

Installation and Operation Instructions for

MAGNATHERM® FT

MODULATING AND CONDENSING

20:1 TURNDOWN

LAARS LINC®

TRU TRAC®

Boiler

Model CFH1000
999 MBTU/h
Model CFH1500
1,500 MBTU/h

Model CFH2000
1,999 MBTU/h

Model CFH3000
3,000 MBTU/h

FOR YOUR SAFETY: This product must be installed and serviced by a professional service technician, qualified in hot boiler 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 unit.

WHAT TO DO IF YOU SMELL GAS

- Do not try to light any unit.
- 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 service 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.

H2407600E

LAARS® Heating Systems Company

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LAARS
Heating Systems Company

SECTION 1 General Information

1.A Introduction

This manual includes information which will help you to install, operate, and maintain the Laars Heating Systems MagnaTherm FT. Please read this manual completely before proceeding with the installation. If you have any questions regarding this equipment, please contact Laars Heating Systems, or your local Laars representative. Experience has shown that most operating problems are caused by improper installation.



1.B Model Identification

Primary information regarding your unit can be found on the **Rating Plate** on the outside face of the right-side panel.

1.C Warranty

LAARS Heating Systems MagnaTherm FT boilers are covered by a limited warranty. The owner should complete the warranty registration at

www.LAARS.com

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

1	2	3
C	F	H

Series
CFH- Commercial Fire Tube

4	5	6	7

Size / MBH			
1	0	0	0
1	5	0	0
2	0	0	0
3	0	0	0

8

Fuel
N- Nat

9

Construction
G- Standard
H- CSD-1

10

Electrical System
A- 120V, single ph (1000-2000)
F- 208V, single ph (1000-2000)
B- 220/240V, single ph (1000-2000)
C- 208V, three ph (2000-3000)
D- 480V, three ph (2000-3000)
E- 600V, three ph (2000-3000)

11
1

Revision
1- First

12

13

Waterway Options
X- 75psi PRV, std
A- 30psi PRV
B- 50psi PRV
C- 60psi PRV
E- 125psi PRV
F- 150psi PRV

Additional Options		
X- None	E- Gateway BACnet IP & alarm bell	H- Gateway LONworks & alarm bell
A- Gateway, BACnet IP	F- Gateway BACnet IP & high limits	J- Gateway LONworks & high limits
B- Gateway, LONworks	G- Gateway BACnet IP & alarm bell & high limits	K- Gateway LONworks & alarm bell & high limits
C- Alarm bell		L- Alarm & high limits
D- Auto/manual high limits (Additional)		

1.D Safety Notes

Safety Notes are used thoughout this manual to bring attention to the presence of hazards with various risk levels and to offer important information concering 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 changes to safety-related configuration parameters must only be done by experienced and/or licensed burner/boiler operators and mechanics.

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.

NOTE: This unit is protected against hydronic over-pressurization. A pressure relief valve is included with each unit.

⚠ WARNING

The inlet gas pressure to the unit must not exceed 13" W.C. (3.2kPa).

⚠ 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

Improper adjustment of the burners may lead to poor combustion quality, increasing the amount of carbon monoxide produced. Excessive carbon monoxide levels may lead to personal injury or death.

⚠ WARNING

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

AS REQUIRED BY THE STATE OF CALIFORNIA PROPOSITION 65.

⚠ 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.

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.

⚠ CAUTION

CO needs to be less than 150 ppm.

⚠ ATTENTION

Le CO doit être inférieur à 150 ppm

NOTE: 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.

REMARQUER : L'installateur doit vérifier qu'au moins un avertisseur de monoxyde de carbone a été installé dans un espace de vie résidentiel ou une maison en suivant les instructions du fabricant de l'avertisseur et les codes locaux applicables avant de mettre l'appareil en marche.

⚠ 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.

NOTE: FOR YOUR SAFETY READ BEFORE OPERATING

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

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

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

C. 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.

NOTE: POUR VOTRE SÉCURITÉ VEUILLEZ LIRE

AVERTISSEMENT : Si vous ne suivez pas ces instructions à la lettre, un incendie ou une explosion entraînant des dommages matériels, des blessures ou la perte de la vie."

A. Cet appareil n'a pas de pilote. Il est équipé d'un dispositif d'allumage qui allume automatiquement le brûleur. N'essayez pas d'allumer le brûleur à la main.

B. AVANT D'UTILISER L'odorat tout autour de l'appareil pour le gaz.

C. N'util˙ ›z pas cet appareil si une partie a été sous l˙eau. Appelez immédiatement un technicien de service qualifié pour inspecter l'appareil et remplacez toute partie du système de contrôle et toute commande qui ont été plongées dans l'eau.

1.E Venting Dimensions & Sizing

Model	Vent / Air Connector Size		Air Pipe Size		Maximum Ducted Air Pipe Length		Category IV Vent Pipe Size		Maximum Category IV Vent Pipe Length		Typical Category II Vent Pipe Size***	
	inches	*cm*	inches	*cm*	ft*	*m*	inches	*cm*	ft*	*m*	inches	*cm*
1000	6	*15*	6	*15*	100	*30.5*	6	*15*	100	*30.5*	12	*30*
1500	8	*20*	8	*20*	100	*30.5*	8	*20*	100	*30.5*	14	*36*
2000	8	*20*	8	*20*	100	*30.5*	8	*20*	100	*30.5*	18	*46*
3000	10	*25*	10	*25*	100	*30.5*	10	*25*	100	*30.5*	22	*56*

Table 1. Vent Sizing

*Equivalent Feet: Equivalent Feet: To calculate maximum equivalent length, measure the linear feet of the pipe and add 5 feet (1.5m) for each elbow used.

***Category II: Category II pipe size may vary. Draft must remain between -0.1 and -0.001" w.c..

1.F Dimensions

Model	"A"		"B"		"C"		"D"		"E"		"F"		"G"		"H"	
	in	*(cm)*	in	*(cm)*	in	*(cm)*	in	*(cm)*	in	*(cm)*	in	*(cm)*	in	*(cm)*	in	*(cm)*
1000	30.2	*(76.7)*	80.0	*(203)*	52.4	*(133)*	70.5	*(179)*	60.0	*(152)*	8.2	*(20.9)*	60.0	*(152)*	74.2	*(188)*
1500	30.2	*(76.7)*	80.0	*(203)*	52.4	*(133)*	70.5	*(179)*	60.0	*(152)*	7.8	*(19.7)*	60.3	*(153)*	74.2	*(188)*
2000	34.6	*(87.9)*	80.0	*(203)*	56.3	*(143)*	73.3	*(189)*	60.0	*(152)*	9.1	*(23.0)*	63.1	*(160)*	73.6	*(187)*
3000	34.6	*(87.9)*	80.0	*(203)*	56.3	*(143)*	75.5	*(192)*	60.0	*(152)*	8.4	*(21.4)*	65.4	*(166)*	73.6	*(187)*

Table 2. Dimensions

NOTES:

1. Installations in the U.S. require exhaust vent pipe that is CPVC complying with ANSI/ASTM D1785 F441, stainless steel complying with UL1738, or polypropylene complying with ULC S636.
2. Installations in Canada require exhaust vent pipe that is certified to ULC S636.
3. Intake (air) pipe must be PVC or CPVC that complies with ANSI/ASTM ANSI/ASTM D1527, stainless steel, or galvanized material. D1785 F441, ABS that complies with ANSI/ASTM D1527, stainless steel, or galvanized material.

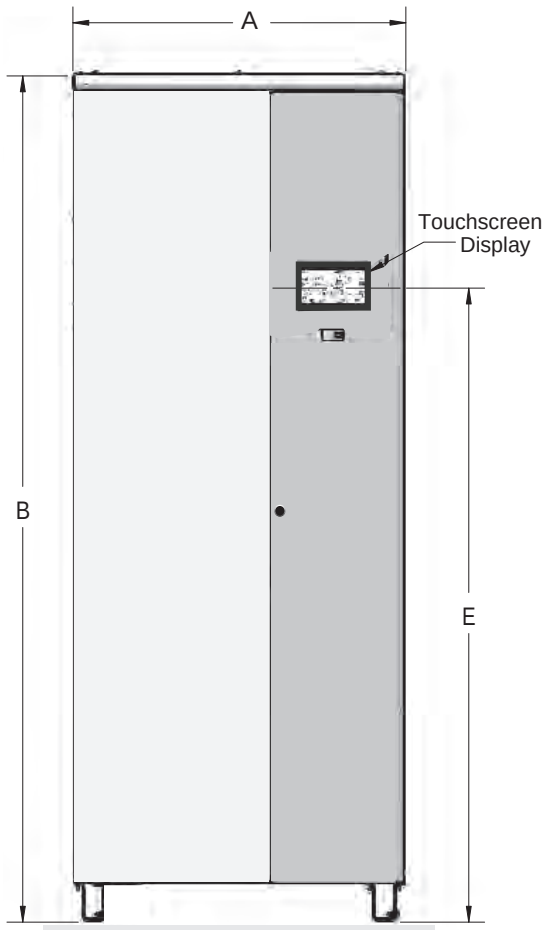
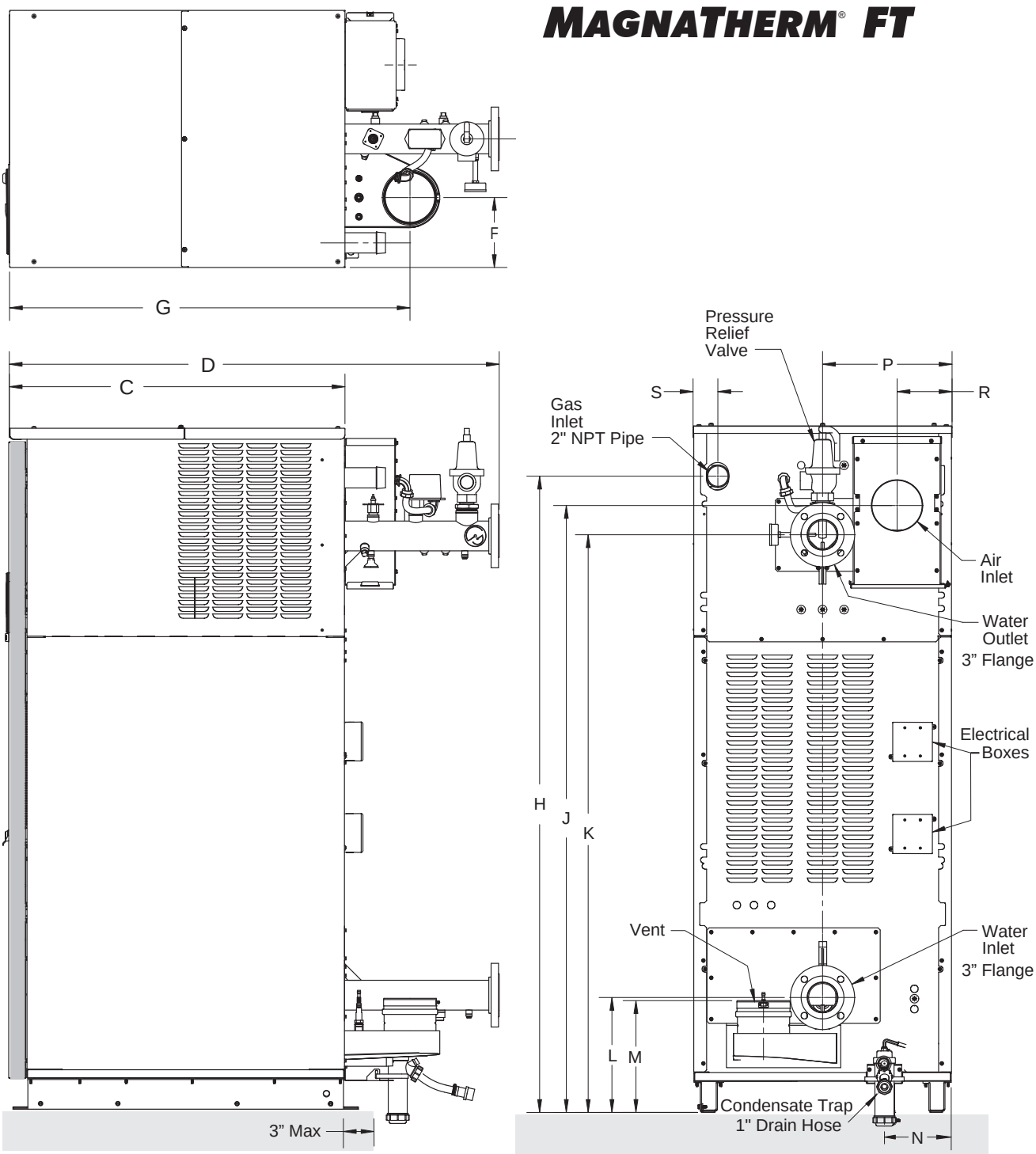


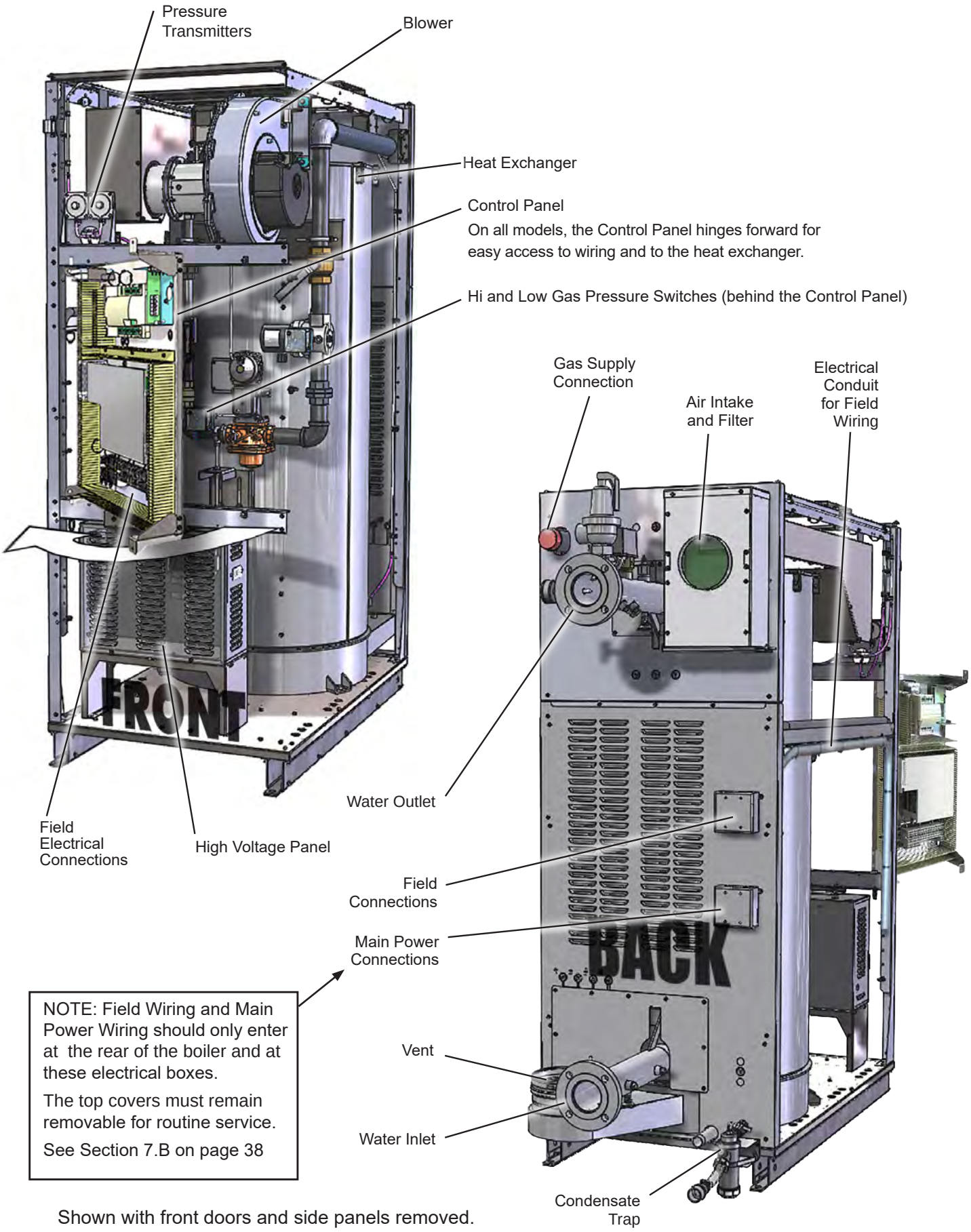
Figure 1. Dimensions

Model	"J"		"K"		"L"		"M"		"N"		"P"		"R"		"S"	
	in	*(cm)*	in	*(cm)*	in	*(cm)*	in	*(cm)*	in	*(cm)*	in	*(cm)*	in	*(cm)*	in	*(cm)*
1000	70.8	*(180)*	67.3	*(171)*	13.4	*(34.0)*	13.0	*(33.1)*	7.9	*(20)*	15.1	*(38.4)*	6.4	*(16.3)*	2.9	*(7.3)*
1500	70.8	*(180)*	67.3	*(171)*	13.4	*(34.0)*	13.0	*(33.1)*	7.9	*(20)*	15.1	*(38.4)*	6.4	*(16.3)*	2.7	*(6.9)*
2000	72.0	*(183)*	67.3	*(171)*	13.4	*(34.0)*	13.0	*(33.1)*	10.1	*(26)*	17.3	*(44.0)*	8.2	*(20.9)*	3.8	*(9.5)*
3000	72.0	*(183)*	68.4	*(174)*	14.4	*(36.6)*	14.0	*(35.5)*	10.1	*(26)*	17.3	*(44.0)*	8.2	*(20.9)*	3.6	*(9.1)*

Table 2. Dimensions (continued)



1.G Unit Overview



NOTE: Field Wiring and Main Power Wiring should only enter at the rear of the boiler and at these electrical boxes.

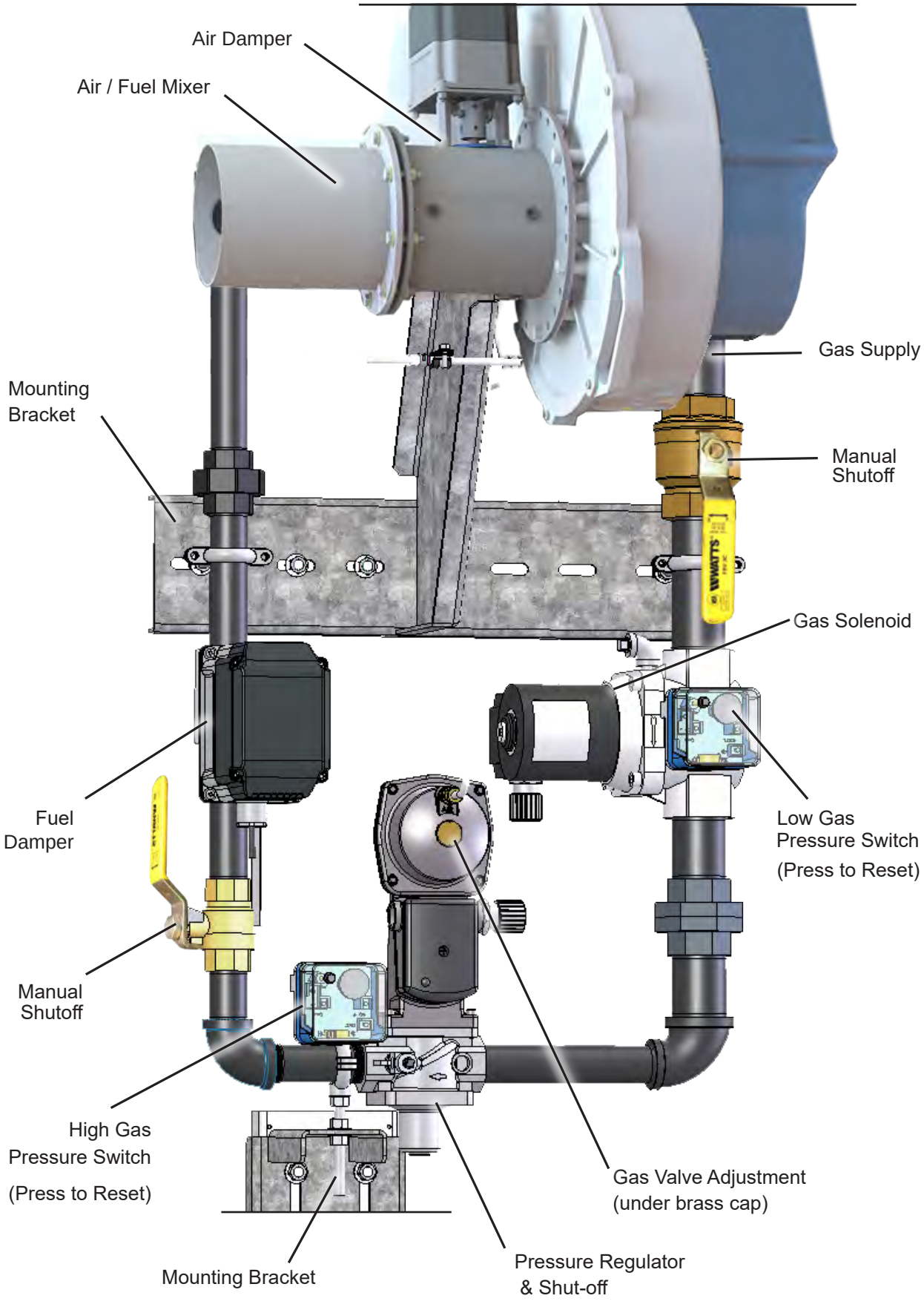
The top covers must remain removable for routine service.

See Section 7.B on page 38

Shown with front doors and side panels removed.

1.H Gas Train Components

The Gas Train for all sizes has the same general layout. The only difference between them is the size of the components and piping.



1.I Unpacking and the Install Kit

This unit is shipped in a single crate. Carefully disassemble the crate and inspect the unit for any damage during shipping. Included in the crate and yet outside of the unit is the 'Installation Kit' box.

Inspect the contents of the the Installation Kit box, making sure that all parts are included and not damaged.

1. Gromet, Nylon.
2. Box containing Outdoor Sensor
3. Box containing System Sensor
4. Tank Sensor
5. Spring Clip (used to hold tank sensor in sensor well)
6. Condensate Trap Assembly (some assembly required). Instructions are included with the kit or can be found in SECTION 6 on page 36 of this Installation Manual.
7. Installation Instructions for Sensor.

NOTE: A condensate neutralizer is NOT included.

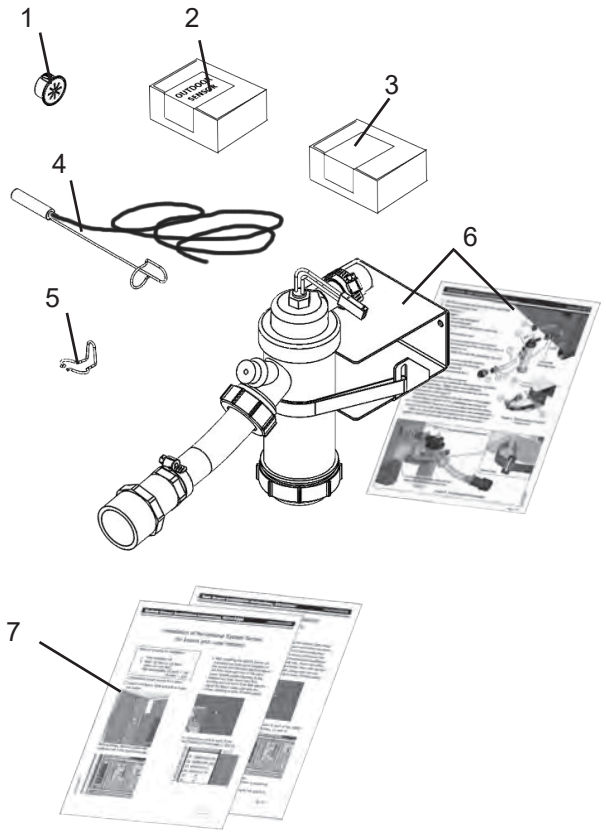


Figure 2. Installation Kit

1.J Locating the Unit

This unit may be installed indoors or outdoors. If installing outdoors in a location that may experience freezing temperatures, precautions must be taken to prevent water in the heat exchanger and condensate inside and outside of the boiler from freezing. Damage due to freezing water or condensate is not covered by the warranty.

Choose a location for the unit which allows clearances on all sides for maintenance and inspection. See Table 3.

Always install the unit on a firm, level surface. The unit must be installed on a 4" equipment pad or suitable blocking so that there is elevation for the condensate trap and condensate neutralizer (not included). See Figure 16 on page 36 for pad dimensions and condensate trap position.

The unit should not be located in an area where leakage of any connections will result in damage to the area adjacent to the unit, or to lower floors of the structure.

When this type of location is not available, install a suitable drain pan, adequately drained, under the unit.

This unit is design-certified by CSA-International for installation on combustible flooring; in basements; in utility rooms or alcoves**. Boilers must never be installed on carpeting.** The location for the unit should be chosen with regard to the vent pipe lengths and external plumbing.

The unit shall be installed such that the gas ignition system components are protected from water (dripping, spraying, rain, etc.) during operation and service (circulator replacement, control replacement, etc.).

When vented 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 local area, both terminals should be installed at an appropriate level above grade or the maximum expected snow line.

The dimensions and requirements that are shown in Table 3 must be met when choosing the location for the unit.

Ensure the location takes into account the maximum allowable vent length shown in SECTION 2 of this manual.

NOTE : The unit shall be installed such that the gas ignition system components are protected from water (dripping, spraying, rain, etc.) during operation and service (circulator replacement, control replacement, etc.).

1.K Clearances

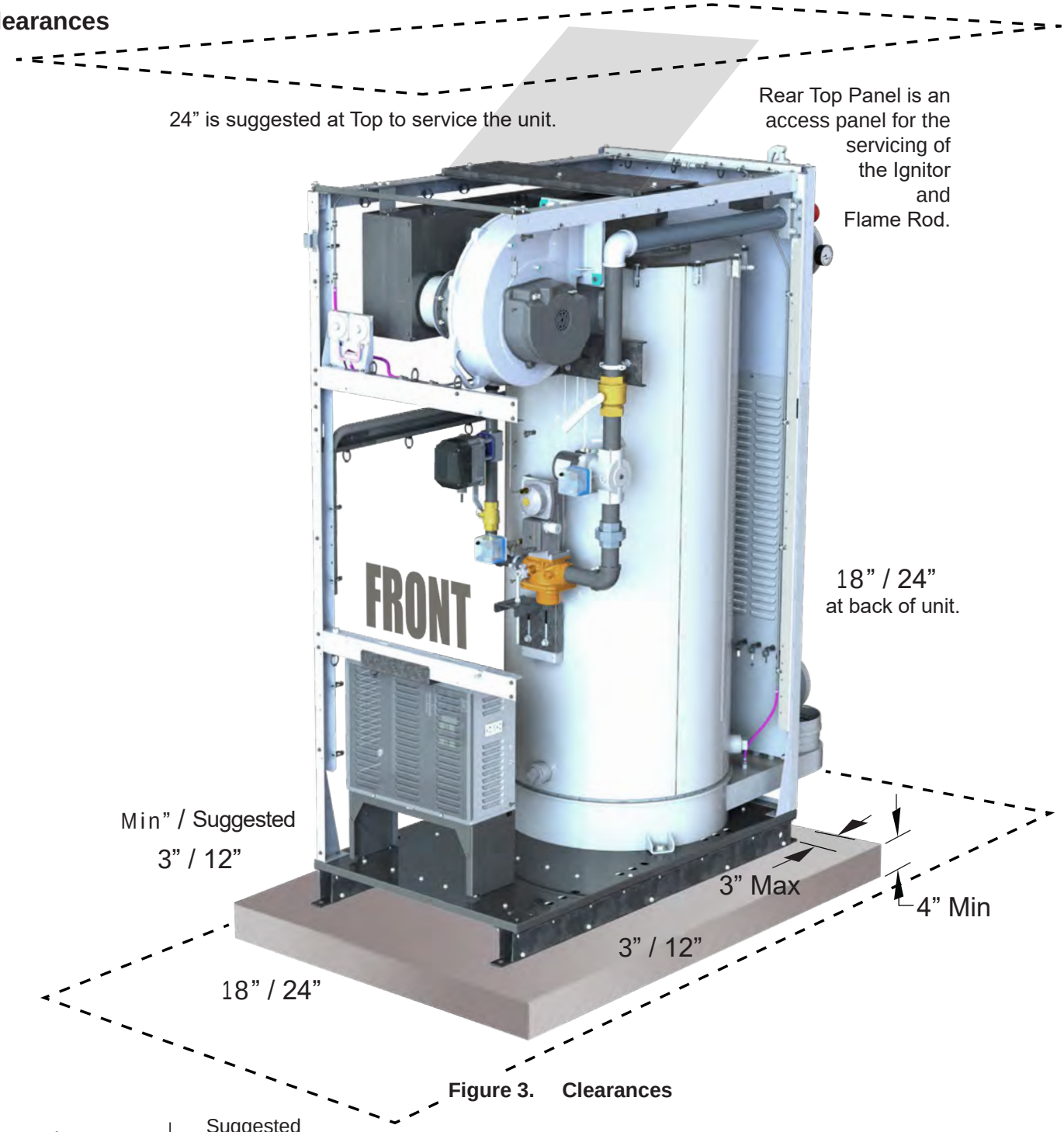


Figure 3. Clearances

	Minimum Clearance to Combustibles		Suggested Service Clearance	
	inches	*cm*	inches	*cm*
Front	18	*46*	24	*61*
Back	18	*46*	24	*61*
Left	3	*8*	12	*30*
Right	3	*8*	12	*30*
Top	3	*8*	24*	*61*

Table 3. Clearances

NOTES : A 4” high equipment pad is required. This pad must NOT extend more than 3” beyond the boiler base structure at the rear of the boiler.

*24” top clearance is required to service the unit.

SECTION 2 Venting and Combustion Air

2.A General Venting Information

⚠ 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

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

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 Cat 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.

⚠ 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, CSAB149.2 and ULC S636. Failure to follow this manual and applicable codes may lead to property damage, severe injury, or death.

NOTE: For Category II and IV boilers, the horizontal runs must be sloping upwards not less than 1/4 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.

ATTENTION: Pour la catégorie II & IV, les chaudières ont horizontal en pente vers le haut au moins 1/4 de pouce par pied (21 mm/m) à partir de la chaudière pour l'évent borne; être installé de façon à éviter l'accumulation de condensats; et, le cas échéant, ont des moyens prévus pour l'évacuation des condensats.

If the system temperatures are unknown at the time of installation, class IIC or higher venting material is recommended.

This unit is certified to vent as a Category II (negative pressure condensing) or Category IV (positive pressure condensing) appliance. It may be installed with vent materials meeting the standards listed in Table 6.
The vent can terminate through the roof, or through an outside wall.

All installations must be done following the vent supplier's recommended installation techniques. If these are not available, refer to the manufacturer recommendations for the material used.

The boilers are outfitted with vent connections consisting of Duravent FasNSeal female fittings of the nominal size listed in Table 10 on page 17.

The intake connections are sheet metal collars with an outer diameter 0.060" less than the nominal size listed in Table 10. For example, the outer diameter of the 8" intake is 7.94".

2.B Vent and Air Pipe Material

This unit requires a special venting system. Refer to venting supplier's instructions for complete parts list and method of installation. The manufacturers and product lines listed in Table 4 and Table 5 have been tested and authorized 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.

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.

2.B.1 Venting Requirements Unique to Canada

These high efficiency boilers are Vent Category II and IV units. Per the requirements of CAN/CSA-B149.1, only BH vent systems can be connected to these units and such vent systems, either ULC S636 certified stainless steel or other ULC S636 certified BH vent (eg. plastics) must be installed per the vent manufacturer's certified installation instructions.

It is the responsibility of the appropriately licensed technician installing this unit to use ULC S636 certified vent material consistent with the requirements as described in the Venting and Combustion Air section.

Class I venting systems are suitable for gas-fired units producing flue gas temperature of more than 135°C (275°F), but not more than 245°C (473°F).

Class II venting systems are suitable for gas-fired units producing flue gas temperatures of 135°C or less.

Class II venting systems are further classified into four temperature ratings as follows:

A Up to and including 65°C / 149°F

B Up to and including 90°C / 194°F

C Up to and including 110°C / 230°F and

D Up to and including 135°C / 275°F

2.B.1.a Flue Gas Sampling Port

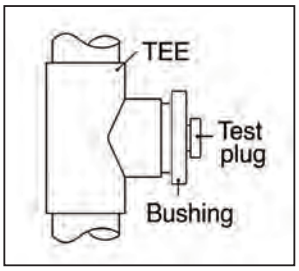


Figure 4. Test Port

It is also the responsibility of the installer to ensure that a flue gas sampling port is installed in the vent system. This flue gas sampling port must be installed near the flue connection of the unit: within 2 feet of the flue connection. There is no flue gas sampling port internal to the unit, so one must be installed in the vent system external to the unit. A flue gas sampling port available

	Manufacturer Model Numbers (abbreviated)		
Example Components	**Heatfab®**	**Duravent®**	**Z-Flex®**
	Trade Name/Model		
	Saf-T Vent®	**FasNSeal®**	**Z-Vent®**
90° Elbow	9**D**14	FSELB90**DD**	2SVEE**DD**90
Pipe	9**DLL***	FSVL**LDD**	2SVEP**DDLL**
Boiler Adapter	9**D**01MAD	N/A	2SVAFN**DD**
Horizontal Termination (Bird Screen)	9**D**92	FSBS**D**	2SVSTPX**DD**
Vertical Termination (Rain Cap)	5**D**00CI	FSRC**D**	2SVSRC**DD**
Inlet Air Termination	9**D**14TERM	FSAIH06**	2SVEE**DD**90 with 2SVSTPX**DD**
Adapter, SS to CPVC	N/A	FSA-**D**FNSM-**D**PVCF	N/A
Manf. Approved Hanger Straps	Distance between Hanger Straps (Horizontal Run) = 6' MAX	Distance between Hanger Straps (Horizontal Run) = 6' MAX	Distance between Hanger Straps (Horizontal Run) = 4' MAX
	Distance between Hanger Straps (Vertical Run) = 30' MAX	Distance between Hanger Straps (Vertical Run) = 12' MAX	Distance between Hanger Straps (Vertical Run) = 16' MAX
	*Check Maf. Catalog for Pipe Length Code Options	**Only Avail. In 6"	

NOTES:
1. A bolded uppercase D (**D**) is used in place of the Diameter (inches) needed. In some cases a Single Digit Diameter is written with a 0 in front.
2. A bolded uppercase L (**L**) is used in place of the Length Needed. See Manufacturers Catalog for a particular application
3. The **D's** and **L's** refer to variations in nominal size. See Manufacturers Catalog for a particular application

Table 4. Allowable Single Wall Stainless Steel Vent Suppliers and Part Numbers

	Manufacturer Model Numbers (abbreviated)	
Example Components	**CentroTherm**	**Duravent®**
	Trade Name/Model	
	InnoFlue®	**PolyPro®**
Single Wall Pipe	ISVL**DDLL**	**D**PPS-**LL**L****
Elbow	ISEL**DD**87* ISELS0887 (8" ONLY)	**D**PPS-E90L****
Boiler Adapter	ISSA**DDDD****	810007030-FSA-06M-6PPF (6" ONLY) 810007031-FSA-08M-8PPF (8" ONLY)
Horizontal Termination (Bird Screen)	IASPP06 (6" ONLY, fits within InnoFlue® SW Pipe) IASSS**DD*****	**D**PPS-HSTL****
Vertical Termination (Rain Cap)	ISTT**DD**20	**D**PPS-VTML****
Manf. Approved Hanger Straps	Distance between Hanger Straps (Horizontal Run) = 3' MAX	Distance between Hanger Straps (Horizontal Run) = 5' MAX
	Distance between Hanger Straps (Vertical Run) = 6' MAX	Distance between Hanger Straps (Vertical Run) = 10' MAX
	*(For Diameters: 6", 10", 12") **There are 4 **D's** because the diameter is repeated. Example: 6" would be ISSA0606 ***(For Diameters: 8", 10", 12")	****(6" and 8" ONLY)

NOTES:
1. A bolded uppercase D (**D**) is used in place of the Diameter (inches) Needed. In some cases a Single Digit Dia is written with a 0 in front.
2. A bolded uppercase L (**L**) is used in place of the Length Needed. See Manufacturer's Catalog for a particular application
3. The **D's** and **L's** refer to variations in nominal size. See Manufacturer's Catalog for a particular application

Table 5. Allowable Polypropylene Vent Manufacturers / Trade Names

as a component of the ULC S636 certified vent system is preferred. However, if one is not available with the certified vent system, 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 resealable with a cap or other means to ensure the vent system remains sealed. (See Figure 4)

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.

2.B.1.b Exhaust Vent Terminal

An exhaust vent terminal must be installed. If an exhaust vent terminal is not available with the certified vent system, the manufacturer suggests the use of a coupler fitting from the certified vent system into which the vent terminal screen can be installed. Be sure to install and terminate both vent and combustion air pipes per the instructions in this section.

2.C Vent and Air Pipe Sizing

This unit is certified to vent as a Category II or Category IV 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.

The venting must be correct to allow the condensate to run back to the unit to drain. Route the vent pipe to the boiler as directly as possible. Seal all joints. Provide adequate hangers as required in the venting system manufacturer's Installation Instructions, or at least every 4 feet.

The unit must not support the weight of the vent pipe. **The maximum equivalent pipe length allowed is 100 feet (30.5m).** Each elbow is considered to be 5 feet (1.5m). The manufacturer offers accessory kits to use with horizontal and vertical exhaust vent systems, as shown in Table 7.

Installation Standards		
Material	**United States**	**Canada**
Stainless steel	UL 1738	Venting must be ULC S636 certified for use as venting material. The venting material class must be chosen based upon the intended application of the boiler and must be installed according to the maximum flue gas temperature and the vent manufacturer's instructions.
CPVC, sch 40	ANSI/ASTM F441	
Polypropylene	ULC S636 Class 2C	

Table 6. Required Exhaust Vent Material

	Model 1000	Model 1500	Model 2000	Model 3000
Horizontal vent terminal for stainless steel	D2012004	D2012001	D2012001	D2012002
Screen for horizontal CPVC vent	CA012104	CA012101	CA012101	CA012102
Screen for vertical stainless steel vent	CA011904	CA011901	CA011901	CA011902
Screen for vertical CPVC vent	CA012504	CA012501	CA012501	CA012502

Table 7. Exhaust Vent Accessories

Material	**United States**	**Canada**
ABS	ANSI/ASTM D1527	The air pipe material must be chosen based upon the intended application of the boiler and must be installed according to the vent manufacturer's installation instructions.
PVC, sch. 40	ANSI/ASTM D1785 or D2665	
CPVC, sch. 40	ANSI/ASTM F441	
Single wall galv. steel	26 gauge	
Polypropylene	ULC S636 Class 2C	

NOTE: The use of PVC or CPVC schedule 80 is not permitted.

Table 8. Required Combustion Air Pipe Material

	Model 1000	Model 1500	Model 2000	Model 3000
Screen for horizontal galvanized air pipe	D2012104	D2012101	D2012101	D2012102
Screen for horizontal PVC air pipe	CA012004	CA012001	CA012001	CA012002
Screen for horizontal polypropylene air pipe	CA012200	CA012201	CA012201	CA012202
Screen for vertical galvanized air pipe	D2012204	D2012201	D2012201	D2012202
Screen for vertical polypropylene air pipe	CA012604	CA012601	CA012601	CA012602

Table 9. Ducted Air Accessories

2.C.1 Category IV Vent Sizes

Positive pressure vent systems may be either horizontally or vertically vented. The vent pipe used must be suitable for positive pressure. Table 10 shows the pipe size and allowable maximum equivalent of piping allowed for both air and vent in a Category IV system.

The forced draft combustion air blower in the unit has sufficient power to vent properly when the guidelines in Section 1.E are followed.

⚠ WARNING

Cat IV venting must be installed with appropriate condensate traps and using only specific manufacturers, models and materials as outlined in this manual.

⚠ WARNING

All non-metallic vent pipe (PVC, CPVC, Polypropylene, or others) shall not be insulated or covered.

2.C.2 Category II Vent Sizes

Non-positive pressure vent systems are generally vertically terminated. Table 10 gives guidelines for vent and air pipe sizes.

⚠ WARNING

Cat II venting must be installed such that draft must always remain between -0.1” and -0.001” 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.

2.C.3 Common Venting

This unit can be common vented, however, the common venting must be a professionally designed and approved system. See Document 1396.pdf ***Application Guide for Common Venting (commercial condensing)***, available online at the manufacturers website. See Back Cover for website.)

Category II and IV units are never permitted to share a vent with any Category 1 units.

Model	Vent / Air Connector Size		Air Pipe Size		Maximum Ducted Air Pipe Length		Category IV Vent Pipe Size		Maximum Category IV Vent Pipe Length		Typical Category II Vent Pipe Size***	
	inches	*cm*	inches	*cm*	ft*	*m*	inches	*cm*	ft*	*m*	inches	*cm*
1000	6	*15*	6	*15*	100	*30.5*	6	*15*	100	*30.5*	12	*30*
1500	8	*20*	8	*20*	100	*30.5*	8	*20*	100	*30.5*	14	*36*
2000	8	*20*	8	*20*	100	*30.5*	8	*20*	100	*30.5*	18	*46*
3000	10	*25*	10	*25*	100	*30.5*	10	*25*	100	*30.5*	22	*56*

*Equivalent Feet: Equivalent Feet: To calculate maximum equivalent length, measure the linear feet of the pipe and add 5 feet (1.5m) for each elbow used.

***Category II: Category II pipe size may vary. Draft must remain between -0.1 and -0.001" w.c..

Notes:

1. Installations in the U.S. require exhaust vent pipe that is CPVC complying with ANSI/ASTM D1785 F441, stainless steel complying with UL1738, or polypropylene complying with ULC S636.
2. Installations in Canada require exhaust vent pipe that is certified to ULC S636.
3. Intake (air) pipe must be PVC or CPVC that complies with ANSI/ASTM D1785 F441, ABS that complies with ANSI/ASTM D1527, stainless steel, or galvanized material.

Table 10. Vent Sizing

2.C.4 Common Vent Test

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

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 units remaining connected to it.

At the time of removal of an existing boiler, the following steps shall be followed with each unit remaining connected to the common venting system placed in operation, while the other units remaining 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 or 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 units remaining connected to the common venting system are located and other spaces of the building. Turn on any clothes dryers and any unit 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 unit being inspected. Follow the startup instructions. Adjust thermostat so unit will operate continuously.
5. Test for spillage at the draft hood relief opening after five 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 unit remaining connected to the common venting system properly vents when tested as outlined above, return the doors, windows, exhaust fans, fireplace dampers and any other gas burning unit to their previous conditions 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 and/or CAN/CSA B149.1, National Gas and Propane Installation Code. When resizing any portion of the common venting system, the common venting system should be resized to approach the minimum size as determined using the appropriate tables in Appendix F in the National Fuel Gas Code, ANSI Z223.1 NFPA 54 and/or CAN/CSA B149.1, National Gas and Propane Installation Code.

Au moment du retrait d'une chaudiére existante, les mesures suivantes doivent être prises pour chaque appareil toujurs raccordé au systéme d'évacuation commun et qui fonctionne alors que d'autres appareils toujours raccordés au système d'évacuation ne fonctionnent pas:

Au moment de la sortie d'une chaudière existante, la procédure suivante doit être suivie avec chaque appareil reste connecté au système de ventilation communs placés dans l'exploitation, tandis que les autres appareils reste connecté au système de ventilation communs ne sont pas en fonctionnement.

1. Sceller toutes les ouvertures non utilisées du système d'évacuation.
2. Inspecter de facon 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, 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 et toutes les portes entre l'espace où les appareils toujours raccordés au système d'évacuation sont installés et les autres espaces du bâtiment. Mettre en march les sécheuses, tous les appareils non raccordés au système d'évacuation commun et tous les ventilateurs d'extraction comme les hottes de cuisinière et les ventilateurs des salles de bain. S'assurer que ces ventilateurs fonctionnent à la vitesse maximale. Ne pas faire fonctionner les ventilateurs d'été. Fermer les registres des cheminées.
4. Mettre l'appareil inspecté en marche. Suivre les instructions d'allumage. Régler le thermostat de facon que l'appareil fonctionne de facon continue.
5. Faire fonctionner le brûleur principal pendant 5 min ensuite, déterminer si le coup-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 déterminеé, selon la méthode indiquée ci-dessus, que chaque appareil raccordé au système d'évacuation est mis à l'air libre de facon adéquate. Remettre les portes et les fenêtres, les vientilateurs, les registre de cheminées et les appareils au gaz àleur position originale.
7, Tout mauvais fonctionnement du système d'évacuation commun devrait être corrigé de facon que l'installation soit conforme au National Fuel Gas Code, ANSI Z223.1/NFPA 54 et (ou) aux codes d'installation CAN/CSA-B149.1. Si la grosseur d'une section du système d'évacuation doit être modifié pour respecter les valeurs minimales des tableaux pertinents de l'appendice F du National Fuel Gas Code, ANSI Z223.1/NFPA 54 et (ou) aux codes d'installation CAN/CSA-B149.1.

2.C.5 Combustion Air

Boilers must have provisions for combustion and ventilation air in accordance with the applicable requirements for Combustion Air Supply and Ventilation in the National Fuel Gas Code, ANSI Z223 1; or in Canada, the Natural Gas and Propane Installation Code, CSA B149.1. All applicable provisions of local building codes must also be adhered to.

This unit can take combustion air from the space in which it is installed, or the combustion air can be ducted directly to the unit. Combustion and ventilation air must be provided in either case.

2.C.5.a 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. (See the following descriptions.) 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” (30 cm) of the top and one commencing within 12” (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 to the outdoors through vertical ducts, each opening shall have a minimum free area of 1 square inch per 4000 Btu/hr (550 square mm/kW) of total input rating of all equipment in the enclosure. When communicating to the outdoors through horizontal ducts, each opening shall have a minimum free area of not less than 1 square inch per 2000 Btu/hr (1100 square mm/kW) of total input rating of all equipment in the enclosure.

Method 2: One permanent opening, commencing within 12” (300 mm) 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 3000 Btu/hr (734 square mm/kW) of the total input rating of all equipment located in the enclosure. This opening must not be less than the sum of the areas of all vent connectors in the confined space.

Other methods of introducing combustion and ventilation air are acceptable, providing 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 CAN/CSA B149.

2.C.5.b Ducted Combustion Air

The combustion air can be taken through the wall, or through the roof. The manufacturer offers accessories to use with ducted air systems, as shown in Table 9.

See Table 8 to select the appropriate diameter air pipe. When taken from the roof, a field-supplied rain cap or an elbow arrangement must be used to prevent entry of rain water. (See Figure 7).

Use ABS, PVC, CPVC, polypropylene, stainless steel, or galvanized pipe for the combustion air intake (See Table 8 for allowable materials). The intake must be sized per Table 1 on page 8. Route the intake to the boiler as directly as possible. Seal all joints. Provide adequate hangers. The unit must not support the weight of the combustion air intake pipe. The maximum equivalent pipe length allowed is 100 feet (30 m). Each elbow is considered to be 5 feet (1.5m).

When using polypropylene or stainless steel materials in horizontal duct configurations, a single elbow must be installed on the end of the air inlet to act as an outdoor terminal. In vertical duct applications, two elbows must be installed on the end of the inlet to act as a vent terminal. When elbows are use as terminals, appropriate screens must be installed to prevent blockage.
The elbow(s) required for termination are not included in the kits shown in Table 9.

The connection for the intake air pipe is on the back panel.

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.

2.D Locating the Vent and Combustion Air Terminals

2.D.1 Side-wall Vent Terminal

The appropriate side-wall vent terminal must be used. The terminal must be located in accordance with ANSI Z223.1/NFPA 54 and applicable local codes. In Canada, the installation must be in accordance with CSA B149.1 or .2 and local applicable codes.

Consider the following when installing the terminal:

1. Figure 6 on page 22 shows the requirements for mechanical vent terminal clearances for the U.S. and Canada.
2. Vent terminals for condensing units or units with condensing vents are **not** permitted to terminate above a public walkway, or over an area where condensate or vapor could create a nuisance or hazard.
3. Locate the vent terminal so that vent gases cannot be drawn into air conditioning system inlets.
4. Locate the vent terminal 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.
5. Locate the vent terminal so that it cannot be blocked by snow. The installer may determine that a vent terminal must be higher than the minimum shown in codes, depending upon local conditions.
6. Locate the terminal so the vent exhaust does not settle on building surfaces or other nearby objects. Vent exhaust bi-products may damage surfaces or objects.
7. If the boiler or boiler uses ducted combustion air from an intake terminal located on the same wall, see See Figure 6 on page 22 for proper spacing and orientation.

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.

		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.

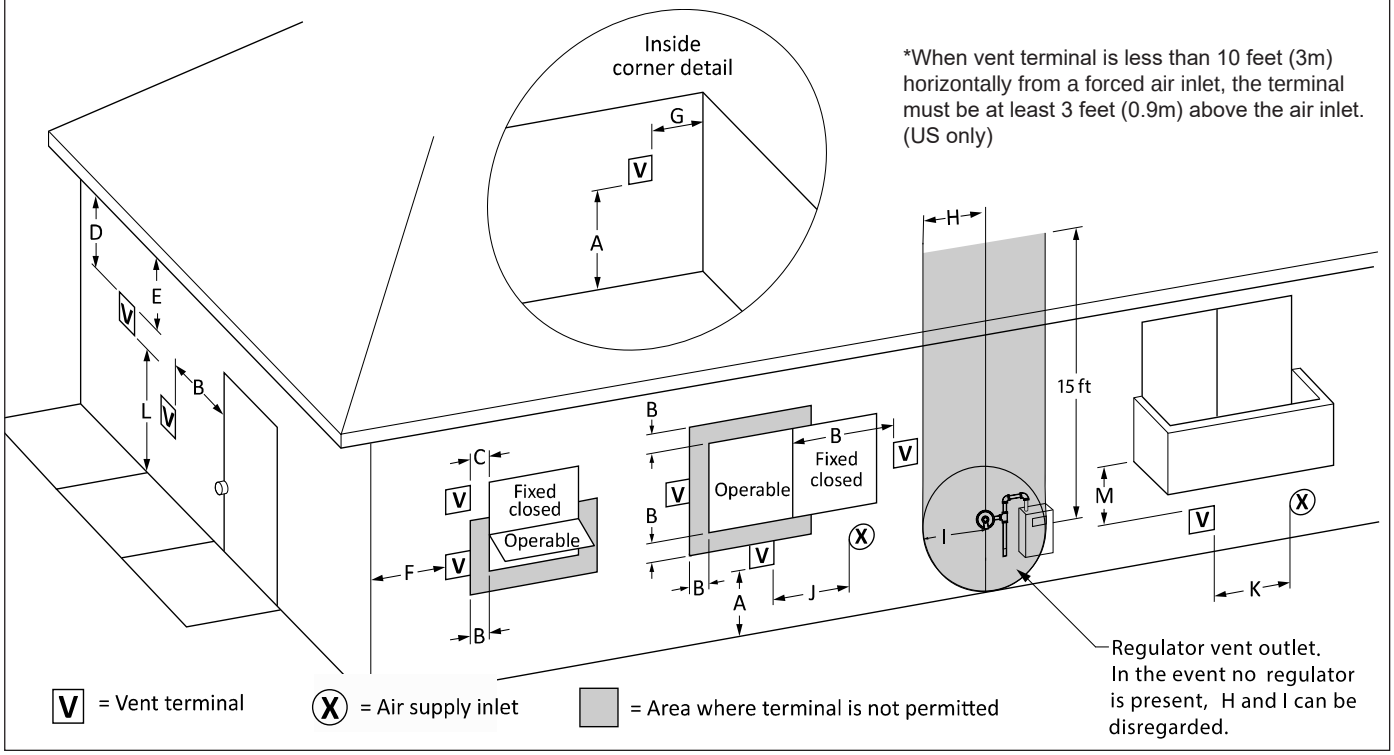


Figure 5. Combustion Air and Vent Through Side-wall.

