

Installation and Operation Instructions for

NEOTHERM® XTR

with Touchscreen

Modulating Boilers and Volume Water Heaters

NT2(H,V) 399 MBTU/h
NT2(H,V) 500 MBTU/h
NT2(H,V) 650 MBTU/h
NT2(H,V) 800 MBTU/h
NT2(H,V) 999 MBTU/h
NT2(H,V) 1500 MBTU/h

FOR YOUR SAFETY: This product must be installed and serviced by a professional service technician, qualified in hot water boiler and heater installation and maintenance. Improper installation and/or operation could create carbon monoxide gas in flue gases which could cause serious injury, property damage, or death. Improper installation and/or operation will void the warranty.

⚠ WARNING

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

Do not store or use gasoline or other flammable vapors and liquids 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 nearby phone. Follow the gas supplier's instructions.
- If you cannot reach your gas supplier, call the fire department.

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

⚠ AVERTISSEMENT

Assurez-vous de bien suivres les instructions données dans cette notice pour réduire au minimum le risque d'incendie ou d'explosion ou pour éviter tout dommage matériel, toute blessure ou la mort.

Ne pas entreposer ni utiliser d'essence ni d'autres vapeurs ou liquides inflammables dans le voisinage de cet appareil ou de tout autre appareil.

QUE FAIRE SI VOUS SENTEZ UNE ODEUR DE GAZ:

- Ne pas tenter d'allumer d'appareils.
- Ne touchez à aucun interrupteur. Ne pas vous servir des téléphones dansle bâtiment où vous êtes.
- Appelez immédiatement votre fournisseur de gaz depuis un voisin. Suivez les instructions du fournisseur.
- Si vous ne pouvez rejoindre le fournisseur de gaz, appelez le sservice des incendies.

L'installation et l'entretien doivent être assurés par un installateur ou un service d'entretien qualifié ou par le fournisseur de gaz.

H2410000A

LAARS® Heating Systems Company

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SECTION 1
GENERAL INFORMATION

1.A Introduction

This manual provides information necessary for the installation, operation, and maintenance of Laars Heating Systems NeoTherm XTR boilers and water heaters. Read it carefully before starting the installation.

All application and installation procedures should be reviewed completely before proceeding with the installation. Consult the Laars Heating Systems factory, or local factory representative, with any problems or questions regarding this equipment. Experience has shown that most operating problems are caused by improper installation.

A pressure relief valve is included with each NeoTherm XTR to protect against over pressurization and must be installed prior to filling the system. Refer to Section 6.A on page 31 for PRV install location.

1.B Warranty

Laars Heating Systems NeoTherm XTRs are covered by a limited warranty. The owner should complete the warranty registration at www.Laars.com.

All warranty claims must be made to an authorized Laars Heating Systems representative. Claims must include the serial number and model (this information can be found on the rating plate), installation date, and name of the installer. Shipping costs are not included in the warranty coverage.

1.C Rating Plate

The rating plate is located on the back panel of the NeoTherm XTR (see Figure 1) and contains all of the characteristics and information that pertain to this particular model.



Figure 1. Location of the Rating Plate

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NOTE: Throughout the content of this manual, the NeoTherm XTR will be referred to as a 'unit'.

1.D Model Identification

Consult the **Rating Plate** on the back of the unit. The following information describes the Model Identification (Model Nomenclature).

(1-3) **Model Series Designation**
N T 2 = NeoTherm XTR

(4) **Usage**
H = Hydronic
V = Volume Water

(5-8) **Size**
0 3 9 9 = 399,000 BTU/hr input
0 5 0 0 = 500,000 BTU/hr input
0 6 5 0 = 650,000 BTU/hr input
0 8 0 0 = 800,000 BTU/hr input
0 9 9 9 = 999,000 BTU/hr input
1 5 0 0 = 1,500,000 BTU/hr input

(9) **Fuel**
N = Natural Gas

(10) **Configuration**
X = Standard
J = J-CSD-1* (includes LWCO and high & low gas pressure switches)

(11) **Options**
N = Normal Water Pump
X = No pump
L = LWCO & Normal Water Pump
W = LWCO no Pump
H = Hard Water Pump (NT2V Only)
M = LWCO & Hard Water Pump (NT2V Only)

(12) **PRVs**
X = NT2H = 75 psi
NT2V = 125 psi

Optional
A = 30 psi (NT2H only)
B = 50 psi (NT2H only)
C = 60 psi
D = 75 psi (NT2V only)
(Std on NT2H - use X)
E = 125 psi (NT2H only)
(Std on NT2V - use X)
F = 150 psi PRV

(13) **Revision**
1 = First version

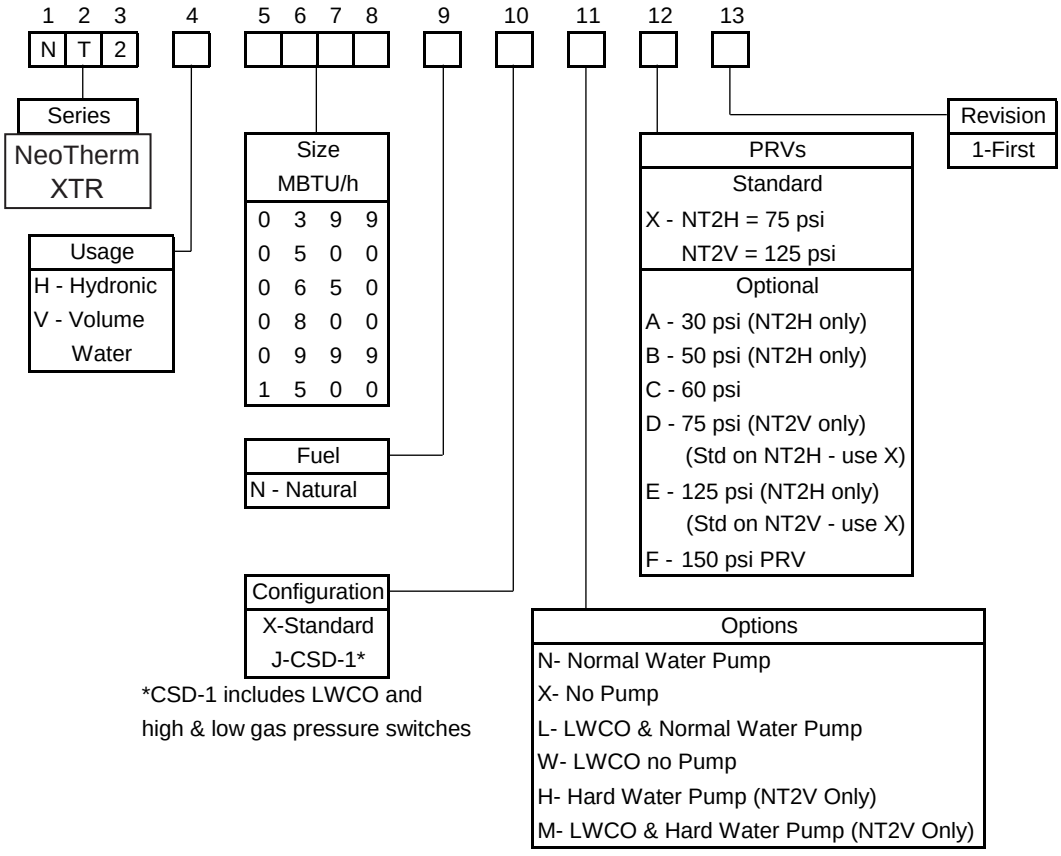


Figure 2. Model Nomenclature

1.E Safety Notes

Safety notes are used throughout this manual to bring attention to the presence of hazards with various risk levels and to offer important information concerning the life of this product. There are 3 basic types.

1	**⚠ WARNING**	Indicates an imminently hazardous situation which, if not avoided, can or will result in death or serious injury and can or will result in catastrophic property damage.
2	**⚠ CAUTION**	Indicates a potentially hazardous situation which, if not avoided, may result in moderate injury and/or property damage.
3	NOTE:	Indicates instructions that are important to that topic but not related to personal injury or property damage.

⚠ WARNING

- Water temperature over 125°F (52°C) can cause severe burns instantly or death from scalds.
- Children, disabled and elderly are at highest risk of being scalded.
- See instruction manual before setting temperature at the unit.
- Feel water before bathing or showering.
- If this unit is used to produce water that could scald if too hot, such as domestic hot water use, adjust the outlet control (limit) or use temperature limiting valves to obtain a maximum water temperature of 125°F (52°C).



⚠ WARNING

Fire or Explosion Hazard

Improper configuration can cause fuel buildup and explosion. Improper user operation may result in property loss, severe physical injury, or death.

Any change to safety-related configuration parameters must only be done by experienced and/or licensed burner/boiler operators and mechanics.

Should overheating occur or the gas supply fails to shut off, turn off the manual gas control valve to the appliance.

If any odor of gas is detected, or if the gas burner does not appear to be functioning in a normal manner, close the main gas shutoff valve. Do not shut off the power switch. Contact your heating contractor, gas company, or factory representative.

⚠ AVERTISSEMENT

En cas de surchauffe ou si l'alimentation en gaz ne s'arrête pas, fermez.

⚠ WARNING

This unit must be installed in accordance with the procedures detailed in this manual, or the manufacturers warranty will be voided. The installation must conform to the requirements of the local jurisdiction having authority, and, in the United States, to the latest edition of the National Fuel Gas Code, ANSI Z223.1/NFPA54. In Canada, the installation must conform to the latest edition of CSA B149.1 Natural Gas and Propane Gas Installation Code, and/or local codes. Where required by the authority having jurisdiction, the installation of these units must conform to the Standard for Controls and Safety Devices for Automatically Fired Boilers, ANSI/ASME CSD-1. Any modifications to the boiler, its gas controls, or wiring may void the warranty. If field conditions require modifications, consult the factory representative before initiating such modifications.

⚠ WARNING

Carbon Monoxide Hazard

This product burns gas to produce heat. The appliance must be properly installed, operated, and maintained to avoid exposure to appreciable levels of carbon monoxide.

The installer must verify that at least one carbon monoxide alarm has been installed within a residential living space or home following the alarm manufacturer's instructions and applicable local codes before putting the appliance into operation. It is important for carbon monoxide alarms to be installed, maintained, and replaced following the alarm manufacturer's instructions and applicable local codes.

⚠ AVERTISSEMENT

L'installateur est tenu de vérifier qu'au moins une alarme de détection de monoxyde de carbone soit installée dans un espace résidentiel ou dans un domicile conformément aux directives du fabricant de l'alarme et aux codes locaux applicables avant de mettre l'appareil en service.

⚠ WARNING

Electrical Shock Hazard

Electrical shock can cause severe injury, death or property damage. Disconnect the power supply before beginning installation or changing the wiring to prevent electrical shock or damage to the equipment. It may be necessary to turn off more than one power supply to disconnect.

All electrical wiring is to be done in accordance with local codes, or in the absence of local codes, with: 1) The National Electrical Code ANSI/NFPA No. 70 - latest Edition, or 2) CSA STD. C22.1 "Canadian Electrical Code - Part 1." This appliance must be electrically grounded in accordance with these codes.

⚠ WARNING

The Repair Parts list designates parts that contain refractory ceramic fibers (RCF). RCF has been classified as a possible human carcinogen. When exposed to temperatures above 180ºF, such as during direct flame contact, RCF changes into crystalline silica, a known carcinogen. When disturbed as a result of servicing or repair, these substances become airborne and, if inhaled, may be hazardous to your health.

Do not remove or replace RCF parts or attempt any service or repair work involving RCF without wearing the following protective gear:

1. A National Institute for Occupational Safety and Health (NIOSH) approved respirator.
2. Long sleeved, loose fitting clothing.
3. Gloves.
4. Eye Protection.

⚠ WARNING

CANCER AND REPRODUCTIVE HARM.
WWW.P65WARNINGS.CA.GOV.

AS REQUIRED BY THE STATE OF CALIFORNIA PROPOSITION 65.

NOTE: All installations must be made in accordance with 1) American National Standard Z223.1/NFPA54-Latest Edition "National Fuel Gas Code" or 2) CSA B149.1 "Natural Gas and Propane Installation Code" or in Canada reference the B149.1 latest edition and with the requirement of the local utility or other authorities having jurisdiction. Such applicable requirements take precedence over the general instructions contained herein. All electrical wiring is to be done in accordance with the local codes, or in the absence of local codes, with: 1) The National Electrical Code ANSI/NFPA No. 70-latest Edition, or 2) CSA STD. C22.1 "Canadian Electrical Code - Part 1". This appliance must be electrically grounded in accordance with these codes.

NOTE: A pressure relief valve is included with each unit and must be installed prior to filling the system.

1.F Model Overview

The locations of components are similar across each model size. Access to all components can be made through the access panels at the front, top, and rear.

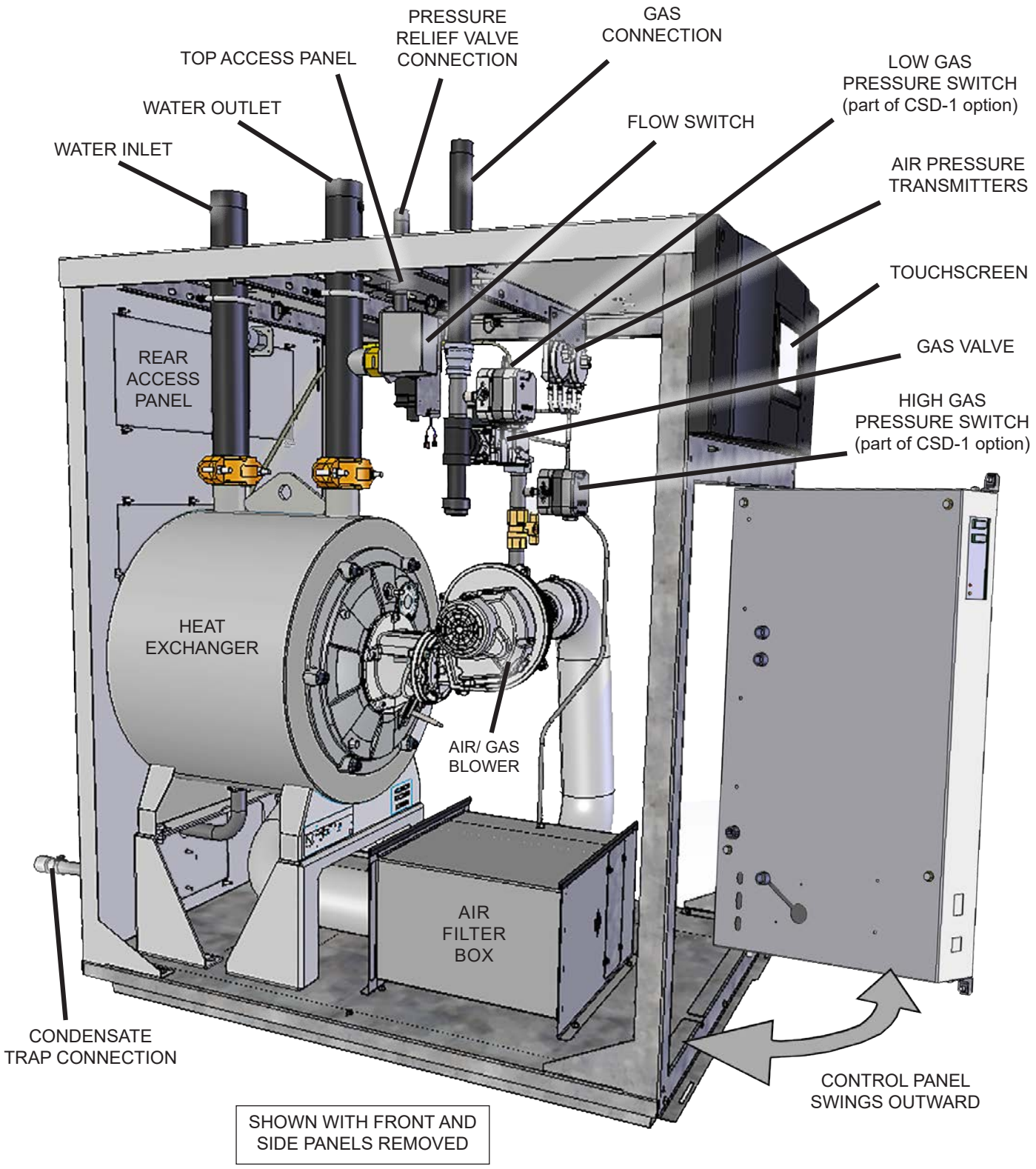


Figure 3. Location of Components Models 399 - 500

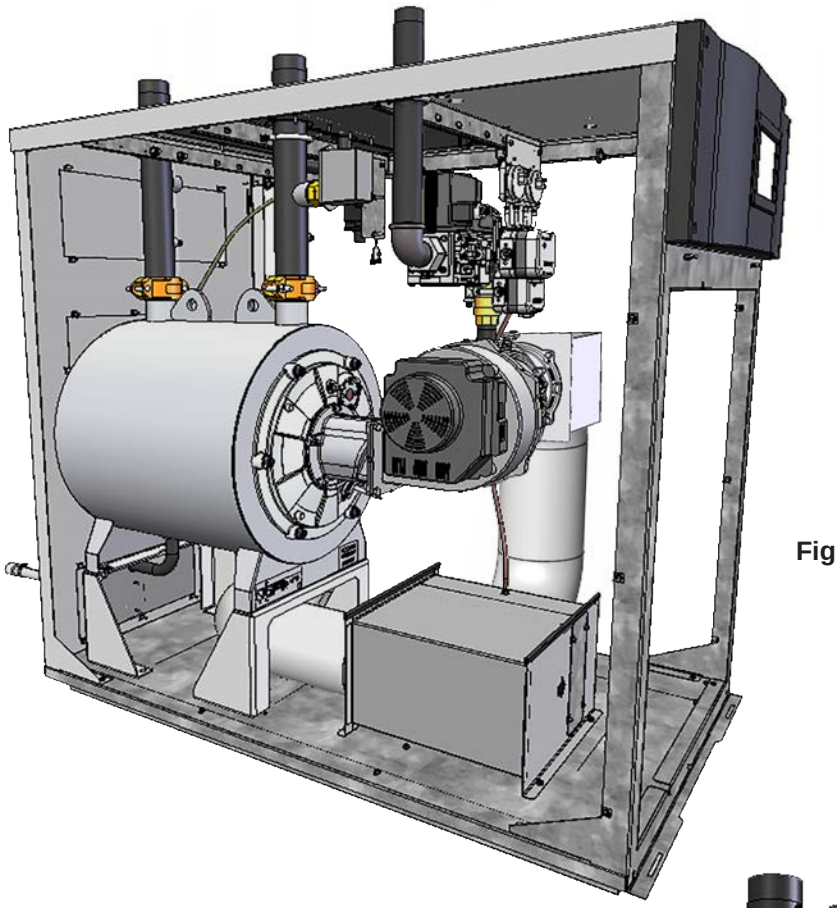
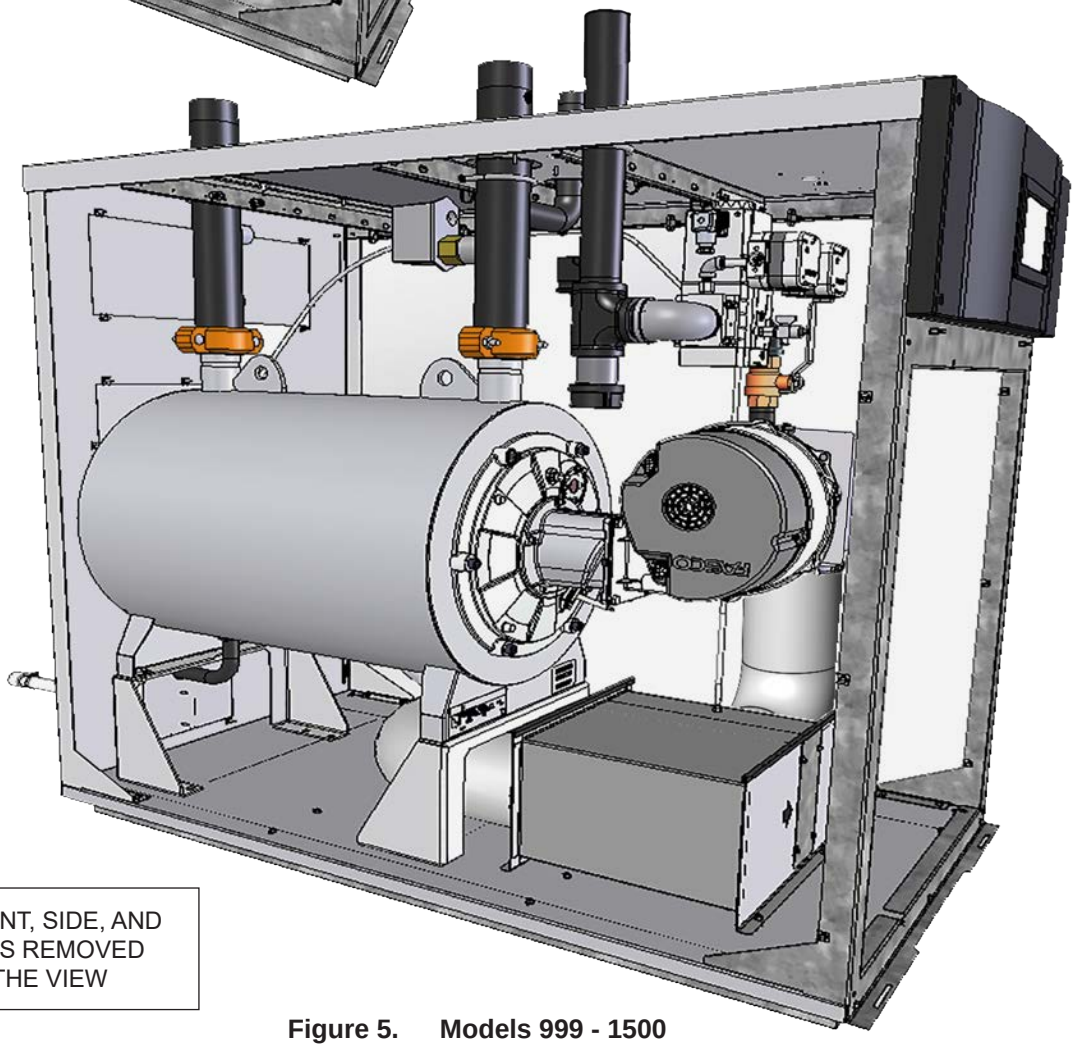


Figure 4. Models 650 - 850



SHOWN WITH FRONT, SIDE, AND CONTROL PANELS REMOVED TO SIMPLIFY THE VIEW

Figure 5. Models 999 - 1500

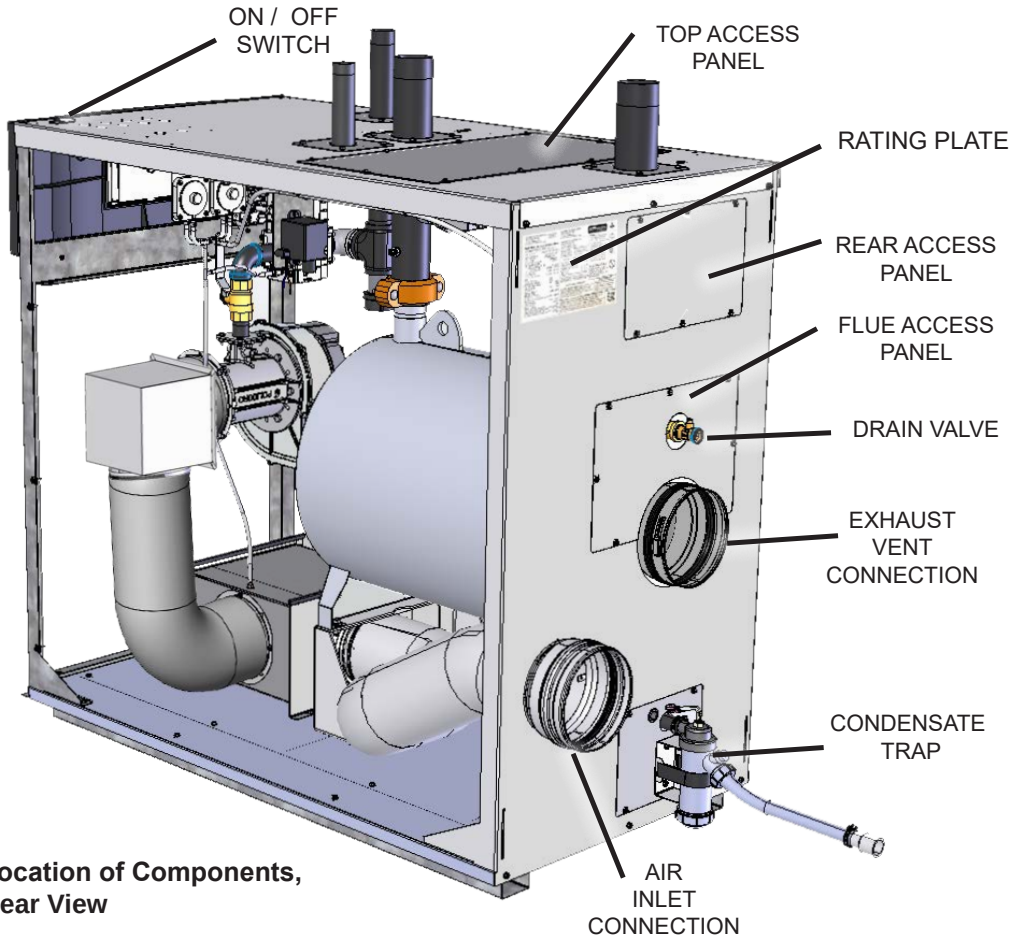


Figure 6. Location of Components, Rear View

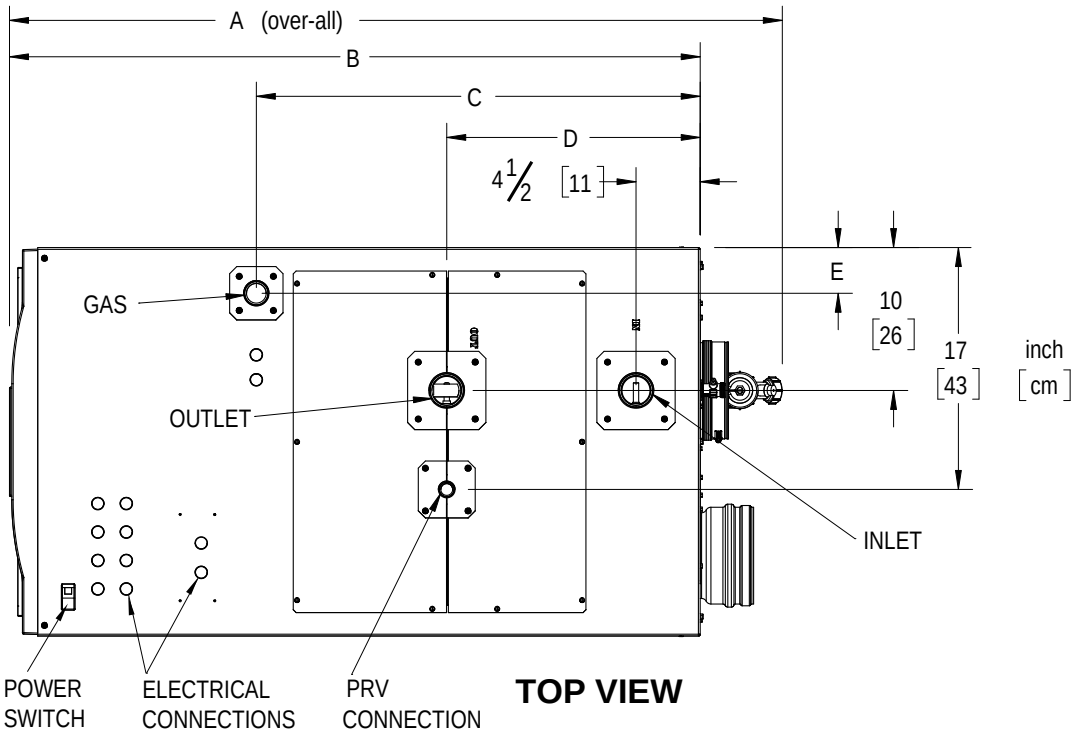
1.G Dimensions

Model	Dimensions (Inches)								
	A	B	C	D	E	Gas Conn.	Water Conn.	Air Inlet	Vent
399	47-1/4	41-1/2	23-1/4	12	5	1	2	4	4
500	47-1/4	41-1/2	24-1/2	13-1/2	5	1	2	4	4
650	54-1/4	48-1/2	31-1/4	17-3/4	3-1/4	1-1/4	2	6	6
800	54-1/4	48-1/2	34	20-3/4	3-1/4	1-1/4	2	6	6
999	57-3/4	52	35	25-1/2	4	1-1/2	2-1/2	6	6
1500	66-3/4	61	42-1/2	33	4	1-1/2	2-1/2	8	8

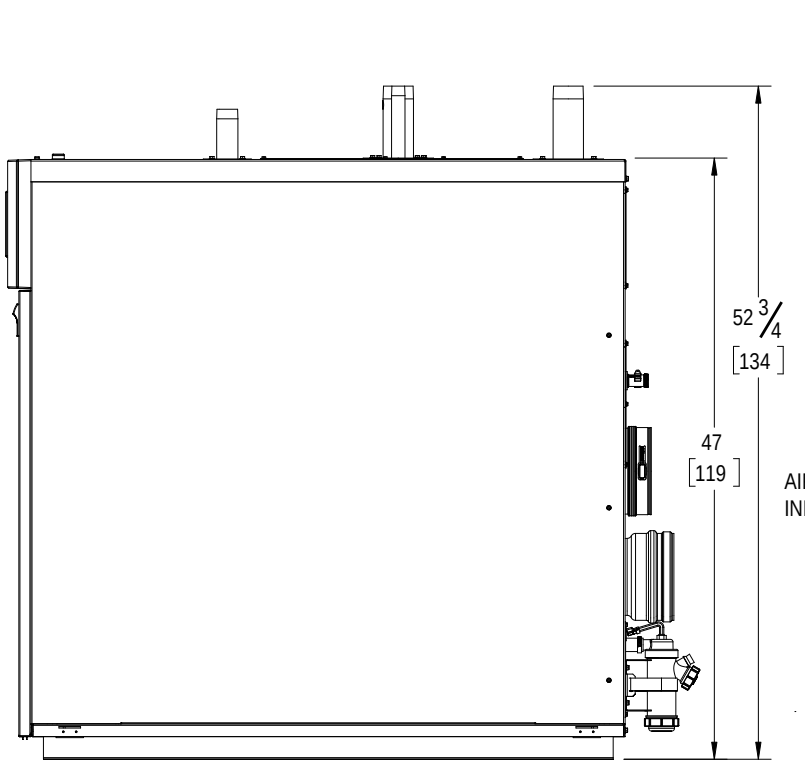
Model	Dimensions (cm)				
	A	B	C	D	E
399	120	105	59	31	13
500	120	105	62	34	13
650	138	123	79	45	8
800	138	123	86	53	8
999	147	132	89	65	10
1500	169	155	108	84	10

Table 1. Dimensions

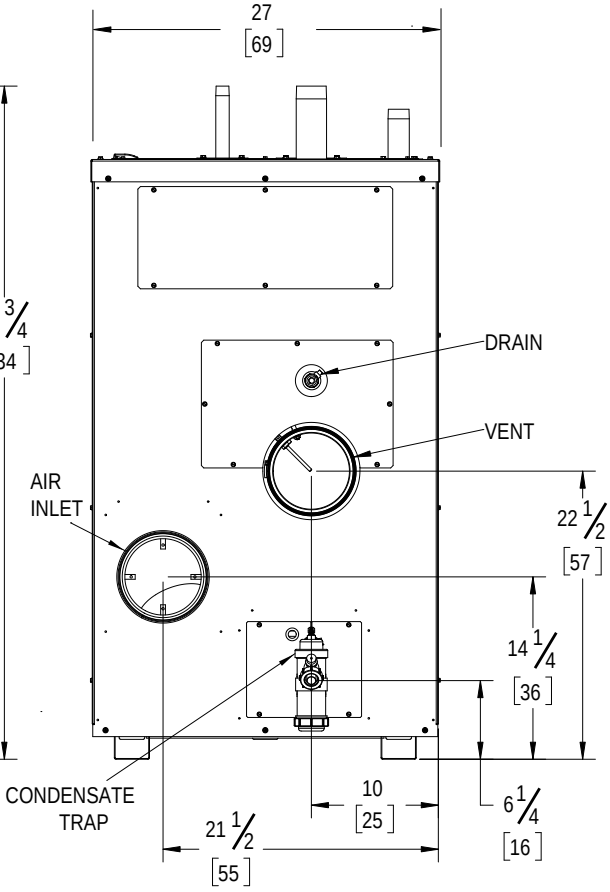
Dimensions (continued)



TOP VIEW



RIGHT SIDE VIEW



BACK VIEW

SECTION 2
LOCATING THE UNIT

2.A Removing a boiler from an Existing Common Vent

NOTE: This section does not describe a method for common venting this unit. It describes what must be done when a unit is removed from a common vent system. Contact the factory or your factory representative if you have questions about common venting this unit.

⚠ WARNING

When an existing boiler is removed from a common venting system, the common venting system is likely to be too large for proper venting of the appliances remaining connected to it.

At the time of removal of an existing boiler, the following steps must be followed with each appliance remaining connected to the common venting system placed in operation, while the other appliances remining connected to the common venting system are not in operation.

1. Seal any unused openings in the common venting system.

2. Visually inspect the venting system for proper size and horizontal pitch and determine there is no blockage or restriction, leakage, corrosion, and other deficiencies which could cause an unsafe condition.

3. Insofar as is practical, close all building doors and windows and all doors between the space in which the appliances remaining connected to the common venting system are located and other spaces of the building. Turn on clothes dryers and any appliance not connected to the common venting system. Turn on any exhaust fans, such as range hoods and bathroom exhausts, so they will operate at maximum speed. Do not operate a summer exhaust fan. Close fireplace dampers.

4. Place in operation the appliance being inspected. Follow the lighting instructions. Adjust thermostat so appliance will operate continuously.

5. Test for spillage at the draft hood relief opening after 5 minutes of main burner operation. Use the flame of a match or candle, or smoke from a cigarette, cigar, or pipe.

6. After it has been determined that each appliance remaining connected to the common venting system properly vents when tested as outlined above, return doors, windows, exhaust fans, fireplace dampers, and any other gas burning appliance to their previous condition of use.

7. Any improper operation of the common venting system should be corrected so the installation conforms with the National Fuel Gas Code, ANSI Z223.1/NFPA 54 in the US and the Natural Gas and Propane Installation Code, CSA B149.1 in Canada. When resizing any portion of the common venting system, the common venting system must be resized to approach the minimum size as determined using the appropriate tables in the National Fuel Gas Code, ANSI Z223.1/NFPA 54 in the US and the Natural Gas and Propane Installation Code, CSA B149.1 in Canada.

⚠ AVERTISSEMENT

Au moment du retrait d'une chaudière existante, les mesures suivantes seront prises pour chaque appareil toujours raccordé au système d'évacuation commun et qui fonctionne alors que d'autres appareils toujours raccordés au système d'évacuation commun ne fonctionnent pas.

1. Sceller toutes les ouvertures non utilisées du système d'évacuation commun.

2. Inspecter de façon visuelle le système d'évacuation pour déterminer la grosseur et l'inclinaison horizontale qui conviennent et s'assurer que le système est exempt d'obstruction ou d'étranglement, de fuite, de corrosion et autres défaillances qui pourraient présenter des risques.

3. Dans la mesure du possible, fermer toutes les portes et les fenêtres du bâtiment, de même que toutes les portes entre l'espace où les appareils toujours raccordés au système commun d'évacuation sont installés et les autres espaces du bâtiment. Mettre en marche les sécheuses et tout appareil non raccordé au système d'évacuation commun. Mettre en marche tout ventilateur d'extraction comme les hottes de cuisinière et les ventilateurs de salles de bain. S'assurer que ces ventilateurs fonctionnent à la vitesse maximale. Ne pas faire fonctionner un ventilateur d'été. Fermer les registres de foyers.

4. Mettre l'appareil inspecté en marche. Suivre les instructions d'allumage. Régler le thermostat de façon que l'appareil fonctionne de façon continue.

5. Faire fonctionner le brûleur principal pendant 5 minutes, déterminer ensuite si le coupe-tirage déborde à l'ouverture de décharge. Utiliser la flamme d'une allumette ou d'une chandelle ou la fumée d'une cigarette, d'un cigare ou d'une pipe.

6. Une fois qu'il a été déterminé, selon la méthode indiquée ci-dessus, que chaque appareil toujours raccordé au système commun d'évacuation est mis à l'air libre de façon adéquate, remettre les portes et les fenêtres, les ventilateurs, les registres de foyers et les appareils au gaz dans leur condition d'utilisation précédente.

7. Tout fonctionnement défectueux du système d'évacuation commun sera corrigé de façon que l'installation soit conforme au National Fuel Gas Code, ANSI Z223.1/NFPA 54 aux É.-U. et au Code d'installation du gaz naturel et du propane, CSA-B149.1 au Canada. Lorsque la grosseur d'une section du système d'évacuation requiert une modification, le système sera modifié pour respecter les valeurs minimales des tableaux pertinents de du National Fuel Gas Code, ANSI Z223.1/NFPA 54 aux É.-U. et le Code d'installation du gaz naturel et du propane, CSA-B149.1 au Canada.

2.B Unpacking and the Install Kit

This unit is shipped in a single crate. Carefully disassemble the crate and inspect the unit for any damage caused during shipping.

An installation kit is included with the unit. Check the contents of the installation kit to make sure all the parts are included and not damaged.

- Document Bag
- Pressure Relief Valve
- Temp/Pressure Gauge
- Termination Screens
- Tank Sensor
- Outdoor Sensor
- System Sensors
- Condensate Hose (see Section 7.A on page 42)

NOTE: A condensate neutralizer is NOT included with the unit.

Additional option kits may also be packed inside the crate of the unit.

2.C Locating the Unit

Unless installed with a factory supplied outdoor kit (see 2.D), this unit is certified for indoor installation only.

Choose a location for the unit which allows clearances on all sides for maintenance and inspection. See Table 4 on page 14 for suggested service clearances.

The unit should not be located in an area where leakage of any connections will result in damage to the area adjacent to the appliance or to lower floors of the structure. When such a location is not available, it is recommended that a suitable drain pan, adequately drained, be installed under the appliance.

Always install the unit on a firm, level surface. The unit is certified by CSA-International for installation on combustible flooring, in basements, closets, or utility rooms. The unit must never be installed directly on carpeting. For installations on carpeting, the unit must be installed on a metal or wood panel extending beyond the full width and depth of the unit by at least 3 inches in every direction. If it is installed in a closet, the entire floor shall be covered by the panel. The panel must be strong enough to support the operating weight of the unit.

The location for the unit should be chosen with regard to the vent pipe lengths and external plumbing. When venting vertically, the unit must be located as close as practical to the vertical section of the vent. If the vent terminal and/or combustion air terminal terminate through a wall, and there is potential for snow accumulation in the area, both terminals should be installed at an appropriate level above grade or the maximum expected snow line. Ensure the installation location considers the maximum allowable vent length as described in Section 3 of this manual.

2.D Outdoor Installation

⚠ CAUTION

This unit is not intended for installations where temperatures may drop below 32°F (0°C). If installing in a location that may experience freezing temperatures, precautions must be taken to prevent water in the heat exchanger and condensate trap from freezing. **Damage due to freezing water or condensate is not covered by the warranty.**

This unit may be installed outdoors using a factory supplied outdoor installation kit. See Table 2 on page 14. When properly installed, this kit protects the unit from the weather.

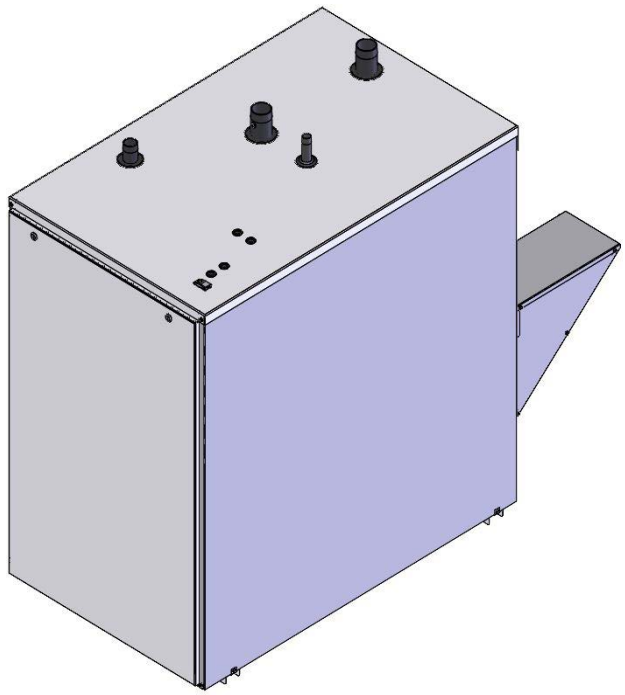


Figure 7. Outdoor Installation Kit

Outdoor Installation (continued)

Model	Outdoor Kit
399	CA023300
500	CA022800
650	CA022900
800	CA023000
999	CA023100
1500	CA023200

Table 2. Outdoor Installation Kits

The outdoor installation kit includes the following:

- Outdoor Jacket
- Air Inlet Cover
- Condensate Trap Cover
- Vent Support Bracket
- Installation Instructions

If the unit is installed with a factory supplied pump and the pump will also be installed outdoors, an outdoor pump housing kit must be used (see Table 3 for part numbers).

Model	Outdoor Pump Housing Kit
399 - 800	CA021900
800 W/ HARD WATER PUMP, 999 - 1500	CA022000
1500 W/ HARD WATER PUMP	CA022100

Table 3. Outdoor Pump Housing Kits

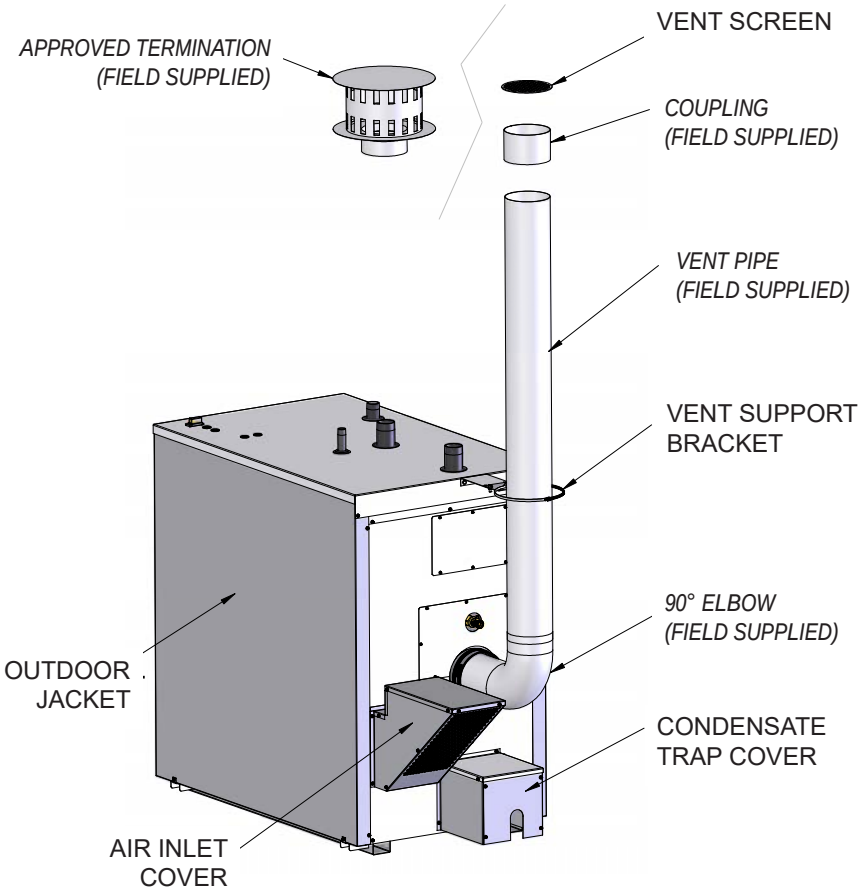


Figure 8. Outdoor Installation Kit Components

2.E Clearances

The following table lists the certified clearances to combustible construction and the suggested minimum clearances for service access.

	Clearance to Combustibles		Suggested Service Clearance	
	Inches	cm	Inches	cm
Front	0	*0*	24	*61*
Back	0	*0*	24	*61*
Left	0	*0*	0	*0*
Right	0	*0*	0	*0*
Top	0	*0*	24	*61*

Table 4. Clearances

SECTION 3
VENTING AND COMBUSTION AIR

3.A General Venting Information

This unit is certified to vent as a Category IV (positive pressure condensing) or Category II (negative pressure condensing) appliance. The vent can terminate through the roof, or through an outside wall. All vent systems which discharge horizontally (without the use of a power venter) are considered Category IV vent systems.

The venting system must be adequately supported to prevent sagging and low sections that could trap condensate. Follow the venting manufacturer's instructions for the proper method and intervals to place hangers and other supports. The unit must not support the weight of the vent pipe.

Ensure all joints are sealed.

3.A.1 Venting Safety Warnings

⚠ WARNING

All venting must be installed according to this manual and any other applicable local codes, including but not limited to: ANSI Z223.1/NFPA 54, CSA B149.1, CSA B149.2 and ULC S636. Failure to follow this manual and applicable codes may lead to property damage, severe injury, or death.

⚠ WARNING

Failure to use the appropriate vent material, installation techniques, or glues and sealants could lead to vent failure causing property damage, personal injury, or death.

⚠ WARNING

Selection of improper vent materials for installations that are installed in closets, or will be operated in high ambient temperature levels, may lead to property damage, personal injury, or death.

⚠ WARNING

Use of cellular core PVC (ASTM F891), cellular core CPVC, or Radel®(polyphenolsulfone) used in non-metallic venting systems is prohibited.

Non-metallic vent pipe (PVC, CPVC, polypropylene, or other) shall NOT be insulated or covered. Insulating or covering non-metallic venting may cause overheating which diminishes the integrity of the pipe.

⚠ WARNING

When an existing Category I appliance is removed or replaced, the original venting system may no longer be sized to properly vent the attached appliances. Under no circumstances should an improperly sized vent be used. An improperly sized vent may cause operational and safety problems, and could result in serious injury, death, or property damage.

This unit must never share a vent with any Category I appliance or any appliance designed to burn solid fuel.

⚠ WARNING

Venting must be installed with appropriate condensate traps, and using only the specific manufacturers, models, and materials outlined in this manual.

⚠ WARNING

If the unit is installed within a residential living space or home, the installer must confirm that at least one carbon monoxide alarm has been installed following the alarm manufacturer's instructions and applicable local codes before putting the appliance into operation. The manufacturer strongly recommends installation of carbon monoxide alarms in all installations.

NOTE: For Category II and IV boilers, the horizontal runs must be sloping upwards not less than ¼ inch per foot (21 mm/m) from the boiler to the vent terminal, so as to prevent accumulation of condensate and, where necessary, have the means provided for drainage of condensate.

3.B Flue Gas Sampling Port

It is the responsibility of the installer to ensure that a flue gas sampling port is installed in the vent system. There is no flue gas sampling port internal to the unit, so one must be installed in the vent system external to the unit.

The port must be installed within 2 feet of the flue connection. A flue gas sampling port available as a component of the ULC S636 certified vent system is preferred. However, if one is not available, the manufacturer suggests using a tee with the branch connection sized to allow for insertion of a flue gas analyzer probe. The branch connection must be re-sealable with a cap or other means to ensure the vent system remains sealed.

Consideration must be given to the placement and orientation of the flue gas sampling port to ensure that condensate is free to flow back into the unit and not collect anywhere in the vent system – including in the flue gas sampling port.

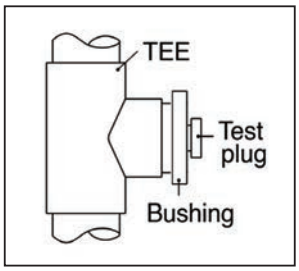


Figure 9. Test Port

3.C Approved Materials

This unit requires a special venting system. The manufacturers, materials, and product lines listed in this section are approved to safely operate with this equipment. Suppliers of stainless steel and polypropylene venting that are not listed on these tables are not permitted for use with this appliance. Refer to venting supplier's instructions for complete parts lists and methods of installation.

Do not mix venting suppliers and models in venting systems. Failure to comply could result in personal injury, property damage, or death.

Installations must comply with applicable national, state, and local codes.

The following materials may be used for the air intake:

Material	Notes
Schedule 40 PVC	Schedule 80 PVC is not permitted
Schedule 40 CPVC	Schedule 80 CPVC is not permitted
Polypropylene	See table 10 for approved manufacturers
Stainless Steel	See table 12 for approved manufacturers
Galvanized Steel	26 Ga. Minimum

Table 5. Allowed Air Intake Material

The following materials may be used for the vent:

Material	Required Certification for Installation in:		Notes
	United States	Canada	
Schedule 40 PVC	UL 1738, ULC S636, ANSI/ASTM D1785, or D2665	ULC S636	Schedule 80 PVC is not permitted
Schedule 40 CPVC	UL 1738, ULC S636, ANSI/ASTM F441	ULC S636	Schedule 80 CPVC is not permitted
Polypropylene	UL 1738 or ULC S636	ULC S636	See Table 10 for approved manufacturers
Stainless Steel	UL 1738	ULC S636	See Table 12 for approved manufacturers

Table 6. Allowed Vent Material

The following table lists the size and pipe material that the vent and air intake collars on the appliance are designed to accept. If a material other than that listed in the table is used, a boiler adapter is required to transition from the collar. See Table 11 on page 18 for a list of polypropylene adapters and Table 13 on page 19 for a list of stainless-steel adapters.

Model	Air Intake Collar		Vent Collar	
	Diameter (in)	Accepts	Diameter (in)	Accepts
399	4	Schedule 40 PVC/CPVC	4	Schedule 40 PVC/CPVC
500	4	Schedule 40 PVC/CPVC	4	Schedule 40 PVC/CPVC
650	6	Schedule 40 PVC/CPVC	6	Schedule 40 PVC/CPVC
800	6	Schedule 40 PVC/CPVC	6	Schedule 40 PVC/CPVC
999	6	Schedule 40 PVC/CPVC	6	Schedule 40 PVC/CPVC
1500	8	Galvanized Steel	8	Duravent FasNSeal

Table 7. Collar Size

3.C.1 PVC/CPVC

Model sizes 399, 500, 650, 800, and 999 are designed to accept PVC/CPVC vent material, so if venting with PVC or CPVC on these models, no boiler adapter is required. If venting with PVC or CPVC with the 1500 model, Duravent adapter FSA-8FNSM-8PVCF will be required.

In the United States, all PVC pipe material used for venting must conform to ANSI/ASTM D1785 or D2665. CPVC must conform to ANSI/ASTM F441. In Canada all PVC or CPVC pipe, fittings, cement, and primer must be ULC-S636 certified. Only schedule 40 pipe is allowed. Schedule 80 is not permitted.

All PVC or CPVC pipe and fittings must be properly assembled and sealed using appropriate primers and cements to prevent flue gas leakage.

3.C.1.a PVC/CPVC Terminations

For sidewall venting, a 90° elbow must be used for the air intake termination and the vent termination must be a straight coupling. For vertical venting, the air intake must terminate in a double elbow arrangement, and the vent termination must be a straight coupling. Termination screens that fit PVC/CPVC pipe are included with models 399, 500, 650, 800, and 999. See Section 3.F on page 23 for information on locating terminations.

3.C.1.b PVC/CPVC Concentric Terminations

Model sizes 399 and 500 can be vented concentrically. The following Ipex PVC and CPVC concentric terminations are approved for use.

Ipex System 636			
Model	PVC Low Profile Termination Kit	PVC Concentric Termination Kit	CPVC Concentric Termination Kit
399 - 500	196986	196021	197021

Table 8. Approved Ipex Concentric Termination Kits

Concentric termination kits are also available from the factory.

Model	PVC Low Profile Termination Kit	PVC Concentric Termination Kit	CPVC Concentric Termination Kit
399 - 500	CA010102	CA021700	CA021800

Table 9. Factory Concentric Termination Kits

3.C.2 Polypropylene

The following polypropylene vent manufacturers and models are approved for use with the unit.

