.3CL	8718.7 CL	8572.7 CL

Table 1 *Specifications*

Ignition Stages Timings	
Fan Pre-purge	15 seconds
Trial for Ignition	4 seconds
Flame Failure Response	<0.8 second

Table 2 *Ignition Timings*

Connection specifications

Connection		Boiler 85, Boiler 115	Boiler 160	Boiler 199
A	Flue Outlet	3" Schedule 40 or 3" PP (80mm)		
B	Combustion Air	3" Schedule 40 or 3" PP (80mm)		
C	LCD Display	2¼" x 4"		
D	Water Outlet	1" NPT-M	1" NPT-M	1¼” NPT-M
E	Water Inlet	1" NPT-M	1" NPT-M	1¼” NPT-M
F	Knock-outs (8)	½"		
G	Gas Inlet	½" NPT-F		
H	Condensate Outlet	¾" Hose		

Table 3 *Connections*

[1](Natural gas or propane) Air intake options: either direct vent or indoor supply

Cabinet dimensions

Boiler 85, Boiler 115

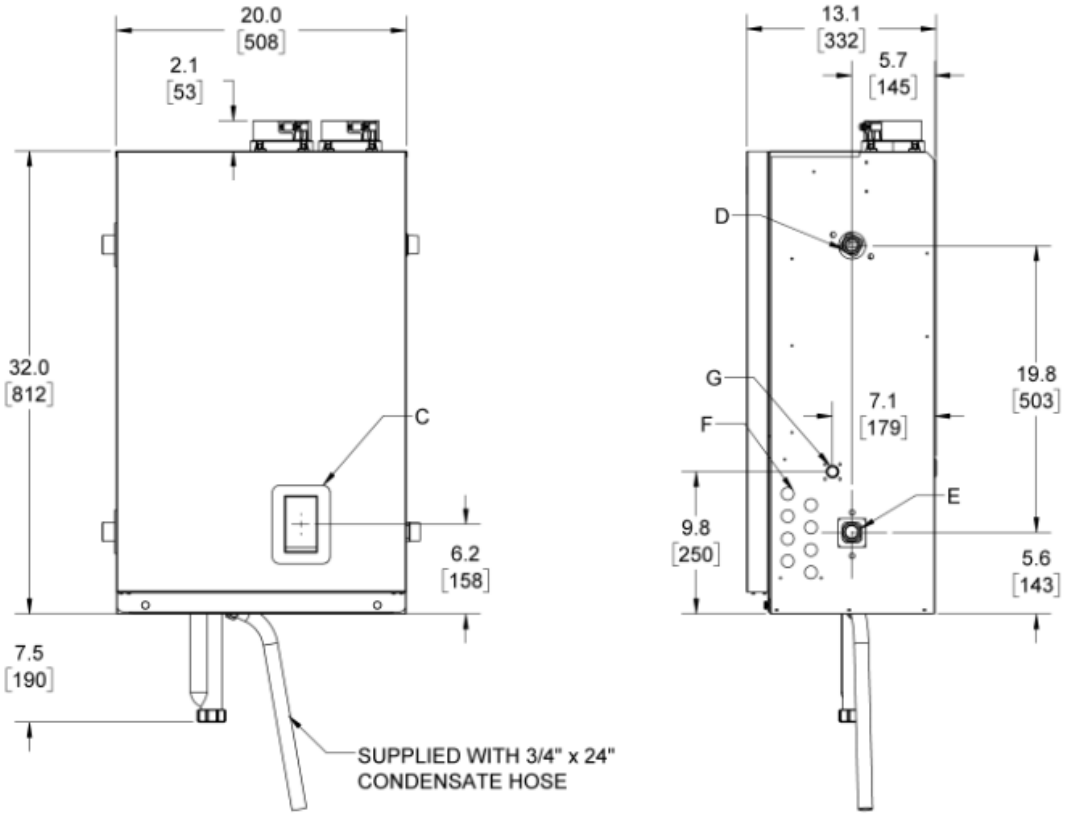


Figure 1 : *Front and side view - Boiler 85, Boiler 115*

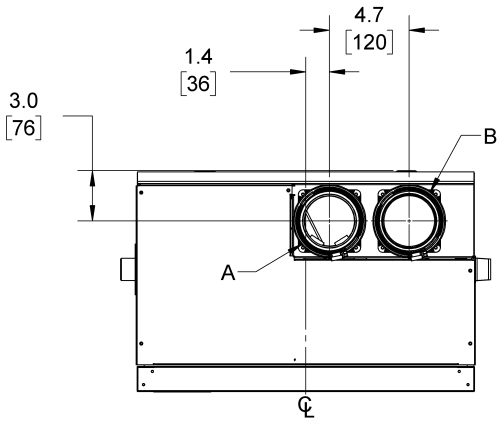


Figure 2 : *Top view - Boiler 85, Boiler 115*

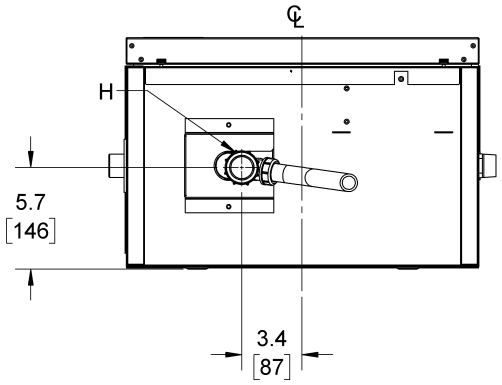


Figure 3 : *Bottom view - Boiler 85, Boiler 115*

Boiler 160

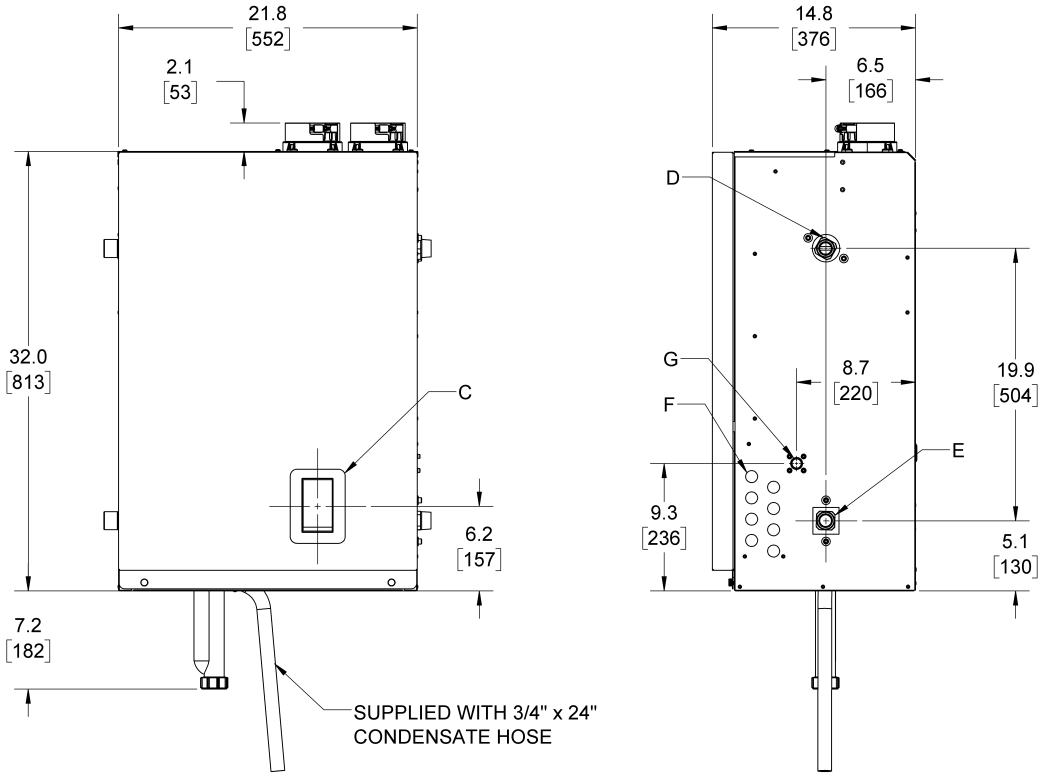


Figure 4 : *Front and side view - Boiler 160*

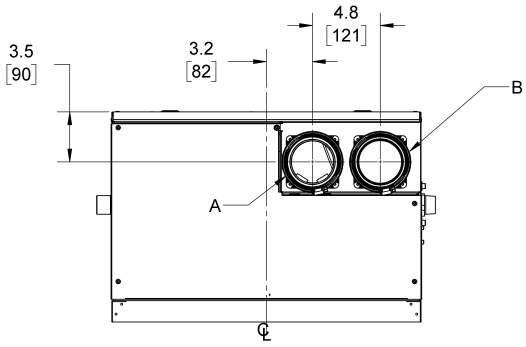


Figure 5 : *Top view - Boiler 160*

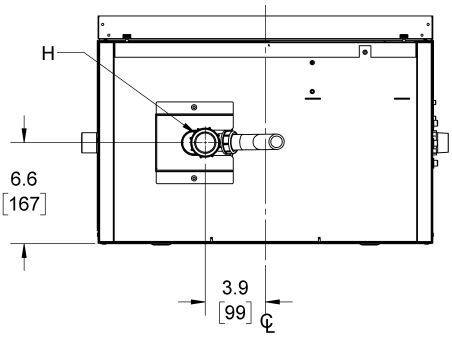


Figure 6 : *Bottom view - Boiler 160*

Boiler 199

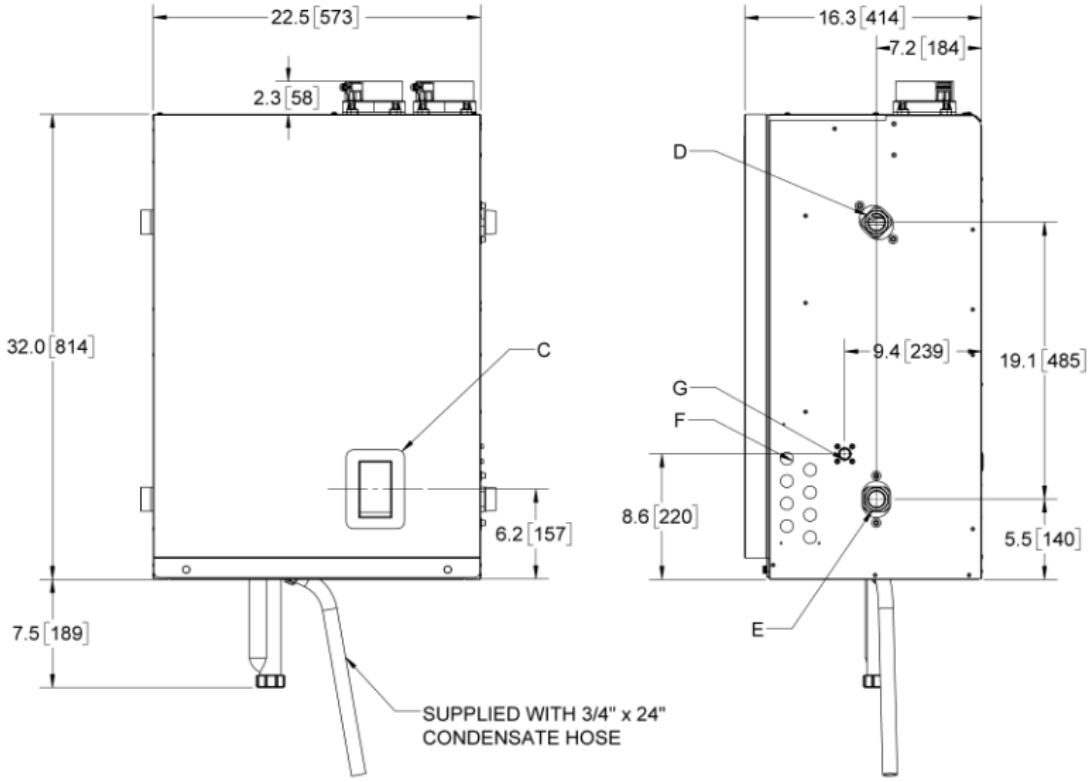


Figure 7 *Front and side view - Boiler 199*

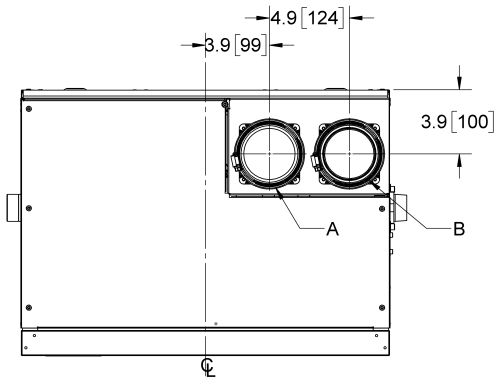


Figure 8 *Top view - Boiler 199*

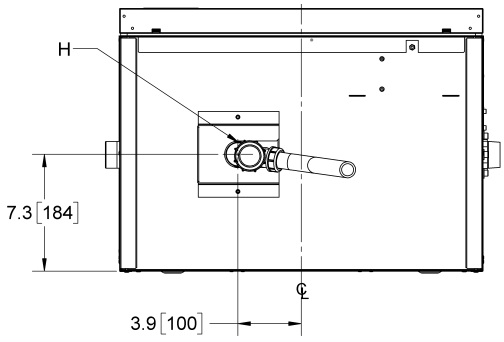


Figure 9 *Bottom view - Boiler 199*

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2.0 Introduction

The residential gas-fired modulating boilers are low pressure, fully condensing units with a variable input range. Approved as “Category IV” vented appliances, the boilers use direct vent (sealed combustion) or indoor combustion air.

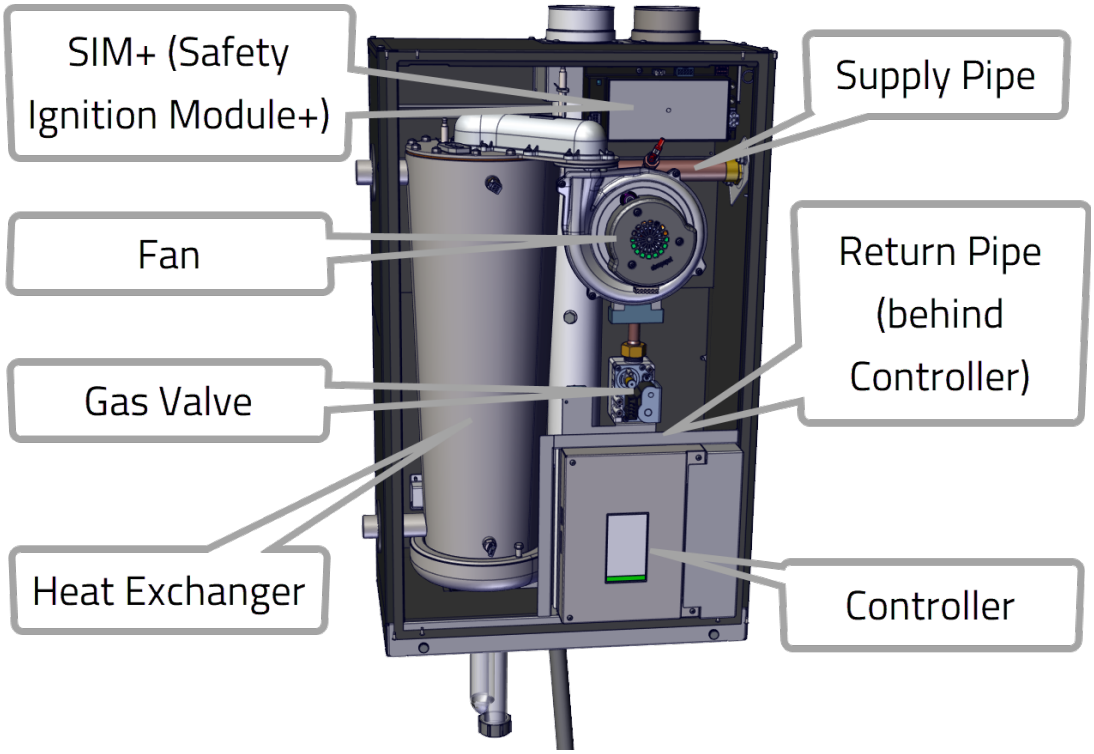


Figure 10 *View from the front - Residential boilers*

2.1 Standard features and benefits

- High thermal efficiency
- Turn-down ratio 10 to 1
- 4 load pumps control
- 1 boiler pump control
- Outdoor reset control
- Load zoning – simultaneous operation of up to four loads with the same control settings
- Load combining – simultaneous operation of two similar water temperature loads
- Ability to manage and/or operate in a network of up to 24 V10 controller boilers
- Can accept 0-10 VDC signal from external controller
- BACnet over IP compatible
- Easy-to-use touchscreen

2.2 Warranty

For residential applications, the boiler carries a 5-year warranty on all parts against defects in materials or workmanship and failures due to thermal shock.

In addition, the manufacturer offers a limited warranty on the heat exchanger, according to the following terms:

- 0 - 10 years (100% coverage)
- 11+ years (25% coverage).

For non-residential applications, the boiler carries a 5-year warranty on all parts against defects in materials or workmanship and failures due to thermal shock. In addition, the heat exchanger carries a limited 10 year warranty, according to the following terms:

- 0 - 5 years (100% coverage)
- 6 - 7 years (50% coverage)
- 8 years (40% coverage)
- 9 years (30% coverage)
- 10 years (20% coverage).

To view the full warranty statement for the Residential series and to register your product, go to the manufacturer's website.

3.0 Before installation

Caution

Care must be taken to properly size the combi boiler for its intended use. Prolonged full fire run time, over-sizing or under-sizing, and incorrect flow rates through the boiler can lead to increased maintenance costs, equipment stress and premature failure.

Before installing the appliance, it is important to review and observe the following checklist of precautions:

Precautions	Check
Ensure you install the appliance where the combustion air source is not subject to chemical fouling or agricultural vapors. Exposure to corrosive chemical fumes such as chlorinated and/or fluorinated hydrocarbons can reduce the life of a boiler. Cleaners, bleaches, air fresheners, refrigerants, aerosol propellants, dry-cleaning fluids, de-greasers and paint-removers all contain vapors that can form corrosive acid compounds when burned in a gas flame. Airborne chlorides such as those released with the use of laundry detergents are also to be avoided.	☐
Locate the appliance where water leakage will not result in damage to the area. If there is no suitable location, install a suitable drain pan under the boiler. Do not install above carpeting.	☐
At a new construction site, or during renovations, protect the appliance from drywall dust or other construction-related contaminants. Draw combustion air from a **clean** source (e.g., outdoors) and isolate the boiler from interior dust sources. Do not seal boiler case openings directly when firing - allow for air circulation and ventilation in the immediate area.	☐
Place the exhaust outlet 12" minimum above the down-turned intake to avoid exhaust re-ingestion.	☐
For sidewall venting options, place the inlet and exhaust terminations on the same side of the building. The elevation of both pipes can be raised in “periscope style” after passing through the wall to gain required clearance above grade and snow level.	☐
If using the indoor combustion air option, ensure combustion air openings to the boiler room remain unblocked and free of obstructions.	☐
Examine the condensate outlet to ensure proper disposal of condensate will occur during operation. If condensates are to be discharged into building drain piping materials that are subject to corrosion, a neutralization package must be used.	☐
Ensure that the pressure relief valve is installed with no valves or other means of isolation between its inlet and the boiler. Make sure the relief valve outlet is piped with unobstructed piping (minimum ¾" diameter) to a safe discharge location.	☐
If the appliance is likely to be exposed to fluid temperatures below 34° F (1° C), a method of protection to prevent freezing of condensate should be employed. Contact Tech Support for further information.	☐

Precautions	Check
When the appliance is in operation, assess the impact of the steam plume typical of a condensing boiler's exhaust terminal. Generally, intake and exhaust pipes should terminate at a rooftop or sterile wall location. Boiler condensate is corrosive. Protective measures must be taken to prevent corrosion damage to metal roofs or other metal building components in contact with the condensate. Keep exhaust plumes well away from all building air intakes including those of neighboring properties.	☐

4.0 Installation

Refer to the Specifications section for dimensional drawings and connection specifications. Use these drawings to find a suitable location for the appliance.

4.1 Code requirements

The appliances are tested and certified under CSA 4.9 / ANSI Z21.13 (latest edition). Below are the code requirements for every installation.

Canada	US
Conform to local codes, or in the absence of these, with the latest editions of CAN/CGA B149.1 and the Canadian Electrical Code Part 1 CSA C22.2 No. 1. Where required by jurisdiction, installation must conform to the Standard for Controls and Safety Devices for Automatically Fired Boilers, ANSI/ASME CSD-1. If there is any conflict, follow the more stringent regulations.	Conform to the current National Fuel Gas Code ANSI Z223.1 and the National Electrical Code ANSI/NFPA 70. Where required by jurisdiction, installation must conform to the Standard for Controls and Safety Devices for Automatically Fired Boilers, ANSI/ASME CSD-1. If there is any conflict, follow the more stringent regulations.

Table 4 *Code requirements by country*

4.2 Removing an existing boiler

When an existing boiler is removed from a common venting system, the common venting system may be too large for proper venting of the appliances that remain connected to it. When resizing any portion of the common venting system, use the minimum size according to the appropriate tables in the National Fuel Gas Code, ANSI Z223.1 - latest edition. In Canada, follow the B149.1 Installation Code.

When removing an existing boiler, the following checks must be carried out for each of the appliances still connected to the common exhaust system, by operating them one at a time:

- Seal any unused opening in the common venting system.
- Visually inspect the venting system for proper size and horizontal pitch. Determine that there is no blockage or restriction, leakage, corrosion and other deficiencies that could cause an unsafe condition.
- (Where practical) Close all building doors and windows such as doors adjacent to appliances remaining connected to the common venting system and other spaces of the building.
  - » Turn on the clothes dryers and any appliance not connected to the common venting system.

  - » Turn on any exhaust fans, such as range hoods and bathroom exhausts, so they will operate at maximum speed. Do not operate a summer exhaust fan.
  - » Close fireplace dampers.
- Place in operation the appliance being inspected.
  - » Follow the lighting instructions.
  - » Adjust the thermostat so that the appliance operates continuously.
- After determining that each appliance remaining connected to the common venting system properly vents when tested as outlined above, return doors, windows, exhaust fans, fireplace dampers and any other gas-burning appliance to their previous condition.
- Any improper operation of the common venting system should be corrected, so the installation conforms with the National Fuel Gas Code, ANSI Z223.1 - latest edition. In Canada, all installations must conform with the current CAN/CGA - B149.1-10 Installation Code and/or local codes.

4.3 Determining location of the appliance

The boilers are designed and approved for indoor installation (wall or rack mounting) in areas such as an alcove, basement, or utility room. These areas should have a surrounding temperature of 32 °F (0°C) to 122 °F (50 °C) and less than 90% relative humidity.

Danger

Do not common vent this appliance with other existing appliances or with a new appliance.

Warnings

- Keep the area around a boiler clear of combustible materials, gasoline, and other flammable vapors and liquids.
- Ensure combustion air is not drawn from areas containing corrosive air such as swimming pools or spas, including air directly next to outdoor pools and spas.
- Ensure that a boiler is not exposed to water leaks from piping or components located overhead, including condensation from uninsulated cold water lines overhead.
- Protect the gas ignition system components from water (dripping, spraying, rain, etc.) during appliance operation and when servicing (pump replacement, condensate trap servicing, control replacement, etc.).
- Ensure that combustible materials do not make contact with exposed water piping and associated components (relief valves, circulators, etc.). Check local codes for required clearances and/or provide adequate insulation.

Best installation conditions

Below are some factors to consider for best installation conditions:

- Install the boiler in areas where the combustion air source is not subject to chemical fouling or agricultural vapors. Exposure to corrosive chemical fumes such as chlorinated and/or fluorinated hydrocarbons can reduce the life of a boiler. See list of known contaminants on the *Known Contaminants* on page 1. If boiler is installed in a laundry room, boiler must be direct vented, and the intake cannot terminate near a dryer vent. Similarly, ensure any direct vent air source is not near a clothes dryer exhaust terminal. Avoid locating the boiler and intake air where they can be affected by ammonia and/or dust.
- Avoid installing a boiler where water leakage will cause damage; for example, above carpeting. If unavoidable, install a suitable drain pan under the appliance.
- **Vent location** - An important consideration is managing the impact of the steam plume normally at the exhaust terminal of a condensing boiler. Generally, intake and exhaust pipes should terminate at a rooftop or sterile wall location to maximize customer satisfaction. Keep exhaust plumes well away from all building air intakes including those of neighboring properties. Refer to *Table 7* and *Figure 18* in *Sidewall vent termination on page 28*.
- The minimum clearance requirements for combustible materials (see *Table 5*).
- For adequate servicing, we recommend a minimum 24" clearance at the front and 6" above the boiler. Check local codes for additional access and service clearance requirements.
- At a new construction site, or when renovating:
  - Protect the boiler from drywall dust or other construction related contaminants.
  - Ensure combustion air is drawn from a **clean** source (e.g., outdoors).
  - Isolate the boiler from interior dust sources.
  - If a dusty environment is temporarily unavoidable, shut off the boiler and service boiler thoroughly after resuming operation.

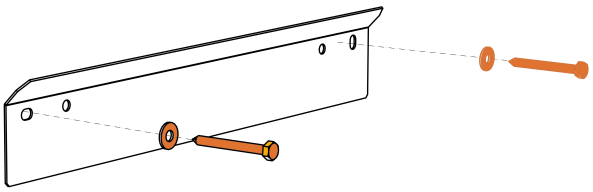
4.4 Mounting the boiler

Warning

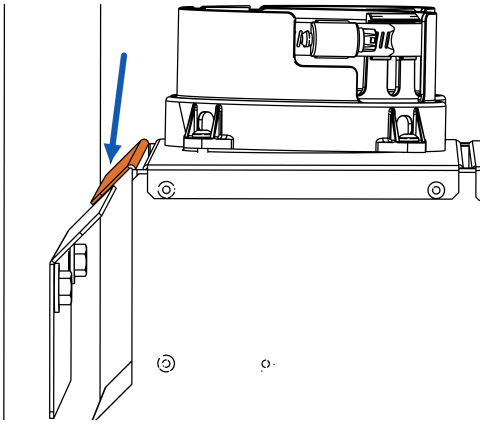
Do not mount the appliance to hollow wall structures - The combined weight of the boiler, its water content and associated piping components can exceed 200 pounds. Fasteners must be rated for this strain, and must be firmly anchored into solid material that will support this weight. Installers must take necessary precautions to avoid injury during the installation of this boiler.

You must attach fasteners to solid material capable of supporting the combined weight of the boiler and piping assembly components. Boiler 399 weight – without water, system piping and components – is approximately 150 lbs / 69 kg.

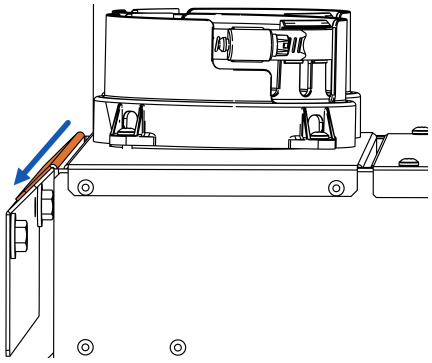
1. Attach the support bracket (supplied) to the wall studs using the supplied **¼" x 2½"** long lag screws (min. 4) with ¼" flat washers.



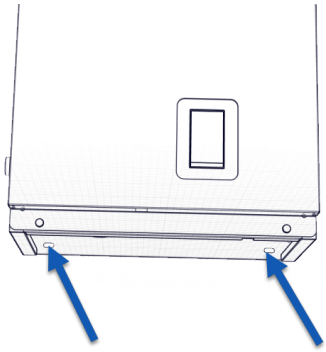
2. Hook the boiler tab (located on back of boiler) over the support bracket flange.



3. Ensure that the boiler tab is flush against the mounting bracket flange.



4. Secure the lower part of the boiler to the wall with two field-supplied ¼" bolts.



4.5 Connecting the vent and air intake pipes

These appliances offer 3" connections that accept standard 3" PVC/CPVC and polypropylene (PP) pipe. If appropriate to adapt to smaller diameter pipe, use reducing fittings (not bushings).

Note

Mark the full-insertion depth on the vent pipe.

For PP, no transition adapter is required. The vent connection has a second gasket approximately 2.5” below the first 3” PVC/CPVC sized gasket that will seal to standard 80 mm PP pipe. Care should be taken to ensure that PP pipe is installed so that it extends past this second gasket. For PP material exposed to outdoor conditions, follow the venting supplier’s recommendations on UV protection.