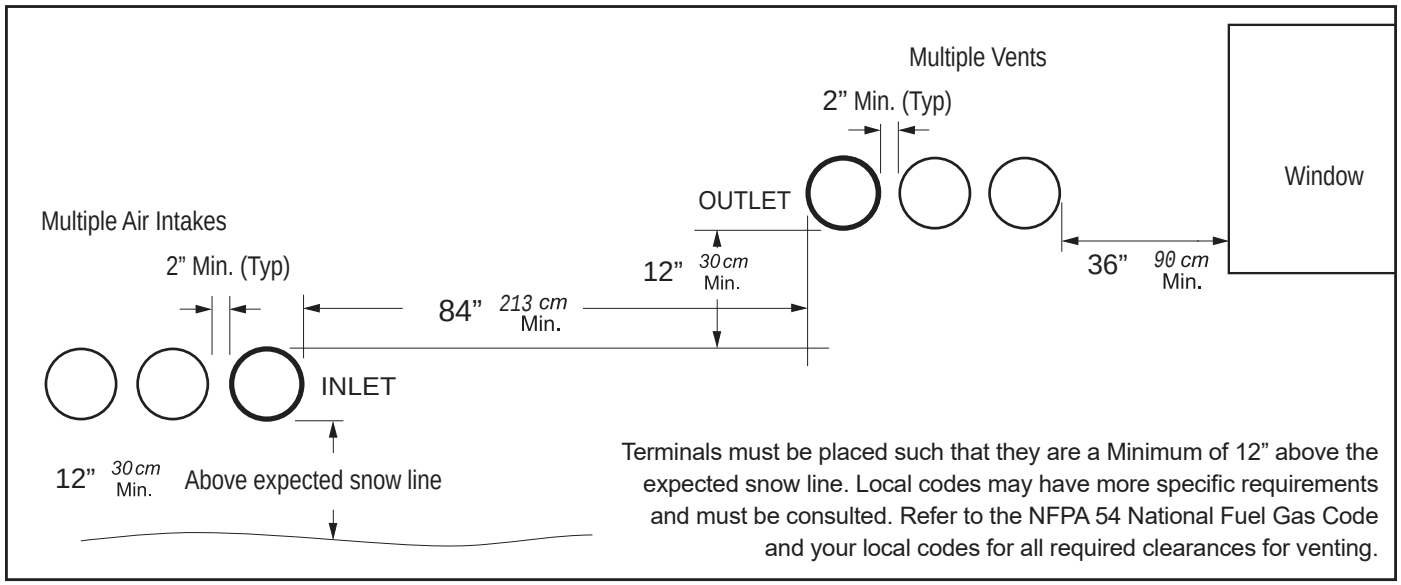


Figure 6. Sidewall Vent and Air Terminals

2.D.2 Side-wall Combustion Air Terminal

Consider the following when installing the terminal.

1. Do not locate the air inlet terminal near a source of corrosive chemical fumes (e.g., cleaning fluid, chlorine compounds, etc.).
2. Locate the terminal so that it will not be subject to damage by accident or vandalism. It must be at least 7 feet (2.1 m) above a public walkway.
3. Locate the combustion air terminal so that it cannot be blocked by snow. The National Fuel Gas Code requires that it be at least 12 inches (30 cm) above grade, but the installer may determine it should be higher, depending upon local conditions.
4. If the unit is side-wall vented to the same wall, use Figure 6 to determine the proper mounting locations.
5. Multiple vent kits should be installed such that the horizontal distance between outlet group and inlet group is 84” (213 cm). (See Figure 6)
6. The vent outlet must be at least 12” above the top of the air inlet, and must be at least 84” (213 cm) horizontally from the air inlet. (See Figure 6).

2.D.3 Vertical Vent Terminal

When the unit is vented through the roof, the vent must extend at least 3 feet (0.9 m) above the point at which it penetrates the roof. It must extend at least 2 feet (0.6 m) higher than any portion of a building within a horizontal distance of 10 feet (3.0 m), and high enough above the roof line to prevent blockage from snow. When the combustion air is taken from the roof, the combustion air must terminate at least 12” (30 cm) below the vent terminal.

2.D.4 Vertical Combustion Air Terminal

When combustion air is taken from the roof, a field-supplied rain cap or an elbow arrangement must be used to prevent entry of rain water. The opening on the end of the terminal must be at least 12” (30 cm) above the point at which it penetrates the roof, and high enough above the roof line to prevent blockage from snow. When the vent terminates on the roof, the combustion air must terminate at least 12” (30 cm) below the vent terminal.

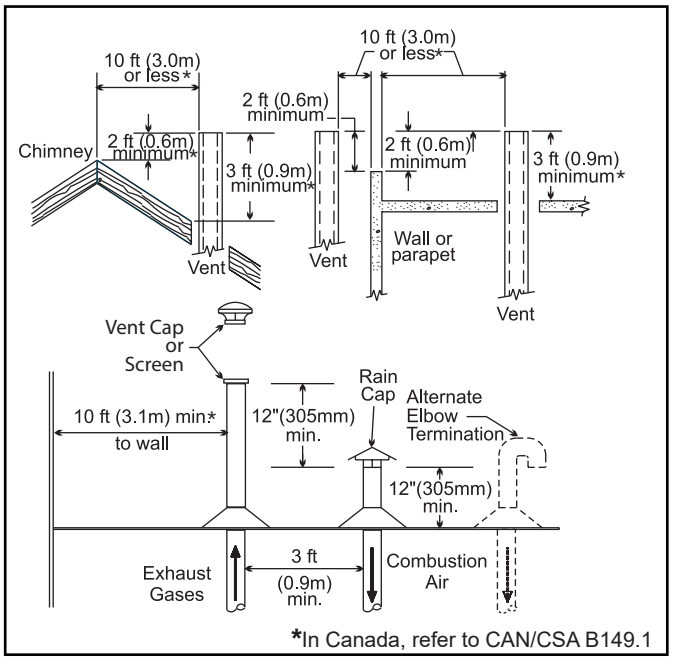


Figure 7. Combustion Air and Vent Through Roof

	Model 1000	Model 1500	Model 2000	Model 3000
Air intake screen for unit placed outdoors	CA011904	CA011901	CA011901	CA011901
Vent terminal for unit placed outdoors	CA017201	CA017202	CA017202	CA017203

Table 11. Air & Vent Accessories for units placed outdoors

2.E Outdoor Installation

This unit may be installed indoors or outdoors. If installing outdoors in a location that may experience freezing temperatures, precautions must be taken to prevent water in the heat exchanger and condensate inside and outside of the boiler from freezing. Damage due to freezing water or condensate is not covered by the warranty.

For proper operation in outdoor installations, the boiler must be equipped with the inlet air and exhaust terminal kits listed in Table 11. Additional instructions are supplied with the terminal kits.

⚠ WARNING

If installing outdoors in a location that may experience freezing temperatures, provisions must be made to protect the unit from freeze damage. manufacturer does not warranty damage caused by freezing temperatures.

2.F 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 3 Gas supply and Piping

3.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 unit.

Review the following instructions before proceeding with the installation.

1. Verify that the unit is fitted for the proper type of gas by checking the rating plate.

NOTE: This unit is equipped to operate at elevations up to 2000 feet (610m). However, the unit will function properly without the use of high altitude modification at elevations up to 10,000 feet (3050 m).
For elevations above 2000 ft (600 m), the input gas rating shall be reduced at a rate of 4 percent for each 1000 ft (300 m) above sea level. This must be considered before selecting the equipment size.

2. The gas pressure settings are shown in Table 12.
3. Table 13 offers some gas pipe sizing sizing information. Refer to the applicable gas code for more detailed sizing information.
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. A sediment trap must be provided upstream of the gas controls.
7. All threaded joints should be coated with piping compound resistant to action of liquified petroleum gas.
8. The unit 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).
9. 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).
10. The unit and its gas connection must be leak tested before placing it in operation.
11. Purge all air from gas lines

	Natural Gas
Min	4.0 IN - W.C.
Max	10.5 IN - W.C.

Table 12. Gas Pressure

⚠ WARNING

Do not use 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 unit and all other gas units 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. The units may be equipped with low and high pressure gas switches that are integrally vent limited. These types of devices do not require venting to atmosphere.

NOTE: After placing the boiler in operation, the ignition system safety shutoff device must be tested. See Section 10.A on page 108

3.B Gas Pipe Sizing

The following are gas line sizing examples from the National Fuel Gas Code. Size your gas lines properly, based on your installation and all applicable codes.

See Table 13

SCH 40 METAL PIPE CAPACITY FOR 0.60 SPECIFIC GRAVITY NATURAL GAS					
NOMINAL PIPE SIZE @ 0.50" W.C. PRESSURE DROP					
Nominal:	2"	2½"	3"	4"	5"
Actual ID:	2.067"	2.469"	3.068"	4.026"	5.047"
Length (ft)	Capacity in Cubic Feet of Gas per Hour				
10	4,020	6,400	11,300	23,100	41,800
20	2,760	4,400	7,780	15,900	28,700
30	2,220	3,530	6,250	12,700	23,000
40	1,900	3,020	5,350	10,900	19,700
50	1,680	2,680	4,740	9,660	17,500
60	1,520	2,430	4,290	8,760	15,800
70	1,400	2,230	3,950	8,050	14,600
80	1,300	2,080	3,670	7,490	13,600
90	1,220	1,950	3,450	7,030	12,700
100	1,160	1,840	3,260	6,640	12,000
125	1,020	1,630	2,890	5,890	10,600
150	928	1,480	2,610	5,330	9,650
175	854	1,360	2,410	4,910	8,880
200	794	1,270	2,240	4,560	8,260
150	704	1,120	1,980	4,050	7,320
300	638	1,020	1,800	3,670	6,630
350	587	935	1,650	3,370	6,100
400	546	870	1,540	3,140	5,680

Table 13. Pipe Capacity for Natural Gas

SECTION 4 Water Flow and Headloss Data

4.A General Water Flow Information

This appliance is a fire-tube design that requires water flow for operation. Boilers are generally used in closed systems, so Manufacturer bases the water flow data on temperature rise (difference between boiler inlet and outlet temperature.)

4.B Water Flow & Headloss Data

The water flow and headloss data for the MagnaTherm FT is shown in Table 14 This data is given for various water temperature rises at full boiler input rate.

The MagnaTherm FT must be configured in a closed loop configuration and fill operations should be limited. If the system needs to be refilled frequently, check for leaks in the primary water circuit. The boiler water hardness should be kept below 10 grains per gallon.

The MagnaTherm FT is equipped with a water flow switch in the boiler outlet which will prevent operation of the boiler if the water flow is below approximately 20 gallons per minute. This water flow switch is part of the main safety circuit and prevents boiler operation when there is little or no flow at low fire. Table 15 provides maximum and minimum flow rates for each boiler size. The minimum flow rate is at low fire conditions with water as the heating fluid. Boilers with antifreeze may require higher minimum flow rates. The control system is also equipped with a water Delta T feature which determines the allowable maximum differential water temperatures for a given input rate at which the boiler can safely operate at. These parameters are adjustable within pre-set limits. For further information on this feature please see 8.D.9 on page 87

Size	Maximum Flow Rate (gpm)	Minimum Flow Rate (gpm)
1000	250	20
1500	250	25
2000	250	25
3000	250	30

Table 15. Maximum and Minimum Water Flow Rates

		20°F		30°F		40°F		50°F		60°F		70°F	
Size	Output Max Btu/hr	Flow GPM	Head Loss Feet	Flow GPM	Head Loss Feet	Flow GPM	Head Loss Feet	Flow GPM	Head Loss Feet	Flow GPM	Head Loss Feet	Flow GPM	Head Loss Feet
1000	950000	95.0	1.9	63.3	1.1	47.5	0.72	38.0	0.53	31.7	0.41	27.1	0.33
1500	1425000	142.4	3.4	95.0	1.6	71.2	0.96	57.0	0.64	47.5	0.46	40.7	0.34
2000	1900000	189.9	4.5	126.6	2.1	95.0	1.2	76.0	0.82	63.3	0.58	54.3	0.44
3000	2850000	250*	5.5	189.9	3.5	142.4	2.1	113.9	1.4	95.0	1.0	81.4	0.79

		11°C		17°C		22°C		28°C		33°C		39°C	
Size	Output Max Btu/hr	Flow LPM	Head Loss Meters	Flow LPM	Head Loss Meters	Flow LPM	Head Loss Meters	Flow LPM	Head Loss Meters	Flow LPM	Head Loss Meters	Flow LPM	Head Loss Meters
1000	950000	359	0.59	240	0.33	180	0.22	144	0.16	120	0.12	103	0.10
1500	1425000	539	1.03	359	0.49	270	0.29	216	0.19	180	0.14	154	0.10
2000	1900000	719	1.38	479	0.65	359	0.38	288	0.25	240	0.18	205	0.13
3000	2850000	946*	2.33	719	1.06	539	0.64	431	0.43	359	0.32	308	0.24

*Minimum temperature rise is 23°F (13°C) at maximum flow limit.

Table 14. Boiler Water Flow and Headloss

SECTION 5 Boiler Piping

5.A Boiler Water Connections

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

The water piping should be supported by suitable hangers or floor stands. Do not support the piping with this unit. The hangers used should allow for expansion and contraction of pipe. Rigid hangers may transmit noise through the system resulting from the piping sliding in the hangers. We recommend that padding be used when rigid hangers are installed. Maintain 1" (2.5 cm) clearance to combustibles for all hot water pipes.

Suggested piping diagrams are shown in Figure 8 on page 27 through Figure 15 on page 34 These diagrams are meant only as guides. Components required by local codes must be properly installed.

This unit's efficiency is higher with lower return water temperatures. Therefore, to get the best low return temperature with multiple boilers, pipe as shown in Section 5.D on page 27.

Pipe the discharge of the relief valve (full size) to a drain or in a manner to prevent injury in the event of pressure relief. Install an air purger, air vent, expansion tank, hydronic flow check valve in the system supply loop, and any other devices required by local codes. The minimum fill pressure must be 12 psig (82.7 kPa). Install shutoff valves where required by code.

5.B 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.

In some installations, a hot water heating boiler is connected to heating coils located in an air handling unit where the coils may be exposed to refrigerated air circulation. In these cases, the boiler piping system 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.

5.C Freeze Protection

This unit may be installed indoors or outdoors. If installing outdoors in a location that may experience freezing temperatures, precautions must be taken to prevent water in the heat exchanger and condensate inside and outside of the boiler from freezing. Damage due to freezing water or condensate is not covered by the warranty.

If installed indoors, and there is an event such as a power outage, interruption of gas supply, failure of system components, activation of safety devices, etc., this 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 pipes in the system.** When water freezes, it expands. This may result in bursting of pipes, or damage to the boiler, and this could result in leaking or flooding conditions.

Do not use automotive antifreeze. To help prevent freezing, the manufacturer recommends the use of inhibited propylene glycol concentrations between 20% and 35% glycol. Typically, this concentration will serve as burst protection for temperatures down to approximately -5°F (-20°C). If temperatures are expected to be lower than -5°F (-20°C), propylene glycol concentrations up to 50% can be used. **When concentrations greater than 35% are used, water flow rates must be increased by 15% to maintain the desired temperature rise through the boiler.**

Different propylene glycol products may provide varying degrees of protection. Propylene glycol products must be maintained properly in a heating system, or they may become ineffective. Consult the glycol specifications, or the glycol manufacturer, for information about specific products, maintenance of solutions, and set up according to your particular conditions.

The following manufacturers offer propylene glycols, inhibitors, and anti foamants that are suitable for use in the unit. Please refer to the manufacturers instructions for proper selection and application.

- Sentinel Performance Solutions Group
- Hercules Chemical Company
- Dow Chemical Company

On initial installations, drain and flush the system before adding propylene glycol. Sludge and other sediments in the boiler can inhibit flow, resulting in rapid breakdown of glycol. Check the propylene glycol concentration annually. Add more water or propylene glycol as needed.

The boiler control offers some assistance with freeze protection, as long as the boiler is energized and able to fire.

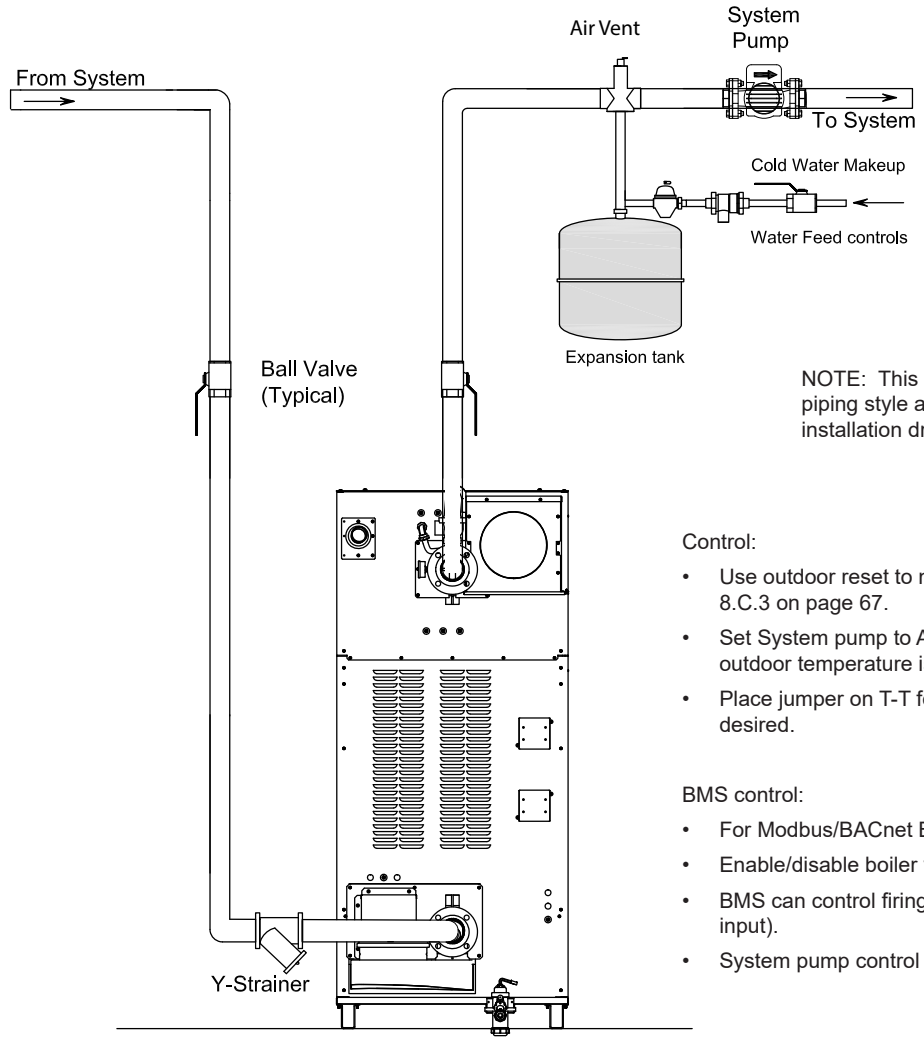
1. If the outlet sensor detects less than 45°F, the control energizes the boiler pump.
2. If the outlet sensor detects less than 35°F, the control will fire at low rate.
3. Once in freeze protect mode, the boiler will remain in that state until the outlet sensor detects greater than 50°F.

5.D Suggested Boiler Piping Schematics

This boiler is a high efficiency appliance. Boiler efficiency can be maximized by using piping and distribution configurations that return the lowest temperature possible to the boiler, while still meeting the needs of the system.

Figure 8 on page 27 through Figure 15 on page 34 show suggested piping configurations for boilers. These diagrams are only meant as guides. All components or piping required by local code must be installed.

For multi-boiler installations where a primary only configuration is used, an optional water isolation valve is available. This valve is field installed but comes with a wiring harness which connects with pre-installed boiler wiring via a quick disconnect connector. The control system contains the necessary logic to open and close the insolation valves in conjunction with the boiler heat demand while always maintaining an open valve to maintain system flow.



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.

Control:

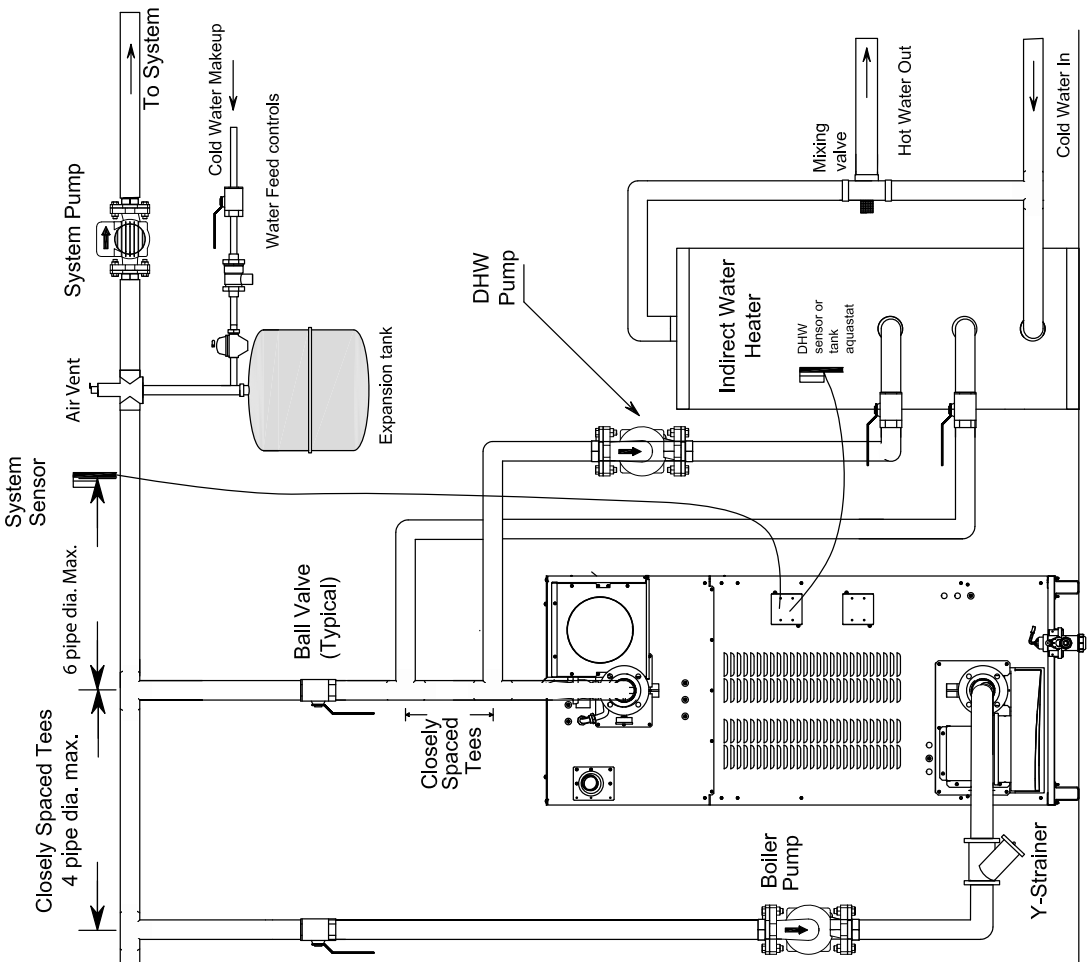
- Use outdoor reset to maintain building loop temperature. See Section 8.C.3 on page 67.
- Set System pump to AUTO, pump runs during space heating when outdoor temperature is below warm weather shutdown.
- Place jumper on T-T for constant heating call; or interrupted if so desired.

BMS control:

- For Modbus/BACnet BMS mapping, refer to Section 7.F on page 44.
- Enable/disable boiler via T-T terminals (49, 50).
- BMS can control firing rate or setpoint via terminals 55 and 56. (analog input).
- System pump control by BMS or Touchscreen Control.

Figure 8. Single Boiler, Variable Primary, Space Heating only

5.D Suggested Boiler Piping Schematics (continued)



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.

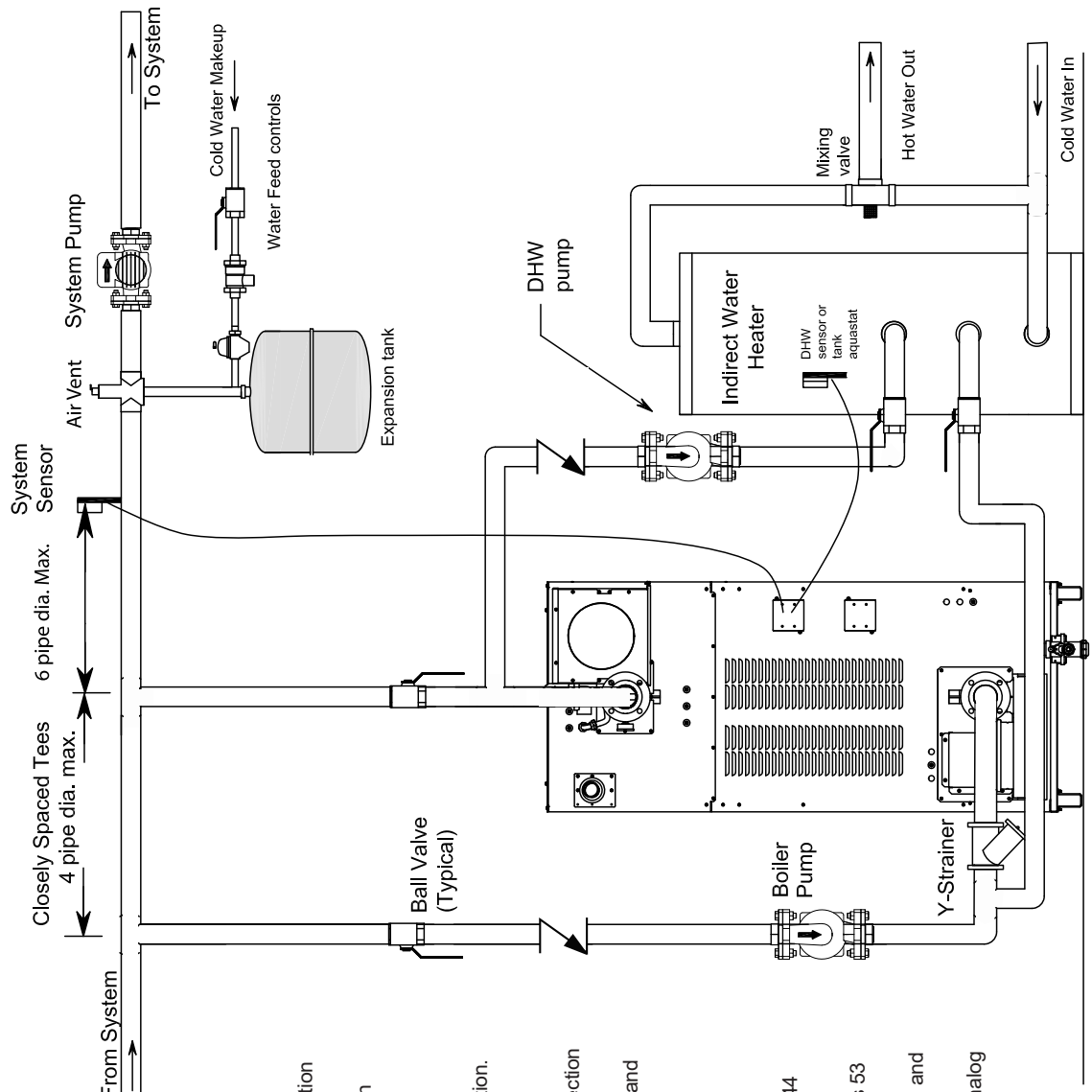
Control:

- Use outdoor reset to maintain building loop temperature.See Section 8.C.3 on page 67.
- Set System pump to AUTO, pump runs during space heating when outdoor temperature is below warm weather shutdown.
- Place jumper on T-T for constant heating call; or interrupted if so desired.
- System sensor required for outdoor reset operation in this piping arrangement.
- Boiler, System and DHW pumps all controlled by The Touchscreen Control.
- Pump operation configurable in pump configuration menu. See Section 8.D.6 on page 83
- Use DHW sensor or aquastat for DHW temp sensor, connect to terminals (53, 54).
- For high temp operation, System pump can run during DHW.
- For low temp operation, System pump must be OFF during DHW.

BMS control:

- For Modbus/BACnet BMS mapping, refer to Section 7.F on page 44.
- Enable/disable boiler via T-T terminals (49, 50) for space heating. (Section 8.D.2).
- To enable/disable boiler for DHW using an aquastat, use terminals 53 and 54.
- To enable/disable boiler for DHW using a sensor, use terminals 39 and 40.
- BMS can control firing rate or setpoint via terminals 55 and 56. (analog input).
- System, boiler and DHW pumps controlled by BMS or The Touchscreen Control.

Figure 9. Single Boiler, P/S Piping for Space Heating with P/S for Indirect Tank



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.

Control:

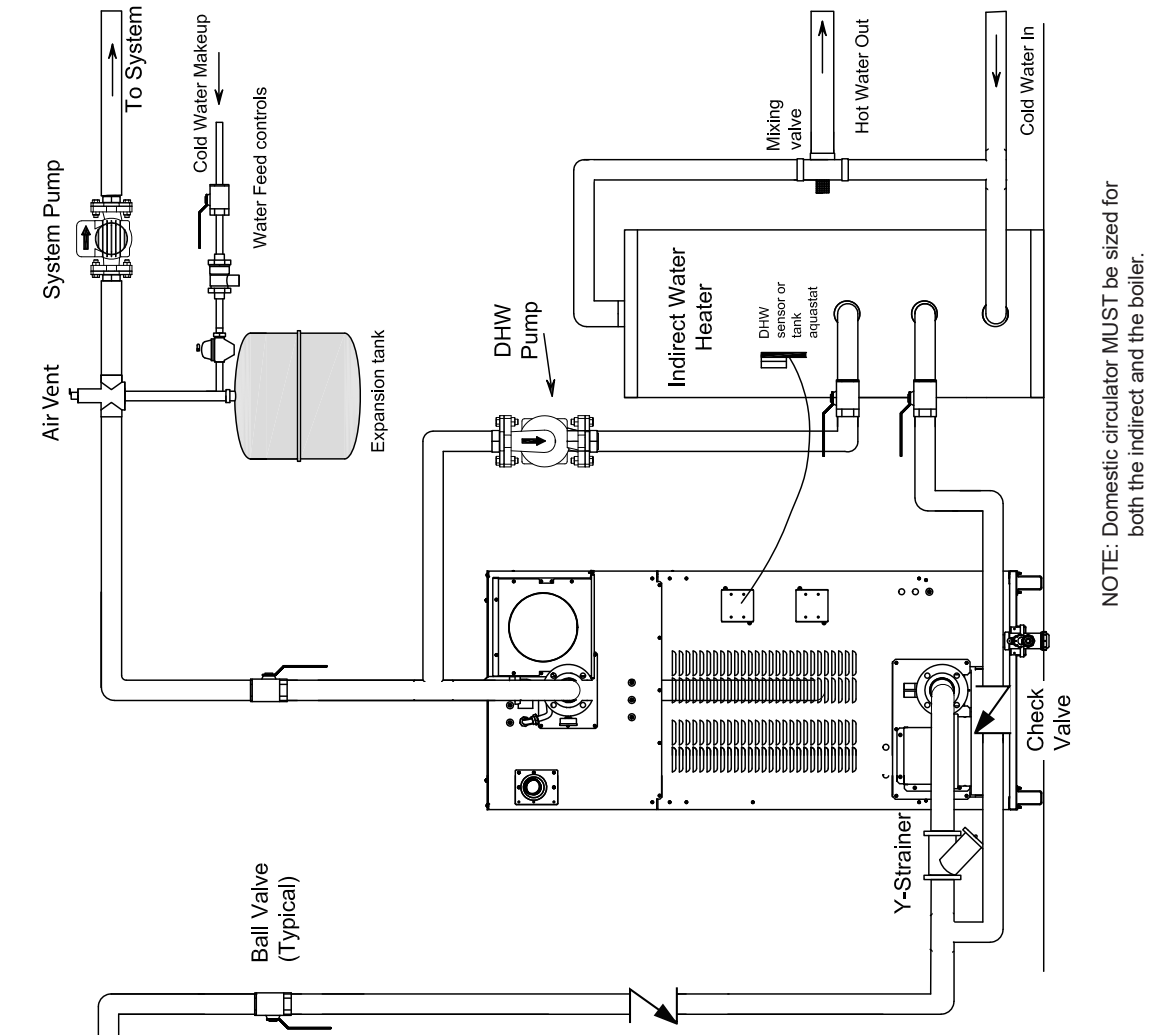
- Use outdoor reset to maintain building loop temperature. See Section 8.C.3 on page 67.
- Set System pump to AUTO, pump runs during space heating when outdoor temperature is below warm weather shutdown.
- Place jumper on T-T for constant heating call; or interrupted if so desired.
- System sensor required for outdoor reset operation in this application.
- Boiler, System and DHW pumps controlled by The Touchscreen Control.
- Pump operation configurable in pump configuration menu. See Section 8.D.6 on page 83
- Use DHW sensor, terminals 39 and 40, or aquastat, terminals 53 and 54.
- Boiler pump must be OFF during DHW operation for DHW priority.

BMS control:

- For Modbus/BACnet BMS mapping, refer to Section 7.F on page 44
- Enable/disable boiler via T-T terminals (49, 50) for space heating.
- To enable/disable boiler for DHW using an aquastat, use terminals 53 and 54.
- To enable/disable boiler for DHW using a sensor, use terminals 39 and 40.
- BMS can control firing rate or setpoint via terminals 55 and 56. (analog input).
- System, boiler and DHW pumps controlled by BMS or The Touchscreen Control.

Figure 10. Single Boiler, P/S Piping for Space Heating with Parallel Piping for indirect Tank

5.D Suggested Boiler Piping Schematics (continued)



Common piping shown must be sized for maximum combined heater flow rates.

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.

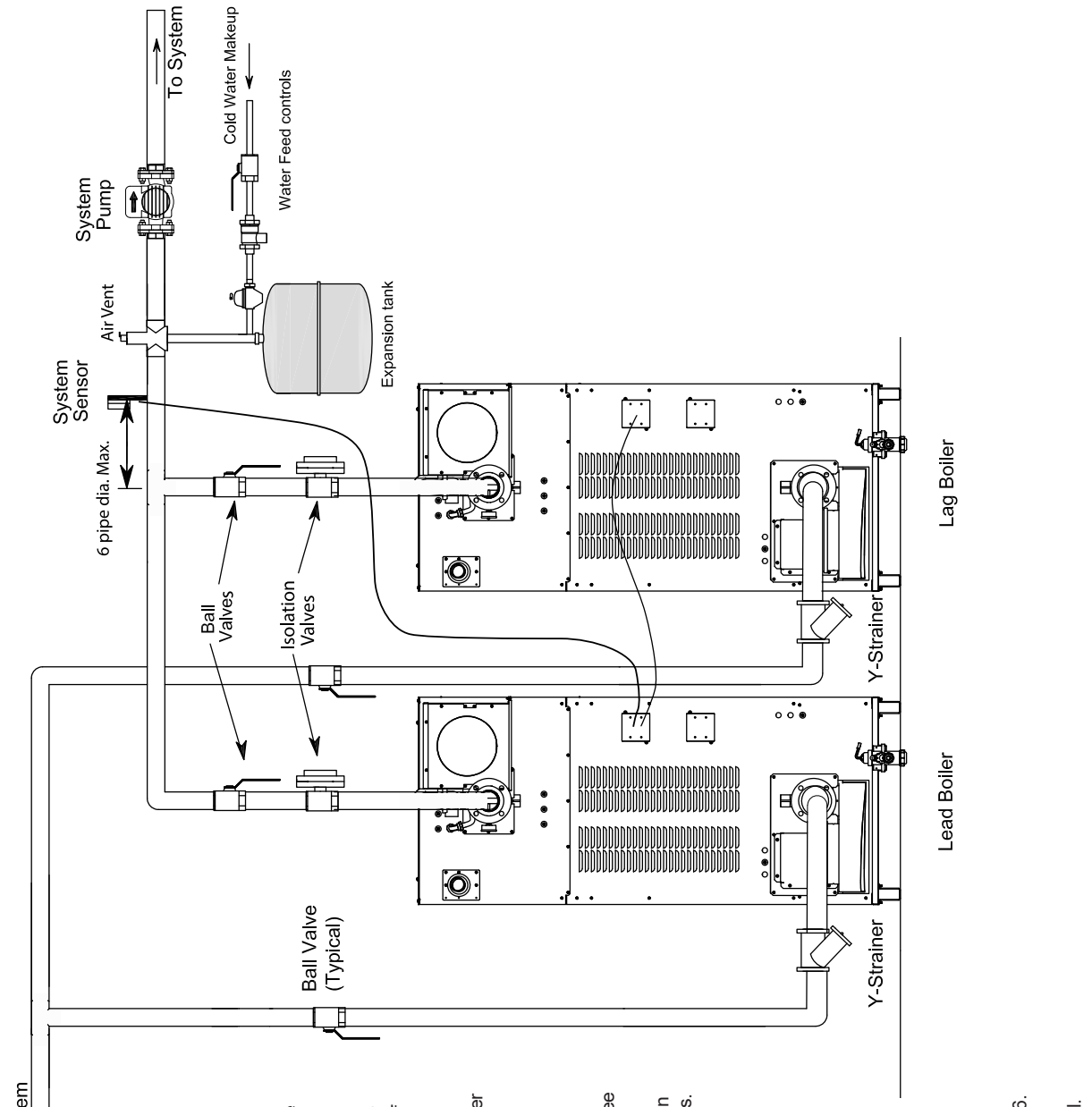
Control:

- Use outdoor reset to maintain building loop temperature. See Section 8.C.3 on page 67.
- Set System pump to AUTO, pump runs during space heating when outdoor temperature is below warm weather shutdown.
- Place jumper on T-T for constant heating call; or interrupted if so desired.
- System and DHW pumps all controlled by The Touchscreen Control. Boiler pump not used.
- Pump operation configurable in pump configuration menu. See Section 8.D.6 on page 83
- Use DHW sensor, terminals 39 and 40, or aquastat, terminals 53 and 54.
- System Pump must be OFF during DHW operation for DHW priority.

BMS control:

- For Modbus/BACnet BMS mapping, refer to Section 7.F on page 44
- Enable/disable boiler via T-T terminals (49, 50) for space heating.
- To enable/disable boiler for DHW using an aquastat, use terminals 53 and 54.
- To enable/disable boiler for DHW using a sensor, use terminals 39 and 40.
- BMS can control firing rate or setpoint via terminals 55 and 56. (analog input).
- System, boiler and DHW pumps controlled by BMS or The Touchscreen Control.

Figure 11. Single Boiler, Variable Primary Space Heating with Parallel Piping for indirect Tank



Common piping shown must be sized for maximum combined heater flow rates.

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.

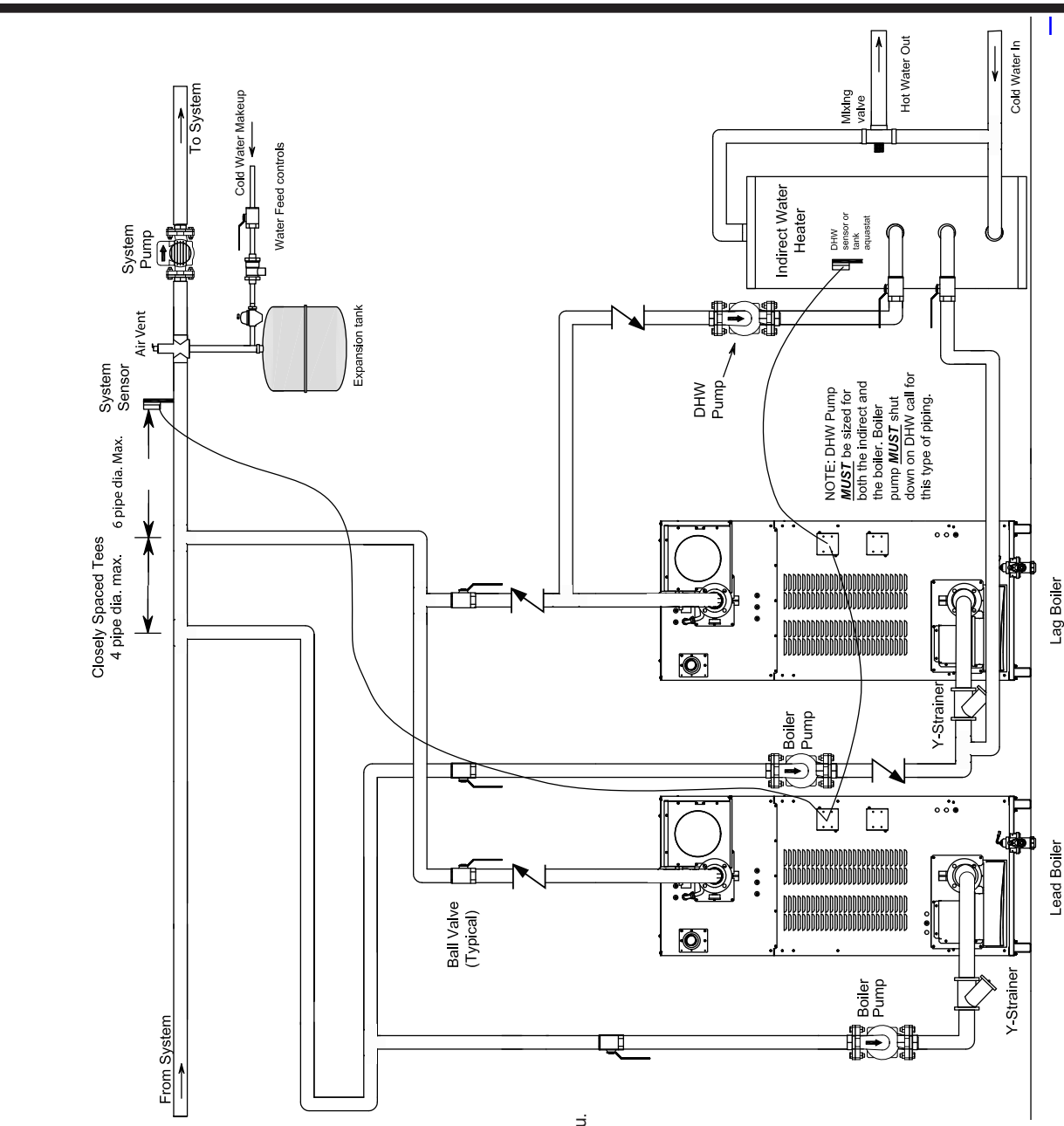
Control:

- Use outdoor reset to maintain building loop temperature. See Section 8.C.3 on page 67.
- Set System pump to AUTO, pump runs during space heating when outdoor temperature is below warm weather shutdown.
- Place jumper on T-T for constant heating call; or interrupted if so desired.
- System sensor required for cascade, outdoor reset operation and connected to Lead boiler; place sensor in common header 6 pipe diameters from last connected unit. See Section 8.D.3 on page 73
- System pump controlled by The Touchscreen Control. Boiler pump(s) not used.
- Pump operation configurable in pump configuration menu. See Section 8.D.6 on page 83.
- Quick connect isolation valves, controlled by The Touchscreen Control, are available from and required for 3+ boiler systems. See Section 8.D.4 on page 74.

BMS control:

- For Modbus/BACnet BMS mapping, refer to Section 7.F on page 44.
- Enable/disable boiler via T-T terminals (49, 50) for space heating.
- To enable/disable boiler for DHW using an aquastat, use terminals 53 and 54.
- To enable/disable boiler for DHW using a sensor, use terminals 39 and 40.
- BMS can control firing rate or setpoint via terminals 55 and 56. (analog input).
- System pump controlled by BMS or The Touchscreen Control.

Figure 12. Multiple Boilers, Variable Primary Space Heating with Individual Isolation Valves



Common piping shown must be sized for maximum combined heater flow rates.

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.

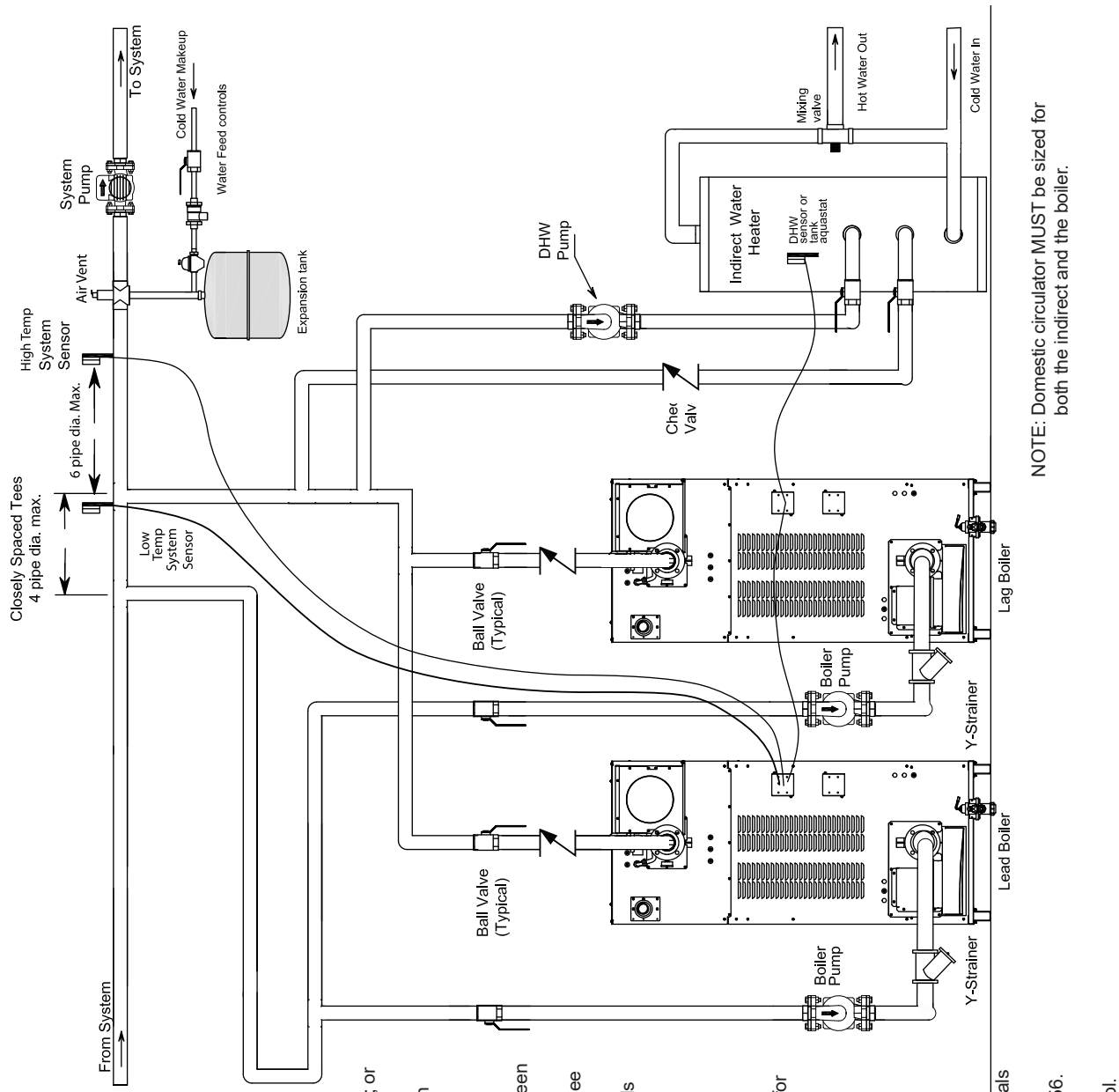
Control:

- Use outdoor reset to maintain building loop temperature.See Section 8.C.3 on page 67.
- Set System pump to AUTO, pump runs during space heating when outdoor temperature is below warm weather shutdown.
- Place jumper on T-T on the Lead Boiler for constant heating call; or interrupted if so desired.
- System sensor required for cascade, outdoor reset operation and connected to Lead boiler; place sensor in common header 6 pipe diameters from last connected unit. See Section 8.D.3 on page 73.
- Boiler, System and DHW pumps controlled by The Touchscreen Control.
- Pump operation configurable in pump configuration menu. See Section 8.D.6 on page 83.
- Use on Lag Boiler DHW sensor, terminals 39 and 40, or aquastat, terminals 53 and 54.
- Lag Boiler Pump must be OFF during DHW operation.
- Lag Boiler must be configured for local DHW demand priority; DHW Pump must be wired to Lag Boiler.

BMS control:

- For Modbus/BACnet BMS mapping, refer to Section 7.F on page 44
- Enable/disable boiler via T-T terminals (49, 50) for space heating.
- To enable/disable boiler for DHW using an aquastat, use terminals 53 and 54.
- To enable/disable boiler for DHW using a sensor, use terminals 39 and 40.
- BMS can control firing rate or setpoint via terminals 55 and 56. (analog input).
- System pump controlled by BMS or The Touchscreen Control.

Figure 13. Multiple Boilers, P/S Piping for Space Heating and simultaneous DHW heating w/ parallel piped single boiler



Common piping shown must be sized for maximum combined heater flow rates.

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.

NOTE: Domestic circulator MUST be sized for both the indirect and the boiler.