Manufacturer	Trade Name/Model
Duravent	PolyPro
Centrotherm	InnoFlue
Z-Flex	Z-Dens
Ecco	CoxDens

Table 10. Approved Polypropylene Vent Manufacturers

All polypropylene pipe and fittings must be properly assembled per the manufacturer's instructions to prevent flue gas leakage. A boiler adapter is required when venting with polypropylene. See Table 11 on page 18 for boiler adapter part numbers for each approved polypropylene vent manufacturer.

3.C.2.a Polypropylene Adapters & Terminations

For sidewall venting, a 90° elbow must be used for the air intake termination and the vent termination must be a straight coupling. For vertical venting, the air intake must terminate in a double elbow arrangement, and the vent termination must be a straight coupling. Termination screens should be installed to prevent debris from entering the vent or air intake. The polypropylene adapters and terminations listed in Table 11 on page 18 are approved for use with the unit. Contact the venting manufacturer or your local distributor to order parts.

See Section 3.F on page 23 for information on locating terminations.

Polypropylene (continued)

Model	Duravent PolyPro			Centrotherm InnoFlue			Z-Flex Z-Dens		
	Boiler Adapter	Air Intake Termination	Vent Termination	Boiler Adapter	Air Intake Termination	Vent Termination	Boiler Adapter	Air Intake Termination	Vent Termination
399 - 500	4PPS-04PVCM-4PPF	4PPS-E90BC	4PPS-BG	ISAAL0404	ISELS0487UV	IASPP04	2ZDCPVCG4	2ZDE487UV	2ZDES4
650 - 999	6PPS-06PVCM-6PPF	6PPS-E90BC	6PPS-BG	ISAAL0606	ISEL0687UV	IASPP06	2ZDCPVCG6	2ZDE687	2ZDES6
1500	FSA-08M-8PPF	8PPS-E90C		ISSA0808	ISELS0887	IASSS08	2ZDAFNS08	2ZDE887	2ZDES8
	Ecco CoxDens								
399 - 500	4PPSSAD	487PEL	4PPSSG						
650 - 999	6PPSSAD	687PEL	6PPSSG						
1500	8PPSTLAD	887PEL	8PPSSG						

Table 11. Approved Polypropylene Adapters & Terminations

3.C.3 Stainless Steel

The following stainless-steel vent manufacturers and models are approved for use with the unit.

Manufacturer	Trade Name/Model
Duravent	FasNSeal
Heatfab	Saf-T Vent EZ Seal
Z-Flex	Z-Vent
Metal Fab	Corr/Guard
Security Chimney	Secure Seal
ICC	VIC
Schebler	eVent
Van Packer	MW
Jeremias	SWGV

Table 12. Approved Stainless Steel Vent Manufacturers

All stainless-steel pipe and fittings must be properly assembled per the manufacturer's instructions to prevent flue gas leakage. A boiler adapter is required when venting with stainless-steel. See Table 13 on page 19 for boiler adapter part numbers for each approved stainless-steel vent manufacturer.

3.C.3.a Stainless-Steel Adapters & Terminations

For sidewall venting, a 90° elbow must be used for the air intake termination. The vent termination may be a straight, 23°, or 45° angled termination. For vertical venting, the air intake must terminate in a double elbow arrangement or a rain cap. The vent termination must be a straight coupling. Do not use a rain cap for a vent termination. If they are not already included, termination screens should be installed to prevent debris from entering the vent or air intake. The stainless-steel adapters and terminations listed on Table 13 on page 19, are approved for use with the unit. Contact the venting manufacturer or your local distributor to order parts.

See Section 3.F on page 23 for information on locating terminations.

Stainless Steel (continued)

Model	Duravent FasNSeal			Heat Fab Saf-T Vent EZ Seal		
	Boiler Adapter	Air Intake Terminations	Vent Terminations	Boiler Adapter	Air Intake Terminations	Vent Terminations
399 - 500	FSA-4PVCS-4FNSF	FSELB9004 FSRC4	FSBS4	9401PVC	9414TERM 5400CI	9492
650 - 999	FSA-6PVCS-6FNSF	FSELB9006 FSRC6	FSBS6	9601PVC	9614TERM 5600CI	9690 9692
1500	N/A	FSELB9008 FSRC8	FSBS8	9801MAD	9814TERM 5800CI	9890 9892
	Z-Flex Z-Vent			**Metal Fab Corr/Guard**		
399 - 500	2SVSTTA04	2SVSTEX0490 2SVSRCX04	2SVSTPX04	4CGPVCA	4CGSW90LT 4CGSWC	4CGSWHTM 4CGSWMCM
650 - 999	2SVSTTA06	2SVEE0690 2SVSRC06	2SVSTPX06 2SVSAT06	6FCSPVCA	6FCSSW90L 6FCSSWCB	6FCSSWMCM
1500	2SVSAFNS08	2SVEE0890 2SVSRC08	2SVSTPX08 2SVSAT08	8FCSLCA	8FCSSW90L 8FCSSWCB	8FCSSWMCM
	Security Chimney Secure Seal			**ICC VIC**		
399 - 500	SS4PVCU	SS4ST90A SS4RCU	SS4ST SS4STA SS4MC	HO-04PAF26000S	HE-04E9F26000S HM-04RCF26000S	HM-04SRF26000S HM-04MCF26000S
650 - 999	SS6PVCU	SS6ST90A SS6RCU	SS6ST SS6STA SS6MC	HO-06PAF26000S	HE-06E9F26000S HM-06RCF26000S	HM-06SRF26000S HM-06MCF26000S
1500	SS8FFNSAU	SS8ST90A SS8RCU	SS8ST SS8STA SS8MC	HO-08CAF26000S0708	HE-08E9F26000S HM-08RCF26000S	HM-08SRF26000S HM-08MCF26000S
	Schebler eVent			**Van Packer MW**		
399 - 500	-	-	-	C04PVC4.44B	M0490EB M04SCSB	M04SCTB M04SDSB
650 - 999	EVD-PVC6-06	ESW-90L-06T ESW-CC-06T	ESW-HT-06T	C06PVC6.56B	M0690EB M06SCSB	M06SCTB M06SDSB
1500	EVD-UNAK3-08	ESW-90L-08T ESW-CC-08T	ESW-HT-08T	CM08MOAB	M0890EB M08SCSB	M08SCTB M08SDSB
	Jeremias SWGV					
399 - 500	SWGV4-PVCS	SWGV4-90ET SWGV4-WRC	SWGV6-OTS SWGV6-MCS SWGV6-30ET			
650 - 999	SWGV6-PVCS	SWGV6-90ET SWGV6-WRC	SWGV6-OTS SWGV6-MCS SWGV6-30ET			
1500	SWGV8-RCIS	SWGV8-90ET SWGV8-WRC	SWGV8-OTS SWGV8-MCS SWGV8-30ET			

Table 13. Approved Stainless Steel Adapters & Terminations

3.D Sizing

This unit is certified to vent as a Category IV or Category II appliance. Because Category II vent is non-positive, the vent size may not be the same as the positive pressure Category IV vent, even when the unit is the same size. Be sure to follow the instructions in this manual based on the type of venting in your installation.

Model	Air Intake			Vent			
	Diameter (in)	Min. Equivalent* Length (ft)	Max. Equivalent* Length (ft)	Category IV Diameter (in)	Category IV Min. Equivalent* Length (ft)	Category IV Max. Equivalent* Length (ft)	Typical** Category II Diameter (in)
399	4	0	150	4	10	150	12
500	4	0	150	4	10	150	12
650	6	0	150	6	10	150	12
800	6	0	150	6	10	150	12
999	6	0	150	6	10	150	12
1500	8	0	150	8	10	150	12

Table 14. Min & Max Equivalent Lengths

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

Diameter (in)	Elbow Equivalent Lengths (ft)					
	Air Intake			Vent		
	90^o Elbows (up to 6)	90^o Elbows (after first 6)	45^o Elbows	90^o Elbows (up to 6)	90^o Elbows (after first 6)	45^o Elbows
4	5	5	3	5	5	3
6	5	10	5	5	10	5
8	5	15	8	5	15	8

Table 15. Elbow Equivalent Lengths

3.D.1 Category IV Vent Sizing

Category IV vent systems may be either horizontally or vertically vented. The vent pipe used must be suitable for positive pressure. The table below lists the minimum and maximum equivalent lengths allowed on the vent and air intake for each model. When determining equivalent lengths, additional length must be added for each 90° and 45° elbow. Add 5 feet for each 90° up to the first 6. If more than 6 are needed in either the vent or air intake, or any 45° elbows are required, see Table 15 for the additional length to be added.

The following tables can be used to simplify the calculation of the equivalent length.

Air Intake Equivalent Length Calculation

	Straight Pipe (ft)		=
+	90° Elbows (up to 6)	_____ (# 90°s) x 5 (5ft)	=
+	90° Elbows (after first 6)	_____ (# addt'l 90°s) x See Table 15	=
+	45° Elbows	_____ (#45°s) x See Table 15	=
=	Equivalent Length (ft)		

Vent Equivalent Length Calculation

	Straight Pipe (ft)		=
+	90° Elbows (up to 6)	_____ (# 90°s) x 5 (5ft)	=
+	90° Elbows (after first 6)	_____ (# addt'l 90°s) x See Table 15	=
+	45° Elbows	_____ (#45°s) x See Table 15	=
=	Equivalent Length (ft)		

Example Equivalent Length Calculation

An 8-inch diameter vent is constructed of fifty feet of straight pipe, seven 90° elbows, and two 45° elbows.

	Straight Pipe (ft)		=	*50*
+	*90° Elbows (up to 6)*	*6* (# 90°s) x *5* (5ft)	=	*30*
+	*90° Elbows (after first 6)*	*1* (# addt'l 90°s) x *15* (See Table 15)	=	*15*
+	*45° Elbows*	*2* (#45°s) x *8* (See Table 15)	=	*16*
=	*Equivalent Length (ft)*			*111*

3.D.2 Category II Vent Sizing

Category II vent systems are generally vertically terminated. Table 14 gives guidelines for vent sizes.

⚠ WARNING

Cat II venting must be installed such that the draft always remains between -0.001" and -0.10" at all firing rates. If pressures outside of this range are measured, consult a professional venting engineer for recommendations, such as double-acting barometric dampers, to avoid reduced performance or hazardous conditions.

3.E Air for Combustion and Ventilation

Boilers and water heaters must have provisions for combustion and ventilation air in accordance with Section 9.3, Air for Combustion and Ventilation of the National Fuel Gas Code, ANSI Z223.1, or Sections 7.2, 7.3, or 7.4 of CSA B149.1, Installation Codes, or applicable provisions of the local building codes.

The unit may receive combustion air from the space in which it is installed, or it can be ducted directly to the unit from the outside. Ventilation air must be provided in either case.

3.E.1 Combustion Air from Room

In the United States, the most common requirements specify that the space shall communicate with the outdoors in accordance with method 1 or 2, which follow. Where ducts are used, they shall be of the same cross-sectional area as the free area of the openings to which they connect.

Method 1: Two permanent openings, one commencing within 12 inches (30 cm) of the top and one commencing within 12 inches (30 cm) of the bottom of the enclosure shall be provided. The openings shall communicate directly, or by ducts with the outdoors or spaces that freely communicate with the outdoors. When directly communicating with the outdoors, or when communicating the outdoors through vertical ducts, each opening shall have a minimum free area of 1 square inch per 4,000 Btu/hr (5.5 square cm/kW) of total input rating of all equipment in the enclosure. When communicating with the outdoors through horizontal ducts, each opening shall have a minimum free area of not less than 1 square inch per 2000 Btu/hr (11 square cm/kW) of total input rating of all equipment in the enclosure.

Method 2: one permanent opening, commencing within 12 inches (30 cm) of the top of the enclosure, shall be permitted. The opening shall directly communicate with the outdoors or shall communicate through a vertical or horizontal duct to the outdoors or spaces that directly communicate with the outdoors and shall have a minimum free area of 1 square inch per 3,000 Btu/hr (7 square cm/kW) of the total input rating of all equipment located in the enclosure. This opening must not be less than the sum of the area of all vent connectors in the confined space.

Other methods of introducing combustion and ventilation air are acceptable, provided they conform to the requirements in the applicable codes listed above. In Canada, consult local building and safety codes, or, in absence of such requirements, follow CSA B149.1.

3.E.2 Ducted Combustion Air

The combustion air can be taken through the wall, or through the roof. When taken from the wall, a field-supplied elbow must be used as a termination. When taken from the roof, a field-supplied elbow arrangement or a rain cap must be used to prevent entry of rain water. A screen should be placed at the termination to keep debris from entering the air intake.

See Table 5 on page 16 for a list of allowable air intake pipe materials. The maximum equivalent length allowed is 150 feet (45 m). The intake must be sized per Section 3.D. All joints must be sealed. Adequate hangers must be provided to support the weight of the air intake pipe. The unit must not support the weight of the air intake pipe.

In addition to air needed for combustion, air shall also be supplied for ventilation, including air required for comfort and proper working conditions for personnel. Refer to the applicable codes.

3.F Locating Terminations

3.F.1 Side Wall Terminations

Locate side wall terminals according to the following:

1. The vent must terminate in either a straight coupling, elbow, or an approved vent termination listed in this manual. No matter what terminal is used, the vent termination must face outward away from the wall as shown in Figure 10. The vent termination must not face downward, or flue gas recirculation could occur. When ducted combustion air is used, the air intake must terminate in a down-turned elbow.
2. The vent and air intake terminals may be located on either the same or different walls.
3. If located on the same wall, the vent must terminate at least 12 inches (30 cm) above the air intake.
4. **Locate terminals so they cannot be blocked by snow. The National Fuel Gas Code requires that terminals be located at least 12 inches (30 cm) above grade, but the installer may determine it should be higher, depending upon local conditions.**
5. Vent terminals are not permitted to terminate above a public walkway, or over an area where condensate or vapor could create a nuisance or hazard.
6. Locate the vent terminal so that vent gases cannot be drawn into air conditioning system inlets and so that vent gases cannot enter the building through doors, windows, gravity inlets, or other openings. Whenever possible, avoid locations under windows or near doors.
7. Locate the vent terminal so the vent exhaust does not settle on building surfaces or other nearby objects. Vent exhaust bi-products may damage surfaces or objects.
8. Do not locate the air inlet terminal near a source of chemical fumes (e.g., cleaning fluid, chlorine compounds, pool chemicals, etc.).
9. See Figure 16 for additional vent and air intake terminal clearances for the U.S. and Canada which must be maintained.
10. Multiple terminations must be installed with a minimum horizontal separation between the outlet group and inlet group of 12 inches (30 cm). (See Figure 11).
11. Install screens on all terminations to prevent debris from entering the vent or air intake.

NOTE: For US installations, the vent for this appliance shall not terminate:

i) over public walkways; or
ii) near soffit vents or crawl space vents or other areas where condensate or vapor could create a nuisance or hazard or cause property damage; or
iii) where condensate vapor could cause damage or could be detrimental to the operation of regulators, relief valves, or other equipment.

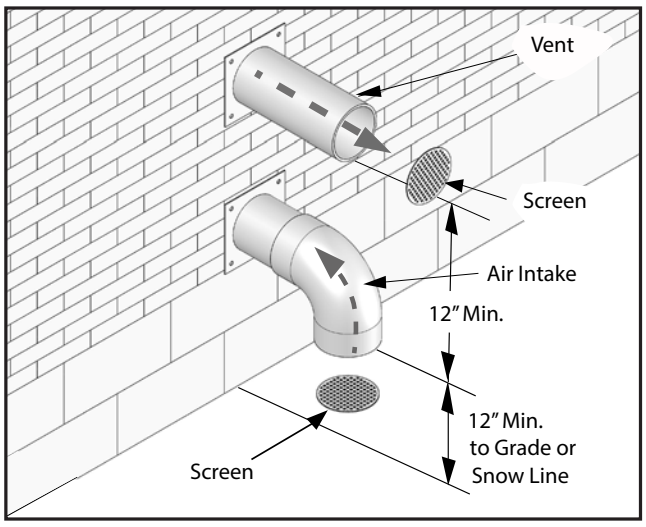


Figure 10. Side Wall Termination

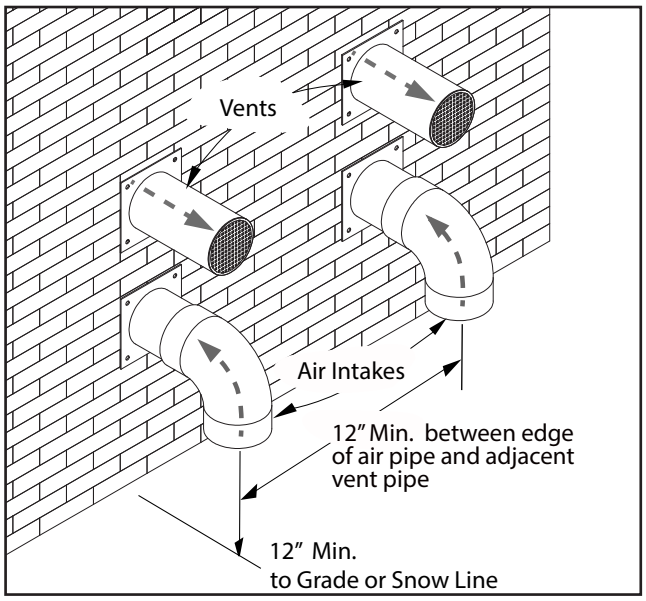


Figure 11. Multiple Side Wall Terminations

3.F.1.a Side Wall Low Profile Terminations (399 – 500 Models Only)

In addition to the side wall location requirements of 3.F.1, the following must also be considered when installing low profile terminations:

1. Low profile terminations must be installed in the proper orientation. See Figure 12 for possible mounting orientations.
2. Multiple low profile terminations must be installed with a minimum horizontal separation between the edge of the air inlet and the edge of the vent of the adjacent termination of at least 36 inches (90 cm). See Figure 13.
3. Follow the instructions included with the low profile kit for additional installation requirements.



Figure 12. Low Profile Termination Orientations

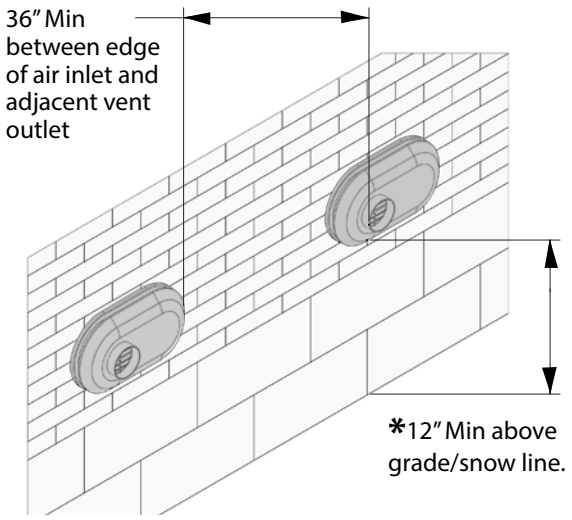


Figure 13. Multiple Low Profile Terminations

3.F.1.b Side Wall Concentric Terminations (399 – 500 Models Only)

In addition to the side wall location requirements of 3.F.1, the following must also be considered when installing concentric terminations:

1. Concentric terminals must be installed so that the horizontal distance between the wall and the air intake is between 1 and 2 inches (2.5 to 5 cm). See Figure 14.
2. Multiple concentric terminals must be installed with a minimum horizontal distance between adjacent terminals of at least 36 inches (90 cm), or alternatively, a maximum distance of 4 inches (10 cm) (for up to 2 terminals). For example, if 4 concentric terminals are installed, they could either each be installed at least 36 inches (90 cm) apart, or grouped into 2 pairs, with the terminals in each pair less than 4 inches (10 cm) apart and the groups separated by more than 36 inches (90 cm) See Figure 15.
3. Follow the instructions included with the concentric kit for additional installation requirements.

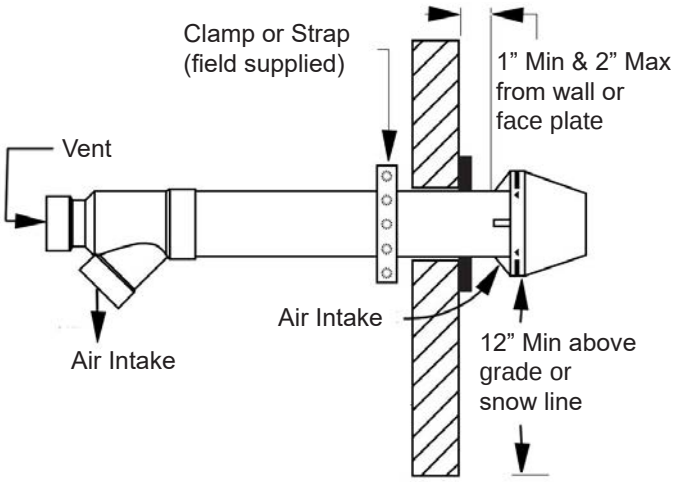


Figure 14. Concentric Termination Installation

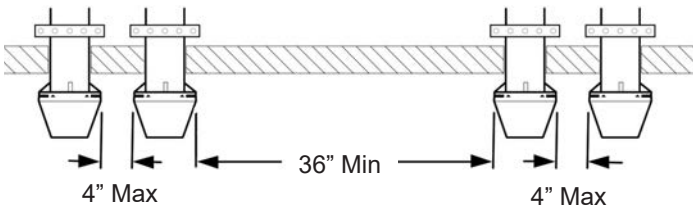


Figure 15. Multiple Concentric Terminations

		Canadian Installations[1]	U.S. Installations[2]
A =	Clearance above grade, veranda, porch, deck, or balcony	12 in (30 cm)	12 in (30 cm)
B =	Clearance to window or door that may be opened	• 6 in (15 cm) for appliances ≤ 10,000 Btuh (3 kW) • 12 in (30 cm) for appliances > 10,000 Btuh (3 kW) and ≤ 100,000 Btuh (30 kW) • 36 in (91 cm) for appliances >100,000 Btuh (30 kW)	• 6 in (15 cm) for appliances ≤ 10,000 Btuh (3 kW) • 9 in (23 cm) for appliances > 10,000 Btuh (3 kW) and ≤ 50,000 Btuh (15 kW) • 12 in (30 cm) for appliances >50,000 Btuh (15 kW)
C =	Clearance to permanently closed window	See Note 4	See Note 5
D =	Vertical clearance to ventilated soffit located above the terminal within a horizontal distance of 2 ft (61 cm) from the center line of the terminal	See Note 4	See Note 5
E =	Clearance to unventilated soffit	See Note 4	See Note 5
F =	Clearance to outside corner	See Note 4	See Note 5
G =	Clearance to inside corner	See Note 4	See Note 5
H =	Clearance to each side of centerline extended above meter / regulator assy	3 ft (91 cm) within a height of 15 ft (4.6 m)	See Note 5
I =	Clearance to service regulator vent outlet	3 ft (91 cm)	See Note 5
J =	Clearance to nonmechanical air supply inlet to building or the combustion air inlet to any other appliance	• 6 in (15 cm) for appliances ≤ 10,000 Btuh (3 kW) • 12 in (30cm) for appliances > 10,000 Btuh (3 kW) and ≤ 100,000 Btuh (30 kW) • 36 in (91 cm) for appliances > 100,000 Btuh (30 kW)	• 6 in (15 cm) for appliances ≤ 10,000 Btuh (3 kW) • 9 in (23cm) for appliances > 10,000 Btuh (3 kW) and ≤ 50,000 Btuh (15 kW) • 12 in (30 cm) for appliances > 50,000 Btuh (15 kW)
K =	Clearance to a mechanical air supply inlet	6 ft (1.83 m)	3 ft (91 cm) above if within 10 ft (3 m) horizontally
L =	Clearance above paved sidewalk or paved driveway located on public property	7 ft (2.13 m)†	7 ft (2.13 m) for mechanical draft systems (Category I appliances). Vents for Category II and IV appliances cannot be located above public walkways or other areas where condensate or vapor can cause a nuisance or hazard*
M =	Clearance under veranda, porch, deck, or balcony	12 in (30 cm)‡	See Note 5

† A vent shall not terminate directly above a sidewalk or paved driveway that is located between two single family dwellings and serves both dwellings.
‡ Permitted only if veranda, porch, deck, or balcony is fully open on a minimum of two sides beneath the floor.

Notes:
1) In accordance with the current CSA B149.1, Natural Gas and Propane Installation Code.
2) In accordance with the current ANSI Z223.1/NFPA 54, Natural Fuel Gas Code.
3) If locally adopted installation codes specify clearances different than those illustrated, then the most stringent clearance shall prevail.
4) For clearances not specified in CAN/CSA-B149, clearance is in accordance with local installation codes and the requirements of the gas supplier.
5) For clearances not specified in ANSI Z223.1/ NFPA 54, clearance is in accordance with local installation codes and the requirements of the gas supplier.
6) IMPORTANT: Terminal must be placed such that it remains a minimum of 12” above maximum expected snow line. Local codes may have more specific requirements, and must be consulted.

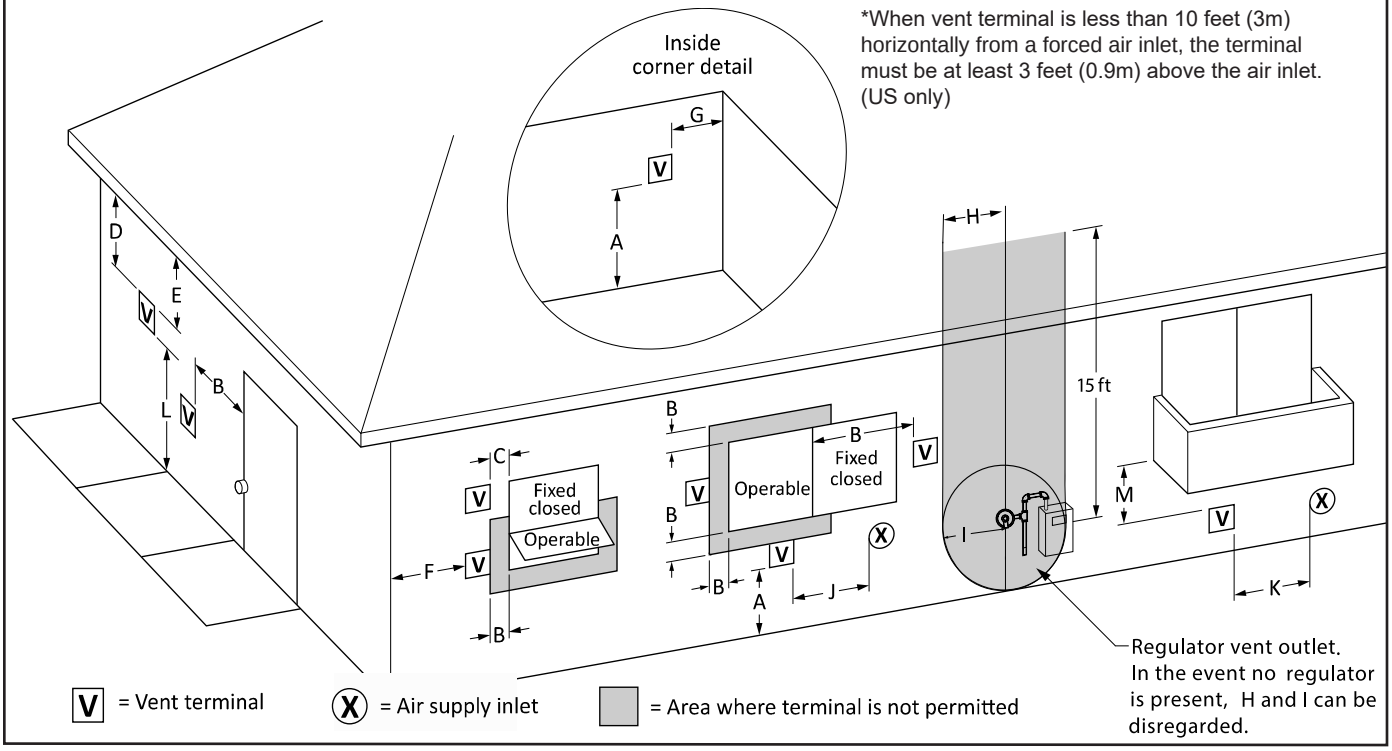


Figure 16. Combustion Air and Vent Through Side Wall

3.F.2 Vertical Terminations

Locate vertical terminals according to the following:

1. The vent must terminate in a straight length of pipe or coupling. **Do not use a rain/vent cap for a vent termination.** When the combustion air is taken from the roof, it must terminate in a double elbow arrangement as shown in Figure 17, or an approved rain cap (for stainless steel venting only).

2. The vent must extend at least 3 feet (0.9 m) above the point at which it penetrates the roof and at least 2 feet (0.6 m) higher than any portion of a building within a horizontal distance of 10 feet (3.0 m).

3. When both the vent and combustion air are taken from the roof, the vent must terminate at least 12 inches (30 cm) above the air intake.

4. The combustion air terminal must be at least 12 inches (30 cm) above the point at which it penetrates the roof, and high enough above the roof line to prevent blockage from snow.

5. Vent and combustion air terminals must be horizontally separated by at least 36 inches (90 cm).

6. For multiple terminations, ensure that a minimum vertical separation of 12 inches (30 cm) and a minimum horizontal separation of 36 inches (90 cm) is maintained between each vent terminal and each air intake (See Figure 18 and Figure 19).

7. Install screens on all terminations to prevent debris from entering the vent or air intake.

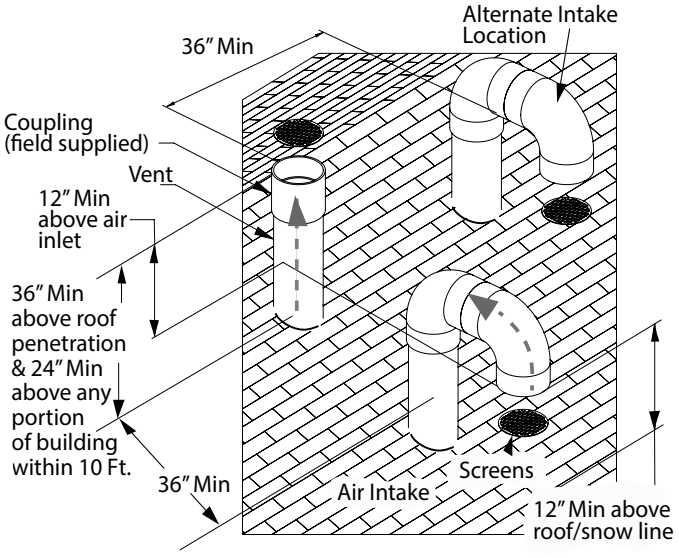


Figure 17. Vertical Terminations

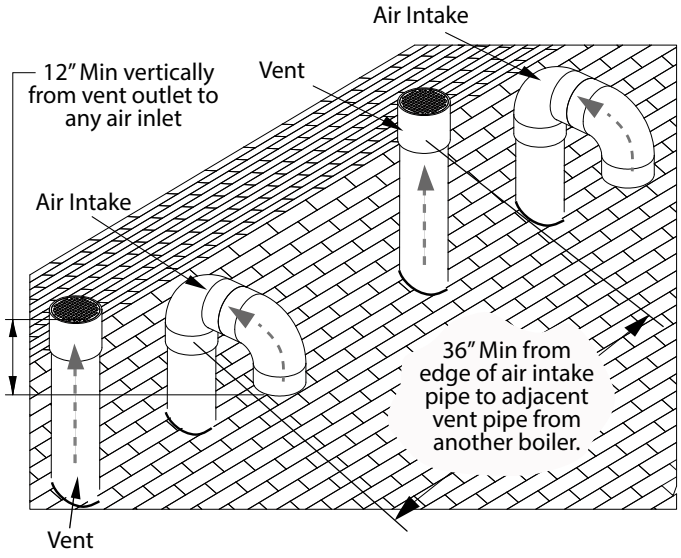


Figure 18. Multiple Vertical Terminations

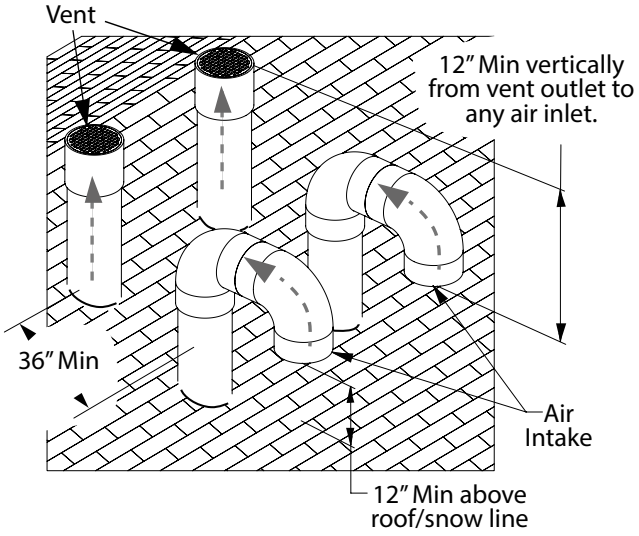


Figure 19. Multiple Vertical Terminations

3.G Installations in the Commonwealth of Massachusetts

In Massachusetts the following items are required if the side-wall exhaust vent termination is less than seven (7) feet above finished grade in the area of the venting, including but not limited to decks and porches. (From Massachusetts Rules and regulations 248 CMR 5.08.)

1. Installation of Carbon Monoxide Detectors

At the time of installation of the side-wall vented gas fueled unit, the installing plumber or gasfitter shall observe that a hard wired carbon monoxide detector with an alarm battery back-up is installed on the floor level where the gas unit is to be installed. In addition, the installing plumber or gasfitter shall observe that a battery operated or hard wired carbon monoxide detector with an alarm is installed on each additional level of the dwelling, building or structure served by the side-wall horizontally vented gas fueled equipment. It shall be the responsibility of the property owner to secure the services of qualified licensed professionals for installation of hard wired carbon monoxide detectors.

a. In the event that the side-wall horizontally vented gas fueled equipment is installed in a crawl space or an attic, the hard wired carbon monoxide with alarm and battery back-up may be installed on the next adjacent floor level.

b. In the event that the requirements of the subdivision 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 be installed.

2. Approved Carbon Monoxide Detectors

Each carbon monoxide detector shall comply with NFPA 720 and be ANSI/UL 2034 listed and IAS certified.

3. Signage

A metal or plastic identification plate shall be permanently mounted to the exterior of the building at a minimum height of eight (8) feet above grade directly in line with the exhaust vent terminal for horizontally vented gas fueled heating unit or equipment. The sign shall read, in print no less than one-half (1/2) inch in size: “GAS VENT DIRECTLY BELOW, KEEP CLEAR OF ALL OBSTRUCTIONS.”

4. Inspection

The state or local gas inspector of the side-wall horizontally vented gas fueled unit shall not approve the installation unless, upon inspection, the inspector observes carbon monoxide detectors and signage installed in accordance with the provisions of 248 CMR 5.08(2)(a) 1-4.

SECTION 4
GAS SUPPLY AND PIPING

4.A Gas Supply and Piping.

All Installations must conform to the National Fuel Gas Code ANSI Z223.1/NFPA54, and/or local codes. In Canada, the installation must conform to the latest edition of CSA B149.1 Natural Gas and Propane Gas Installation Code, and/or local codes. Gas piping should be supported by suitable hangers or floor stands, not the appliance.

Review the following instructions before proceeding with the installation.

1. Verify that the appliance is fitted for the proper type of gas by checking the rating plate.
2. Verify that the unit’s control is setup for the correct altitude per 9.E.1.b on page 87.
3. Refer to Section 4.B to size the piping.
4. Run gas supply line in accordance with all applicable codes.
5. Locate and install manual shutoff valves in accordance with state and local requirements.
6. All threaded joints should be coated with piping compound resistant to action of liquefied petroleum gas.
7. The appliance and its individual shutoff valve must be disconnected from the gas supply piping during any pressure testing of that system at test pressures in excess of 1/2 PSIG (3.45kPa).
8. The unit must be isolated from the gas supply 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 1/2 PSIG (3.45kPa).
9. The appliance and its gas connection must be leak tested before placing it in operation.
10. Purge all air from gas lines.
11. Place the unit in operation per SECTION 11. Measure the gas supply pressure at the gas supply measurement port shown in Figure 51 – Figure 53 on page 101. Ensure the gas supply pressure is between the Min and Max values shown in Table 16, while the unit is running at both high (100%) fire and low (10%) fire. If any other appliances share the gas supply line, the pressure must also be checked to ensure it is within the values shown with every appliance that shares the supply line operating at maximum capacity.

Inlet Gas Supply Pressure (in. W.C.)		
	Min	Max
Natural Gas	3.5	10.5

Table 16. Gas Pressure

⚠ WARNING

Do not use an open flame to check for leaks. An open flame could lead to explosion, which could result in property damage, serious injury, or death.

⚠ WARNING

If an inline high gas pressure regulator is used, it MUST BE of the lockup type and located a minimum of 10 feet from the unit. Failure to do so may result in insufficient gas volume supplied to the unit.

NOTE: This appliance and all other gas appliances sharing the gas supply line must be firing at maximum capacity to properly measure the inlet supply pressure. The pressure can be measured at the supply pressure port on the gas valve. Low gas pressure could be an indication of an undersized gas meter, undersized gas supply lines and/or an obstructed gas supply line. Some units are equipped with low and high gas pressure switches that are integrally vent limited. These types of devices do not require venting to atmosphere.

4.B Gas Pipe Sizing

To Size piping:

1. Measure the length from the meter outlet to the farthest appliance. In Table 17 on page 28, round up to the next closest length value. This value will be used to size each branch of the piping
2. For each branch of the piping, add the input of all the appliances downstream. For natural gas, divide by 1000 to obtain cubic feet per hour. Locate the next highest capacity value in the table at the length row determined in step 1. Follow the column to the top to determine the required pipe size for that branch.
3. Repeat for each branch of the piping.
4. Note that Table 17 on page 28 is for schedule 40 metallic pipe and pressure drops of 0.3” w.c. and 0.5” w.c., respectively. For additional pipe sizing information, refer to ANSI Z223.1, or B149.1 for Canadian Installations.

Length (ft)	Pipe Size (inches)								
	1/2"	3/4"	1"	1 1/4"	1 1/2"	2"	2 1/2"	3"	4"
10	131	273	514	1,060	1,580	3,050	4,860	8,580	17,500
20	90	188	353	726	1,090	2,090	3,340	5,900	12,000
30	72	151	284	583	873	1,680	2,680	4,740	9,660
40	62	129	243	499	747	1,440	2,290	4,050	8,270
50	55	114	215	442	662	1,280	2,030	3,590	7,330
60	50	104	195	400	600	1,160	1,840	3,260	6,640
70	46	95	179	368	552	1,060	1,690	3,000	6,110
80	42	89	167	343	514	989	1,580	2,790	5,680
90	40	83	157	322	482	928	1,480	2,610	5,330
100	38	79	148	304	455	877	1,400	2,470	5,040
125	33	70	131	269	403	777	1,240	2,190	4,460
150	30	63	119	244	366	704	1,120	1,980	4,050
175	28	58	109	224	336	648	1,030	1,820	3,720
200	26	54	102	209	313	602	960	1,700	3,460
250	23	48	90	185	277	534	851	1,500	3,070
300	21	43	82	168	251	484	771	1,360	2,780
350	19	40	75	154	231	445	709	1,250	2,560
400	18	37	70	143	215	414	660	1,170	2,380

Table 17. Natural Gas Pipe Capacity in Cubic Feet per Hour
Schedule 40 metallic pipe, 0.60 specific gravity, 0.30” w.c. pressure drop

SECTION 5
PUMP REQUIREMENTS

5.A Boiler Flow and Head Requirements

Model	Temperature Rise (°F)									
	20		30		40		50		60	
	Flow	H/L	Flow	H/L	Flow	H/L	Flow	H/L	Flow	H/L
	gpm	ft	gpm	ft	gpm	ft	gpm	ft	gpm	ft
399	38	10.8	26	4.8	19	2.7	15	1.8	13	1.2
500	48	12.0	32	5.3	24	2.9	19	1.9	16	1.3
650	62	12.2	42	5.4	31	3.0	25	1.9	21	1.3
800	77	13.3	51	5.9	38	3.3	31	2.2	26	1.5
999	96	15.0	64	6.8	48	3.9	38	2.5	32	1.8
1500	144	35.2	96	15.7	72	8.8	58	5.7	48	4.0

Model	Temperature Rise (°C)									
	11		17		22		28		33	
	Flow	H/L	Flow	H/L	Flow	H/L	Flow	H/L	Flow	H/L
	lpm	m	lpm	m	lpm	m	lpm	m	lpm	m
399	145	3.3	97	1.5	72	0.8	58	0.5	48	0.4
500	182	3.7	121	1.6	91	0.9	73	0.6	61	0.4
650	236	3.7	157	1.6	118	0.9	94	0.6	79	0.4
800	291	4.1	194	1.8	145	1.0	116	0.7	97	0.5
999	363	4.6	242	2.1	182	1.2	145	0.8	121	0.5
1500	545	10.7	363	4.8	273	2.7	218	1.7	182	1.2

Table 18. Boiler Flow and Head Requirements

5.B Water Heater Flow and Head Requirements

Model	Water Hardness 5 - 12 gpg			Water Hardness 12 - 15 gpg		
	Flow	H/L	Delta-T	Flow	H/L	Delta-T
	gpm	ft	°F	gpm	ft	°F
399	31	7.0	25	41	12.3	20
500	37	7.0	25	49	12.6	20
650	49	7.5	25	66	13.4	20
800	61	8.5	25	82	15.1	20
999	74	8.9	25	98	15.7	20
1500	80	10.8	36	106	19.2	27

Model	Water Hardness 5 - 12 gpg			Water Hardness 12 - 15 gpg		
	Flow	H/L	Delta-T	Flow	H/L	Delta-T
	lpm	m	°C	lpm	m	°C
399	116	2.1	14	155	3.7	11
500	139	2.1	14	186	3.8	11
650	186	2.3	14	248	4.1	11
800	232	2.6	14	310	4.6	11
999	279	2.7	14	372	4.8	11
1500	302	3.3	20	403	5.9	15

Table 19. Water Heater Flow and Headloss Requirements

5.C Water Heater Recovery Data

Model	Required Water Temperature Rise (°F)								
	40	50	60	70	80	90	100	120	140
	gph	gph	gph	gph	gph	gph	gph	gph	gph
399	1149	919	766	657	575	511	460	383	328
500	1440	1152	960	823	720	640	576	480	411
650	1872	1498	1248	1070	936	832	749	624	535
800	2304	1843	1536	1317	1152	1024	922	768	658
999	2877	2302	1918	1644	1439	1279	1151	959	822
1500	4320	3456	2880	2469	2160	1920	1728	1440	1234

Model	Required Water Temperature Rise (°C)								
	22	28	33	39	44	50	56	67	78
	lph	lph	lph	lph	lph	lph	lph	lph	lph
399	4350	3480	2900	2486	2175	1933	1740	1450	1243
500	5451	4361	3634	3115	2725	2423	2180	1817	1557
650	7086	5669	4724	4049	3543	3149	2835	2362	2025
800	8722	6977	5814	4984	4361	3876	3489	2907	2492
999	10891	8713	7261	6223	5446	4840	4356	3630	3112
1500	16353	13082	10902	9345	8176	7268	6541	5451	4672

Table 20. Water Heater Recovery Data

SECTION 6
WATER PIPING

6.A Install the Pressure Relief Valve and Temp/Pressure Gauge

Every unit comes with a pressure relief valve and a temperature/pressure gauge which must be installed before filling the system. Connect them directly to the locations shown in the figure below. Do not connect any valves or fittings in between the pressure relief valve and the unit.

Pipe the discharge of the pressure relief valve in a manner to prevent injury in the event of pressure relief. Use full size piping and pipe the discharge as short and directly as possible. Do not connect any reducers or other fittings in the discharge piping that could reduce the relieving capacity of the pressure relief valve.

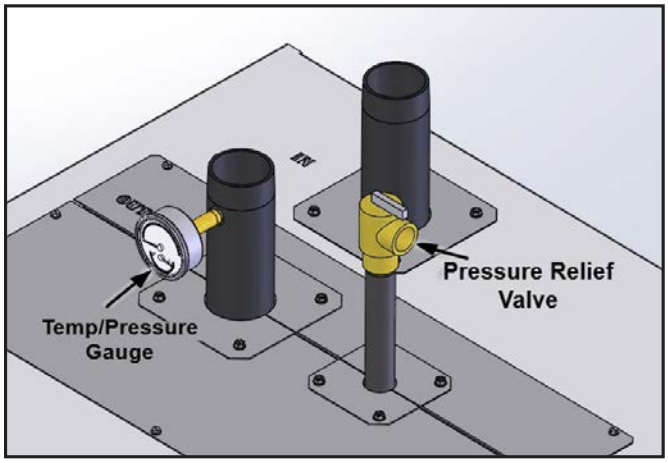


Figure 20. Pressure Relief Valve

⚠ WARNING

A pressure relief valve with adequate relieving capacity for the intended application must be installed on every unit. Failure to install a pressure relief valve, or installation of a valve with inadequate relieving capacity could lead to over-pressurization of the unit causing property damage, personal injury, or death.

NOTE: The pressure relief valve should not discharge water during normal unit operation. If it does, this may be due to thermal expansion of the closed water system. Contact a qualified service technician to correct this situation. Never plug the relief valve.

6.B Boiler Piping

NOTE**:** This appliance must be installed in a closed pressure system with a minimum of 12 psi (82.7kPa) static pressure at the boiler.

Water piping should be supported by suitable hangers or floor stands. Do not support piping with this appliance. Due to expansion and contraction of copper pipe, consideration should be given to the type of hangers used. Rigid hangers may transmit noise through the system resulting from the piping sliding in the hangers. It is recommended that padding be used when rigid hangers are installed. Maintain 1” (2.5cm) clearance to combustibles for hot water pipes.

Install an air purger, an air vent, a diaphragm-type expansion tank, and a hydronic flow check in the system supply loop. Minimum fill pressure must be 12psig (82.7kPa). Install shutoff valves where required by code.

All boiler models can be ordered with a pump. When the pump is included with the boiler, the boiler must be located within 15 feet (4.6m) of the supply/return header (or hydraulic separator). These units must be piped in a primary-secondary fashion, such that the pump that is included only serves the boiler. The pumps are sized for the headloss of the boiler and a maximum of 30 feet (9.1m) of piping that is the same size as the boiler water connections. See SECTION 5.

If longer pipe lengths or alternate piping methods are being used, the pump must be sized for the boiler and the piping it will serve. SECTION 5 on page 29 shows water flow and headloss data for the boiler. The manufacturer strongly recommends primary-secondary piping.

If the unit supplies hot water to heating coils in air handler units, flow control valves or other devices must be installed to prevent gravity circulation of the water in the coils during the cooling cycle.

When used in conjunction with a refrigeration system, chilled water must be piped in parallel to prevent it from entering the unit.

6.B.1 Boiler Cold Water Make-Up

1. Connect the cold water supply to the inlet connection of an automatic fill valve.
2. Install a suitable back flow preventer between the automatic fill valve and the cold water supply.
3. Install shut off valves where required.

The boiler piping system of a hot water heating boiler connected to heating coils located in air handling

appliances where they may be exposed to refrigerated air circulation must be equipped with flow control valves or other automatic means to prevent gravity circulation of the boiler water during the cooling cycle.

A boiler installed above radiation level, or as required by the authority having jurisdiction, must be provided with a low water cutoff device either as a part of the boiler or at the time of boiler installation.

6.B.2 Freeze Protection

Proper precautions for freeze protection are recommended for boiler installations in areas where the danger of freezing exists.
Power outage, interruption of gas supply, failure of system components, activation of safety devices, etc., may prevent a boiler from firing. **Any time a boiler is subjected to freezing conditions, and the boiler is not able to fire, and/or the water is not able to circulate, there is a risk of freezing in the boiler or in the system piping.** When water freezes, it expands, which may result in bursting of pipes, or damage to the boiler, which could result in leaking or flooding conditions.

To help prevent freezing, the manufacturer recommends the use of inhibited glycol concentrations between 20% and 35%. Typically, this concentration will serve as burst protection for temperatures down to approximately -5°F (-20°C). If necessary, glycol concentrations up to 50% can be used.

Some items to consider when using glycol solutions:

- When using glycol solutions, heat transfer is reduced and head pressure is increased. For example: a 30% mixture of glycol will result in a BTU output loss of 15% and a 5% increase in head against the system circulator. A 50% mixture of glycol will result in a BTU output loss of 30% and a 50% increase in head against the system circulator. **When glycol solutions are used, water flow rates must be increased to maintain a 20˚F to 25˚F temperature rise through the boiler. If flow rates are not increased, short-cycling of the burner can occur.**
- Glycol/antifreeze solutions expand more than water; this must be considered during the system design. For example: a 40% glycol solution expands 4.8% in volume for a temperature increase from 32°F to 180°F, while water expands 3% over the same temperature rise.
- Glycol products must be maintained properly in a heating system, or they may become ineffective. The glycol solution should be tested as recommended by the manufacturer, but not less than annually. Some items of concern are pH additive breakdown, inhibitor reduction, etc. Consult the glycol manufacturer for information about specific products, maintenance of solutions, and set up according to your particular conditions.

⚠ WARNING

Glycol must not be used in domestic hot water applications.

⚠ WARNING

Do NOT use automotive antifreeze or ethylene glycol. Use only inhibited propylene glycol solutions which are specially formulated for hydronic systems. Ethylene glycol is toxic and can attack gaskets, seals, and metallic components used in hydronic systems. A correct glycol concentration and inhibitor level is critical.

NOTE: Manufacturer's supplied pumps are not all capable of maintaining the reduced temperature rise required with glycol concentrations greater than 35%. If glycol concentrations required are greater than 35% a field supplied pump should be used.

6.B.3 Boiler Suggested Piping Schematics

Figure 21 through Figure 27 show suggested piping configurations for Boilers. These diagrams are only meant as a guide. All components or piping required by local code must be installed.

⚠ WARNING

These piping schematics show suggested piping configuration and valving. Check with local codes and ordinances for additional requirements.

⚠ CAUTION

Pump sizing must be based on water hardness at job site.

