INSTALLATION AND OPERATING MANUAL

High-efficiency Condensing Combi Boiler

150,000 Btu/hr

199,000 Btu/hr

(Natural Gas or Propane)

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.

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. Repeated or uncontrolled water fills will increase the potential for damage.

High levels of dissolved solids or minerals may precipitate out of the fluid onto the hottest part of the heat exchanger, impairing heat transfer and resulting in overheating and premature failure. The amount of solids that may form on the heat exchanger will depend on the degree of hardness and the total water volume in the system. A high water volume system with a low hardness count may cause as much damage as a system with less volume and higher hardness, so for high-volume systems it is recommended to reduce dissolved solids to 10 ppm - 30 ppm before the introduction of inhibitors and / or glycol. Final water chemistry limits are as follows:

- Hardness to be between 1 and 9 grains
- TDS is to be between 10 and 150 ppm
- Acidity pH is to be between 6.6 and 8.5
- Chloride is to be less than 125 mg/l
- Iron is to be less than 0.3 mg/l
- Cu less than 0.1 mg/l
- Conductivity is to be between 20 and 300 µS/cm at 77°F (25°C)

Important: Ensure that these limits are acceptable for the other water-side components in the system.

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

Contents

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.

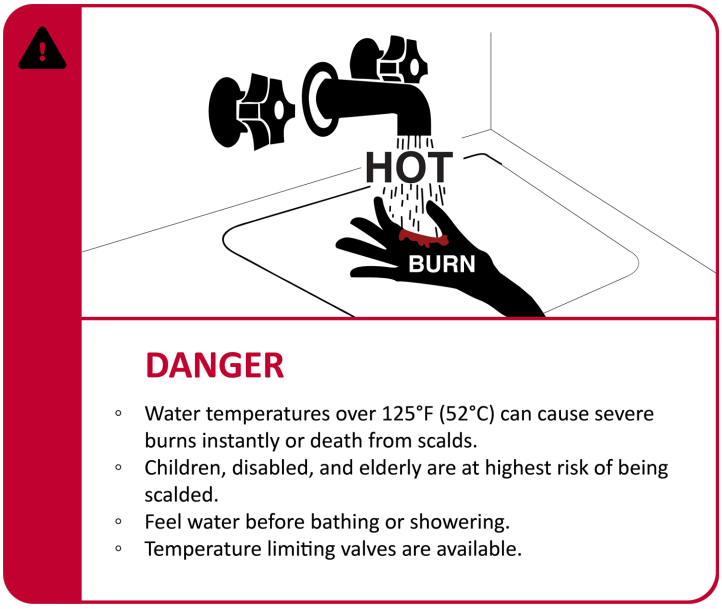
Note

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 CombiBoilers 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 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	

Intentionally left empty

1.0 Specifications

Specification	150,000 Btu/hr	199,000 Btu/hr
CSA Input (Natural Gas or Propane)	15 - 150 MBH	20 - 199 MBH
CSA Input (Natural Gas or Propane)	4.4 - 44 kW	5.9 - 58.3 kW
CSA Output	14.3 - 138.5 MBH	19.1 - 183.7 MBH
CSA Output	4.2 - 40.6 kW	5.6 - 53.8 kW
DHW - CSA Input (Natural Gas or Propane)	15 - 150 MBH	20 - 199 MBH
DHW - CSA Input (Natural Gas or Propane)	4.4 - 44 kW	5.9 - 58.3 kW
AFUE	95%	95%
Minimum gas supply pressure (natural gas or propane)	4 inch w.c.	4 inch w.c.
Maximum gas supply pressure (natural gas or propane)	14 inch w.c.	14 inch w.c.
Minimum ambient temperature	32°F / 0°C	32°F / 0°C
Maximum ambient temperature	122°F / 50°C	122°F / 50°C
Max. relative humidity (non-condensing)	90%	90%
Minimum water temp.	34°F / 1°C	34°F / 1°C
Maximum water temp. (electronic hi-limit)	190°F / 88°C	190°F / 88°C
Max. ΔT - supply/return (electronic fence)	40°F / 22.2°C	40°F / 22.2°C
Max. water temperature lockout limit	201°F / 94°C	201°F / 94°C
Power use (120Vac/60Hz) @ full fire (with internal pump)	224.9 Watts	234.2 Watts
Weight (empty)	100 lbs / 45.4 Kg	113 lbs / 51.3 Kg
Pressure vessel water content	2.79 USG/ 10.56 L	3.51 USG/ 13.29 L
Maximum boiler flow rate	19 USgpm	25 USgpm
Minimum boiler flow rate	3 USgpm	4 USgpm
Maximum boiler operating water pressure	50 psig	50 psig
Minimum boiler water pressure	8 psig	8 psig
Maximum DHW water pressure	150 psig	150 psig
Minimum DHW water pressure	40 psig	40 psig
Relief valve pressure (supplied)	30 psig	30 psig
Approved installation altitude	0 - 12,000' ASL	0 - 12,000' ASL
Maximum equivalent 2" vent length (vent & air intake each)	50 feet	N/A
Maximum equivalent 3" vent length (vent & air intake each)	170 feet	100 feet
CRN	9415.7CL	9298.7CL

Specification	150,000 Btu/hr	199,000 Btu/hr
(Natural Gas Only) Meets Ultra Low NO_x 14 ng/J requirements	Yes	Yes
DHW block certified for low lead NSF 372	Yes	Yes

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*

Domestic Hot Water Delivery	
@ 70°F / 39°C temperature rise	
150,000 BTU/hr	4.1 GPM
199,000 BTU/hr	5.5 GPM
Combi Model 150 DHW Delivery: AlternativeTemperature Rises	
Temperature rise	**DHW delivery**
@ 50°F / 27.8°C	5.36 GPM
@ 55°F / 30.6°C	4.95 GPM
@ 60°F / 33.3°C	4.57 GPM
@ 65°F / 36.1°C	4.22 GPM
@ 75°F / 41.7°C	3.59 GPM
@ 80°F / 44.4°C	3.32 GPM
@ 85°F / 47.2°C	3.06 GPM
@ 90°F / 50.0°C	2.83 GPM
@ 95°F / 52.8°C	2.61 GPM
@ 100°F / 55.6°C	2.41 GPM

Combi Model 199 DHW Delivery: Alternative Temperature Rises	
Temperature rise	**DHW delivery**
@ 75°F / 41.7°C	4.96 GPM
@ 80°F / 44.4°C	4.64 GPM
@ 85°F / 47.2°C	4.36 GPM
@ 90°F / 50.0°C	4.11 GPM
@ 95°F / 52.8°C	3.89 GPM
@ 100°F / 55.6°C	3.69 GPM

Table 3 *DHW deliveries at alternative temperature rises*

Cabinet dimensions

Combi Model 150 dimensions

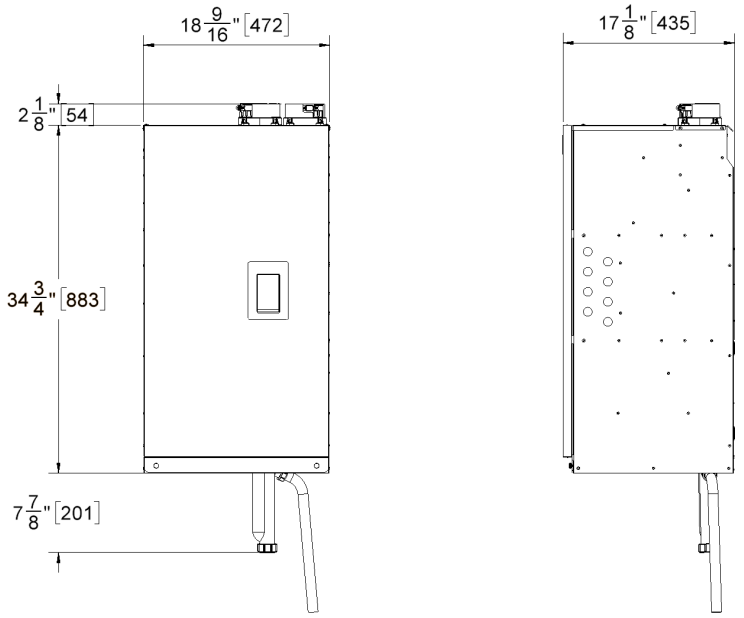


Figure 1 *Front and side view - Combi Model 150*

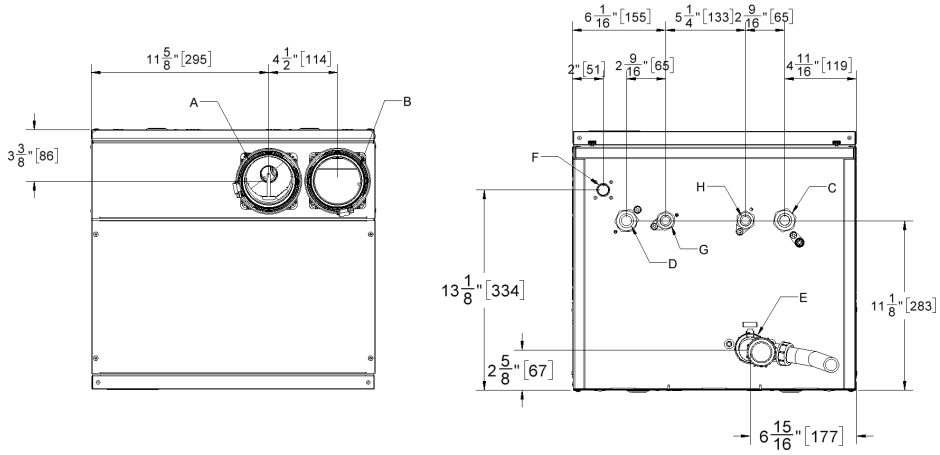


Figure 2 *Top and bottom view - Combi Model 150*

Combi Model 199 dimensions

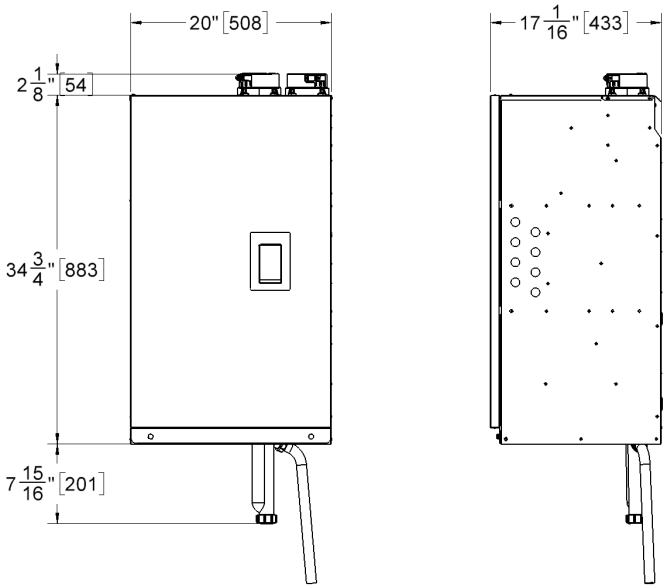


Figure 3 *Front and side view -Combi Model 199*

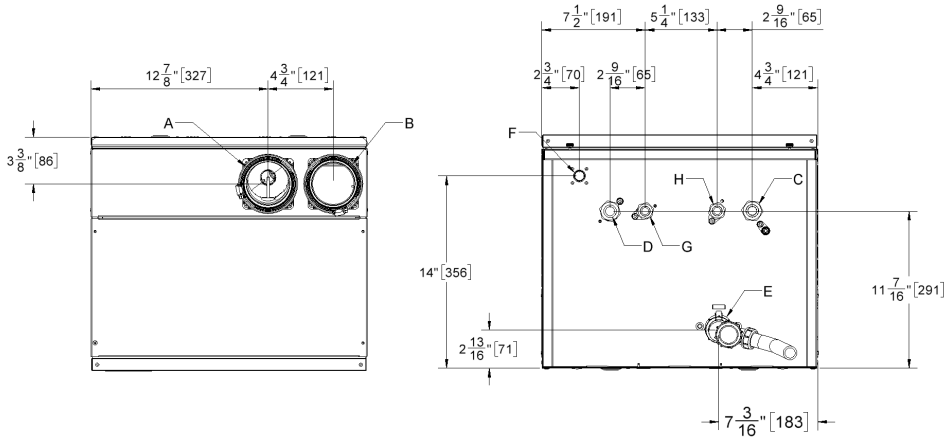


Figure 4 *Top and bottom view - Combi Model 199*

Connection specifications

The following table displays the required connection specifications.

	Description	150,000 Btu/hr	199,000 Btu/hr
A	Flue Outlet	3" Schedule 40 or 3" PP (80 mm)	3" Schedule 40 or 3" PP (80 mm)
B	Combustion Air Inlet	3" Schedule 40 or 3" PP (80 mm)	3" Schedule 40 or 3" PP (80 mm)
C	Boiler Return Water Inlet	1" NPT-M	1" NPT-M
D	Boiler Supply Water Outlet	1" NPT-M	1" NPT-M
E	Condensate Outlet	¾" Hose	¾" Hose
F	Gas Inlet	½" NPT-F	½" NPT-F
G	DHW outlet (hot water)	¾" NPT-M	¾" NPT-M
H	DHW inlet (cold water)	¾" NPT-M	¾" NPT-M

Table 4 *Connections*

2.0 Introduction

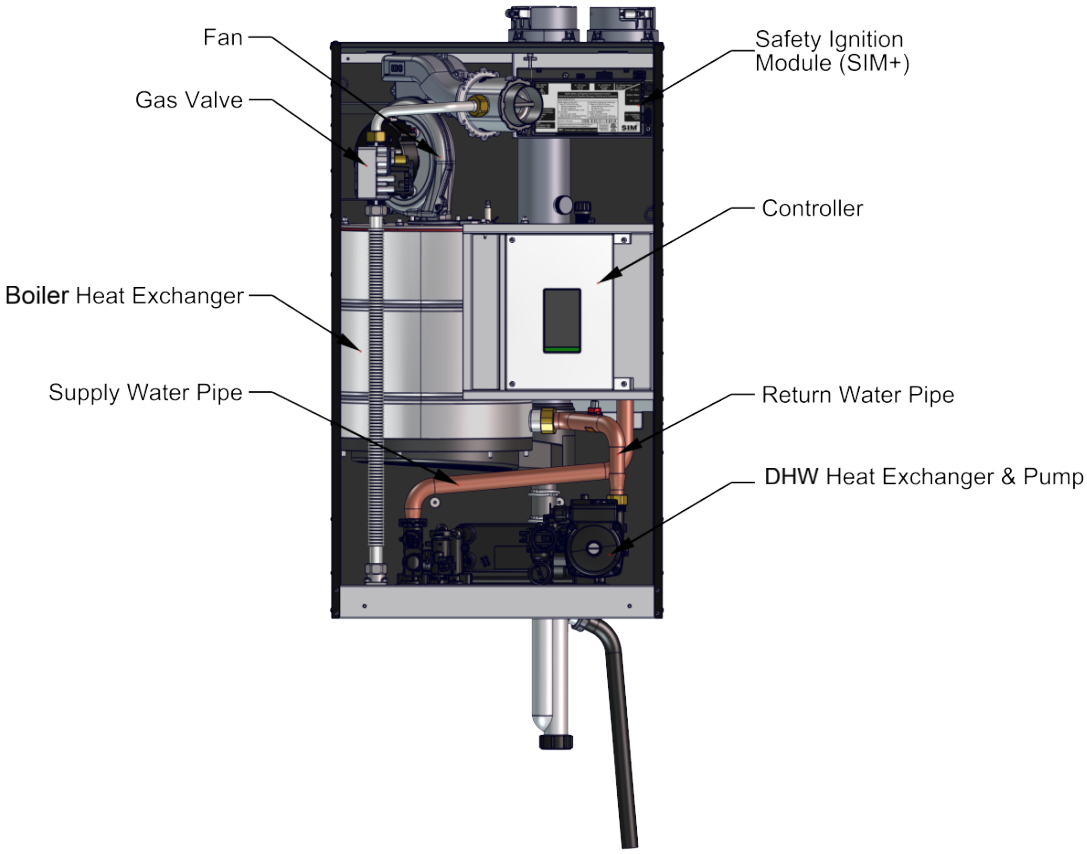


Figure 5 *View from the front*

2.1 Standard features and benefits

- High thermal efficiency
- Compact
- Coordinated Boiler and DHW circuits
- Cascade up to 4 appliances
- Turn-down ratio 10 to 1
- 4 load pump management
- Built-in boiler pump
- Easy-to-use touchscreen

2.2 Warranty

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

The heat exchanger carries a 15-year limited warranty.

For commercial applications, the combi boiler carries a 5-year warranty on the heat exchanger and a 2-year warranty on all parts against defects in materials or workmanship and failures due to thermal shock.

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 5 *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 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.

4.3.1 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 page 9*. 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 *Sidewall vent termination on page 34*.
- The minimum clearance requirements for combustible materials (see *Table 6*).
- 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.

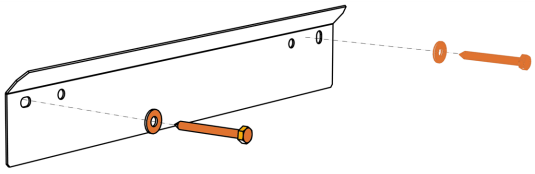
4.4 Mounting the boiler

Warning

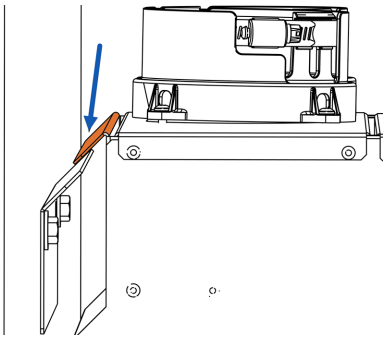
Do not mount the appliance to hollow wall structures - The combined weight of the boiler, its water content and associated piping components exceed 113 pounds. Fasteners must be rated for this strain, and must be firmly anchored into solid material that will support this weight. Installers must take 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 weight – without water, system piping and components – is approximately 113 lbs / 51 kg.