Control:

- Use outdoor reset to maintain building loop temperature. See Section 8.C.3 on page 67.
- Set System pump to AUTO, pump runs during space heating when outdoor temperature is below warm weather shutdown.
- Place jumper on T-T on Lead Boiler for constant heating call; or interrupted if so desired.
- System sensor required for cascade, outdoor reset operation and connect to Lead boiler; place system sensor as shown, depending on low or high temperature space heating application.
- Boiler, System and DHW pumps controlled by The Touchscreen Control.
- Pump operation configurable in pump configuration menu. See Section 8.D.6 on page 83
- Use DHW sensor, terminals 39 and 40, or aquastat, terminals 53 and 54 and connect to Lead Boiler.
- During DHW operation, System pump must be OFF in low temperature space heating applications. In high temperature applications, System pump can continue to operate.
- Caution: Boiler firing rates during DHW heating may need to be lowered to prevent burner short cycling. Consult factory for set-up guidance.

BMS control:

- Enable/disable boiler via T-T terminals (49, 50) for space heating.
- To enable/disable boiler for DHW using an aquastat, use terminals 53 and 54.
- To enable/disable boiler for DHW using a sensor, use terminals 39 and 40.
- BMS can control firing rate or setpoint via terminals 55 and 56. (analog input).
- System pump controlled by BMS or The Touchscreen Control.

Figure 14. Multiple Boilers, P/S Piping for Space Heating with redundant P/S for Indirect Tank

5.E DHW Heating

The MagnaTherm FT must not be used as a direct domestic (potable) water heater. It can be connected to an indirect water heater or heat exchanger to generate domestic (potable) hot water and the boiler's controller includes indirect water heating logic. Examples of piping arrangements for indirect domestic water heating can be found in Section 5.D.

Boiler efficiency can be maximized by using piping configurations that return the lowest temperature possible to the boiler, while still meeting the needs of the system.

Control:

- No communication required between the Plate(s) and boiler(s).
- Boiler(s) assumed to operate on outdoor reset with suitably high temperature 24 / 7 / 365.
- DHW charging pump runs constant to supply hydronic water.
- A manually adjustable 2-way valve on Plate allows bypass flow to avoid pump "dead-heading" during no DHW loads.
- Plate equipped with its own control system, monitors DHW and incoming temperatures, modulates its 3-way valve and internal DHW recirc pump for fast response.
- This system has instant response to DHW to demand, small foot print and is easily added o any central boiler plant for local (in the boiler room) or remotely in the building for DHW production.
- A buffer tank may be required to avoid burner short cycling. Consult factory for guidelines.
- In case of multiple boilers, connect system senso to the lead boiler.

BMS control:

- Enable/disable boiler via T-T terminals (49, 50) for space heating.
- To enable/disable boiler for DHW using an aquastat, use terminals 53 and 54.
- To enable/disable boiler for DHW using a sensor, use terminals 39 and 40.
- BMS can control firing rate or setpoint via terminals 55 and 56. (analog input).
- System pump controlled by BMS or The Touchscreen Control.

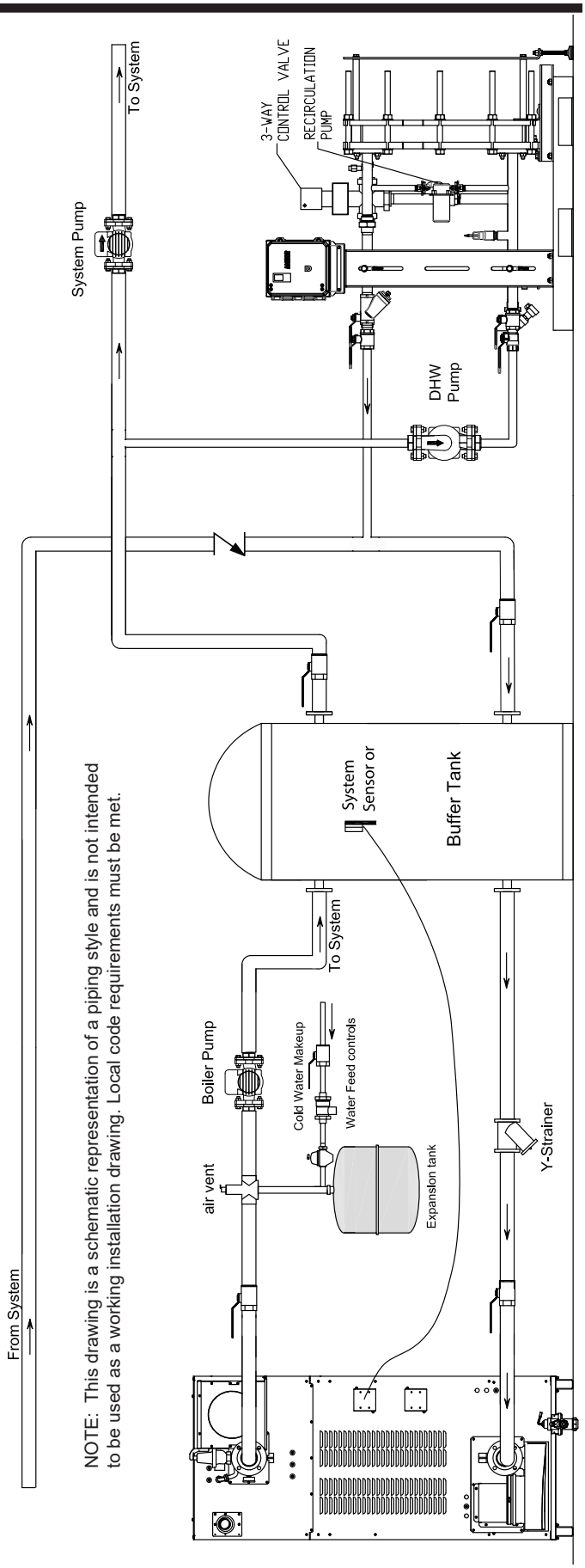


Figure 15. Boiler piping with Plate for instantaneous DHW heating and Space Heating

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SECTION 6 Condensate Drain Trap

This appliance creates condensation as a by-product of high combustion efficiency. The condensate must be drained from unit and from the vent system.

A combination condensate drain trap is included with the unit for on-site assembly. This condensate drain trap must be installed to prevent the accumulation of condensate. Connect a ¾" PVC pipe between the drain connection and a floor drain. The PVC pipe must continuously slope downward toward the drain, with no spiraling. If there is no accessible floor drain, or if the drain pipe cannot be installed with the proper slope, a condensate pump will be needed to ensure that the condensate is removed.

The condensate that forms in the vent pipe should also be drained to help prevent excessive condensate from entering the unit at the vent. The vent condensate is typically drained at a drain tee located in the first section of vent pipe, as this should be the lowest section of the vent pipe.

Consult local codes for direction on disposal of condensate. In some cases (given code requirements or drain material), condensate will need to be neutralized. A condensate neutralizer is not included with the unit, but is available from the manufacturer (see back cover) as an accessory. If a neutralizer is required, it is helpful to install the boiler on a raised 4" concrete platform. This will generally allow sufficient elevation for the condensate neutralizer to be installed below the condensate trap. See Figure 16.

If the unit is installed outdoors 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 this units warranty.

⚠ CAUTION

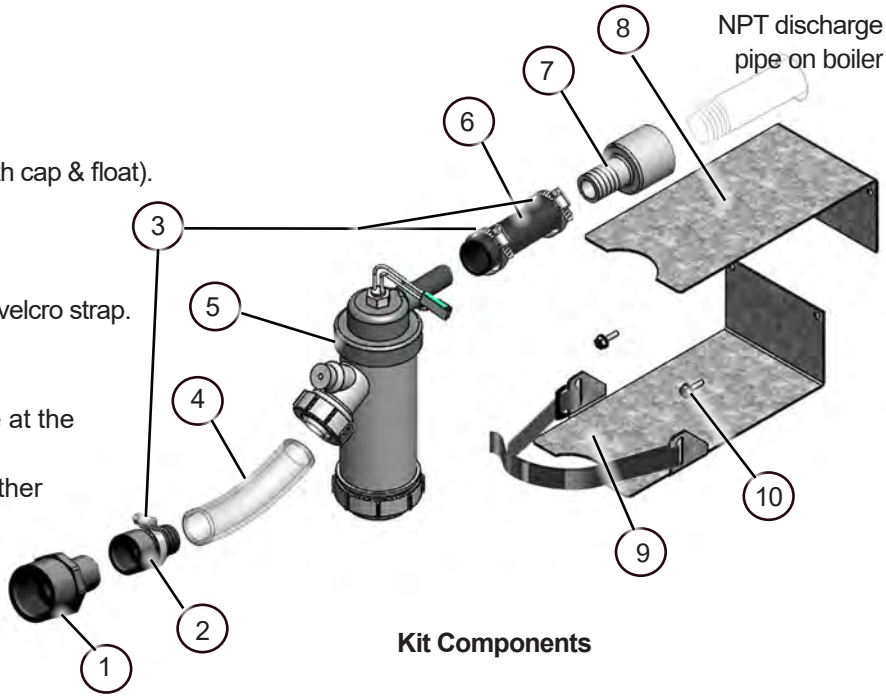
Condensate is mildly acidic (pH=5) and may harm some floor drains and/or pipes, particularly those that are metal. Ensure that the drain, drainpipe, and anything that will come in contact with the condensate can withstand the acidity, or neutralize the condensate before disposal. **Damage caused by failure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



Figure 16. Raised 4" Concrete Platform

6.A Condensate Trap Installation Instructions

1. The discharge hose 'end adapter'.
2. Hose adapter.
3. Hose clamps (3).
4. Transparent discharge hose.
5. The condensate trap (pre-assembled with cap & float).
6. Inlet Hose, 2.5" x .75".
7. Adapter, .75" barb x 1.0" NPT, PVC.
8. Mounting bracket (top half).
9. Mounting bracket (bottom half) with the velcro strap.
10. Screws (2).



Kit Components

Thread item 7 onto the discharge pipe at the back of the unit. Do not over tighten.

Place the two mounting brackets together and fasten them to the unit just below the condensate discharge hose using the 2 screws as shown.

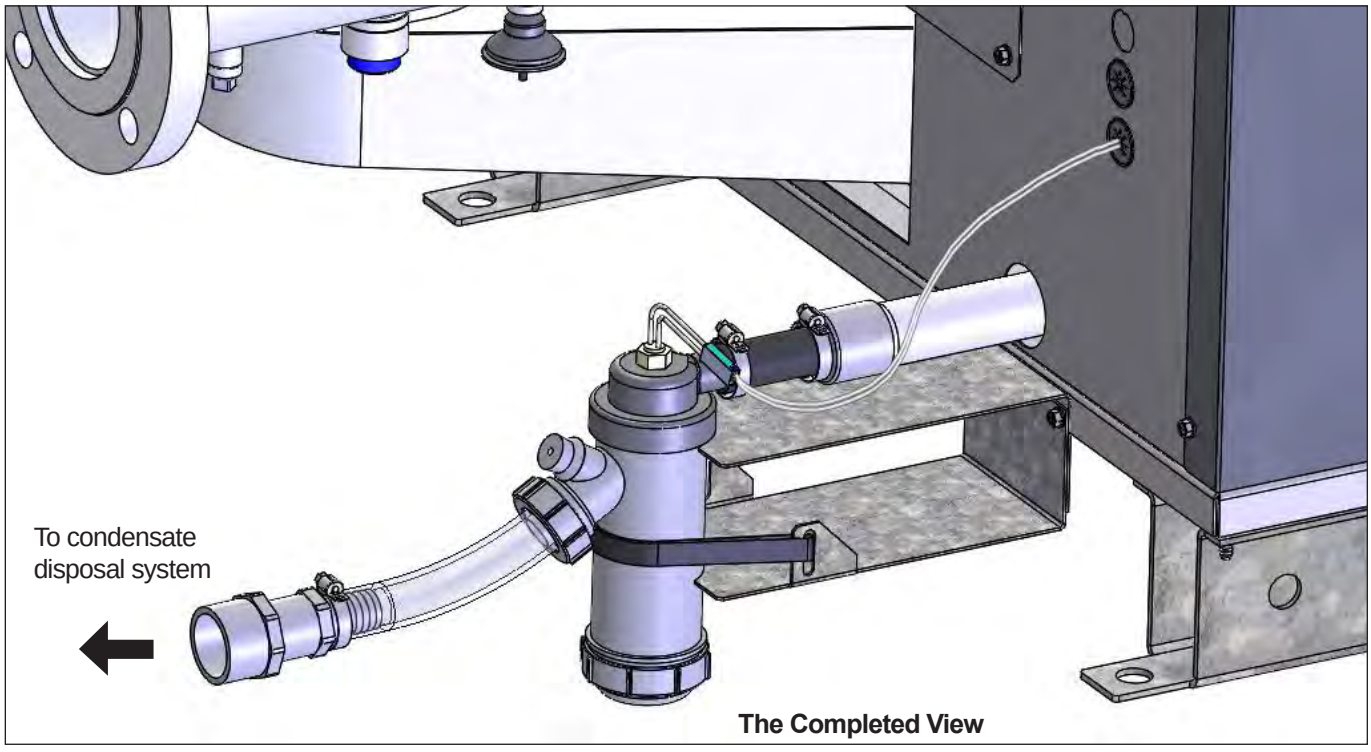
Assemble items 1 thru 6 to make the condensate trap sub-assembly. There will be a remaining hose clamp. Place it over the inlet hose and leave it loose.

With the 3rd hose clamp on the inlet hose, press the inlet side of the condensate trap assembly onto the PVC adapter. The condensate trap will fit into the bracket as shown below. Tighten the third hose clamp sufficiently. Re-check all hose clamps.

Use the velcro strap to fasten the condensate trap into the bracket assembly as shown below.

Run the Molex connector of the condensate trap sensor into the closest wiring grommet as shown. Reach into the access panel and find the Molex connector on the inside (blue and blue/white wire) and connect them.

Attach the condensate disposal system of your choice to the 'end adapter'. Check for condensate leakage when the unit is running.



The Completed View

Figure 17. Condensation Trap Assembly

SECTION 7 Electrical Connections

7.A Installation Warnings

⚠ 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 units supply voltage is toggled as a call for heat signal, premature failure of these components may result.

The unit does not recognize 4mA as a signal to shut off. If the call for heat is not connected between the field interlock terminals, the unit will remain in low fire when it sees 4mA as a modulating signal.

⚠ 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 National 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 prewired. No attempt should be made to connect electrical wires to any other location except the terminal blocks.

7.B Main Power Connections

This unit is provided with an electrical junction boxes on the rear panel for main power connections. See Figure 18. All power wires are factory installed between this junction box and the main high voltage box at the front of the unit. The unit is available with multiple voltage packages to adapt to customer needs ranging from 120-600 volts with single or three phase versions. Refer to the rating plate on your unit and to Section 7.C of this manual, for voltage and current ratings.

As a common industry practice, the manufacturer has color coded the single and three phase wires as shown in Table 17.

On single phase models, the incoming voltage will be protected by the appropriate circuit breaker, sized and installed by a qualified electrician/authorized personnel. The 120-volt and 24-volt systems will be protected with resettable fuses mounted in the top of the high voltage box. The 24-volt transformer is also redundantly protected by its integrated 4 amp resettable fuse.

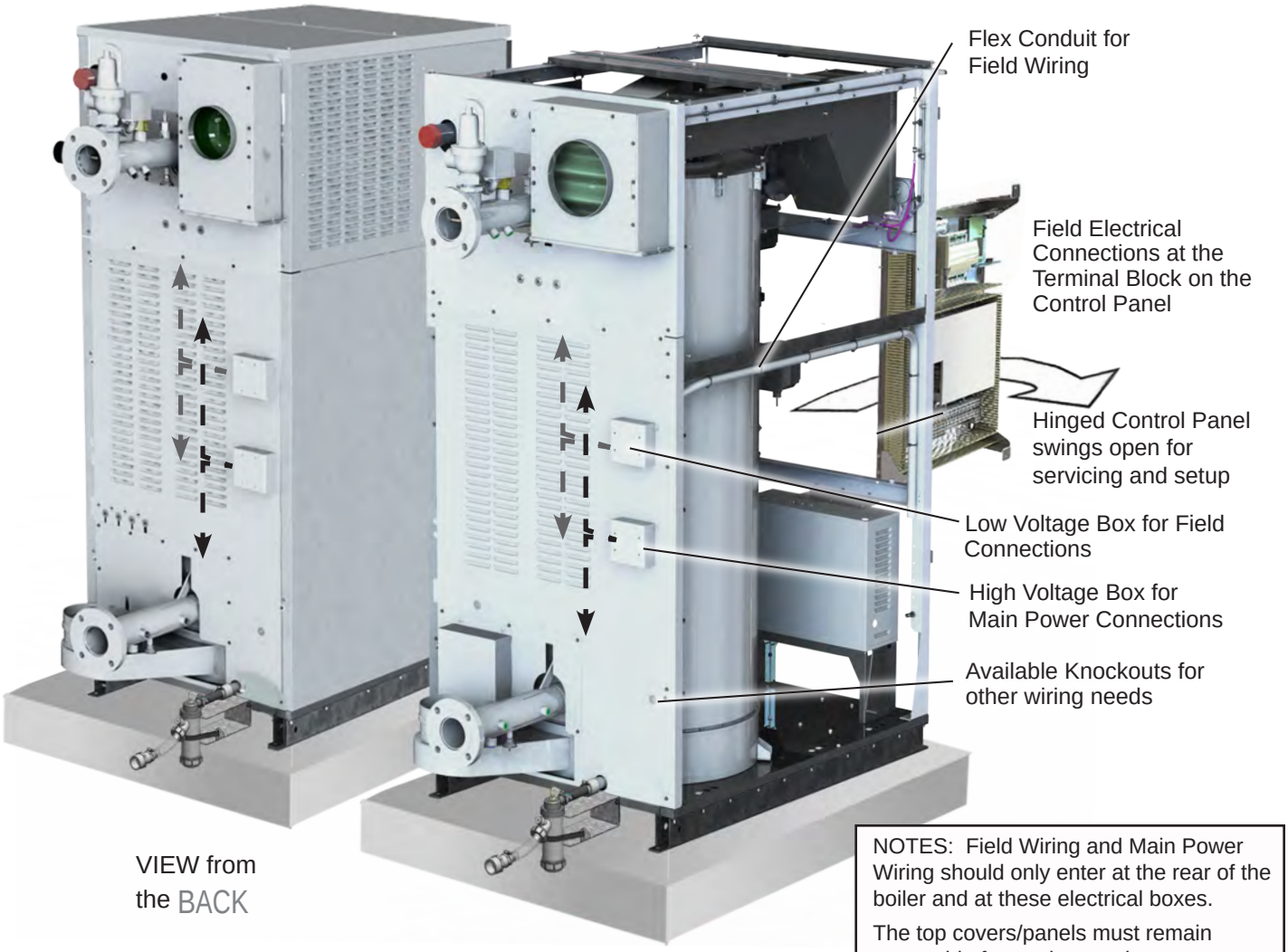
On three phase models, a step down transformer (which is protected using an appropriate din rail mounted circuit breaker) generates 120-volt single phase to power the 24-volt transformer. The 120-volt and 24-volt outputs of either transformer are protected with resettable fuses mounted in the top of the high voltage box. The 24-volt transformer is also redundantly protected by its integrated 4 amp resettable fuse.

⚠ CAUTION

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

⚠ ATTENTION

Au moment de l'entretien des commandes, étiquetez tous les fils avant de les débrancher. Les erreurs de câblage peuvent nuire au bon fonctionnement et être dangereuses. S'assurer que l'appareil fonctionne adéquatement une fois l'entretien terminé.



NOTES: Field Wiring and Main Power Wiring should only enter at the rear of the boiler and at these electrical boxes.

The top covers/panels must remain removable for routine service.

Figure 18. Electrical Connections

7.C Main Power Data

	1000 Current			1500 Current			2000 Current			3000 Current		
Voltage	FLA	MCA	MOP	FLA	MCA	MOP	FLA	MCA	MOP	FLA	MCA	MOP
120V, 1 phase	5.0	6.2	15.0	6.2	7.8	15.0	7.8	9.7	20.0	N/A	N/A	N/A
208V, 1 phase	2.9	3.6	15.0	3.6	4.5	15.0	4.5	5.6	15.0	N/A	N/A	N/A
220/240V, 1 phase	2.7	3.4	15.0	3.4	4.2	15.0	4.3	5.3	15.0	N/A	N/A	N/A
208V, 3 phase	N/A	N/A	N/A	N/A	N/A	N/A	3.3	4.1	15.0	4.5	5.6	15.0
480V, 3 phase	N/A	N/A	N/A	N/A	N/A	N/A	1.5	1.9	15.0	2.1	2.6	15.0
600V, 3 phase	N/A	N/A	N/A	N/A	N/A	N/A	1.1	1.4	15.0	1.4	1.8	15.0

Table 16. Electrical Data FLA = Full Load Amperage MCA = Minimum Circuit Ampacity MOP = Max Over-current Protection

Single Phase			
	120	240	208
L1	Blk	Blk	Blk
L2	Wht	Red	Red

Three Phase			
	600	480	208
L1	P	BR	Red
L2	V	O	Blk
L3	T	Y	BL

Blk = Black	T = Tan
Wht = White	O = Orange
Br = Brown	Y = Yellow
P = Purple	Bl = Blue
V = Violet	

Table 17. Voltage Phase Color Identification

7.D Control Panel Layout

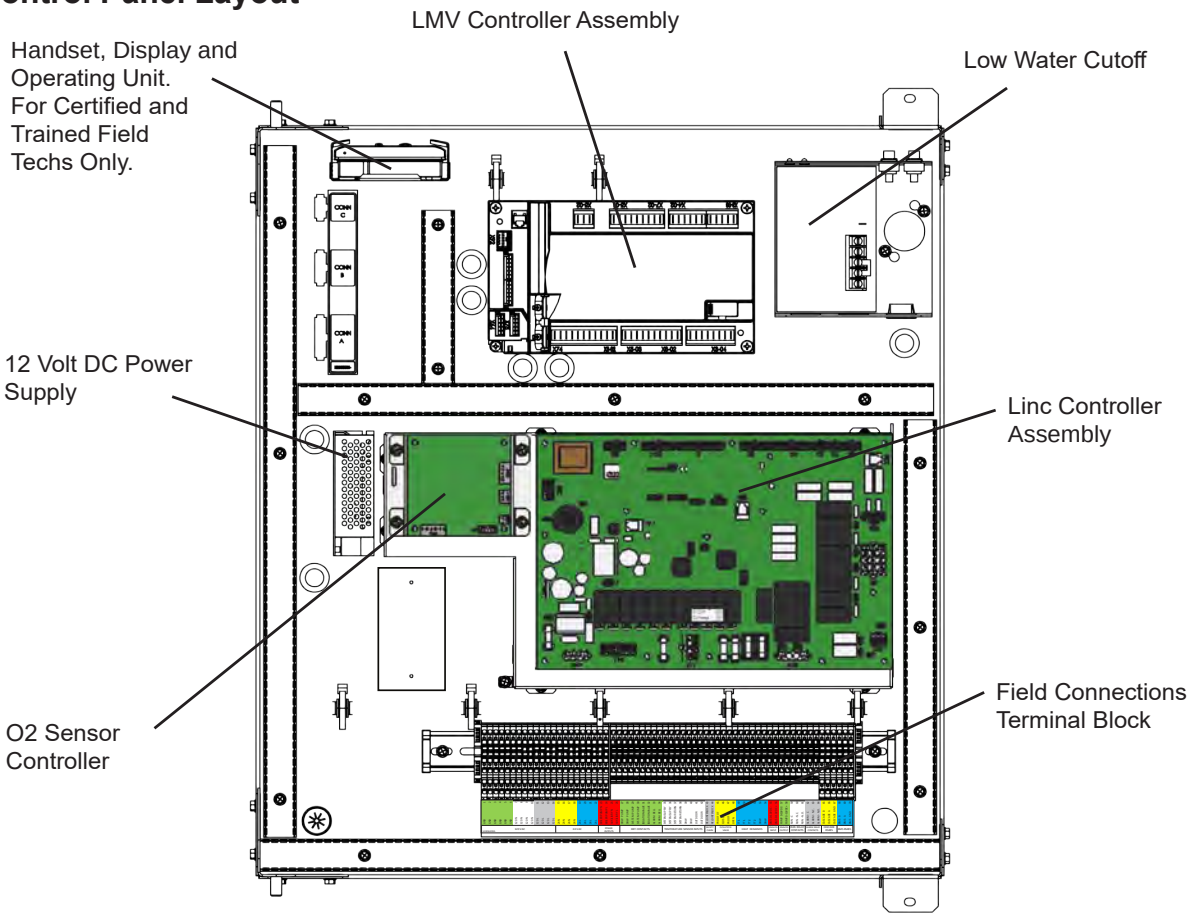


Figure 19. Control Panel Components

7.E Field Connections

Wiring for all field connections must be run through the available electrical conduit to the low voltage box at the back of the unit. See Figure 18.

Refer to Figure 20 in reference to Sections 7.E.1 thru 7.E.10

7.E.1 Power

Boiler Pump – If connecting a boiler contactor or pump, use terminals 23 (neutral) and 24 (line voltage). The output of these terminals is 120VAC with a maximum output current of 1.5 amps. Boiler pump functionality is configured using the touch screen.

Auxiliary – no functionality is available on this unit.

7.E.2 Dry Contacts

DHW Pump - If connecting a domestic hot water (DHW) pump, use terminals 27 and 28 (See Figure 20). This is a dry contact. The DHW pump supply voltage or DHW pump relay coil voltage should be applied at terminal 27, and when the DHW pump is called, would be switch to terminal 28. Contact ratings are 250VAC, 1.5A

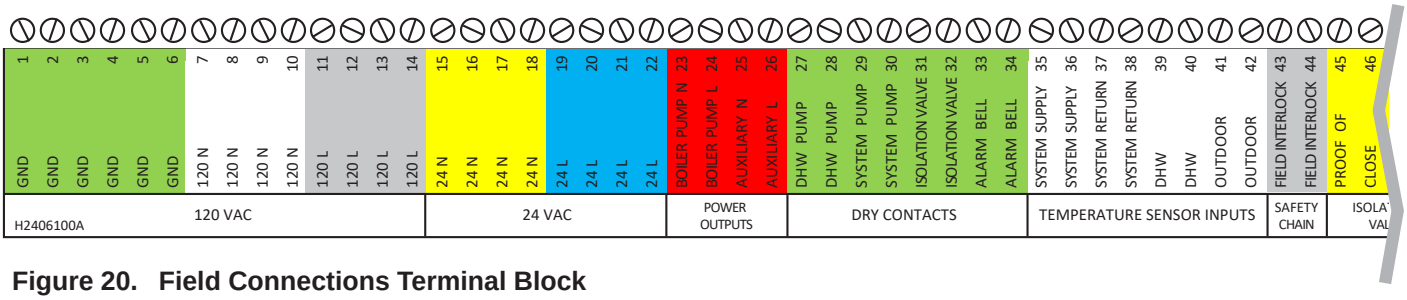


Figure 20. Field Connections Terminal Block

maximum. DHW pump functionality is configured using the touch screen.

System Pump - If connecting a system pump, use terminals 29 and 30. As this is a dry contact, the system pump supply voltage or system pump relay coil voltage would be applied at terminal 29, and when the system pump is activated, power will be available at terminal 30. Contact ratings are 250VAC, 1.5A maximum. System pump functionality is configured using the touch screen.

Isolation Valve – See Section 7.E.5 on page 42

Alarm Bell – If connecting an alarm bell, use terminals 33 and 34. As this is a dry contact, the alarm bell supply voltage is applied at terminal 33, with the alarm bell connected to terminal 34.

7.E.3 Temperature Sensors

System Supply - If used, connect to terminals 35 and 36 (See Figure 20 on page 40). 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.

System Return - If used, connect to terminals 37 and 38. 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 used, connect to terminals 39 and 40. When connected, the unit will use this sensor to perform the DHW thermostat function and the temperature is shown on the home screen below the faucet icon. The controller automatically detects the presence of this sensor and initiates a call for heat when the DHW temperature drops below the DHW set point by the value of the DHW On Hysteresis (DHW Set Point – DHW On Hysteresis = DHW heat demand).

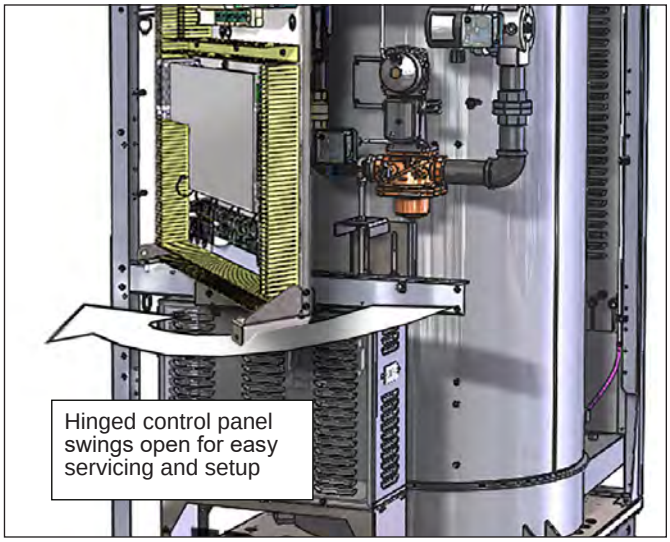
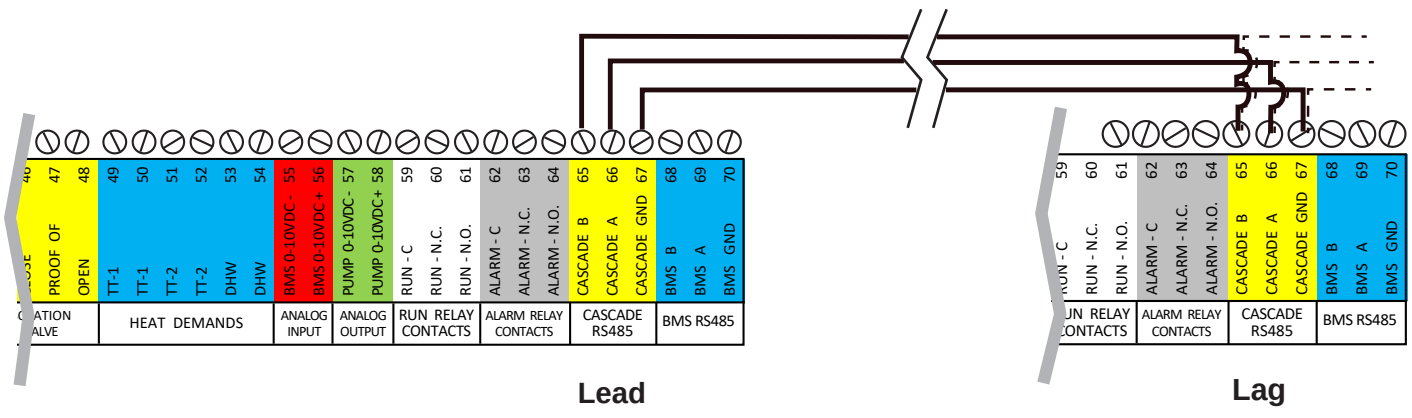


Figure 21. Hinged Control Panel

Outdoor - If used, is connected to terminals 41 and 42. When connected, the controller automatically detects the presence of this sensor and the temperature is shown on the home screen as the Outdoor air 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 elevated readings from sunlight or hot equipment.

7.E.4 Safety Chain

Field Interlock - If a field installed interlock (dry contact only) is used, connect to terminals 43 and 44. When open, the interlock will open the safety chain, removing the heat demand. When closed, this interlock in the safety chain is satisfied.



NOTE: When running the Power and Field Connection wires (Lead Lag, System Sensor, Outdoor Sensor, Building Automation, etc.), it is helpful to exit and enter the units through the lower back panels so that during future servicing, the wires do not interfere with the removal of the panels.

AVIS: Lors de l'exécution de la puissance et des câbles de raccordement (câble de capteur du système, Lag, capteur Extérieur, domotique, etc.), il est utile pour sortir et entrer dans les unités à travers la partie inférieure arrière de sorte qu'au cours de l'entretien futur, les fils n'interfèrent pas avec l'enlèvement des panneaux.

7.E.5 Isolation Valve

If an optional boiler water isolation valve is purchased, Terminals 31, 32, and 45 to 48 are used to open, close and monitor the position of the valve. These terminals are pre-wired with a cable that terminates with an 8 pin connector at the rear of the boiler. The optional isolation valve, which is ordered separately (PN CA017300), is wired with the mating cable and connector for easy field installation. This valve is used to prevent water flow through the boiler when the boiler is not in use, see 8.D.11.g on page 95 for operational details.

7.E.6 Heat Demands

TT1 - If a thermostat/aquastat or end switch (isolated contact only) is used as a heat demand, connect to terminals 49 and 50 (See Figure 20 on page 40). TT1 functionality is configured on the touch screen on the CH1/DHW1 screens.

TT2 – If an additional thermostat/aquastat or end switch (isolated contact only) is required as a heat demand, connect to terminals 51 and 52. TT2 functionality is configured on the touch screen on CH2/DHW2 screens.

DHW – If an aquastat, end switch (isolated contact only), or flow switch is used as a DHW heat demand, connect to terminals 53 and 54. If preferred, a DHW tank sensor can be used in lieu of an aquastat to generate a heat demand.

NOTE: TT1, TT2, and DHW heat demand contacts must be dry contacts. The controllers heat demand voltage is 24VDC.

Refer to CH1 in 8.G on page 104– Active Demands.

⚠ 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 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 unit must be electrically grounded in accordance with these codes.

⚠ AVERTISSEMENT

Risque de choc électrique un choc électrique peut provoquer des blessures graves, la mort ou des dommages matériels. Débrancher l'alimentation électrique avant de commencer l'installation ou la modification du branchement pour éviter tout choc électrique ou d'endommager l'équipement. Il peut être nécessaire de désactiver plusieurs alimentations débrancher. Tout le câblage électrique doit être fait en conformité avec les codes locaux, ou en l'absence de codes locaux, avec : 1) Le National Electrical Code ANSI/NFPA no 70 - Dernière édition, ou 2) CSA STD.

7.E.7 Analog In and Analog Out

Analog In

BMS – if an analog input (0-10VDC or 4-20mA) from a BMS is used as a remote set point or remote firing rate command, wire to terminals 55 and 56. (See Figure 20 on page 40). Polarity is shown on the terminal label. Selecting voltage or current input is accomplished through jumper placement on the control board. See Figure 22. Analog BMS functionality is configured using the touch screen.

Blower – this input is factory wired. When using a VFD for blower speed control, this input provides speed feedback from the VFD to the controls.

Analog Out

Pump – When using Variable Speed Pump Control,, wire the pump speed wires to terminals 57 and 58. Polarity is shown on the terminal label. Selecting voltage or current output is accomplished through jumper placement on the control board. See Figure 22.

Variable Speed Pump Control, functionality is configured using the touch screen.
Blower – this output is factory wired. When using a VFD for blower speed control, this output provides the speed signal to the VFD.

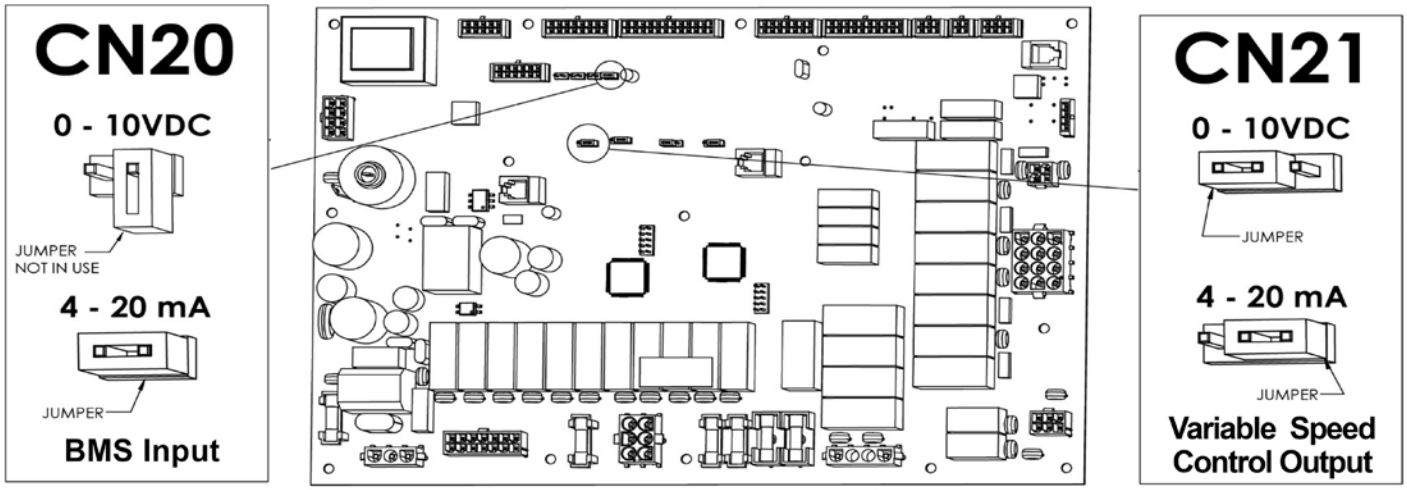


Figure 22. Analog IN / Out. Jumper locations at the integrated control board

7.E.8 Dry Contacts. Run & Alarm

Run - When used, is connected to terminals 59 (common), 60 (normally closed), and 61 (normally open) (See Figure 20 on page 40). The controller closes the normally open set of contacts whenever the unit is running. Contact ratings are 250VAC, 0.6A maximum.

Alarm - When used, is connected to terminals 63 (common), 63 (normally closed), and 64 (normally open). The controller closes the normally open set of contacts whenever the unit is locked out. Contact ratings are 250VAC, 0.6A maximum.

7.E.9 RS485 for Cascade (Lead Lag)

Cascade - Prior to wiring units for cascade operations, select one unit as the lead boiler. Other units connected to the lead boiler 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 65, 66, and 67 (See Figure 20 on page 40). Use 2-wire twisted pair, shielded w/drain (communication cable) between units. Connect one wire of the communication cable to A (-), terminal 66, and the other wire to terminal B (+), terminal 65, and a third conductor to GND, terminal 67 (see RS485 NOTE: Grounding). Connect the other end of the cable to the next unit, matching the termination wiring on the previous unit. 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 8.D.4 on page 74 shows how these systems are configured in the touchscreen controls.

7.E.10 RS485 BMS

BMS – If communicating to the unit via RS485 serial communications, either Modbus or BACnet MSTP, connect to terminals 68, 69, and 70 (See Figure 20 on page 40). Use 2-wire twisted pair, shielded w/drain (communication cable) between units. Connect one wire of the communication cable to A (-), terminal 68, and the other wire to terminal B (+), terminal 69, and a third conductor to GND, terminal 70.

Section 8.D.9 on page 87 shows how these systems are configured in the touchscreen controls.

If changes are made to the RS485 settings, the boiler power will need to be cycled in order for the changes to take effect.

NOTE: A system supply sensor (supplied with each unit) 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.

NOTE: RS485 Grounding & Shielding

Grounding: To ensure that common mode voltage does not compromise the date, 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.

7.F Modbus to BACnet Memory Map

Modbus Address	Type	R/W	Map Descriptor Name	BACnet Data Type	BACnet Object ID	R/W	Notes
0	S16	Read	Inlet Sensor	AI	0	Read	°C/°F
1	S16	Read	Outlet Sensor	AI	1	Read	°C/°F
2	S16	Read	Flue Sensor	AI	2	Read	°C/°F
3	S16	Read	DHW Sensor	AI	3	Read	°C/°F
4	S16	Read	System Inlet Sensor	AI	4	Read	°C/°F
5	S16	Read	System Outlet Sensor	AI	5	Read	°C/°F
6	S16	Read	Outdoor Sensor	AI	6	Read	°C/°F
14	S16	Read	0-10VDC (4-20mA) Input for BMS	AI	14	Read	mV (mA)
18	S16	Read	Safety Chain Status	AI	18	Read	bit0 = Flow Switch bit1 = LWCO bit2 = MRHL bit3 = Field Interlock bit4 = High Gas Pressure bit5 = Low Gas Pressure bit6 = ARHL bit7 = Condensate Level
19	S16	Read	Non-safety Chain Status	AI	19	Read	bit0 = Proof of Open bit1 = Proof of Close
20	S16	Read	Demand Source	AI	20	Read	0=None 1=Anti-Short Cycle 2=Service 3=DHW 4=Cascade 5=External 6=CH1 7=CH2 10=Anti-Frost 11=Warm weather shutdown
21	S16	Read	Digital Output Status	AI	21	Read	bit0 = Run contact bit1 = Alarm Contact bit2 = DHW Pump bit3 = System Pump bit4 = Spare bit5 = Isolation Valve bit6 = Alarm Bell bit7 = Boiler pump bit8 = Aux powered contact
22	S16	Read	Gas and Pilot Valve Status	AI	22	Read	bit 1 = Burner 1 Gas valve 1
23	S16	Read	0-10VDC (4-20mA) Output for Pump Speed	AI	23	Read	mV (mA)
24	S16	Read	0-10VDC (4-20mA) Output for Fan Speed	AI	24	Read	mV (mA)
28	S16	Read	O2	AI	28	Read	%
30	S16	Read	CO2	AI	30	Read	%
31	S16	Read	Pressure 1	AI	31	Read	"W.C.
32	S16	Read	Pressure 2	AI	32	Read	"W.C.
35	S16	Read	Lockout code	AI	35	Read	FLOW SWITCH = 0 LOW WATER CUT OFF ERROR = 1 MANUAL RESET HIGH LIMIT = 2 PRESSURE SWITCH = 3 HIGH GAS PRESSURE SWITCH = 4 LOW GAS PRESSURE SWITCH = 5 FIELD INTERLOCK = 6 SPARE SAFETY CHAIN = 7 OUTLET PROBE LOCKOUT = 8 OUTLET PROBE DRIFT = 9 OUTLET PROBE HIGH LIMIT = 10 FLUE PROBE LOCKOUT = 11 FLUE PROBE DRIFT = 13 FLUE PROBE HIGH LIMIT = 14 INLET PROBE LOCKOUT = 15 DELTA-T = 16 GENERIC LOCKOUT = 17 BURNER APS LOCKOUT = 18 BURNER PARASITIC FLAME = 20 BURNER MAX IGNITION ATTEMPTS = 22 BURNER MAX FLAME LOSS = 24 NO LOCKOUT = 255
36	S16	Read	Error Code	AI	36	Read	24 VDC ERROR = 30 24 VAC ERROR = 31 DHW PROBE ERROR = 32 SYSTEM SUPPLY PROBE ERROR = 33 SYSTEM RETURN PROBE ERROR = 34 OUTDOOR PROBE ERROR = 35 HIGH LIMIT AUTO ERROR = 41

Modbus Address	Type	R/W	Map Descriptor Name	BACnet Data Type	BACnet Object ID	R/W	Notes
							HIGH DELTA-T ERROR = 42
							FAN SPEED ERROR = 43
37	S16	Read	LMV_Phase	AI	37	Read	0 = Lockout
							2 = Safety
							10 = Home Run Position
							12 = Burner Standby
							22 = Combustion Fan, SV On
							24 = Drive to Prepurge Position
							30 = Prepurge
							35 = VSD Drive to Ignition Position
							36 = Drive to Ignition Position
							38 = Preignition (Spark) On
							40 = Pilot Vlave On
							42 = Ignition (Spark) Off
							44 = Interval 1 (Pilot Stabilization)
							50 = Safety Time 2
							52 = Interval 2 (Main Stabilization)
							60 = Operation 1 (Normal Operation)
							62 = Operation 2 (Driving to Low Fire)
							64 = Drive to Ignition Position
							65 = Interval 2
							66 = Ignition (Spark) + Pilot Valve On
							67 = Main Valve Off
							68 = Pilot Waiting Time
							69 = Pilot Waiting Time - Startup (Interval 1)
							70 = Afterburn Time
							72 = Drive to Postpurge Position
							74 = Mandatory Postpurge
							78 = Optional Postpurge
							80 = Evacuate
							81 = Atmospheric Test
							82 = Fill
							83 = Pressure Test
							90 = Gas Shortage
38	U16	Read	History - DHW Demand Cycles	AI	38	Read	Cycles * 10
39	U16	Read	History - CH1 Demand Cycles	AI	39	Read	Cycles * 10
40	U16	Read	History - CH2 Demand Cycles	AI	40	Read	Cycles * 10
43	U16	Read	History - Cascade Demand Cycles	AI	43	Read	Cycles * 10
44	U16	Read	History - Burner Stage 1 Cycles	AI	44	Read	Cycles * 10
45	S16	Read	LMV - Fuel Actuator Position	AI	45	Read	-50° to 150°
46	S16	Read	LMV - Air Actuator Position	AI	46	Read	-50° to 150°
47	S16	Read	LMV - VSD Setting	AI	47	Read	0 to 100%
48	U16	Read	History - Boiler Pump Cycles	AI	48	Read	Cycles * 10
49	U16	Read	History - DHW Pump Cycles	AI	49	Read	Cycles * 10
50	U16	Read	History - System Pump Cycles	AI	50	Read	Cycles * 10
51	S16	Read	History - Average Boiler Outlet Temp	AI	51	Read	°C/°F
52	S16	Read	History - Maximum Boiler Outlet Temp	AI	52	Read	°C/°F
53	S16	Read	History - Minimum Boiler Outlet Temp	AI	53	Read	°C/°F
54	S16	Read	History - Boiler Average Firing Temp	AI	54	Read	°C/°F
55	U16	Read	History - Boiler Maximum Firing Time	AI	55	Read	Hours
56	U16	Read	History - Boiler Minimum Firing Time	AI	56	Read	Hours
57	U16	Read	LMV - Modulation Rate	AI	57	Read	%
58	U16	Read	LMV - Flame Signal	AI	58	Read	%
59	U16	Read	LMV - Error Code	AI	59	Read	0 to 255
60	U16	Read	LMV - Diagnostic Code	AI	60	Read	0 to 255
61	U16	Read	LMV-Inputs	AI	61	Read	Bit 0 = Controller On/Off
							Bit 1 = Fan contactor contact
							Bit 2 = Fuel selection oil
							Bit 3 = Fuel selection gas
							Bit 4 = Not used
							Bit 5 = Pressure switch-max-oil
							Bit 6 = Pressure switch-min-oil
							Bit 7 = Pressure switch - valve proving
							Bit 8 = Safety loop
							Bit 9 = Not used
							Bit 10 = Pressure switch-min-gas
							Bit 11 = Pressure switch-max-gas
							Bit 12 = Not used
							Bit 13 = LP
							Bit 14 = Start release oil
							Bit 15 = Heavy oil immediate start
							Bit 0 = Alarm
							Bit 1 = Not used

7.F Modbus and BACnet memory Map (continued)

Modbus Address	Type	R/W	Map Descriptor Name	BACnet Data Type	BACnet Object ID	R/W	Notes
62	U16	Read	LMV-Outputs	AI	62	Read	Bit 2 = Not used Bit 3 = Not used Bit 4 = Ignition Bit 5 = Start signal/DW valve Bit 6 = Fan Bit 7 = Oil pump/magnetic coupling Bit 8 = Fuel valve SV oil Bit 9 = Fuel vlave V1 oil Bit 10 = Fuel valve V2 oil Bit 11 = Fuel valve V3 oil Bit 12 = Fuel valve SV gas Bit 13 = Fuel valve V1 gas Bit 14 = Fuel valve V2 gas Bit 15 = Fuel valve PV gas
63	S16	Read	LMV-Burner ID	AI	63	Read	Refer to LMV Manual
64	S16	Read	Modulation sensor	AI	64	Read	0 = None 1 = Outlet 2 = DHW 3 = System 4 = Inlet 5 = Flue 6 = System Return
65	U16	Read	Lead Lag (Cascade) active service	AI	65	Read	
66	U16	Read	Lag 1 State	AI	66	Read	0 = Not Present 1 = Not Available 2 = Available 3 = Running 4 = Locked Out
67	U16	Read	Lag 1 Firing Rate	AI	67	Read	Current firing rate (0-100%)
68	U16	Read	Lag 2 State	AI	68	Read	0 = Not Present 1 = Not Available 2 = Available 3 = Running 4 = Locked Out
69	U16	Read	Lag 2 Firing Rate	AI	69	Read	Current firing rate (0-100%)
70	U16	Read	Lag 3 State	AI	70	Read	0 = Not Present 1 = Not Available 2 = Available 3 = Running 4 = Locked Out
71	U16	Read	Lag 3 Firing Rate	AI	71	Read	Current firing rate (0-100%)
72	U16	Read	Lag 4 State	AI	72	Read	0 = Not Present 1 = Not Available 2 = Available 3 = Running 4 = Locked Out
73	U16	Read	Lag 4 Firing Rate	AI	73	Read	Current firing rate (0-100%)
74	U16	Read	Lag 5 State	AI	74	Read	0 = Not Present 1 = Not Available 2 = Available 3 = Running 4 = Locked Out
75	U16	Read	Lag 5 Firing Rate	AI	75	Read	Ccrrent firing rate (0-100%)
76	U16	Read	Lag 6 State	AI	76	Read	0 = Not Present 1 = Not Available 2 = Available 3 = Running 4 = Locked Out
77	U16	Read	Lag 6 Firing Rate	AI	77	Read	Ccrrent firing rate (0-100%)
78	U16	Read	Lag 7 State	AI	78	Read	0 = Not Present 1 = Not Available 2 = Available 3 = Running 4 = Locked Out
79	U16	Read	Lag 7 Firing Rate	AI	79	Read	Current firing rate (0-100%)
80	U16	Read	Lead 0 State	AI	80	Read	0 = Not Present 1 = Not Available 2 = Available 3 = Running 4 = Locked Out
81	U16	Read	Lead 0 Firing Rate	AI	81	Read	Current firing rate (0-100%)
83	U16	Read	Active CH Setpoint	AI	83	Read	
							0=None