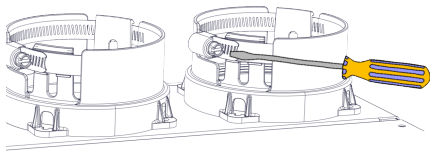


Figure 11 *Securing a pipe connection*

Warning

Ensure that you lubricate the gasket with silicone grease before inserting the venting material. Fully insert the approved venting material into the boiler's exhaust outlet, and tighten clamp to ensure the venting connection is locked in place (as shown above).

If using combustion air piping, insert directly into the connector on the right. PP pipe should be inserted firmly into the connector until it cannot go further. The pipe must be secured with the built-in clamp.

Venting must be supported in accordance with the applicable code and instructions supplied by the manufacturers.

Warning

Do not mix venting materials from different manufacturers. These venting materials are designed to be installed as part of a complete system. Failure to comply may result in severe personal injury or death.

4.6 Installation clearances

Boiler cabinet clearances		
Surface	**Minimum distance from combustible surfaces**	**Recommended minimum clearance for installation and service**
Front	2"	24"
Rear	0	0
Left side	1"	4" (for water connections)
Right side	1"	4" (for water, electric, and gas connections)
Top	2"	6" (for vent connection)
Bottom	0	12" (for condensate trap)

Table 5 *Clearance distances for boiler mounting sites*

A minimum of 12 inches below the boiler is required to provide clearance for the supplied condensation trap assembly. Additional side clearances will typically be required to accommodate water and gas piping.

Warning

Exposed water piping and associated components (relief valves, circulators, etc.) should not be in contact with combustible materials. Check local codes for required clearances and / or provide adequate insulation.

4.7 Exhaust venting and air intake

Warning

Venting, condensate drainage, and combustion air systems for all boilers must be installed in compliance with all applicable codes and with instructions provided in the respective installation manuals.
Inspect finished vent and air piping thoroughly to ensure all are airtight, and comply with the instructions provided as well as with the requirements of applicable codes. Failure to comply will result in severe personal injury or death.

These approved “Category IV” vented appliances offer flexible installations via direct vent (sealed combustion) or indoor combustion air.

4.7.1 Venting code

All venting must be installed in accordance with the requirements of the jurisdiction having authority: in Canada, Part 8, Venting Systems of the CAN/CSA B149.1-10 Code and any other local building codes are to be followed. In the USA, the National Fuel Gas Code, ANSI Z223.1, latest edition prevails. Where there is a discrepancy between the installation instructions provided and the code requirements, apply the more stringent.

4.7.2 Venting options

These appliances are approved with alternative venting options: either 2-pipe direct vent or vent pipe with indoor air. With direct vent, combustion air is piped directly to the boiler’s air intake from outdoors. Using the indoor air alternative, air for combustion is drawn from the indoor air surrounding the boiler.

Provided the maximum overall vent length limit is not exceeded, the boiler may be vented through the wall, directly through the roof, or upward using an existing, but otherwise unused, chimney as a vent raceway.

4.7.3 Exhaust vent material



Warnings

Covering non-metallic vent pipe and fittings with thermal insulation is prohibited.

Exhaust vent material – Canada

Use PVC, CPVC, or polypropylene vent component systems approved under ULC-S636 Standard for Type BH Gas Venting Systems, or stainless steel (SS) Type BH venting systems. ULC-S636 components are certified as systems including pipe, fittings and cement/primer for PVC/CPVC and must be installed in strict accordance with manufacturer's instructions. The boiler controller acts to reduce flue temperature during high temperature operation with the use a flue temperature sensor, however, venting system suitability is dependent on vent material selection, installation conditions, vent manufacturer requirements, and applicable installation codes.

Exhaust vent material – U.S.A

PVC, CPVC, PP, or SS venting materials are approved for use with these boilers in most of the USA. Check local codes to determine if any materials are prohibited. The boiler controller acts to reduce flue temperature during high temperature operation with the use a flue temperature sensor, however, venting system suitability is dependent on vent material selection, installation conditions, vent manufacturer requirements, and applicable installation codes. PVC venting material shall be certified to Sch. 40 ASTM D1785 or D2665. CPVC material shall be certified to Sch. 40/ASTM F441.

Exhaust vent material - general

Use of cellular core PVC (ASTM F891), cellular core CPVC, ABS or Radel® (polyphenolsulfone) in venting systems is prohibited. Do not use ABS or any cellular core pipe for exhaust venting.

For SS material, use the 3-inch transition / adapter fitting offered by the SS manufacturers M&G Dura Vent (# FSA-3PVCM-3FNSF) or Heat Fab (Saf-T-Vent) 9301PVC.

4.7.4 Direct vent

Direct vent is a two-pipe system that draws combustion air (air intake) from outdoors, and discharges exhaust gases to the outdoors. Ensure that adequate separation is maintained between the air intake inlet and the exhaust vent terminal. Refer to the vent terminal configuration drawings in the "Vent Termination" sections.

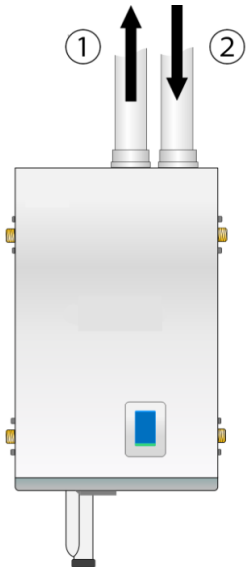


Figure 12 *Direct vent*

1	Flue gas exhaust to outdoors	
2	Combustion air from outdoors. "Direct Vent" installation: check air intake outside is clear of obstructions.	

Indoor combustion air installation

An “Indoor Combustion Air installation” can be described as air for combustion that is taken from the air surrounding the boiler.

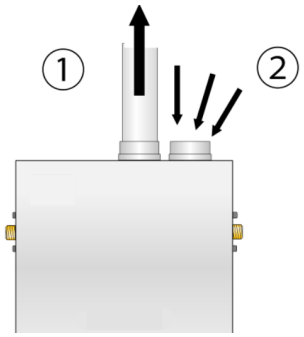


Figure 13 *Indoor combustion air intake*

1	Flue gas exhaust to outdoors
2	Combustion air from boiler room. For indoor air installation, check air intake and boiler room combustion air opening(s) to ensure they are clear of obstructions.

Warning

When using indoor air options, supply adequate combustion air to the boiler room according to the requirements of all applicable codes.

At a new construction site, or during renovations, action must be taken to protect the boiler from drywall dust or other construction related contaminants; combustion air should be drawn from a **clean** source (e.g. outdoors) and the boiler should be isolated from interior dust sources. Do not seal boiler case openings directly when firing (See *Known Contaminants* on page 1).

Warnings

- The boiler door must be in place during operation (except for maintenance and service).
- In addition to preventing ingestion of chemical contaminants, ensure air intake terminals are not installed in locations where contamination might occur due to ingestion of particulate foreign material (dust, dirt and debris).
- Configure intake air openings, so that rain or other forms of moisture cannot enter the air intake piping system. Otherwise serious damage to the boiler may result.

Notes

- When installing air intake piping, ensure that a "trap" is not formed in the piping causing a build-up of water and blockage of intake air. Such blockages will cause a boiler safety shut-down.
- Filters require checking and cleaning or replacing on a regular schedule based on the severity of the problem.

Exhaust venting installation

Horizontal sections of exhaust venting must slope down towards the boiler, maintaining a minimum of 1/4" per foot slope so condensate runs back to the boiler. Polypropylene exhaust venting requires minimum slope 5/8" per foot. Support should be provided for intake and vent piping where it passes through unheated spaces or underground, with appropriate pipe insulation to prevent freezing of condensates.

Certain installations of theresidential models can employ 2" vent options. We caution installers when using horizontal runs of 2" pipe. Air friction from the fast moving exhaust during long burner runs at high-fire in a 2" pipe can overcome gravity on ¼" per foot vent slope, leaving a pool of condensate at the next upturned elbow. Pooling can impair the achievement of full high-fire rating plate performance.

(1) Ensure pipe and fittings are beveled for trouble-free insertion through exhaust and intake pipe gaskets.

Exhaust piping is inserted directly into the left connector on the top of the boiler, then runs horizontally or vertically to the outdoors. Screen material can be placed at the outlet as appropriate for the environment (e.g., insects, dust).

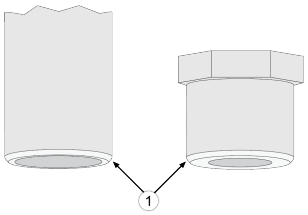


Figure 14 *Pipe and fitting beveling*

- Check that material meets local codes including fire stopping requirements. Some local jurisdictions require a minimum initial length of pipe be exposed or accessible for inspection. Pipe clearances - no manufacturer requirements; follow local codes. All piping must be liquid and pressure tight.
- Ensure all venting components are clear of burrs/debris prior to assembly. Clear plastic debris left in the combustion air piping to avoid intake into the fan.
- Secure joints using appropriate solvent cement to bond the respective pipe material (CPVC cement approved under ULC-S636, in accordance with its manufacturer instructions; PVC (ASTM D2564), or PVC/ABS (D2235)). - Use transition glue anywhere that PVC and CPVC are joined. Follow the cement manufacturer's instructions closely when joining various components. For PP, connections shall be secured using approved retainer clips supplied by the respective PP manufacturer.
- Ensure that vent connections are liquid and pressure tight. Prior to firing the boiler, and before any of the venting run is concealed, run the fan in high fire via the test operation menu, then coat the exhaust joints under fan pressure with the vent blocked, using a soap and water solution just as you would joint in a gas line. Inspect to see if bubbles form, indicating that there is a leak. The installer must fill the condensate trap prior to testing.
- **Re: venting passage through ceiling and floor**:
  - » Confirm material meets local codes including fire stopping requirements.
  - » Check the local jurisdiction on the minimum initial length of pipe that should be exposed or accessible for inspection.
  - » Follow the local codes for pipe clearances - no manufacturer requirements.
  - » Ensure that piping is liquid and pressure tight.

Air intake and exhaust vent length allowance

Warning

Follow all installation instructions supplied by the piping and fitting manufacturer.

Notes

Unused intake travel *cannot* be added to the exhaust.
Unequal intake and exhaust piping is allowed.
Support should be provided for intake and vent piping, particularly for horizontal runs (follow local code).

The maximum vent lengths shown are separate for the intake and exhaust. For example, for a maximum vent length of 100 ft, the exhaust can travel a maximum of 100 equivalent ft and the intake can travel a maximum of 100 equivalent ft. Any unused vent lengths used on one side can not be added to the other. Equivalent feet of any elbows, termination kits, or flexible pipe must be subtracted from the maximum length using the following table:

Vent Lengths				
Intake/Exhaust	**Maximum Equivalent Length**			
	Boiler 85	**Boiler 115**	**Boiler 160**	**Boiler 199**
2-inch rigid pipe	100 ft	100 ft	35 ft	n/a
3-inch rigid pipe	240 ft	240 ft	170 ft	150 ft
90° elbow	Each elbow equivalent to 8 ft			
90° long sweep elbow	Each elbow equivalent to 5 ft			
45° elbow	Each elbow equivalent to 3 ft			
PP 87-90° elbows	Each elbow equivalent to 8 ft			
Air Intake Filter (*P-357*)	Equivalent to 8 ft (Permitted on intake only)			
2-inch Stainless Sidewall Terminal (*P-256*)	Intake: equivalent to 0 (zero) ft. Exhaust: equivalent to 20 ft		Not permitted	
3-inch Stainless Sidewall Terminal (*P-257*)	Intake: equivalent to 0 (zero) ft. Exhaust: equivalent to 8 ft			
3-inch flexible PP	Limited to 45 ft maximum	Limited to 45 ft maximum	Limited to 45 ft maximum	Limited to 30 ft maximum
3-inch flexible PP equivalents	Equivalent to length x 1.2 (e.g., 10' of flexible = 12')	Equivalent to length x 1.2 (e.g., 10' of flexible = 12')	Equivalent to length x 2 (e.g., 10' of flexible = 20')	Equivalent to length x 3.3 (e.g., 10' of flexible = 33 feet)

Table 6 *Maximum air intake pipe and maximum exhaust vent length*

Example of equivalent length calculations for Boiler 115:
A Boiler 115 can be situated up to 240 feet (actual vent length allowance) from the vent termination using 3-inch pipe.
For 6 x 90º elbows, the maximum straight length of pipe allowed is 192 feet (240’ – 48' = 192').
For 3-inch flexible PP pipe, up to 45 linear feet is allowed in vertical orientation (> 45 °). The equivalent length of 3-inch flexible PP pipe should be calculated using a multiple of 1.2 (e.g., 10' x 1.2 = 12').

Caution
Take care installing termination kits when the outdoor temperature drops below 5°F/-15°C. Possible blockage of the combustion air intake can occur when the outdoor temperature drops below this temperature.

4.7.5 Rooftop vent termination

Warning
Condensate can cause corrosion of metal roofing components and other roofing materials. pH levels can be as low as 3.0. Check with the builder or roofing contractor to ensure that materials are resistant to acidic condensate.

a. Rooftop vents must terminate as follows:
   - **Do not** exhaust vent into a common venting system.
   - The exhaust pipe can terminate in an open vertical orientation without concern about rain infiltration; rain will drain away through the condensate trap.
   - Optional bird screen may be placed in a termination fitting. Leave unglued, and hold in place with a short nipple. This permits easy access for cleaning.

b. For rooftop direct vent systems:
   - Rooftop, two pipe, direct vent configurations, including typical clearance requirements are shown below in the following images.

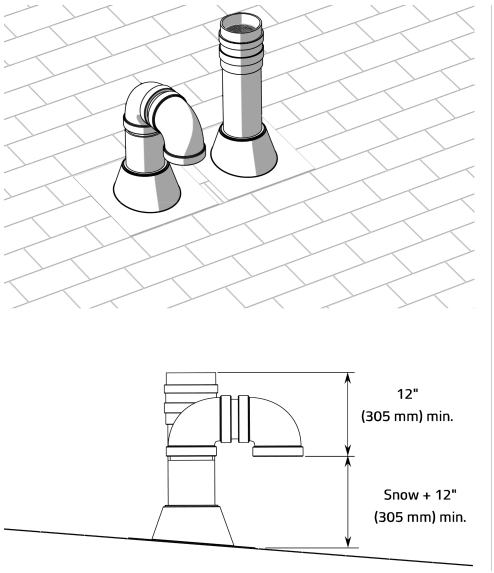


Figure 15 *Rooftop vent terminal configurations*

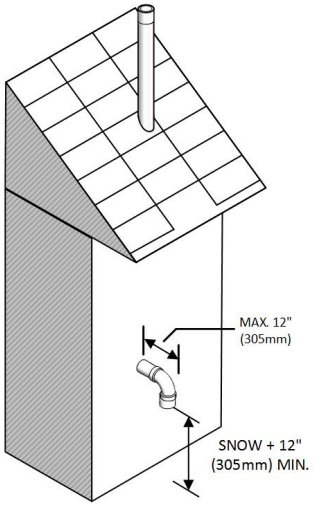


Figure 16 *Rooftop vent termination with sidewall combustion air*

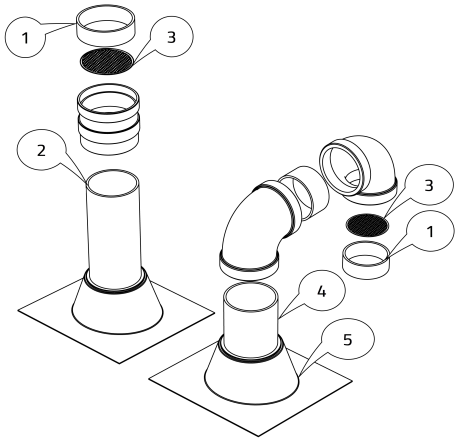


Figure 17 *Rooftop vent terminal vent screen and retainer*

1	Vent screen retainer	4	Inlet
2	Exhaust	5	Flashing
3	Vent screen		

- The intake air pipe is not typically drained, so it must be terminated with a down-turned elbow as shown.
- The intake pipe does not need to penetrate the roof at the same elevation as the exhaust (as shown); lower down on the roof is acceptable.

Best Practice: To reduce the possibility of expansion noise, allow a ¼ inch gap around the exhaust and air intake piping.

- For roof top venting of multiple boiler sets, group all intake terminals together for a common penetration through a custom cap. Alternatively, place close together using commonly available pipe flashing. Similarly, group the exhaust pipes and place the two separate groups of pipes at least 3 feet apart (the closest intake and exhaust pipes must be 36 inches, or more, apart). Use the same 12-inch (minimum) vertical separation for all termination options. For alternate group terminations, contact Technical Support for written guidance.
- Roof top concentric termination kits are approved for use with the boiler model. Installation of the vertical roof top termination must follow the installation instructions supplied with the venting material manufacturer. Care must be taken to install the termination kit a minimum horizontal distance of 10' (305 cm) away from any portion of the building and a minimum of 1 foot (30 cm) above the roof line plus the anticipated snow line.

4.7.6 Sidewall vent termination

Caution

Vent termination clearances in this section are code minimum, and may be inadequate for your installation. Building envelope details must be examined carefully. Take action to avoid moisture entering building structures. Serious structural damage may occur if adequate precautions and clearances are not considered. These precautions apply to neighboring structures as well as to the structure the boiler(s) are installed in.

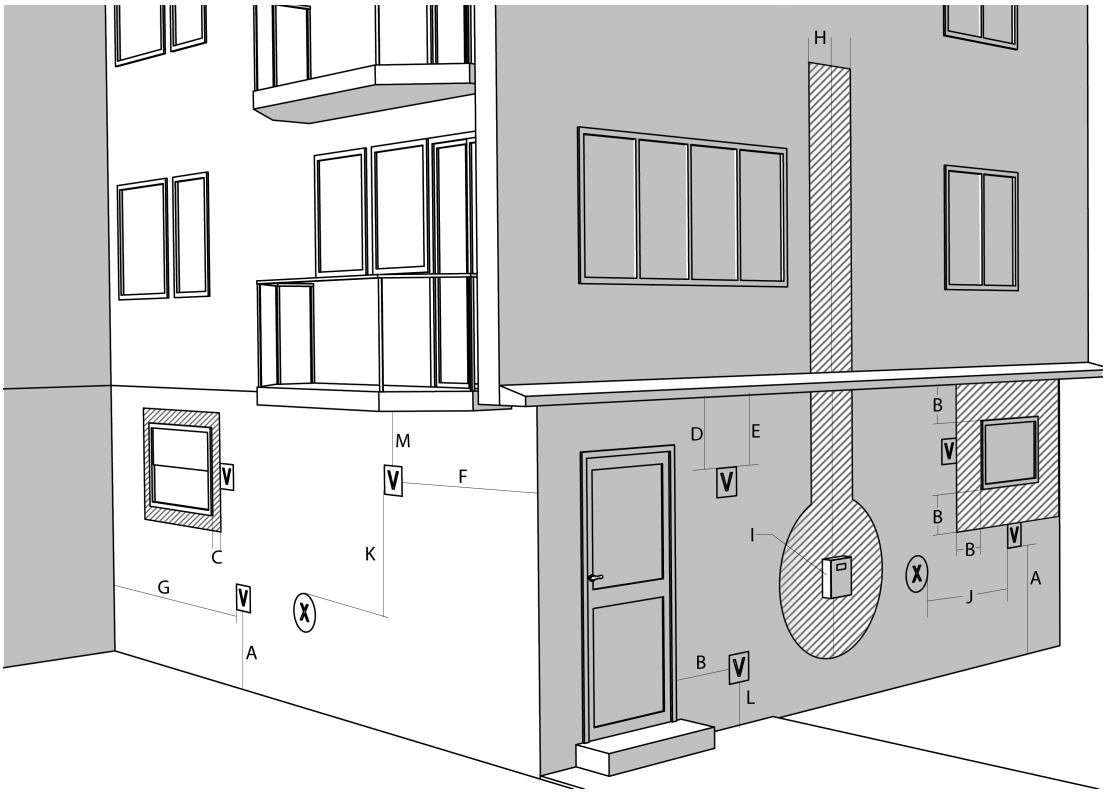


Figure 18 *Minimum clearances from vent/air inlet terminations*

V	Vent terminal
X	Air supply inlet
▨	Area where terminal is not permitted

	Description	Canadian Installations[1,2]	US Installations[2,3]
A	Clearance above grade, veranda, porch, deck, or balcony	12 in (30 cm)	12 in (30 cm)
B	Clearance to window or door that may be opened	12 in (30 cm) for appliances > 10,000 Btuh (3 kW) and ≤ 100,000 Btuh (30 kW), 36 in (91 cm) for appliances >100,000 Btuh (30 kW)	12 in (30 cm) for appliances > 50,000 Btuh (15 kW)
C	Clearance to permanently closed window	*	*
D	Vertical clearance to ventilated soffit located above the terminal within a horizontal distance of 2ft (61 cm) from the center line of the terminal	*	*
E	Clearance to unventilated soffit	*	*
F	Clearance to outside corner	*	*
G	Clearance to inside corner	4 ft (122 cm)	4 ft (122 cm)
H	Clearance to each side of center line extended above meter/regulator assembly	3 ft (91 cm) within a height 15 ft above the meter/ regulator assembly	*
I	Clearance to service regulator vent outlet	Above a regulator within 3 ft (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 non-mechanical air supply inlet to building or the combustion air inlet to any other appliance	12 in (30 cm) for appliances > 10,000 Btuh (3 kW) and ≤ 100,000 Btuh (30 kW), 36 in (91 cm) for appliances >100,000 Btuh (30 kW)	12 in (30 cm) for appliances > 50,000 Btuh (15 kW)

[1] In accordance with the current CAN/CSA-B149 Installation Codes.

[2] If locally adopted installation codes specify clearances different than those illustrated, then the most stringent shall apply.

[3] In accordance with the current ANSI Z223.1 / NFPA 54 National Fuel Gas Code.

* Clearances in accordance with local installation codes and the requirements of the gas supplier. The minimum distance from adjacent public walkways, adjacent buildings, openable windows, and building openings shall not be less than those values specified in the National Fuel Gas Code, ANSI Z223.1/NFPA 54, and/or the Natural Gas and Propane Installation Code, CSA 8149.1.

	Description	Canadian Installations [1,2]	US Installations [2,3]
K	Clearance to mechanical air supply inlet	6 ft (1.83 m)	3 ft (91 cm) above if within 10 ft (3 m) horizontally
L	Do not terminate above paved sidewalk or paved driveway	7 ft (2.13 m) [4]	Vents cannot be located above public walkways or other areas where condensate or vapor can cause a nuisance or hazard
M	Clearance under veranda, porch, deck or balcony	12 in (30 cm) [5]	See note[6]

Table 7 *Vent/air inlet termination clearances*

Sidewall direct vent with separate vent and air pipes must be terminated as follows:

- Locate the intake air and exhaust vent terminations on the same plane (side) of the building.
- Place the exhaust vent termination so that it reaches minimum 12" above the down-turned intake to avoid exhaust re-ingestion.
- (Optionally) Raise the elevation of exhaust termination “periscope style” after passing through the wall, to gain the required clearance as shown in *Figure 19* and *Figure 20* .
- Use a 45° elbow on the exhaust termination to launch the plume up and off the sidewall (for protection of wall). A short piece of venting cut at 45° gives a horizontal termination protected from wind loads (see *Figure 20* , and *Figure 22*).
- Recommended: the use of a bird screen of ¼" stainless steel or plastic mesh (IPEX System 636 drain grate) to guard against foreign objects.

[1] In accordance with the current CAN/CSA-B149 Installation Codes.

[2] If locally adopted installation codes specify clearances different than those illustrated, then the most stringent shall apply.

[3] In accordance with the current ANSI Z223.1 / NFPA 54 National Fuel Gas Code.

[4] A vent shall not terminate directly above a sidewalk or paved driveway that is located between two single family dwellings and serves both dwellings.

[5] Permitted only if veranda, porch, deck, or balcony is fully open on a minimum of two sides beneath the floor.

[6] Clearances in accordance with local installation codes and the requirements of the gas supplier. The minimum distance from adjacent public walkways, adjacent buildings, openable windows, and building openings shall not be less than those values specified in the National Fuel Gas Code, ANSI Z223.1/NFPA 54, and/or the Natural Gas and Propane Installation Code, CSA 8149.1..

Warning

Important!: Maintain at least the minimum separation of exhaust vent termination from boiler intake air as illustrated in *Figure 19* , *Figure 20* , *Figure 21* and *Figure 22* . Failure to maintain the minimum separation can result in a dangerous situation where exhaust gasses are re-ingested with combustion air. Damage to the boiler can result from a failure to maintain these separations. Third party vent termination kits and concentric wall penetration kits that do not maintain these minimum separations must **not** be used. Improper installation will void the warranty.