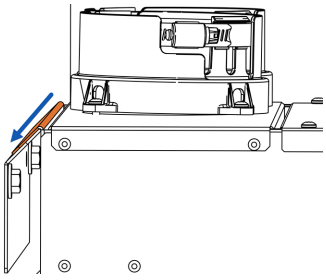
1. Attach the support bracket (supplied) to the wall studs using the two **¼" x 2½"** long lag screws with flat washers.



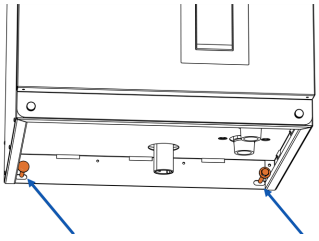
2. Hook the boiler tab (located on back of boiler) over the support bracket flange.



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

The appliance offers 3" connections that accept standard 3" PVC/CPVC and polypropylene (PP) pipe. Use reducing fittings (not bushings) to adapt to smaller diameter pipe. Insert pipe directly into the 3" female fitting past the gasket, and secure with the built-in clamp (see image below).

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 polypropylene pipe is installed so that it extends past this second gasket. For polypropylene material exposed to outdoor conditions, follow the venting supplier’s recommendations on UV protection.

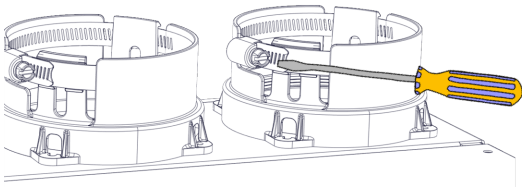


Figure 6 *Securing a pipe connection*

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).

Combustion air piping - if used - is inserted directly into the 3" connector on the right side. 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 polypropylene 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

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.

150,000 Btu/hr, 199,000 Btu/hr Clearances		
Surface	**Minimum distance from combustible surfaces**	**Recommended clearance for installation and service**
Front	2"	24"
Rear flue connection	0"	0"
Left side	0"	4" (allow access to water connections)
Right side	1"	4" (allow access to water connections)
Top	2"	6" (for vent connections)
Bottom	0" (clearance for pipes)	12" (for condensate trap and piping)

Table 6 *Clearance distances for boiler mounting sites*

A minimum distance below the boiler of 12" is required to provide clearance for the supplied condensation trap assembly. More clearance will typically be required to accommodate associated water and gas piping.

4.7 Exhaust venting and air intake

Warning

Venting, condensate drainage, and combustion air systems for the combi boiler 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.

When planning a boiler's installation, consider the appropriate vent materials, travel and termination.

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 B149.1-10 Code and any other local building codes are to be followed. In the USA, the National Fuel Gas Code, ANSI 223.1, 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

Warning

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

Exhaust vent material – Canada

Use PVC, CPVC, Polypropylene (PP), or Stainless Steel (SS) vent component systems approved under ULC-S636 Standard for Type BH Gas Venting Systems, or stainless steel 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 manufacturers instructions. The vent temperature is limited by the boiler controller with the use of a flue temperature sensor to ensure the maximum temperature of the PVC venting material is not exceeded.

Exhaust vent material – U.S.A

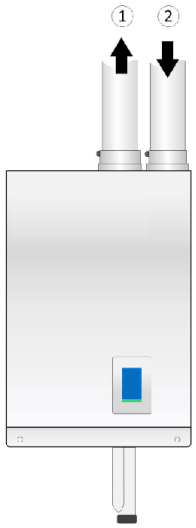
PVC, CPVC, PP, or SS venting materials are approved for use with these boilers in most of the USA. Check local codes to determine if any materials are prohibited. The vent temperature is limited with the use of the flue temperature sensor and software to ensure that the maximum temperature of the PVC venting material is not exceeded. 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, or Radel® (polyphenolsulfone) in venting systems is prohibited. Do not use ABS or any cellular core pipe for exhaust venting.

4.7.4 Direct vent

Direct vent is a 2-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.



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

Figure 7 *Direct vent*

Air intake installation

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 9*).

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 PVC/CPVC exhaust venting must slope down towards the boiler maintaining a minimum grade of 1/4" per foot to ensure that condensate runs back to the boiler. Polypropylene exhaust venting requires 5/8" per foot minimum slope.

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).

- 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's 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, PVC cement approved under ASTM D2564, or PVC/ABS cement under ASTM D2235) in accordance with its manufacturer instructions. Use transition glue anywhere that PVC and CPVC are joined. Follow the cement manufacturer’s instructions closely when joining various components. For polypropylene, connections must be secured using approved clips or clamps (follow vent manufacturers installation instructions).
- 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 on the boiler display. Then coat all joints with an approved leak test solution just as

you would joints in a gas line and 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's 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.

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:

Intake/Exhaust	150,000 Btu/hr	199,000 Btu/hr
2-inch rigid pipe	50 ft (max.)	Not permitted
3-inch rigid pipe	170 ft (max.)	100 ft (max.)
90° elbow	Each 90° elbow is equivalent to 8 feet	
90° long sweep elbow	Each 90° elbow is equivalent to 5 feet	
45° elbow	Each 45° elbow is equivalent to 3 feet	
PP 87-90° elbow	Each 87-90° elbow is equivalent to 8 feet	
(Intake only) Air Intake Filter (P-357)	Equivalent to 8 ft	
2-inch Stainless Sidewall Terminal (P-256)	Not permitted	
3-inch Stainless Sidewall Terminal (P-257)	Exhaust is equivalent to 20 feet	
	Intake is equivalent to 0 (zero) feet	
Flexible PP 3-inch Flexible pipe maximums	Limited to 45 feet	Limited to 30 feet
Flexible PP 3-inch Flexible pipe equivalents	Equivalent to 2 x actual length (e.g., 10 feet of 3-inch flexible pipe = 20 feet of rigid pipe)	Equivalent to 3.3 x actual length (e.g., 10 feet of 3-inch flexible pipe = 33 feet of rigid pipe)

Table 7 Maximum air intake pipe and maximum exhaust vent length

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).

Example of equivalent length calculations for a Combi Model 150:
A Combi Model 150 can be situated up to 50 feet (actual vent length allowance) from the vent termination using 2-inch pipe, or up to 170 feet using 3-inch pipe.
For 4 x 90º elbows the equivalent length is 4 x 8' = 32', so the maximum straight length of pipe allowed using 2-inch pipe is 18 feet (50' – 32' = 18'). The same boiler using 3-inch pipe can have up to 138 feet (170' – 32' = 138').
For 3-inch flexible PP pipe, up to 45 feet is allowed in vertical orientation (> 45 °). The equivalent length of 3-inch flexible PP pipe should be calculated using a multiple of 2 (e.g., 45' x 2 = 90').

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.

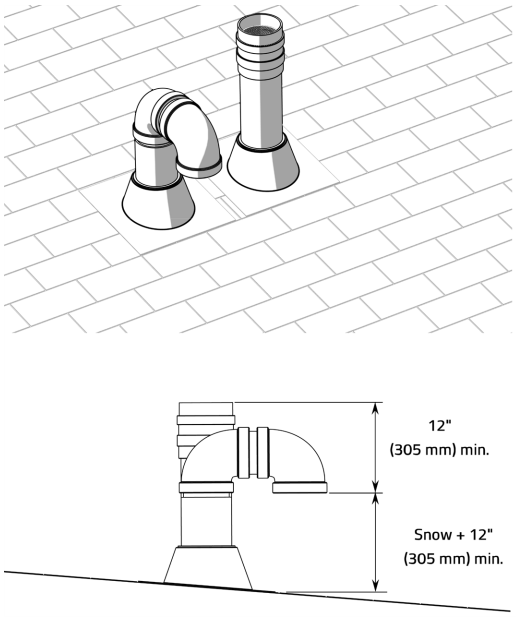


Figure 8 *Rooftop vent terminal configurations*

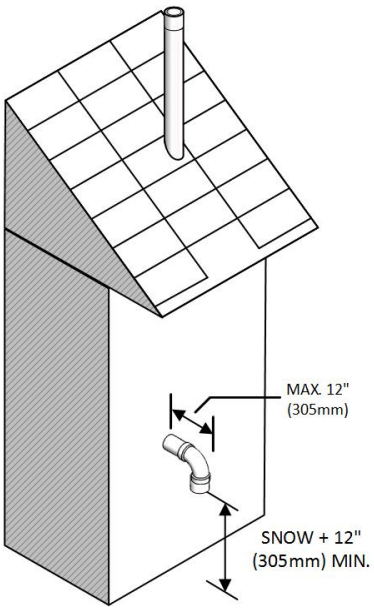
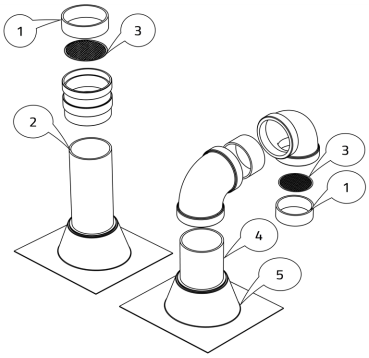


Figure 9 *Rooftop vent termination with sidewall combustion air*



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

Figure 10 *Rooftop vent terminal vent screen and retainer*

- 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" 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 2 separate groups of pipes at least 3' apart (the closest intake and exhaust pipes must be 36", or more, apart). Use the same 12" (minimum) vertical separation for all termination options. For alternate group terminations, contact Tech 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.

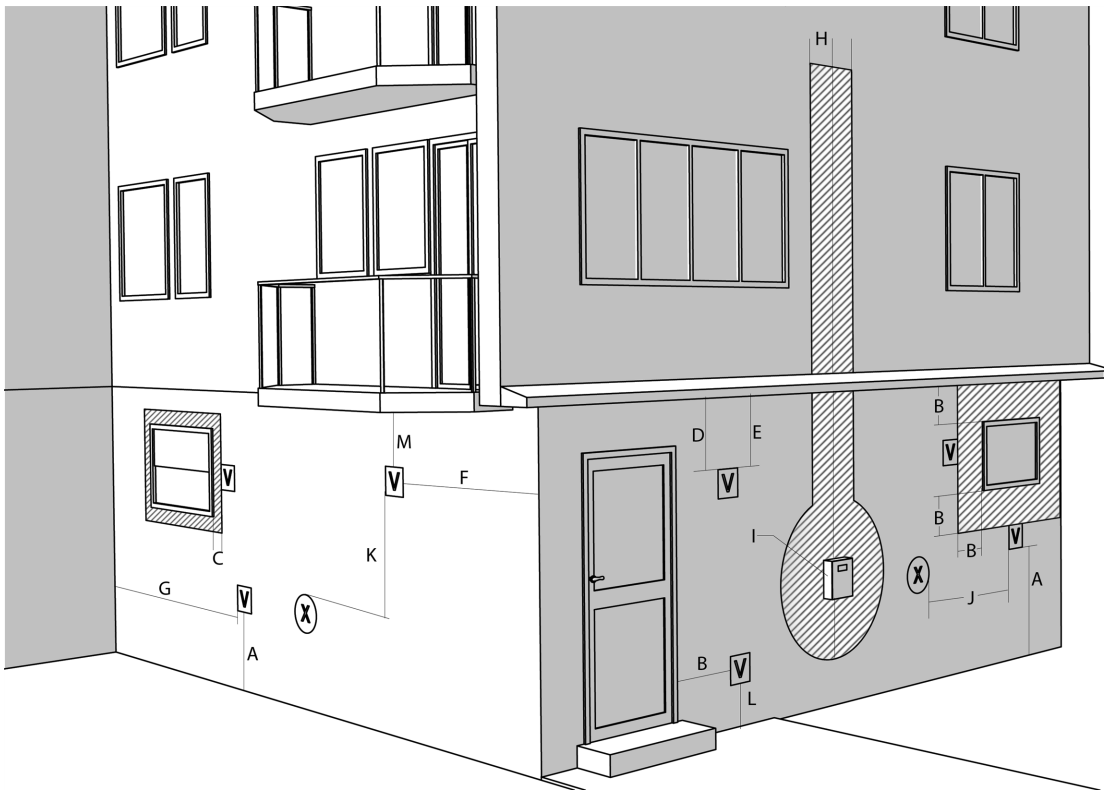
Caution

Take care installing Concentric Rooftop 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.

4.7.6 Sidewall vent termination

Caution

Vent termination clearances in this section are code minimum , or manufacturer's requirements, 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.



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

Figure 11 *Minimum clearances from vent/air inlet terminations*

	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	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	36 in (91 cm) for appliances >100,000 Btuh (30 kW)	12 in (30 cm) for appliances > 50,000 Btuh (15 kW)
K	Clearance to mechanical air supply inlet	6 ft (1.83 m)	3 ft (91 cm) above if within 10 ft (3 m) horizontally

[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]
L	Clearance 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]	*

Table 8 *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 12* and *Figure 13* .
- 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 13* , and *Figure 15*).
- Recommended: the use of a bird screen of ¼" stainless steel or plastic mesh (IPEX System 636 drain grate) to guard against foreign objects.

Warning

Important!: Maintain at least the minimum separation of exhaust vent termination from boiler intake air as illustrated in *Figure 12* , *Figure 13* , *Figure 14* and *Figure 15* .

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.

[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.

* 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.