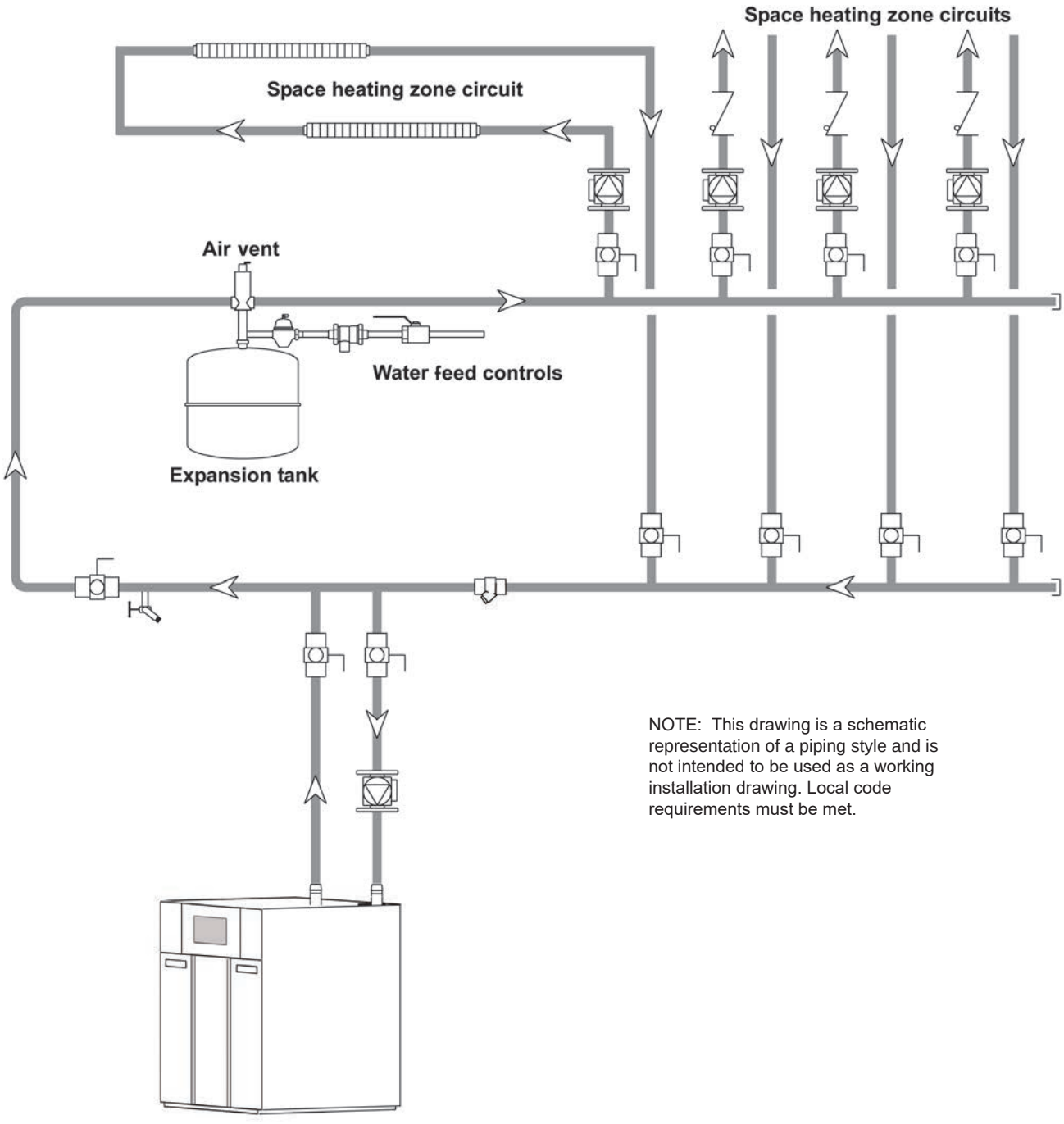


Figure 21. Hydronic Piping — Single Boiler, Zoning with Circulators

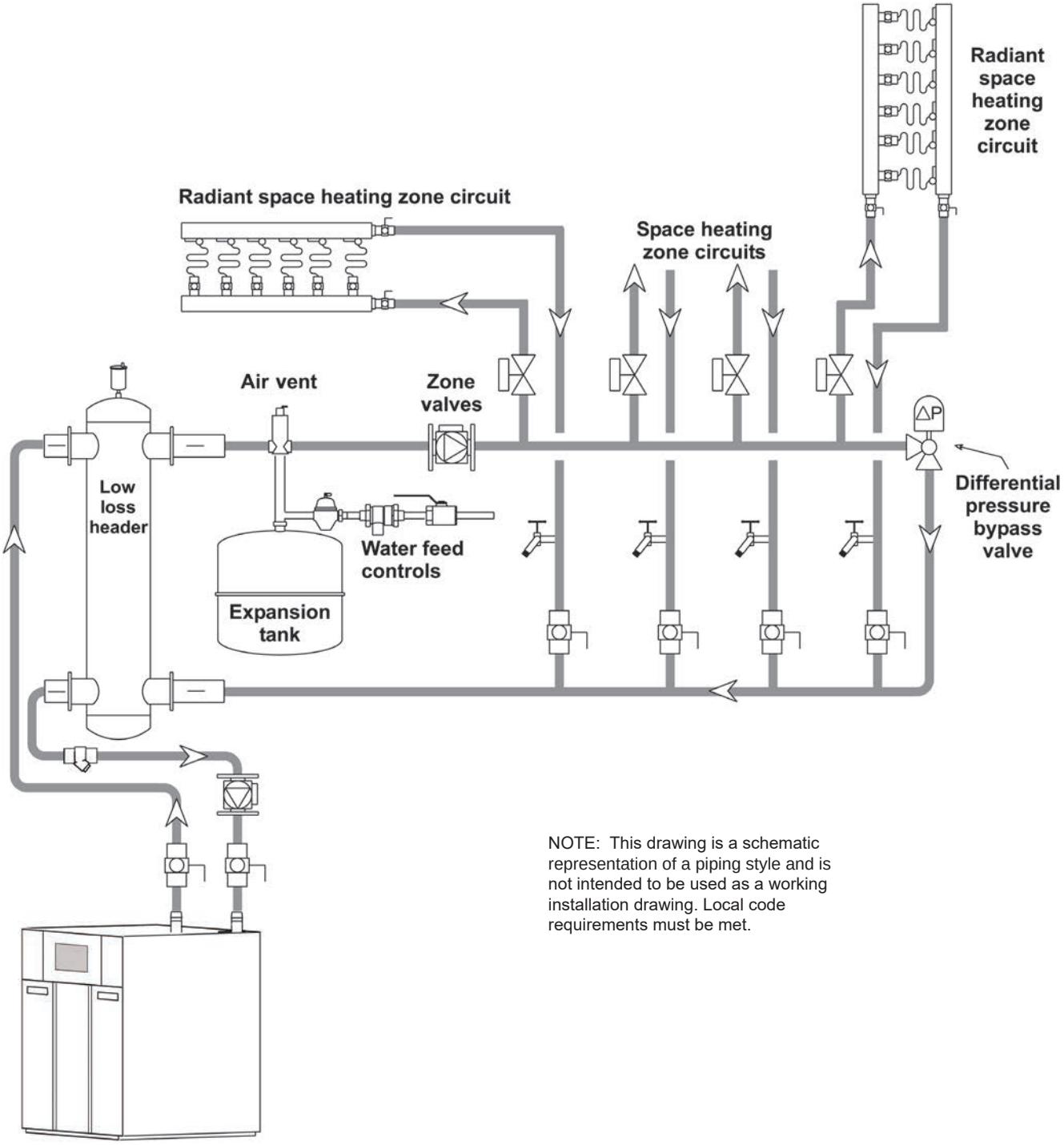
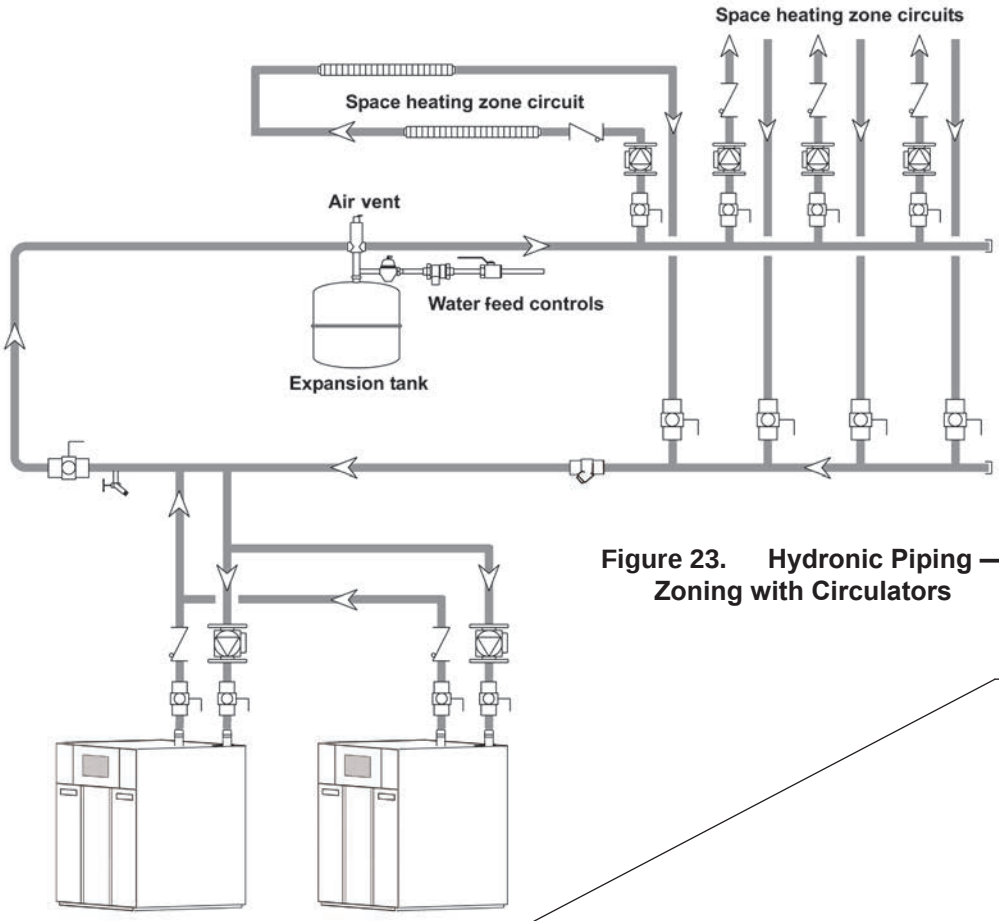
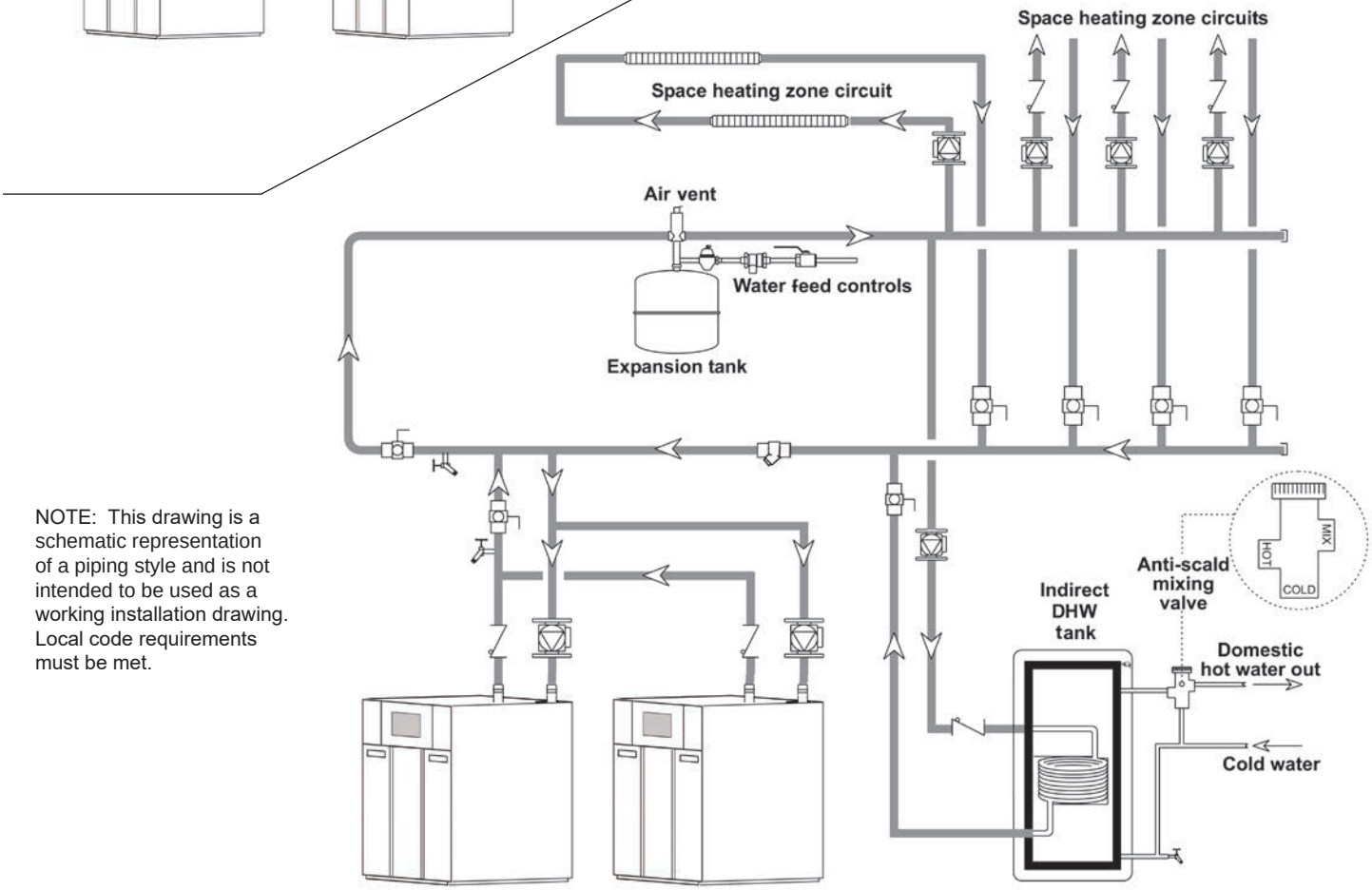


Figure 22. Hydronic Piping — Single Boiler, Low Temp Radiant Space Heating Using Low Loss Header and Zone Valves



NOTE: This drawing is a schematic representation of a piping style and is not intended to be used as a working installation drawing. Local code requirements must be met.

Figure 23. Hydronic Piping — Multiple Boilers, Zoning with Circulators



NOTE: This drawing is a schematic representation of a piping style and is not intended to be used as a working installation drawing. Local code requirements must be met.

Figure 24. Hydronic Piping — Multiple Boilers with Indirect DHW Tank Piped from System Loop

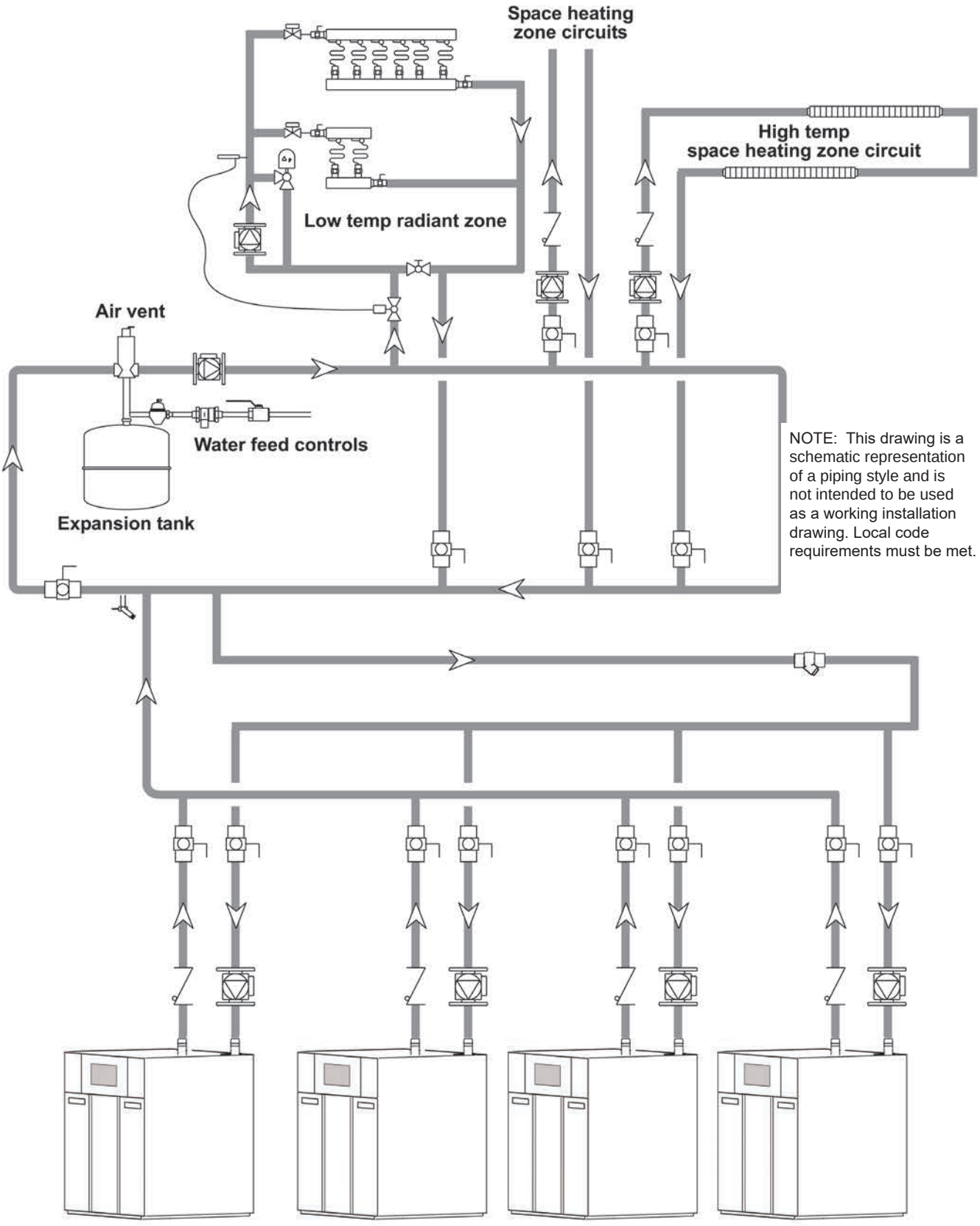


Figure 25. Hydronic Piping — Multiple Boilers, Reverse Return, Multi-Temp Zones, Zoning with Circulators

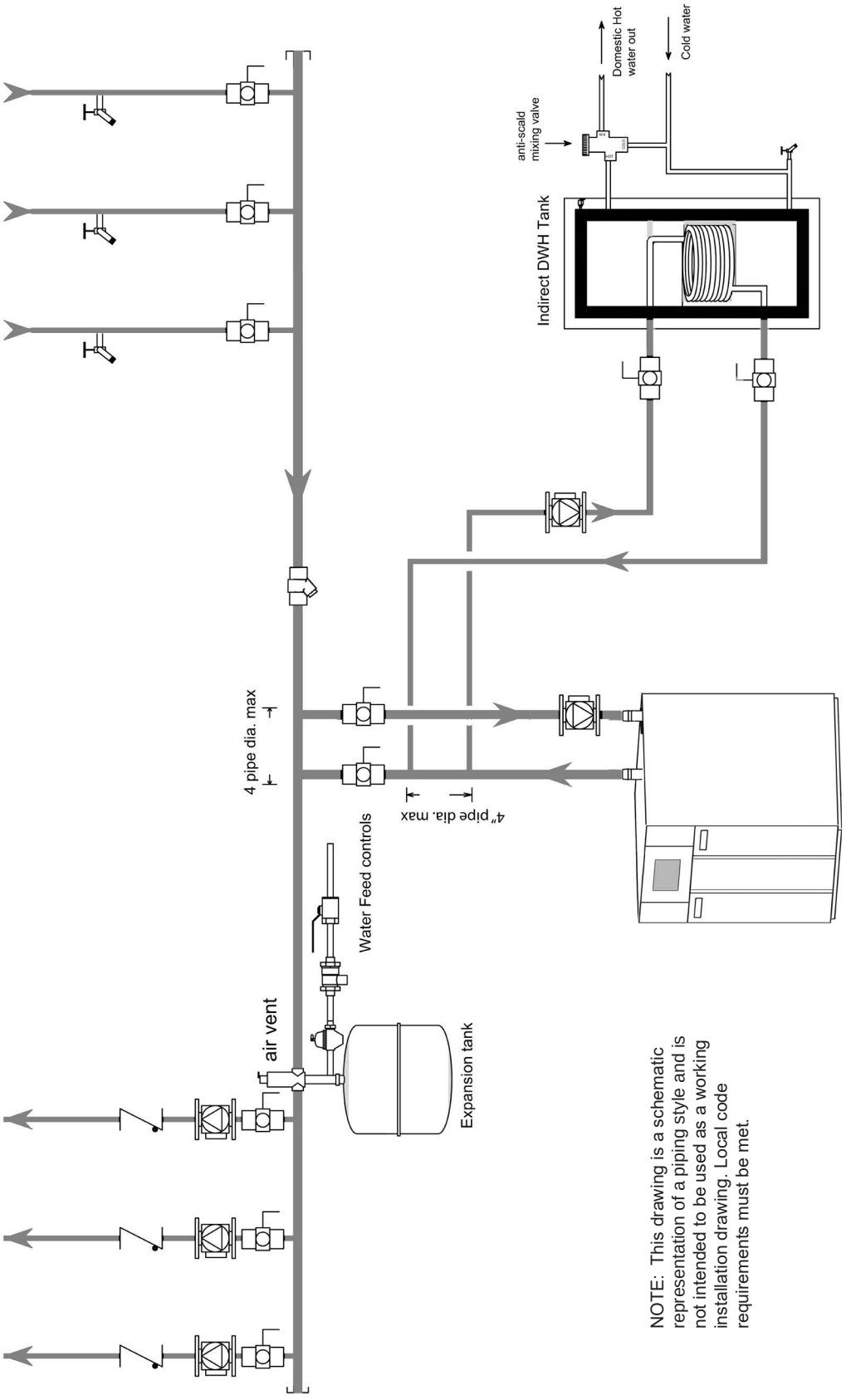


Figure 26. Hydronic Piping — Heating Zones with Indirect DHW Tank Piped with Zone Pumps
The indirect DHW tank is piped directly off of the boiler.

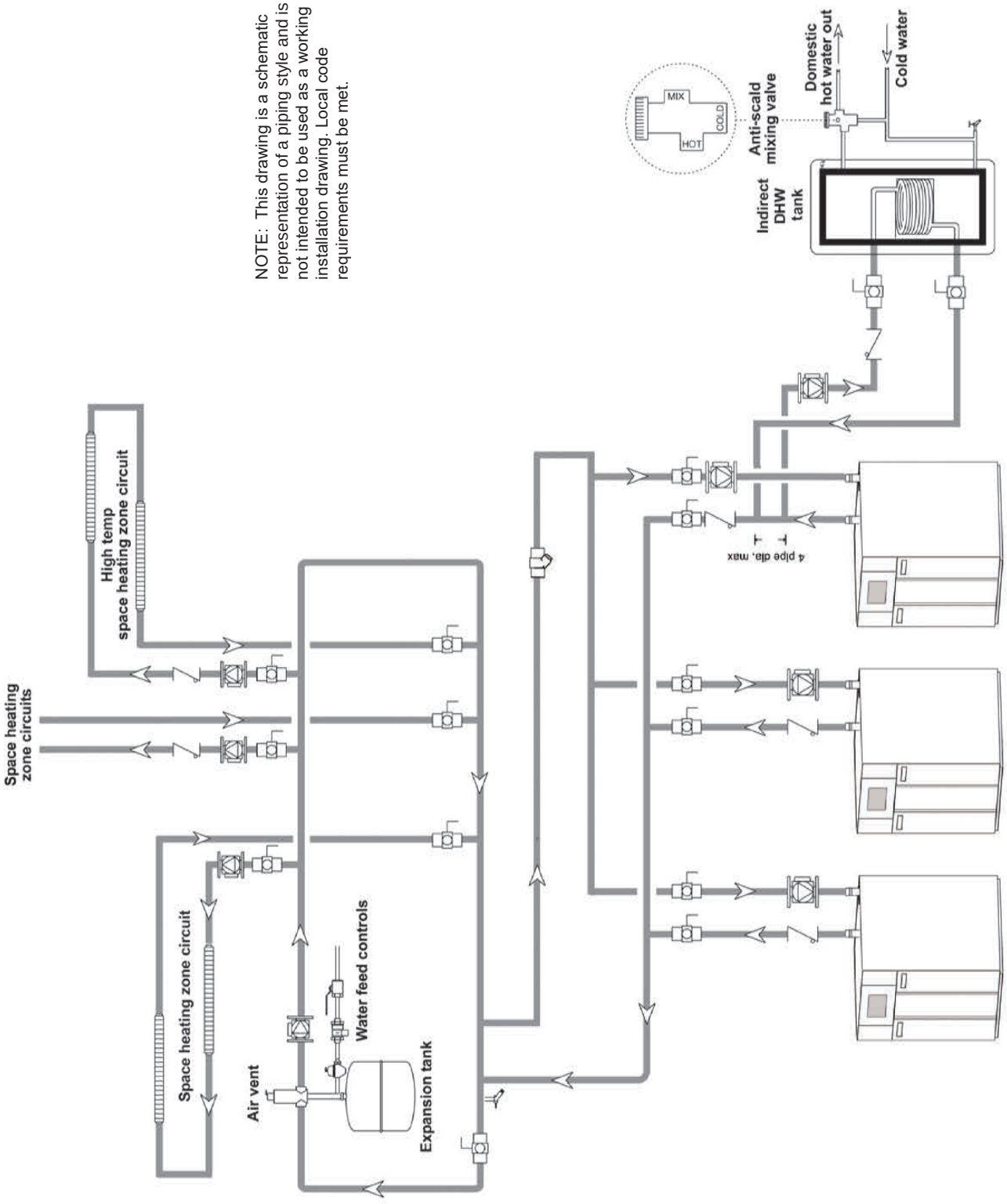


Figure 27. Hydronic Piping, Multiple Boilers with Indirect DHW Off of One Boiler

6.C Water Heater Piping

6.C.1 Water Quality

Water heaters must be installed in water conditions of 15 gpg hardness or less with a pH range of 6.5 to 8.5. Note that at higher water hardness, more flow is required. See Table 19 on page 29 for the flow required at hardness ranges of 5 – 12 gpg and 12 – 15 gpg. Operating the heater in water with higher hardness or pH levels, or with insufficient flow will cause heat exchanger fouling, erosion, or corrosion, leading to premature component failure, reduced efficiency, heat exchanger failure, or system failure. Failure of this type will not be warranted. If the water in use exceeds the conditions recommended, a water softener or other device must be installed to improve water quality.

6.C.2 Piping Requirements

Water piping should be supported by suitable hangers and floor stands. Do not support piping with the appliance. Due to expansion and contraction of copper pipe, consideration should be given to the type of hangers and supports used. Rigid hangers may transmit noise through the system resulting from piping sliding in the hangers. It is recommended that padding be used when rigid hangers are installed. Maintain 1" (2.5cm) clearance to combustibles for hot water pipes.

Pipe the discharge of the relief valve (full size) to the drain or in a manner to prevent injury in the event of pressure relief. Install a diaphragm-type expansion tank, flow check, and shutoff valves where needed or as required by code.

Most water heaters can be ordered with a pump that is sized to serve only one heater. When the pump is included with the heater, the heater must be located within 15 feet (4.6m) of the storage tank. The pumps are sized for the headloss of the heater and a maximum of 30 feet (9.1m) of piping that is the same size as the heater water connections. See SECTION 5 on page 29.

If longer pipe lengths or alternate piping methods are being used, the pump must be sized for the heater and the piping it will serve. The manufacturer recommends that each heater have its own pump. Table 19 on page 29 shows water flow and headloss data for the heater. Improper pipe sizing may result in conditions that cause internal scale buildup and failure of the heat exchanger.

6.C.3 Cold Water Make-Up

The cold water make-up may be connected to the tank or to the inlet of the boiler as shown in Figure 28 through Figure 31 on page 41. Install back flow preventers and shut offs where needed or required by code. Pipe sizes may have to be increased to accommodate cold water make-up flow.

6.C.4 Freeze Protection

This unit is not intended for installations where temperatures may drop below 32°F (0°C). In an event such as power outage, component failure or other issue and freezing could occur, the heater and system must be drained to avoid the risk of damage due to freezing. Glycol must ***not*** be used in volume water heating applications.

6.C.5 Heater Suggested Piping Schematics

Figure 28 through Figure 31 show suggested piping configurations for water heaters. These diagrams are only meant as guides. All components or piping required by local code must be installed.

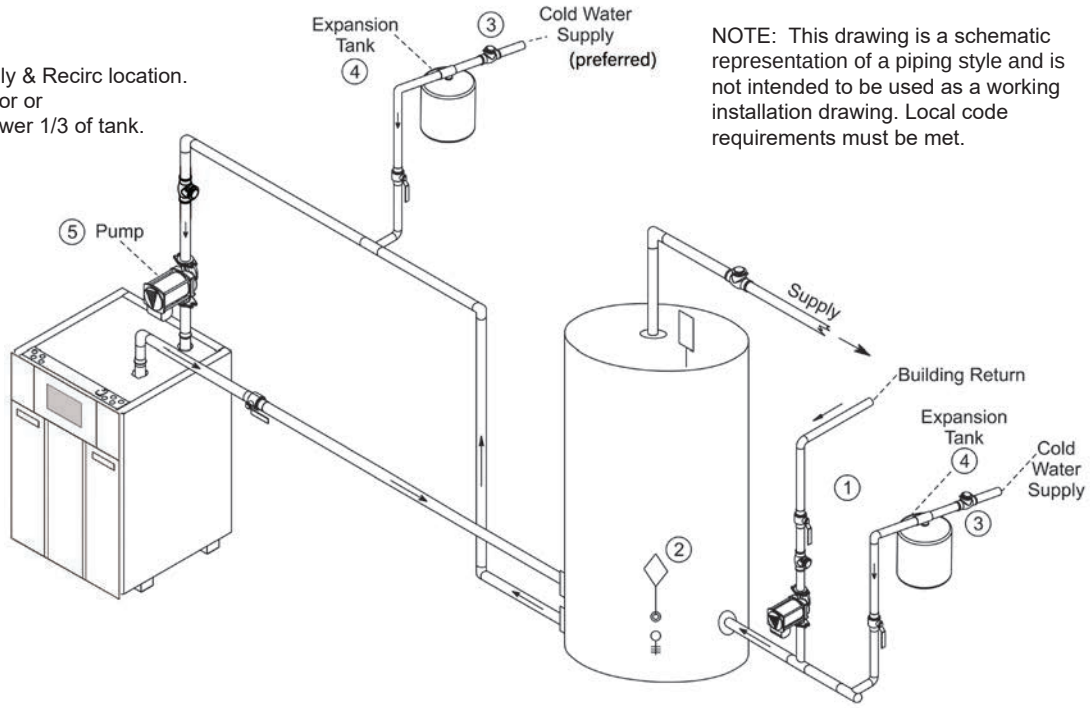
⚠ WARNING

These piping schematics show suggested piping configuration and valving. Check with local codes and ordinances for additional requirements.

⚠ CAUTION

Pump sizing must be based on water hardness at job site.

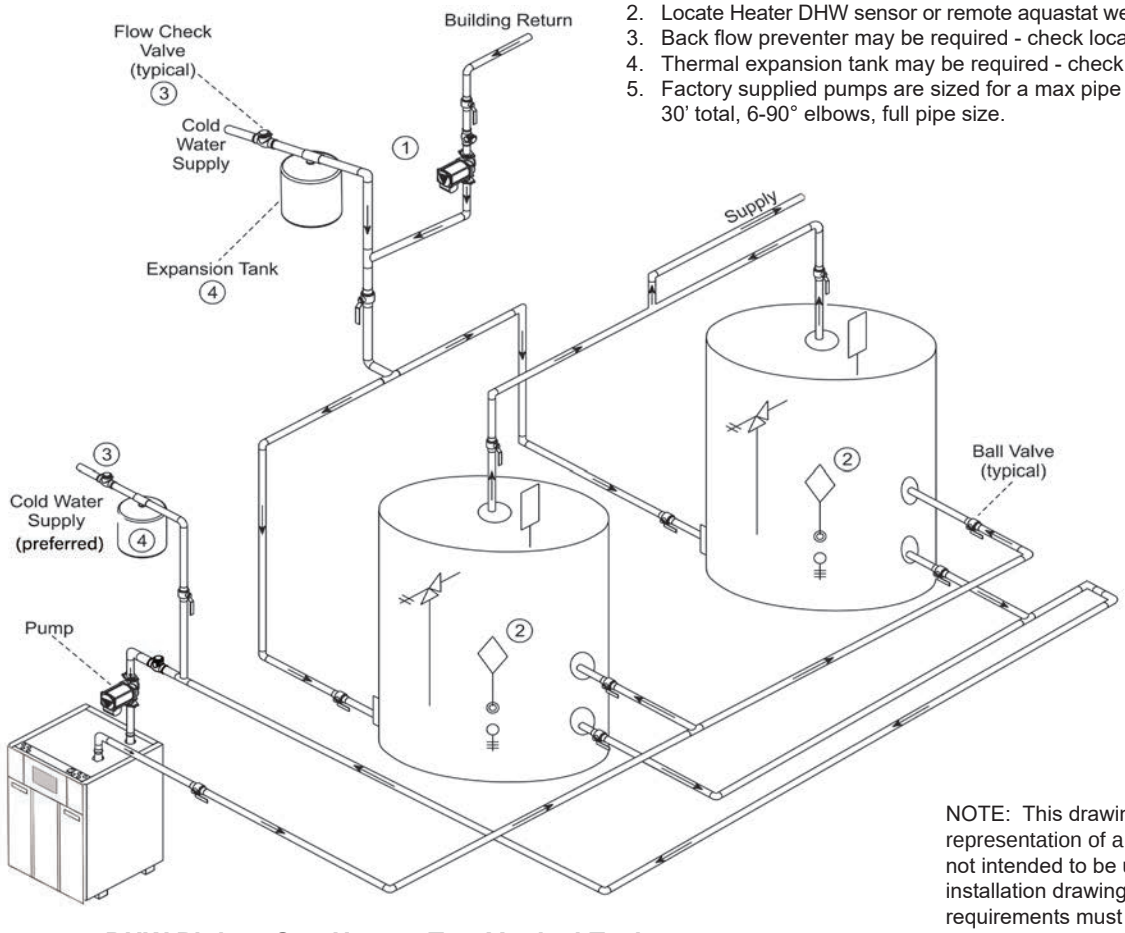
NOTES:
1. Optional Cold Water Supply & Recirc location.
2. Locate Heater DHW sensor or remote aquastat well in lower 1/3 of tank.
3. Back flow preventer may be required - check local codes.
4. Thermal expansion tank may be required - check local codes.
5. Factory supplied pumps are sized for a max pipe length of 30' total, 6-90° elbows, full pipe size.



NOTE: This drawing is a schematic representation of a piping style and is not intended to be used as a working installation drawing. Local code requirements must be met.

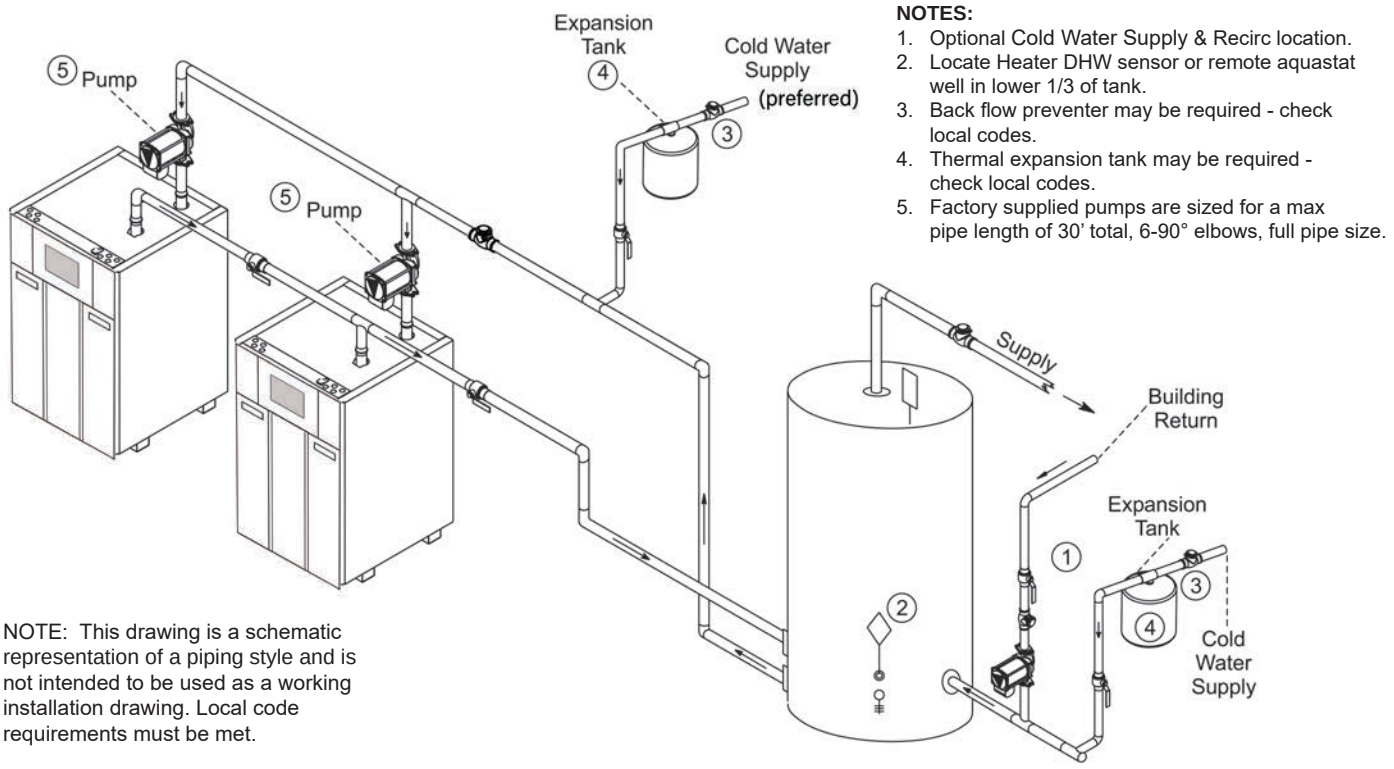
Figure 28. DHW Piping, One Heater, One Vertical Tank

NOTES:
1. Optional Cold Water Supply & Recirc location.
2. Locate Heater DHW sensor or remote aquastat well in lower 1/3 of tank.
3. Back flow preventer may be required - check local codes.
4. Thermal expansion tank may be required - check local codes.
5. Factory supplied pumps are sized for a max pipe length of 30' total, 6-90° elbows, full pipe size.



NOTE: This drawing is a schematic representation of a piping style and is not intended to be used as a working installation drawing. Local code requirements must be met.

Figure 29. DHW Piping, One Heater, Two Vertical Tanks

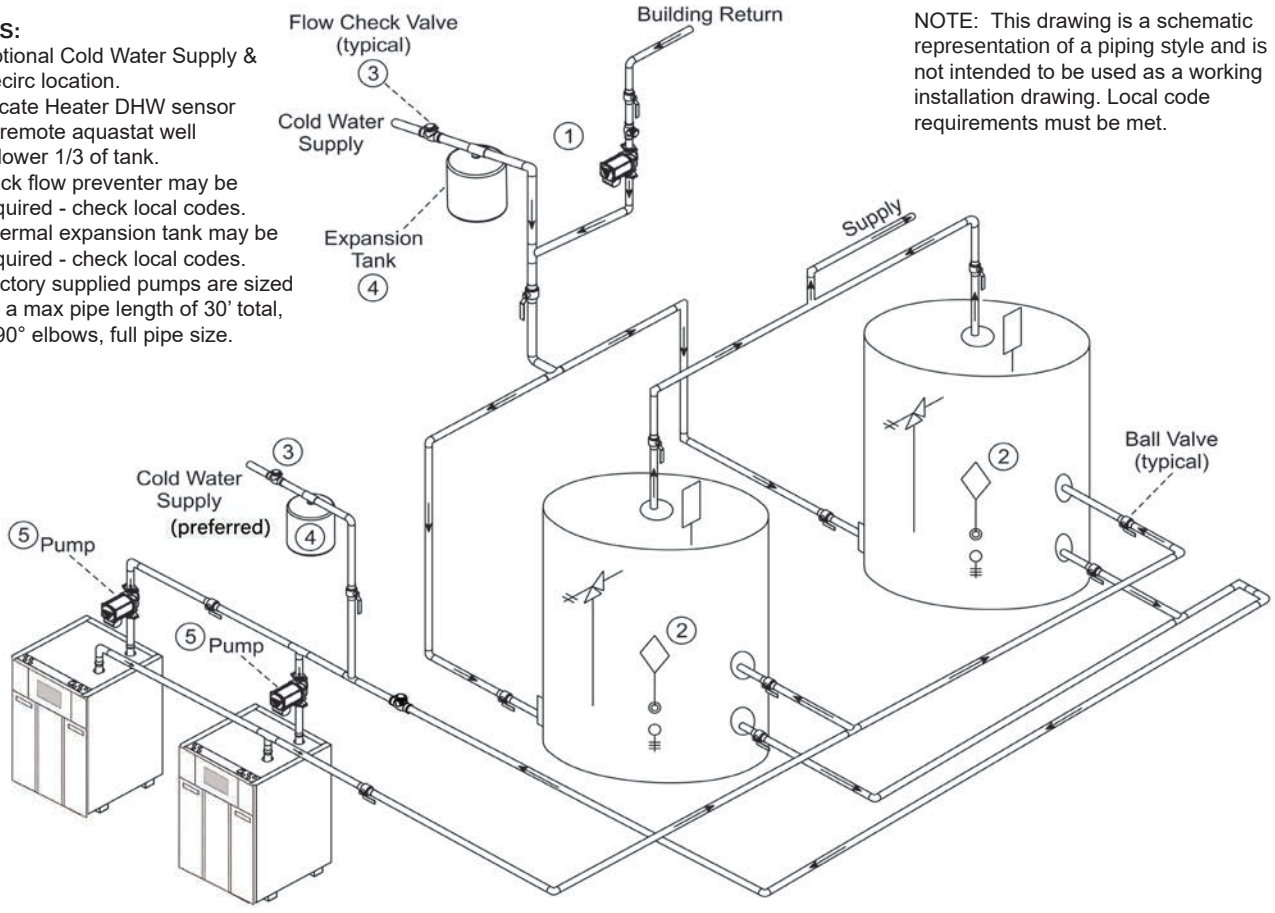


NOTES:
1. Optional Cold Water Supply & Recirc location.
2. Locate Heater DHW sensor or remote aquastat well in lower 1/3 of tank.
3. Back flow preventer may be required - check local codes.
4. Thermal expansion tank may be required - check local codes.
5. Factory supplied pumps are sized for a max pipe length of 30' total, 6-90° elbows, full pipe size.

NOTE: This drawing is a schematic representation of a piping style and is not intended to be used as a working installation drawing. Local code requirements must be met.

Figure 30. DHW Piping, Two Heaters, One Vertical Tank

NOTES:
1. Optional Cold Water Supply & Recirc location.
2. Locate Heater DHW sensor or remote aquastat well in lower 1/3 of tank.
3. Back flow preventer may be required - check local codes.
4. Thermal expansion tank may be required - check local codes.
5. Factory supplied pumps are sized for a max pipe length of 30' total, 6-90° elbows, full pipe size.



NOTE: This drawing is a schematic representation of a piping style and is not intended to be used as a working installation drawing. Local code requirements must be met.

Figure 31. DHW Piping, Two Heaters, Two Vertical Tanks

SECTION 7
Condensate Drain Trap

7.A Condensate Trap Installation

This appliance creates condensate at some operating conditions as a by-product of combustion. A condensate drain trap is pre-installed at the back of the unit and is used to drain the condensate from the heat exchanger. This condensate drain trap must be connected to a condensate disposal system to prevent the accumulation of condensate.

Connect the hose included in the installation kit to the trap as shown.

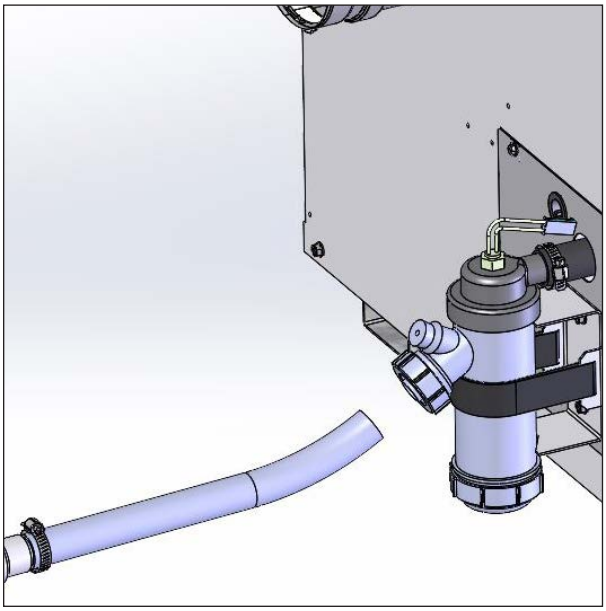


Figure 32. Attach Condensate Hose

Connect a ¾" PVC pipe between the drain connection and a floor drain. The PVC pipe must continuously slope downward toward the drain. If there is no accessible floor drain, or if the drain pipe cannot be installed with the proper slope, a condensate pump must be installed to ensure that the condensate is removed.

Consult local codes for direction on disposal of condensate. In some cases (code requirements or drain material), condensate will need to be neutralized before disposal. A condensate neutralizer is not included with the unit but is available from Laars as an accessory. If a neutralizer is required, it is helpful to install the boiler or water heater on a raised 4" (minimum) concrete platform. This will generally allow sufficient elevation for the condensate neutralizer to be installed below the condensate trap.

If the unit is installed in a location that may experience freezing temperatures, precautions must be taken to prevent condensate from freezing. Damage due to freezing condensate is not covered by the warranty.

⚠ CAUTION

Condensate is mildly acidic (pH = 5), and may harm some floor drains and/or pipes, particularly those that are metal. Ensure that the drain, drainpipe, and anything that will come in contact with the condensate can withstand the acidity, or neutralize the condensate before disposal. **Damage caused by failure to install a neutralizer kit or to adequately treat condensate will not be the manufacturer's responsibility.**

7.B Condensate Level Error

A condensate level error can be caused by a blockage in the condensate trap or line, or by a blockage in the vent pipe. If this error occurs, first check the vent pipe to ensure it is free from obstructions. If the error was caused by an obstructed vent, the float in the trap may be stuck at the bottom of the trap and need to be reset. To reset it, remove the plug from the trap to equalize the pressure, and if necessary, tap to loosen the float from the bottom of the trap.

Also check to ensure that the trap and condensate line are free of any debris or obstructions that could block the flow of condensate and check that the level switch moves freely.

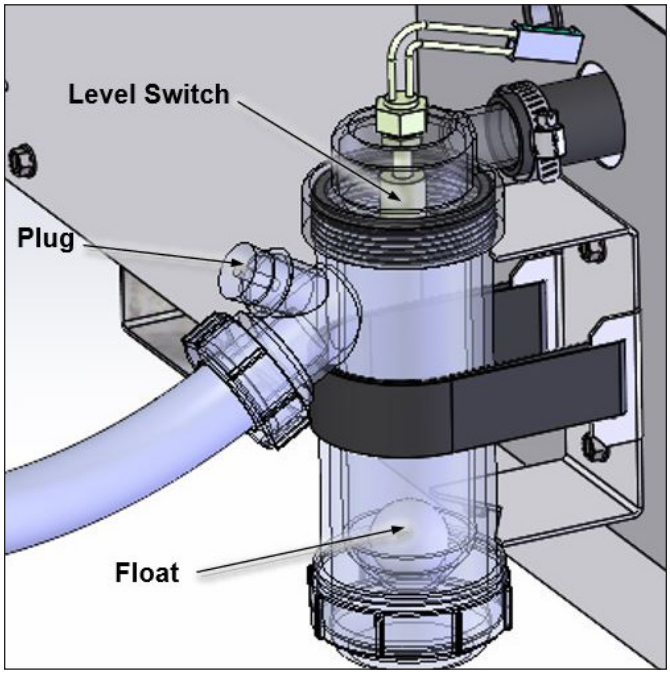


Figure 33. Condensate Trap Components

⚠ WARNING

The float must always be installed in the condensate trap. Removal of the float could cause flue gases to leak into occupied spaces, resulting in severe personal injury or death.

SECTION 8
INSTALLATION AND WIRING

8.A Installation Warnings

⚠ WARNING

The unit must be electrically grounded in accordance with the requirements of the authority having jurisdiction or, in the absence of such requirements, with the latest edition of the Nation Electrical Code, ANSI/NFPA 70, in the U.S. and with the latest edition of CSA C22.1 Canadian Electrical Code, Part 1, in Canada. Do not rely on the gas or water piping to ground the metal parts of the unit. Plastic pipe or dielectric unions may isolate the unit electrically. Service and maintenance personnel, who work on or around the unit, may be standing on wet floors and could be electrocuted by an ungrounded unit. Electrocution can result in severe injury or death.

Single pole switches, including those of safety controls and protective devices, must not be wired in a grounded line.

All electrical connections are made on the terminal blocks that are located inside the control panel.

All internal electrical components have been pre-wired. No attempt should be made to connect electrical wires to any other location except the terminal blocks.

⚠ CAUTION

The supply voltage to this unit must not be disconnected, except for service or isolation, or unless otherwise instructed by procedures outlined in this manual. To signal a call for heat, use the heat demand inputs, as shown in the wiring diagram.

DO NOT MAKE AND BREAK THE LINE VOLTAGE TO THE UNIT TO SIGNAL A CALL FOR HEAT. A call for heat/end call for heat MUST be connected to the heat demand terminals. Some components are designed to have constant voltage during normal operation. If the unit's supply voltage is toggled as a call for heat signal, premature failure of these components may result.

⚠ CAUTION

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

8.B Main Power Ratings

All units are powered by 120 volts. Refer to the tables below for current ratings.

Boiler Only				
Model	**Voltage**	**FLA**	**MCA**	**MOP**
399	120	2.8	3.5	15
500	120	3.1	3.9	15
650	120	3.1	3.9	15
800	120	3.2	4.0	15
999	120	4.2	5.3	15
1500	120	5.4	6.8	15

Boiler and Pump				
Model	**Voltage**	**FLA**	**MCA**	**MOP**
399	120	4.7	5.9	15
500	120	5.0	6.3	15
650	120	6.7	8.4	15
800	120	6.8	8.5	15
999	120	10.3	12.9	20
1500*	120	-	-	-

*On 1500 heaters with factory supplied pumps and 999 heaters with factory supplied hard water pumps, it is necessary to use two circuits: one to supply power for the heater and another to power the pump.

Pump Only				
Model	**Voltage**	**FLA**	**MCA**	**MOP**
399	120	1.9	2.4	15
500	120	1.9	2.4	15
650	120	3.6	4.5	15
800	120	3.6	4.5	15
999	120	6.1	7.6	15
1500	120	8.8	11.0	15

Table 21. Boiler Electrical Ratings

⚠ ATTENTION

Au moment de l'entretien des commandes, étiquetez tous les fils avant de les débrancher. Les erreurs de câblage risquent de causer un fonctionnement déficient et dangereux. S'assurer que l'appareil fonctionne adéquatement une fois l'entretien terminé.

Water Heater Only				
Model	**Voltage**	**FLA**	**MCA**	**MOP**
399	120	2.8	3.5	15
500	120	3.1	3.9	15
650	120	3.1	3.9	15
800	120	3.2	4.0	15
999	120	4.2	5.3	15
1500	120	5.4	6.8	15

FLA = Full Load Amperage
MCA = Minimum Circuit Ampacity
MOP = Maximum Over-current Protection

On all models, the incoming voltage must be protected by an appropriately sized circuit breaker, installed by qualified/authorized personnel. The 24-volt systems on the unit are protected with an integrated auto-resetting thermal fuse.

Water Heater and Pump								
Model	**5 - 12 gpg Pump**				**12 - 15 gpg Pump**			
	Voltage	**FLA**	**MCA**	**MOP**	**Voltage**	**FLA**	**MCA**	**MOP**
399	120	4.7	5.9	15	120	6.4	8.0	15
500	120	5.0	6.3	15	120	8.0	10.0	15
650	120	6.7	8.4	15	120	8.0	10.0	15
800	120	6.8	8.5	15	120	12.0	15.0	20
999	120	10.3	12.9	20	120	-	-	-
1500*	120	-	-	-	120	-	-	-

*On 1500 heaters with factory supplied pumps and 999 heaters with factory supplied hard water pumps, it is necessary to use two circuits: one to supply power for the heater and another to power the pump.

Pump Only								
Model	**5 - 12 gpg Pump**				**12 - 15 gpg Pump**			
	Voltage	**FLA**	**MCA**	**MOP**	**Voltage**	**FLA**	**MCA**	**MOP**
399	120	1.9	2.4	15	120	3.6	4.5	15
500	120	1.9	2.4	15	120	4.9	6.1	15
650	120	3.6	4.5	15	120	4.9	6.1	15
800	120	3.6	4.5	15	120	8.8	11.0	15
999	120	6.1	7.6	15	120	12.4	15.5	20
1500	120	8.8	11.0	15	120	12.4	15.5	20

Table 22. Water Heater Electrical Ratings

8.C Wiring

Route all wires through the knockouts provided in the top panel of the unit, then through the grommets in the side of the control panel and connect them to the correct screw terminals on the terminal boards.