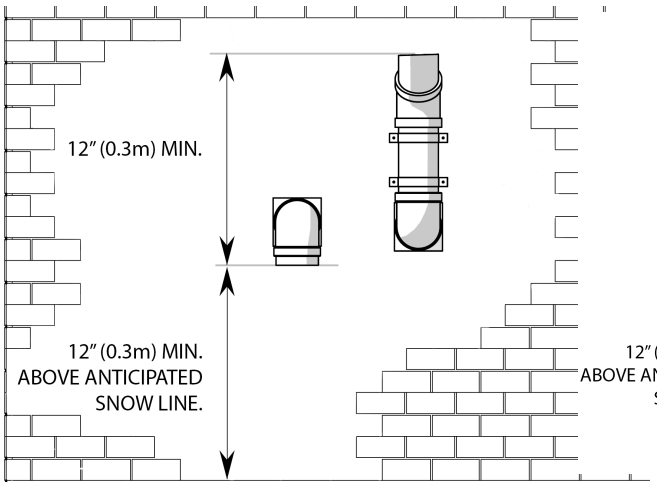


Figure 19 *Vent termination clearance--horizontal perforations*

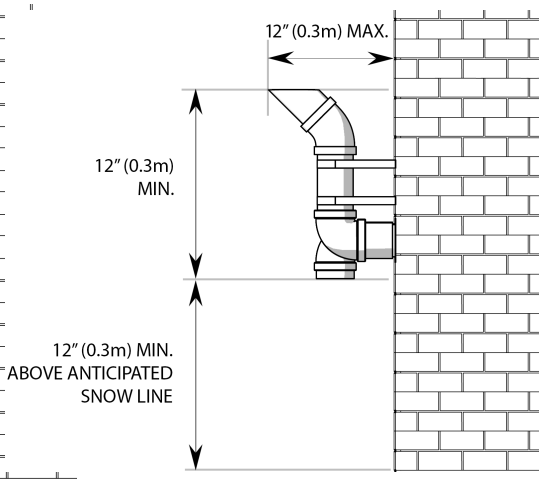


Figure 20 *Vent termination clearances--horizontal perforations, side view*

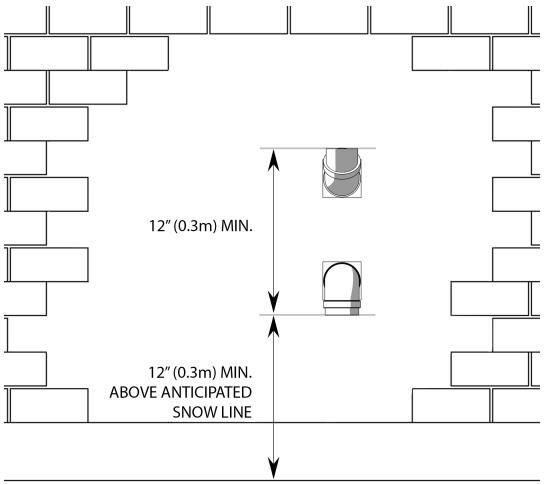


Figure 21 *Vent termination clearance--vertical alignment*

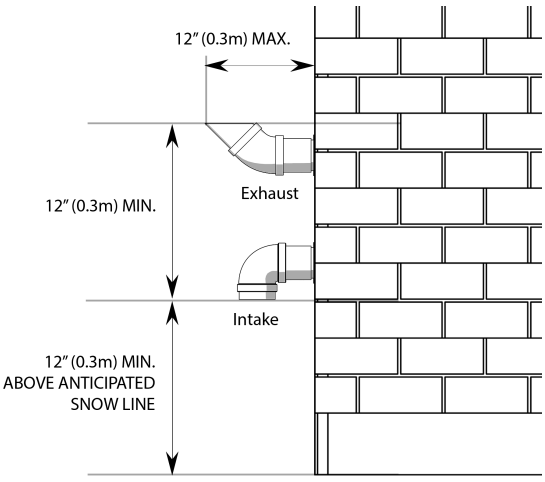


Figure 22 *Vent termination clearances--vertical alignment, side view*

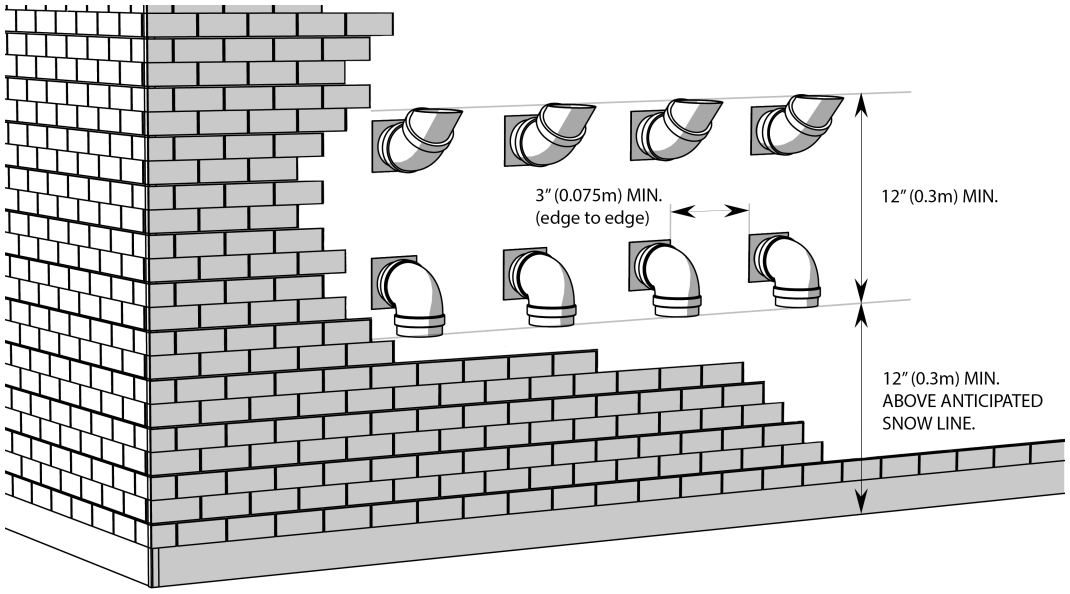


Figure 23 *Sidewall vent termination configuration option 1*

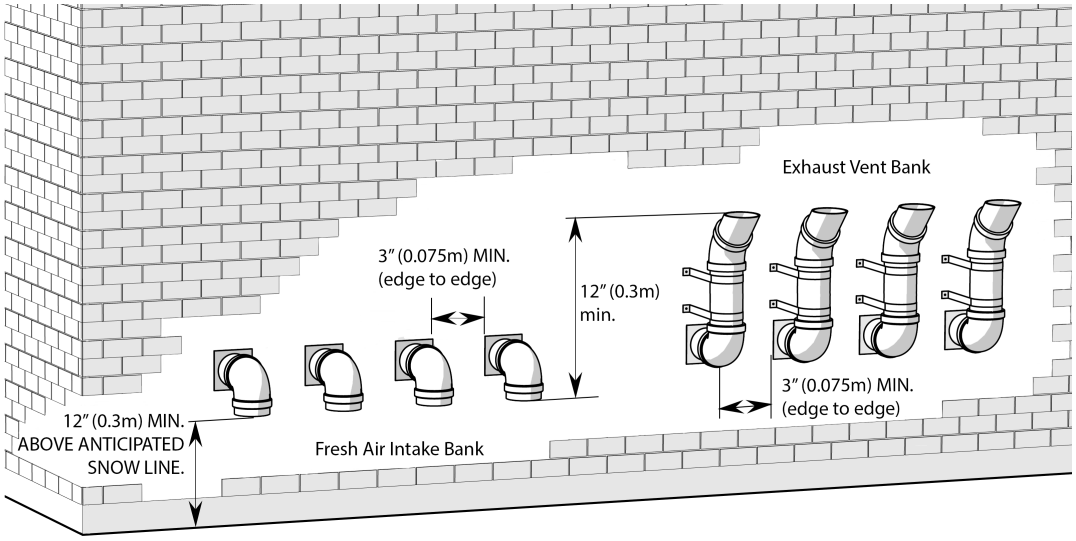


Figure 24 *Sidewall vent termination configuration option 2*

Sidewall direct vent with stainless sidewall terminal must be terminated as follows:

- The Stainless Sidewall Terminal (SST) 3 inch (P-257) is approved for use with all boilers when the equivalent length calculation (for exhaust) in *Air intake and exhaust vent length allowance on page 24* is used. The SST 2 inch (P-256) is approved for use with the Boiler 85 and the Boiler 115.

- Install the SST to comply with the minimum vent clearances listed in *Table 7 on page 31*.
- Install the SST with the vent and intake pipes horizontally beside each other or vertically with the vent pipe on top. The vent pipe cannot be installed below the intake. The vent cap must be installed with the openings directed up and down (see *Figure 25*), and not side to side.

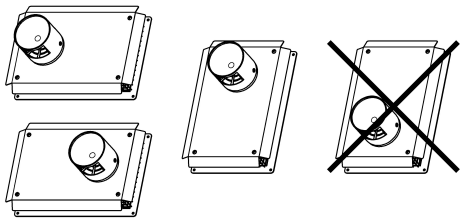


Figure 25 *Allowed SST installation orientations*

- The SST vent/air connections fit Sched. 40 PVC/CPVC pipe. PP pipe cannot be used with the SST. The pipes must extend completely through the wall as shown below. The SST is an external fixture, and is not part of the sealed vent system that runs inside the building.

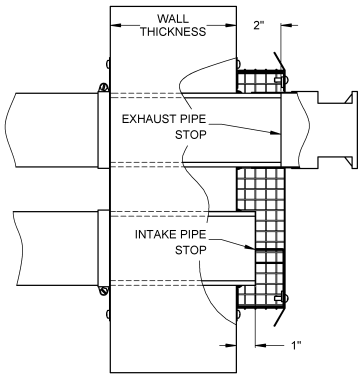


Figure 26 *Pipes extend completely through the wall (Vertical orientation shown)*

- Ensure that the vent termination location does not exceed the allowed maximum equivalent vent length, including the allowance for the SST (*Figure 27*).
- Install multiple vent SST installations level with one another and maintain at least the minimum separation distances shown below. The terminals shall not be stacked vertically (*Figure 28*).

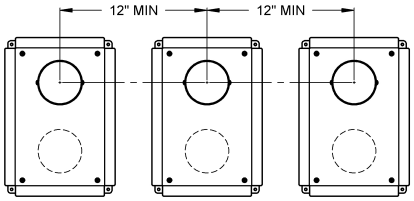


Figure 27 *Minimum separation for multiple vent installation - vertical orientation*

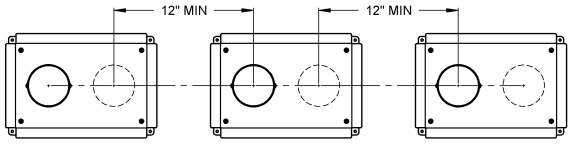


Figure 28 *Minimum separations for multiple vent installation - horizontal orientation*

Approved PVC Side Wall Termination kits are listed below:

- Ipex # 196984 2" (Boiler 85, Boiler 115)
- Ipex # 196985 3"

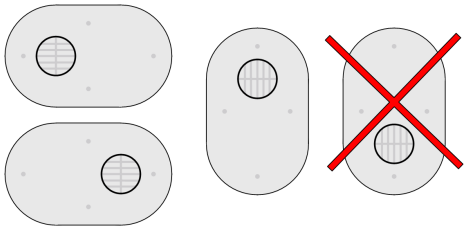


Figure 29 *Approved PVC Side Wall Termination configuration*

Warning

In areas of high snowfall, users must be advised to check side wall vent and air intake terminations on a regular basis to ensure blockage does not occur.

- Where an exhaust passes through a sidewall too close to a soffit, the venting must extend past the soffit by transitioning to vertical as shown in *Figure 30*..

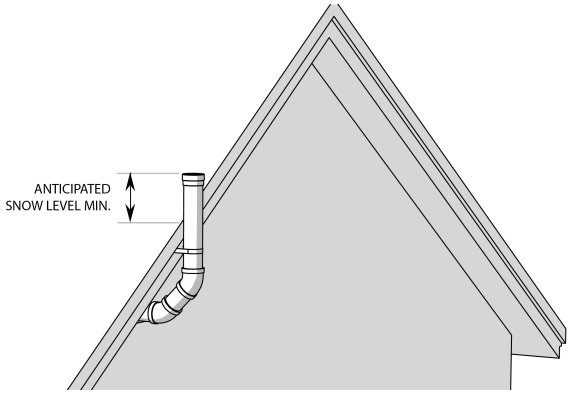


Figure 30 *Sidewall vent termination transition to vertical to clear soffit*

4.7.7 Combustion air filtration system

If combustion air is subject to particulate contamination, an optional air intake filter may be installed. The *P-357* air intake filter is equivalent to 8 feet of straight pipe in the boiler's intake air venting.

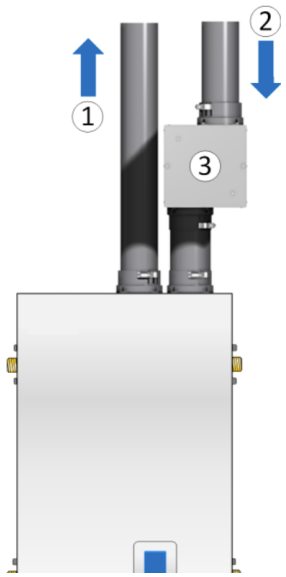
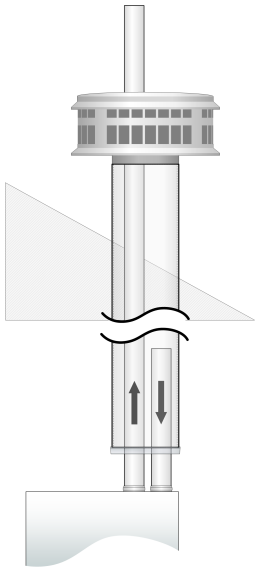


Figure 31 *Direct vent - intake, exhaust system with optional air intake filter (filtration may also be used on indoor air applications as required)*

1	Flue gas exhaust to outdoors
2	Combustion air in - check air intake outside to make sure it is clear of obstructions. 3" Schedule 40 pipe.
3	Air intake filter - P-357. Check and clean air filter regularly.

4.7.8 Using an existing vent as a chase

Existing, de-commissioned venting can serve as a chase to greatly simplify the venting of a retrofit boiler. B-vent from a replaced atmospheric boiler can be used as a chase for a boiler's exhaust venting and also a source for its intake air, as illustrated, if the chase vent meets the minimum size shown below.



Exhaust chase / intake air vent size	
Boiler vent requirement	**Chase vent minimum**
2 "	4"
3"	6"
4"	7"
6"	10"

Table 8 *Minimum vent sizes for exhaust chase and intake air*

Figure 32 *Using an existing vent as a chase for exhaust venting and intake air supply*

Refer to Rheem.com for a Technical Note on details that must be observed.

Information is also given on using an existing vent as a chase to vent multiple boilers.

4.8 Closet installations

For installations in a confined space (such as a closet), ventilation openings may be needed through a door or wall to prevent excessive heat from building up inside the space.

The appliance must not be exposed to surrounding air above 122°F (50°C) or below 32°F (0°C).

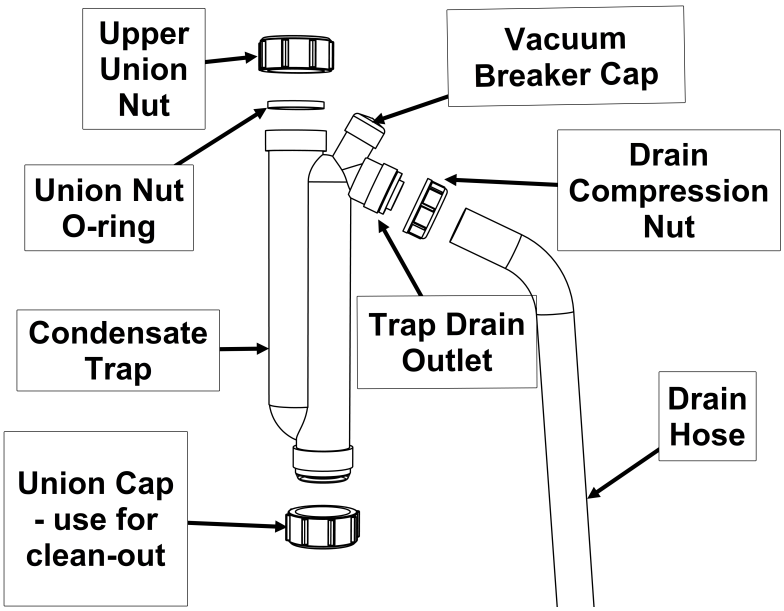
4.9 Installing the condensate trap

The vent configuration promotes the safe drainage of moisture from the boiler and exhaust venting without flowing liquids back through the heat exchanger (as done by some other condensing boilers).

Warning

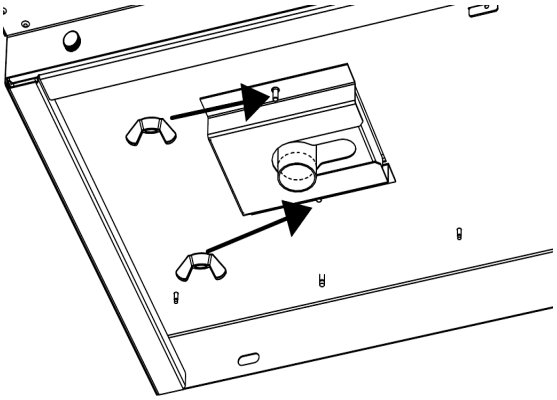
Fill the trap with water before initially firing the boiler to prevent exhaust fumes from entering the room. Never operate the boiler unless the trap is filled with water. Failure to comply will result in severe personal injury or death.

- Ensure the supplied trap is correctly installed and filled with water.
- When required, add (and maintain in good condition) a neutralization tank. For information on neutralizers, see *Installing a condensate neutralizer on page 40*.

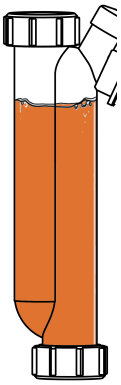


The condensate trap must be installed on the drain connection at the base of the boiler. The condensate drain must be piped to within 1 inch of a drain or connected to a condensate pump. The drainage line must slope down to the drain at a pitch of ¼ inch per foot so condensate runs towards the drain.

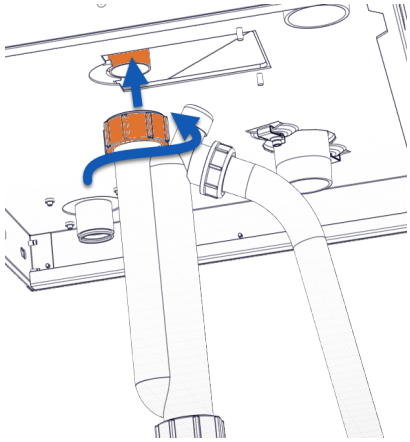
1. To remove the condensate retainer, undo the two wing nuts, and put aside.



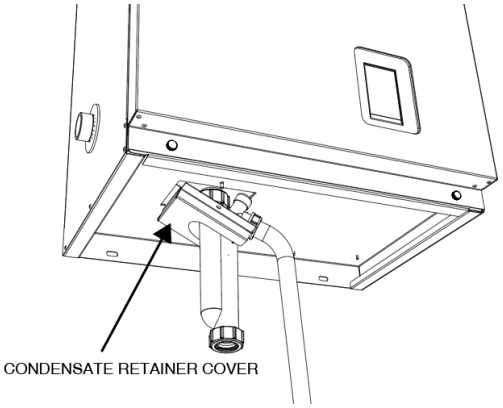
2. Fill the condensate trap with water, and ensure that the bottom union cap is hand-tightened to prevent leakage.



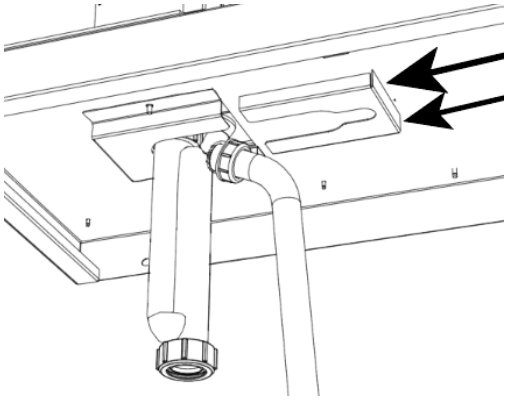
3. Loosen the upper union nut, and slide the trap over the boiler drain outlet, and then tighten the upper union nut.



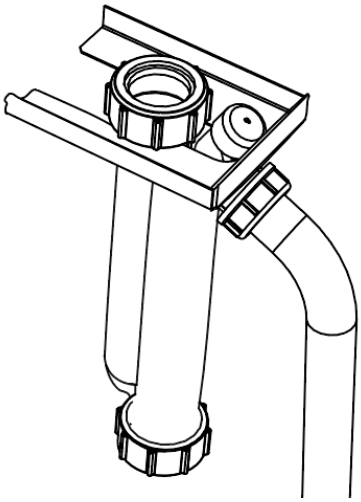
4. To reinstall the condensate retainer, tilt the retainer to enable you to slide the tab under the chassis of the boiler.



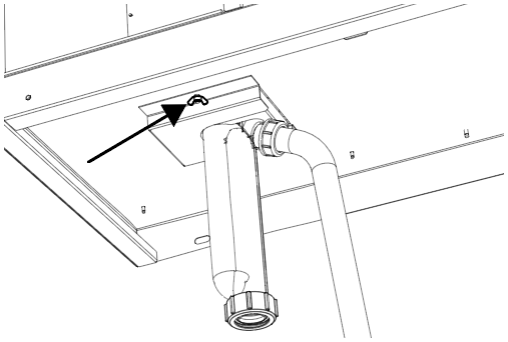
5. Slide the condensate retainer into the retainer cover.



Ensure that the condensate retainer fits securely below the condensate nut.



6. Screw the nuts onto the studs to secure everything in place.



Condensate drainage: The drain hose should run to a suitable drain or condensate neutralize. Free flow of condensate from venting systems and pressure vessel must be maintained at all times. Trap and condensate drain piping must be accessible to allow regular inspection and cleaning.

4.10 Installing a condensate neutralizer

Caution – risk of serious property damage

If drain material is subject to corrosion (e.g. cast iron or copper), an acid neutralizer MUST be installed before the drain.

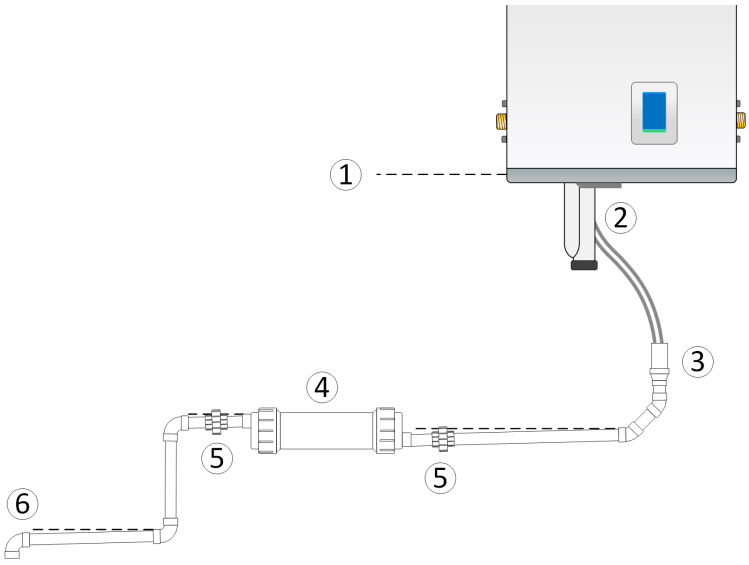


Figure 33 *Condensate neutralization tank*

1 Condensate water line: All condensate discharge lines, including neutralization tank inlet,

must be at a lower elevation than the condensate water line in order to avoid damage to appliance.

2	Factory-supplied condensate trap
3	Plastic piping
4	Condensate neutralizer. Refer to the neutralization instructions of the manufacturer. Access to the discharge before the drain is necessary for proper maintenance, which includes checking the effectiveness of the neutralizing agent.
5	Inlet and outlet unions for ease of maintenance.
6	To drain. Confirm slope to drain. Secure to prevent accidental disassembly.

Danger

The water in the condensate neutralizer can cause severe burns to the skin. Do not use hands to stir material. Wear protective gloves and eye wear when servicing the condensate neutralizer.

Caution

After installing a condensate neutralization package, a simple pH test should be performed annually to ensure neutralizing agent is still effective. If the pH falls below 6.5 the neutralizing material should be replaced. The agent (limestone chips minimum 85% calcium carbonate) can be purchased from a local supplier.

4.11 Water Piping

Warning

Water quality has a significant impact on the lifetime and performance of a boiler's heat exchanger. Improperly prepared water in a heating circuit may cause damage to the heat exchanger through fouling or corrosion.

Dissolved solids or minerals precipitate onto the hottest part of the heat exchanger, impairing heat transfer and service life. A large volume of water with a low hardness may cause as much damage as a small volume with high hardness, so for systems over 40 gallons it is recommended to reduce total dissolved solids (TDS) to 10–30 ppm (before the introduction of inhibitors or glycol).

Water Chemistry Limits	Site Volume:
Hardness between 1 and 9 grains	grains
TDS between 10 and 150 ppm	TDS
Acidity pH between 6.6 and 8.5	pH
Chloride less than 125 mg/l	mg/l
Iron less than 0.3 mg/l	mg/l
Copper less than 0.1 mg/l	mg/l
Conductivity between 20 and 300 µS/cm at 77°F (25°C)	µS/cm

Important: Ensure that these limits are acceptable for the other water-side components in the system.
Uncontrolled water fills are not permitted.

Boilers can be connected directly to a floor of non-oxygen barrier polybutylene material (PB tubing). For maintenance of warranty on such systems, all loops must be flushed thoroughly, and a dirt separator or side stream filter must be installed. After the retrofit, a separator / filter maintenance routine must be performed, with filter clearing as needed including after the first day, first week, month, annually thereafter. Ferrous fitting and pumps must not be used on non-oxygen barrier tube systems.

Boiler Head Loss - Boiler 85, Boiler 115							
Flow rate	2 gpm	4 gpm	6 gpm	8 gpm	10 gpm	12 gpm	14 gpm
Head @ flow	0.5 ft	1.5 ft	2.5 ft	3.0 ft	4.0 ft	4.5 ft	6.0 ft

Table 9 *Boiler 85, Boiler 115 Boiler Head Loss*

Boiler Head Loss - Boiler 160							
Flow rate	4 gpm	6 gpm	8 gpm	10 gpm	12 gpm	14 gpm	16 gpm
Head @ flow	0.5 ft	1.0 ft	1.5 ft	2.0 ft	3.0 ft	4.0 ft	5.0 ft

Table 10 *Boiler 160 Boiler Head Loss*

Boiler Head Loss - Boiler 199					
Flow rate	6 gpm	10 gpm	15 gpm	20 gpm	22 gpm
Head @ flow	2.0 ft	3.5 ft	5.5 ft	8.0 ft	13.0 ft

Table 11 *Boiler 199 Boiler Head Loss*

Ensure that the pump is rated for the design circulating water temperatures; some pumps have a minimum water temperature rating above the low temperature potential of the boiler. Following installation, confirm the actual performance by measuring Δ°T (under high and low flow conditions) after establishing the correct firing rate.

After a call for heat is satisfied, there can be a significant amount of residual heat contained in the heat exchanger. This residual heat is utilized by a feature called pump post-purge. Default settings will run the primary pump for up to 5 minutes after a call for ht is completed. Secondary pumps can be configured to run up to 15 minutes after a call for heat is completed. However, secondary pumps should only be configured to do so when zone valves are not used, as this will protect the pump from deadheading when the zone valves are closed. In order for built-in pump-purge to operate, boiler and system pumps must be under the control of the boiler.

Propylene glycol usage

Warning

Do not use automotive-type ethylene or other types of automotive glycol antifreeze, or undiluted antifreeze of any kind. This may result in severe boiler damage. It is the responsibility of the Installer to ensure that glycol solutions are formulated to inhibit corrosion in hydronic heating systems of mixed materials. Improper mixtures and chemical additives may cause damage to ferrous and non-ferrous components as well as non-metallic, wet components, normally found in hydronic systems. Ethylene glycol is toxic, and may be prohibited for use by codes applicable to your installation location. For environmental and toxicity reasons, it is recommended to use only using non-toxic propylene glycol.

Propylene glycol solution is commonly used in a closed loop where freeze protection is required. Its specific gravity is lower than that of water, resulting in lower thermal performance at a given flow and pressure. Generally, a 50:50 solution of propylene glycol and water requires an increased system circulation rate (gpm up 10%), and system head (up 20%) to provide performance equivalent to straight water.

4.11.1 General piping best practices

Primary/secondary piping, or the use of a hydraulic separator (such as the Caleffi 549 SEP4™ 4-in-1 Magnetic Hydraulic Separators) is recommended for maximum flexibility in multi-load applications. Piping loads in parallel is also encouraged in systems that only have two loads, or when loads are operating simultaneously. The extremely low pressure drop through the heat exchanger affords more flexible options unavailable in other designs.

Caution

Contact local water purveyors about the suitability of the supply for use in hydronic heating systems. If unsure about water quality, request testing and assessment (and treatment, if required) from a local water treatment expert. Alternatively, water or hydronic fluid of known quality can be brought to the site.

4.11.2 System piping

Note

The piping drawings in this manual are simple schematic guides to a successful installation. There are many necessary components not shown, and details such as thermal traps are left out so the drawings have greater clarity. Boilers must be installed by licensed and experienced heating professionals familiar with the applicable local and national codes. System design is to be completed by an experienced hydronic designer or engineer. You should carefully read and follow the installation instructions along with the application drawing that fits your system.

System piping is connected to the boiler using 1 inch NPT-Male threaded fittings on the right or left side connection ports. To simplify servicing, we recommend using unions or ball valves at the boiler's supply and return water connections.

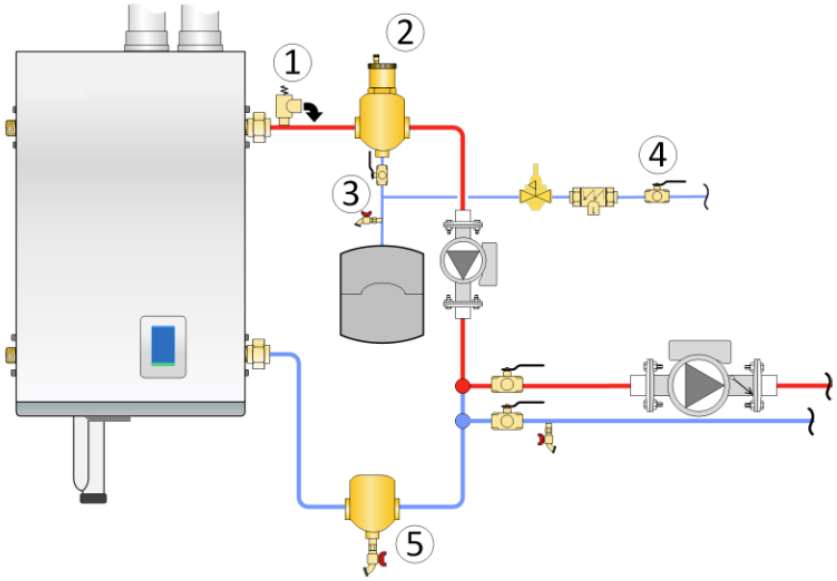


Figure 34 *Basic boiler trim options*

1	Relief valve (required). No isolation valve permitted between boiler and relief valve
2	Microbubble air eliminators should be installed as close as reasonably possible to the supply outlet of the boiler.