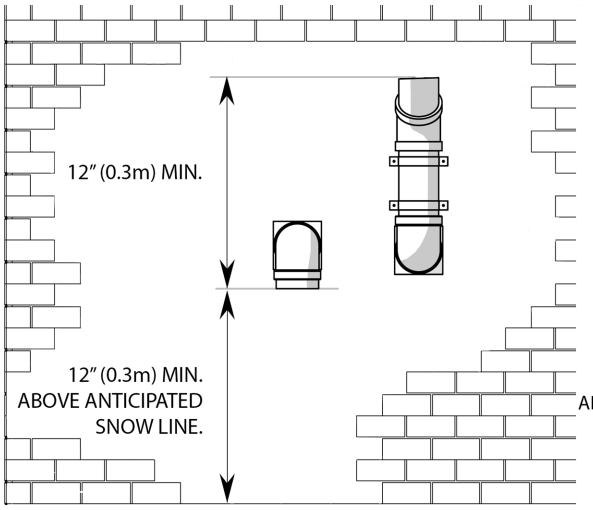


Figure 12 *Vent termination clearance--horizontal perforations*

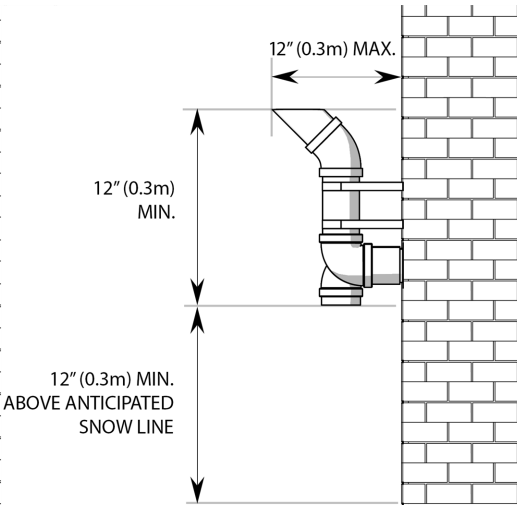


Figure 13 *Vent termination clearances--horizontal perforations, side view*

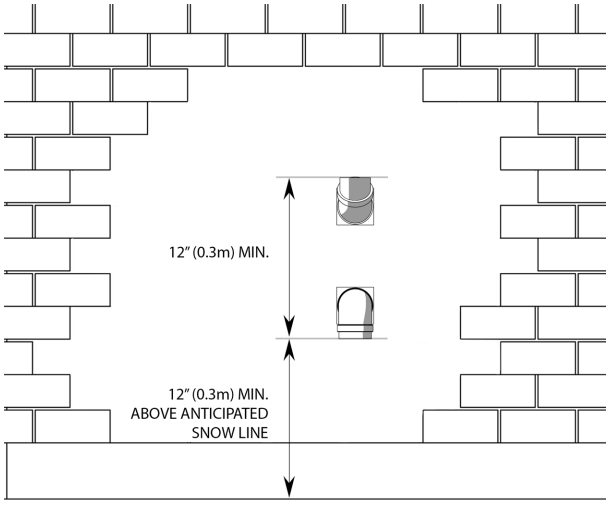


Figure 14 *Vent termination clearance--vertical alignment*

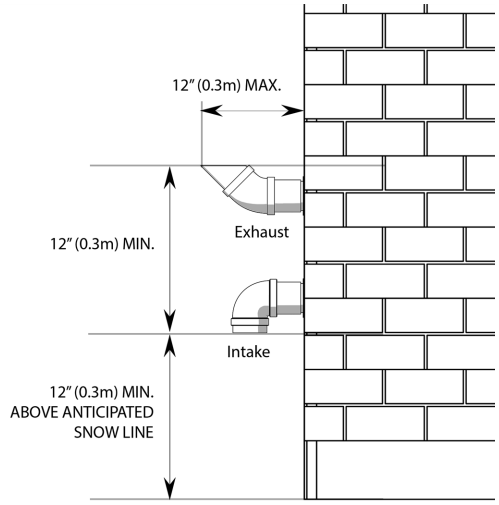


Figure 15 *Vent termination clearances--vertical alignment, side view*

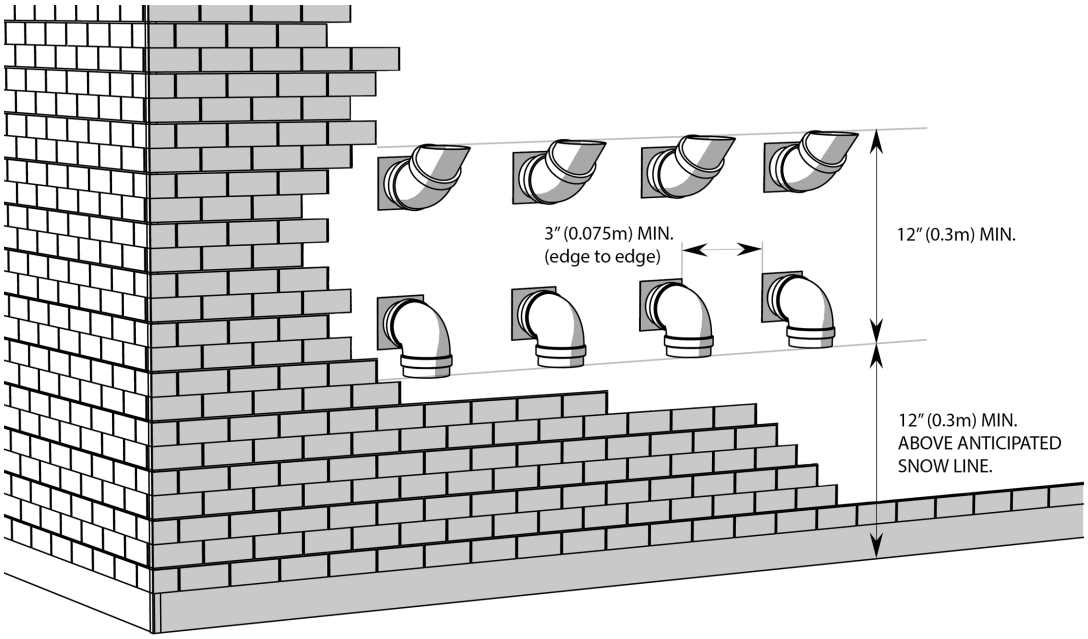


Figure 16 *Sidewall vent termination configuration option 1*

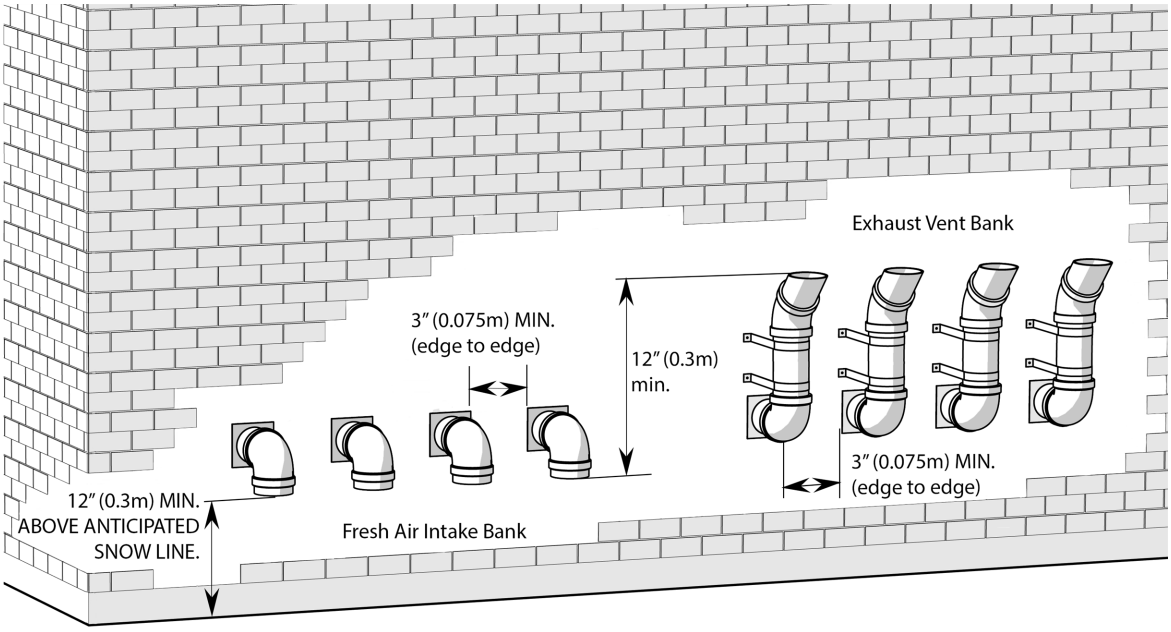


Figure 17 *Sidewall vent termination configuration option 2*

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

- The Stainless Sidewall Terminal (SST) three-inch P-257 is approved for use with both Combi Model 150 and Combi Model 199 when the 20 foot equivalent length calculation (for exhaust) in the preceding table is used.
- Install the SST to comply with the minimum vent clearances listed in *Table 8* .
- 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 18*), and not side to side.

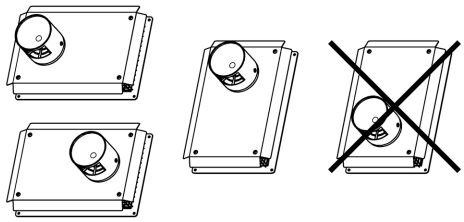


Figure 18 *Allowed SST installation orientations*

- 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.

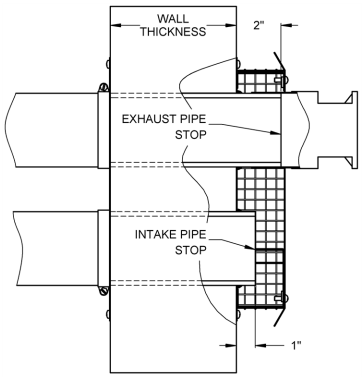


Figure 19 *Pipes extend completely through the wall (Vertical orientation shown)*

- Ensure that the vent termination location does not exceed the allowed maximum equivalent vent length, including the allowance for the SST.
- 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.

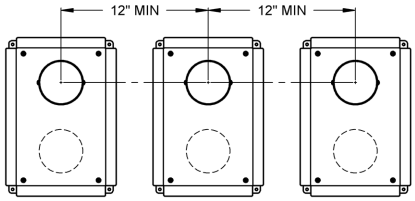


Figure 20 : *Minimum separation for multiple vent installation - vertical orientation*

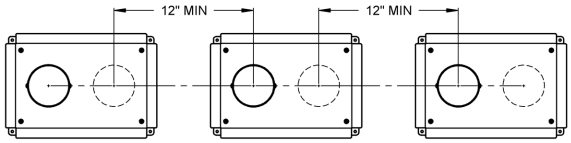


Figure 21 : *Minimum separations for multiple vent installation - horizontal orientation*

Approved PVC Side Wall Termination kits are listed below:

» Ipex # 196985 3"

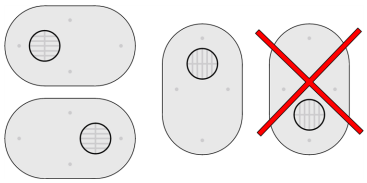


Figure 22 *Approved PVC Side Wall Termination configuration*

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 below.

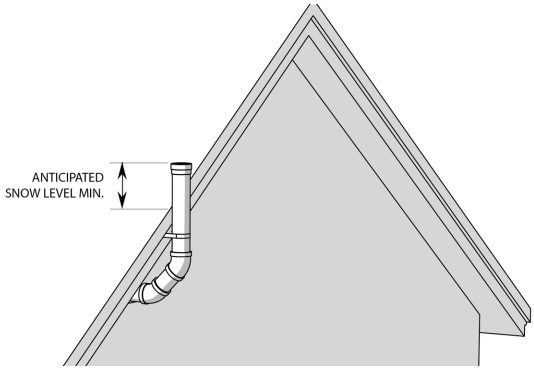


Figure 23 *Sidewall vent termination transition to vertical to clear soffit*

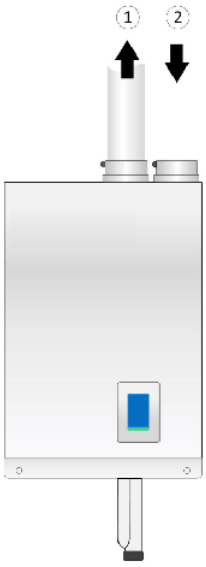
This illustrates the scenario where indoor air is used for combustion. Where combustion air is drawn from outdoors, combustion venting should also transition to vertical and terminations should observe the limitations shown for rooftop terminations.

4.7.7 Indoor air combustion air intake

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

Warning

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



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.

Figure 24 *Indoor combustion air intake*

To support combustion, an ample air supply is required. This may require direct openings in the boiler room to the outside. If the boiler is not in a room adjacent to an outside wall, air may be ducted from outside wall openings.

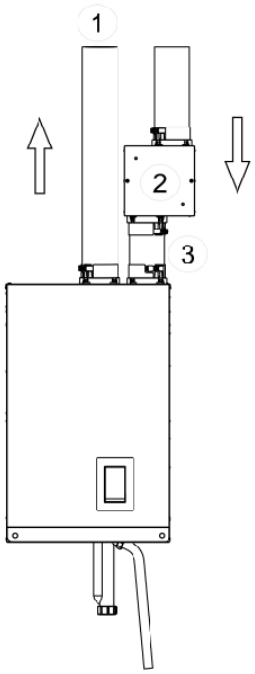
Provisions for combustion and ventilation air must be made as follows:

» in the USA, in accordance with the National Fuel Gas Code, ANSI Z223.1 (latest edition), or applicable provisions of the local building codes.

» in Canada, in compliance with B149.1 (latest edition), or applicable provisions of the local building codes.

4.7.8 Combustion air filtration system

If combustion air contamination from ingested particulate matter is a concern in any installation, an optional air intake filter may be installed. The P-357 is equivalent to eight feet of vent pipe and should be used as a component of the combustion air system according in *Table 7* .



1	Flue gas exhaust to outdoors
2	P-357 Air intake filter
3	3-inch schedule 40 pipe

Figure 25 *Direct vent - intake, exhaust system with optional air intake filter (filtration may also be used on indoor air applications as required)*

4.7.9 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.

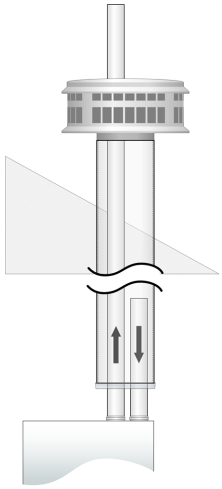


Figure 26 *Using an existing vent as a chase for exhaust venting and intake air supply*

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

Table 9 *Minimum vent sizes for exhaust chase and intake air*

Refer to Rheem.com for a Technical Note on details that must be observed. Information is also given on using 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.

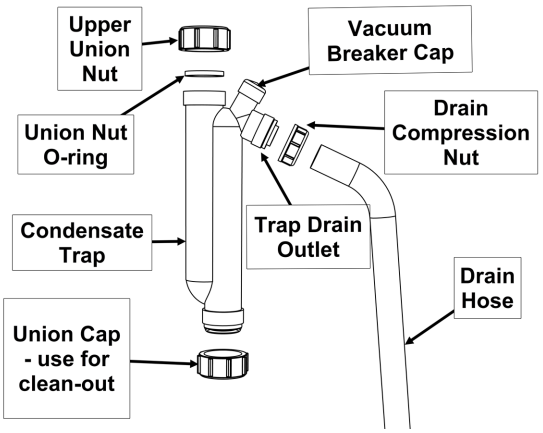
The appliance must not be exposed to surrounding air above 122°F (50°C) or below 32°F (0°C).

4.9 Installing a 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).

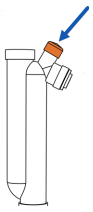
Warning

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.

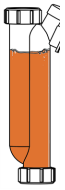


- Ensure the supplied trap is correctly installed and filled with water.
- When required, add (and maintain in good condition) a neutralization tank. For information on installing a condensate neutralizer, see *Installing a condensate neutralizer on page 45*.
- The condensate trap must be installed on the drain connection at the base of the boiler. The condensate drain must be piped to within 1" of a drain or connected to a condensate pump. The drainage line must slope down to the drain at a pitch of ¼" per foot so condensate runs towards the drain.

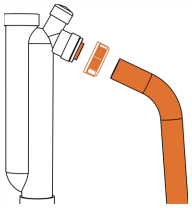
1. Place the vacuum breaker cap over the vacuum breaker opening and push firmly.



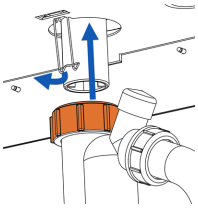
2. Fill the condensate trap with water.



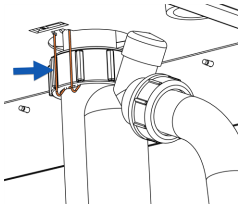
3. Attach the drain hose and tighten the drain compression nut (including washer).



4. Slide the trap over the boiler drain outlet, and tighten upper union nut.



5. Ensure that the trap upper union nut is secured by the outlet clip.



6. Check that all trap fittings have been hand-tightened to prevent leakage of flue gases. Do not use tools and over-torque. Check for leaks.

4.10 Installing a condensate neutralizer

If discharging condensate into building drain piping materials that are subject to corrosion, use a neutralization package.

Caution

After installing a condensate neutralization package, the pH of the condensate discharge must be measured on a regular schedule to ensure the neutralizing agent is active and effective.

Danger

The water in the condensate neutralizer can cause severe burns to the skin. Wear protective gloves and eye wear when servicing the condensate neutralizer.

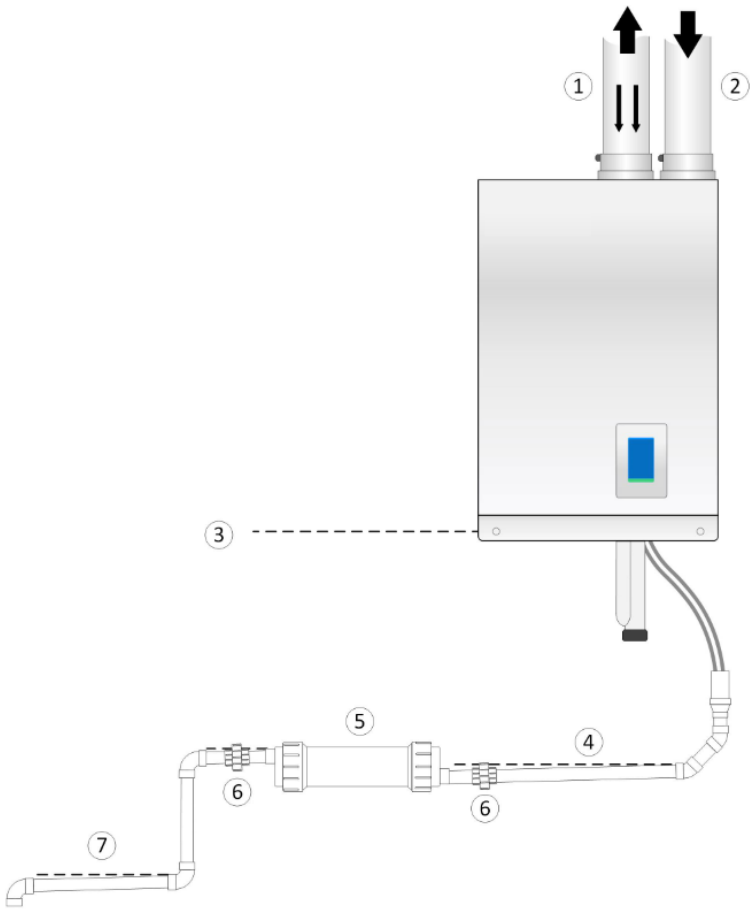


Figure 27 *Condensate neutralization tank*

1	Flue gas exhaust: condensate, and potentially rain water, flow back from the venting system.
2	Air intake piping: fresh air supply for boiler. Ensure that rain water cannot enter air intake to avoid damage to the appliance.
3	Condensate water line: All condensate discharge lines, including neutralization tank inlet, must be at a lower elevation than the condensate water line of the appliance to avoid damage to the appliance.
4	Free flow of condensate from venting systems and the pressure vessel must be maintained at all times. Trap and condensate drain piping must be accessible to allow regular inspection and cleaning.

Warning

Risk of injury. Tank fluid can be highly acidic. Do not use hands to stir material. Refer to the neutralization instructions of the manufacturer.

5	Condensate neutralizer: Drain materials subject to corrosion must be protected by acid neutralization. Access to the discharge, before the drain, is necessary for proper maintenance in order to check the effectiveness of the neutralizing agent. 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 with a minimum calcium carbonate content of 85%) can be purchased from a local supplier.
6	¾" FPT inlet and outlet. Unions for ease of maintenance (ships with shown model NT-1S, available from plumbing supply houses).
7	To drain. Confirm slope. Slope the condensate hose and drain piping toward the drain and secure to prevent accidental disassembly.

4.11 Water piping (space heating)

Water piping (space heating)

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. Repeated or uncontrolled water fills will increase the potential for damage.

High levels of dissolved solids or minerals may precipitate out of the fluid onto the hottest part of the heat exchanger, impairing heat transfer and resulting in overheating and premature failure. The amount of solids that may form on the heat exchanger will depend on the degree of hardness and the total water volume in the system. A high water volume system with a low hardness count may cause as much damage as a system with less volume and higher hardness, so for high-volume systems it is recommended to reduce dissolved solids to 10 ppm - 30 ppm before the introduction of inhibitors and / or glycol. Final water chemistry limits are as follows:

- Hardness to be between 1 and 9 grains
- TDS is to be between 10 and 150 ppm
- Acidity pH is to be between 6.6 and 8.5
- Chloride is to be less than 125 mg/l
- Iron is to be less than 0.3 mg/l
- Cu less than 0.1 mg/l
- Conductivity is to be between 20 and 300 µS/cm at 77°F (25°C)

Important: Ensure that these limits are acceptable for the other water-side components in the system.

4.11.1 Available Head Chart

The Combi Boiler internal space-heating pump must be set to setting 3. The boiler pump is designed to circulate through a short primary loop only. The chart below is provided for the contractor who wishes to determine whether the internal pump can also provide adequate flow through a distribution system with a known head loss.

