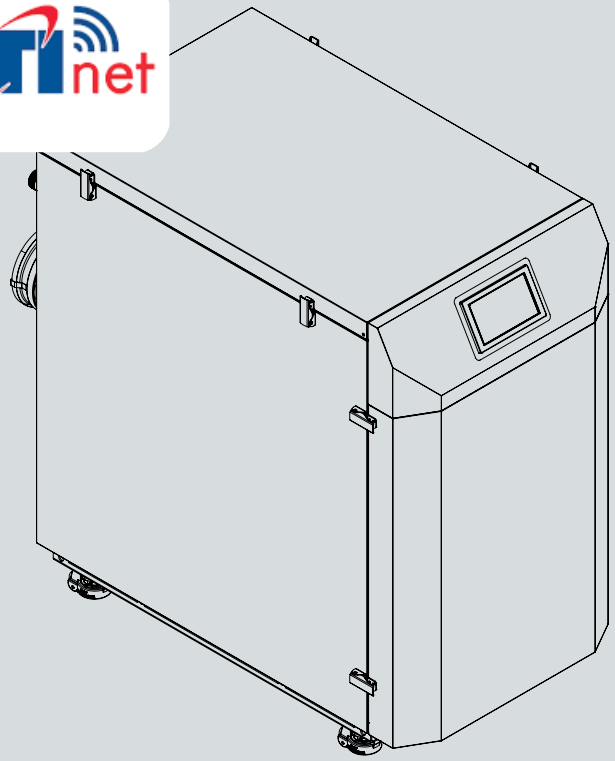
NCW

Commercial Condensing Gas Boiler / Water Heater

INSTALLATION
START-UP
MAINTENANCE

For models:

NCW400(WH)
NCW500(WH)
NCW650(WH)
NCW800(WH)
NCW1000(WH)



Heat Exchanger Bears the ASME "H" Stamp

NOTICE

The manufacturer reserves the right to make product changes or updates without notice and will not be held liable for typographical errors in literature.

The surfaces of these products contacted by potable (consumable) water contain less than 0.25% lead by weight as required by the Safe Drinking Water Act, Section 1417.

⚠ DANGER

THIS MANUAL MUST ONLY BE USED BY A QUALIFIED INSTALLER / SERVICE TECHNICIAN. READ ALL INSTRUCTIONS IN THIS MANUAL BEFORE INSTALLING. PERFORM STEPS IN THE GIVEN ORDER. FAILURE TO DO SO COULD RESULT IN SUBSTANTIAL PROPERTY DAMAGE, SEVERE PERSONAL INJURY, OR DEATH.

⚠ WARNING

Improper installation, adjustment, alteration, service, or maintenance could void product warranty and cause property damage, severe personal injury, or death.

California Proposition 65 Warning: This product contains chemicals known to the State of California to cause cancer, birth defects, or other reproductive harm.

⚠ WARNING

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

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

WHAT TO DO IF YOU SMELL GAS

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

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

FOR YOUR SAFETY READ BEFORE OPERATING

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

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

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

WHAT TO DO IF YOU SMELL GAS

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

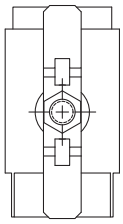
C. Use only your hand to turn the gas control knob. Never use tools. If the handle will not turn by hand, don't try to repair it, call a qualified service technician. Force or attempted repair may result in a fire or explosion.

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

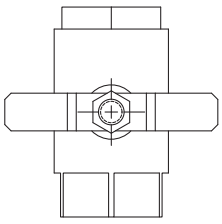
OPERATING INSTRUCTIONS

1. **STOP! Read the safety information above.**
2. **Set the thermostat to lowest setting.**
3. **Turn off all electric power to the appliance.**
4. **This appliance is equipped with an ignition device which automatically lights the burner. Do not try to light the burner by hand.**

GAS VALVE ON



GAS VALVE OFF



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

TO TURN OFF GAS TO APPLIANCE

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

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SPECIAL ATTENTION BOXES

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

⚠ DANGER

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

⚠ WARNING

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

⚠ CAUTION

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

CAUTION

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

NOTICE

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

Foreword

This manual is intended to be used in conjunction with other literature provided with the appliance. This includes all related control information. It is important that this manual, all other documents included in this system, and additional publications including the *National Fuel Gas Code - ANSI Z223.1* in the United States and the *Natural Gas and Propane Installation Code - B149.1* in Canada (latest versions), be reviewed in their entirety before beginning any work.

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

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

NOTE: The manufacturer reserves the right to modify product technical specifications and components without prior notice.

User Responsibilities

This appliance must be installed and serviced by a qualified installer or service technician. This appliance must be serviced and inspected annually when operating in normal residential applications. Demanding applications or extreme conditions (i.e. commercial use) may require more frequent service and inspection. As the User/Owner of this equipment, you are responsible for ensuring the maintenance is performed at the required intervals; see section 15.0 ANNUAL MAINTENANCE AND INSPECTION.

⚠ WARNING

Failure to have the appliance properly serviced and inspected on a regular basis by a qualified service technician may result in property damage, serious injury or death.

Failure to keep the Exhaust and Combustion Air Intake clear of ice, snow, and other debris may result in property damage, serious injury, or death.

For the Installer

This appliance must be installed by qualified and licensed personnel. The installer should be guided by the instructions furnished with the appliance, and by local codes and utility company requirements. In the absence of local codes, preference should be given to the *National Fuel Gas Code - ANSI Z223.1* in the United States and the *Natural Gas and Propane Installation Code - B149.1* in Canada (latest versions).

Installations Must Comply With:
Local, state, provincial, and national codes, laws, regulations, and ordinances.

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

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

In Canada - The latest versions of the *Natural Gas and Propane Installation Code, CSA B149.1*, and the *Canadian Electrical Code, C22.1*, from CSA Group, 178 Rexdale Blvd, Toronto, Ontario, Canada M9W 1R3.

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

Where required by the Authority, the installation must conform to the standard for "Controls and Safety Devices for Automatically Fired Boilers ANSI/ASME CSD-1.

⚠ WARNING

CARBON MONOXIDE DETECTORS
The installer must verify that at least one carbon monoxide alarm has been installed within each residential living space or home, and in the boiler room, following the alarm manufacturer's instructions and applicable local codes before putting the appliance into operation.

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

! WARNING

Crystalline Silica – Certain components confined in the combustion chamber may contain this potential carcinogen. Improper installation, adjustment, alteration, service, or maintenance can cause property damage, serious injury (exposure to hazardous materials) or death.

Installation and service must be performed by a qualified installer, service agency, or the gas supplier (who must read and follow the supplied instructions before installing, servicing, or removing this appliance.)

This appliance contains materials that have been identified as carcinogenic, or possibly carcinogenic, to humans.

The combustion chamber insulation in this product contains ceramic fiber material. Ceramic fibers can be converted to cristobalite in very high temperature applications. The International Agency for Research on Cancer (IARC) has concluded, "Crystalline silica inhaled in the form of quartz or cristobalite from occupational sources is carcinogenic to humans (Group 1)."

- Avoid breathing dust and contact with skin and eyes.
- Use a NIOSH certified dust respirator (N95). This type of respirator is based on the OSHA requirements for cristobalite at the time this document was written. Other types of respirators may be needed depending on job site conditions. Current NIOSH recommendations can be found on the NIOSH website: http://www.cdc.gov/niosh/homepage.html. NIOSH approved respirators, manufacturers, and phone numbers are also listed on this website.
- Wear long-sleeved, loose fitting clothing, gloves, and eye protection.
- Apply enough water to the combustion chamber lining to prevent dust.
- Wash potentially contaminated clothes separately from other clothing. Rinse clothes washer thoroughly.

NIOSH stated First Aid.

- Eye: Irrigate immediately.
- Breathing: Fresh air.

! WARNING

Void Warranty – This appliance must have water flowing through it whenever the burner is on, or it will damage the unit and void the warranty. Failure to follow these instructions may result in serious injury or death.

! DANGER

Scald Risk – Water temperatures abover 125°F can cause severe burns instantly or even death from scalds. Children, elderly persons, and those with disabilities are at highest risk of being scalded. See instructions in the Menu Guide section of this manual for instructions on setting the temperature for water heating applications.

NOTICE

IMPORTANT

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

These features include:

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

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

IMPORTANT

In accordance with Section 325 (f) (3) of the Energy Policy and Conservation Act, this appliance is equipped with a feature that saves energy by reducing the outlet 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 outlet water temperature as the heating load decreases.**
- **This appliance is not used for space heating.**
- **This appliance is part of a modular or multiple appliance system having a total input of 300,000 BTU/hr or greater.**

NOTICE

ASME CSD-1, Section CW-400 requires the temperature controls of hot water heating boilers to:

a) be accepted by a nationally recognized testing agency to conform to UL 353;
b) shutoff the fuel supply when the system water reaches a preset operating temperature;
c) have a high-temperature limit control that prevents the water temperature from exceeding the maximum allowable temperature by causing safety shutdown and lockout.

The temperature controls of this appliance have been accepted by a nationally recognized testing agency to conform to UL 353; they work to shutoff the fuel supply when the system water temperature reaches the preset operating temperature; and they cause a safety shutdown and lockout, requiring a manual reset to start, when the water temperature reaches 212°F.

Part 1 - General Safety Information

A. Operation and Installation Warnings

To avoid serious injury or death, read, understand, and follow all of the precautions listed here.

⚠ WARNING

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

DO NOT alter or modify the appliance or appliance controls. Altering any Ariston Canada appliance with parts not approved by Ariston Canada **WILL INSTANTLY VOID** the warranty and could result in property damage, personal injury, or death.

⚠ DANGER

This appliance is approved for indoor installations only and is not intended for use as a pool heater.

B. Before Operating with Propane

⚠ DANGER

These appliances are factory set to operate with Natural Gas; **BEFORE OPERATING WITH PROPANE**, they must be converted using the appropriate Natural Gas to LP Conversion Kit; see below. Failure to properly convert the unit to safely operate with Propane will cause dangerous burner operation, resulting in property damage, serious injury or death.

Model Size	LP Conversion Kit No.
400	560001002500
500	560001002500
650	560001002600
800	560001002700
1000	560001002800

Table 1 - LP Conversion Kit Part Nos.

⚠ WARNING

Liquefied Petroleum (LP) propane gas is heavier than air. Do not install the boiler in a pit or similar location that will permit heavier than air gas to collect. Check with Local Codes as they may require appliances fueled with LP gas to be provided with an approved means of removing unburned gases from the room. Failure to follow these instructions may result in serious injury or death.

C. Exhaust / Intake Air Vent Piping

⚠ DANGER

These appliances are certified as "Category IV" (positive pressure) or "Category II" (negative pressure) systems and require a “Special Venting System” designed for pressurized venting or adherence to specific rules and guidelines set out in the Venting section of this manual, respectively. The exhaust gases must be piped directly to the outdoors using the vent materials and rules outlined in these instructions. Failure to follow these instructions will result in serious injury or death.

D. DHW Temperature Adjustment and Scalding

This appliance, when configured as a Water Heater (WH) or connected to an Indirect Water Heater (IWH) can deliver scalding water. Be careful whenever using hot water to avoid scalding injury. Certain appliances such as dishwashers and automatic clothes washers may require increased water temperatures. By setting the thermostat on this appliance to obtain the increased water temperature required by these appliances you may create the potential for scald injury.
To protect against injury, install a mixing valve in the water system. This valve will reduce point of use discharge temperatures by mixing cold and hot water in branch supply lines. Such valves are available from your local plumbing supplier.
Table 2 details the relationship of water temperature and time regarding scald injury and may be used as a guide in determining the safest water temperature for your applications.

Temperature	Scald Time
120°F	More than 5 minutes
125°F	1.5 to 2 minutes
130°F	About 30 seconds
135°F	About 10 seconds
140°F	Less than 5 seconds
145°F	Less than 3 seconds
150°F	About 1.5 seconds
155°F	About 1 second

Table 2 - Approximate Scald Time to Temperature Relationship

E. Carbon Monoxide Detectors

In the Commonwealth of Massachusetts and as Required by State and Local Codes:
Installation of Carbon Monoxide Detectors: At the time of installation or replacement of the vented gas fueled appliance, the installing plumber or gas fitter shall observe that a hard wired carbon monoxide detector with an alarm and battery back-up is installed on the floor level where the gas appliance is installed, unless the appliance is located in a detached, uninhabitable structure separate from the dwelling, building, or structure used in whole or in part for residential purposes.
In addition, the installing plumber or gas fitter shall observe that a hard wired carbon monoxide detector with an alarm and battery back-up is installed on each additional level of the dwelling, building, or structure served by the vented gas appliance. It shall be the responsibility of the property owner to secure the service of qualified licensed professionals for the installation of hard wired carbon monoxide detectors.

a. In the event that the vented gas fueled appliance is installed in a crawl space or attic, the hard wired carbon monoxide detector with alarm and battery back-up shall be installed on the next adjacent floor level.
b. In the event that these requirements cannot be met at the time of completion of installation, the owner shall have a period of thirty (30) days to comply with the above requirements; provided, however, that during said thirty (30) day period, a battery operated carbon monoxide detector with an alarm shall be installed.

Part 2 - Dimensions & Specifications

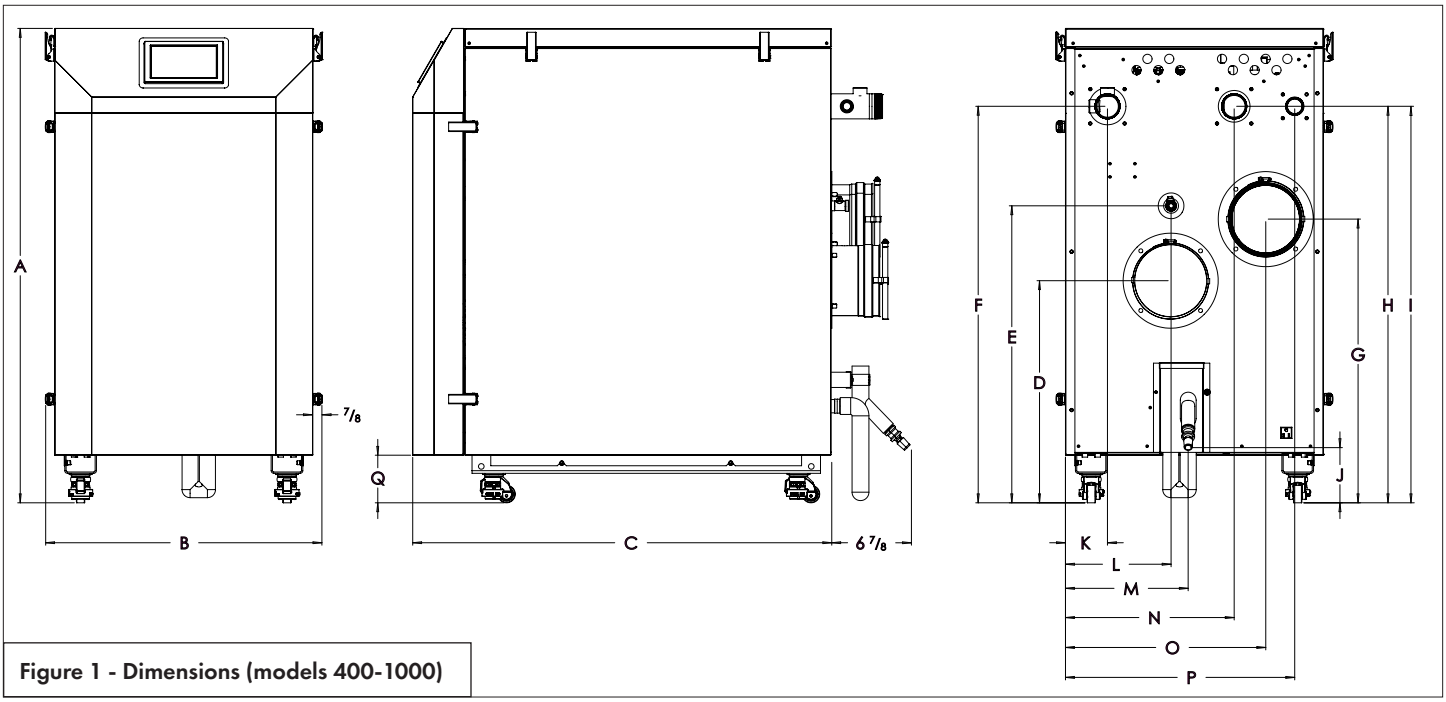


Figure 1 - Dimensions (models 400-1000)

MODEL	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
400	44.9	26.2	31.6	21.0	28.1	37.5	26.9	37.5	37.5	5.25	4.0	10.0	11.6	16.0	19.0	21.1	4.5
500																	
650			39.6													21.7	
800	45.4		42.4	21.5	28.5	38	27.3	38	38	5.75							4.9
1000			47.2														

Table 3 - Dimensions

Model Size		400	500	650	800	1000
Installation		Indoor, Floor Mounted, Fully Condensing				
Minimum / Maximum Input (BTU/hr)[1]		39,900 / 399,000	50,000 / 500,000	65,000 / 650,000	80,000 / 800,000	100,000 / 1,000,000
Heating Capacity[1, 2] (MBH)		387	485	630	776	970
Net AHRI Rating, Water (MBH)[2]		337	422	548	675	843
Water Heater only	Thermal Efficiency (%)	98				
	Recovery Rating (US Gal./hr)	475	594	772	950	1188
	Standby Loss (BTU/hr)	N/A				
Flue System		Catergory IV, Sealed Combustion Direct Vent, Non-Direct Vent				
Air Intake Vent Length		0-150 feet				
Exhaust Vent Length		6-150 feet				
Approved Exhaust Vent Materials[3]		PVC, CPVC, PP, Stainless Steel				
Gas Supply Pressure	NG	3.5"to 10.5"WC				
	LP	8"to 13"WC				
Power Supply		120V, 60 Hz, less than 12A				
Ignition System		Direct Electronic Spark Ignition / Flame Rectification				
Burner System		Premixed Fuel Modulation / Stainless Steel Burner				
Gas Valve System		Air Ratio Valve				
Shipping Weight (lbs)		TBD	TBD	TBD	TBD	TBD
Approx. Water Content (Gallons)		3.8	4.3	5.6	6.6	8.1
Approx. Full Weight (lbs)		TBD	TBD	TBD	TBD	TBD
Setpoint Temperature Range		50 – 190°F				
Water Pressure (PSI)	Heat Exchanger MAWP	160				
	Pressure Relief Valve	50 (boiler) | 150 (water heater)				
Control Panel / Main Controller		AristonThermo Display / AristonThermo ACP Control				
Connection Sizes (NPT)	Supply / Return	2"				
	Gas Inlet	¾"	1"	1¼"		
Materials	Cabinet	Painted Steel				
	Heat Exchanger	316L Stainless Steel Water Tube				
Safety Devices		Flame Rectifier Probe, Temperature Limit Control (210°F), Water Pressure Sensor, Freeze Protection, Blocked Condensate Pressure Switch, Condensate Trap, Flue Temperature High Limit Sensor (210°F), Blocked Vent Pressure Switch, Flow Switch				

Table 4 - Technical Specifications

NOTES:

[1] Listed Input and Output Ratings are at minimum vent lengths at an altitude of 0 - 2000 ft. Numbers will be lower with longer venting and/or altitudes greater than 2000 ft.

[2] Ratings based on standard test procedures prescribed by the US Department of Energy.

[3] This appliance requires a special venting system when installed as Category IV. Use only the vent materials and methods detailed in these installation instructions.

High Elevation Installations

This appliance is designed to operate at its maximum listed capacity in installations located at 0 - 2000 ft above Sea Level. Since the density of air decreases as elevation increases, maximum specified capacity should be de-rated for elevations above 2000 ft (610 m), in accordance with Table 5.

Elevations	2001 ft (610 m)	3000 ft (914 m)	4000 ft (1219 m)	4500 ft (1372 m)	5000 ft (1524 m)
In Canada[1], de-rate by:	10%	10%	10%	10%	may vary
In USA[2], de-rate by:	-	12%	16%	18%	20%

NOTES:

[1] Canada: Elevations between 2000 - 4500 ft (610 - 1372 m), de-rate by 10%. Consult local authorities for de-rating for elevations above 4500 ft (1372 m).

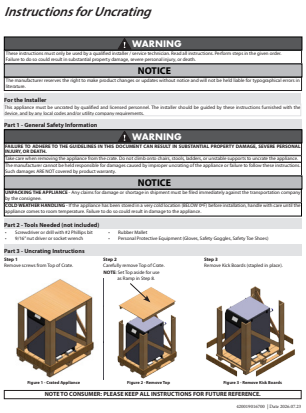
[2] USA: If elevation is above 2000 ft (610 m), de-rate capacity by 4% for every 1000 ft (305 m).

Table 5 - De-Rate % for High Elevations

Part 3 - Appliance Contents

NOTICE

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


Instructions for Uncrating

WARNING

These instructions must only be used by a qualified installer / service technician. Read all instructions. Perform steps in the given order. Failure to do so could result in substantial property damage, severe personal injury, or death.

NOTICE

The manufacturer reserves the right to make product changes or updates without notice and will not be held liable for typographical errors in literature.

For the Installer

This appliance must be uncrated by qualified and licensed personnel. The installer should be guided by these instructions furnished with the device, and by any local codes and/or utility company requirements.

Part 1 - General Safety Information

WARNING

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

Take Top off before removing the appliance from the crate. Do not stand on chairs, stools, ladders, or unstable supports to uncrate the appliance.

The manufacturer cannot be held responsible for damages caused by improper uncrating of the appliance or failure to follow these instructions. Such damages ARE NOT covered by product warranty.

NOTICE

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

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

Part 2 - Tools Needed (not included)

- Screwdriver or drill with #2 Phillips bit
- 9/16" nut driver or socket wrench
- Rubber Mallet
- Personal Protective Equipment (Gloves, Safety Goggles, Safety Toe Shoes)

Part 3 - Uncrating Instructions

Step 1 Remove screws from Top of Crate.

Step 2 Carefully remove Top of Crate. **NOTE:** Set Top aside for use as Ramp in Step 8.

Step 3 Remove Kick Boards (stapled in place).

Figure 1 - Ostinol Appliance | Figure 2 - Remove Top | Figure 3 - Remove Kick Boards

NOTE TO CONSUMER: PLEASE KEEP ALL INSTRUCTIONS FOR FUTURE REFERENCE.

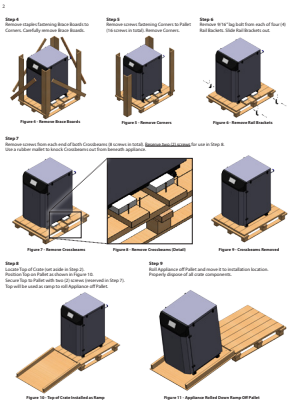


Figure 6 - Remove Brace Boards | Figure 5 - Remove Corners | Figure 4 - Remove Rail Brackets

Figure 7 - Remove Crossbeams | Figure 8 - Remove Crossbeams (Detail) | Figure 9 - Crossbeams Removed

Figure 10 - Top of Crate Installed as Ramp | Figure 11 - Appliance Rolled Down Ramp Off Pallet

Remove the appliance from the packaging following the Uncrating Instructions.

Remove the accessory box from the appliance.

Take care to place the appliance in a safe location prior to installation to prevent damage to the mechanical connections.

A. What's in the Box

Included components:

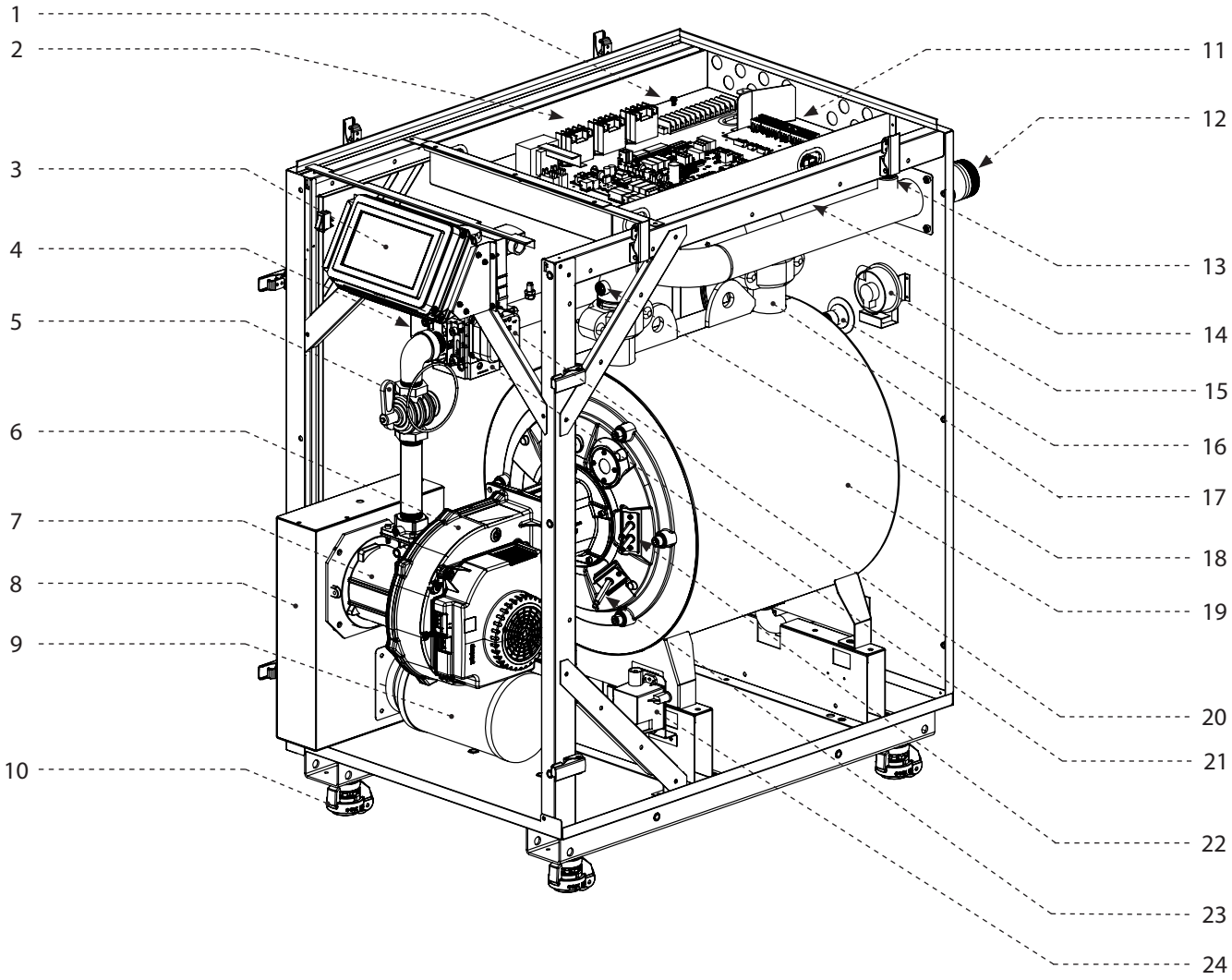
Nr.	Quantity	Description
	1	Condensing Gas Boiler / Water Heater
	1	50 psi Pressure Relief Valve
	1	Tridicator (80 psi | 250°F)
	1	150 psi Pressure Relief Valve
	1	Tridicator (250 psi | 250°F)
	1	System Sensor
	1	Condensate Drain Tube, Connector, and Clamp
	1	Outdoor Sensor Kit
	1	CPVC Stub (var. length; 400-1000 models only)
	2	Vent Screen
	1	'Gas Vent Directly Below' decal
	1	LP Gas Conversion Kit
	1	LP Conversion Instructions
	1	LP Mixer
	1	LP Conversion Decal
	1	Adhesive Foil Tape
	1	Installation Manual (this document)
	1	User Information Manual
	1	Warranty Information Card

B. Optional Equipment

Optional equipment available (Part #):

- System Sensor(*) (6000084010)
  (*) One system sensor is required when cascading multiple units; it is not compatible with a single unit.
- Tank Sensor (6000084632)
- Room Sensor (3319455)
- Building Management Clip-in, for 0-10V/4-20mA external control (3319457)
- N-Link 3-Zone Control (3260184)

Components



1.	High-voltage Field Wiring	14.	Water Pressure Sensor (not shown)
2.	Pump Outputs		Temperature Sensor, Inlet (not shown)
3.	HMI Touchscreen Display	15.	Air Pressure Switch
4.	Gas Pressure Switch (High)	16.	Heat Exchanger Drain
5.	Gas Shuf-off Valve	17.	Water Inlet Connection
6.	Combustion Blower	18.	Temperature Sensor, Outlet
7.	Gas Mixer (Venturi)	19.	Heat Exchanger Module
8	Air Box	20.	Gas Pressure Switch (Low)
9.	Air Filter	21.	Gas Valve
10.	Caster (x4)	22.	Ignition Electrode
11.	Low-voltage Field Wiring	23.	Flame Detection Electrode
12.	Water Outlet Pipe	24.	Spark Generator
13.	Flow Switch		

Figure 2 - Component Locations and Descriptions

Part 5 - Preparing the Appliance for Installation

CAUTION

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

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

! WARNING

Ensure that the structure of the installation location is sufficient to support the full installed weight of the appliance, including water content of the heat exchanger and related piping and components. If the mounting location cannot support a minimum of 500-2500 lbs. (depending on model), it is recommended to locate the appliance in a mounting location that can support the minimum weight. Failure to ensure the structure of the installation location is structurally sound before installation of the appliance and properly mount the appliance can result in structural failure, substantial property damage, severe personal injury, or death.

! WARNING

The manufacturer cannot anticipate all installation conditions. These instructions and included parts may not apply to wall-mounting the appliance at your installation location. The appliance must be properly and securely mounted by a qualified installer according to installation conditions, the technical specifications of the appliance, and to meet AHJ / building code requirements. All applicable permits must be obtained before installing the appliance. Failure to follow these instructions could result in property damage, severe personal injury, or death. Any damages resulting from improper installation are not covered by product warranty.

CAUTION

If the appliance is not installed upright, vertically plumb, and level, improper and unsatisfactory operation may occur, causing excessive condensation build-up, nuisance fault codes, and unnecessary maintenance.

! WARNING

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

A. Locating the Appliance

! WARNING

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

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

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

If flooding is possible, elevate the appliance to prevent floodwater from reaching the unit.
Ensure the appliance is installed in a location that minimizes the risk of water damage due to leaking valves, pumps, unions, etc.

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

! WARNING

This appliance has a condensate disposal system that may freeze if exposed to sustained temperatures below 32°F. Precautions should be taken to protect the condensate trap and drain lines from sustained freezing conditions.

2. Check for nearby connections to:
   - System water piping
   - Venting connections
   - Gas supply piping
   - Electrical power
   - Condensate drain

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

! WARNING

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

CAUTION

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

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

4. Gas control system components must be protected from dripping water during operation and service.
5. If the appliance is to replace an existing appliance, check for and correct any existing system problems, such as:
   - System leaks
   - Location that could cause the system and appliance to freeze and leak
   - Incorrectly sized expansion tank

CAUTION

Always take future maintenance into consideration when locating the appliance. If the appliance is located in an installation location with limited clearances, it may be necessary to remove the appliance from the space to perform maintenance. Failure to consider maintenance when determining installation location could result in property damage.

6. Clean and flush system when reinstalling a boiler (or water heater).

! WARNING

Do not introduce toxic chemicals, such as antifreeze or appliance treatments, into any piping meant for potable water purposes.

Do not connect DHW connections to any heating systems or components that have been previously used for nonpotable applications.

Ensure that all piping and components connected to the appliance are suitable for potable water applications.

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

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

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

CAUTION

All appliances eventually leak. Locate the appliance where any leakage from the relief valve, related piping, tank, or connections will not result in damage to surrounding areas or lower floors of the building. Any appliance should be installed such that, if a leak should occur, the resulting flow of water will not cause damage to the area in which it is installed. If the appliance is installed in a location where a leak could cause damage, it is required to provide containment measures. Such measures include but are not limited to: a properly sized drain pan installed beneath the appliance and piped to an open drain line, or installing the appliance on a concrete floor pitched to a free flowing drain. Failure to provide containment measures is the sole responsibility of the owner and/or installer. Leakage damages ARE NOT covered by warranty.

In addition, water leak detection devices and automatic water shutoff valves are readily available at plumbing supply houses.

IT IS HIGHLY RECOMMENDED BY THE MANUFACTURER TO INSTALL WATER LEAK DETECTION DEVICES AND AUTOMATIC SHUTOFF VALVES IN ANY APPLIANCE INSTALLATION WHERE A LEAKAGE OF WATER COULD RESULT IN PROPERTY DAMAGES.

B. Leveling

CAUTION

The appliance must be installed level for the condensate to properly flow out of the collection system. Failure to do so will result in improper appliance operation.

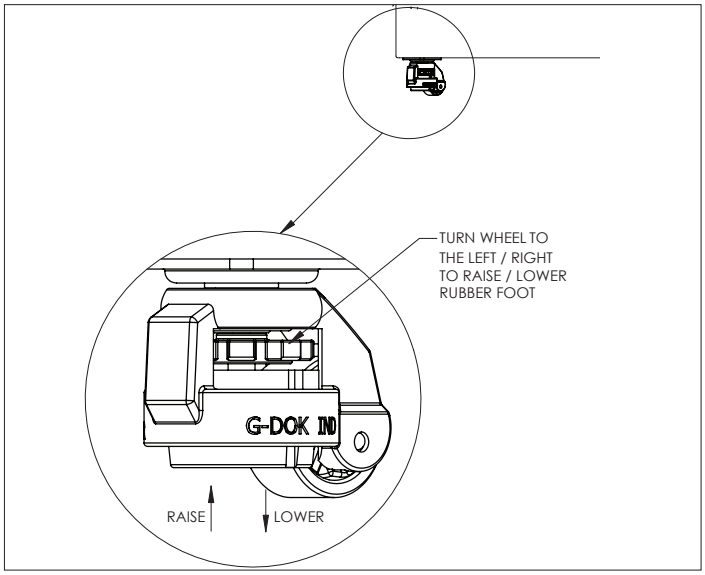


Figure 5 - Caster Wheel Adjustment

C. Clearances

WARNING

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

Minimum Clearances from Combustible Materials

- Hot water pipes — at least 1" from combustible materials
- Exhaust vent pipe — at least 1" from combustible materials; refer to vent system manufacturer's instructions.
- Cabinet surfaces — 0" from combustible materials

NOTE: For closet installations, a combustible door or removable panel is acceptable front clearance. A 3" minimum clearance must be provided from the appliance front cover to the removable panel or combustible door.

Recommended clearances for service access

- 24" is recommended on all sides (see Fig. 6)
- The rear of the appliance **must** remain accessible during and after installation for service and maintenance.

NOTE: Multiple appliances may be installed side by side with no clearance between; however, service access will be limited from the sides. Consult with the local inspection authority for approval.

NOTE: If you do not provide the recommended clearances shown in Figure 6 it might not be possible to service the appliance without removing it from the space.

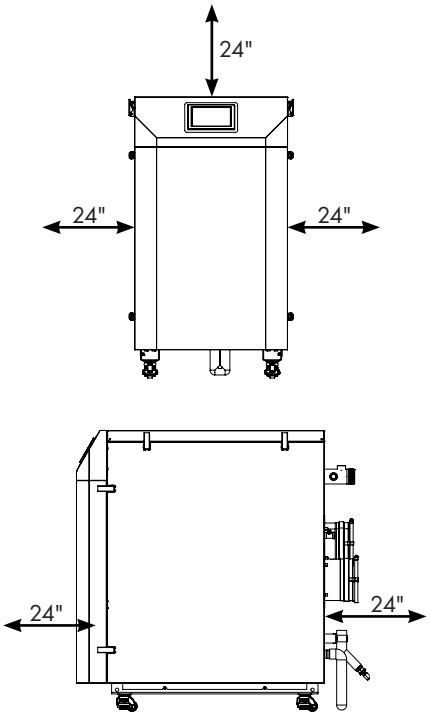


Figure 6 - Recommended Service Clearances

D. Mechanical Area Ventilation Air Openings

Direct Vent

If clearances are less than the recommended clearances, the mechanical area/room must be ventilated.

EXCEPTION: If the mechanical area/room has a volume of 275 ft^3 or greater, ventilation of the area/room is not required.

Each ventilation air opening must meet the minimum requirements of 1 in^2 per 1000 BTU/hr., but not less than 100 in^2. The lower ventilation opening must be located within 6 in. of the floor, while the upper opening must be located 6 in. from the top of the space.

NOTICE

If the mechanical area has a volume less than 275 ft^3, it is considered a Closet or Alcove. In the US/Canada, PVC vent pipe and fittings SHALL NOT BE USED within the closet or alcove. Only approved CPVC, Polypropylene, or Stainless Steel vent pipe and fittings may be used. See Table 15 for a list of approved materials. Under all circumstances proper clearances must be provided.

Power Vent / Indoor Combustion Air

When using Indoor Combustion Air in lieu of Direct Vent air intake piping, provisions for combustion and ventilation air, in accordance with section "Air for Combustion and Ventilation," of the National Fuel Gas Code, ANSI Z223.1/NFPA 54 (U.S.), or Clause 8.2, 8.3 or 8.4 of Natural Gas and Propane Installation Code, CAN/CSA B149.1 (Canada), or applicable provisions of the local building codes, must be adhered to.

Closet Installations

For closet installations it is necessary to provide two ventilation air openings, each providing a minimum area equal to 1 in^2 per 1000 Btu/hr, but not less than 100 in^2, each within 6" of the top and bottom of the closet door, respectively.

Alcove Installations

Alcove installations have the same minimum dimensions as closet installations, except the installation must be completely open to the room at a distance no greater than 18 in. (457 mm) from the front of the appliance and the room must be at least three (3) times the size of the alcove. Provided these conditions are met, the appliance requires no extra ventilation air openings to the space. If these conditions are not met, follow the requirements for Closet Installations.

WARNING

The space must be provided with correctly sized combustion/ventilation air openings for all other appliances located in the space with the unit. For non-Direct Vent installations using room air for combustion, refer to the venting section, this manual, for descriptions of confined and unconfined spaces. Do not install in an attic. The cover must be securely fastened to prevent the unit from drawing air from the mechanical room. This is particularly important if the unit is in a room with other appliances. Failure to comply with the above warnings could result in substantial property damage, severe personal injury, or death.

E. Exhaust Vent and Intake Pipe

DANGER

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

WARNING

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

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

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

1. Direct Vent of Exhaust and Intake

If installing a direct vent option, combustion air must be drawn from the outdoors directly into the appliance intake and exhaust must terminate outdoors. There are three basic direct vent options detailed in this manual:

1. Side Wall Venting,
2. Roof Venting.
3. Unbalanced Venting.

Be sure to locate the appliance such that the exhaust vent and intake piping can be routed through the building and properly terminated. Different vent terminals can be used to simplify and eliminate multiple penetrations in the building structure (see Optional Equipment in Venting Section). The exhaust vent and intake piping lengths, routing, and termination methods must all comply with the methods and limits given in the Venting Section, this manual.
When installing a combustion air intake from outdoors, care must be taken to utilize uncontaminated combustion air. **To prevent combustion air contamination, see following section.**

2. Non-Direct Vent, Indoor Combustion Air in Confined or Unconfined Space

This appliance requires fresh, uncontaminated air for safe operation and must be installed in a mechanical room where there is adequate combustion and ventilating air. **NOTE: To prevent combustion air contamination, see following section.**
Combustion air from the indoor space can be used if the space has adequate area or when air is provided through a duct or louver to supply sufficient combustion air based on the appliance input. Never obstruct the supply of combustion air to the appliance. If the appliance is installed in areas where indoor air is contaminated (see Table 10) it is imperative that the appliance be installed as direct vent so that all combustion air is taken directly from the outdoors into the appliance intake connection.
Unconfined space is space with volume greater than 50 cubic feet per 1,000 BTU/hr (4.8 cubic meters per kW) of the total input rating of all fuel-burning appliances installed in that space. Rooms connected directly to this space through openings not furnished with doors are considered part of the space. See Venting Section for details.

Confined space is space with volume less than 50 cubic feet per 1,000 BTU/hr (4.8 cubic meters per kW) of the total input rating of all fuel-burning appliances installed in that space. Rooms connected directly to this space through openings not furnished with doors are considered part of the space.
When drawing combustion air from inside a conventionally constructed building to a confined space, such space should be provided with two permanent openings: one located 6" (15 cm) below the space ceiling, the other 6" (15 cm) above the space floor. Each opening should have a free area of one square inch per 1,000 BTU/hr (22 cm^2/kW) of the total input of all appliances in the space, but not less than 100 square inches (645 cm^2). If the confined space is within a building of tight construction, air for combustion must be obtained from the outdoors as outlined in the Venting section of this manual.

CAUTION

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

WARNING

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

WARNING

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

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

Part 5 - Preparing the Appliance for Installation

F. Prevent Combustion Air Contamination

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

! WARNING

Ensure that the intake air will not contain any of the contaminants in Table 10. Contaminated air will damage the appliance, resulting in possible substantial property damage, severe personal injury, or death. For example, do not pipe intake air near a swimming pool or laundry facilities. These areas always contain contaminants.

Products to Avoid	Areas Likely to Have Contaminants
Antistatic fabric softeners, bleaches, detergents, cleaners	Laundry facilities
Perchloroethylene (PCE), hydrocarbon-based cleaners	Dry cleaning facilities
Chemical fertilizer, herbicides/ pesticides, dust, methane gas	Farms or areas with livestock and manure
Paint or varnish removers, cements or glues, sawdust	Wood working or furniture refinishing shops
Water chlorination chemicals (chloride, fluoride)	Swimming pools, hot tubs
Solvents, cutting oils, fiberglass, cleaning solvents	Auto body or metal working shops
Refrigerant charge with CFC or HCFC	Refrigerant repair shops
Permanent wave solutions	Beauty shops
Fixer, hydrochloric acid (muriatic acid), bromide, iodine	Photo labs, chemical / plastics processing plants
Cement powder, crack fill dust, cellulose, fiber-based insulation	Concrete plant or construction site

Table 10 - Products and Areas Likely to Have Contaminants

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

G. Removing an Appliance from a Common Vent System

NOTICE

This section does not describe a method for, nor prohibit, common venting this unit. It merely details the steps required when removing an existing appliance from a common vent system.
Contact Ariston Canada or their representative for details on common venting this appliance, or refer to the Venting section of this manual for guidelines on Category II venting.

! WARNING

When an existing appliance is removed from a common venting system, the common venting system is likely to be too large for proper venting of the appliances remaining connected to it.
At the time of removal of an existing appliance, the following steps must be followed with each appliance remaining connected to the common venting system placed in operation, while the other appliances remaining connected to the common venting system are not in operation.
Failure to follow these steps may cause flue gas spillage or appliance malfunction, resulting in possible substantial property damage, severe personal injury, or death.

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

! WARNING

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

The National Standard Plumbing Code, the National Plumbing Code of Canada, and the Uniform Plumbing Code limit heat transfer fluid pressure to less than the minimum working pressure of the potable water system up to 30 PSI maximum. In addition, the heat transfer fluid must be water or another non-toxic fluid having a toxicity of Class 1, as listed in Clinical Toxicology of Commercial Products, 5th Edition. Failure to follow this warning could result in property damage, severe personal injury, or death.

CAUTION

Galvanized steel fittings must not be used in any system loop with this appliance. Dielectric unions must not be used with this water heater. Doing so WILL VOID the warranty. Use only copper, brass, stainless steel, or black iron (CH loop ONLY) fittings.

Plumbing of this product should only be done by a qualified, licensed plumber in accordance with all local plumbing codes. The appliance may be installed as a boiler and connected to an indirect water heater to supply domestic hot water, or may be installed directly as a water heater.

A. General Plumbing Information

CAUTION

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

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

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

The water connections must be installed in accordance with all local and national plumbing codes, or any applicable standard with prevails.

- Pipe material must be suitable to meet local codes and industry standards.
- The pipe must be cleaned and without blemish before any connections are made.
- Isolation (shut-off valves) should be used to ease future servicing.
- All piping should be insulated.
- plumbing inspector on how to control this situation.

It is recommended to install a sweat shut-off valve and a union in the return and supply piping to ease future servicing.
If there is a backflow preventer or any type of a no return valve in the system, install an additional tee here suitable for an expansion tank.

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

B. Water Quality

Water Quality is important to the proper operation and lifespan of the appliance; the information on water quality provided in this document must be followed. Damage caused by failure to follow these requirements will not be covered by the warranty.
During installation and yearly maintenance, the water quality must be checked. Common water quality heat exchanger failures are easily prevented when properly addressed.

Follow these system water best practices:

- Test system fill water and understand what you are putting into the system.
- Ensure that there is adequate air elimination in the system.
- Treat all appliance feed water as though it is hard water.
- Use chemical inhibitors on every job - BOILER ONLY
- Flush old and new systems with fresh clean water before commissioning a new appliance (see System Cleaning below).
- Use magnetic dirt separators on systems containing large amounts of iron.
- Use Dirt Separators to remove debris from system water.
- Where possible, treat appliance feed water.
- Repair system leaks immediately to prevent oxygen (air) and untreated water from entering the system.

Proper equipment must be used to test the water. Digital meters are highly recommended because they can be calibrated. The use of test strips is not recommended because they degrade over time and can be influenced by many factors.

System Cleaning (Boiler installations ONLY) – Existing and new heating systems must be cleaned with a hydronic system cleaner; see list of recommended hydronic system cleaners below; equivalent products from other manufacturers may also be used. System cleaner must be drained and thoroughly flushed with clean water to remove any residual cleaner, prior to installing a new appliance. NEVER leave a system cleaner for longer than recommended by the manufacturer of the cleaner; follow the instructions provided by the system cleaner manufacturer.

- Noble Noburst Hydronic System Cleaner
- Fernox F3 Cleaner
- Rhomar Hydro-Solv 9100
- Sentinel X400

Air Elimination – A micro bubble air elimination device must be installed on every appliance installation. Automatic air-vents alone are not an acceptable substitute for a micro bubble air elimination device. Below are a few examples of acceptable devices.

- Spirovent
- Taco 4900 series
- Caleffi Discal

Automatic feed valves should not be left open indefinitely. In the event of a leak, an automatic feed valve will continue to supply fresh untreated water into the heating system. Fresh water contains both oxygen and added minerals, either of these could lead to scaling and/or corrosion of the heat exchanger.

Glycol, Snow Melt, and Oxygen Permeable Piping – When freeze protection is required, only multi metal inhibited propylene glycol, at a minimum of 20% and a maximum of 50%, is allowed for use with this appliance system. If the appliance is being used with a snow melt system that requires a concentration of glycol higher than 50%, then a plate heat exchanger is required to separate the snow melt system from the appliance water. Note: the use of glycol may reduce the usable output capacity of the appliance, thus requiring the unit to be "down-fired" by limiting the maximum operating capacity and/or the maximum water temperature. If oxygen permeable piping (non-oxygen barrier tubing) is used in the system a plate heat exchanger is required to separate it from the boiler water.

NOTICE

Ethylene glycol is prohibited for use with the appliance, only inhibited propylene glycol is allowed for use with the appliance.

Water Treatment – When filling the appliance system, the water must be tested. Table 12 outlines the parameters that should be tested for, and the corresponding ranges that are permitted. Water quality that does not fall within the stated ranges will void the warranty of the appliance. Utilize proper testing equipment, such as digital meters, to verify water quality.

NOTICE

Inhibitors should be used for all BOILER installations in both new and existing heating systems. DO NOT use inhibitors designed for hydonic systems in potable water heating applications. Follow the instructions provided by the inhibitor manufacturer when adding it to the system to ensure the correct concentration. A list of approved inhibitors is provided below:

- Rhomar Pro-tek 922
- Sentinel X100
- Fernox Protector F1

Total Water Hardness Specifications	
Contaminant	**Maximum Allowable Level**
Total Hardness	120 mg/l (7 grains/gallon)
Aluminum	0.05 to 0.2 mg/l or PPM
Chloride	100 mg/l or PPM
Copper	1 mg/l or PPM
Iron	0.3 mg/l or PPM
Manganese	0.05 mg/l or PPM
pH	6.5 - 8.5
Sulfate	205 mg/l or PPM
Total Dissolved Solids (TDS)	500 mg/l or PPM
Zinc	5 mg/l or PPM
Dissolved Carbon Dioxide (CO_2)	15 mg/l or PPM

Table 12 - Water Quality Specifications

C. Expansion Tank

Expansion Tank and Make-Up Water

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

! WARNING

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

CAUTION

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

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

Model Size	Total Water Volume (Gallons)
400	3.8
500	4.3
650	5.6
800	6.6
1000	8.1

Table 11 - Total Water Volume (To Aid in Expansion Tank Sizing)

2. The expansion tank must be located as shown in the following section of this manual, or following recognized design methods. See expansion tank manufacturer's instructions for details.
3. Connect the expansion tank to the air separator only if the air separator is on the suction side of the circulator. Always install the system fill connection at the same point as the expansion tank connection to the system.

D. Near-appliance Plumbing

These appliances are intended solely for use in pressurized closed-loop heating systems operating with a minimum pressure of 12 PSI at the outlet. Carefully follow the instructions and piping diagrams illustrated in this section.

Pressure Relief Valve – two Pressure Relief Valves are factory supplied with each unit: 50 psi for boiler applications; 150 psi for water heater applications. The appropriate valve must be field installed in the vertical position, with the outlet facing horizontally and piped towards the floor away from where it could be harmful; see Figure 7.
Note: maximum allowable operating pressure of the appliance is 160 PSI.

CAUTION

If installed in the incorrect orientation (horizontally with drain pipe out the bottom) the relief valve may not function properly resulting in property damage or personal injury.

! WARNING

Ensure the discharge of the pressure relief is piped to a location where the steam or water will not cause property damage or serious injury.

! WARNING

Do not run the appliance unattended until the following procedure is completed. Failure to follow this procedure may lead to unsafe appliance operation resulting in fire, property damage and loss of life.

Auto Air Vent – Always install an automatic air vent on top of the air separator to remove residual air from the system. Open the auto air vent's vent-cap to promote the removal of air during commissioning of the appliance and to avoid malfunctioning of the LWCO (if used). Once the air is removed from the system, close the vent-cap to prevent water from leaking to prevent unnecessary system water leaks.

Pressure & Temperature Gauge – two Pressure and Temperature Gauges are factory supplied with each unit: 80 PSI | 250°F for boiler applications; 250 PSI | 250°F for water heater applications. The gauge must be installed at the outlet prior to any circulators; see Figure 7.

Low Water Cutoff (LWCO) – this appliance is equipped with a factory-installed flow switch to prevent operation without sufficient water flow. Despite this, in some jurisdictions, it may be necessary to install a LWCO to satisfy local requirements. In such cases, a simple 'Tee' fitting may be threaded onto the Outlet pipe, allowing for the LWCO to be installed and wired in close proximity to the appliance. Follow the LWCO manufacturer's instructions to ensure proper function.