3	Expansion tank connection should be on the suction side of the circulator, with minimal pressure drop between.
4	Fill station with isolation valve closed, or fill tank.
5	Dirt separator recommended

Fluid fill is most often accomplished by using a boiler regulator and fill valve set at 12 psig or higher, with the appropriate backflow prevention device as required by local code. This is acceptable in areas where municipal water or well water has been treated and filtered to remove excessive minerals and sediment, and water chemistry is known to be suitable for closed loop hydronic systems. In areas where water quality is in question, or when chemical treatment or glycol is required, other options should be considered. Follow the applicable codes and good piping practice.

Warning

Close the fill valve after any addition of water to the system, to reduce risk of water escaping.

There are a number of boiler feed and pressurization devices on the market that may be a better choice than a raw water fill from the mains. When regular maintenance requires relief valve blow-off, the discharge may be directed back into the pressurization appliance for recycling of boiler fluid and chemicals back into the system.

In buildings that may be unoccupied for long periods of time, pressurization appliances are useful to prevent flood damage should leakage occur from any component in the system. An additional benefit is that backflow prevention devices are not required when using these devices.

Do not place any water connections above the boiler to avoid damage to the fan and controls. If needed, create a shield over the top of the cover, but allow clearance for airflow and service access.

Note

Note that the supply pipe off the right-hand side of the heat exchanger carries the LWCO device. If all heating loads are on the left-hand side only, ensure that the right-hand supply connections use an auto air vent or a flushing valve.

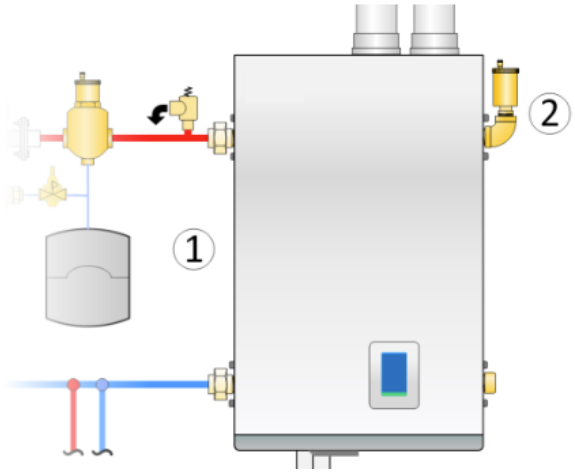


Figure 35 *When piping off left side only, install an air vent on the right*

1	Heating supply and return
2	Auto air vent (*P-195C*) or flushing valve

Due to the various piping options available, positioning the pressure relief valve can vary.

These boilers are designed for use within a closed loop, forced circulation, low pressure system. A 30 psi pressure relief is supplied for field installation in the relief valve fitting on the boiler. Relief valve discharge piping must terminate between 6 inches (15 cm) and 12 inches (30 cm) above the floor or per local code.

Warning

During operation, the relief valve may discharge large amounts of steam and/or hot water. To reduce the potential for bodily injury and property damage, install a discharge line that:

- Is connected from the valve outlet with no intervening valve and directed downward to a safe point of discharge.
- Allows complete drainage of both the valve and the discharge line.
- Is independently supported and securely anchored, so as to avoid applied stress on the valve.
- Is as short and straight as possible.
- Terminates freely to atmosphere where any discharge will be clearly visible and is at no risk of freezing. terminates with a plain end which is not threaded.
- Is constructed of a material suitable for exposure to temperatures of 375° F or greater.
- Is, over its entire length, of a pipe size equal to or greater than that of the valve outlet.

Do not cap, plug or obstruct the discharge pipe outlet.

If piping from both sides at the same time, a relief valve must be installed on either supply outlet, immediately on exiting the boiler so that there is no possibility of installing an isolation valve between the pressure vessel and the relief valve.

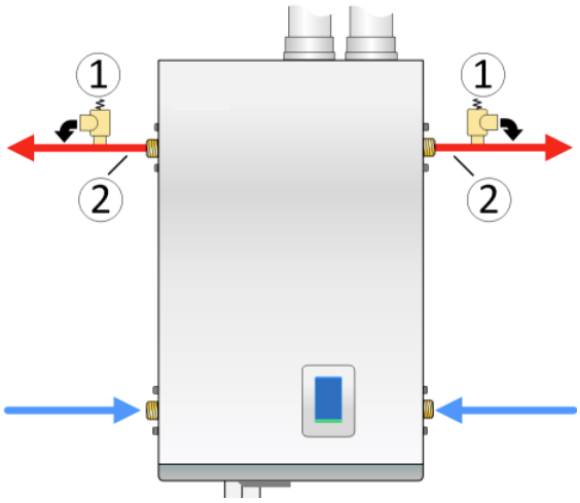


Figure 36 *Relief piping with dual side piping connections*

1	Pressure relief valve locations (pick one)
2	No shut-off valve

Primary-Secondary piping

For best results use a primary / secondary piping configuration, ensuring that the primary (boiler) loop is adequately sized. Primary/Secondary piping ensures adequate flow and de-couples ΔT issues (boiler vs. distribution). It also adds to the system's thermal buffering, to assist in handling small loads and temperature transition. Aim for a 20°F to 30°F ΔT across the heat exchanger at high fire, as there is a boiler protection throttle fence limiting the ΔT to 40°F.

These boilers are designed to supply four different heating loads with temperatures within the range 34°F to 180°F - to meet four separately piped loads. Use closely-spaced tees to connect each pumped load (e.g. DHW, baseboards or radiant floor) to the primary loop, or employ the use of a hydraulic separator to isolate the boiler loop from the system and pipe the system from the secondary side of the separator.

In primary / secondary piping, the boiler pump is sized for the boiler loop only. For the model Boiler 115; the heat exchanger head loss is only 1.5’ at 4 gpm and approximately 4’ at 10 gpm. Ensure that the pump is rated for the design circulating water temperatures; some pumps have a minimum water temperature rating above the low temperature potential of the boiler. Following installation, confirm the actual performance by measuring Δ°T (under high and low flow conditions).

Check valves or thermal traps should be used to isolate both the supply and return piping for each load - to avoid thermal siphoning and reverse flow.

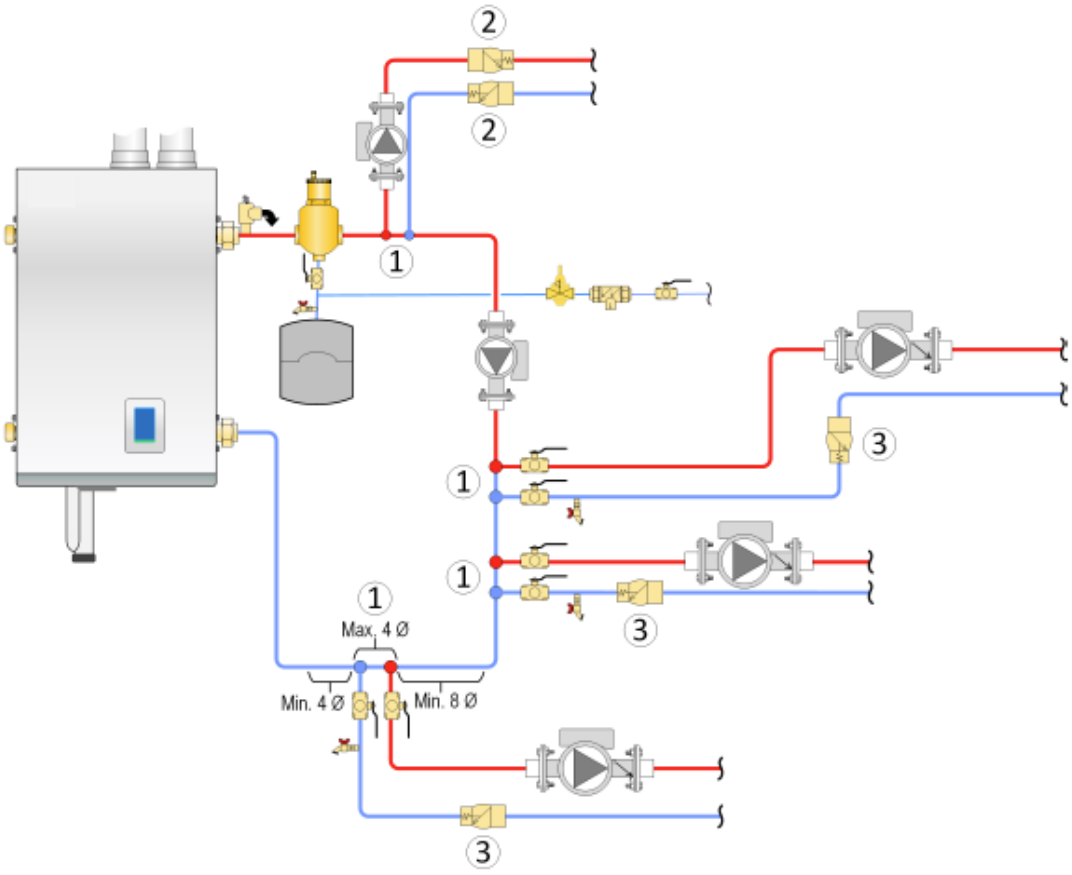


Figure 37 *Primary-secondary piping details with closely-spaced tees*

1	Closely-spaced tees, installed with straight piping a minimum of 8 pipe diameters upstream and 4 pipe diameters downstream, with tees as close together as possible, maximum four pipe diameters (no restrictions between).
2	Heat Migration: on secondary loops that extend vertically to a load above the primary loop, use check valves on both supply and return of secondary piping.
3	Check valves or zone valves on return.

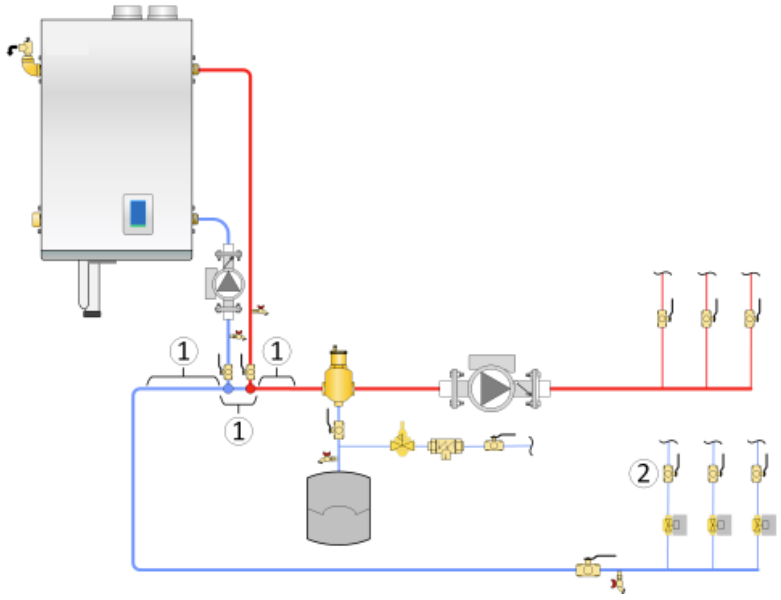


Figure 38 *One-temperature space heating - tees on secondary piping*

1	Closely-spaced tees (see *Primary-secondary piping details with closely-spaced tees on page 49*
2	Optional

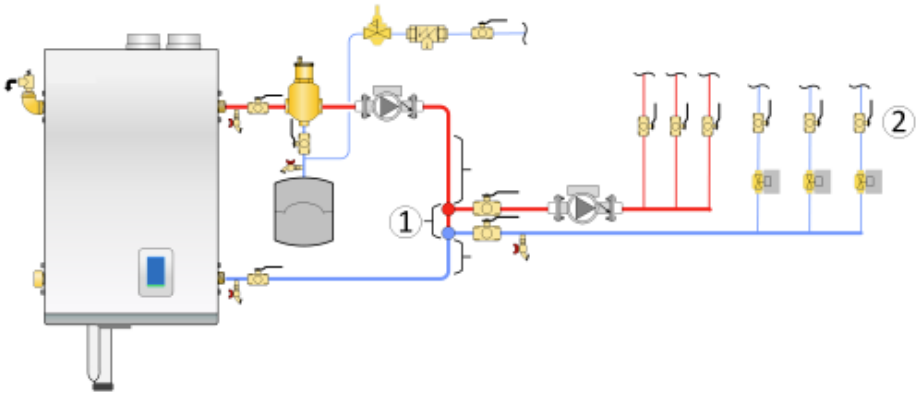


Figure 39 *Typical one-temperature space heating piping concept*

1	Closely-spaced tees (see *Primary-secondary piping details with closely-spaced tees on page 49*
2	Optional

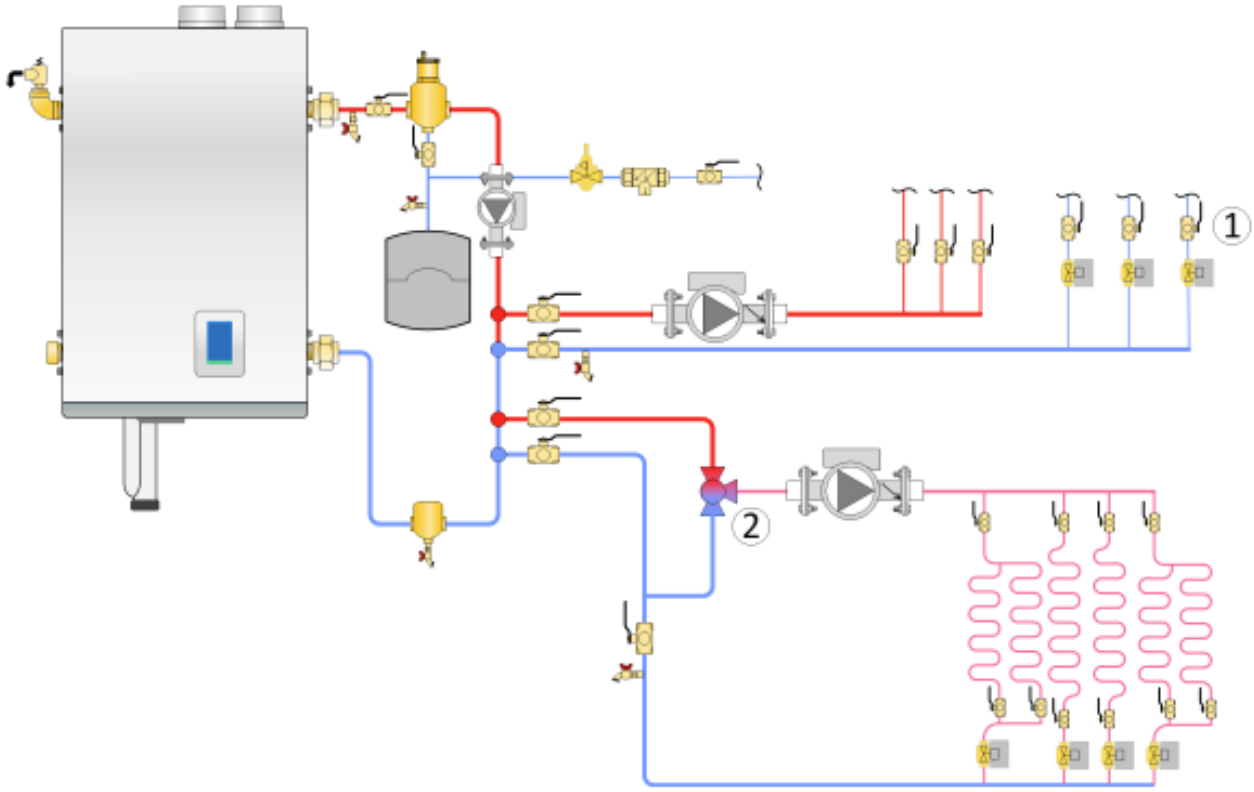


Figure 40 *Typical two-temperature space heating piping concept.*

1	Optional isolation valve
2	Thermostatic mixing valve to permit simultaneous operation with high-temperature space-heating

A parallel piped load (e.g. DHW) can also be incorporated using our unique dual side piping configuration. A benefit when using external pump / zone relay controls is that during priority DHW these do not need to shut down (as the boiler pump pauses circulation through the heat exchanger).

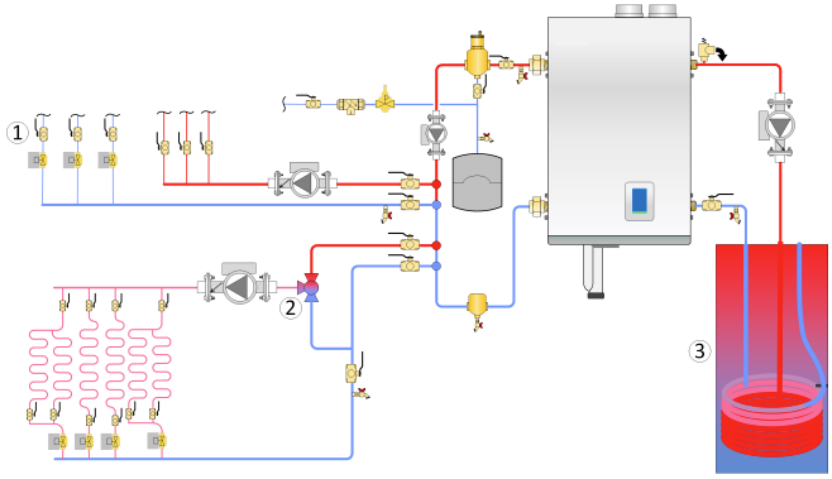


Figure 41 *Two sided piping, DHW and space heating - piping concept*

1	Optional
2	Thermostatic mixing valve
3	Indirect DHW tank

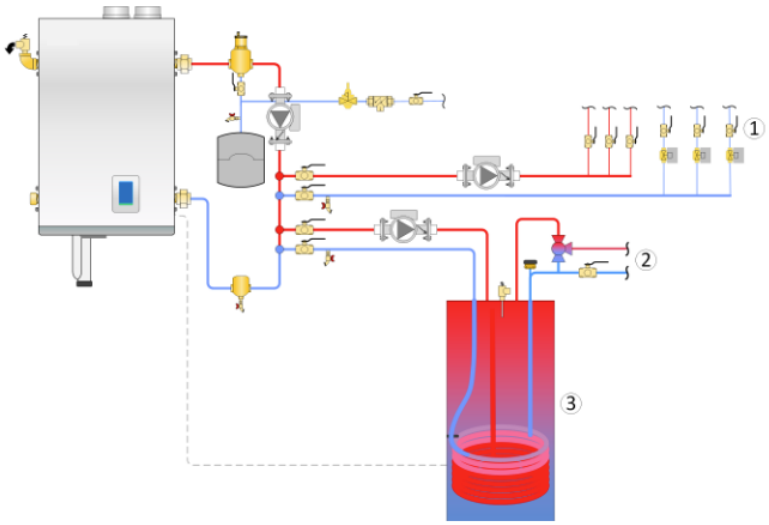


Figure 42 *Indirect domestic hot water - piping concept*

2	Domestic water, hot and cold: A thermostatic DHW tempering valve may be required by local code.
3	Indirect hot water tank

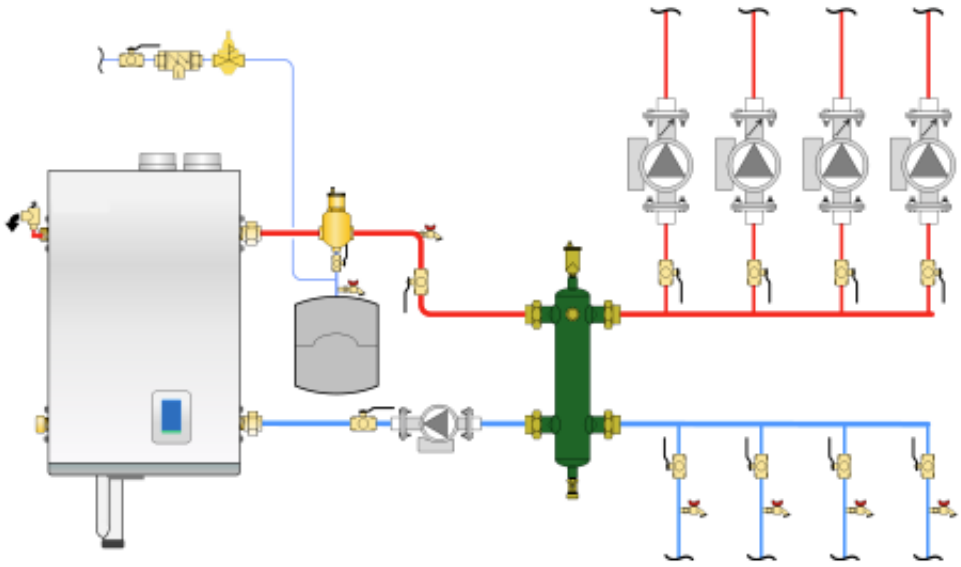


Figure 43 *Basic primary-secondary piping with hydraulic separator - piping concept*

Parallel load piping

Compared with the primary-secondary approach, the design below saves one pump.

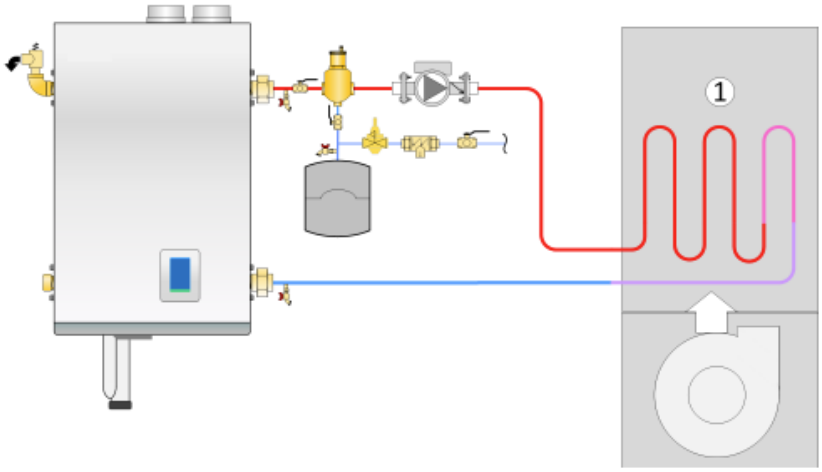


Figure 44 *One pump parallel piping concept*

1 Air handler

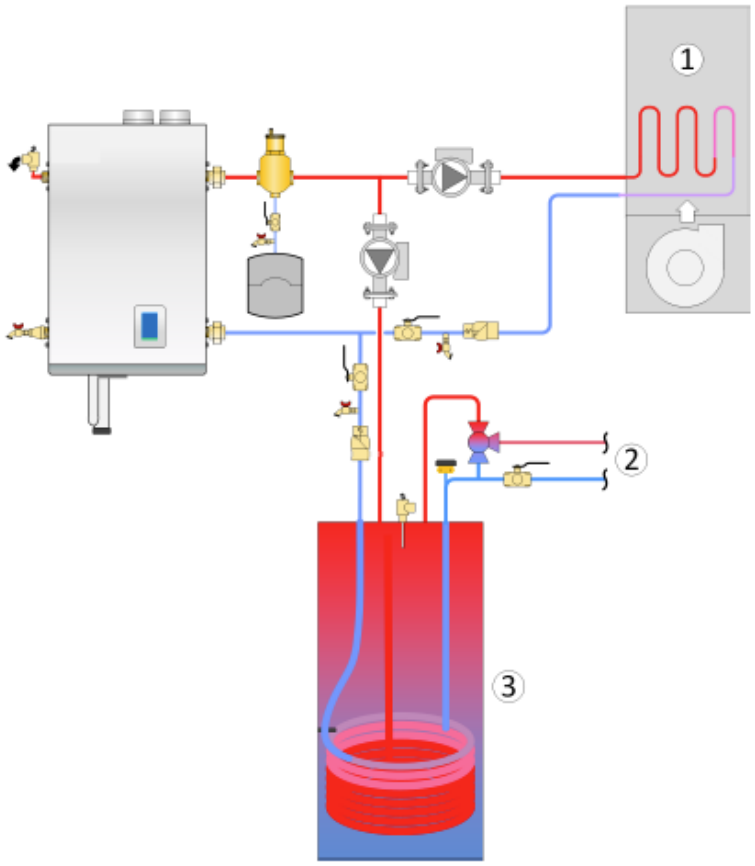


Figure 45 *Two pump, two load parallel piping concept*

1	Air handler
2	Domestic water, hot and cold: a thermostatic tempering valve for DHW may be required by local code.
3	Indirect hot water tank

In order to ensure appropriate flow of water through the boiler in the case of high pressure drops or heating of a single zone, it may be necessary to install a pressure-activated bypass device on any circuit where the flow rate could drop below the minimum requirements.

Multiple-boiler piping

Multiple boilers can be installed together to provide redundancy, greater output, and wider turn-down capabilities. Primary-secondary piping must be employed, and each boiler must be installed with its own pump as illustrated below. This approach provides constant head and flow at each boiler, regardless of flow variations in the main building loop.

One boiler control is set up as a "Master" boiler, and up to 23 additional boilers can be added to the system as "Subordinate" boilers. No additional controls are needed.

Check valves are used in each boiler's piping to prevent reverse flow when the boiler is off.

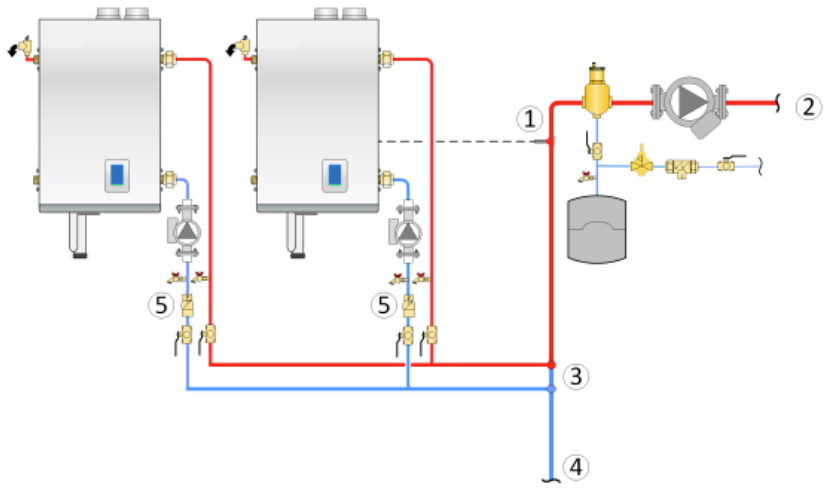


Figure 46 *Multiple boiler piping concept*

1	Secondary loop sensor to Master boiler
2	To building
3	Closely spaced tees (see *Primary-secondary piping details with closely-spaced tees on page 49*
4	From building
5	Check valves

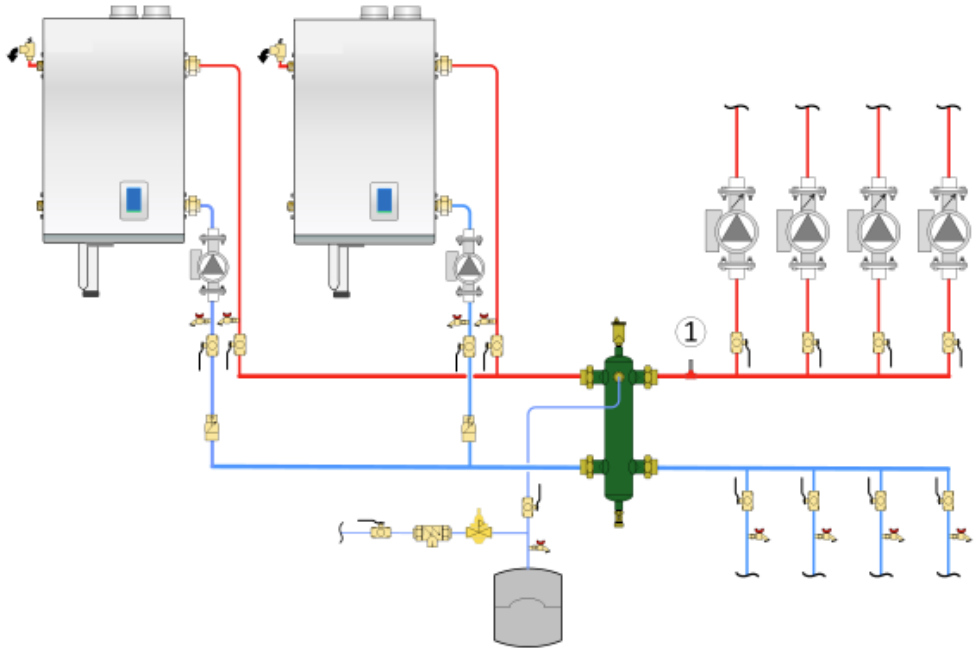


Figure 47 *Multiple boiler low loss header - piping concept*

1 Secondary loop sensor to Master boiler

4.12 Gas piping

Note

Due to the precision of modern modulating boilers it is important to pay special attention to gas pressure regulation.