Modbus Address	Type	R/W	Map Descriptor Name	BACnet Data Type	BACnet Object ID	R/W	Notes
84	U16	Read	Burner Status 1	AI	84	Read	5 = Start 24 = Error Block 160 = Standby 165 = Check Safety Swtich 166 = Run 177 = Prepurge Open 181 = Parameter Block 183 = Lockout 188 = Testmode 194 = Prepurge Closed 195 = Wait for HIS Free 196 = HIS Preheat/Prespark 200 = Verify Primary SF 217 = interpurge 241 = Postpurge 245 = Trial for Ignition 250 = Trial for Ignition Main 52=Post Purge
85	U16	Read	LMV - Lower Trim Limit	AI	85	Read	(See LMV Manual)
86	U16	Read	LMV - Upper Trim Limit	AI	86	Read	(See LMV Manual)
87	U16	Read	LMV - Current Trim	AI	87	Read	(See LMV Manual)
88	U16	Read	LMV - Fan Speed	AI	88	Read	%
89	U16	Read	Boiler Pump Status	AI	89	Read	0 = Off 1 = On
90	U16	Read	Cascade Master Heat Demand	AI	90	Read	0 = Off 1 = On
91	U16	Read	Burner 1 Run Time	AI	91	Read	Hours
92	U16	Read	Burner ID 0	AI	92	Read	
93	U16	Read	Burner ID 1	AI	93	Read	
94	U16	Read	Burner ID 2	AI	94	Read	
95	U16	Read	Burner ID 3	AI	95	Read	
96	U16	Read	Burner ID 4	AI	96	Read	
97	U16	Read	Burner ID 5	AI	97	Read	
98	U16	Read	Burner ID 6	AI	98	Read	
99	U16	Read	Burner ID 7	AI	99	Read	
128	S16	Read/Write	CH1 Enable/Disable	AV	0	Read/Write	
129	S16	Read/Write	CH1 Set Point	AV	1	Read/Write	
130	S16	Read/Write	CH1 PID Low - P	AV	2	Read/Write	
131	S16	Read/Write	CH1 PID Low - I	AV	3	Read/Write	
132	S16	Read/Write	CH1 PID Low - D	AV	4	Read/Write	
133	S16	Read/Write	CH2 Enable/Disable	AV	5	Read/Write	
134	S16	Read/Write	CH2 Set Point	AV	6	Read/Write	
135	S16	Read/Write	CH2 PID Low - P	AV	7	Read/Write	
136	S16	Read/Write	CH2 PID Low - I	AV	8	Read/Write	
137	S16	Read/Write	CH2 PID Low - D	AV	9	Read/Write	
140	S16	Read/Write	CH1 PID High - P	AV	12	Read/Write	
141	S16	Read/Write	CH1 PID High - I	AV	13	Read/Write	
142	S16	Read/Write	CH1 PID High - D	AV	14	Read/Write	
145	S16	Read/Write	CH2 PID High - P	AV	17	Read/Write	
146	S16	Read/Write	CH2 PID High - I	AV	18	Read/Write	
147	S16	Read/Write	CH2 PID High - D	AV	19	Read/Write	
148	S16	Read/Write	DHW Enable/Disable	AV	20	Read/Write	
149	S16	Read/Write	DHW Set Point	AV	21	Read/Write	
150	S16	Read/Write	DHW PID Low - P	AV	22	Read/Write	
151	S16	Read/Write	DHW PID Low - I	AV	23	Read/Write	
152	S16	Read/Write	DHW PID Low - D	AV	24	Read/Write	
159	S16	Read/Write	DHW PID High - P	AV	31	Read/Write	
160	S16	Read/Write	DHW PID High - I	AV	32	Read/Write	
161	S16	Read/Write	DHW PID High - D	AV	33	Read/Write	
165	S16	Read/Write	Vari-Prime P - Proportional Term	AV	37	Read/Write	
166	S16	Read/Write	Vari-Prime I - Integral Term	AV	38	Read/Write	
167	S16	Read/Write	Vari-Prime D - Derivative Term	AV	39	Read/Write	
168	S16	Read/Write	Vari-Prime Delta T	AV	40	Read/Write	
174	S16	Read/Write	DHW Demand switch	BV	0	Read/Write	0 = No Heat Demand; 1 = Heat Demand
175	S16	Read/Write	CH 1 Demand switch	BV	1	Read/Write	0 = No Heat Demand; 1 = Heat Demand
176	S16	Read/Write	CH 2 Demand switch	BV	2	Read/Write	0 = No Heat Demand; 1 = Heat Demand
179	S16	Read/Write	Modbus Parameter Write Enable				

7.G Wiring Diagram

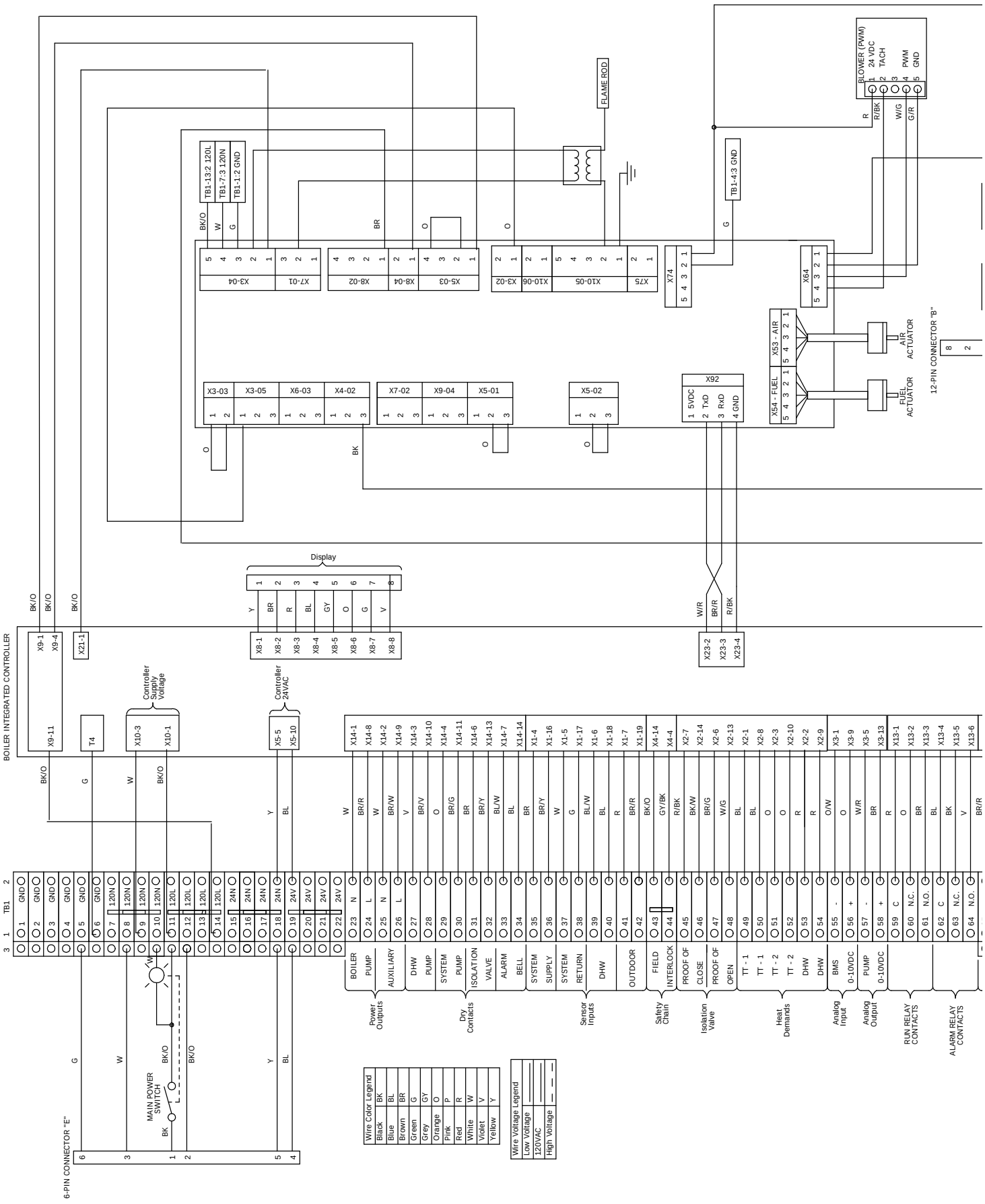
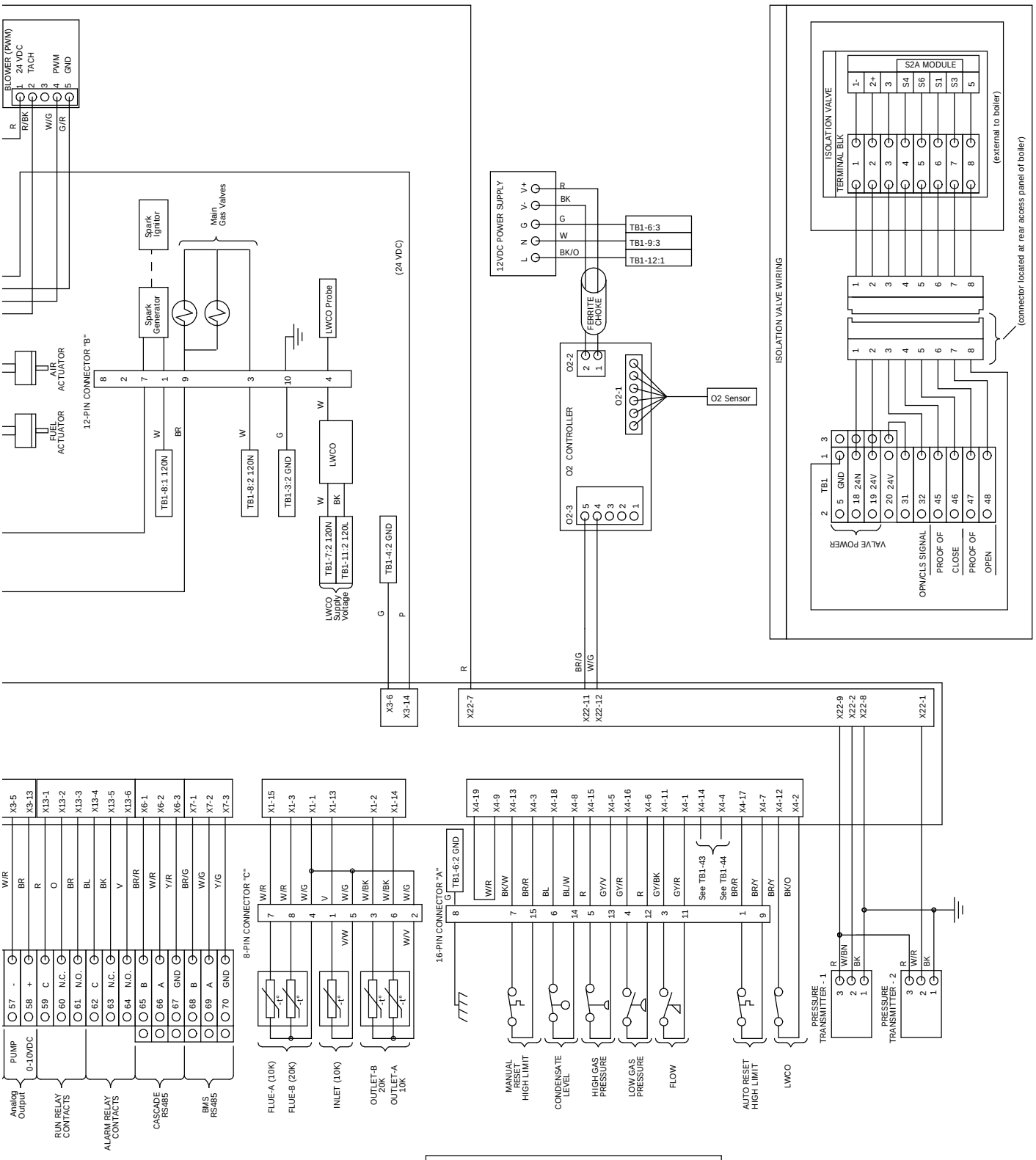


Figure 23. Wiring Diagram, Models 1000 - 3000



WIRING DIAGRAM
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7.H HIgh Voltage Wiring Diagrams

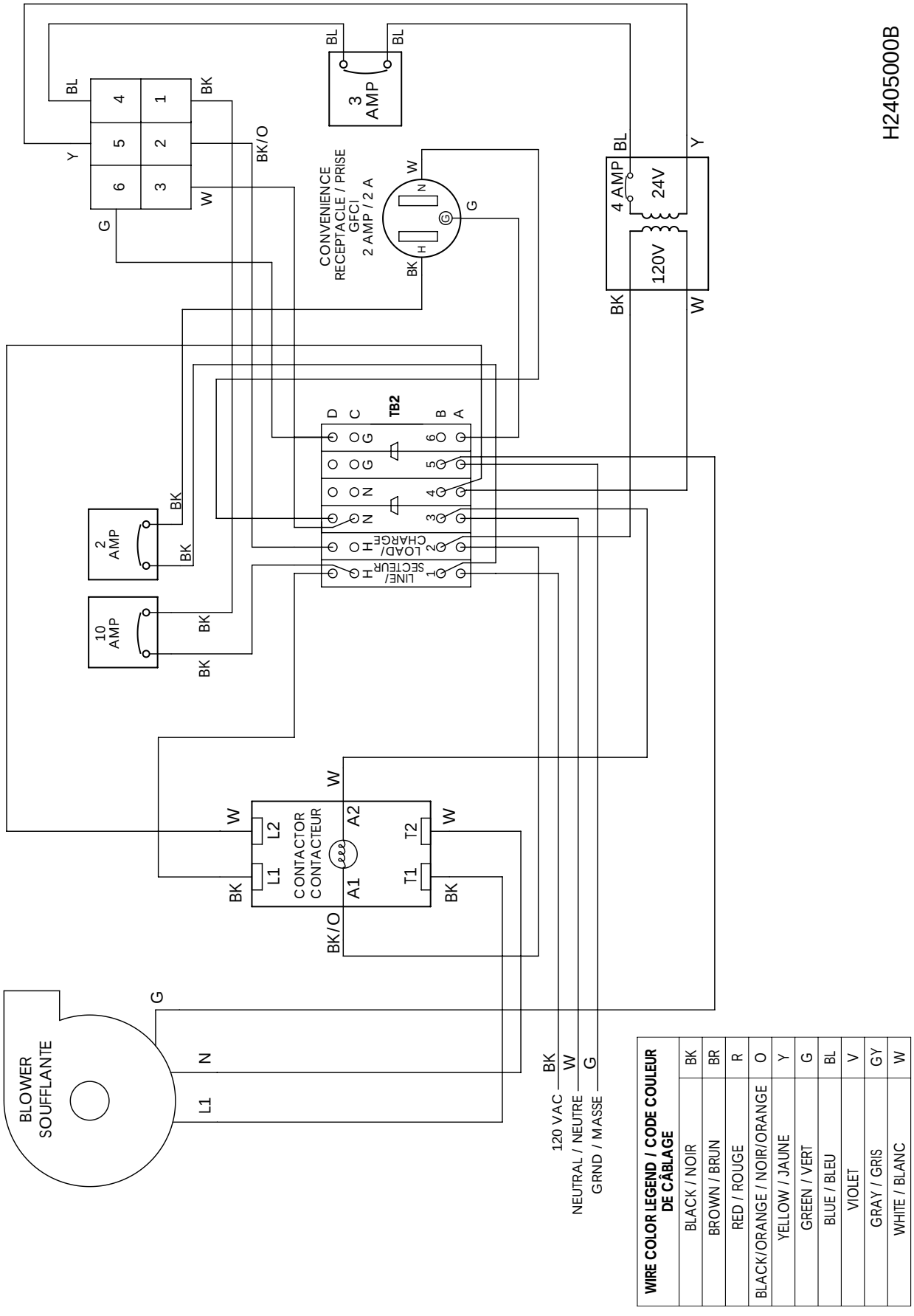


Figure 24. High Voltage Wiring Diagram 120V, Single Phase

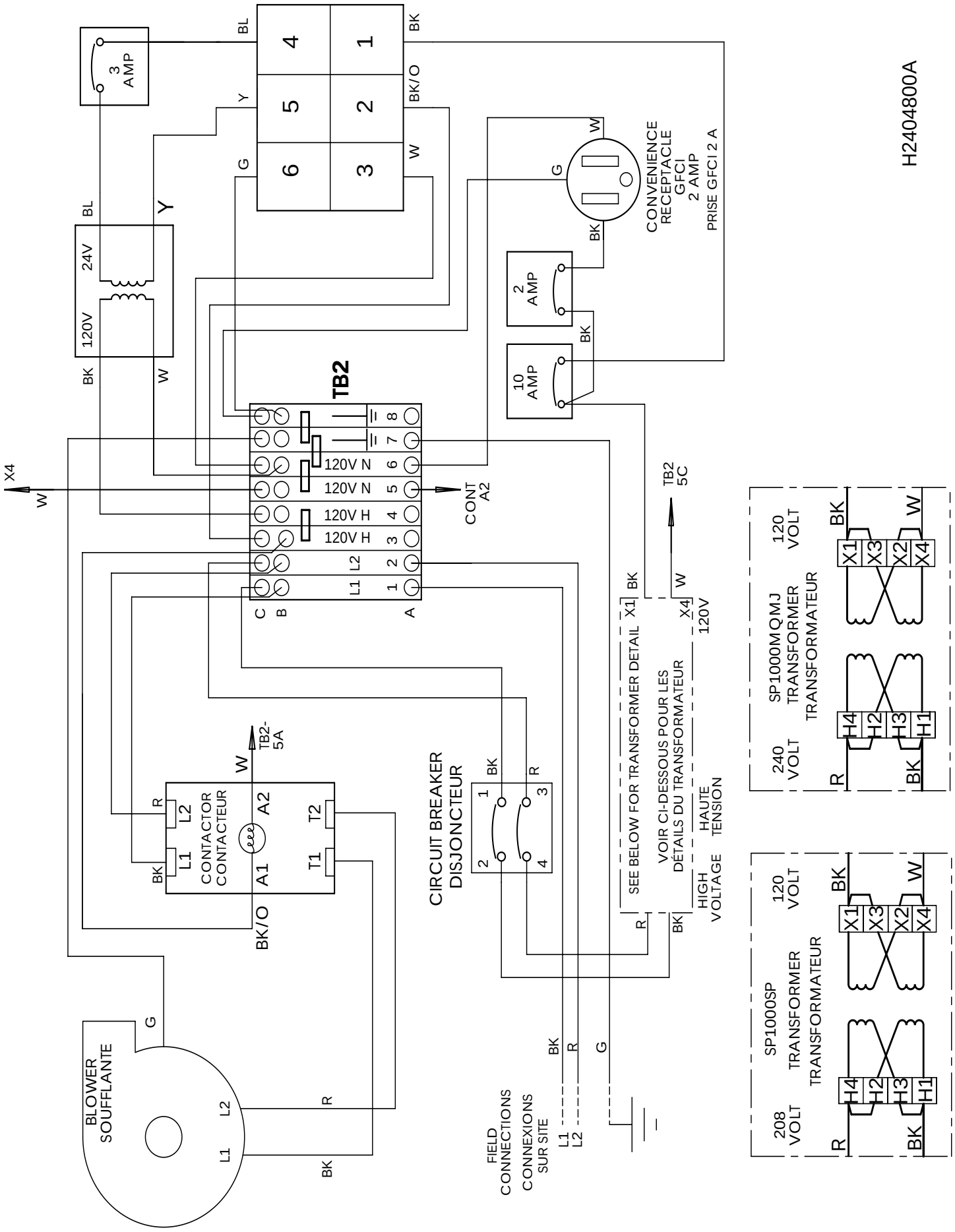


Figure 25. High Voltage Wiring Diagram 208V / 240V Single Phase

7.H High Voltage Wiring Diagrams (continued)

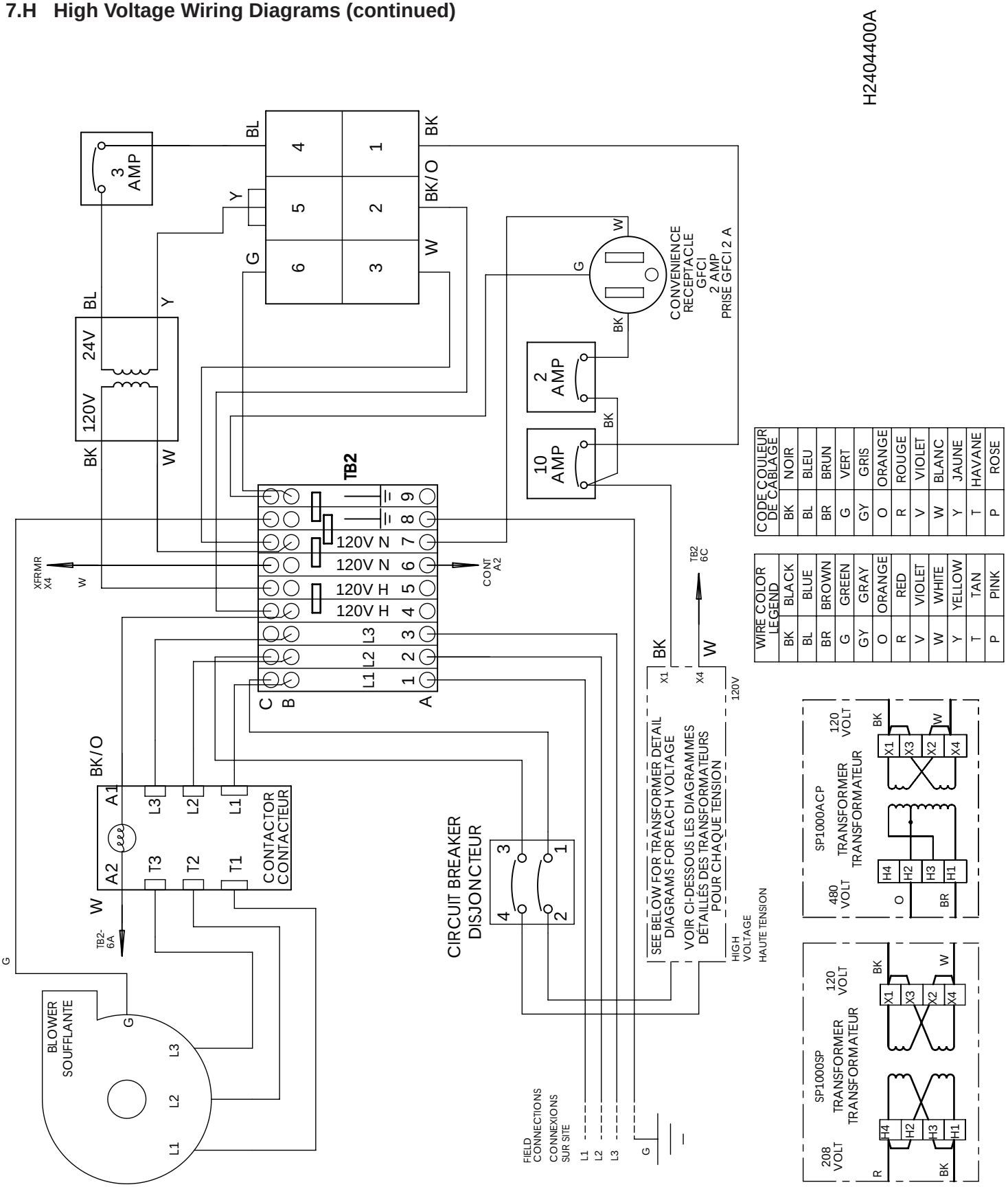


Figure 26. High Voltage Wiring Diagram 208V / 489V, Three Phase

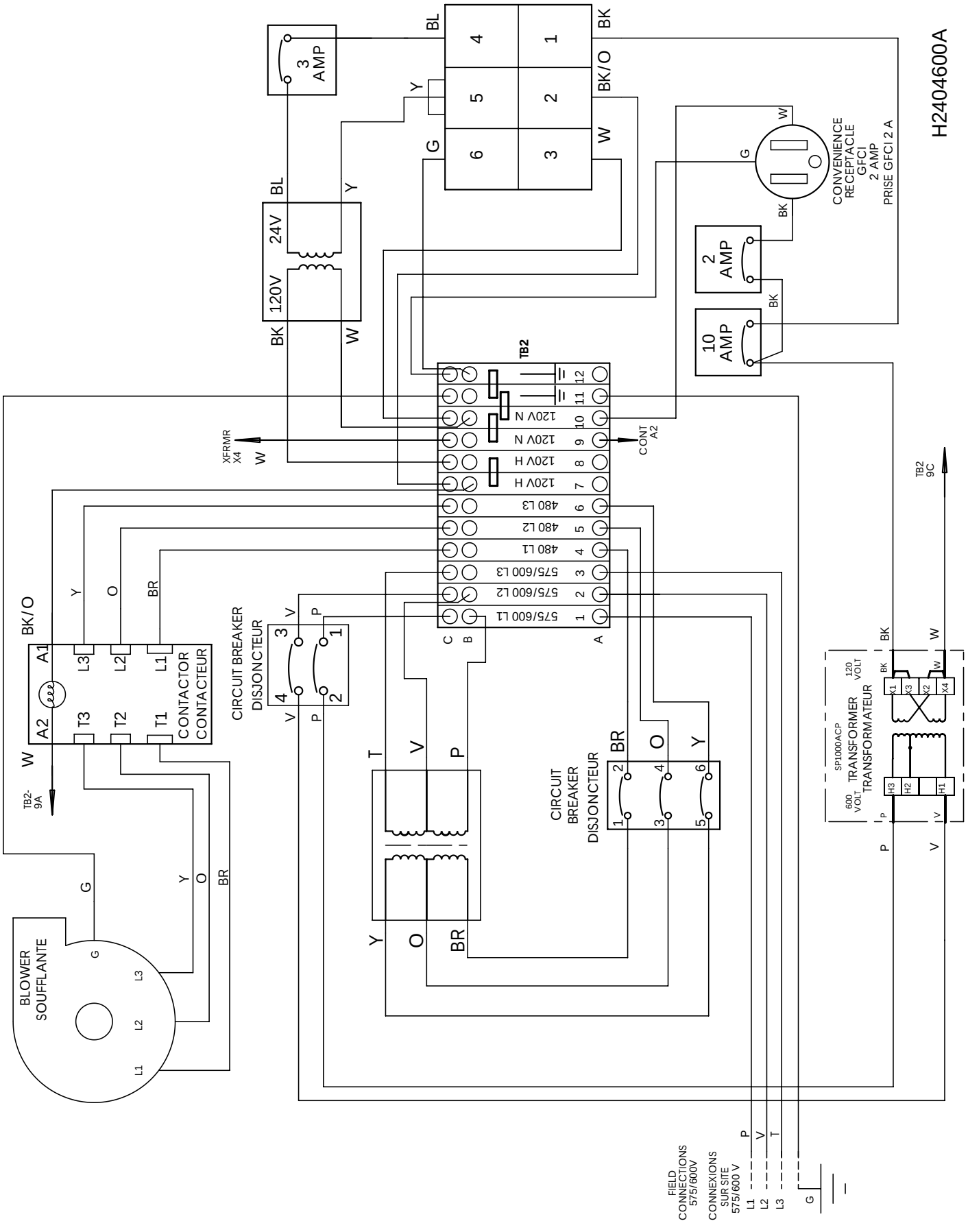


Figure 27. High Voltage Wiring Diagram 600V, Three Phase

7.I Ladder Diagrams

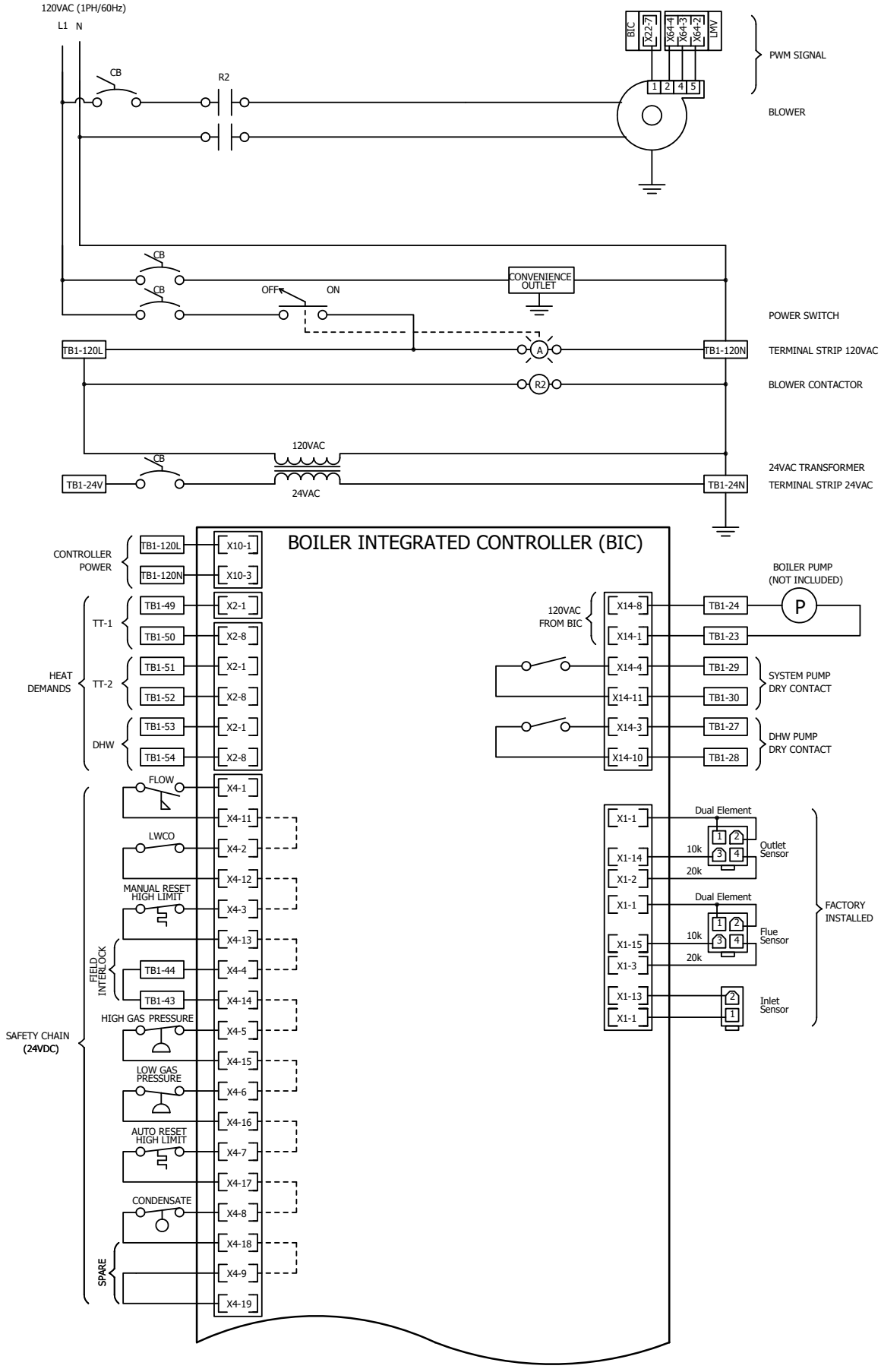
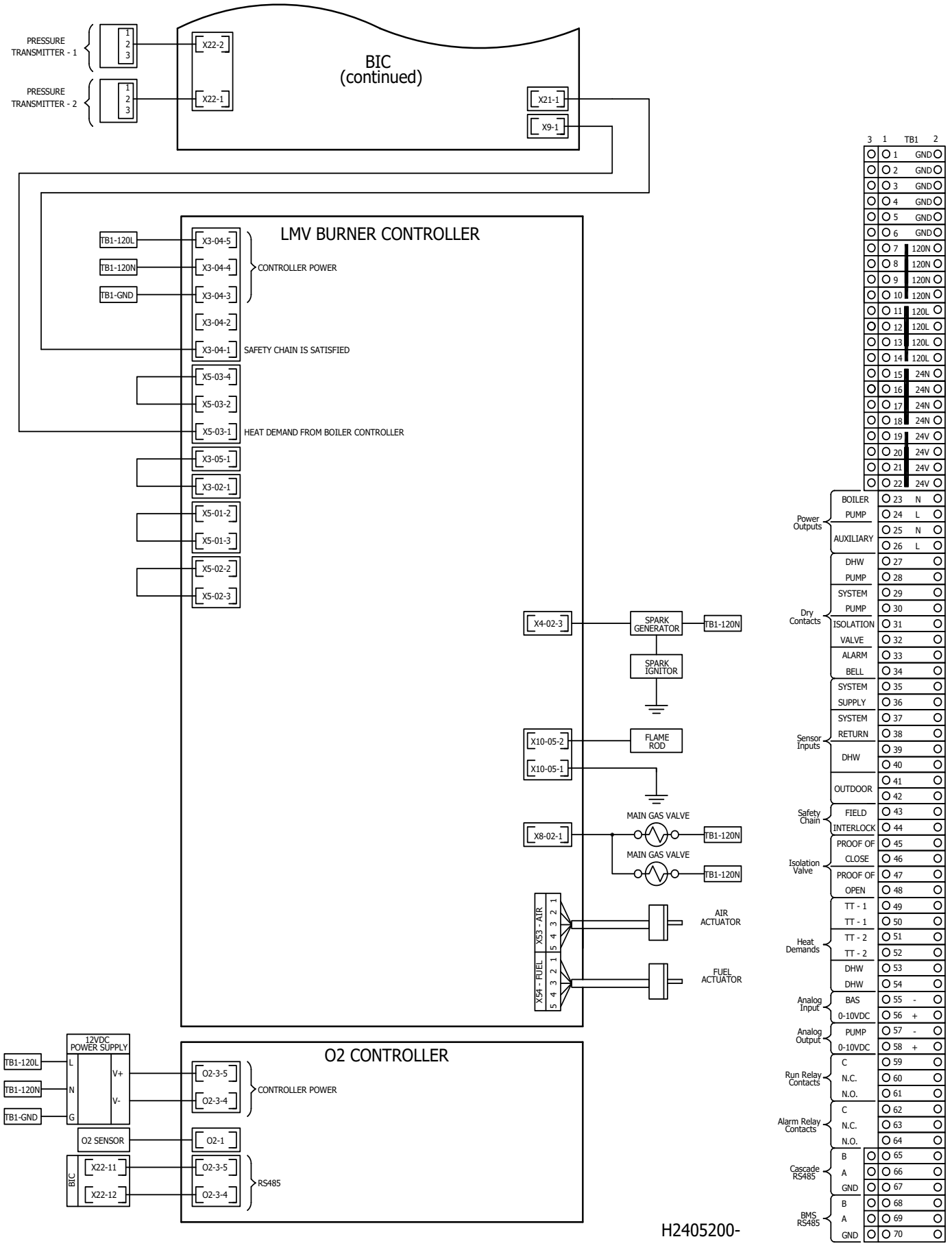


Figure 28. Ladder Diagram, Models 1000, 1500, 2000. 120V



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7.I Ladder Diagrams (continued)

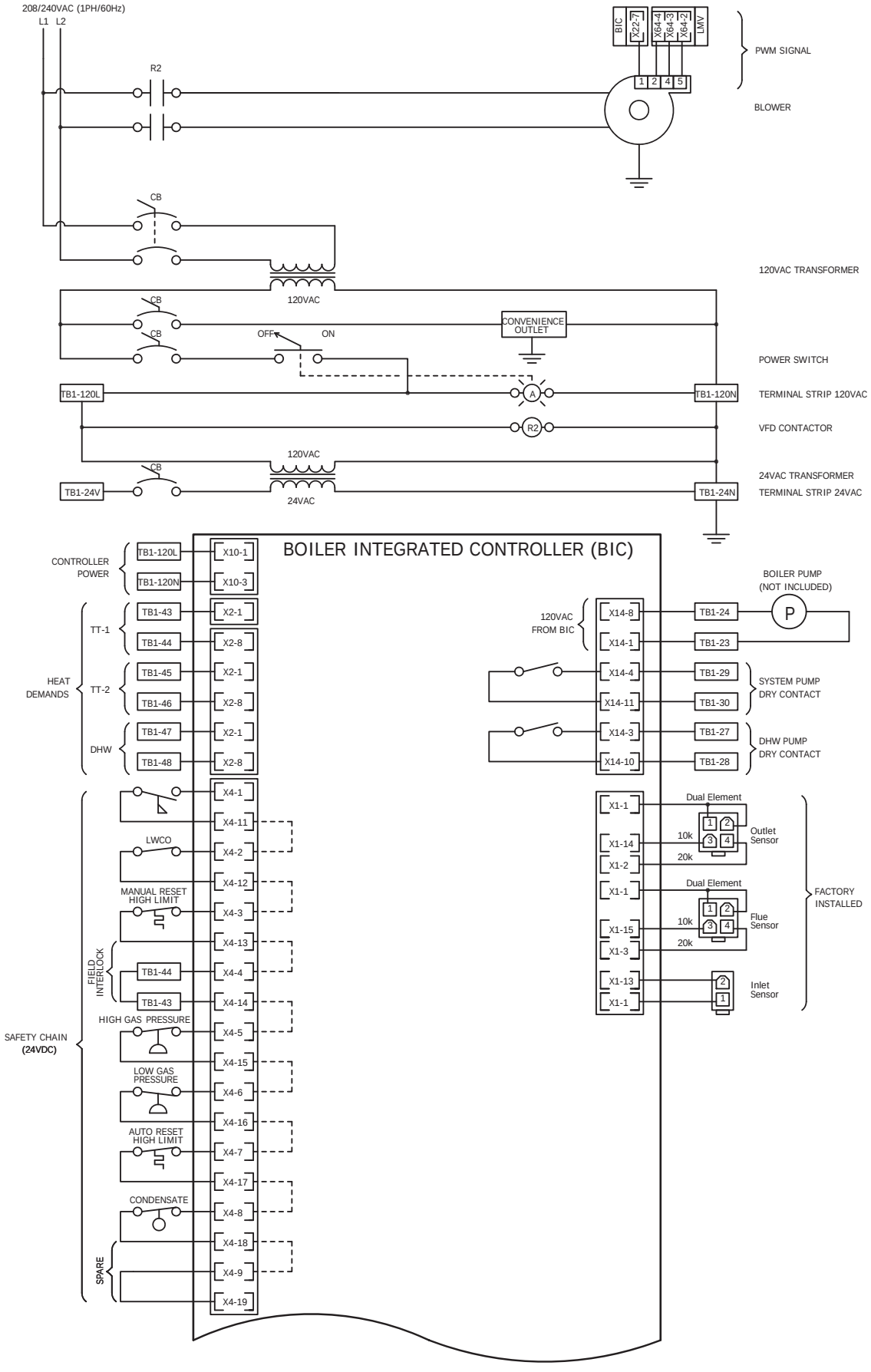
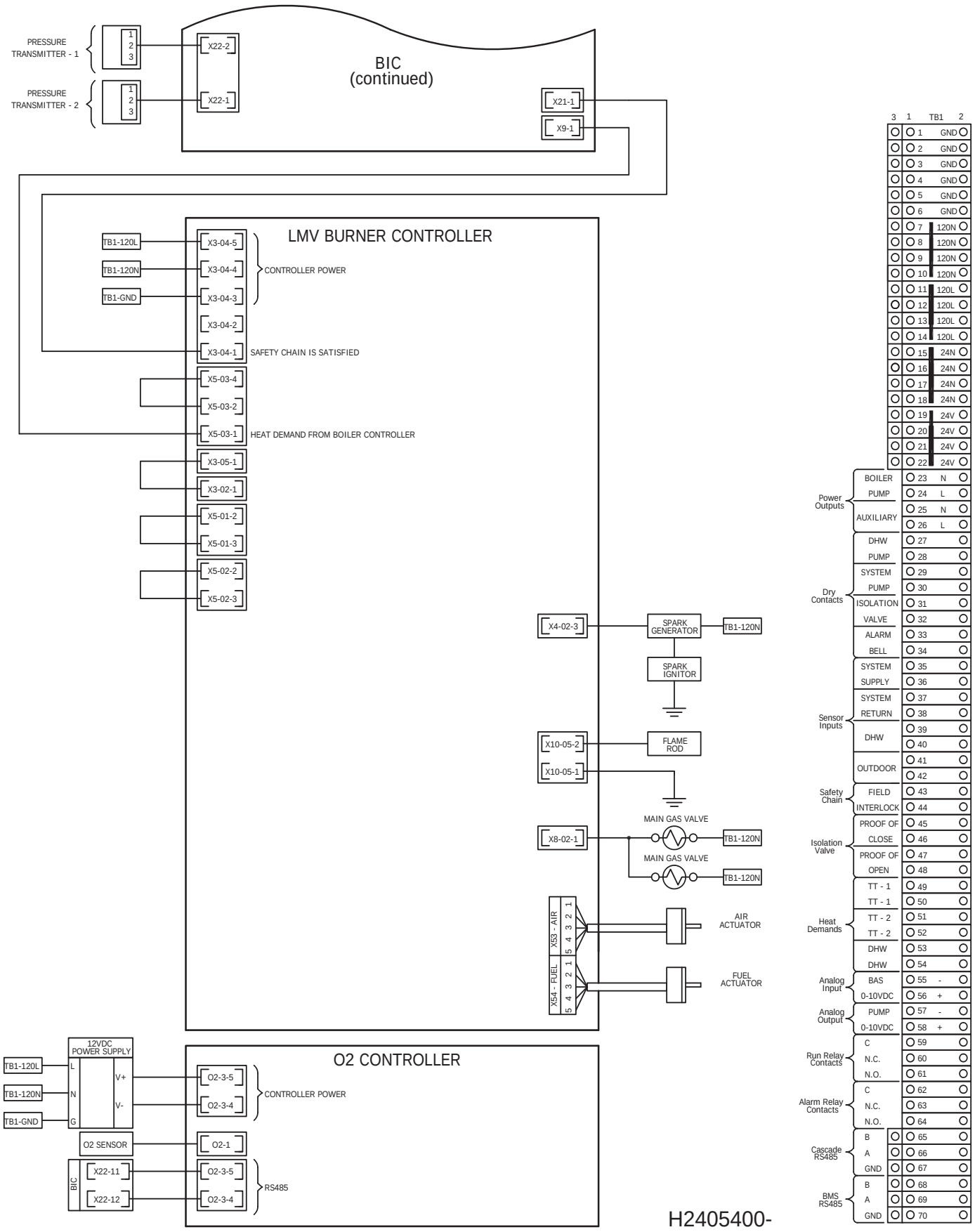


Figure 29. Ladder Diagram, Models 1000, 1500, 2000. 208V / 240V, Single Phase



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7.I Ladder Diagrams (continued)

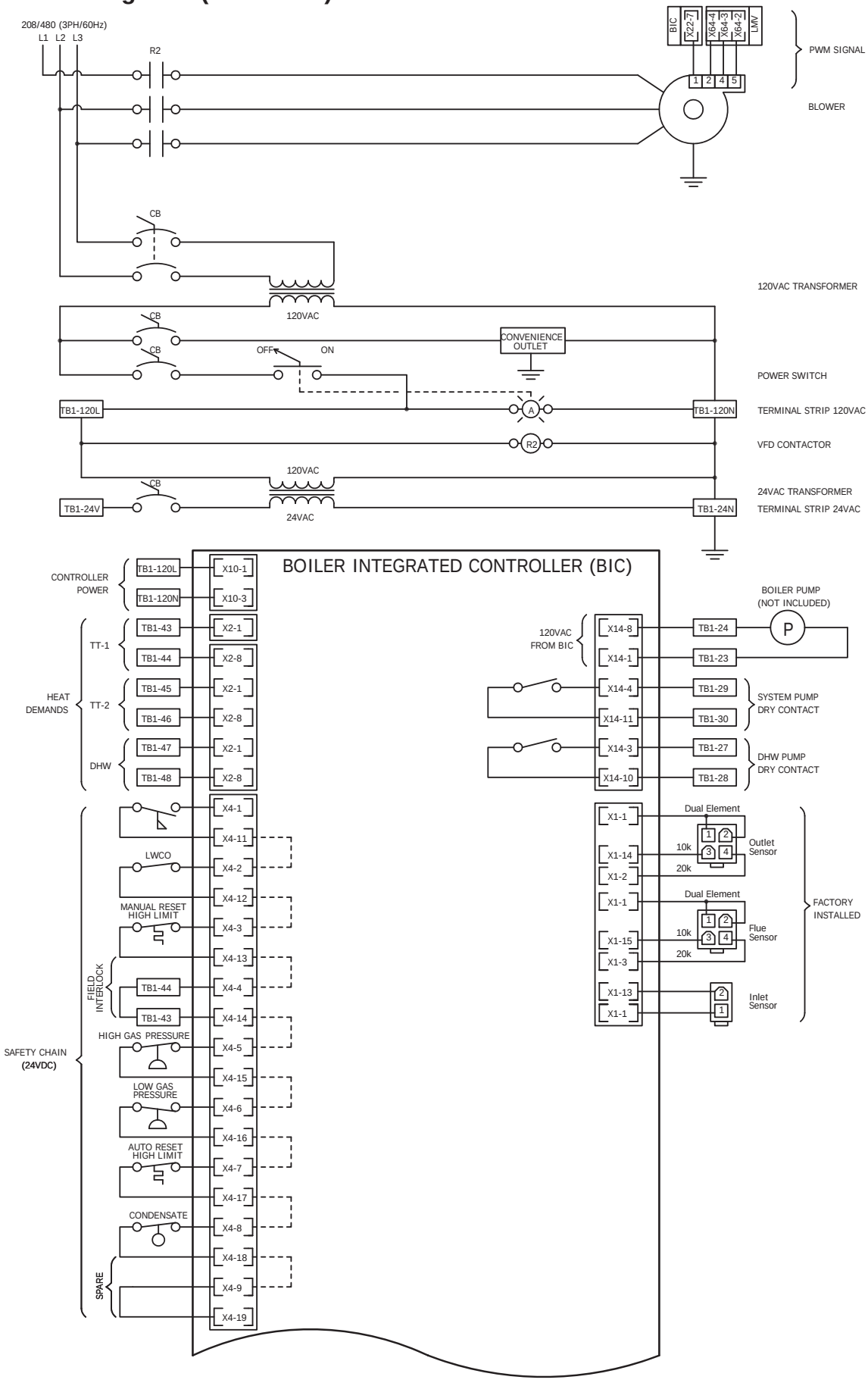
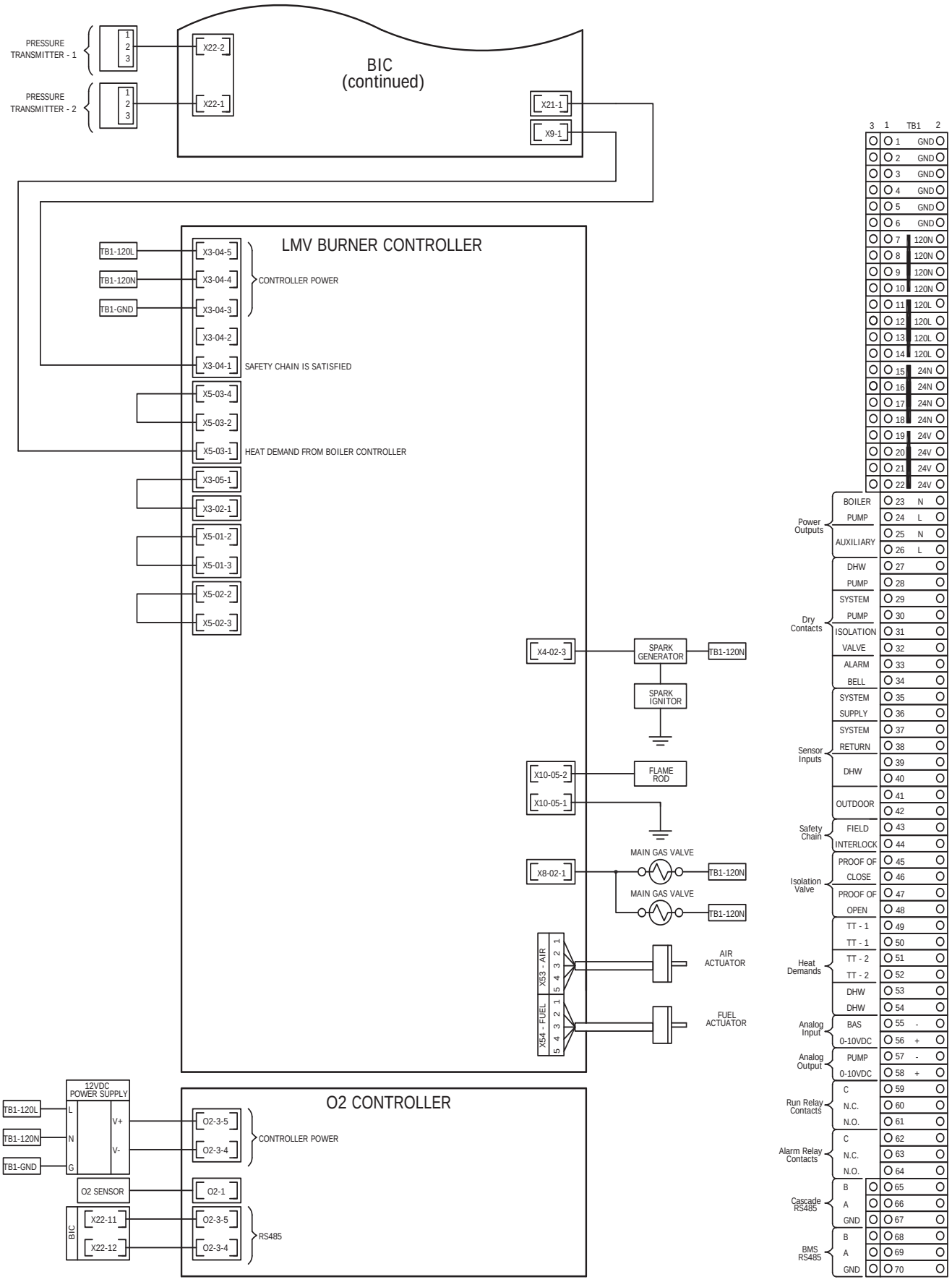


Figure 30. Ladder Diagram, Models 2000, 3000. 208V / 240V, Three Phase



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7.I Ladder Diagrams (continued)