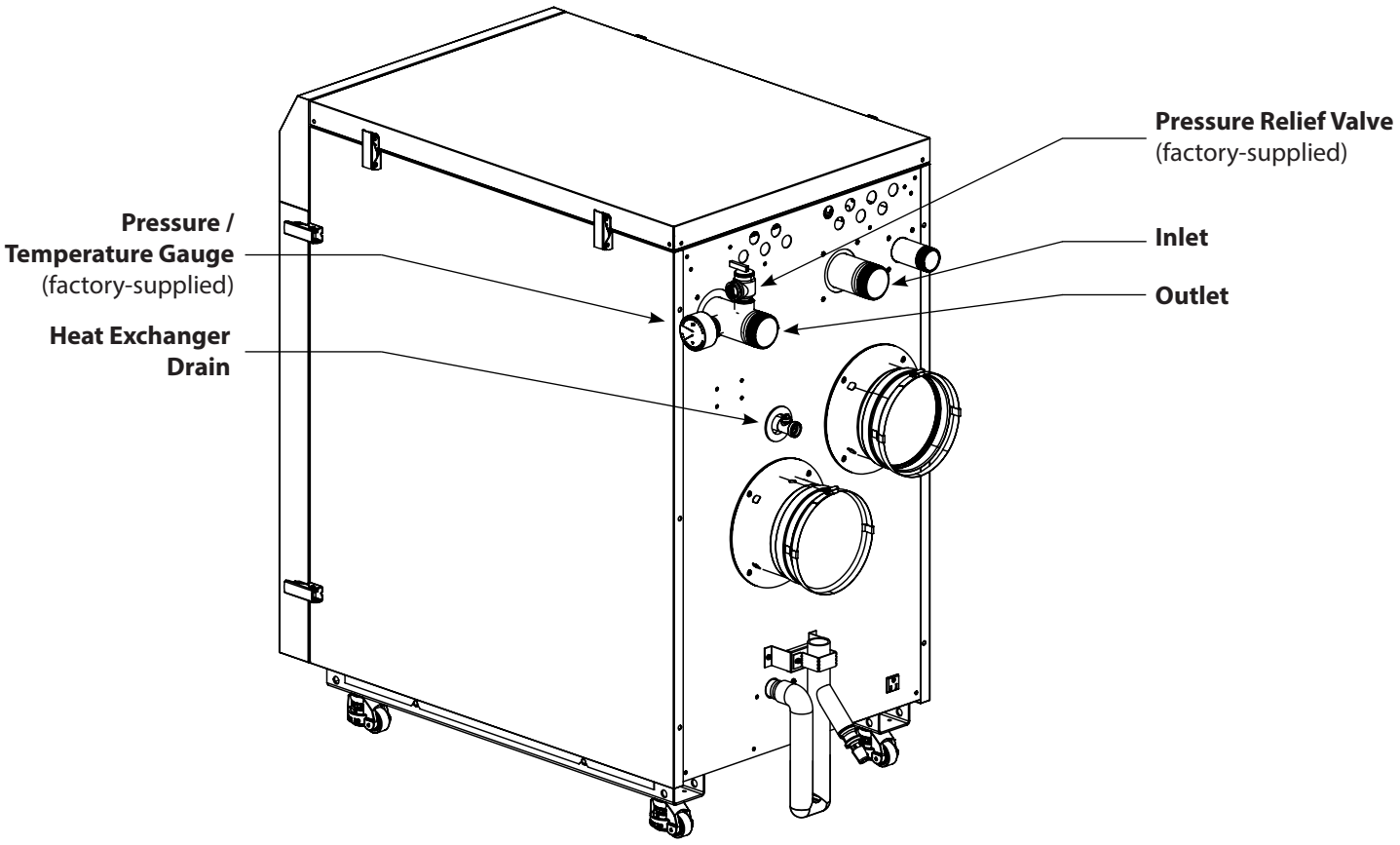


Figure 7 - Near-appliance Piping

E. Appliance Circulation Requirements

To calculate the size of the circulators required for this appliance, see the Figure and Table below.

Appliance Head Loss

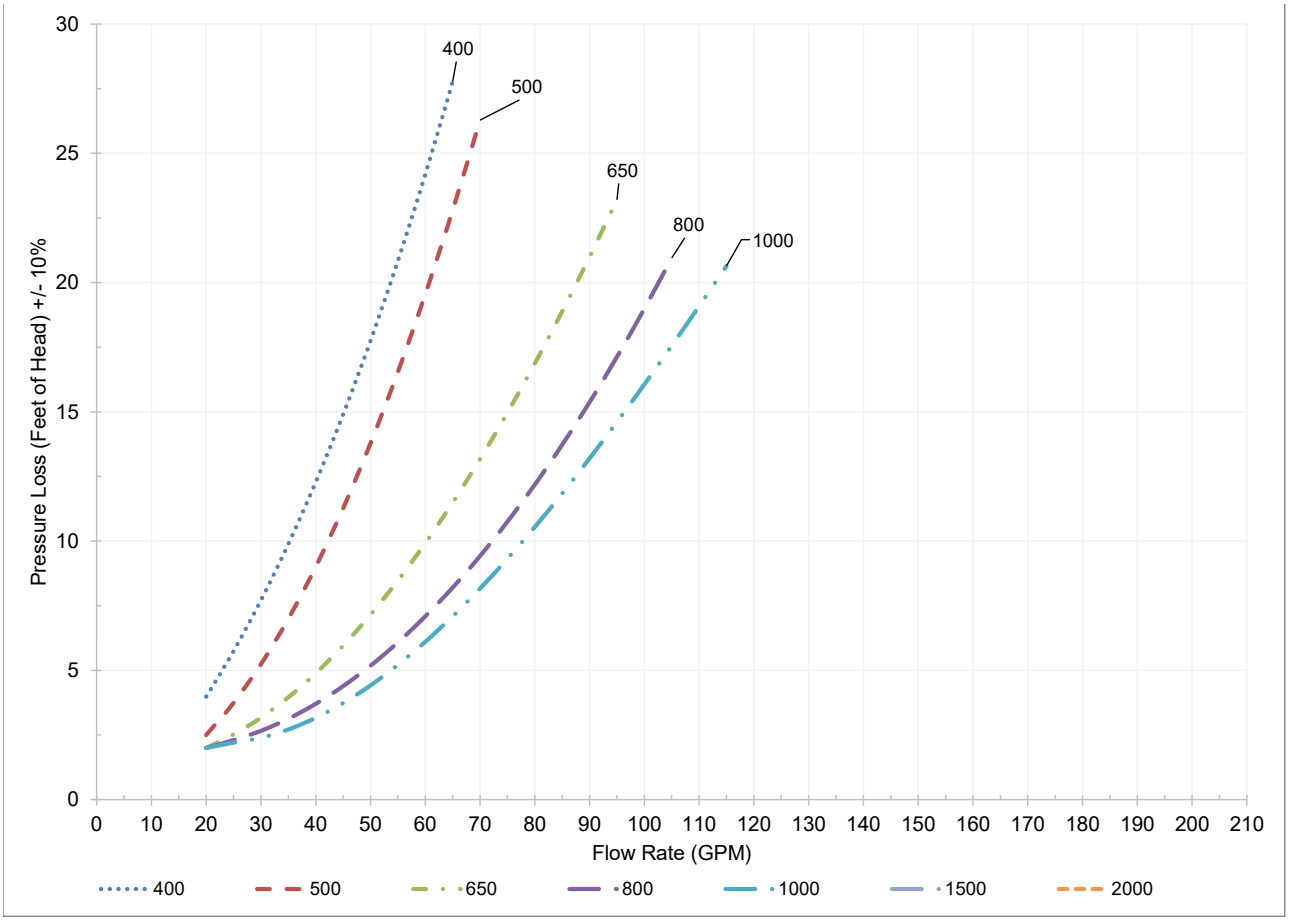


Figure 8 - Appliance Head Loss Curve

Model	20°F			30°F			40°F		
	Boiler Flow Rate (GPM)	Boiler Head Loss (ft.)	Minimum Pipe Size (in.)	Boiler Flow Rate (GPM)	Boiler Head Loss (ft.)	Minimum Pipe Size (in.)	Boiler Flow Rate (GPM)	Boiler Head Loss (ft.)	Minimum Pipe Size (in.)
400	39	12.0	2	26	7.2	2	19	4.0	2
500	48	11.4	2	32	5.4	2	24	3.2	2
650	63	11.5	2.5	42	6.2	2	31	4.0	2
800	77	12	2.5	52	6	2	39	3	2
1000	96	14.0	2.5	64	7	2.5	48	4.7	2

Table 13 - Pressure Drop at Various Flow Rates

To ensure the minimum flow rate is attained, it is strongly recommended to install the appliance in a "Primary/Secondary" plumbing configuration utilizing "Closely Spaced Tees" or a "Low Loss Header" to de-couple the Appliance-Primary loop from the System-Secondary loop(s). See the examples of Primary/Secondary Loop configurations in Figures 9 through 15.

Failure to ensure the minimum water flow rate through the appliance when the burner is operating will result in "short-cycling", reduced performance and operating efficiency, and may also cause overheating and premature failure which will void the warranty. Failure to follow instructions may result in fire, property damage, serious injury or death.

Circulator Pump Outputs – this appliance is equipped with four (4) dedicated 120VAC pump outputs:

1. BLR PUMP – operates during CH, DHW or Buffer Tank demands.
2. DHW PUMP – operates during DHW demand only.
3. AUX1 PUMP – configurable as None, System Pump, DHW Recirc (pump), Buffer Tank (pump), or Cascade Pump via parameter Auxiliary Pump 1 Selection (24.7.0). Default setting = System Pump
   - When configured as System Pump, the operation of the output is dependent on the setting of parameter System Pump Activation Logic (24.4.6); when set to CH Only, the output only turns on during CH demands. When set to Always Active, the output will also turn on during DHW demands if DHW Mode (24.5.2/24.5.3) is configured as Downstream IWH (24.5.2 = Tank Sensor or Aquastat and 24.5.3 = CH Only).
   - When configured as DHW Recirc, the output turns on when the DHW Recirc temperature drops below the DHW Recirc Setpoint (24.20.5/24.20.6).
   - When configured as Buffer Tank, the output turns on when the buffer tank temperature drops below the Buffer Setpoint (20.0.3) if Buffer Tank Function (20.0.0/20.0.7) is set to Fixed or Variable Temperature.
   - When configured as Cascade Pump, the output turns on when the unit is commanded to serve the cascade system (i.e., cascade CH/DHW). Only applicable for a cascaded boiler that is also connected to an Upstream IWH; see Figure 11-1(a)(b)(c)
4. AUX2 PUMP – configurable as None, System Pump, DHW Recirc (pump), Buffer Tank (pump), or Cascade Pump via parameter Auxiliary Pump 2 Selection (24.7.1). See AUX1 PUMP for description of how output functions. Default setting = None.

NOTE: Buffer Tank and DHW Recirc temperature inputs connect to the unit at sensor inputs *AUX1 NTC* and *AUX2 NTC*, which are configured via parameters Auxiliary Sensor 1 (24.6.1) and Auxiliary Sensor 2 (24.6.2).

NOTE: Use of these circulator outputs will depend on the system configuration selected; see Figures 9 through 15. For further pump output details and wiring instructions, see Field Wiring (Part 11).

NOTICE

Circulators responsible for forcing water flow through the unit must be sized to account for the head loss of the unit *and* piping at the required flow rate; see Table 13 and Figure 8.

Zone Outputs – this appliance is also equipped with three (3) zone outputs (*ZONE 1*, ZONE 2 & *ZONE 3*), each activating when the respective zone's room thermostat calls for heat (via inputs *T-STAT #1*, *T-STAT #2* & *T-STAT #3*). The zone outputs deliver the power that is applied to terminal *ZONE INPUT* (see Figures 9 through 15). Each output is protected with a 5 Amp fuse.

NOTE: when supplying terminal *ZONE INPUT* with 24VAC from the unit's 24V Supply, the circuit is further protected by the 2 Amp fuse located on the Low Voltage Connection Board.

Part 7 - Plumbing Schematics

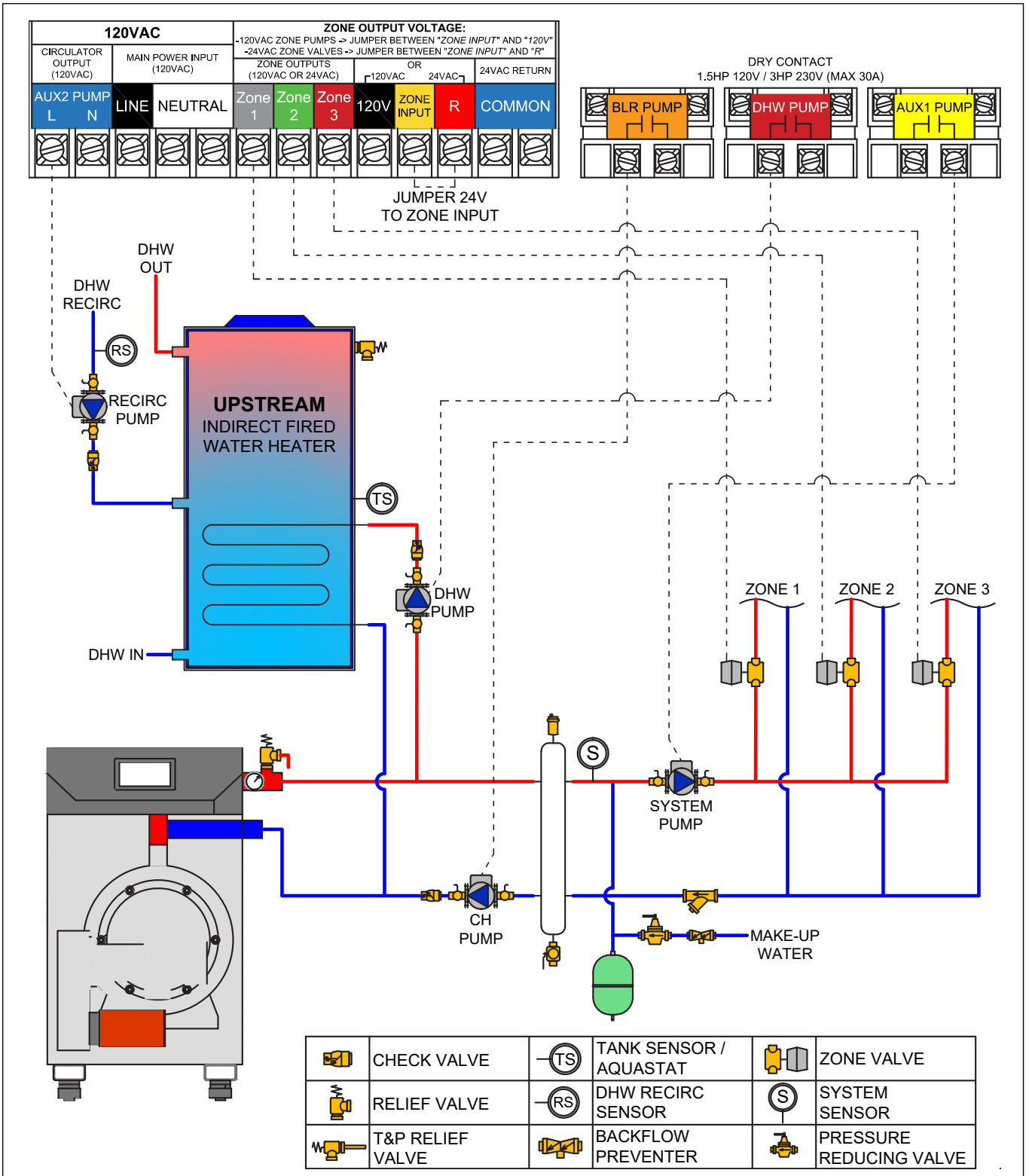


Figure 9 - Plumbing Schematic - Boiler with CH Zone Valves and Upstream IWH (and optional DHW Recirc)

NOTES:

1. For *ZONE 1-3* to output 24 VAC (as illustrated), jumper *ZONE INPUT* to *R* (24 VAC).
2. CH PUMP and DHW PUMP each provide the water circulation through the boiler, so size accordingly.
3. If using a System Sensor, set Sensor Configuration option Auxiliary Sensor 1 (24.6.1) = System Sensor.
4. If application uses a System Sensor, it will be necessary to set DHW Setup option DHW Mode = Upstream IWH (Tank Sensor or Aquastat); otherwise it can remain set as Downstream IWH (Tank Sensor or Aquastat).
5. DHW RECIRC PUMP – connect to AUX2 PUMP and set Pump Control Settings option Auxiliary Pump 2 Selection (24.7.1) = DHW Recirc.
6. DHW RECIRC SENSOR – connect to AUX2 NTC and set Sensor Configuration option Auxiliary Sensor 2 (24.6.2) = DHW Recirc.

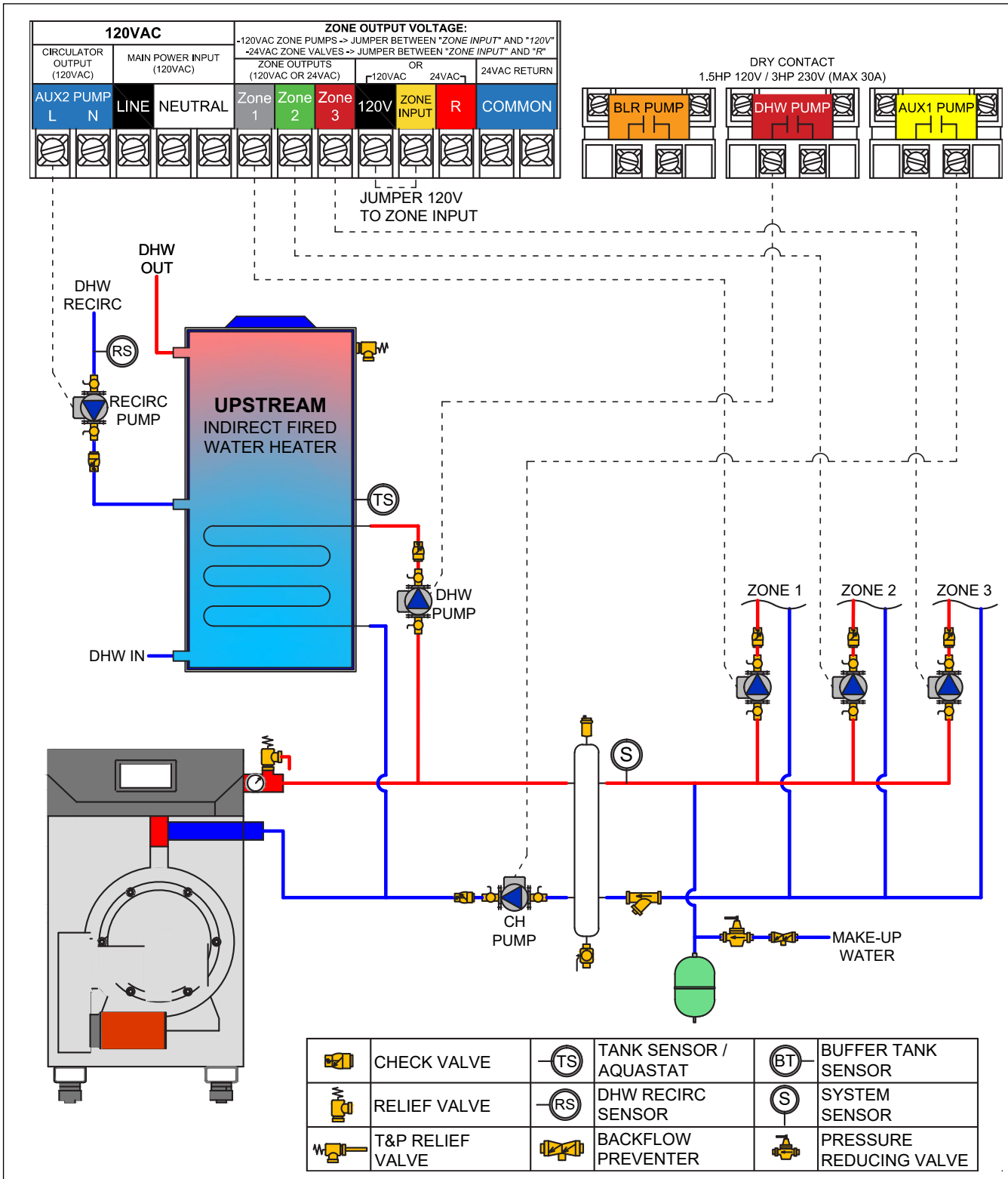


Figure 10 - Plumbing Schematic - Boiler with CH Zone Pumps and Upstream IWH (and optional DHW Recirc)

NOTES:

1. For *ZONE 1-3* to output 120 VAC (as illustrated), jumper *ZONE INPUT* to *120V* (120 VAC).
2. CH PUMP and DHW PUMP each provide the water circulation through the boiler, so size accordingly.
3. If using a System Sensor, set Sensor Configuration option Auxiliary Sensor 1 (24.6.1) = System Sensor.
4. If application uses a System Sensor, it will be necessary to set DHW Setup option DHW Mode = Upstream IWH (Tank Sensor or Aquastat); otherwise it can remain set as Downstream IWH (Tank Sensor or Aquastat).
5. DHW RECIRC PUMP – connect to AUX2 PUMP and set Pump Control Settings option Auxiliary Pump 2 Selection (24.7.1) = DHW Recirc.
6. DHW RECIRC SENSOR – connect to AUX2 NTC and set Sensor Configuration option Auxiliary Sensor 2 (24.6.2) = DHW Recirc.

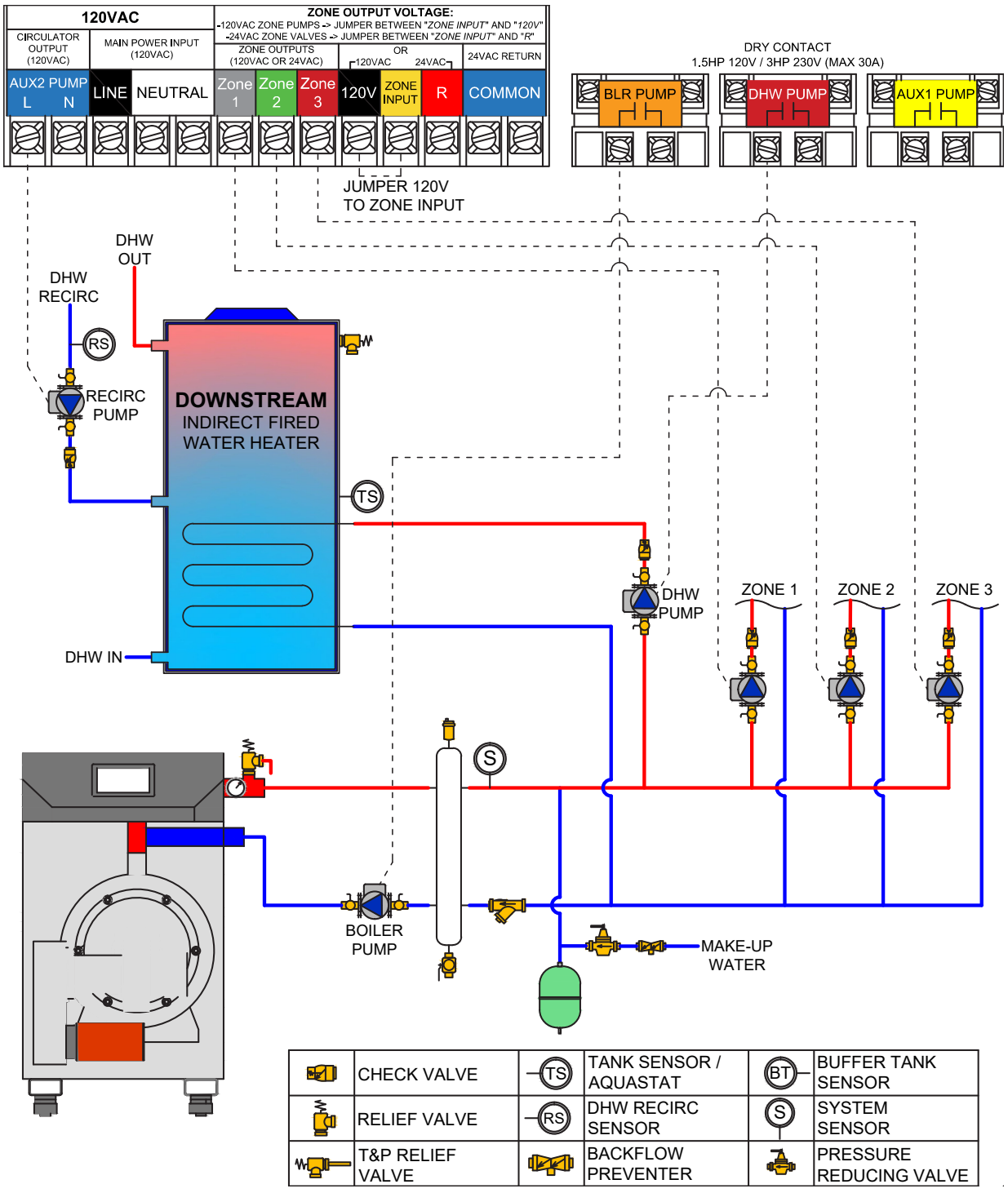


Figure 11 - Plumbing Schematic - Boiler with CH Zone Pumps and Downstream IWH (and optional DHW Recirc)

NOTES:

1. For *ZONE 1-3* to output 120 VAC (as illustrated), jumper *ZONE INPUT* to *120V* (120 VAC).
2. BOILER PUMP provides the water circulation through the boiler, so size accordingly.
3. If using a System Sensor, set Sensor Configuration option Auxiliary Sensor 1 (24.6.1) = System Sensor.
4. If application uses a System Sensor, it will be necessary to set DHW Setup option DHW Mode = Downstream IWH (Tank Sensor or Aquastat); otherwise it is acceptable to be set as Upstream IWH (Tank Sensor or Aquastat).
5. DHW RECIRC PUMP – connect to AUX2 PUMP and set Pump Control Settings option Auxiliary Pump 2 Selection (24.7.1) = DHW Recirc.
6. DHW RECIRC SENSOR – connect to AUX2 NTC (not shown) and set Sensor Configuration option Auxiliary Sensor 2 (24.6.2) = DHW Recirc.
7. To prevent Zone Pumps from post-circulating during DHW demands, set Pump Control Settings option Zone Outputs Overrun During DHW (7.2.9) = Off.

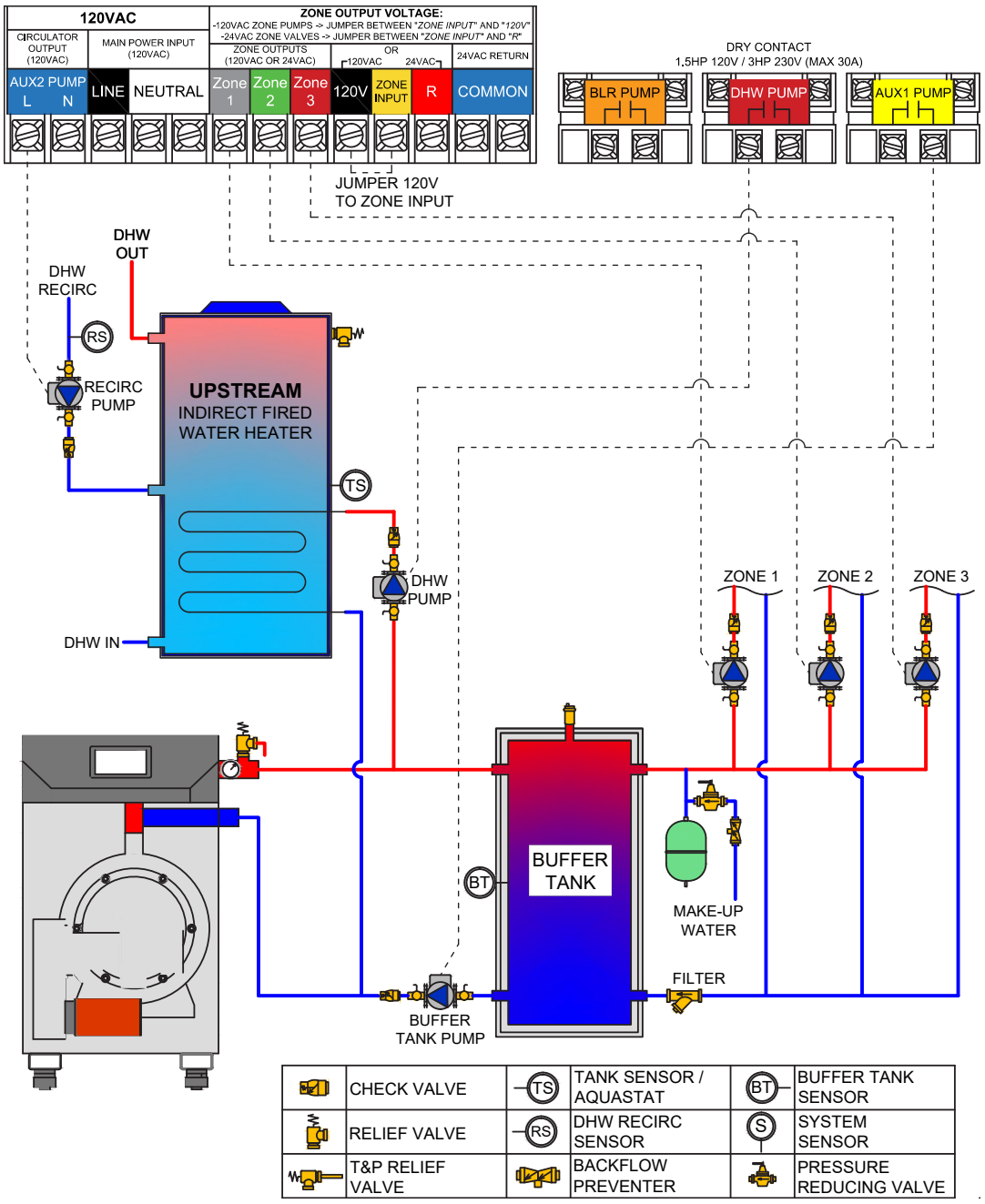


Figure 12 - Plumbing Schematic - Boiler with CH Zone Pumps, Buffer Tank, and Upstream IWH (and optional DHW Recirc)

NOTES:

1. For *ZONE 1-3* to output 120 VAC (as illustrated), jumper *ZONE INPUT* to *120V* (120 VAC).
2. The DHW and BUFFER TANK PUMPS each provide the water circulation through the boiler, so size accordingly.
3. Via the CH Setup menu, with Zone Selection = Buffer Tank, set Buffer Tank Function (20.0.0/7) = Fixed or Variable Temperature.
   NOTE: the Boiler services the Buffer Tank and Upstream IWH; CH Zones are serviced by the Buffer Tank.
4. BUFFER TANK PUMP – connect to *AUX1 PUMP* and set Pump Control Settings option Auxiliary Pump 1 Selection (24.7.0) = Buffer Tank.
5. Buffer Tank Sensor – mandatory when using Buffer Tank Function. Connect to *AUX1 NTC* and set Sensor Configuration option Auxiliary Sensor 1 (24.6.1) = Buffer Tank.
6. Upsteam IWH – set DHW Setup option DHW Mode = Upstream IWH (Tank Sensor or Aquastat).
7. DHW RECIRC PUMP – connect to AUX2 PUMP and set Pump Control Settings option Auxiliary Pump 2 Selection (24.7.1) = DHW Recirc.
8. DHW RECIRC SENSOR – connect to AUX2 NTC (not shown) and set Sensor Configuration option Auxiliary Sensor 2 (24.6.2) = DHW Recirc.
9. To prevent Zone Pumps from post-circulating during DHW demands, set Pump Control Settings option Zone Outputs Overrun During DHW (7.2.9) = Off.
10. **CAUTION**: when combining low and high temperature zones with the use of a buffer tank, it may be necessary to install a mixing device to protect the low temperature zones from overheating.

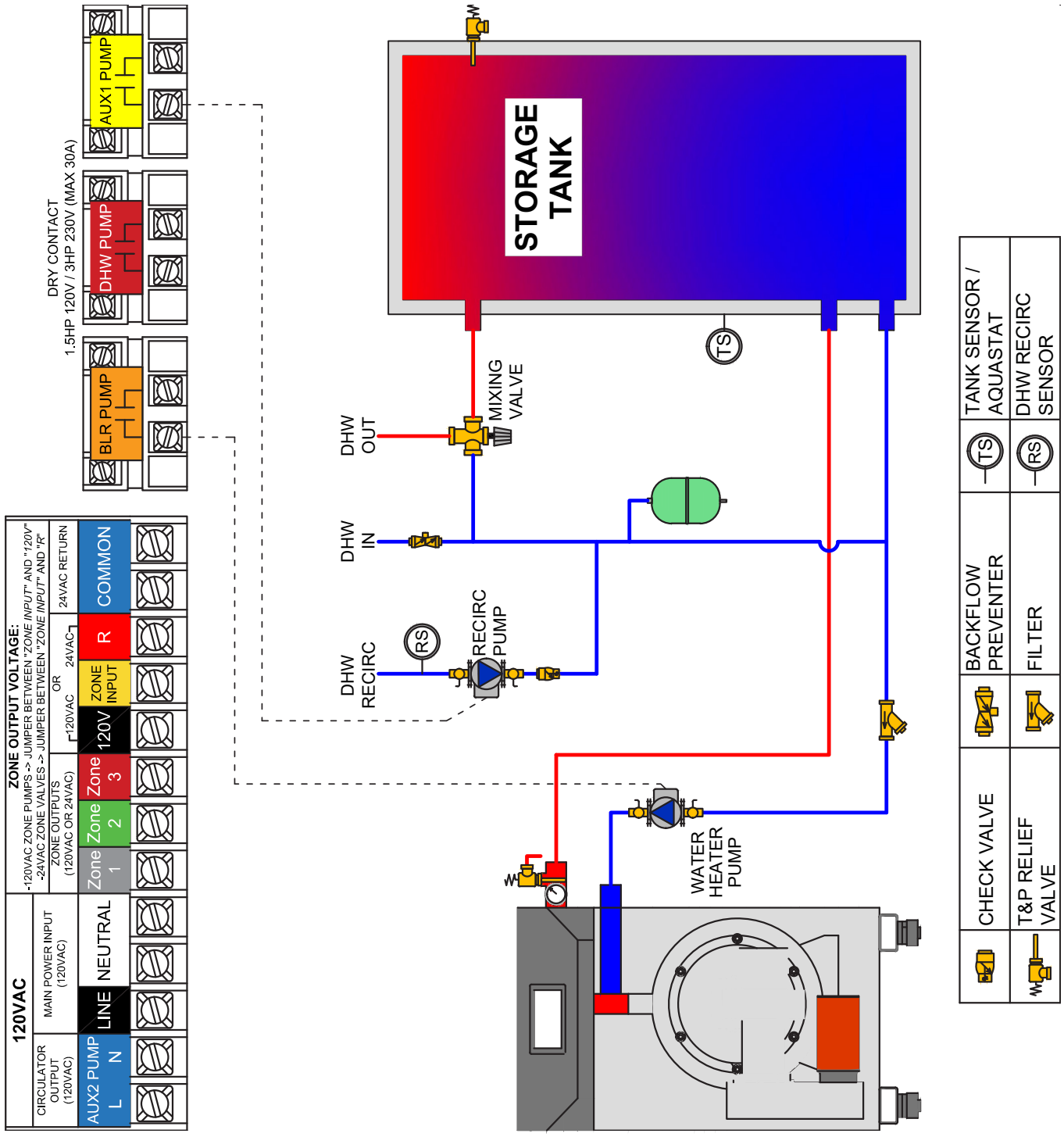


Figure 13 - Plumbing Schematic - Water Heater with Storage Tank (and optional DHW Recirc)

NOTES:

1. WATER HEATER PUMP provides the water circulation through the unit; size accordingly.
2. DHW RECIRC PUMP – connect to AUX1 PUMP and set Pump Control Settings option Auxiliary Pump 1 Selection (24.7.0) = DHW Recirc.
3. DHW RECIRC SENSOR – connect to AUX1 NTC (not shown) and set Sensor Configuration option Auxiliary Sensor 1 (24.6.1) = DHW Recirc.

Multiple Appliance Applications

The ACP controller has the internal capacity to stage/lead-lag up to eight (8) appliances connected in cascade, without the need for external controls. Each appliance in cascade is connected to the BUS circuit, which allows the "Manager" to communicate with and control the "Followers". Use the instructions detailed in this section to complete the installation and setup of the cascade, taking care to follow the instructions in the order presented.

A. General Installation Instructions

1. **Plumbing** – install as many as 8 units in parallel in a primary/ secondary plumbing configuration as illustrated in Figure 14. Size common piping as per Table 14.
2. **Boiler / Water Heater Pump** – each unit must have its own circulator which is controlled by its respective *BLR PUMP* output (or *AUX1/2 PUMP* output in cases where it is connected to an Upstream IWH); see Figure 14. The Pump must be sized appropriately; see Table 13.
3. **System Pump** (if applicable) – wire to the *AUX1 PUMP* output of the unit set as Manager; see Figure 14.
4. **DHW Pump – Downstream IWH** (if applicable) – wire to the *DHW PUMP* output of the unit that will be set as Manager; see Figure 14.
5. **DHW Pump – Upstream IWH** (if applicable) – wire to the *DHW PUMP* output of the unit that the Upstream IWH is piped to; see Figure 10 for a non- Cascade example.

   NOTE: The Manager unit cannot be configured to heat an Upstream IWH if the cascade system includes a Downstream IWH. When a Downstream IWH is present, Upstream IWHs may only be connected to the Follower units.
6. **System Sensor** (mandatory) – install a system sensor on the common outlet (supply) pipe feeding the heating system and wire it to the *AUX1 NTC* input of the unit that will be set as Manager.

   NOTE: A system sensor is needed for the cascade system to function properly. Failure to connect the system sensor and properly configure the *AUX1 NTC* input will result in "Blocking Error 115" (Common flow sensor error), and the cascade will function using an average of the outlet temperature from each unit in cascade.
7. **Outdoor Sensor** (optional) – wire the outdoor sensor to the *OD NTC* input of the unit that will be set as Manager.
8. **Downstream IWH DHW Tank Sensor or Aquastat** (if applicable) – wire to the *DHW SWITCH/NTC* input of the unit that will be set as Manager.
9. **Upstream IWH DHW Tank Sensor or Aquastat** (if applicable) – wire to the *DHW SWITCH/NTC* input of the unit that the Upstream IWH is piped to.

   NOTE: The Manager unit cannot be configured to heat an Upstream IWH if the cascade system includes a Downstream IWH. When a Downstream IWH is present, Upstream IWHs may only be connected to Follower units.
10. **DHW Recirc Sensor** (if applicable) – connect to the *AUX2 NTC* input of the unit that will be set as Manager.
11. **Buffer Tank Sensor** (if applicable) – connect to the *AUX2 NTC* input of the unit that will be set as Manager.

    NOTE: The *AUX2 NTC* input can be used to connect either a DHW Recirc sensor or a Buffer Tank sensor, not both. Cascade configurations are not compatible with applications requiring both DHW recirculation temperature control and buffer tank temperature control.
12. **CH Thermostat Inputs and Zone Outputs** – connect up-to six (6) thermostat inputs to T-STAT #1/2/3 at two (2) of the units in cascade. Connect the respective zone loads (pumps or valves) to the same unit's ZONE OUTPUTS (ZONE 1/ZONE 2/ZONE 3).

    NOTE: Each unit is equipped with a zone controller capable of operating 3 zones, but only two of the zone controllers can remain connected on the BUS when cascading (for a total of 6 zones), the others need to be disconnected; see Figure 11-2.

    NOTE: Zones 1, 2 and 3 at the unit whose zone controller have the dipswitches set to off, become zones 4, 5 and 6 respectfully; see Figure 11-2. The examples in Figure 11-1 assume that the Follower's zone control dipswitches are set to off, while the Manager's DIP switches remained in the factory on position.

Model	Number of units in Cascade						
	2	3	4	5	6	7	8
400	2.5 in.	3 in.	4 in.	4 in.	5 in.	5 in.	5 in.
500	3 in.	4 in.	4 in.	5 in.	5 in.	5 in.	6 in.
650	3 in.	4 in.	5 in.	5 in.	6 in.	6 in.	6 in.
800	4 in.	5 in.	5 in.	6 in.	6 in.	8 in.	8 in.
1000	4 in.	5 in.	6 in.	6 in.	8 in.	8 in.	8 in.

Table 14 - Minimum Pipe Sizes for Multiple Appliance Applications

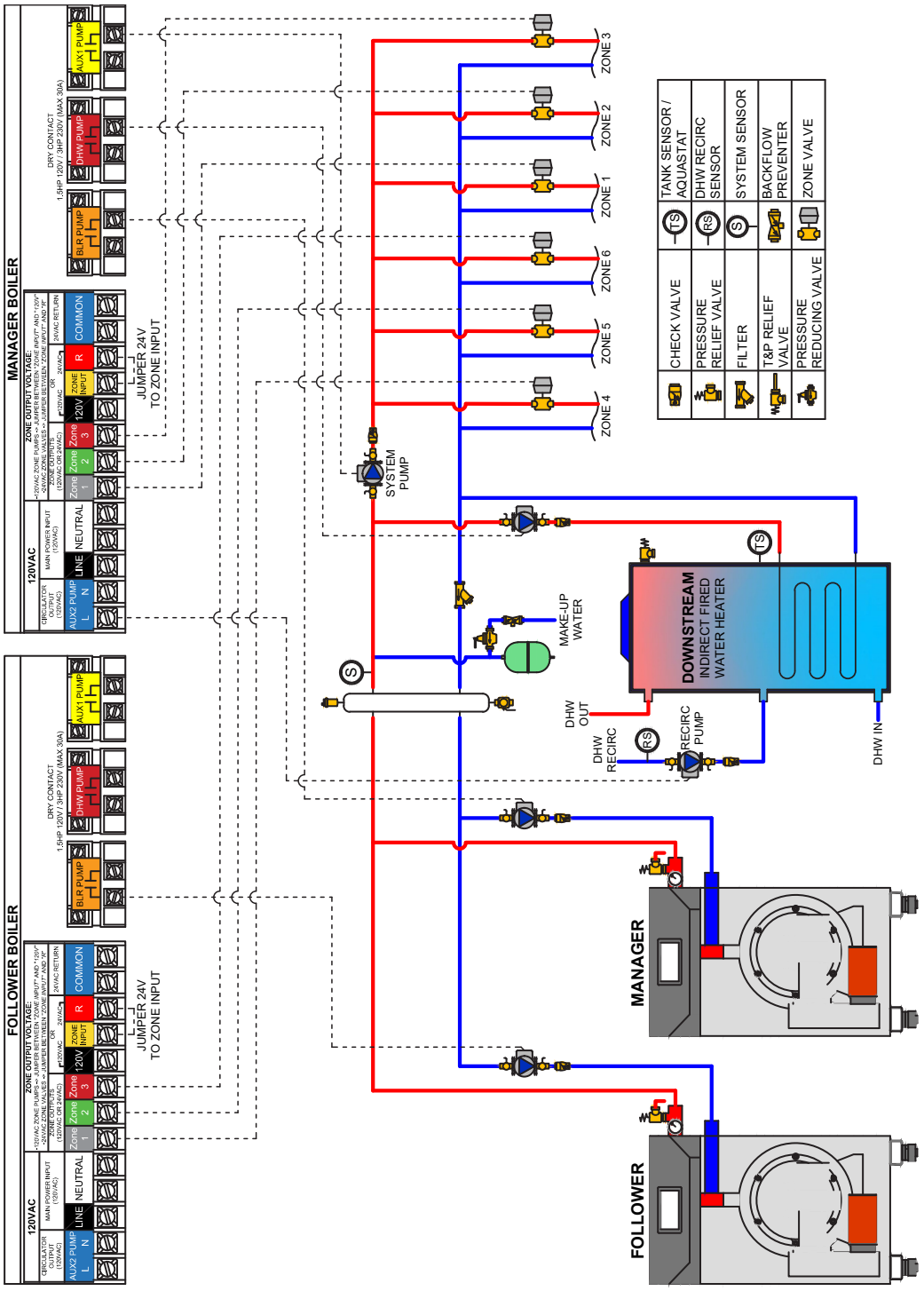


Figure 14 - Plumbing Schematic - Boilers in Cascade with CH Zone Valves and Downstream IWH

NOTES:

1. For *ZONE 1-3* to output 24 VAC (as illustrated), jumper *ZONE INPUT* to *R* (24 VAC).
2. BOILER PUMPS each provide the water circulation through the each boiler, so size accordingly.
3. System Sensor – mandatory in cascade configurations; must be installed downstream of the LL-header.
   Connect to *AUX1 NTC* (Manager) and set Sensor Configuration option Auxiliary Sensor 1 (24.6.1) = System Sensor.
4. Downstream IWH – connect the Tank Sensor (or Aquastat) and DHW Pump to the Manager and set Cascade Setup option DHW Mode (Cascade) = Downstream IWH (Tank Sensor or Aquastat).
5. DHW RECIRC PUMP – connect to *AUX2 PUMP* (Manager) and set Pump Control Settings option Auxiliary Pump 2 Selection (24.7.1) = DHW Recirc.
6. DHW RECIRC SENSOR – connect to *AUX2 NTC* (not shown) and set Sensor Configuration option Auxiliary Sensor 2 (24.6.2) = DHW Recirc.

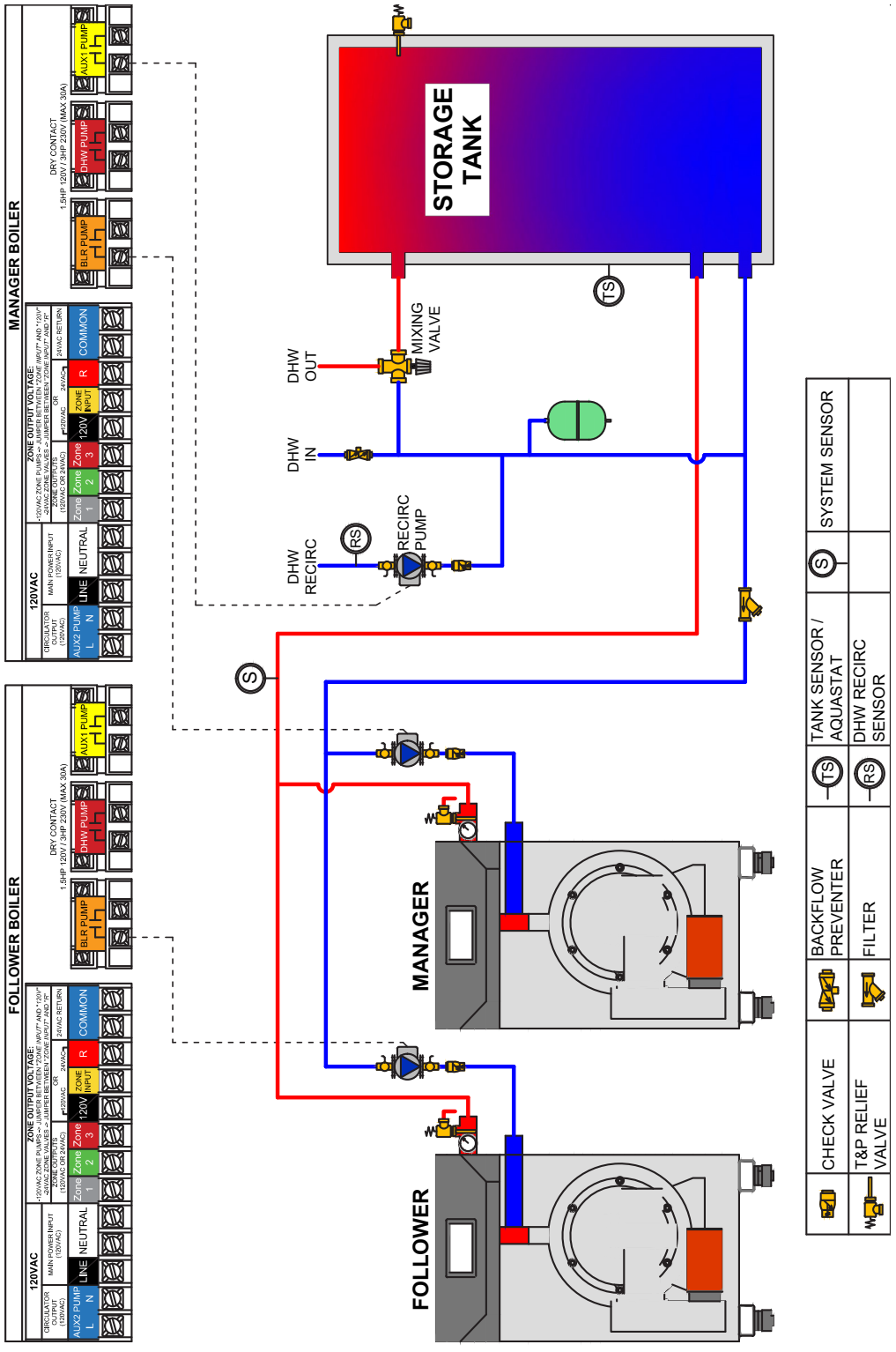


Figure 15 - Plumbing Schematic - Water Heaters in Cascade with Storage Tank (and optional DHW Recirc)

NOTES:

1. System Sensor – mandatory in cascade configurations. Connect to AUX1 NTC (Manager) and set Sensor Configuration option Auxiliary Sensor 1 (24.6.1) = System Sensor.
2. WATER HEATER PUMPS provides the water circulation through the unit; size accordingly.
3. DHW RECIRC PUMP – connect to *AUX2 PUMP* (Manager) and set Pump Control Settings option Auxiliary Pump 2 Selection (24.7.1) = DHW Recirc.
4. DHW RECIRC SENSOR – connect to *AUX2 NTC* (not shown) and set Sensor Configuration option Auxiliary Sensor 2 (24.6.2) = DHW Recirc.