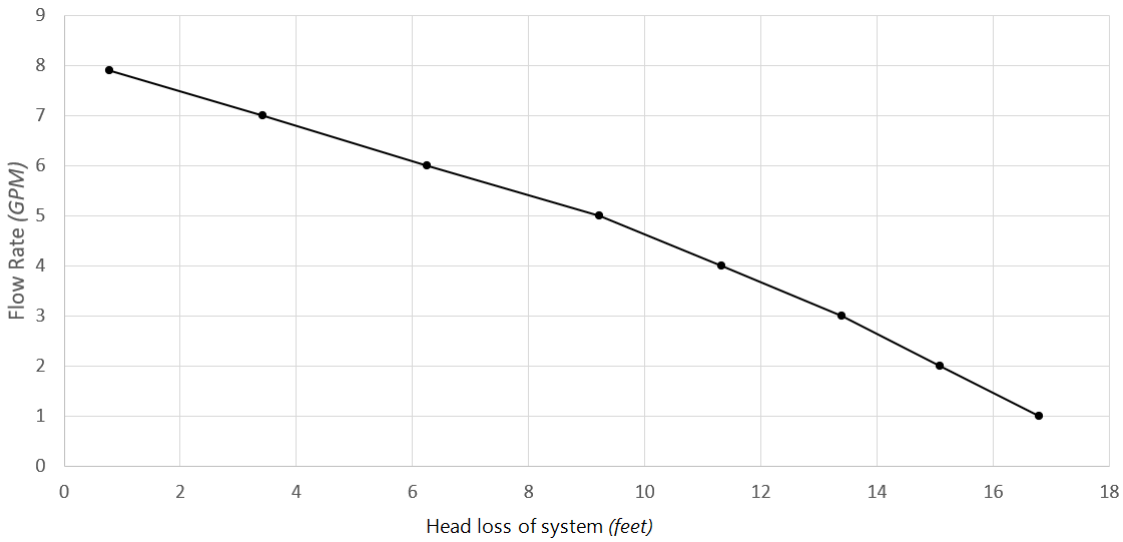


Figure 28 *Available system head Loss (feet) vs. Flow rate for Space Heating*

To simplify the control application, promote good loads and flow management, installers must conform to the piping design configurations provided.

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. Installers must 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, wetted 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 only using non-toxic propylene glycol.

Note

Any glycol solution used in the system **must** be non-toxic due to the DHW heat exchanger.

Propylene glycol solution is commonly used in a closed loop where freeze protection is required. Its specific heat 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.

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 on the outlet piping. Relief valve discharge piping must terminate between 6" (15 cm) and 12" (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 (¾" NPT).

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

4.11.2 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 2 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.

4.11.3 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.

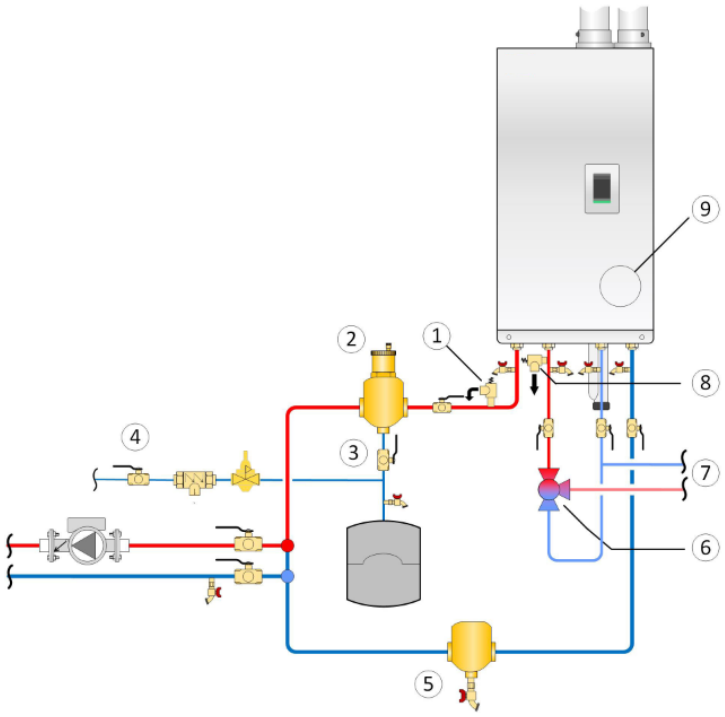
System piping is connected to the boiler using 1" NPT-Male threaded fittings. To simplify servicing, we recommend using unions at the boiler's supply and return water connections.

Figure 29 *Piping connections*

1	Space heating supply
2	Domestic hot water (DHW); mixing valve required, not shown
3	Domestic cold water (DCW)
4	Space heating return

Figure 30 *Relief valve connection*

1	Pressure relief valve (required) - shipped with boiler
2	**Important:** Shut-off valves are **not allowed** between the relief valve and the boiler
3	Space heating supply



1	Isolation valve between boiler and relief valve not permitted
2	Microbubble air eliminators are best installed where the fluid is at the highest temperature and lowest pressure
3	Expansion tank connection (point of no pressure change) 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
6	Thermostatic mixing valve (REQUIRED)
7	Domestic water
8	DHW relief valve
9	Primary loop circulator built into return side of boiler

Figure 31 *Boiler trim options - single boiler*

Fluid fill is most often accomplished by using a boiler regulator and fill valve set at 12 psig or more, 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.

Today 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.

Primary-Secondary piping

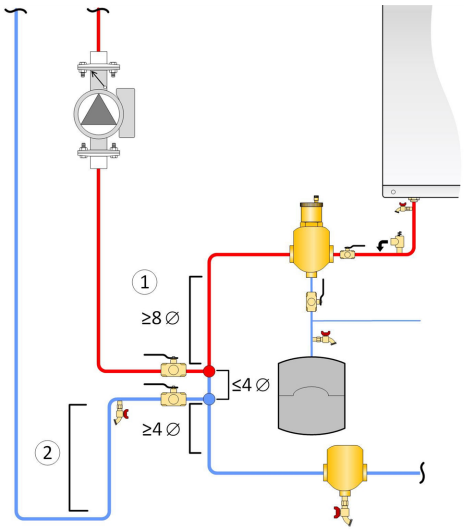
For best results use a primary / secondary piping system ensuring that the boiler loop is adequately sized. Primary / Secondary piping ensures adequate flow and de-couples ΔT issues (boiler vs. distribution). Aim for a 20°F to 30°F ΔT across the heat exchanger at high fire (there is a boiler protection throttle fence limiting the ΔT to 40°F).

These boilers can supply four different heating loads within the temperature range of 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. Alternatively, use a hydraulic separator between the boiler loop and the system. As well, two load systems may also be piped in parallel.

To ensure adequate water flow through the boiler under high-head / single-zone space heating conditions, a pressure-activated bypass or other means of bypass must be used on any load where the flow rate might drop below minimum requirements.

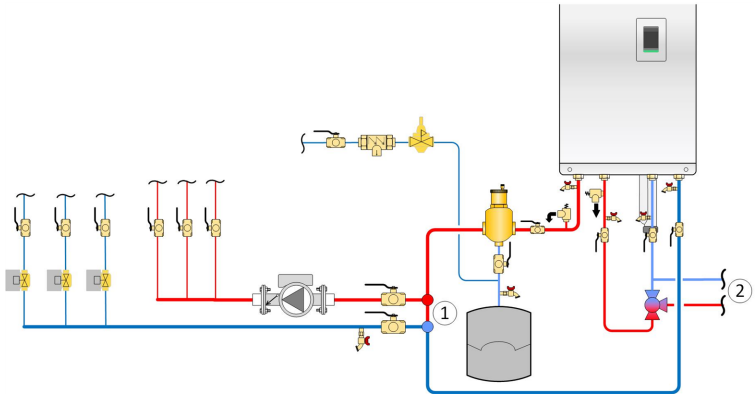
Ensure that the pump is rated for the design circulating water temperatures; some pumps have a minimum water temperature rating above the low temperature potential of the boiler. Following installation, confirm the actual performance by measuring ΔT (under high and low flow conditions).

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.



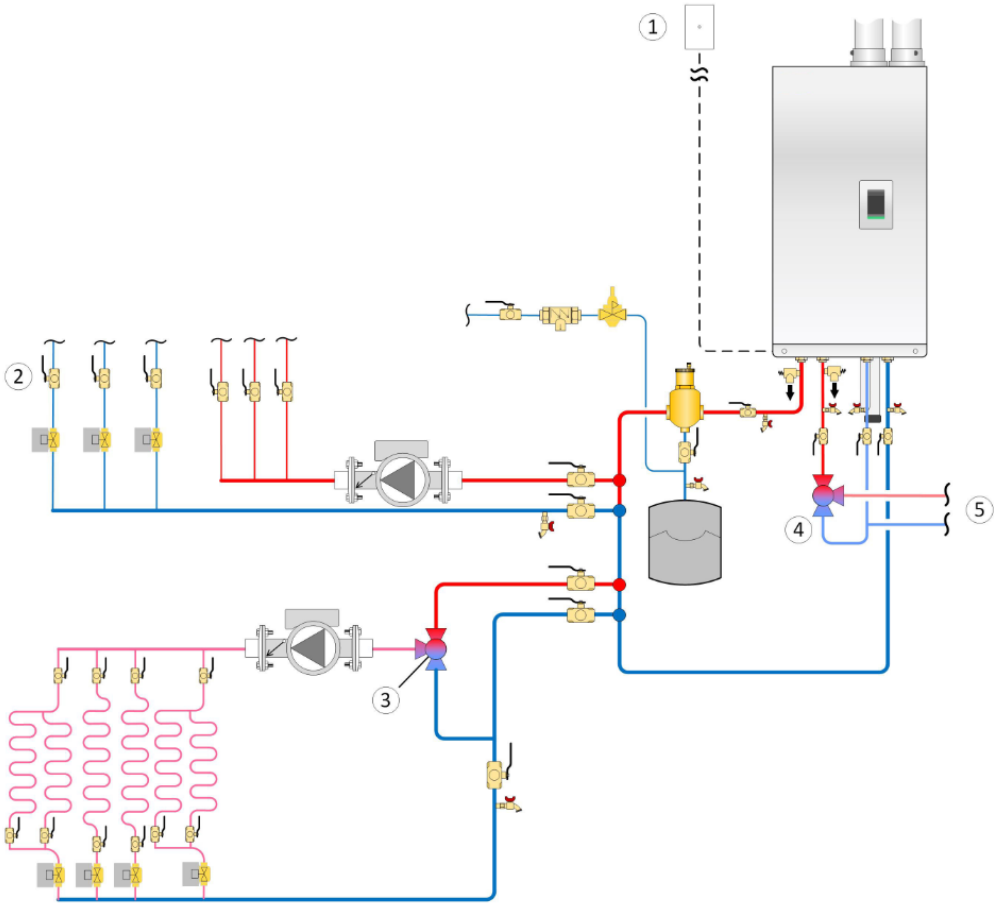
1	**Closely-spaced tees**: Install tees with straight piping (min. 8 pipe diameter upstream, 4 downstream), with tees maximum 4 pipe diameters apart, and no restrictions between fittings.
2	**Heat migration**: To prevent heat migration on secondary loops extending vertically to a load above the primary loop (especially where head loss is low): install check valves on both supply and return of secondary piping, or install a check valve in the supply piping and create a thermal trap in the return piping (min. 18" (46 cm) drop).

Figure 32 *Primary-secondary piping details with closely-spaced tees*



1	Closely-spaced tees (see *Figure 32*)
2	Domestic water (note thermostatic mixing valve)

Figure 33 *Typical one-temperature space heating piping concept*



1	Outdoor sensor
2	Optional isolation valves
3	Thermostatic mixing valve for the lower-temperature emitter (required for simultaneous operation of 2 space-heating temperatures)
4	Thermostatic mixing valve (REQUIRED)
5	Domestic water

Figure 34 *Typical 2-temperature space heating piping concept*

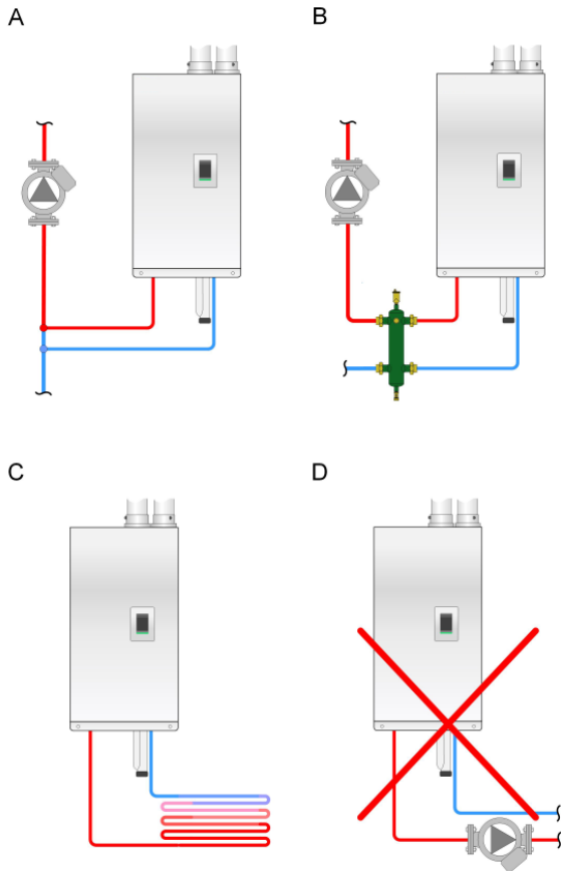
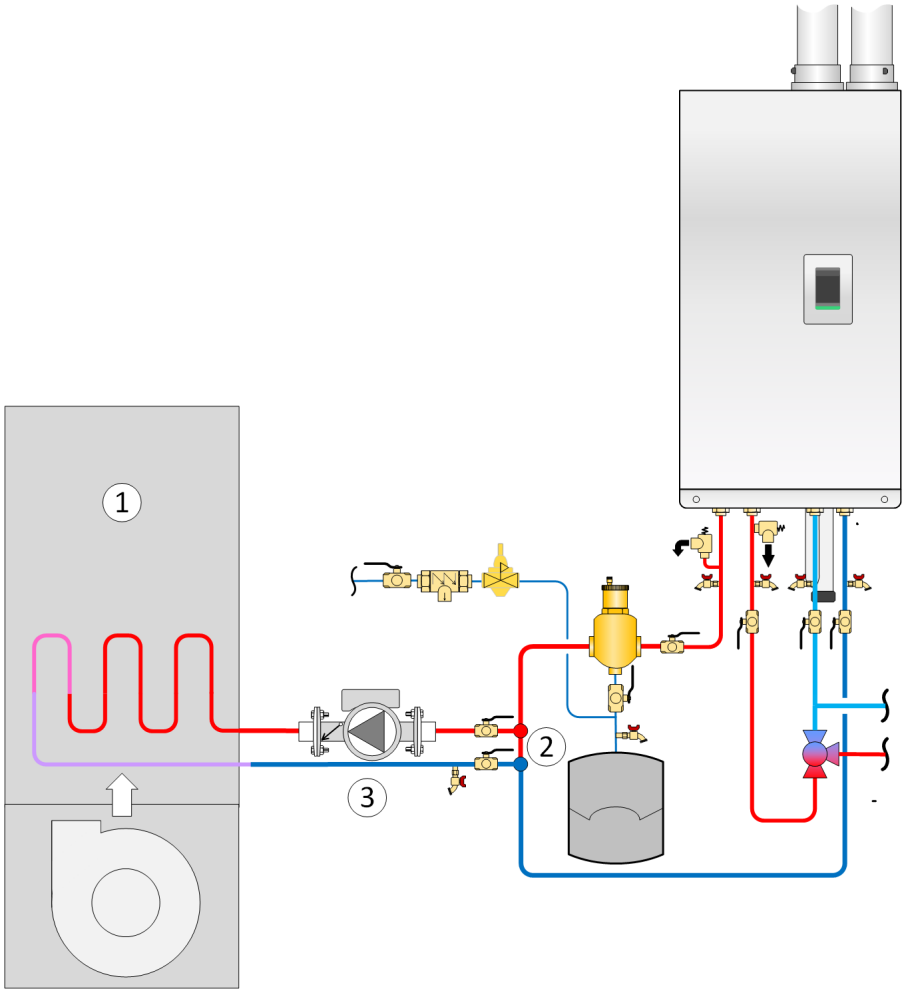


Figure 35 *Combi Boiler hydraulic separation*

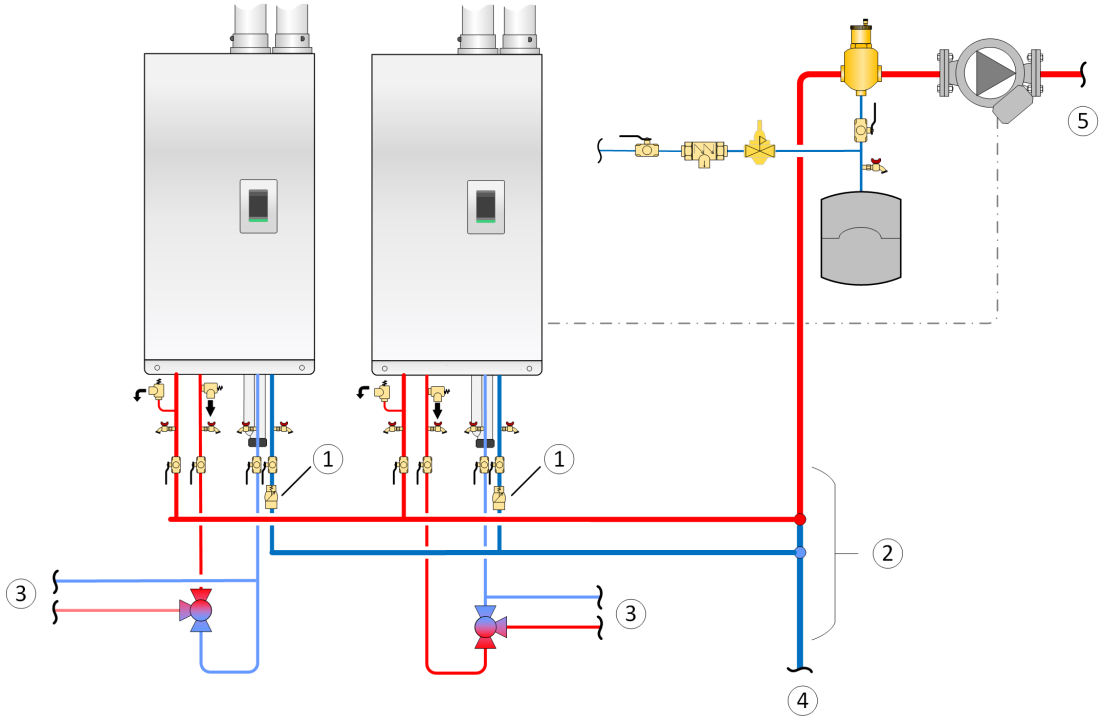
The Combi Boiler internal space heating pump can be hydraulically separated from the distribution pump by (A) closely-spaced tees, or by (B) a low-loss header, as shown in the figure above. Although best practice is to use primary/secondary piping, in a few cases (C) the internal pump will be adequate to provide flow through the building's heat emitters. Ensure that the internal pump is powerful enough for system distribution. Avoid (D), where an external pump is placed in series with the internal pump.