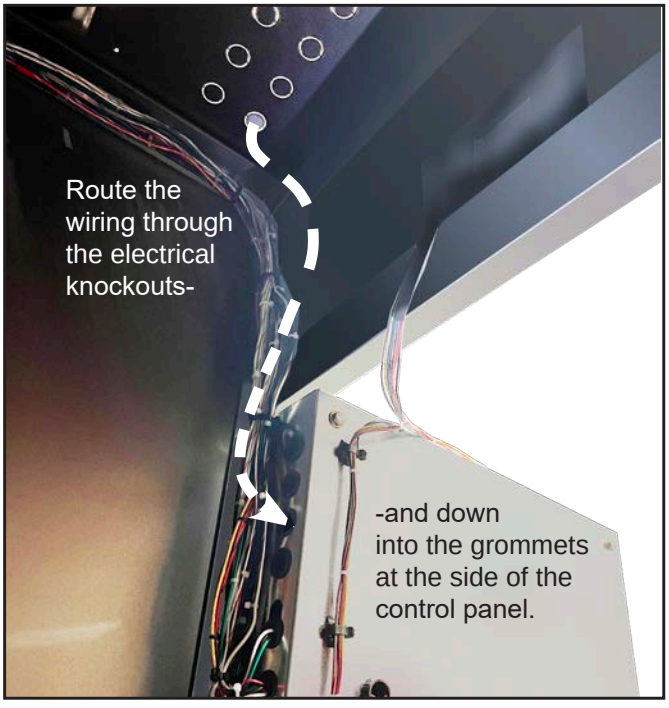


Figure 34. Field Wiring to the Control Panel

8.D Control Panel Layout

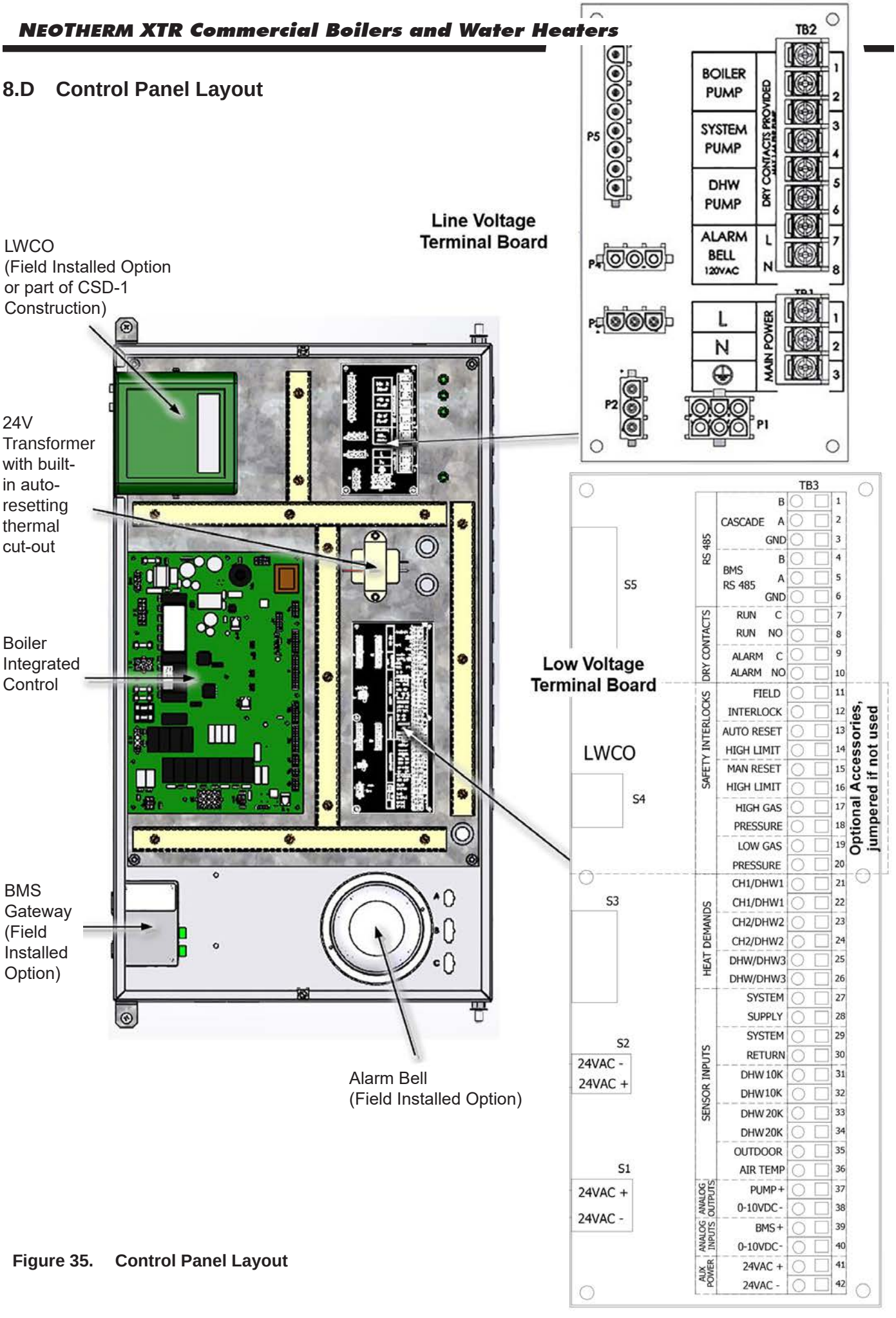


Figure 35. Control Panel Layout

8.E Field Connections

8.E.1 Pump Contacts (Dry)

Boiler Pump - when connecting a boiler pump, use terminals 1 and 2 on the line voltage board. This is a dry contact, so the pump supply voltage or contactor coil voltage must be supplied externally. Contact ratings are 120VAC, 1.6A maximum. If the boiler pump exceeds these ratings, a pump contactor must be used. Boiler pump functionality is configured using the touch screen.

System Pump - when connecting a system pump, use terminals 3 and 4 on the line voltage board. This is a dry contact, so the pump supply voltage or contactor coil voltage must be supplied externally. Contact ratings are 120VAC, 1.6A maximum. If the system pump exceeds these ratings, a pump contactor must be used. System pump functionality is configured using the touch screen.

DHW Pump – when connecting a domestic hot water (DHW) pump, use terminals 5 and 6 on the line voltage board. This is a dry contact, so the pump supply voltage or contactor coil voltage must be supplied externally. Contact ratings are 120VAC, 1.6A maximum. If the DHW pump exceeds these ratings, a pump contactor must be used. DHW pump functionality is configured using the touch screen.

8.E.2 Alarm Bell

If connecting an alarm, use terminals 7 and 8 on the line voltage board.

8.E.3 RS485 for Cascade (Lead Lag)

This unit can be cascaded up to a total of 8 units (controllers). One as the Lead control and up to 7 more as Lag controllers. Prior to wiring units for cascade operations, select one unit as the lead boiler/ water heater. Other units connected to the lead boiler/ water heater will be referred to as lag units. Communication between lead and lag units is accomplished using RS485. When wiring these units for cascade operations, use terminals 1, 2, and 3 on the low voltage board. Use 2-wire twisted pair, shielded w/drain (communication cable) between units. Connect one wire of the communication cable to A (terminal 2), and the other wire to B (terminal 1), and a third conductor to GND (terminal 3) (see RS485 NOTE: Grounding). Connect the other end of the cable to the next unit, matching the termination wiring on the previous unit. See Figure 36 on page 46
If more than two units are cascaded together, daisy chain the wiring from unit to unit, keeping the cables as short as possible. A system supply sensor must be installed and connected to the lead boiler. The lead boiler will use this system supply sensor as the temperature control sensor for cascade operations.

Section 9.D.4 on page 66 shows how these systems are configured in the touchscreen controls. Any heat demand at the lead boiler/ water heater will be treated as a cascade heat demand.

8.E.4 RS485 for BMS

If communicating to the unit via RS485 serial communications, either Modbus or BACnet MSTP, connect to terminals 4, 5, and 6 on the low voltage board. Use 2-wire twisted pair, shielded w/drain (communication cable) between units. Connect one wire of the communication cable to A (terminal 5), and the other wire to B (terminal 4), and a third conductor to GND (terminal 6) (see RS485 NOTE: Grounding & Shielding).

Section 9.D.11.d on page 84 shows how these systems are configured in the touchscreen controls.

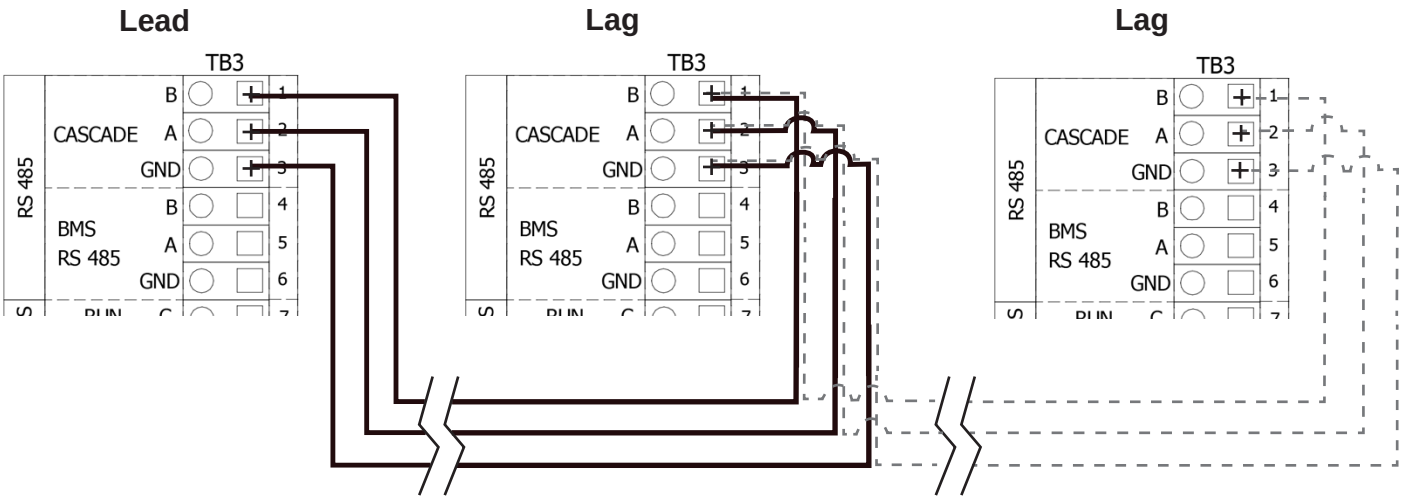


Figure 36. Cascade Wiring Connections

RS485 NOTE: RS485 Grounding & Shielding

Grounding: to ensure that common mode voltage does not compromise the data, or damage the equipment, an extra wire should always be used to connect the signal grounds. This means that a "two-wire" system actually requires three conductors. Although it is possible to obtain cable with a twisted pair and a third conductor, it is simpler to use a cable with an extra twisted pair and use one or both conductors for the signal ground.

Shielding: it is often difficult to make a clear determination as to whether shielded cable is required in an application. Since the added cost of shielded cable is usually minimal, in most cases it is worth installing. If shielded cable is used, the shield should be grounded at one end only, preferably to earth ground. It is not recommended to use a shield drain wire as the signal ground.

8.E.5 Dry Contacts (Run & Alarm)

Alarm

When used, connect to terminals 7 (common) and 8 (normally open) on the low voltage board. The controller closes the normally open set of contacts whenever the unit is locked out. Contact ratings are 30VAC, 0.6A maximum.

Run

When used, connect to terminals 9 (common) and 10 (normally open) on the low voltage board. The controller closes the normally open set of contacts whenever the unit is running. Contact ratings are 30VAC, 0.6A maximum.

8.E.6 Safety Interlocks

Field Interlock

If the field interlock is used, remove the jumper from terminals 11 and 12 of the low voltage board and wire the interlock to these terminals.

Auto Reset High Limit

if an additional auto reset high temperature limit switch is used, remove the jumper from terminals 13 and 14 on the low voltage board and wire the limit to these terminals.

Manual Reset High Limit

if an additional manual reset high temperature limit switch is used, remove the jumper from terminals 15 and 16 on the low voltage board and wire the limit to these terminals.

High Gas Pressure

if a high gas pressure switch is used, remove the jumper from terminals 17 and 18 on the low voltage board and wire the switch to these terminals.

Low Gas Pressure

if a low gas pressure switch is used, remove the jumper from terminals 19 and 20 on the low voltage board and wire the switch to these terminals.

NOTE: Only dry contacts can be connected to the safety interlock terminals.

8.E.7 Heat Demands

CH1/DHW1 – if a thermostat/aquastat or end switch (isolated contact only) is used as a heat demand, connect to terminals 21 and 22 on the low voltage board. CH1/DHW1 functionality is configurated on the touch screen on the CH1/DHW1 screens.

CH2/DHW2 – if a thermostat/aquastat or end switch (isolated contact only) is used as a heat demand, connect to terminals 23 and 24 on the low voltage board. CH2/DHW2 functionality is configurated on the touch screen on the CH2/DHW2 screens.

DHW/DHW3 – if an aquastat, end switch (isolated contact only), or flow switch is used as a DHW heat demand, connect to terminals 25 and 26 on the low voltage board. If preferred, a DHW tank sensor can be used in lieu of an aquastat to generate a heat demand (see Sensor Inputs section below).

NOTE: CH1/DHW1, CH2/DHW2, and DHW heat demand contacts must be dry contacts. The controller's heat demand voltage is 24VDC.

8.E.8 Sensor Inputs

System Supply – if used, connect to terminals 27 and 28 on the low voltage board. When connected, the controller automatically detects the presence of this sensor and the temperature is shown on the home screen above the red system supply arrow. When installed, the unit controls the firing rate to maintain the system supply temperature to the heat demand set point (or CSP) and hysteresis.

System Return – if used, connect to terminals 29 and 30 on the low voltage board. When connected, the controller automatically detects the presence of this sensor and the temperature is shown on the home screen above the blue system output arrow.

Domestic Hot Water (DHW) – if a tank sensor is used, connect the brown and white wires to terminals 31 and 32, and connect the yellow and green wires to terminals 33 and 34 on the low voltage board. When connected, the unit will automatically detect the presence of this sensor and perform the DHW thermostat function based

on the settings selected at the DHW or DHW3 parameter screens. The temperature is displayed ond the home screen below the faucet icon. The controller initiates a call for heat, maintaining the set point within the on and off hysteresis values selected at the DHW or DHW3 demand screen, without any need for jumpers.

Outdoor Air Temperature – if used, connect to terminals 35 and 36 on the low voltage board. When connected, the controller automatically detects the presence of this sensor and the temperature is shown on the home screen as the Outdoor Ambient Temperature (OAT). If installed, options such as outdoor reset and warm weather shutdown can be enabled through the display. Always install the outdoor sensor at an outdoor location that is not affected by false temperature readings such as sunlight or hot equipment.

8.E.9 Analog Output, Pump

When using Vari-Prime pump control, wire the pump speed wires to terminals 37 and 38 on the low voltage board. Polarity is shown on the terminal label. Selecting voltage or current output is accomplished through jumper placement on the control board. See Figure 37. Vari-Prime functionality is configured using the touch screen.

8.E.10 Analog BMS

If an analog input (0 – 10VDC or 4-20mA) from a building management system is used as a remote set point or remote firing rate command, wire to terminals 39 and 40 on the low voltage board. Polarity is shown on the terminal label. Selecting voltage or current input is accomplished through jumper placement on the control board. See Figure 37. Analog BMS functionality is configured using the touch screen.

8.E.11 Auxiliary 24VAC Power

Terminals 41 and 42 on the low voltage terminal board are used to power the BMS gateway when it is installed.

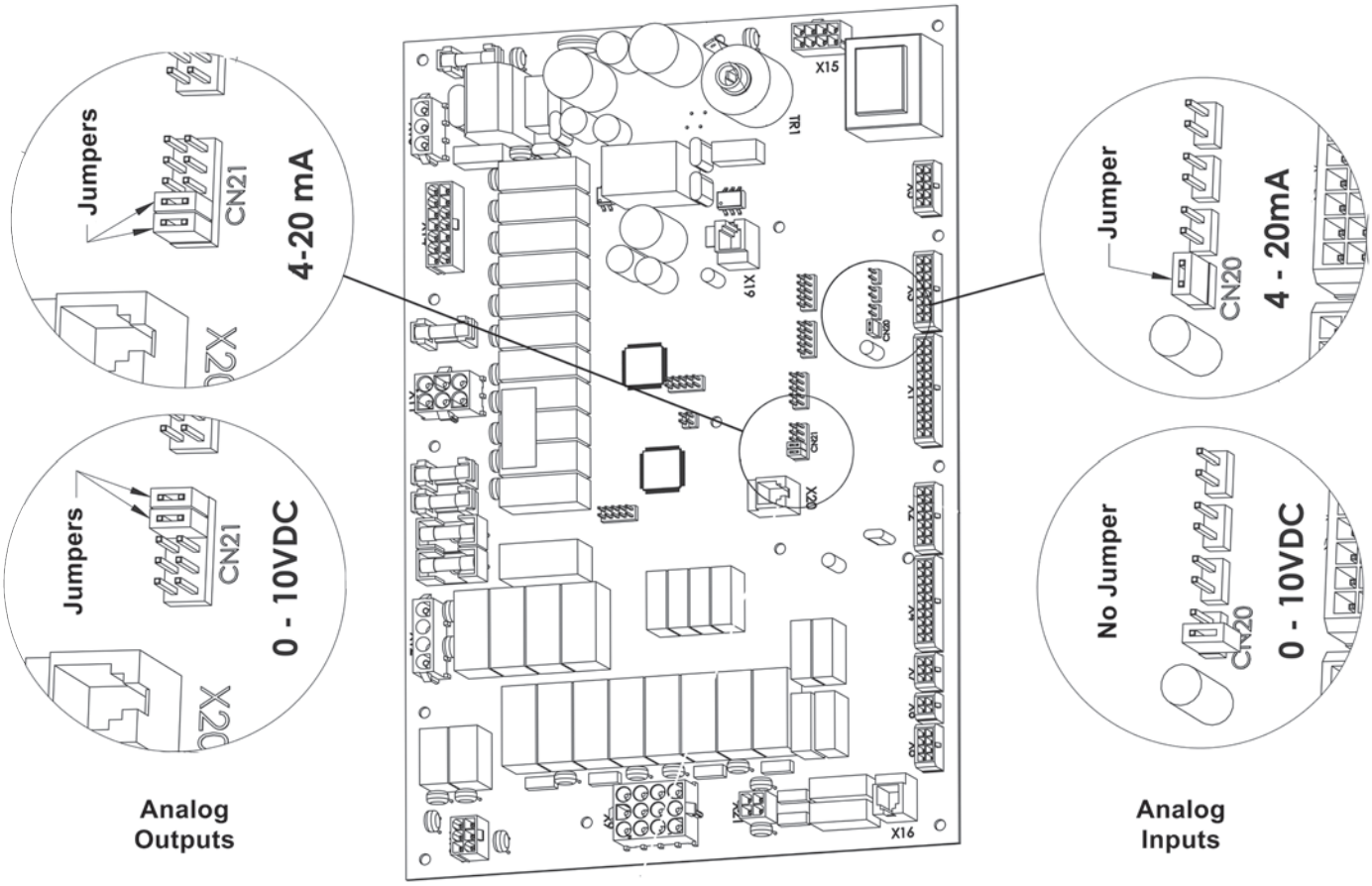


Figure 37. Jumper Locations at the Inputs

8.F Modbus/BACnet Memory Map

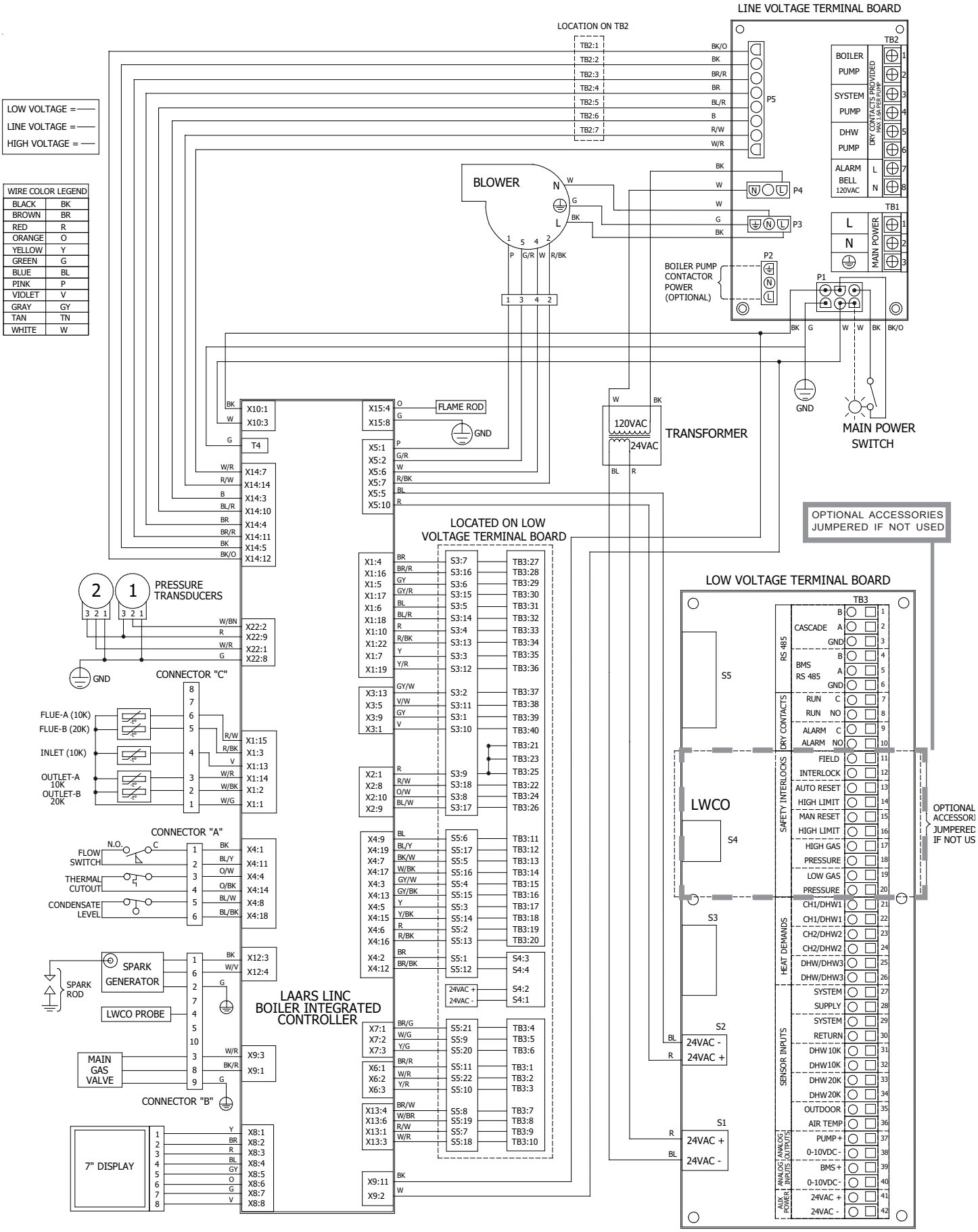
Description/ Object Name	ModBus Address	BACnet Data Type	BACnet Object ID	Units	Notes
Read Only					
Inlet Temperature	0	AI	0	°F/ °C	
Outlet Temperature	1	AI	1	°F/ °C	
DHW Temperature	3	AI	3	°F/ °C	
System Return Temperature	4	AI	4	°F/ °C	
System Supply Temperature	5	AI	5	°F/ °C	
Outdoor Temperature	6	AI	6	°F/ °C	
Flue Temperature	7	AI	7	°F/ °C	
Flame Signal	12	AI	12	µA	
0-10VDC (4-20mA) Input for BMS	14	AI	14	mV/ µA	
Safety Chain Status	18	AI	18		bit0 = Flow Switch bit1 = Low Water Cut Off bit2 = Manual Reset High Limit - External bit3 = Thermal Cutout bit4 = High Gas Pressure Switch bit5 = Low Gas Pressure Switch bit6 = Auto Reset High Limit - External bit7 = Condensate Level Switch bit8 = Field Interlock
Demand Source	20	AI	20		0 = None 1 = Anti-Short Cycle 2 = Manual Heat Demand 3 = DHW/DHW3 4 = Cascade 5 = External 6 = CH1/DHW1 7 = CH2/DHW2 10 = Anti-Frost
Digital Output Status	21	AI	21		bit0 = Run contact bit1 = Alarm Contact bit2 = DHW Pump bit3 = System Pump bit7 = Boiler pump
Gas Valve Status	22	AI	22		bit1 = Gas Valve Status
0-10VDC (4-20mA) Output for Pump Speed	23	AI	23	mV/ µA	
Fan Speed	27	AI	27	RPM	The current speed of the unit's combustion blower.
Firing Rate	33	AI	33	%	The current firing rate (0-100%) of the unit.
Lockout Code	35	AI	35		1 = Low Water Cut Off 2 = Manual Reset High Limit - External 3 = Thermal Cutout Open 4 = High Gas Pressure 5 = Low Gas Pressure 8 = Outlet Probe 9 = Outlet Probe Drift 10 = Manual Reset High Limit - Onboard 11 = Flue Probe 13 = Flue Probe Drift 14 = Flue Probe High Limit 15 = Inlet Probe 16 = High Delta T 17 = Pressure Sensor Fault 19 = Pressure Sensor Drift 20 = High Pressure Drop 24 = Burner Parasitic Flame 26 = Max Ignition Trials 32 = Fan Speed Error 34 = Low Air Proving Press 38 = High Air Proving Press 255 = None

Modbus/BACnet Memory Map (continued)

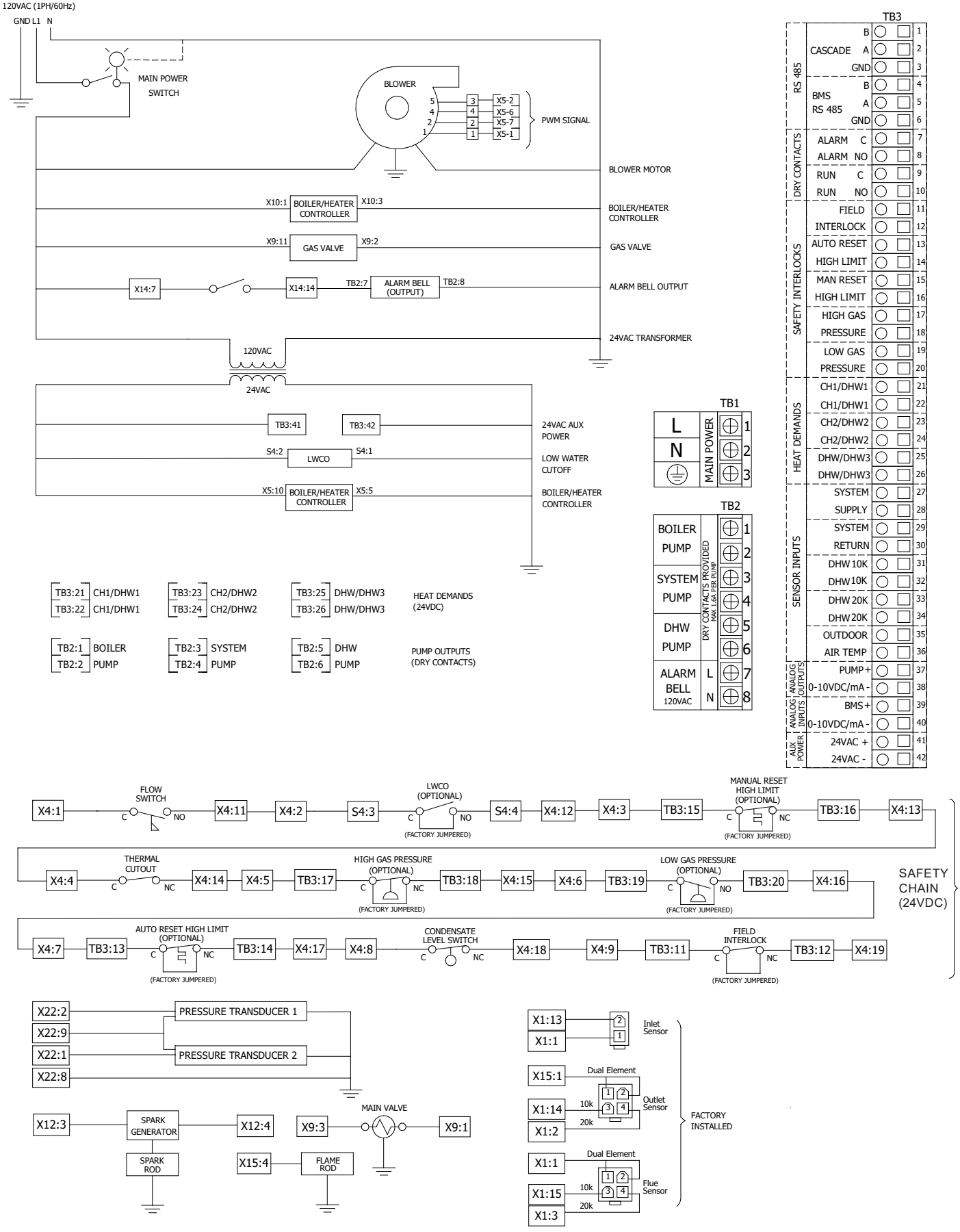
Error Code	36	AI	36		40 = 24VDC Error 41 = 24VAC Error 55 = 5VDC Error 42 = DHW Probe 51 = Auto Reset High Limit - Onboard 54 = Condensate Level Switch Open 56 = High Pressure Drop 57 = DHW Probe Drift 58 = Flow Switch Open 59 = Field Interlock Open 60 = Auto Reset High Limit - External 255 = None
History - DHW/DHW3 Demand Cycles	38	AI	38	See Notes	Units: Cycles (BACnet), 1/10 Cycle (ModBus)
History - CH1/DHW1 Demand Cycles	39	AI	39	See Notes	Units: Cycles (BACnet), 1/10 Cycle (ModBus)
History - CH2/DHW2 Demand Cycles	40	AI	40	See Notes	Units: Cycles (BACnet), 1/10 Cycle (ModBus)
History - Cascade Demand Cycles	43	AI	43	See Notes	Units: Cycles (BACnet), 1/10 Cycle (ModBus)
History - Burner Cycles	44	AI	44	See Notes	Units: Cycles (BACnet), 1/10 Cycle (ModBus)
History - Boiler Pump Cycles	48	AI	48	See Notes	Units: Cycles (BACnet), 1/10 Cycle (ModBus)
History - DHW Pump Cycles	49	AI	49	See Notes	Units: Cycles (BACnet), 1/10 Cycle (ModBus)
History - System Pump Cycles	50	AI	50	See Notes	Units: Cycles (BACnet), 1/10 Cycle (ModBus)
History - Max Outlet Temperature	52	AI	52	^{o}F/ ^{o}C	
History - Min Outlet Temperature	53	AI	53	^{o}F/ ^{o}C	
History - Avg Run Time	54	AI	54	Minutes	
History - Max Run Time	55	AI	55	Minutes	
History - Min Run Time	56	AI	56	Minutes	
Cascade Control Sensor	64	AI	64		Indicates the active control sensor for the cascade: 0 = None 1 = Outlet Sensor 2 = DHW Sensor 3 = System Supply Sensor
Manual Firing Rate Control	65	AI	65		Indicates if Manual Firing Rate Control is enabled: 0 = Disabled (Auto Mode) 1 = Enabled (Manual Mode)
Lag 1 State	66	AI	66		0 = Not connected 1 = Not available 2 = Available 3 = Running 4 = Locked out
Lag 1 Firing Rate	67	AI	67	%	The current firing rate (0-100%) of Lag 1.
Lag 2 State	68	AI	68		0 = Not connected 1 = Not available 2 = Available 3 = Running 4 = Locked out
Lag 2 Firing Rate	69	AI	69	%	The current firing rate (0-100%) of Lag 2.
Lag 3 State	70	AI	70		0 = Not connected 1 = Not available 2 = Available 3 = Running 4 = Locked out
Lag 3 Firing Rate	71	AI	71	%	The current firing rate (0-100%) of Lag 3.
Lag 4 State	72	AI	72		0 = Not connected 1 = Not available 2 = Available 3 = Running 4 = Locked out
Lag 4 Firing Rate	73	AI	73	%	The current firing rate (0-100%) of Lag 4.
Lag 5 State	74	AI	74		0 = Not connected 1 = Not available 2 = Available 3 = Running 4 = Locked out
Lag 5 Firing Rate	75	AI	75	%	The current firing rate (0-100%) of Lag 5.
Lag 6 State	76	AI	76		0 = Not connected 1 = Not available 2 = Available 3 = Running 4 = Locked out
Lag 6 Firing Rate	77	AI	77	%	The current firing rate (0-100%) of Lag 6.

Lag 7 State	78	AI	78		0 = Not connected 1 = Not available 2 = Available 3 = Running 4 = Locked out
Lag 7 Firing Rate	79	AI	79	%	The current firing rate (0-100%) of Lag 7.
Lead State	80	AI	80		0 = Not connected 1 = Not available 2 = Available 3 = Running 4 = Locked out
Lead Firing Rate	81	AI	81	%	The current firing rate (0-100%) of the Lead.
Total Cascade Firing Rate	82	AI	82	%	The total firing rate of the cascade (0-800%).
Calculated Set Point	83	AI	83	°F/ °C	The active set point temperature of the unit.
Burner Status	84	AI	84		0 = None 5 = Start 24 = Error Block 160 = Standby 165 = Safety Chain Open 166 = Running 177 = Prepurge Open 181 = Parameter Block 183 = Lockout 188 = Testmode 194 = Prepurge Closed 196 = Prespark 217 = Interpurge 241 = Postpurge 245 = Ignition
Boiler Pump Status	89	AI	89		0 = Off; 1 = On
Cascade Heat Demand	90	AI	90		Indicates if the cascade has an active heat demand: 0 = No Heat Demand 1 = Heat Demand
History - Total Run Time	91	AI	91	Hours	
Read/Write					
CH1/DHW1 Enable/Disable	128	AV	0		0 = Disable; 1 = Enable
CH1/DHW1 Set Point	129	AV	1	°F/ °C	
CH1/DHW1 PID Low - P	130	AV	2		
CH1/DHW1 PID Low - I	131	AV	3		
CH1/DHW1 PID Low - D	132	AV	4		
CH2/DHW2 Enable/Disable	133	AV	5		0 = Disable; 1 = Enable
CH2/DHW2 Set Point	134	AV	6	°F/ °C	
CH2/DHW2 PID Low - P	135	AV	7		
CH2/DHW2 PID Low - I	136	AV	8		
CH2/DHW2 PID Low - D	137	AV	9		
CH1/DHW1 PID High - P	140	AV	12		
CH1/DHW1 PID High - I	141	AV	13		
CH1/DHW1 PID High - D	142	AV	14		
CH2/DHW2 PID High - P	145	AV	17		
CH2/DHW2 PID High - I	146	AV	18		
CH2/DHW2 PID High - D	147	AV	19		
DHW/DHW3 Enable/Disable	148	AV	20		0 = Disable; 1 = Enable
DHW/DHW3 Set Point	149	AV	21	°F/ °C	
DHW/DHW3 PID Low - P	150	AV	22		
DHW/DHW3 PID Low - I	151	AV	23		
DHW/DHW3 PID Low - D	152	AV	24		
DHW/DHW3 PID High - P	159	AV	31		
DHW/DHW3 PID High - I	160	AV	32		
DHW/DHW3 PID High- D	161	AV	33		
Vari-Prime PID - P	165	AV	37		
Vari-Prime PID - I	166	AV	38		
Vari-Prime PID - D	167	AV	39		
Vari-Prime Delta T	168	AV	40	°F/ °C	
Cascade External Firing Rate	179	AV	50	%	Sets the total firing rate of the cascade (0-800%).
DHW/DHW3 Demand Switch	174	BV	0		0 = No Heat Demand; 1 = Heat Demand
CH1/DHW1 Demand Switch	175	BV	1		0 = No Heat Demand; 1 = Heat Demand
CH2/DHW2 Demand Switch	176	BV	2		0 = No Heat Demand; 1 = Heat Demand
Modbus Parameter Write Enable	180				

8.G Wiring Diagram



8.H Logic Diagram



SECTION 9 USING THE TOUCH SCREEN

9.A The Home Screen

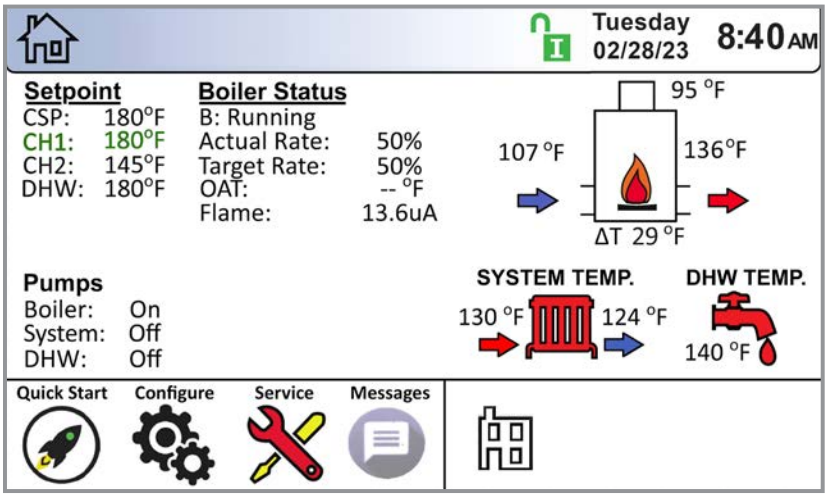


Figure 38. Home Screen Active Icons

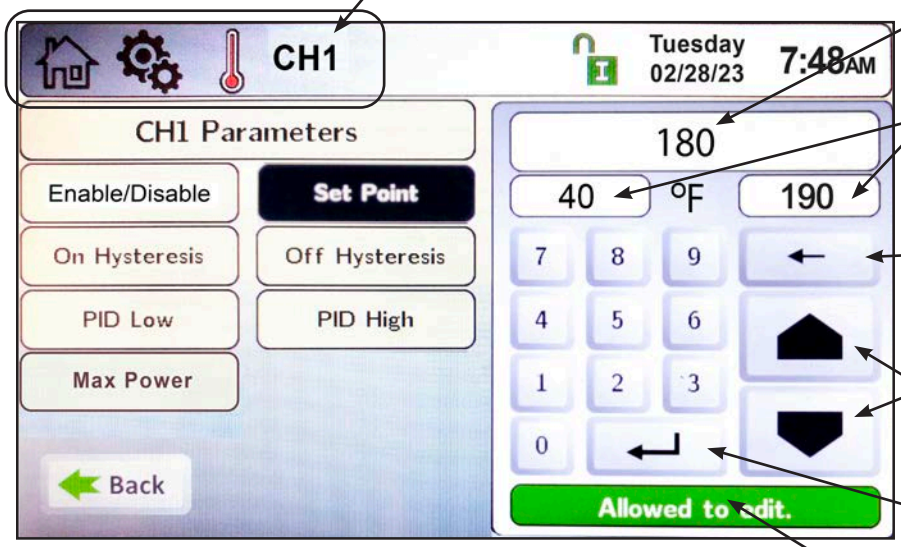
Name	Icon	Description
Security		Displays the current lock status icon. Touch the lock icon to lock or unlock the Touchscreen Display. See **Section 9.B on page 56**
Quick Start		Provides quick access to the most commonly used parameters for easy installation. See **Section 9.C on page 57**
Configure		Provides access to ALL of your configurations for a detailed setup of the unit. See **Section 9.D on page 61**
Service		Allows the service technician to access the basic diagnostic and troubleshooting information. See **Section 9.E on page 86**
Messages		Will show an 'Exclamation Point' when there is a message. Clicking onto the Message icon will take you to the message itself. The USB functionality will show the USB Icon at this location, if being used. See **Section 9.F on page 91** 
Active Demands		Will show icons that indicate the active parameters that are currently in demand. See **Section 9.G on page 92**
Navigation Bar		Top left of every menu. The constant indicator of where you are as you navigate into and out of the touchscreens. **See Section 9.A.1 on page 55** **The alarm bell icon indicates that the units alarm has been silenced.** **LOCKOUTS and ERROR** Codes are also show in the ***Navigation Bar*** when there is one of several unit Lockouts, Errors or Shut-downs that have occurred. See **Section 13.B on page 110** 
Date & Time		To change date and time, simply touch the date or time and follow the directions. See **Section 9.D.10 on page 80**

Figure 39. Active Areas of the Home Screen

9.A.1 Keypad Operations

NOTE: You can always tell exactly where you have navigated to by looking at the icons in the ***Navigation Bar.***

In this example you are in
Home / Configure / Central Heat / Central Heat One



Shows the current setting of the parameter.

These windows will reflect the allowable ranges of the parameter.

To delete the current setting before entering in the new value.

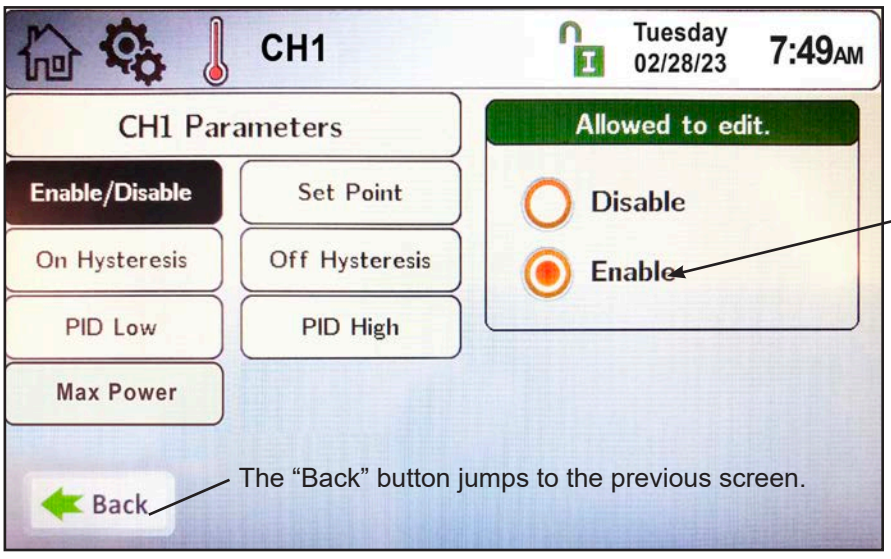
"Up and Down" arrows are used to increment the setting accordingly.

The "Enter" button is used to accept the new value.

This is the indicator that will be shown when the correct password has been entered to allow the setting to change.

A Typical Numeric Keypad Entry Screen.

Remember to always save the new setting with the button.



The highlighted button (orange) shows which one is selected. Some screens may only allow you to set one or the other, while some other screens (example: pump selection) will allow you to select any or all of the options.

The "Back" button jumps to the previous screen.

A Typical Selection Screen.

9.B Login to Lock / Unlock the Display Screen

Password Protection:

To change configuration or parameters, a password is required. The control system includes three levels of password protection. Touch the 'Current Lock Status' icon at the top of the screen.

1- USER password is lhs. This password is for 'Safe' access 'Non-Critical' adjustments and functions. Use this password if you want to make adjustments without fear of altering the critical configuration of the system. When unlocked in the User mode, the icon will change to

2- INSTALLER password is 17. This password is for the trained Installer / Technician for configuration and parameter changes made during the initial setup and commissioning. Be aware that in this level of password protection, changes to the configuration setup may result in lock-outs or conflicts with your system setup, resulting in technical issues.
When unlocked in the Installer mode, the icon will change to

3- OEM: Configuration and parameter changes available only to the factory. When unlocked in the OEM mode, the icon will change to



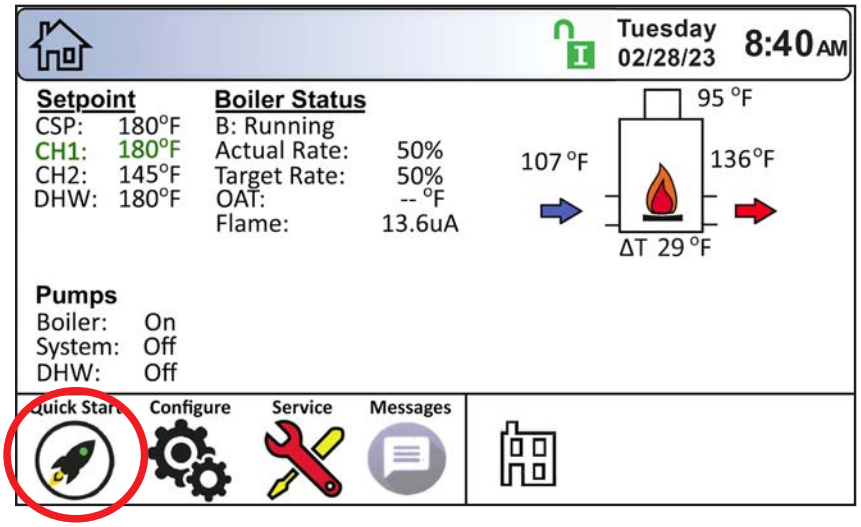
Logout. If the Installer is done and wants to lock the display immediately, tap the Logout icon to exit Installer or User Mode. Exiting the Installer or User Mode will lock the unit.

Walk-Away Result. The user can choose how long the control will remain unlocked after interaction with the control has stopped. After this time (default is 5 minutes), the screen will lock itself.
See "9.E.4 Screen Settings Timeout" on page 89.



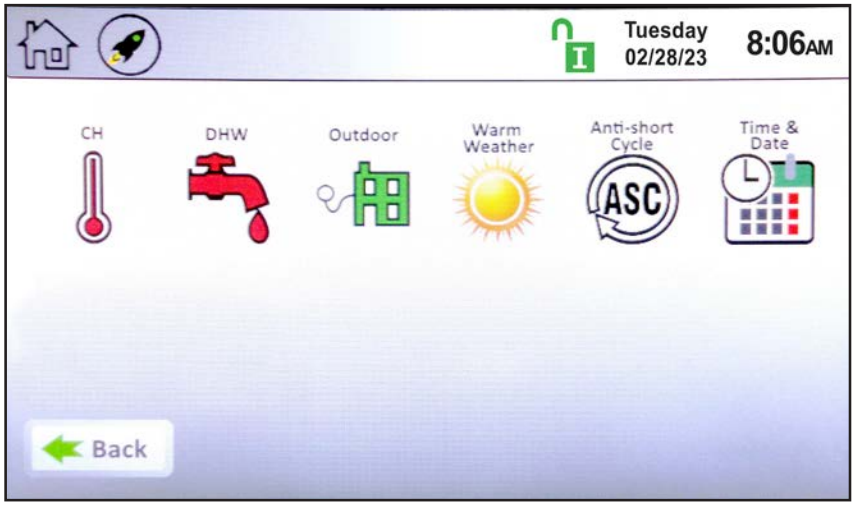
9.C Quick Start

Quick Start will allow a user to configure the BASIC functionality of the control, without going through all of the parameters that are available.



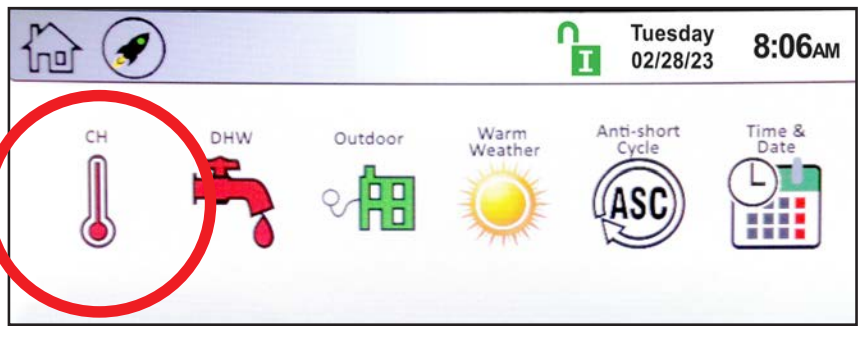
The 6 BASIC functions are

- **Central Heat**
- **Domestic Hot Water**
- **Outdoor Reset**
- **Warm Weather Shutdown**
- **Anti-short Cycle**
- **Time & Date**



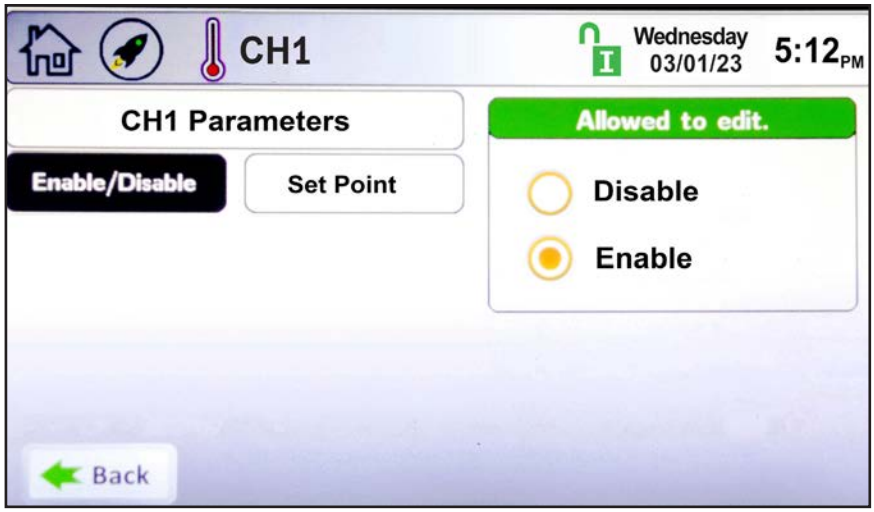
9.C.1 CH (Central Heat)

"CH" stands for "Central Heat." It is used for space heating demands. On the Quick Start Screen, touch the CH thermometer icon to navigate to the CH Selection Screen.
There are two identical heat demands, CH1 and CH2, each with independent control algorithms and independent inputs on the input terminal strip, see "9.C Quick Start" on page 57.
Touching CH1 navigates to the CH1 Quick Start Screen.



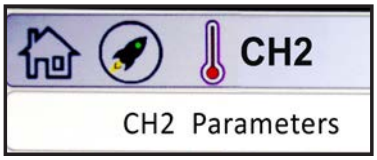
9.C.1.a CH1 (Central Heat, One)

• **Enable/Disable** – This allows CH1 to be enabled/disabled. The default setting is Enabled.
• **Set Point** – This is the set point temperature.



9.C.1.b CH2 (Central Heat, Two)

To navigate to the CH2 Quick Start Screen, touch the CH2 Icon on the CH Quick Start Selection Screen. The CH2 screen will be have the same look and functionality as the CH1 Screen.



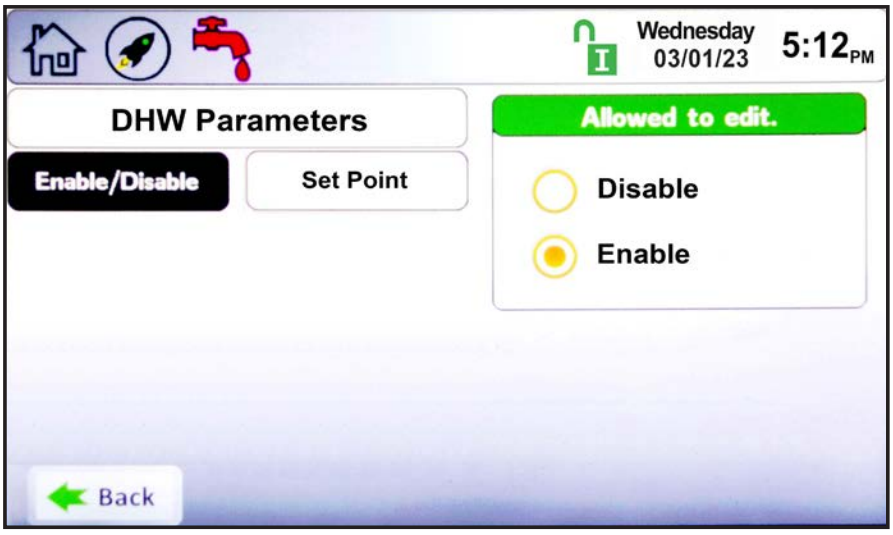
9.C.2 DHW (Domestic Hot Water)

"DHW" stands for "domestic hot water." To navigate to the DHW Quick Start Screen, touch the DHW icon on the Quick Start Screen.

The DHW Quick Start Screen allows adjustment of the following parameters:

• **Enable/Disable** – This allows DHW to be enabled/disabled. The default setting is Enabled.
• **Set Point** – This is the hot water set point temperature.

NOTE: A DHW heat demand can be initiated by an aquastat or sensor. See 8.E.7 on page 47.