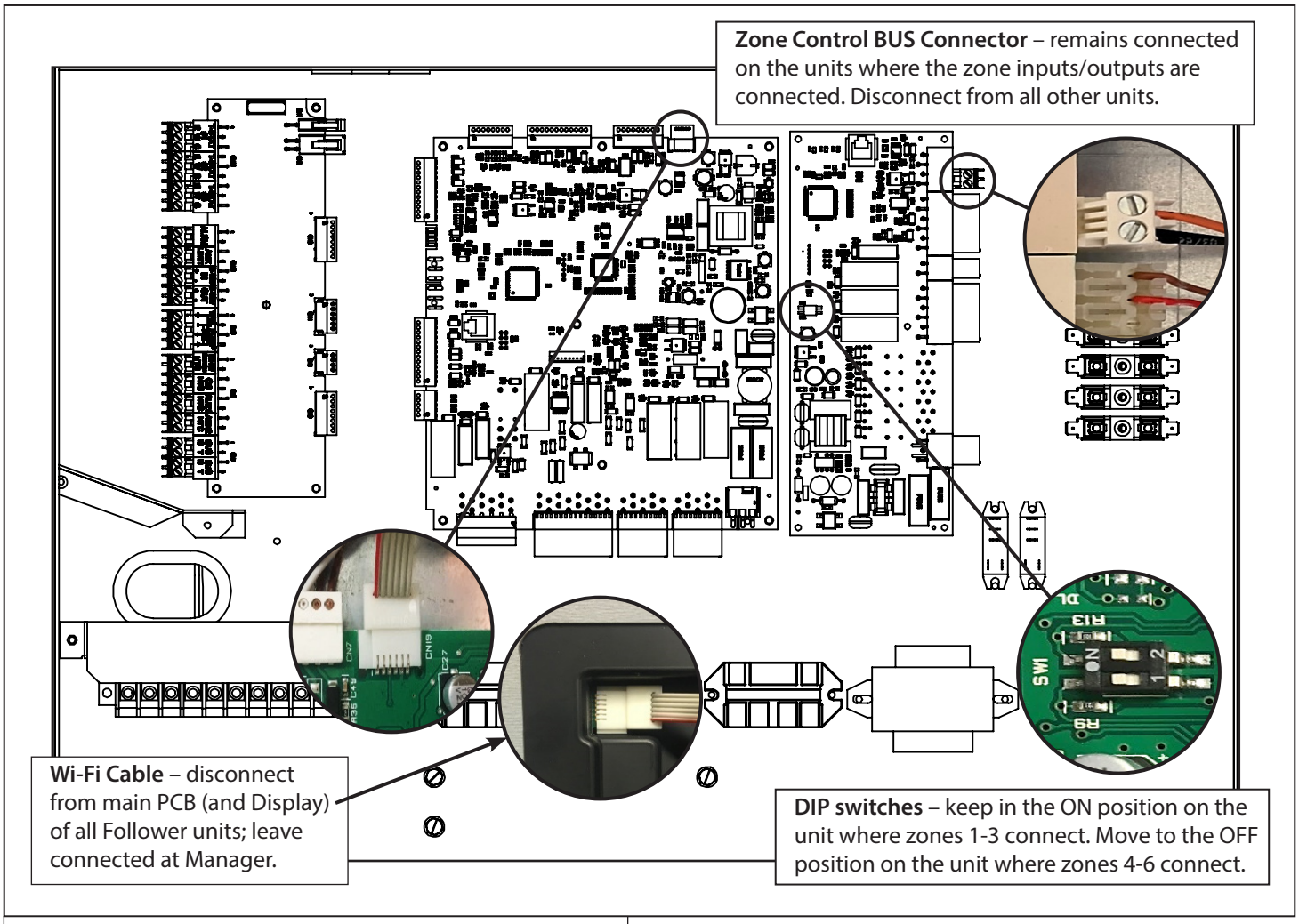
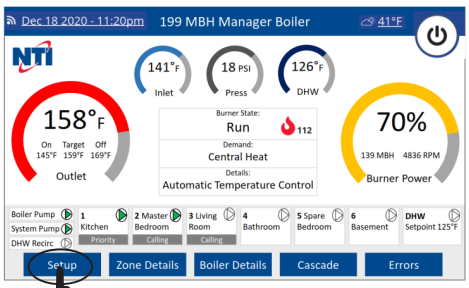


Figure 16 - Wi-Fi Cable and Zone Controller Prep

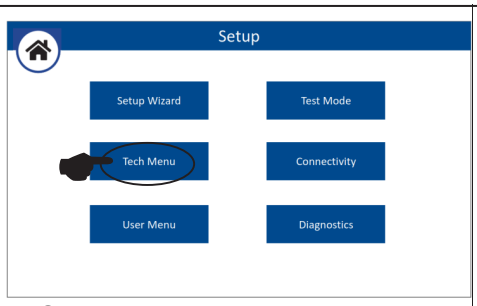
B. Setup Procedure

After completing the General Installation above, and before turning the power on or connecting the BUS terminals to each unit, proceed with the following Setup Procedure in the order listed:

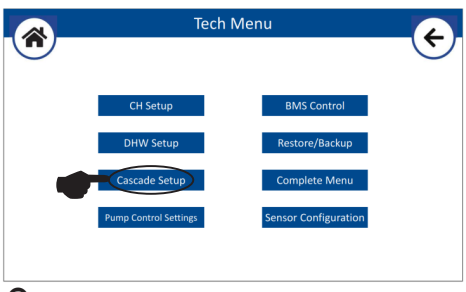
1. **Disconnect Wi-Fi Cable from Follower units** – Permanently disconnect and remove the Wi-Fi Cable from each Follower; only the Manager unit can be connected to Wi-Fi – see Figure 16. Connecting more than one Wi-Fi module (integrated inside the display) will result in a BUS network communication error.
2. **Configure Zone Controllers** – the zone controller of the unit where zones 1-3 connect (typically the Manager) remains in the factory configuration, i.e., BUS wire connected and DIP switches in the ON position. The BUS wire also remains connected to the zone controller of the unit where zones 4-6 connect, but the DIP switches must be moved to the OFF position. The BUS wire must be disconnected from the zone controller of all other units connected to the cascade. See Figure 16.
3. **Set Boiler Address** – turn the power on to each unit and set the *Boiler Address* from the *Cascade Setup* menu. The unit chosen for connecting the System Sensor (and, if applicable Outdoor, DHW Recirc or Buffer Tank Sensors and System Pump) must be set as Manager, while the others must be set uniquely as Follower 1, 2…7. See Figure 17.
4. **BUS Connection** – with the power turned OFF to all unit, wire the BUS connections of each unit together in parallel (i.e., daisy-chained). Make sure to maintain correct polarity of B and T terminals.
5. Turn Power On to all units
   - (if prompted) Backup the New PCB Settings to the Display Memory – if the PCB settings had previously been backed up to the display memory, the display will prompt you to back up the new settings, select "Keep PCB Boiler Address and Backup the PCB settings to the display memory", see Figure 18.
   - If an "Unconfigured" message appears on the screen, proceed as described in Figure 19.



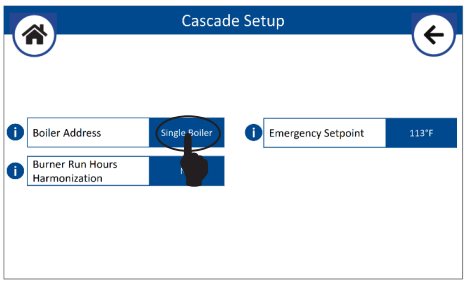
❶ Select **Setup** from the home screen



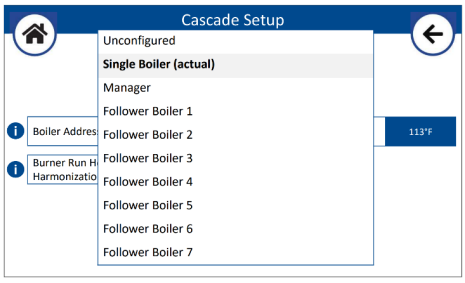
❷ Select **Tech Menu** from the Setup menu



❸ Select **Cascade Setup** from the Tech Menu



❹ Select the Boiler Address to access the configuration options.

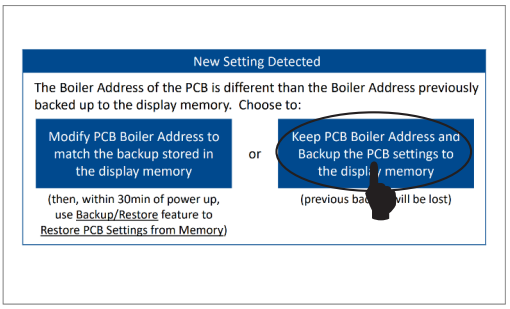


❺ Select from the dropdown menu a unique address for each boiler, i.e., Manager, Follower Boiler 1, 2…7, then select OK.

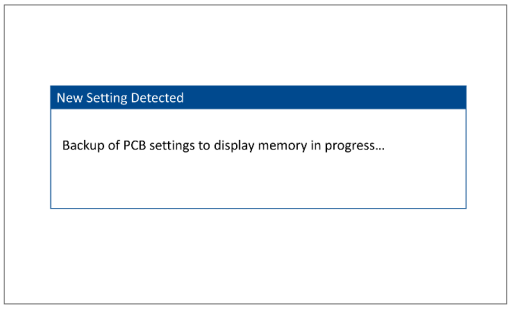


❻ When the controller starts the reboot sequence, turn the power off.

Figure 17 - Setting Appliance Address

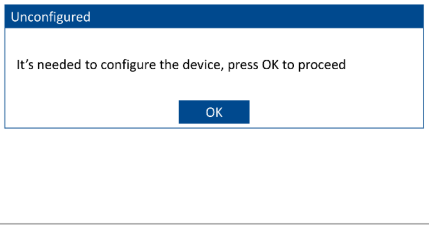


❶ Select **Keep PCB Boiler Address and Backup**….

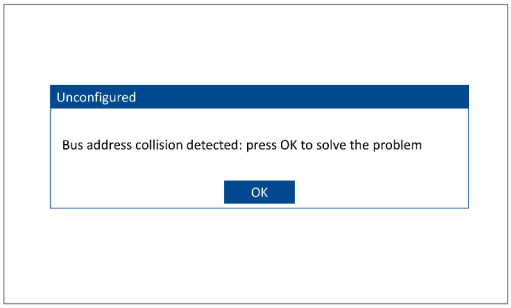


❷ Wait until backup is complete and the display reboots

Figure 18 - Backup PCB Settings (if prompted)



Signifies that a Manager is not detected on the BUS, or that the BUS polarity is reversed; check BUS wiring. If problem persists, select OK and confirm that one of the boilers is configured as Manager.



Confirm the correct configuration of each boiler's zone controller and that the Wi-Fi cable is removed from all Follower boilers (Figure 11-2), then select OK and confirm that each boiler is set to a unique Boiler Address.

Figure 19 - "Unconfigured" message

6. **Configure System Sensor Input** – from the Sensor Configuration menu of the Manager, set Auxiliary Sensor 1 = System Sensor; see Figure 20.

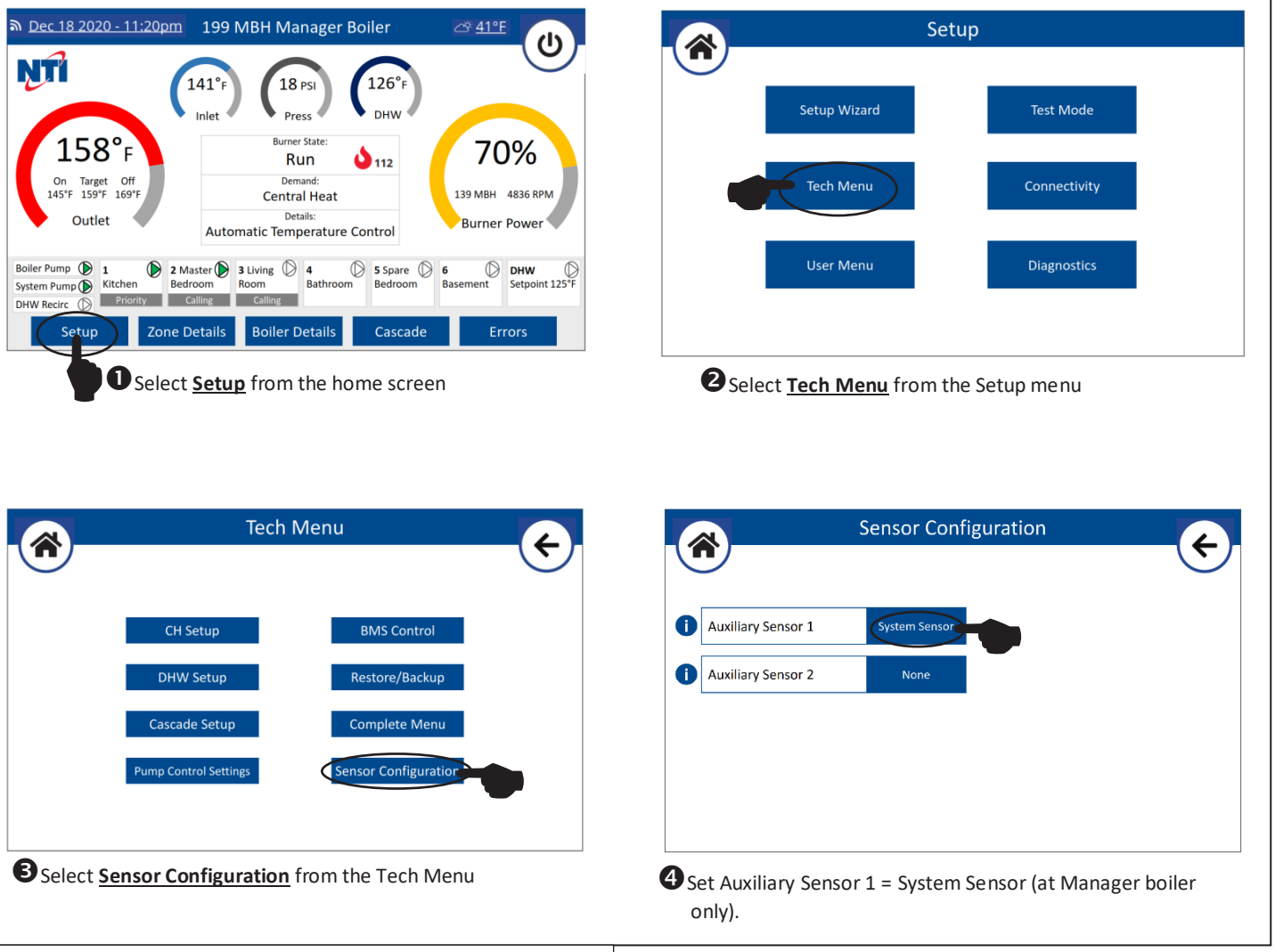


Figure 20 - Configuring System Sensor Input

7. Configure Settings
   - CH Setup and Wi-Fi Connectivity are managed by the Cascade Manager and need to be set from the display of the Manager via the typical menus; see Parts 16 – Controls and 17 – Wi-Fi Connection. Use the Setup Wizard to have the display walk you through the setup procedure.

     NOTE: DHW settings Tank Setpoint (Comfort), Tank Setpoint (Reduced) and Zone Mode are shared for Upstream and Downstream IWHs and are adjusted from the Manager via the Setup Wizard or the DHW Setup menu.
   - **Downstream IWH** – if the cascade system is heating a Downstream IWH, it is necessary to set the Manager's Cascade Setup option DHW Mode (Cascade) = Downstream IWH (Tank Sensor or Aquastat).
   - **Upstream IWH** – if connecting an Upstream IWH to an individual unit, configure the respective unit's DHW Mode accordingly. To access a Follower's DHW Mode setting, it will be necessary to access parameter x.5.3 from the Complete Menu (x = 26 for Follower 1; 27 for Follower 2; etc.)

     NOTE: For unit connected to an Upstream IWH, connect the "boiler pump" at *AUX1 PUMP* or *AUX2 PUMP* and set Pump Control Settings option Auxiliary Pump 1 Selection (x.7.0) or Auxiliary Pump 2 Selection (x.7.1) = Cascade Pump. It will be necessary to configure x.7.0 / x.7.1 from the Complete Menu (x = 24 for Manager; 26 for Follower 1; 27 for Follower 2; etc.)

     NOTE: An Upstream IWH cannot be connected to the Manager if the system includes a Downstream IWH.

   BMS Control – if using an external signal (0-10V) for modulation control of the Cascade power or setpoint temperature, set Control Mode from the BMS Control menu of the Manager accordingly.

⚠ DANGER

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

A. General

⚠ DANGER

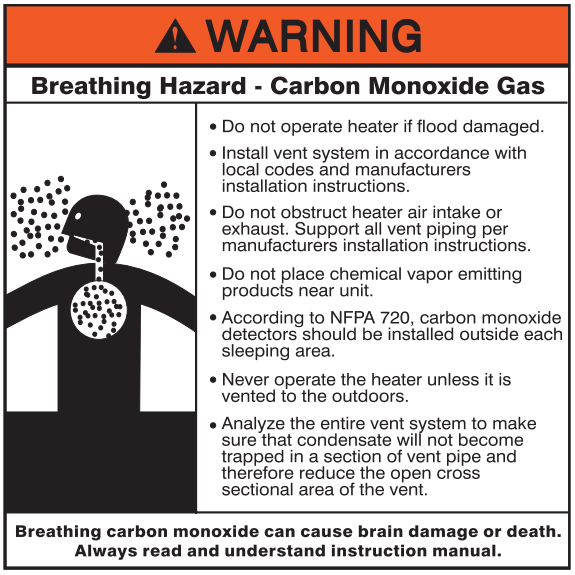
This appliance is certified as "Category IV" (positive pressure, and requiring a special venting system) or "Category II" (negative pressure). Exhaust gases must be piped directly outdoors using the vent materials and rules outlined in these instructions. Do not connect vent connectors serving appliances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

In Category IV configurations, exhaust and intake are to be piped separately, and cannot be shared between appliances. In Category II confirgurations, common venting is permitted – see detailed instructions in this Section. Failure to follow these instructions will result in substantial property damage, severe personal injury, or death.

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

NOTE: To avoid contamination often contained in indoor air, it is best to pipe all intake combustion air directly to the outdoors.

NOTE: Care must be taken to prevent condensate freezing in the exhaust vent pipe system. See local, state, provincial, and national codes for best practices to prevent condensate freezing in the exhaust vent pipe system.



⚠ WARNING

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

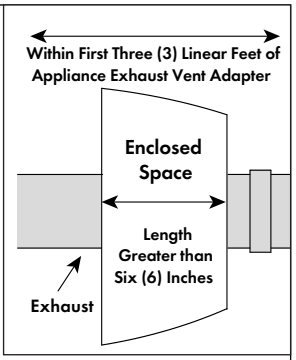
Exhaust vent connections are not designed as load-bearing devices, and must not be used to support exhaust vent piping. All vent pipes must be properly connected, supported, and the exhaust vent must be pitched a minimum of ¼" per foot back to the appliance to allow drainage of condensate. Failure to properly support vent piping and follow the information in this statement could result in product damage, severe personal injury, or death.

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

⚠ DANGER

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

⚠ WARNING



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

*This rule applies when the exhaust vent passes through the enclosed space into another interior space, i.e. through a floor or wall from the mechanical room into another room. This rule DOES NOT apply when the exhaust vent passes through the enclosed space immediately to the exterior of the building.

B. Approved Materials for Exhaust Vent and Intake Pipe

Item	Material	Standards for Installation In:	
		United States	Canada
Pipe and Fittings Approved for Intake ONLY	ABS*	ANSI/ASTM D2661	ANSI/ASTM D2661
Pipe Approved for Intake OR Exhaust Vent	PVC Schedule 40/80	UL-1738 or ANSI/ASTM D1785	UL-1738 or ULC-S636
	PVC-DWV Schedule 40/80	UL-1738 or ANSI/ASTM D2665	
	CPVC Schedule 40/80	UL-1738 or ANSI/ASTM F441	
	Polypropylene	UL-1738 or ULC-S636	
	Stainless Steel AL29-4C	Certified for Category IV and Direct Vent Appliance Venting	
Pipe Fittings	PVC Schedule 40	UL-1738, ANSI/ASTM D2466 or D2665	UL-1738 or ULC-S636
	PVC Schedule 80	UL-1738, ANSI/ASTM D2467 or D2665	
	CPVC Schedule 40	UL-1738 or ANSI/ASTM F438	
	CPVC Schedule 80	UL-1738 or ANSI/ASTM F439	
Pipe Cement	ABS*	ANSI/ASTM D2235	ANSI/ASTM D2235
	PVC	ANSI/ASTM D2564	ULC-S636 Approved Cements and Primers
	CPVC	ANSI/ASTM F493	
Pipe Primer	PVC / CPVC	ASTM F656	

Table 15 - Approved Materials for Exhaust Vent and Intake Pipe

⚠ DANGER

- The exhaust and intake components installed with this appliance must be used for near appliance piping BEFORE transitioning to the approved materials listed above. DO NOT REMOVE these installed components. Doing so WILL VOID appliance warranty.
- In the US/Canada, PVC vent pipe and fittings SHALL NOT BE USED within the closet or alcove. Only approved CPVC, Polypropylene, or Stainless Steel vent pipe and fittings may be used.
- PVC / CPVC pipe and fittings of the same diameter are considered interchangeable.
- The use of cellular core PVC (ASTM F891), cellular core CPVC, or Radel® (polyphenolsulfone) in exhaust venting systems is prohibited.
- Covering non-metallic vent pipe and fittings with thermal insulation is prohibited.
- The appliance's vent and air intake connections are designed to accept PVC/CPVC and Polypropylene directly. DO NOT insert PVC piping into the appliance's exhaust connection. When venting with PVC, insert the factory supplied length of CPVC before transitioning to PVC.
- When installing AL29-4C vent piping, install a PVC-to-stainless adapter at the appliance vent connection, and at the termination when using a PVC termination kit. DO NOT mix AL29-4C piping from different manufacturers unless using adapters specifically designed for the purpose by the manufacturer.
- DO NOT mix components from different venting systems without proper adapters. The vent system could fail, causing leakage of flue products into the living space. Use only the approved pipe and fitting materials, and primer and cement specifically designed for the material used, as listed in the above table.
- A double wall vent or insulated material may be used when using stainless steel vent material in a freezing climate.
- *ABS may be used for air intake applications ONLY.
- Contact the venting material manufacturer if there is any question about the applicability of the proposed venting material.

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

CAUTION

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

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

⚠ DANGER

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

C. Additional Requirements for Installation in Canada

1. Installations must be made with a vent pipe system certified to ULC-S636.
2. The first three (3) feet of vent pipe from the appliance flue outlet must be readily accessible for visual inspection.
3. The components of the certified vent system must not be interchanged with other vent systems or unlisted pipe / fittings.

D. Exhaust Vent and Intake Pipe Location

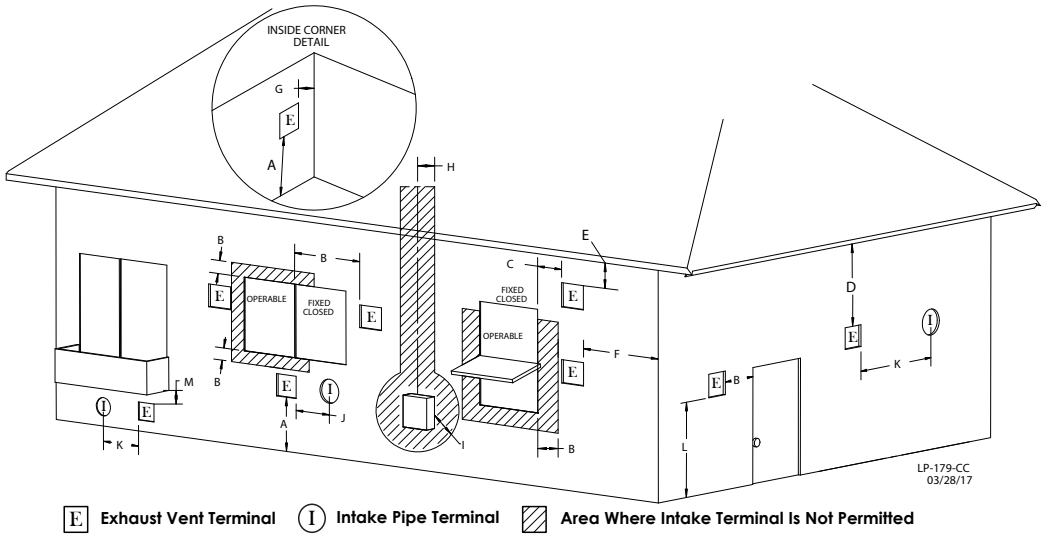


Figure 21 - Exit Terminals for Direct Vent Systems - ANSI Z223.1 / NFPA 54 for US and CAN/CSA B149.1 for Canada

	DESCRIPTION		US	CANADA
A	Clearance above grade, veranda, porch, deck, or balcony		1 foot (30 cm)	
B	Clearance to window or door that may be opened	Direct Vent	1 foot	1 ft (30 cm) for inputs up to and including 100 MBH
		Non-Direct Vent	4 ft below or to side of opening; 1 ft above opening	3 ft (91 cm) for inputs exceeding 100 MBH
C	Clearance to permanently closed window		Not Applicable	
D	Vertical clearance to ventilated soffit located above the terminal within a horizontal distance 2 feet (61 cm) from the center line of the terminal		6 feet (1.83 m)	
E	Clearance to unventilated soffit		Not Applicable	
F	Clearance to outside corner		Not Applicable	
G	Clearance to inside corner		3 feet (91 cm)	
H	Clearance to each side of center line extended above meter / regulator assembly		3 feet (91 cm) within a height of 15 feet (4.6 m)	
I	Clearance to service regulator vent outlet		refer to ANSI Z223.1 / NFPA 54	refer to CSA B149.1
J	Clearance to nonmechanical air supply inlet to building or the combustion air inlet to any other appliance	Direct Vent	1 foot	3 feet (91 cm)
		Non-Direct Vent	4 ft below or to side of opening; 1 ft above opening	
K	Clearance to mechanical air supply inlet		3 feet above if within 10 feet horizontally	6 feet (1.83 m)
L	Clearance above paved sidewalk or paved driveway located on public property	Direct Vent	*	7 feet (2.13 m)
		Non-Direct Vent	7 feet (2.13 m)	
M	Clearance under veranda, porch deck, or balcony		*	1 foot (30 cm)

Table 16 - Vent Termination Clearances - *NOTE: For clearances not specified in ANSI Z223.1 / NFPA 54 for US and CAN/CSA B149.1 for Canada, please use clearances in accordance with local installation codes and the requirements of the gas supplier.

! WARNING

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

! WARNING

Appliances that terminate through an outside wall of a building and discharge flue gases perpendicular to the adjacent wall shall be located not less than 10 ft (3.05 m) horizontally from an operable opening in an adjacent building.
This requirement shall not apply to vent terminals that are 2 ft (61 cm) or more above or 25 ft (7.62 m) or more below operable openings.

E. Exhaust Vent and Intake Pipe Sizing

This unit is certified as a Category II (negative pressure) or Category IV (positive pressure) appliance. As a result, Category II vent size may differ from Category IV vent size, even for similar units (see Table 17. Be sure to follow the instuctions in this manual based on the type of venting in your installation.

NOTE: Category II venting is typically terminated vertically. Any horizontally-terminated vent system (absent a power venter) is considered Category IV.

WARNING

Category II venting must be installed in such a way that the draft remains between -0.001" and -0.10" w.c. at all times, and at all firing rates. If pressure measurements fall outside this range, consult a professional venting engineer for recommendations to avoid a reduction in performance or hazardous conditions.

1. The total length of the intake air pipe run must not exceed **one hundred fifty (150) feet.**

NOTE: There is no minimum length for the intake air pipe run.

2. The **total length** of the exhaust vent pipe run **must not be less than six (6) feet.**
3. The **total length** of the exhaust vent pipe run **must not exceed one hundred fifty (150) feet pipe.**
4. The equivalent length of elbows, tees, and other fittings are listed in the Friction Loss Table below.

Friction Loss Equivalent in Piping and Fittings	
90 Degree Elbow*	5′
45 Degree Elbow	3′
Coupling	0′
One Foot of Straight Pipe	1′
Concentric Kit	3′

Table 18 - *Friction loss for long radius elbow is 1 foot less. NOTE: Consult Polypropylene venting instructions for friction loss and pressure drop equivalents.

Vent Sizing Example

If the exhaust vent run has two 90º elbows, 10 feet of straight pipe and a concentric kit we will calculate:

Exhaust Vent Equivalent Length = (2x5) + 10 + 3 = **23 feet** - Well below the maximum of 150 ft.

If the intake air pipe run has one 90º elbow, two 45º elbows, and 14 feet of straight pipe:

Intake Air Pipe Equivalent Length = 5 + (2x3) + 14 = **25 feet** - Well below the maximum of 150 ft.

NOTE: The intake air pipe and exhaust vent do not have to be of equal length. There is no balancing requirement between intake and exhaust.

WARNING

Failure to install the appliance within the minimum and maximum vent length requirements could result in improper product operation and property damage, serious personal injury, or death.

F. Tightening Appliance Collar to Exhaust Vent and Intake Pipe

Follow the steps to install exhaust vent pipe into the appliance vent collar.

NOTE: Clean and dry the appliance connection.

DO NOT use primer or cement on the appliance connection.

When preparing pipe for installation:

- Ensure cuts are square.
- Bevel cut edges by 1/16" - 1/8". Deburr the pipe.
- Lubricate the gasket.

1. Push the length of pipe into the connection until it touches the bottom of the fitting.
2. Tighten the clamps using a screwdriver.
3. Ensure the pipe is secure before continuing installation.

NOTE: To install intake pipe, follow the steps for installing exhaust vent pipe.

WARNING

When venting with PVC, first install the appropriate length of CPVC into the exhaust connection, then adapt to PVC using approved CPVC to PVC transition cement. Installing PVC pipe into the appliance's exhaust connection is strictly prohibited - the strain of the gear clamp combined with heat can deform PVC over time and result in flue gas leakage causing property damage, severe personal injury, or death.

Model	Air Intake			Vent			
				Category IV			Typical Category II Diameter* (in)
	Diameter (in)	Min. Equivalent Length (ft)	Max. Equivalent Length (ft)	Diameter (in)	Min. Equivalent Length (ft)	Max. Equivalent Length (ft)	
400	4	0	150	4	0	150	12
500	4	0	150	4	0	150	12
650	6	0	150	6	0	150	12
800	6	0	150	6	0	150	12
1000	6	0	150	6	0	150	12

Table 17 - Minimum - Maximum Vent Runs

***NOTE:** Category II vent pipe size may vary.
Draft must remain between -0.001" and -0.10" w.c.

G. Exhaust Vent and Intake Pipe Installation

WARNING

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

1. Use only solid PVC, CPVC, or stainless steel pipe or a Polypropylene vent system approved for use with Category IV appliances.
   ABS pipe material may be used on air inlet piping **only**.
2. Remove all burrs and debris from joints and fittings.
3. When using PVC or CPVC pipe, all joints must be properly cleaned, primed, and cemented.
   Use only cement and primer approved for use with the pipe material. Cement must conform to ASTM D2564 for PVC and ASTM F493 for CPVC pipe.
   NOTE: DO NOT CEMENT POLYPROPYLENE PIPE.
4. Ensure the vent is located where it will not be exposed to prevailing winds.
5. In all roof venting applications, exhaust discharge must point away from the pitch of the roof.
6. If the exhaust vent is to be terminated in a walled off area (such as a roof with a parapet wall), ensure the exhaust vent terminates a minimum of 10' from nearest wall and extends level with or above the top of the wall.
   This will ensure flue gas does does not get trapped and possibly recirculated into the intake air pipe, which could contaminate the combustion air.
7. To prevent water leakage, install adequate roof flashing where the pipe enters the roof.
8. If it can be avoided do not locate vent directly over public walkways, driveways, or parking lots in climates where freezing conditions are possible.
   Condensate could drip and freeze, resulting in a slip hazard or damage to vehicles or machinery.
9. Due to potential moisture build-up, sidewall venting may not be the preferred venting option. To save time and cost, carefully consider venting installation and location.
10. Horizontal lengths of exhaust vent must slope back towards the appliance not less than ¼" per foot to allow condensate to drain from the vent pipe.
11. Do not terminate vent where vapors can accumulate and harm people or pets.
12. When it can be avoided, do not terminate vent where vapors can damage shrubs or plants. Such damages are not covered by product warranty.
13. Moisture in the exhaust gas will condense as it leaves the vent terminal. In cold weather this condensate can freeze on the exterior wall, under the eaves, and on surrounding objects, including shrubs.
    Some discoloration to the exterior of the building is to be expected. However, improper location or installation can result in severe damage to the structure or exterior finish of the building, and increase the opportunity for vent blockages and nuisance shutdowns.
14. In vacant chimney applications, install and seal a rain cap over existing chimney openings.
15. All piping must be fully supported. Use pipe hangers at a minimum of 4 foot intervals to prevent sagging of the pipe where condensate may form.
16. Do not use the appliance to support any piping.
17. Ensure the outdoor exhaust vent and intake pipe terminations are screened to prevent blockage caused by debris or birds. Vent screens are included with this appliance.
18. Maximum Snow Level Determination: These installation instructions reference snow levels in establishing a minimum height for the installation of exhaust vent or air intake terminations. Snow levels shall be determined as follows:
    a. The installation location may, by ordinance, designate how snow levels are calculated in that location; or
    b. In the absence of specific ordinances, snow levels shall be calculated from the average monthly maximum depth of snow accumulation as indicated by the National Weather Service's 10 year statistics for the installation location/geographical area.

In addition:

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

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

- The vented gas fueled appliance shall not be installed so its combustion, ventilation, or dilution air is obtained from a bedroom or bathroom.
- Signage: Whenever any through-the-wall (horizontal or sidewall) vent is installed less than seven feet above the finished grade, a metal or plastic identification plate shall be permanently mounted to the exterior of the building at a minimum height of eight feet above grade directly in line with the exhaust vent terminal. The sign shall read, in print no less than 0.5 inches in size, "GAS VENT DIRECTLY BELOW. KEEP CLEAR OF ALL OBSTRUCTIONS".
- Marking of Exhaust Vent and Intake Pipe: Piping used for ventilation, make-up, or combustion air intake shall be labeled as follows:
  a. Throughout the entire developed length:
     i. Labels must be placed every ten feet for exposed/visible piping; or
     ii. Labels must be placed every three feet for concealed piping.
  b. At all changes of direction;
  c. On each side of a penetration through a partition, wall or ceiling; and
  d. The labels shall be black lettering that:
     i. Indicates that the piping is used for ventilation, make-up, or combustion air intake, and
     ii. The letters shall be sized equal to a minimum of the pipe diameter. However, for piping with a diameter exceeding two inches, said lettering does not need to be larger than two inches.

Description	Vent Size	Supplier Part Number	Figure	Vent Material Compatibility	Termination	
					Roof	Wall
IPEX Concentric (Wall/Roof)[5, 6, 7]	4"	196021 / 197021	19, 23, 30, 34	PVC/CPVC[7]	•	•
Duravent Polypro® Twin Pipe (Wall)	4"	4PPS-HTPL	20, 24	Polypro® Polypropylene	-	•
Duravent Polypro®Concentric (Wall)	4"	4PPS-HK	20, 24			
Duravent Polypro® Concentric (Roof)	4"	4PPS-VK	31, 35		•	-
InnoFlue® Concentric (Wall)[8]	4"	ICWT462, ICTC0446	20, 24	InnoFlue® Polypropylene	-	•
InnoFlue® Concentric (Roof)[8]	4"	ICRT4679, ICTC0446	31, 35		•	-
Z-DENS® Horizontal Kit Low Profile (Wall)	4"	2ZDHKLP4	Not Shown	Z-DENS® Polypropylene	-	•
Z-DENS® Concentric (Wall)	4"	2ZDHK4	Not Shown		-	•
Z-DENS® Concentric (Roof)	4"	2ZDVK4	Not Shown		•	-
Z-VENT® Termination Hood – Exhaust (Wall)	4"-5"	2SVSHTX04, 2SVSHTX05	Not Shown	Z-VENT® Stainless Steel	-	•
SS Miter Cut – Exhaust (Wall)	4"-8"	SS4MCU – SS8MCU	Not Shown	Secure Seal® Stainless Steel	-	•
Saf-T Vent® Mitered Termination – Exhaust (Wall)	4"-8"	9490, 9590, 9690, 9790, 9690	Not Shown	Saf-T Vent® Stainless Steel	-	•
ICC Miter Cut – Exhaust (Wall)	5"-8"	HM-5MC – HM-8MC	Not Shown	ICC Chimney Stainless Steel	-	•

NOTES:
1 Instructions included with termination kits contain detailed assembly and installation instructions.
2 Clearance requirements in this manual supersede those of the instructions included with the vent terminal.
3 Piping **MUST** be secured to the vent terminal during installation.
4 IPEX Concentric Terminal **MUST** be cemented together and to the vent pipes during installation.
5 Vent Screens provided with appliance may be used with the IPEX Concentric Vent Kits;
6. Vent Screens provided with appliance may be used with the IPEX Concentric Vent Kits;
7. IPEX Low Profile and Concentric kits (excluding P/N 197021) are constructed out of ULC S636 approved PVC, check with your local authority for the acceptance of PVC as a venting material prior to use.
8. Centrotherm Concentric termination kits must use the applicable "Twin pipe to concentric adapter," part number ICTC0446.
9. 4-in and 5-in Vent Termination Kits are only permitted for use with model sizes 400 and 500.

Table 19 - Optional Vent Termination Kits

Venting Applications

1. Direct Vent Installation of Exhaust and Intake

If installing a direct vent option, combustion air must be drawn from the outdoors directly into the appliance intake, and exhaust must terminate outside. There are three basic direct vent options detailed in this manual:

1. Side Wall Venting,
2. Roof Venting, and
3. Unbalanced Venting

Be sure to locate the appliance such that the exhaust vent and intake pipe can be routed through the building and properly terminated. Different vent terminals can be used to simplify and eliminate multiple penetrations in the building structure (see Optional Equipment in Venting Section). The exhaust vent and intake pipe lengths, routing and termination methods must all comply with the methods and limits given in the Venting section of this manual.
When installing a combustion air intake from outdoors, care must be taken to utilize uncontaminated combustion air.
NOTE: To prevent combustion air contamination, see Table 6.

! WARNING

All vent pipes must be glued, properly supported, and the exhaust pitched a minimum of ¼" per foot back to the appliance to allow drainage of condensate. When placing support brackets on vent piping, the first bracket must be within 1 foot of the appliance and the balance of 4 foot intervals on the vent pipe. Venting must be readily accessible for visual inspection from the first three feet from the appliance.

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

Sidewall Venting Options - Direct Vent Installation

Two Pipe Termination

WARNING

Exhaust must terminate a minimum of 18" above the air intake termination. See Figure 26 for more details.

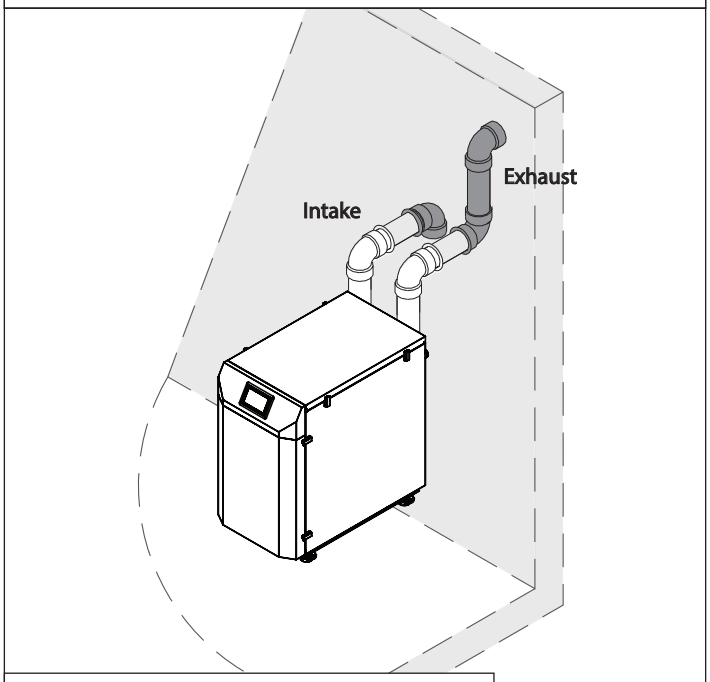


Figure 22 - Two Pipe Sidewall Venting

Low Profile Termination

WARNING

Exhaust must terminate a minimum of 18" above the air intake termination. See Figure 27 for more details.

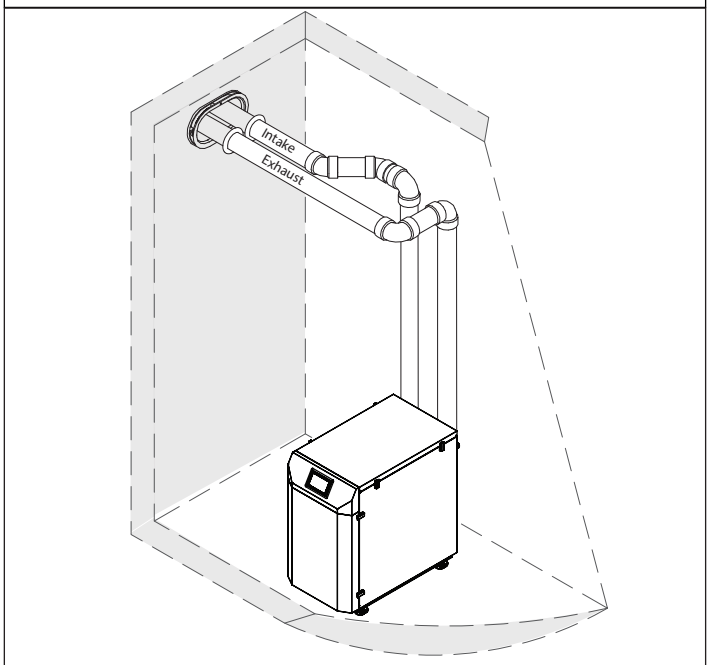


Figure 23 - Low Profile Sidewall Termination

Concentric Termination

WARNING

IPEX Concentric Termination illustrated. See Figure 28 for more details.

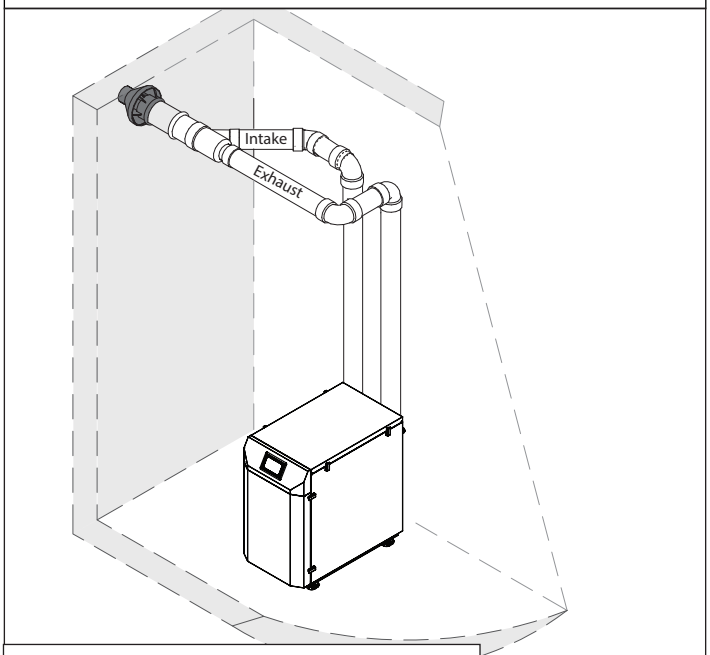


Figure 24 - Sidewall Concentric Termination (with Optional IPEX kit)

WARNING

Duravent / Innoflue Concentric Termination illustrated. See Figure 29 for more details.

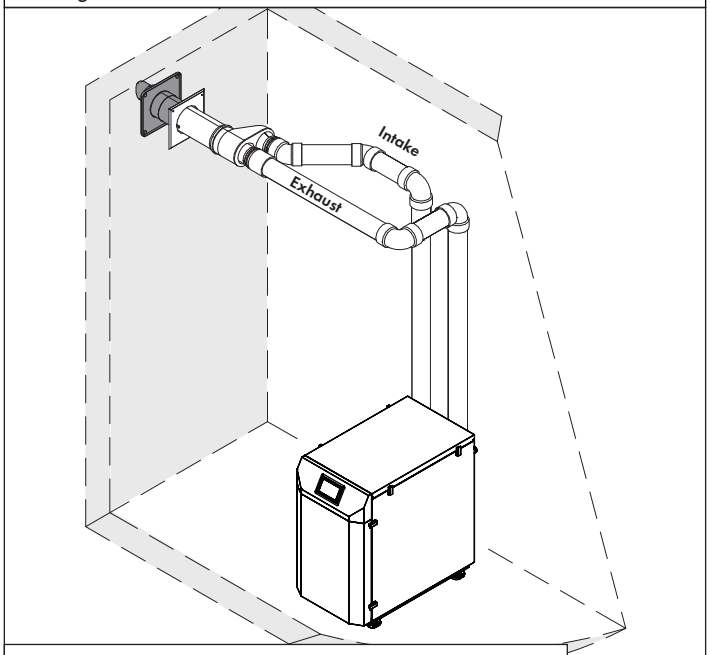


Figure 25 - Sidewall Concentric Termination (with Optional Duravent / Innoflue Kit)

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

Part 10 - Venting Applications

Sidewall Venting Options - Direct Vent Installation

Two Pipe Termination

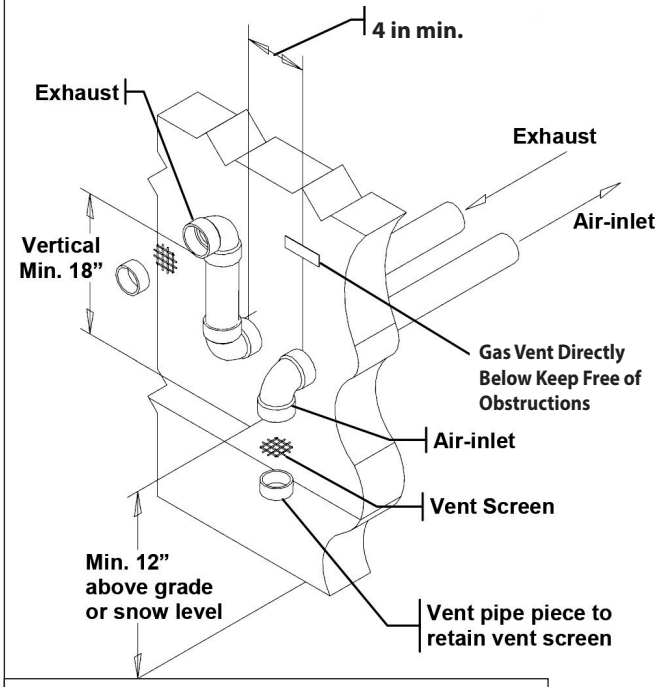


Figure 26 - Two Pipe Sidewall Venting Detail

Low Profile Termination

WARNING

Refer to documentation included with termination kit for complete installation instructions.

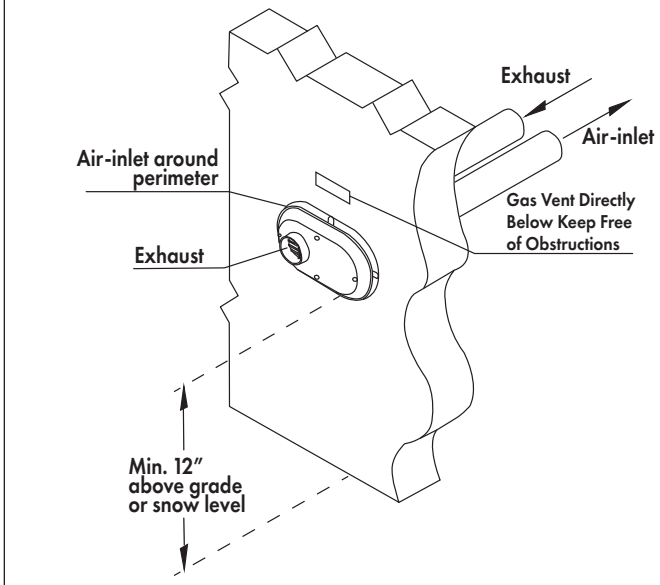


Figure 27 - Low Profile Sidewall Termination

Concentric Termination

WARNING

Refer to documentation included with termination kit for complete installation instructions.

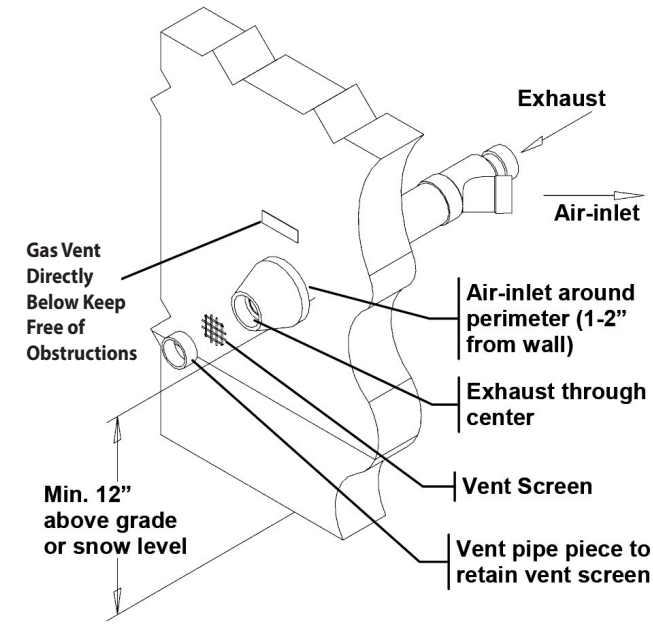


Figure 28 - Sidewall Concentric Termination (with Optional IPEX kit)

WARNING

Refer to documentation included with termination kit for complete installation instructions.

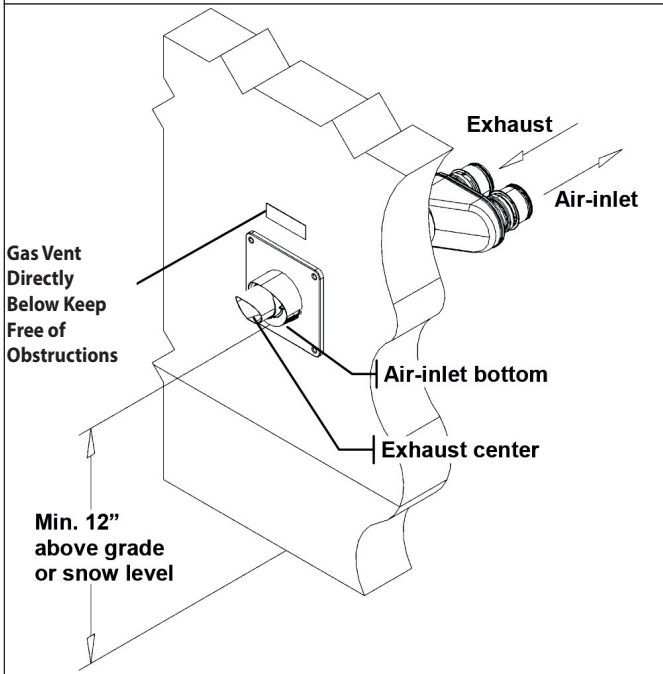


Figure 29 - Sidewall Concentric Termination (with Optional Duravent / InnoFlue Kit)

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

Snorkel Venting (Two Pipe Sidewall Venting Terminations Beneath an Overhang)

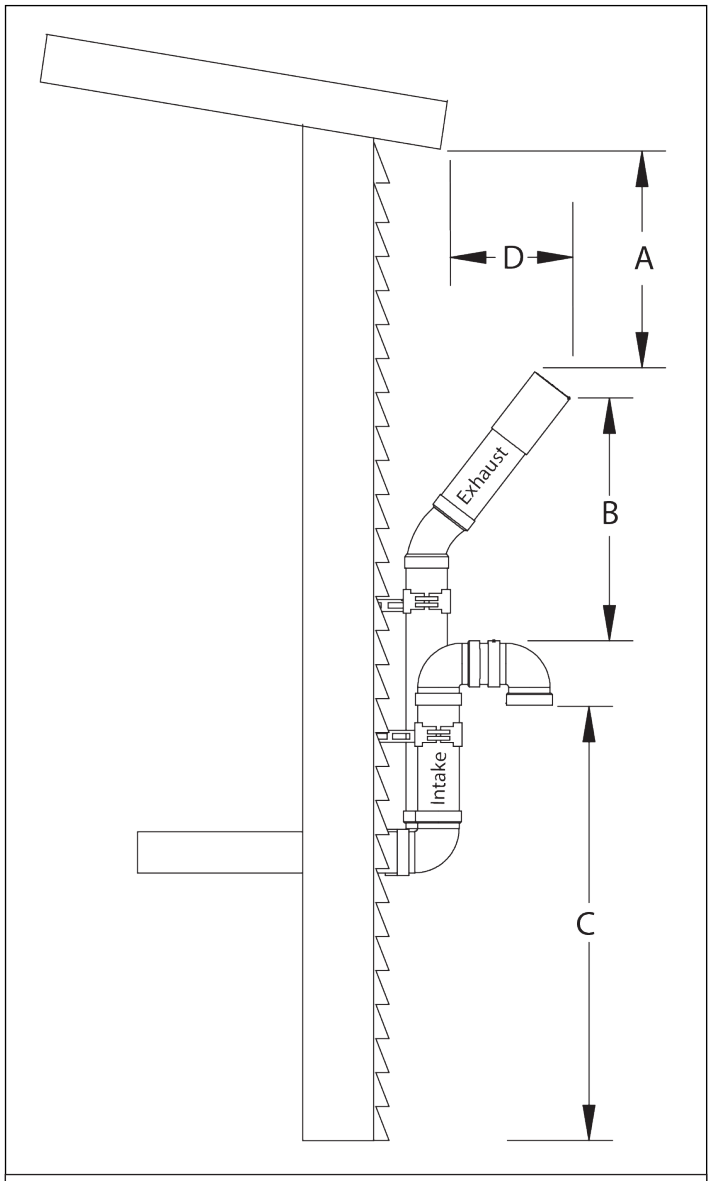


Figure 30 - Two Pipe Sidewall (Horizontal Snorkel) Venting

NOTES:

A. For every 1" of overhang, the exhaust vent must be located 1" vertical below the overhang (12" minimum). Overhang means top of building structure (roof) and not two adjacent walls (corner of building).
B. Maintain minimum separation between exhaust vent and air intake sidewall terminations, as required by local codes.
C. Maintain 12" minimum clearance above highest anticipated snow level or grade (whichever is greater).
D. The exhaust vent must extend a minimum of 12" to a maximum of 24" beyond the building.