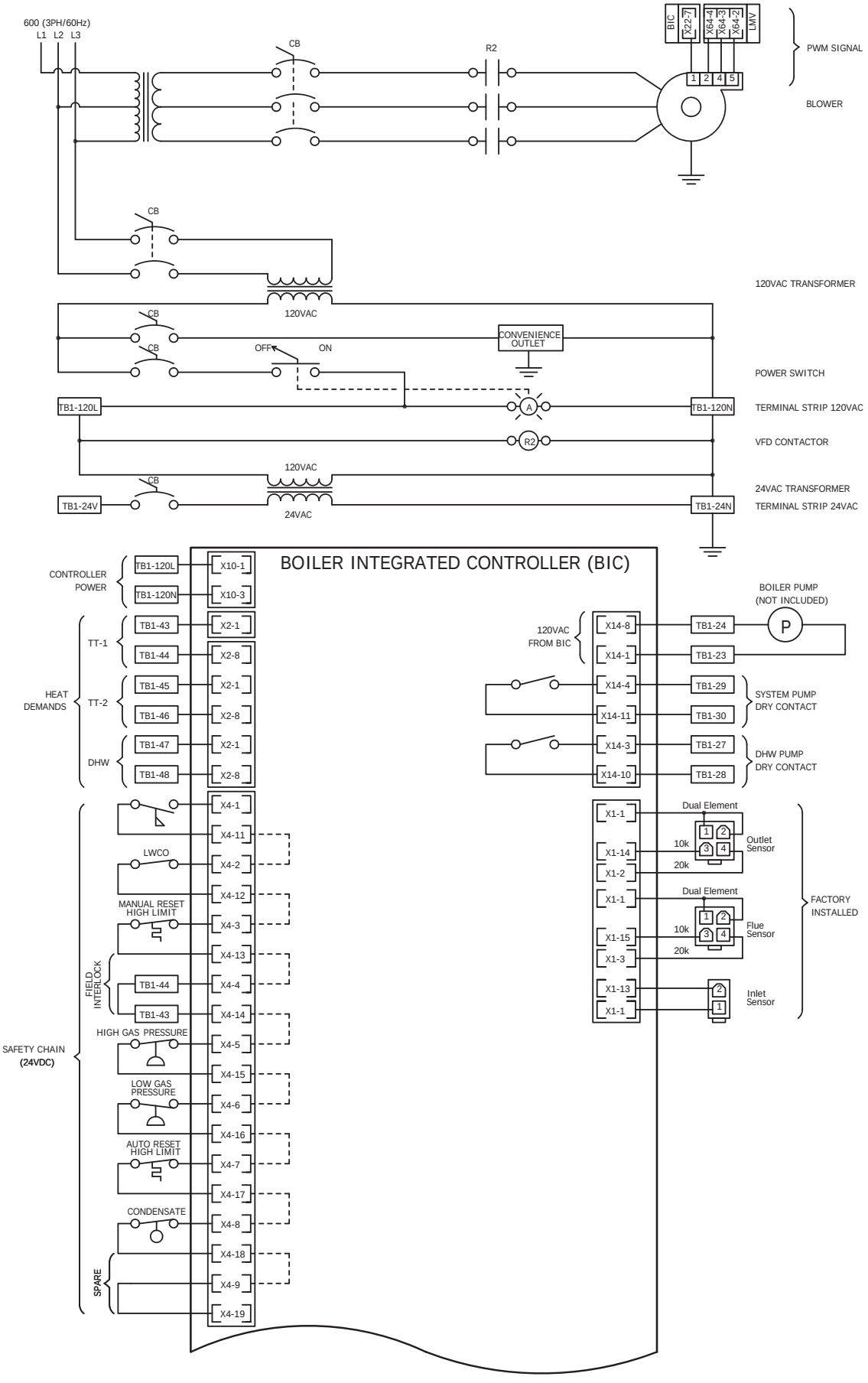
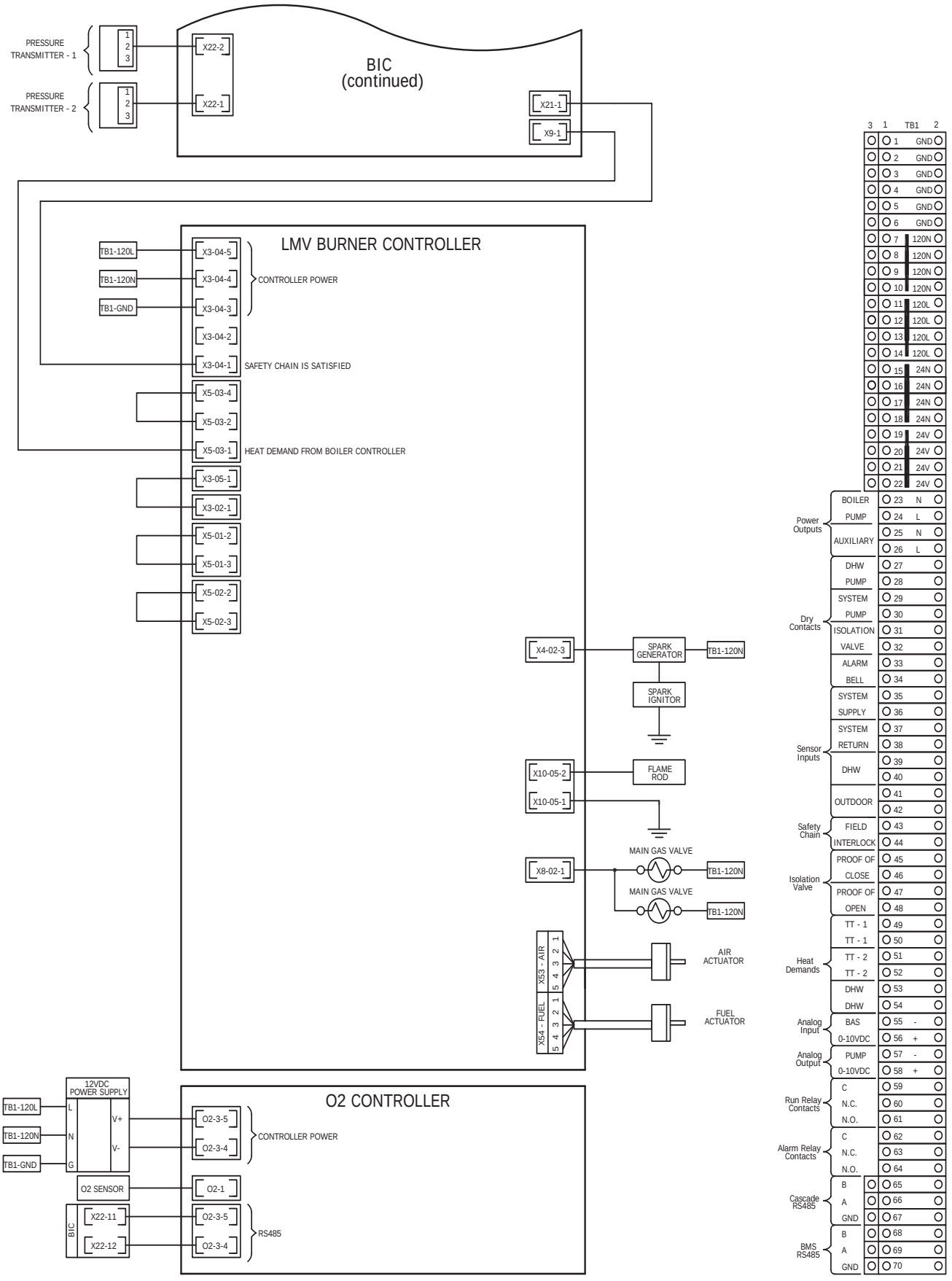


Figure 31. Ladder Diagram, Models 2000, 3000. 600V, Three Phase



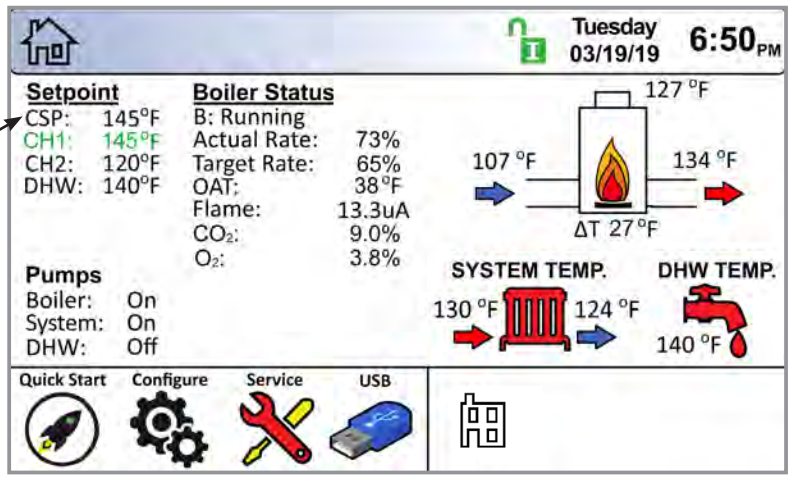
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SECTION 8 Control Operation

8.A The Home Screen

CSP: is the Calculated (and Current) Set Point. It can be based on the CH1 (Central Heat One), CH2, or the DHW (Domestic Hot Water) setpoint, depending on the model and the installation set up and may be adjusted by the Outdoor Reset and the DHW Offset.



8.A.1 Home Screen Active Icons

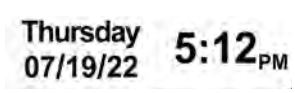
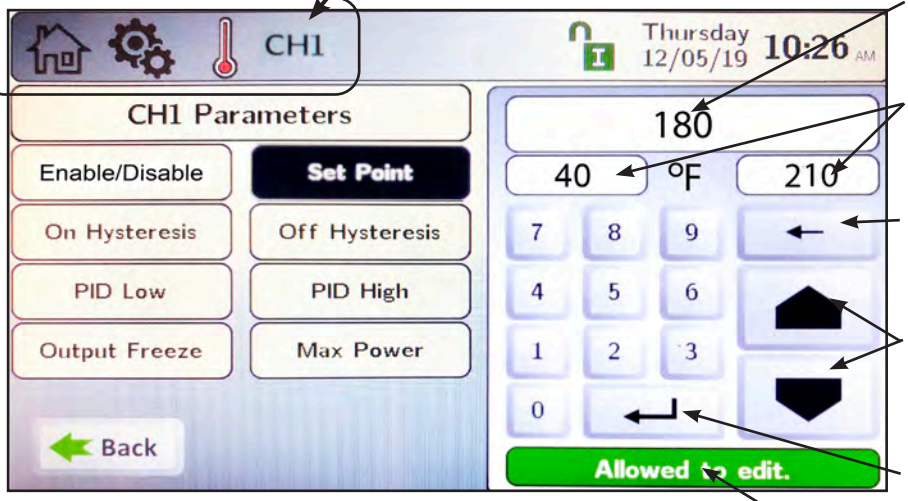
Name	Icon	Description
Security		Displays the current lock status icon. Touch the lock icon to lock or unlock the Touchscreen Display. See **Section 8.B on page 64**
Quick Start		Provides quick access to the most commonly used parameters for easy installation. See **Section 8.C on page 65**
Configure		Provides access to ALL of your configurations for a detailed setup of the unit. See **Section 8.D on page 69**
Service		Allows the service technician to access the basic diagnostic and troubleshooting information. See **Section 8.E on page 98**
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 8.F on page 103** 
Active Demands		Will show icons that indicate the active parameters that are currently in demand. **See Section 8.G on page 104**
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 8.A.2 on page 63** **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. **SECTION 12 on page 120** 
Date & Time		To change date and time, simply touch the date or time and follow the directions. **Section 8.D.10 on page 89**

Figure 32. Active Areas of the Home Screen

8.A.2 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.

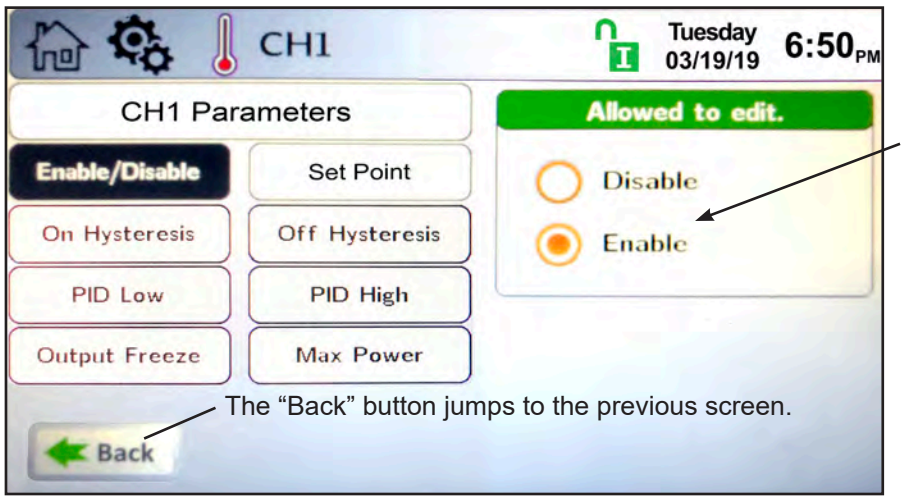
"Up and Down" arrows are used to increment the setting accordingly.

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.

8.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



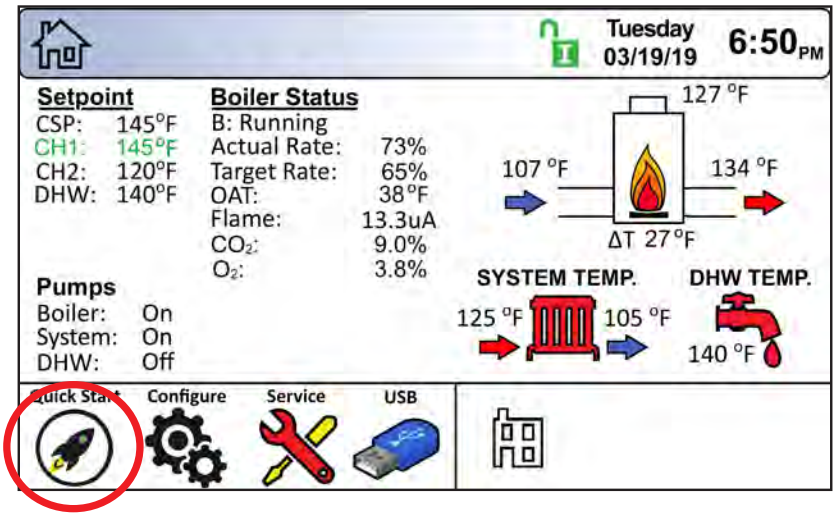
Logout. If the Installer is done and wants to lock the display immediately, tap the Logout icon to exit Installer or User Mode. Exiting the Installer or User Mode will lock the unit.

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 "8.E.4 Screen Settings Timeout" on page 101.



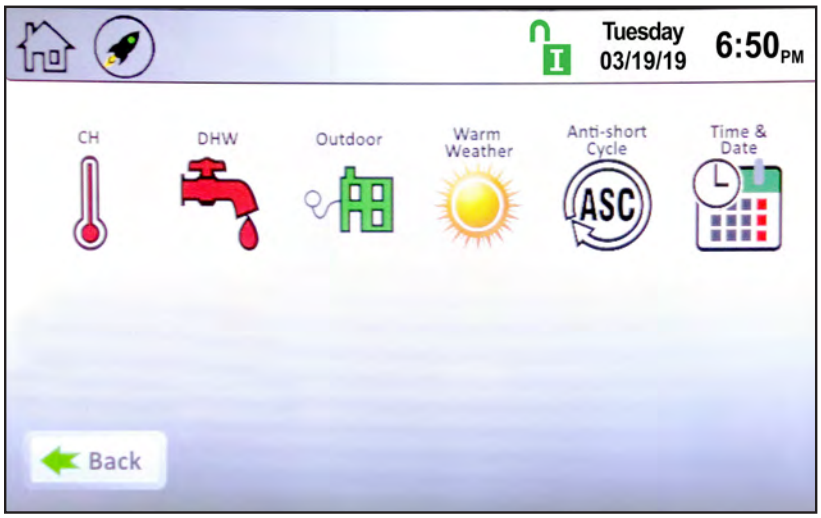
8.C Quick Start

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



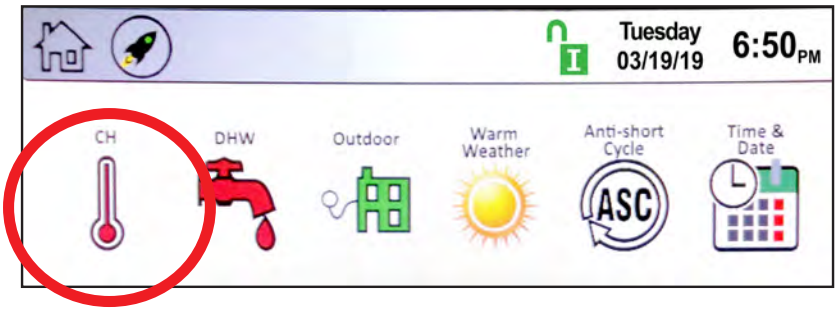
The 6 BASIC functions at Quick Start are

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



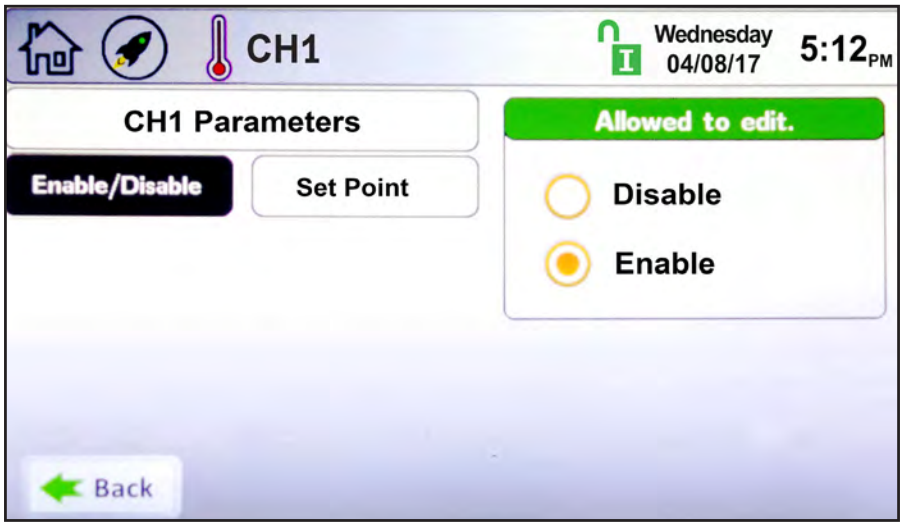
8.C.1 CH (Central Heat)

"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 "8.D Configuration" on page 69.
Touching CH1 navigates to the CH1 Quick Start Screen.



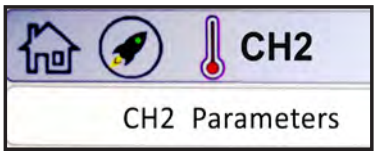
8.C.1.a CH1 (Central Heat, One) 1

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



8.C.1.b CH2 (Central Heat, Two) 2

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.



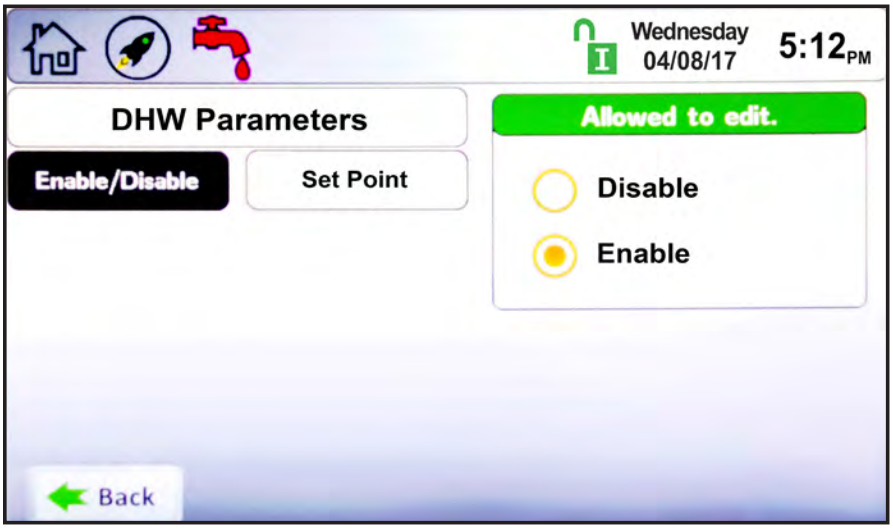
8.C.2 DHW (Domestic Hot Water)

"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 Section 7.E.3 on page 41



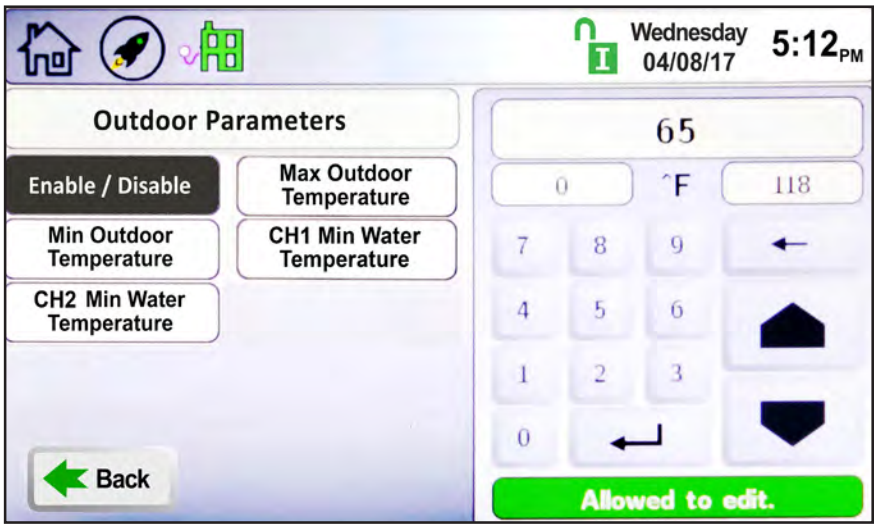
8.C.3 Outdoor Reset

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 start using the minimum water temperature as the set point.
- **Minimum Outdoor Temperature** – The outdoor temperature at which the unit will start using the maximum water temperature as the set point.
- **CH1 Minimum Water Temperature** – The minimum boiler CH1 outlet temperature based on the Maximum Outdoor Temperature.
- **CH2 Minimum Water Temperature** – The minimum boiler CH2 outlet temperature based on the Maximum Outdoor Temperature.



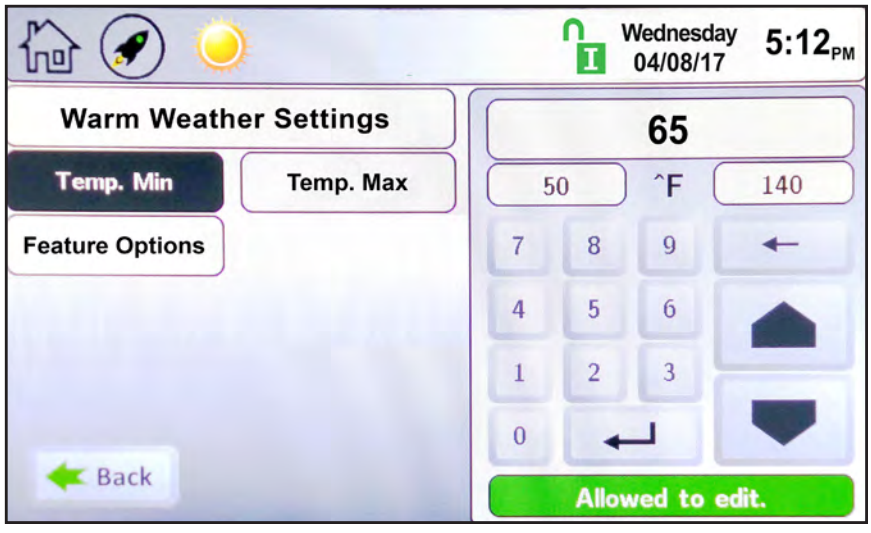
8.C.4 Warm Weather Shut Down

Warm weather shut down allows the user to disable the 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 the heating operation when the air temperature drops to this value.
- **Temp Max** – The outdoor air 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.



8.C.5 Anti-Short Cycle

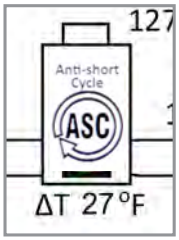
To navigate to the Anti-Short Cycle Quick Start Screen, touch the Anti-Short Cycle Icon on the Quick Start Screen.

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.





NOTE: Anti-Short Cycle may appear in the boiler icon on the home page.

8.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:

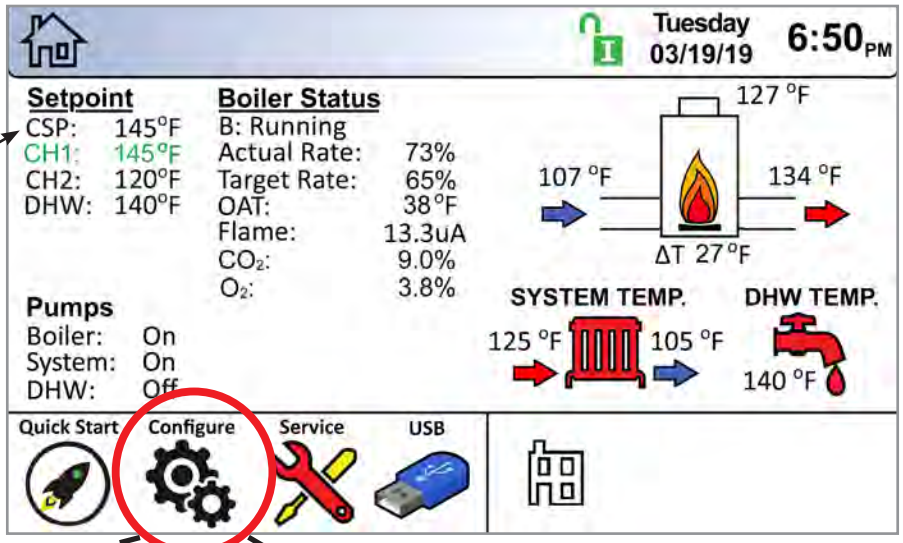
- **Hour**
- **Minute**
- **Month**
- **Day**
- **Year**

8.D Configuration

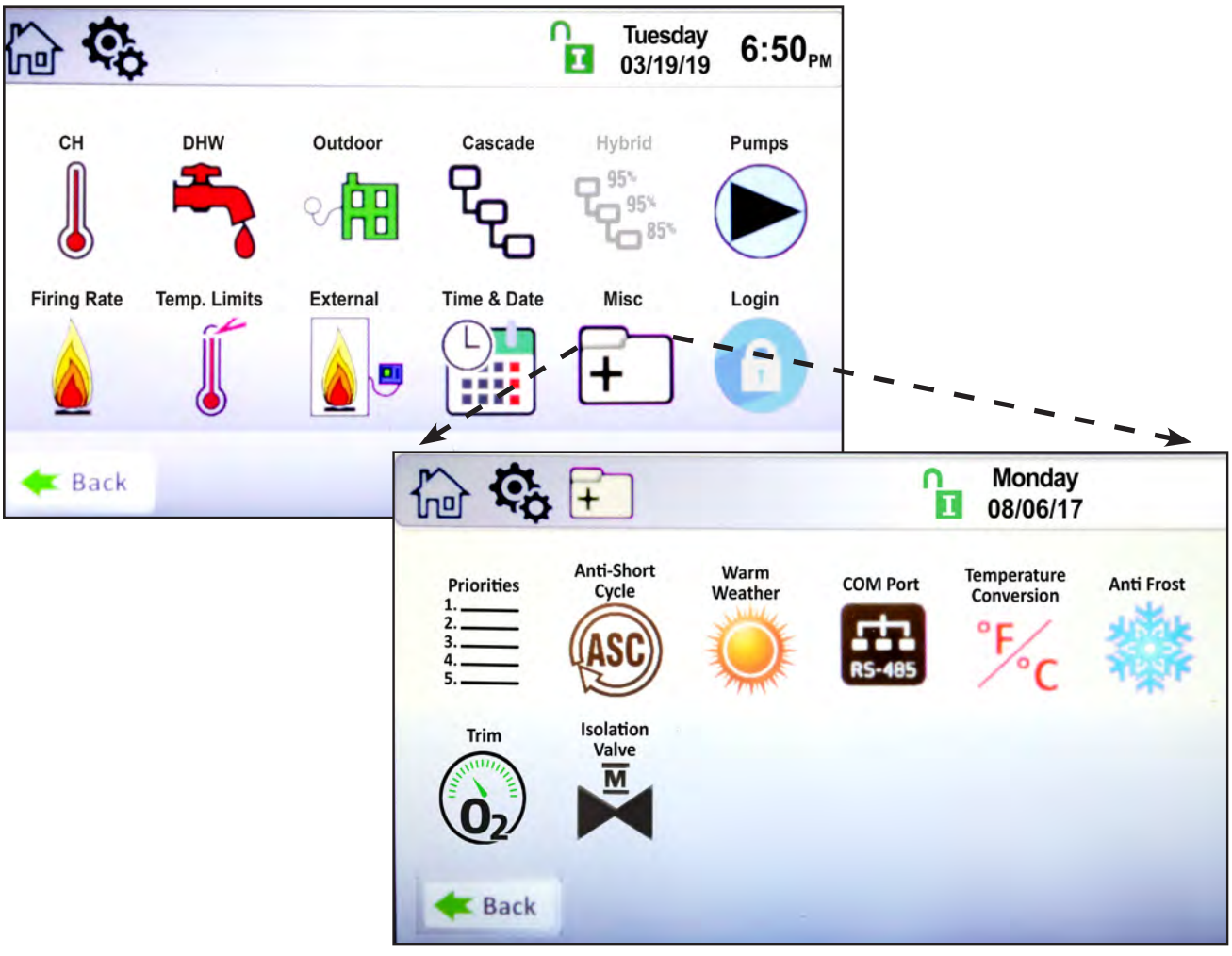
This area of the controller allows access to all parameters available, based on the access level that is unlocked.

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

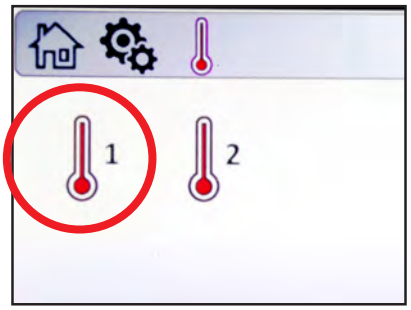
CSP: is the Calculated (and Current) Set Point. It can be based on the CH1 (Central Heat One), CH2, or the DHW (Domestic Hot Water) setpoint, depending on the model and the installation set up and may be adjusted by the Outdoor Reset and the DHW Offset.



The Configuration Screen shows all configurable parameters.



8.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.

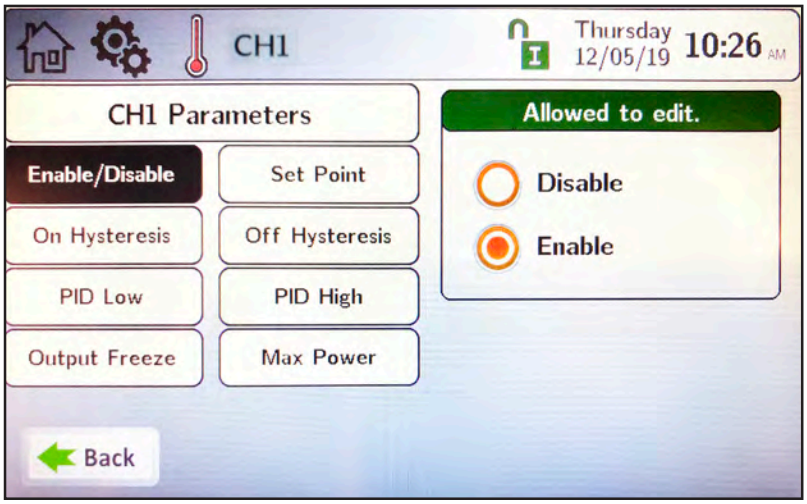
There are two identical heat demands, CH1 and CH2, each with independent control algorithms and independent inputs on the input terminal strip, see 7.E.6 on page 42.

From the CH Selection Screen, touching CH1 navigates to the CH1 Parameters Menu.

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

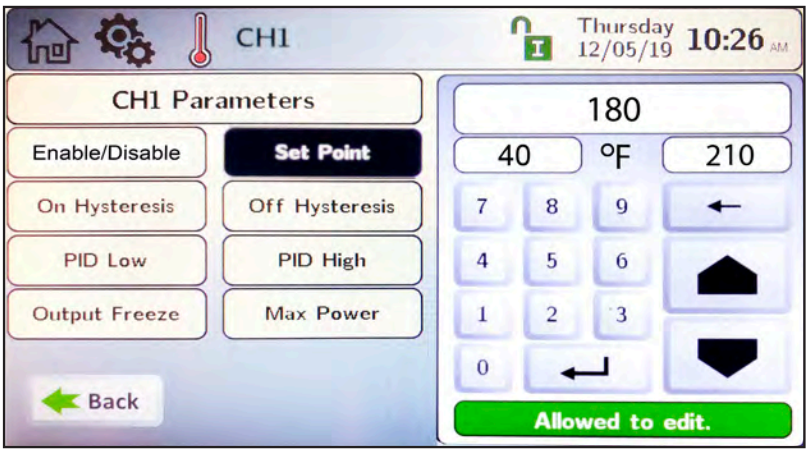
CH1 is one of the heat demands available. The CH1 Configuration Screen allows adjustment of the following parameters:

- **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 temperature at which the hysteresis will turn on.
- **Off Hysteresis** - The temperature at which the hysteresis will turn off.
- **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.
- **Output Freeze** - changes the allowable variance between actual and target firing rate. The larger the percentage the faster the system can respond however overshoot can increase too, depending on the system. (Not available in Cascade)
- **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 40-210°F, and default is 180°F.

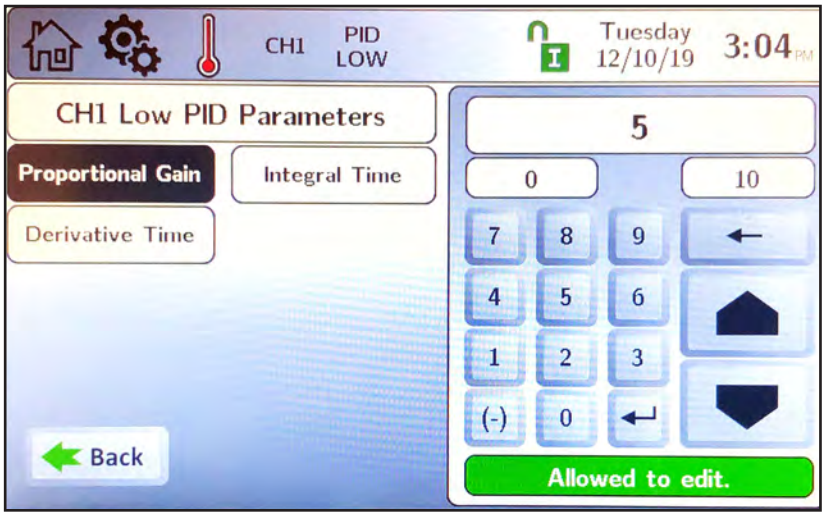


8.D.1.a.1 PID Low

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.

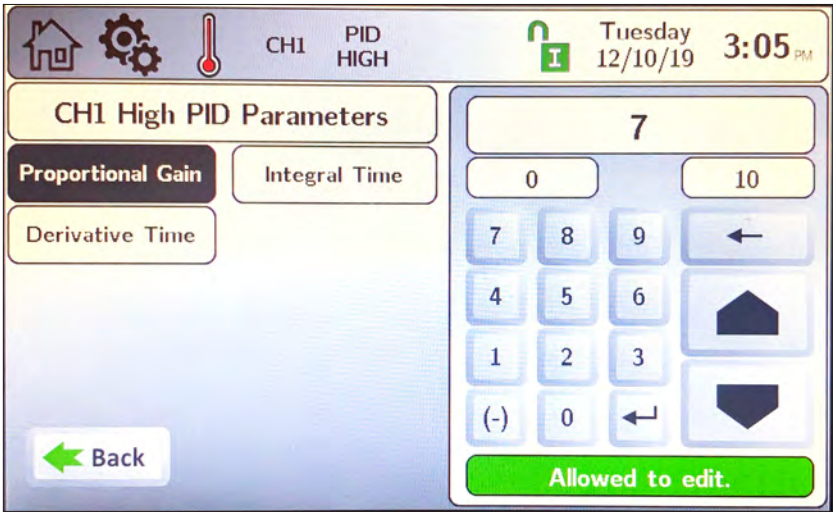
NOTE: By default, the control sensor is the unit outlet sensor, or when installed, the system supply sensor.



8.D.1.a.2 PID High

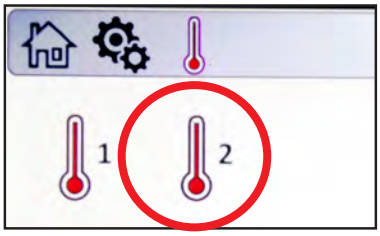
Note that in most cases, PID parameters will not need to be changed. The PID Parameters Screen allows adjustment to the following parameters:

- **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.



8.D.1.b CH2 (Central Heat, Two)

Additional heat demands CH2 are available, and are set up in the same manner as CH1.

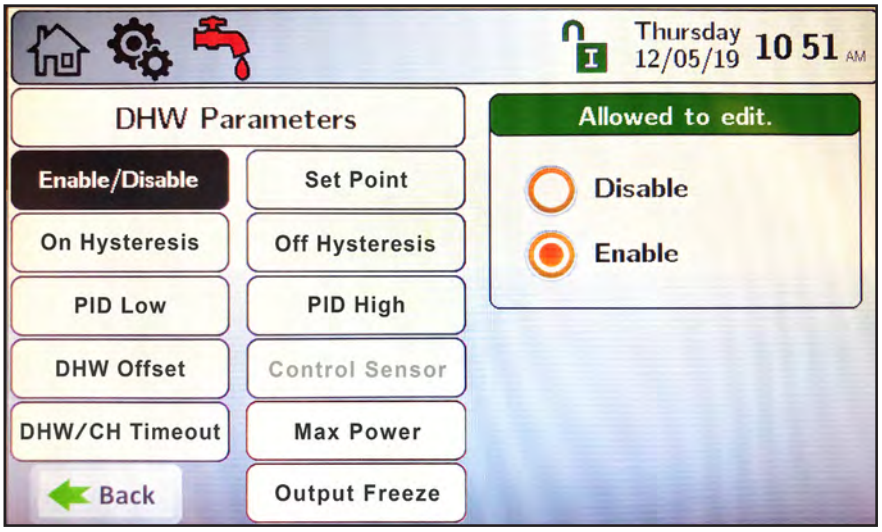


8.D.2 DHW (Domestic Hot Water)

NOTE: A DHW heat demand can be initiated by an aquastat or sensor. See Section 7.E.3 on page 41 or Section 7.E.6 on page 42

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

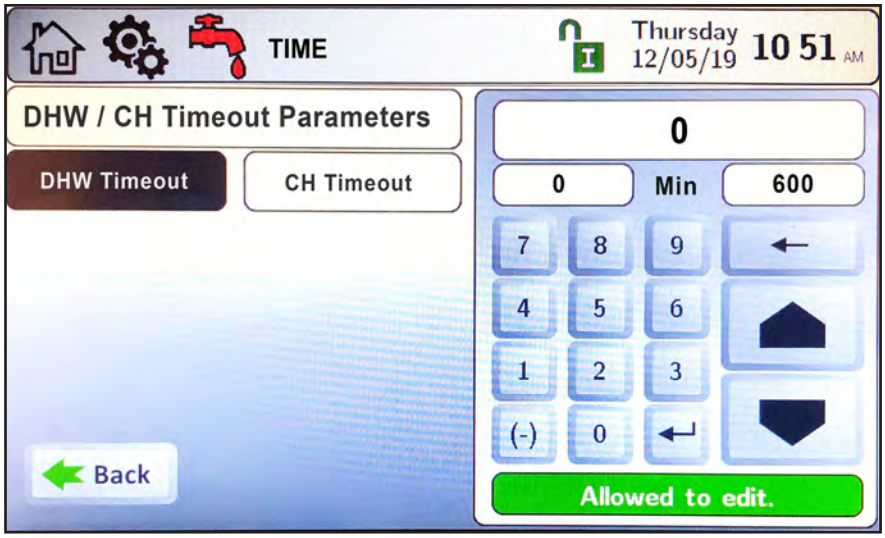
DHW Parameters has all the same parameters as CH1 and CH2 with a few exceptions. DHW has the following additional parameters for adjustment:



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.

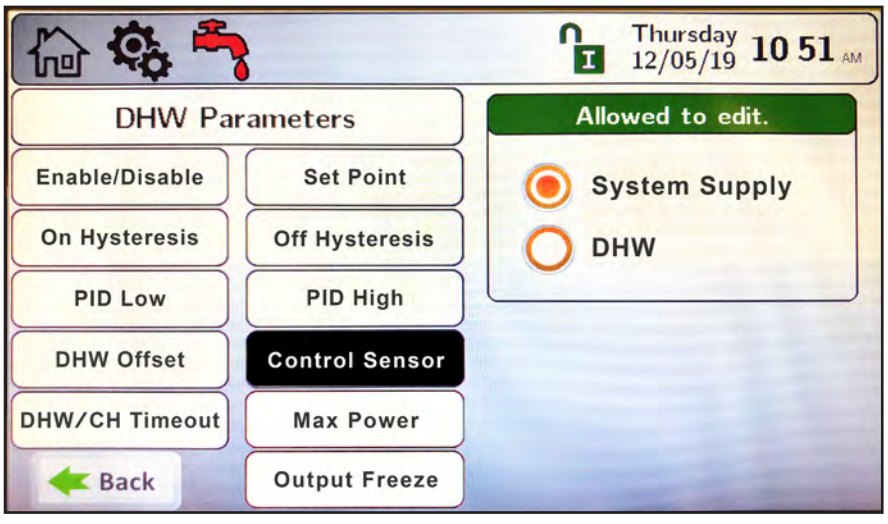
DHW/CH Timeout

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.



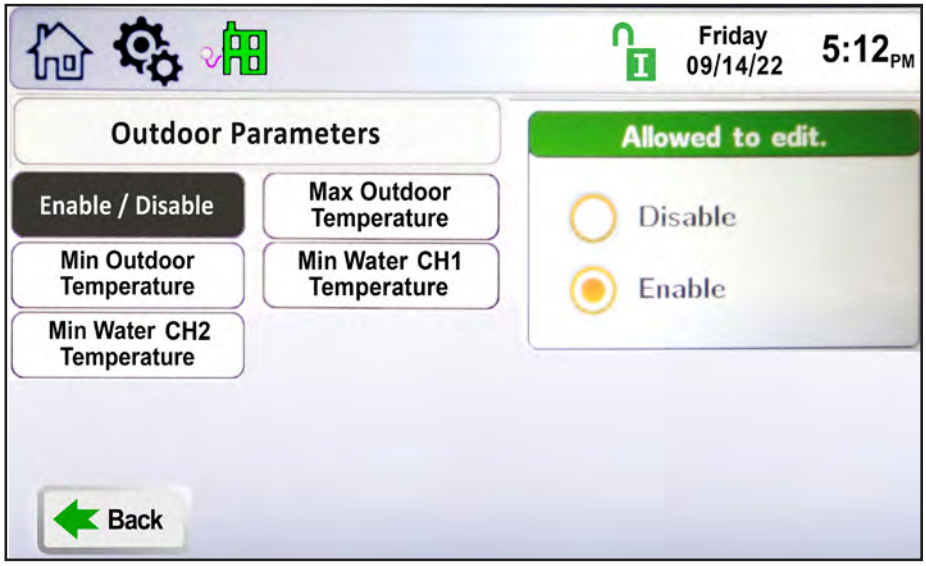
Control Sensor - This button is only selectable if the boiler is configured as the lead boiler in a cascade configuration. If configured as the lead boiler, this button allows the installer to select if a DHW heat demand applied at the lead boiler will control to the system sensor or the DHW sensor.

8.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 start using the minimum water temperature as the set point.
- **Minimum Outdoor Temperature** – The outdoor temperature at which the unit will start using 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 (below) 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:	14 %
CH2:	170°F	Target Rate:	14 %
DHW:	140°F	OAT:	42°F
		Flame:	13.6uA

Pumps

Boiler:	On
System:	On
DHW:	Off

Figure 33. Status Window, Outdoor Reset Example

CH1 and CH2 use the set points on the Parameter screen as the "Max Hot Water Temp" allowing two distinct curves based on the demand in use.

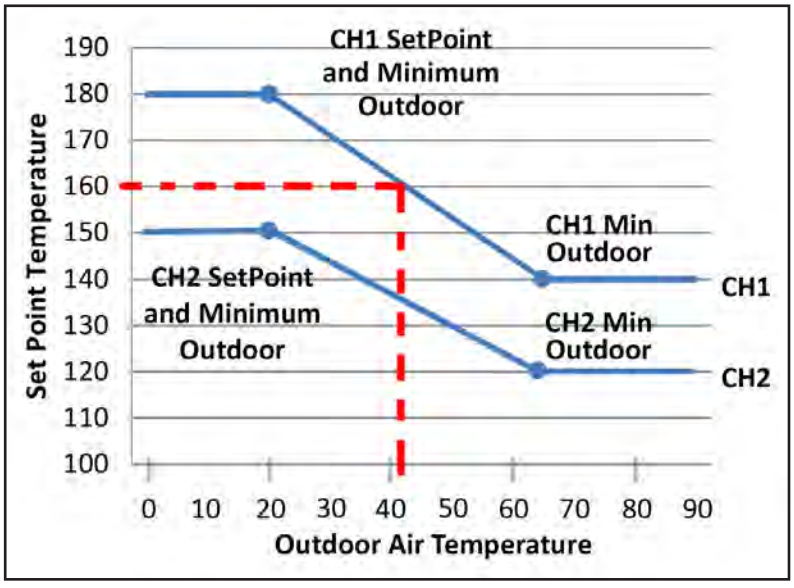


Figure 34. Outdoor Reset Example

8.D.4 Cascade (All about Lead / Lag)

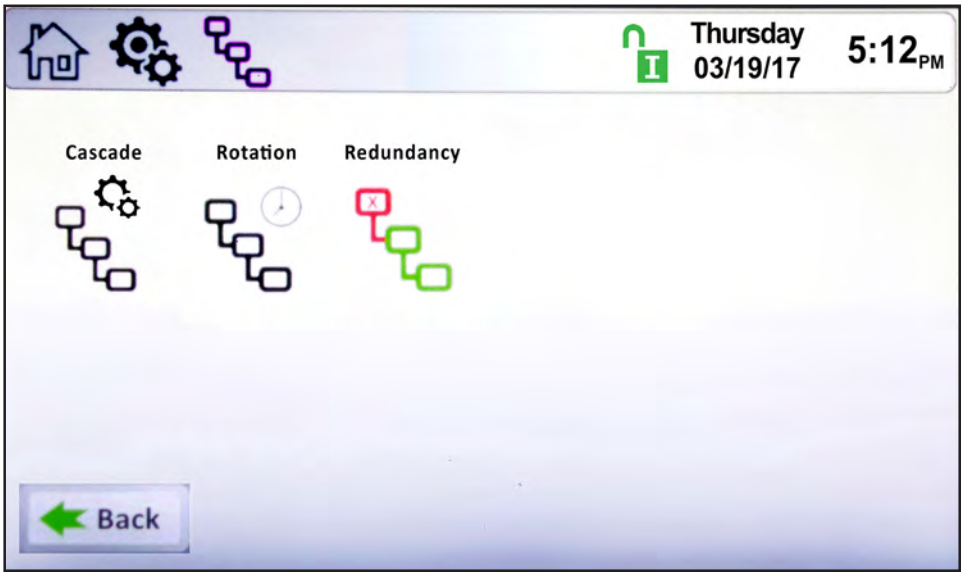
An installation with two or more units may be configured for cascade operation. Up to eight units can be cascaded and controlled together.

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

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

- **Cascade** – This icon navigates to the Cascade Parameters screen for hydronic boiler cascade operations. This icon is available on hydronic boilers (MGH) only.
- **Rotation** – This icon navigates to the cascade rotation screen.
- **Redundancy** – This icon navigates to the setup screen for cascade leader redundancy options.

NOTE: A system supply sensor (supplied with each unit) 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.



About Cascading (Lead / Lag)

The Lead boiler 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 75%. 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.

Upon an active cascade heat demand, the Lead boiler 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 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 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%

Boiler Qty	Recommended Base Load	Recommended Drop Load
1	N/A	N/A
2	75%	15%
3	75%	15%
4	75%	15%
5	75%	15%
6	75%	15%
7	75%	15%
8	75%	15%

Table 18. Recommended Base Load Values

	Log In			Settings			
Parameter	User	Installer	OEM	Min	Max	Default	Unit
Base Load		X	X	40	100	75	%
Drop Load		X	X	5	100	15	%
Min On Time		X	X	30	1200	300	Seconds
Min Off Time		X	X	30	600	30	Seconds

Table 19. Parameter Settings

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.

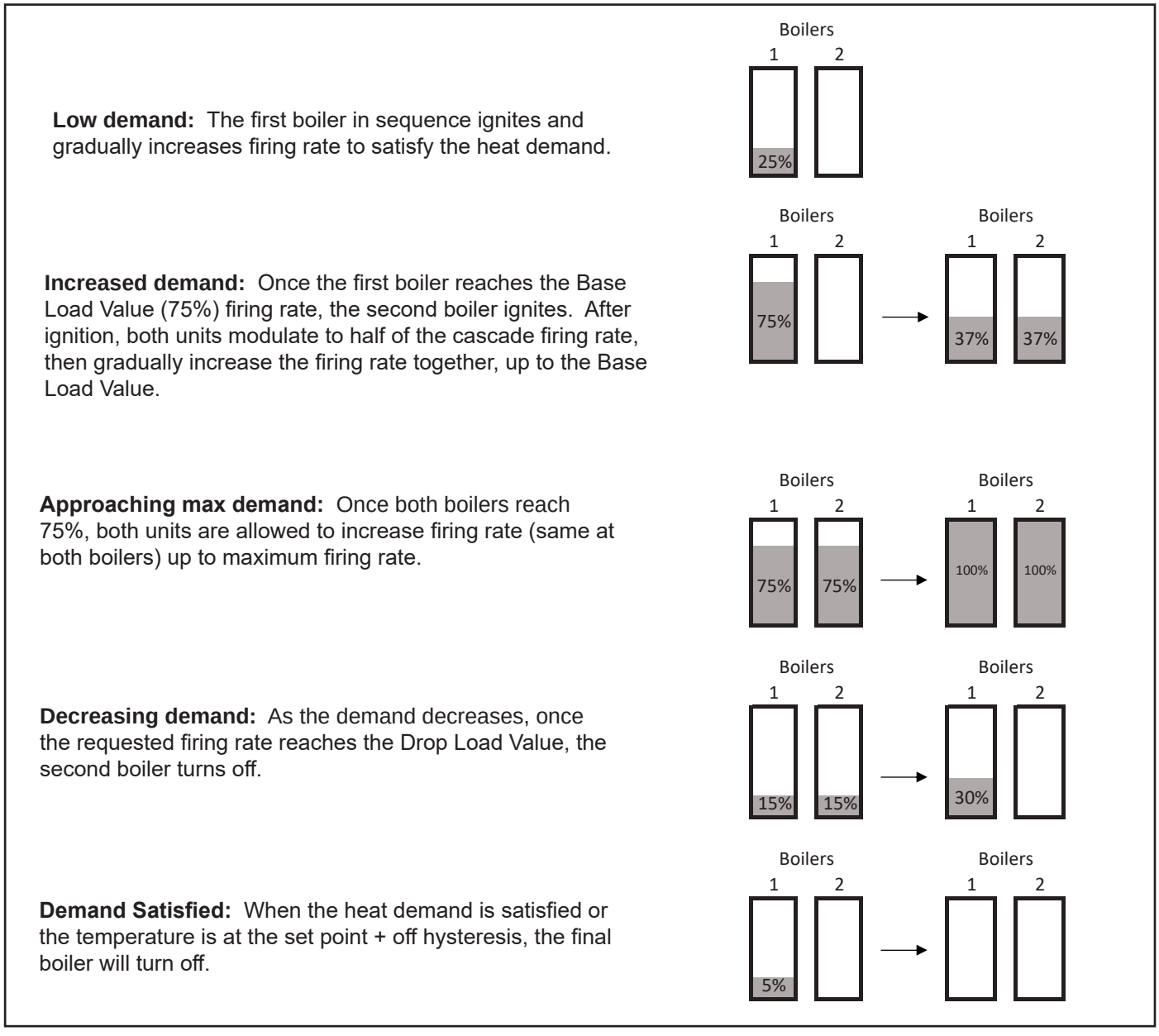


Figure 35. Lead / Lag, 2 Boilers

About Cascading (Lead / Lag) -continued

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 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 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 satisfy the heat demand.