The boilers can supply multiple heating loads with compatible supply temperature requirements. Always ensure that loads sensitive to high temperatures are protected using means such as mixing valves.



1	Air handler
2	Closely-spaced tees
3	Circulator sized for secondary piping only

Figure 36 *Air handler on primary loop and direct domestic water piping*

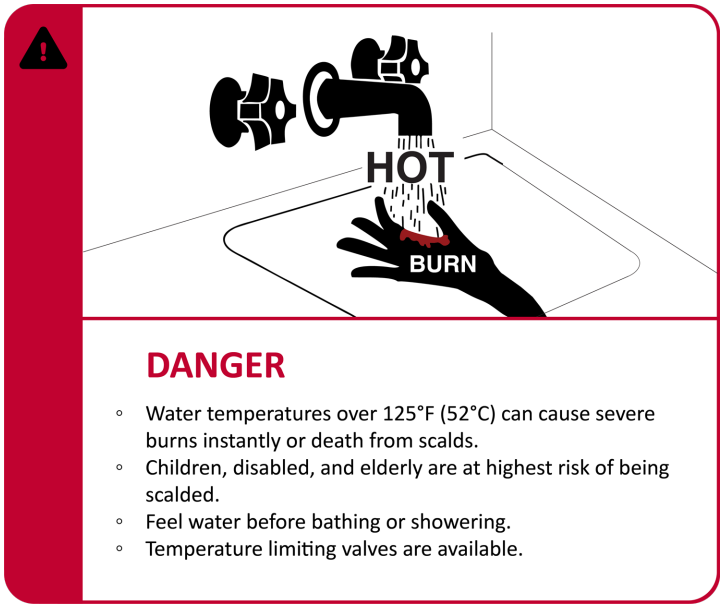


1	Check valve (typical of each boiler)
2	Closely-spaced tees
3	Domestic water. Thermostatic mixing valve (REQUIRED)
4	From building
5	To building

Figure 37 *Multiple boiler piping*

4.12 Water piping (domestic hot water)

4.12.1 Domestic hot water system



These appliances have an independent piping circuit for efficiently generating domestic hot water. When a faucet is opened to draw hot water, water flow is detected with a flow sensor and the appliance fires up to begin generating domestic hot water.

We strongly recommend treating hard water and adjusting the pH between 6.5 and 8.5. Refer to the table on drinking water guidelines published by the US EPA. Consult a water treatment adviser in your area to assess your local needs. Proper water treatment will aid in the longevity of the appliance and ensure maximum efficiencies.

Warning

HOT WATER CAN SCALD

Water Temperatures over 125°F / 52°C can cause severe burns instantly or death from scalds.

Children, disabled persons, and elderly persons are at highest risk of being scalded.

- Never leave them unattended in or near the shower, bathtub or sink.
- Never allow small children to use a hot water faucet or draw their own bath.

The manufacturer requires that, to avoid any potential scald hazard, the installer MUST:

- Install a thermostatic mixing valve at this appliance and ensure it is working properly AND
- Set the thermostatic mixing valve to the lowest temperature which satisfies the end-user's hot water needs, but in no case above the maximum dictated by the code in effect.

To avoid injury:

- Feel and adjust water temperature before bathing or showering.
- Water drained from the system drain valve may be extremely hot.
- Make sure all connections are tight.
- Direct water flow away from any person

Description	Min	Max
Water pressure	40 psi	150 psi
Minimum flow rate to activate DHW sensor	0.5 GPM	N/A
Acceptable pH range	6.5 pH	8.5 pH
Total dissolved solids		500 mg/L
Total hardness		200 mg/L 11.68 gr/gal
Aluminum		0.05 to 0.2 mg/L
Chlorides		250 mg/L
Copper		1.0 mg/L
Iron		0.3 mg/L
Manganese		0.05 mg/L
Zinc		5 mg/L

Table 10 *Domestic water quality guidelines*

Warning

Bacteria can develop in domestic hot water tanks and indirect water heaters if the minimum water temperature is not set high enough to prevent its growth.

Warning

A potentially hazardous situation, which can cause serious injury or death, can exist if the unused domestic water connections are capped off. The unused domestic water connections are meant to be left open if not used to allow for the air in the coil to expand and contract as the appliance is in operation.

4.12.2 Domestic hot water piping

The domestic water piping connections are located at the bottom of the appliance. The connections are ¾" male NPT threads. The cold water inlet is on the right side and the hot water outlet is on the left side.

Required equipment: pressure relief valve

A pressure relief valve must be installed:

» With a maximum pressure setting of 150 PSI and rated for a minimum capacity of not less than the rated input of the appliance (NOT supplied with the appliance) on the domestic hot water outlet piping within 6" of the appliance.

» Between the appliance's outlet and any isolation valve to ensure the pressure relief valve cannot be isolated by closing a valve. We recommend a valve kit designed for this purpose to reduce installation time and to reduce the space required.

Required equipment: thermostatic mixing valve

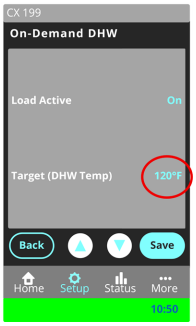
This combi boiler is capable of supplying water hot enough to seriously scald a person. The installer MUST install a field-supplied thermostatic mixing valve on the outlet of the appliance to prevent excessively hot water from reaching a faucet. The valve is required regardless of the intended DHW temperature setting.

Thermostatic mixing valve install and setup

A field-supplied thermostatic mixing valve must be installed on the DHW supply line, after field-supplied relief, purging and shutoff valves (see *Piping connections on page 50*).

Follow mixing valve manufacturer's instructions. Connect the DHW supply line to the H side of the valve. Connect a branch off the cold domestic water to the C side of the valve. The mixed outlet goes out from the valve as domestic hot water.

After installation, set the mixing valve for the lowest temperature that will meet the end-user's DHW needs, but in no case above the maximum temperature dictated by the code in effect. IBC recommends 120°F (49°C).



On the V10 DHW setup screen, set the DWH supply temperature to 10°F (5°C) above the mixing valve temperature. For example, if the mixing valve is set to 120°F, program the DWH supply temperature to 130°F (54°C).

At the fixture nearest to the CX run DHW until the water temperature is steady. Verify proper operation by filling a container and measuring water temperature with an immersion thermometer.

Other piping considerations

The appliance can be connected to the pressurized ½" or larger domestic cold water supply piping and the domestic hot water piping in the home. Do not cap off the hot and cold piping connections if they are not being used. The minimum domestic water pressure required is 40 PSI and recommended to be 50 PSI or higher. Generating domestic hot water with a water pressure lower than 40 PSI reduces the amount of hot water generated and increases the risk of scaling in the heat exchanger.

The domestic hot and cold water connections must be furnished with isolation valves and flushing taps.

Thermal expansion of the water in the domestic hot water piping and appliance can cause excessive pressures to build in the piping system. This can cause the pressure relief valve to discharge on a regular basis. This condition must be prevented with the installation of a properly sized and installed domestic water expansion tank or other device designed for the purpose.

4.12.3 DHW pressure drop / head loss

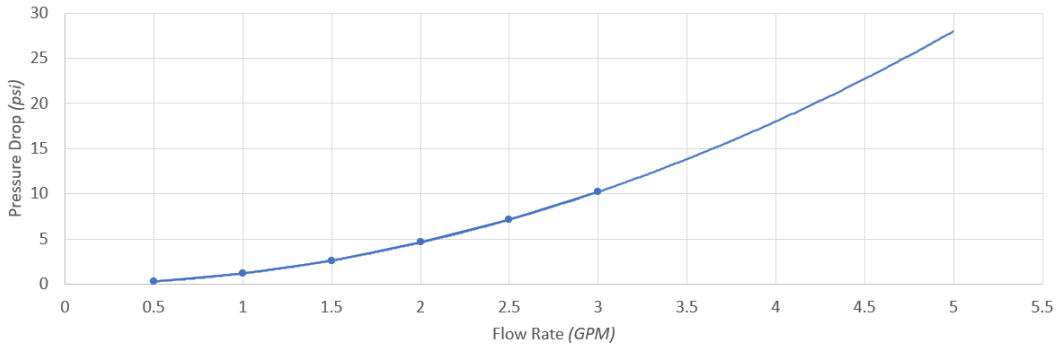
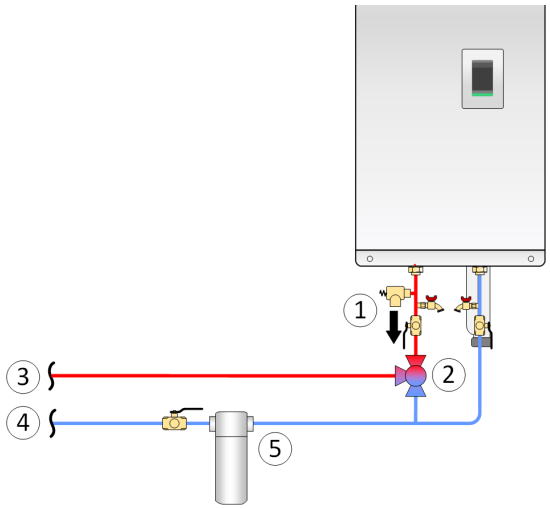


Figure 38 *Pressure Drop (psi) vs. Flow Rate (GPM) - Combi Boiler DHW heat exchanger*

A filter is required where contaminants are present in the supply water.



1	Domestic hot water (DHW) on-demand application: DHW relief valve on outlet of water heater. An isolation valve is **not allowed** between the water heater and the relief valve
2	**REQUIRED**: thermostatic mixing valve; follow manufacturer's installation and operation directions.
3	DHW
4	DCW
4	Filter (optional)

Figure 39 *Tankless DHW Piping Options*

Caution

A field-supplied thermostatic mixing valve MUST be installed on the direct DHW piping connections. Local code and / or application may require a mixing valve at the outlet of a DHW storage tank. Failure to install the thermostatic mixing valve may result in a hazardous situation which can cause serious injury or death.

Domestic Hot Water Delivery	
@ 70°F / 39°C temperature rise	
150,000 BTU/hr	4.1 GPM
199,000 BTU/hr	5.5 GPM

Table 11 *Domestic hot water delivery*

See *Combi Model 150 DHW Delivery: AlternativeTemperature Rises on page 12* for other temperature rises

4.13 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.

4.13.1 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 chart.

Maximum Gas Pipe Length (ft)				
Model	½" IPS	¾" IPS	1" IPS	1¼ " IPS
150,000 BTU/hr (natural gas)	20'	80'	200'	900'
150,000 BTU/hr(propane)	50'	200'	600'	2,000'
199,000 BTU/hr (natural gas)	10'	40'	150'	900'
199,000 BTU/hr(propane)	30'	125'	400'	1,400'

Table 12 *Maximum Gas Pipe Length (ft)*

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.

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

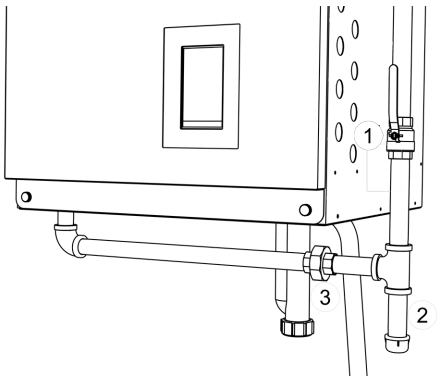


Figure 40 *Typical gas piping*

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 zero inches wc.

4.14 Electrical connections

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

4.14.1 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

This Combi 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.

4.14.2 120VAC line-voltage hook-up

Line-voltage wiring is done within the field-wiring box (see *Wiring and operation diagrams on page 111*). 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.

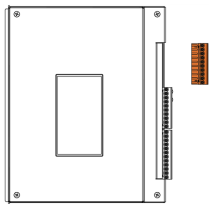


Figure 41 *Line voltage load pump terminals*

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 (primary) pump is factory-installed and wired.

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 24VAC 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).

4.14.3 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.

4.14.4 Thermostat wiring

Thermostat / sensor wiring

Each of the four loads has dry contacts for thermostats as marked on the lower connector strip (for example, Therm 1 is associated 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 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.

4.14.5 Thermostat heat anticipator

"Therm" contacts draw no power, so a thermostat anticipator setting of zero is appropriate for the V10. 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.

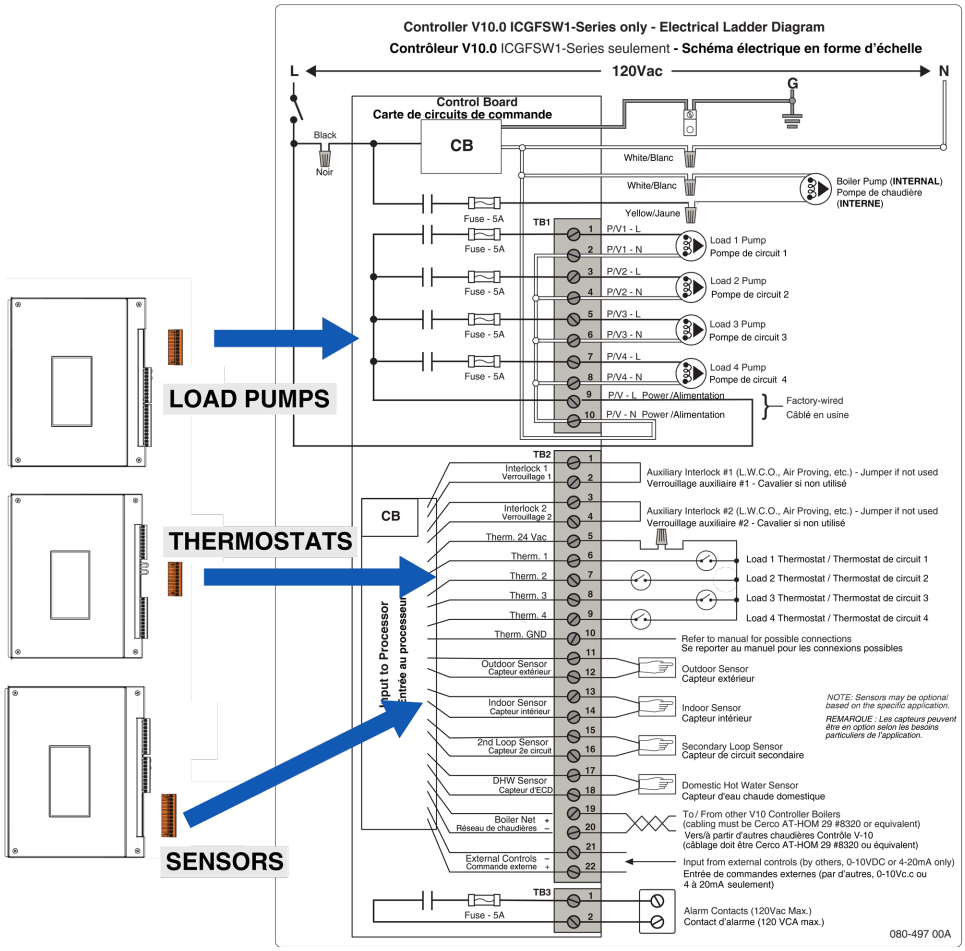


Figure 42 *Electric wiring connections*

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 5 pumps – 1 boiler pump + 4 separate load pumps
- Outdoor Reset control
- Set Point temperature regulation
- Domestic Hot Water (DHW)
- 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 4 pumps
- Load Combining – simultaneous operation of 2 similar water temperature loads
- Programmable setback / override schedule
- A boiler heating network of up to four V10 controller boilers without additional controller
- Connectivity with Sky-35 controller.
- Some of the new features available in the touchscreen control include:
  - Setup Menu for simple, quick programming
  - Portal connectivity for remote monitoring and 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

Operational and historical data may be accessed from the **Status** menu > **Load Status** > **Load Profiles** and **Load Statistics** screens. 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 has been left on the Home screen long enough (user adjustable, 10 minutes by default) the display dims to save power.

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 system filling and 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 installation on page 19*. To understand the boiler start-up process, see *Sequence of Operation on page 113*. If the sight glass viewport clouds up at start-up, see *Cleaning the sight glass on page 95*.

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.

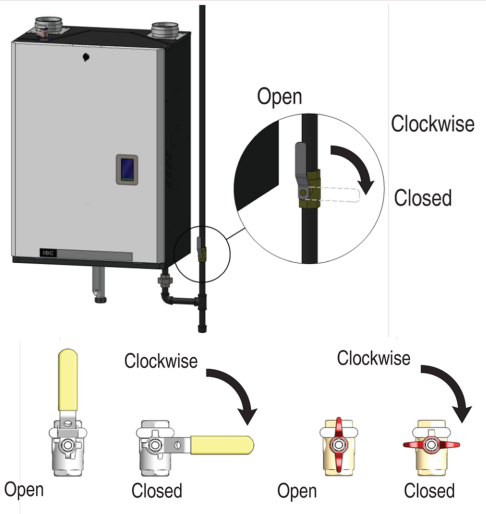
D. Do not use this appliance if any part has been under water. Immediately call a qualified service technician to inspect the appliance and to replace any part of the control system and any gas control which has been under water.