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

Venting Below Grade

For installations that exit the wall below grade:

1. Excavate the site to a point where the pipes are to exit as shown in Figure 31.
2. Ensure the wall is fully sealed where the pipes penetrate.
3. The exhaust vent / air intake piping MUST be secured to the side of the building above grade, as shown, to provide rigidity.
4. Ensure that the exhaust vent / air intake clearances are maintained.

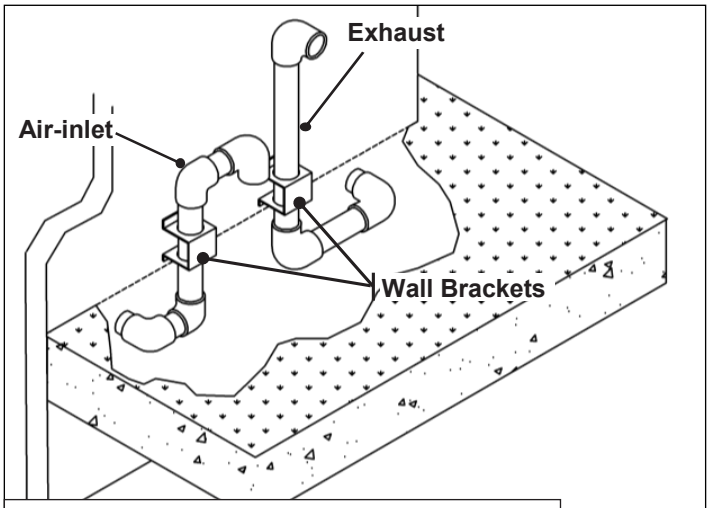


Figure 31 - Venting Below Grade

Outdoor Venting

Vent piping outside the building is permitted under the following conditions:

1. The maximum length outside the building is 20 feet (6.1 m). Note that outdoor length must be included in the overall vent length calculation.
2. All normal termination clearances are maintained.
3. The pipe is supported every 24" (610 mm).
4. The exhaust and air intake are sloped back to the appliance ½" elevation for every linear foot (13 mm for every linear 305 mm).

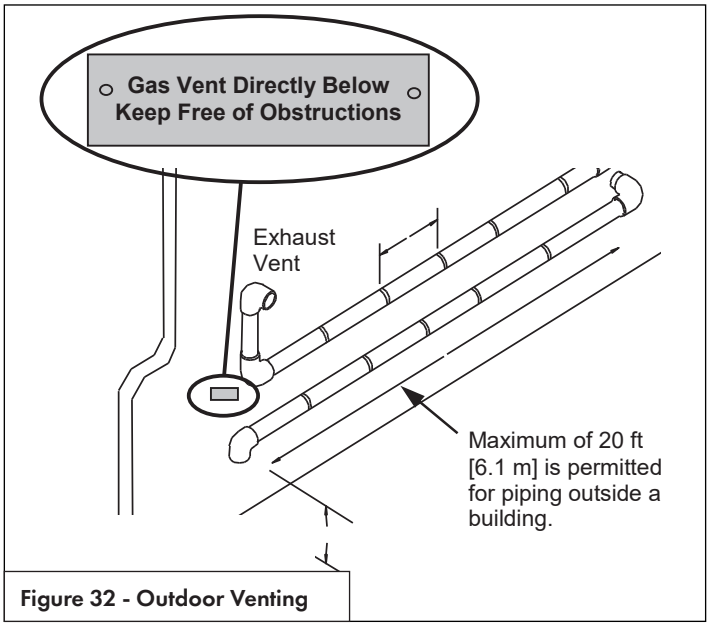


Figure 32 - Outdoor Venting

Roof Venting Options - Direct Vent Installation

Two Pipe Termination

WARNING

Exhaust must terminate a minimum of 18" above the air intake termination. See Figure 37 for more details.

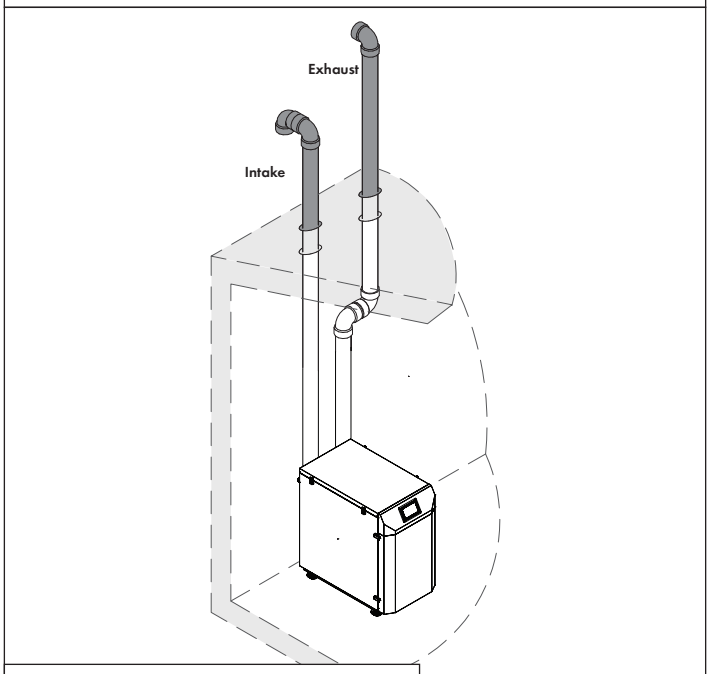


Figure 33 - Two Pipe Roof Venting

Unbalanced Termination (Roof Exhaust / Sidewall Intake)

WARNING

Exhaust must terminate a minimum of 12" above snow level. See Figure 38 for more details.

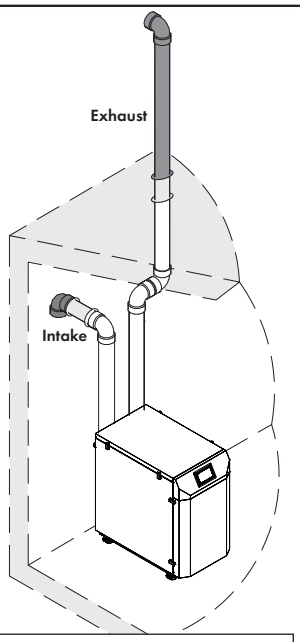


Figure 34 - Unbalanced Venting - Roof Exhaust and Sidewall Intake

Concentric Termination

WARNING

IPEX Concentric Termination illustrated. See Figure 39 for more details.

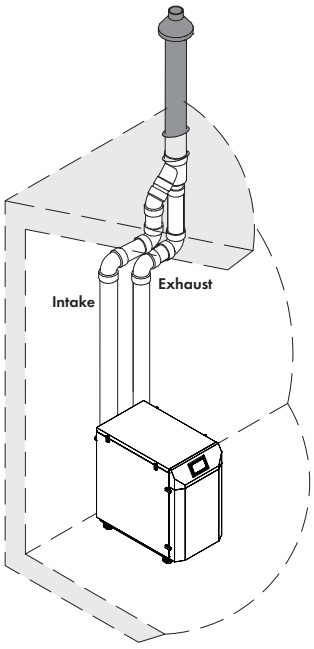


Figure 35 - Roof Concentric Termination (with Optional IPEX kit)

WARNING

Polypro / Innoflue Concentric Termination illustrated. See Figure 40 for more details.

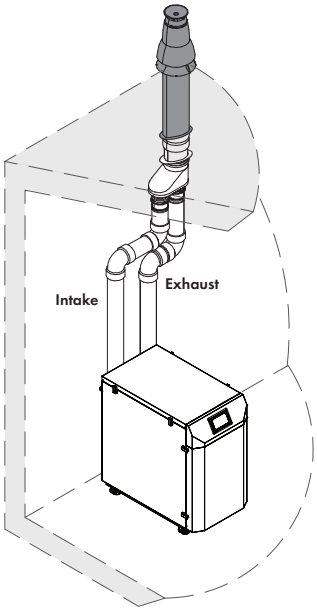


Figure 36 - Roof Concentric Termination (with Optional Duravent / InnoFlue Kit)

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

Roof Venting Options - Direct Vent Installation

Two Pipe Termination

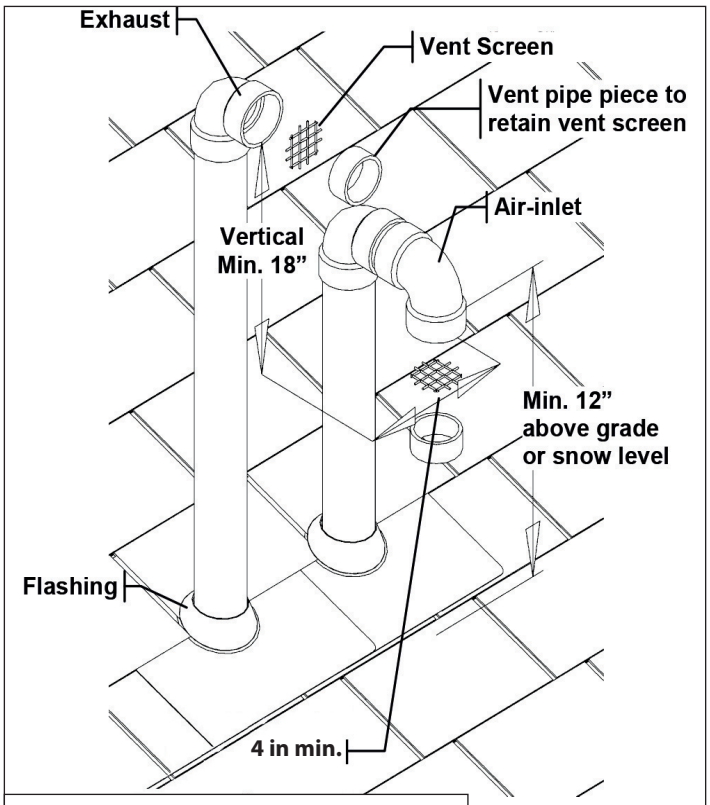


Figure 37 - Two Pipe Roof Venting Detail

Unbalanced Venting - Roof Exhaust Termination

WARNING

Figure 30 illustrates two options for exhaust termination only. Neither vent pipe illustrated is intended for combustion air intake.

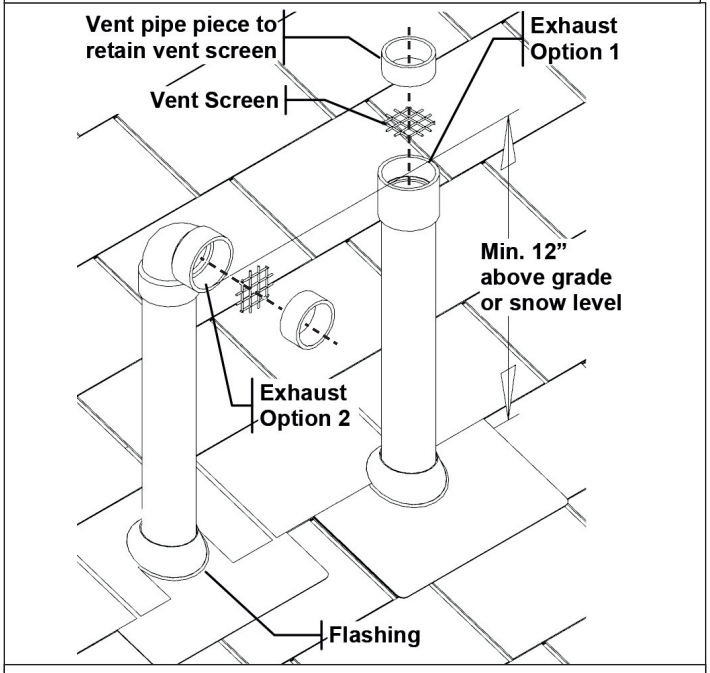


Figure 38 - Unbalanced Venting - Roof Exhaust Termination Options

Concentric Termination

WARNING

Refer to documentation included with termination kit for complete installation instructions.

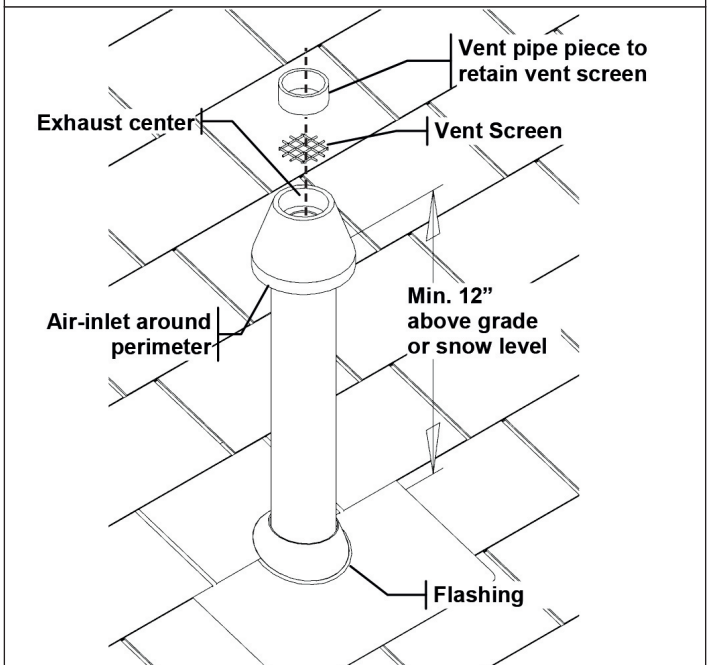


Figure 39 - Roof Concentric Termination (with Optional IPEX kit)

WARNING

Refer to documentation included with termination kit for complete installation instructions.

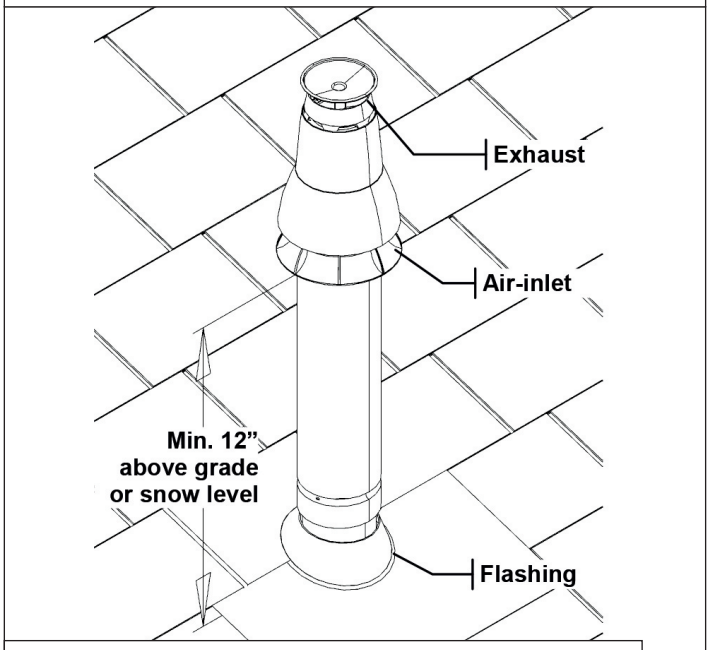


Figure 40 - Roof Concentric Termination (with Optional Duravent / InnoFlue Kit)

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

2. Non-Direct Vent, Indoor Combustion Air

This appliance requires fresh, uncontaminated air for safe operation and must be installed in a mechanical room where there is adequate combustion and ventilating air. **NOTE: To prevent combustion air contamination, see Table 6.**

When the installation uses Indoor Combustion Air, provisions for combustion and ventilation air, in accordance with section "Air for Combustion and Ventilation," of the National Fuel Gas Code, ANSI Z223.1/NFPA 54 (USA), or Clause 8.2, 8.3 or 8.4 of the Natural Gas and Propane Installation Code, CAN/CSA B149.1 (Canada), or applicable provisions of the local building codes, must be adhered to.

Combustion air from the indoor space can be used if the space has adequate area or when air is provided through a duct or louver to supply sufficient combustion air based on the appliance input. **Never obstruct the supply of combustion air to the appliance.** If the appliance is installed in areas where indoor air is contaminated (see Figure 44) it is imperative that the appliance be installed as direct vent so that all combustion air is taken directly from the outdoors into the appliance intake connection.

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

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

When drawing combustion air from inside a conventionally constructed building to a confined space, such space should be provided with two permanent openings: one located 6" (15 cm) below the space ceiling, the other 6" (15cm) above the space floor. Each opening should have a free area of one square inch per 1,000 Btu/hr (22cm2/kW) of the total input of all appliances in the space, but not less than 100 square inches (645cm2).

If the confined space is within a building of tight construction, air for combustion must be obtained from the outdoors as outlined in the Venting section of this manual. See Figure 45.

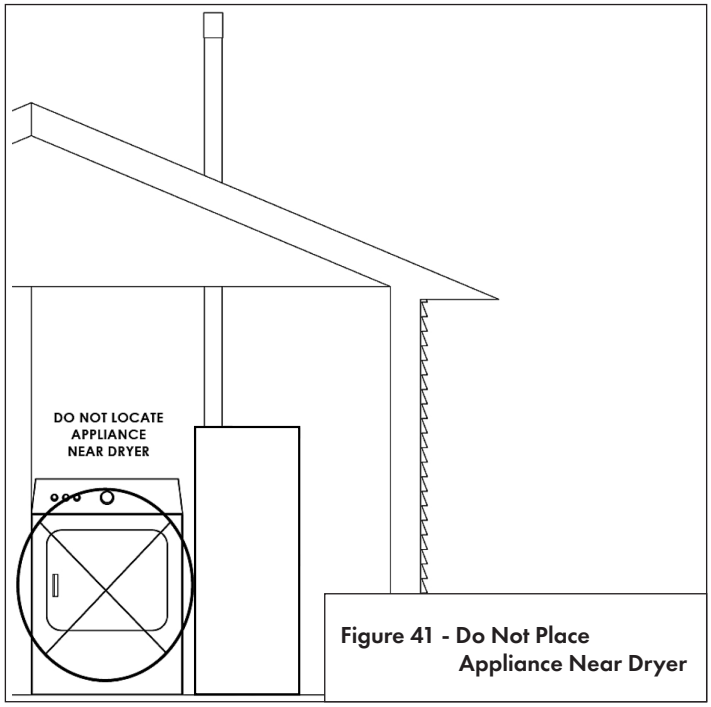
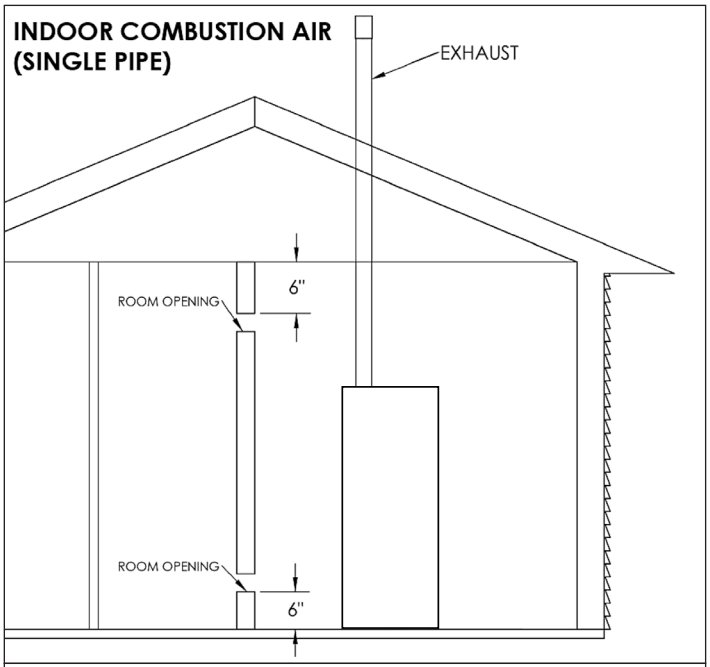


Figure 41 - Do Not Place Appliance Near Dryer



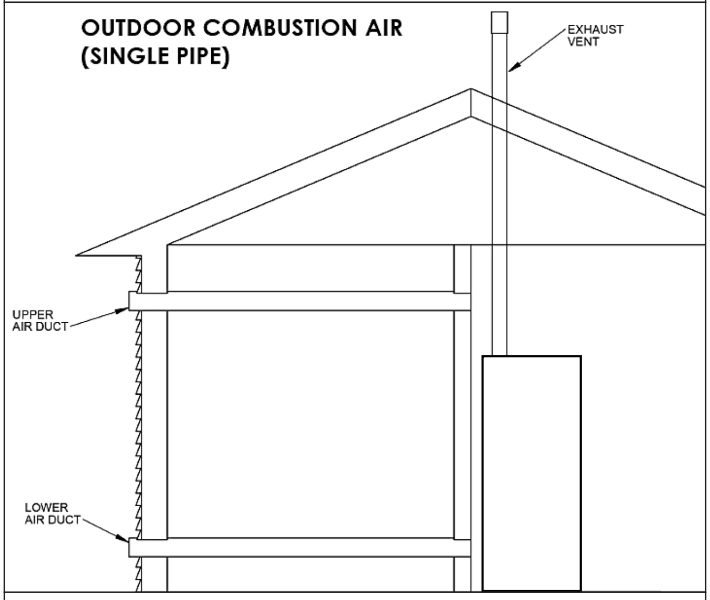


Figure 42 - Indoor and Outdoor Combustion Air - Single Pipe

⚠ WARNING

Breathing Hazard - Carbon Monoxide Gas



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

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

CAUTION

This unit produces liquid condensate in the heat exchanger and venting system as a product of combustion. Steps must be taken to ensure condensate does not collect in the venting system; therefore, all exhaust piping must slope back to the appliance a minimum 1/4" per linear foot of vent. Condensate must be drained from the unit into a household drain.

This condensing high efficiency appliance has a condensate removal system. Condensate is water vapor derived from combustion products, similar to that produced by an automobile when it is initially started. It is very important that the condensate line is sloped down away from the appliance and to a suitable drain.

The condensate line must remain unobstructed. If allowed to freeze in the line or obstructed in any other manner, condensate can exit from the appliance tee, resulting in potential water damage to property.

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

Condensate from the appliance will be slightly acidic (pH from 2 to 4.5). Check with your local gas company to determine if combustion condensate disposal is permitted in your area. Install a neutralizing filter if required by local codes.

Condensate Trap (Siphon) Installation

The appliance is supplied with a condensate trap (see Kit Box) which must be assembled and installed prior to lighting (see Figure 43 & 37):

1. **Attach Condensate Trap** – Affix the Trap to the Condensate Outlet using the provided gear clamp.
2. **Prime Condensate Trap** – Fill the Condensate Trap with water to prevent flue gases from escaping during initial firing of the burner.
3. **Secure Condensate Trap** – Affix the Condensate Bracket and Lid using the provided screws.
4. **Connect Adapter** – Insert the adapter to connect appropriate drain tubing to the Condensate Trap.

NOTES:

1. Due to its efficient design, the appliance produces condensate (water) as a normal by-product. This condensate is acidic, with a pH level between 2 and 4.5. This condensate must be drained away from the appliance and disposed in accordance with all local regulations.
2. The condensate line should be as short as possible and must be pitched at least ¼" per foot to properly drain. If this cannot be done, increase the condensate line to a minimum of 1" ID and place a tee in the line to properly reduce vacuum lock in the drain line. Tees should be placed after the condensate neutralizer (if used).
3. Use corrosion-resistant materials to drain condensate. Use the included flexible plastic hose and flexible tube, PVC, or CPVC pipe. PVC or CPVC pipe must comply with ASTM D1785, F441, or D2665. Cement must comply with ASTM D2564 for PVC pipe or F493 for CPVC pipe. For Canadian applications, use CSA or ULC certified flexible tube, PVC or CPVC pipe, fittings, and cement.
4. If using flexible tube, place an overflow tee in the tube line to prevent condensate backing up into the appliance if the tube should kink. Ensure the overflow tee is positioned near a drain or in a location that will not damage the surrounding area.
5. Do not reduce the size of the condensate line. The line must at minimum equal the diameter of the line included with the appliance.
6. A frozen condensate line could result in a blocked vent condition. It is very important to protect the condensate line from freezing temperatures or any type of blockage. In installations that may encounter sustained freezing conditions, the use of heat tape is recommended to avoid freezing of the condensate line. Longer condensate runs are more prone to freezing.
7. Support of the condensate line may be necessary to avoid blockage of the condensate flow.
8. Local building codes may require an in-line neutralizer to be installed (not included) to treat the condensate. If required by local authorities, a condensate filter of lime crystals, marble, or phosphate chips will neutralize slightly acidic condensate. Follow all the installation instructions included with the neutralizer. If a neutralizer is installed, periodic replacement of the limestone (or neutralizing agent) will be required. The rate of depletion of the limestone varies with usage of the appliance. During the first year of appliance operation, check the neutralizer every few months for depletion.

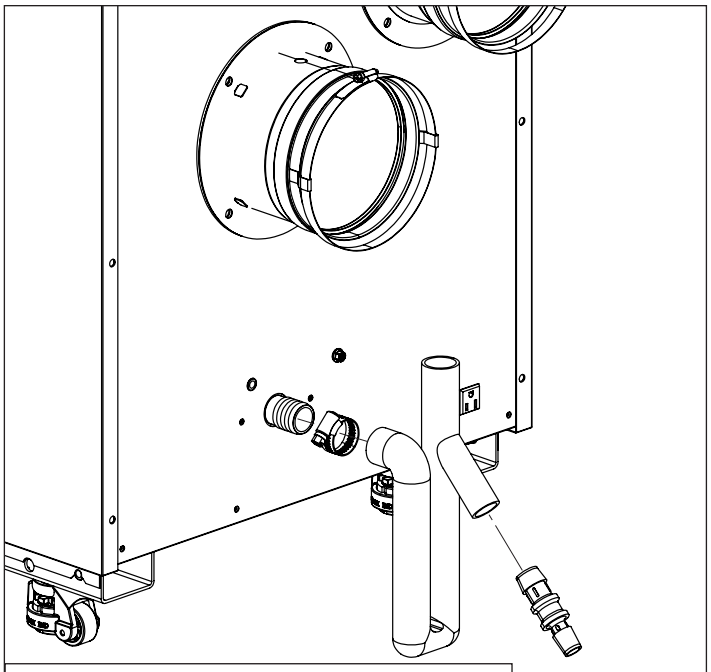


Figure 43 - Condensate Trap (exploded view)

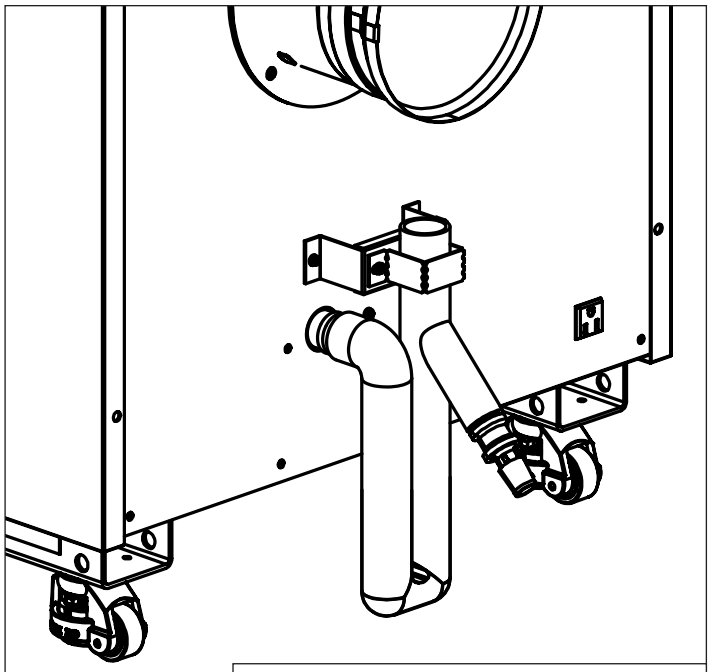


Figure 44 - Condensate Trap (assembled)

Part 11 - Condensate

9. Route the drain line to a nearby floor drain, laundry tub, or condensate pump. If the appliance condensate outlet is lower than the drain, you must use a condensate removal pump.
   NOTE: If a nearby laundry tub is used as a disposal for waste water from the washing machine, draining the condensate into this tub allows the soapy water discharge to neutralize the acidic condensate.
10. An error will appear on the appliance display if condensate line is blocked. The appliance will not operate with a blocked condensate line. It is extremely important to have this condition repaired by a qualified service technician.
11. Damages due to frozen or blocked condensate lines or leaks ARE NOT covered by warranty.
    NOTE: To clean out condensate trap, see Maintenance section.

CAUTION

The Condensate Trap must be periodically cleaned as part of a regular maintenance plan. Failure to clean the trap regularly can cause condensate drain blockage leading to malfunction, property damage and even personal injury.

! WARNING

Carefully follow the above instructions and the accompanying figure – check to ensure the Condensate Trap is secure and that no strain is placed on it. Failure to install the condensate trap properly will result in flue gas spillage and leeching of carbon monoxide emissions into the surroundings resulting in serious injury or death.

⚠ WARNING

Install wiring and electrically ground appliance in accordance with the authority having jurisdiction or, in the absence of such an authority, follow the National Electrical Code, NFPA 70, and/or CSA C22.1 Electrical Code-Part 1 in Canada. Failure to follow all applicable local, state, and national regulations, mandates, and building supply codes for guidelines to install the electrical power supply could result in property damage, serious personal injury, or death.

ELECTRICAL SHOCK HAZARD – To ensure safety, turn off electrical power supply at service entrance panel before making any electrical connections to avoid possible electric shock hazard. Failure to do so could result in property damage, serious personal injury, or death.

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

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

NOTE: For additional electrical protection, the use of a whole house surge protector is recommended. Damage caused by power surges IS NOT covered by the warranty.

Wiring

The appliance must be powered using a single-phase, properly-grounded 120 V AC power supply that is fused (or protected via a circuit breaker) to allow a maximum of 15 A / 20 A (depending on model).

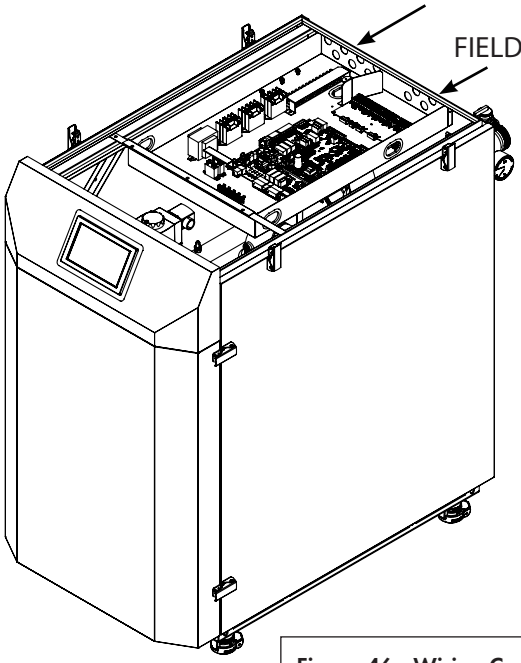


Figure 46 - Wiring Connections

CAUTION

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

Before connecting the line voltage wiring, perform a continuity check between all wires and ground to make sure that there are no electrical leaks that could blow a fuse or damage electrical components. Also check the polarity of the line and neutral wires. Line must measure 120VAC to ground; neutral must measure zero. Failure to follow instructions may damage the unit.

1. This appliance must be properly grounded. Ensure the electrical receptacle is properly grounded.
2. Do not attach the ground wire to either the gas or water piping.
3. The wiring diagrams in this manual are to be used for reference purposes only.
4. Refer to these diagrams and the wiring diagrams of any external controls used with the installation when wiring the appliance. Read, understand, and follow all wiring instructions supplied with the controls.
5. Do not disconnect the power supply when the appliance is in normal operation.

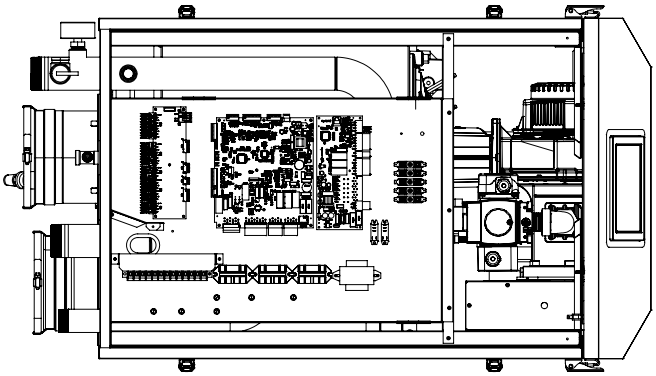


Figure 47 - Control Panel

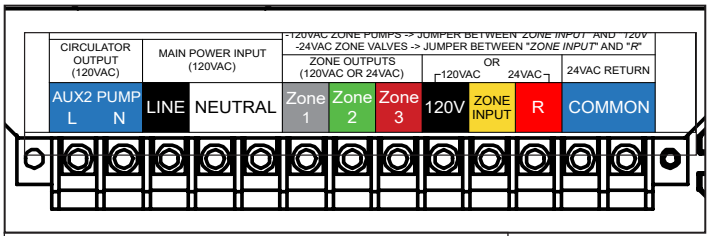


Figure 48 - High-voltage Wiring Connections

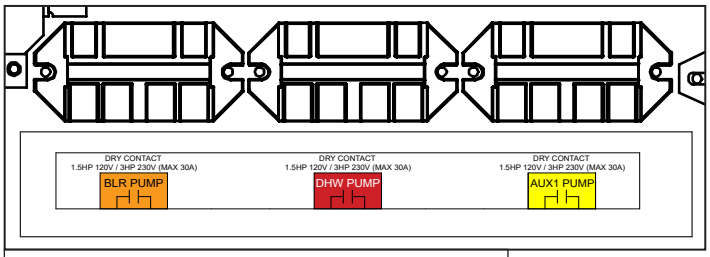
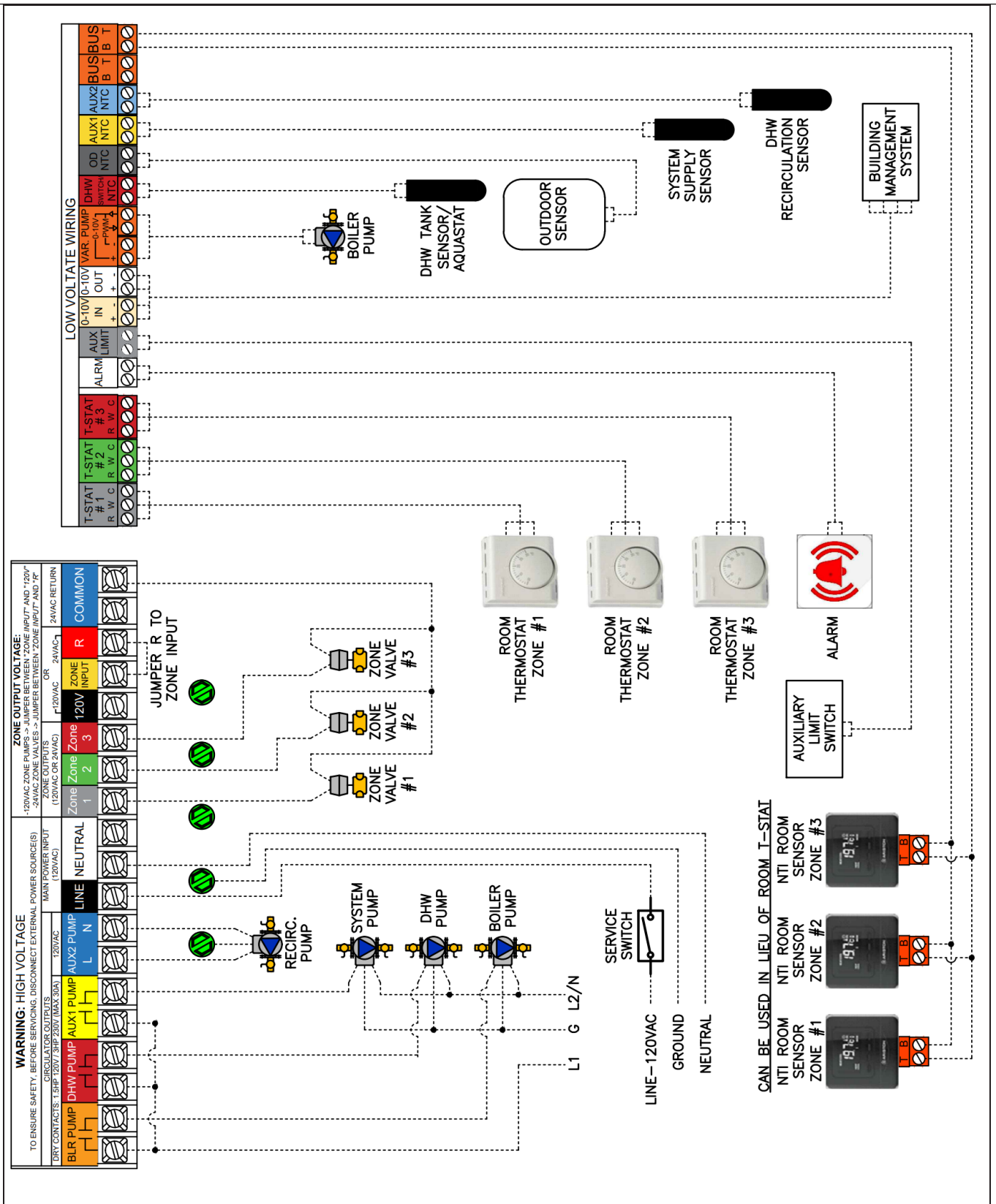


Figure 49 - Pump Output Wiring Connections

Connection		Description
BLR PUMP		BOILER PUMP OUTPUT **(Dry Contact, Max 30A)** – closes during all demands except buffer tank charging.
DHW PUMP		DHW PUMP OUTPUT **(Dry Contact, Max 30A)** – closes during DHW tank demands; see Low Voltage Field Connection *DHW SWITCH/NTC*.
AUX1 PUMP		AUX1 PUMP OUTPUT **(Dry Contact, Max 30A)** – closure is determined by the setting of Pump Control Settings option Auxiliary Pump 1 Selection (24.7.0): • None – output does not function. • System Pump (default) – closes during CH demands. Also closes during Downstream IWH demands if DHW Setup -> Advanced Settings option System Pump Activation Logic (24.4.6) = Always Active. • DHW Recirc – closes during DHW Recirc demands; see Low Voltage Field Connection *AUX2 NTC*. • Buffer Tank – closes during Buffer Tank demands; see Low Voltage Field Connections *AUX1 NTC* and *AUX2 NTC*. • Cascade Pump – closes when the boiler is commanded to serve the cascade system (i.e., cascade CH/DHW). Only applicable for a cascaded boiler that is also connected to an Upstream IWH.
AUX2 PUMP	L N	AUX2 PUMP 120VAC OUTPUT – operation is determined by the setting of Pump Control Settings option Auxiliary Pump 2 Selection (24.7.1): • None (default) – output does not function. • System Pump – powers during CH demands. Will also power during Downstream IWH demands if DHW Setup -> Advanced Settings option System Pump Activation Logic (24.4.6) = Always Active. • DHW Recirc – powers during DHW Recirc demands; see Low Voltage Field Connection *AUX2 NTC*. • Buffer Tank – powers during Buffer Tank demands; see Low Voltage Field Connections *AUX1 NTC* and *AUX2 NTC*. • Cascade Pump – powers when the boiler is commanded to serve the cascade system (i.e., cascade CH/DHW). Only applicable for a cascaded boiler that is also connected to an Upstream IWH Circuit is protected with a dedicated 5A fuse at "Zone Outputs/AUX2"; see Figure 18-4.
LINE	L	Location for connecting Line of the incoming 120VAC power supply.
NEUTRAL	N N	Location for connecting Neutral of the incoming 120VAC power supply, and optional Neutral junction for 120VAC loads, e.g., zone pumps.
ZONE 1 ZONE 2 ZONE 3		ZONE OUTPUTS – engage when a CH demand is applied to the respective *T-STAT* input (or via NTI Room Sensor configured to an individual zone). Output voltage is sourced from *ZONE INPUT*. When the respective zone demand ends, the output will remain powered until Pump Control Settings option Zone Outputs Overrun Time (7.2.8) elapses. Outputs disengage (following the overrun time) when a DHW demand is applied. Each circuit is protected with a dedicated 5A fuse at "Zone Outputs/AUX2"; see Figure 18-4. **NOTE:** the Zone Outputs Overrun Time can be aborted immediately upon apply a DHW demand by setting Zone Outputs Overrun During DHW (7.2.9) = Off.
120V		120VAC POWER SUPPLY – jumper to *ZONE INPUT* if Zone Outputs loads are 120VAC.
ZONE INPUT		ZONE INPUT POWER – jumper to required power supply for the zone outputs used, i.e., jumper to *120V* for zone pumps, or *R* (24V) for zone valves.
R (24V)		24VAC POWER SUPPLY – jumper to *ZONE INPUT* if Zone Outputs loads are 24VAC. Circuit is protected with a 2 Amp fuse, located on the Low Voltage Connection PCB; see Figure 18-4.
COMMON		24VAC COMMON – return/neutral leg of 24VAC power supply. Location for connecting return of 24VAC loads, e.g., zone valves.

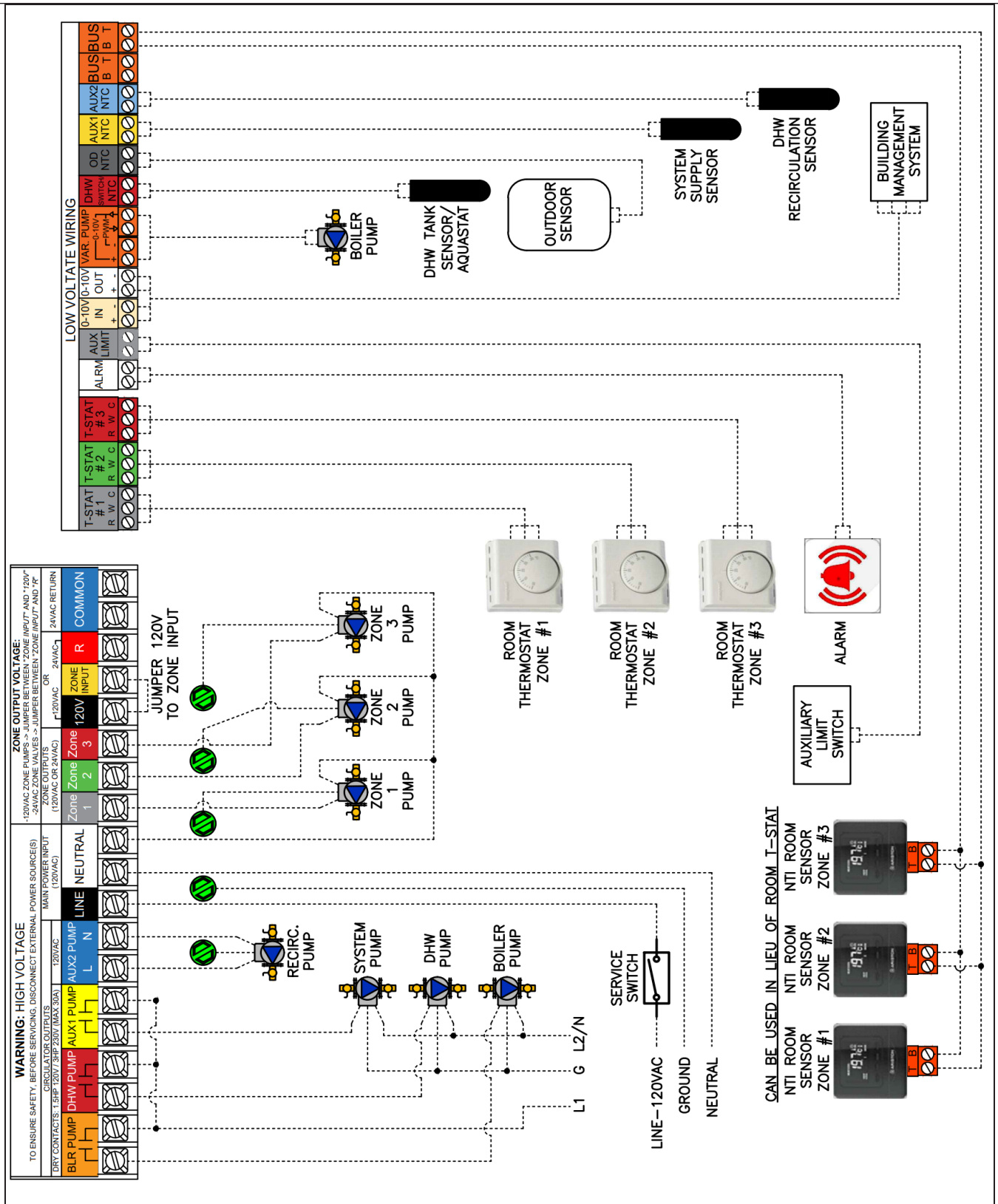
Connection		Description
T-STAT #1	R	THERMOSTAT INPUT (ZONE 1) – closure of R to W circuit initiates a zone 1 CH demand, activating the *ZONE 1* output. R = 24VAC Output; W = 24VAC Input; C = Common. Circuit is protected with a 2 Amp fuse, located on the low voltage connection PCB. **NOTE**: For two-wire devices connect only to R and W (do NOT connect to C).
	W	
	C	
T-STAT #2	R	THERMOSTAT INPUT (ZONE 2) – closure of R to W circuit initiates a zone 2 CH demand, activating the *ZONE 2* output. R = 24VAC Output; W = 24VAC Input; C = Common. Circuit is protected with a 2 Amp fuse, located on the low voltage connection PCB. **NOTE**: For two-wire devices connect only to R and W (do NOT connect to C).
	W	
	C	
T-STAT #3	R	THERMOSTAT INPUT (ZONE 3) – closure of R to W circuit initiates a zone 3 CH demand, activating the *ZONE 3* output. R = 24VAC Output; W = 24VAC Input; C = Common. Circuit is protected with a 2 Amp fuse, located on the low voltage connection PCB. **NOTE**: For two-wire devices connect only to R and W (do NOT connect to C).
	W	
	C	
ALRM		ALARM CONTACTS (NO) – Contacts close during a lockout or other alarm condition. May be connected to a BMS. Maximum capacity of contacts = 2 Amps at 24VAC.
AUX LIMIT		AUXILIARY LIMIT (SAFETY LIMIT INPUT) – circuit can be used to connect an external limit device if required by the AHJ. Boiler will produce an a volatile (Auto Reset) safety lockout when circuit is open. Circuit comes factory wired with a jumper – remove jumper if installing an external limit. NOTE: Lockout can be set as Manual Reset "Safety lock non-volatile" via parameter 24.6.5.
0-10V IN	+	EXTERNAL MODULATION CONTROL (0-10V INPUT) – allows an external control to directly modulate the burner firing rate or adjust the active set point. To activate this input, set BMS Control option Control Mode (42.0.0) to the desired control mode, i.e., Voltage Power for firing rate control or Voltage Temp for setpoint control.
	-	
0-10V OUT	+	BURNER POWER OUTPUT SIGNAL (0-10V OUTPUT) – outputs a 0-10V output signal proportional to the operating power of the burner.
	-	
VAR. PUMP 0-10V PWM	+	VARIABLE SPEED PUMP CONTROL – the boiler can control a variable speed BOILER PUMP via 0-10V or PWM output signal. For 0-10V control connect to the "+" and "return" (in arrow) terminals. For PWM control connect to the "-", "return" and "out" (out arrow) terminals. Select the type of pump speed control from Pump Configuration option Boiler Pump Speed Control Signal.
	-	
	↓	
	↑	
DHW SWITCH/NTC		DHW TANK SENSOR OR AQUASTAT – input for a tank sensor or tank thermostat (Aquastat) installed in an Indirect Water Heater (IWH). Tank sensor must be 10k beta = 3977 NTC. A tank sensor is available from NTI (P/N 84632).
OD NTC		OUTDOOR SENSOR – input for factory supplied outdoor sensor. Reading provides pertinent information to the boiler for automatic temperature adjustment. Alternatively, the outdoor temperature can be sourced from the Internet, if the boiler is connecting to Wi-Fi.
AUX1 NTC		AUX1 SENSOR INPUT – function is determined by the setting of Sensor Configuration option Auxiliary Sensor 1 (24.6.1): - System Sensor – input for optional system supply temperature sensor, so that the boiler can directly control the system supply temperature. - Buffer Tank – input for optional buffer tank temperature sensor, so that the boiler can directly control the temperature of an external buffer tank. Sensor must be 10k beta = 3977 NTC; an optional strap-on System Sensor is available from NTI (P/N 84010).
AUX2 NTC		AUX2 SENSOR INPUT – function is determined by the setting of Sensor Configuration option Auxiliary Sensor 2 (24.6.2): - DHW Recirc – input for a temperature sensor installed in a DHW recirculation loop, so that the boiler can directly control the heating of a recirculation loop connected to the DHW IWH. - Buffer Tank – input for optional buffer tank temperature sensor, so that the boiler can directly control the temperature of an external buffer tank. Sensor must be 10k beta = 3977 NTC; an optional strap-on System Sensor is available from NTI (P/N 84010).
BUS	B	BUS COMMUNICATION – provides a link to the communication port of the main PCB of the boiler. Connection is used to connect to other NTI devices such as NTI Room Sensors, NTI Zone Controller (N-Link ZC3), or to cascade to other NTI boilers. Take care to maintain the same polarity of B and T connections at each device.
	T	
BUS	B	
	T	



NOTES:

1. For *ZONE 1-3* to output 24VAC (as illustrated), jumper *ZONE INPUT* to *R* (24V).
2. NTI Room Sensors can be used in place of convential room thermostats. Daisy-chain *B* and *T* of each sensor to *BUS* terminals *B* & *T* at the boiler, taking care to match polarity. Each room sensor must be configured for the zone it is located in.
3. Only the BOILER PUMP can be a variable-speed type and controlled by the boiler; figure illustrates 0-10V control.
4. *SYSTEM*, *DHW* and *BLR PUMP* outputs are Normally Open dry contacts – power source must be supplied separately.

Figure 50 - Field Wiring Example – 24V Zone Valves



NOTES:

1. *ZONE 1-3* to output 120VAC (as illustrated), jumper *ZONE INPUT* to *120V*.
2. NTI Room Sensors can be used in place of convential room thermostats. Daisy-chain *B* and *T* of each sensor to *BUS* terminals *B* & *T* at the boiler, taking care to match polarity. Each room sensor must be configured for the zone it is located in.
3. Only the BOILER PUMP can be a variable-speed type and controlled by the boiler; figure illustrates PWM control.
4. *SYSTEM*, *DHW* and *BLR PUMP* outputs are Normally Open dry contacts – power source must be supplied separately.