Increased demand: Once the first boiler reaches the Base Load Value (75%) 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 (75%) 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 (75%), 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.

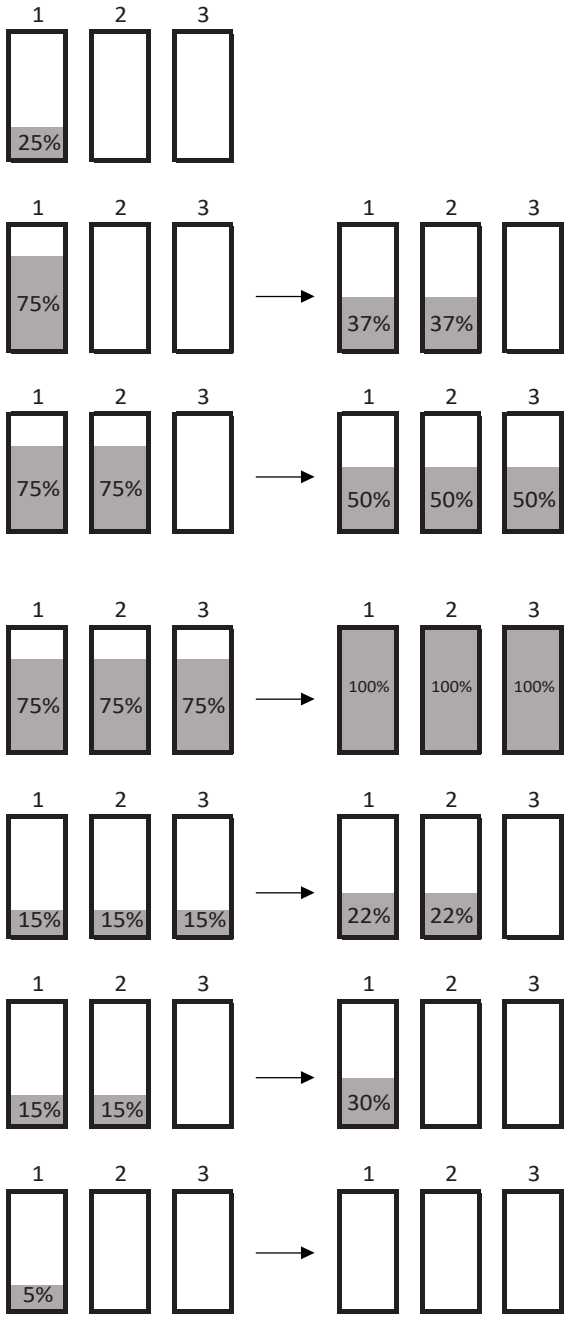


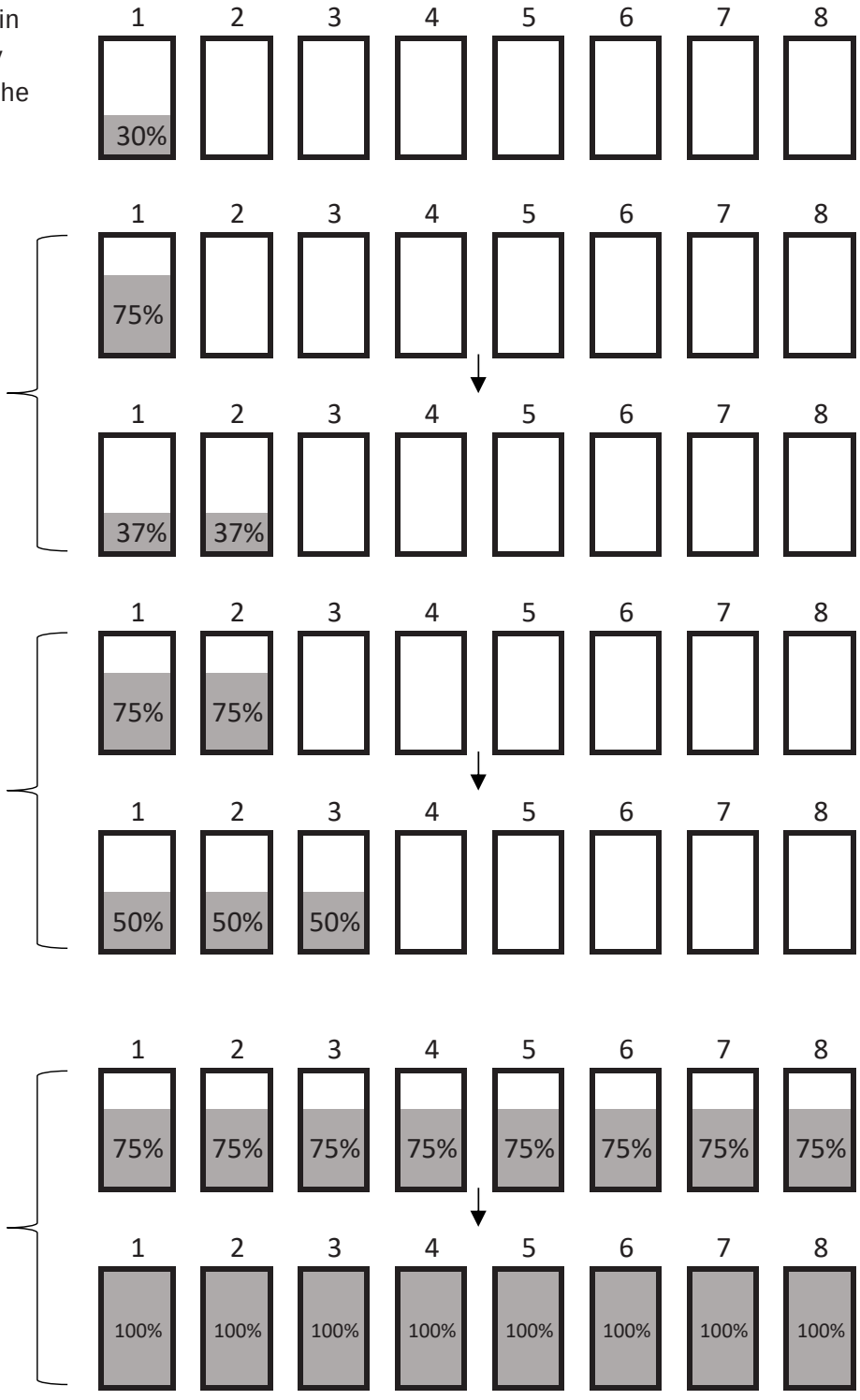
Figure 36. Lead / Lag, 3 Boilers

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 (75%) 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* (75%), 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.

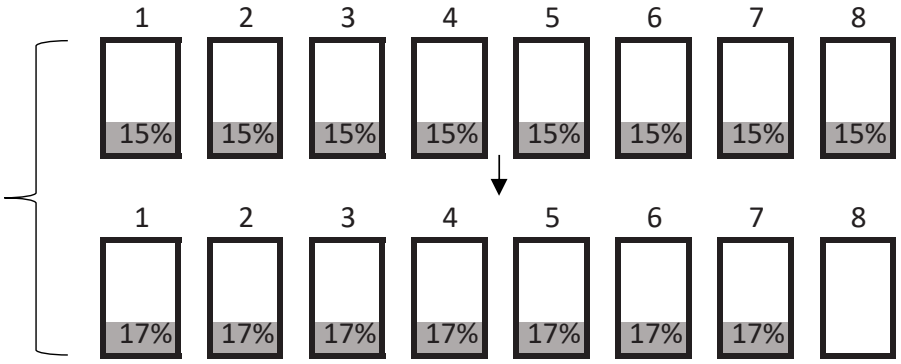


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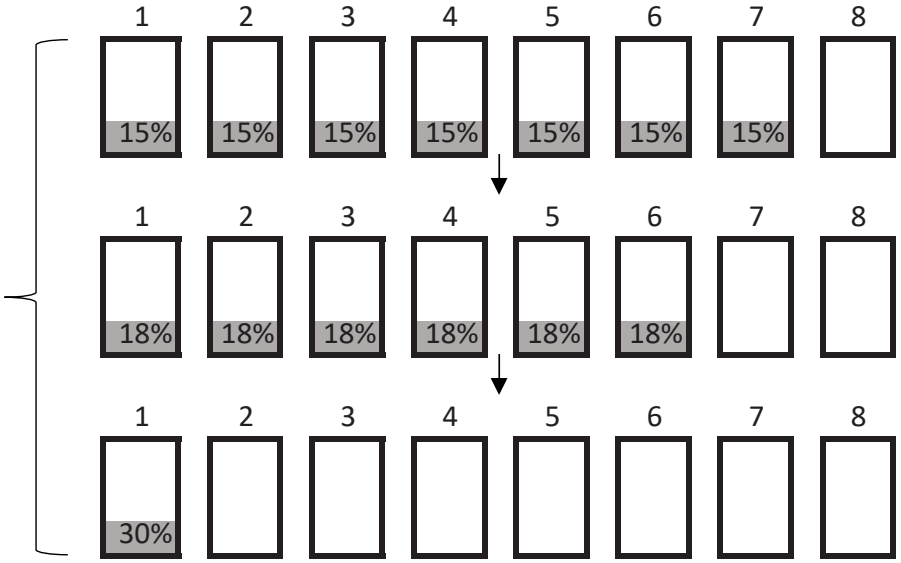
Figure 37. Lead / Lag, Demand Increase, 4 to 8 Boilers

About Cascading (Lead / Lag) -continued

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.

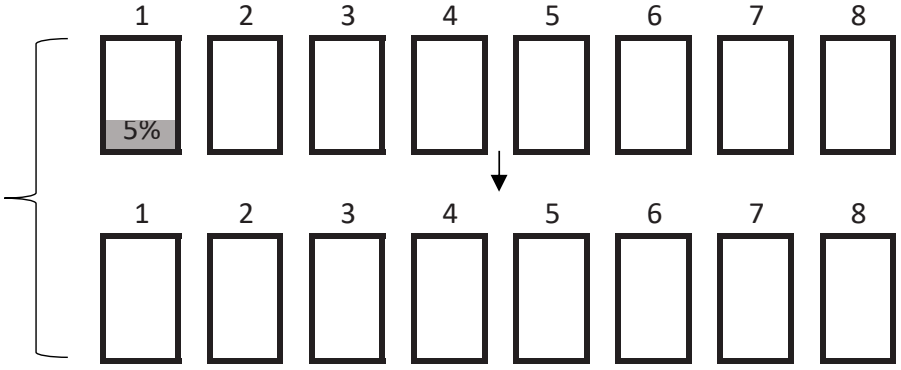


Figure 38. Lead / Lag, Demand Decrease, 4 to 8 Boilers

8.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.

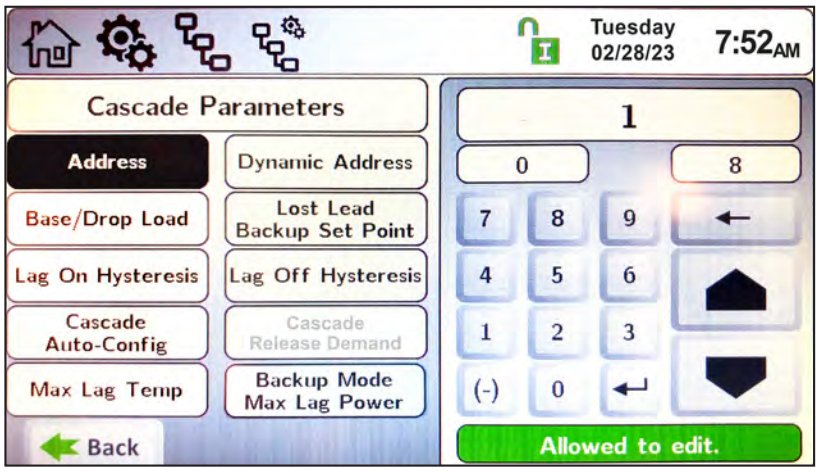
The Cascade Parameters Screen allows adjustment of the following parameters:

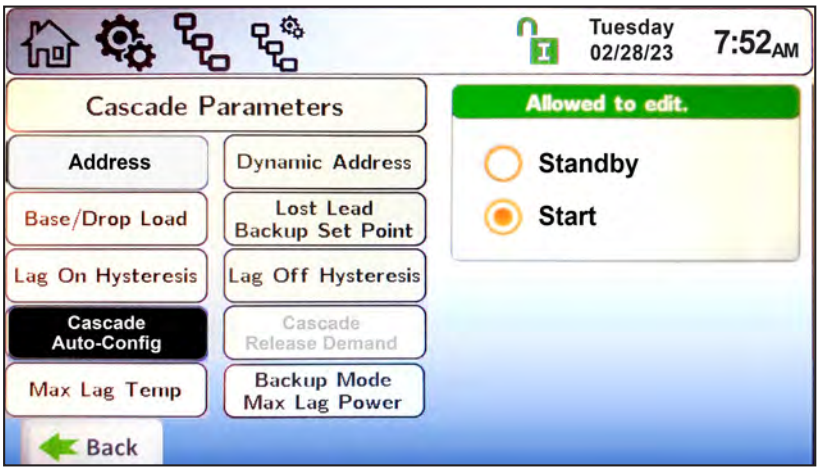
- **Address** – When manually addressing each boiler/heater for cascade operations, this parameter is used to set the local boiler/heater address. Each boiler/heater must have a unique address. A boiler/heater with a value of 1 is the lead boiler/heater. Lag boilers/heaters use values 2 through 8. When 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 communications 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. **See Section 8.D.4.c on page 82**

- **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.





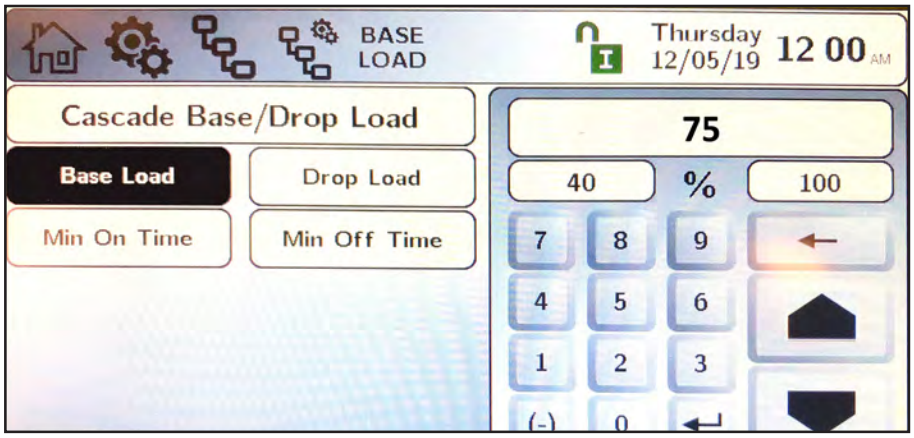
8.D.4.a.1 Base / Drop Load

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.



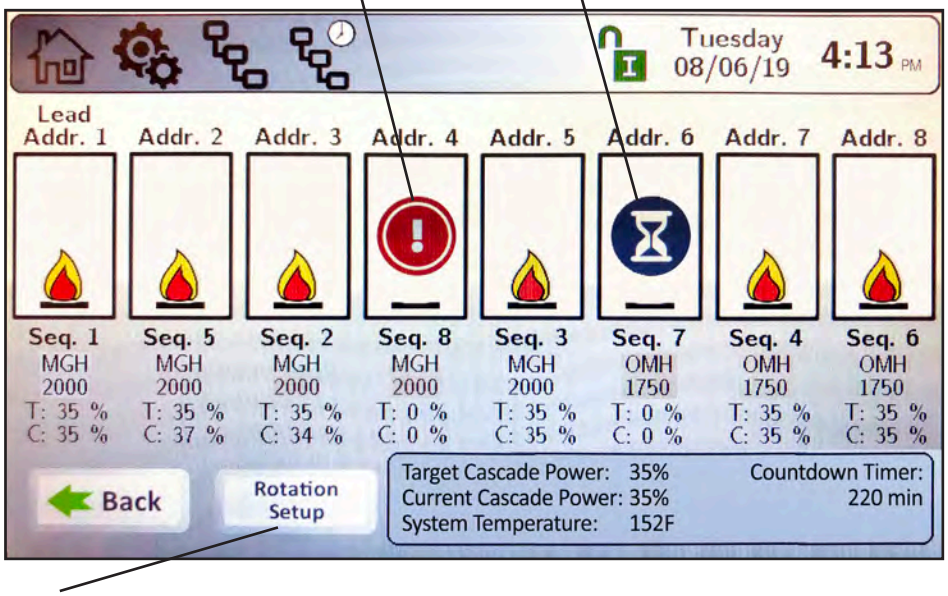
8.D.4.b Rotation

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.

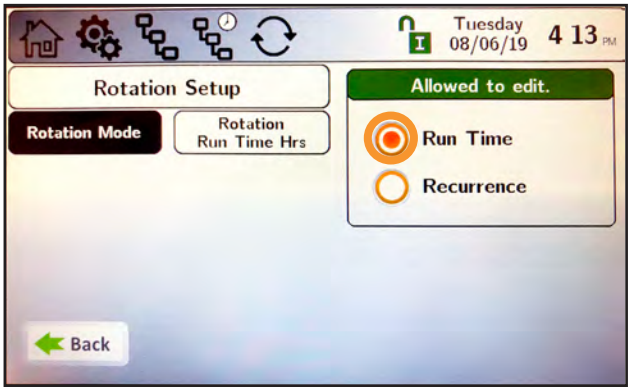


The Rotation Setup button is found only on the boiler that is assigned as ‘Lead’.

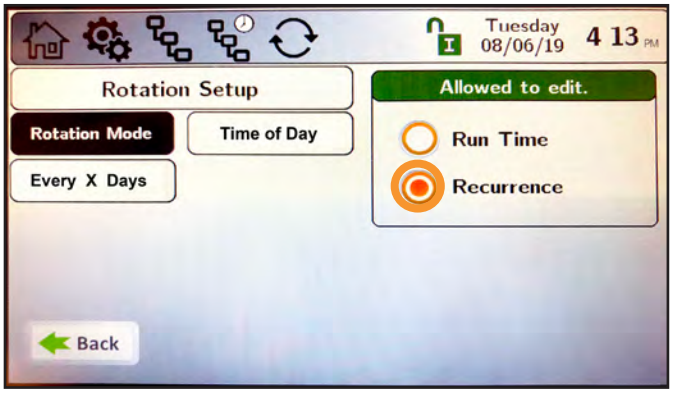
8.D.4.b.1 Rotation Setup

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.

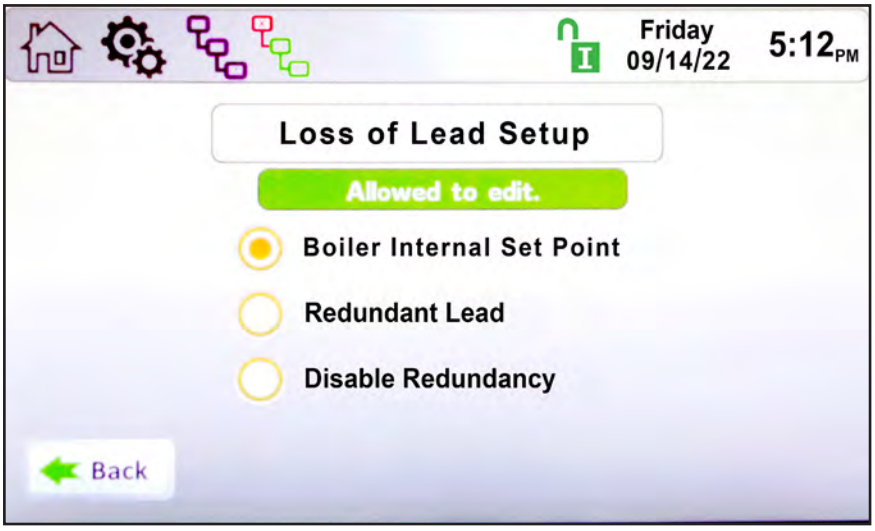
8.D.4.c Redundancy

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:

NOTE: In cascade, if the lead unit losses the system sensor, it will turn on the system pump contacts and fire the cascaded units to meet the CSP at the individual boiler outlet sensors. Each unit responds simultaneously to meet the demand, no longer cascading.

- **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.

8.D.5 Hybrid

8.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 if System Temp is reached. - If the heat demand is active, but the temperature limit has been reached. the pump will turn off until the boiler is again actively satisfying a heat demand.

- **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.

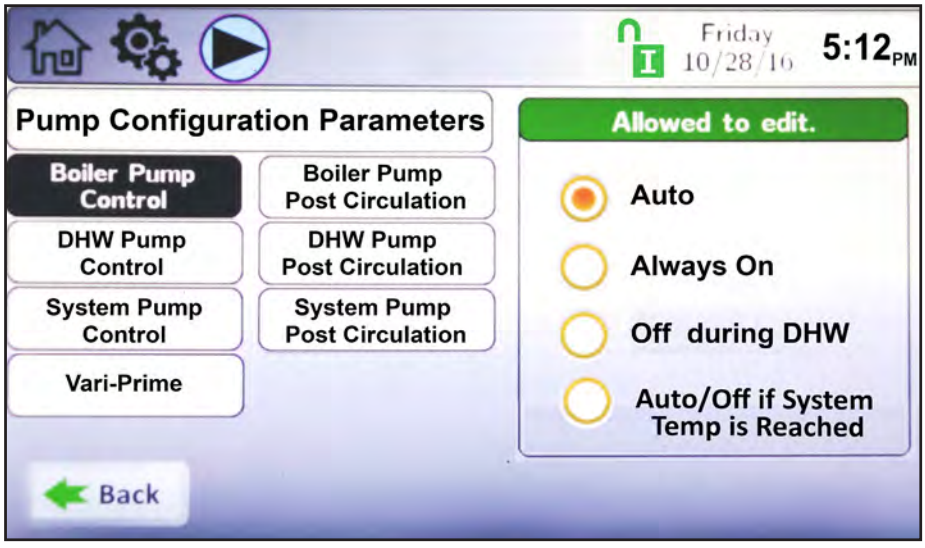
  Always On – the pump will run continuously, with or without a heat demand.

  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.

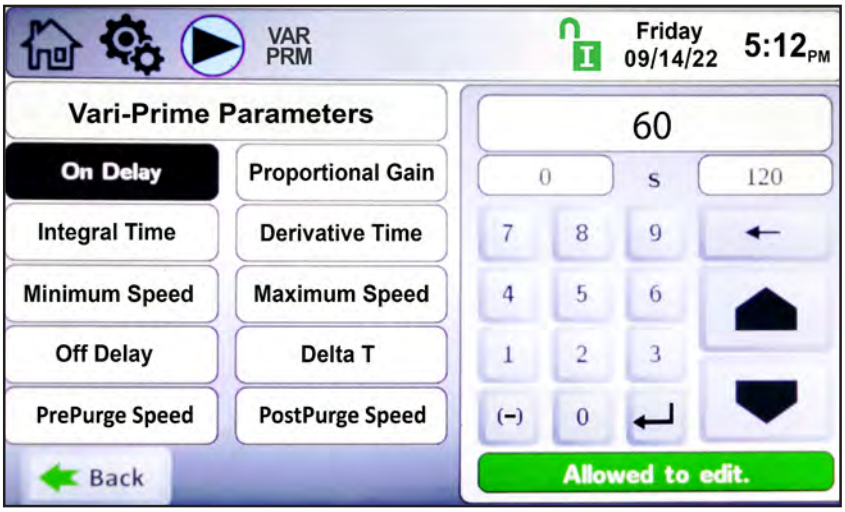
- **Vari-Prime -** Select Vari-Prime to get to the controls of the variable speed pump.



8.D.6.a VARI-PRIME®

The Vari-Prime Screen allows the adjustment of the following parameters:

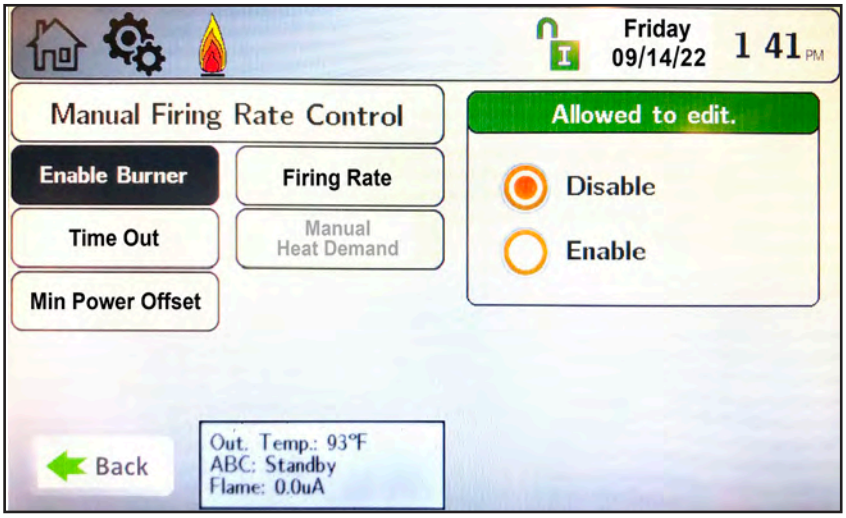
- **On Delay** – Upon a call for heat, once the unit ignites, this is the amount of time the unit will wait prior to modulating the pump speed.
- **Proportional Gain** – This value is the corrective action that is proportional to the error (Set Point – Control Temperature).
- **Integral Time** – This 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 the Vari-Prime will control the pump.
- **Maximum Speed** – This 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.

8.D.7 Manual Firing Rate

- **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** – 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.

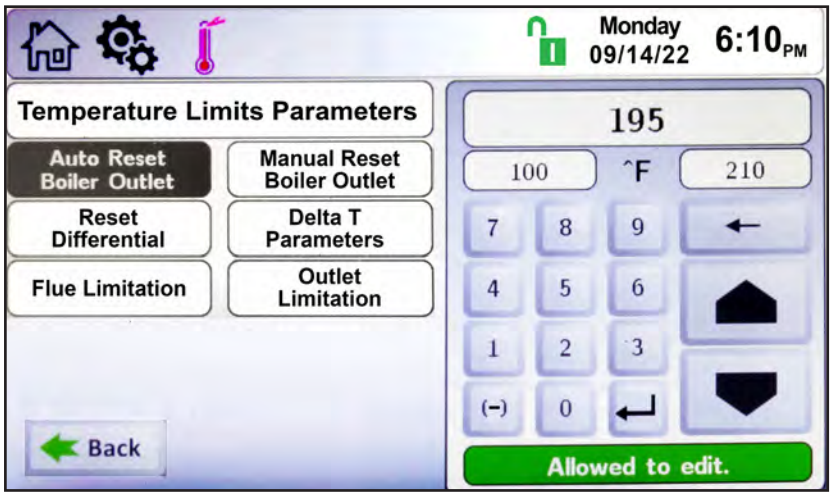


8.D.8 Temp Limits

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 CH–** The temperature at which the unit will shut down when outlet temperature exceeds its maximum auto reset set point. The control will automatically reset, based on the reset differential.
- **Manual Reset CH –** The temperature at which the unit will shut down when outlet temperature exceeds its maximum manual reset set point. The control will require manual reset in this condition.
- **Reset Differential –** The value below the Auto Reset temperature at which the unit will automatically reset itself and resume functionality.
- **Delta T Parameters–** Allows enabling/disabling of the Delta T derate functionality and adjustment of the Delta T value at which the boiler should begin to derate.
- **Flue Limitation –** Sets the flue temp limitations.
- **Outlet Limitation Parameters –** Allows for the adjustment of Min and Max Outlet Temps.

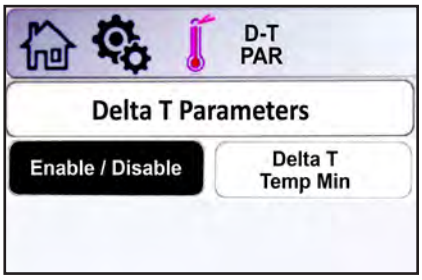


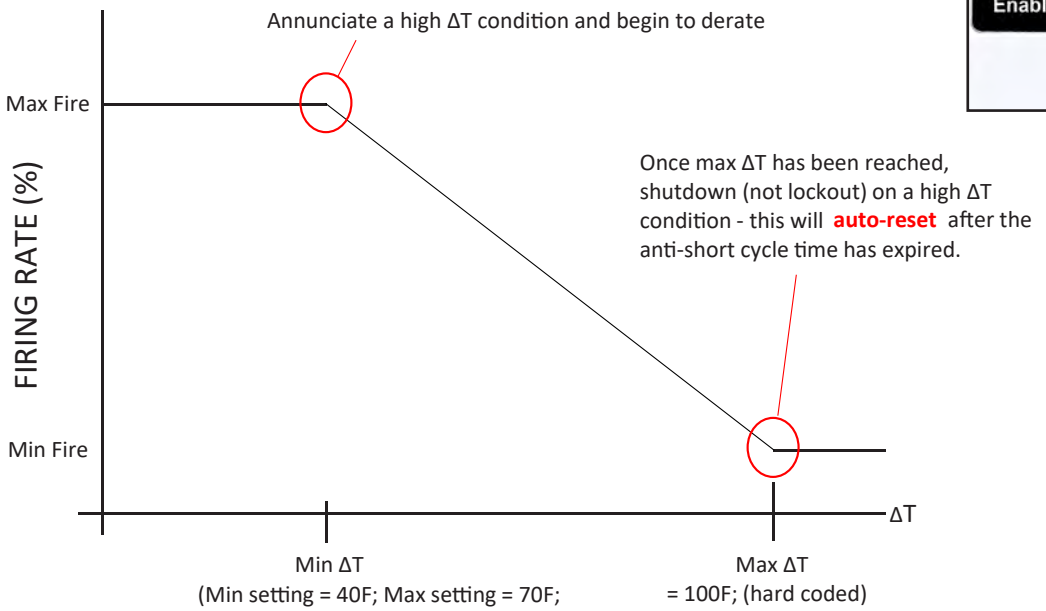
8.D.8.a Delta T Parameters

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 boiler will derate as shown in the image below.

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

- **Enable/Disable** – Enables/disables the Delta T temperature functionality.
- **Delta T Temp Min** – The temperature difference between the unit's inlet and outlet at which the boiler will begin to derate to prevent a Delta T auto-reset condition.



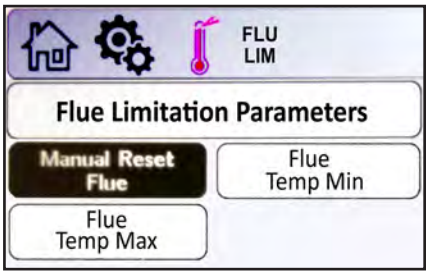


8.D.8.b Flue Limitation Parameters

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.

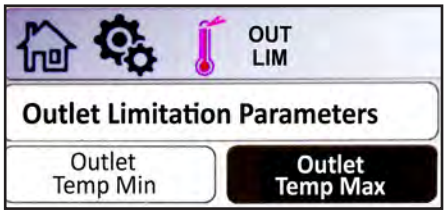


8.D.8.c Outlet Limitation Parameters

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 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 will shut down on a manual reset high temperature outlet condition.



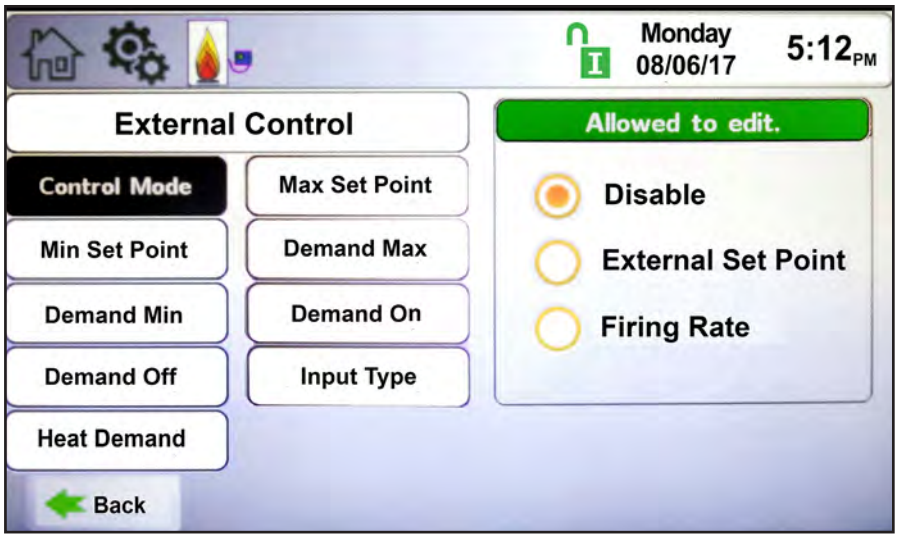
8.D.9 External

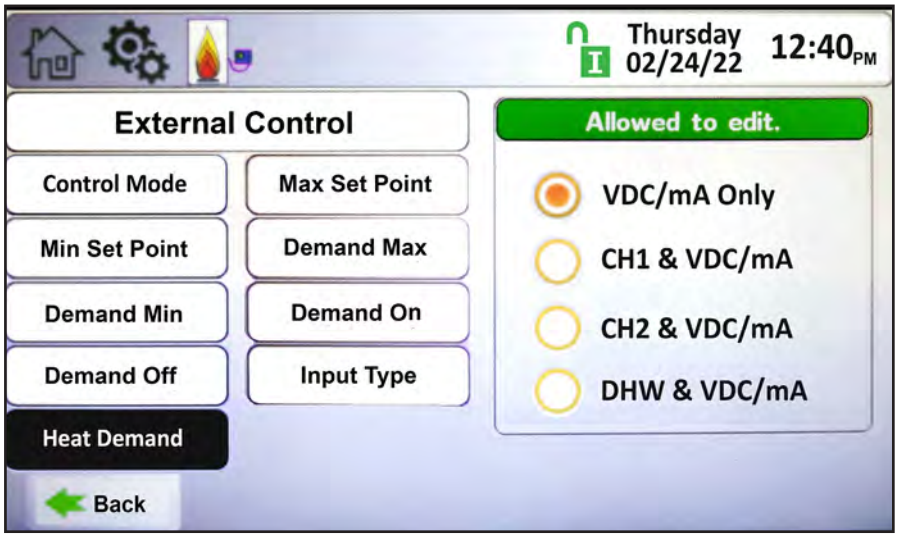
The External Configuration Screen applies to the 0-10VDC (4-20mA) analog input BAS signal, and allows adjustment of the following parameters:

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 Boiler Set Point, this is the maximum value that corresponds to the Demand Max value.
- **Min Set Point –** When the Control Mode is set to Boiler 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 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 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.
- **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.

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





8.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 39**.

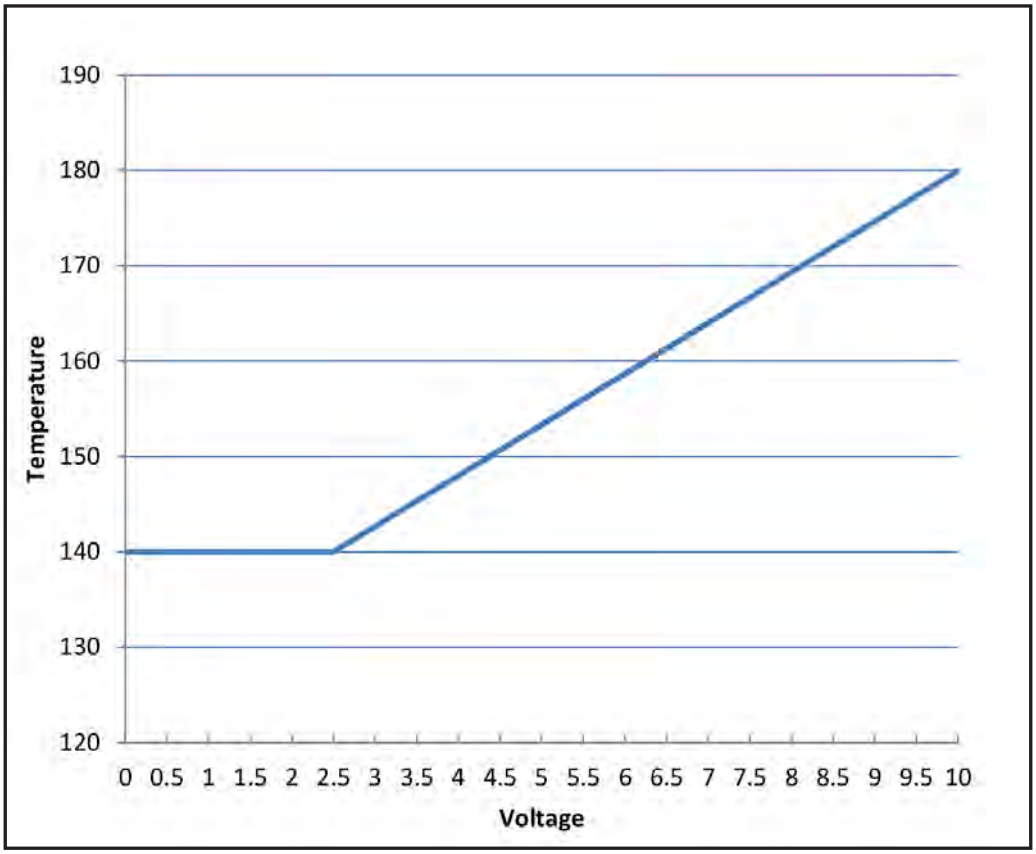


Figure 39. External Setp Point Example

8.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 40**. 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.

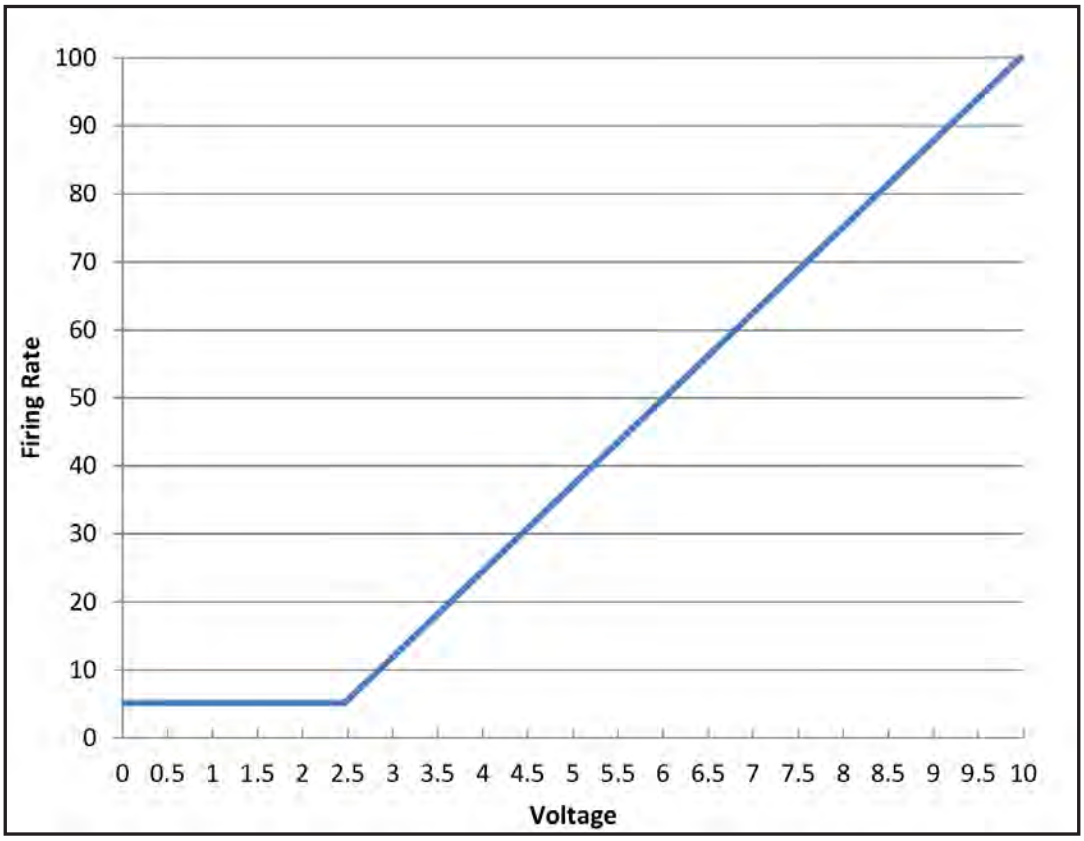


Figure 40. External Firing Rate Example

8.D.10 Time & Date

To navigate to the Time & Date 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 Screen allows adjustment of the following parameters:

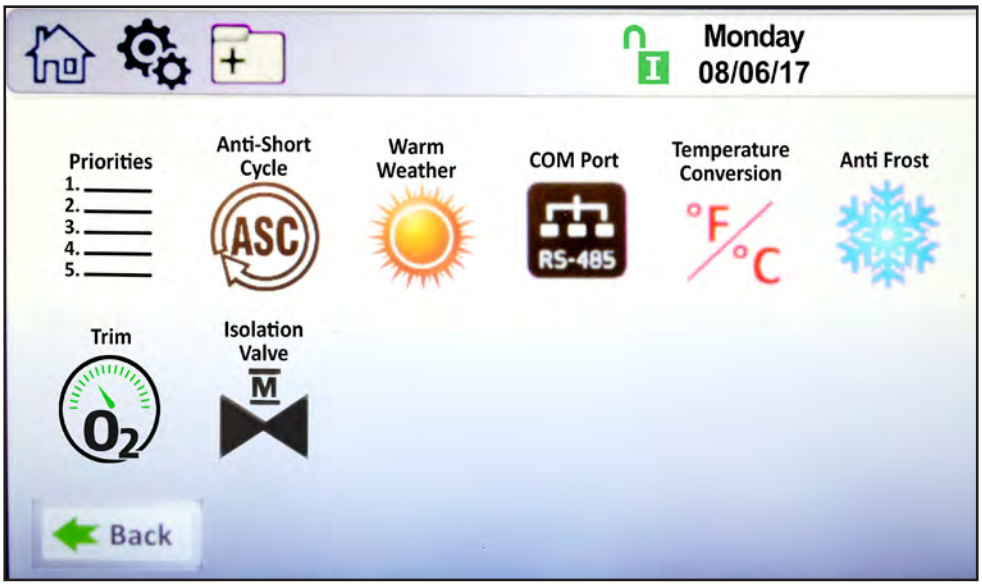
- **Hour**
- **Minute**
- **Month**
- **Day**
- **Year**

8.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 for 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.
- **Trim –** To navigate to the Oxygen Sensor Control Configuration Screen.
- **Isolation Valve –** To enable / disable and set the time delay and more for the isolation valve.

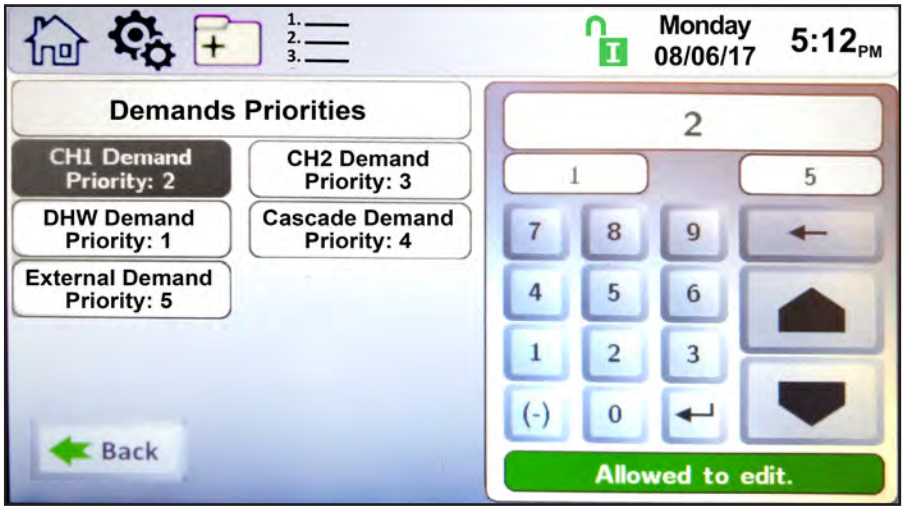


8.D.11.a Demands Priorities

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.

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



Remember to always save the new setting with the button.

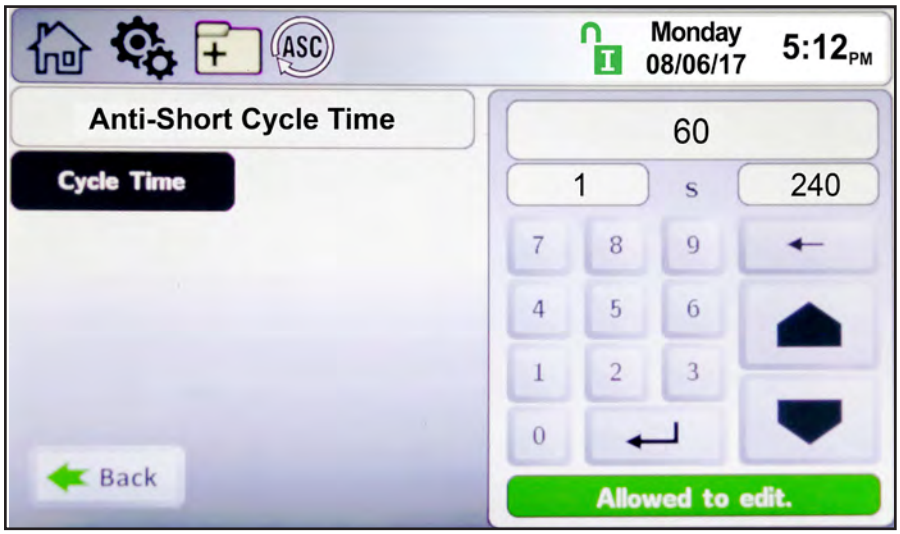
8.D.11.b Anti-Short Cycle

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.

8.D.11.c Warm Weather

To navigate to the Warm Weather 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

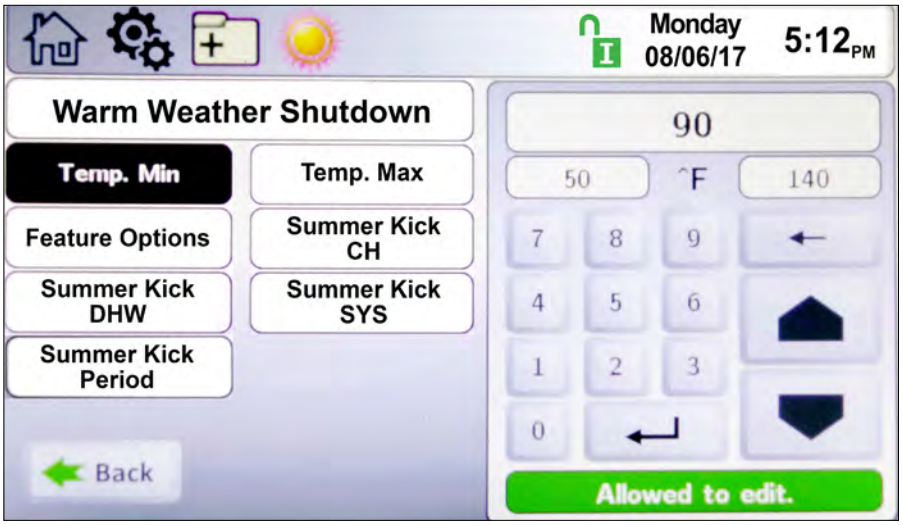
When the outdoor sensor measures an outdoor air temperature that exceeds the WWSD set point, one of the following two conditions will occur. If the unit is idle, upon a call for heat, the unit will not turn on to satisfy a heat demand. If the unit is running to satisfy a call for heat, the unit will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



8.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:

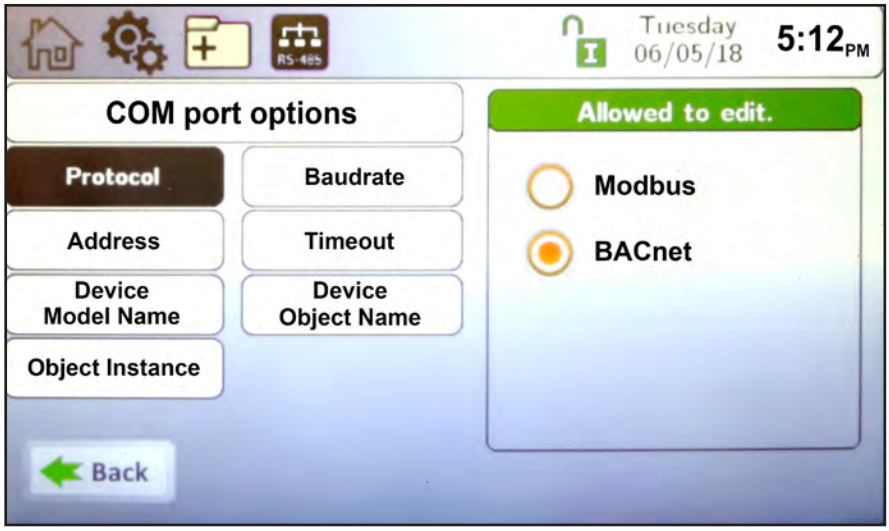
With Modbus protocol selected, the following parameters are adjustable on this screen:

- **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.



8.D.11.e Temperature Conversion °F/°C

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.