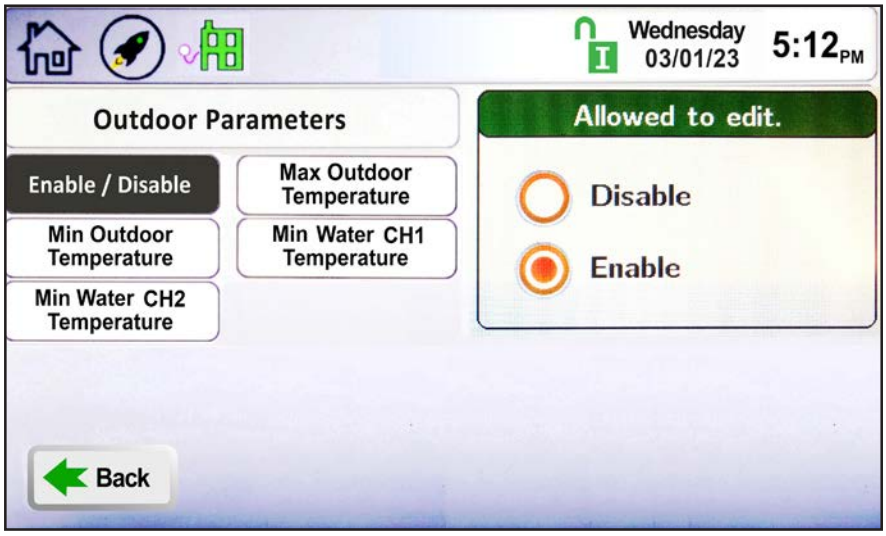
9.C.3 Outdoor Reset

Outdoor reset adjusts a boiler's setpoint based on outdoor air temperature. This is for boilers only, and is not used for domestic water.

To navigate to the Outdoor Quick Start Screen, touch the Outdoor Icon on the Quick Start Screen.

The Outdoor Quick Start Screen allows the adjustment of the following parameters:

- **Enable/Disable** – Enables and disables the outdoor reset functionality.
- **Maximum Outdoor Temperature** – The outdoor temperature at which the unit will use the minimum water temperature as the set point.
- **Minimum Outdoor Temperature** – The outdoor temperature at which the unit will use the maximum water temperature as the set point.
- **Minimum Water CH1 Temperature** – The minimum boiler CH1 outlet temperature based on the Maximum Outdoor Temperature.
- **Minimum Water CH2 Temperature** – The minimum boiler CH2 outlet temperature based on the Maximum Outdoor Temperature. based on the Maximum Outdoor Temperature.



9.C.4 Warm Weather Shut Down

Warm weather shut down allows the user to disable to heating system based on outside air temperature. It is used for boilers only.

To navigate to the Warm Weather Quick Start Screen, touch the Warm Weather Icon on the Quick Start Screen.

The Warm Weather Quick Start Screen allows adjustment of the following parameters:

- **Temp Min** – If the unit is in warm weather shutdown mode, it will resume normal operation when the air temperature drops to this value.
- **Temp Max** – The temperature at which the warm weather shutdown condition will occur.
- **Feature Options** – This allows the shutdown to be enabled or disabled. When enabled, and the outside air temperature rises to the shut down (temp max) value, this tells the controller whether to shut down immediately or satisfy the current call for heat before shutting down.



9.C.5 Anti-Short Cycle

To navigate to the Anti-Short Cycle Quick Start Screen, touch the Anti-Short Cycle Icon on the Quick Start Screen.

The Anti-Short Cycle Quick Start Screen allows adjustment of the following parameter:

- **Cycle Time** – The amount of time after a heat demand is satisfied that the unit will wait to satisfy the next active heat demand.

NOTE: Anti-Short Cycle Time does not apply to DHW heat demands



9.C.6 Time & Date

To navigate to the Time & Date Quick Start Screen, touch the Time & Date area on any screen.

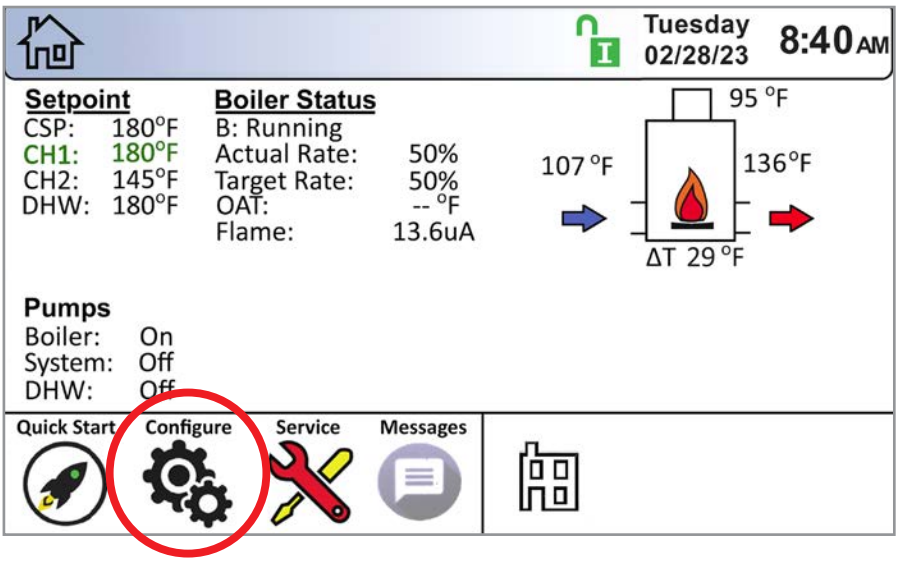
NOTE: The Time is set in a 24 hour parameter, but displays only as a 12 hour clock with the AM / PM automatically added.

The Time & Date Quick Start Screen allows adjustment of the following parameters:

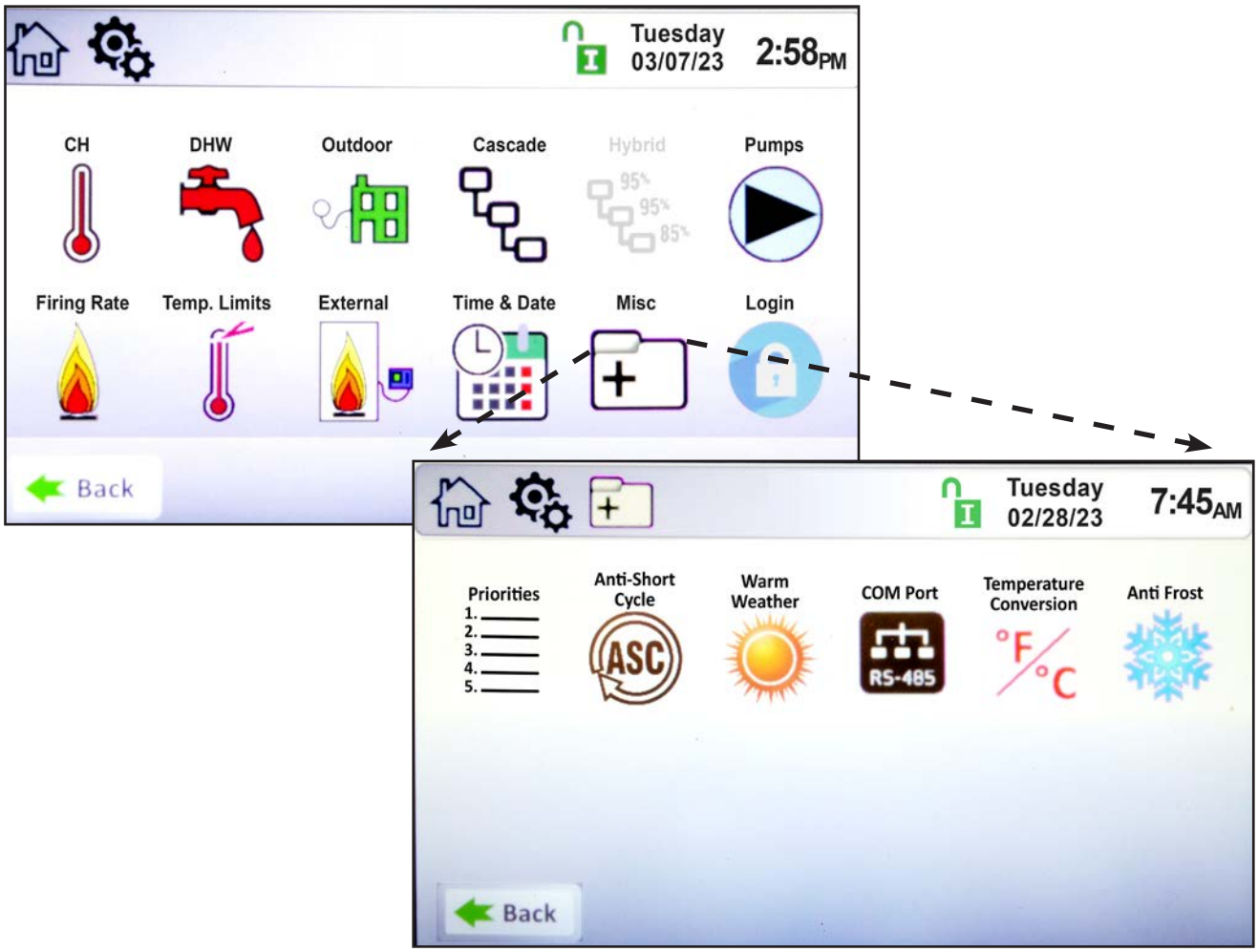
- **Hour**
- **Minute**
- **Month**
- **Day**
- **Year**

9.D Configuration

This area of the controller allows access to all parameters available, based on the access level that is unlocked. To navigate to the Configuration Screen, touch the Configure Icon in the lower left portion of the Home Screen.



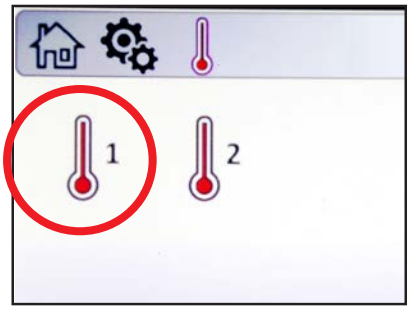
The Configuration Screen shows all configurable parameters.



9.D.1 CH (Central Heat)

"CH" stands for "Central Heat." It is used for space heating demands. On the Configure Screen, touch the CH thermometer icon to navigate to the CH Selection Screen

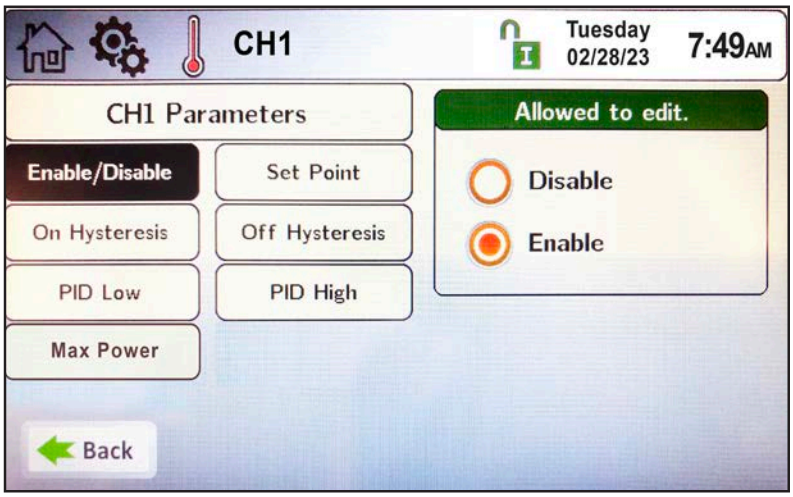
There are two identical heat demands, CH1 and CH2, each with independent control algorithms and independent inputs on the input terminal strip.



9.D.1.a CH1 (Central Heat, One) 1

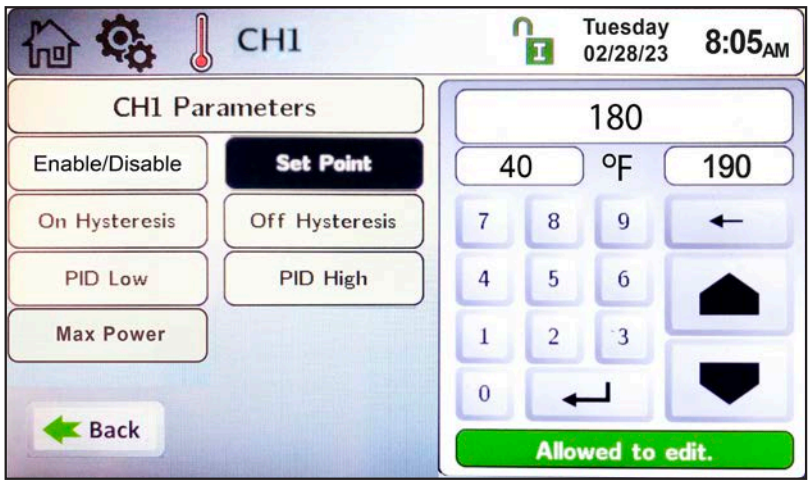
CH1 is one of the heat demands available. The CH1 Configuration Screen allows adjustment of the following parameters:

- **Enable/Disable** - This allows CH1 to be enabled or disabled. The default setting is Enabled.
- **Set Point** - This is the temperature set point for CH1.
- **On Hysteresis** - The unit will turn on to satisfy the heat demand if the temperature is below the set point minus the on hysteresis.
- **Off Hysteresis** - The heat demand will be satisfied once the temperature reaches the set point plus the off hysteresis.
- **PID Low** - Controls the firing rate whenever the temperature is below the set point. Lower values in P and I will reduce overshoot.
- **PID High** - Controls the firing rate between the set point and the off Hysteresis. Higher values in P and I will reduce overshoot.
- **Max Power** - Allows the user to set a max BTU output less than the boilers full output. Used when small loads are applied.



Set Point

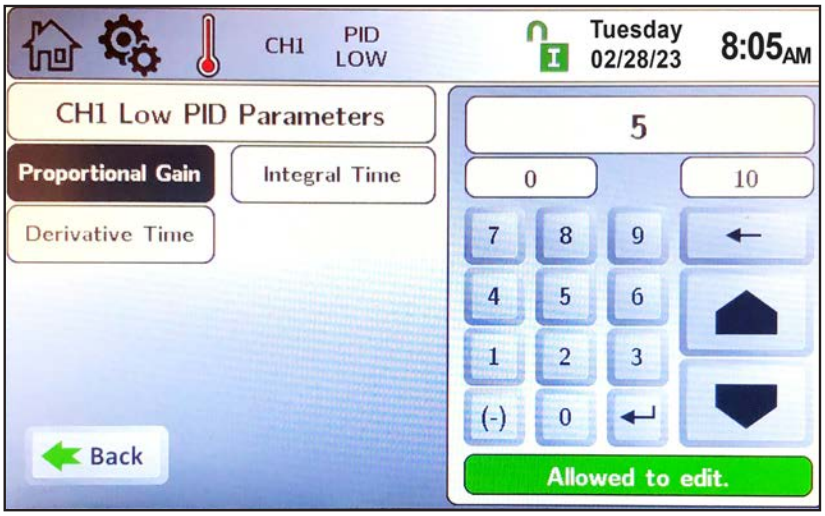
On the Set Point screen, use the keypad on the right or the up/down arrows to enter the desired temperature set point for CH1. Press the "Enter" button to save the setting. Set Point range is 40-190°F, and default is 180°F.



9.D.1.a.1 PID Low

Note that in most cases, PID parameters will not need to be changed. The PID Parameters Screen allows adjustment to the following parameters:

- **Proportional Gain** – This value is the corrective action that is proportional to the error (set point – control temperature).
- **Integral Time** – This value is applied to the sum of the error over a period of time.
- **Derivative Time** – This value is applied to the rate of change of the error.

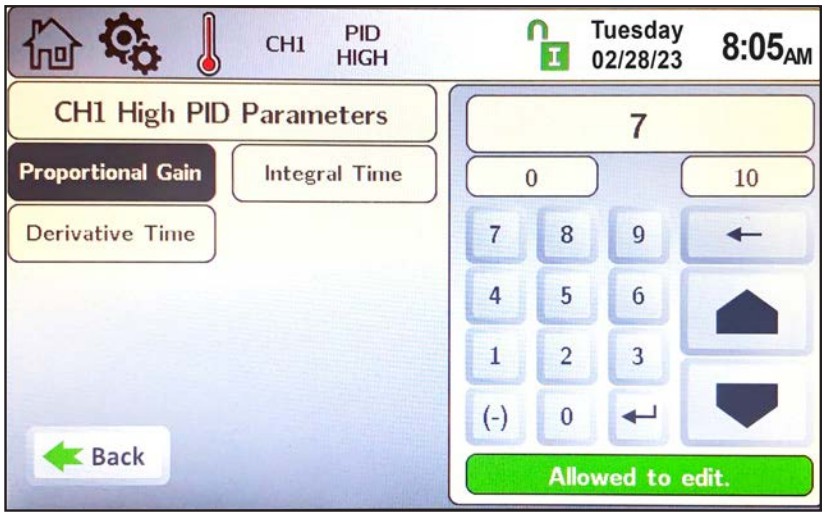


NOTE: By default, the control sensor is the unit outlet sensor, or when installed, the system supply sensor.

9.D.1.a.2 PID High

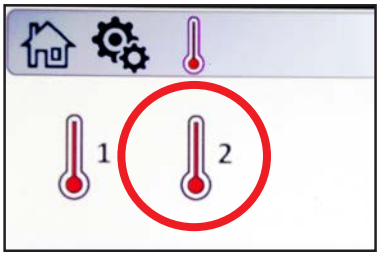
Note that in most cases, PID parameters will not need to be changed. The PID Parameters Screen allows adjustment to the following parameters:

- **Proportional Gain** – This value is the corrective action that is proportional to the error (set point – control temperature).
- **Integral Time** – This value is applied to the sum of the error over a period of time.
- **Derivative Time** – This value is applied to the rate of change of the error.



9.D.1.b CH2 (Central Heat, Two) 2

Additional heat demand CH2 is available and is set up in the same manner as CH1.

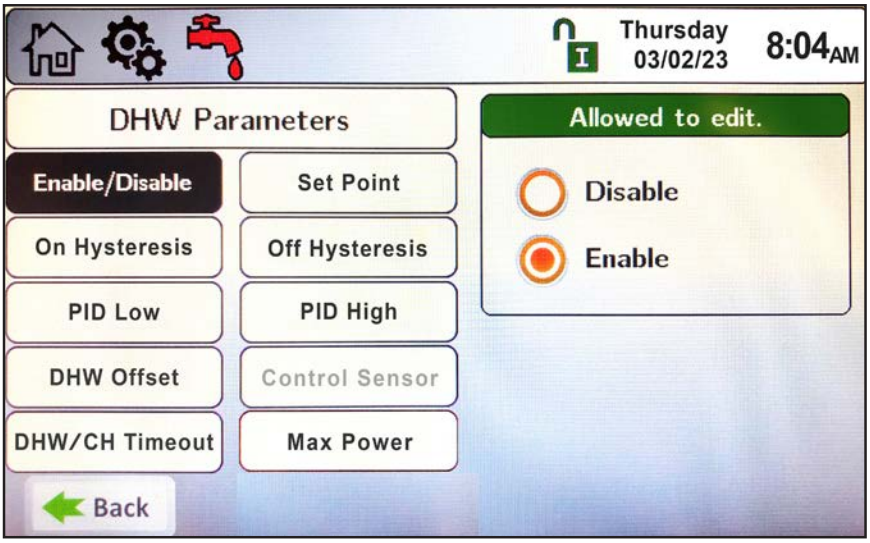


9.D.2 DHW Parameters (Domestic Hot Water)

NOTE: A DHW heat demand can be initiated by an aquastat or sensor. See Section 8.E.7 and 8.E.8 on page 47

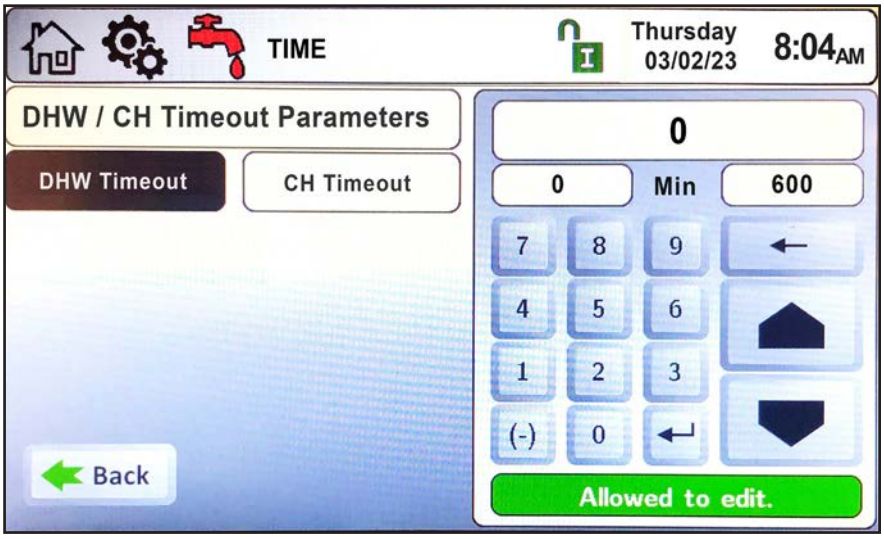
To navigate to the DHW Screen, touch the DHW faucet icon on the Configure Screen.

DHW Parameters has all the same parameters as CH1 and CH2 with a few exceptions. DHW has the following additional parameters for adjustment:



DHW Offset - Upon a DHW heat demand, the unit will control the outlet temperature to the DHW Set Point plus the DHW Offset (set point + DHW Offset).
For example, with a DHW Set Point of 140°F and a DHW Offset of 40°F, the unit will control the boiler/heater outlet temperature to 180°F (140°F + 40°F) to satisfy the heat demand.

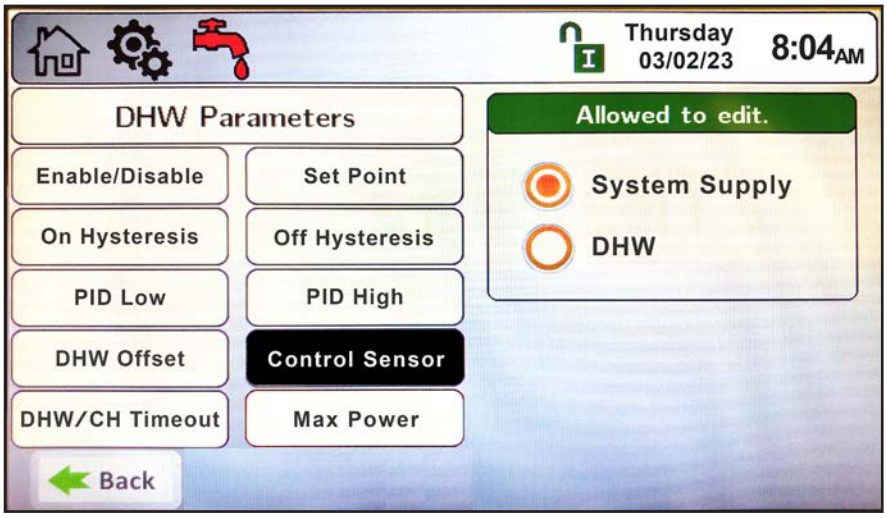
DHW/CH Timeout



DHW Timeout - When there is both a DHW and CH heat demand, DHW Timeout is the amount of time the boiler will satisfy the higher priority DHW heat demand before timing out and swapping over to the CH heat demand. A DHW Timeout value of 0 means this feature is disabled.

CH Timeout - When there is both a CH and DHW heat demand, the CH Timeout is the amount of time the boiler will satisfy the CH heat demand before swapping over to the DHW heat demand.

NOTE: If DHW has a higher priority than CH, and only CH Timeout has a non-zero value, the DHW heat demand will always be satisfied before swapping over to CH. In order to use CH Timeout, DHW Timeout must be a non-zero value.



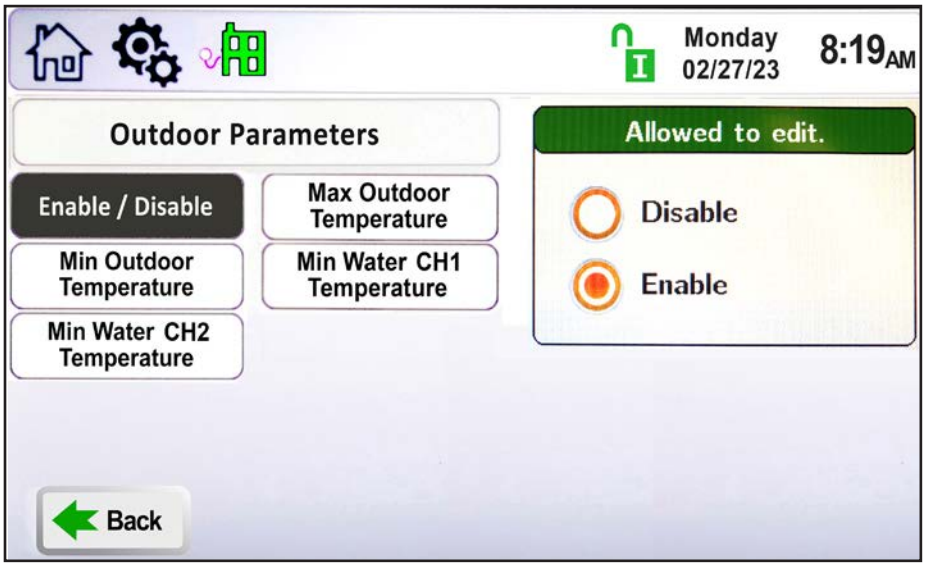
Control Sensor - This button is only selectable if the boiler is configured as the lead boiler in a cascade configuration. If configured as the lead boiler, this button allows the installer to select if a DHW heat demand applied at the lead boiler will control to the system sensor or the DHW sensor.

9.D.3 Outdoor Reset

Outdoor reset adjusts a boiler's setpoint based on outdoor air temperature. This is for boilers only, and is not used for domestic water. The Outdoor Parameters Screen allows the adjustment of the following parameters:

- **Enable/Disable** – Enables and disables the outdoor reset functionality.
- **Maximum Outdoor Temperature** – The outdoor temperature at which the unit will use the minimum water temperature as the set point.
- **Minimum Outdoor Temperature** – The outdoor temperature at which the unit will use the maximum water temperature as the set point.
- **Minimum Water CH1 Temperature** – The minimum CH1 boiler outlet temperature based on the Maximum Outdoor Temperature.
- **Minimum Water CH2 Temperature** – The minimum CH2 boiler outlet temperature based on the Maximum Outdoor Temperature.

When there is an active outdoor reset condition, the set point will be a calculated value (CSP) based on the outdoor reset settings. The example in Figure 40 and Figure 41 shows that the Outdoor Air Temperature is 42°F. Based on this, and without a call for DHW, the set point (CSP) is 160°F. As the outdoor air temperature increases, the CSP decreases.



Setpoint		Boiler Status	
CSP:	160°F	B: Running	
CH1:	180°F	Actual Rate:	20 %
CH2:	145°F	Target Rate:	20 %
DHW:	180°F	OAT:	42°F
		Flame:	13.6uA

Pumps

Boiler:	On
System:	On
DHW:	Off

Figure 40. Status Window, Outdoor Reset Example

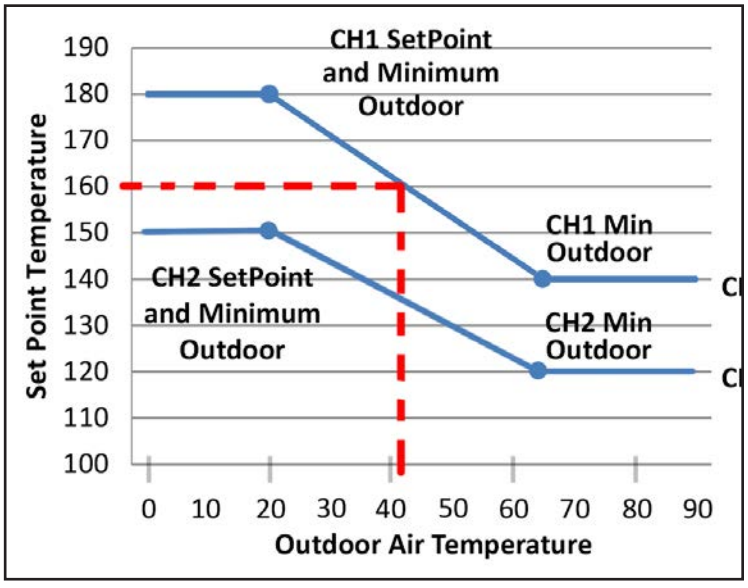


Figure 41. Outdoor Reset Example

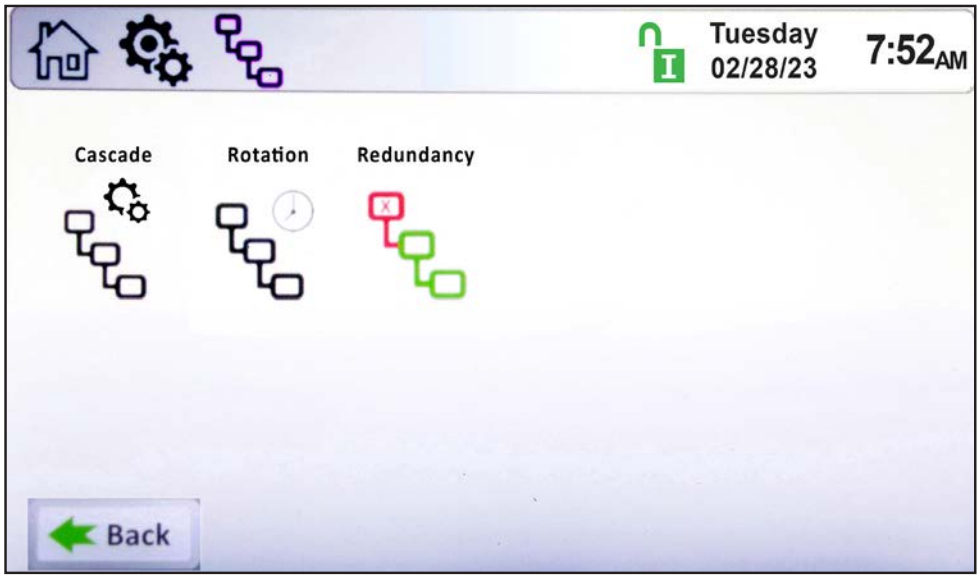
9.D.4 Cascade

An installation with two or more units may be configured for cascade operation. Up to eight units can be cascaded and controlled together.

To navigate to the Cascade Screen, touch the Cascade Icon on the Configuration Screen.

The Cascade Screen provides three navigation icons to configure the system for cascade operations. These navigation icons are:

- **Cascade** – This icon navigates to the Cascade Parameters screen.
- **Rotation** – This icon navigates to the cascade rotation screen.
- **Redundancy** – This icon navigates to the setup screen for cascade leader redundancy options.



NOTE: Cascading is possible only with other units of the same manufacture and using the same control system.

About Cascading (Lead / Lag)

The Lead boiler/heater uses the Base Load Value to determine when to fire the Lag units and at what firing rate. The Base Load Value should be adjusted based on the number of units installed, with a default value of 65%. Recommended base load values based on the number of units installed is shown in the table below. The Base Load Value is adjustable via the DU with installer login credentials.

Boiler Qty	Recommended Base Load	Recommended Drop Load
1	N/A	N/A
2	65%	20%
3	65%	20%
4	65%	20%
5	65%	20%
6	65%	20%
7	65%	20%
8	65%	20%

Table 23. Recommended Base Load Values

Upon an active cascade heat demand, the Lead boiler/heater will dictate which unit will fire first based on the cascade rotation logic. As the firing rate of this unit reaches the Base Load Value, once the Min On Time timer expires, the next unit in the sequence will fire and both units will modulate up or down together at the same firing rate in reaction to changes in heat demand. This pattern will continue until the firing rates of all cascaded units reach the base load value. Once all units are firing at the base load value, the firing rate can exceed the base load value, with all units maintaining the same firing rate. Refer to the Lead / Lag figures below for additional clarification.

With boilers/heaters firing at the same firing rate, minimum firing rates need to be taken into consideration. Units with varying turndown ratios can be cascaded together, therefore, the unit with the highest minimum firing rate dictates the minimum firing rate of the total cascaded system. For example, if a 5:1 unit is cascaded with a 20:1 unit, and the 5:1 unit has reached the base load value, the

About Cascading (Lead / Lag) -continued

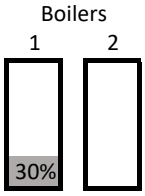
	Log In			Settings			
Parameter	User	Installer	OEM	Min	Max	Default	Unit
Base Load		X	X	40	100	65	%
Drop Load		X	X	10	100	20	%
Min On Time		X	X	30	600	60	Seconds
Min Off Time		X	X	30	600	60	Seconds

Table 24. Parameter Settings

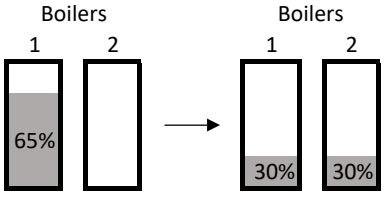
20:1 will be called to run. The 20:1 will fire at the same firing rate as the 5:1, which is limited to 20% minimum (instead of the allowable minimum firing rate of 5%). In addition, if the Drop Load Value is higher than the minimum firing rate of the unit, the unit will turn off at the Drop Load Value and not the minimum firing rate of the unit.

NOTE: The single exception to a unit turning off at the Drop Load Value in a cascade configuration is when there is only one unit running, where the single unit acts as a standalone boiler/heater.

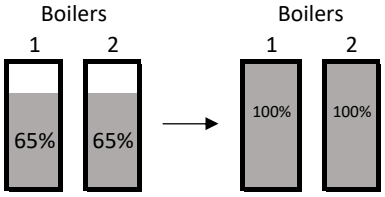
Low demand: The first boiler in sequence ignites and gradually increases firing rate to satisfy the heat demand.



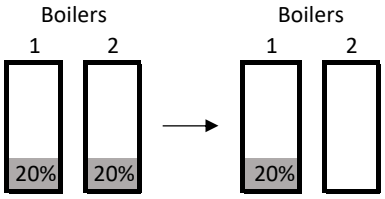
Increased demand: Once the first boiler reaches the Base Load Value (65%) firing rate, the second boiler ignites. After ignition, both units modulate to half of the cascade firing rate, then gradually increase the firing rate together, up to the Base Load Value.



Approaching max demand: Once both boilers reach 65%, both units are allowed to increase firing rate (same at both boilers) up to maximum firing rate.



Decreasing demand: As the demand decreases, once the requested firing rate reaches the Drop Load Value, the second boiler turns off.



Demand Satisfied: When the heat demand is satisfied or the temperature is at the set point + off hysteresis, the final boiler will turn off.

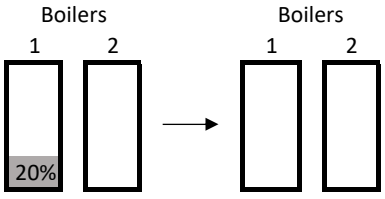


Figure 42. Lead / Lag, 2 Boilers

As the load increases:

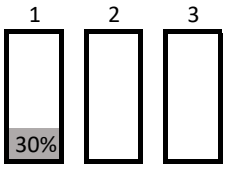
- Until all units are firing, no unit is requested to exceed the base load value.
- Additional units are added once the Base Load Value has been reached and the Min On Time timer has expired.
- As long as all boilers/heaters are firing, the base load value can be exceeded, as long as all units maintain the same firing rate.

As the load decreases:

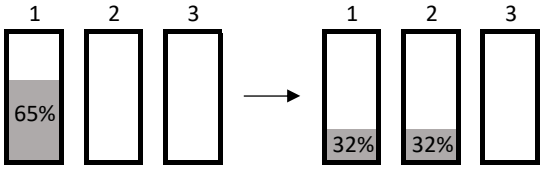
- As long as all units are firing – the base load value can be exceeded, as long as all units maintain the same firing rate.
- As the firing rate decreases below the Drop Load Value, the last unit to ignite turns off first (last on/first off), following this pattern until the heat demand is satisfied and all units are off.

Units in Lead / Lag mode maintain local boiler/heater limiting features (firing rate limiting based on outlet or flue temperature) when in Lead / Lag mode operations.

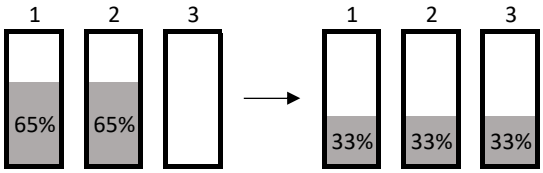
Low demand: The first boiler in sequence ignites and gradually increases firing rate to satify the heat demand.



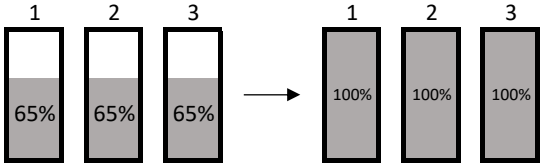
Increased demand: Once the first boiler reaches the Base Load Value (65%) firing rate, the second boiler ignites. After ignition, both units modulate to half of the cascade firing rate, then gradually increase the firing rate together, up to the Base Load Value.



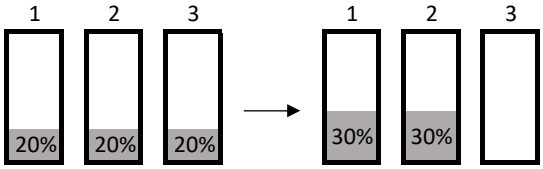
Increased demand: Once the first two boilers reach the Base Load Value (65%) firing rate, the third boiler ignites. After ignition, the three units modulate at 1/3 of the cascade firing rate, then gradually increase firing rate together, up to the Base Load Value.



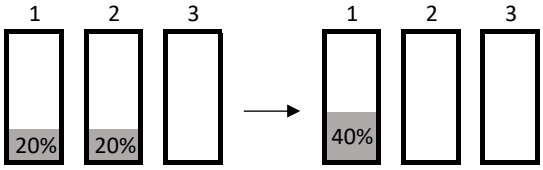
Approaching max demand: Once all three boilers reach the Base Load Value (65%), all units are allowed to increase firing rate (same at all boilers) up to maximum firing rate.



Decreasing demand: As the demand decreases, once the requested firing rate reaches the Drop Load Value, the third boiler turns off.



Continued Decreasing demand: As the demand decreases, once the requested firing rate reaches the Drop Load Value, the second boiler turns off.



Demand Satisfied: When the heat demand is satisfied or the temperature reaches set point + off hysteresis, the final boiler will turn off.

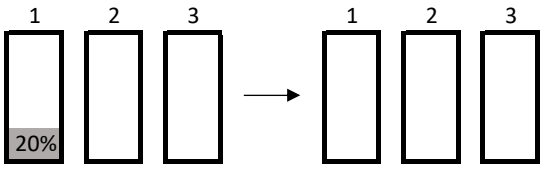


Figure 43. Lead / Lag, 3 Boilers

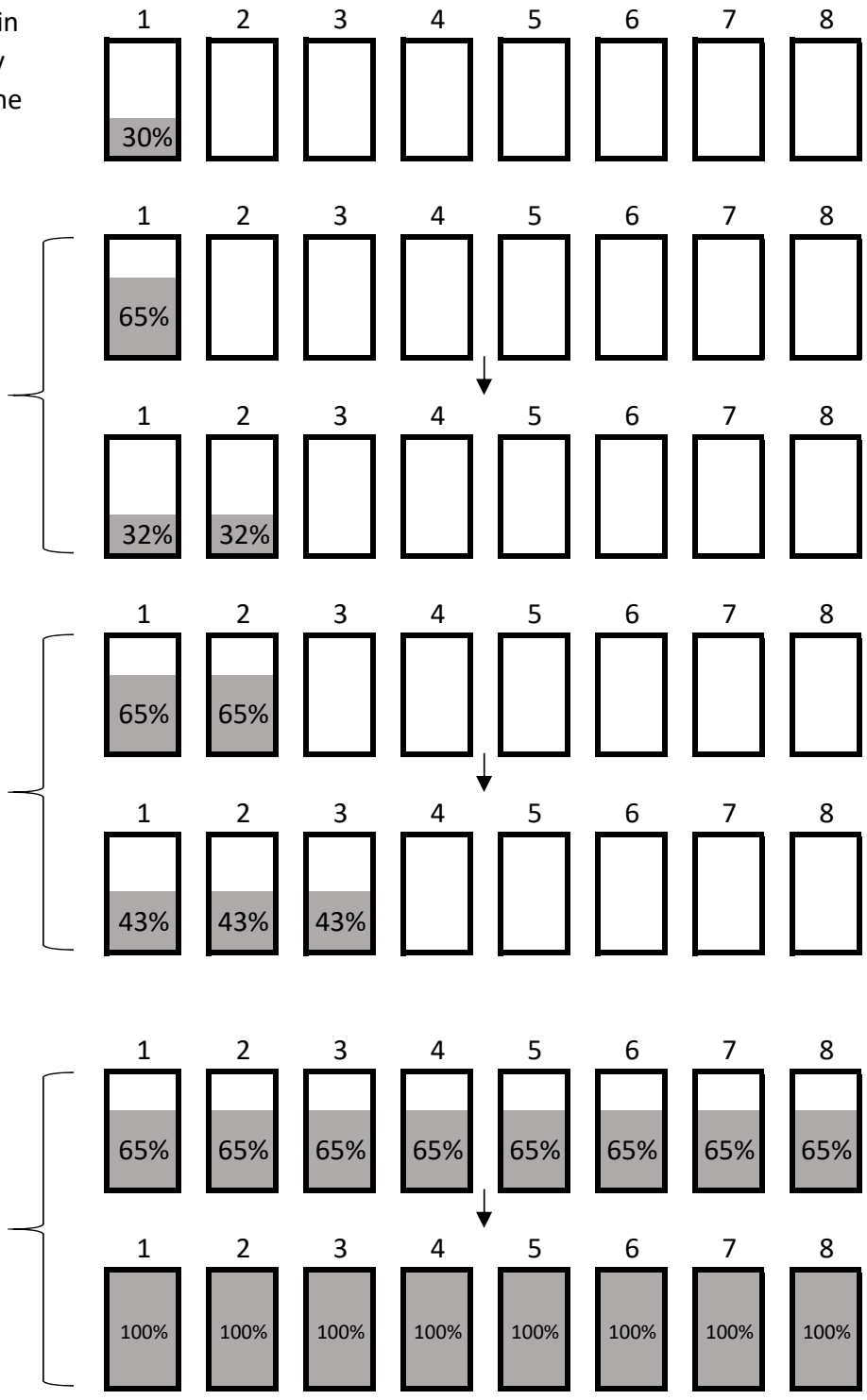
About Cascading (Lead / Lag) -continued

Low demand: The first boiler in sequence ignites and gradually increases firing rate to satify the heat demand.

Increased demand: Once the first boiler reaches the Base Load Value (65%) firing rate, the second boiler ignites. After ignition, both units modulate to half of the cascade firing rate, then gradually increase the firing rate together, up to the Base Load Value.

Increased demand: Once the first two boilers reach the *Base Load Value* (65%), the third boiler ignites. After ignition, all three units modulate to 1/3 of the cascade firing rate, then gradually increase firing rate together, up to the *Base Load Value* . This pattern continues as demand increases.

Approaching max demand: Once all eight boilers reach the *Base Load Value* , all units are allowed to increase firing rate (same at all boilers) up to maximum firing rate.

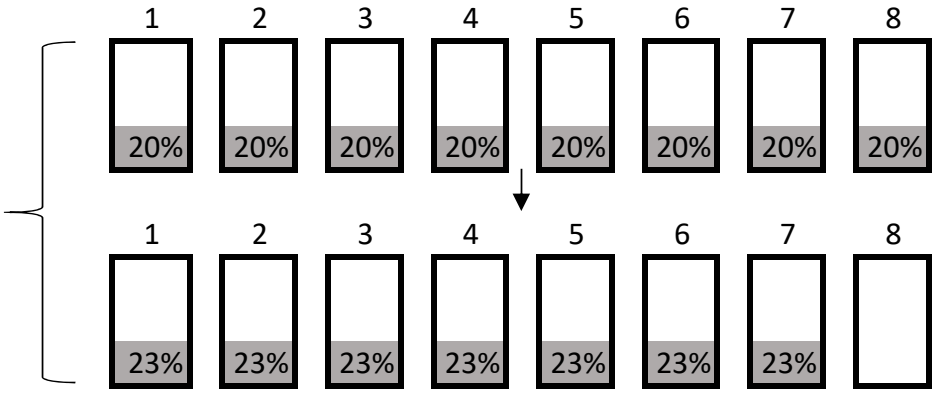


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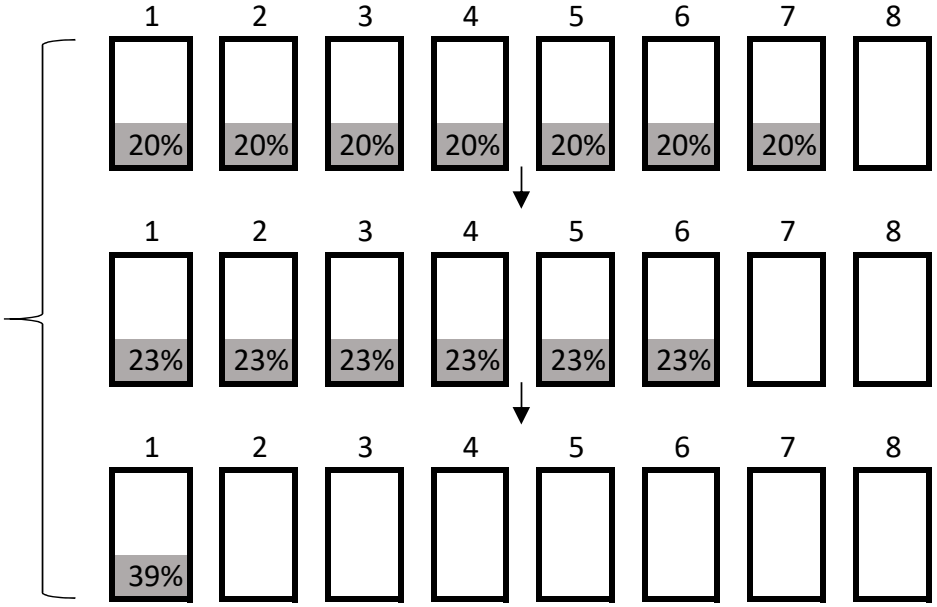
Figure 44. Lead / Lag, Demand Increase, 4 to 8 Boilers

(continued from previous page)

Decreasing demand: As the demand decreases, once the requested firing rate reaches the *Drop Load Value* , the eighth boiler turns off.



Continued decreasing demand: As the demand decreases, once the requested firing rate reaches the *Drop Load Value* , the seventh boiler turns off. This pattern continues as demand continues to decrease until there is a single boiler firing.



Demand Satisfied: When the heat demand is satisfied or the temperature reaches the set point + off hysteresis, the final boiler will turn off.

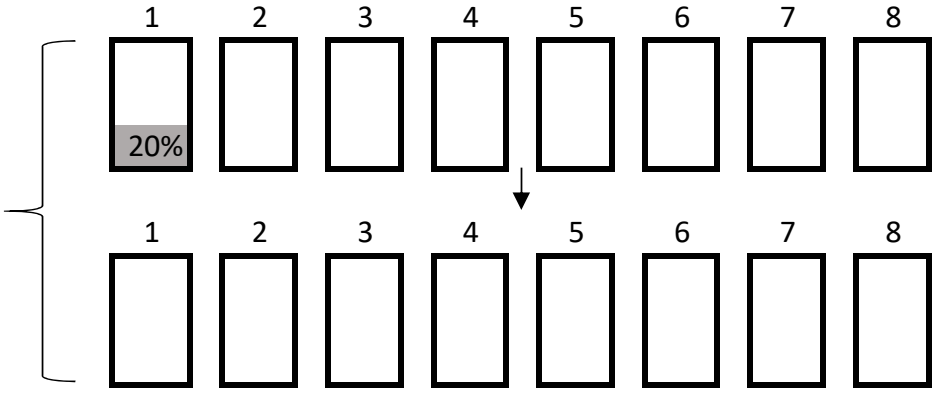


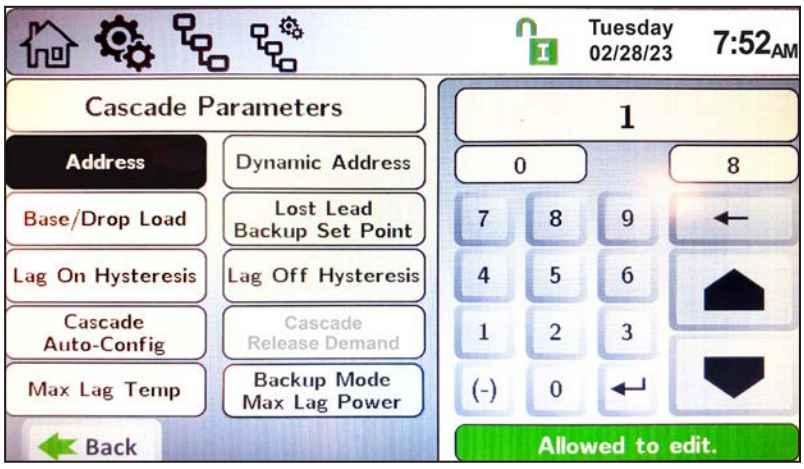
Figure 45. Lead / Lag, Demand Decrease, 4 to 8 Boilers

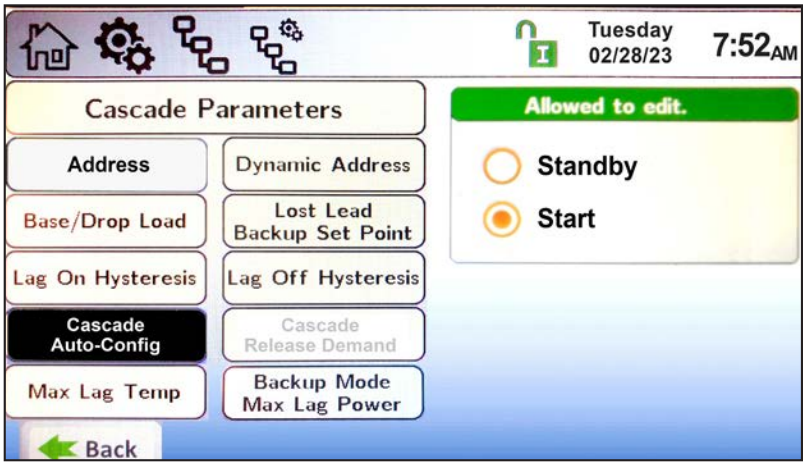
9.D.4.a Cascade Parameters

To navigate to the Cascade Parameters Screen, touch the Cascade Icon on the Configuration Screen, then touch the Cascade Parameters Icon.

The Cascade Parameters Screen allows adjustment of the following parameters:

- **Address** – When manually addressing each boiler/heater for cascade operations, this parameter is used to set the local boiler/heater address. Each boiler/heater must have a unique address. A boiler/heater with a value of 1 is the lead boiler/heater. Lag boilers/heaters use values 2 through 8. When automatically addressing each boiler/heater, set the lead boiler/heater to a value of 1. With a value of 1, the Cascade Auto-Config button is available to use, refer to this parameter below for instructions for automatic addressing the lag boilers/heaters.
- **Dynamic Address** – This reflects the address of the local boiler/heater after it has been manually or automatically addressed. After a boiler/heater has been manually/automatically addressed, setting this parameter to 0 will remove the boiler/heater from cascade operations.
- **Base / Drop Load** – This button will get you to the Base / Drop Load screen which allows you to manually enter the base firing percentage of the next cascading boiler as well as the firing point at which this boiler will drop the remaining load to the next cascaded boiler.
- **Lost Lead Backup Setpoint** – When configured for Cascade Redundancy - Boiler Internal Set Point, this parameter is the maximum outlet temperature the local boiler/heater is allowed to supply the system.
- **Lag On Hysteresis** - The value below the Max Lag Temp (Max Lag Temp – Lag On Hysteresis) that the boiler/heater will turn on to satisfy an active cascade demand based on the local boiler/heater outlet water temperature. Max Lag Temp is set at the Lead boiler/heater.
- **Lag Off Hysteresis** - The value above the Max Lag Temp (Max Lag Temp + Lag Off Hysteresis) that the boiler/heater will turn off when satisfying an active cascade heat demand based on the local boiler/heater outlet water temperature. Max Lag Temp is set at the Lead boiler/heater.
- **Cascade Auto-Config** – Once configured as the lead boiler / heater, you can initiate automatic addressing by pressing the 'Start' option. This is only adjustable at the lead boiler/heater. Once configured as the lead boiler/heater, pressing this button will initiate the lead boiler/heater to find and address all lag boilers automatically.
- **Cascade Release Demand -** When communication with the master is lost and the lag units continue to satisfy the cascade heat demand, pressing this button will remove the heat demand.
  NOTE: This only applies when configured for cascade - Boiler Internal Set Point Control.
- **Max Lag Temp** – The maximum outlet temperature a lag unit is allowed to supply the system.
- **Backup Mode Max Lag Power** – The maximum firing rate cascaded boilers will run at if the system sensor is lost on the master.