Figure 51 - Field Wiring Example – 24V Zone Valves

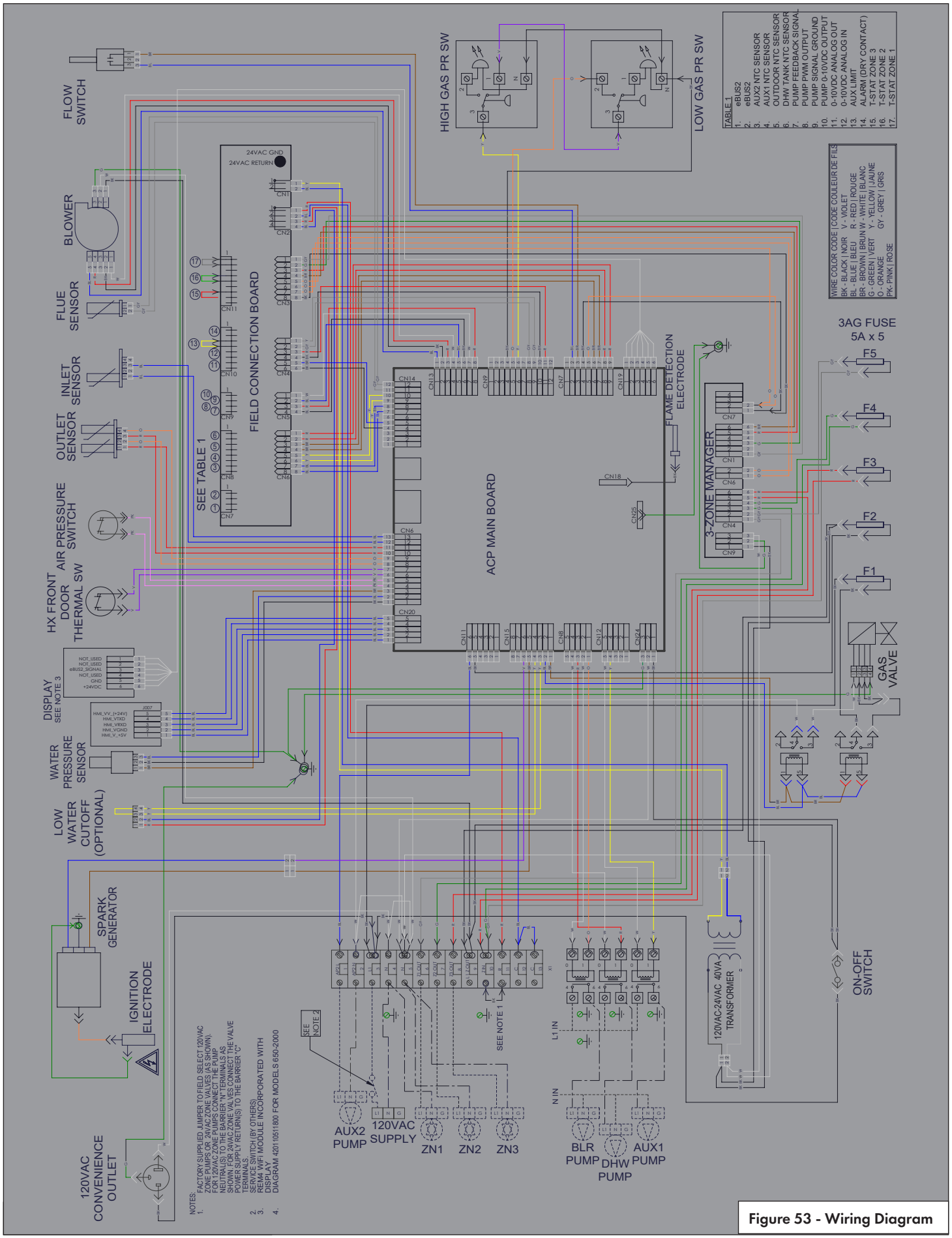


Figure 53 - Wiring Diagram

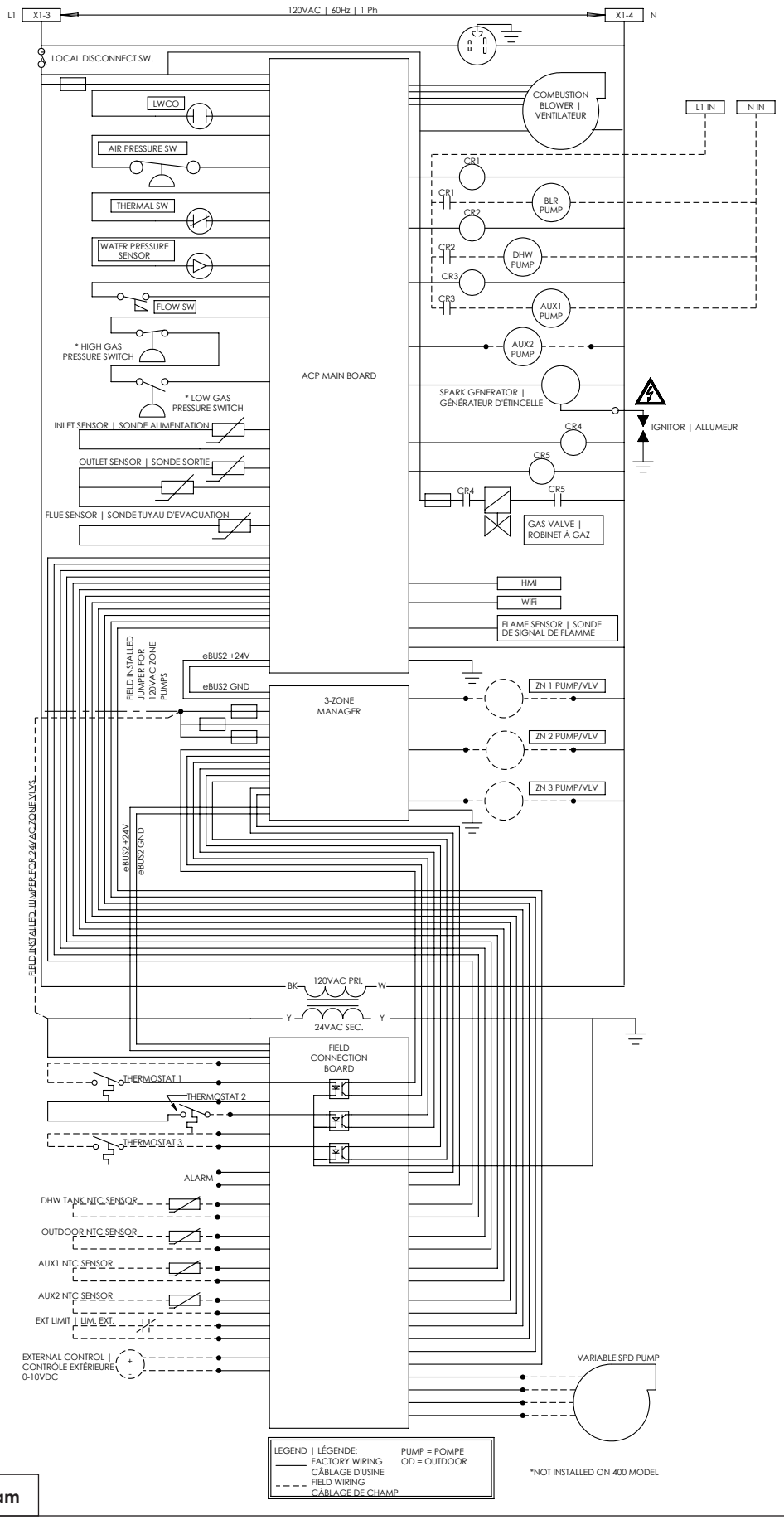


Figure 54 - Ladder Diagram

⚠ WARNING

FIRE AND/OR EXPLOSION HAZARD

To avoid serious injury or death, the gas line installation and the gas line inlet pressure test must be done by a licensed professional.

Ensure the gas on which the appliance will operate is the same type specified on the rating plate (natural gas or LP gas). This appliance must be converted to propane operation. Follow Gas Conversion Manual instructions (separate document). Failure to follow these instructions could result in property damage, personal injury, or death.

A. Gas Pipe Sizing Tables

1. Gas Pipe Sizing

This information is for reference use only. Refer to gas pipe manufacturer specifications for actual delivery capacity. The DOE standard for Natural Gas is 1100 BTU/ft^3. Contact the local gas supplier for actual BTU/ft^3 rating.

⚠ WARNING

Make sure the gas line pressures are within normal limits. Pressures outside normal limits can result in poor performance and hazardous operating conditions, property damage, personal injury, or death.

NOTICE

Do not operate the appliance on Natural Gas or LP gas with average sulfur rates greater than 30 mg/m^3. Doing so could result in improper product operation and failure, and WILL VOID the warranty.

2. Natural Gas Pipe Sizing

The following tables list maximum capacity of pipe in cubic feet of gas per hour for gas pressures of 14" or less and a pressure drop of 0.5 inches water column, based on a 0.60 specific gravity for natural gas.

3. LP (Liquid Propane) Gas Pipe Sizing

Contact gas supplier to size pipes, tanks, and 100% lockup gas pressure regulator. Adjust propane supply regulator provided by the gas supplier for 14 inches w.c. maximum pressure.

B. Gas Connection Requirements

1. The gas connection fitting is NPT (see Table 3 for sizing).
   NOTE: The gas pipe size must not be less than the inlet pipe size.
   NOTE: DO NOT USE 1/2" quick flex gas lines! Doing so will result in improper appliance operation.
2. The supply line must be sized for the maximum input of the appliance being installed. If there are additional gas appliances on the main supply line, measure the size of the supply line according to the COMBINED total maximum BTUH draw for the appliances as if they were operating at the same time.
3. Measure the length of the gas supply line from the gas meter to the appliance. The appliance must be installed downstream of the gas meter to ensure adequate gas supply. Use the tables in this manual or refer to the gas line manufacturer's sizing information to determine the correct supply pipe size.
4. The National Fuel Gas Code (NFPA 54) requires that a sediment trap (drip leg) be installed in the gas line on appliances not so equipped. The drip leg must be accessible, a minimum of 3" in length, and not subject to freezing conditions. See Figure 56.
5. A manual gas shut-off valve should be installed in the gas supply line close to the appliance. See See Figure 56.
6. To facilitate any future maintenance, it is also recommended that an approved gas union fitting be installed in the supply line between the shut-off valve and the NPT connection on the appliance.
7. Use a manometer to test the gas pressure to make sure it meets the minimum standards and does not exceed the maximum standards of the appliance.
8. Leak test the gas line pipe before placing the appliance in operation. Only use approved leak detector liquid solutions to check for leaks.
9. Do not operate the appliance until all connections have been completed and the heat exchanger is filled with water.

C. Additional Precaution for Excess Flow Valve (EFV)

If an excess flow valve (EFV) is in the gas line, check the manufacturer's minimum and maximum flow capacity ratings.

An improperly sized EFV will not allow for a full flow of gas to the appliance and will cause the appliance to malfunction. See Figure 50.



Figure 55 - Excess Flow Valve (EFV)

Pipe Size (in.)	Length of Pipe (Feet)										BTU's Per Hour x 1,000
	10	20	30	40	50	60	80	100	150	200	
3/4	360	247	199	170	151	137	117	104	83	71	Schedule 40 Metallic Pipe (0.60 Specific Gravity, 0.5 WC Pressure Drop)
1	678	466	374	320	284	257	220	195	157	134	
1 1/4	1390	957	768	657	583	528	452	400	322	275	
1 1/2	2090	1430	1150	985	873	791	677	600	482	412	
2	4020	2760	2220	1900	1680	1520	1300	1160	928	794	
3	11300	7780	6250	5350	4740	4290	3670	3260	2610	2240	
4	23100	15900	12700	10900	9660	8760	7490	6640	5330	4560	

Table 21 - Natural Gas Delivery Capacity - Refer to ANSI Z223.1 - National Fuel Gas Code, Latest Edition

D. Checking Gas Pressure

1. The appliance and its individual shutoff valve must be disconnected from the gas supply piping system during any pressure testing of the system at test pressures greater than ½ psi (3.5 kPa).
2. The appliance must be isolated from the gas supply piping system by closing its individual manual shutoff valve during any pressure testing of the gas supply piping system at test pressures equal to or less than ½ psi (3.5 kPa).

The minimum and maximum inlet gas line pressures must meet the requirements shown in Table 22.

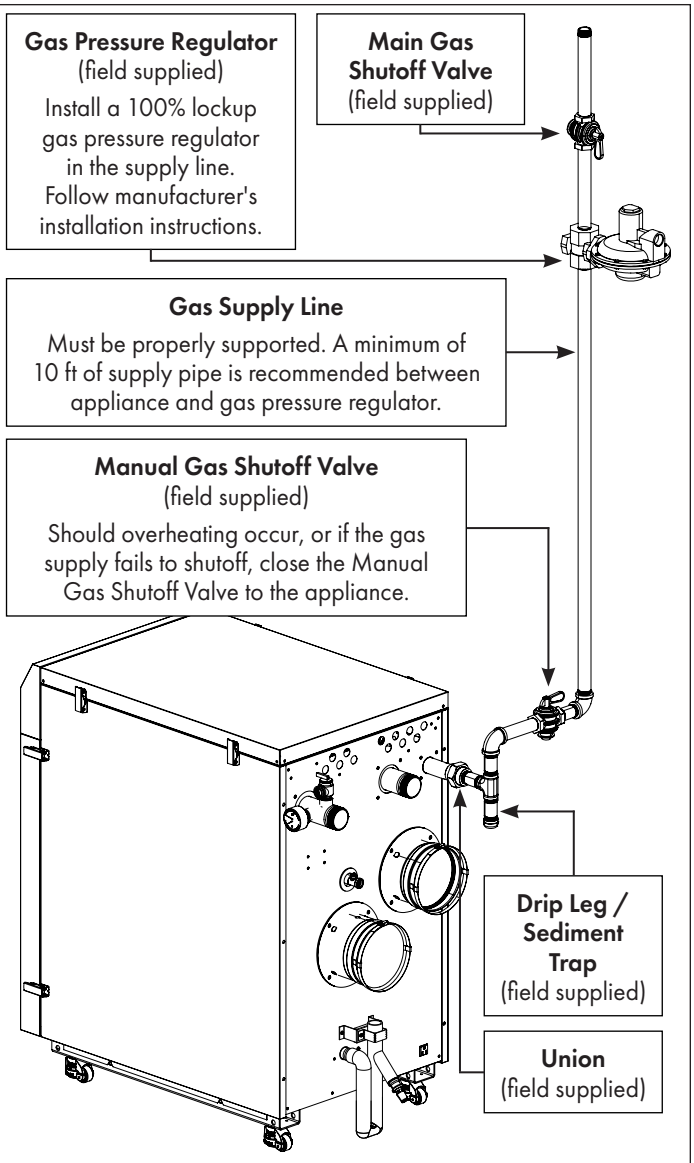


Figure 56 - Gas Line with Shut-Off and Sediment Trap Detail

Natural Gas	
Minimum Pressure	3.5″ WC
Maximum Pressure	10.5″WC
LP Gas	
Minimum Pressure	8″ WC
Maximum Pressure	13″WC

Table 22 - Gas Pressure Requirements

! WARNING

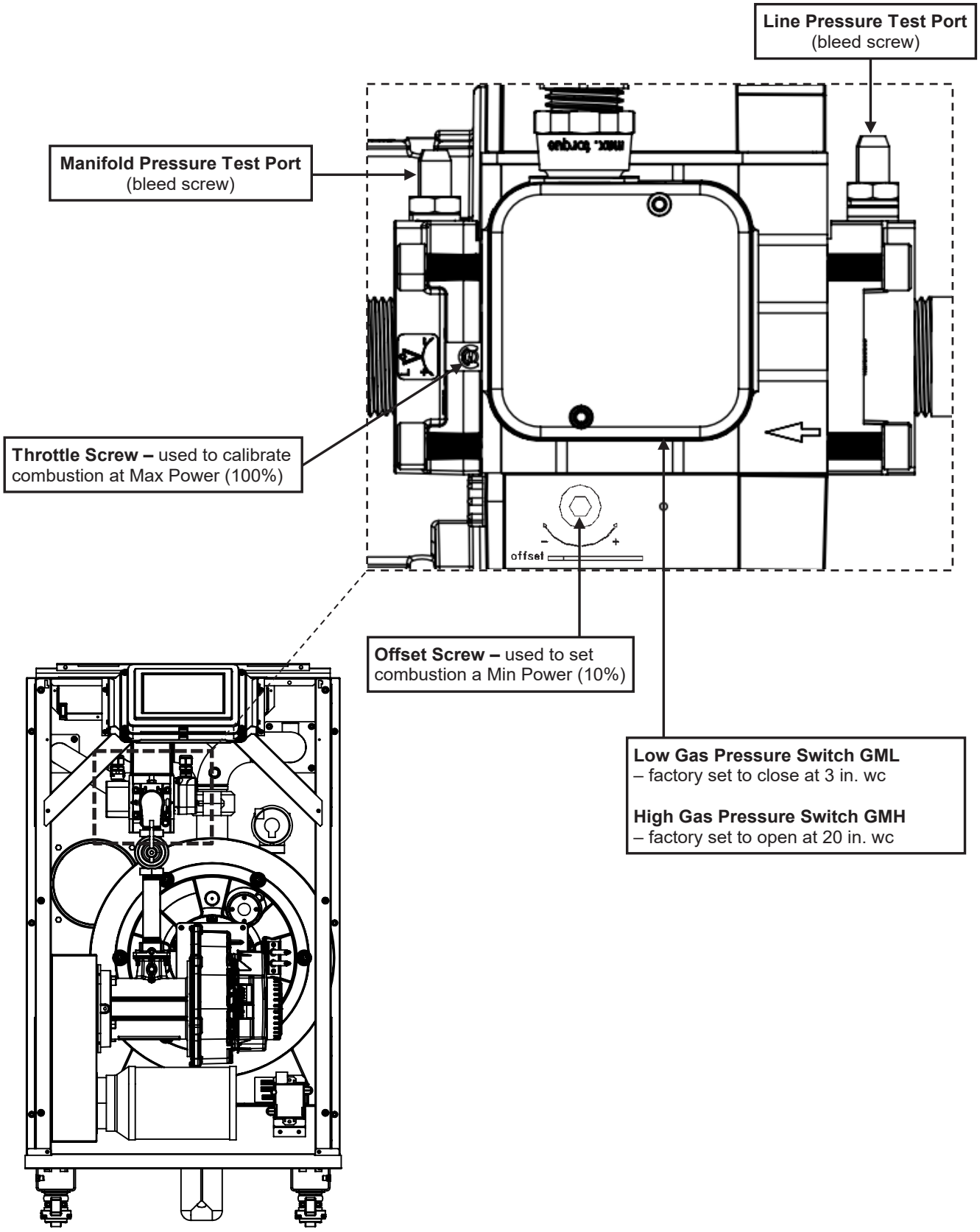
When performing a pressure test on the gas line pipng, be sure the appliance is disconnected or isolated if the test pressure is expected to exceed 1/2 PSI (14″ WC), as damage to the gas valve could occur. Such damage could result in fire, property damage, serious personal injury, or death.

To check inlet gas pressure:

1. Turn the supply of gas to the appliance off.
2. Open the bleed screw of the line pressure test port approximately 1-½ turns. This port is directly connected to the gas line feeding the appliance. See Figure 57.
3. Force ¼" ID tubing over the housing of the line pressure test port; install the other end of the tubing to an appropriate line pressure test gauge or manometer. Ensure both ends of the tubing make a tight connection.
4. Open the supply of gas to the appliance and check for gas leaks.
5. Observe the line pressure under static conditions and compare it to Table 22. The pressure will be greatest under static conditions.
6. With all other gas appliances in the application running, operate the burner at Max Power (100%) and compare the observed line pressure with Table 22. The pressure will be lowest during the maximum flow of gas.
7. Adjust the gas line pressure to ensure the parameters in Table 9-1 are attained under all conditions. If possible, adjust the line pressure to the "Nominal" value listed in Table 22, while the unit is operating at Max Power (100%).
8. Continue observing the gas line pressure until the completion of the combustion analyses in case adjustments need to be made.
9. Complete pressure testing, and then return the bleed screw of the Line Pressure Test Port to the closed position.

NOTICE

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



⚠ WARNING Improperly adjusted Gas Valve Offset Pressure will result in incorrect combustion leading to burner damage or excessive Carbon Monoxide concentrations causing property damage, personal injury, or death.

Figure 57 - Gas Valve

WARNING

Set-up of the gas valve must be performed by a licensed Gas Technician. Failure to perform the set-up correctly may result in incorrect operation, component failure, property damage, serious injury or death.

Combustion Calibration Procedure

To calibrate burner combustion, perform the following procedure using a calibrated combustion analyzer capable of measuring CO_2 and CO from a Natural Gas or Propane burning appliance:

1. Set analyzer to the appropriate fuel (Natural Gas or Propane).
2. Gas Line Pressure Test – monitor gas line pressure throughout all combustion tests and verify it is maintained within tolerance. See Gas Line Pressure Test below.
3. Set Throttle Screw – with the burner operating at Max Power (100%); set combustion according to Table 23 using the Throttle Screw; allow time for the analyzer readings to stabilize between adjustments – record CO_2 value. See Throttle Screw Adjustment section below.
4. Set Offset Screw – with the burner operating at Min Power (10%); using the Offset Screw, set the CO_2 in accordance with Table 23, i.e., 0.5-1.0% lower than the value obtained during the Max Power test. See Offset Screw Adjustment section below.

WARNING

Combustion Calibration is mandatory upon installation and during each annual service. Failure to perform the Combustion Calibration in accordance with these instructions may result in incorrect combustion leading to burner damage or excessive Carbon Monoxide concentrations causing property damage, personal injury, or death.

Carbon Monoxide – Never leave the unit operating while producing Carbon Monoxide (CO) concentrations more than 175 ppm. Failure to follow this warning may result in serious injury or death.

Throttle Screw Adjustment

The gas valve Throttle Screw (see Figure 49) is used to calibrate the CO_2 concentration with the burner operating at or near the Max Power (100%). Turning the Throttle Screw in (clockwise) decreases the CO_2 concentration. Turning the Throttle Screw out (counterclockwise) increases the CO_2 concentration. Typical adjustment required is 0 – ¼ of a turn in or out from the factory setting.

Note: The modulation rate can be manually adjusted from the Burner Test menu under Test Mode; see Figure 59.

WARNING

Adjustments to the **Throttle Screw** may only be made by a qualified gas technician using a calibrated combustion analyzer capable of measuring CO_2 and CO. Adjustments may only be performed if the gas line pressure is maintained above minimum levels throughout the duration of the test (see Table 23). Failure to follow these instructions may result in serious injury or death.

Offset Screw Adjustment

The gas valve Offset Screw (see Figure 49) is used to calibrate the CO_2offset at minimum modulation vs. maximum modulation. Turning the Offset Screw in (clockwise) increases the CO_2 concentration at minimum modulation rate. Turning the Offset Screw out (counterclockwise) decreases the CO_2 concentration at Min Power (10%). Typical adjustment required is 0 – ¼ of a turn in or out from the factory setting.

Note: Calibration of the Offset Screw must only be performed with the burner operating at the Min Power (10%).

Note: The modulation rate can be manually adjusted from the Burner Test menu under Test Mode; see Figure 9-1.

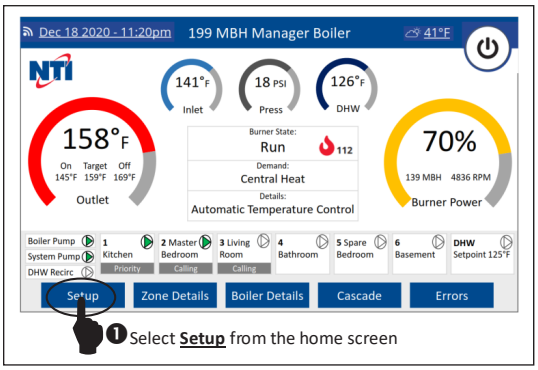
WARNING

Adjustments to the **Throttle Screw** may only be made by a qualified gas technician using a calibrated combustion analyzer capable of measuring CO_2 and CO. Adjustments may only be performed if the gas line pressure is maintained above minimum levels throughout the duration of the test (see Table 23). Failure to follow these instructions may result in serious injury or death.

	CO_2 (%)		CO (ppm)	Line Pressure (in. w.c.)
	MAX Power (100%)	MIN Power (10%)		
NG	8.3 – 9.3	7.9 – 8.9	< 175	3.5 – 10.5
LP	9.3 – 10.3	8.9 – 9.9	< 175	8.0 – 13.5

Table 23 - Combustion Parameters

Note: the CO_2 at MIN. Power (10%) must be set lower than the CO_2 at MAX. Power (100%) by 0.4 – 0.8%.



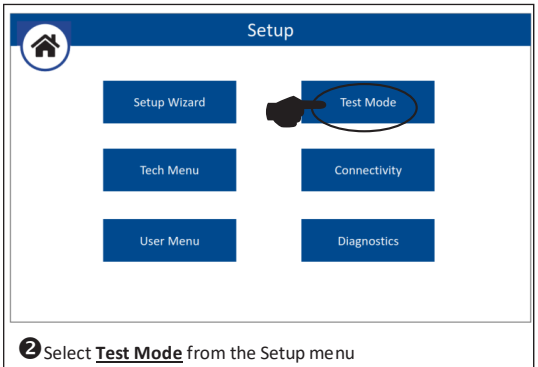
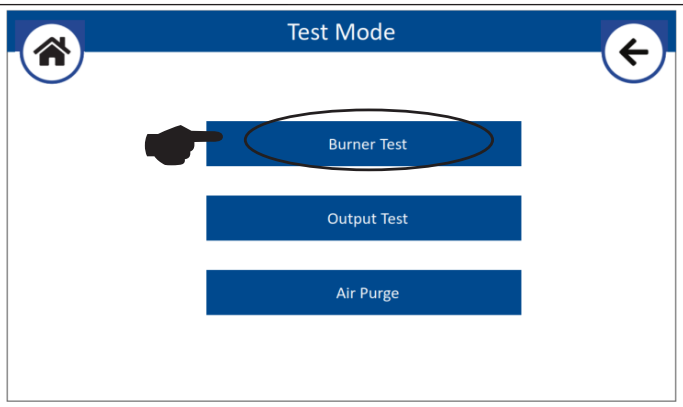
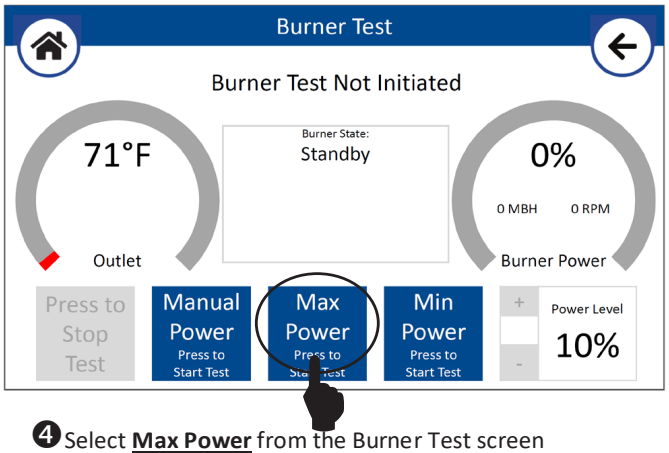


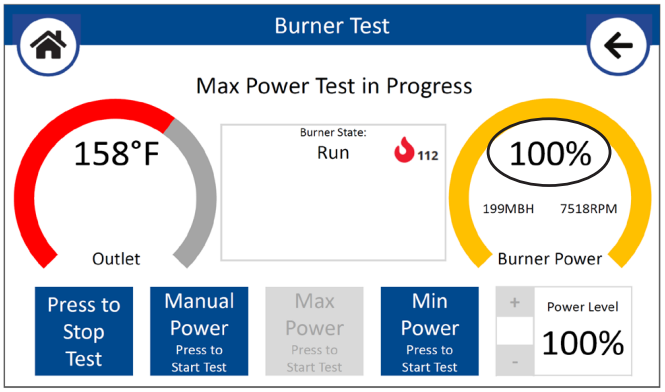
Figure 58 - Accessing Test Mode - Burner Test Menu



❸ Select **Burner Test** from the Test Mode screen



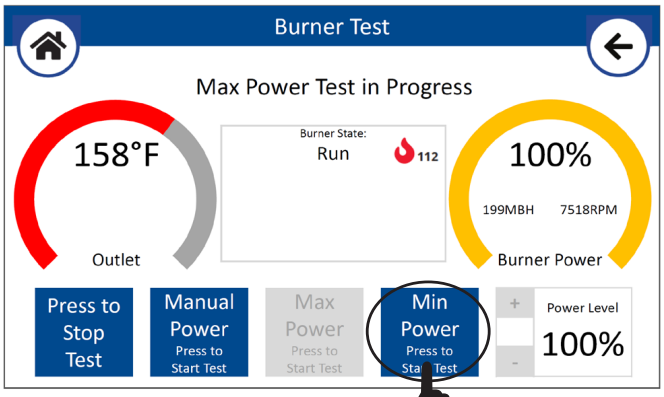
❹ Select **Max Power** from the Burner Test screen



❺ Verify Burner Power goes to 100% before proceeding with Max Power combustion calibration (see Table 24).

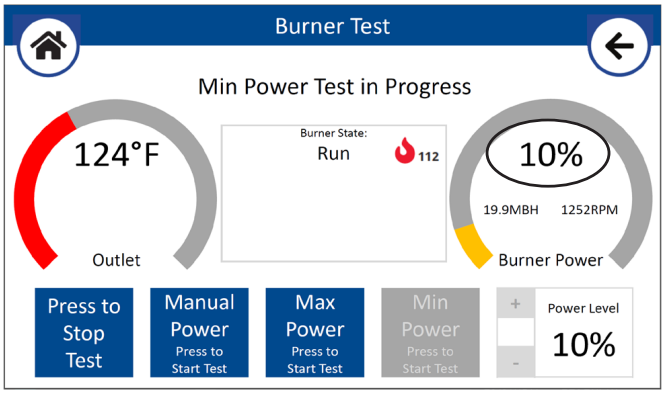
Note: Use the Throttle Screw to adjust Max Power combustion – see Figure 49.

Note: Verify gas line pressure to unit is within range while operating at Max Power – see Table 24.



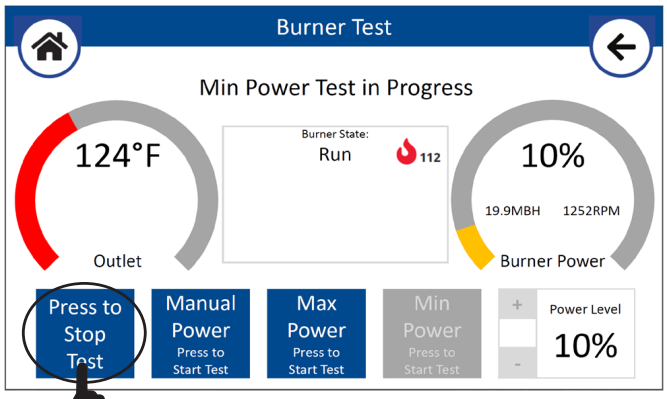
Note: If the Burner Power gauge and Power Level are flashing, it means that the Power Limiting function is active, and the burner power will not exceed 50%. The Power Limiting function finishes after 5min of normal burner operation.

❻ Upon completing Max Power calibration, select **Min Power** from the Burner Test screen.



Verify Burner Power goes to 10% before proceeding with Min Power combustion calibration (see Table 24).

Note: Use the Offset Screw to adjust Min Power combustion – see Figure 49.



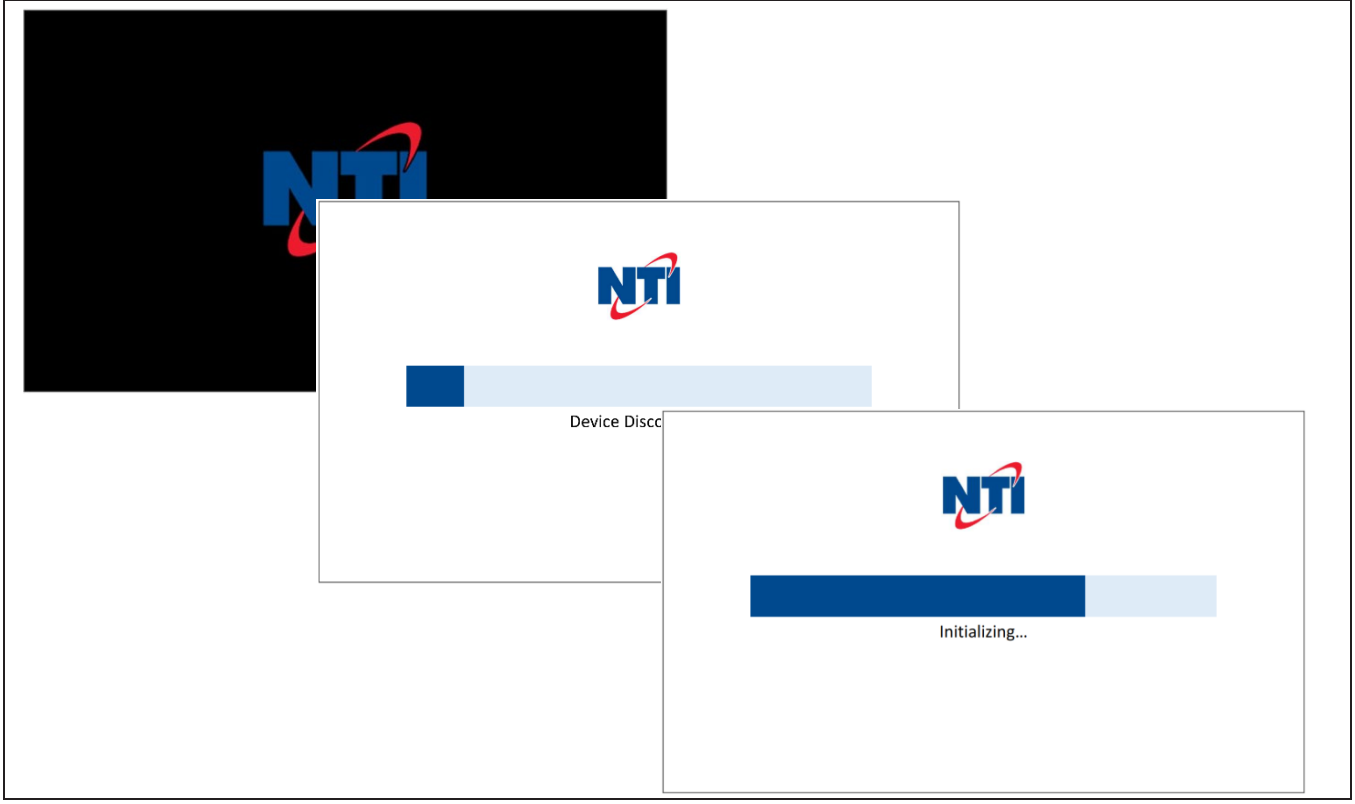
❽ Select **Press to Stop Test** upon completing the combustion calibration procedure. Proceed to other menus by selecting the Home or Back buttons.

Figure 59 - Manually Adjusting Burner Power via Test Mode - Burner Test Menu

Initial Power-up

Immediately following power-up of the boiler, the system will go through a process of “Device Discovery”, where the devices connected to the boiler are discovered. This is followed by an “Initializing” process.

Figure 16-1 Initial Power-up



After device discovery and initializing, the controller performs an air purge sequence that is designed to purge air from the boiler water. The air purge sequence cycles the circulators off and on, for a period of 6 minutes (12 minutes for cascade systems), to help free air pockets that may exists in the heat exchanger and boiler piping.

NOTICE

The air purge sequence is only initiated following the first power-up of the boiler (or via the Test Mode menu); if air has already been adequately purged from the system the sequence can be stopped by pressing Cancel, see Figure 16-2.

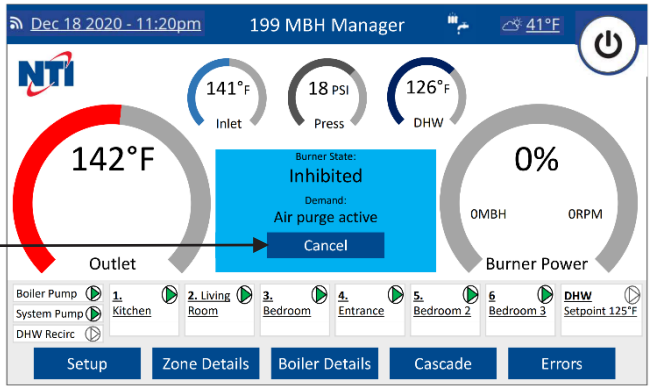
⚠ WARNING

The air purge sequence is designed to remove air from the system; failure to adequately remove air from the system can damage the heat exchanger and void the warranty and may lead to property damage and personal injury.

Figure 16-2 Air Purge Active

Press Cancel to abort the Air purge cycle.

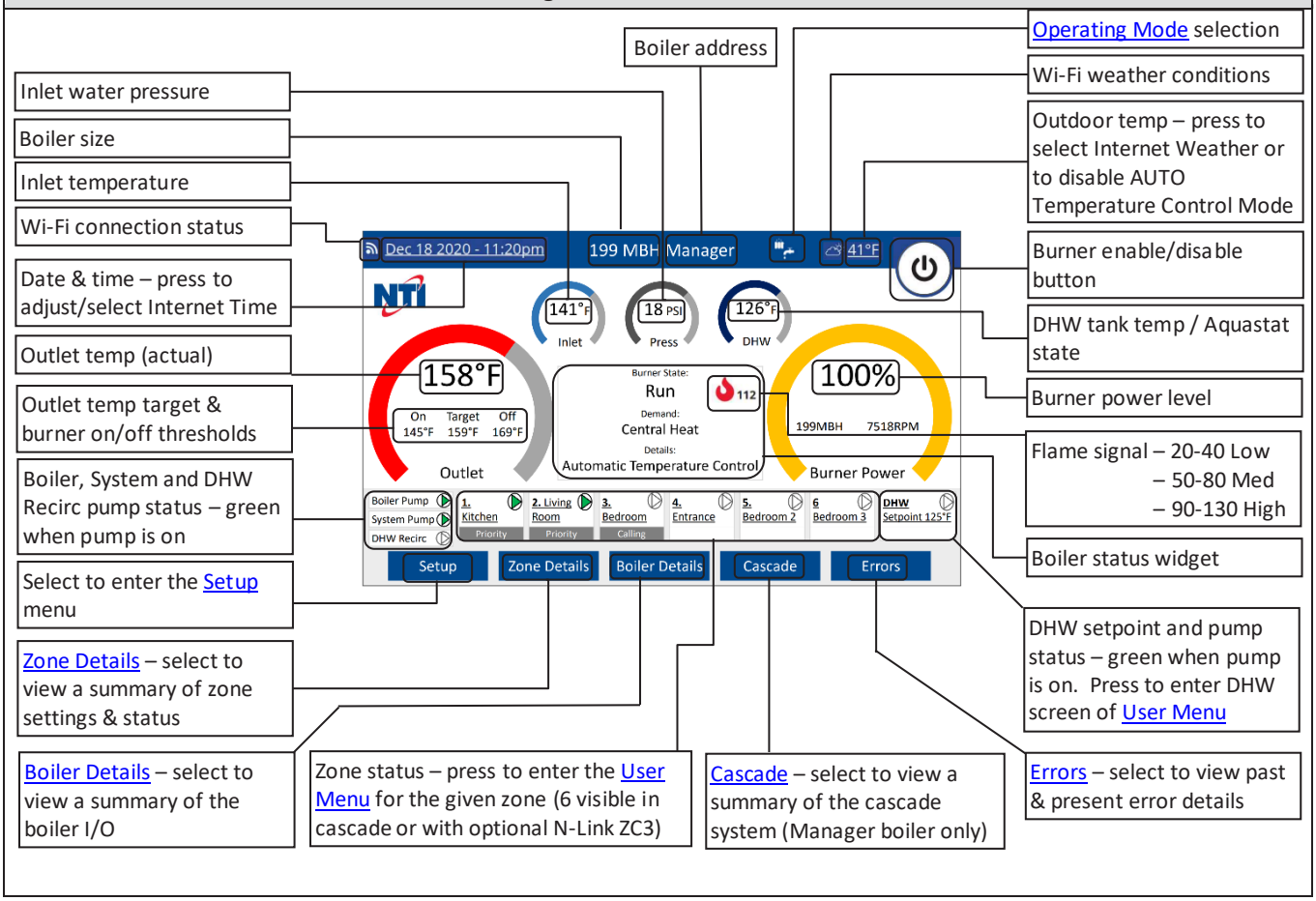
NOTE: it is imperative to purge the air from the boiler system before attempting to fire the burner.



16.1 Home Screen

After power-up, following the initialization sequence (see Figure 16-1), the boiler defaults to the Home Screen.

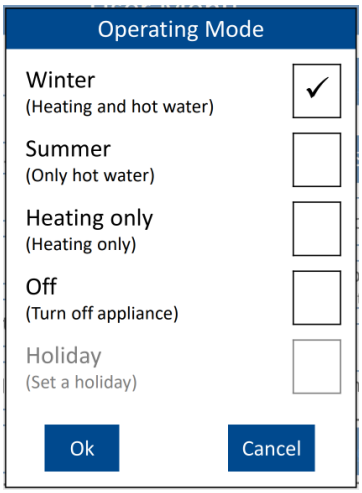
Figure 16-3 Home Screen



16.2 Operating Mode

Operating mode can be used to select the mode or modes that the boiler will operate for, i.e., CH, DHW, CH & DHW or OFF.

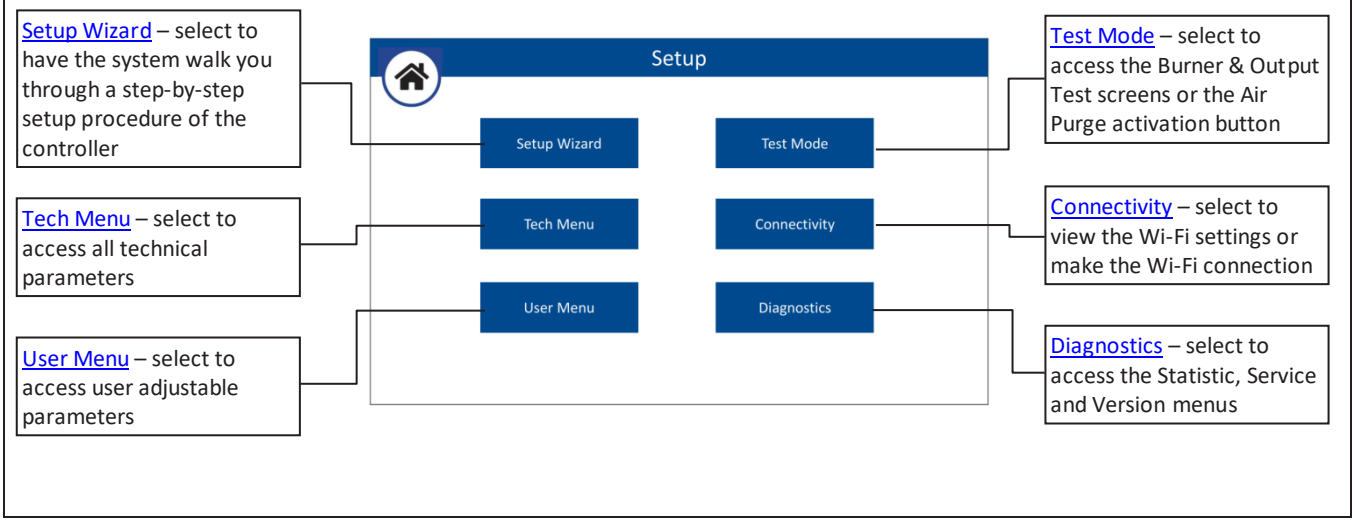
Figure 16-4 Operating Mode



	Winter (default) – boiler operates for both central heating (CH) and domestic hot water (DHW) demands, i.e., normal operation.
	Summer – boiler only operates for domestic hot water (DHW) demands.
	Heating only – boiler only operates for central heating (CH demands)
	Off – boiler will only operate for Anti-freeze function (if set to Enabled)
	Holiday – boiler will only run to maintain the room temperatures of zones with NTI Room Sensors at the Holiday setpoint; other CH zones will remain off. DHW will only be heated by the Anti-legionella Function (if set to On), or DHW frost protection (tank temp < 46°F). Holiday operating mode is not selectable from the display, only via the web or mobile app. Note: the boiler will still perform the Anti-freeze Function with Operating Mode set to Holiday.

16.3 Setup Menu

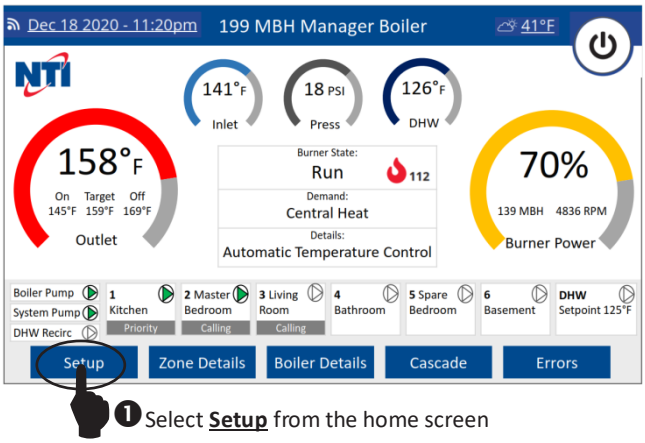
Figure 16-5 Setup Menu



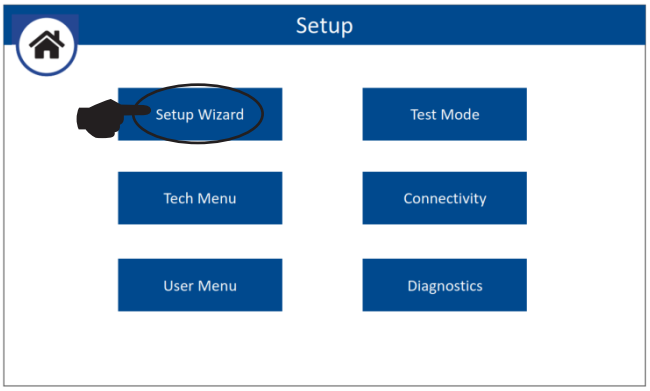
16.3.1 Setup Wizard

It is recommended to use the Setup Wizard to walk you through the basic setup of the boiler controller, including CH and DHW setup and connecting the boiler to Wi-Fi.

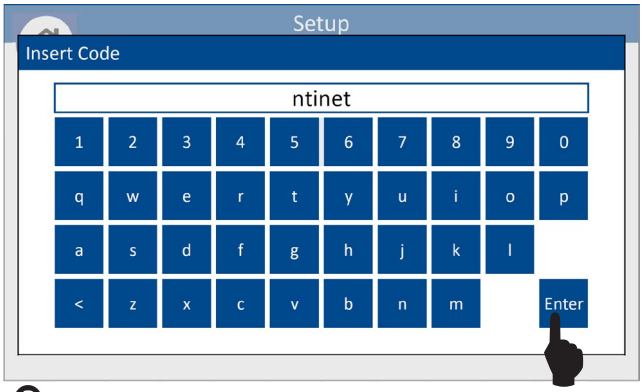
Figure 16-6 Setup Wizard



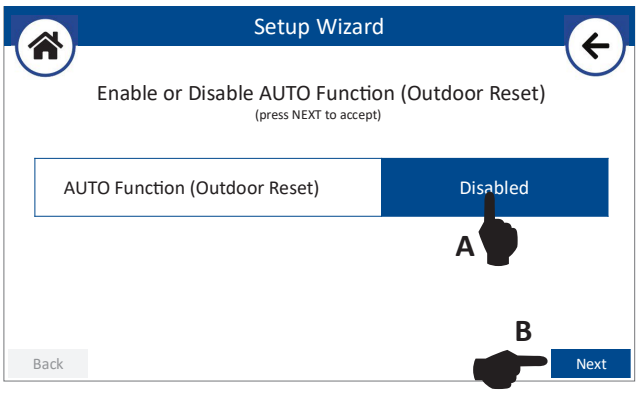
❶ Select **Setup** from the home screen



❷ Select **Setup Wizard** from the Setup menu



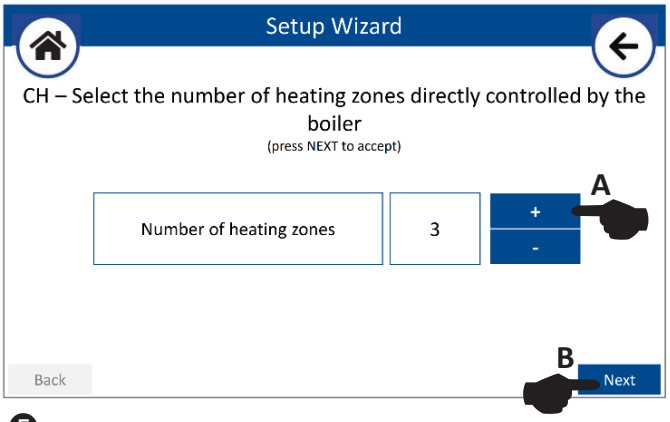
❸ If prompted, insert the password "ntinet" and press **Enter**.



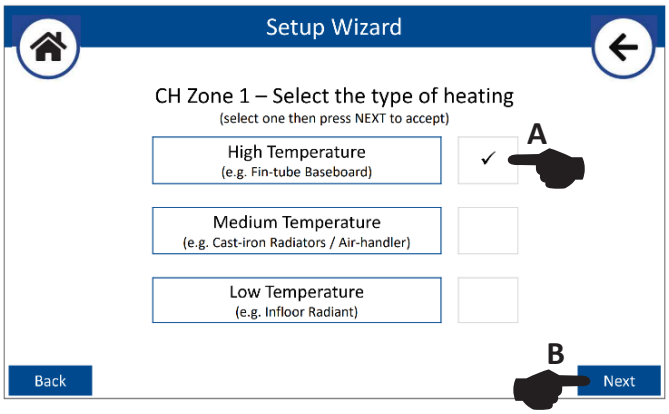
❹ Select to Active or Disable AUTO Function (Outdoor Reset), then press **Next**.

(Continued)

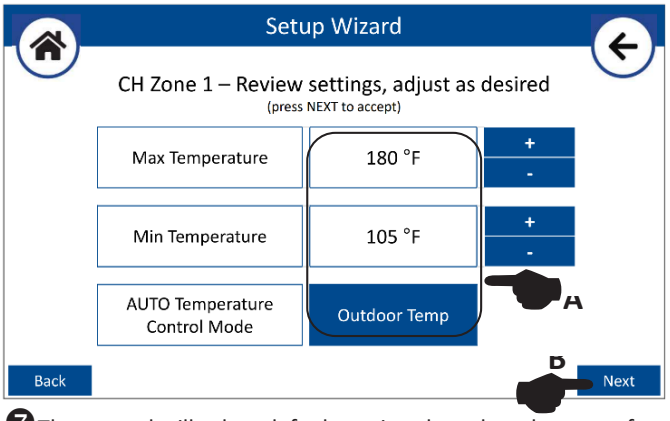
Figure 16-6 Setup Wizard (...Concluded)



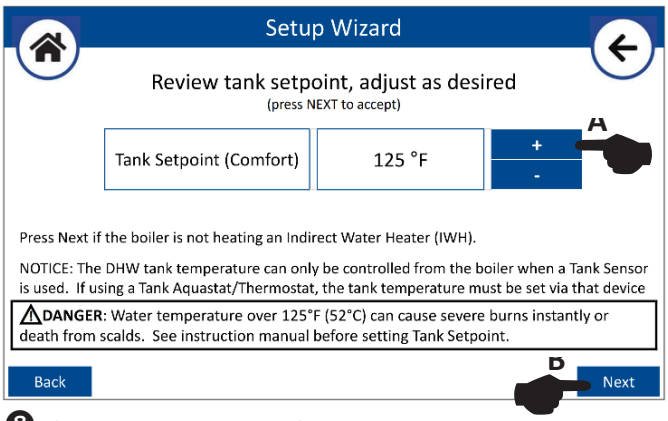
❺ Select the number of heating zones controlled by the boiler (i.e., number of T-STAT inputs used), then press **Next**.



❻ Select the type of radiation for the 1st zone (i.e., zone connected to T-STAT #1 input and ZONE 1 output), then press **Next**.

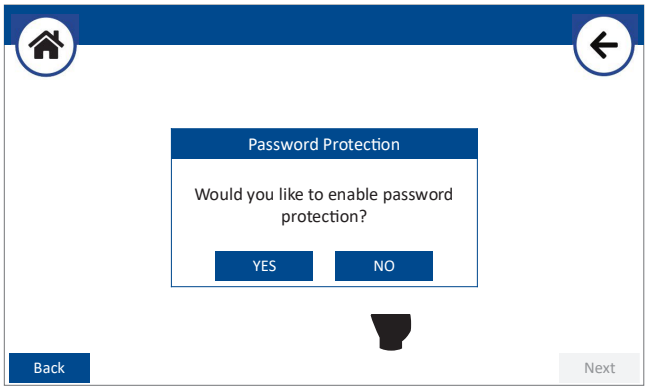


❼ The control will select default settings based on the type of radiation selected, adjust if desired then press **Next**. Note: if the number of heating zones selected was greater than 1, you will be prompted to input the type of radiation for the next zone (step 5).