Important: Check gas supply pressure to each boiler with a manometer or other high-quality precision measuring device. Pressure should be monitored before firing the boiler, during operation throughout the boiler's full modulation range, and after the call when the regulator is in a "lock-up" condition.

Pay special attention to retrofit situations where existing regulators may have an over-sized orifice and/or worn seats, causing pressure “creep” and high lock-up pressures. A high quality regulator will maintain constant pressure above the boiler’s minimum specification at all firing rates, and will not exceed the boiler’s maximum pressure rating when locked-up with no load.

4.12.1 Gas pressure

The boilers require a minimum inlet gas supply pressure of 4.0" w.c. for natural gas or propane during high fire operation. For either fuel, the inlet pressure shall be no greater than 14.0" w.c. Confirm this pressure range is available with your local gas supplier.

The inlet gas connection to the boiler is ½" NPT (female).

Adequate gas supply piping must be installed with no smaller than ½" Schedule 40 (e.g., Iron Pipe Size (IPS) and using a 1" w.c. pressure drop, in accordance with the following table.

Maximum Pipe Length (ft)					
Model		½ inch IPS	¾ inch IPS	1 inch IPS	1¼ inch IPS
Boiler 85,Boiler 115	Natural Gas	30 ft	125 ft	400 ft	-
Boiler 160	Natural Gas	10 ft	70 ft	200 ft	-
Boiler 199	Natural Gas	10 ft	40 ft	150 ft	600 ft

Table 12 *Maximum Gas Pipe Length (ft)*

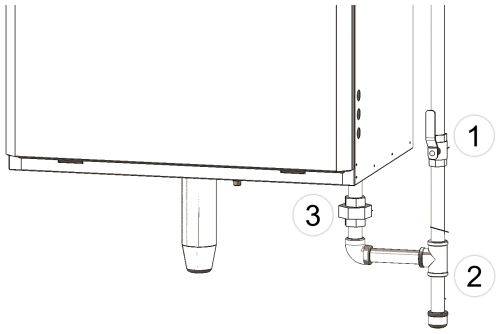


Figure 48 *Typical gas piping*

1	Install manual shut-off valve. Check local code for height requirement
2	Full-sized sediment trap
3	Union

Gas piping must have a sediment trap ahead of the boiler's gas valve. A manual shutoff valve must be located outside the boiler, in accordance with local codes or standards. All threaded joints in gas piping should be made with an approved piping compound resistant to the action of natural gas or propane. Use proper hangers to support gas supply piping as per applicable codes.

The boiler must be disconnected or otherwise isolated from the gas supply during any pressure testing of the system at test pressures in excess of ½ psig. Dissipate test pressure prior to reconnecting. The boiler and its gas piping must be leak-tested before being placed into operation.

The gas valve is provided with pressure taps to measure gas pressure upstream (supply pressure) and downstream (manifold pressure) of the gas valve. Note that manifold pressure varies slightly in accordance with firing rates with the modulating series boilers, but will always be close to 0" wc.

4.13 Electrical connections

All electrical wiring to the boiler (including grounding) must conform to local electrical codes and/or to the National Electrical Code, ANSI/NFPA No. 70 – latest edition, or to the Canadian Electrical Code, C22.1 - Part 1.

4.13.1 Power management, quality and electrical protection

In areas of unreliable power, appropriate surge protectors and or power conditioning equipment should be installed in power supply wiring circuits.

Note

The boiler (like any modern appliance that contains electronic equipment) must have a “clean” power supply, and is susceptible to power surges and spikes, lightning strikes and other forms of severe electrical “noise”. Power conditioning equipment (surge protectors, APC or UPS devices) may be required in areas where power quality is suspect.

In temporary or manual operation, for example in new construction heating, use a construction thermostat or jumper with an in-line on/off switch for on/off management of the boiler. **Do not** turn off the heat by removing power to the boiler. This will interrupt the moisture management routine (fan turns at ultra low rpm for 90 minutes after burner shutdown) resulting in serious damage to the boiler. Treat the boiler like a computer, where you do not just pull the plug when done.

4.13.2 120VAC line-voltage hook-up

Line-voltage wiring is done within the field-wiring box (see *Wiring diagrams on page 99*). Connect the boiler to the grid power using a separate, fused circuit and on/off switch within sight of the boiler. Use 14-gauge wire in BX cable or conduit properly secured to the boiler case for mains supply and pump circuits.

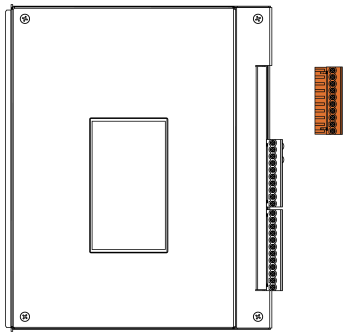


Figure 49 *Line voltage load pump terminals*

Caution

The on-board controller load pump relays are protected with 5 Amp fuses. The maximum recommended load on each fuse is 4 Amps (80% of rating). The maximum combined pump load is 10 Amps. Isolation relays or contactors **must** be used if the loads exceed these maximums.

Connect a 120VAC / 15 amp supply to the "AC IN" tagged leads in the wiring box. The maximum actual draw (with five typical residential size pumps) is less than 4 amp.

Load pumps

The 120 VAC power supply to the load pumps (P/V1, P/V2, P/V3, and P/V4) has been factory installed and connected to P/V-L and P/V-N for your convenience. The upper 4 pairs of contacts on this connector strip (labelled TB1) are then powered to manage up to 4 load pumps – the top pair for Load 1, the second pair for #2 etc. Once the controller is programmed for the respective loads, the boiler manages all the loads without need of further relays, for loads up to 1/3 HP. For loads drawing over 1/3 HP, use a protective relay.

Boiler pump

The boiler pump (primary pump) is powered by the white / yellow wire from the pair labeled "Boiler Pump" (Primary Pump). This lead is factory wired to the controller (and its 120 VAC supply) at the upper right backside of the controller board. Do not attempt to connect the primary pump to the pump/zone valve terminal block along the controller's right edge - this is for the secondary pumps and/or zone valves only. Connect the pump's black wire to the yellow of this pair (switched Hot). The

white/yellow pair should be individually capped if the primary pump does not obtain its power from this pair (e.g. if a variable speed primary pump is connected to the mains power).

Pumps can be switched on/off using the touchscreen controller, so there is no need for temporary pump wiring during system filling / air purging.

Instructions for manual pump purge:



Warning

Ensure zone valves are open and system is not air-locked to avoid deadheading pumps..

1. After defining loads, go to ●●● > **System Settings** > **Site Settings** > In the **Manual Pump Purge** field, set to "**On**" . The manual pump purge runs until it is turned off, or when there is a call for heat.
2. To shut off the manual pump purge, tap "**On**" to toggle to "Off".

The combined current of all load pumps connected through the on-board pump relays should not exceed 10 amps. The control circuit board is protected using on-board field replaceable fuses. Each pump is fused with a separate 5 Amp fuse. The Alarm contact is fused with a 5 Amp fuse and the 24 VAC boiler control circuit is protected with a 2 Amp fuse.

The *VS Output* leads are not commonly used, except when providing a boiler output signal to an external direct digital control (DDC).

4.13.3 Sensor and other wiring



Danger

Do not connect sensors to “Therm” terminals. Overheating components can result in serious personal injury and/or property damage.

Other optional low voltage connections to the control board include:

- Two auxiliary *Interlocks* - for external safety devices as may be required by some jurisdictions, such as an external low-water cutoff.
- Contacts for *Indoor* and *Outdoor* temperatures *Sensors* associated with reset heating. A 10K ohm thermister (resistor dependent on temperature) for outdoor reset sensing is supplied with the boiler for improved comfort and combustion efficiency.
- One pair for a DHW tank sensor. Connect to *DHW S* (not the respective Therm. 1,2,3,4 location) and the boiler automatically runs a smart DHW routine.
- One pair of contacts for remote *Secondary Loop* temperature control.
- One pair (marked *BoilerNet*) for network connection – this is used for connecting multiple V10 controller appliances for autonomous staging.

- The bottom pair of contacts (labeled *External Control*) receives a 0-10VDC (default) or 4-20 mA signal from an external boiler controller for direct throttle control. The boiler's own sensors act as high limits only. The user must enter maximum and minimum boiler supply temperatures.

> **Note**
>
> Sensors connected to any sensor input contacts must be of the NTC 10k ohm type 2 thermistor with a resistance of 10,000 ohms at 77°F (25°C) and β = 3892. We do not recommend using 3rd party supplied sensors. Compatible water temperature sensors and outdoor sensors can be supplied by your distributor.

4.13.4 Thermostat wiring

Each of the four loads has dry contacts for thermostats as marked on the lower connector strip (for example, Therm 1 is linked with Load 1). Ensure that there are no disturbing influences on the call-for-heat lines - for example, from being run in the same conduit as line voltage wires.

The controller is compatible with conventional thermostats.

> **Caution: power-stealing thermostats**
>
> The V10 rev. 15 controller does not support power-stealing thermostats. Power stealing thermostats take their operating power from the thermostat line. If a t-stat has electronic display but does not use a C-wire or a battery, it is power-stealing.

When the thermostats energize zone valves, the zone valves' end-switches are wired to the boiler Therm connection. For multi-zoned loads, the end switches can be ganged together and wired to a single therm connection.

When wiring thermostats directly to the V10, ensure no other electrical components are wired in series with the thermostat, such as relay coils or zone valves. Consult the V10 Controller manual for more detailed instructions.

4.13.5 Thermostat heat anticipator

"Therm" contacts draw no power, so a thermostat anticipator setting of zero is appropriate for use with the V10 Touchscreen controller. In the case of a single temperature / heat load where zone valves are used to manage individual thermostatically controlled zones, each room thermostat's heat anticipator should be adjusted to the current draw of its associated zone valve.

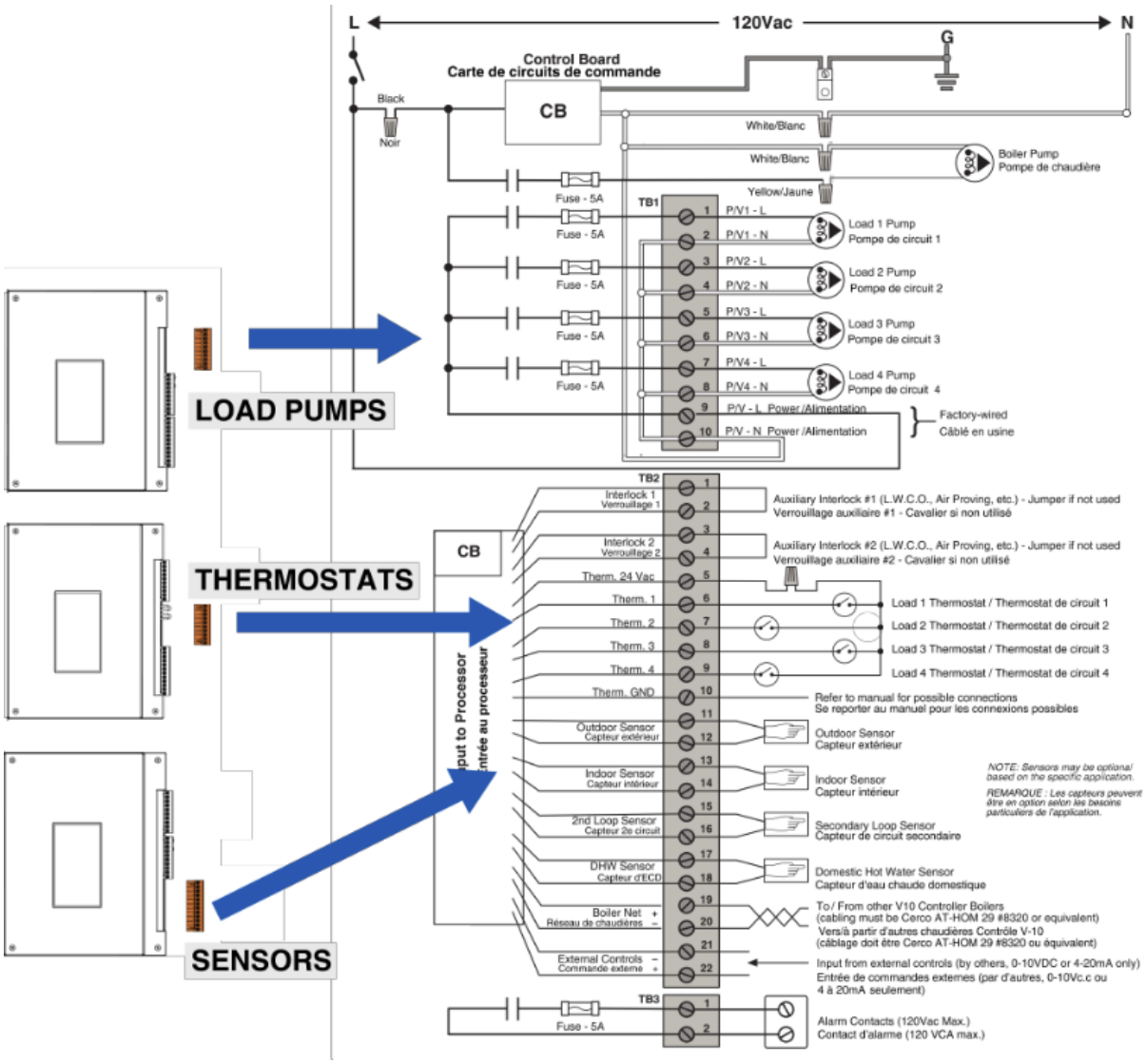


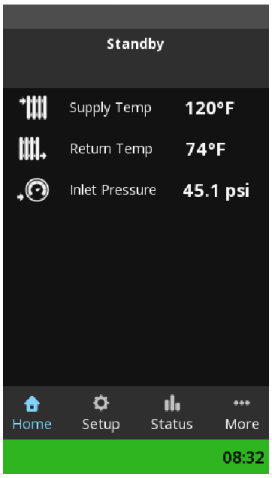
Figure 50 *Electric wiring connections*

5.0 About the boiler controller

This boiler is equipped with a touchscreen controller for programming the boiler. For detailed instructions on using the controller, see the *Touchscreen Controller* manual.

> **Note**
> Use only a stylus or a clean finger to interact with the touchscreen. Using sharp or metallic objects will cause damage.

The controller is equipped to provide:

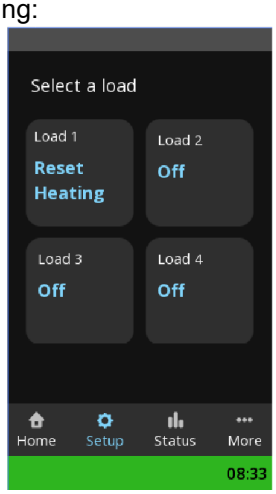


- Control of up to five pumps – one boiler pump + four separate load pumps
- Outdoor Reset control
- Set Point temperature regulation
- Control for Domestic Hot Water (DHW) tank
- Freeze Protection routine
- External control using 0-10VDC or 4-20mA signal
- Manual control of firing rate for gas valve calibration
- Alarm dry contacts
- Zoning - simultaneous operation of up to four pumps
- Load Combining – simultaneous operation of two similar water temperature loads
- Programmable setback / override schedule
- The controller can manage or operate in a network of up to V10 controller boilers without an additional controller
- Features available in the touchscreen control include:
  - » Setup Menu for simple, quick programming
  - » Superior warning messages while setting up the control
  - » Advanced Error messages with visual display on the Home Screen

5.1 Controller

When the boiler is first energized, the controller will go through a power up sequence that will take approximately 45 seconds. During this time the controller is completing a self-diagnostic and loading all previous settings. In the event of a power interruption the boiler will automatically resume operation when power is restored with all the previously stored values.

The controller provides overall management of the boiler operations including:



- Power-up, self-diagnostics, easy Load parameter adjustments
- Burner operation, safety management systems, call-for-heat management and load priority
- Real time boiler data
- Temperature and throttle operation
- Maintenance of operational and error service logs
- 2-way communication with other V10 controller boilers
- BACnet over IP available with purchase P-9222

Operational and historical data may be accessed from the **Status** menu > **Load Status** > **Load Profiles** and **Load Statistics** screens. Also in the **Status** menu, you can view error logs, including records of all errors since original power-up complete with the date and time of the error.

5.2 Control interface

The control interface is provided through a color touchscreen display. The touchscreen responds to a light finger touch on the screen. You can also use a stylus, pencil, or similar device to operate the touch controls. Do not use a sharp or metallic object such as a screw driver to operate the control as it could damage the touchscreen.

Prior to any interaction with the touchscreen, the display shows the Home screen details of the current boiler status. If the controller is not interacted with for 10 minutes the display dims to save power. The power saving display feature is user adjustable and is set to 10 minutes by default.

The control automatically returns to the home screen if left unattended. The screens will step back one screen at a time in 10-minute increments if the touchscreen has not been touched. The pop-up windows will also step back automatically in 2-minute intervals.

The boiler status bar indicates if the boiler is in a normal, warning or alarm state. When no warning or alarm state is present, the bar will be green and the time will be displayed inside the green area. The bar can also be yellow or red corresponding a warning or alarm state. Text inside the bar will indicate the specific warning or alarm present. If more than one alarm is present the text display will slowly change, rotating though the alarms that are present.

6.0 Before operating the boiler

Danger

Do not store or use gasoline or other flammable vapors or liquids in the vicinity of this or any other appliance. If you smell gas vapors, do not try to operate any appliance - do not touch any electrical switch or use any phone in the building. Immediately, call the gas supplier from a phone located remotely. Follow the gas supplier's instructions, or if the supplier is unavailable, contact the fire department.

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 under water.

Should overheating occur or the gas supply fails to shut off, do not turn off or disconnect the electrical supply to the pump. Instead shut off the gas supply at a location external to the appliance.

Important pre-ignition checks

Once installation of the appliance is completed, and before operating the appliance, it is important to review the following checklist of precautions:

Checklist for electrical conditions, ducting and water connections

Checking electrical conditions	Check
Check all line voltage electrical connections to ensure all connections are correct and tight.	☐
Check thermostat connections.	☐
Thermostat in a suitable location.	☐
Checking venting connections	**Check**
All vent pipe are installed in the correct size and that joints are sealed.	☐
Confirm any common venting system at the installation site is isolated and independent of the boiler.	☐
Confirm that any holes left from the removal of a previous boiler have been sealed, and that any resizing of the old flue has been done.	☐
Checking piping connections	**Check**
Check that the water piping system is fully flushed and charged, and that all air has been discharged through loosened bleed caps. Note that it is possible to run all pumps from the touchscreen without a call for heat. This simplifies air bleeding (refer to "Performing a manual pump purge" in the *Controller* manual). Load must be assigned. Use a minimum water pressure of 12 psig and confirm that the pressure relief valve is installed and safely drained.	☐

Checking electrical conditions	Check
All connections are pressure-tested and leak free.	☐
Check the external pump is flowing in the correct direction.	☐
Checking gas connections	**Check**
All connections are pressure tested and leak free.	☐
Check to see that adequate gas pressure is present at the inlet gas supply test port. Connect a manometer and open the gas control valve. Requirements are minimum 4" w.c and maximum 14" w.c.	☐
Powering on the Boiler	**Check**
The installer must verify that at least one carbon monoxide alarm has been installed within a residential living space or home following the alarm manufacturer's instructions and applicable local codes before putting the appliance into operation.	☐
Boiler door must be in place during normal operation.	☐
Perform a final check of electrical wiring, and provide power to the boiler to initialize operation.	☐



Warning

Fill the condensate trap with water before you first fire the boiler to prevent exhaust fumes from entering the room. Never operate the boiler unless the trap is filled with water. Failure to comply will result in severe personal injury or death.

7.0 Boiler operation

Before operating the appliance, there are some important pre-igntion checks that need to be performed. For more information, see *Before operating the boiler on page 65*. To understand the boiler start-up process, see *Sequence of Operation on page 101*.

7.1 Lighting and shutting down the boiler

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 neighbour's phone. Follow the gas supplier's instructions
- If you cannot reach your gas supplier, call the fire department.

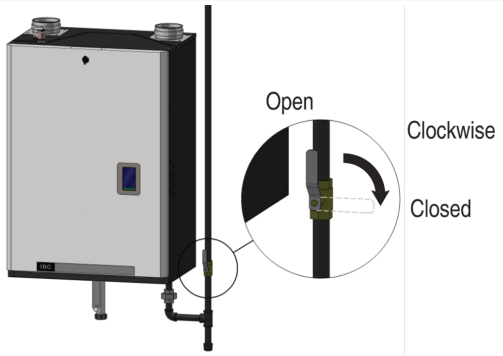
C. Use only your hand to turn the gas control valve. Never force using tools. If the valve will not turn by hand, don't try to repair it, call a qualified service technician. Force or attempted repair may result in a fire or explosion.
D. Do not use this appliance if any part has been under water. Immediately 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.

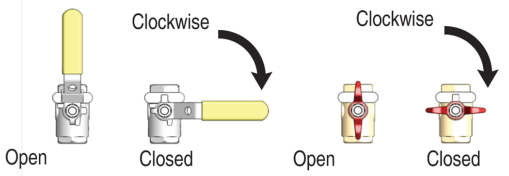
OPERATING INSTRUCTIONS

1. STOP! Read the safety information above on this label before doing anything.
2. Set the thermostat to lowest setting.
3. Turn off all electric power to the appliance by selecting main power switch to OFF.
4. This appliance is equipped with an ignition device which automatically lights the burner. Do not try to light the burner by hand.
5. Locate manual gas shut-off valve (see pictures below) and turn clockwise to "CLOSE".
6. Wait five (5) minutes to clear out any gas. Then smell for gas, including near the floor. If you smell gas, STOP! Follow step "B" in the safety information above on this label. If you don't smell gas, go to the next step.

TO TURN OFF GAS APPLIANCE

1. Set the thermostat to lowest setting.
2. Turn off all electric power to the appliance by selecting main power switch to OFF.
3. Turn gas control valve to CLOSE.





OPERATING INSTRUCTIONS
cont.

7. Turn gas control valve to OPEN.
8. Turn on electric power to appliance by selecting main power switch to ON.
9. Set thermostat to desired setting.
10. If the appliance will not operate, follow the instructions "TO TURN OFF GAS APPLIANCE" and call your service technician or gas supplier.

Start-up Checklist	Check
Followed lighting and shutting down procedure.	☐
Tested the ignition safety shutoff function (see *Testing the ignition safety shutoff on page 68*).	☐
Checked the appliance's fuel source, and if necessary, performed a fuel conversion using the appropriate P-kit.	☐
Performed gas pressure test by measuring the inlet gas pressure.	☐
Tested efficiency of the appliance and made necessary adjustments by Performing a combustion test and adjustment.	☐

Start-up Checklist	Check
Tested the low water cutoff function to check that the LWCO sensor is working. Refer to "Testing the LWCO function" in the *Controller* manual.	☐
Tested the high limit temperature function to check that the High limit temperature sensor is working. Refer to "Testing the Hi-Limit cutoff temperature function" in the *Controller* manual.	☐

7.2 Testing the ignition safety shutoff

To test the ignition system safety shutoff function:

1. With the boiler in operation, shut off the gas control valve directly outside the boiler case.
2. The controller will cycle through purging and igniting three times. When the ignition attempt is unsuccessful, Ignition Trials Exceeded will be displayed in red on the bottom of the screen.
3. On the touchscreen controller tap (Status)> **Clear Errors** > **Yes**.

7.3 Commissioning

The appliances are factory calibrated to operate with either natural gas or propane at sea level. The high-fire, low-fire, or both adjustment screws may need adjusting to attain optimum combustion results. Note that only qualified technicians using properly functioning and calibrated combustion analyzing equipment should perform a mixture adjustment.

7.3.1 Checking a boiler's fuel source

Danger

Operating any appliance using a fuel other than the fuel listed on its rating plate is prohibited. Failure to follow the instructions on converting to alternate fuels can result in a fire or explosion, which may cause property damage, personal injury, or loss of life.

Check the rating plate of the appliance to ensure it is configured for the fuel you are using. If the fuel is incorrect for the appliance, a conversion kit must be ordered and the gas valve adjusted accordingly. Failure to perform the required fuel conversion can result in an immediate hazard.

This boiler model can burn either natural gas or propane if equipped with the correct fuel-air metering device. Examine the rating plate of the boiler to ensure it is configured for the fuel you are using. For example, if the boiler is configured for natural gas, but needs to be converted to propane, use the conversion kit to install the appropriate fitting(s) and adjust the gas valve accordingly. See *Table 13* for the required conversion kit.

Fuel conversion kit numbers

Compare the boiler model number with the Kit # found in the table below:

Model Number	Natural Gas to Propane	Propane to Natural Gas
Boiler 85, Boiler 115	P-304	P-305
Boiler 160	P-306	P-307
Boiler 199	P-308	P-309

Table 13 *Fuel Conversion Kits*

7.3.2 Performing a fuel conversion

Caution
The gas supply shall be shut off prior to disconnecting the electrical power, before proceeding with the conversion.

You must be a qualified heating professional to perform this procedure. In this fuel conversion, you will be replacing the orifice, located between the gas valve and gas line to the fan, with the fuel-appropriate orifice supplied in the kit.

To perform a fuel conversion on the Boiler 85, Boiler 115 and Boiler 160:

1. Ensure that the gas supply is turned off at the gas shut-off valve.
2. Disconnect the electrical power
3. Change the gas fuel source.
4. Remove the front door.
5. Undo the nut at the top of the gas valve.
    a. Push down on the gas valve, and remove the orifice and O-ring.
    b. Insert the fuel-appropriate orifice (from kit) into the O-ring.
    c. Reinstall the orifice and O-ring.
    d. Tighten the upper nut onto the gas valve.
6. Turn on the gas supply and connect the electrical power.
7. Check for gas leaks.
8. Tune the gas valve (see "Adjusting the gas valve" below).
9. Place conversion labels associated with the new fuel onto the boiler.

To perform a fuel conversion on the Boiler 199:

1. Ensure that the gas supply is turned off at the gas shut-off valve.
2. Disconnect the electrical power.
3. Change the gas fuel source.
4. Remove the front door.
5. **NOTE for the Boiler 199 model there is no need to change the orifice:**
   a. if converting to LP, turn the High Fire (gas : air ratio) adjustment screw 2½ turns counter-clockwise.
   b. if converting to NG, turn the High Fire (gas : air ratio) adjustment screw 2½ turns clockwise.
6. Restore the gas supply by opening the gas control valve and reconnect the electrical power.
7. When the boiler is running, use an approved leak detection solution to soap test all joints.
8. Tune the gas valve (see "Adjusting the gas valve" below).
9. Place conversion labels associated with the new fuel onto the boiler.



Danger

Making adjustments to the gas valve without a properly calibrated gas combustion analyzer and by persons who are not trained and experienced in its use is forbidden. Failure to use an analyzer can result in an immediate hazard.

7.3.3 Adjusting the gas valve

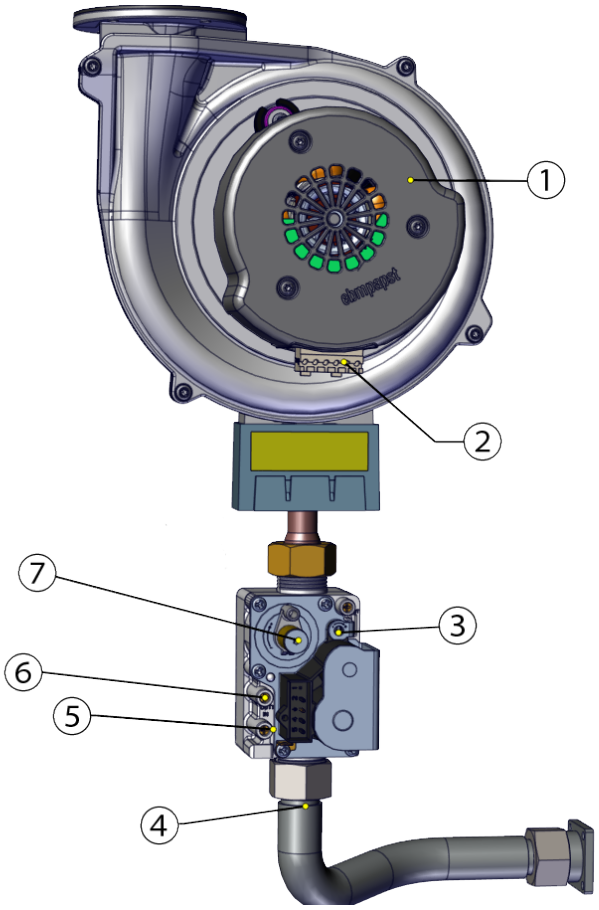


Figure 51 *Gas valve and fan components*

1	Combustion fan	5	Inlet gas pressure port
2	Fan plug	6	Manifold pressure port (not used)
3	High fire (gas:air ratio) adjustment	7	Low fire adjustment (under cap)
4	Gas valve inlet		

Measuring the inlet gas pressure

To perform a gas pressure test, you will need to use a Torx 15 screwdriver and a manometer.