NOTE: All boilers/heaters must be wired for cascade operations prior to performing Cascade Auto-Config.

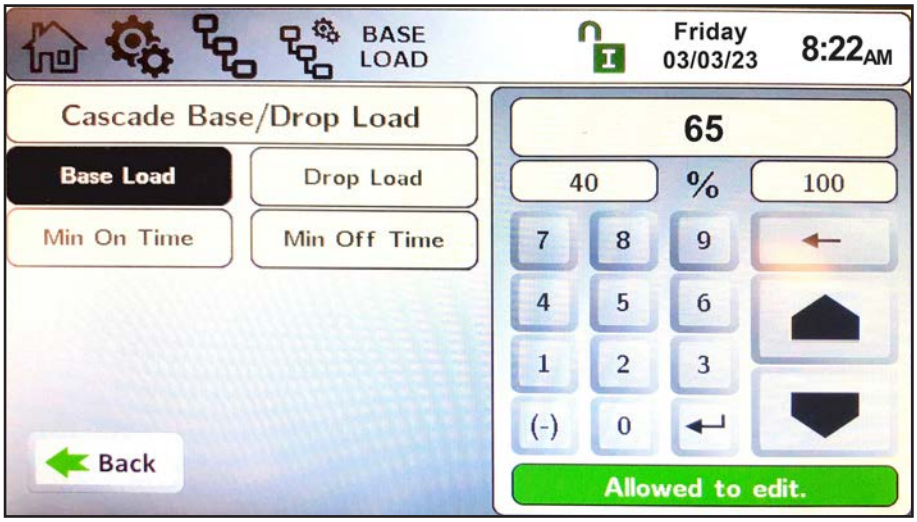
9.D.4.a.1 Base / Drop Load

Base Load – Is the firing rate that must be achieved prior to adding another unit to satisfy the heat demand.

Drop Load – As the demand for heat decreases, this is the firing rate that units turn off. The last unit to fire is the first to get turned off.

Min On Time – As the demand for heat increases, this is the delay time prior to firing additional units.

Min Off Time – As the demand for heat decreases, this is the delay time prior to turning off additional units.



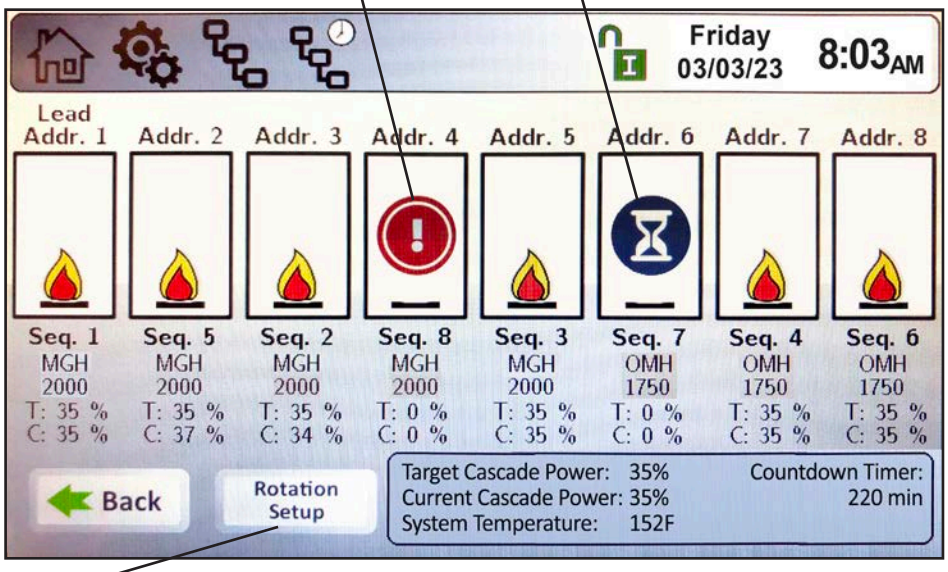
9.D.4.b Rotation

To navigate to the Cascade Rotation Screen, touch the Cascade Icon on the Configure Screen, then touch the Rotation Icon on the Cascade Configuration Screen.

The Cascade Rotation Screen is a view only screen. This screen indicates how many units are connected in a cascade configuration, the order in which each unit will run, and the percent at which each unit is running.

The red circle with the exclamation mark means that that boiler is locked out and will need to be manually reset to return to operations.

The blue circle means that that boiler has a soft or auto-reset condition and the lead boiler has placed it later in the queue to attempt to re-fire.

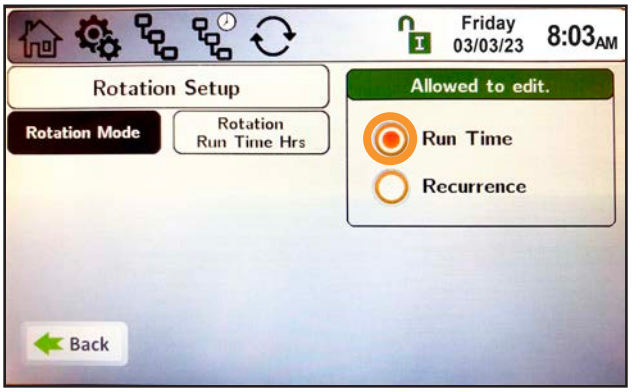


The Rotation Setup button is found only on the boiler that is assigned as 'Lead'.

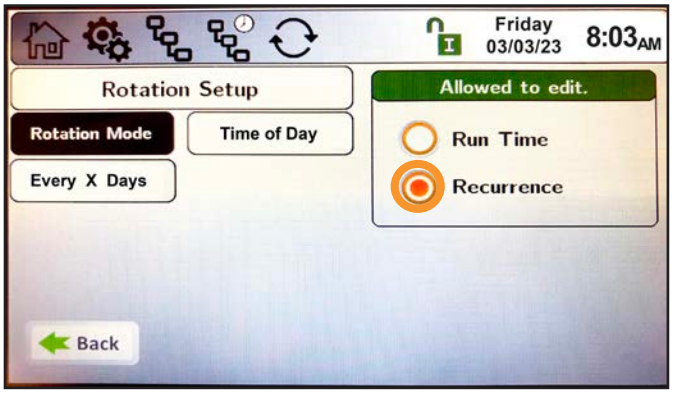
9.D.4.b.1 Rotation Setup

There are two options for cascade Rotation Setup, Rotation 'Mode':

1. **Run Time**
2. **Recurrence**



In the **Run Time** Mode, you can adjust only the Rotation Run Time Hours. This chooses which unit will fire first based on run time hours.



For **Recurrence** Mode, there are two parameters:

1. **Time of Day.** You can adjust the hour and minute of the day for rotation.
2. **Every X Days**. You can select how many days you want to wait until rotation, and then it will rotate at the hour and minute of the day previously selected.

9.D.4.c Redundancy

To navigate to the Cascade Redundancy Screen, touch the Cascade Icon on the Configuration Screen, then touch the Redundancy Icon on the Cascade Configuration Screen.

The Cascade Redundancy Screen allows the selection of one of three options for redundancy in cascade systems. These options are:



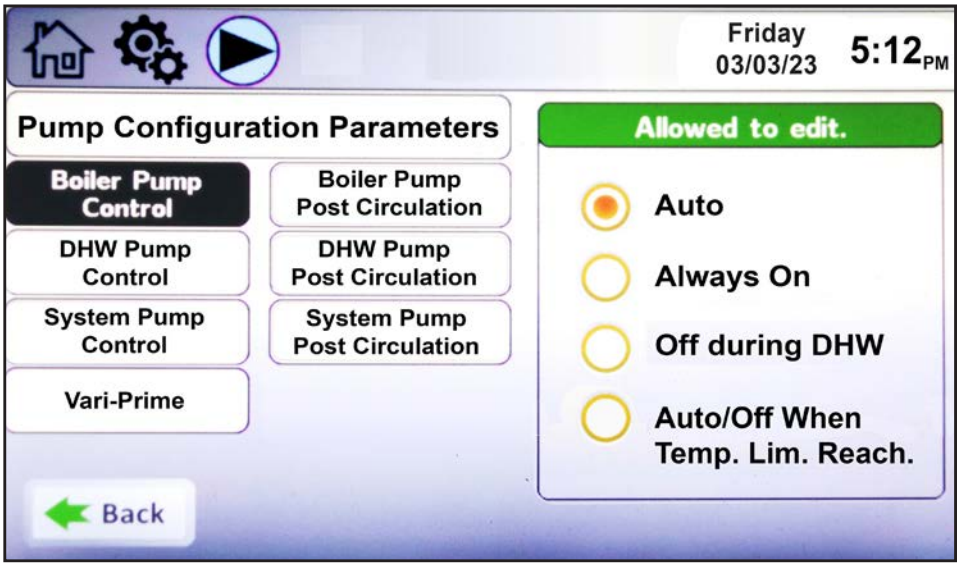
- **Boiler Internal Set Point** – In a cascade configuration, upon loss of communication with the lead unit, the lag units will all ignite, controlling to the 'Lost Lead Backup Set Point' without an external call for heat. This mode of operation will continue until communication with the lead unit is restored or until this mode is turned off by pressing the 'Release Demand' button on the Cascade Parameters screen.
- **Redundant Lead** – In a cascade configuration, upon loss of communication with the Lead unit, a second unit will assume Lead responsibilities.
- **Disable Redundancy** – In a cascade configuration, upon loss of communication with the Lead unit, Lag units will no longer satisfy the cascade heat demand.

NOTE: The redundant lead unit should have a system sensor and be connected to the system pump (if / where applicable). If the lead boiler maintains communication with the lag units, but loses connectivity with the system sensor, the cascaded units will run at the calculated set point (CSP) provided by the lead unit, but will control to their individual outlet sensor. In this mode, the temperature can be limited using the Backup Mode Max Lag Power parameter.

9.D.5 Hybrid N/A

9.D.6 Pumps

The Pump Configuration Screen allows adjustment of the following 7 parameters:



- **Boiler Pump Control –** This parameter provides the ability to set the boiler pump functionality to be:
  - **Auto** – the pump will turn on automatically upon a call for heat.
  - **Always On** – the pump will run continuously.
  - **Off During DHW** – the pump will not turn on during a DHW heat demand.
  - **Auto/Off When Temp. Lim. Reach.** – the pump will automatically turn off when the water temperature set point has been achieved, turn off the pump after the pump over run time.

- **Boiler Pump Post Circulation –** This parameter is the amount of time the boiler/heater pump will continue to run after a heat demand has been satisfied or after a lock-out condition has occurred.

- **DHW Pump Control –** This parameter provides the ability to set the DHW pump functionality to be:
  Auto – the pump will turn on automatically upon a call for heat.
  Always On – the pump will run continuously.
  Disable – the pump will not turn on upon a DHW heat demand.

- **DHW Pump Post Circulation –** This parameter is the amount of time the DHW pump will continue to run after a heat demand has been satisfied or after a lock-out condition has occurred.

- **System Pump Control** – This parameter provides the ability to set the system pump functionality to be:
  Auto – the pump will turn on automatically upon a call for heat.
  Always On – the pump will run continuously, with or without a heat demand.
  Off During DHW – the pump will not turn on during a DHW heat demand.
  Disable – the pump will not turn on during a call for heat.

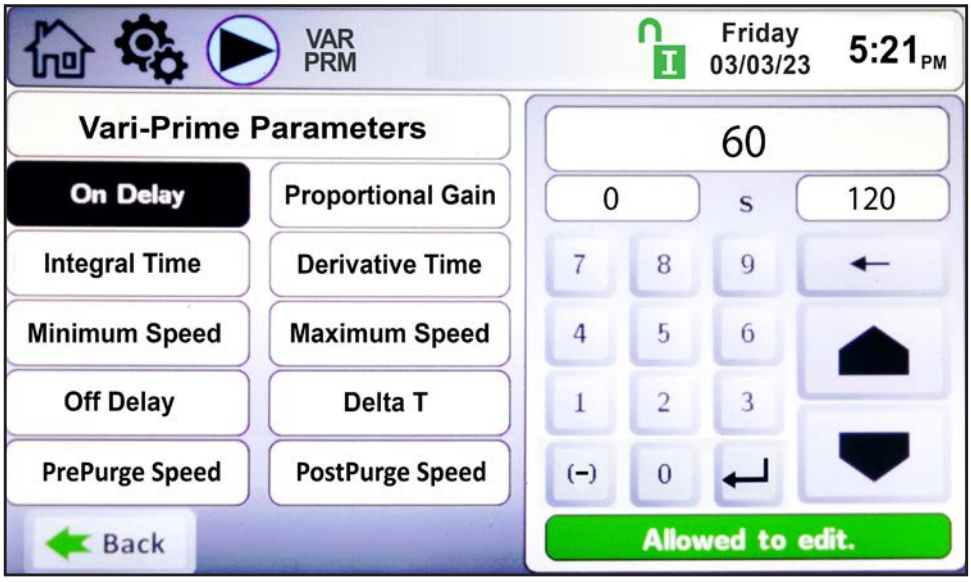
- **System Pump Post Circulation** – This parameter is the amount of time the System pump will continue to run after a heat demand has been satisfied or after a lock-out condition has occurred.

- **Vari-Prime** – Select Vari-Prime to get to the controls of the variable speed pump.
  Variable speed pump control is available only on hydronic units.

9.D.6.a VARI-PRIME®

Vari-Prime is the variable speed pump control and the Vari-Prime Screen allows the adjustment of the following parameters:

- **On Delay** – Upon a call for heat, once the unit ignites, this is the amount of time the unit will wait prior to modulating the pump speed.
- **Proportional Gain** – This value is the corrective action that is proportional to the error (Set Point – Control Temperature).
- **Integral Time** – This value is applied to the sum of the error over a period of time.
- **Derivative Time** – This value is applied to the rate of change of the error.
- **Minimum Speed** – This is the minimum speed to which Vari-Prime will control the pump.
- **Maximum Speed** – The is the maximum speed to which the Vari-Prime will control the pump.
- **Off Delay** – Once the heat demand is satisfied, Vari-Prime will control to the maximum pump speed until the Off Delay time expires.
- **Delta T** – Vari-Prime will control the pump to maintain this delta T (temperature rise) across the unit.
- **PrePurge Speed -** When using Vari-Prime, when there is an active heat demand but the burner is not yet lit, this parameter allows the adjustment of pump speed during this time.
- **PostPurge Speed** - When using Vari-Prime, when the boiler goes into post purge, this parameter allows the adjustment of pump speed during this time.



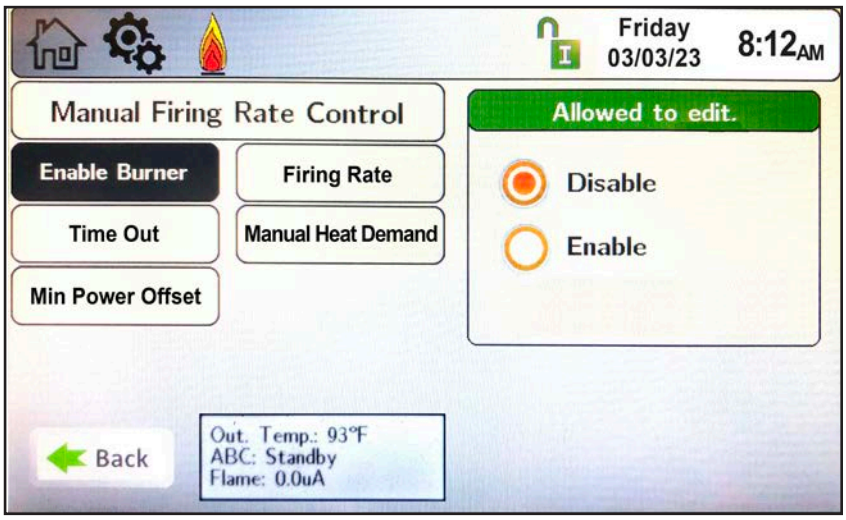
NOTE: VARI-PRIME® applies only to Boilers.

9.D.7 Manual Firing Rate

To navigate to the Manual Firing Rate Screen, touch the Manual Firing Rate Icon on the Configuration Screen.

The Manual Firing Rate Control Screen allows the adjustment of the following parameters:

- **Enable/Disable** – Enables and disables the manual firing rate functionality.
- **Firing Rate** – With the manual firing rate functionality enabled, an operator can manually set the firing rate. This functionality is used for combustion adjustment purposes. With the manual firing rate functionality enabled, and the desired firing rate set, apply a heat demand using the 'Manual Heat Demand' button on this screen.
- **Time Out** – is the setable amount of time that the operator has to adjust the Manual Firing Rate before the control will go back to automatic. It's a walkaway timer and safety feature.
- **Manual Heat Demand** - The 'Manual Heat Demand' button allows an installer to initiate a digital heat demand, eliminating the need for a physical heat demand. This digital heat demand is treated as a local heat demand only. This means that, in a cascade system, if the digital heat demand is applied at the lead boiler, the lead boiler will treat the digital heat demand as a local only heat demand.
- **Min Power Offset** - Allows an installer to increase the minimum firing rate. This minimum firing rate is also applied when running in cascade mode.

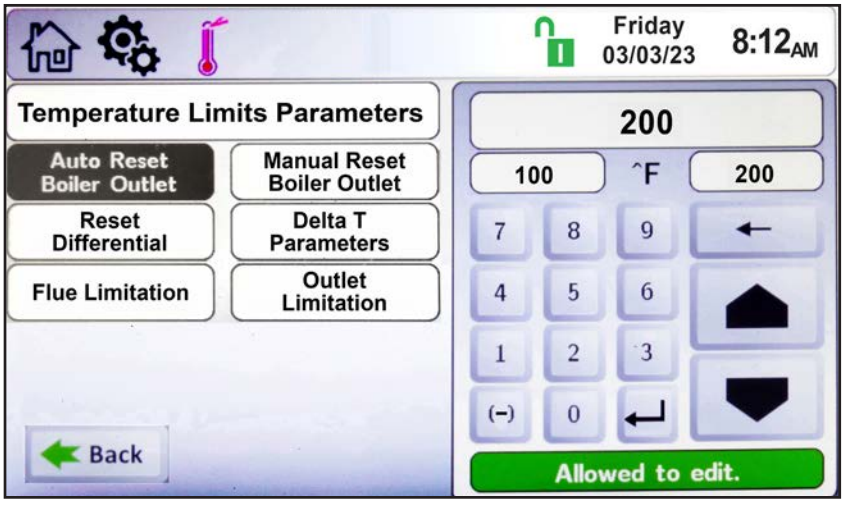


9.D.8 Temp Limits

To navigate to the Temp Limits Screen, touch the Temp Limits Icon on the Configuration Screen.

The Temp Limits Configuration Screen allows adjustment of the following parameters:

- **Auto Reset Boiler Outlet–** If the outlet temperature reaches this value, the unit will shut down. The control will automatically reset once the temperature drops below the auto reset boiler outlet set point minus the reset differential.
- **Manual Reset Boiler Outlet –** If the outlet temperature reaches this value, the unit will shut down. The control will require manual reset.
- **Reset Differential –** The value below the Auto Reset temperature at which the unit will automatically reset itself and resume functionality.
- **Delta T Parameters–** The MIN and MAX Temperature between which your system will modulate.
- **Flue Limitation –** Sets the flue temp limitations.
- **Outlet Limitation Parameters –** Allows for the adjustment of Min and Max Outlet Temps.

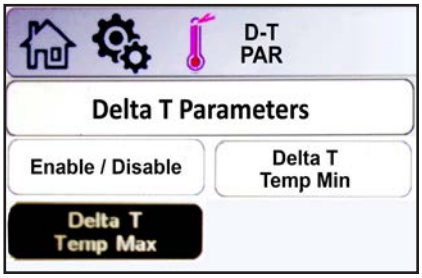


9.D.8.a Delta T Parameters

To navigate to the Delta T Parameters Screen, touch the Temp Limits Icon on the Configuration Screen, then touch the Delta T Parameters button on the Temperature Limits Parameters Screen.

The Delta T Parameters Screen allows adjustment of the following parameters:

- **Enable/Disable** – Enables/disables the Delta T temperature functionality.
- **Delta T Temp Max** – The temperature difference between the unit's inlet and outlet at which the boiler/heater will run at the minimum firing rate.
- **Delta T Temp Min** – The temperature difference between the unit's inlet and outlet at which the boiler/heater will begin to de-rate to prevent a Delta T shut down condition.

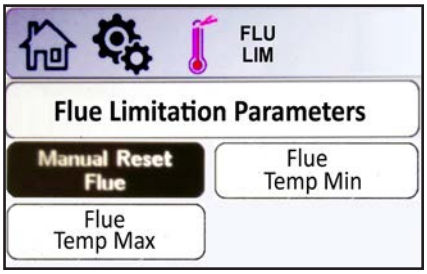


9.D.8.b Flue Limitation Parameters

To navigate to the Flue Limitation Parameters Screen, touch the Temp Limits Icon on the Configuration Screen, then touch the Flue Limitation button on the Temperature Limits Parameters Screen.

The Flue Limitation Parameters Screen allows adjustment of the following parameters:

- **Manual Reset Flue** – The temperature at which the unit will shut down due to exceeding a flue temperature manual reset condition.
- **Flue Temp MIN & Flue Temp Max-** The control will attempt to prevent the unit from reaching the Manual Reset Flue lockout condition by modulating the fan speed (and therefore, the input). Flue Temp Min is the temperature setting at which the unit will begin to de-rate the input. It de-rates linearly until it hits the Flue Temp Max setting, where the fan is at minimum speed.

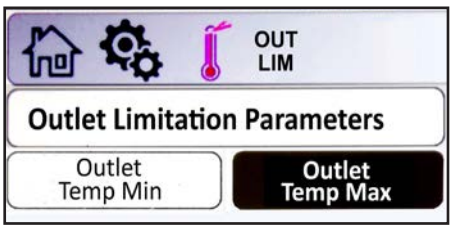


9.D.8.c Outlet Limitation Parameters

To navigate to the Outlet Limitation Parameters Screen, touch the Temp Limits Icon on the Configuration Screen, then touch the Outlet Limitation button on the Temperature Limits Parameters Screen.

The Outlet Limitation Parameters Screen allows adjustment of the following parameters:

- **Outlet Temp Min** – The outlet temperature at which the boiler/heater will begin to de-rate, in an attempt to prevent a manual reset high temperature outlet shut down condition.
- **Outlet Temp Max** – The outlet temperature at which the boiler/heater will run at the minimum firing rate.



9.D.9 External

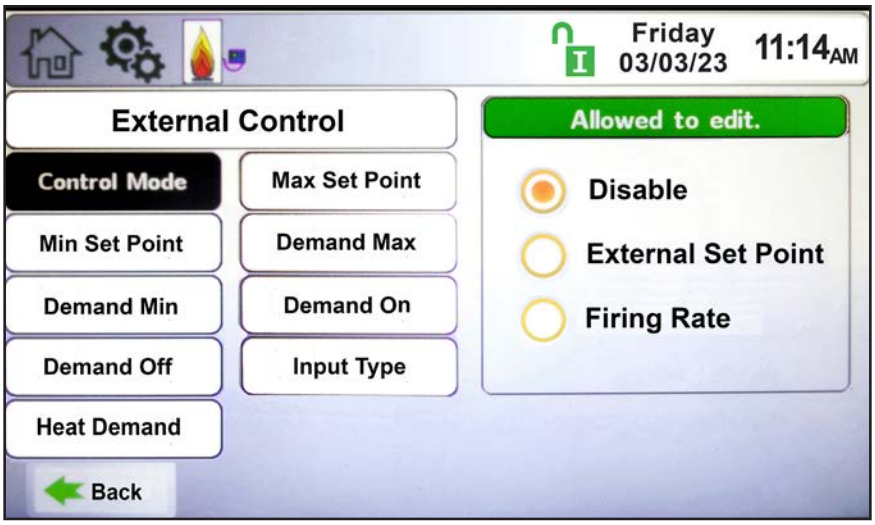
The External Configuration Screen applies to the 0-10VDC (4-20mA) analog input BAS signal, and allows adjustment of the following parameters:

To navigate to the External Configuration Screen, touch the External Icon on the Configuration Screen.

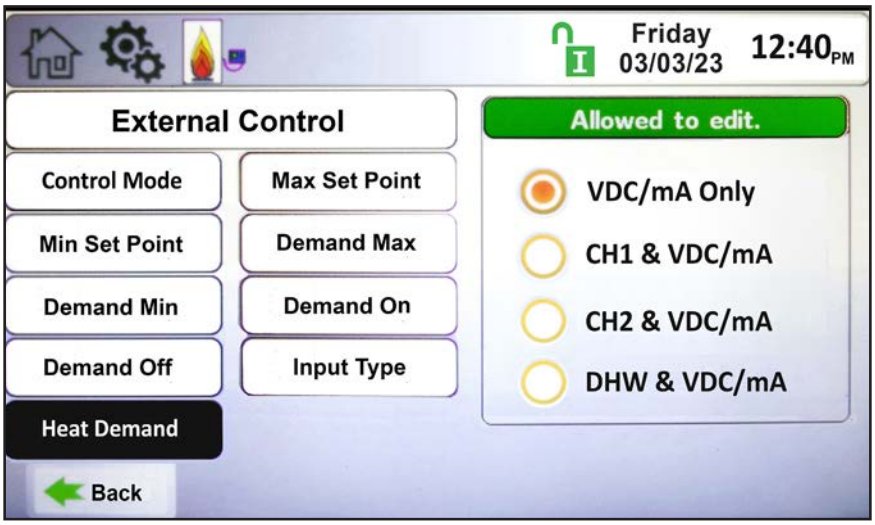
- **Control Mode –** This parameter provides the ability to either disable external control or configure the unit for Boiler Set Point or Firing Rate control mode.
- **Max Set Point –** When the Control Mode is set to External Set Point, this is the maximum value that corresponds to the Demand Max value.
- **Min Set Point –** When the Control Mode is set to External Set Point, this is the minimum value that corresponds to the Demand Min value.
- **Demand Max –** This is the maximum value that corresponds to the control mode selected. With Firing Rate control mode selected, this is the maximum rate at which the boiler/heater will run. The unit of this parameter is %, so if the value of this parameter is 10000, or 100.00%, this equates to 10.0VDC or 20mA.
- **Demand Min –** This is the minimum value that corresponds to the control mode selected. With Firing Rate control mode selected, this is the minimum rate at which the boiler/heater will run. The unit of this parameter is %, so if the value of this parameter is 2000, or 20.00%, this equates to 2.0VDC or 4.8mA.

  NOTE: An external demand applied to the Lead boiler in a cascaded system will be treated as a local or stand alone heat demand and not trigger the cascade heat demand.

NOTE: If an external heat demand option is chosen, the 'Demand On' and 'Demand Off' buttons will be grayed out.



- **Demand On –** This is the threshold (VDC/mA) at which the input signal will initiate the selected control mode behavior. The unit of this parameter is %, so if the value of this parameter is 1500, or 15.00%, this equates to 1.5VDC or 4.6mA.
- **Demand Off –** This is the threshold (VDC/mA) at which the input signal will deactivate the selected control mode behavior. The unit of this parameter is %, so if the value of this parameter is 1000, or 10.00%, this equates to 1.0VDC or 4.4mA.
- **Input Type –** This parameter allows the user to select between voltage (0-10VDC) or current (4-20mA) input. Jumpers will need to be configured accordingly.
- **Heat Demand -** Allows an installer to use the VDC/mA signal as the heat demand signal as well as the external firing rate/set point signal OR to use an external heat demand (CH1/DHW1, CH2/DHW2, DHW/DHW3) as the heat demand while the VDC/mA only provides the external firing rate/set point signal.



9.D.9.a External – Remote Set Point

External (0 – 10VDC or 4 – 20mA)

- An External heat demand can be initiated by a Building Automation System (BAS) using a 0-10VDC or 4-20mA signal. This input can be configured for Remote Set Point or Remote Firing Rate operations.
- With Remote Set Point selected, the unit will initiate a heat demand once the analog input signal exceeds the Demand On value. Once the demand is initiated, the analog input signal must be lower than Demand Off to remove the heat demand. With an active demand, the unit will locate the set point according to the analog input signal.
- Using the default values for Boiler Max Set Point (180°F), Boiler Min Set Point (140°F), Demand Minimum (2.5VDC), Demand Maximum (10.0VDC), the unit will linearize the set point, as shown in **Figure 46**.

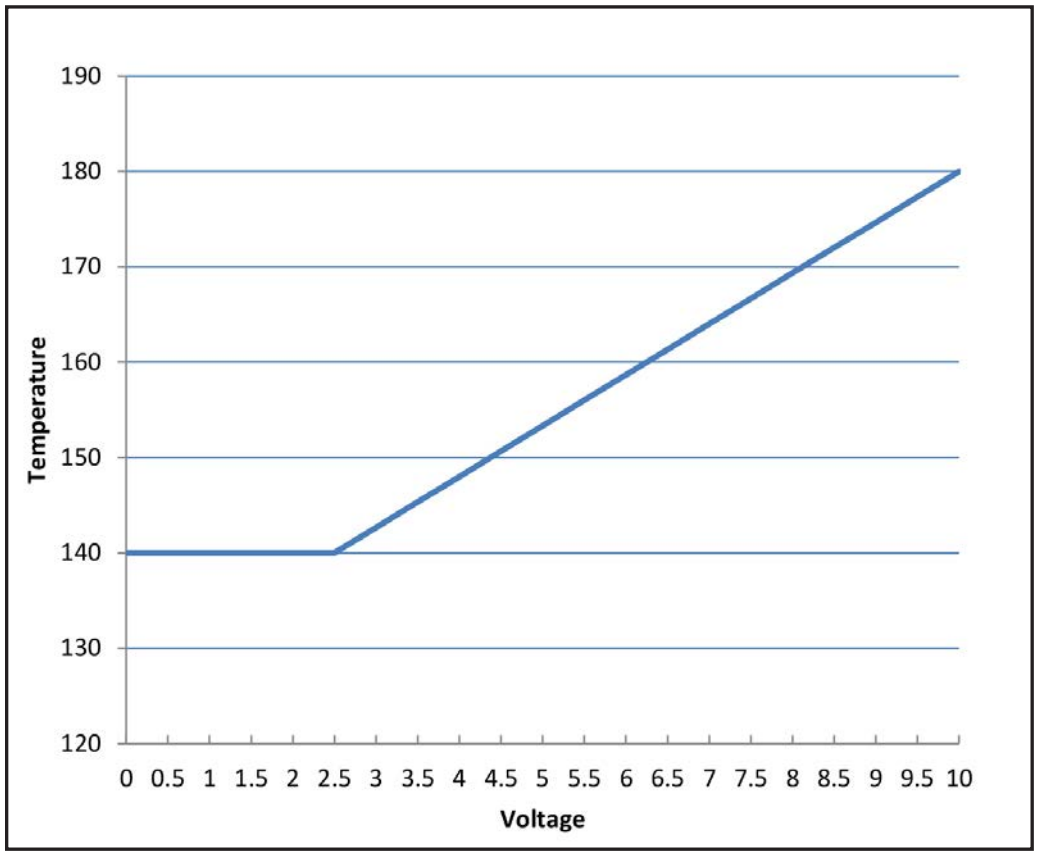


Figure 46. External Set Point Example

9.D.9.b External Firing Rate

With External Firing Rate selected, the unit will initiate a heat demand once the analog input signal exceeds the Demand On value. Once the demand is initiated, the analog input signal must be lower than Demand Off to remove the heat demand. The external analog signal will activate stages as shown in **Figure 47**. In this control mode, if the unit outlet temperature exceeds the Auto Reset High Limit setting, the boiler will shut down and an "Auto Reset High Limit" condition will appear on the Messages screen. Once the outlet temperature decreases below the value of (Auto Reset High Limit – Reset Differential), the boiler will turn back on at the firing rate set by the analog input signal.

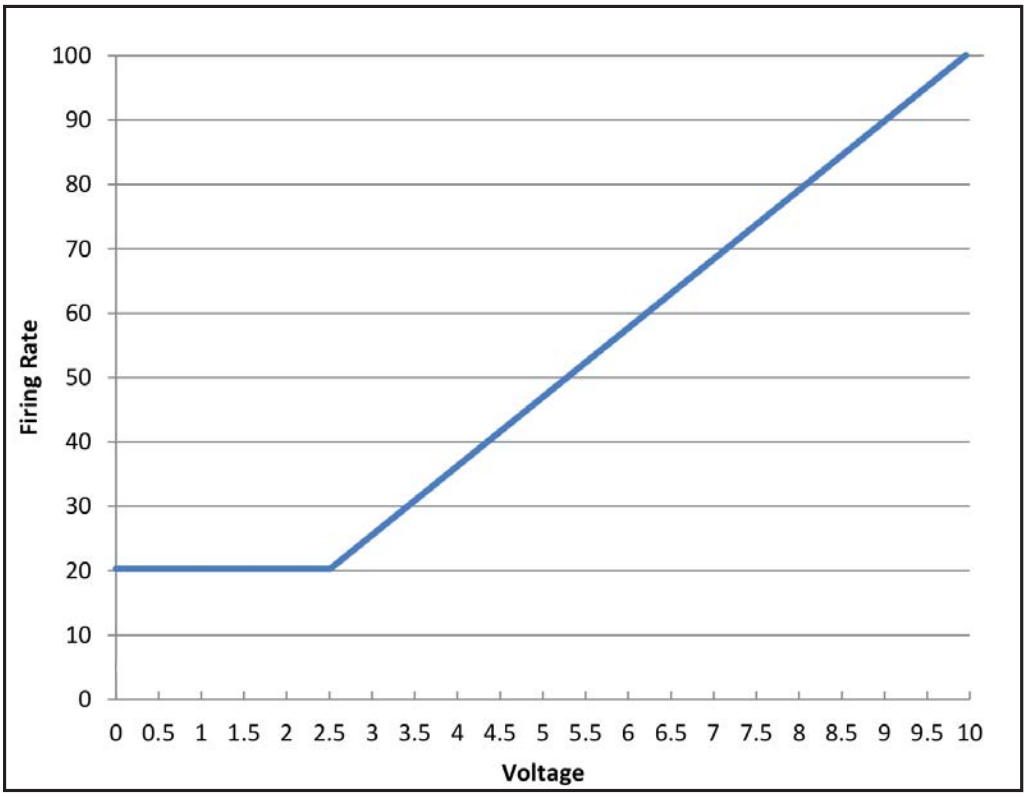


Figure 47. External Firing Rate Example

9.D.10 Time & Date

To navigate to the Time & Date Quick Start Screen, touch the Time and Date area of ANY Screen.

NOTE: The Time is set in a 24 hour parameter but displays only as a 12 hour clock with the AM / PM automatically added.

The Time & Date Quick Start Screen allows adjustment of the following parameters:

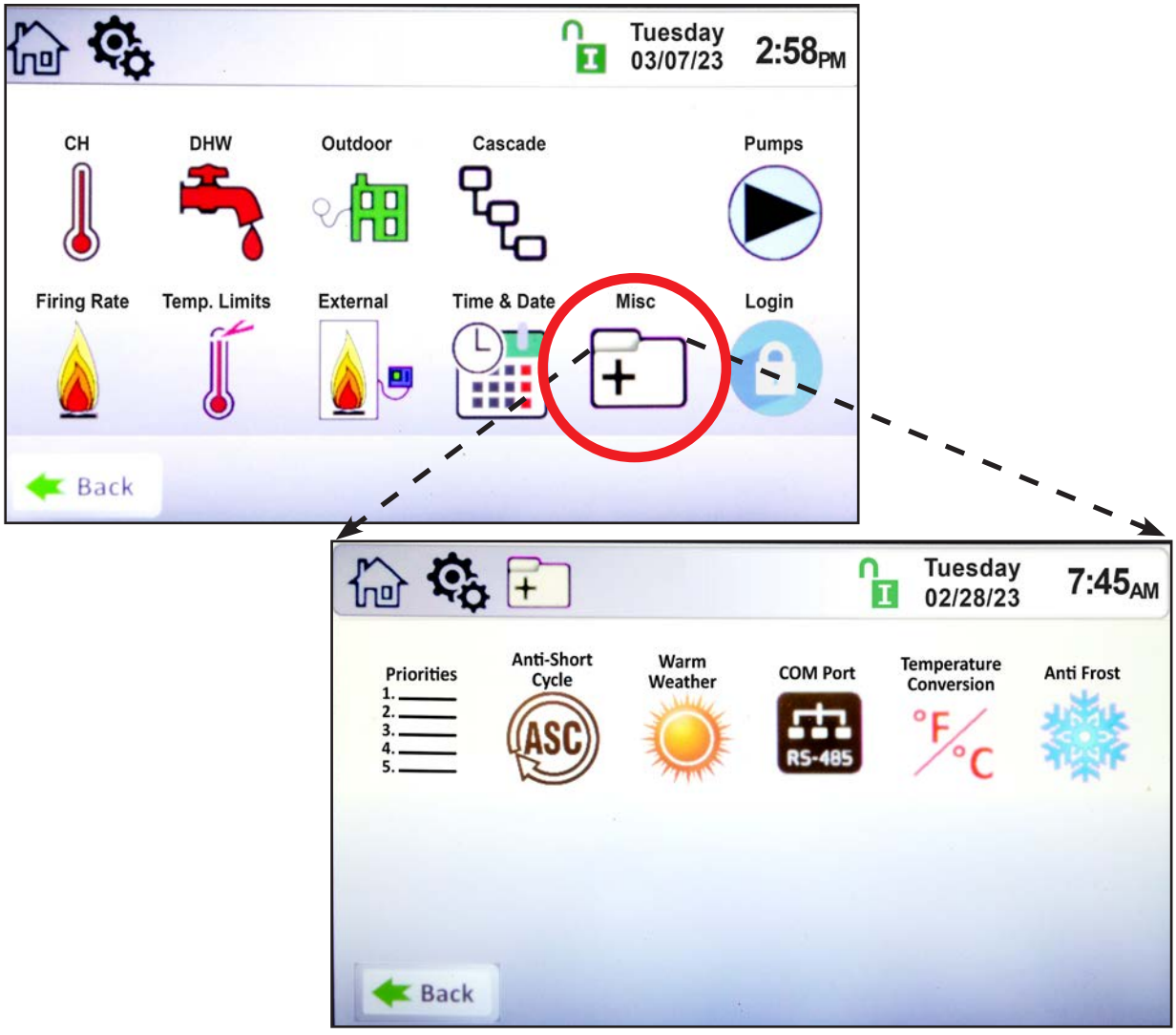
- **Hour**
- **Minute**
- **Month**
- **Day**
- **Year**

9.D.11 Miscellaneous Features

To navigate to the Miscellaneous Features Screen, touch the Miscellaneous Features Icon on the Configuration Screen.

The Miscellaneous Features screen provides navigation to the following items:

- **Priorities –** To set the Demand Priorities for all configured CHW or DHW heating demands. The higher the number, the higher the priority it is assigned.
- **Anti-Short Cycle –** To navigate to the Anti-Short Cycle Configuration Screen.
- **Warm Weather –** To navigate to the Warm Weather Configuration Screen.
- **COM Port –** To navigate to the Communication Port (Modbus / BACnet MSTP) Configuration Screen.
- **Temperature Conversion –** To navigate to the Temperature Conversion Configuration Screen.
- **Anti-Frost –** To navigate to the Anti-Frost Configuration Screen.

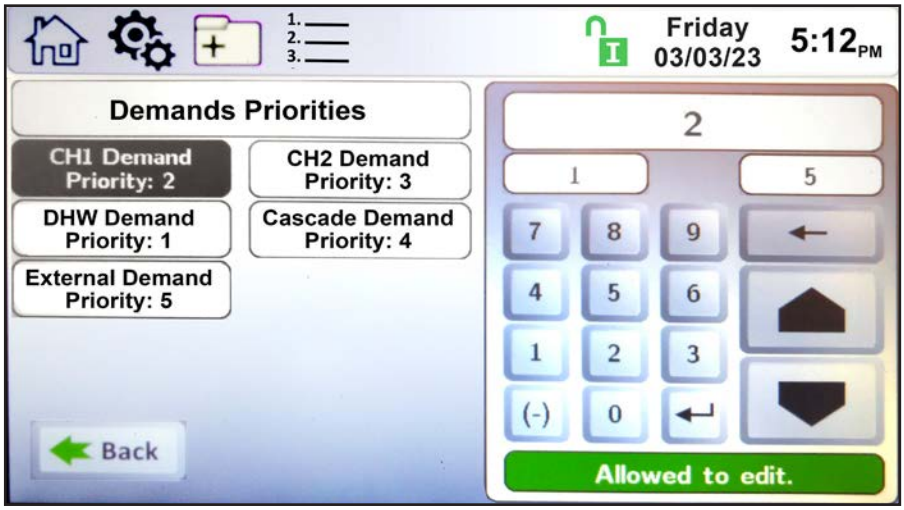


9.D.11.a Demands Priorities

To navigate to the Demands Priorities Screen, first go to the Miscellaneous folder.

At the Demands Priorities screen select each configured demand and assign a priority number. The higher the number, the higher the priority that demand is assigned.

NOTE: Demands Priorities is only active on the lag or stand alone boilers.



Remember to always save the new setting with the button.

9.D.11.b Anti-Short Cycle

To navigate to the Anti-Short Cycle Configuration Screen, touch the Miscellaneous Features Icon on the Configuration Screen, then touch the Anti-Short Cycle Icon on the Miscellaneous Features screen.

The Anti-Short Cycle Configuration Screen allows adjustment of the following parameter:

- **Cycle Time –** The amount of time after a heat demand is satisfied that the unit will wait to initiate the next active heat demand.

NOTE: Anti-Short Cycle Time does not apply to DHW heat demands.



Remember to always save the new setting with the button.

9.D.11.c Warm Weather Shutdown

To navigate to the Warm Weather Shutdown Configuration Screen, touch the Miscellaneous Features on the Configuration Screen, then touch the Warm Weather Icon on the Miscellaneous Features screen. The Warm Weather Configuration Screen allows adjustment of the following parameters:

- **Temp Min –** Upon an active warm weather shutdown condition, this is the temperature at which the unit will reset the shutdown condition to satisfy a heat demand.
- **Temp Max –** This is the temperature at which the warm weather shutdown condition will occur.
- **Feature Options –** This parameter provides the ability to either disable warm weather shutdown or upon a warm weather condition, configure the unit to shut down immediately or to shut down after the current heat demand is satisfied.
- **Summer Kick CH –** The amount of time the unit pump is energized if it hasn't cycled for an extended period of time.
- **Summer Kick DHW –** The amount of time the DHW pump is energized if it hasn't cycled for an extended period of time.
- **Summer Kick SYS –** The amount of time the SYS pump is energized if it hasn't cycled for an extended period of time.
- **Summer Kick Period –** The duration of time between heat demands that the boiler will wait before exercising the boiler, DHW, and system pumps.

There are three options for Warm Weather Shutdown (WWSD). WWSD is only applicable to boilers. It is not mandatory, so it can be enabled/disabled on the WWSD configuration screen.

1 - WWSD - Shutdown Immediately

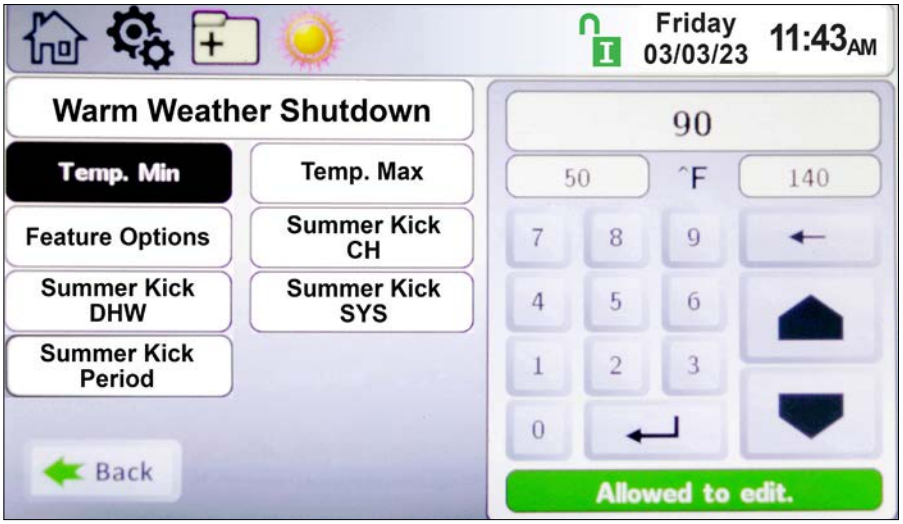
When the outdoor sensor measures an outdoor air temperature that exceeds the WWSD set point, one of the following two conditions will occur. If the unit is idle, upon a call for heat, the unit will not turn on to satisfy a heat demand. If the unit is running to satisfy a call for heat, the unit will immediately shutdown. In either case, the WWSD icon will appear on the home screen.

2 - WWSD – Shutdown After Demand is Satisfied

When the outdoor sensor measures an outdoor air temperature that exceeds the WWSD set point, one of the following two conditions will occur. If the unit is idle, upon a call for heat, the unit will not turn on to satisfy a heat demand, and the WWSD icon will be shown on the home screen. If the unit is running to satisfy a call for heat, the unit will satisfy the heat demand and then the WWSD shutdown icon will appear. As long as the unit is in a WWSD condition, no additional heat demands will be satisfied.

3 - WWSD – Disabled

Control ignores any WWSD set points, and operates normally.



9.D.11.d COM Port, BMS

The control has Modbus and BACnet MSTP (RS485) protocols on board, for use with Building Management Systems. Gateways can be used for other communication protocols.

To navigate to the COM Port Configuration Screen, touch the Misc Icon on the Configuration Screen, then touch the COM Port Icon on the Misc Configuration Screen. The COM Port Configuration Screen allows adjustment of the following parameters:

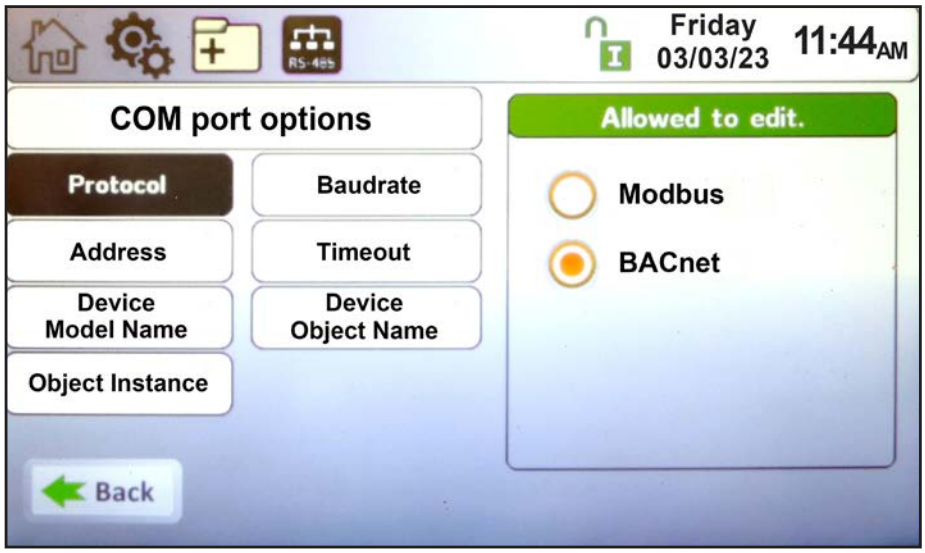
With Modbus protocol selected, the following parameters are adjustable on this screen:

- **Baudrate –** Modbus can be configured for the following standard baudrates: 9600, 19200, 38400, and 57600.
- **Address –** The address of the unit on the Modbus network.
- **Timeout –** Upon loss of communication, this is the duration of time in which the unit will wait prior to timeout conditions occurring.

With BACnet protocol selected, the following parameters are adjustable on this screen:

- **Baudrate –** BACnet can be configured for the following standard baudrates: 9600, 19200, 38400, and 76800.
- **Address –** The address of the unit on the BACnet network.
- **Timeout –** Upon loss of communication, this is the duration of time in which the unit will wait prior to timeout conditions occurring.
- **Device Model Name –** The name of the unit Model on the BACnet network.
- **Device Object Name –** The name of the unit Object on the BACnet network.
- **Object Instance –** The object number of the unit on the BACnet network.

NOTE: Changing the protocol requires a power cycle of the unit for the change to take effect.



9.D.11.e Temperature Conversion

To navigate to the Temperature Conversion Configuration Screen, touch the ***Temperature Conversion*** Icon on the Miscellaneous Features screen.

The Temperature Conversion Configuration Screen allows adjustment of the following parameter:

- **Conversion unit –** This parameter can be set to Fahrenheit or Celsius.

9.D.11.f Anti-Frost

To navigate to the Anti-Frost Configuration Screen, touch the Miscellaneous Features Icon on the Configuration Screen, then touch the Anti-Frost Icon on the Miscellaneous Features screen.

The Anti-Frost Configuration Screen allows adjustment of the following parameters:

- **Anti-Frost –** This parameter provides the ability to either disable anti-frost or upon an anti-frost condition, configure the unit to only turn on the pump or to turn on the pump and fire the burner.
- **Set Point –** The unit will enter anti-frost mode when the unit's inlet sensor reads the set point minus the hysteresis value. It will leave anti-frost mode at the set point plus the hysteresis value.
- **Hysteresis –** This parameter is a +/- offset of the Anti-Frost Set Point used to turn on/off the Anti-Frost mode.
- **Pump Control –** This parameter provides the ability to select which pump(s) are used in Anti-Frost Mode.

The Set Point parameter is the temperature at the boiler inlet sensor to which the boiler/heater will apply the Hysteresis value to enable the Anti-Frost mode.

For example, if the Set Point is 44°F, and the Hysteresis is 4, Anti-Frost will initiate at 40°F (set point – hysteresis) and then will end at 48°F (set point + hysteresis). If Pump Only or Pump and Burner mode is selected, the Pump Control parameter allows configuration of which pump(s) will run during an anti-frost condition. At least one pump must be selected, but all three pumps (unit, DHW, or System) can be selected. If Anti-Frost mode is active, a snow flake icon will appear above the unit inlet temperature on the home screen. As shown in Figure 48

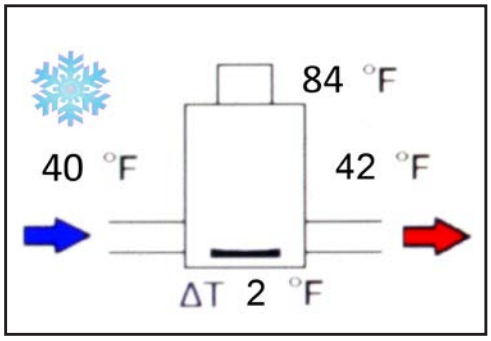
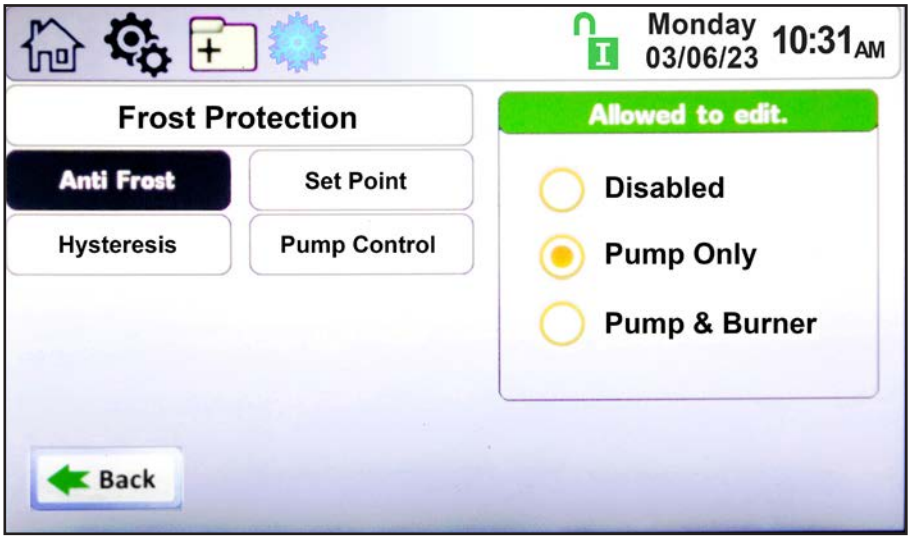


Figure 48. Active Anti Frost Condition



9.D.12 Login

To navigate to the Login Screen, touch the Lock Icon on ANY screen.