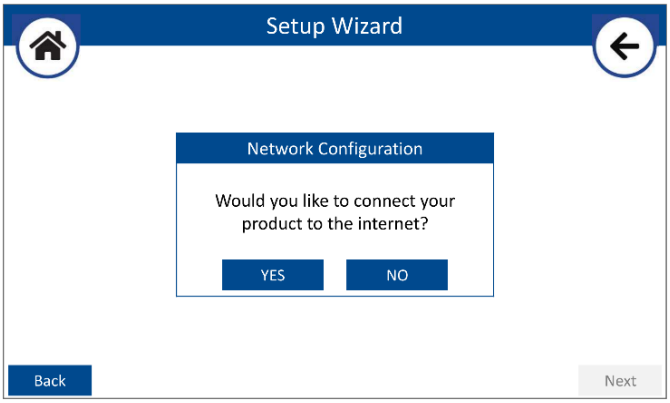
❽ After each CH zone is configured, the wizard will prompt you to set the Tank Setpoint temperature (default = 125°F). Adjust if desired then press **Next**.

DANGER: water temperature over 125°F can cause severe burns instantly, or death from scalds. See section 1.6 DHW Temperature Adjustment and Scalding



❾ Select "Yes" to enable or "No" to disable password protection and proceed to the next step. If "Yes" is selected, the password "ntinet" will appear on the display – select "Ok" to proceed.

Note: Password protection can also be enabled/disabled by selecting the lock symbol at the top of the Tech Menu.



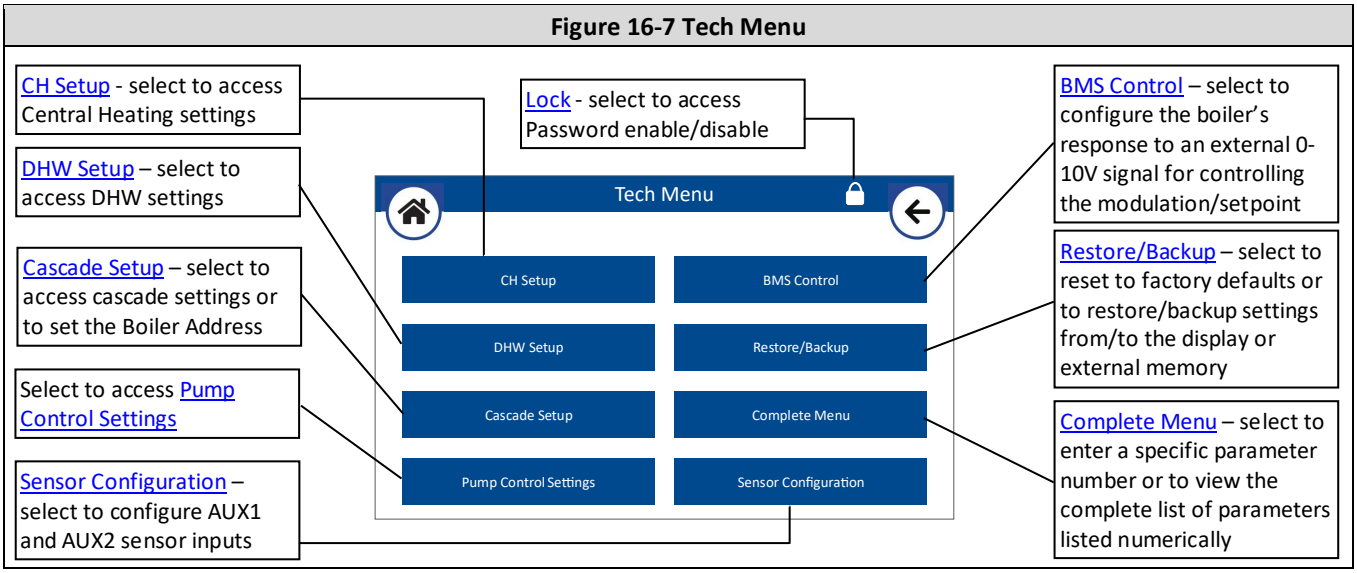
❽ Select NO to finish the Setup Wizard or select YES to start the process of connecting the boiler to the internet – see section 17.0 WI-FI CONNECTION section. When the boiler is connected the Setup Wizard is complete – select Finish to return to the Home Screen.

16.3.2 Tech Menu

All technical parameters of the main controller are accessed from the Tech Menu.

Note: if you have not entered the "ntinet" passcode within the last 30 minutes, you will be asked to enter it again upon selecting Tech Menu; see section 16.3.1 Setup Wizard (not applicable when Password Protection is disabled).

Figure 16-7 Tech Menu



16.3.2.1 CH Setup

Navigate the Central Heat menus as illustrated in Figure 16-8. Tables 16-1 through 16-5 provide a description of each menu option.

Figure 16-8 CH Setup Menus

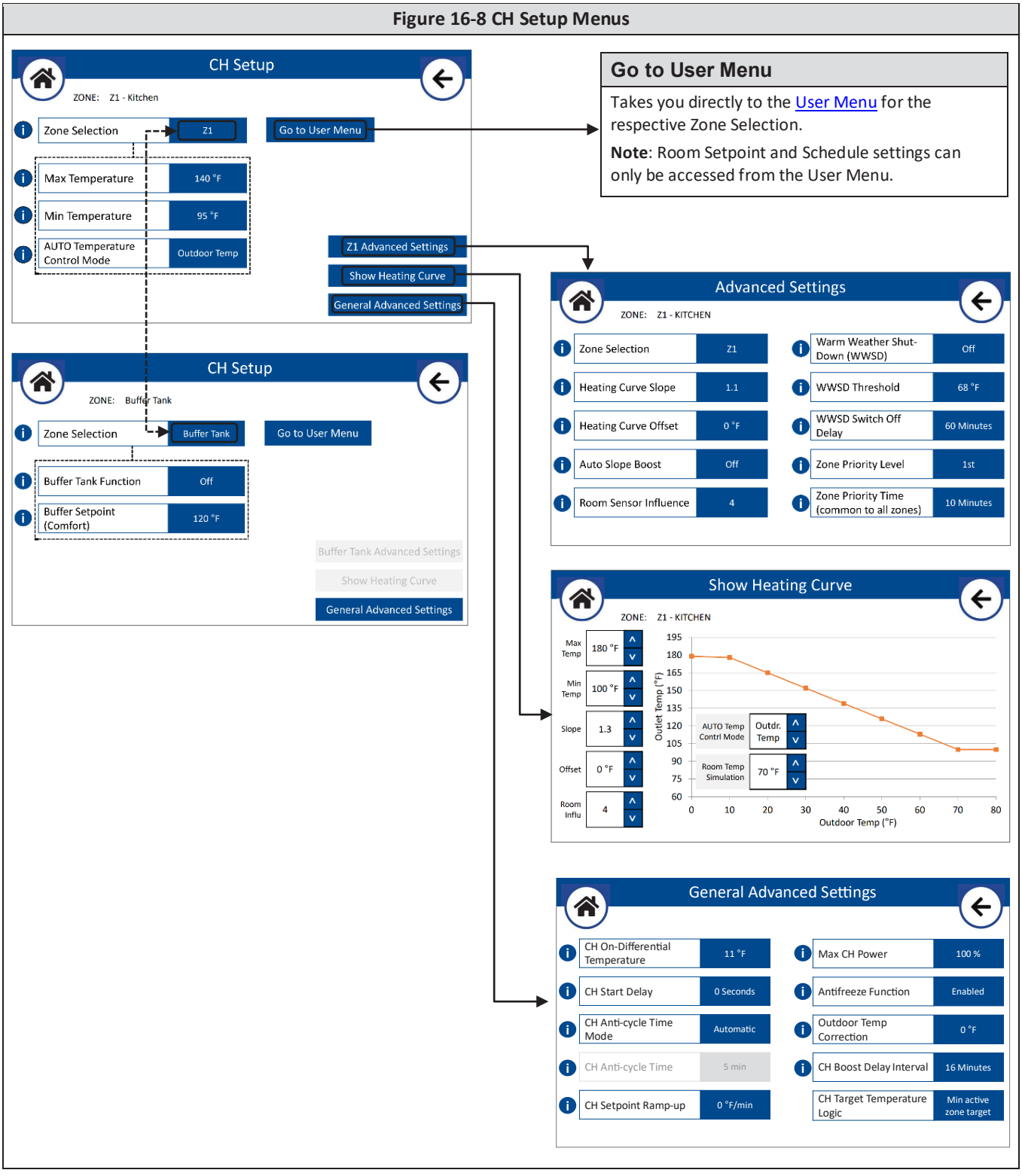


Table 16-1 CH Setup

Setting	Parameter*	Description/Range	Factory Setting
Zone Selection	NA	Allows selection of the zone that you would like to view/modify; options are Z1 (zone 1), Z2, Z3 & Buffer Tank. Options extend to Z4, Z5 & Z6 if using an NTI N-Link ZC3 zone controller.	Z1
Max Temperature	4.2.5	Sets the allowable operating outlet water temperature range of the boiler. (Range = 68-190°F)	140°F
Min Temperature	4.2.6		95°F
AUTO Temperature Control Mode	4.2.1	Sets the type of automatic temperature control for zone 1: **Fixed Outlet** – AUTO Temperature Control is off, boiler operates to the (manually adjustable) Max Temperature setting. **Basic On/Off** – the boiler uses the ON/OFF condition of the room thermostat to boost/reduce the boiler target temperature. With a starting (first time) boiler target temperature of 136°F, the function boosts the target temperature by 7°F every 16 minutes (adjustable via the CH Boost Delay Interval setting) a call for heat is continuously active. Similarly, the target temperature is reduced 7°F every 16 minutes that the heat call is continuously inactive. The temperature will boost/reduce a maximum of 3 times (21°F) for a given thermostat ON/OFF cycle. **Room Temp** – the boiler target temperature automatically adjusts between the Min and Max Temperature Settings, based on the input temperature provided by an optional NTI Room Sensor. **Outdoor Temp** – The boiler target temperature automatically adjusts between the Min and Max Temperature Settings, based on the input temperature provided by the included Outdoor Sensor (or Internet Weather via Wi-Fi connection). **Room&Outdoor** – the boiler target temperature automatically adjusts between the Min and Max Temperature Settings, based upon the input temperatures provided by an optional NTI Room Sensor AND the included Outdoor Sensor (or Internet Weather via Wi-Fi connection).	Outdoor Temp
Buffer Tank Function	20.0.0/ 20.0.7	When enabled, the boiler anticipates the connection of a buffer tank sensor at the *AUX1* or *AUX2 NTC* input (configure Sensor Configuration setting Auxiliary Sensor 1 [or 2] accordingly). The boiler operates the burner and buffer tank pump (configure Pump Configuration setting Auxiliary Pump 1 [or 2] Selection accordingly) to maintain the buffer tank temperature at the buffer tank setpoint. CH and Downstream IWH demands are serviced by the buffer tank. **Off** - Buffer Tank Function is disabled. **Fixed Temperature** – the buffer tank setpoint follows the specific Buffer Setpoints (Comfort & Reduced), based on the Zone Mode selected. **Variable Temperature** – the buffer tank setpoint follows the greater of the target of the active (or most recent) CH zone demand and the DHW Tank Setpoint (24.5.0) + 9°F (if DHW Mode = Downstream IWH).	Off
Buffer Setpoint (Comfort)	20.0.3	Buffer tank setpoint during Comfort time period. (Range = 50-190°F)	120°F

* Parameter numbers starting with 4 are for Zone 1; substitute the 4 with a 5 (for Zone 2); 6 (for Zone 3); 14 (for Zone 4); 15 (for Zone 5) or 16 (for Zone 6) for equivalent respect zone parameter.

Table 16-3 CH Setup – Advanced Settings (Applicable to selected zone)

Setting	Parameter*	Range/Description	Factory Setting
Zone Selection	NA	See Table 16-1	Z1
Heating Curve Slope	4.2.2	Sets the slope of the heating curve. The greater the slope, the quicker the boiler target temperature raises as the outdoor temperature decreases. Applicable when AUTO Temperature Control Mode = Outdoor Temp or Room&Outdoor. (Range = 0.2-3.5)	1.1
Heating Curve Offset	4.2.3	See Table 16-14 (a)	0
Auto Slope Boost	4.7.5	Acts to automatically adjust the slope of the heating curve to better match the needs of the heating system. The function boosts the boiler target temperature by increasing the slope 10% every 10 minutes a call for heat is continuously active, to a maximum of 2X the Heating Curve Slope setting. While the heat call is satisfied, the slope decreases by 1% every minute to a minimum equal to the Heating Curve Slope setting.	Off
Room Sensor Influence	4.2.4	Adjusts the influence of room temperature on target boiler temperature – a higher setting causes a greater increase to the boiler target temperature as the indoor temperature drops below room setpoint. Applicable when AUTO Temperature Control Mode = Room Temp or Room&Outdoor. (Range = 0-20)	2
Warm Weather Shutdown (WWSD)	4.1.0	When set to On, disables the zone 1 heating demand when the outdoor temperature exceeds the WWSD Threshold for longer than the WWSD Switch Off Delay time.	Off
WWSD Threshold	4.1.1	Outdoor temperature where the zone 1 heating demand is disabled – if WWSD is set to On. (Range = 32-86°F)	68°F
WWSD Switch Off Delay	4.1.2	Length of time required for the outdoor temperature to exceed the WWSD Threshold before disabling the zone 1 heating demand. (Range = 0-300min)	60 min
Zone Priority Level	4.8.5	Sets the priority level for zone 1. Only zones with the same priority level can operate together. Zones with the highest priority level (lowest numerically) are given the priority first. The priority is switched to the zone with the next highest priority level after the Zone Priority Time elapses. (Range = 1st-3rd) **Note**: zones set with the same priority level will run concurrently if being call upon simultaneously. Under this scenario, the boiler will operate to the highest setpoint of the concurrently operating zones.	1st
Zone Priority Time	4.8.6	Length of time that the boiler will service a zone with higher priority, while another zone with lower priority is calling, before switching to service the zone with lower priority. Setting is common to all zones. (Range = 0-1440min)	10 min

* Parameter numbers starting with 4 are for Zone 1; substitute the 4 with a 5 (for Zone 2); 6 (for Zone 3); 14 (for Zone 4); 15 (for Zone 5) or 16 (for Zone 6) for equivalent respect zone parameter.

Table 16-4 CH Setup – show Heating Curve (Applicable to selected zone)

Setting	Parameter*	Range/Description	Factory Setting
Max Temp	4.2.5	Max Temperature; see Table 16-1	140°F
Min Temp	4.2.6	Min Temperature; see Table 16-1	95°F
Slope	4.2.2	Heating Curve Slope; see Table 16-3	1.1
Offset	4.2.3	Heating Curve Offset; see Table 16-14 (a)	0
Room Influ	4.2.4	Room Sensor Influence; see Table 16-3	2
AUTO Temp Contrl Mode	4.2.1	AUTO Temperature Control Mode; see Table 16-1	Outdoor Temp
Room Temp Simulation	NA	Simulates a room temperature for zone 1, to show the impact on the heating curve. Only applicable when using an NTI Room Sensor. (Range = 50-90°F)	70°F

* Parameter numbers starting with 4 are for Zone 1; substitute the 4 with a 5 (for Zone 2); 6 (for Zone 3); 14 (for Zone 4); 15 (for Zone 5) or 16 (for Zone 6) for equivalent respect zone parameter.

Table 16-5 CH Setup – General Advanced Settings (Applicable to all heating zones)

Setting	Parameter	Range/Description	Factory Setting
CH On-Differential Temperature	24.21.1	Determines how much the boiler outlet temperature can drop below target before turning the burner back on. (Range = 0-40°F)	15°F
CH Start Delay	24.21.5	Sets the delay of the initialization of the burner and SYSTEM & BOILER pumps after a central heating call is applied. Can be used to give zone valves an opportunity to fully open. (Range = Disabled/10sec/90sec/210sec)	Disabled
CH Anti-cycle Time Mode	24.21.3	**Manual** – burner CH anti-cycle time is set manually via setting CH Anti-cycle Time. **Automatic** – the minimum amount of time burner must remain off between CH burner on cycles is set automatically.	Automatic
CH Anti-cycle Time	24.21.4	With CH Anti-cycle Time Mode set to Manual, determines the minimum amount of time the burner must remain off between CH burner on cycles. (Range = 0-240min)	5 min
CH Setpoint Ramp-up	24.4.4	Limits the rate at which the boiler setpoint temperature increases. Upon receiving a CH request the boiler setpoint is limited to the greater of the minimum setpoint temperature and the current boiler temperature; the setpoint then increases at a rate equal to this setting, until the normal setpoint is achieved. Note: a setting of zero disables this function. (Range = 0-27°F)	0°F/min
Max CH Power	24.0.3	Establishes the maximum power the burner will operate at for CH demands. (Range = 0-100%)	100%
Antifreeze Function	24.20.8	If enabled: - when the boiler temp drops below 46°F, the boiler, system and zone pumps are turned on in 2-minute intervals - when the boiler temp drops below 39°F, the burner is operated at min power for 15 minutes, with switch off/on temperatures of 104/95°F	Enabled
Outdoor Temp Correction	24.4.1	Allows the operator to adjust/offset the outdoor temperature reading in case the reading from the sensor or Internet weather is incorrect. (Range = -10-10°F)	0°F
CH Boost Delay Interval	24.4.2	Sets the time delay between the automatic adjustments of the boiler target temperature in increments of +/- 7°F. Only applicable when the AUTO Temperature Control Mode = Basic On/Off	16 min

16.3.2.2 DHW Setup

Navigate the DHW menus as illustrated in Figure 16-9. Tables 16-6 through 16-8 provide a description of each menu option.

Figure 16-9 DHW Setup

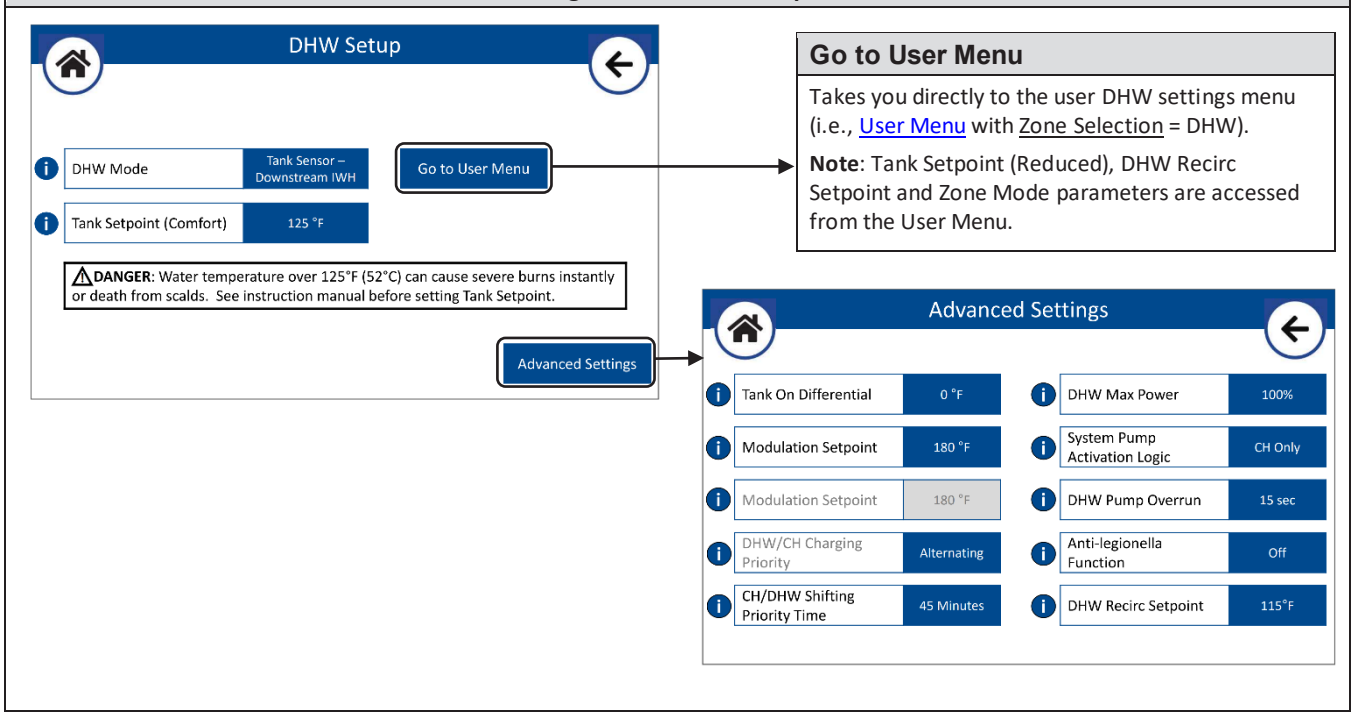


Table 16-6 DHW Setup

Setting	Parameter	Range/Description	Factory Setting
DHW Mode	24.5.2 24.5.3	Setting defines for the boiler control which is the configuration of the DHW Indirect Water Heater (IWH): **Tank Sensor-Upstream IWH** – boiler is expecting a temperature sensor reading from an IWH that is located upstream (boiler side) of the hydraulic separator. **Aquastat-Upstream IWH** – boiler is expecting an on/off switch input from an IWH that is located upstream (boiler side) of the hydraulic separator. **Tank Sensor-Downstream IWH** – boiler is expecting a temperature sensor reading from an IWH that is located downstream (system side) of the hydraulic separator. **Aquastat-Downstream IWH** – boiler is expecting an on/off switch input from an IWH that is located downstream (system side) of the hydraulic separator. **Off** – DHW is disabled Note: the boiler will automatically switch to Tanks Sensor if a sensor is connected to *DHW Switch/NTC.*	Aquastat-Downstream IWH
Tank Setpoint (Comfort)	24.5.0	Establishes the target temperature of the DHW tank (IWH) during Comfort time period. Setting is only applicable when DHW Mode is set to Tank Sensor. (Range = 50-190°F)	125°F

Table 16-8 DHW Setup – Advanced Settings

Setting	Parameter	Range/Description	Factory Setting
Tank On Differential	24.21.0	Sets how much the DHW storage tank temperature can drop below target before initiating a DHW demand. Only applicable when using a Tank Sensor. (Range = 0-36°F)	0
Modulation Setpoint	24.20.0	Boiler outlet water temperature target during DHW demands. (Range = 68-190°F)	180°F
Modulation Setpoint	25.2.7	System water temperature target during DHW demands serviced by a cascade system. Only applicable for Manager boiler, and with DHW configured as Downstream IWH. (Range = 68-190°F)	180°F
DHW/CH Charging Priority	24.5.9	**Alternating** – DHW and CH will not operate simultaneously. Priority switches between DHW and CH at an interval defined by the DHW/CH Shifting Priority Time (first priority is DHW); if set to 0, then DHW has priority indefinitely. **None-Absolute** – DHW and CH operate simultaneously for the period defined by the DHW/CH Shifting Priority Time. After the time elapses, priority switches to DHW until the DHW request ends. **None** – DHW and CH can operate simultaneously indefinitely. Only applicable for DHW Mode configured as Downstream IWH; Upstream IWH configuration always functions as Alternating	Alternating
DHW/CH Charging Priority Time	24.4.8	Determines how long a CH or DHW demand can last before the priority is switched. A value of 0 keeps the priority with DHW indefinitely. (Range = 0-720min)	45 min
DHW Max Power	24.0.8	Establishes the maximum power the burner will operate at for DHW demands. (Range = 0-100%)	100%
System Pump Activation Logic	24.4.6	**Always Active** – SYSTEM PUMP output (AUX2) turns on for both CH and DHW demands (with DHW Mode set to Downstream). **CH Only** – SYSTEM PUMP output (AUX2) only turns on for CH demands.	CH Only
DHW Pump Overrun Time	24.3.6	Sets the length of time the DHW PUMP output operates after a DHW demand is satisfied. (Range = 0-255sec)	15sec
Anti-legionella Function	24.5.4	This function prevents the formation of Legionnaires' disease bacteria which may develop in piping and IWHs at temperature between 68°F and 104°F. When set to On, if the IWH temperature stays below 138°F for over 100 hours, the boiler will heat the water in the IWH until it reaches 149°F for 30 minutes. Only applicable when a Tank Sensor is used.	Off
DHW Recirc Setpoint	24.20.6	See Table 16-14 (c)	115°F

16.3.2.3 Cascade Setup

The Cascade Setup menu must be accessed to set the Boiler Address of each boiler that will be configured as part of a cascade system; see section 11.0 CASCADE INSTALLATION. Once the cascade system is configured, the Cascade Setup menu of the Manager boiler can be accessed to modify the operation of the cascade system. For Follower boilers in cascade, the Cascade Setup menu can be accessed to modify the Emergency Setpoint or Burner Run Hours Harmonization settings.

Figure 16-10 Cascade Setup Menu

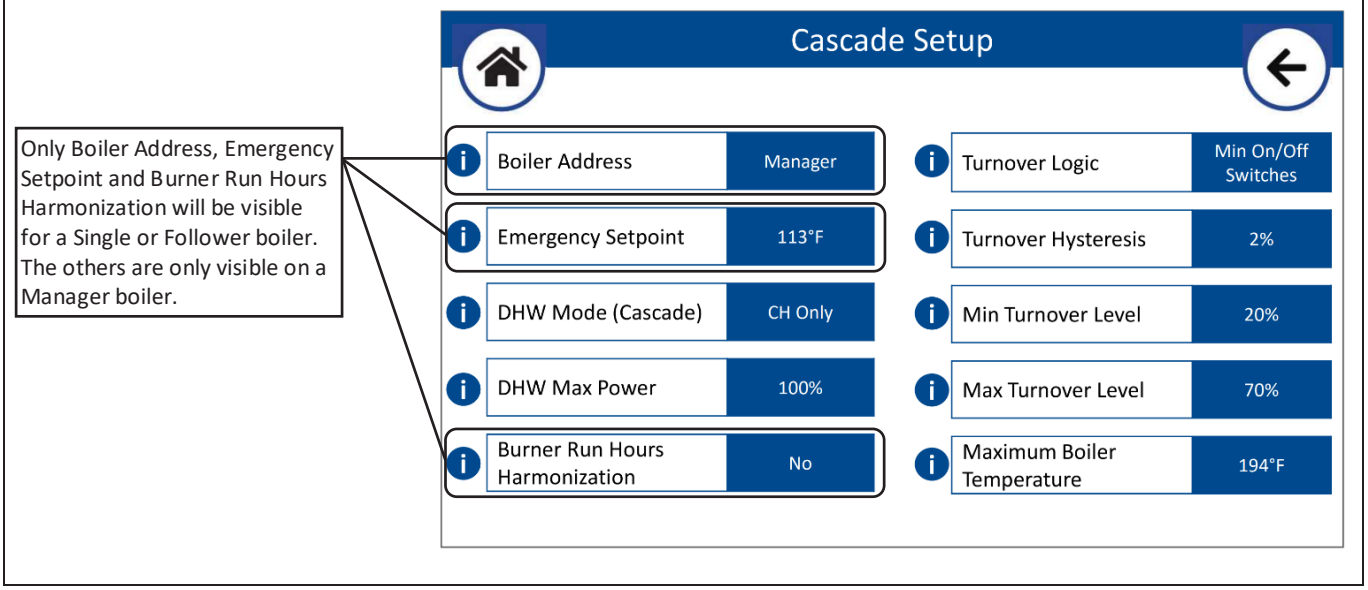


Table 16-9 Cascade Setup

Setting[1]	Parameter[2]	Range/Description	Factory Setting
Boiler Address	0.4.6	Establishes the configuration and role of the given boiler on the communication BUS: **Unconfigured** – boiler will only operate in Emergency mode. Boilers connected on the communication BUS, without one configured as Manager, will eventually default to Unconfigured. Default setting for replacement controllers. **Single Boiler** – for "stand alone" boilers, that are not connected to other boilers via the communication BUS. **Manager Boiler** – for the managing boiler in a cascade of multiple boilers. Only one boiler in a cascade can be configured as Manager. **Follower Boiler 1...7** – for non-managing boilers in a cascade of multiple boilers. Each Follower in the cascade must have a unique address, i.e., 1...7. Note: for boilers already configured as a Follower Boiler, setting options Single Boiler and Manager Boiler will not be available. To make them available, first set the Follower Boilers as Unconfigured and disconnect it from other boilers on the BUS.	Single Boiler
Emergency Setpoint	24.0.7/ 26...32.0.7	Sets the boiler operating temperature when there is a malfunction of the BUS circuit. Applicable for Unconfigured and Follower boilers when the cascade Manager is not connected on the BUS.	113°F

(Continued...)

Table 16-9 Cascade Setup *(…Concluded)*

Setting[1]	Parameter[2]	Range/Description	Factory Setting
DHW Mode (Cascade)*	25.2.2	Applicable to an IWH that is installed downstream (system side) of the hydraulic separator, which is serviced by the entire cascade. Set as CH Only if there isn't a downstream IWH serviced by the entire cascade. **CH Only –** cascade system will not service the DHW request. **Tank Sensor** – cascade manager is expecting a temperature sensor reading from a Downstream IWH. **Aquastat** – cascade manager is expecting an on/off switch input from a Downstream IWH located	CH Only
DHW Max Power*	25.0.1	Establishes the maximum power the total cascade will operate at for DHW demands.	100%
Burner Run Hours Harmonization	24.9.4/ 26…32.9.4	Sets the burner run hours statistics to equal the average of the other boilers in the cascade. Perform this function ONLY on the boiler where the PCB has just been replaced. Settings is not applicable for Single boilers.	No
Turnover Logic*	25.0.2	Sets the power division algorithm for the cascade. **Min Off-On Switches** – when more than one boiler is servicing the demand, one is subtracted (switched off) when the required power is less than the sum of the active boilers operating at the Min Turnover Level. Generally, results in a greater number of boilers operating at a lower power level. **Max Power Division** – when more than one boiler is servicing the demand, one is subtracted (switched off) when the required power could be achieved by one fewer boilers operating at or below the Max Turnover Level. Generally, results in a fewer number of boilers operating at a higher power level. In each scenario a new boiler is added (switched on) when the required power is greater than the sum of the active boilers operating at the Max Turnover Level.	Min Off-On Switches
Turnover Hysteresis*	25.0.3	Sets the amount the required power level must drop below Min Turnover Level before a boiler is switched off. See Min Turnover Level. (Range = 0-20%)	2%
Min Turnover Level*	25.0.4	Sets the minimum power level for multiple boilers operating together in a cascade. If the required power is less than the sum of the active boilers operating at the Min Turnover Level (less the Turnover Hysteresis) a boiler is switched off. To avoid short cycling, ensure the Min Turnover Level is set to less than half of the Max Turnover Level setting. Only applicable when Turnover Logic = Min Off/On Switches. (Range = 20-MaxTurnoverLevel)	30%
Max Turnover Level*	25.0.5	Sets the maximum power level for operable boilers when not all boilers in cascade are switched on. If the required power is greater than the sum of the active boilers operating at the Max Turnover Level, then the next boiler is switched on. (Range = MinTurnoverLevel-100%)	65%
Maximum Boiler Temperature*	25.0.6	Establishes the maximum permissible operating temperature for the individual cascade boiler. Higher temperatures will cause the individual boiler to switch off. (Range = 68-199°F)	199°F

Notes:
1. Settings marked with an asterisk (*) are only applicable for the Manager boiler.
2. The parameter number for some Follower boiler settings will begin with 26-32 (instead of 24 or 25); 26 for Follower Boiler 1, 27 for Follower Boiler 2 and so on. Follower boiler settings are available from the "NTI net" webapp, and from the Complete Menu of the Manager boiler by entering the applicable parameter number.

16.3.2.4 Pump Control Settings

Access the Pump Control Settings screen to set the overrun time of the boiler, system, and zone pump outputs, configure AUX1 & AUX2 outputs, or to setup the variable speed pump control.

Note: the overrun time for the DHW pump output is configured from the DHW Setup -> Advanced Settings screen.

Figure 16-11 Pump Control Settings Menu

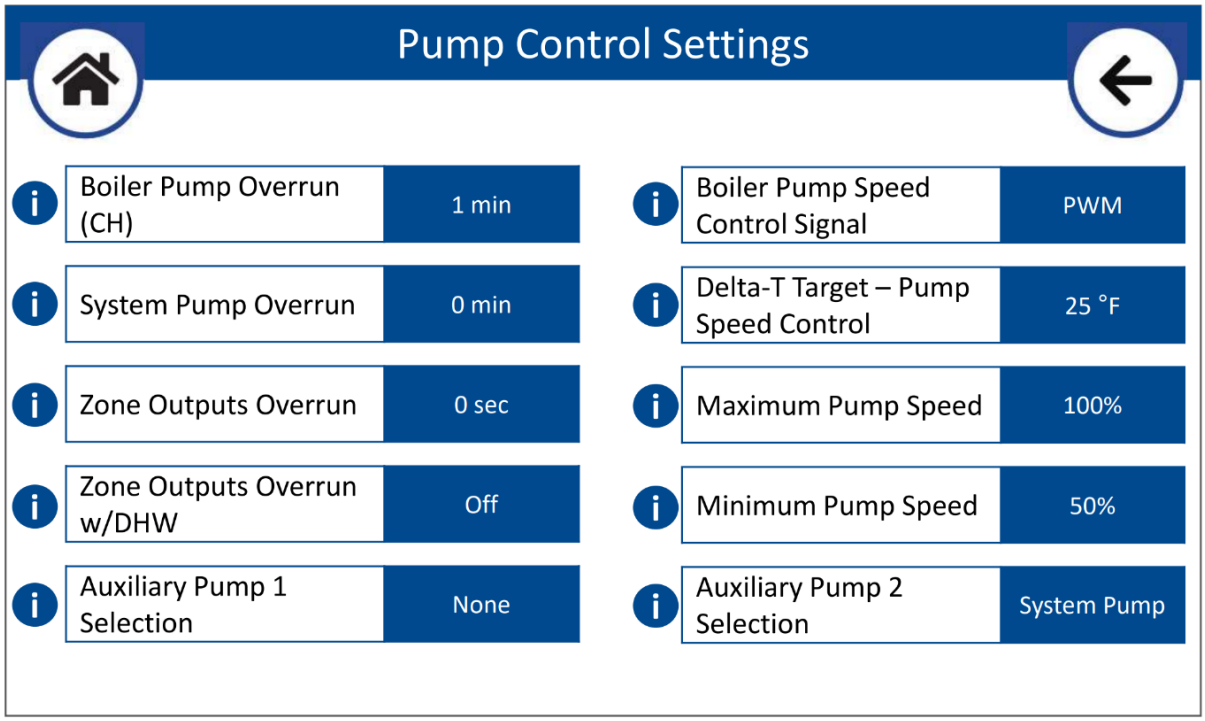


Table 16-10 Pump Control Settings

Setting	Parameter	Range/Description	Factory Setting
Boiler Pump Overrun (CH)	24.3.2	Sets the post circulation time for the boiler pump following a CH demand. (Range = 0-255min; 255 = Always on)	1 min
System Pump Overrun	24.4.5	Sets the post circulation time for the system pump following a demand. (Rang = 0-255sec)	0 sec
Zone Outputs Overrun	7.2.8	Sets how long the zone outputs remain energized following the end of the respective zone demand. (Range = 0-7200sec)	0 sec
Zone Outputs Overrun During DHW	7.2.9	**On** – allows the Zone Outputs Overrun to occur during a concurrent DHW demand. **Off** – the Zone Outputs Overrun is aborted if a DHW demand occurs.	Off

(Continued…)

Table 16-10 Pump Control Settings *(…Concluded)*

Setting	Parameter	Range/Description	Factory Setting
Auxiliary Pump 1 Selection	24.7.0	Sets the functionality of output AUX1 120VAC. **System Pump** – powers during CH demands. Will also power during Downstream IWH demands if System Pump Activation Logic, in the Advanced Settings screen of the DHW Setup menu, is set as Always Active. **DHW Recirc** – powers during DHW Recirc demands; see setting Auxiliary Sensor 2 in the Sensor Configuration menu for setup of a DHW Recirc sensor. **Buffer Tank** – powers during Buffer Tank demands; see settings Auxiliary Sensor 1 and Auxiliary Sensor 2 in the Sensor Configuration menu for setup of a Buffer Tank sensor. **Cascade Pump** – powers when the boiler is commanded to serve the cascade system (i.e., cascade CH/DHW). Only applicable for a cascaded boiler that is also connected to an Upstream IWH.	None
Boiler Pump Speed Control Signal	24.3.4	Sets the type of signal that the boiler will output to drive the speed of a variable speed boiler pump to achieve a delta-T equal to the Delta-T Target - Pump Speed Control setting. **0-10V** – connect to VAR. PUMP terminals "+" and "return" (in arrow). **PWM** – connect to VAR. PUMP terminals "-", "return" and "out" (out arrow).	PWM
Delta-T Target – Pump Speed Control	24.3.5	Sets the delta-T target for the boiler when using Boiler Pump Speed Control Signal to control the speed of a variable speed boiler pump. (Range = 5-45°F)	25°F
Maximum Pump Speed	24.3.0	Sets the maximum control signal to the boiler pump when using Boiler Pump Speed Control Signal to control the speed of a variable speed boiler pump. (Range = MinimumPumpSpeed-100%)	100%
Minimum Pump Speed	24.3.1	Sets the minimum control signal to the boiler pump when using Boiler Pump Speed Control Signal to control the speed of a variable speed boiler pump. (Range = 20-MaximumPumpSpeed)	50%
Auxiliary Pump 2 Selection	24.7.1	Sets the functionality of output AUX2 120VAC. **System Pump** – powers during CH demands. Will also power during Downstream IWH demands if System Pump Activation Logic, in the Advanced Settings screen of the DHW Setup menu, is set as Always Active. **DHW Recirc** – powers during DHW Recirc demands; see setting Auxiliary Sensor 2 in the Sensor Configuration menu for setup of a DHW Recirc sensor. **Buffer Tank** – powers during Buffer Tank demands; see settings Auxiliary Sensor 1 and Auxiliary Sensor 2 in the Sensor Configuration menu for setup of a Buffer Tank sensor. **Cascade Pump** – powers when the boiler is commanded to serve the cascade system (i.e., cascade CH/DHW). Only applicable for a cascaded boiler that is also connected to an Upstream IWH.	System Pump

16.3.2.5 BMS Control

Access the BMS Control screen to configure the boiler to allow control of the burner firing rate or temperature setting from an external device, i.e., 0-10V signal applied to *0-10V IN*, or communication through the *BUS* connection from a 3rd party BMS via NTI BMS Gateway P/N: 3260186.

Note: BMS Control is only applicable for CH demands – not DHW demands. For cascade systems, the external input must be applied to the Manager boiler. Use of external control (0-10V or External) disables the boiler's 3-zone controller.

Figure 16-12 BMS Control Menu

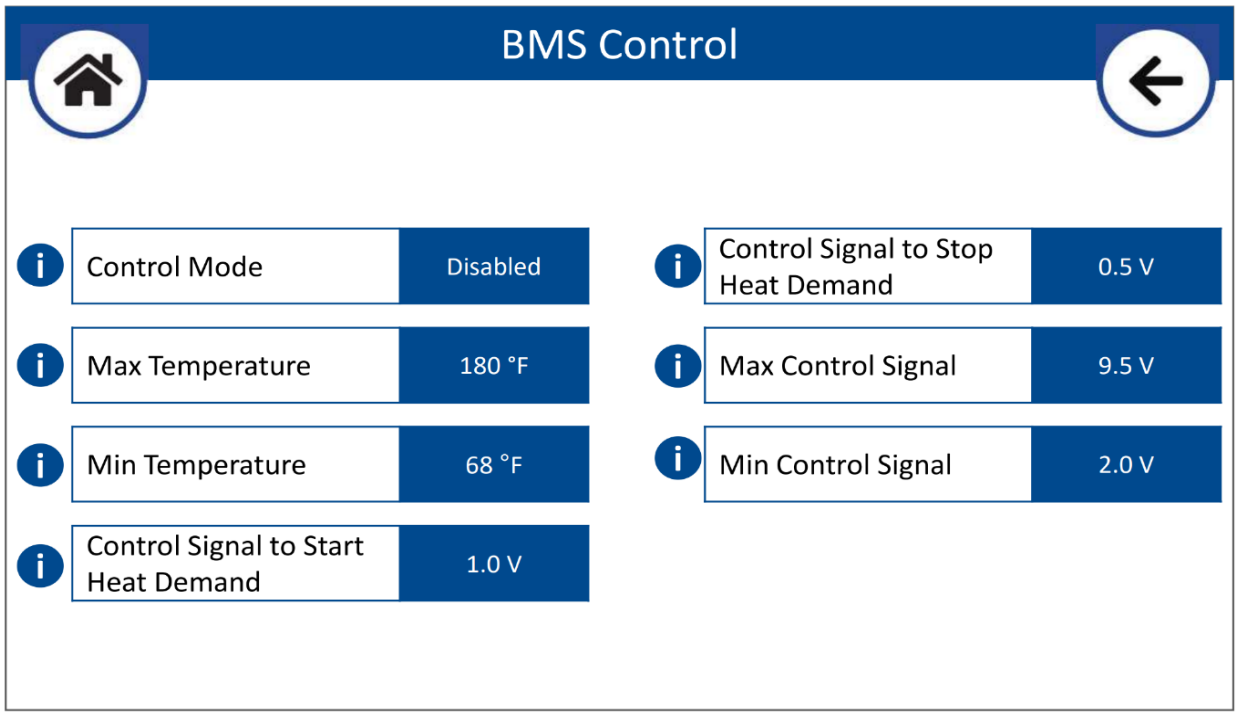


Table 16-11 BMS Control

Setting	Parameter	Range/Description	Factory Setting
Control Mode	42.0.0	**Disabled** – the boiler maintains control of the burner power and setpoint temperature. **0-10V (Power or Temp)** – the boiler power level, or setpoint temperature, is modulated proportionally to the *0-10V IN* signal. **External controller (power or temp)** – the boiler power level, or setpoint temperature, is controlled directly by a BMS communicating through the NTI BMS Gateway (3260186) connected to the *BUS*.	Disabled
Max Temperature	42.0.1	Sets the maximum boiler temperature, corresponding to an input signal equal to the Max Control Signal, when Control Mode is configured to 0-10V / Temp. (Range = Min Temperature to 190°F)	180°F
Min Temperature	42.0.2	Sets the minimum boiler temperature, corresponding to an input signal equal to the Min Control Signal, when Control Mode is configured to 0-10V / Temp. (Range = 68°F to Max Temperature)	68°F
Control Signal to Start Heat Demand	42.1.0	Sets the minimum input control signal required to start a heat demand. (Range = Control Signal to Stop Heat Demand to Min Control Signal)	1.0V
Control Signal to Stop Heat Demand	42.1.1	Sets the input control signal threshold where the heat demand is stopped. (Range = 0 to Control Signal to Start Heat Demand)	0.5V
Max Control Signal	42.1.2	Sets the control signal that correlates to the Max Temperature if Control Mode = 0-10V / Temp or max burner power if Control Mode = 0-10V / Power. (Range = Min Control Signal to 10.0V)	9.5V
Min Control Signal	42.1.3	Sets the control signal that correlates to the Min Temperature if Control Mode = 0-10V / Temp or min burner power if Control Mode = 0-10V / Power. (Range = Control Signal to Start Heat Demand to Max Control Signal)	2.0V

16.3.2.6 Restore/Backup

The factory settings are stored in memory in the PCB and can be restored at any time using the "Reset PCB to Factory Defaults Settings" option. After 30 minutes of the boiler first being powered on, the PCB settings are automatically backed up to the display memory for future use (i.e., in the event the PCB is replaced). The operator can at any time select to back up the PCB settings to, or restore the PCB settings from, the display memory, or an external memory (USB Flash Drive) connected to the USB port of the display. See Figure 16-13 and Table 16-12 for details.

Figure 16-13 Restore/Backup Menus

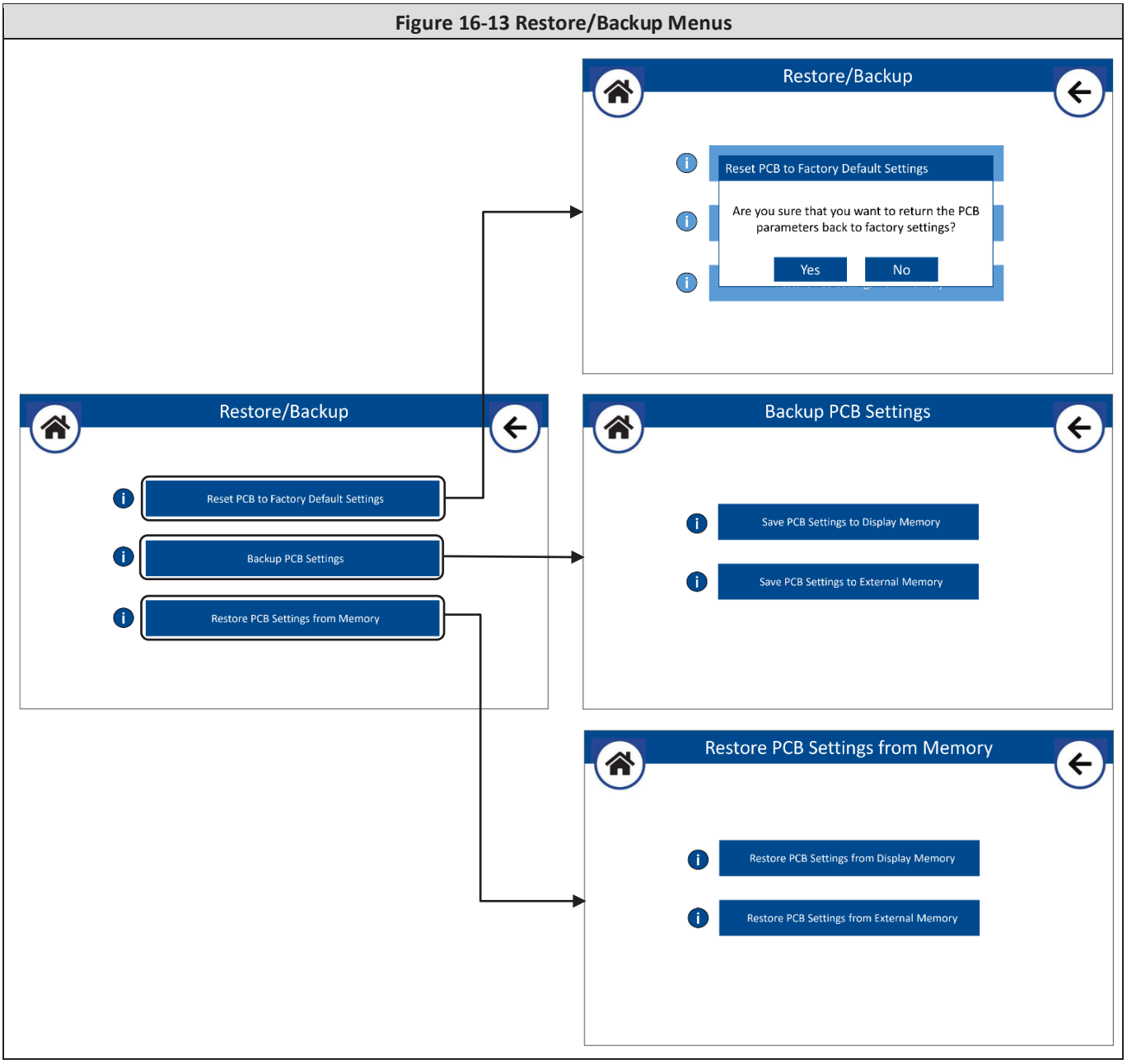


Table 16-12 Restore/Backup

Option	Parameter	Description
Reset PCB to Factory Default Settings	24.19.0	Resets the PCB setting to the values originally set on the PCB at the factory. Note: if it is a replacement PCB the settings will be reset to the default settings of a replacement PCB.

(Continued…)

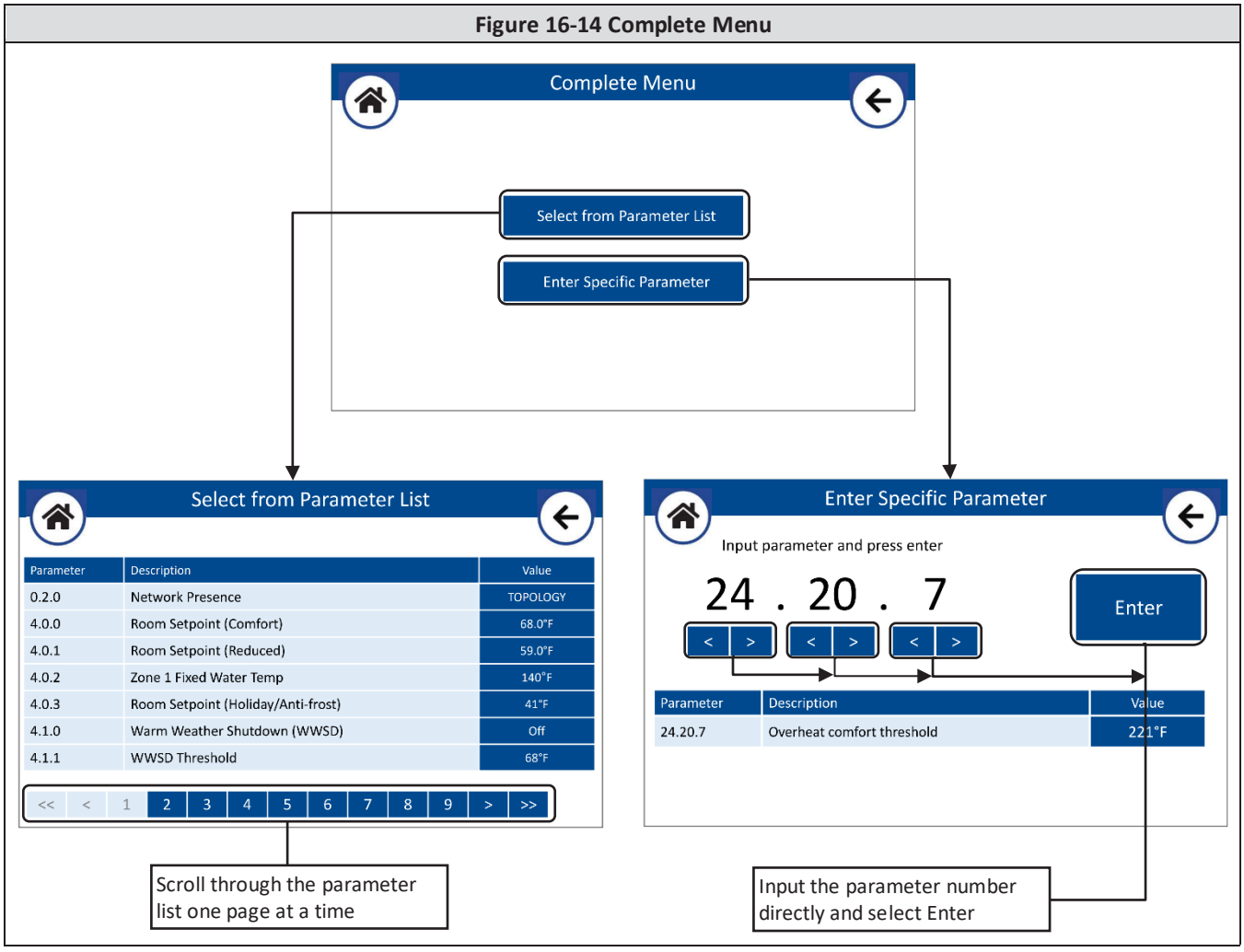
Table 16-12 Restore/Backup *(…Concluded)*

Option	Parameter	Description
Backup PCB Settings	NA	Select to back up the PCB settings to the display memory, or to a USB flash drive. **Save PCB Settings to Display Memory** – select to back up the PCB settings (locally) to the display memory, so they can be restored to the PCB later, i.e., in the event the PCB is replaced. **Save PCB Settings to USB** – Select to back up the PCB settings to a USB flash drive so they can be restored to the PCB later or to another boiler. **NOTE:** the process of saving PCB settings to a USB first, copies the PCB settings to the display memory, then transfers those settings to the USB.
Restore PCB Settings from Memory	NA	Select to copy the settings from the display memory or from a USB flash drive to the PCB. **Restore PCB Settings from Display Memory** – select to copy the settings from the display memory to the PCB. **Restore PCB Settings from USB** – select to start the process of copying the settings from a USB flash drive to the PCB. **NOTE**: selecting this feature copies the settings from a USB to the display memory (not to the PCB). When this process is complete it is necessary to transfer the settings from the display memory to the PCB using the Restore PCB Settings from Display Memory feature.