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 74*).	☐
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.	☐
Tested the low water cutoff function to check that the LWCO sensor is working. See *Testing the LWCO function on page 80*.	☐
Tested the high limit temperature function to check that the High limit temperature sensor is working. See *Testing the Hi-Limit cutoff temperature function on page 80*.	☐

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 natural gas (or propane if desired) at sea level. The gas-air ratio or zero-offset adjustment screw 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 (sold separately) to install the appropriate fitting(s) and adjust the gas valve accordingly. See *Table 13* for the required conversion kit.

The V10 touchscreen controller will automatically detect the installation's altitude and make the appropriate adjustments to operate the boiler up to 4,500 feet in elevation without de-ration. The boiler will automatically de-rate at altitudes above 4,500 feet.

Fuel conversion kit numbers

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

Model Number	To Propane	To Natural Gas
Combi Model 150	*P-1600*	*P-1601*
Combi Model 199	*P-1602*	*P-1603*

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 mixer, located between the gas line and the fan, with the fuel-appropriate mixer supplied in the kit.

To perform a fuel conversion:

Removing the mixer

1. Turn off the gas supply.
2. Change the gas fuel source.
3. Before you disconnect the electrical power, shut off the gas supply at the gas shut-off valve.
4. Disconnect the electrical power.
5. Remove the front door cover.
6. Undo the brass union nut between the gas valve outlet pipe and the mixer. Set the gasket aside for re-installation.
7. Note the orientation and the positions of the mixer's Philips head bolts.
8. Remove the bolts and the mixer from the fan.
9. Ensure that the fan O-Ring is not damaged and is seated in the groove.

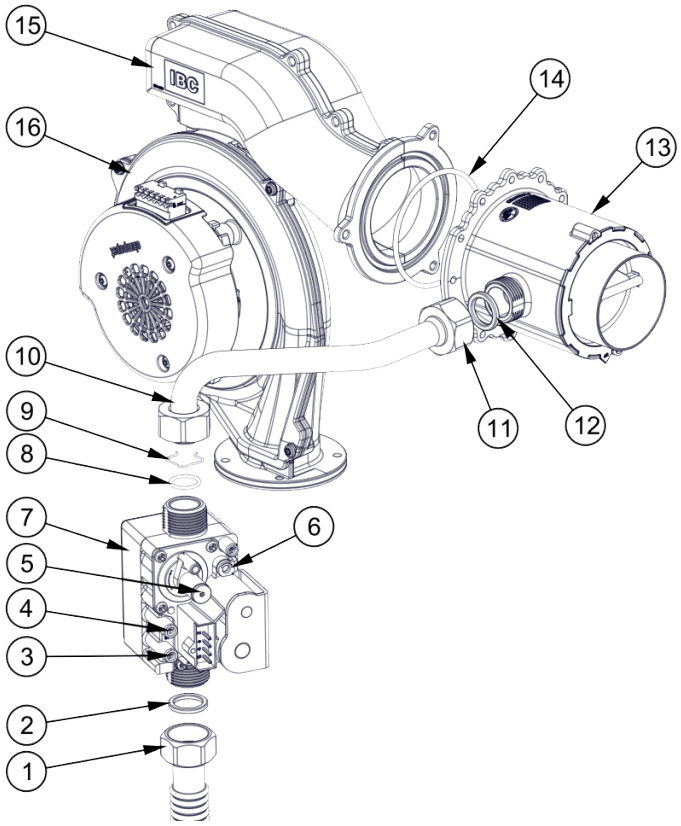
Installing the new mixer

1. Install the new fuel-appropriate mixer with the Philips head bolts.
2. Check that the gasket is in place between the gas valve outlet pipe and the mixer.
3. Connect the gas line to the mixer using the brass union nut.
4. Restore the gas supply by opening the gas control valve and reconnect the electrical power.
5. Perform a combustion test (see instructions below).
6. When the boiler is running, use an approved leak detection solution to soap test all joints.
7. Place conversion labels associated with the new fuel onto the boiler.

7.3.3 Adjusting the gas valve

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.



1	Gas valve inlet	9	Nut retainer
2	Gasket	10	Gas valve outlet pipe
3	Inlet gas pressure test port	11	Brass union nut
4	Manifold gas pressure test port (not used)	12	Gasket
5	Low-fire adjustment (under cap)	13	Mixer
6	High-fire adjustment	14	Fan coupler O-ring
7	Gas valve	15	Fan coupler
8	O-ring	16	Fan

Figure 43 *Gas valve and fan components*

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 (see *Figure 44*). Do not perform a test from the manifold gas pressure test port.
2. On the gas valve, loosen the inlet gas pressure test port screw counter-clockwise.

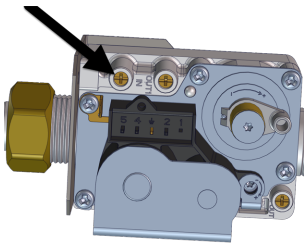


Figure 44 *Location of inlet gas pressure test port*

3. Attach the manometer to the inlet gas pressure test port.
4. Switch on the gas supply; record the static pressure. The static pressure should be around 7" wc for natural gas and 11" wc for propane.
5. Give the unit a call for heat or a full DHW load.
6. To run the boiler at high fire, go to ●●● > **Test Operation**. In the **Fan Test: Heat Out** field, tap **0 MBtu**, then enter the unit's maximum MBH.
7. When at high-fire, record the working pressure. Working pressure should drop from the static pressure by no more than 1" wc.
8. After completing the inlet gas pressure test, remove the call and switch off the gas supply.
9. Remove the manometer from the inlet gas pressure test port.
10. Tighten inlet gas pressure test port screw.
11. Switch on the gas supply, and return 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 on 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 ●●● > **Test Operation** > In the **Fan Test: Heat Out** field, tap **0 MBtu**, then enter the maximum MBH.

When the boiler reaches high fire, insert the combustion analyzer test probe into the flue gas test port. Then verify that the CO2 reading is within the combustion test targets at *Table 15* values.

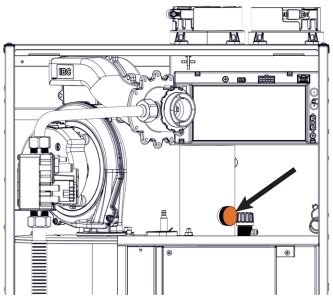


Figure 45 *Flue gas test port*

4. Adjust the high fire according to values in *Table 15* using a Torx 15 screwdriver. Turn the screwdriver clockwise no more than a maximum of 1 full rotation at a time to raise the CO_2% (to richen). Turn counter-clockwise no more than a maximum of 1 full rotation at a time to lower CO_2%.
5. Set the heat-out value in Test Operation mode to the minimum MBH for the boiler. To do this, go to ●●● > **Test Operation** > In the **Fan Test: Heat Out** field, tap **0 MBtu**, then enter the minimum MBH.
6. Adjust the low fire according to values in *Table 15* using a Torx 15 screwdriver. 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.
7. 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.

8. To exit the **Test Operation** screen, select **Back**.
9. Remove the call for heat.
10. If a manometer is connected to the gas valve inlet gas pressure port:
    a. Turn off the gas supply at the external gas shut-off valve.
    b. Disconnect the manometer.
    c. Tighten the inlet pressure port screw with a Torx 15 screwdriver.
11. Remove the analyzer probe, and install the test port plug.

12. Turn on the gas supply shut off valve.

Fuel	High fire CO_2		Low fire CO_2		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

Tableau 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.

Table 15 *Combustion test target ranges - CO_2 / Maximum CO*

7.3.4 Testing the LWCO function

The low water cutoff (LWCO) function provides continuous protection against low water in the boiler. If the SIM detects low water, the boiler enters a lockout state. Perform the test to ensure that the LWCO sensor is functioning.

1. Go to Status > **SIM Menu** > **LWCO Test** > Read the instructions.
2. After the test, on the touchscreen controller, select the **Reset** button.

   The message: "The SIM Module has been reset" is displayed.

3. Tap **Close** > **Back** to exit the test.

7.3.5 Testing the Hi-Limit cutoff temperature function

The hi-limit temperature function monitors the maximum supply temperature set in the safety ignition module (SIM). If the water temperature exceeds the hi-limit temperature, the boiler goes into a lockout condition, requiring a manual reset. Perform the test to ensure that the water temperature sensor is functioning.

To test the Hi-limit temperature function:

1. Go to > **SIM Menu** > **Hi-Limit Test** > Read the instructions.
   » You will need to enter a cutoff temperature below the actual supply temperature value currently displayed. For example, if the Supply Temp. value is 180°F, enter

170°F in the Cut Off Temp. box.

2. In the **Cut-Off Temp.** field, enter a number value > **OK**.
   - » The message: "Hi-Limit Detected" is displayed.
3. To reset the boiler, select the **Reset** button. The cutoff value reverts to normal upon reset.
   - » The message: "The SIM module has been reset" is displayed.
4. Tap **Close** > **Back** to exit the test.

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.	☐

Maintenance Required	Check
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	☐

8.2.2 Torque

Heat exchanger cleaning requires removal of the heat exchanger lid. The heat exchanger lids are fastened by (depending on model) 5 or 6 nuts. Upon reassembly these should be tightened, using a cross pattern, to a torque between 50 inch•lb and 60 inch•lb.

8.2.3 General combi boiler maintenance

Component	Maintenance Required	Frequency	Check
Condensate trap	Remove and clean annually (see *Cleaning the condensate trap on page 96*). 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	☐
Burner	Remove the burner to inspect for extent of fouling (see *Replacing the burner on page 91*. a. Rinse the burner thoroughly from outside to inside using a kitchen sprayer or hose 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	☐

Component	Maintenance Required	Frequency	Check
	Warning When removing the burner for inspection or combi 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.		
	If the burner is operating improperly, remove and clean or replace. Use a CO_2 analyzer to determine proper combustion. See *Combustion test target ranges - CO2 / Maximum CO on page 80* for correct values.	Annually	☐
Heat exchanger	With the heat exchanger lid removed, 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 Δ°T, 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	☐
Heat Exchanger treatment	Check consistency of any heat exchanger 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	☐

Component	Maintenance Required	Frequency	Check
	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 combi 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 only use 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.		
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 any noise in the system. Check also 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 water temperatures match targets and are appropriate for application.	Annually	☐
	Ensure any direct “city fill” water connections are left in the closed position to minimize exposure to leaks and flooding.	Annually	☐
Relief valve - maintenance and testing	The relief valve manufacturer requires that under normal operating conditions a “try lever test” must be performed every 2 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	☐

Component	Maintenance Required	Frequency	Check
	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 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. If the system has glycol and a system feeder, the discharged fluid will need to be captured and returned to the system feeder appliance.		

8.3 Replacing the fan, gas valve, and burner

This section documents the following maintenance procedures:

- Replacing the fan
- Replacing the gas valve
- Replacing the burner.

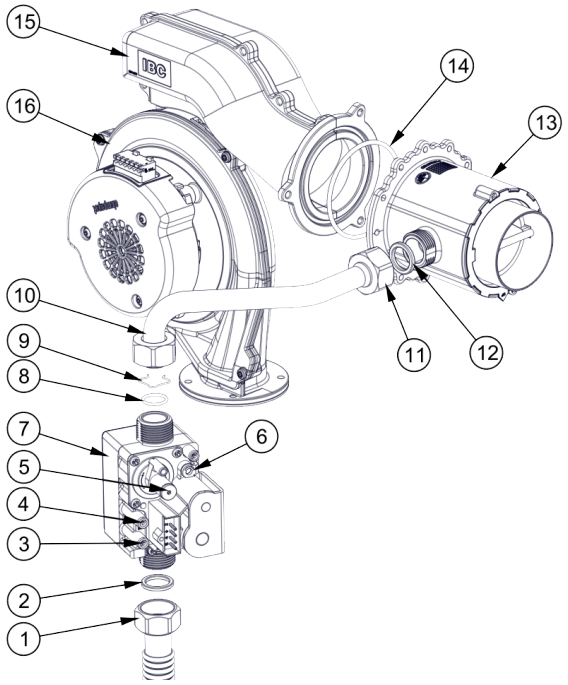


Figure 46 *Gas valve and fan components*

1	Gas valve inlet	9	Nut retainer
2	Gasket	10	Gas valve outlet pipe
3	Inlet gas pressure test port	11	Brass union nut
4	Manifold gas pressure test port (do not use)	12	Gasket
5	Low fire adjustment (under cap)	13	Mixer
6	High Fire Adjustment	14	Fan coupler O-ring
7	Gas valve	15	Fan coupler
8	O-ring	16	Fan

8.3.1 Replacing the fan

1. Turn off the electric power and gas supply to the combi boiler.
2. Ensure the combi boiler cools down. Do not drain the combi boiler unless freezing conditions are expected during this procedure.
3. Remove the front cover, and then remove the 4 Torx 20 head screws on the top panel of the combi boiler.

   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. Undo the union nut at the gas valve outlet.
5. Ensure that the O-ring (8) and nut retainer (9) are secured to the pipe.
6. Undo the union nut (11) connecting the gas valve outlet pipe to the mixer.
7. Carefully remove the gas valve outlet pipe (10) and gasket (12), and set aside for re-installation.
8. Note the orientation and positions of the mixer's Philips head bolts.
9. Remove the Philips head bolts attaching the mixer to the fan, and set the mixer aside for re-installation.
10. Carefully remove the fan O-ring (14) and note its position for re-installation.
11. Remove the electrical connection to the fan.
12. To remove the fan, unscrew the 2 nuts at the base of the fan, and retain for re-installation.
13. Carefully lift and tilt the fan backwards to safely remove the fan from the heat exchanger lid.
14. Remove the fan gasket.
15. Position the fan gasket (supplied in kit) onto the new fan, so that the holes align.
16. Secure the new fan onto the heat exchanger lid with the 2 nuts.
17. Reinstall the components in reverse order. Upon reassembly, ensure that all O-rings and gaskets are correctly positioned.
18. Check for leaks at the gas valve outlet and at the connection point between the fan and the heat exchanger lid.

8.3.2 Replacing the gas valve

1. Turn off the electric power and gas supply to the combi boiler.
2. Ensure that the combi boiler cools down to the surrounding temperature.
3. Remove the front cover, and then remove the 4 Torx 20 head screws on the top panel of the combi boiler.

   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. Remove the electrical connection to the gas valve with a Philips head screwdriver.
5. Undo the union nut at the gas valve inlet (1).
6. Carefully remove the gas valve gasket (2) for re-installation.
7. Undo the union nut (11) connecting the gas valve outlet pipe to the mixer, and carefully remove the gas valve/gas valve outlet pipe assembly and gasket (12) from the combi boiler case. Set aside the gasket for re-installation.
8. To detach the gas valve from the gas valve outlet pipe, undo the union nut at the gas valve outlet, and set the pipe aside for re-installation.
9. Ensure that the O-ring (8) and nut retainer (9) are secured to the pipe.
10. Attach the new gas valve on the gas valve outlet pipe, tightening the union nut on the gas valve outlet with the nut retainer and O-ring in place.
11. Reinstall the components in reverse order. Upon reassembly, ensure that all O-rings and gaskets are correctly positioned.
12. Before restoring the combi boiler to normal operation, check for leaks at the gas valve inlet .
13. With the combi boiler operating, check for leaks at the gas valve outlet.
14. Tune the gas valve. For instructions, see *Adjusting the gas valve on page 76*.
15. After removing test equipment check test ports and replace door.

8.3.3 Replacing the burner

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 damage occurs, contact the factory for directions.

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.

1. Turn off the electric power and gas supply to the combi boiler.
2. Remove the front cover, then remove the 4 top panel Torx screws to remove the top access panel.

Warning

Wear a suitable protective mask to avoid ingesting particles from the refractory.

3. Remove the electrical connection to the gas valve with a Philips head screwdriver.
4. Undo the union nut at the gas valve outlet.
5. Ensure that the O-ring (8) and nut retainer (9) are secured to the pipe.

6. Remove the fan/mixer/gas valve outlet pipe assembly. Tilt the fan to safely remove the assembly. For instructions on removing the fan, see *Replacing the fan on page 89*, starting from step 11.
7. Remove the ignitor cables (green and red).
8. Remove the 5 (Combi Model 150) or 6 (Combi Model 199) nuts securing the lid to the heat exchanger. The burner is attached to the underside of the heat exchanger lid.
9. Carefully lift the lid upwards away from the studs. The gasket/refractory/burner should stay with the lid as it is removed.
10. Remove the screws securing the ignitor, and then remove the ignitor and ignitor gasket.
11. Remove the refractory by sliding it over the burner.
12. Turn the heat exchanger lid over.
13. Remove the screws securing the burner to the heat exchanger lid, and remove the burner and gasket. The burner gasket may be damaged during removal, and will likely need to be replaced.
14. Install the new burner and gasket, ensuring that all screws are tightened evenly by repeating the tightening sequence a few times as shown in the images below.
15. Reinstall the refractory. Carefully slide it over the burner all the way to the lid, ensuring that the openings for the ignitor, view port and heat exchanger studs are aligned correctly.
16. Reinstall the ignitor gasket and ignitor with 2 screws.
17. Re-install the lid with burner and gasket/refractory assembly. Ensure that you tighten each nut evenly by following the order indicated in the pattern below.
18. Re-install the remaining components in reverse order.
19. Turn on the electric power and gas supply to the combi boiler.
20. After firing the combi boiler, check for leaks at the gas valve inlet and at the connection between the fan and the heat exchanger lid (if the fan was removed).
21. Check the gas valve tuning, and adjust as needed.
22. After removing test equipment check test ports and replace door.