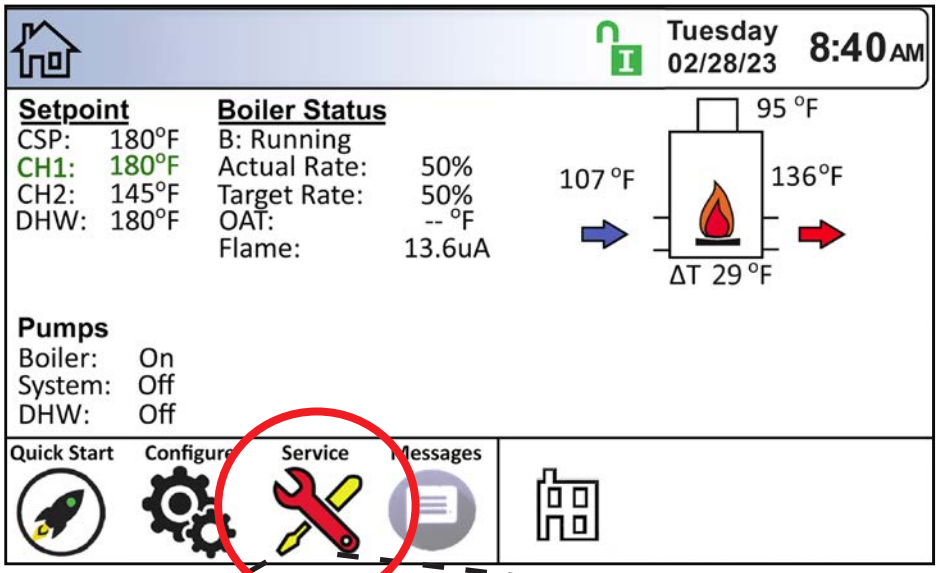
The Login Screen allows the operator to make parameter adjustments based on the level of the login credentials.

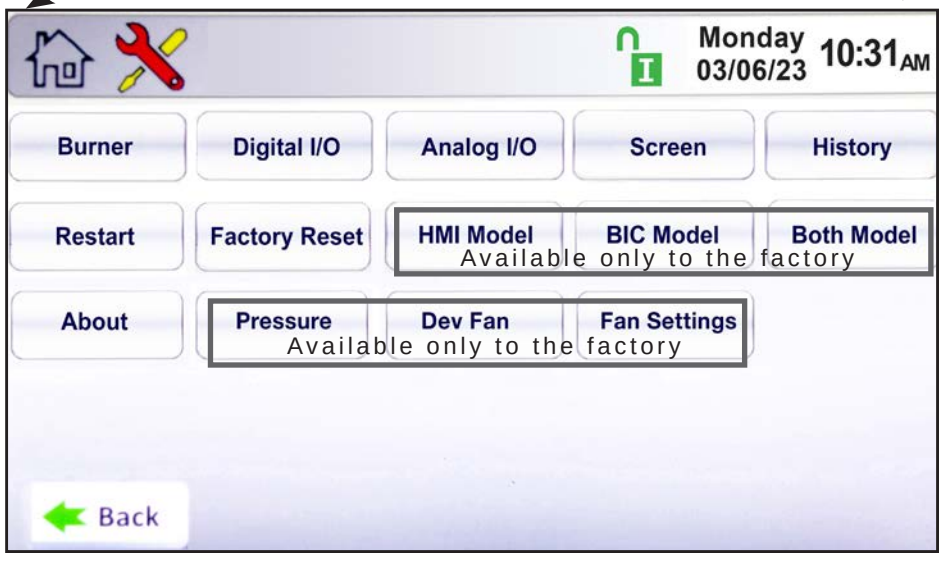
See Section 9.B on page 56



9.E Service Screens

To navigate to the Service Screen, touch the Service Icon in the lower left portion of the Home Screen.



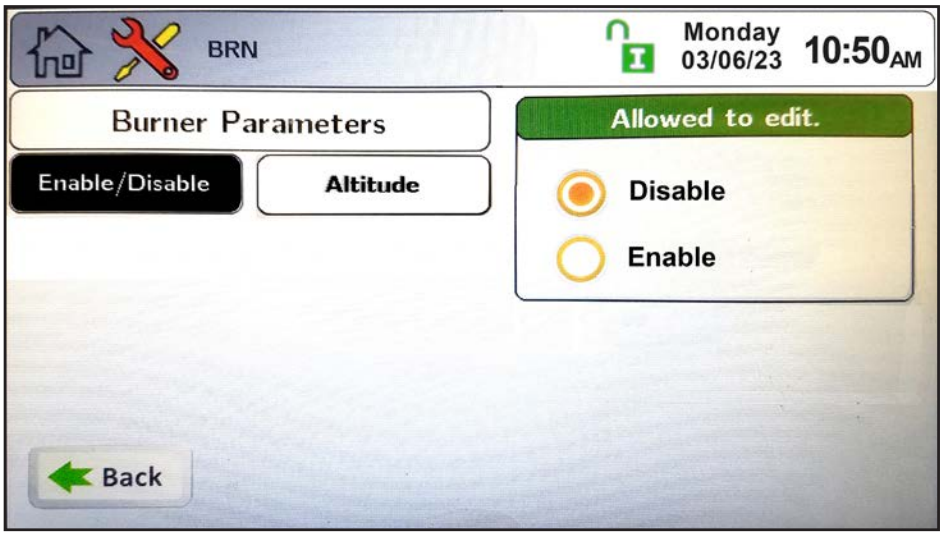


9.E.1 Burner

Navigate to the Burner Screen by touching the Burner Button on the Service Screen.

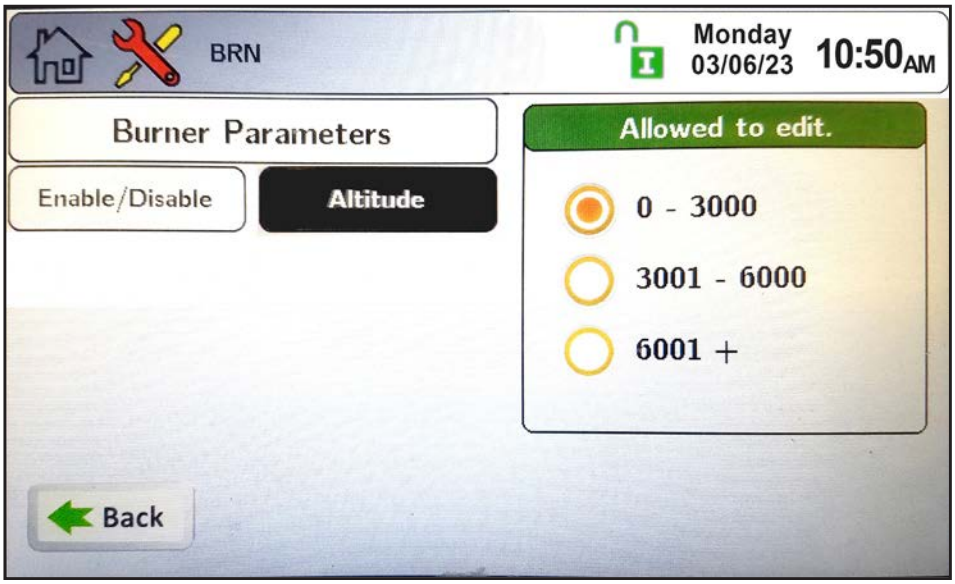
9.E.1.a Enable / Disable

At this menu, you can enable or disable the burner.



9.E.1.b Altitude Adjustment

Before starting the unit, verify that the unit's control is setup for the correct altitude.



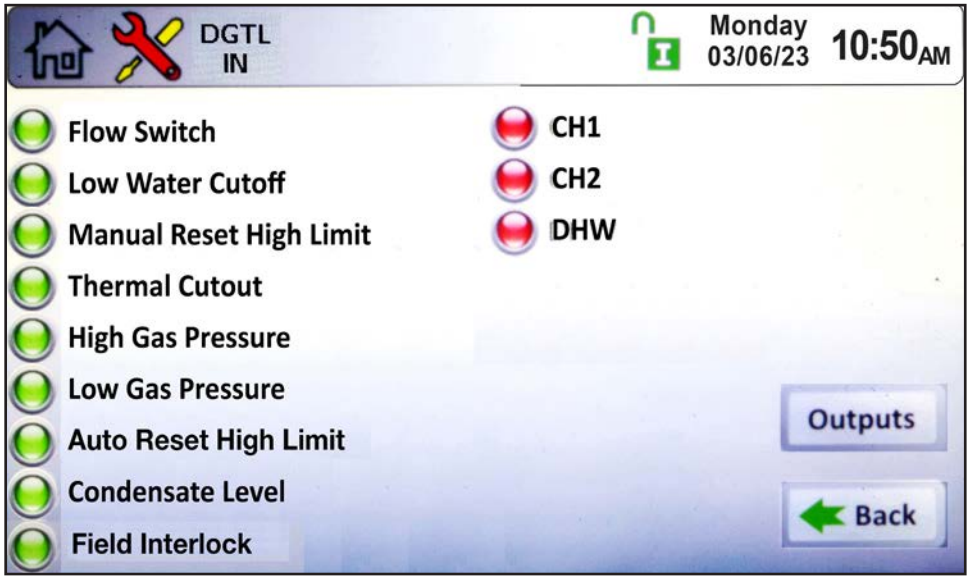
9.E.2 Digital I/O (Input / Output)

There are two screen associated with the Digital I/O: Digital I/O Screen-Inputs; Digital I/O Screen-Outputs.

Navigate to the Digital I/O Screen by touching the Digital I/O Button on the Service Screen.

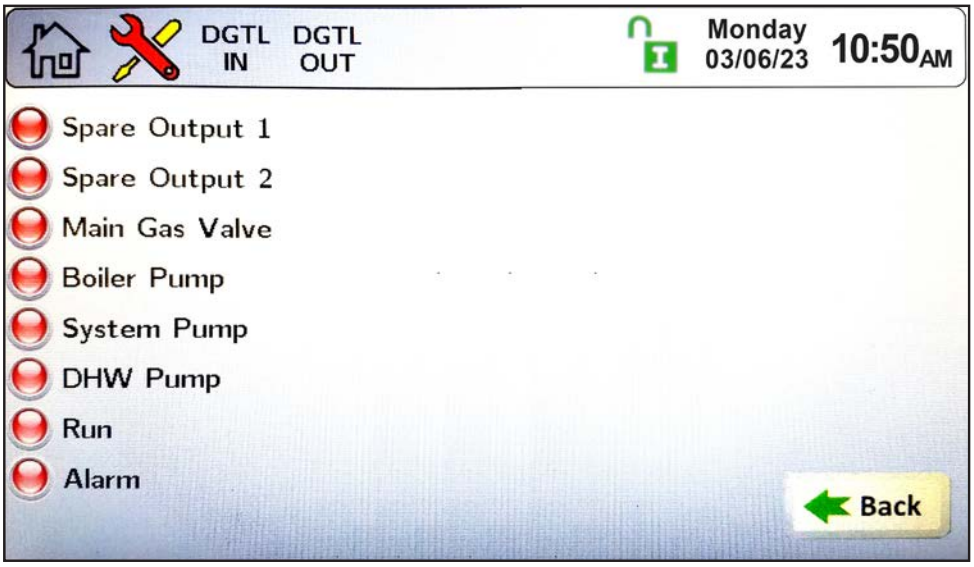
Digital I/O Inputs: The indicator light associated with the input is green when the input is satisfied. For example, if there is adequate flow, the flow switch is satisfied, and the flow switch digital input indicator light is green. The indicator light associated with the input is red, when the input is not satisfied. For example, if the blower is off, the air proving switch is not satisfied and the air proving switch digital input indicator light is red.

Inputs



Digital I/O Outputs: The output is on, the indicator light associated with that output is green. For example, if the boiler pump is running, the boiler pump output indicator light is green. If the output is off, the indicator light associated with that output is red. For example, if there is no call for heat, the gas valves are off, and the gas valve indicator lights are red.

Outputs



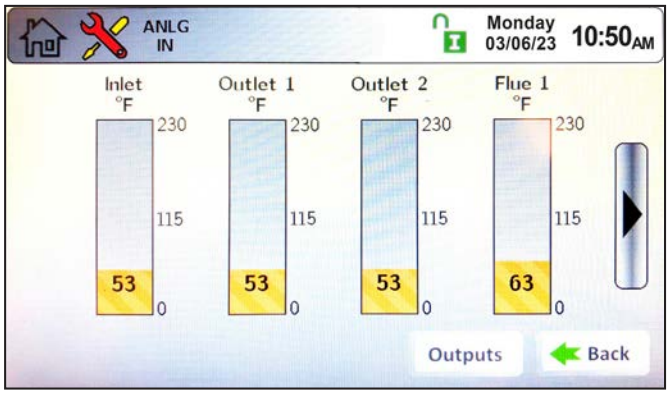
9.E.3 Analog I/O

Navigate to the Analog I/O Screen by touching the Analog I/O Button on the Service Screen.

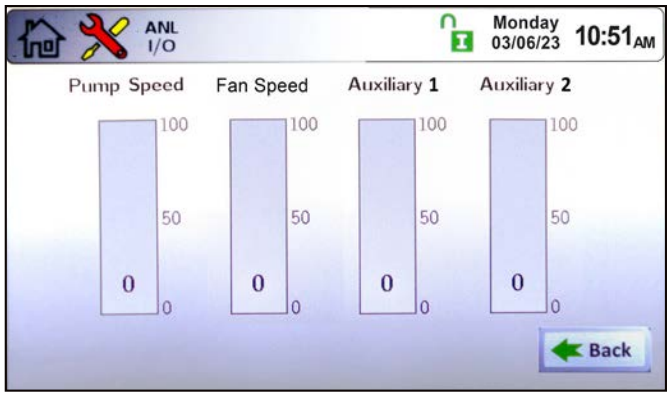
There are two screens associated with the Analog I/O: Analog I/O Inputs; Analog I/O Outputs.

Analog I/O Input: There are three types of analog inputs; temperature sensors, flame signal, and voltage/current (VDC/mA). Wiring of these inputs are covered in SECTION 8

NOTE: If the input is not attached, the value will be zero.



Inputs



Outputs

9.E.4 Screen Settings Timeout

Navigate to Screen Settings by touching the Screen Button on the Service Screen.

There are two adjustable screen settings: Light Timeout and AutoLock Timeout.

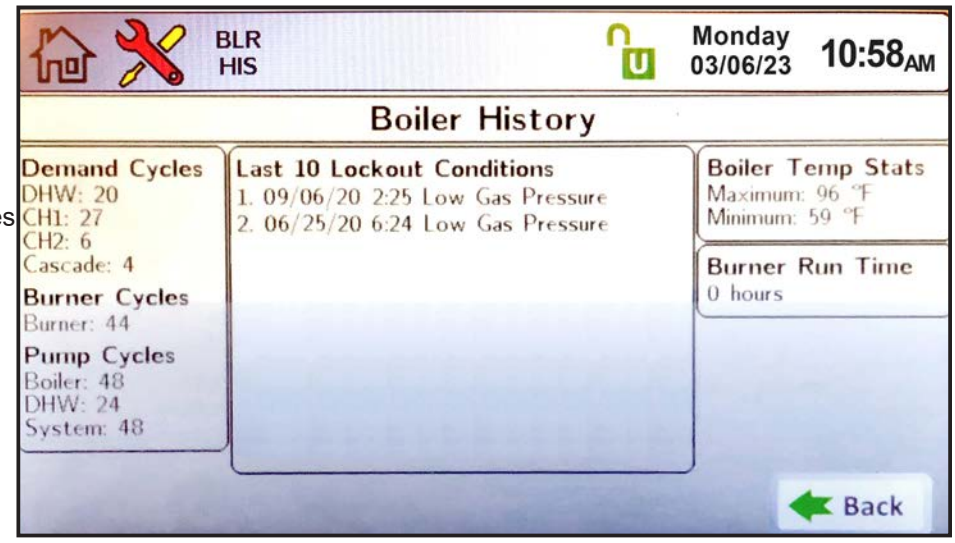
- Light Timeout allows the user to adjust the amount of time the touch screen backlight will remain lit after user interaction has ceased.
- AutoLock Timeout allows the user to adjust the amount of time the touch screen will remain unlocked with no user interaction.



9.E.5 History

Navigate to the History Screen by touching the History Button on the Service Screen.

The History Screen provides information on boiler operations and cycle counts. The control accumulates and displays the number of heat demand cycles, burner cycles, and pump cycles. It displays the 10 most recent lock-out conditions, unit temperatures, and firing statistics.

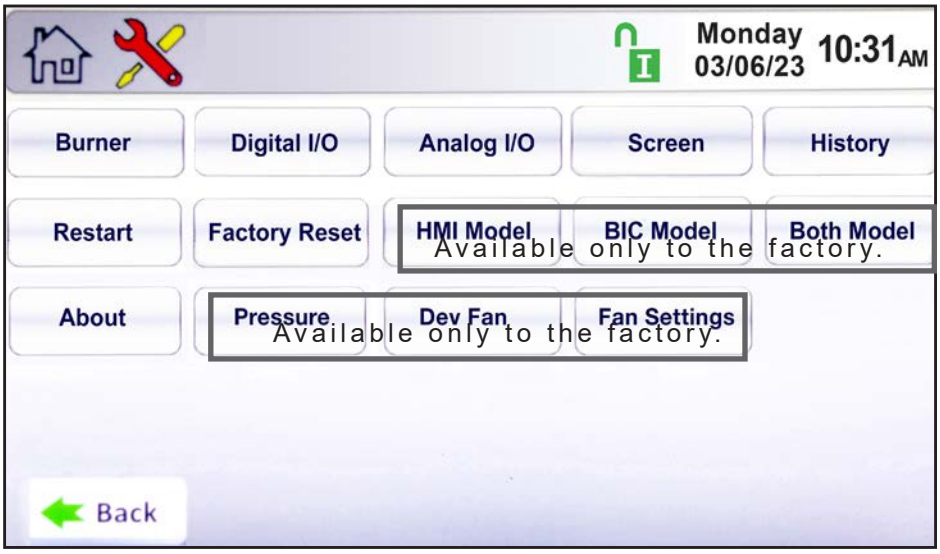


9.E.6 Restart Touchscreen & Recalibrate

Touching the Restart Button on the Service Screen reboots the display. If the touchscreen seems to be out of alignment, it can be recalibrated by pressing the Restart Button, promptly touching (and holding) the touch screen. Follow the calibration procedure as shown on the touch screen.

9.E.7 Factory Reset

Touching the Factory Reset Button on the Service Screen resets all touch screen adjustable parameters back to the factory default setting.



9.E.8 HMI Model OEM only.

9.E.9 BIC Model OEM only

9.E.10 Both Model OEM only.

9.E.11 About About the Firmware version of the touchscreen.

9.E.12 Pressure OEM only.

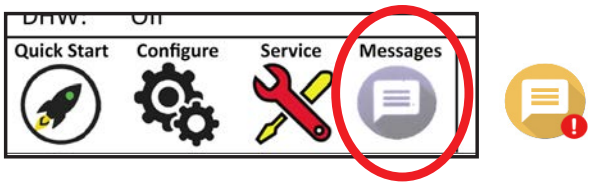
9.E.13 Dev Fan OEM only.

9.E.14 Fan Settings OEM only.

9.F Messages and USB

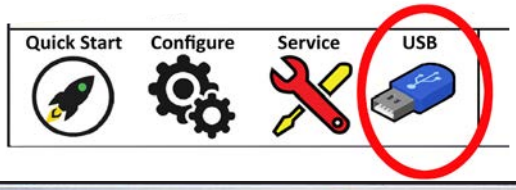
9.F.1 Messages

The ‘Messages’ icon at the bottom of the home screen displays an ‘Exclamation Point’ when messages are present. Press the icon to see the message(s).



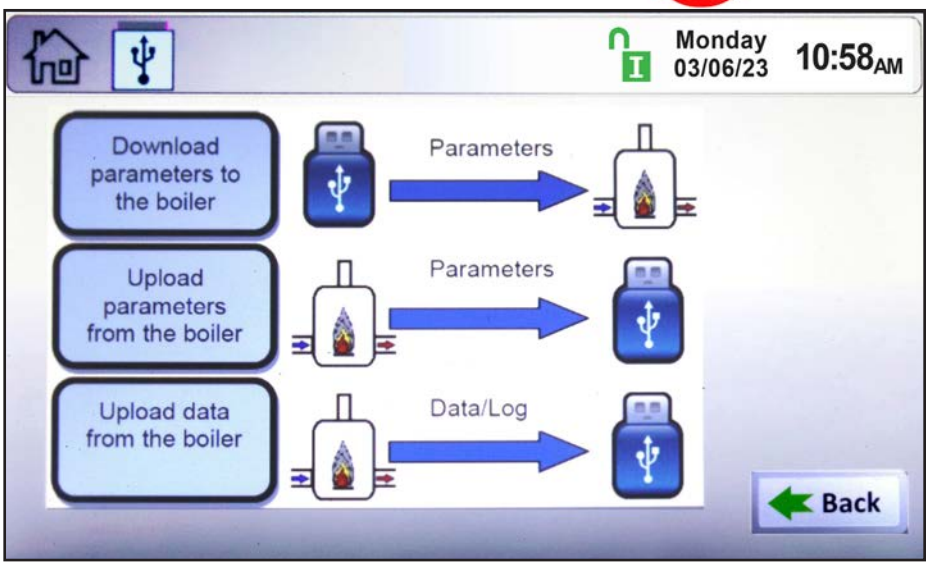
9.F.2 USB Functionality

The USB port is on the back of the display. To access it, unscrew the 4 screws on the display panel and look for the USB slot on the back of the display. See Figure 49.



When the USB icon has appeared over the Message icon, press the USB icon to access the USB menu. The following three tasks will be available:

- **Download Parameters from the boiler:** During a cascade setup or a control replacement, enter the values in one unit, to copy into the others.
- **Upload Parameters from the boiler:** Uploads all parameters and settings into a thumb drive for documentation purposes, or copies these settings from unit to unit.
- **Upload Data from the boiler:** This is used to retrieve runtime data, and history. It captures all settings in a tab delimited text file, for use with spreadsheet programs.



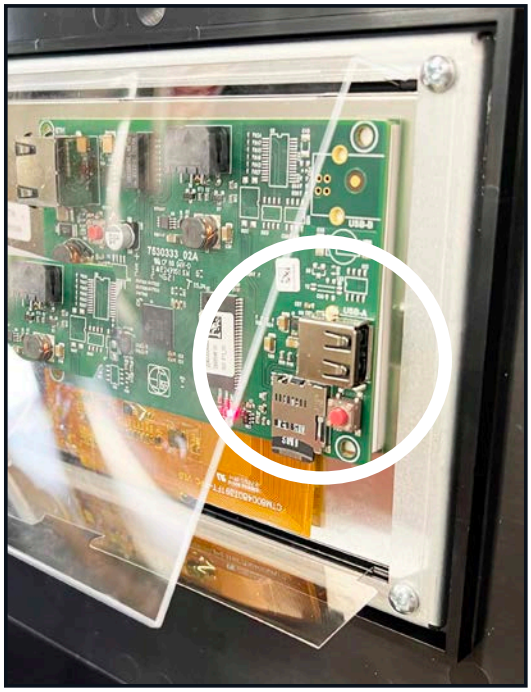
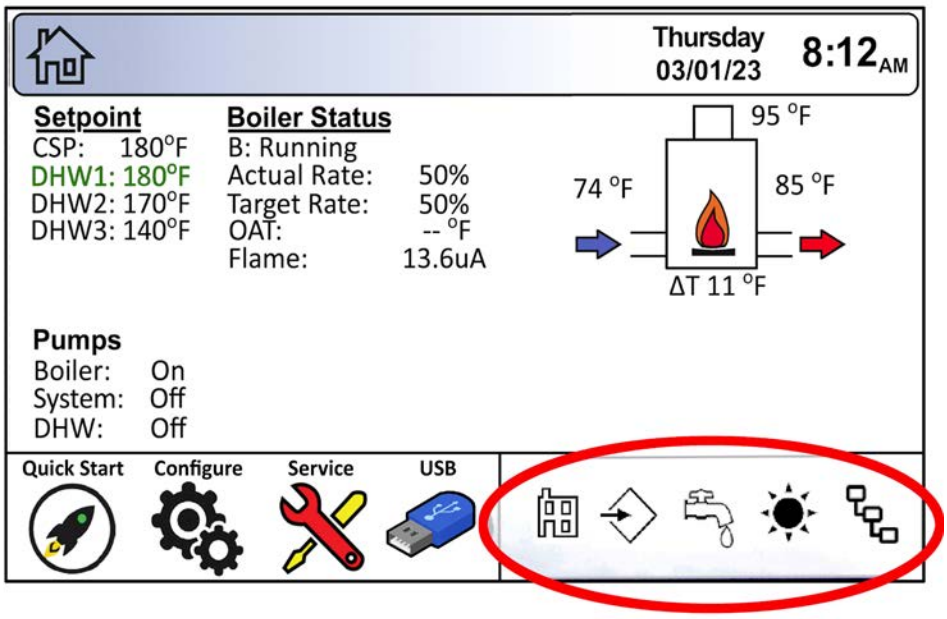


Figure 49. Photo of USB Slot on the back of touchscreen display.

9.G Active Demands

The Active Demand Window indicates the status of active heat demands.



A black heat demand icon indicates the heat demand that is currently being satisfied. A "grayed out" heat demand icon is either lower in priority than the heat demand that is currently being satisfied, or the heat demand has reached set point, but remains active.

Icon	Demand
	CH1/2 or DHW1/2
	DHW or DHW3
	External
	Warm Weather Shutdown **NOTE:** Warm Weather Shutdown is not a heat demand. This icon indicates that a space heating demand is disabled due to high outdoor ambient temperature.
	Cascade

Table 25. Demand Examples

SECTION 10 Parameter Tables 10.A Boilers

399-1500 Hydronic	User	Installer	OEM	Minimum	Maximum	Default
Time & Date						
Hour	x	x	x	NA	NA	NA
Minute	x	x	x	NA	NA	NA
Month	x	x	x	NA	NA	NA
Day	x	x	x	NA	NA	NA
Year	x	x	x	NA	NA	NA
CH1						
CH1 Enable/Disable		x	x	Disable	Enable	Enable
CH1 Setpoint	x	x	x	40 F	190 F	180 F
CH1 On Hysteresis		x	x	0 F	20 F	10 F
CH1 Off Hysteresis		x	x	0 F	20 F	10 F
CH1 PID Low - Proportional Gain		x	x	0	10	5
CH1 PID Low - Integral Time		x	x	0	10	2
CH1 PID Low - Derivative Time		x	x	0	10	0
CH1 PID High - Proportional Gain		x	x	0	10	7
CH1 PID High - Integral Time		x	x	0	10	7
CH1 PID High - Derivative Time		x	x	0	10	0
CH1 Max Power		x	x	10	100	100
CH2						
CH2 Enable/Disable		x	x	Disable	Enable	Enable
CH2 Setpoint	x	x	x	40 F	190 F	170 F
CH2 On Hysteresis		x	x	0 F	20 F	10 F
CH2 Off Hysteresis		x	x	0 F	20 F	10 F
CH2 PID Low - Proportional Gain		x	x	0	10	5
CH2 PID Low - Integral Time		x	x	0	10	2
CH2 PID Low - Derivative Time		x	x	0	10	0
CH2 PID High - Proportional Gain		x	x	0	10	7
CH2 PID High - Integral Time		x	x	0	10	7
CH2 PID High - Derivative Time		x	x	0	10	0
CH2 Max Power		x	x	10	100	100
DHW						
DHW Enable/Disable		x	x	Disable	Enable	Enable
DHW Setpoint	x	x	x	40 F	190 F	140 F
DHW On Hysteresis		x	x	0 F	60 F	10 F
DHW Off Hysteresis		x	x	0 F	20 F	10 F
DHW PID Low - Proportional Gain		x	x	0	10	5
DHW PID Low - Integral Time		x	x	0	10	2
DHW PID Low - Derivative Time		x	x	0	10	0
DHW PID High - Proportional Gain		x	x	0	10	7
DHW PID High - Integral Time		x	x	0	10	7
DHW PID High - Derivative Time		x	x	0	10	0
DHW Offset	x	x	x	0 F	70 F	0 F
DHW Max Power		x	x	10	100	100
DHW Timeout		x	x	0 min	500 min	0 min
CH Timeout		x	x	0 min	500 min	0 min
Control Sensor		x	x	System Supply	DHW	System Supply
Outdoor Reset						
Outdoor Reset Enable/Disable		x	x	Disable	Enable	Disable
Maximum Outdoor Temperature		x	x	0 F	120 F	65 F
Minimum Outdoor Temperature		x	x	-40 F	65	0 F
Minimum Water CH1 Temperature		x	x	100 F	200 F	120 F
Minimum Water CH2 Temperature		x	x	100 F	200 F	120 F
Cascade						
Address		x	x	0	8	0
Dynamic Address		x	x	0	8	0
Base Load		x	x	40	100	65
Drop Load		x	x	10	100	10
Minimum On Time		x	x	30 s	600 s	60 s
Minimum Off Time		x	x	30 s	600 s	60 s
Lost Lead Backup Setpoint		x	x	120 F	190 F	140 F
Lag On Hysteresis		x	x	0 F	20 F	10 F
Lag Off Hysteresis		x	x	0 F	20 F	10 F
Maximum Lag Temperature		x	x	120 F	190 F	180 F
Backup Mode Max Lag Power		x	x	10%	100%	100%
Cascade Rotation						
Rotation Mode		x	x	Run Time	Recurrence	Run Time
Run Time Hours		x	x	12 hrs	744 hrs	24 hrs
Time of Day - Hour		x	x	0	23	2
Time of Day - Minutes		x	x	0	59	0
Every X Day		x	x	1	365	1
Cascade Redundancy						
Loss of Lead Setup		x	x	Disable	Boiler Internal Setpoint/ Redundant Lead	Disable
Pump Configuration						

Table 26. NT2H (Boiler) Parameter and Range Table (next 3 pages)

399-1500 Hydronic	User	Installer	OEM	Minimum	Maximum	Default
Boiler Pump Control		x	x	Disable	Auto/ Always On/ Off During DHW/Auto - Off When Temperature Reached	Auto
Boiler Pump Post Circulation		x	x	0 secs	600 secs	60 secs
DHW Pump Control		x	x	Disable	Auto/ Always On	Auto
DHW Pump Post Circulation		x	x	0 secs	600 secs	60 secs
System Pump Control		x	x	Disable	Auto/ Always On/ Off During DHW	Auto
System Pump Post Circulation		x	x	0 secs	600 secs	60 secs
Vari-Prime						
Pump On Delay Timer		x	x	0 secs	120 secs	60 secs
Proportional Gain		x	x	0	10	5
Integral Time		x	x	0	10	2
Derivative Time		x	x	0	10	0
Pump Minimum Speed		x	x	0 mV	10000 mV	2000 mV
Pump Maximum Speed		x	x	2000 mV	10000 mV	10000 mV
Pump Off Delay Timer		x	x	0 secs	600 secs	60 secs
Delta Temperature		x	x	0 F	60 F	20 F
PrePurge Speed		x	x	2000 mV	10000 mV	10000 mV
PostPurge Speed		x	x	2000 mV	10000 mV	10000 mV
Firing Rate						
Enable Burner		x	x	Disable	Enable	Disable
Firing Rate		x	x	10%	100%	100%
Time Out		x	x	60	3600	1200
Manual Heat Demand		x	x	Disable	Enable	Disable
Min Power Offset		x	x	0%	50%	0%
Temperature Limits						
Auto Reset Boiler Outlet		x	x	100 F	200 F	200 F
Manual Reset Boiler Outlet		x	x	100 F	210 F	210 F
Reset Differential		x	x	1 F	30 F	20 F
Manual Reset Flue		x	x	170	220	215
Flue Temp Min		x	x	170	210	200
Flue Temp Max		x	x	175	220	210
Delta T Minimum Temperature		x	x	0 F	60 F	50 F
Delta T Maximum Temperature		x	x	0 F	60 F	60 F
Delta T Enable/Disable		x	x	Disable	Enable	Enable
Outlet Temp Minimum		x	x	180	190	185
Outlet Temp Maximum		x	x	190	200	195
External Control						
Control Mode		x	x	Disable	External Setpoint/ Firing Rate	Disable
Maximum Setpoint		x	x	40 F	190 F	150 F
Minimum Setpoint		x	x	40 F	190 F	130 F
Maximum Firing Rate		x	x	10%	100%	100%
Minimum Firing Rate		x	x	10%	100%	10%
Demand Max		x	x	0%	100%	100%
Demand Min		x	x	0%	100%	10%
Demand On		x	x	0%	25%	10%
Demand Off		x	x	0%	25%	5%
Input Type		x	x	0-10 Volt	4-20 mA	0-10 Volt
Heat Demand		x	x	VDC/mA Only	CH1&VDC-mA/ CH2&VDC-mA/ DHW&VDC-mA	CH1&VDC-mA
Demand Priorities						
CH1 Demand Priority		x	x	1	5	2
CH2 Demand Priority		x	x	1	5	3
DHW Demand Priority		x	x	1	5	1
Cascade Demand Priority		x	x	1	5	4
External Demand Priority		x	x	1	5	5
Anti- Frost						
Anti Frost Mode		x	x	Disable	Pump Only/ Pump & Burner	Pump Only
Anti- Frost Setpoint		x	x	32 F	120 F	40 F
Anti- Frost Hysteresis		x	x	2 F	10 F	5 F
Anti- Frost Pump Control		x	x	NA	Boiler/ DHW/ System	Boiler
Warm Weather Shutdown						
Temperature Minimum		x	x	50 F	140 F	90 F
Temperature Maximum		x	x	50 F	140 F	95 F
Feature Options		x	x	Disable	Shutdown Immediately/ Shutdown After Demand is Satisfied	Shutdown Immediately
Summer Kick CH		x	x	0 secs	600 secs	120 secs

399-1500 Hydronic	User	Installer	OEM	Minimum	Maximum	Default					
Summer Kick DHW		x	x	0 secs	600 secs	120 secs					
Summer Kick System		x	x	0 secs	600 secs	120 secs					
Summer Kick Period		x	x	10 min	2000 min	1440 min					
Anti- Short Cycle Time											
Cycle Time		x	x	0 secs	240 secs	60 secs					
Temperature Conversion											
Conversion Unit		x	x	Celsius	Fahrenheit	Fahrenheit					
COM port Options											
Protocol		x	x	Modbus	BACnet	BACnet					
Baudrate		x	x	9600	76800	76800					
Address		x	x	0	255	127					
Device Model Name		x	x	NA	NA	NA					
Device Object Name		x	x	NA	NA	NA					
Object Instance		x	x	0	4194303	600000					
Timeout		x	x	0 secs	300 secs	300 secs					
Service											
Burner Enable/Disable		x	x	Disable	Enable	Enable					
Altitude		x	x	0-3000	3001 - 6000/ 6001+	0-3000					
Screen Settings											
Light Timeout	x	x	x	60 secs	3600 secs	1200 secs					
AutoLock Timeout	x	x	x	60 secs	3600 secs	1200 secs					
Pressure						**399**	**500**	**650**	**800**	**1000**	**1500**
a (Pa)			x	-32768	32767	86	103	200	120	122	120
b (Pa)			x	-32768	32767	475	475	475	475	475	475
c (Pa)			x	-32768	32767	-500	-400	-450	-250	-380	-380
Maximum Allowable Drift			x	1%	10%	10%					
Validation Time			x	0 secs	20 secs	10 secs					
Min Drift Value (0.01" W.C.)			x	0	40	10					
Pressure - Fan Limits						**399**	**500**	**650**	**800**	**1000**	**1500**
Air Proving Limit (0.01" W.C.)			x	0	402	25	40	20	20	30	40
Hysteresis (0.01" W.C.)			x	0	402	3					
Pressure - Transmitter Scaling											
Slope			x	0	2000	1000					
Offset			x	-1000	1000	0					
P1 Voltage			x	0 mV	5000 mV	500					
P2 Voltage			x	0 mV	5000 mV	4500					
P1 Pressure (0.01" W.C.)			x	0	803	0					
P2 Pressure (0.01" W.C.)			x	0	803	400					

10.B Volume Water Heaters

399-1500 VW	User	Installer	OEM	Minimum	Maximum	Default
Time & Date						
Hour	x	x	x	NA	NA	NA
Minute	x	x	x	NA	NA	NA
Month	x	x	x	NA	NA	NA
Day	x	x	x	NA	NA	NA
Year	x	x	x	NA	NA	NA
DHW1						
DHW1 Enable/Disable		x	x	Disable	Enable	Enable
DHW1 Setpoint	x	x	x	40F	190 F	180 F
DHW1 On Hysteresis		x	x	0 F	20 F	10 F
DHW1 Off Hysteresis		x	x	0 F	20 F	10 F
DHW1 PID Low - Proportional Gain		x	x	0	10	5
DHW1 PID Low - Integral Time		x	x	0	10	2
DHW1 PID Low - Derivative Time		x	x	0	10	0
DHW1 PID High - Proportional Gain		x	x	0	10	7
DHW1 PID High - Integral Time		x	x	0	10	7
DHW1 PID High - Derivative Time		x	x	0	10	0
DHW1 Max Power		x	x	10	100	100
DHW2						
DHW2 Enable/Disable		x	x	Disable	Enable	Enable
DHW2 Setpoint	x	x	x	40 F	190 F	170 F
DHW2 On Hysteresis		x	x	0 F	20 F	10 F
DHW2 Off Hysteresis		x	x	0 F	20 F	10 F
DHW2 PID Low - Proportional Gain		x	x	0	10	5
DHW2 PID Low - Integral Time		x	x	0	10	2
DHW2 PID Low - Derivative Time		x	x	0	10	0
DHW2 PID High - Proportional Gain		x	x	0	10	7
DHW2 PID High - Integral Time		x	x	0	10	7
DHW2 PID High - Derivative Time		x	x	0	10	0
DHW2 Max Power		x	x	10	100	100
DHW3						
DHW3 Enable/Disable		x	x	Disable	Enable	Enable
DHW3 Setpoint	x	x	x	40 F	190 F	140 F
DHW3 On Hysteresis		x	x	0 F	60 F	10 F
DHW3 Off Hysteresis		x	x	0 F	20 F	10 F
DHW3 PID Low - Proportional Gain		x	x	0	10	5
DHW3 PID Low - Integral Time		x	x	0	10	2
DHW3 PID Low - Derivative Time		x	x	0	10	0
DHW3 PID High - Proportional Gain		x	x	0	10	7
DHW3 PID High - Integral Time		x	x	0	10	7
DHW3 PID High - Derivative Time		x	x	0	10	0
DHW3 Offset	x	x	x	0 F	70 F	0 F
DHW3 Max Power		x	x	10%	100%	100%
Control Sensor		x	x	System Supply	DHW	System Supply
DHW Timeout		x	x	0 min	500 min	0 min
CH Timeout		x	x	0 min	500 min	0 min
Cascade DHW						
Address		x	x	0	8	0
Dynamic Address		x	x	0	8	0
Base Load		x	x	40	100	65
Drop Load		x	x	10	100	10
Minimum On Time		x	x	30 s	600 s	60 s
Minimum Off Time		x	x	30 s	600 s	60 s
Lost Lead Backup Setpoint		x	x	120 F	190 F	140 F
Lag On Hysteresis		x	x	0 F	20 F	10 F
Lag Off Hysteresis		x	x	0 F	20 F	10 F
Maximum Lag Temperature		x	x	120 F	190 F	180 F
Backup Mode Max Lag Power		x	x	10%	100%	100%
Cascade Rotation						
Rotation Mode		x	x	Run Time	Recurrence	Run Time
Run Time Hours		x	x	12 hrs	744 hrs	24 hrs
Time of Day - Hour		x	x	0	23	2
Time of Day - Minutes		x	x	0	59	0
Every X Day		x	x	1	365	1
Cascade Redundancy						
Loss of Lead Setup		x	x	Disable	Boiler Internal Setpoint/ Redundant Lead	Disable
Pump Configuration						
Boiler Pump Control		x	x	Disable	Auto/ Always On/ Off During DHW/Auto - Off When Temperature Reached	Auto
Boiler Pump Post Circulation		x	x	0 secs	600 secs	60 secs
DHW Pump Control		x	x	Disable	Auto/ Always On	Auto
DHW Pump Post Circulation		x	x	0 secs	600 secs	60 secs

Table 27. NT2V (Volume Water) Parameter and Range Table (next 3 pages)

399-1500 VW	User	Installer	OEM	Minimum	Maximum	Default
System Pump Control		x	x	Disable	Auto/ Always On/ Off During DHW	Auto
System Pump Post Circulation		x	x	0 secs	600 secs	60 secs
Firing Rate						
Enable Burner		x	x	Disable	Enable	Disable
Firing Rate		x	x	10%	100%	100%
Time Out		x	x	60	3600	1200
Manual Heat Demand		x	x	Disable	Enable	Disable
Min Power Offset		x	x	0%	50%	0%
Temperature Limits						
Auto Reset Boiler Outlet		x	x	100 F	200 F	200 F
Manual Reset Boiler Outlet		x	x	100 F	210 F	210 F
Reset Differential		x	x	1 F	30 F	20 F
Manual Reset Flue		x	x	170	220	215
Flue Temp Min		x	x	170	210	200
Flue Temp Max		x	x	175	220	210
Delta T Minimum Temperature		x	x	0 F	60 F	50 F
Delta T Maximum Temperature		x	x	0 F	60 F	60 F
Delta T Enable/Disable		x	x	Disable	Enable	Enable
Outlet Temp Minimum		x	x	180	190	190
Outlet Temp Maximum		x	x	190	200	195
External Control						
Control Mode		x	x	Disable	External Setpoint	Disable
Maximum Setpoint		x	x	40 F	190 F	150 F
Minimum Setpoint		x	x	40 F	190 F	130 F
Maximum Firing Rate		x	x	10%	100%	100%
Minimum Firing Rate		x	x	10%	100%	10%
Demand Max		x	x	0%	100%	100%
Demand Min		x	x	0%	100%	10%
Demand On		x	x	0%	25%	10%
Demand Off		x	x	0%	25%	5%
Input Type		x	x	0-10 Volt	4-20 mA	0-10 Volt
Heat Demand		x	x	VDC/mA Only	DHW1&VDC-mA/ DHW2&VDC-mA/ DHW3&VDC-mA	DHW1&VDC-mA
Demand Priorities						
DHW1 Demand Priority		x	x	1	5	2
DHW2 Demand Priority		x	x	1	5	3
DHW3 Demand Priority		x	x	1	5	1
Cascade Demand Priority		x	x	1	5	4
External Demand Priority		x	x	1	5	5
Anti- Frost						
Anti Frost Mode		x	x	Disable	Pump Only/ Pump & Burner	Pump Only
Anti- Frost Setpoint		x	x	32 F	120 F	40 F
Anti- Frost Hysteresis		x	x	2 F	10 F	5 F
Anti- Frost Pump Control		x	x	NA	Boiler/ DHW/ System	Boiler
Anti- Short Cycle Time						
Cycle Time		x	x	0 secs	240 secs	60 secs
Temperature Conversion						
Conversion Unit		x	x	Celsius	Fahrenheit	Fahrenheit
COM port Options						
Protocol		x	x	Modbus	BACnet	BACnet
Baudrate		x	x	9600	76800	76800
Address		x	x	0	255	127
Device Model Name		x	x	NA	NA	NA
Device Object Name		x	x	NA	NA	NA
Object Instance		x	x	0	4194303	600000
Timeout		x	x	0 secs	300 secs	300 secs
Service						
Burner Enable/Disable		x	x	Disable	Enable	Enable
Altitude		x	x	0-3000	3001 - 6000/ 6001+	0-3000
Screen Settings						
Light Timeout	x	x	x	60 secs	3600 secs	1200 secs
AutoLock Timeout	x	x	x	60 secs	3600 secs	1200 secs
Pressure						**399** **500** **650** **800** **1000** **1500**
a (Pa)			x	-32768	32767	86 103 200 120 122 120
b (Pa)			x	-32768	32767	475 475 475 475 475 475
c (Pa)			x	-32768	32767	-500 -400 -450 -250 -380 -380
Maximum Allowable Drift			x	1%	10%	10%
Validation Time			x	0 secs	20 secs	10 secs
Min Drift Value (0.01" W.C.)			x	0	40	10
Pressure - Fan Limits						**399** **500** **650** **800** **1000** **1500**
Air Proving Limit (0.01" W.C.)			x	0	402	25 40 20 20 30 40

Parameters Tables (continued)

399-1500 VW	User	Installer	OEM	Minimum	Maximum	Default
Hysteresis (0.01" W.C.)			x	0	402	3
Pressure - Transmitter Scaling						
Slope			x	0	2000	1000
Offset			x	-1000	1000	0
P1 Voltage			x	0 mV	5000 mV	500
P2 Voltage			x	0 mV	5000 mV	4500
P1 Pressure (0.01" W.C.)			x	0	803	0
P2 Pressure (0.01" W.C.)			x	0	803	400

SECTION 11 FIRST START UP AND ADJUSTMENT

⚠ WARNING

Failure to remove all air from the heat exchanger could lead to property damage, severe injury or death.

⚠ WARNING

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.

⚠ AVERTISSEMENT

N'utilisez pas cet appareil s'il a été plongé dans l'eau, même partiellement. Faites inspecter l'appareil par un technicien qualifié et remplacez toute partie du système de contrôle et toute commande qui ont été plongés dans l'eau.

⚠ WARNING

If you detect any odor of gas, or if the gas burner does not appear to be functioning in a normal manner, close the main gas shutoff valve. Do not shut off the switch. Contact your heating contractor, gas company, or factory representative.

NOTE: The installer is responsible for identifying to the owner/operator the location of all emergency shutoff devices.

11.A Filling the Boiler System

1. Ensure the system is fully connected and all air-bleeding devices are closed.
2. Connect a hose to the system drain valve.
3. Close the manual valve between the drain valve and the make-up line.
4. Open the drain valve and the make-up water valve. Allow the system to fill slowly. Open zones one-by-one to purge them individually.
5. Once the system is purged of air, close the drain valve. If a pressure reducing valve is provided on the make-up water line, adjust it to provide at least 12 psi (81.8 kPa) at the highest point in the heating loop. If a make-up water pump is employed, adjust the pressure switch on the pumping system to provide a minimum of 12 psi (81.8 kPa) at the highest point in the heating loop.
6. Bleed all remaining air from the heating system by opening any bleed valves (air eliminators) throughout the heating system, unless automatic air bleeders are provided at those points.
7. To remove air from the heat exchanger, purging can be accomplished by opening the pressure relief valve using the manual lever.

   NOTE: Before manually actuating the pressure relief valve, ensure it is piped in such a way to prevent injury due to hot water. Check that the discharge is piped to a suitable drain, or a bucket is placed underneath to prevent water damage.

8. Isolate and open all strainers in the circulating system and check for debris. If debris is present, clean out the strainers to ensure proper circulation.
9. Start up the boiler following the procedure in this manual. Operate the entire system, including the pump, boiler, and radiation units for one hour.
10. Shut down the entire system and vent all radiation units and high points in the system piping as described in step 6.

11.B Altitude Adjustment

Before starting the unit, verify that the unit's control is setup for the correct altitude per 9.E.1.b on page 87.

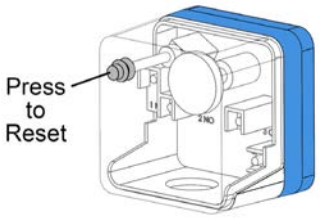
11.C Initial Operation

The initial setup must be checked before the unit is put into operation. Problems such as failure to start, rough ignition, strong exhaust odors, etc. can be due to improper setup. Damage to the boiler resulting from improper setup is not covered by the warranty.

1. Using this manual, make sure the installation is complete and in full compliance with the instructions and all local codes.
2. Ensure the unit and system are filled with water and all air has been purged.
3. Observe all warnings on the Operating Instructions label and turn on gas and electrical power to the unit.

11.C.1 Initial Burner Operation

1. If the unit includes a low gas pressure switch, it may need to be reset.
2. After all safety devices are verified, the unit will enter the start sequence. The blower and pump will energize for pre-purge, then the ignition sequence will start, and the gas valve will open. If ignition doesn't occur, turn off the unit. Check that there is an adequate supply of gas. Wait five minutes and start the unit again.



3. If ignition starts normally, leave the unit turned on.
4. After placing the unit into operation, the burner safety shutoff device must be tested:
   (a) Close the gas shutoff valve with the burner operating.
   (b) The flame will go out and the blower will continue to run for the post-purge cycle. One or three additional attempts to light will follow depending on the controller model. Ignition will not occur because the gas is off. The ignition control will lockout after a single or a third try depending on the controller model.
   (c) Open the gas shutoff valve. Reset the control by pressing the Reset button on the display. If the unit has a low gas pressure switch, it will need to be reset.
   (d) Restart the appliance. The ignition sequence will start again, and the burner will start.

11.D Combustion Setup

⚠ WARNING

The combustion must be properly adjusted before placing the unit into operation. An improperly adjusted unit could result in serious injury or death. If the CO2 or CO cannot be adjusted to the values specified, contact the factory.

The combustion system must be setup properly, so the unit will run cleanly and efficiently at its installed conditions. This section describes how to adjust the gas valve to ensure proper combustion.

1. Use a combustion analyzer to verify that the CO_2 and CO are within the ranges specified in Table 28. If any values measure outside of the ranges specified, adjustments will need to be made to the unit's gas valve.
2. To access the gas valve, unscrew the 4 Phillips-head screws on the display. Move the display up and mount it in the position shown using 2 Phillips-head screws.

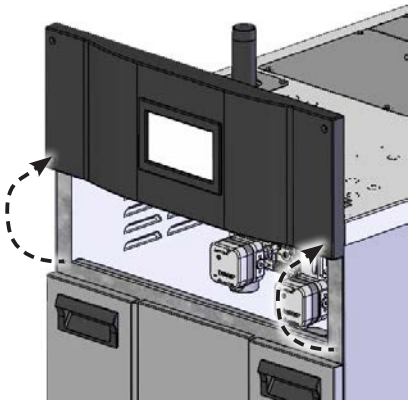
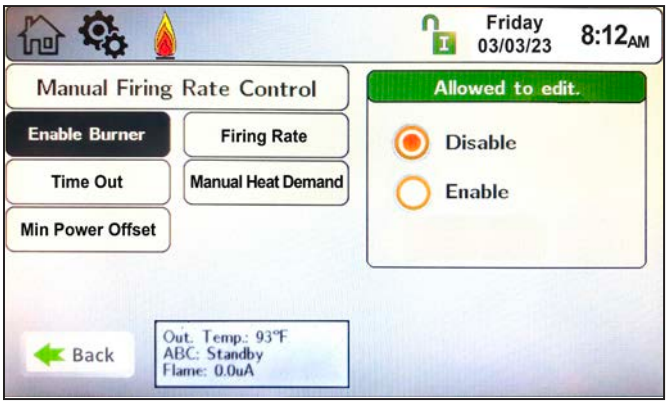


Figure 50. Remove and Refasten the Black Panel

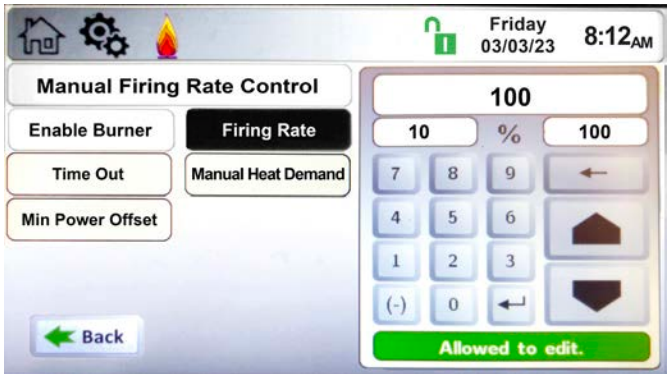
3. Force the unit to high fire. On the touchscreen, navigate to Configure >> Firing Rate >> Enable burner and select 'Enable' as shown.