8.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 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 41

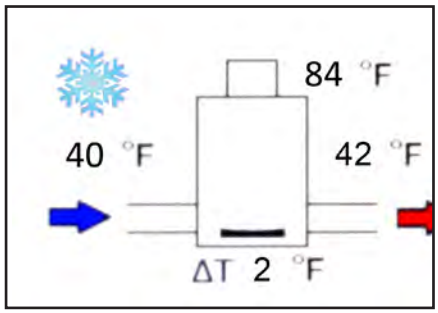
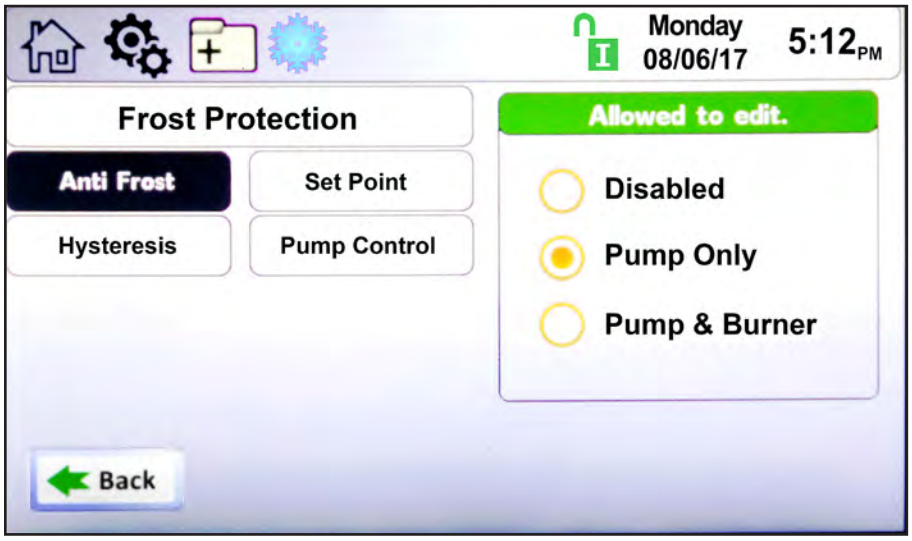


Figure 41. Active Anti Frost Condition



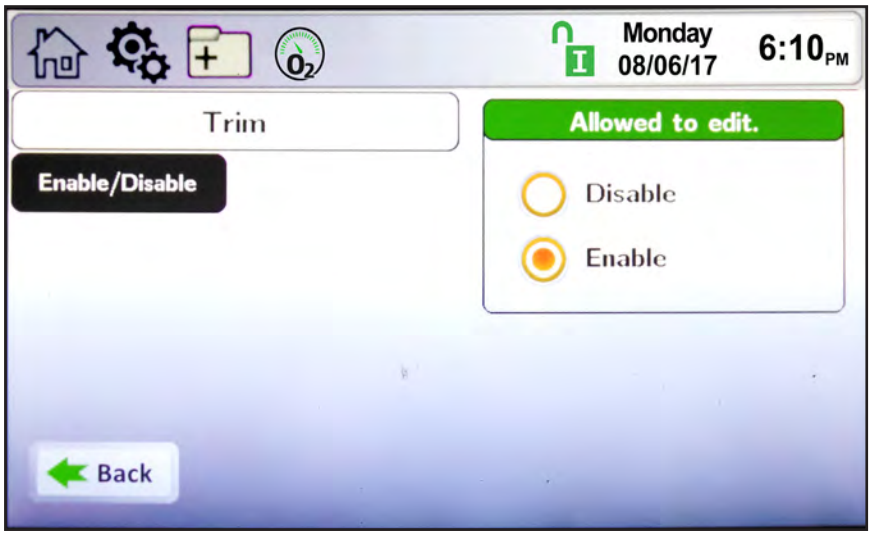
8.D.11.g Trim O_2 (Tru Trac®, O_2 Trim Enable / Disable)

To navigate to the Trim Menu, touch the Trim Icon on the Miscellaneous Menu Screen.

This O_2 Trim Menu allows you to

- **Enable/Disable**

NOTE: All Service Options for O_2 Trim are available only with the OEM Login.

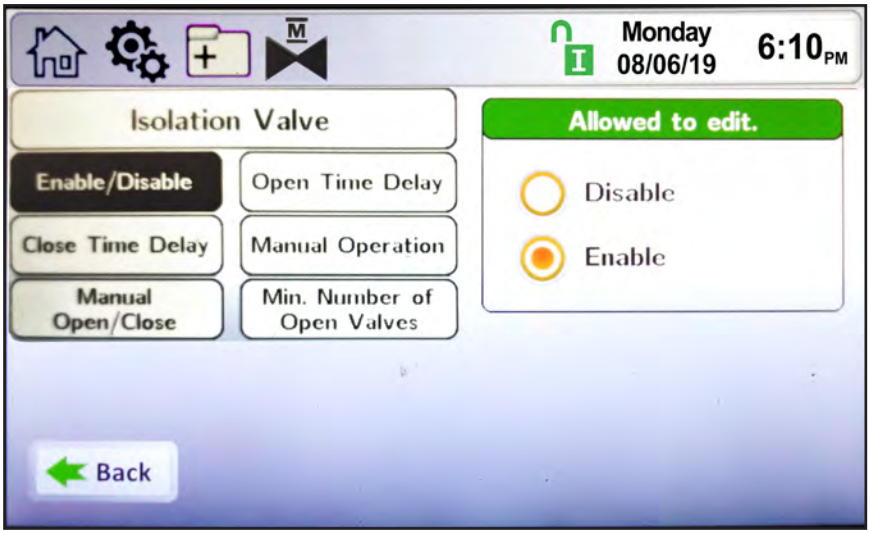


8.D.11.h Isolation Valve

To navigate to the Isolation Valve Menu, touch the Isolation Valve Icon on the Miscellaneous Menu Screen.

The Isolation Valve Configuration Screen allows adjustment of the following parameters:

- Enable/Disable – Enables/disables the isolation valve functionality.
- Open Time Delay – The amount of time the controller expects to receive indication that the isolation valve is open.
- Close Time Delay – The amount of time the controller expects to received indication that the isolation valve is closed.
- Manual Operation – Allows the user to select manual or automatic isolation valve operations.
- Manual Open/Close – If manual operation is selected, this will manually open/close the isolation valve.
- Min. Number of Open Valves – This parameter allows the user to select the number of isolation valves that must remain open to satisfy system flow requirements.



Isolation Valve - Single Boiler Operation 

1. Disabled – if the isolation valve functionality is disabled, via the display, the isolation valve output will not actuate, and the boiler will ignore the status of the end switch inputs.
2. Enabled – if the isolation valve functionality is enabled (default setting), the following will occur:
   i. Upon a heat demand, the valve will open. Once the boiler receives feedback from the proof of open switch that the valve is fully open, the boiler (and system pump, if configured to run with the boiler pump) pump will run.

      If the isolation valve proof of open switch feedback is not achieved within the “Open Time Delay” setting (adjustable via the display), the boiler will fault with an “Isolation Valve Err” fault indication across the navigation banner of the display. This condition requires a manual reset via display.

   ii. If the temperature set point has been reached, but the heat demand remains (i.e. boiler pump remains running), the isolation valve will remain open.

   iii. If the heat demand has been satisfied and the call for heat has been removed, the isolation valve will remain open for the duration of the boiler pump post circulation time. Once the boiler pump turns off, the isolation valve will close.

      If the isolation valve proof of close switch feedback is not achieved within the “Close Time Delay” setting (adjustable via the display), the boiler will fault with an “Isolation Valve Failed to Close” fault indication across the navigation banner of the display. This condition requires a manual reset via display.

Isolation Valve - Cascade Boiler Operation

In cascade operations, all isolation valves settings are made at the lead boiler.

1. Disabled – if the isolation valve functionality is disabled on the lead boiler, the isolation valve output will not actuate on the cascaded boilers, and the boiler will ignore the status of the end switch inputs on the cascaded boilers.
2. Enabled – if the isolation valve functionality is enabled, it is imperative that at least 1 isolation valve remain open at all times to prevent the system pump from dead heading. If the isolation valve functionality is enabled (default setting) of the lead boiler, the following will occur:
   i. Prior to reacting to a heat demand, the lead boiler will look at the value of the parameter “Min. # of Open Valves” set at the lead boiler. If this value is 1, the isolation valve of the boiler in sequence to fire first will automatically open. If this value is 2, the lead boiler will tell the first two boilers in sequence to fire first to open their isolation valves automatically. This pattern would continue as the “Min. # of Open Valves” reaches the maximum value of 8. The opening of the isolation valves prior to a heat demand prevents the system pump from dead heading and is chosen to match system flow requirements.

      If the isolation valve proof of open feedback is not achieved within the “Open Time Delay” setting (adjustable via the display), the boiler will fault with an “Isolation Valve Err” fault indication across the navigation banner of the display. This condition requires a manual reset. The lead boiler will then transition to the next boiler in the cascade sequence, as it would with any fault condition, and verify that the isolation valve is open.

   ii. Upon a heat demand, the isolation valve on the first (non-faulted) boiler in the firing sequence will already be open (or multiple isolation valves will be open if the value of “Min # of Open Valves” is greater than 1), and the boiler will run, following typical cascade – base load functionality.

   iii. As the demand increases and another boiler is called upon by the lead boiler to fire, the isolation valve of that unit must open prior to initiating the firing sequence (or might already be opened, based on the value of “Min. # of Open Valves”), otherwise follow the functionality as explained above.

   iv. As the demand decreases and a boiler is turned off, the isolation valve of that boiler will close, unless it is required to remain open based on the value of “Min. # of Open Valves”.

      If the isolation proof of close limit switch feedback is not achieved within the “Close Time Delay” setting (adjustable via the display), the boiler will fault with an “Isolation Valve Err” fault indication across the navigation banner of the display. This condition requires a manual reset.

   v. As the heat demand is satisfied, and the last boiler running turns off, the isolation valve to that boiler remains

open, to avoid dead heading the system pump. Additional isolation valves may also be open, based on the value of “Min. # of Open Valves”.

vi. As the cascade rotation functionality rotates which boiler fires first to satisfy a heat demand, the proof of open switch of the new boiler that will fire first must be open prior to closing the isolation valve of the previous boiler that was in the sequence to fire first. In addition, if the value of “Min. # of Open Valves” is greater than 1, those valves will rotate and must also remain open prior to the previous isolation valves close.

8.D.12 Login

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

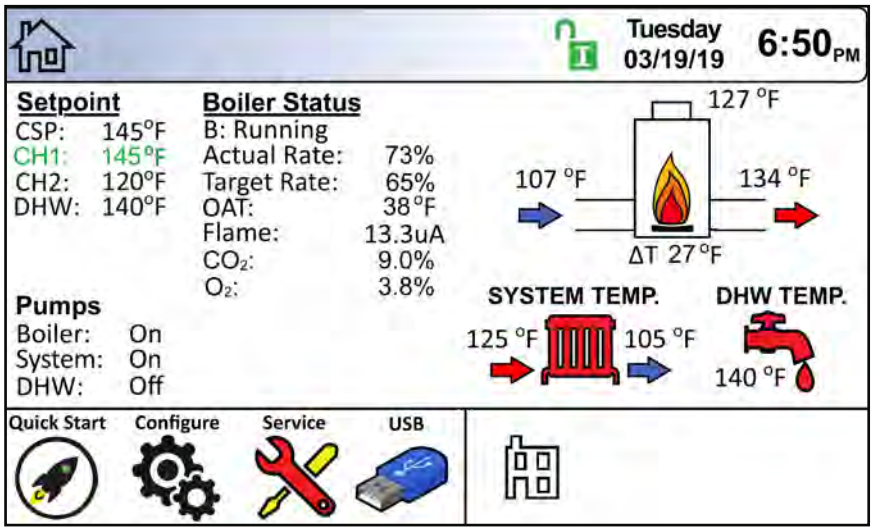
The Login Screen allows the operator to make parameter adjustments based on the level of the login credentials.

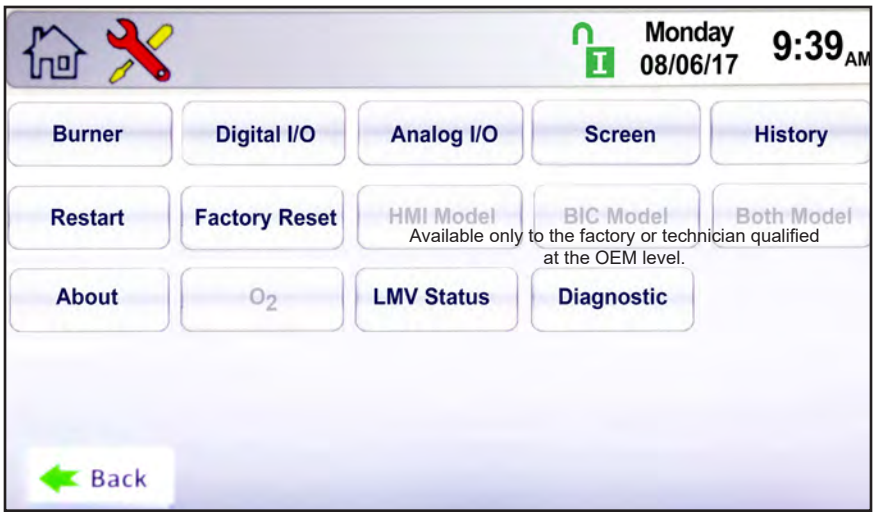
See Section 8.B on page 64 for the passwords and the various Login levels.



8.E Service Screens

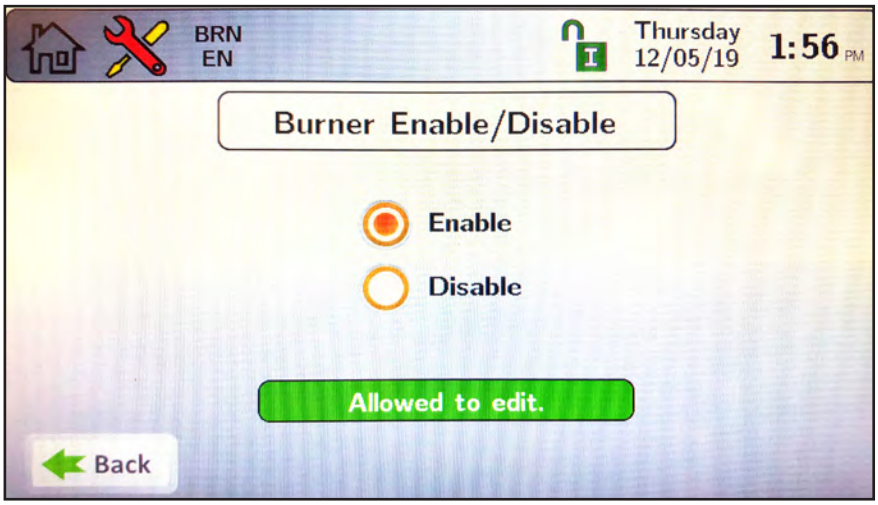
To navigate to the Service Screen, touch the Service Icon in the lower left portion of the Home Screen.





8.E.1 Burner

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



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

There are two screens 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.

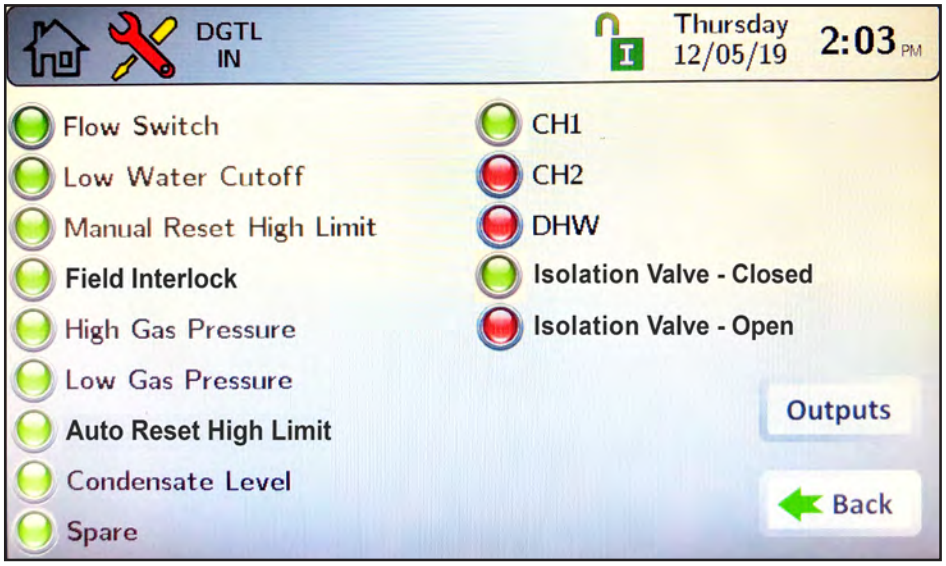
Digital I/O Inputs: The indicator light associated with the input is green when the input is satisfied. For example, if there is adequate flow, the flow switch is satisfied, and the flow switch digital input indicator light is green. The indicator light associated with the input is red, when the input is not satisfied. For example, if the boiler is not full of water, the Low Water Cutoff indicator light is red. All lights below a 'not satisfied' switch will also be red.

The boiler will operate until all inputs are satisfied (Green)

A spare input is available and is shipped jumpered at the control board in the satisfied condition.

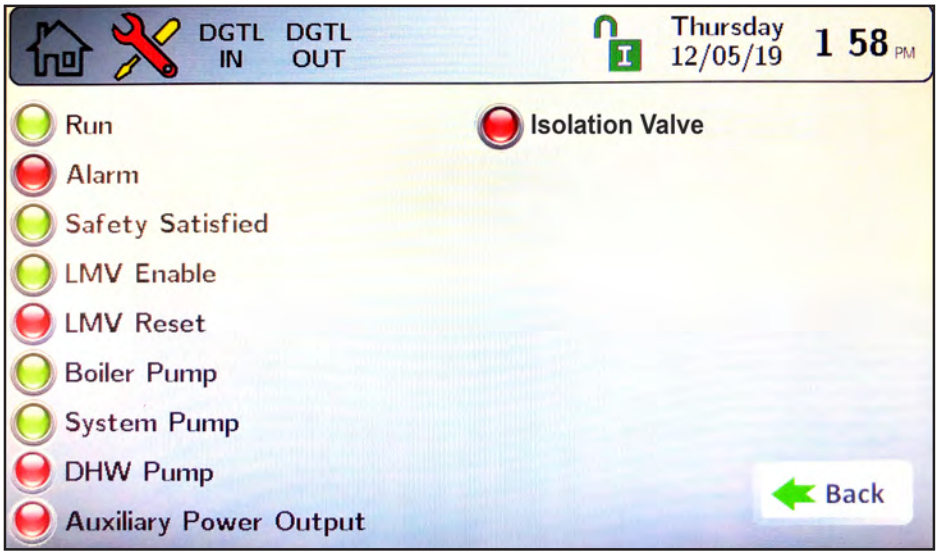
NOTE: The manual reset and additional high limit functions are only active if the boiler has been purchased with the 'high limit' option. In this case, a pair of switches activated by remote temperature sensing bulbs are provided. These switches are located behind the main control panel on the left side of the boiler.

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



8.E.3 Analog I/O

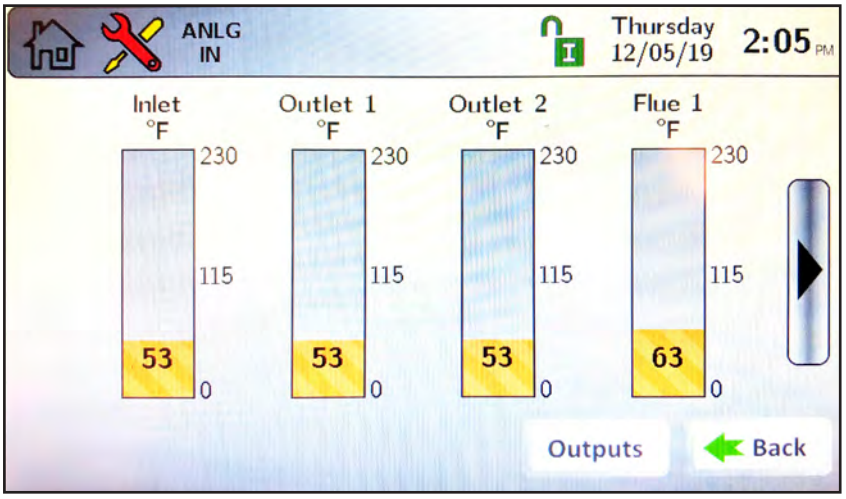
Navigate to the Analog I/O Screen by touching the Analog I/O Button on the Service Screen.

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

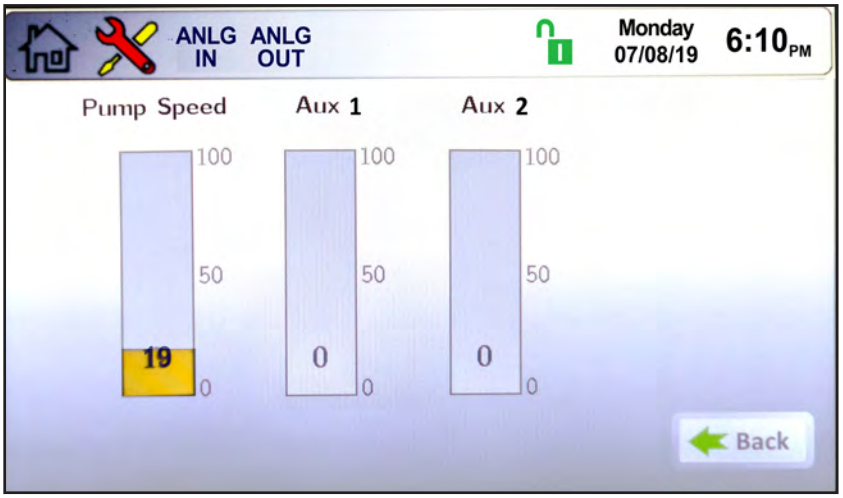
Analog I/O Input: There are three types of analog inputs; temperature sensors, flame signal, and voltage/current (VDC/mA). Wiring of these inputs are covered in SECTION 7

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

Inputs



Outputs

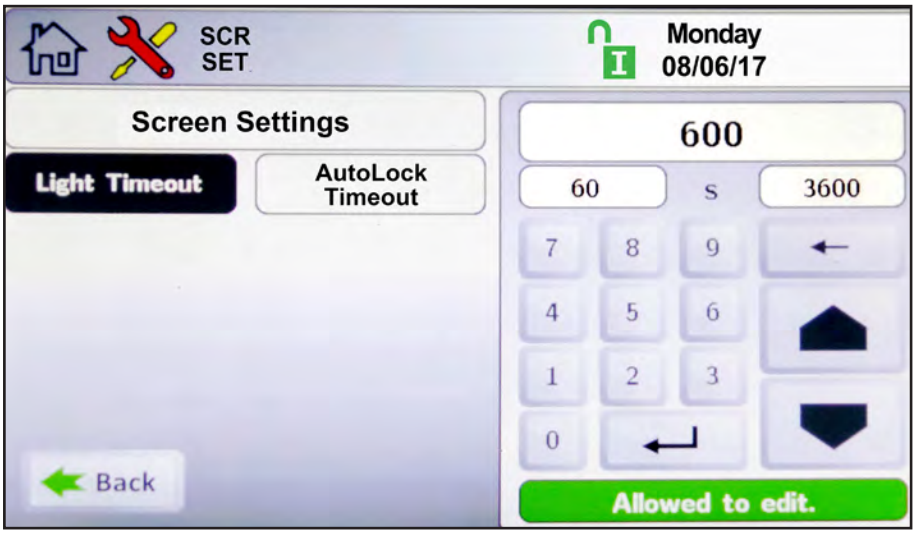


8.E.4 Screen Settings Timeout

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

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

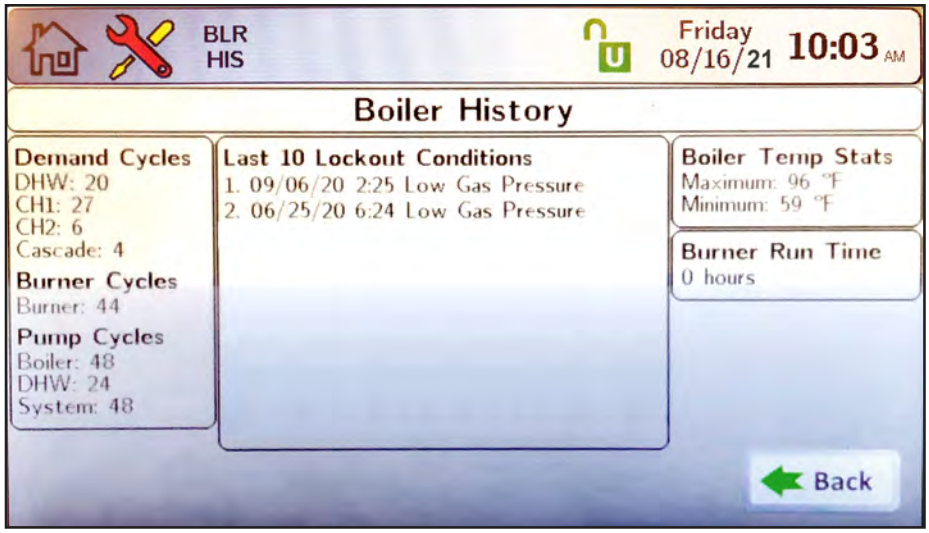
- Light Timeout allows the user to adjust the amount of time the touch screen backlight will remain lit after user interaction has ceased.
- AutoLock Timeout allows the user to adjust the amount of time the touch screen will remain unlocked with no user interaction.



8.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.



8.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.

8.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.

8.E.8 HMI Model OEM only.

8.E.9 BIC Model OEM only.

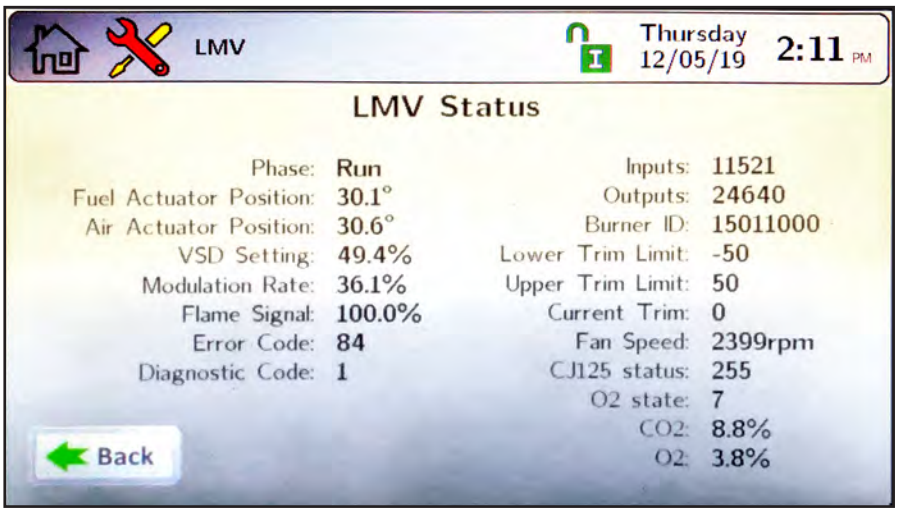
8.E.10 Both Model. OEM only.

8.E.11 About the Firmware

8.E.12 O_2. OEM only.

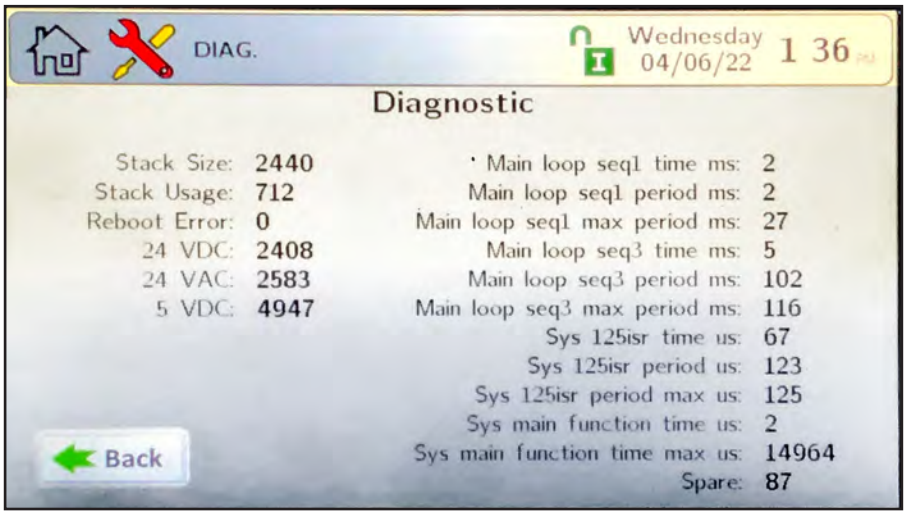
8.E.13 LMV

'LMV' stands for 'Linkageless Modulating Valve' and is the burner management system on the unit.
Touching the LMV button on the service screen will show the LMV Status screen. This is display only. There isn't any functionality here.



8.E.14 Diagnostic

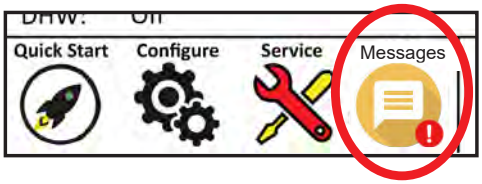
Touching the Diagnostic button on the service screen will navigate to the Diagnostic screen.
This is display only, capturing the status of the burner controller.



8.F Messages and USB

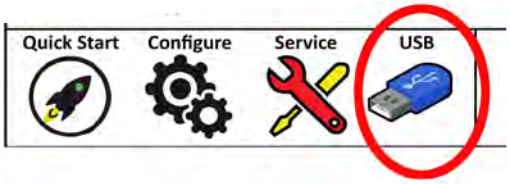
8.F.1 Messages

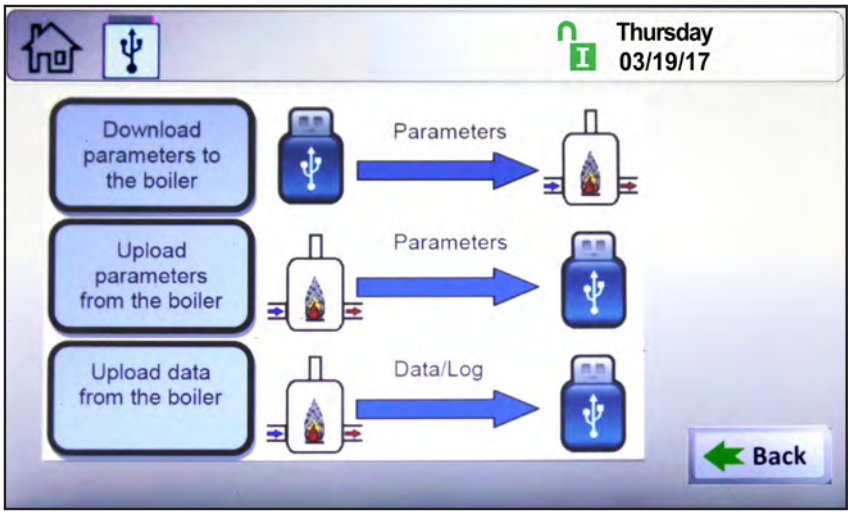
The ‘Messages’ icon at the bottom of the home screen displays an ‘Exclamation Point’ when messages are present. Press the icon to see the message(s).



8.F.2 USB Functionality

The USB port is on the back of the display. To access it, open both panels and look for the black USB cable extending from the back of the display. See Figure 42.





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:

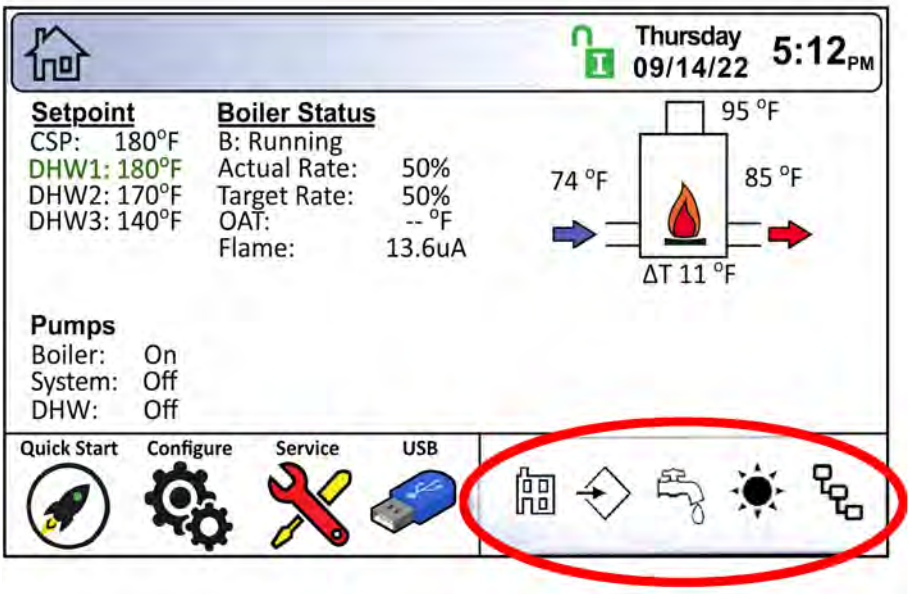
- **Download Parameters from the boiler:** During a cascade setup or a control replacement, enter the values in one unit, to copy into the others.
- **Upload Parameters from the boiler:** Uploads all parameters and settings into a thumb drive for documentation purposes, or copies these settings from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



Figure 42. Photo of USB Slot on the back of touchscreen display.

8.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 20. Demand Examples

SECTION 9 Parameter Tables

Table 21. CFH Parameter and Range Table (includes next 2 pages)

CFH	User	Installer	OEM	Minimum	Maximum	Default	Unit
Time & Date							
Hour	x	x	x	NA	NA	NA	Hour
Minute	x	x	x	NA	NA	NA	Minute
Month	x	x	x	NA	NA	NA	Month
Day	x	x	x	NA	NA	NA	Day
Year	x	x	x	NA	NA	NA	Year
CH1							
CH1 Enable/Disable		x	x	Disable	Enable	Enable	N/A
CH1 Setpoint	x	x	x	40	210	180	°F/C
CH1 On Hysteresis		x	x	0	20	10	°F/C
CH1 Off Hysteresis		x	x	0	20	10	°F/C
CH1 PID Low - Proportional Gain		x	x	0	10	5	N/A
CH1 PID Low - Integral Time		x	x	0	10	2	Seconds
CH1 PID Low - Derivative Time		x	x	0	10	0	Seconds
CH1 PID High - Proportional Gain		x	x	0	10	7	N/A
CH1 PID High - Integral Time		x	x	0	10	7	Seconds
CH1 PID High - Derivative Time		x	x	0	10	0	Seconds
Max Power		x	x	20	100	100	%
Output Freeze		x	x	2	20	5	%
CH2							
CH2 Enable/Disable		x	x	Disable	Enable	Enable	N/A
CH2 Setpoint	x	x	x	40	210	170	°F/C
CH2 On Hysteresis		x	x	0	20	10	°F/C
CH2 Off Hysteresis		x	x	0	20	10	°F/C
CH2 PID Low - Proportional Gain		x	x	0	10	5	N/A
CH2 PID Low - Integral Time		x	x	0	10	2	Seconds
CH2 PID Low - Derivative Time		x	x	0	10	0	Seconds
CH2 PID High - Proportional Gain		x	x	0	10	7	N/A
CH2 PID High - Integral Time		x	x	0	10	7	Seconds
CH2 PID High - Derivative Time		x	x	0	10	0	Seconds
Max Power		x	x	20	100	100	%
Output Freeze		x	x	2	20	5	%
DHW							
DHW Enable/Disable		x	x	Disable	Enable	Enable	N/A
DHW Setpoint	x	x	x	40	200	180	°F/C
DHW On Hysteresis		x	x	0	20	10	°F/C
DHW Off Hysteresis		x	x	0	20	10	°F/C
DHW PID Low - Proportional Gain		x	x	0	10	5	N/A
DHW PID Low - Integral Time		x	x	0	10	2	Seconds
DHW PID Low - Derivative Time		x	x	0	10	0	Seconds
DHW PID High - Proportional Gain		x	x	0	10	7	N/A
DHW PID High - Integral Time		x	x	0	10	7	Seconds
DHW PID High - Derivative Time		x	x	0	10	0	Seconds
Max Power		x	x	20	100	100	%
Output Freeze		x	x	2	20	5	%
Control Sensor		x	x	System Supply	DHW	System Supply	N/A
DHW Timeout		x	x	0	600	0	Minutes
CH Timeout		x	x	0	600	0	Minutes
DHW Offset	x	x	x	0	40	0	°F/C
Outdoor Reset							
Outdoor Reset Enable/Disable		x	x	Disable	Enable	Disable	N/A
Maximum Outdoor Temperature		x	x	0	140	65	°F/C
Minimum Outdoor Temperature		x	x	-40	65	0	°F/C
CH1 Minimum Water Temperature		x	x	40	210	120	°F/C
CH2 Minimum Water Temperature		x	x	40	210	120	°F/C
Cascade CH							
Address		x	x	0	8	0	N/A
Dynamic Address		x	x	0	8	0	N/A
Lost Lead Backup Setpoint		x	x	40	210	180	°F/C
Lag On Hysteresis		x	x	0	20	10	°F/C
Lag Off Hysteresis		x	x	0	20	10	°F/C
Cascade Auto-Config		x	x	Standby	Start	Standby	N/A
Maximum Lag Temperature		x	x	40	210	180	°F/C
Backup Mode Max Lag Power		x	x	20	100	100	%
Base Load		x	x	40	100	75	%
Drop Load		x	x	5	100	15	%

CFH	User	Installer	OEM	Minimum	Maximum	Default	Unit
Min On Time		x	x	30	1200	300	Seconds
Min Off Time		x	x	30	600	30	Seconds
Cascade Rotation							
Rotation Mode		x	x	Run Time	Recurrence	Run Time	N/A
Run Time Hours		x	x	12	744	24	Hours
Time of Day - Hour		x	x	0	23	2	Hour
Time of Day - Minute		x	x	0	59	0	Minute
Every X Day		x	x	1	365	1	Day
Cascade Redundancy							
Loss of Lead Setup		x	x	Disable	Boiler Internal Setpoint/ Redundant Lead	Disable	N/A
Pump Configuration							
Boiler Pump Control		x	x	Auto	Auto/ Always On/ Off During DHW/ Auto-Off is System Temp is Reached	Auto	N/A
Boiler Pump Post Circulation		x	x	0	600	60	Seconds
DHW Pump Control		x	x	Disable	Auto/ Always On	Auto	N/A
DHW Pump Post Circulation		x	x	0	600	60	Seconds
System Pump Control		x	x	Disable	Auto/ Always On/ Off During DHW	Auto	N/A
System Pump Post Circulation		x	x	0	600	60	Seconds
Variprime							
Pump On Delay Timer		x	x	1	120	1	Seconds
Proportional Gain		x	x	0	10	5	N/A
Integral Time		x	x	0	10	2	Seconds
Derivative Time		x	x	0	10	0	Seconds
Pump Minimum Speed		x	x	0	10000	2000	milli-Volt
Pump Maximum Speed		x	x	2000	10000	10000	milli-Volt
Pump Off Delay Timer		x	x	0	600	60	Seconds
Delta Temperature		x	x	0	45	20	°F/C
PrePurge Speed		x	x	2000	10000	10000	milli-Volt
PostPurge Speed		x	x	2000	10000	10000	milli-Volt
Firing Rate							
Enable Burner		x	x	Disable	Enable	Disable	N/A
Firing Rate		x	x	5	100	5	%
Time Out		x	x	60	3600	1200	Seconds
Min Power Offset		x	x	0	50	0	%
Manual Heat Demand		x	x	Disable	Enable	Disable	N/A
Temperature Limits							
Auto Reset Boiler Outlet		x	x	100	205	195	°F/C
Manual Reset Boiler Outlet		x	x	100	210	210	°F/C
Reset Differential		x	x	1	10	5	°F/C
Flue temp Min		x	x	195	220	205	°F/C
Flue temp Max		x	x	195	220	220	°F/C
Manual Reset Flue		x	x	195	220	220	°F/C
Outlet Temp Min		x	x	90	200	190	°F/C
Outlet Temp Max		x	x	95	205	195	°F/C
Delta T Parameters							
Delta T Minimum Temperature		x	x	40	70	60	°F/C
Delta T Enable/Disable		x	x	Disable	Enable	Enable	N/A
External Control							
Control Mode		x	x	Disable	External Setpoint/ Firing Rate	Disable	N/A
Maximum Setpoint		x	x	40	210	180	°F/C
Minimum Setpoint		x	x	40	210	110	°F/C
Maximum Firing Rate		x	x	5	100	100	%
Minimum Firing Rate		x	x	5	100	20	%
Demand Max		x	x	20	100	100	%
Demand Min		x	x	0	100	20	%
Demand On		x	x	0	25	15	%
Demand Off		x	x	0	25	10	%
Input Type		x	x	0-10VDC	4-20 mA	0-10 VDC	VDC/mA
Heat Demand		x	x	VDC/mA Only	CH1&VDC-mA/CH2&VDC-mA /DHW&VDC-mA	CH1&VDC-mA	VDC/mA
Demand Priorities							
CH1 Demand Priority		x	x	1	5	2	N/A
CH2 Demand Priority		x	x	1	5	3	N/A
DHW Demand Priority		x	x	1	5	1	N/A
Cascade Demand Priority		x	x	1	5	4	N/A
External Demand Priority		x	x	1	5	5	N/A
Anti- Frost							

CFH	User	Installer	OEM	Minimum	Maximum	Default	Unit
Anti Frost Mode		x	x	Disable	Pump Only/ Pump & Burner	Pump Only	N/A
Anti- Frost Setpoint		x	x	32	120	40	°F/C
Anti- Frost Hysteresis		x	x	2	10	5	°F/C
Anti- Frost Pump Control		x	x	Boiler	DHW/ System	Boiler	N/A
Warm Weather Shutdown							
Temperature Minimum		x	x	50	140	90	°F/C
Temperature Maximum		x	x	50	140	95	°F/C
Feature Options		x	x	Disable	Shutdown Immediately/ Shutdown After Demand is Satisfied	Shutdown Immediately	N/A
Summer Kick CH		x	x	0	600	300	Seconds
Summer Kick DHW		x	x	0	600	300	Seconds
Summer Kick System		x	x	0	600	300	Seconds
Summer Kick Isolation Valve		x	x	10	2000	1440	Minute
Summer Kick Period		x	x	10	2000	1440	Minute
Anti- Short Cycle Time							
Cycle Time		x	x	1	240	60	Seconds
Temperature Conversion							
Conversion Unit		x	x	Celsius	Fahrenheit	Fahrenheit	°F/C
BACnet							
Protocol		x	x	Modbus	BACnet	BACnet	N/A
Baudrate		x	x	9600	19200/38400/76800	76800	Bits/Second
Address		x	x	0	255	127	N/A
Device Model Name		x	x	N/A	N/A	N/A	N/A
Device Object Name		x	x	N/A	N/A	N/A	N/A
Object Instance		x	x	0	4194303	600000	N/A
Timeout		x	x	0	300	300	Seconds
Isolation Valve							
Enable/Disable		x	x	Disable	Enable	Enable	N/A
Open Time Delay		x	x	70	250	160	Seconds
Close Time Delay		x	x	70	250	160	Seconds
Manual Operation		x	x	Auto	Manual	Auto	N/A
Manual Open/Close		x	x	Close	Open	Close	N/A
Min. # of Open Valves		x	x	1	8	1	N/A
Service Screens							
Burner							
Burner Enable/Disable		x	x	Disable	Enable	Enable	N/A
Screen Settings							
Light Timeout	x	x	x	60	3600	600	Seconds
AutoLock Timeout	x	x	x	60	3600	600	Seconds
Pressure						**1.0** / **1.5** / **2.0** / **3.0**	
a			x	-32768	32767	600 / 600 / 600 / 700	N/A
b			x	-32768	32767	-5000 / -7500 / -7500 / -5000	N/A
c			x	-32768	32767	10000 / 8000 / 12000 / 12000	N/A
Maximum Allowable Drift			x	1	10	10	%
Validation Time			x	0	20	10	Seconds
Min Drift Value			x	0	40	10	0.01" W.C.
Hysteresis			x	0	402	10	0.01" W.C.
Pressure - Fan Limits						**1.0** / **1.5** / **2.0** / **3.0**	
No Fan Limit			x	0	402	25	0.01" W.C.
Maximum Fan Limit Lower			x	0	402	50 / 50 / 50 / 50	0.01" W.C.
Maximum Fan Limit Higher			x	0	402	350 / 350 / 350 / 350	0.01" W.C.
Pressure - Transmitter Scaling							
Slope			x	0	2000	1000	N/A
Offset			x	-1000	1000	0	N/A
P1 Voltage			x	0	5000	450	mV
P2 Voltage			x	0	5000	4500	mV
P1 Pressure			x	0	803	0	0.01" W.C.
P2 Pressure			x	0	803	400	0.01" W.C.
O_2							
Enable/Disable (Configuration - Misc Screen Only)		x	x	Disable	Enable	Enable	N/A
Trim Slope (used to be Trim Value)			x	-150	250	0	0.10%
Trim Offset			x	-1000	1000	0	uA
Trim Set Point		x	x	20	50	38	0.10%
Proportional Gain			x	-32768	32767	2	N/A
Integral Time			x	-32768	32767	1	Seconds
Derivative Time			x	-32768	32767	0	Seconds
Air Check Low		x	x	1000	2100	1600	0.01%
Air Check High			x	2150	2300	2200	0.01%

SECTION 10 Initial startup Instructions

10.A Filling the Boiler System

1. Ensure the system is fully connected. Close all bleeding devices and open the make-up water valve. Allow the system to fill slowly.
2. If a make-up water pump is employed, adjust the pressure switch on pumping system to provide a minimum of 12 psi (81.8 kPa) at the highest point in the heating loop.
3. If a water pressure regulator is provided on the make-up water line, adjust the pressure regulator to provide at least 12 psi (81.8 kPa) at the highest point in the heating loop.
4. Bleed all air from the heating system by opening any bleed valves (air eliminators) throughout the heated system, unless automatic air bleeders are provided at those points.
5. To remove all air from the heat exchanger, Initial purging of air from the heat exchanger can be accomplished by opening the pressure relief valve using the manual lever.

⚠ WARNING

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

6. Open all strainers in the circulating system, check the operation of the flow switch (if equipped), and check for debris. If debris is present, clean out the strainers to ensure proper circulation.
7. Check the liquid level in the expansion tank. With the system full of water and under normal operating pressure, the level of water in the expansion tank should not exceed ¼ of the total with the balance filled with air.
8. Start up the boiler following the procedure in this manual. Operate the entire system, including the pump, boiler, and radiation units for one hour.
9. Recheck the water level in the expansion tank. If the water level exceeds ¼ of the volume of the expansion tank, open the tank drain, and drain to that level.
10. Shut down the entire system and vent all radiation units and high points in the system piping, as described in Step 4.
11. Close the make-up water valve. Check the strainer in the pressure reducing valve for sediment or debris from the make-up water line. Reopen the make-up water valve.
12. Check the gauge for correct water pressure and also check the water level in the system. If the height indicated above the boiler ensures that water is at the highest point in the circulating loop, then the system is ready for operation.
13. Refer to local codes and the make-up water valve manufacturer's instructions as to whether the make-up water valve should be left open or closed.
14. Press the reset on the low pressure switch.
15. After placing the unit in operation, the ignition system safety shutoff device must be tested.

    First, shut off the manual gas valve, and then call the unit for heat. The main gas terminals will be energized and attempting to light for five seconds and then will de-energize. The unit will go into lockout after the required number of trials for ignition periods.

    Second, press the manual reset button on the boiler control, or the user display, open the manual gas valve and allow the unit to light. While the unit is operating, close the manual gas valve and ensure that power to the main gas valve has been cut.
16. Within three (3) days of start up, recheck all air bleeders and the expansion tank as described previously in Steps 4 and 8.

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

⚠ WARNING

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

⚠ WARNING

Do not use automotive antifreeze. To help prevent freezing, the manufacturer recommends the use of inhibited propylene glycol. See 5.C on page 26

10.B Initial Operation (Pre-Start Up)

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 limited warranty.

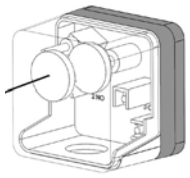
1. Using this manual, make sure the installation is complete and in full compliance with the instructions and all local codes.
2. Determine that the unit and system are filled with

water and all air has been bled from both. Open all valves.

3. Observe all warnings on the Operating Instructions label and turn on gas and electrical power to the unit.

10.B.1 Initial Burner Operation

1. It may be necessary to reset the low pressure switch.



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 proper 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. The primary and secondary gas valves will close and the blower will wind down. The display will show a 'Loss of Flame' and an 'Auto Reset in Progress' message. After several seconds, the system will initiate the burner startup sequence. Ignition will not occur because the gas is turned off and a 'No Flame at Ign' will be shown. See the note in 10.E on page 113 regarding the number of ignition retries.
   (c) Open the gas shutoff valve. Reset the boiler control by pressing the Reset button on the control. Restart the unit. The ignition sequence will start again and the burner will start. The unit will return to its previous mode of operation.

⚠ WARNING

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.

10.B.2 Combustion Setup Procedure

IMPORTANT NOTE: The combustion setup procedure shown in this manual is for units that were manufactured AFTER July of 2022.

If your unit was manufactured BEFORE July of 2022, the firmware is of an earlier version that does not have a 'Manual Heat Demand' at the Firing Rate menu screen. Also, units in cascade that were manufactured BEFORE July of 2022 will need to be taken out of cascade before they can be combustion tested.

⚠ WARNING

Improper adjustment may lead to poor combustion quality, increasing the amount of carbon monoxide produced. Excess carbon monoxide levels may lead to personal injury or death.

IMPORTANT:

At the time of installation, the gas system must be set up properly so that the boiler will run efficiently throughout it's modulation range.

There are multiple points (9) along the modulation range that need to be checked / adjusted to achieve maximum combustion efficiency, -but first, you can do a quick HI-Fire and LOW-Fire 'Test', BEFORE needing to do the 9 point check.

This setup should only be performed by a factory trained technician.

10.B.2.a Quick HIGH-Fire and LOW-Fire 'Test' (FIRST)

1. Check incoming gas pressure. Set up a digital manometer at the test plug on the supply gas line.

NOTE: Check the gas supply pressure before running this combustion set up. Between High Fire and Low Fire, the gas supply pressure cannot be allowed to drop by more than 1" of water column (W.C).

During high fire run, it is also critical that inlet pressure remain between pressures called out in Table 22.