1. Shut off the gas supply. You will be measuring the inlet gas supply from the test port. (Do not use the manifold gas pressure test port.)
2. On the gas valve, loosen the inlet gas pressure test port screw counter-clockwise with a Torx 15 screwdriver.
3. Attach the manometer to the inlet gas pressure test port.
4. Switch on the gas supply. Record the static inlet gas pressure. The static gas pressure should be around 7" for natural gas w.c. and 11" w.c. for propane.
5. Give the boiler a call for heat. Ensure that you have a load large enough to allow the boiler to operate at high fire for over 10 minutes.
6. When the boiler is operating at high fire, measure the gas pressure. The gas pressure should not drop more than 2" w.c. from the previously recorded static pressure.
7. After completing the inlet gas pressure test, switch off the gas supply.
8. Remove the manometer from the inlet gas pressure test port.
9. Tighten the inlet gas pressure test port screw.
10. Switch on the gas supply, and soap test for leaks before returning the boiler to normal operation.

Performing a combustion test and adjustment

The High Fire (gas-air ratio) adjustment screw will have to be adjusted to attain optimum combustion results whenever fuel conversion is undertaken, however, no mixture adjustment must be performed unless done by a qualified technician using properly functioning and calibrated combustion analyzing equipment.

1. Turn off the boiler's external gas shut-off valve.
2. Give the boiler a call for heat.
3. To run the boiler at high fire, you can set the heat-out value in Test Operation mode to the maximum MBH for the boiler. To do this, on the controller, go to ●●● (More) > **Test Operation** > In the **Fan Test: Heat Out** field, tap **0 MBtu**, then enter the maximum MBH.
4. When the boiler reaches high fire, insert the combustion analyzer test probe into the flue gas test port. Then verify that the CO_2reading is within the combustion test targets at *7.0* values.
5. Adjust the high fire according to values in *7.0* using the high fire adjustment screw . Make adjustments of no more than one full turn at a time. Do not over-adjust. Turning the High Fire screw clockwise will raise the CO_2 percentage. Turn counter-clockwise to lower CO_2%.
6. Set the heat-out value in Test Operation mode to the minimum MBH for the boiler. To do this, go to ●●● (More) > **Test Operation** > In the **Fan Test: Heat Out** field, tap **0 MBtu**, then enter the minimum MBH.

7. Adjust the low fire according to values in *7.0* using the low fire adjustment screw. Turn the screwdriver clockwise to raise the CO_2% (to richen). Turn counter-clockwise to lower CO_2%. Start with ⅛ of a turn until you see the analyzer measure a change then only make 1/16 adjustments. If changing direction on this adjustment, you may notice a significant backlash.
8. Check the results and confirm the correct settings when you return the boiler to high fire, and then to low fire.

   Note
   For Natural gas, clock the gas meter to confirm full maximum rating plate input.
9. To exit the **Test Operation** screen, select **Back**.
10. Remove the call for heat.
11. Remove the analyzer probe, and install the test port plug.
12. Turn on the gas supply shut off valve, and soap test for leaks.

Fuel	CO_2 at High fire		CO_2 at Low fire		CO max
	Range	Target	Range	Target	
Natural Gas	8.9% - 10.0%	9.5%	8.2% - 9.2%	8.7%	<150 ppm
Propane	10.3% - 11.3%	10.8%	9.3% -10.3%	9.8%	< 250 ppm

Table 14 *CO_2 concentration targets and ranges*

Note
The low-fire CO_2 concentration must be at least 0.5% lower than the high-fire CO_2 concentration.

Intentionally left empty

8.0 Service and maintenance

Inspection of the boiler is to be performed annually by a qualified service technician.

Caution

The owner is responsible for general care of the boiler. Improper maintenance of the boiler may result in a hazardous condition.

8.1 Maintenance checklist for homeowner

Maintenance Required	Frequency	Check
Inspect system for unusual noises or odors. Call your local heating contractor for service if needed	As needed	☐
Keep vent terminals clear of obstructions (snow, dirt, etc.).	As needed	☐
Keep combustible materials and flammable liquids and vapors away from the boiler.	As needed	☐
Check for signs of corrosion and deposits at venting transitions and terminations, or the appearance of soot at the vent termination: any such signs should be brought to the immediate attention of a qualified service technician.	Monthly	☐
Check system for signs of leaks.	Monthly	☐
Inspection of the boiler is to be performed annually by a qualified service technician.	Annually	☐

8.2 Maintenance checklist for heating contractor

Caution

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

Maintenance Required	Check
Remove any obstructions (e.g. leaves, dust, other debris) from vent terminals	☐
Check and clean or replace intake air filters or screens as required.	☐
Check for holes or leaks in venting. Replace venting as needed.	☐
Examine for any signs of moisture caused by sweating intake air pipes; insulate as required.	☐
Ensure proper resealing or re-installation of venting on each servicing.	☐
Test Low-water cut-off (LWCO) safety operation on each servicing: see *Testing LWCO function* in the Touchscreen Boiler Controller Manual.	☐

8.2.1 Touchscreen boiler controller

Maintenance Required for Boiler Controller	Frequency	Check
Check that boiler operation is consistent with the steps in the Touchscreen Boiler Controller Manual.	Annually	☐
Check that water temperature targets and setpoint is satisfactory and have not been adversely amended.	Annually	☐
Check the operating history using the boiler's Logs menu and Error Logs menu. The controller tracks the duty cycle of the boiler in each of the loads separately. This information can be used to adjust the water temperatures of each load.	As needed	☐

8.3 Torque

Heat exchanger cleaning requires removal of the heat exchanger lid. The Residential-series heat exchanger lids are fastened by (depending on model) six or eight nuts. Upon reassembly these should be tightened, using a cross pattern, to a torque between 23 inch•lb and 27 inch•lb.

8.4 General boiler maintenance

Boiler Component	Maintenance Required	Frequency	Check
Condensate trap	Remove and clean annually (see *Cleaning the condensate trap on page 83*). Ensure that the trap has been re-filled completely before firing the boiler.	Annually	☐
	If condensate neutralization is used, check the pH level of condensate discharge.	Annually	☐

Warning

When removing the burner for inspection or boiler servicing, examine the sealing gaskets and replace if damaged. Upon re-assembly, test all sealing areas to ensure there is no leakage of combustible gas/air premix.

Burner	Remove the burner to inspect for extent of fouling (see *Replacing the burner on the Boiler 85, Boiler 115, Boiler 160, and Boiler 199 on page 82*. a. Rinse the burner thoroughly from outside to inside using a hose or kitchen sprayer, and dry using compressed air. b. Reassemble. Visually inspect the burner through sight glass. Ensure the flame is stable, without excessive fluttering. Normal flame pattern is evenly distributed over the burner surface.	As needed	☐

Boiler Component	Maintenance Required	Frequency	Check
	If the burner is operating improperly, remove and clean or replace. Use a CO_2 analyzer to determine proper combustion. See *Boiler operation on page 67* for correct values.	Annually	☐
Heat exchanger	Remove the heat exchanger lid and examine the heat exchanger for signs of contamination and clean if necessary. When cleaning use only water, stainless steel safe cleaners and plastic bristled brushes. Do not use anything metallic that may damage the stainless surface. Ensure condensate trap is in place and directed to a drain then run water through the fire tubes.	Annually	☐
Boiler Pump	Check that the pump is on in normal operation. Visually check for leaks or damage and ensure the pump operates smoothly without unusual noises. Excessive ΔT or frequent *Circulating* statuses during boiler operation can be signs of a failing pump	Annually	☐
Gas Piping	Check for damage or leaks and repair as needed.	Annually	☐
Boiler treatment	Check consistency of any boiler treatment used, for appropriate mixture. Chemical inhibitors are consumed over time, lowering their density.	Annually	☐
	Verify proper operation after servicing.	Annually	☐
Freeze protection	Check the effectiveness of the glycol in the system. Use only antifreeze made specifically for hydronic systems. Inhibited propylene glycol is recommended. Antifreeze volume must be between 25% and 50% of the total volume of water in the system.	Annually	☐

Warning

Do not use automotive-type ethylene or other types of automotive glycol antifreeze, or undiluted antifreeze of any kind. This may result in severe boiler damage. It is the responsibility of the Installer to ensure that glycol solutions are formulated to inhibit corrosion in hydronic heating systems of mixed materials. Improper mixtures and chemical additives may cause damage to ferrous and non-ferrous components as well as non-metallic, wet components, normally found in hydronic systems. Ethylene glycol is toxic, and may be prohibited for use by codes applicable to your installation location. For environmental and toxicity reasons, it is recommended to use only using non-toxic propylene glycol.

Caution

Installers should inquire of local water purveyors as to the suitability of their supply for use in hydronic heating systems. If water quality is questionable, a local water treatment expert must be consulted for testing, assessment and, if required, treatment. Alternatively, water or hydronic fluid of known quality can be brought to the site.

Boiler Component	Maintenance Required	Frequency	Check
Water	Check the water pressure. Pressure should be stable when the boiler is firing and the water temperature is rising. If pressure rises sharply, consider replacement of expansion tank.	Annually	☐
	Test water quality for excessive TDS. Refer to the Water Quality Guidelines for more information.	Annually	☐
	Check for noise at high fire, which may signal water quality problems.	Annually	☐
	Check water piping for damage or leaks and repair as needed.	Annually	☐
	Check target water temperatures are appropriate for application and are achieved in operation.	Annually	☐
	Ensure any direct “city fill” water connections are left in the closed position to minimize exposure to leaks and flooding.	Annually	☐

Caution

Before testing the relief valve, ensure the discharge pipe is properly connected to the valve outlet and arranged to contain and safely dispose of equipment discharge.

Relief valve - maintenance and testing	The relief valve manufacturer requires that under normal operating conditions a “try lever test” must be performed every two months. Under severe service conditions, or if corrosion and/or deposits are noticed within the valve body, testing must be performed more often. A “try lever test” must also be performed at the end of any non-service period.	Annually	☐

Try lever test:

Test at or near the maximum operating pressure by holding the test lever fully open for at least 5 seconds to flush the valve seat free of sediment and debris. Then release the lever and allow the valve to snap shut.
If the lever does not activate, or if there is no sign of discharge, discontinue use of equipment immediately and contact a licensed contractor or qualified service personnel.
If the relief valve does not completely seal, and fluid continues to leak from the discharge pipe - perform the test again to try and flush any debris that may be lodged in the valve. If repeated

Boiler Component	Maintenance Required	Frequency	Check

tries fail to stop the leakage, contact a licensed contractor or qualified service personnel to replace the valve.
While performing a "try lever test", a quantity of heat transfer fluid will be discharged from the piping system and the system pressure will drop. This fluid must be replaced. We recommend using a system pressurization appliance; capture the discharged fluid in a container and recycle it by returning it to the system feeder appliance.

8.5 Replacing the fan, gas valve, and burner

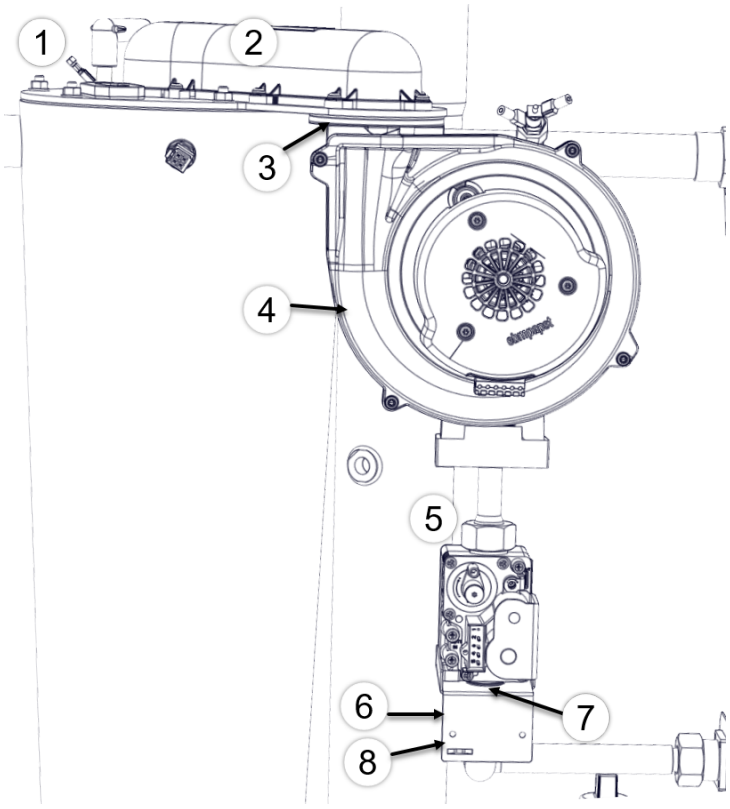


Figure 52 *Gas valve and fan components*

1	Ignition cable, ground wire, ignitor	5	Upper nut, orifice and O-ring
2	Fan coupler and gasket	6	Lower nut (behind bracket) and gasket
3	Screws/nuts securing fan to fan coupler (location of fan gasket)	7	Gas valve electrical cable and screw
4	Fan	8	Gas valve support bracket

8.5.1 Replacing the fan on the Boiler 85, Boiler 115, Boiler 160, and Boiler 199

Removing the fan

1. For reference, see *Figure 52* Turn off the electric power and gas supply to the boiler.
2. Ensure the boiler cools down to the surrounding temperature. Do not drain the boiler unless freezing conditions are expected during this procedure.
3. Remove the door.
   - A ladder or step may be required to have a clear vertical view of the work area. Do not attempt to reach from the front without a clear view, as damage to connectors or screws may occur.
4. Disconnect the gas valve electrical cable ⑧ by removing the screw.
5. Unscrew the upper nut ⑤ of the gas valve.
6. Carefully push down the gas valve, and remove the orifice and O-ring.
7. To remove the gas valve, unscrew the lower nut ⑥. Ensure that the gasket remains inside the nut.
8. Disconnect the electrical cable from the fan.
9. Remove the screws or nuts ③ securing the fan to the coupler.
10. Remove the fan and fan gasket.

Installing the new fan

1. Install the new fan gasket and fan.
2. Secure the fan to the coupler using the two screws.
3. Reconnect the electrical cable to the fan.
4. Insert the lower part of the gas valve so that it is supported by the gas valve bracket, then tighten with the lower nut. Ensure that the lower gas valve gasket is in place.
5. Ensure that the gas valve orifice and O-ring are in place before you tighten the upper nut.
6. Reconnect the gas valve electrical cable with the screw.
7. Turn on the power and gas supply.
8. Check for gas leaks.
9. Tune the gas valve.
10. After removing test equipment, check test ports and replace door.

8.5.2 Replacing the gas valve on the Boiler 85, Boiler 115, Boiler 160, and Boiler 199

Removing the gas valve

1. For reference, see *Figure 52* Turn off the electric power and gas supply to the boiler.
2. Ensure that the boiler cools down to the surrounding temperature. Do not drain the boiler unless freezing conditions are expected during this procedure.
3. Remove the door and the top cover/lid.
   - A ladder or step may be required to have a clear vertical view of the work area. Do not attempt to reach from the front without a clear view, as damage to connectors or screws may occur.
4. To disconnect the gas valve electrical cable ⑧, remove the screw.
5. Unscrew the upper nut ⑤ of the gas valve.
6. Carefully push down on the gas valve, and remove the orifice and O-ring.
7. Unscrew the lower nut ⑥ of the gas valve, and remove from the gas valve bracket. Ensure that the gasket remains inside the nut.

Installing the new gas valve

1. Position the lower part of the new gas valve so that it is supported by the gas valve bracket, then tighten with the lower nut. Ensure that the gasket is in place.
2. Ensure that the gas valve orifice and O-ring are in place before you tighten the upper nut.
3. Reconnect the gas valve electrical cable with the screw.
4. Turn on the power and gas supply.
5. Check for gas leaks.
6. Tune the gas valve.
7. After removing test equipment, check test ports and replace door.

8.5.3 Replacing the burner on the Boiler 85, Boiler 115, Boiler 160, and Boiler 199

Warning

The heat exchanger has a small amount of combustion chamber insulation (refractory), which contains ceramic fibers.

When exposed to extremely high temperatures, the ceramic fibers that contain crystalline silica can be converted into cristobalite, classified as a possible human carcinogen.

Avoid disturbing or damaging the refractory. If the refractory is damaged, it must be replaced following the directions below.

Avoid breathing and contact with skin and eyes and follow these precautions:

1. For conditions of frequent use or heavy exposure, respirator protection is required. Refer to the “NIOSH Guide to the Selection and Use of Particulate Respirators Certified under 42 CFR 84” for selection and use of respirators certified by NIOSH.

   For the most current information, NIOSH can be contacted at 1-800-356-4676 or on the web at www.cdc.gov/niosh.

2. Wear long sleeved, loose fitting clothing, gloves and eyes protection.
3. Assure adequate ventilation.
4. Wash with soap and water after contact.
5. Wash potentially contaminated clothes separately from other laundry and rinse washing machine thoroughly.
6. Discard used insulation in an air tight plastic bag.

NIOSH stated first aid:

- Eye contact - Irrigate and wash immediately.
- Breathing - Provide fresh air.

Removing the burner

1. For reference, see *Figure 52* Turn off the electric power and gas supply to the boiler.
2. Ensure that the boiler cools down to the surrounding temperature. Do not drain the boiler unless freezing conditions are expected during this procedure.
3. Remove the door and the cabinet top.
   - A ladder or step may be required to have a clear vertical view of the work area. Do not attempt to reach from the front without a clear view, as damage to connectors,

screws or refractory may occur.

4. Disconnect the ignition cable and ground wire (1) from the ignitor.
5. Remove the fan coupler screws (3), and put aside along with the coupler and gasket.
6. Remove the burner and burner gasket.

Installing the new burner and new burner gasket

1. Insert the new gasket and new burner.
2. Reinstall the coupler gasket and coupler, using a criss-cross pattern to tighten the screws.
3. Reconnect the ignition cable and ground wire to the ignitor.
4. Turn on the power and gas supply.
5. Check for leaks.
6. Tune the gas valve.
7. After removing the test equipment, check test ports and replace door.

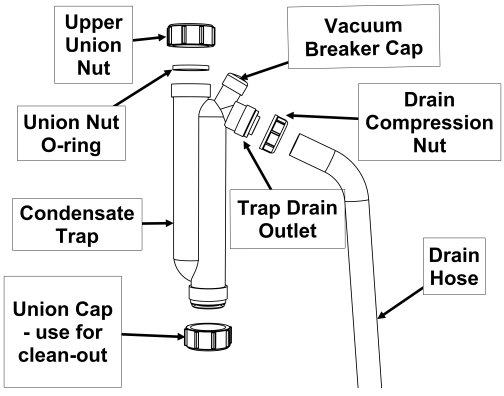
8.6 Cleaning the condensate trap

Warning

If condensate neutralization is used, check the pH level of condensate before and after neutralization to verify effectiveness and ensure that the discharge has neutral pH levels. Never operate the boiler unless the trap is filled with water. Failure to comply will result in severe personal injury or death.

Warning

Before replacing the condensate trap, turn off the power to the boiler and allow to cool down.



Condensate traps should be checked every year, cleaned and refilled as necessary. Before cleaning the condensate trap, you must turn off the power to the boiler, and allow it to cool down.

Important: Installers or service contractors should ensure that the end user is instructed on cleaning and refilling the trap

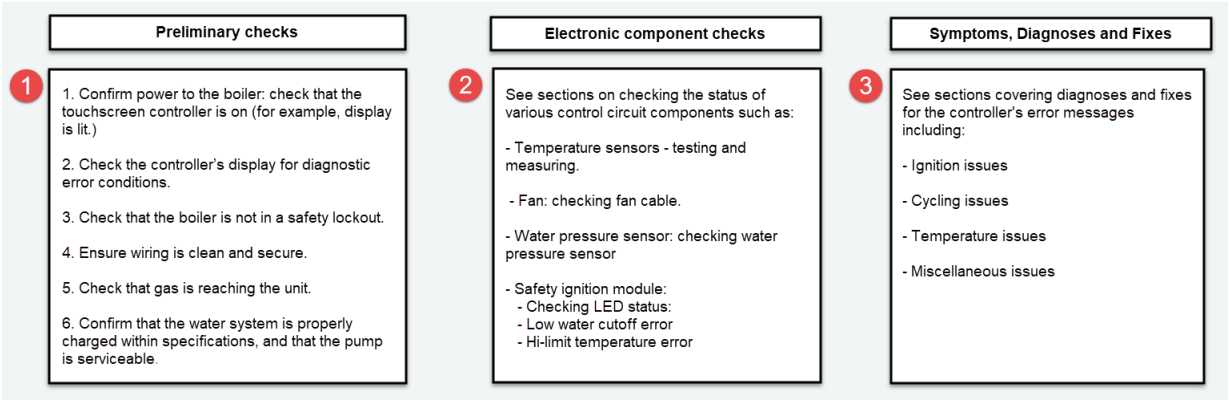
8.7 Ensure door is in place

Replace door after service, maintenance or inspection. The boiler door must be in place during regular operation.

Intentionally left empty

9.0 Troubleshooting

This section includes various conditions as well as possible solutions. Often, a problem can be identified and solved through basic checks: confirming the electrical power supply, gas flow and resetting the thermostat control. Below are some common troubleshooting issues including fixes.



9.1 Electronic components

This section details the method for troubleshooting the non-standard electronic components on the boiler.

9.1.1 Temperature sensors

The resistance of the temperature sensors varies inversely with temperature. To test, measure the temperature of the sensed environment and compare with the value derived from the measurement of the resistance (obtained by connecting a good quality test meter capable of measuring up to 5,000 kΩ (5,000,000Ω) at the controller end of the sensor lead).

To obtain a resistance reading, remove power to the boiler. For the supply water, return water, and vent temperature sensors, remove the wire leads by disconnecting their respective Molex connectors. Place multi-meter probes into the sensor's female Molex connector socket. Do not apply voltage to the sensor as damage may result.

The supply water and vent temperature sensors each contain two separate circuits. Test each pair. Both circuits must deliver accurate readings. Note that a sensor might fail only within certain temperature ranges.

Temp. °F/°C	Resist. Ω – Ohm	Temp. °F/°C	Resist. Ω – Ohm
0 / -18	85,362	100 / 38	5,828
5 / -15	72,918	105 / 41	5,210
10 / -12	62,465	110 / 43	4,665
15 / -9	53,658	115 / 46	4,184
20 / -7	42,218	120 / 49	3,760
25 / -4	39,913	125 / 52	3,383
30 / -1	34,558	130 / 54	3,050
35 / 2	29,996	135 / 57	2,754
40 / 4	26,099	140 / 60	2,490
45 / 7	22,763	145 / 63	2,255
50 / 10	19,900	150 / 66	2,045
55 / 13	17,436	155 / 68	1,857
60 / 16	15,311	160 / 71	1,689
65 / 18	13,474	165 / 74	1,538
70 / 21	11,883	170 / 77	1,403
75 / 24	10,501	175 / 79	1,281
80 / 27	9,299	180 / 82	1,172
85 / 29	8,250	185 / 85	1,073
90 / 32	7,334	190 / 88	983
95 / 35	6,532	195 / 91	903

Table 15 *Temperature sensor resistance values - 10K ohms*

9.1.2 Fan

The fan is controlled via the SIM+ control. The SIM+ provides electronic commutating power to the fan windings determining the fan speed and power usage.

9.1.3 Water pressure sensor

The water pressure sensor ensures that there is adequate pressure in the heating system for safe operation. The pressure is displayed in PSI as the default. If the system pressure should drop below 8 PSI the firing rate of the boiler is reduced. If the pressure drops to 4 PSI or lower, the boiler will not fire.

Check the operation of the sensor by isolating the boiler from its system piping, and close the system fill valve, and then crack the pressure relief valve. The pressure displayed should reflect

declining pressure. If it remains “fixed”, drain the boiler and replace the sensor, or dislodge any blocking debris from the sensor inlet channel and reinsert.

9.1.4 Safety and Ignition Module (SIM+)

The SIM+ is a safety control, certified to conform to the UL 60730-5-5 and ANSI Z21.20 • CAN/CSA-C22.2 No. 60730-2-5-14 standards.

The module controls the boiler’s combustion fan, gas valve, sensors, safety and ignition functions including:

- Direct spark automatic ignition
- Flame detection and current measurement
- Supply water temperature sensing
- Flue gas temperature sensing
- Supply water maximum temperature shutdown
- Flue gas maximum temperature shutdown
- Low water cut-off.

The SIM+ continuously communicates with the boiler’s main controller reporting sensor readings and status. The sensor readings and error status, if any are displayed on the boiler controller’s screen.

Table showing LED operating status

Its two status LEDs indicate the operating status as shown in the table below.

SIM Status Indicators			
LED 1	**LED 2**	**State**	**Description, LED status indication**
Rapid flash		Power up or resetting	Startup checks and initialization
Off	Off	Standby	LED 1 Off=flame or sparking LED 2 = Burner-on call state
Off	On	Pre-purge or inter-purge	LED 1 Off=no flame or sparking LED 2 = Burner-on call state
On	On	Heating	LED 1 On = Flame detected LED 2 = Burner-on call state
Rapid flash	On	Igniting	LED 1 Flashing - Electrode sparking LED 2 = Burner-on call state

SIM Status Indicators			
LED 1	**LED 2**	**State**	**Description, LED status indication**
Off	Flashing	Lockout	Possible errors: • An operating limit was exceeded • A sequence failed • An external sensor fault was detected.
Flash alternately with LED 2	Flash alternately with LED 1	Fail-safe	An error was detected - the boiler requires a power cycle

Table 16 SIM+ LED status Indicators

Resetting a boiler after a LWCO lockout

A boiler in a lockout condition due to a LWCO error will need to be reset.

1. Go to > **Clear Errors** > **Yes**.
2. Check that there is enough water in the system and that the boiler is pressurized.
3. To reset the boiler, go to > **SIM Menu**> **LWCO Test** > **Reset** > **Yes**.
4. Run the boiler to ensure that the error has been cleared.
5. If the error persists inspect for the presence of water at the LWCO sensor. Confirm yellow wire is connected to central tab and green to lower tab.
6. If the error persists perform a LWCO test. Go to **> SIM Menu> LWCO Test** Run the test to check if the low water cutoff sensor is properly detecting water.

Resetting a boiler after a high-limit temperature lockout

A boiler in a lockout condition due to a hi-limit temperature error will need to be reset.

1. Go to > **Clear Errors** > **Yes**.
2. Check that there is no air trapped in the system and that the boiler is pressurized.
3. To reset the SIM Module, go to > **SIM Menu**> **Hi-Limit Test** > **Reset** > **Yes**.
4. Run the boiler to ensure that the error has been cleared.
5. If the error persists, perform a hi-limit test. Go to > **SIM Menu**> **Hi-Limit Test** > Run the test to see if the hi-limit switch is operational.

9.2 Troubleshooting error messages

The bottom line of the touchscreen displays the boiler's error status. The following colors represent the boiler's operating status:

- Green – Normal
- Yellow – Warning
- Red – Alarm

Errors shown on the touchscreen controller are described below as well as diagnoses and fixes. The text inside the bar will indicate the specific warning or alarm. If there is more than one alarm present the text will scroll slowly through all current alarm conditions. Besides the errors listed below, see also *Miscellaneous touchscreen controller errors on page 90*.

9.2.1 Ignition trials exceeded error

Ignition Trials Exceeded Error		
Issue	**Diagnosis**	**Fix**
Error – *Ignition trials exceeded*. Ignition Failure after 3 tries boiler has failed to ignite on 3 successive attempts. Boiler is in lockout for 1 hour, then repeats 3-try sequence. Consult service technician if error recurs.	No spark	• Check that ignition lead is secure at the control module and at the probe. • Adjust ignition probe rod gap between ⅛ and 3/16th inch (3.2-4.7 mm).
	Gas line not fully purged, or manual shutoff closed.	Purge gas lines. Check for gas flow. Open manual gas shutoff and reset boiler.
	Boiler ignites, but shuts off at the end of the ignition trial. Improperly grounded pressure vessel/burner or unserviceable ignition lead or spark module.	Ensure the pressure vessel is grounded. Check the ignition probe/flame sensor is electrically isolated from the vessel, and its ceramic insulator is intact. Replace ignition lead. Replace spark module.