High Fire		Low Fire	
CO_2 %	CO (ppm)	CO_2 %	CO (ppm)
8.8	<200	8.5	<10

Table 28. Combustion Settings

4. At the Firing Rate screen, set the firing rate to 100%.



5. Press the 'Manual Heat Demand' button to enable a manual heat demand.
6. Once the unit is firing at 100%, use a 6mm Allen key (399 – 500), a 3mm Allen key (650 – 800), or a flathead screwdriver (999 – 1500) to adjust the high fire adjustment screw on the gas valve to obtain the correct CO_2 and CO measurements as shown in Table 28. See Figure 51, Figure 52, and Figure 53 on the next page.
7. While the unit is running at high fire, measure the gas pressure at the gas supply measurement port shown in Figure 51 – Figure 53 on page 101. For models 399 – 500, use a T10 Torx driver to open the port, and for models 650 – 1500 install a 1/8" NPT barbed fitting. Ensure the supply pressure is equal to or greater than 3.5" w.c. If any other appliances share the gas supply line, the pressure must also be checked to ensure it is above 3.5" w.c. with every appliance that shares the supply line operating at maximum capacity. If the gas pressure is greater than 10.5" w.c. turn off the main shut-off gas valve upstream of the unit and, as necessary, adjust or replace the fuel regulating components.
8. Once the combustion at high fire is properly adjusted, navigate to the Firing Rate screen and set the Firing Rate to 10% to force the unit to low fire.
9. Allow the unit to stabilize at low fire. Using a T40 Torx (399 – 800) or a 2.5mm Allen key (999 – 1500), adjust the low fire adjustment screw on the gas valve to obtain the correct CO_2 and CO measurements as shown in Table 28. While the unit is running at low fire, check that the gas supply pressure is within the correct range per step 7.
10. Remove the manual heat demand.
11. Navigate to the Firing Rate screen and disable the burner.

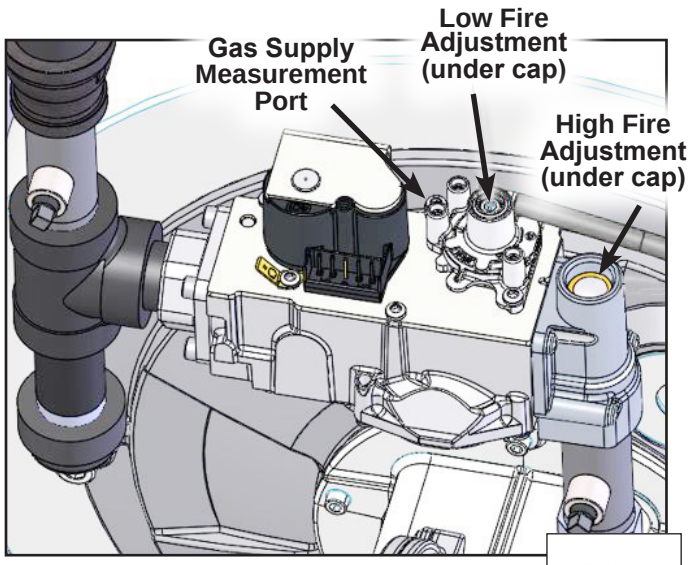


Figure 51. Gas Valve Adjust, 399 - 500

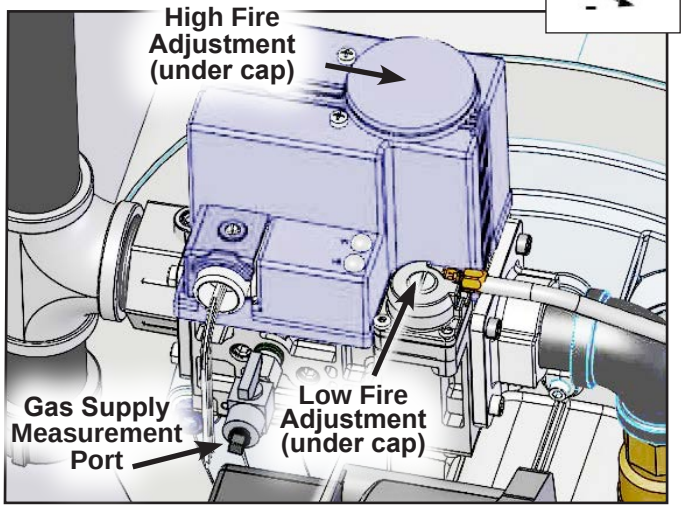


Figure 52. Gas Valve Adjust, 650 - 800

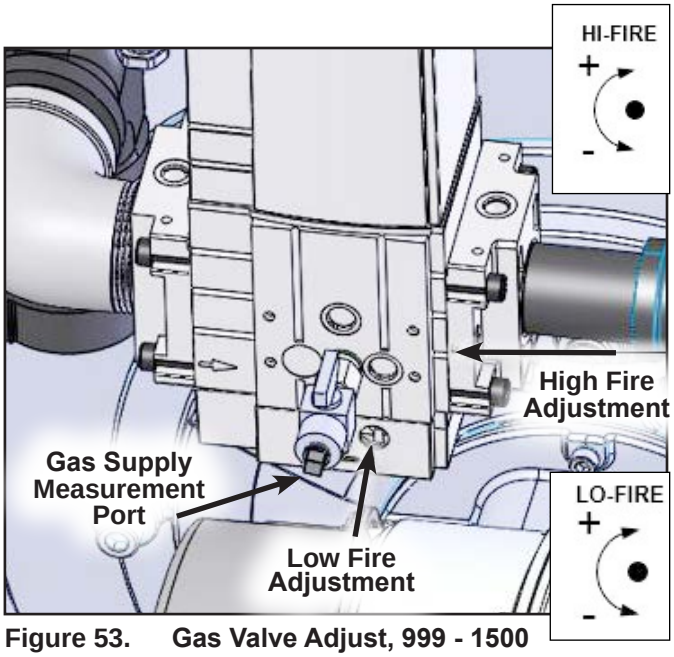


Figure 53. Gas Valve Adjust, 999 - 1500

11.E Shutting Down the Unit

1. Turn off the main electrical disconnect switch.
2. Close all manual gas valves.
3. If freezing is anticipated, drain the unit and system piping. If the unit or the system piping are not properly drained, damage from freezing may occur.

NOTE: Due to the elevated location of the unit's drain valve, some water will remain in the lower portion of the heat exchanger after draining. As long as it has been drained to this level, any remaining water that freezes will not cause damage to the unit. To remove all water, the unit must be purged with air at 15 psi.

11.F Restarting the Unit

If the unit has been drained, see 11.A on page 99 in this manual for instructions on proper filling and purging.

1. Turn on the main power switch.
2. Open all manual gas valves.
3. If the unit includes a low gas pressure switch, it may need to be reset.
4. Set the temperature controller to the desired temperature setting.
5. The unit will go through a pre-purge period followed by ignition.
6. If ignition doesn't occur, turn off the power switch and close all manual gas valves. Check that there is a proper supply of gas. Wait five minutes and start the unit again.

SECTION 12 MAINTENANCE

⚠ WARNING

Disconnect all power to the unit before attempting any service procedures. Contact with electricity can result in severe injury or death.

⚠ CAUTION

When servicing the controls, label all wires before disconnecting them. Wiring errors can cause improper and dangerous operation. Verify proper operation after servicing.

NOTE: The warranty does not cover damage caused by lack of required maintenance, lack of water flow, or improper operating practices.

12.A Annually

Do the following once a year:

1. Inspect the venting system. Ensure there are no obstructions or leakage. Ensure that all joints are sealed properly. If any joints need to be re-sealed, follow the venting manufacturer's instructions. Clean the screens in the vent terminal and combustion air terminal.
2. Remove and inspect the air filter. Vacuum the filter and clean it with soapy water if needed per 12.B.3 on page 103. Be sure that the filter is dry and that the airflow direction arrow on the filter is pointing in the correct direction before re-inserting it back into the filter box. Replace the filter if it is damaged.
3. Clean the condensate trap per section 12.B.2 on page 103. Ensure the float and level switch operate properly.
4. Inspect the condensate neutralizer (if equipped) for signs of debris or sediment that could cause blockage. If necessary, remove and rinse the media. Check the pH level at the outlet of the neutralizer. If the pH is below the minimum level allowed by the local water authority, the media should be replaced.
5. Inspect the water and gas piping and ensure there are no leaks. Clean any strainers located in the water piping or the pressure reducing valve.
6. Inspect and clean the heat exchanger and burner per section 12.B.1 on page 102.
7. Test the pressure relief valve.
8. Test the low water cutoff, if equipped.
9. Ensure that the area around the unit is clear of combustible materials, gasoline or other flammable vapors or liquids, and chemicals.
10. Ensure that the air intake is isolated from any source of corrosive chemical fumes such as pool chemicals, refrigerants, paint, spray cans, cleaning, and laundry chemicals. When the air intake is contaminated with these chemicals, rapid deterioration of the unit will occur.
11. If the unit is not going to be used for extended periods in locations where freezing normally occurs, it should be isolated from the system and drained of all water.

⚠ WARNING

Failure to clean debris from the heat exchanger may lead to clogged condensate lines, traps, and neutralizers. Condensate pumps (if used) may also be damaged from debris, possibly causing property damage.

⚠ CAUTION

Use only plastic brushes to clean the heat exchanger. Do not clean the heat exchanger with any acid or alkali products. Cleaning with these products or using a metal brush could cause damage to the coils.

12.B Maintenance Notes by Component

Use only genuine manufacturers replacement parts.

12.B.1 Heat Exchanger and Burner

The gas and electric controls are engineered for long life and dependable operation, but the safety of the equipment depends on their proper functioning.

Inspect and clean the heat exchanger and burner annually per the following:

1. Shut off the main power switch and close all manual gas valves connecting the unit to the main gas supply line.
2. Open the front doors to the unit. Swing the control panel out of the way.
3. Disconnect the condensate drain line from the heat exchanger. Place a drain pan underneath.
4. On models 650 – 1500, remove the 4 ¼-20 hex head screws connecting the air intake to the venturi. On models 399 – 500, undo the hose clamp connecting the flexible duct to the venturi and move the flexible duct out of the way.
5. On models 650 – 1500, remove the 4 #10-24 screws connecting the gastrain to the venturi. On models 399 – 500, unscrew the brass union nut connecting the gastrain to the venturi.
6. Remove the 4 M8 hex head screws (for models 650

– 1500) or 4 M5 socket head screws (for models 399 – 500) connecting the blower to the heat exchanger. Remove the blower and venturi.

7. Remove the 6 M10 socket head screws connecting the burner door to the heat exchanger.
8. Remove the burner door.
9. Use a vacuum to remove debris from the coils.
10. Use a nylon bristle brush to further clean the coils and loosen up debris.

NOTE: Use only a plastic brush for cleaning. A metal brush could damage the coils. Vacuum any additional debris.

11. Rinse any remaining debris out of the bottom of the heat exchanger and into the drain pan with a small amount of water.
12. Inspect the insulation at the back of the heat exchanger. If it shows signs of damage, it must be replaced. Consult the factory for replacement parts.
13. Inspect the insulation and gasket on the burner door. If either shows signs of damage, it must be replaced. Consult the factory for replacement parts.
14. Inspect the burner for clogged ports. If any ports are clogged, they can be cleaned by blowing compressed air through the burner. The burner can be disassembled from the burner door by removing the 5 M5 socket head screws. Clogged ports may be an indication of a dirty or improperly installed air filter. Re-assemble the burner onto the burner door after cleaning, ensuring the gasket is in place. Tighten the M5 socket head screws in a star pattern to 44lb-in (5Nm).
15. Re-assemble the burner door onto the heat exchanger. Tighten the M10 socket head screws in a star-pattern to 37lb-ft (50Nm).
16. Re-assemble the blower and venturi, ensuring all gaskets and O-rings are in place.
17. Restart the unit and confirm proper operation.

12.B.2 Condensate Trap

The condensate drain trap located at the back of the unit allows condensate to drain from the heat exchanger, while preventing flue gas from escaping. It should be inspected and cleaned annually to prevent clogging of the condensate line and nuisance shut-downs of the unit. To clean the trap:

1. Disconnect the wire harness from the condensate trap.
2. Unscrew the hose clamps and disconnect both the inlet and outlet hoses from the trap. Remove the trap.
3. Unscrew the top and bottom caps from the trap. Remove any debris. Rinse the float, level switch, and the trap with water to remove all debris. Check that the level switch moves freely.
4. Reassemble the trap. Ensure that all gaskets and the float are in place.
5. Reconnect the trap to the hoses and connect the wire harness.
6. Restart the unit and check to ensure condensate is draining properly and there are no flue gas leaks.

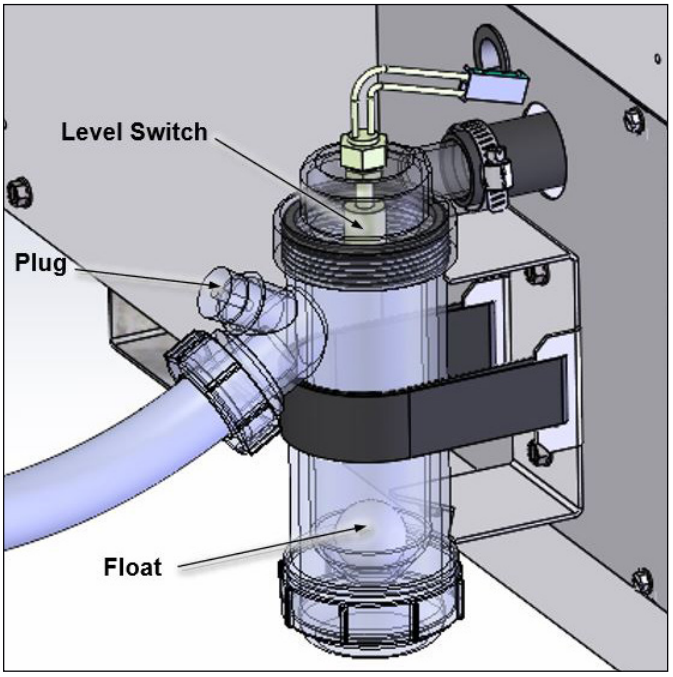


Figure 54. Condensate Trap Components

⚠ WARNING

The float must always be installed in the condensate trap. Removal of the float could cause flue gases to leak into occupied spaces, resulting in severe personal injury or death.

12.B.3 Air Filter

The unit includes a cleanable air filter to catch debris in the air intake and prevent clogged burner ports. The filter should be Inspected and cleaned annually to ensure peak performance of the unit. To clean the filter:

1. Open the front doors to the unit. Swing the control panel out of the way.
2. Remove the four screws on the air filter access cover. Remove the filter.
3. Vacuum the filter to remove debris, then wash it with soapy water.

4. Be sure that the filter is dry and that the airflow direction arrow on the filter is pointing in the correct direction per the figure. Re-insert the filter into the filter box and replace the access cover.

12.B.4 Spark and Flame Sensor Electrodes

The spark electrode is a dual rod assembly and the flame sensor electrode is a single rod assembly.

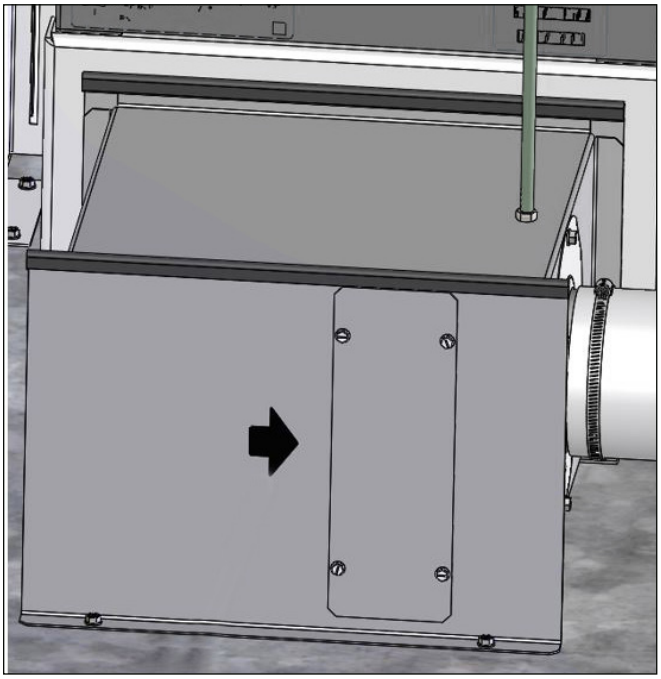


Figure 55. Air Flow Direction

To remove the spark and flame sensor electrodes for service or replacement:

1. Shut off the main power switch and close all manual gas valves connecting the unit to the main gas supply line.
2. Open the front doors to the unit. Swing the control panel out of the way.
3. Disconnect the high voltage ignition wire and ground wire from the spark wire. Disconnect the flame sensor wire and the flame sensor ground wire.
4. Remove the 2 M4 socket head screws holding each electrode assembly in place. Remove the electrodes.
5. To install new electrodes, repeat the steps above in the reverse order, replacing the gaskets if necessary. Tighten each M4 socket head screw to 19lb-in (2.2Nm). Ensure each wire is connected properly.
6. Restart the unit and confirm proper operation.

12.B.5 Gas Valve

The gas valve consists of a valve body that incorporates the on/off flow control and a negative pressure regulator. It provides the air/gas ratio control in combination with the fuel/air mixer to the unit. It is designed to operate with gas supply pressures between 3.5” – 10.5” w.c.

To remove the gas valve for service or replacement:

1. Shut off the main power switch to the boiler.
2. Close all manual gas valves connecting the boiler to the main gas supply line.
3. To access the gas valve, unscrew the 4 Phillips-head screws on the display. Move the display up and mount it in the position shown using 2 Phillips-head screws.

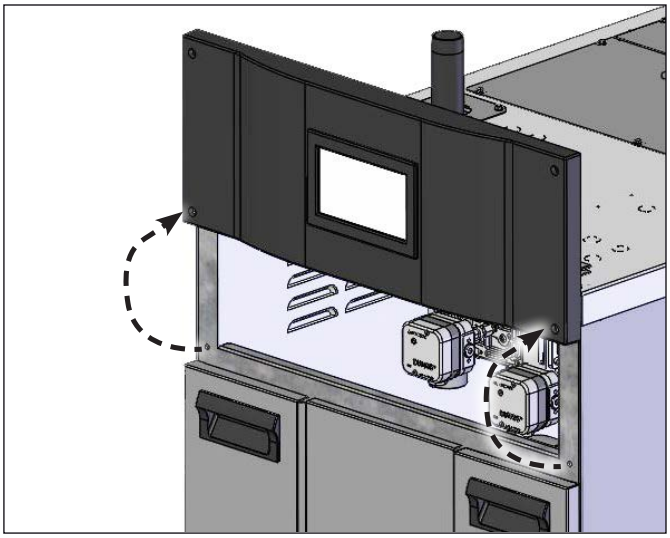


Figure 56. Remove and refasten the black panel

4. Disconnect the wire harness from the gas valve.
5. Disconnect the air reference line tubing from the gas valve.
6. For models 650 – 1500, remove the 4 socket head screws on both the right and left flanges. For models 399 – 500, remove the 4 socket head screws on the left flange, and the 4 Phillips head screws on the right flange. Remove the valve.
7. Use a wrench to remove all fittings connected to the valve.
8. To re-install the valve, repeat the steps above in the reverse order. Ensure that all gaskets and O-rings are in place during re-assembly and that the air reference tubing is securely connected.
9. Restart the unit and confirm proper operation.

12.B.6 Blower

The combustion air blower is a high-pressure centrifugal blower with a variable speed motor. The blower is driven by the control using a PWM signal.

To remove the blower for service or replacement:

1. Shut off the main power switch and close all manual gas valves connecting the unit to the main gas supply line.
2. Open the front doors to the unit. Swing the control panel out of the way.
3. Disconnect the two wire harnesses from the blower.
4. Remove the 6 M8 hex head screws (for models 650 – 1500) or 6 M4 socket head screws (for models 399 – 500) connecting the blower to the venturi.
5. Remove the 4 M8 hex head screws (for models 650 – 1500) or 4 M5 socket head screws (for models 399 – 500) connecting the blower to the heat exchanger. Remove the blower.
6. To re-install the blower, repeat the steps above in the reverse order. Ensure that all of the required gaskets and O-rings are properly installed at each connection.
7. Restart the unit and confirm proper operation.

12.B.7 Control

Each unit has an integrated controller that incorporates auto and manual reset high limit control, operating temperature control, burner modulation control, ignition control, outdoor reset control, pump control, and many other features. If any of these features are thought to be defective, please consult the factory for proper troubleshooting practices before replacing a control.

If it is necessary to replace a controller follow these steps:

1. Shut off the main power switch and close all manual gas valves connecting the unit to the main gas supply line.
2. Open the front doors to the unit and remove the control panel cover.
3. Remove all wire harness connections from the control board. The control board connections are keyed to only allow connection in the proper location, but proper handling techniques should be used to avoid damage to the wiring or connectors.
4. To remove the control, press the mounting tab on each standoff while gently pulling the control board forward. Repeat this process for all standoffs and then remove the control.
5. To replace the control, repeat the steps above in the reverse order, making sure to connect all wires in the proper locations.
6. Turn the power to the unit back on and confirm proper operation.

12.B.8 Touchscreen Display

The touchscreen display is used to adjust all operating parameters of the unit.

If it is necessary to replace a display, follow these steps:

1. Shut off the main power switch and close all manual gas valves connecting the unit to the main gas supply line.
2. Remove the 4 Phillips head screws connecting the display assembly to the front of the unit.
3. Disconnect the wire harness from the back of the display.
4. Remove the mounting bracket by taking out the 4 Phillips head screws holding it to the display assembly.
5. Remove the display from the clear display protector.
6. To re-install, repeat the steps above in the previous order.
7. Turn the power to the unit back on and confirm proper display operation.

12.B.9 Flow Switch

Each unit is equipped with a flow switch which will shut down the boiler/ water heater if there is insufficient water flow for safe operation. The switch may also shut the unit down if the system has not been thoroughly purged of air (see 11.A on page 99).

NOTE: The system must be completely drained of water before removing the flow switch.

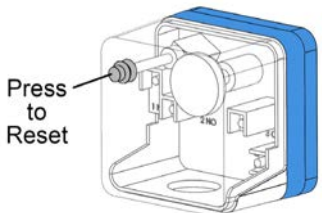
1. To remove the flow switch for service or replacement, remove the screws on the top access cover of the unit and pull off the cover.
2. Remove the screws on the housing of the flow switch and pull off the housing.
3. Disconnect the two wires from the screw terminals.
4. Use a wrench to unscrew the flow switch from its fitting in the outlet water pipe.
5. Inspect the paddle. Ensure that it is not bent or damaged, and that it is screwed securely to the switch. Replace the paddle if it is damaged.
6. To re-install, follow the steps above in the reverse order. Use pipe sealant on the threaded end of the switch and check for leaks during assembly. Ensure that the flow direction arrow on the switch is pointing up.
7. Fill the system and restart the unit per section 10.

12.B.10 Gas Pressure Switches (optional)

If equipped, the high and low gas pressure switches are manual reset switches that act to cut power to the safety interlock circuit if the gas pressure is too low or too high for proper operation. There is a manual reset on both. The gas pressure switches used are integrally vent limited and do not require venting to atmosphere.

To remove a switch:

1. Shut off the main power switch and close all manual gas valves connecting the unit to the main gas supply line.
2. To access the gas pressure switches, unscrew the 4 Phillips-head screws on the display. Move the display up and mount it using 2 Phillips-head screws. .



3. Remove the screws on the plastic switch housing and pull the clear cover off.
4. Disconnect the two wires from the screw terminals.
5. Twist the switch off the pipe nipple.
6. Reassemble in reverse order. Use pipe sealant on the nipple and check for leaks during assembly.
7. Set the low-pressure switch to 3.5" w.c. Set the high-pressure switch to 3" w.c.

12.B.11 Pressure Transmitters

The pressure transmitters measure the air-side pressure drop across the unit and are used for both air proving during Prepurge and as a safety device which will shut down the unit in the event of an obstructed vent or air intake. They are powered by 5 VDC from the control and output a 0.5 to 4.5 VDC signal from 0 to 4" w.c. differential pressure. The transmitter values are displayed on the analog input menu of the touchscreen display.

If it is necessary to replace a pressure transmitter follow these steps:

1. Shut off the main power switch and close all manual gas valves connecting the unit to the main gas supply line.
2. Open the front door to the unit. Swing the control panel out of the way.
3. Disconnect the wire harness from the pressure transmitter.
4. Disconnect the 2 pressure tubes from the bottom of the transmitter.
5. Remove the screws on the top access panel of the unit and pull off the panel.
6. Using a ¼" nut driver, remove the 4 screws from the back of the pressure transmitter. Remove the transmitter.
7. To re-install, repeat the steps above in the previous order.

SECTION 13 Troubleshooting

13.A Sequence of Operation

13.A.1 Start

Upon power-up, the boiler/heater enters Start mode. The spark and gas valve are off, and the blower turns on and modulates to the Start Purge Speed. The unit will stay in Start mode for the duration of the Start Timer. Once the timer expires, the unit will transition to Standby mode.

13.A.2 Standby

After Start mode, the unit enters Standby mode. The blower, spark, and gas valve are off. Upon a call for heat, the unit will start the circulator(s) then transition to Prepurge Open mode.

13.A.3 Prepurge Open

In Prepurge Open mode, the unit confirms that the pressure is below the Air Proving Limit. If the pressure is below the Air Proving Limit, the unit will transition to Prepurge Closed. If the pressure is not below the Air Proving Limit and the Prepurge Open Timer expires, the unit will transition to Lockout mode and display a "Lockout: High Air Proving Press" error. If the safety chain opens or an error is detected, the unit will transition to Safety Chain Open, Error Block, or Lockout mode depending on the specific error condition. If the heat demand is removed, the unit will transition to Standby mode.

13.A.4 Prepurge Closed

In Prepurge Closed mode, the blower turns on and modulates to the Prepurge Speed. Once the Prepurge Speed is reached, the Prepurge Closed Timer starts. Once the Prepurge Closed Timer expires and the pressure is above the Air Proving Limit, the unit will transition to Prespark mode. If the pressure is not above the Air Proving Limit and the Prepurge Closed

Timer has expired, the unit will transition to Lockout mode and display a “Lockout: Low Air Proving Press” error. If the safety chain opens or an error is detected, the unit will transition to Safety Chain Open, Error Block, or Lockout mode depending on the specific error condition. If the heat demand is removed, the unit will transition to Standby mode.

NOTE: The duration of Prepurge is established to ensure proper evacuation of any unburned fuel in the combustion chamber and flue collector.

13.A.5 Prespark

In Prespark mode, the spark is energized and the blower modulates to the Ignition Speed. Once the blower reaches the Ignition Speed, the unit transitions to Ignition mode. If the safety chain opens or an error is detected, the unit will transition to Safety Chain Open, Error Block, or Lockout mode depending on the specific error condition. If the call for heat is removed, the unit will transition to Standby mode.

13.A.6 Ignition

In Ignition mode, the blower continues to run at the Ignition Speed, the spark continues to be energized, and the gas valve is energized for the Main Flame Establishing Period. Proper ignition has occurred if the flame signal is greater than or equal to the Flame Signal Lower Threshold prior to the Main Flame Establishing Period expiring. If proper ignition has been established, the unit will transition to Run mode. If proper ignition does not occur, and the maximum attempts for ignition have not been reached, the unit will transition to Interpurge, then retry the ignition. If proper ignition does not occur, and the maximum attempts for ignition have been reached, the unit will transition to Lockout mode. If the call for heat is removed, the unit will transition to Postpurge mode prior to returning to Standby mode.

NOTE: Four attempts for ignition, prior to lockout, is standard. CSD-1 units have a single re-try for ignition prior to lock-out (two attempts).

13.A.7 Run

In Run mode, the blower will modulate to the required firing rate to satisfy the heat demand. If the safety chain opens or there is a loss of flame, the unit will transition to Interpurge mode. If an error is detected, the unit will transition to Error Block or Lockout mode depending on the specific error condition. When the heat demand has been satisfied (or if the heat demand is removed), the unit will transition to Postpurge mode prior to returning to Standby mode.

13.A.8 Interpurge

In Interpurge mode, the gas valve will de-energize and the blower will modulate to the Interpurge Speed. Once reached, the Interpurge Timer will start. Once the Interpurge Timer expires, the unit will transition to the next mode. If the safety chain is closed and the maximum attempts for ignition have not been reached, the unit will transition to Prespark mode. If the safety chain is open or the maximum attempts for ignition have been reached, the unit will transition to either Safety Chain Open, Error Block, or Lockout mode depending on the specific error condition. If the heat demand is removed, the unit will transition to Postpurge mode prior to returning to Standby mode.

NOTE: The duration of Interpurge is established to ensure proper evacuation of any unburned fuel in the combustion chamber and flue collector.

13.A.9 Postpurge

In Postpurge mode, the spark and gas valve are off and the blower will modulate to the Postpurge Speed. The unit will stay in Postpurge mode for the duration of the Postpurge Timer. Once the timer expires, the unit will transition to Standby mode.

13.A.10 Safety Chain Open

If the safety chain is open and the condition does not require manual reset, the unit will go to Safety Chain Open mode. The spark and gas valve are off. If the unit was running or in Ignition prior to the safety chain opening, the unit will perform a purge to remove any products of combustion and unburned fuel in the combustion chamber. Once the safety chain is closed, the unit will transition to Standby mode.

13.A.11 Error Block

If a sensor is disconnected or reading a value that is out of bounds, or a fault is detected by the control, and the condition does not require manual reset, the unit will go to Error Block mode. The spark and gas valve are off. If the unit was running or in Ignition prior to the error, the unit will perform a purge to remove any products of combustion and unburned fuel in the combustion chamber. Once the error has been fixed, the unit will transition to Standby mode.

13.A.12 Lockout

If the safety chain is open or an error occurs and the condition requires manual reset, the unit will go to Lockout mode. The spark and gas valve are off. If the unit was running or in Ignition prior to the lockout occurring, the unit will perform a purge to remove any products of combustion and unburned fuel in the combustion chamber. The unit will stay in Lockout mode until the lockout condition has been manually reset and the safety chain is closed and/or the error(s) have been fixed. Once both conditions have been satisfied, the unit will transition to Standby mode.

Troubleshooting (continued)

Parameter	Value		Description
Air Proving Limit	399	0.25 in. W.C.	The pressure must be below this value during Prepurge Open mode and above this value during Prepurge Closed mode.
	500	0.40 in. W.C.	
	650	0.20 in. W.C.	
	800	0.20 in. W.C.	
	999	0.30 in. W.C.	
	1500	0.40 in. W.C.	
Start Timer	15 seconds		The unit will remain in Start mode for the duration of the Start Timer.
Prepurge Open Timer	60 seconds		The maximum amount of time the boiler/heater will wait for the pressure to be below the Air Proving Limit.
Prepurge Closed Timer	15 seconds		Once the blower reaches the Prepurge Speed, it will remain on at this speed until the Prepurge Closed Timer has expired.
Main Flame Establishing Period	4 seconds		After the gas valve is energized, this is the maximum amount of time the unit will try to ignite prior to mode transition.
Flame Signal Lower Threshold	0.8 µA		Flame is considered absent if the flame signal is below the Flame Signal Lower Threshold.
Interpurge Timer	15 seconds		If the unit fails to ignite, and the maximum number of ignition attempts has not been reached, the blower will modulate to the Interpurge Speed and remain on at this speed until the Interpurge Timer has expired.
Postpurge Timer	15 seconds		The unit will remain in Postpurge mode for the duration of the Postpurge Timer.

Table 29. Burner Control Parameters

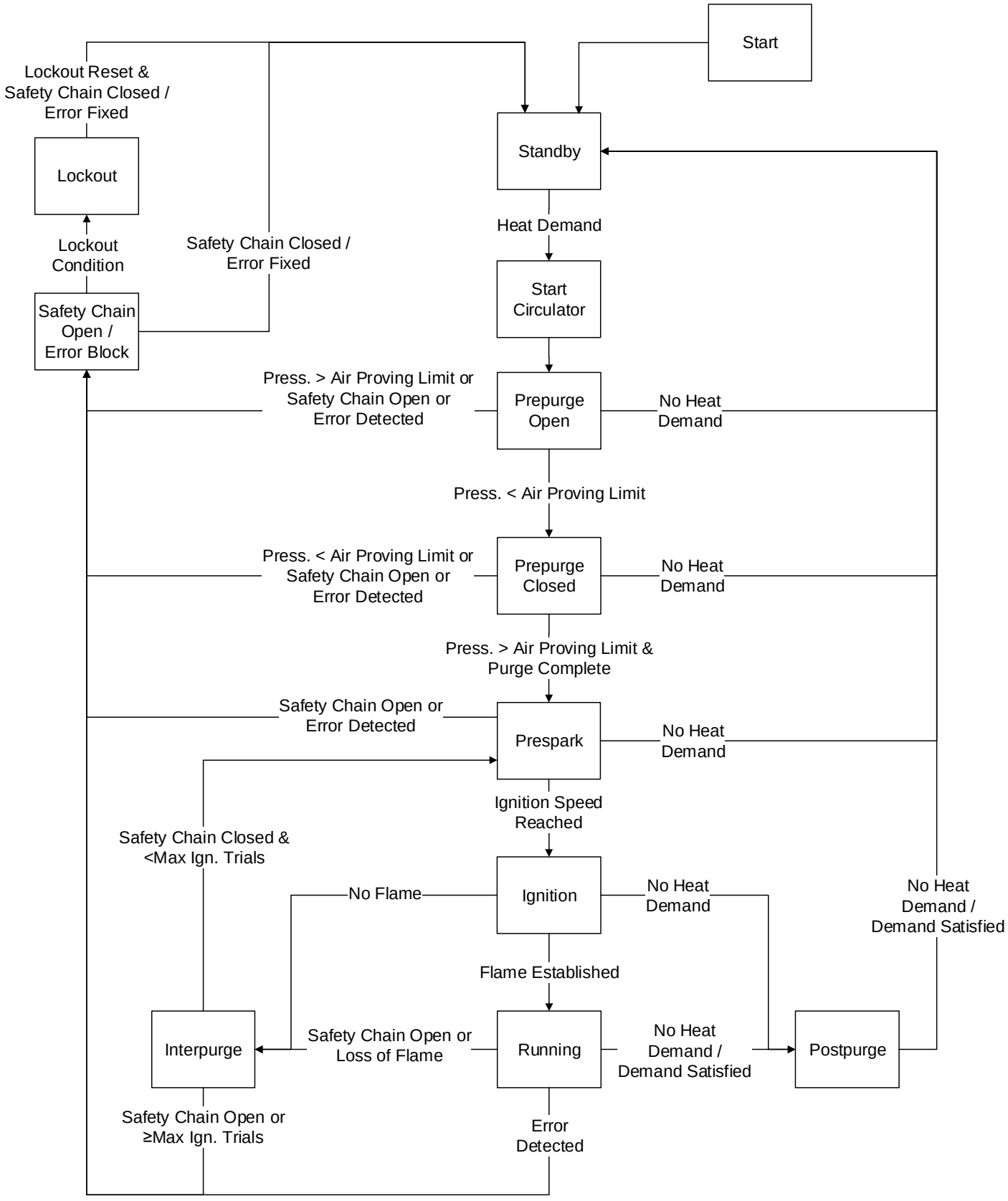


Figure 57. Sequence of Operations Flowchart

13.B Error Codes.

<table>
<tr><th>Condition</th><th>Information</th><th>Corrective Action(s)</th></tr>
<tr><td>Auto Reset High Limit - External</td><td>• The outlet water temperature has exceeded the field installed auto reset high limit setting.
• Auto-reset condition
• Annunciation – “Auto Reset High Limit - External” on Message Screen</td><td>• Verify that the system is full of water and all air has been purged from the system.
• Verify that the boiler/heater is piped properly into the heating system.
• Check for proper pump operations.
• Check the field installed auto reset high limit set point.
• If the unit does not include a field installed auto reset high limit, check that the jumper between terminals 13 and 14 of the low voltage board is installed properly.</td></tr>
<tr><td>Auto Reset High Limit - Onboard</td><td>• The outlet water temperature has exceeded the unit’s onboard auto reset high limit setting.
• Auto-reset condition
• Annunciation – “Auto Reset High Limit - Onboard” on Message Screen</td><td>• Verify that the system is full of water and all air has been purged from the system.
• Verify that the boiler/heater is piped properly into the heating system.
• Check for proper pump operations.
• Check the unit’s auto reset high limit set point.</td></tr>
<tr><td>Burner Parasitic Flame</td><td>• Flame has been detected on the burner prior to ignition.
• Manual-reset condition
• Annunciation – on Navigation Bar
Lockout: Burner Parasitic Flame</td><td>• Inspect the flame sensor and wiring for damage and continuity. Replace if necessary.</td></tr>
<tr><td>Condensate Level Switch Open</td><td>• The condensate trap water level is high.
• Auto-reset condition
• Annunciation – “Condensate Level Switch Open” on Message Screen</td><td>• Check that the condensate line and trap are not blocked and that condensate is draining properly.
• Check that the exhaust duct is not blocked.
• Check that the level switch at the top of the condensate trap is not stuck and moves freely.</td></tr>
<tr><td>DHW Probe</td><td>• The DHW probe is damaged or not properly connected.
• Auto-reset condition
• Annunciation – “DHW probe” on Message Screen</td><td>• Check the 2 DHW probe readings on the analog input screen.
• Check the wiring. The DHW probe is a dual element probe with 10K and 20K thermistors. Verify that the 10K sensor is wired to terminals 31 and 32 of the low voltage board and the 20K sensor is wired to terminals 33 and 34.
• Check the resistance of each sensor. A quick test is to measure resistance and verify one resistance is double the other. Replace if necessary. The table below gives the resistance of the probe at various temperatures.
<table>
<tr><th></th><th>10K</th><th>20K</th></tr>
<tr><th>Temp (°F)</th><th>Resistance (kΩ)</th><th>Resistance (kΩ)</th></tr>
<tr><td>50</td><td>20.3</td><td>40.5</td></tr>
<tr><td>55</td><td>17.7</td><td>35.3</td></tr>
<tr><td>60</td><td>15.5</td><td>30.9</td></tr>
<tr><td>65</td><td>13.6</td><td>27.1</td></tr>
<tr><td>70</td><td>11.9</td><td>23.8</td></tr>
<tr><td>75</td><td>10.5</td><td>21.0</td></tr>
<tr><td>80</td><td>9.3</td><td>18.6</td></tr>
<tr><td>85</td><td>8.2</td><td>16.4</td></tr>
<tr><td>90</td><td>7.3</td><td>14.6</td></tr>
</table></td></tr>
<tr><td>DHW Probe Drift</td><td>• The DHW probe is damaged or not properly connected.
• Auto-reset condition
• Annunciation – “DHW probe drift” on Message Screen</td><td>• Check the 2 DHW probe readings on the analog input screen.
• Check the wiring. The DHW probe is a dual element probe with 10K and 20K thermistors. Verify that the 10K sensor is wired to terminals 31 and 32 of the low voltage board and the 20K sensor is wired to terminals 33 and 34.
• Check the resistance of each sensor. A quick test is to measure resistance and verify one resistance is double the other. Replace if necessary. The</td></tr>
</table>

Error Codes (continued)

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<tr><td>Fan Speed Error</td><td>• The fan is unable to reach its target speed.
• Manual-reset condition
• Annunciation – on Navigation Bar
Lockout: Fan Speed Error</td><td>• Verify that the supply voltage to the boiler/heater is adequate. Refer to Section 8, Installation and Wiring.
• Check that the fan is powered and that it turns on when the unit first starts up.
• Check that both fan wiring harnesses are properly connected to the fan and the control board.
• Verify that the fan modulates according to the signal from the unit's control board.</td></tr>
<tr><td>Field Interlock Open</td><td>• The field interlock is open.
• Auto-reset condition
• Annunciation – "Field Interlock Open" on Message Screen</td><td>• Check the device wired to the field interlock for proper operation.
• If no device is connected to the field interlock, check that the jumper between terminals 11 and 12 of the low voltage board is installed properly.</td></tr>
<tr><td>Flow Switch Open</td><td>• There is insufficient water flow through the boiler/heater.
• Auto-reset condition
• Annunciation – "Flow switch Open" on Message Screen</td><td>• Faulty boiler/heater pump – replace pump.
• Faulty pump contactor – replace contactor.
• Blown boiler/heater pump fuse – replace fuse F14 on the control board.</td></tr>
<tr><td>Flue Probe</td><td>• The flue probe is damaged or not connected.
• Manual-reset condition
• Annunciation – on Navigation Bar
Lockout: Flue Probe</td><td>• Check the 2 flue probe sensor readings on the analog input screen.
• Check the wiring and verify that there is continuity between each probe wire and the control board.
• Check the probe resistance. The flue probe is a dual element probe with 10K and 20K thermistors. A quick test is to measure resistance and verify one resistance is double the other. Replace if necessary. The table below gives the resistance of the probe at various temperatures.

<table><tr><td rowspan="2">Temp (°F)</td><td>10K</td><td>20K</td></tr><tr><td>Resistance (kΩ)</td><td>Resistance (kΩ)</td></tr><tr><td>50</td><td>20.3</td><td>40.5</td></tr><tr><td>55</td><td>17.7</td><td>35.3</td></tr><tr><td>60</td><td>15.5</td><td>30.9</td></tr><tr><td>65</td><td>13.6</td><td>27.1</td></tr><tr><td>70</td><td>11.9</td><td>23.8</td></tr><tr><td>75</td><td>10.5</td><td>21.0</td></tr><tr><td>80</td><td>9.3</td><td>18.6</td></tr><tr><td>85</td><td>8.2</td><td>16.4</td></tr><tr><td>90</td><td>7.3</td><td>14.6</td></tr></table></td></tr>
<tr><td>Flue Probe Drift</td><td>• The 2 flue probe sensor readings do not agree.
• Manual-reset condition
• Annunciation – on Navigation Bar
Lockout: Flue Probe Drift</td><td>• Check the 2 flue probe sensor readings on the analog input screen.
• Check the wiring and verify that there is continuity between each probe wire and the control board.
• Check the probe resistance. The flue probe is a dual element probe with 10K and 20K thermistors. A quick test is to measure resistance and verify one resistance is double the other. Replace if necessary. The table below gives the resistance of the probe at various temperatures.</td></tr>
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Error Codes (continued)

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<tr><th>Condition</th><th>Information</th><th>Corrective Action(s)</th></tr>
<tr><td></td><td></td><td>
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<tr><td rowspan="2">Temp (°F)</td><td>10K</td><td>20K</td></tr>
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<tr><td>90</td><td>7.3</td><td>14.6</td></tr>
</table>
</td></tr>
<tr><td>Flue Probe High Limit</td><td>• The flue temperature has exceeded the unit's onboard flue probe high limit setting.
• Manual-reset condition
• Annunciation – on Navigation Bar
Lockout: Flue Probe High Limit</td><td>• Check the flue probe high limit set point.
• Inspect and clean the heat exchanger per Section 12.C.1.</td></tr>
<tr><td>High Air Proving Pressure</td><td>• During the Prepurge Open mode of the burner operating sequence, the pressure is above the Air Proving Limit.
• Manual-reset condition
• Annunciation – on Navigation Bar
Lockout: High Air Proving Press</td><td>• Verify that the pressure sense lines are not disconnected, kinked, or nicked.
• Check the wiring connections at the pressure transmitters and the control board (connector X22).
• Check the pressure levels on the analog input screen as the unit goes through its sequence of operation.</td></tr>
<tr><td>High Delta T</td><td>• The temperature rise (Delta-T) across the unit has exceeded the delta T maximum temperature setting.
• Manual-reset condition
• Annunciation – on Navigation Bar
Lockout: High Delta T</td><td>• Verify that the system is full of water and all air has been purged from the system.
• Verify that the boiler/heater is piped properly into the heating system.
• Check for proper pump operations. Refer to Section 5 for Pump Requirements. Verify that the pump meets the flow and head requirements specified.
• Check the delta T maximum temperature setting.</td></tr>
<tr><td>High Gas Pressure</td><td>• The high gas pressure switch has tripped.
• Manual-reset condition
• Annunciation – on Navigation Bar
Lockout: High Gas Pressure</td><td>• Refer to Section 4 for Gas Supply and Piping information. Verify that the gas supply pressure meets the requirements specified.
• If the unit does not include a high gas pressure switch, check that the jumper between terminals 17 and 18 of the low voltage board is installed properly.</td></tr>
<tr><td>High Pressure Drop</td><td>• The air-side pressure drop across the unit is too high.
• Manual-reset condition
• Annunciation – on Navigation Bar
Lockout: High pressure drop</td><td>• Refer to Section 3 for Venting and Combustion Air information. Verify that the vent and air intake installations meet the requirements specified.
• Check that the air inlet and exhaust ducts are not blocked.
• Check the cleanliness of the unit's air filter per Section 12.C.3.
• Verify that the pressure sense lines are not disconnected, kinked, or nicked.
• Check the wiring connections at the pressure transmitters and the control board (connector X22).
• Check the pressure levels on the analog input screen as the unit goes through its sequence of operation.</td></tr>
<tr><td>Inlet Probe</td><td>• The inlet probe is damaged or not connected.
• Manual-reset condition
• Annunciation – on Navigation Bar
Lockout: Inlet Probe</td><td>• Check the inlet sensor reading on the analog input screen.
• Check the wiring and verify that there is continuity between each probe wire and the control board.
• Check the probe resistance. The inlet probe is a single element probe with a 10K thermistor. A quick test is to measure resistance at room temperature and verify that it is approximately 10K. Replace if necessary. The table below gives</td></tr>
</table>

<table>
<tr><th>Condition</th><th>Information</th><th>Corrective Action(s)</th></tr>
<tr><td></td><td></td><td>the resistance of the probe at various temperatures.
<table><tr><th>Temp (°F)</th><th>Resistance (kΩ)</th></tr><tr><td>50</td><td>20.3</td></tr><tr><td>55</td><td>17.7</td></tr><tr><td>60</td><td>15.5</td></tr><tr><td>65</td><td>13.6</td></tr><tr><td>70</td><td>11.9</td></tr><tr><td>75</td><td>10.5</td></tr><tr><td>80</td><td>9.3</td></tr><tr><td>85</td><td>8.2</td></tr><tr><td>90</td><td>7.3</td></tr></table></td></tr>
<tr><td>Low Air Proving Pressure</td><td>• During the Prepurge Closed mode of the burner operating sequence, the pressure is below the Air Proving Limit.
• Manual-reset condition
• Annunciation – on Navigation Bar
Lockout: Low Air Proving Press</td><td>• Verify that the pressure sense lines are not disconnected, kinked, or nicked.
• Check the wiring connections at the pressure transmitters and the control board (connector X22).
• Check the pressure levels on the analog input screen as the unit goes through its sequence of operation.</td></tr>
<tr><td>Low Gas Pressure</td><td>• The low gas pressure switch has tripped.
• Manual-reset condition
• Annunciation – on Navigation Bar
Lockout: Low Gas Pressure</td><td>• Refer to Section 4 for Gas Supply and Piping information. Verify that the gas supply pressure is within the requirements specified.
• If the unit does not include a high gas pressure switch, check that the jumper between terminals 19 and 20 of the low voltage board is installed properly.</td></tr>
<tr><td>Low Water Cut Off</td><td>• The water level is insufficient or there is air trapped in the boiler/heater.
• Manual-reset condition
• Annunciation – on Navigation Bar
Lockout: Low Water Cut Off</td><td>• Verify that the system is full of water and all air has been purged from the system.
• Reset the LWCO by pushing the reset button on the LWCO module.
• If the unit does not include a LWCO, check that the jumper is installed properly on the low voltage board.</td></tr>
<tr><td>Manual Reset High Limit - External</td><td>• The outlet water temperature has exceeded the field installed manual reset high limit setting.
• Manual-reset condition
• Annunciation – on Navigation Bar
Lockout: Man Reset Hi Lim-External</td><td>• Verify that the system is full of water and all air has been purged from the system.
• Verify that the boiler/heater is piped properly into the heating system.
• Check for proper pump operations.
• Check the field installed manual reset high limit set point.
• If the unit does not include a field installed manual reset high limit, check that the jumper between terminals 15 and 16 of the low voltage board is installed properly.</td></tr>
<tr><td>Manual Reset High Limit - Onboard</td><td>• The outlet water temperature has exceeded the unit's onboard manual reset high limit setting.
• Manual-reset condition
• Annunciation – on Navigation Bar
Lockout: Man Reset Hi Lim-Onboard</td><td>• Verify that the system is full of water and all air has been purged from the system.
• Verify that the boiler/heater is piped properly into the heating system.
• Check for proper pump operations.
• Check the unit's onboard manual reset high limit set point.</td></tr>
<tr><td>Max Ignition Trials</td><td>• The maximum attempts for ignition have occurred without sensing flame.
• Manual-reset condition
• Annunciation – on Navigation Bar
Lockout: Max Ignition Trials</td><td>• Refer to Section 4 for Gas Supply and Piping information. Verify that the gas supply pressure meets the requirements specified.
• Verify proper operation of the gas valve.
• Remove and inspect the ignitor and flame sense electrodes per Section 12.C.4. Clean or replace as required.
• Remove and inspect the burner for cleanliness per Section 12.C.1.</td></tr>
</table>

Error Codes (continued)

<table>
<tr><th>Condition</th><th>Information</th><th>Corrective Action(s)</th></tr>
<tr><td>Outlet Probe</td><td>• The outlet probe is damaged or not connected.
• Manual-reset condition
• Annunciation – on Navigation Bar
Lockout: Outlet Probe</td><td>• Check the 2 outlet probe sensor readings on the analog input screen.
• Check the wiring and verify that there is continuity between each probe wire and the control board.
• Check the probe resistance. The outlet probe is a dual element probe with 10K and 20K thermistors. A quick test is to measure resistance and verify one resistance is double the other. Replace if necessary. The table below gives the resistance of the probe at various temperatures.
<table><tr><th></th><th>10K</th><th>20K</th></tr><tr><th>Temp (°F)</th><th>Resistance (kΩ)</th><th>Resistance (kΩ)</th></tr><tr><td>50</td><td>20.3</td><td>40.5</td></tr><tr><td>55</td><td>17.7</td><td>35.3</td></tr><tr><td>60</td><td>15.5</td><td>30.9</td></tr><tr><td>65</td><td>13.6</td><td>27.1</td></tr><tr><td>70</td><td>11.9</td><td>23.8</td></tr><tr><td>75</td><td>10.5</td><td>21.0</td></tr><tr><td>80</td><td>9.3</td><td>18.6</td></tr><tr><td>85</td><td>8.2</td><td>16.4</td></tr><tr><td>90</td><td>7.3</td><td>14.6</td></tr></table></td></tr>
<tr><td>Outlet Probe Drift</td><td>• The 2 outlet probe sensor readings do not agree.
• Manual-reset condition
• Annunciation – on Navigation Bar
Lockout: Outlet Probe Drift</td><td>• Check the 2 outlet probe sensor readings on the analog input screen.
• Check the wiring and verify that there is continuity between each probe wire and the control board.
• Check the probe resistance. The outlet probe is a dual element probe with 10K and 20K thermistors. A quick test is to measure resistance and verify one resistance is double the other. Replace if necessary. The table below gives the resistance of the probe at various temperatures.
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<tr><td>Pressure Sensor Drift</td><td>• The 2 pressure transmitter readings do not agree.
• Manual-reset condition
• Annunciation – on Navigation Bar
Lockout: Pressure Sensor Drift</td><td>• Verify that the pressure sense lines are not disconnected, kinked, or nicked.
• Check the wiring connections at the pressure transmitters and the control board (connector X22).
• Check the pressure levels on the analog input screen as the unit goes through its sequence of operation.</td></tr>
<tr><td>Pressure Sensor Fault</td><td>• The pressure transmitters are disconnected or faulty.
• Manual-reset condition
• Annunciation – on Navigation Bar
Lockout: Pressure Sensor Fault</td><td>• Verify that the pressure sense lines are not disconnected, kinked, or nicked.
• Check the wiring connections at the pressure transmitters and the control board (connector X22).
• Check the pressure levels on the analog input screen as the unit goes through its sequence of operation.</td></tr>
<tr><td>Thermal Cutout</td><td>• The temperature of the heat exchanger burner door has exceeded the limit of the thermal cutout.
• Manual-reset condition
• Annunciation – on Navigation Bar
Lockout: Thermal Cutout</td><td>• Remove the burner door of the heat exchanger per Section 12.C.1. Inspect the insulation, gasket, and the burner door for signs of damage and to verify proper assembly. Replace components as required.</td></tr>
</table>

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Notes:

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