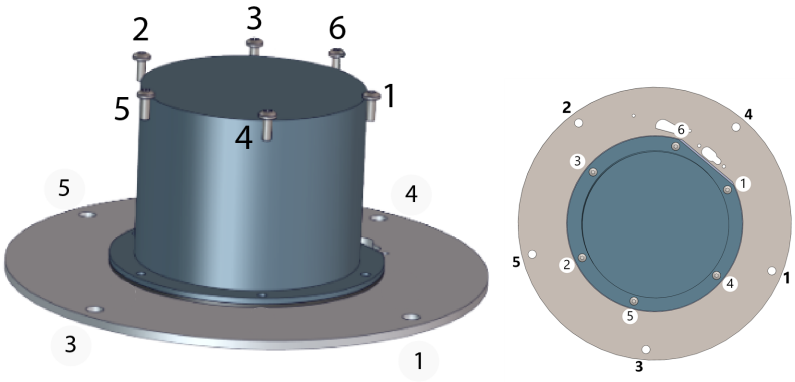
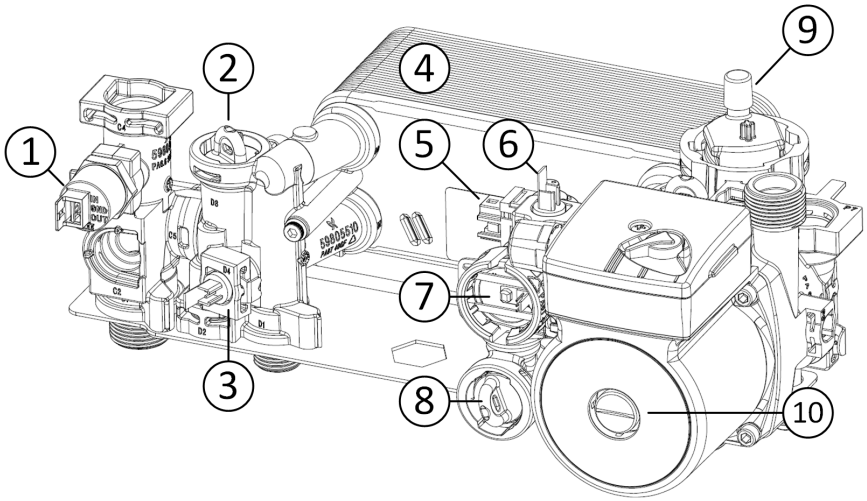


Figure 47 *Order for tightening screws on burner and nuts on the lid - Combi Model 150.*

8.4 Maintenance of the On-Demand DHW block

The On-Demand DHW block is an assembly including the DHW flat-plate heat exchanger, the bypass valve with actuator, the primary pump, the 4 water external connection ports, 2 temperature sensors, the flow sensor, a boiler circuit drain port (not visible below--located behind boiler inlet connector), and the strainer / flow restrictor.



1	Boiler circuit water pressure sensor
2	Bypass check valve
3	DHW outlet temperature sensor
4	DHW flat-plate heat exchanger
5	Bypass valve actuator (partially obscured)
6	DCW inlet temperature sensor
7	Flow Sensor
8	Flow restrictor / water strainer
9	Auto air vent (keep cap open)
10	Boiler pump air purge valve (normally closed)

Figure 48 *Combi block service points*

8.4.1 Cleaning the bypass check valve

1. Turn off the electric power and gas supply to the combi boiler.
2. Isolate boiler circuit and drain.
3. Bypass circuit check valve access is by a bayonet plug on the left-hand side of the On-Demand DHW block (see (2) in *Figure 48*).
4. Lightly push the bayonet knob, rotate counter-clockwise a quarter turn, and pull to remove.
5. Flush clean with water and replace.

8.4.2 Replacing the bypass actuator

1. Turn off the electric power and gas supply to the combi boiler.
2. The actuator ((5) in *Figure 48*) is located immediately behind the flow sensor and can be removed without isolating the water. Unplug the control wire from the bypass valve actuator.
3. The actuator slides to the left out from its base for inspection or replacement.
4. Reinstall by sliding the actuator rightwards back into its base and reconnect control wire.

8.4.3 Removing the flow sensor

1. Turn off the electric power and gas supply to the combi boiler.
2. Isolate DHW circuit and drain.
3. Remove flow sensor ((7) in *Figure 48*) wiring harness.
4. Sensor is retained by a fork-shaped clip. Caution: this may be sharp to the touch. Use needle-nose pliers to squeeze the clip prongs together; when prongs disengage from their secured position, pull the clip out to the left.
5. Grasp the flow sensor by its central nub and pull straight forward to remove.
6. The underside of the sensor is a paddle wheel. This should show no erosion nor fouling, and when blown at should spin easily. Clean or replace as necessary.
7. Reinsert sensor such that the harness pins are oriented to the right side. Slide retainer clip until it clicks in place, and reattach wiring harness.

8.4.4 Cleaning the water strainer / flow restrictor

1. Turn off the electric power and gas supply to the combi boiler.
2. Isolate DHW circuit and drain.
3. Water strainer / flow restrictor access is by a bayonet-mount plug on the right-hand side of the On-Demand DHW block (see (8) in *Figure 48*).
4. Lightly push the bayonet knob, rotate counter-clockwise a quarter turn to unlock, then pull forward to remove a black cyclinder. Note that on the end of the cylinder there is an white bar: grasp bar to remove the strainer from the cylinder. Backflush strainer / flow sensor to

clean as necessary. Reinstall in the same orientation, and lock bayonet port with a clockwise quarter-turn.

8.5 Cleaning the sight glass

When a new combi boiler is first fired up, gases in the system can cloud up the viewport. If so, you will need to clean the sight glass to view the presence of a flame.

1. Turn off the electric power and gas supply to the combi boiler.
2. Allow the combi boiler to cool down.
3. Remove the 2 screws holding the sight glass in place.
4. Remove the 4 components of the sight glass and wipe the glass clean.
5. Before you reassemble the sight glass, check that the gaskets are in good condition.
6. Assemble the components (see image below), by first inserting the rubber gasket ③ inside the refractory top ④ followed by the glass ②, and then the graphite gasket ①.

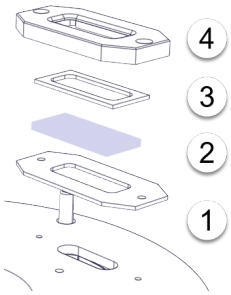


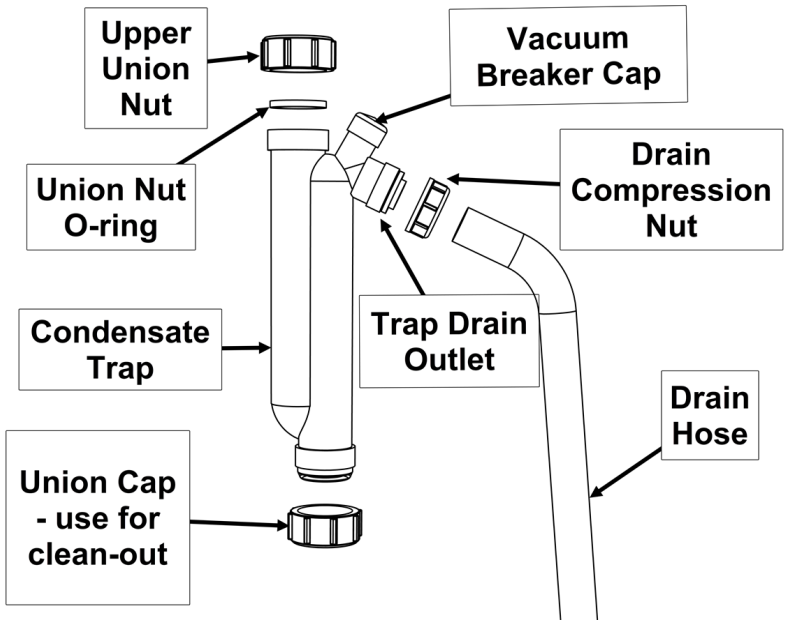
Figure 49 *4 components of the sight glass*

7. Replace onto the lid, and fasten with the 2 screws.

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 combi boiler unless the trap is filled with water. Failure to comply will result in severe personal injury or death.



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 combi 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.

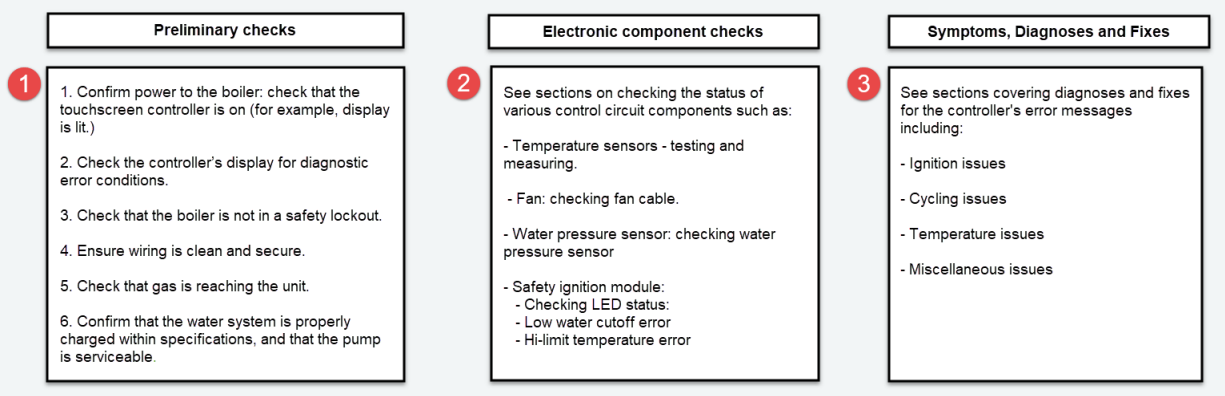
For details, see *Installing a condensate trap on page 44*.

8.7 Ensure door in place

The boiler door must be in place during operation. Ensure door is in place after service.

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, DHW inlet, DHW outlet, 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 2 separate circuits. Test each pair. Both circuits must deliver accurate (although not necessarily identical) readings. Note that failures may occur 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 16 *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 DHW flow sensor

The DHW flow sensor ensures that there is adequate flow in the DHW system. The flow is displayed in GPM as the default. A minimum of 0.5 GPM is required to activate the DHW heating.

Check the operation of the sensor by allowing domestic water to flow through the unit. On the controller, go to **Status > Boiler Status**, and scroll down to view the **DHW Flow**. The display should indicate a number greater than 0 (zero). Check the flow sensor for fouling or loose wiring. If sensor is spinning freely and connected, replace the sensor.

9.1.5 Safety and Ignition Module (SIM+)

The SIM+ is a safety control, certified to conform to the UL 60730-5-5 and ANSI Z21.20-2014 • 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 2 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 = No 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
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 17 *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, confirm the presence of water at the manual air vent.

Resetting a boiler after a hi-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.

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 103*.

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 3⁄16 th 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 *Resetting a boiler after a hi-limit temperature lockout on page 100*.

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 *Resetting a boiler after a LWCO lockout on page 100*.

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*	• Venting material set to CPVC or Polypropylene (PP): exhaust gas temperature exceeds 248°F for 6 seconds, or 232°F for 60 sec. Boiler is in hard lockout mode. • Venting material set to PVC: exhaust gas temperature exceeds 205°F for 6 seconds, or 189°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 below 20mA)	• Inspect harness and ignition cable • 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

<table>
<tr><th colspan="3">Miscellaneous errors</th></tr>
<tr><th>Issue</th><th>Diagnosis</th><th>Fix</th></tr>
<tr><td>Error - Controller Board</td><td>Error internal to control board</td><td>• Typically result of poor incoming power
• May require a reboot</td></tr>
<tr><td>Error - No Boilernet Comm</td><td>Controller set as Master cannot detect at least one other board</td><td>• Check Subordinate boiler is on
• Check network wiring
• Check IP Network numbers</td></tr>
<tr><td>Error - No MAC address</td><td>Boiler cannot verify a valid MAC address</td><td>• See Network Settings</td></tr>
<tr><td>Error - Flame Signal / Vent Block</td><td>SIM+ flame current drops below minimum values shown here:
Flame Current Minimums
Model | ≤3500 RPM | >3500 RPM
150 | 3.4 µA | 2.9 µA
199 | 3.2 µA | 4.0 µA</td><td>• 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</td></tr>
<tr><td>Error - Reversed Flow</td><td>Return temperature reads higher than supply temperature for 10 minutes</td><td>• Check boiler pump flow direction
• Check wiring connections for supply and return sensors</td></tr>
<tr><td>Error - Temp. probe error</td><td>An internal temperature sensor appears to be shorted or open circuit.</td><td>• Check supply, return and vent temperature sensors
• Error will trigger if above dual sensors deliver divergent values</td></tr>
<tr><td>Error - Combi Block</td><td>Communication error with CBI board</td><td>• Check CBI board connection
• Replace CBI board</td></tr>
<tr><td>Error - Combi Diverter</td><td>Diverter valve current out of range</td><td>• Check for stuck diverter valve
• Check diverter valve connection</td></tr>
<tr><td>Error - No Combi Inlet Temp. Sensor</td><td>Temperature sensor appears to be shorted or open circuit.</td><td>• Check DHW inlet temperature sensor</td></tr>
<tr><td>Error - No Combi Outlet Temp. Sensor</td><td>Temperature sensor appears to be shorted or open circuit.</td><td>• Check DHW outlet temperature sensor</td></tr>
<tr><td>Error - Inverted Combi Temp. Sensor</td><td>DHW Inlet exceeds DHW Outlet 45 seconds during DHW call.</td><td>• Check DHW temperature sensor wiring
• Check DHW sensor accuracy</td></tr>
<tr><td>Error - Unhandled error code</td><td>Reserved for unforeseen conditions</td><td>Contact Tech Support</td></tr>
<tr><td>Blank – screen dark</td><td></td><td>• Check transformer; replace if damaged.
• Check circuit board for visible</td></tr>
</table>

Miscellaneous errors		
Issue	**Diagnosis**	**Fix**
		damage.
Controller is stuck in "service" mode after software update.	If update fails or no updates applied.	• Restarting returns the boiler to normal operation.

Warning

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

On-Demand DHW Error Messages - 150,000 BTU/hr, 199,000 BTU/hr only		
Error Text	**Diagnosis**	**Fix**
Error - *Combi Block*	Communication error with CBI board	• Check CBI board connection • Replace CBI board
Error - *Combi Diverter*	Diverter valve current out of range	• Check for stuck diverter valve • Check diverter valve connection
Error - *No Combi Inlet Temp. Sensor*	Temperature sensor appears to be shorted or open circuit.	• Check DHW inlet temperature sensor
Error - *No Combi Outlet Temp. Sensor*	Temperature sensor appears to be shorted or open circuit.	• Check DHW outlet temperature sensor
Error - *Inverted Combi Temp. Sensor*	DHW Inlet exceeds DHW Outlet 45 seconds during DHW call.	• Check DHW temperature sensor wiring • Check DHW sensor accuracy

Important tip for DHW Errors

For On-Demand DHW Errors, in the Error Log always use the dropdown arrow and access *Details* for all the relevant information.

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

Warning Messages		
Warning Text	**Diagnosis**	**Fix**
• *Inlet/Outlet Sensor* • *Remote Loop Sensor* • *Pressure Switch*	Sensor issue detected between calls for heat.	Treat as corresponding sensor error message

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.
	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.
	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.
One or more zones do not heat properly	Air trapped within zone(s) piping	Vent system/zone 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.	Check operation per manufacturer's instructions.

9.4.3 Miscellaneous issues

Miscellaneous issues		
Issue	**Diagnosis**	**Fix**
Fumes and High Humidity	Improperly installed condensate trap	Refer to installation/operation instructions.
	Leak in vent piping	Inspect using soap solution.
	Flue gas leak within boiler	Visually inspect all mechanical connections.
'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, if necessary 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 *Resetting a boiler after a hi-limit temperature lockout on page 100* and *Resetting a boiler after a LWCO lockout on page 100*.
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 primary pump is able to overcome head loss of boiler and primary loop piping at the required flow rate.
Primary Pump runs but load pumps do not.	Wiring not complete.	Supply power to the PV/L and PV/N terminals from the incoming power supply to the boiler. (Factory wired on boilers with a factory installed touchscreen controller)

9.4.4 Cycling issues

Issue: Short-cycling	
Diagnosis	**Fix**
Improper values entered via keypad.	Check load maximum temps are above target temps, by ½ of the selected boiler differential. Ensure boiler differential is OK (16 - 30 °F / 9-17 °C is generally adequate)
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.	Set anticipator to zero. Check thermostat operation. Refer to manufacturer's instructions.
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.