9.2.2 Water High Limit error

Water High Limit Error		
Issue	**Diagnosis**	**Fix**
Error – Water High-Limit	Water temperature exceeds 208°F, or 201°F for 15 sec. Boiler is in hard lockout mode.	See *Troubleshooting on page 85*.

9.2.3 Low Water Cut-off error

Low Water Cutoff Error		
Issue	**Diagnosis**	**Fix**
Error - Low Water Cutoff	The Safety and Ignition module has detected a low water condition.	See *Troubleshooting on page 85*.

9.2.4 Interlock 1 or 2 error

Interlock 1 or 2 error		
Issue	**Diagnosis**	**Fix**
Error: *Interlock [1 or 2] Open*	Jumper lead on Interlock terminals of TP2 is loose or compromised.	Replace the jumper lead.
	External safety is in an alarm state.	Inspect the external safety devices.

9.2.5 Vent High Limit

Vent High Limit		
Issue	**Diagnosis**	**Fix**
Error: *Vent High Limit*	Exhaust gas temperature exceeds 248°F for 6 seconds, or 232°F for 60 sec. Boiler is in hard lockout mode.	• Check return water temperature.

9.3 Miscellaneous touchscreen controller errors

Miscellaneous errors		
Issue	**Diagnosis**	**Fix**
Error - *Max. delta T Exceeded*	• Outlet is more than 45°F (25°C) above the inlet temperature. • Outlet is rising faster than 9°F (5°C) per minute	• Check water flow. • Check temperature sensor. • Check wiring to temp sensor and control module.
Error - *Low RPM / Air Flow*	Fan is below 1150 RPM at the end of fan pre-purge, or below 100 RPM during heating.	• Check for blocked vent • Check fan wiring connections
Error - *Fan Pressure*	Exceeded SIM+ fan power threshold	• Check for blocked vent
Error - *Module High Current*	Exceeded 24 VAC to SIM+ and gas valve	• Check transformer output
Error - *Low Module Current*	Inadequate current to gas valve (starts below 25mA or stays	• Inspect harness and ignition cable

Miscellaneous errors		
Issue	**Diagnosis**	**Fix**
	below 20mA)	• Inspect Interlock 1 & 2 external safety circuits for excessive resistance • Verify good supply voltage and ground • On SIM+ check for constant 24V between J2 harness terminals 1 (Red) & 7 (Blue) • On SIM+ check for 24V during a trial for ignition between J2 harness terminals 2(Orange) & 7 (Blue)
Error - *Low Water Pressure*	Inlet water pressure below 4 psi	• Check system for leaks • Check water pressure, expansion tank • Check pressure sensor connection
Error - *Inlet Pres. Sensor*	Inlet water pressure sensor appears to be shorted or disconnected.	• Check wiring to sensor • Replace sensor.
Error - *See: Status > SIM menu > Status*	SIM/SIM+ has detected an error that has subsequently cleared	• Note error in log • Restart to observe operation
Error - *Roll Out Switch*	Rollout switch, by combustion chamber, has detected 230°F temperature.	• Inspect lid, fan and ignitor gaskets • Manually reset when safe
Error - *Controller Board*	Error internal to control board	• Typically result of poor incoming power • May require a reboot
Error - *No Boilernet Comm*	Controller set as Master cannot detect at least one other board	• Check Subordinate boiler is on • Check network wiring • Check IP Network numbers
Error - *No MAC address*	Boiler cannot verify a valid MAC address	• See Network Settings
Error - *Flame Signal / Vent Block*	SIM+ flame current drops below minimum values shown here: **Flame Current Minimums** **Model** / **≤ 3500 RPM** **Boiler 85** 1.4 µA **Boiler 115** 1.4 µA **Boiler 160** 1.8 µA **Boiler 199** 3.2 µA	• Check for vent blockage • Check for poor gas pressure • Check for unstable flame or improper combustion CO_2% • Check condition and grounding of flame rod

Miscellaneous errors		
Issue	**Diagnosis**	**Fix**
Error - *Reversed Flow*	Return temperature reads higher than supply temperature for 10 minutes	• Check boiler pump flow direction • Check wiring connections for supply and return sensors
Error - *Temp. probe error*	An internal temperature sensor appears to be shorted or open circuit.	• Check supply, return and vent temperature sensors • Error will trigger if above dual sensors deliver divergent values
Error - *Unhandled error code*	Reserved for unforeseen conditions	Contact Tech Support
Blank – screen dark		• Check transformer; replace if damaged. • Check circuit board for visible damage.
Controller is stuck in "service" mode after software update.	If update fails or no updates applied.	• Restarting returns the boiler to normal operation.

9.4 Warning messages

A warning message alerts the user to a condition they should be aware of, even if it has not yet prevented boiler operation. Some warnings, such as for a temperature sensor failure, turn to errors when a call for heat is detected, while others may appear during heating (e.g. *Output Limited*) or prevent a call for heat from beginning (*Unoccupied*).

Warning Messages		
Warning Text	**Diagnosis**	**Fix**
Outlet Limited	Detected greater than 40°F (22°C) difference between inlet and outlet temperature sensors.	• Check for failed pump • Check flow restriction • Check for failed temperature sensor
Remote offline	A boiler defined as a Master cannot detect any subordinate boilers.	• Confirm boiler is properly wired to subordinate boilers • Check Subordinate boiler is on • Check IP Network numbers • Check that boilers have the same Network ID
Unoccupied	The Occupied box has been unchecked, indicating that the boiler should not fire.	• Go to User Menu, check the box Occupied
Summer	A thermostat call is detected, but the boiler will not fire because the Outdoor temperature is above the *Summer Shutdown* temperature for that load. Applies to space heating loads but not DHW.	• If required, adjust the Summer Shutdown temperature • Check that outdoor sensor is mounted on the North face of the building and not exposed to direct sunlight • Check accuracy of Outdoor temperature sensor
Failsafe Setpoint	Indication that a Subordinate boiler has lost contact with its Master, or a boiler set up for External Control has lost contact with an external controller.	• For boiler networks, confirm Master boiler is operational and properly wired to subordinate boilers • For External Control, check voltage input and wiring
• *Inlet/Outlet Sensor* • *Remote Loop Sensor* • *Pressure Switch*	Sensor issue detected between calls for heat.	Treat as corresponding sensor error message

Warning

Never attempt to repair the control module (circuit board). If the control module is defective, replace it immediately.

9.4.1 Ignition issues

Ignition issues		
Issue	**Diagnosis**	**Fix**
Noisy spark when igniting	Ignition lead is not firmly connected.	Reconnect ignition lead.
	Contaminants / moisture on igniter probe / flame sensor.	Ensure probe is dry by re-running post-purge; otherwise, clean or replace igniter probe.
Boiler rumbles when igniting.	Fluctuating gas pressure/ gas pressure too high / too low.	Check CO_2 level via analyzer.
	Check for proper gas piping	Check pressure with manometer during ignition.
Boiler will not attempt to ignite. Fan and pump are operating normally.	No power to ignition control module.	Check system wiring.
	Igniter probe / flame sensor disconnected.	Reconnect probe.
	Defective Control Module.	Replace SIM+
Boiler will not attempt to ignite. Fan and / or pump are off. Display not illuminated	No power to boiler.	Check line voltage.
	Defective transformer.	Check transformer. Reconnect or replace as needed.

9.4.2 Temperature issues

Temperature issues		
Issue	**Diagnosis**	**Fix**
Low heat	Operating temperature too low. Increase temperature target.	Increase temperature target.
	Priority parameters or load configuration improperly set up.	Review load configuration parameters.
	Appliance undersized.	Refer to Load Calculation vs. Boiler Output.
	Air trapped within system.	Bleed system as required.
	Improper system piping.	Refer to recommended piping guidelines for the respective boiler model.

Temperature issues		
Issue	**Diagnosis**	**Fix**
	System pump undersized.	Check pump manufacturer's data / check temp differential across heat exchanger.
	Poor gas : air mixing.	Check CO_2 level.
	Defective thermostat.	Refer to manufacturer's instructions.
	Obstruction in condensate drain.	Inspect and clean condensate drain.
	Appliance cycling on operating / safety controls.	Check operation with Ohmmeter / Voltmeter.
	System radiation undersized.	Check manufacturer's rating tables for capacity per foot.
Temperature exceeds thermostat setting	Incorrect anticipator setting.	Set to zero.
	Mercury thermostat not level.	Check level.
	'Ghost' call for heat	Short or induced voltage in t-stat wiring
One or more zones do not heat properly	Air trapped within zone(s) piping	Vent zone(s) as required.
	Low radiation/ excessive heat loss.	Check actual length of pipe using radiation / heat loss calculation.
	Low flow rate to zone(s).	Check temperature drop across zone.
	Defective zone valve/ zone circulator.	Set anticipator to zero. Check thermostat operation. Refer to manufacturer's instructions.

9.4.3 Miscellaneous issues

Miscellaneous issues		
Issue	**Diagnosis**	**Fix**
Fumes and High Humidity	Improperly installed condensate trap	Refer to Installation chapter.
	Leak in vent piping	Inspect using soap solution.
	Flue gas leak within boiler	Visually inspect all mechanical connections.

Miscellaneous issues		
Issue	**Diagnosis**	**Fix**
'Ghost' call for heat.	Triac or 'Power-robbing' thermostat sending current to boiler.	Remove Therm. connections from boiler to confirm that stray voltage, or current induced in thermostat wiring, is source of nuisance signal. Replace the Power Robbing thermostat, isolate the thermostat with a relay or install a properly sized resistor (consult the thermostat manufacturer first then Technical Support for instructions).
Error: Water High Limit / Low Water Cutoff won't clear.	Boiler is in 1-hour safety lockout.	For instructions on clearing errors, see the *V10 Touchscreen Controller manual*.
DHW taking too long to heat.	Sensor may be under-reading actual water temp.	Check sensor engagement; note well is 15 cm / almost 6 inches deep and sensor must be fully set to back. Check programmed settings boiler temp set too close to the required DHW temperature.
Boiler output not modulating up to maximum despite target not being reached.	Possible flow issue: check for 35 or 40 °F temperature difference between boiler supply and return water temperatures (evokes electronic fence).	Confirm that the boiler pump is able to overcome head loss of boiler and primary loop piping at the required flow rate.
Boiler pump runs but load pumps do not.	*PV Power* wiring miss.	Supply power to the PV/L and PV/N terminals from the incoming power supply to the boiler. (Factory wired.)
Boiler pump runs during parallel-piped DHW call	Boiler pump is set to On.	Set the boiler pump to *Off* for the DHW load in the Installer Setup menu.

9.4.4 Short-cycling issues

Short-cycling issues	
Diagnosis	**Fix**
Improper values entered via touchscreen	Check load maximum temps are above target temps, by ½ of the selected boiler differential. Ensure boiler differential is OK (16 - 30°F is generally adequate)

Short-cycling issues	
Diagnosis	**Fix**
Excess condensate in venting.	Check venting slopes on horizontal runs. Look for sags.
Obstruction in condensate trap.	Inspect and clean condensate trap.
Improper vent length or improper slope to vent.	Check venting. Compare vent length and diameter.
Incorrect settings or defective thermostat.	Check operation. Refer to manufacturer's instructions. Check setting with ammeter.
Air in system or marginal water flow.	Bleed/purge system as required. Confirm adequate pump size and temp rise in the heat exchanger.
Boiler relighting due to low flame current.	Check that CO_2 level is within specification.
Dirty burner/heat exchanger.	Clean burner / heat exchanger.
Low water flow due to improper piping.	Refer to recommended piping for the respective boiler model.
Low water flow due to undersized pump.	Check manufacturer's rating charts/check temperature differential across heat exchanger.
Low water flow due to restrictions in water pipe.	Check temperature differential across zone/heat exchanger.
Low radiation.	Check actual amount of radiation per zone and refer to manufacturer's rating tables.
Appliance over-fired.	Clock gas meter/check gas pressure with manometer/ check CO_2 level.
Appliance Oversized.	Check load calculation vs. minimum boiler output.
Improperly set or defective controls.	Check operation with ohmmeter/voltmeter.

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Appendices

Wiring diagrams

V-10 Controller electrical diagram

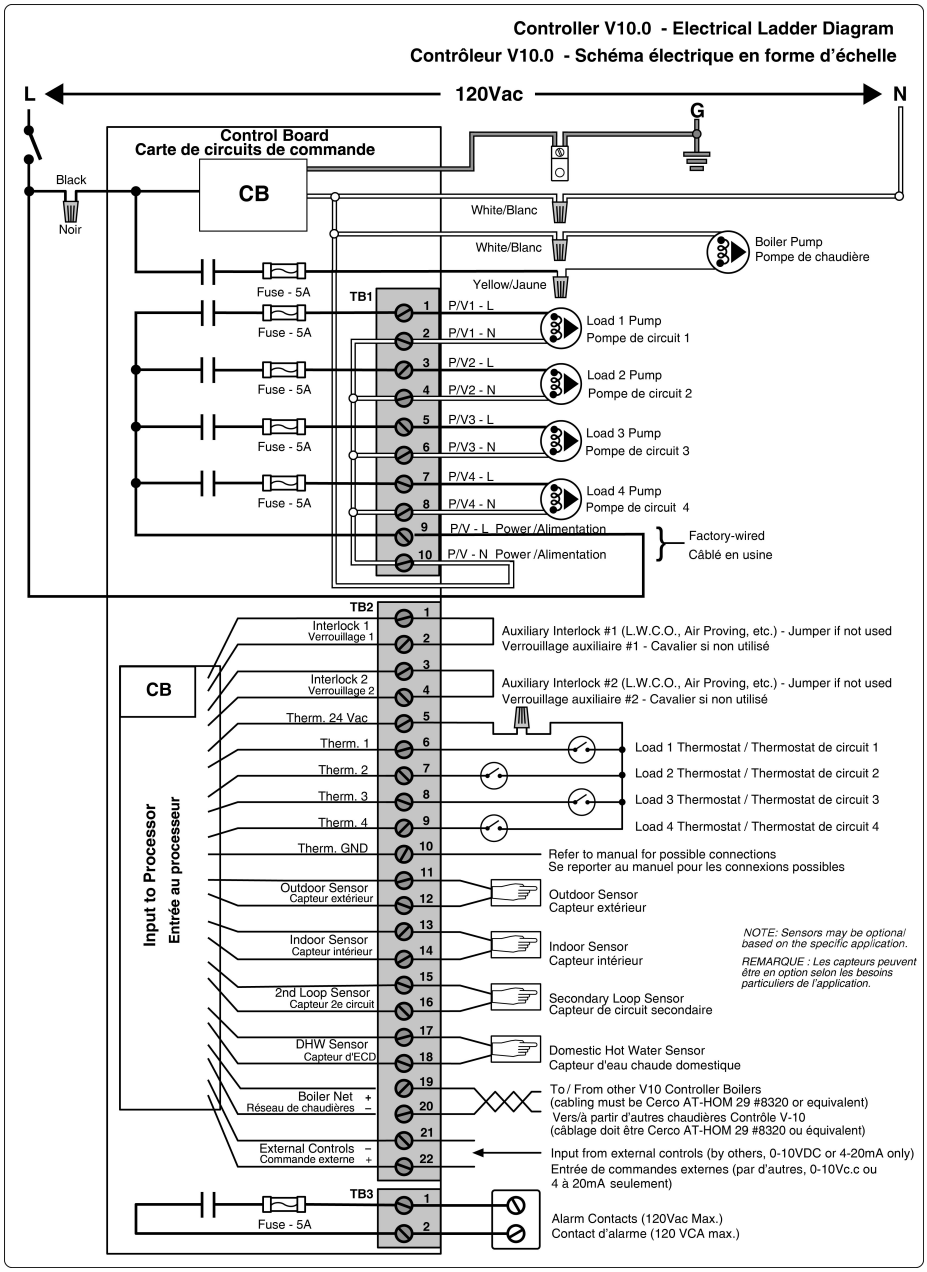


Figure 53 *Controller electrical diagram*

Internal wiring diagram

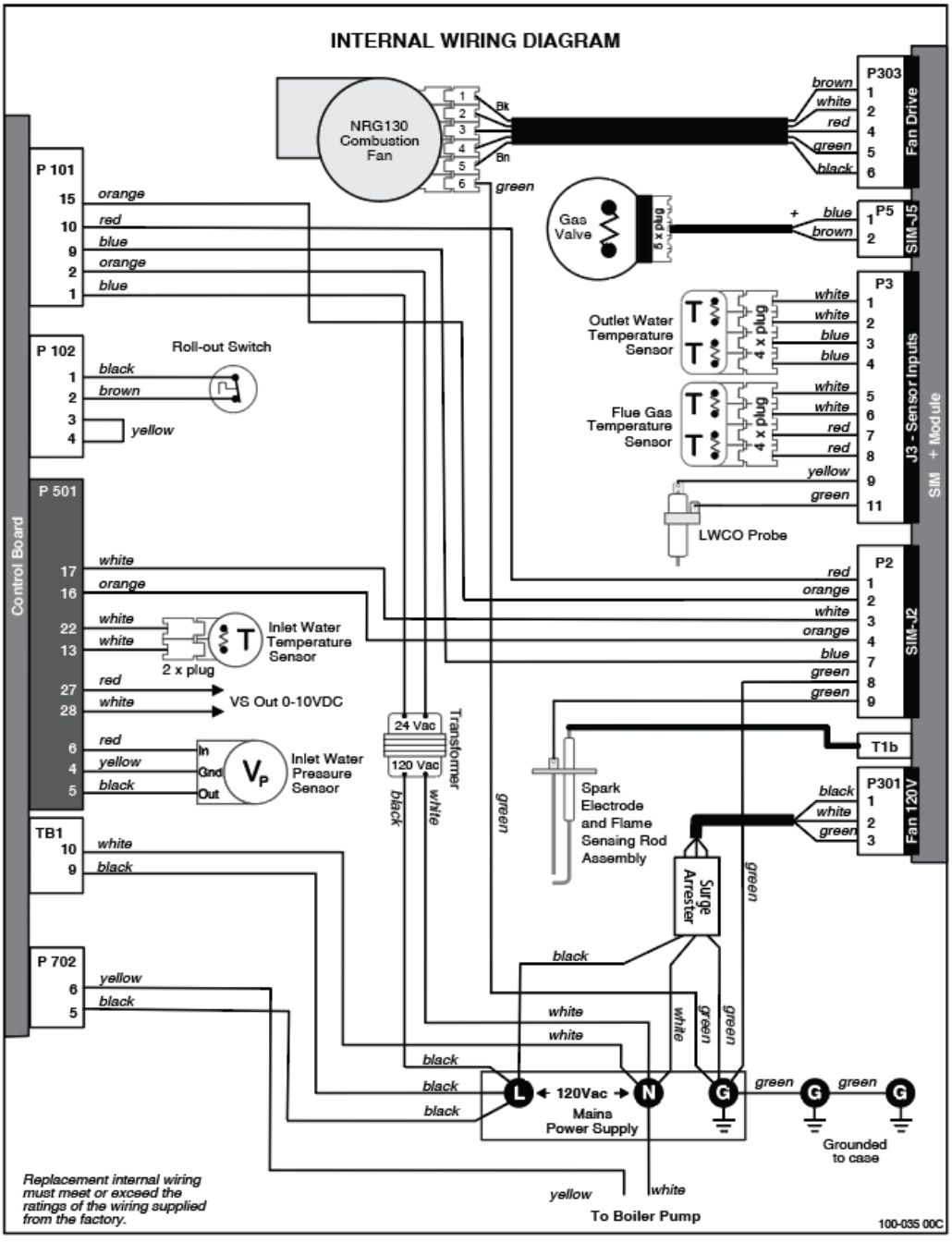


Figure 54 *Internal wiring diagram*

Sequence of Operation

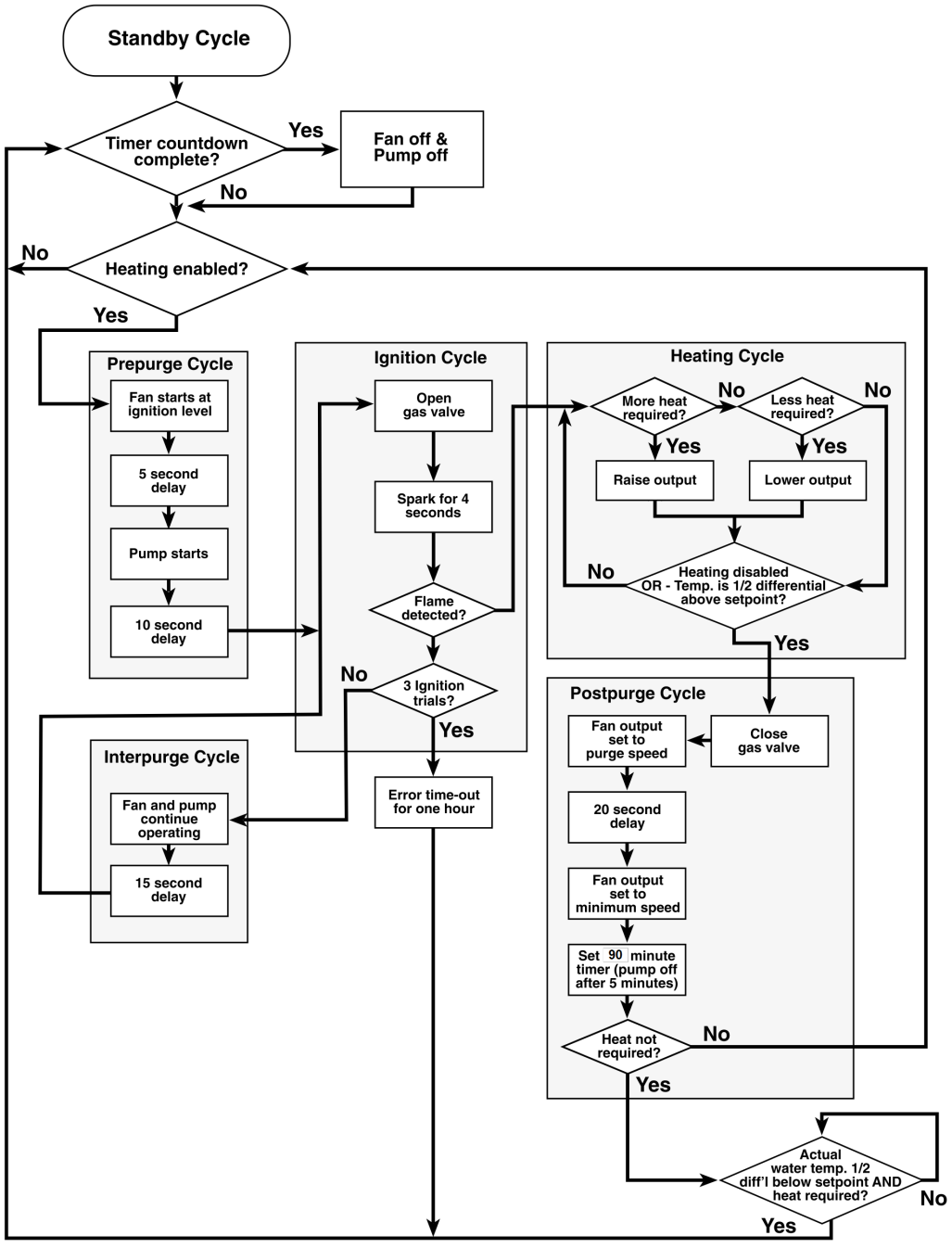


Figure 55 *Sequence of Operation*

Exploded views of boiler parts

Boiler part diagrams - Boiler 85, Boiler 115

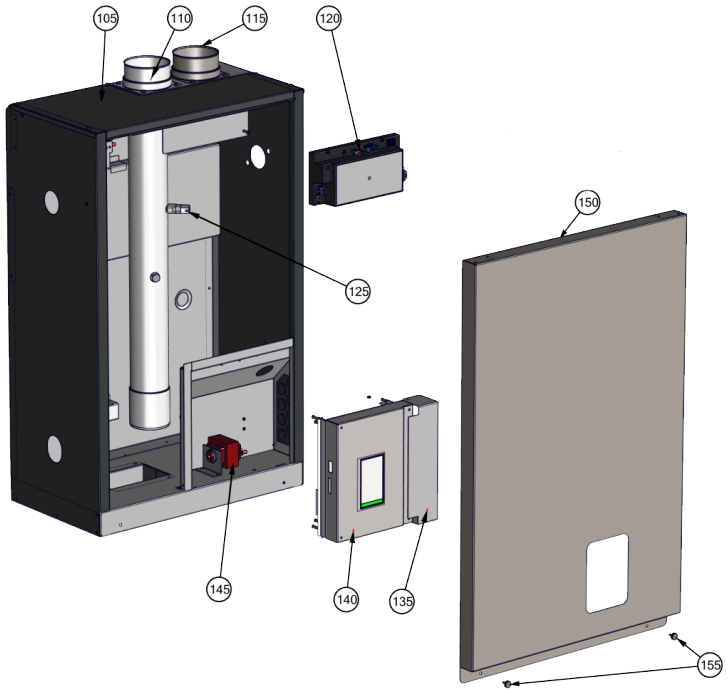


Figure 56 *Exploded exterior view- Boiler 85, Boiler 115*

Item #	Description	P-kit	Quantity
105	Top Access Cover	P-400	1
110	Exhaust Duct	P-390	1
115	Intake Duct	P-391	1
120	Safety Ignition Module+ (SIM+)	P-271B	1
125	Flue Temperature Sensor	P-361	1
135	Terminal Block Cover	P-402	1
140	Controller chassis	P-280	1
	V-10 Touchscreen Controller Board	P-242	1
145	Transformer	P-9059	1
150	Front Access Cover - door assembly	P-331	1
155	Thumb screw	P-405	2