16.3.2.7 Complete Menu

The Complete Menu provides a direct access to all PCB parameters, including some that are not accessible from the other menus, and are generally only accessed by NTI technicians or installers needing to access advanced features. Parameters can be selected by scrolling the complete parameter list, or by entering the specific parameter number directly.

Figure 16-14 Complete Menu



16.3.2.8 Sensor Configuration

The Sensor Configuration menu must be accessed to configure the *AUX1 NTC* and *AUX2 NTC* inputs for use with a System, Buffer Tank, or DHW Recirc sensor; see Figure 16-15 and Table 16-13.

Figure 16-15 Sensor Configuration Menu

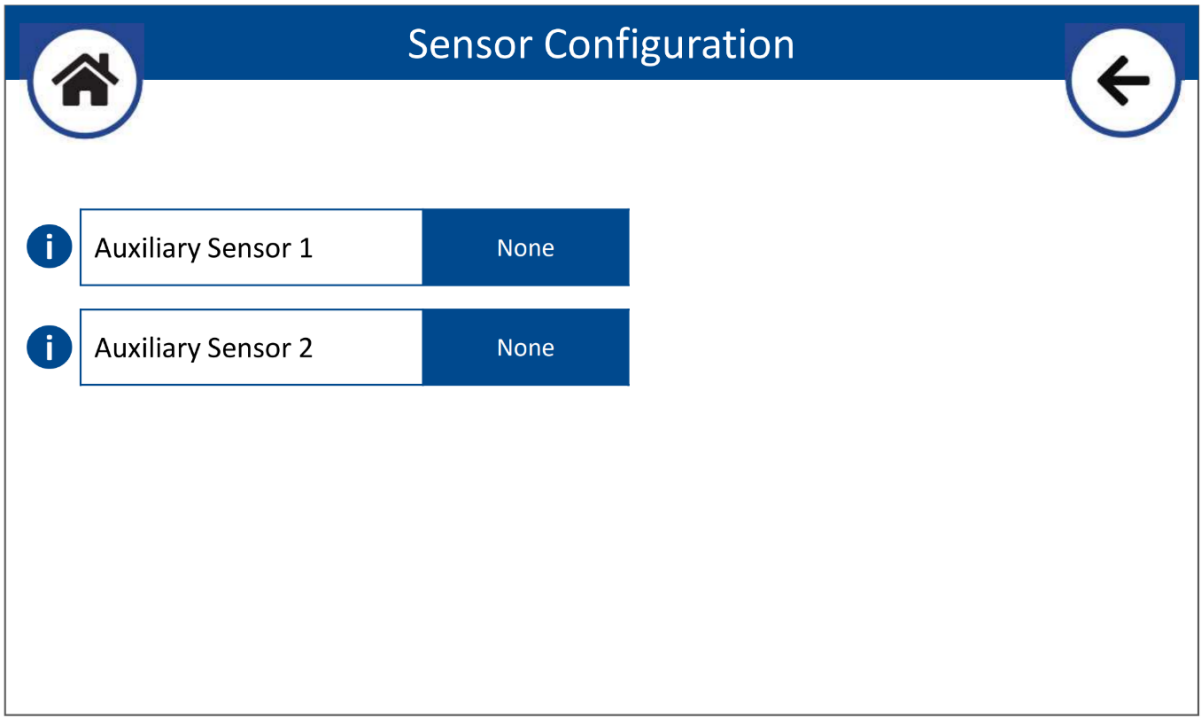


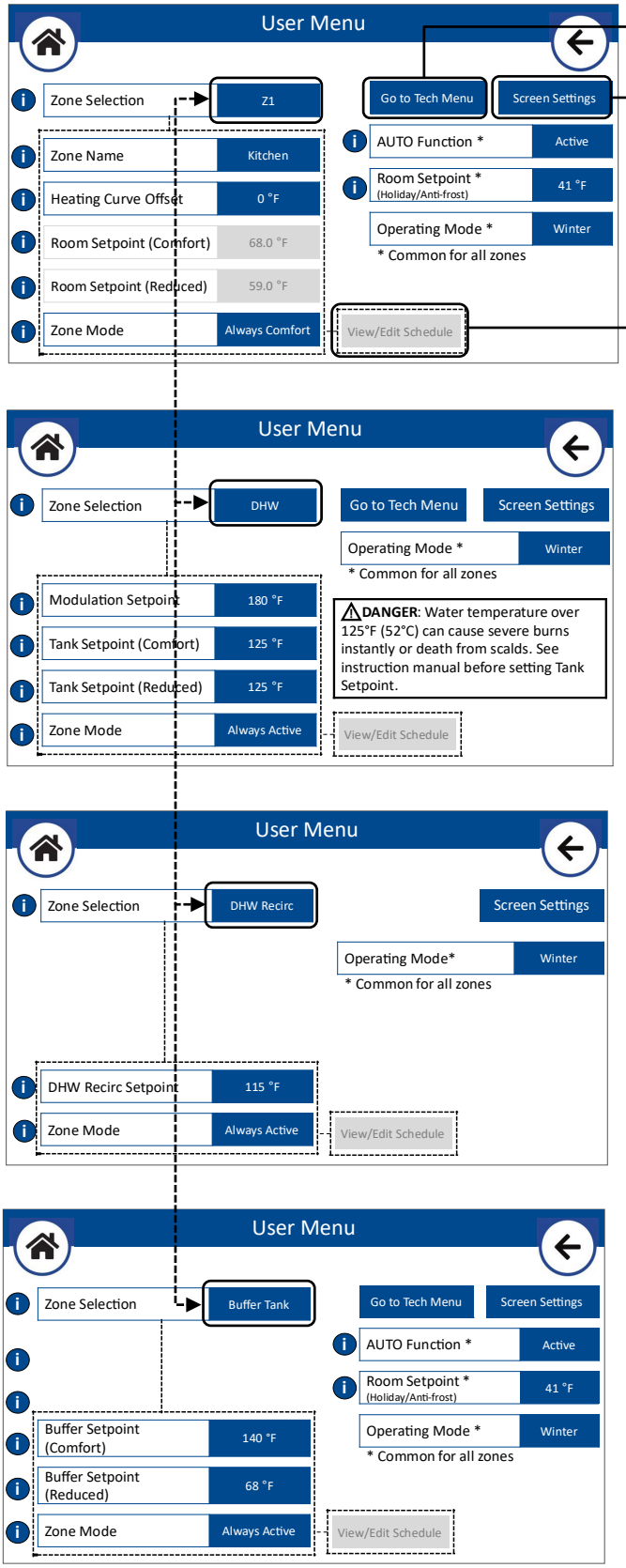
Table 16-13 Sensor Configuration

Setting	Parameter	Range/Description	Factory Setting
Auxiliary Sensor 1	24.6.1	Sets the functionality of input *AUX1 NTC*. **None** – select if there is no sensor being connected to *AUX1 NTC* **System Sensor** – select if connecting a system temperature sensor to *AUX1 NTC* for direct boiler control of the system supply temperature. **Buffer Tank** – select if connecting a buffer tank temperature sensor to *AUX1 NTC* for direct boiler control of the temperature of an external buffer tank. Sensor must be 10k beta = 3977 NTC; an optional strap-on System Sensor is available from NTI (P/N 84010).	None
Auxiliary Sensor 2	24.6.2	Sets the functionality of input *AUX2 NTC*. **None** – select if there is no sensor being connected to *AUX2 NTC* **DHW Recirc** – select if connecting a DHW recirculation temperature sensor to *AUX2 NTC* for direct boiler control of a recirculation loop connected to the DHW IWH. **Buffer Tank** – select if connecting a buffer tank temperature sensor to *AUX2 NTC* for direct boiler control of the temperature of an external buffer tank. Sensor must be 10k beta = 3977 NTC; an optional strap-on System Sensor is available from NTI (P/N 84010).	None

16.3.3 User Menu

The User Menu can be accessed without entering the technician passcode and allows for adjustment of user specific settings (i.e., Room Setpoints and Zone Mode) and some more advanced settings (i.e., DHW Tank Setpoint and CH Heating Curve Offset/Fixed Water Temp). Use the Zone Selection option to pick the zone settings to be accessed.

Figure 16-16 User Menu Navigation



Go to Tech Menu

Takes you directly to the technical menu for the respective Zone Selection (not appliable for Zone Selection = DHW Recirc).

Note: you will be prompted to enter the passcode if it had not been entered within the last 30 minutes; see section 16.3.1 Setup Wizard.

Screen Settings

Allows user to select the preferred language and units.

System unit of measurement: user can select between customary US or International system units. Default = US system

Language: use can select from a list of 22 languages. Default = American English

View/Edit Schedule

Enters the Schedule menu where the user can create/view/edit a 7-day time program schedule for the selected zone. The same schedule can be viewed/edited (or created) by the end user via the "NTI net" mobile App if the boiler is registered to his/her account.

Note: The View/Edit Schedule menu is reserved for a newer release of the display software and is presently not accessible.

Table 16-14 (a) User Menu (with Zone Selection = Z1)

Setting	Parameter*	Range/Description	Factory Setting
Zone Selection	NA	Allows selection of the zone that you would like to view/modify; options are Z1, Z2, Z3, DHW, DHW Recirc & Buffer Tank. **Note**: options extend to Z4, Z5 & Z6 if using an NTI N-Link ZC3 zone controller, or for cascade application.	Z1
Zone Name	NA	Allows the user to select a unique name for each central heating (CH) zone.	Zone #
Heating Curve Offset *(if AUTO = Active)*	4.2.3	Provides a means to offset (+/-) the calculated reset boiler target temperature up or down. (Range = -25-25) **Note**: the setting has no impact if Auto Slope Boost = On. **Note**: settings changes to Zone 1 Fixed Water Temp if AUTO Temperature Control Mode = Active	0
Zone # Fixed Water Temp *(if AUTO = Not Active)*	4.0.2	Boiler target setpoint for CH zone 1 demand. (Range = 4.2.6-4.2.5). **Note**: settings changes to Heating Curve Offset if AUTO Temperature Control Mode = Not Active	4.2.5
Room Setpoint (Comfort)	4.0.0	Room temperature setpoint for selected zone during Comfort time period. Only applicable when using an NTI Room Sensor. (Range = 50-86°F)	68°F
Room Setpoint (Reduced)	4.0.1	Room temperature setpoint for CH zone 1 during Reduced time period. Only applicable when using an NTI Room Sensor. (Range = 50-86°F)	59°F
Zone Mode	4.0.4	Allows the user to select the type of schedule for the selected zone/demand. For heating zones, only applicable when using an NTI Room Sensor: **Always Off** – disabled…boiler ignores demand. **Always Comfort** – temperature is always maintained at the Comfort setpoint. **Always Reduced** – temperature is always maintained at the Reduced setpoint. **Time Program** – temperature setpoint toggles between the Comfort and Reduced setpoints according to the defined time program (see View/Edit Schedule)	Always Comfort
AUTO Temperature Control Mode	24.4.0	Allows the user to globally enable/disable the Automatic Temperature Control Mode.	Active
Room Setpoint (Holiday/Anti-frost)	4.0.3	Sets the global room temperature setpoint during holiday or inactive periods. Only applicable when using an NTI Room Sensor. (Range = 35-75°F)	41°F
Operating Mode	NA	See section 16.2 Operating Mode	Winter

* Parameter numbers starting with 4 are for Zone 1; substitute the 4 with a 5 (for Zone 2); 6 (for Zone 3); 14 (for Zone 4); 15 (for Zone 5) or 16 (for Zone 6) for equivalent respect zone parameter.

Table 16-14 (b) User Menu (with Zone Selection = DHW)

Setting	Parameter	Range/Description	Factory Setting
Zone Selection	NA	Allows selection of the zone that you would like to view/modify; options are Z1, Z2, Z3, DHW, DHW Recirc & Buffer Tank. **Note**: options extend to Z4, Z5 & Z6 if using an NTI N-Link ZC3 zone controller, or for cascade application.	DHW
Modulation Setpoint	24.20.0	Boiler outlet water temperature target during DHW demands. (Range = 68-190°F)	180°F
Tank Setpoint (Comfort)	24.5.0	See Table 16-6	125°F
Tank Setpoint (Reduced)	24.20.9	Establishes the target temperature of the DHW tank (IWH) during Reduced time period. Setting is only applicable when DHW Mode is set to Tank Sensor. (Range = 50-190°F)	125°F
Zone Mode	24.5.1	Allows the user to select the type of schedule for heating the DHW tank. **Disabled –** boiler ignores DHW tank demands. **Time Program –** tank temperature setpoint toggles between the Comfort and Reduced setpoints according to the defined time program (see View/Edit Schedule). Only applicable when a tank sensor is utilized. **Always Active –** tank temperature is always maintained at the Comfort setpoint (if tank sensor is used), or at aquastat setpoint if aquastat is used.	Always Active
Operating Mode	NA	See section 16.2 Operating Mode	Winter

Table 16-14 (c) User Menu (with Zone Selection = DHW Recirc)

Setting	Parameter	Range/Description	Factory Setting
Zone Selection	NA	Allows selection of the zone that you would like to view/modify; options are Z1, Z2, Z3, DHW, DHW Recirc & Buffer Tank. **Note**: options extend to Z4, Z5 & Z6 if using an NTI N-Link ZC3 zone controller, or for cascade application.	DHW Recirc
DHW Recirc Setpoint	24.20.6	Establishes the target temperature of the DHW recirculation loop. (Range = 32-190°F)	115°F
Zone Mode	24.5.7 & 24.5.8	Allows the user to select the type of schedule for heating the DHW Recirculation loop. **Always Active** – DHW Recirc temperature is always maintained at the DHW Recirc setpoint **Time Program** – DHW Recirc temperature is maintained at the DHW Recirc setpoint while the DHW is in Comfort mode **DHW Recirc Time Program** – DHW Recirc temperature is maintained at the DHW Recirc setpoint according to the defined time program (see View/Edit Schedule). Note: If a DHW Recirc sensor is used, then the DHW Recirc pump turns off when the DHW Recirc setpoint is attained - otherwise the DHW Recirc pump remains on.	Always Active
Operating Mode	NA	See section 16.2 Operating Mode	Winter

Table 16-14 (d) User Menu (with Buffer Tank selected)

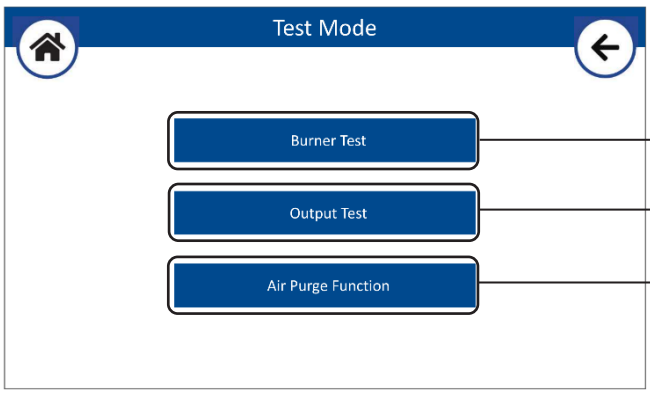
Setting	Parameter*	Range/Description	Factory Setting
Zone Selection	NA	Allows selection of the zone that you would like to view/modify; options are Z1, Z2, Z3, DHW, DHW Recirc & Buffer Tank. **Note**: options extend to Z4, Z5 & Z6 if using an NTI N-Link ZC3 zone controller, or for cascade application.	Buffer Tank
Buffer Setpoint (Comfort)	20.0.3	Buffer tank setpoint during Comfort time period. (Range = 50-190°F)	120°F
Buffer Setpoint (Reduced)	20.3.1	Buffer tank setpoint during Reduced time period. (Range = 50-190°F)	68°F
Zone Mode	20.3.0	Allows the user to select the type of schedule for heating the buffer tank. Only applicable when Buffer Tank Function is set as Fixed Temperature. **Always Off** – disabled…boiler ignores buffer tank demands. **Time Program** – buffer tank temperature setpoint toggles between the Comfort and Reduced setpoints according to the defined time program (see View/Edit Schedule). **Always Active** – Buffer tank temperature is always maintained at the Comfort setpoint.	Always Active
AUTO Temperature Control Mode	24.4.0	Allows the user to globally enable/disable the Automatic Temperature Control Mode.	Active
Room Setpoint (Holiday/Anti-frost)	4.0.3	Sets the global room temperature setpoint during holiday or inactive periods. Only applicable when using an NTI Room Sensor. (Range = 35-75°F)	41°F
Operating Mode	NA	See section 16.2 Operating Mode	Winter

* Parameter numbers starting with 4 are for Zone 1; substitute the 4 with a 5 (for Zone 2); 6 (for Zone 3); 14 (for Zone 4); 15 (for Zone 5) or 16 (for Zone 6) for equivalent respect zone parameter.

16.3.4 Test Mode

The Test Mode is a technical menu and therefore requires the user to enter the passcode “ntinet” if it had not been entered within the last 30 minutes; see section 16.3.1 Setup Wizard for details.

Figure 16-17 Test Mode Menu

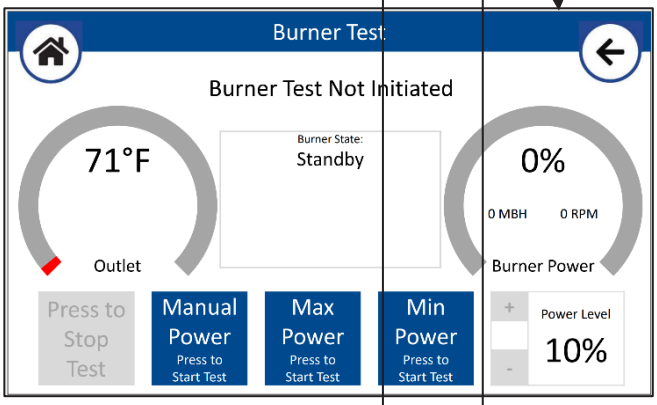


Burner Test

Select the burner power to be tested. If Manual Power is selected the operator can manually adjust the power level from the bottom-right of the screen. To stop the test, select “Press to Stop Test”. See section 9.0 GAS VALVE AND BURNER SET-UP for details.

Note: initiating burner test automatically turns on the Boiler, System and Zone pumps – there is no need to turn on a heating demand.

Note: the burner test is automatically cancelled if there is a blocking error, the Outlet temperature exceeds 185°F, if the Burner Test screen is exited, or after running for 30 minutes

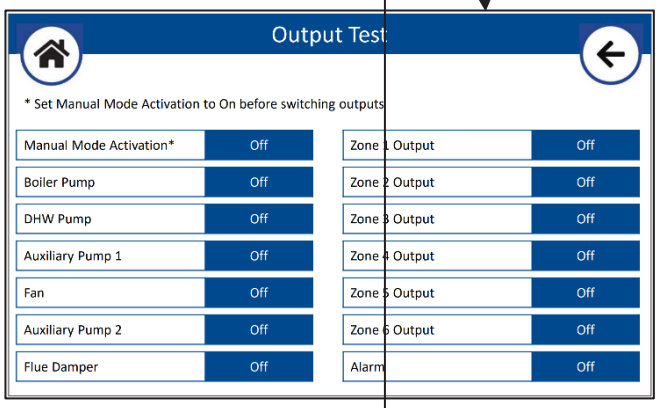


Output Test

Allows for manual operation of each of the boiler’s on/off outputs. Set Manual Mode Activation to On before switching the respective outputs On.

Note: the burner is automatically switched off when the output test is started.

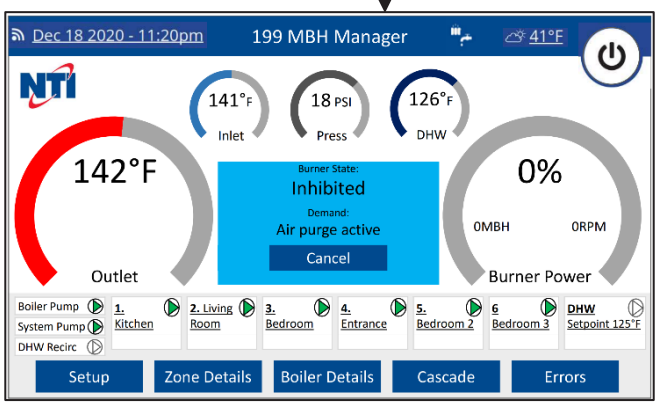
Note: the output test will run for 60 minutes or until Manual Mode Activation is switched off – even if the screen is exited.



Air Purge Function

Selecting causes the controller to perform the air purge sequence that is designed to purge air from the boiler water. The air purge sequence cycles the circulators off and on, for a period of 6 minutes (12 minutes for cascade systems), to help free air pockets that may exists in the heat exchanger and boiler piping. Press Cancel to stop the sequence and return to normal operation.

Note: burner operation is canceled for the duration of the air purged sequence.



16.3.5 Connectivity

The Connectivity menu will need to be accessed to connect the boiler to Wi-Fi unless you opted to "...connect your product to the internet..." from the Setup Wizard. See section 17.0 WI-FI CONNECTION for detailed instructions for connecting the boiler to Wi-Fi.

Figure 16-18 Connectivity Menu

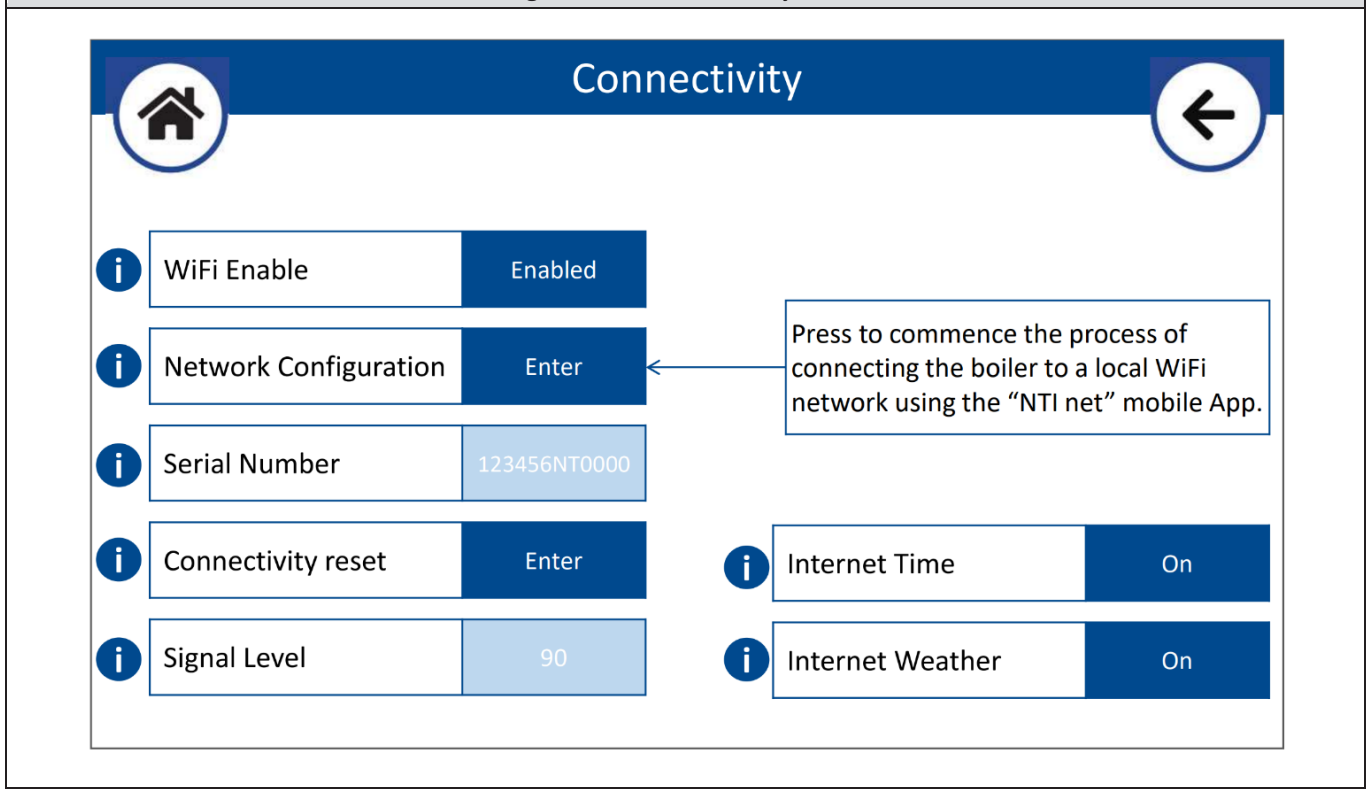


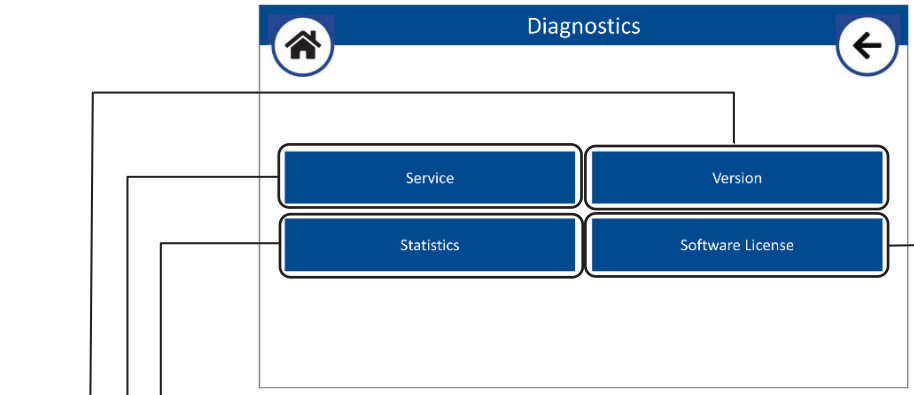
Table 16-15 Connectivity

Setting	Parameter	Range/Description	Factory Setting
Wi-Fi Enable	19.0.0	**On** – connection to Wi-Fi is possible **Off** – disconnects boiler from Wi-Fi	On
Network Configuration	NA	Select Enter to commence the process of connecting the boiler to a local Wi-Fi network using the "NTI net" mobile App	NA
Serial Number	19.1.3	Serial number of the boiler's Wi-Fi gateway. Serial number is required when registering the boiler on the "NTI net" connectivity platform.	NA
Connectivity reset	19.2.0	Select if you need to reconfigure the Wi-Fi connection, i.e., if you need to select a different Wi-Fi network. To re-establish Wi-Fi connection, enter the Network Configuration.	NA
Signal Level	19.1.1	Displays the Wi-Fi router signal strength.	NA
Internet Time	19.0.3	Set to "On" to have the time automatically set via the internet connection based on the boiler's entered address. Note: the address is entered when registering the boiler to an "NTI net" End User or Service Center.	Off
Internet Weather	19.0.4	Set to "On" to have the outdoor temperature reading acquired via the internet connection based on the boiler's entered address. Note: the address is entered when registering the boiler to an "NTI net" End User or Service Center.	Off

16.3.6 Diagnostics

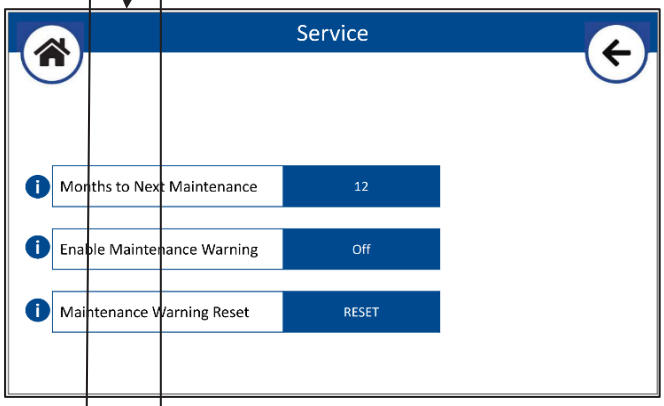
The Diagnostics menu provides access to the Maintenance Warning feature (Service), boiler operating statistics (Statistics), display and PCB software versions (Version), and a list of the open-source licenses used by the display (Software License).

Figure 16-19 Diagnostics Menu



Software License

Provides the open-source licenses of the software components used within the display.

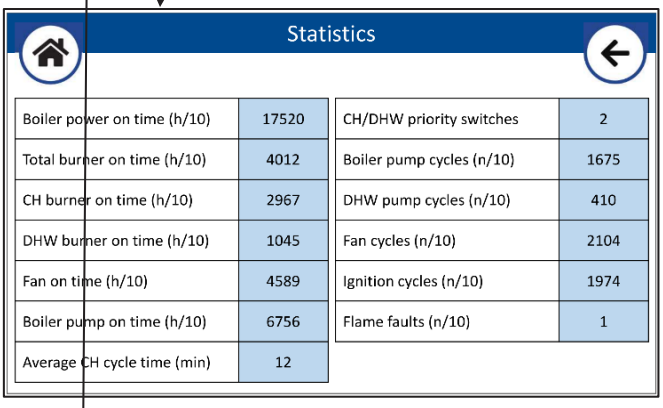


Service

Months to Next Maintenance (parameter 24.17.0): Sets the number of months until a Maintenance Warning is triggered; number counts down over time. Only applicable when Enable Maintenance Warning is set to On. Default = 12 months; Range = 0-24 months.

Enable Maintenance Warning (parameter 24.17.1): When set to On, a Maintenance Warning will occur at a frequency set by Months to Next Maintenance. Default = Off.

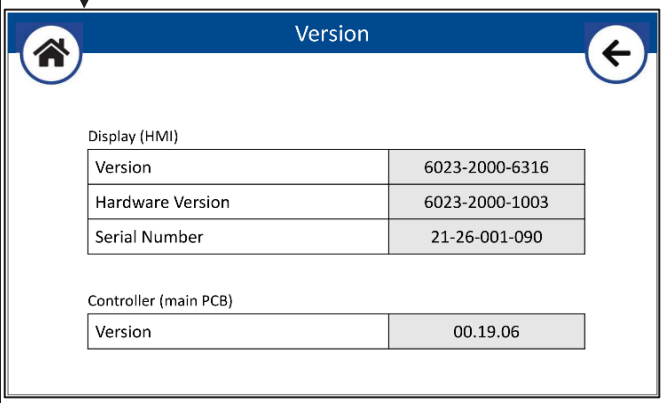
Maintenance Warning Reset (parameter 24.17.2): Press to reset the Months to Next Maintenance counter, i.e., after completing the scheduled maintenance of the appliance.



Statistics

List of all available boiler statistics stored on the main PCB. Values are read only.

Note: if the main PCB is replaced the values will be reset, i.e., revert to the statistics of the replacement PCB.



Version

Display (HMI): lists the software and hardware version, and serial number of the display.

Controller (main PCB): lists the software version of the PCB.

Note: the display software can be updated by inserting a USB flash drive, containing the new software, into the USB port of the display.

16.4 Zone Details

Figure 16-20 Zone Details Screen

Central Heating:

Lists the details and status of each of the CH zones. Note: Zone # 4-6 correspond to zones 1-3 of a second zone controller (applicable for cascade system or with N-link 3ZC).

Room Temp – current room temperature (only applicable for zones using NTI Room Sensor)

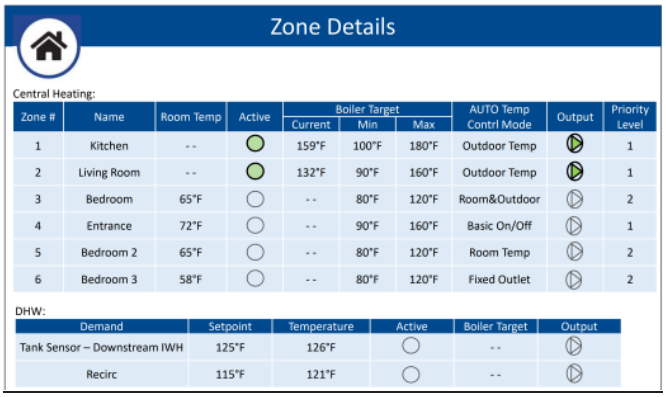
Active – status of the zone input; turns green when the zone is calling, and the Priority Level is current

Boiler Target – calculated (Current) boiler target temperature and possible range (Min/Max) dictated by the given zone. Adjustable via the CH Setup menu

Output – status of the zone output; turns green when the output is switched on

AUTO Temp Contrl Mode – adjustable via CH Setup

Priority Level – adjustable via CH Setup -> Advanced Settings



DHW:

Lists the details and status of the DHW Demands, IWH (Tank Sensor or Aquastat / Downstream or Upstream) and Recirc.

Setpoint – adjustable via DHW Setup and User Menu

Temperature – current temperature readings from *DHW SWITCH/NTC* and *AUX2 NTC*

Active – status of the demand; turns green when calling

Boiler Target – boiler target temperature dictated by the given zone. Adjustable via DHW Setup -> Advanced Settings option Modulation Setpoint. Not applicable for DHW Recirc.

Output – status of the DHW and DHW Recirc pumps.

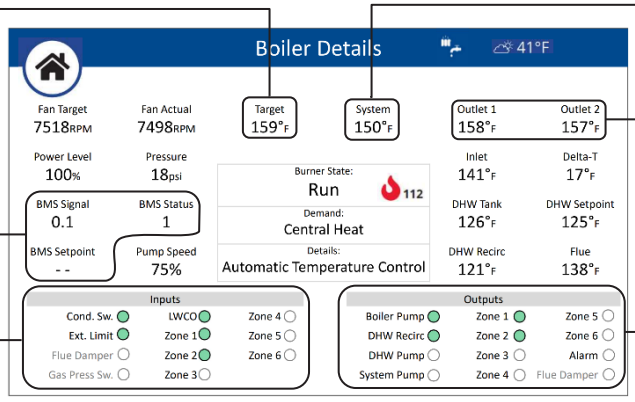
16.5 Boiler Details

Figure 16-21 Boiler Details Screen

Target – select to have the system walk you through a step-by-step setup procedure of the controller

BMS – only applicable when BMS Control Mode is set to 0-10V (Power/Temp)

Inputs – gives the status of each of the boiler's on/off inputs



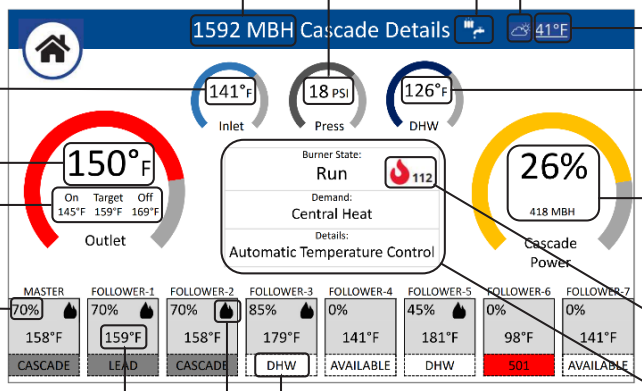
System – only visible when a sensor is connected to *AUX1 NTC* and Auxiliary Sensor 1 is set to System Sensor

Outlet 1,2 – readings from the boiler's duplex outlet sensor

Outputs – gives the status of each of the boiler's on/off outputs, green means on

16.6 Cascade

Figure 16-22 Cascade Details Screen



Inlet water pressure of lead boiler

Size of cascade – sum of all boilers in cascade

Inlet temperature of lead boiler

System temp (actual)

System temp target & burner on/off thresholds

Burner power of respective cascaded boiler

Outlet temp of respective cascaded boiler

Flame icon signifies that the respective cascaded boiler is firing

Operating Mode selection

Wi-Fi weather conditions

Outdoor temp – press to select Internet Weather or to disable AUTO Temperature Control Mode

DHW tank temp / Aquastat state (downstream IWH)

Cascade power level

Flame signal of Manager boiler

Cascade status widget

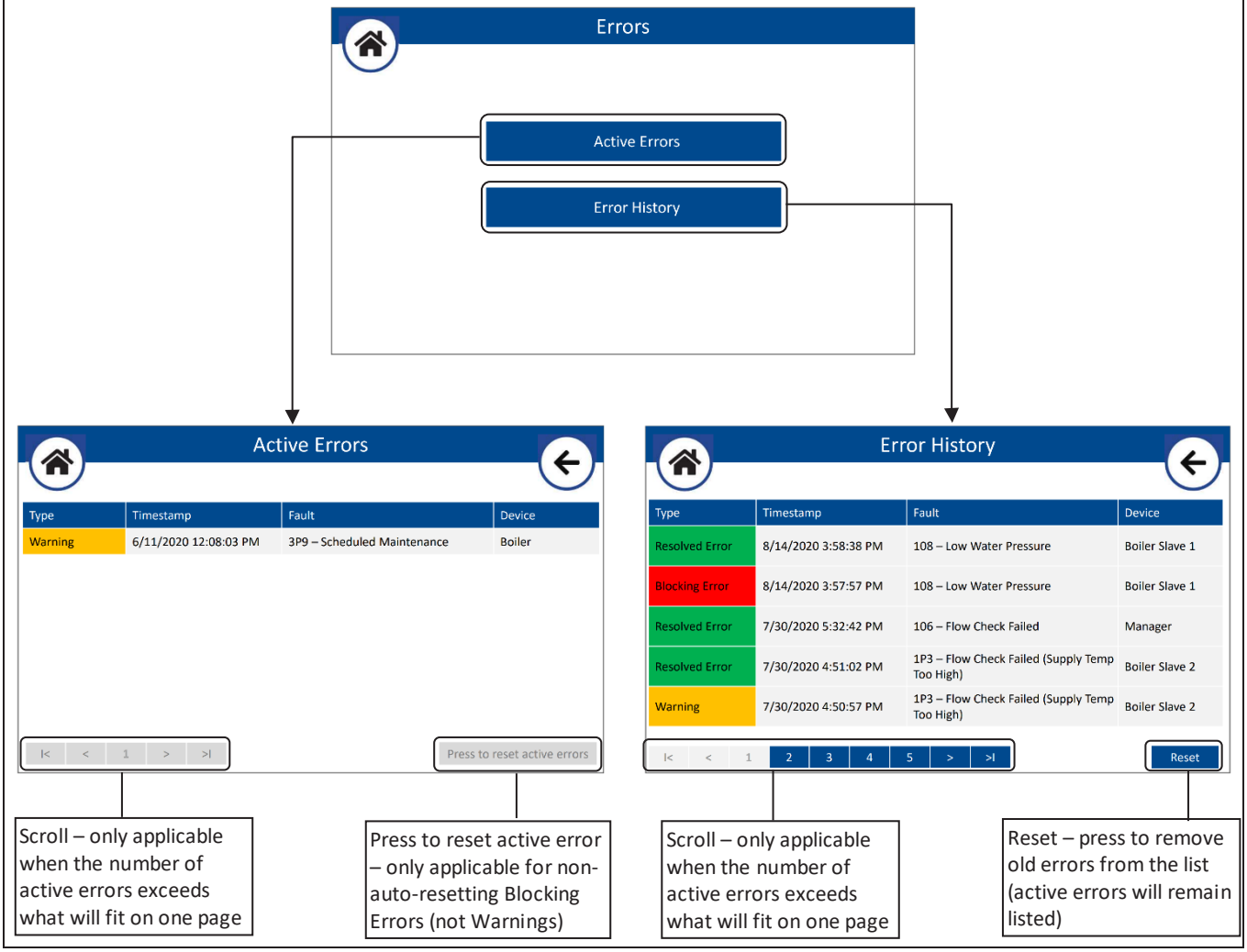
Operating status/availability of respective cascade boiler.

- Grey = servicing cascade
- Red = lockout
- White = DHW (local) or available

16.7 Errors

Active errors and error history are listed on the respective menu option screen selectable from the Errors menu. Each screen lists the type of error (Warning or Blocking Error), timestamp when each occurred, fault description, and device (Boiler, Manager, Boiler Slave 1,2…7) the error occurred on

Figure 16-23 Errors Menu



Part 17 - Wi-Fi Connection

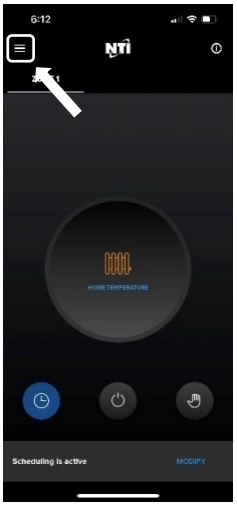
Before proceeding, download the "NTI net" mobile app to your smartphone and login with your "NTI net" credentials. The app guides you through the process of connecting the boiler to the local Wi-Fi Network and registering it to your "NTI net" (nti.remotethermo.com) account. If you do not have an "NTI net" account, visit ntiboilers.com and select the "NTI net" icon to register.

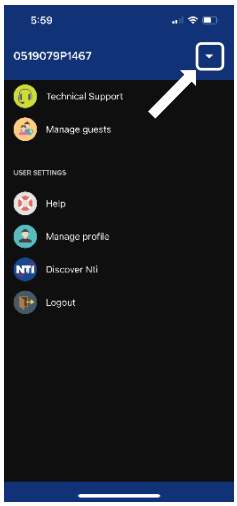
The function of the "NTI net" mobile app depends on the type of user; homeowners can manage connected appliance via the app (including setting and modifying heating schedules), while contactors can only use the app to connect and register appliances. As a result, the landing page when the app is opened will look different for homeowners and contractors:

- **Homeowners** – if you have logged into the app with a homeowner account, you will first need to navigate to the "Add product" page to begin the connection process; see Figure 17-1.
- **Contractors** – if logged into the app with a contractor account, the app will open on the "Add product" page; see Figure 17-2.

Figure 17-1 "NTI net" App – Navigating to the "Add Product Page" (Homeowner account only)

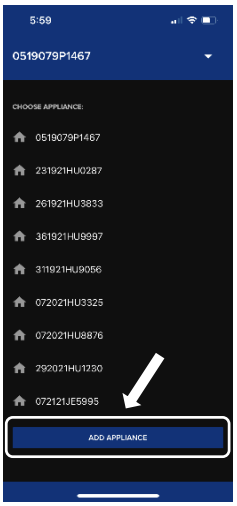
❶ Select the menu button in the top left of the screen

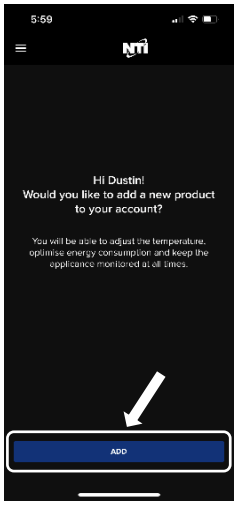




❷ Select the dropdown button to expose the ADD APPLIANCE button

❸ Select **ADD APPLIANCE**

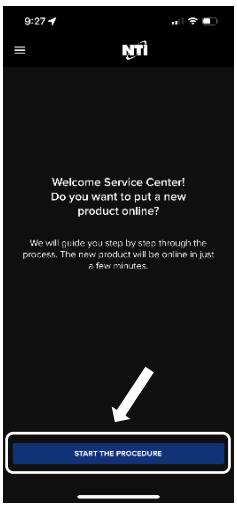


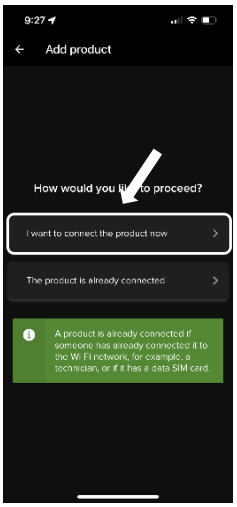


❹ Select **ADD** to proceed to the "Add product" page; see Figure 17-2

Figure 17-2 "NTI net" App – "Add Product Page"

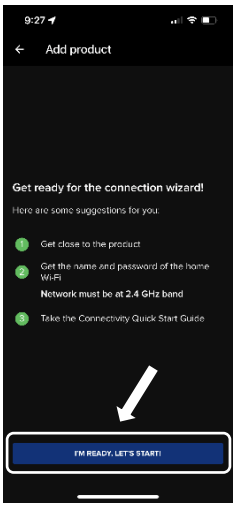
❶ Open the "NTI net" mobile app and press **START THE PROCEDURE**

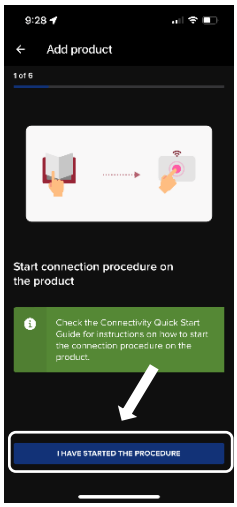




❷ Select **I want to connect the product now**

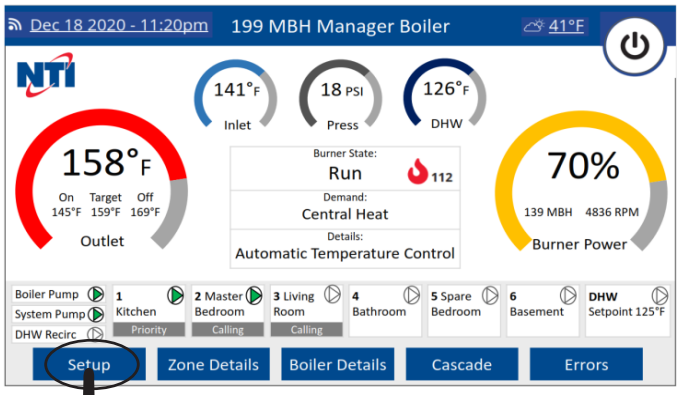
❸ When ready, select **I'M READY, LET'S START!** to proceed



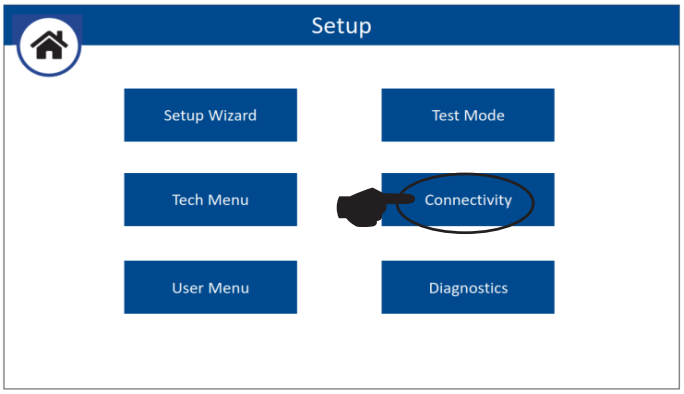


❹ Select **I HAVE STARTED THE PROCEDURE** then move to the boiler display to start the connection procedure on the boiler; see Figure 17-3. If using the Setup Wizard, start at step 4

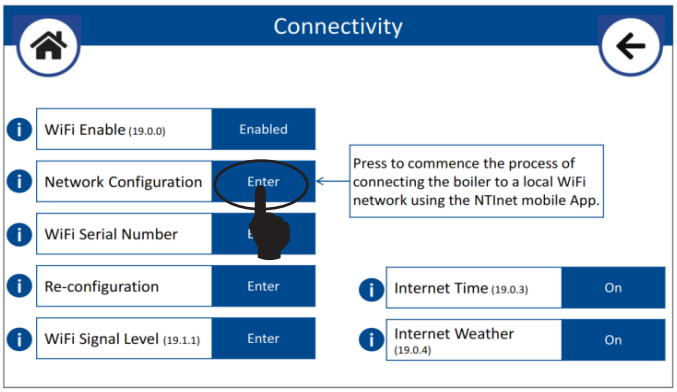
Figure 17-3 Starting the Connection Procedure at the Boiler



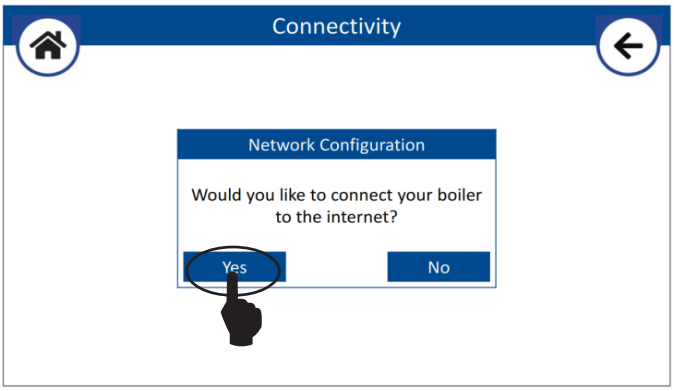
❶ Select **Setup** from the home screen



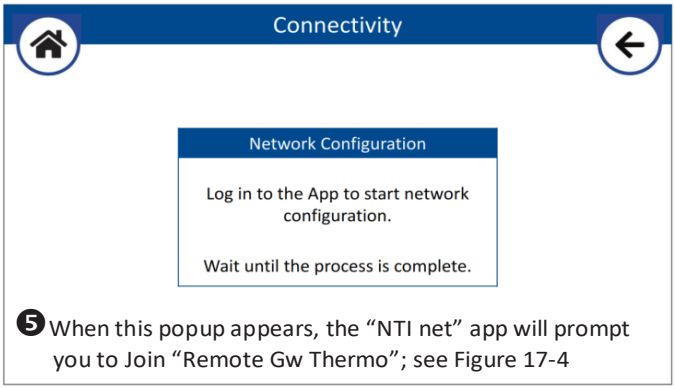
❷ Select **Connectivity** from the Setup menu



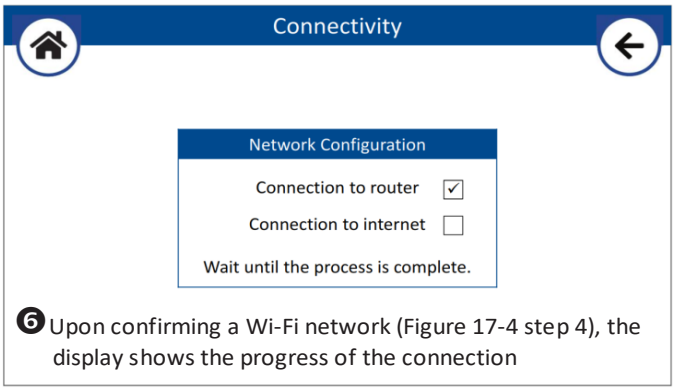
❸ Press Enter to start the **Network Configuration**



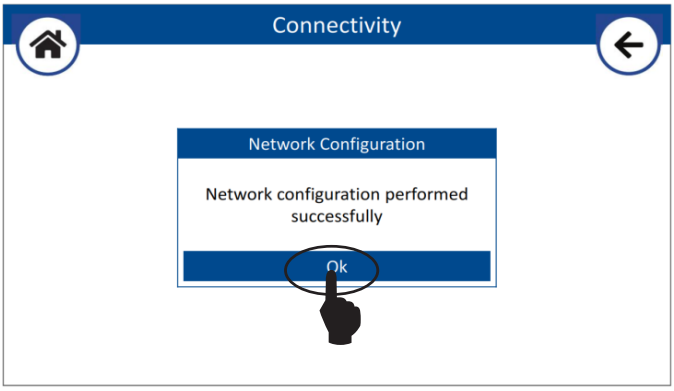
❹ Select **Yes** to connect the boiler to the internet.