10.0 Wiring and operation diagrams

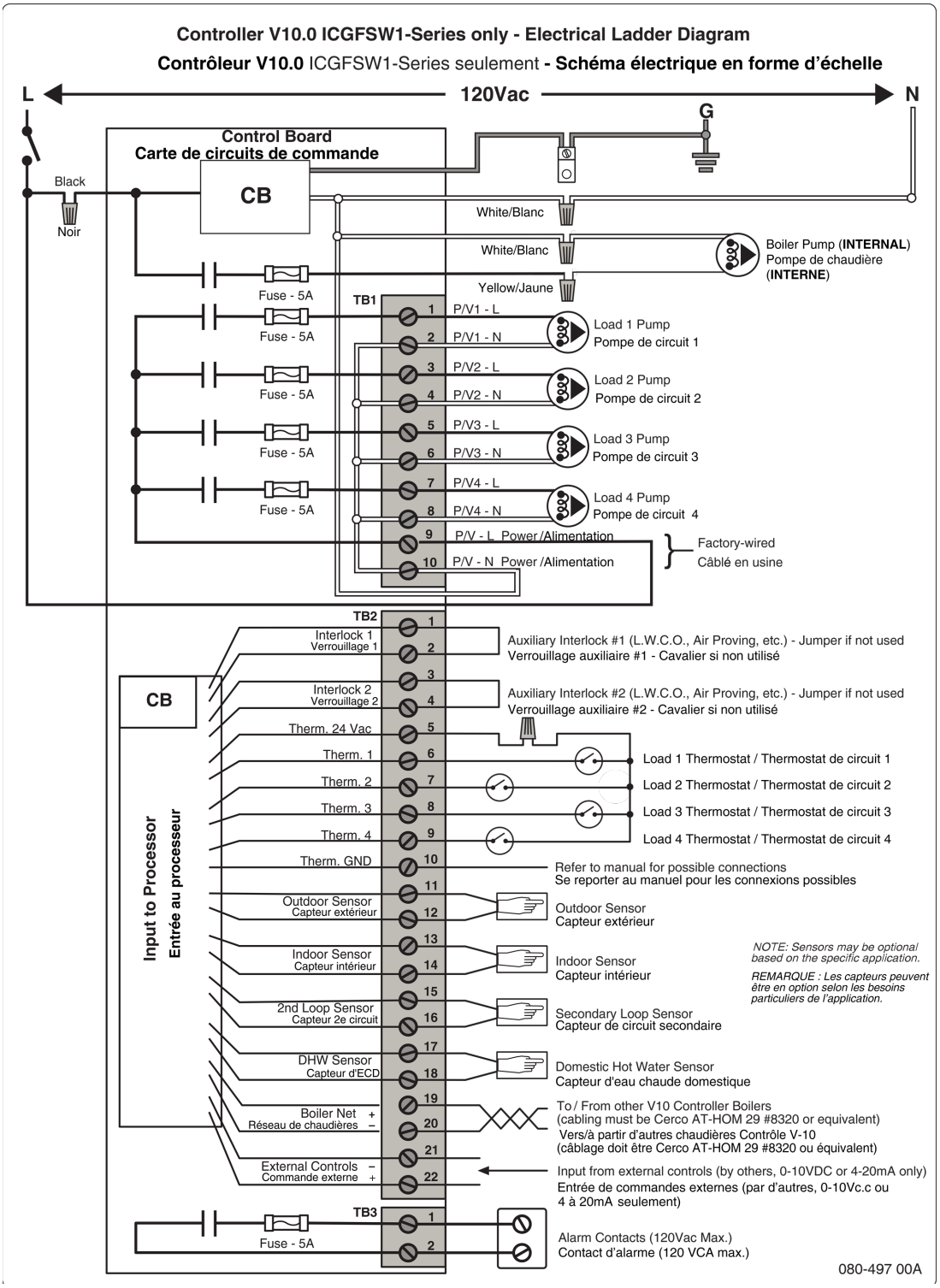


Figure 50 *Controller electrical diagram*

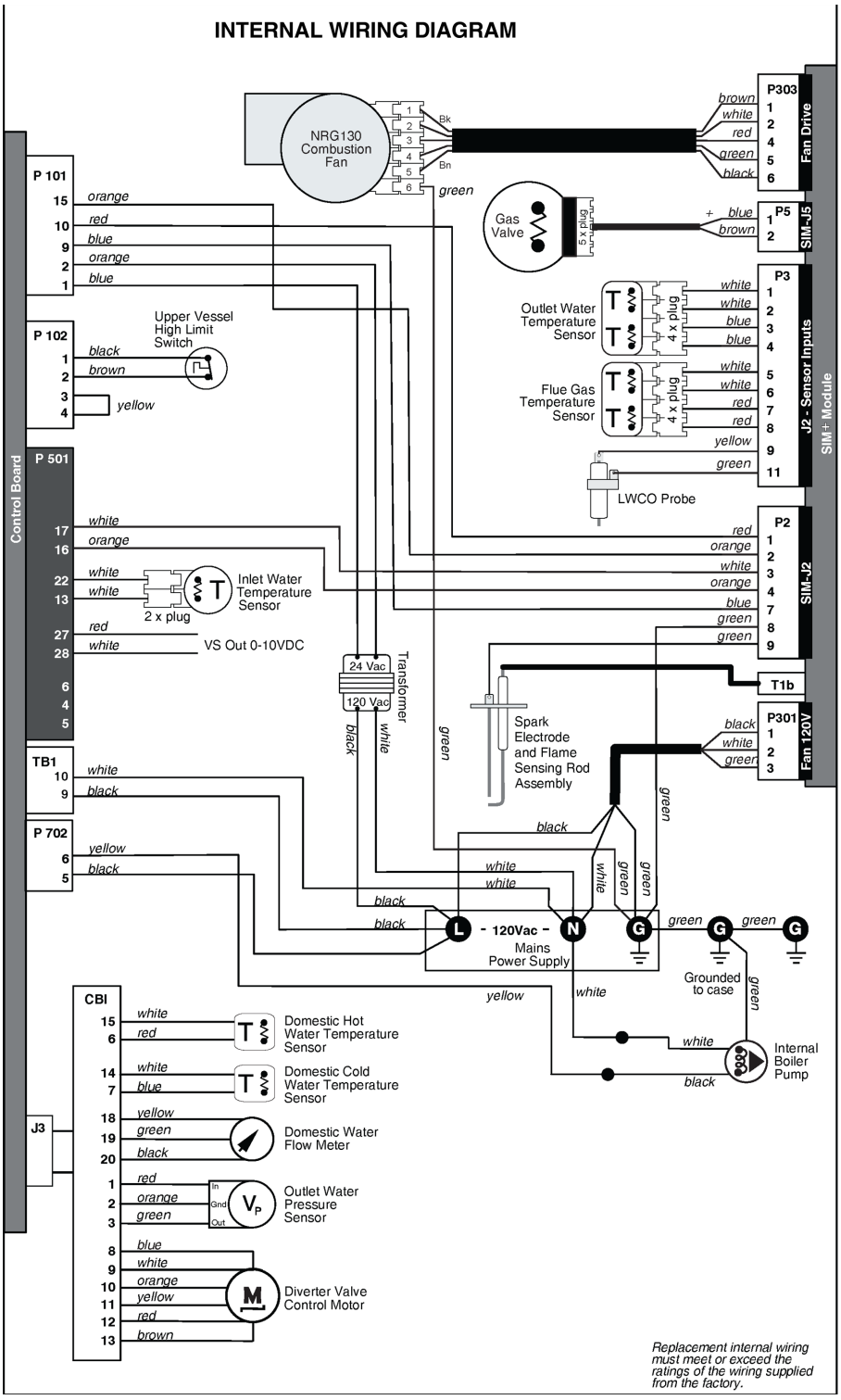


Figure 51 *Internal wiring diagram*

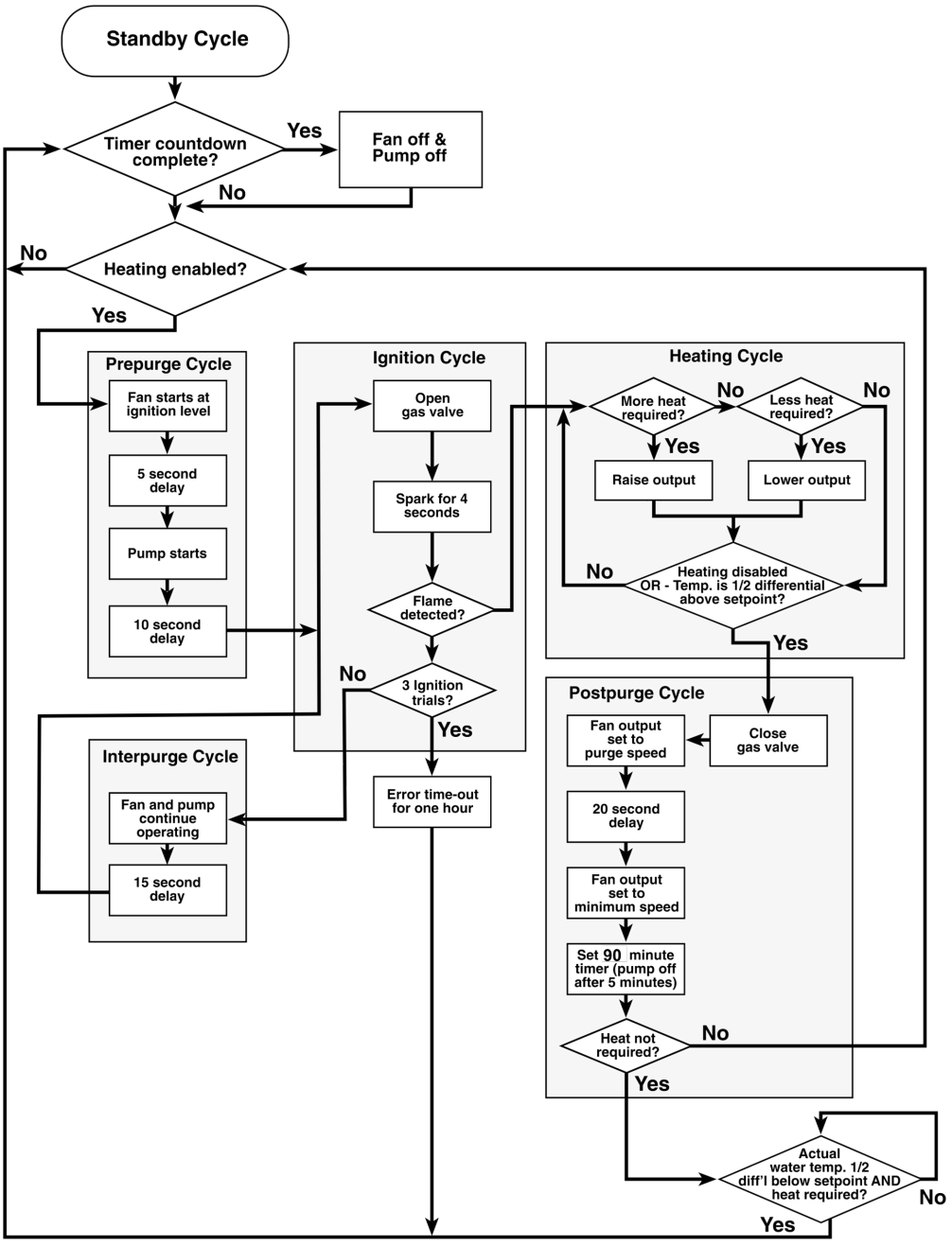
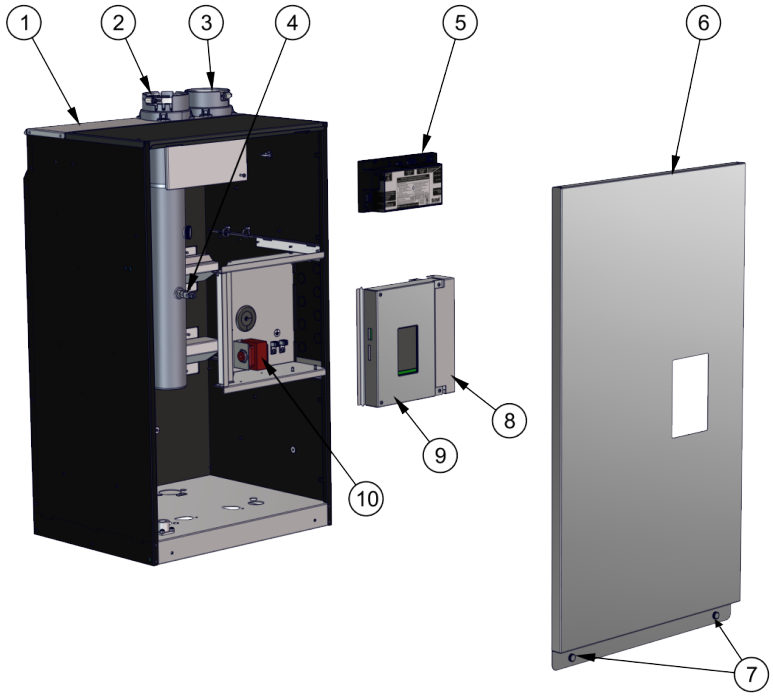


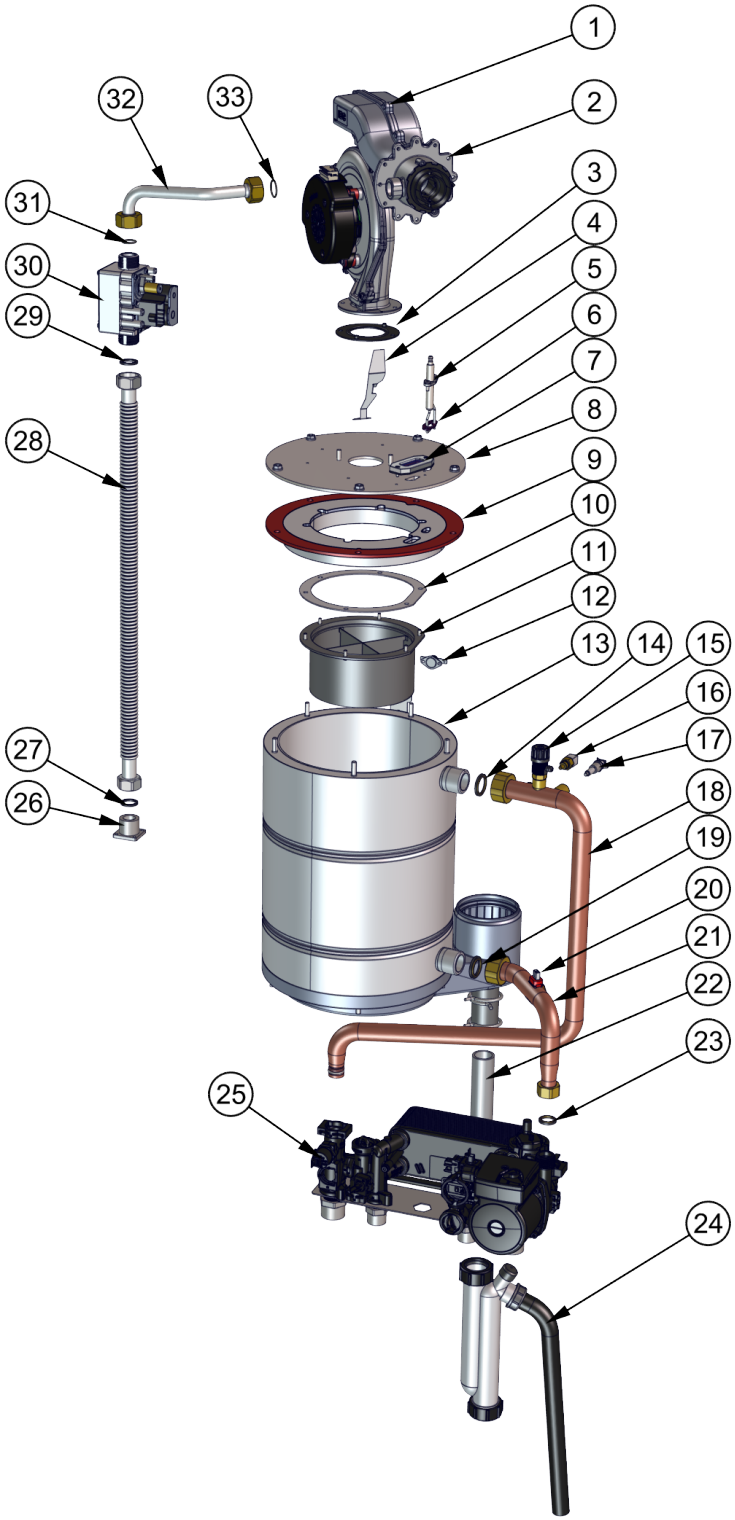
Figure 52 *Sequence of Operation*

Intentionally left empty

11.0 Exploded views of the Combi Boiler



Item	Description	P-kit #	Qty
1	Top access cover - Combi Model 150	P-1628	1
	Top access cover - Combi Model 199	P-1629	1
2	Exhaust duct	P-1634	1
3	Intake duct	P-391	1
4	Temperature sensor	P-361	1
5	Safety Ignition Module plus (SIM+)	P-271B	1
6	Front door cover - Combi Model 150	P-1630	1
	Front door cover - Combi Model 199	P-1631	1
7	Thumb screw		2
8	Terminal block cover		1
9	V-10 touchscreen controller	P-242C	1
	CBI board (in V-10, not visible)	P-1616	1
10	Transformer	P-9059	1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Item	Description	P-kit replacement #	Quantity
1	Fan/fan coupler assembly	P-1608	1
2	Polidoro mixer - Combi Model 150 NG	P-1601	1
	Polidoro mixer - Combi Model 150 LP	P-1600	1
	Polidoro mixer - Combi Model 199 NG	P-1603	1
	Polidoro mixer - Combi Model 199 LP	P-1602	1
3	Fan gasket	P-1625	1
4	Fan insert	P-1608	1
5	Ignitor	P-1511	1
6	Ignitor gasket	P-117	1
7	Sight glass	P-107A	1
8	Heat exchanger lid - Combi Model 150	P-1627	1
	Heat exchanger lid - Combi Model 199	P-1528	1
9	Refractory and heat exchanger lid gasket - Combi Model 150	P-1525	1
	Refractory and heat exchanger lid gasket - Combi Model 199	P-1529	1
10	Burner gasket	P-1625	1
11	Burner - Combi Model 150	P-1526	1
	Burner - Combi Model 199	P-1530	1
12	Rollout switch	P-9070	1
13	Heat exchanger - Combi Model 150	P-1635	1
	Heat exchanger - Combi Model 199	P-1527	1
14	O-ring with brass inner brace	P-9235	1
15	Manual air vent	P-1219	1
16	Supply temperature sensor	P-362	1
17	Low water cutoff probe	P-9061	1
18	Supply water pipe	P-1604	1
19	O-ring with brass inner brace	P-9235	1
20	Return water temperature sensor	P-1011	1
21	Return water pipe	P-1605	1
22	Condensate pipe	P-1609	1
23	O-ring with brass inner brace	P-9236	1

Item	Description	P-kit replacement #	Quantity
24	Condensate trap	P-115	1
25	On-Demand DHW block (DHW heat exchanger block and pump)	P-1606	1
26	Gas inlet, 3/4G to 1/2 NPT	P-408	1
27, 29	Inlet gas line union gasket	P-1522	2
28	Flex gas line	P-1610	1
30	Gas valve	P-326B	1
31	Gasket, gas valve outlet pipe to gas valve	P-1611	1
32	Gas valve outlet pipe		1
33	Gasket, gas valve outlet pipe to mixer	P-1522	1
not shown	Wall mounting bracket	P-9092	1
not shown	30 psig pressure relief valve	P-9009	1
not shown	Outdoor temperature sensor	P-9067	1
not shown	Thermostatic mixing valve	P-1638	1

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.

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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