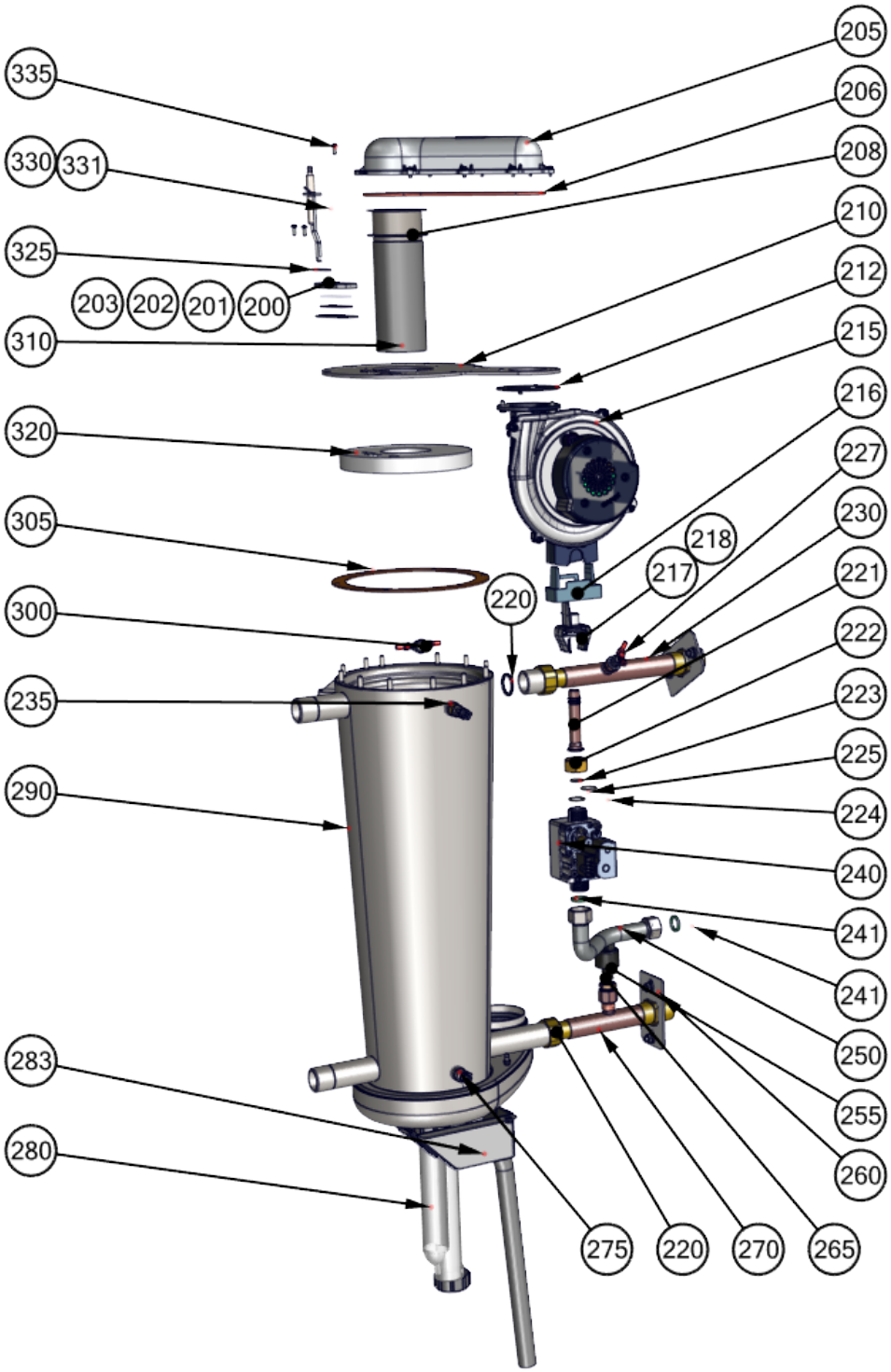


Figure 57 *Exploded interior view- Boiler 85, Boiler 115*

Item #	Description	P-kit	Quantity
200	Sight Glass Housing	P-107A	1
201	Sight Glass		1
202	Sight Glass Gasket		1
203	Sight Glass to Lid Gasket		1
205	Fan Coupler	P-347	1
206	Fan Coupler O-ring		1
208	Burner Gasket	P-428	1
210	Heat Exchanger Lid	P-394	1
212	Fan Gasket	P-9211	1
215	Fan	P-310	1
216	Air Metering Insert (Boiler 85)	P-342	1
	Air Metering Insert (Boiler 115)	P-335	
217	Venturi Insert: Boiler 85	P-342	1
218	Venturi Insert: Boiler 115	P-335	1
220	Water Pipe Gasket	P-9232	2
221	Gas Tube	P-399	1
222	Gas Valve Union Nut		1
223	Orifice O-ring	P-9211	1
224	Orifice 725 - NG	P-305	1
225	Orifice 480 - LP	P-304	1
227	LWCO Probe	P-9061	1
230	Supply Water Pipe, 1"	P-9150	1
235	Supply Duplex Temperature Sensor	P-362	1
240	Gas Valve	P-326B	1
241	Gas Line Gasket		2
250	Flexible Gas Line	P-9216	1
255	Water Pressure Sensor	P-9057	1
260	Water Pipe Bracket	P-403	2
265	Pressure Sensor Bushing	P-9085	1
270	Return Water Pipe	P-9115	1
275	Return Temperature Sensor	P-363	1
280	Condensate Trap	P-115	1

Item #	Description	P-kit	Quantity
283	Condensate Trap Retainer	P-344	1
290	Heat Exchanger	P-321	1
300	Temperature Switch	P-9070	1
305	Heat Exchanger Lid Gasket	P-372	1
310	Burner	P-312	1
320	Refractory	P-9213	1
325	Ignitor Gasket and screws	P-111B	1
330	Ignitor (Boiler 85)	P-437	1
	Ignitor (Boiler 115)	P-111B	
335	Ignitor / Fan Coupler Screws	P-327	10

Boiler part diagrams - Boiler 160

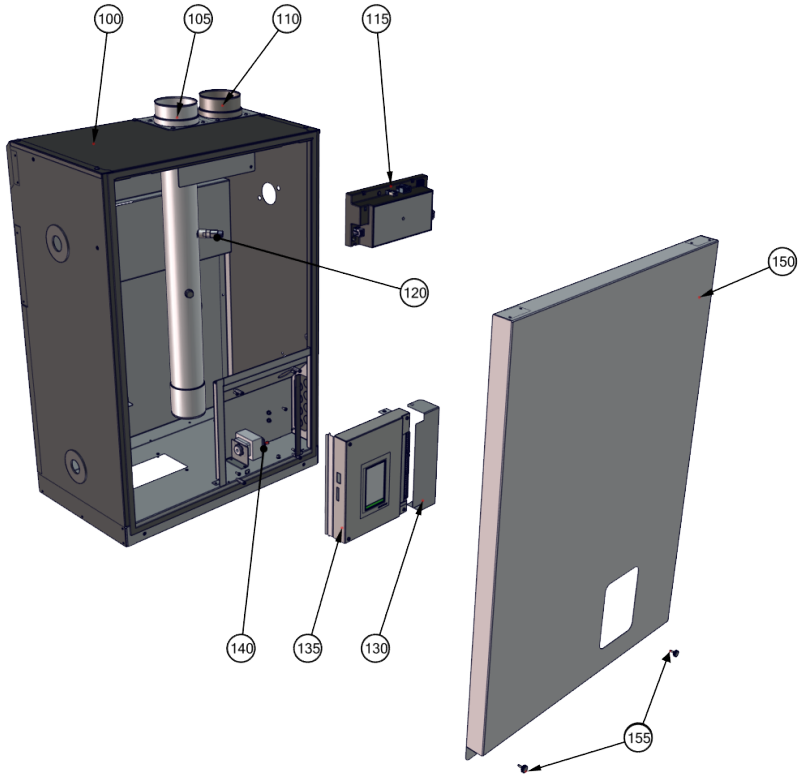


Figure 58 *Exploded exterior view- Boiler 160*

Item #	Description	P-kit	Quantity
100	Top Access Cover	P-409	1
105	Exhaust Duct	P-390	1
110	Intake Duct	P-391	1
115	Safety Ignition Module+ (SIM+)	P-271B	1
120	Flue Temperature Sensor	P-361	1
130	Side Terminal Block Cover	P-402	1
135	Controller chassis	P-280	1
	V-10 Touchscreen Controller	P-242	1
140	Transformer	P-9059	1
150	Front Access Cover - door assembly	P-332	1
155	Thumb screw	P-405	2

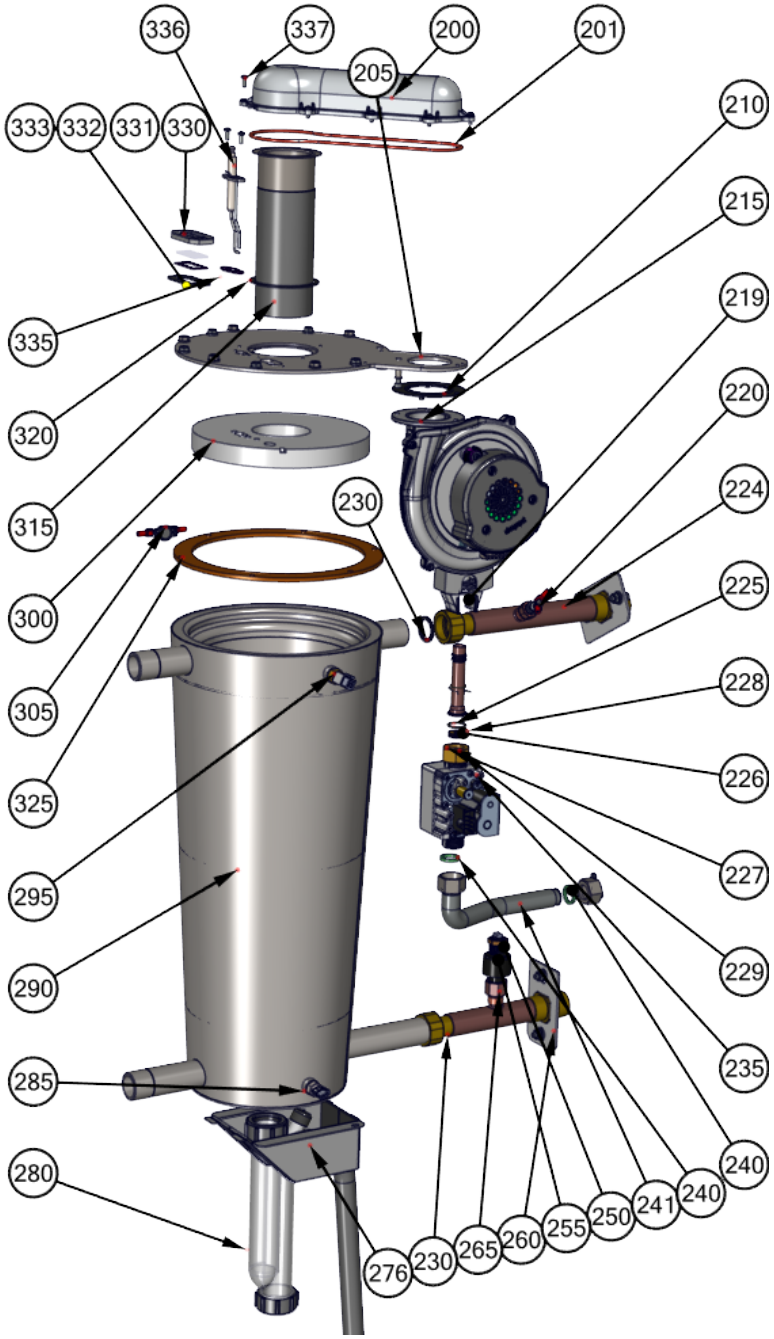


Figure 59 *Exploded interior view- Boiler 160*

Item #	Description	P-kit	Quantity
200	Fan Coupler	P-347	1
201	Fan Coupler O-ring		1
205	Heat Exchanger Lid	P-395	1
210	Fan Gasket	P-9211	1
215	Fan	P-310	1
219	Venturi	P-335	1
220	LWCO Probe	P-9061	1
224	Supply Water Pipe, 1"	P-9150	1
225	Gas Tube	P-399	1
226	Orifice 650 - NG	P-307	1
227	Orifice 505 - LP	P-306	1
228	Orifice O-ring	P-9211	1
229	Gas Valve Union Nut	P-399	1
230	Water Pipe Gasket	P-9211	2
235	Gas Valve	P-326B	1
240	Gas Line Gasket		2
241	Flexible Gas Line	P-9216	1
250	Water Pressure Sensor	P-9057	1
255	Pressure Sensor Bushing	P-9085	1
260	Water Pipe Bracket	P-403	2
265	Return Water Pipe	P-9115	1
276	Condensate Trap Retainer	P-344	1
280	Condensate Trap	P-115	1
285	Return Temperature Sensor	P-363	1
290	Heat Exchanger	P-322	1
295	Supply Duplex Temperature Sensor	P-362	1
300	Refractory	P-9214	1
305	High Limit Switch	P-9070	1
315	Burner	P-313	1
320	Burner Gasket	P-428	1
325	Heat Exchanger Lid Gasket	P-374	1

Item #	Description	P-kit	Quantity
330	Sight Glass Housing	P-107A	1
331	Sight Glass		1
332	Sight Glass Gasket		1
333	Sight Glass to Lid Gasket		1
335	Ignitor Gasket	P-111B	1
336	Ignitor (double prong)		1
337	Ignitor / Fan Coupler Screws	P-317	

Boiler part diagrams - Boiler 199

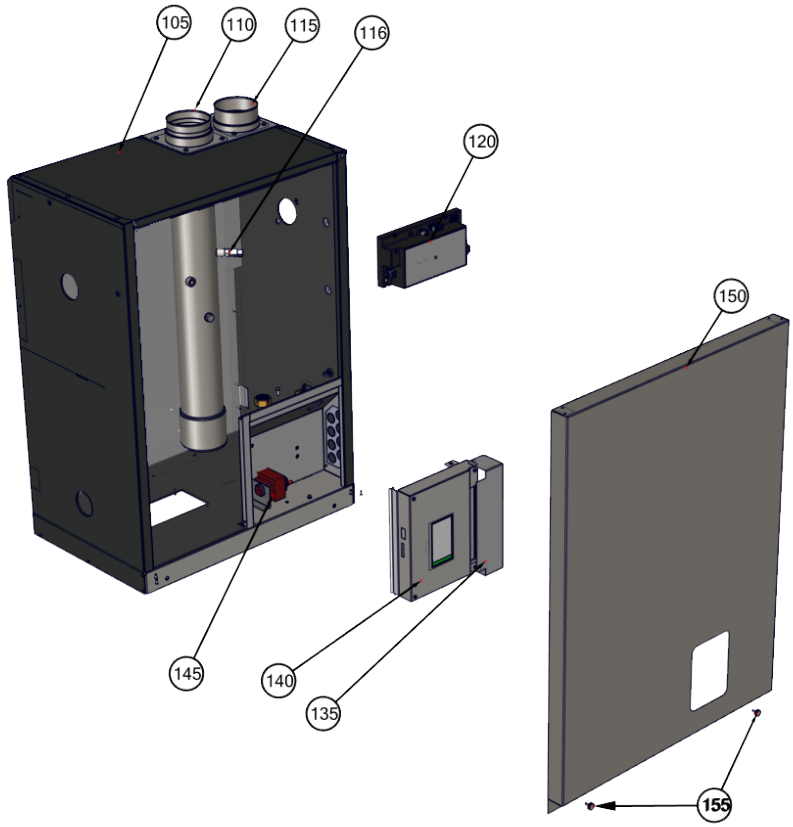


Figure 60 *Exploded exterior view- Boiler 199*

Item #	Description	P-kit	Quantity
105	Top Access Cover	P-410	1
110	Exhaust Duct	P-392	1
115	Intake Duct	P-391	1
116	Flue Temperature Sensor	P-361	1
120	Safety Ignition Module+ (SIM+)	P-271B	1
135	Terminal Block Cover	P-402	1
140	Controller chassis	P-280	
	V-10 Touchscreen Controller	P-242	1
145	Transformer	P-9059	1

Item #	Description	P-kit	Quantity
150	Front Access Cover - door assembly	P-333	1
155	Thumb screw	P-405	2

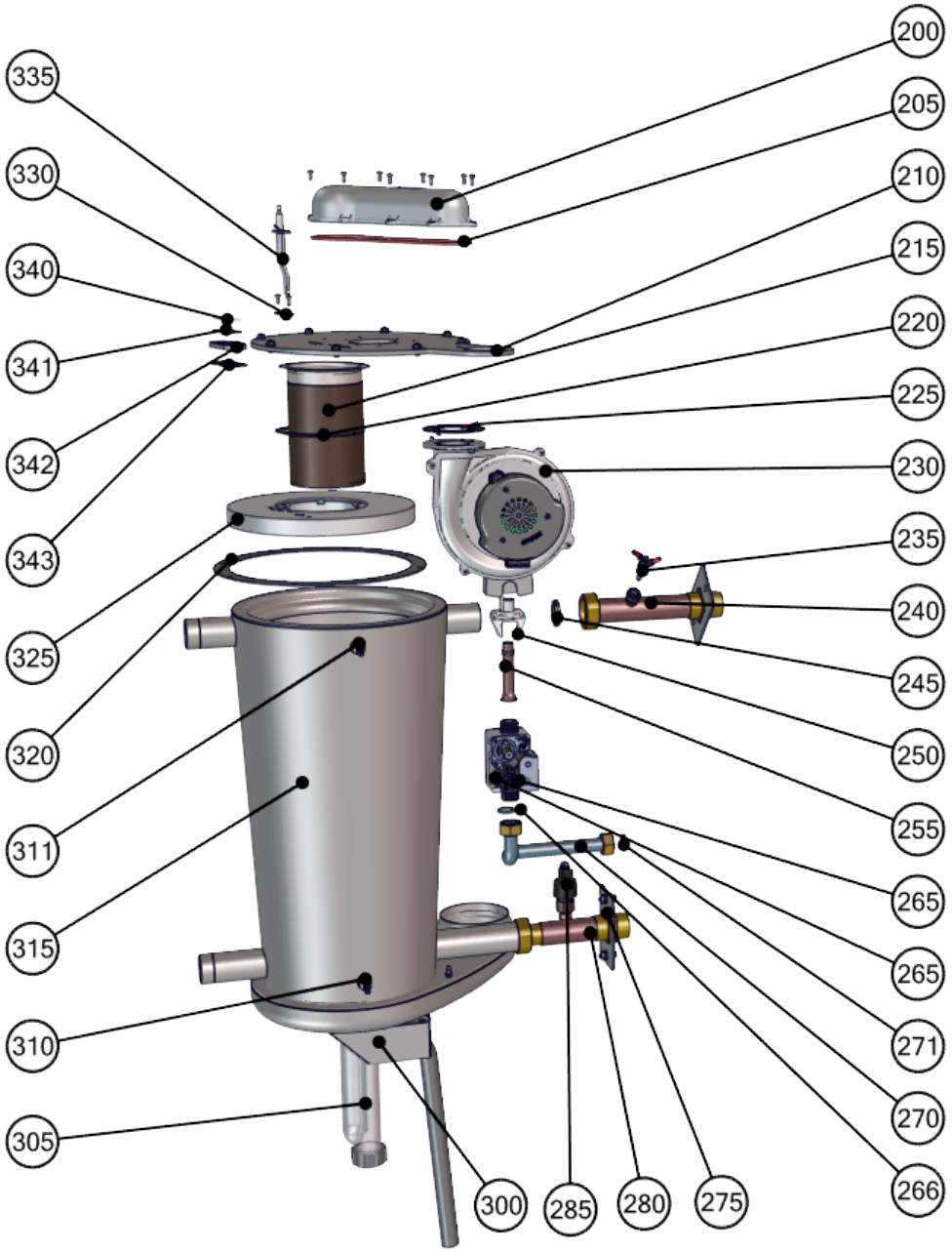


Figure 61 *Exploded interior view- Boiler 199*

Item #	Description	P-kit	Quantity
200	Fan Coupler	P-347	1
205	Fan Coupler O-ring		1
210	Heat Exchanger Lid	P-396	1
215	Burner	P-346	1
220	Burner Gasket	P-375	1
225	Fan Gasket	P-385	1
230	Fan	P-310	1
235	LWCO Probe	P-9061	1
240	Supply Water Pipe	P-379	1
245	Water Pipe Gasket	P-385	1
250	Venturi Insert	P-336	1
255	Gas Tube	P-399	1
265	Gas Valve	P-326B	1
266	Gas Line Gasket	P-385	1
275	Water Pipe Bracket	P-371	1
280	Return Water Pipe	P-370	1
285	Water Pressure Sensor	P-9057	1
300	Condensate Trap Retainer	P-344	1
305	Condensate Trap	P-115	1
310	Return Temperature Sensor	P-363	1
311	Supply Duplex Temperature Sensor	P-362	1
315	Heat Exchanger	P-323	1
320	Heat Exchanger Lid Gasket	P-319	1
325	Refractory	P-386	1
330	Ignitor Gasket	P-111B	1
335	Ignitor		1
340	Sight Glass	P-107A	1
341	Sight Glass Gasket		1
342	Sight Glass Housing		1
343	Sight Glass to Lid Gasket		1

Installation and Commission Report

Model Number	**Serial Number**
Date of Installation	

User contact information	**Installer Information Company**

Fuel (select type)				**Gas Supply Pressure**	**Measured Rate of Input**
Natural Gas	☐	Propane Gas	☐	(high fire)Inches w.c.	(high fire)Btu/hr

Leak testing completed

Gas Piping	☐	Venting System	☐	Fan	☐	Combustion Components	☐

System Cleaned and Flushed	☐	**System Filled**	☐
Type of Cleaner Used		Glycol/ chemicals used?Type/ concentration	

Ignition Safety Shutoff test completed ☐

Flame Current Reading	High Fire	µA
	Low fire	µA

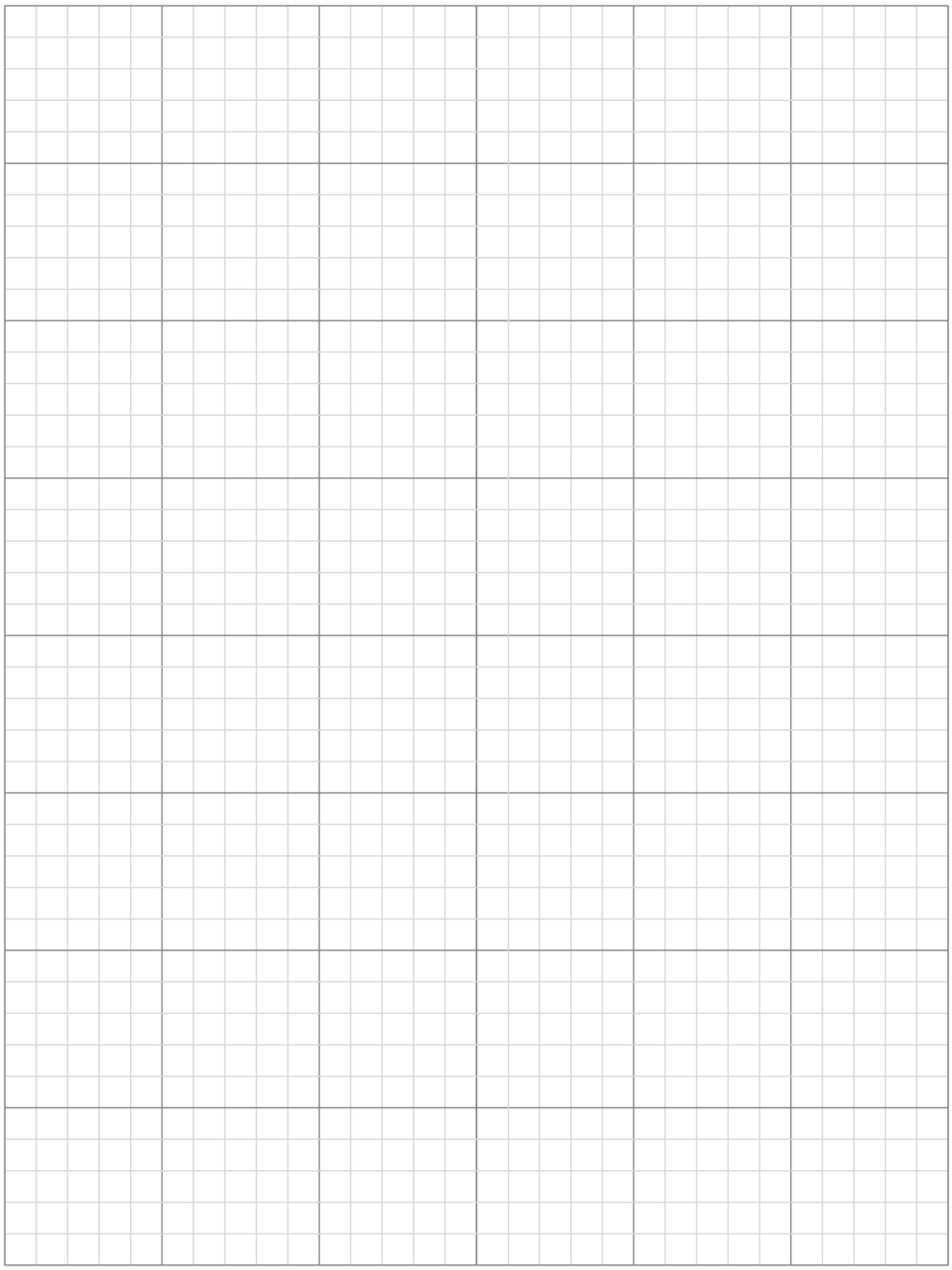
Air purge completed ☐

Relief Valve					**Condensate trap**			
Correctly installed and piped	☐	Relief valve “try lever” test performed	☐	Filled	☐	Drain clear and free flowing	☐	Condensate Neutralization?	☐

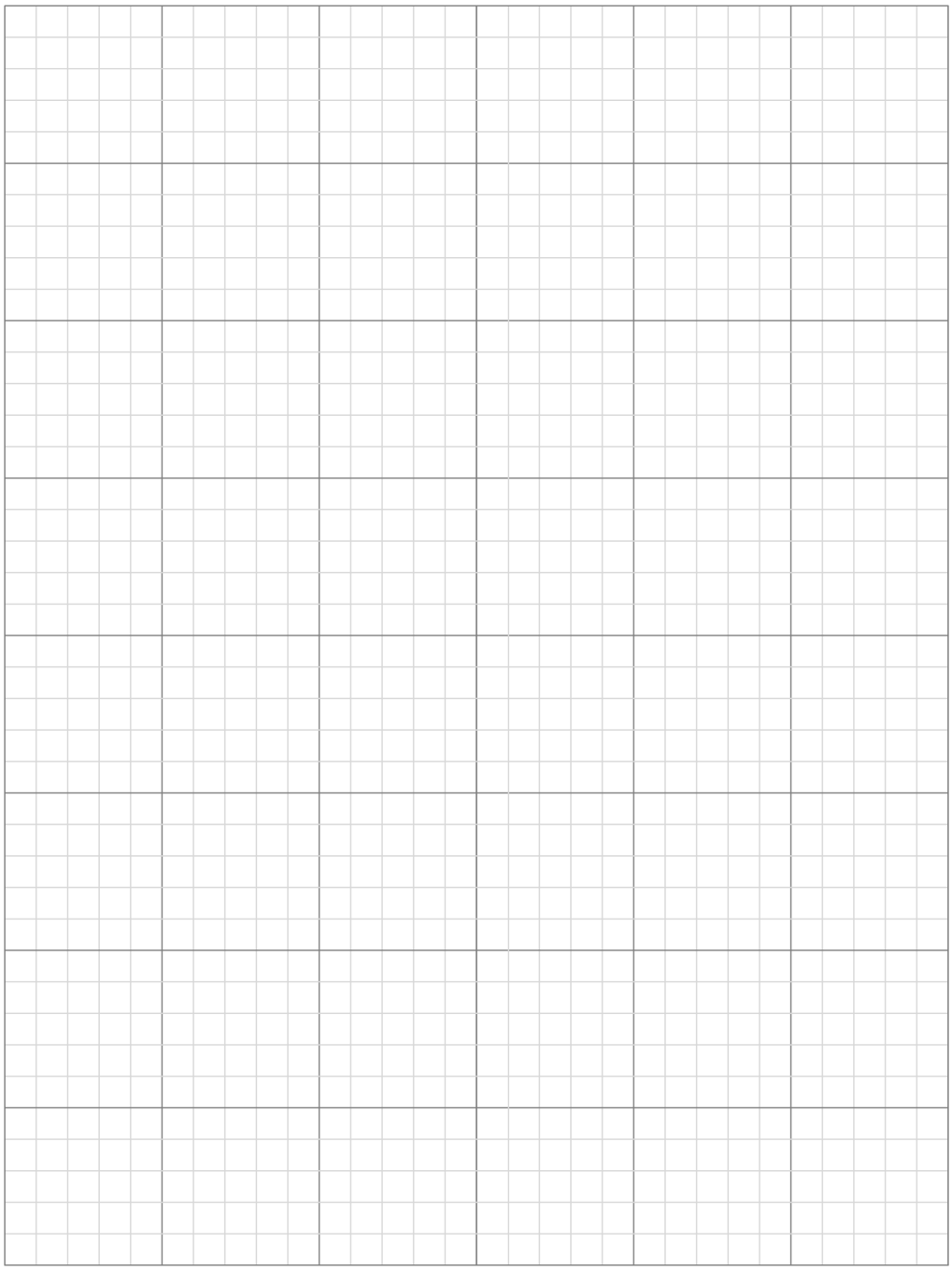
Combustion Readings:	CO_2%	CO ppm	**Flue temperature**	**Return water temperature**
High Fire				
Low Fire			*measure simultaneously*	

Commissioning has been completed as listed on this report		☐
Owner advised and instructed in the safe operation and maintenance of the boiler and system.		☐
Information regarding the appliance and installation received and left with owner.	Yes	No
Installer Signature :		

NOTES



NOTES



Intentionally left empty

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The following message is relevant to users in the USA:

Important

This Boiler is equipped with a feature that saves energy by reducing the boiler water temperature as the heating load decreases. This feature is equipped with an override which is provided primarily to permit the use of an external energy management system that serves the same function. THIS OVERRIDE MUST NOT BE USED UNLESS AT LEAST ONE OF THE FOLLOWING CONDITIONS IS TRUE:

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

US installers should contact their distributor for any further information required.

Manufactured by:

IBC Technologies Inc.

8015 North Fraser Way
Burnaby, BC Canada V5J 5M8
(844) HEAT-IBC / (844) 432-8422

For:

Rheem Sales Co.

Montgomery, AL.
(833) 212-9276

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