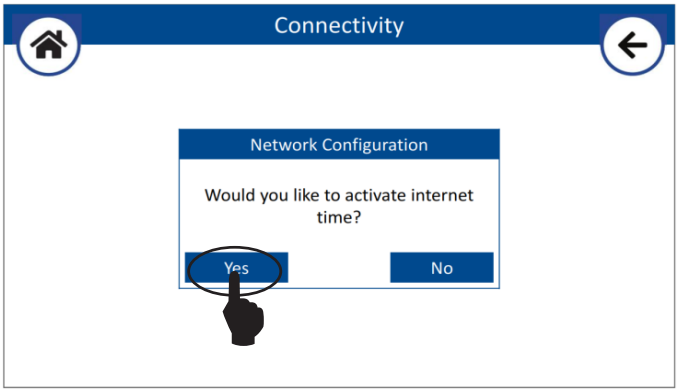
❺ When this popup appears, the "NTI net" app will prompt you to Join "Remote Gw Thermo"; see Figure 17-4



❻ Upon confirming a Wi-Fi network (Figure 17-4 step 4), the display shows the progress of the connection



❼ The boiler will advise when the connection to the local Wi-Fi network is complete. Press **OK** to proceed.

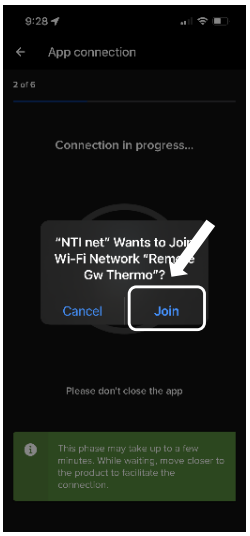


❽ Choose **Yes** or **No** to using Internet Time and Weather. The boiler is not connected to the local Wi-Fi Network.

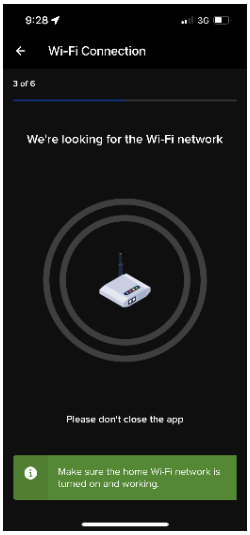
Part 17 - Wi-Fi Connection

Figure 17-4 "NTI net" App – Making Wi-Fi Connection and Registering Product

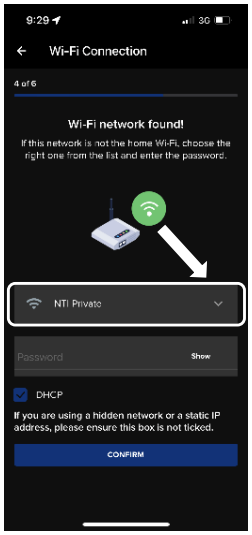
❶ Press **Join** to connect to the boiler



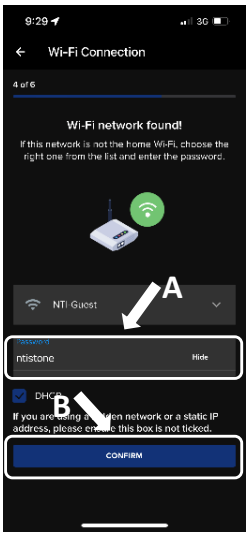
❷ Wait while the app searches for available Wi-Fi networks



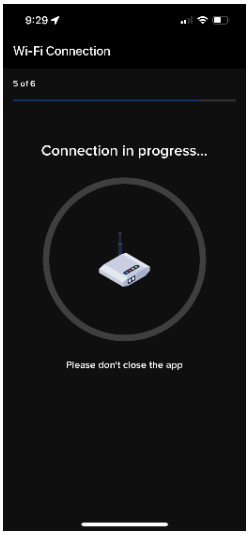
❸ Select the Wi-Fi Network from the dropdown menu



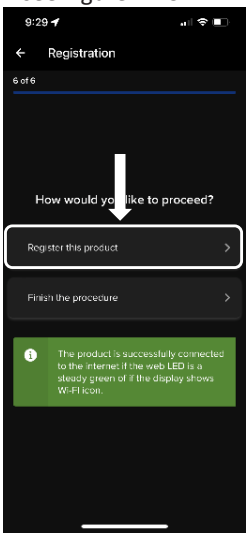
❹ Enter the password and press **Confirm**



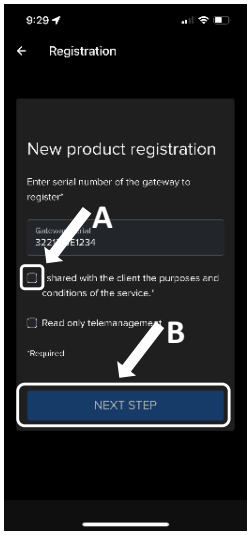
❺ Wait while the connection to the Wi-Fi Network is made



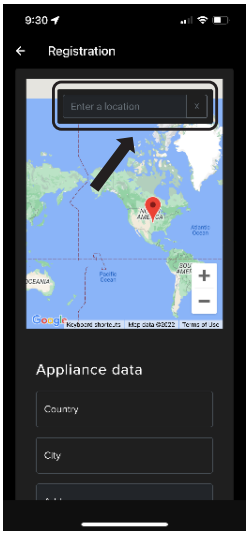
❻ Boiler is successfully connected to Wi-Fi, to register it to your "NTI net" account select **Register the product**; otherwise close the App and finish the setup at the boiler; see Figure 17-3



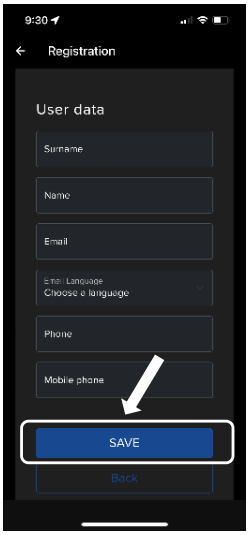
❼ Check the box next to **I shared with the client the purposes and conditions of the service**, then press **NEXT STEP** to proceed



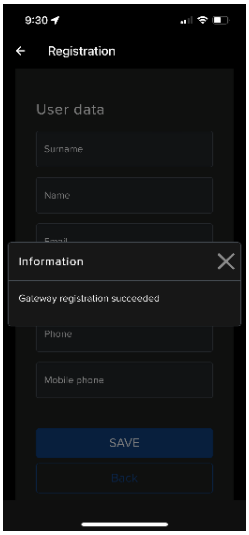
❽ Start typing the address in the box above the map – select the correct address from the autogenerated list.



❾ Scroll down the page and enter the User data (optional), then select **SAVE**



❿ Boiler is now registered to your "NTI net" account and can be remotely monitored and adjusted. Proceed to finish the setup at the boiler; see Figure 17-3 steps 7 & 8



⚠ WARNING Observe the following precautions when servicing the boiler. Failure to comply with these may result in fire, property damage, serious injury or death.

Servicing the Boiler

- Disconnect or shutoff all energy sources to the boiler: 120VAC power, water, and gas.
- Identify and mark wires before disconnecting or removing them.
- Never bypass electrical fuses or limit devices except temporarily for testing.
- Use proper personal protective equipment (PPE) i.e., eye protection, safety footwear.

Diagnostic Procedures

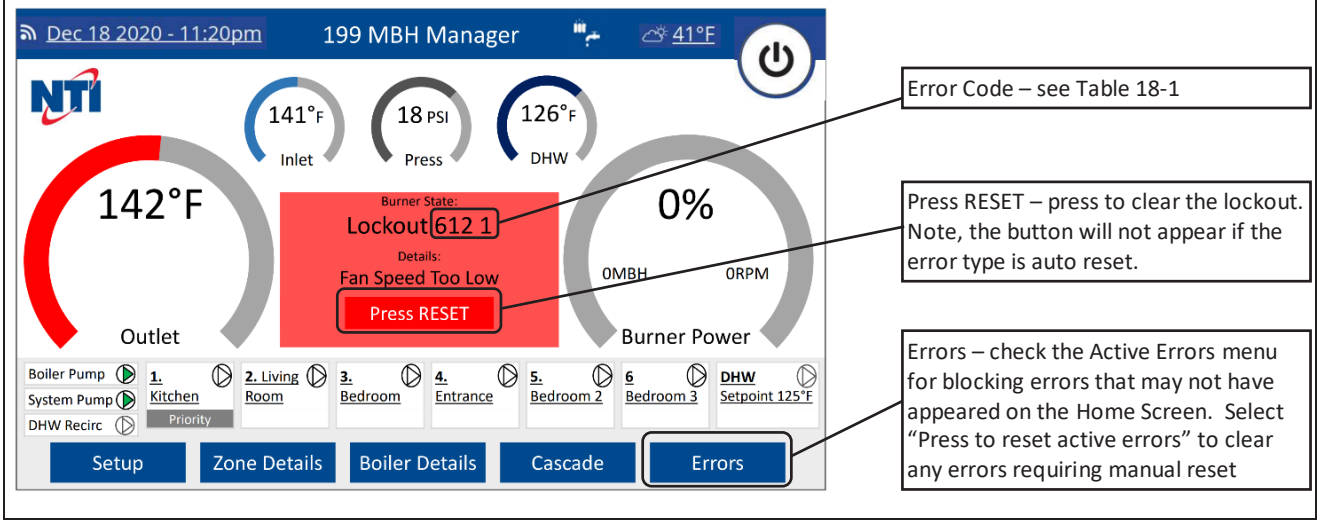
These procedures should only be performed by qualified service personnel when abnormal operation of the boiler is suspected. The boiler incorporates a sophisticated microprocessor-based control which normally responds appropriately to varying conditions. If the boiler operation appears to be incorrect, follow these procedures to identify, and correct, the source of the problem.

1. **Blocking Error** – read the error code displayed on the Home Screen and follow the suggestions listed in Table 18-1. If an error is not displayed on the Home Screen check for errors listed on the Active Errors screen of the Errors menu. If there are no errors listed on the Active Errors screen, then proceed to the next step.

   NOTE: for errors that require a manual reset, a "Press RESET" button will be located beneath the error description – press to clear the lockout; see Figure 18-1. Alternatively, errors requiring manual reset can by cleared from the Active Errors screen by selecting "Press to reset active errors"; see section 16.7 – Errors.

   NOTE: errors that are auto reset will clear automatically when the error condition is resolved; for these errors, the "Press RESET" button will not appear.

Figure 18-1 Clearing Lockouts Requiring Manual Reset

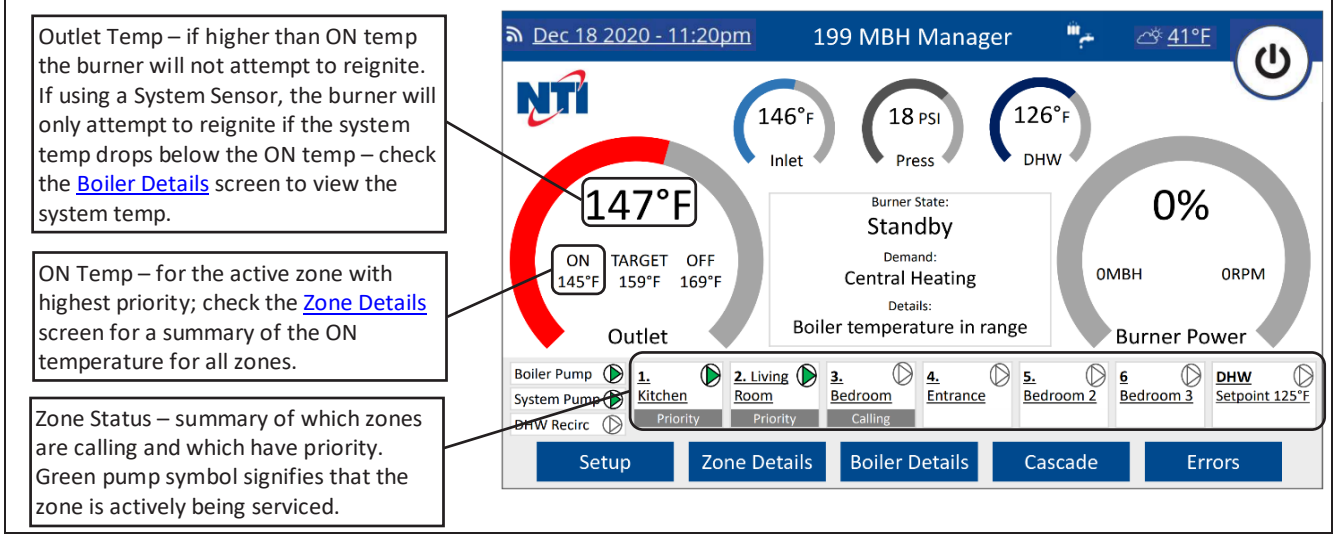


2. **Boiler Temperature in Range** – the burner will only turn on if the boiler outlet temperature (or system temperature – if using a system sensor) is below the ON temperature threshold of the heat demand being serviced. Compare the ON temperature to the outlet (or system) temperature, if the ON temperature is lower, then the burner will not fire; see Figure 18-2.

   NOTE: if the Outlet Temp is lower than the ON temperature, check the System Temp reading from the Boiler Details page. If a System Sensor is used, its reading must be lower than the ON temperature before the burner will turn on.

   NOTE: if the Outlet (or System) Temp is lower than the ON temperature, and the Home Screen is still indicating "Boiler temperature in range", then it is possible that the CH Anti-cycle Time counter has not elapsed; see CH Setup -> General Advanced Settings.

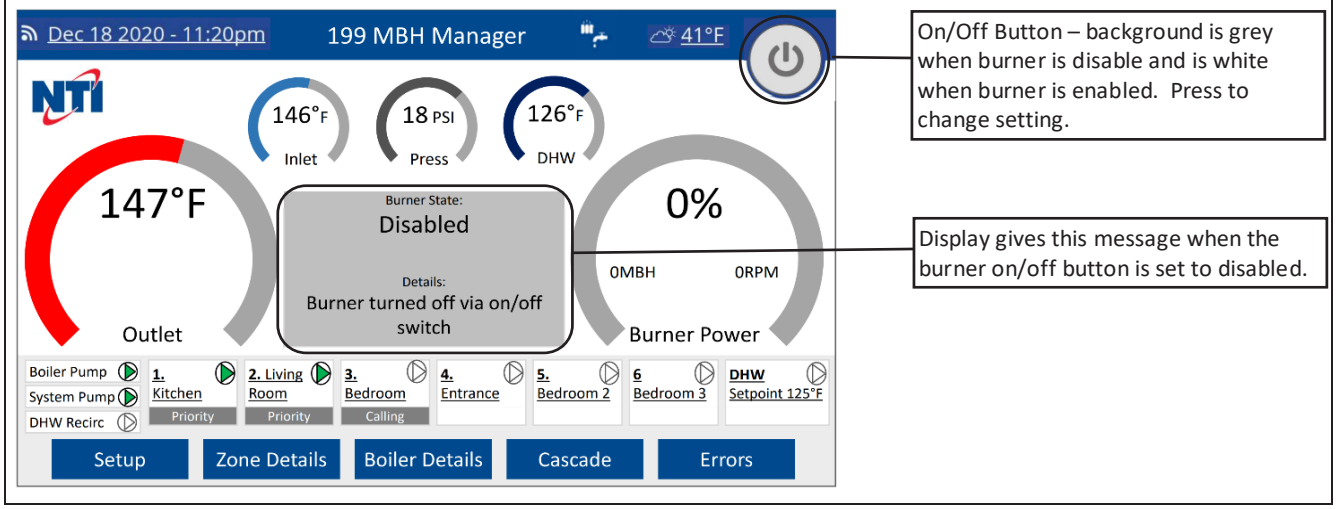
Figure 18-2 Boiler Temperature in Range



3. **No Response to a Central Heat Demand** – if the boiler is not responding to a CH demand, i.e., Zone Status does not show "Priority" or "Calling" and the pump symbol does not turn green (see Figure 18-2), proceed as follows:
   i. Check Zone Mode setting for each zone to make sure it is set to Always Comfort; see Section 16.3.3 User Menu.
   ii. Check the Operating Mode to make sure it is set to "Winter"; see Section 16.2 Operating Mode.
   iii. Check the field wiring to the *T-STAT #1-3* inputs; verify that 24VAC is present on R and W. If 24V is preset on *R* but not on *W*, then the issue is with the thermostat. If 24V is not present on *R*, then check the 2 Amp fuse on the Low Voltage Connection PCB, see Figure 18-4.

   NOTE: if the 2 Amp fuse is blown, check for correct field wiring to *the T-STAT #1-3* inputs.
   iv. Check the Zone Controller Fuses; see Figure 18-4.
4. **Boiler Turned Off Via On/Off Switch** – if this message is shown on the Home Screen it means that the burner was disabled via the on/off button at the top-right of the screen (see Figure 18-3); press the on/off button to enable the burner.

Figure 18-3 Boiler Turned Off Via On/Off Switch



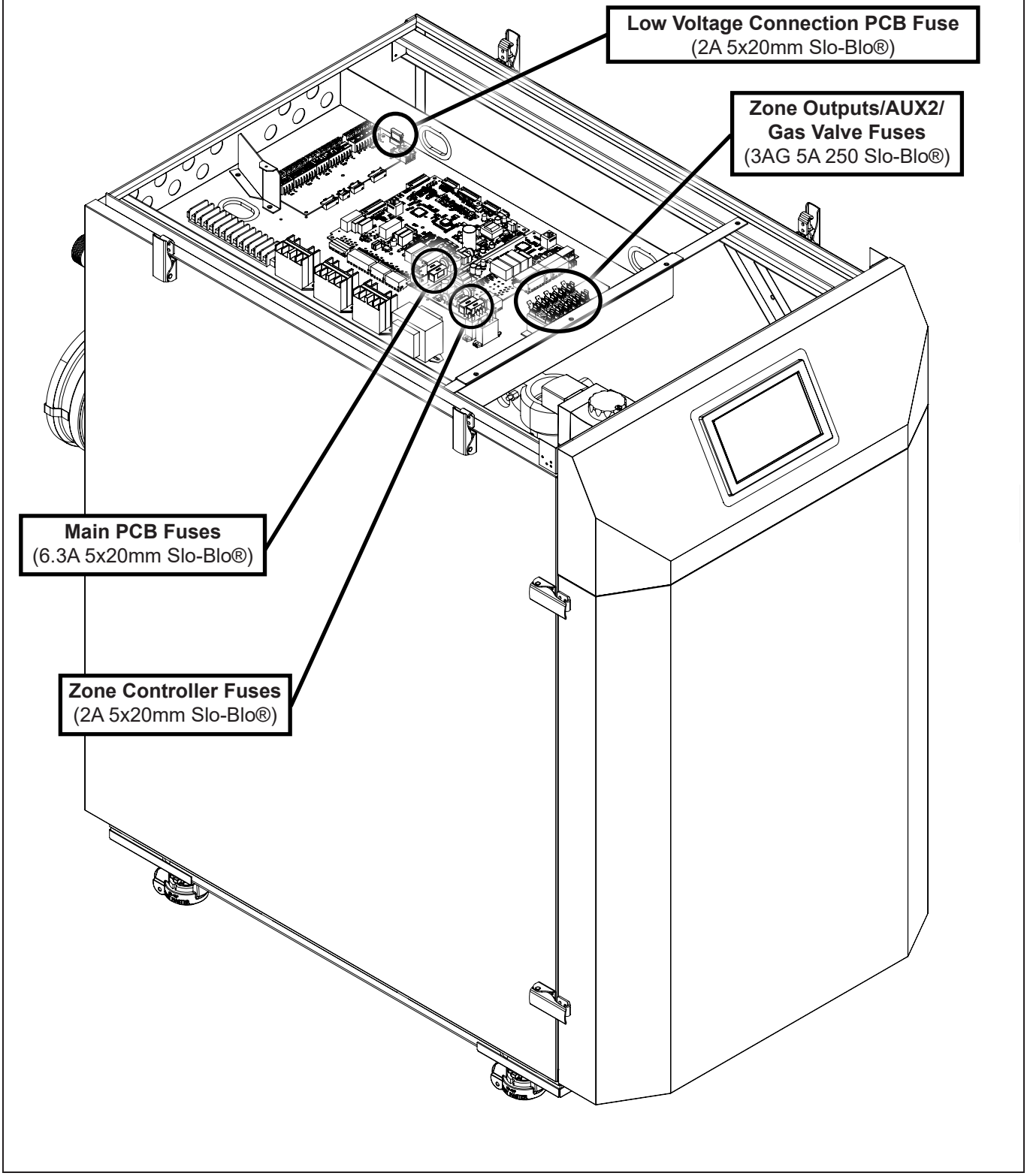
5. **No Power to Zone Outputs:**
   i. Confirm that the jumper wire is connected between terminals *ZONE INPUT* and *120V*, or *ZONE INPUT* and *R* (for 24V loads); see Figures 12-2 & 12-3.
   ii. Check the Zone Output fused on the Control Panel; see Figure 18-4.

NOTE: if the display is not indicating that the zone output is on, i.e., pump symbol does not turn green (see Figure 18-2) then the boiler is not attempted to turn the zone output on.

NOTE: zone outputs will not turn on if there is a priority demand for DHW.

6. **Display is Blank**:
   i. Confirm that the service switch located at the bottom of the control panel (see Figure 18-4) is in the on position.
   ii. Confirm that 120VAC is applied to terminals *LINE* and *NEUTRAL*; see section 12.0 FIELD WIRING.
   iii. Remove the control panel cover and check the cable connecting the display to the main PCB; see Figure 18-4.
   iv. Check the Main PCB Fuses; see Figure 18-4.

Figure 18-4 Control Panel



Fuses

The appliance is equipped with nine (9) fuses – see Figure 18-4. Check these fuses before replacing any of the controllers or other electrical component; if the fuse is blown, it will prevent the protected device(s) from functioning.

⚠ WARNING If replacing a fuse, only replace with an equivalent version – see Figure 18-4. Failure to follow this warning may result in component failure, fire, property damage, serious injury or death.

Main PCB Fuses (120VAC) – the main PCB is equipped with two (2) 6.3 Amp Slow-blow fuses (one each on the Line and Neutral) that protect most 120VAC circuits within the boiler, as well as the *BLR*, *DHW*, and *AUX1 PUMP* outputs.

Zone Controller Fuses (120VAC) – the zone controller is equipped with two (2) 2 Amp Slow-blow fuses (one each on the Line and Neutral).

Zone Output, AUX2 & Gas Valve Fuses (120VAC) – 5 Amp fuses, located on the control panel, protect each of the zone outputs (*ZONE 1*, *ZONE 2*, and *ZONE 3*), the *AUX2 PUMP* output, and the Gas Valve.

Low Voltage Connection PCB Fuse (24VAC) – a 2 Amp fuse, located on the low voltage connection PCB, protects all 24VAC circuits within the boiler.

Error Codes

There are various types of errors, some are blocking (i.e., Manual & Auto Reset type) and required intervention to restore operation, while others are informational (i.e., Warnings) and do not directly block operation.:

! WARNING

Any problem with or malfunction of the appliance must be evaluated by a qualified installer or service technician before returning the appliance to operation. DO NOT reset any Lockout without such an evaluation. Doing so could lead to a fire, an explosion, or a flue gas / carbon monoxide leak, resulting in property damage, personal injury, or death.

Error Types:

- Manual Reset – must be cleared from the Home Screen (by selecting "Press to RESET") or the Errors -> Active Errors menu (by selecting "Press to reset active errors") before the boiler will attempt to resume normal operation.
- Auto Reset – block the boiler from firing but will reset automatically when the error condition is resolved.
- Warning – are informational only and do not block the boiler from firing; however, the warning may be an indication that certain functions are no longer operational and therefore need attention.

Error Code	Problem	Possible Remedy	Error Type
101 1 – Overheat	Inlet or Outlet temperature exceeded 210°F	Lack of water flow – verify that the pump is getting powered and that there is proper water circulation.	Manual Reset
		Faulty wiring – check the wiring to the Inlet and Outlet sensors for water or corrosion	
		Faulty sensor – check for proper readings from the boiler Outlet and Inlet temp sensors (see Table 18-2).	
	Burner plate thermal switch tripped	Remove wires from thermal switch and check switch for continuity. If switch is open inspect the inside of the combustion chamber for damaged or missing insulation. DO NOT OPERATE THE BOILER!	
102 – Pressure sensor error	Water pressure sensor disconnected	Faulty wiring – ensure the wire harness is connected to the water pressure sensor. Check for broken wires	Warning
		Faulty sensor – replace pressure sensor	
103 1 – Flow check failed (Return or Supply Temp Changed Too Quickly)	Outlet or Inlet T-rise > 12.6°F/sec (3x in a row)	Lack of water flow – verify that the pump is getting powered and that there is proper water circulation.	Manual Reset
		Faulty wiring – check the wiring to the Inlet and Outlet sensors for water or corrosion	
		Faulty sensor – check for proper readings from the boiler Outlet and Inlet temp sensors (see Table 18-2).	
104 1 – Flow check failed (Return or Supply Temp Changed Too Quickly)	Outlet or Inlet T-rise > 27°F/sec (3x in a row)	Lack of water flow – verify that the pump is getting powered and that there is proper water circulation.	Manual Reset
		Faulty wiring – check the wiring to the Inlet and Outlet sensors for water or corrosion	
		Faulty sensor – check for proper readings from the boiler Outlet and Inlet temp sensors (see Table 18-2).	
105 1 – Flow check failed (Sensor Delta T Too High)	Delta-T > 63°F (3x in a row)	Lack of water flow – verify that the pump is getting powered and that there is proper water circulation.	Manual Reset
		Faulty wiring – check the wiring to the Inlet and Outlet sensors for water or corrosion	
		Faulty sensor – check for proper readings from the boiler Outlet and Inlet temp sensors (see Table 18-2).	
106 1 – Flow check failed (flow inversion detected)	Inlet > Outlet temp by 18°F (3x in a row)	Reversed piping – verify that the water is flowing through the boiler in the correct direction.	Manual Reset
		Lack of water flow – verify that the pump is getting powered and that there is proper water circulation.	
		Faulty wiring – check the wiring to the Inlet and Outlet sensors for water or corrosion	
		Faulty sensor – check for proper readings from the boiler Outlet and Inlet temp sensors (see Table 18-2).	

Error Code	Problem	Possible Remedy	Error Type
109 – High pressure CH	Water pressure > Max pressure setting (parameter 24.3.3)	Water pressure to high – reduce water pressure. Confirm correct functioning/installation of the pressure regulator and expansion tank.	Warning
		Max pressure setting to low – increase Max pressure setting (parameter 24.3.3).	
		Faulty wiring – ensure the wire harness is connected to the water pressure sensor. Check for broken wires	
		Faulty sensor – replace pressure sensor	
110 1 – Supply Sensor	Outlet temp sensor reads as an open or closed circuit	Faulty wiring – check the wiring to the Outlet sensor for water or corrosion	Auto Reset
		Faulty sensor – check for proper readings from the boiler Outlet temp sensor (see Table 18-2).	
112 1 – Return Sensor	Inlet temp sensor reads as an open or closed circuit	Temp too low – warm sensor until return temp rises	Auto Reset
		Faulty wiring – check the wiring to the Inlet sensor for water or corrosion	
		Faulty sensor – check for proper readings from the boiler Inlet temp sensor (see Table 18-2).	
113 – Low water cut off fault	LWCO circuit is open	Low water – ensure the boiler is free of air and pressurized to at least 12 PSI. Take care to install the auto air-vent on the outlet pipe above the LWCO	Auto Reset
		Blown 24V fuse – If the power light is not on at the LWCO, check the 2A fuse on the Low Voltage Connection PCB; see Figure 18-4.	
		Missing or loose ground screw on the Low Voltage Connection PCB (top left; just above the 2A fuse); see Figure 18-4.	
		Faulty wiring – check the wiring to the LWCO for water or corrosion	
		Faulty LWCO – replace the LWCO	
114 – Outdoor temperature not available	Outdoor temperature reading is not available	Connect an outdoor sensor to OD NTC. If an outdoor sensor is already connected, check the connections and wiring…compare resistance to Table 18-2.	Warning
		If connected to Wi-Fi, turn Internet Weather on; see Connectivity section.	
		If using internet weather, make sure the boiler is connected to Wi-Fi and registered with an address; see Wi-Fi Connection section.	
		If not using outdoor reset, adjust AUTO Temperature Control Mode accordingly, i.e., do not set to “Outdoor Temp”, or set to “Not active” globally from the Home Screen (press blinking house symbol)	

Error Code	Problem	Possible Remedy	Error Type
115 – Common flow sensor error	System sensor reading is invalid	System sensor not connected – if using a system sensor, it must be connected at AUX1 NTC. NOTE: Cascade applications require a system sensor to be connected to the Manager boiler.	Warning
		Auxiliary Sensor 1 set as System Sensor – if NOT using a system sensor, Auxiliary Sensor 1 setting (see Sensor Configuration section) must NOT be set as System Sensor.	
		Faulty wiring – check the wiring to the System sensor for water or corrosion	
		Faulty sensor – check for proper readings from the System sensor (see Table 18-2).	
117 1 – Supply Sensor	Outlet temp sensor reads as an open or closed circuit	See error code 110 1	Auto Reset
118 1 – Primary Probes Test Fail	Inlet/Outlet temp sensor reading has not changed in 23 hours, even after firing the burner	Confirm that the inlet and outlet temperature sensors are properly installed, e.g., ensure that the clip-on sensors (TFTN085-199 models only) are properly clipped onto the piping.	Auto Reset
150 – Common flow sensor overheat	System sensor reading > 210°F	Faulty wiring – check the wiring to the System sensor for water or corrosion	Auto reset
		Faulty sensor – check for proper readings from the System sensor (see Table 18-2).	
1P1 1 – Flow check failed (Supply Temp Change Fast)	Outlet T-rise > 12.6°F/sec	Normal operation – In systems with high and low temperature zones this message may be appear serval times as zones turn off and on.	Warning
1P2 1 – Flow check failed (Sensor Delta T Too High)	Delta-T > 63°F	Normal operation – In systems with high and low temperature zones this message may be appear serval times as zones turn off and on.	Warning
1P3 1 – Flow check failed (Flow inversion detected)	Inlet > Outlet temp by 18°F	Normal operation – In systems with high and low temperature zones this message may be appear serval times as zones turn off and on.	Warning
1P4 – Low Water Pressure	Water pressure reading < 7 psi	Low water pressure – raise the water pressure to a minimum of 12 psi	Warning
		Faulty wiring – ensure the wire harness is connected to the water pressure sensor. Check for broken wires	
		Faulty sensor – replace pressure sensor	

Error Code	Problem	Possible Remedy	Error Type
203 – DHW Sensor	DHW tank sensor reading is invalid	Incorrect setting – DHW Mode is set as "Tank Sensor", but a tank sensor is not being used. Change DHW Mode setting to "Aquastat"	Warning
		Tank sensor not connected – Connect IWH tank sensor to DHW SWITCH/NTC	
		Faulty wiring – check the wiring to the Tank sensor for water or corrosion	
		Faulty sensor – check for proper readings from the Tank sensor (see Table 18-2).	
209 – Storage tank overheat	Tank sensor temp > 175°F	Plumbing problem – Boiler water is circulating through the IWH coil during CH serving – correct piping; see Boiler System Piping section	Warning
		Tank sensor improperly installed – ensure the tank sensor is fully inserted into the well of the tank in the proper location.	
		Faulty wiring – check Tank sensor wiring for water or corrosion	
		Faulty sensor – check Tank sensor readings (see Table 18-2)	
2P2 – Anti-legionella function not finished	Anti-legionella function is not complete (to reset, switch the power to the boiler off/on)	Anti-legionella Function turned on – if the anti-legionella function is not wanted, then set Anti-Legionella Function = Off (see DHW Setup)	Warning
		Boiler setting to low – set DHW Modulation Setpoint = 180°F or higher (see User Menu)	
		Tank sensor improperly installed – ensure the tank sensor is fully inserted into the well of the tank in the proper location.	
		Faulty wiring – check the wiring to the Tank sensor for water or corrosion	
		Faulty sensor – check for proper readings from the Tank sensor (see Table 18-2).	
		Plumbing problem – verify that boiler water is circulating to the IWH coil; see Boiler System Plumbing section	
303 – PCB internal error	PCB internal error (to reset, switch the power to the boiler off/on)	Water pressure sensor wiring damaged or shorted: 1. Check the water pressure switch wiring for damage or shorts 2. Test for proper voltage and grounding.	Manual Reset
		Power problem – test for proper voltage and grounding.	
		Faulty PCB – if the problem persists, replace the PCB	
304 – Too many resets	> 5 resets in 15 minutes (to reset, switch the power to the boiler off/on)	Check error history (see Error section) and correct the source of the respective fault codes.	Manual Reset
306 – PCB internal error	PCB internal error (to reset, switch the power to the boiler off/on)	Power problem – test for proper voltage and grounding.	Manual Reset
		Faulty PCB – if the problem persists, replace the PCB	

Error Code	Problem	Possible Remedy	Error Type
309 – flame detection while burner is off		Damaged flame sensor or flame sensor wire – check flame sensor and flame sensor wire for damage, replace flame sensor	Manual Reset
		Water damage – check flame sensor and PCB for water damage or corrosion	
		Flooded combustion chamber – If the condensate drain was blocked and the chamber flooded, dry the chamber and flame sensor	
		PCB internal fault – If the Flame sensor wire is good and the flame sensor has been replaced, replace the PCB	
3P9 – Sched. Maintenance-Call for Service	Months to next maintenance time has elapsed	Service the boiler and select RESET from the Setup -> Diagnostics -> Service menu; see Diagnostics section.	Warning
411/412/413 – Room sensor circuit open or short circuit Zone 1/2/3	Room sensor circuit open or short circuit Zone 1/2/3	BUS wiring damaged – Inspect BUS wiring for bad connections	Auto reset
		Missing NTI Room Sensor – if using an NTI Room Sensor for Zone 1/2/3, then check that it is properly connected to the BUS and confirm its correct zone association.	
		Incorrect Zone 1/2/3 AUTO Temperature Control Mode setting – if not using an NTI Room Sensors for Zone 1/2/3, then confirm that Zone 1/2/3 AUTO Temperature Control Mode is not set to Room Temp or Room&Outdoor.	
441 – Follower Boiler Missing from BUS	Follower Boiler Missing from BUS	Single boiler configured as a Manager boiler – if this is a stand-alone boiler, set Boiler Address = Single Boiler (see Cascade Setup)	Warning
		Follower BUS wires disconnected – Inspect BUS wiring for damage or shorts, BUS wiring is polarity sensitive.	
		Follower boiler turned off – ensure power is on for all cascade boilers.	
460 – External safety lock	Open circuit at AUX LIMIT	External limit switch wired to AUX LIMIT input is open – check device. If an external limit switch is not being used, place a jumper across AUX LIMIT. NOTE: error type is Manual Reset if parameter 24.6.5 is set to "Safety lock not volatile"	Auto reset

Error Code	Problem	Possible Remedy	Error Type
501 1 – Ignition failed (x2)	Boiler failed to sense flame signal during ignition (2x in a row)	Blown gas valve fuse – check the gas valve fuse located in the control panel (see Figure 18-1). If blown replace with 3AG 5A 250 Slo-Blo®	Manual Reset
		Improper Gas pressure – verify that the gas pressure during an ignition attempt is within the range specified in section 9.0 Gas Valve and Burner Setup.	
		Blocked air-intake – remove front cover and inspect the venturi and boiler air inlet silencer for debris.	
		Blocked exhaust – inspect exhaust for proper slope to boiler and possible restrictions or blockages	
		Blocked condensate drain – inspect condensate drain, if the drain was clogged water may have entered the gas valve. If the valve was wet, it must be replaced.	
		Improper LP conversion – check conversion instructions, increase the gas flow by adjusting the input screw. **A combustion test must be performed if the gas valve is adjusted.	
		No spark – inspect the igniter for cracks or warping (electrode gap should be 3/16"-1/4"). With the gas supply valved off and the igniter removed, observe the spark during the trial for ignition – it should spark for 3-5 seconds. If there is no spark check that the spark transformer receives 120VAC during the ignition trial.	
		Improper combustion settings – adjust the gas valve Throttle Screw to increase the gas flow. Once the boiler remains lit set combustion. See section 9.0 Gas Valve and Burner Setup. Warning: this process may only be performed by a qualified technician with a combustion analyzer	
		Faulty flame sensor – if the boiler lights well and has a strong flame, replace the flame sensor, and inspect the flame sensor harness for shorts or damage.	
502 – Flame detected out of sequence	Flame detected before the gas valve was turned on	Faulty flame sensor – check the flame sensor and wiring for damage, water, or other possible shorts to ground (replace flame sensor)	Auto reset
		Faulty PCB – if problem persists, replace the PCB.	

Error Code	Problem	Possible Remedy	Error Type
504 1 – Flame lost ten times during run	Flame signal lost during run (10x in a row)	Improper Gas pressure – verify that the gas pressure during an ignition attempt is within the range specified in section 9.0 Gas Valve and Burner Setup.	Manual Reset
		Improper combustion settings – test combustion at Max and Min Power as per section 9.0 Gas Valve and Burner Setup	
		Restricted air-intake or exhaust – check for restrictions	
		Dirty combustion chamber or burner – clean the combustion chamber and burner	
		Dirty or fault flame sensor – clean the flame sensor with a mild abrasive or replace the flame sensor.	
		Blocked condensate drain – ensure the condensate drain is clear and drains freely	
		Damaged flame sensor cable – inspect flame sensor wire for loose connections, shorts to ground or damage.	
5P1 – 1st Ignition Failed	Flame signal did not meet the minimum threshold on the 1st ignition attempt	Normal operation – 5P1 may be displayed momentarily if there is a problem the boiler will lock out. Follow the directions for the lockout	Warning
5P2 – 2nd ignition attempt failed	Flame signal did not meet the minimum threshold on the 2nd ignition attempt	See lockout 501	Warning
5P6 – 3rd ignition attempt failed	Flame signal did not meet the minimum threshold on the 3rd ignition attempt	See lockout 501	Warning
5P3 – Detection of Flame loss during run	Flame signal was lost during run	Wind – in some applications the flame will occasionally lift during run due to excessive wind	Warning
		Blocked venting – ensure nothing is obstructing the venting	
		Combustion settings or Gas pressure – if the problem is persistent a lockout will result, follow the trouble shooting for the lockout. If the flame loss is bothersome and does not result in a lockout, see error 504.	

Error Code	Problem	Possible Remedy	Error Type
5P5 – Low gas pressure fault	Tripped Low Gas Pressure switch (switch located on the front of the gas valve)	Gas line pressure too low – press the reset button on the Low Gas Pressure switch, then monitor incoming gas pressure while operating the boiler at high power. Set the incoming gas pressure to within the range stated on the boiler rating plate.	Auto Reset
		Incorrectly adjusted Low Gas Pressure switch – ensure that the Low Gas Pressure switch is set to 3" w.c., then press the reset button.	
	Tripped High Gas Pressure switch (switch located on the rear of the gas valve)	Gas line pressure too high – press the reset button on the High Gas Pressure switch, then check the incoming static gas pressure with the boiler in standby. Set the incoming gas pressure to within the range stated the boiler rating plate.	
		Incorrectly adjusted High Gas Pressure switch – ensure the High Gas Pressure switch is set to 20" w.c., then press the reset button.	
602 – Flue sensor or flue too hot	Exhaust temperature exceeded 200°F (the error can only be cleared when the flue temperature drops below 190°F for 1 minute)	Inadequate water flow – ensure the boiler water is free of air and pressurized to a minimum of 12 psi	Manual Reset
		Dirty Combustion chamber – ensure the combustion chamber is cleaned regularly	
		Water scaling – if the error is accompanied by popping or hissing, the boiler may have scale build-up preventing proper heat transfer. Descale the heat exchanger if needed.	
		Faulty wiring – check Flue sensor wiring for water or corrosion	
		Faulty sensor – check for proper readings from the Flue sensor (see Table 18-2).	
603 1 – APS open	Blocked condensate switch opened	Blocked Condensate – ensure the condensate is draining freely and the tubing to the switch is clear	Manual Reset
		Blocked vent – check exhaust and air-intake venting for blockages.	
		Wiring problem – inspect the wires from the air switch to the boiler control. Disconnect and reconnect each connection	
		Air switch failure – replace the air switch	
605 – Flue sensor open circuit	Flue sensor reading is invalid	Faulty wiring – check the wiring to the Flue sensor for water or corrosion	Auto Reset
		Faulty sensor – check for proper readings from the Flue sensor (see Table 18-2).	
608 – Flue gas damper malfunction	Incorrectly configured PCB	From the Complete Menu, enter parameter 24.6.7 and set it to 0.	Auto Reset
612 1 Fan Speed Too Low Blower	Fan speed did not achieve the correct speed	Faulty wiring – check the 4-wire harness between the fan and PCB for damage and check it for continuity. On the 3-wire harness, verify 120VAC between black and white.	Manual Reset
		Faulty fan – remove the 4-wire harness from the fan, if it does not run at high speed replace the fan.	
		Faulty PCB – if the wiring and fan are ok, replace the main PCB.	

Error Code	Problem	Possible Remedy	Error Type
730 – Buffer high probe error	Buffer tank function is enabled but there is no sensor detected at either the AUX 1 or 2 NTC input	Incorrect setting – Buffer Tank Function is set as "Fixed or Variable Temperature", but a buffer tank sensor is not being used. Change Buffer Tank Function setting to "Off"	Warning
		Buffer tank sensor not connected or configured – Connect buffer tank sensor to AUX 1/2 NTC and configure the respective sensor input as "Buffer Tank"	
		Faulty wiring – check the wiring to the buffer tank sensor for water or corrosion	
		Faulty sensor – check for proper readings from the buffer tank sensor (see Table 18-2).	
Unconfigured – the device must be configured, press OK to proceed	Device is configured as a Follower, but it does not see a Manager boiler connected to the BUS	Faulty wiring – if the boiler is a Follower in a cascade system, check the BUS wiring to each boiler. Note: BUS wiring is polarity sensitive.	
		Missing Manager – configure one of the boilers in cascade as Manager; see section 11.0 Cascade Installation.	
		Incorrect setting – if application is a stand-alone boiler, set Boiler Address = Single Boiler. Press OK and select Single boiler under Available Configurations	
Conflict	BUS conflict	Incorrect settings – two or more boilers in the cascade have been set with the same Boiler Address. Disconnect each from the BUS and set a unique Boiler Address at each boiler.	
		Multiple zone controllers with dip switches set to on – there can only be two zone controllers connected to the BUS, and only one can have the dip switches set to on; see section 11.0 Cascade Installation.	

Temperature °F (°C)	Resistance Ohms (Ω)	Temperature °F (°C)	Resistance Ohms (Ω)	Temperature °F (°C)	Resistance Ohms (Ω)
-22 (-30)	176,133	68 (20)	12,490	149 (65)	2,083
-4 (-20)	96,761	77 (25)	10,000	158 (70)	1,752
14 (-10)	55,218	86 (30)	8,057	167 (75)	1,481
32 (0)	32,650	95 (35)	6,531	176 (80)	1,258
41 (5)	25,390	122 (50)	3,603	185 (85)	1,072
50 (10)	19,900	131 (55)	2,986	194 (90)	918
59 (15)	15,710	140 (60)	2,448	203 (95)	789

Part 19 - Maintenance

A. Procedures

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

! WARNING

The combustion chamber insulation in this product contains ceramic fiber material. Ceramic fibers can be converted to cristobalite in very high temperature applications. The International Agency for Research on Cancer (IARC) has concluded, "Crystalline silica inhaled in the form of quartz or cristobalite from occupational sources is carcinogenic to humans (Group 1)."

- Avoid breathing dust and contact with skin and eyes.
- Use a NIOSH certified dust respirator (N95). This type of respirator is based on the OSHA requirements for cristobalite at the time this document was written. Other types of respirators may be needed depending on job site conditions. Current NIOSH recommendations can be found on the NIOSH website: http://www.cdc.gov/niosh/homepage.html. NIOSH approved respirators, manufacturers, and phone numbers are also listed on this website.
- Wear long-sleeved, loose fitting clothing, gloves, and eye protection.
- Apply enough water to the combustion chamber lining to prevent dust.
- Wash potentially contaminated clothes separately from other clothing. Rinse clothes washer thoroughly.

NIOSH stated First Aid.

- Eye: Irrigate immediately.
- Breathing: Fresh air.

! WARNING

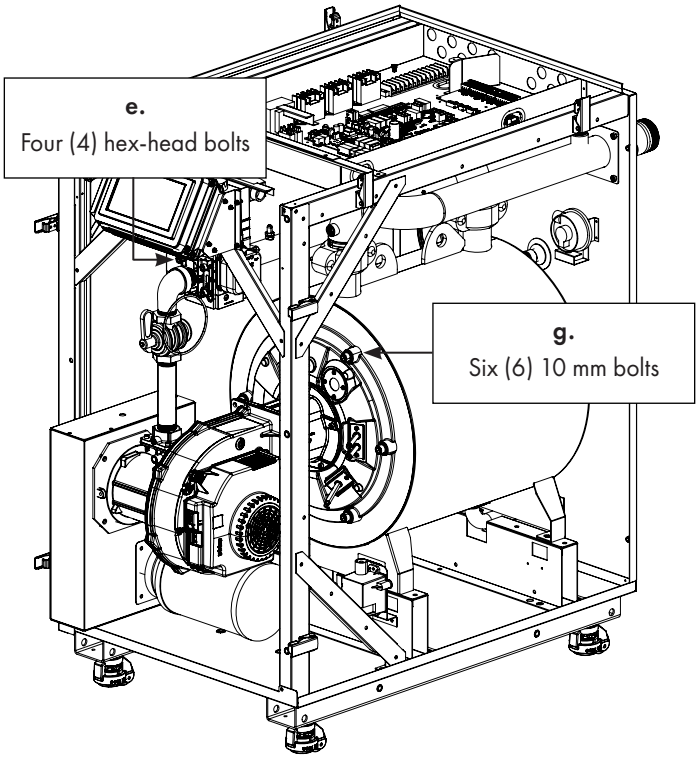
BEFORE EACH HEATING SEASON a trained and qualified service technician should perform the inspections listed in this manual. Failure to do so could result in death or serious injury.

B. Combustion Chamber Coil Cleaning Instructions

*Before beginning this procedure, have on hand the following items:

- a nylon, stainless steel, or brass brush (not steel)
- an FDA approved liquid lime scale remover in a spray bottle
- gloves and eye protection

1. Shut down the appliance by using the following steps:
   a. Shut the power off at the circuit breaker.
   b. Close the gas valve external to the unit. Shut down the unit, and wait for it to be cool to the touch.
   c. Open the condensate trap cleanout outside the appliance, so flow from condensate reservoir can be observed.
   d. Disconnect electrical connections from the gas valve, spark electrode, flame rectification probe, and combustion blower. Make note of connections.
   e. Remove the four (4) hex-head bolts connecting the gas inlet pipe assembly to the gas valve.
   f. Disconnect the feedback hose from the gas valve.
   g. Remove the six (6) 10 mm bolts from the burner plate assembly.
   h. Disconnect the entire blower-mixer-air box-gas valve assembly from the cabinet. Set it aside carefully.



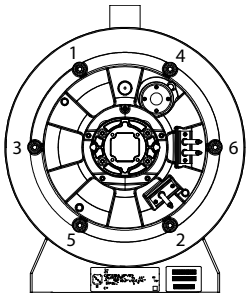
! CAUTION

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

2. Spray the coils liberally with the FDA approved liquid lime scale remover. Confine the spray to the area being cleaned. Avoid getting the ceramic target wall wet. If the condensate system is blocked, use a vacuum to clear it.

3. Scrub coils of any buildup with a nylon, stainless steel, or brass brush. Do not use a steel brush. Vacuum the debris from the coils.

4. Spray the coils again with clear tap water. Confine the spray to the area being cleaned. Flush the combustion chamber with fresh water until it runs clear from the condensate reservoir. At this point, the unit should be ready to be reassembled.
   a. Inspect gaskets.
   b. Reinstall the combustion assembly.
   c. Reinstall and tighten the (6) bolts to the burner plate in the order shown. Tighten to 36.88 ft.lb [50 N.m.]
   d. Reconnect the gas pipe adapter to the gas valve (four (4) bolts).



(IMPORTANT: CHECK FOR GAS LEAKS!)

   e. Reconnect all wiring connections.
   f. Reinstall the feedback hose.
   g. Restore gas and power to the unit.
   h. Turn power on and create a heat demand. When lit, observe condensate flow from the unit. Be sure the unit is operating properly.
   i. Reinstall the condensate trap cleanout trap.

Inspection Activities		Date Last Completed							
Piping		**1st year**	**2nd year**	**3rd year**	**4th year**	**5th year**	**6th year**	**7th year**	**8th year**
Near-appliance piping	Check appliance and system piping for any sign of leakage; make sure pipes are properly supported.								
Vent	Check condition of all vent pipes and joints. Ensure the vent piping terminations are free of obstructions and blockages.								
System		**1st year**	**2nd year**	**3rd year**	**4th year**	**5th year**	**6th year**	**7th year**	**8th year**
Visual	Do a full visual inspection of all system components.								
Functional	Test all functions of the system (Heat, Safeties, ect.)								
Temperatures	Verify safe settings on appliance and/or anti-scald valve.								
	Verify programmed temperature settings.								
Electrical		**1st year**	**2nd year**	**3rd year**	**4th year**	**5th year**	**6th year**	**7th year**	**8th year**
Connections	Check wire connections. Make sure connections are tight.								
Smoke and CO Detectors	Verify devices are installed and working properly. Change batteries if necessary.								
Circuit Breakers	Check to see that the circuit breaker is clearly labeled. Exercise circuit breaker.								
Switch and Plug	Verify ON/OFF switch and convenience plug are both functional.								
Chamber / Burner		**1st year**	**2nd year**	**3rd year**	**4th year**	**5th year**	**6th year**	**7th year**	**8th year**
Combustion Chamber	Check burner tube and combustion chamber coils. Clean according to maintenance section of manual. Vacuum combustion chamber. Replace any gaskets that show signs of damage.								
Electrodes	Clean probes with plumbers cloth to remove oxides.								
Condensate		**1st year**	**2nd year**	**3rd year**	**4th year**	**5th year**	**6th year**	**7th year**	**8th year**
Neutralizer	Check condensate neutralizer. Replace if necessary.								
Condensate Pipe	Disconnect condensate pipe. Clean out dirt. Fill with water to level of outlet and reinstall. (NOTE: Verify the flow of condensate, making sure that the hose is properly connected during final inspection.)								
Gas		**1st year**	**2nd year**	**3rd year**	**4th year**	**5th year**	**6th year**	**7th year**	**8th year**
Pressure	Measure incoming gas pressure.								
Pressure Drop	Measure drop in pressure on light off (no more than 1" w.c.).								
Check Gas Pipe for Leaks	Check gas piping. Test for leaks and signs of aging. Make sure all pipes are properly supported.								
Combustion		**1st year**	**2nd year**	**3rd year**	**4th year**	**5th year**	**6th year**	**7th year**	**8th year**
CO / CO_2 Levels	Check CO and CO_2 levels in exhaust. See Start-Up Procedures for ranges. Record at high and low fire.								
Safeties		**1st year**	**2nd year**	**3rd year**	**4th year**	**5th year**	**6th year**	**7th year**	**8th year**
Sensors	Check wiring. Verify through resistance reading (**Ω**).								
Final Inspection		**1st year**	**2nd year**	**3rd year**	**4th year**	**5th year**	**6th year**	**7th year**	**8th year**
Check List	Verify that you have completed entire check list. WARNING: FAILURE TO DO SO COULD RESULT IN SERIOUS INJURY OR DEATH.								
Homeowner	Review what you have done with the homeowner.								

Notes

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

IMPORTANT

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

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Fax: 1-506-432-1135

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