Nat Gas 4.0 -10.5 in w.c.

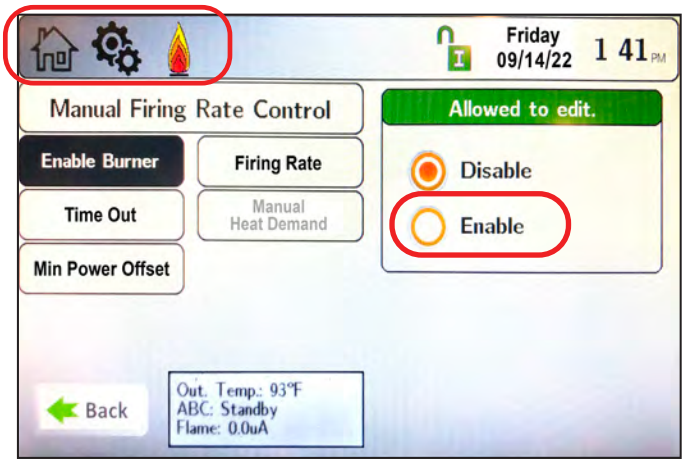
In doing so, if high fire CO2 has changed, ensure it's returned to its desired setting.

Max Supply Pressure	10.5 IN - W.C.
Min Supply Pressure	4.0 IN - W.C

Table 22. Gas Supply Pressure

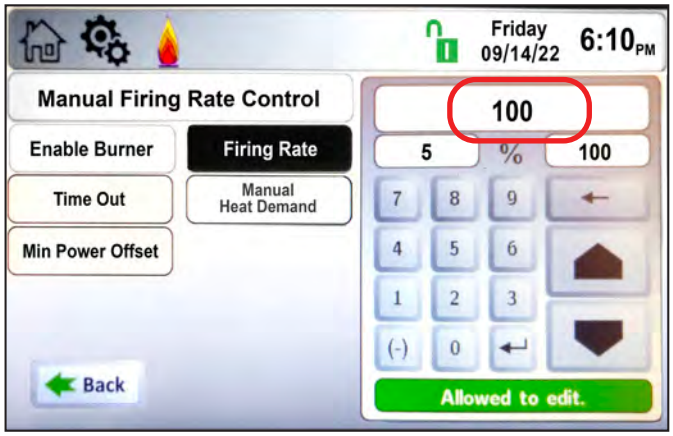
2. Install a combustion analyzer at the boiler exhaust duct.

3. Log-in using the Installer password. See Section 8.B
4 On the touchscreen display proceed to the Miscellaneous folder, select O_2 Trim, and Disable it.
5. On the touchscreen display proceed to the Manual Firing Rate Control Screen and select Enable. This will enable the Manual Heat Demand.



6. Then press the Manual Heat Demand and select Enable (again). This will allow you to now manually change the firing rate for this unit.

7. **HI Fire**. Select Firing Rate and set the Manual Firing Rate to 100%. When the boiler is firing at 100%, check the CO_2 measurement on your combustion analyzer. Be Patient! Give it about 2 minutes to stabilize. CO_2 must be within 9.0% +/- 0.2%



High-Fire CO_2	Low-Fire CO_2	Max CO (ppm)
9.0% +/- 0.2%	9.0% +/- 0.2	50

Table 23. Combustion Settings.

8. **Low-Fire.** Go to Firing Rate again and set the Manual Firing Rate to 5%. Be patient with your combustion analyzer. When the boiler is firing at 5%, check the CO_2 measurement on your combustion. CO_2 must be within 9.0% +/- 0.2%

9. **If HI-Fire and LOW Fire are within 9.0% +/- 0.2%,** then your unit does not need further combustion testing.
   - Go to Manual Firing Rate and Disable Manual Firing Rate.
   - Go to Miscellaneous, O_2 Trim and re-Enable it.
   - Disconnect the manometer and the combustion analyzer.

DONE! **BUT-**

***IF* CO_2 at either Hi Fire or Low Fire are NOT within range (Table 23)**, then a Multi-Point (9 point) combustion setup is needed.

10.B.2.b
Multi-Point (9 point) Combustion Setup

So your CO_2 was NOT within **9.0% +/- 0.2%**

NOTE: Your Manual Firing rate is still Enabled AND your O_2 Trim is still Disabled.

A. Set up a digital manometer on the pressure regulator valve to measure your manifold gas pressure. Reference Figure 48 for the location for your manometer to measure manifold gas pressure.

Model Size	Pressure
1000	1.3" w.c.
1500	1.9" w.c.
2000	2.3" w.c.
3000	2.6" w.c.

Table 24. Manifold Gas Pressure Settings, Inches w.c.

B. Reference Table 24 to find the manifold gas pressure for your size boiler.

C. We must use the AZL control (Siemens hand-held controller) to manually modulate down to **P-Zero** (See Figure 43) where we can then adjust the gas pressure first and THEN do a multi-point CO_2 adjustment. Locate the AZL and familiarize yourself with the buttons and the display.

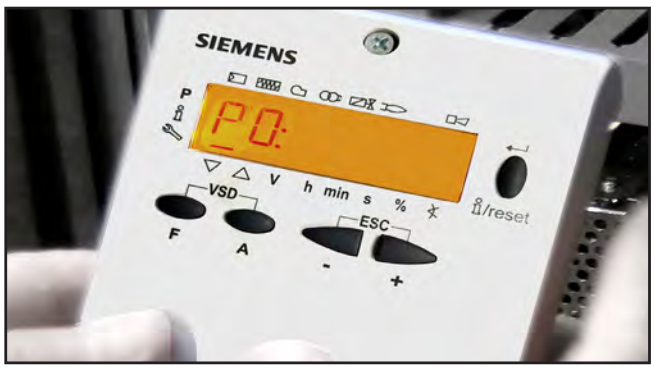


Figure 43. AZL Control (Siemens hand-held controller)

D. Log into the AZL Control by pressing F & A simultaneously.

E. The controller will display 'CODE' and then seven (7) dashed lines will appear as shown in Figure 44.

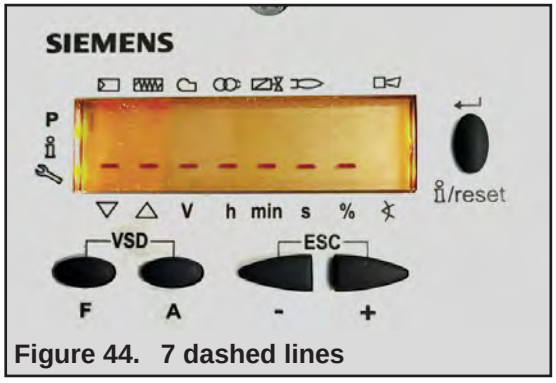


Figure 44. 7 dashed lines

F. Enter the code for your model as per Table 25. Press on the **+** button to start the first number of your code. Press the **<---| / reset** button to enter that first digit. Then do the same to enter the next 3 digits.

Manufacture Date	CODE
Before 12/03/2020	9876
After 12/03/2020	2001

Table 25. AZL CODES

G. Press Enter again and you will see the **400 SEt** on the display.

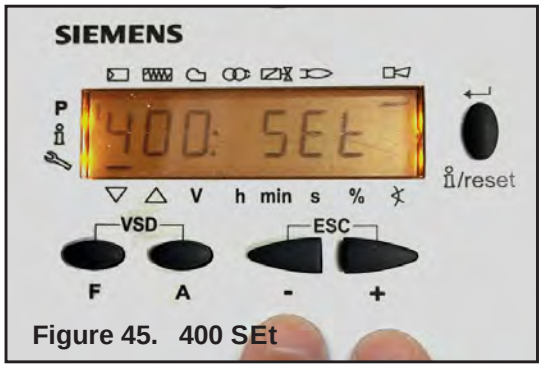


Figure 45. 400 SEt

H. Enter again and you will see **run GASO** on the display.

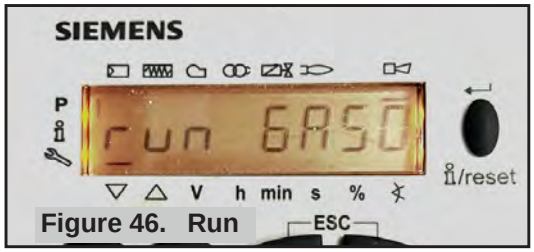


Figure 46. Run

I. Press it one more time (three total times) and you are now at **P1**.

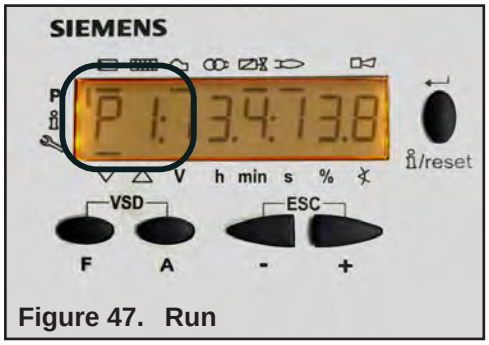


Figure 47. Run

J. Press the 'minus' to get to **P0** (this is light-off)

K. At **P0**, check manifold pressure and compare to your model as listed on Table 24.

L. Locate the pressure adjustment on the Pressure Regulating Gas Valve by removing the brass cap at the top of the gas valve. See Figure 48

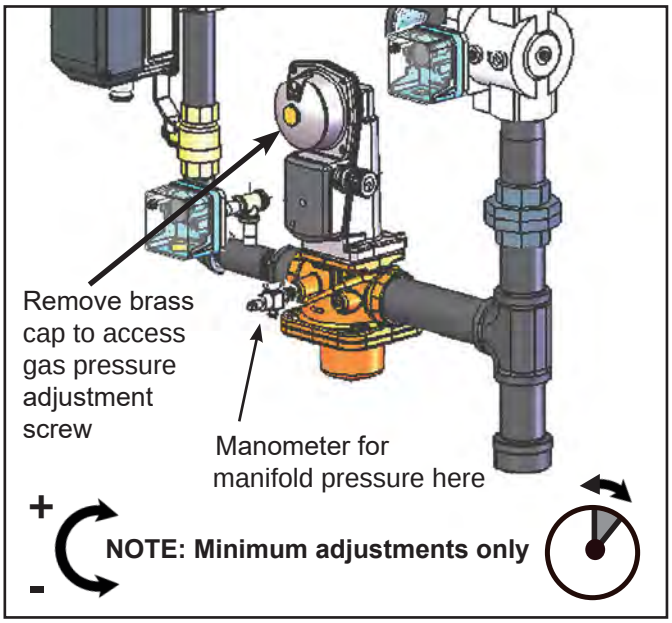


Figure 48. Gas Pressure Adjustment Screw

M. Adjust manifold pressure at the brass screw to match your model as listed on Table 24.

N. Once you have adjusted your manifold gas pressure, shut the port valve and disconnect the manometer.

11 Check/Adjust combustion starting at P9 and then down to P1.

Repeat these next 5 steps all the way to P1.

Step 11 (continued)

Check/Adjust combustion starting at P9 and then down to P1.

IMPORTANT NOTE:
The - + buttons on the AZL controller are far less sensitive at P9 than they will be at P3 or below.
Several taps at P9. One tap at time at P3 or below.
You will notice that at P3 and down to P1, you only need to tap - + once to get your combustion reading to respond.

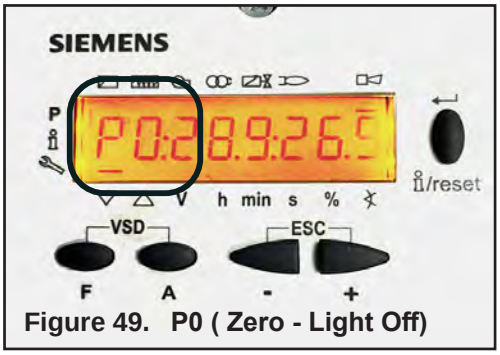


Figure 49. P0 (Zero - Light Off)

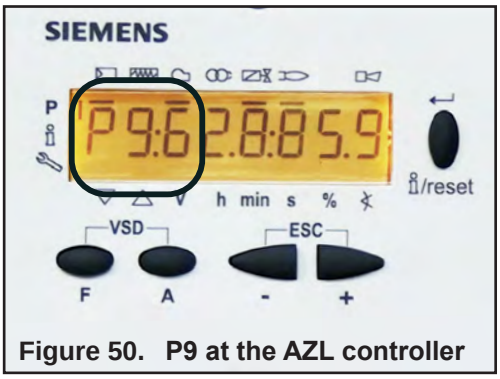


Figure 50. P9 at the AZL controller

A. Press the **plus** button on the AZL and go up to P9 (Hi-Fire).

B. Be patient with your analyzer and then Check Combustion, 9.0% +/- 0.2%. See Table 23 on page 110

C. If CO_2 is high, then add more air by pressing (and hold) the A button (A is for Air) and then tapping the plus symbol about 5 times.

-OR-

If CO_2 is low, you can increase CO_2 by removing air. Press (and hold) the A button and then tap on the 'minus' button about 5 times.

D. Check your analyzer again. Once you are within range, then press the 'minus' button to get to the next lower point.

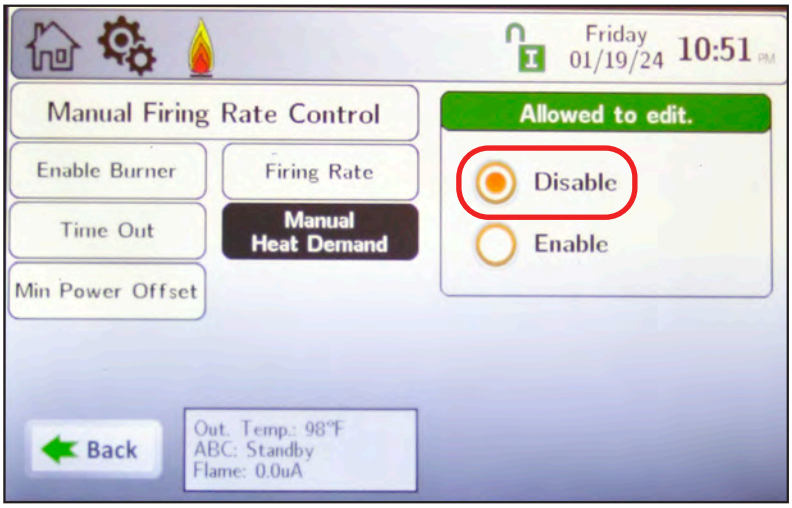
E. Repeat all the way down to, and including, P1.

12. Save and finish with the AZL.

Press the Plus and Minus simultaneously <u>three times</u>.

13. End TT Demand.

Go to Firing Rate Control and select Manual Heat Demand and Disable it. Or, if you used a toggle switch, turn off to end TT.



14. Re-Enable boiler several times
(Re-Light the boiler three times).

DONE.

For Laars Product and Service VIDEOS

https://www.youtube.com/user/laarsHeating

10.C Shutting Down the Unit

This step must be performed by a qualified service person.

1. Turn off the main electrical disconnect switch.
2. Close all manual gas valves.
3. If freezing is anticipated, drain the unit and be sure to also protect the building piping from freezing. All water must be removed from the heat exchanger or damage from freezing may occur.

10.D Restarting the Unit

If the system has been drained, see 10.A for instructions on proper filling and purging.

1. Turn off the main electrical disconnect switch.
2. Close all manual gas valves.
3. ***Wait five minutes.***
4. Set the aquastat or thermostat to its lowest setting.
5. Open all manual gas valves.
6. Reset all safety switches (pressure switch, manual reset high limit, etc.).
7. Set the temperature controller to the desired temperature setting and switch on the electrical power.
8. The unit will go through a prepurge period and ignitor warm-up period, followed by ignition.

BIC Status		LMV States
Phase	**Phase**	
Standy	12	Standby
Call For Heat		
LMV Enable		
	22	Blower On
	24	Component Calibration
Pressure Xmitter Verification	30	Prepurge
Read (via Modbus) at ACC State and Display Touchscreen	36	Move to Ignition Position
	38	Igniter On
	40	Main Fuel On
	42	Ignitor Off/Verify Main Burn
	60	Run
Fan Speed Governed by		
SIT Demand Signal		
End Call for Heat		
LMV Disable		
	70	Post Purge
	74	Shutdown
Standby		Standby

Table 26. BIC Status and LMV Status

10.E About the Controllers

This unit utilizes three (3) separate controllers to manage system functions, burner management and air/fuel ratio control:

- Burner Integrated Control (BIC)
- Linkageless Modulating Valve (LMV)
- Oxygen Controller (O2C)

These controllers communicate with each other via voltage and current signals, and serial digital communication using Modbus protocol. The BIC also communicates with the touch screen display and all user inputs.

When there is a call for heat the BIC will provide an enable signal to the LMV which tells the LMV to initiate burner operation. For this signal to be sent and acted upon, the safety circuit must be satisfied and both controllers must be in standby mode.

The system pressure sensors, which measure the overall system pressure drop must also read zero in order for the Safety Status to be verified.

The Safety Circuit status can be verified on the Services/Digital I/O screen. Once the LMV is enabled it will proceed through the startup states listed in Table 26 until it gets to Run. Once in Run, the LMV will receive a firing rate demand from the BIC and position the fuel and air dampers and blower speed accordingly.

After the burner has been on for two (2) minutes the oxygen trim loop will be enabled and the blower speed will be adjusted to maintain the preset oxygen concentration in the boiler exhaust.

The MagnaTherm FT has a direct ignition system and does not use a separate pilot. A spark ignition is used to light the main burner at a pre-set reduced firing rate. If the main flame is not detected during the “verify main burner” stage, the LMV will enter a ‘Lock-out’ mode and a ‘No Flame at Ign’ error will appear on the display screen. If the maximum attempts for ignition has not been reached, the system will perform an automatic reset and the ignition sequence will be repeated.

NOTE: Three ignition retries is standard before a ‘Hard’ lock-out occurs. If a hard lock-out occurs, the system must be manually reset using the reset button on the display unit. CSD-1 units have a single ignition retry prior to a hard lock-out. For the reset to clear the lockout, there must be a call for heat and the safety circuit must be satisfied.

If the call for heat is satisfied normally, the BIC will remove the enable signal and the LMV will de-energize the fuel valves and enter postpurge. Any time there is an interruption of the BIC safety circuit, both the LMV enable signal and LMV safety loop signal will be removed, triggering a burner shutdown. Along with

the circuit components identified in the System Ladder Logic, the system differential pressure is continuously monitored while the burner is in operation.

10.F About the Transmitters

This unit utilizes a pair of pressure transmitters to determine that the pressure drop across the combustion air/flue gas side of the system is within acceptable bounds for proper operation. If during operation the differential pressure across the system exceeds a predetermined value at a given firing rate, the system will shut down and a 'High Vent Press Drop' will be displayed. The pressure transmitters measure the differential pressure from the inlet filter box to the outlet of the heat exchanger. Figure 51 on page 114 shows the allowable differential versus the firing rate for each size boiler. This condition may arise due to excessive duct lengths, blockage of the inlet or outlet ducts, dirty inlet filter or fouling of the heat exchanger air side.

The pressure transmitter values before and during pre-purge may also prevent the boiler from firing. With the blower off, the pressure transmitters must read within 0.10" w.c. of each other and also must not exceed a No Fan Limit. If the differential pressure during pre-purge exceeds 3.5 inches of water column, the system will enter a lockout condition and a 'High Fan Pressure' will be displayed. If insufficient pressure differential is measured during pre-purge, the system will also enter a lockout condition and a 'Low Fan Pressure' will be displayed. See Section 12.A on page 120

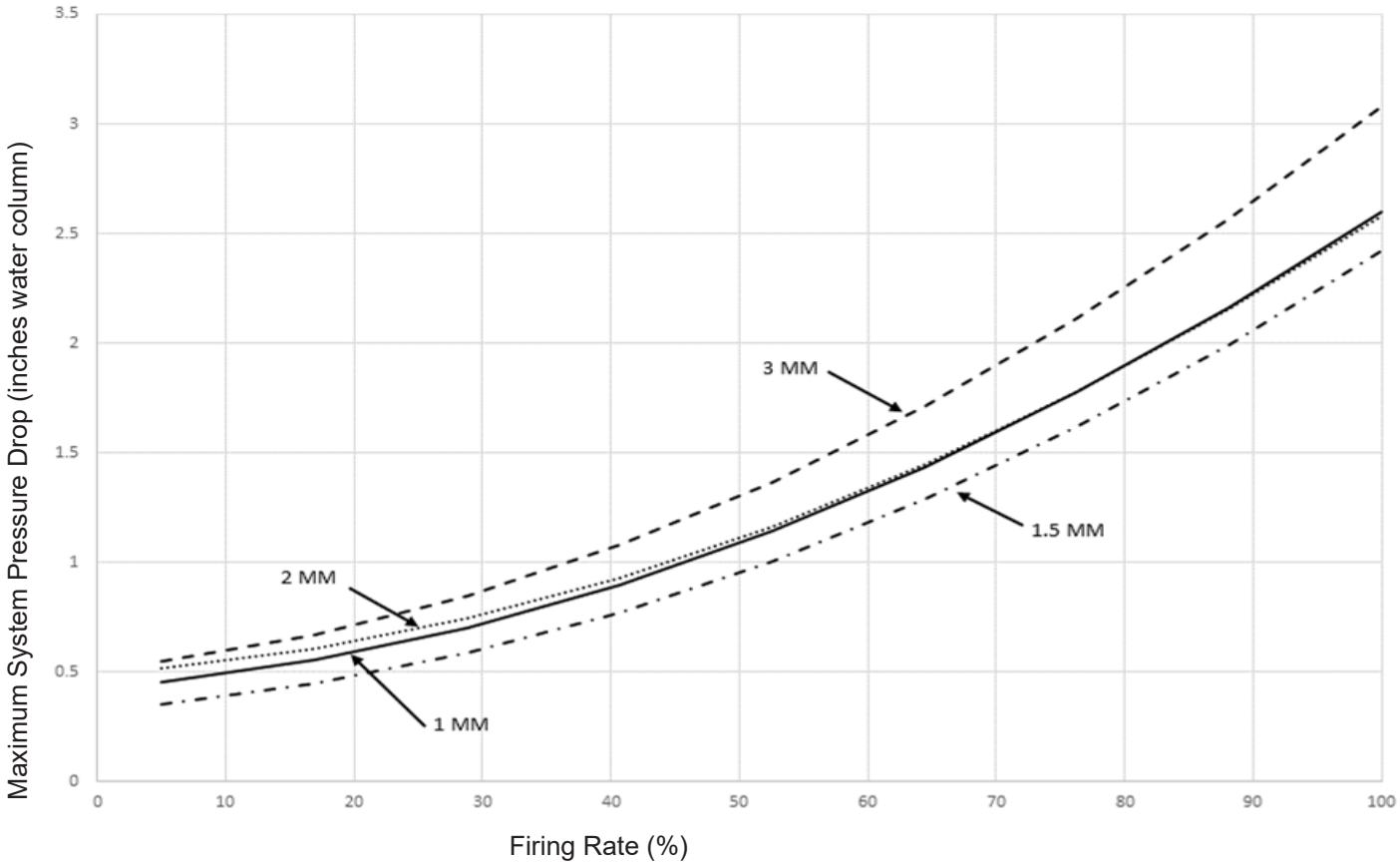


Figure 51. Maximum System Differential Pressure VS Firing Rate

SECTION 11 Maintenance

11.A System Maintenance

11.A.1 Annually:

1. Lubricate all the pumps in the system, per the instructions on the pump.
2. Inspect the venting system for obstruction or leakage. Periodically clean the screens in the vent terminal and combustion air terminal (when used).
3. Remove and inspect the air filter. Clean with soapy water if needed. Be sure that filter is dry before re-inserting back into air filter box. Replace air filter if damaged.
4. Keep the area around the unit clear and free of combustible materials, gasoline, or other flammable vapors or liquids.
5. 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 completely drained of all water.
6. Low water cutoffs should be cleaned and inspected annually.
7. Inspect and clean the condensate collection, float switch and disposal system yearly.
8. Ensure that the condensate is being neutralized properly.
9. Inspect the flue passages and clean them using brushes or vacuums, if necessary. Sooting in flue passages indicates improper combustion. Determine the cause of the problem and correct it.
10. Inspect the vent system and air intake system and ensure that all joints are sealed properly. If any joints need to be resealed, follow venting manufacturer's instructions to clean and reseal vent system.
11. The pressure relief valve should be inspected and tested every year.
12. Once a year, the items listed below should be inspected by a qualified service technician:

- The units controls
- Automatic gas valve
- Air filter
- Pressure transmitters and sense lines
- Pump
- Flow switch
- Low water cutoff
- Ignitor
- Blower
- Burner
- Heat exchanger
- Flame Sensor

11.A.2 Every six (6) months:

1. If a strainer is employed in a pressure reducing valve or the piping, clean it every six months.

11.B Maintenance Notes

Use only genuine manufacturers replacement parts.

⚠ CAUTION

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

⚠ WARNING

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

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

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

11.B.1 Gas Train Components

The air/gas train consists of an on/off solenoid valve, on/off pressure regulating valve, fuel modulating damper, air modulating damper and air/gas mixer. Pipe unions are included to facilitate removal of the piping assembly, in the event, that a component needs to be replaced. In general, the components contain threaded pipe connections and can be removed using standard gas plumbing practices. Before removing components, shut off the power and gas supplies to the boiler.

The air and fuel dampers must be replaced as complete assemblies. Replacement of only the actuator, in the event of actuator failure is prohibited. The cables for the actuator must be disconnected at the main control panel, X54 and X53 at the Siemens LMV36 controller. The cables cannot be disconnected at the actuator. Care must be exercised in removing the cables from the existing wire bundles and once new dampers are installed the cables should be properly coiled and secured and reconnected to the LMV.

In the event of failure of the on/off Honeywell solenoid, the entire valve must be replaced. Replacements solenoids are not available from Honeywell at this time. For the pressure regulating valve, the upper half of the valve may be replaced leaving the valve body in place. Care must be taken to replaced the fuel and air side sensing lines connected to the pressure regulator. When a new regulator is installed, the pressure adjustment screw should be set to the approximate position of the replaced unit for initial startup – this can

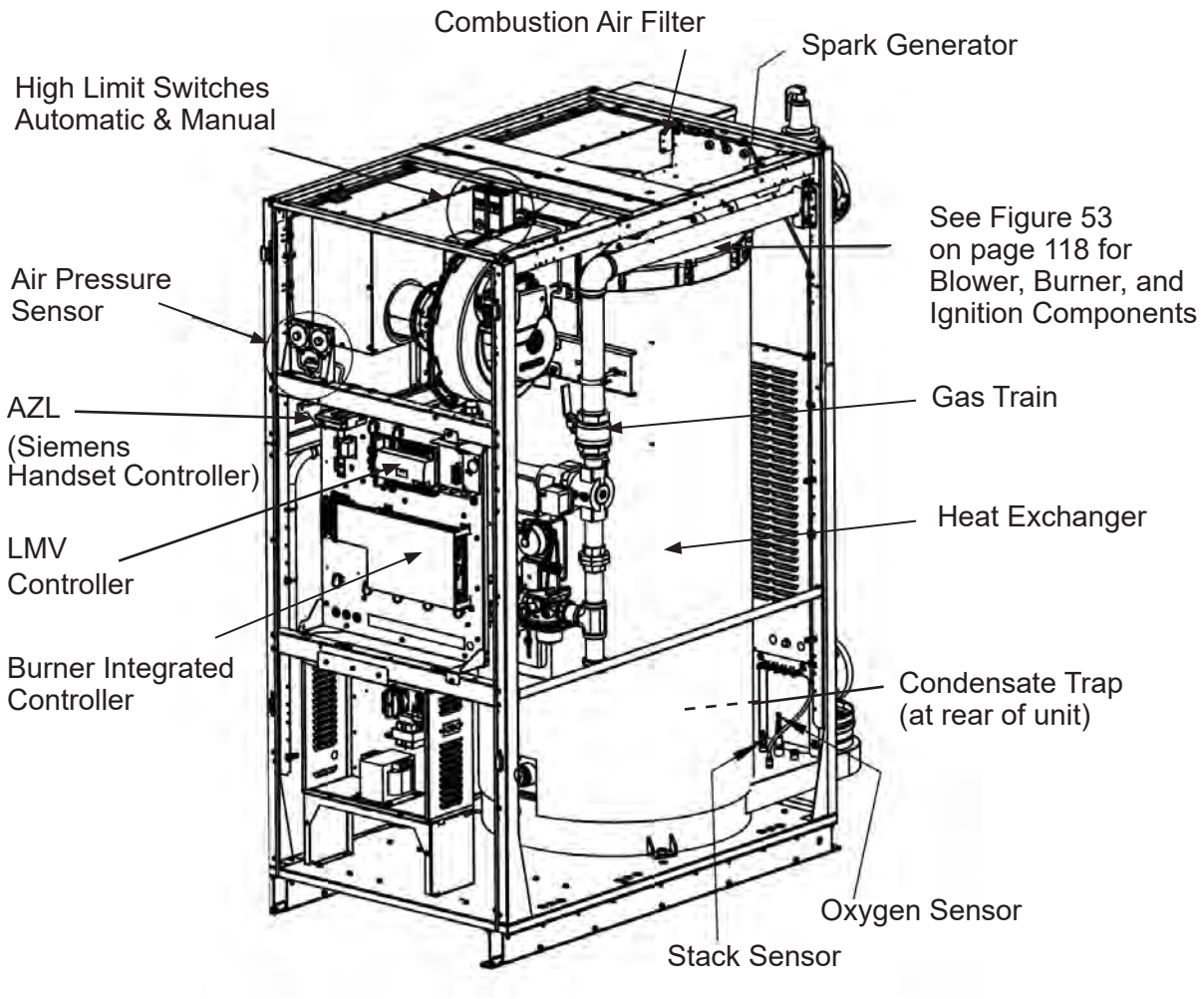


Figure 52. Maintenance Components

be done by counting the exposed threads on the old unit and matching this number on the new unit. The combustion setup procedure outlined in Section 10.B.2 should then be followed to obtain the proper operating conditions.

Replacement of the air damper and air/gas mixer can be achieved by removing the flange bolts at the blower inlet and the flange bolts between the two components. Gaskets and/or o-rings at these flange joints must be carefully re-installed to prevent air leakage into the system.

After removal and replacement of air/gas train components, turn on the manual gas valves and check for gas leaks. Once the boiler is operating, check for leaks again and confirm all fasteners are tight.

Check the setup for the unit according to Section 10.

11.B.2 Burner Integrated Controller

Each unit has Laars Linc controller that incorporates manual reset high limit control, operating temperature control, modulating 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.

Each unit also has a combustion controller (Siemens LMV36) which controls burner operation: ignition, flame sensing, air/fuel ratio control and modulation. The LMV has a unique set of tuning parameters for a given boiler. When replacing the LMV, a factory replacement matching the serial number of the boiler must be utilized.

If it is necessary to replace a controller, turn off all power to the unit and shut off all manual gas valves to the unit. Open the front doors to the unit. Remove all wire 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. To remove the control, undo the mounting screws. To replace the control repeat the steps listed above in the reverse order making sure to connect all wires in the proper locations. Place the unit in operation following the steps outlined in SECTION 10.

11.B.3 Spark Ignition Electrodes

The spark ignition electrode is a dual rod assembly. The ground rod is fastened to the mounting bracket of the spark electrode assembly. The spark electrode passes through a ceramic insulator and then aligns with the ground rod. In order for a proper spark to form, the mounting bracket must be grounded to the boiler chassis. To remove the spark ignition electrodes, shut off the power to the unit, turn off the main gas supply and remove the top rear cover of the boiler to gain access into the top portion of the unit. Remove the high tension ignition wire from the spark electrode. Remove the two (2) nuts and spacers holding the spark electrode assembly in place. Pull the spark ignition electrodes out of the boiler slowly making sure to move the assembly as needed, so the electrodes are not bent as they are being removed. If the old assembly is determined to be defective, install a new spark assembly in the reverse order, replacing the gasket if necessary.

11.B.4 Flame Sensor

The flame sensor is a single rod system. The minimum flame signal that will allow the unit to operate is 24%. The LMV Controller reports the flame intensity as a value from 0 to 100%

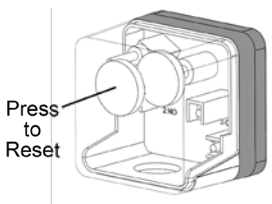
To replace the flame sensor electrode, shut off the power supply to the boiler. Turn off all manual gas valves connecting the boiler to the main gas supply line. Remove the top rear cover of the boiler to gain access into the top portion of the unit. Remove the flame sensor wire from the electrode. Remove the two (2) nuts fastening the electrode to the burner plate. Remove and replace the old flame sensor gasket. If the old electrode is determined to be defective, reinstall a new flame sensor electrode in the reverse order.

⚠ CAUTION

The igniters and sensors can become very hot. If you touch these parts accidentally, this can cause burns or injury.

11.B.5 Gas Pressure Switches

The high and low pressure gas switches are 24 VDC manual reset switches that act to cut power to the 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, remove the screw on the plastic housing and pull the clear cover off. Disconnect the three (3) wires from the screw terminals. Twist the switch off the pipe nipple. Reassemble in reverse order.
Set the low pressure gas switch to 4” w.c.
Set the high pressure gas switch to 3”w.c.”

See 1.H on page 11 for for low and high pressure switch locations.

11.B.6 Pressure Transmitters

The pressure transmitters are powered with 5 VDC from the controller and output a 0.5 to 4.5 VDC signal from 0 to 4 inches water column differential pressure. If the pressure transmitters do not read the same value within a prescribed margin of error a lockout will occur and an “Air Pressure Drift Error” will be displayed. If this occurs, check the transmitter electrical connections and that the pressure sense tubing is intact and there are no kinks. If the condition is not resolved, replace the transmitters.

The transmitter values are displayed on the Analog I/O Output menu; toggle to the right to display Pressure 1 and Pressure 2 and compare the values during fan operation.

11.B.7 Oxygen Sensor

The oxygen sensor is an automotive derived sensor which will require periodic replacement. See Figure 52 If the sensor fails or is out of calibration the Oxygen and Carbon Monoxide lines on the main menu will blink red and dashes will be displayed instead of numeric values. Use only manufacturer’s supplied sensors as replacements and tighten the sensor into the fitting on the heat exchanger exhaust transition to 30 to 40 ft-lb of torque.

11.B.8 High Temperature Limits (optional)

The optional high temperature limits provide redundant high water temperature functions utilizing discrete temperature sensing bulb controllers. The sensing bulbs are located in a sensing well in the outlet water nozzle and the controllers are located above the heat exchanger between the air inlet duct and the blower outlet air transition. See Figure 52

Connectors are provided on the safety chain wire harness to include these limiters in the safety chain when provided. If this option is not included, the connectors are jumpered together.

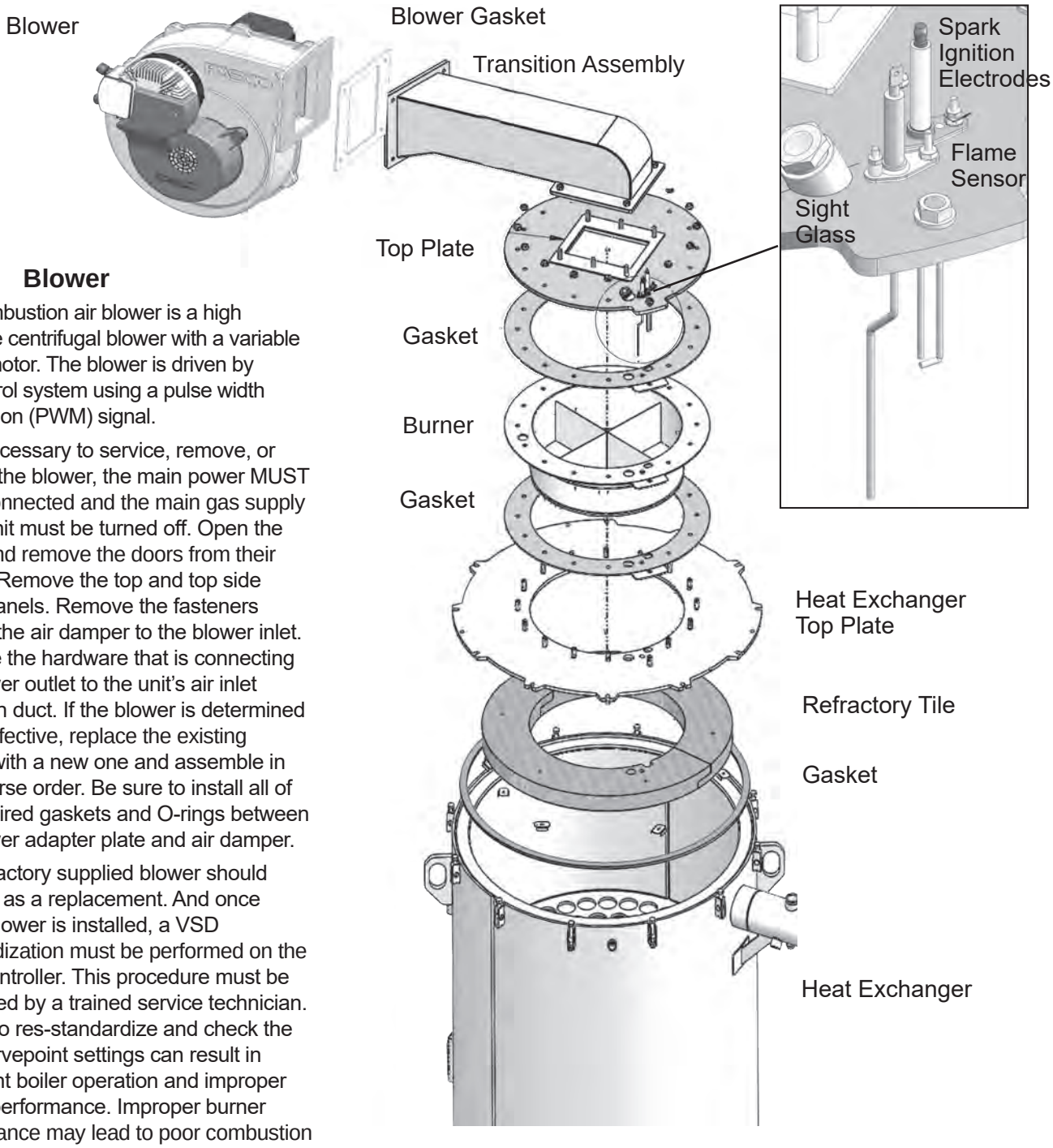


Figure 53. Blower and Ignition Components

11.B.9 Blower

The combustion air blower is a high pressure centrifugal blower with a variable speed motor. The blower is driven by the control system using a pulse width modulation (PWM) signal.

If it is necessary to service, remove, or replace the blower, the main power MUST be disconnected and the main gas supply to the unit must be turned off. Open the doors and remove the doors from their hinges. Remove the top and top side jacket panels. Remove the fasteners holding the air damper to the blower inlet. Remove the hardware that is connecting the blower outlet to the unit's air inlet transition duct. If the blower is determined to be defective, replace the existing blower with a new one and assemble in the reverse order. Be sure to install all of the required gaskets and O-rings between the blower adapter plate and air damper.

Only a factory supplied blower should be used as a replacement. And once a new blower is installed, a VSD standardization must be performed on the LMV Controller. This procedure must be performed by a trained service technician. Failure to res-standardize and check the LMV curvepoint settings can result in inefficient boiler operation and improper burner performance. Improper burner performance may lead to poor combustion quality, increasing the amount of carbon monoxide produced. Excessive carbon monoxide levels may lead to personal injury or death.

11.B.10 Burner

Check the burner for debris. To access the burner, remove the front doors and top panels. Also remove the top cover support cross member. Remove the blower transition assembly to access the blower adapter plate. Remove the ignitor and flame rod. Remove the blower plate to access the burner. Pull the burner up and out. Clean the burner, if necessary, by blowing compressed air from the outside of the burner into the center of the burner, and wipe the inside of the burner with a damp cloth. A dirty burner may be an indication of improper combustion or dirty combustion air. Determine the cause of the problem and correct it.

New gaskets should always be used when reassembling. The blower adapter plate nuts should be tightened to 200 inch-pounds using a star pattern and progressively higher torque settings. Inspect the ignitor and flame rod and replace if necessary. All flange joints should be checked for leaks once the system is operational.

11.B.11 Heat Exchanger

Black carbon soot build-up on the internal surfaces of the heat exchanger is caused by one or more of the following: incomplete combustion, combustion air problems, venting problems or boiler short-cycling. Soot buildup or other debris on the heat exchanger may restrict the flue passages.

⚠ CAUTION

Black carbon soot buildup on a dirty heat exchanger can be ignited by a random spark or flame. To prevent this from happening, dampen the soot deposits with a wet brush or fine water spray before servicing the heat exchanger.

Cleaning this fire-tube heat exchanger requires the removal of the the blower and the burner and must only be done by a trained service technician.

1. Shut off the main power supply to the boiler.
2. Turn off all manual gas valves connecting the boiler to the main gas supply line.
3. Remove the blower assembly and burner from the heat exchanger.
4. Disconnect the condensate drain line.
5. Attach a longer hose to the drain and run it to a bucket.
6. Using a nylon bristle brush, sweep the walls of the combustion chamber and top tube sheet. Use an industrial vacuum cleaner to remove all deposits from combustion chamber. Do not let deposits drop down into the heat transfer tubes.
7. Once the combustion chamber has been brushed clean, rinse the tubes and combustion chamber with a small amount of water to rinse all of the debris out of the bottom of the flue collector and into the longer condensate trap line which is being diverted into a separate container.

⚠ WARNING

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

8. To place the unit back in operation, install all removed components in the reverse order. Do not reuse burner gaskets (S2136300 and S2136400). Be sure all gaskets are in place as the components are installed. Replace any damaged gaskets. Do not reuse damaged gaskets.
9. Place the unit into operation, checking all gas connections for leaks. Confirm all fasteners are tight.

SECTION 12 Troubleshooting

12.A Lockouts and Errors

Condition	Information	Corrective Action
Flow Switch 	• Insufficient flow at the outlet of the boiler/heater • Auto-reset Condition • Annunciation – "Warning Flow switch open" on Message Screen	• Faulty boiler/heater pump – replace pump. • Faulty pump contactor – replace contactor. • Blown boiler/heater pump fuse – replace fuse F14 on the control board.
Low Water Cut Off	• Insufficient water level in the boiler/heater heat exchanger. • Manual-reset Condition • Annunciation – on Navigation Bar Lockout: Low Water Cut Off	• Reset the LWCO from the reset button on the LWCO module. • Verify the system is full of water and all air has been purged from the system. • Check for loose jumpers if the LWCO is not installed.
Manual Reset High Limit	• Outlet water temperature has exceeded the manual reset high limit setting • Manual-reset Condition • Annunciation – on Navigation Bar Lockout: Man Reset High Limit	• Verify the system is full of water and all air has been purged from the system. • Verify the boiler/heater is piped properly into the heating system. • Check for proper pump operations. • Check the manual reset high limit set point.
Auto Reset High Limit 	• Outlet water temperature has exceeded the auto reset high limit setting • Auto-reset Condition • Annunciation – "Warning High limit auto error" on Message Screen	• Verify the system is full of water and all air has been purged from the system. • Verify the boiler/heater is piped properly into the heating system. • Check for proper pump operations. • Check the manual reset high limit set point.
Pressure Transmitter Drift	• Pressure transmitters are not measuring the same values • Manual-reset Condition • Annunciation – on Navigation Bar Lockout: Pressure Xmitter Drift	• Check the wiring connections at transmitter and BIC (X22) • VCC to ground should equal 5VDC • Check pressure levels on analog input screen • Verify pressure sense lines are not kinked, nicked, disconnected, or full of water • The pressure transducer outputs a 0.5 VDC to 4.5 VDC signal. Verify this signal varies as the blower turns on
Blocked Inlet/Outlet Duct or Dirty Filter	• Air pressure is not within limits • Manual-reset Condition • Annunciation – on Navigation Bar Lockout: High vent press. drop	• Check that inlet and exhaust ducts are not blocked and cleanliness of air filter • Check that the blower is rotating in pre-purge • Check the wiring connections at transmitter and BIC (X22) • Verify pressure sense lines are not kinked, nicked, disconnected, or full of water
Pressure Limits during Startup	• With the fan off during the startup sequence, the pressure must be lower than the "No Fan Limit" setting • Manual-reset Condition • Annunciation – on Navigation Bar Lockout: No fan pressure error	• Verify pressure sense lines are connected or are not kinked, nicked, disconnected, or full of water • Verify blower is running in pre-purge • Check the wiring connections at transmitter and BIC (X22) • VCC to ground should equal 5VDC • Check pressure levels on analog input screen • The pressure transducer outputs a 0.5 VDC to 4.5 VDC signal. Verify this signal varies as the blower turns on
Insufficient pressure drop during pre-purge	• Insufficient pressure drop during pre-purge, do not continue the ignition process • Manual-reset Condition • Annunciation – on Navigation Bar Lockout: Low fan pressure	• Verify pressure sense lines are connected or are not kinked, nicked, disconnected, or full of water • Verify blower is running in pre-purge • Check the wiring connections at transmitter and BIC (X22) • VCC to ground should equal 5VDC • Check pressure levels on analog input screen • The pressure transducer outputs a 0.5 VDC to 4.5 VDC signal. Verify this signal varies as the blower turns on
Blocked Inlet/Outlet Duct condition during pre-purge	• Too much pressure during pre-purge, do not continue the ignition process • Manual-reset Condition • Annunciation – on Navigation Bar Lockout: High fan pressure	• Check that inlet and exhaust ducts are not blocked and cleanliness of air filter • Check the wiring connections at transmitter and BIC (X22) • Verify pressure sense lines are not kinked, nicked, disconnected, or full of water
High Gas Pressure	• The high gas pressure switch has tripped • Manual-reset Condition • Annunciation – on Navigation Bar Lockout: High Gas Pressure	• Refer to Section 3 for Gas Supply and Piping information. • Verify supply and manifold gas pressures satisfy installation requirements.
Low Gas Pressure	• The low gas pressure switch has tripped • Manual-reset Condition • Annunciation – on Navigation Bar	• Refer to Section 3 for Gas Supply and Piping information. • Verify supply and manifold gas pressures satisfy installation requirements.

<table>
<tr><th>Condition</th><th>Information</th><th>Corrective Action</th></tr>
<tr><td></td><td>Lockout: Low Gas Pressure</td><td></td></tr>
<tr><td>Flue Sensor</td><td>• Flue probe is not connected
• Manual-reset Condition
• Annunciation – on Navigation Bar
Lockout: Outlet Probe</td><td>• Check the sensor and wiring. Repair or replace as needed.
• 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.
• Measure the resistance of each element of the sensor and compare to the resistance table below. Replace if necessary.
<table><tr><td></td><td>10K</td><td>20K</td></tr><tr><td>Temp (°F)</td><td>Resistance (Ω)</td><td>Resistance (Ω)</td></tr><tr><td>68</td><td>12555</td><td>25099</td></tr><tr><td>86</td><td>8025</td><td>16057</td></tr><tr><td>104</td><td>5279</td><td>10569</td></tr><tr><td>122</td><td>3563</td><td>7139</td></tr><tr><td>140</td><td>2463</td><td>4937</td></tr><tr><td>158</td><td>1739</td><td>3489</td></tr><tr><td>176</td><td>1253</td><td>2514</td></tr><tr><td>194</td><td>919</td><td>1845</td></tr><tr><td>212</td><td>685</td><td>1376</td></tr></table></td></tr>
<tr><td>Flue Sensor Drift</td><td>• Dual element sensor readings do not agree
• Manual-reset Condition
• Annunciation – on Navigation Bar
Lockout: Flue Probe Drift</td><td>• Check the sensor and wiring. Repair or replace as needed.
• 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.
• Measure the resistance of each element of the sensor and compare to the resistance table below. Replace if necessary.
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<tr><td>Outlet Sensor</td><td>• Outlet probe is not connected
• Manual-reset Condition
• Annunciation – on Navigation Bar
Lockout: Outlet Probe</td><td>• Check the sensor and wiring. Repair or replace as needed.
• 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.
• Measure the resistance of each element of the sensor and compare to the resistance table below. Replace if necessary.
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<tr><td>Outlet Sensor Drift</td><td>• Dual element sensor readings do not agree.
• Manual-reset Condition
• Annunciation – on Navigation Bar
Lockout: Outlet Probe Drift</td><td>• Check the sensor and wiring. Repair or replace as needed.
• 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.
• Measure the resistance of each element of the sensor and compare to the resistance table below. Replace if necessary.</td></tr>
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<tr><th>Temp (°F)</th><th>10K Resistance (Ω)</th><th>20K Resistance (Ω)</th></tr>
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<tr><td>194</td><td>919</td><td>1845</td></tr>
<tr><td>212</td><td>685</td><td>1376</td></tr>
</table>
</td></tr>
<tr><td>Inlet Sensor</td><td>• Inlet sensor is damaged or not connected.
• Manual-reset condition
• Annunciation – on Navigation Bar
Lockout: Inlet Probe</td><td>• Check the sensor and wiring. Repair or replace as needed.
• Measure the resistance of the sensor and compare to the resistance table below. Replace if necessary.
<table>
<tr><th>Temp (°F)</th><th>Temp (°C)</th><th>Resistance (Ω)</th></tr>
<tr><td>68</td><td>20</td><td>12555</td></tr>
<tr><td>86</td><td>30</td><td>8025</td></tr>
<tr><td>104</td><td>40</td><td>5279</td></tr>
<tr><td>122</td><td>50</td><td>3563</td></tr>
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<tr><td>212</td><td>100</td><td>685</td></tr>
</table>
</td></tr>
<tr><td>Burner Parasitic Flame</td><td>• Sensing flame on burner prior to ignition.
• Manual-reset Condition
• Annunciation – on Navigation Bar
Lockout: Burner Parasitic Flame</td><td>• Inspect flame and wiring for damage and continuity. Replace if necessary.</td></tr>
<tr><td>Burner Max Trials</td><td>• The maximum attempts for ignition has occurred, without sensing flame.
• Manual-reset Condition
• Annunciation – on Navigation Bar
Lockout: Burner Max Trials</td><td>• Verify supply and manifold gas pressures satisfy installation requirements.
• Verify the proper intake and venting.
• Inspect the burner.
• Check pilot and main valve wiring and operation.
• Check ignition transformer electrode, flame detector wiring and position.</td></tr>
<tr><td>LMV Errors</td><td>• LMV annunciated errors will include the LMV error and diagnostic codes
Example:
LMV Lockout E82 D5</td><td>• Refer to Section 12.B LMV Errors for more information.</td></tr>
<tr><td>Additional High Limit</td><td>• Outlet water temperature has exceeded the additional high limit setting
• Auto-reset Condition
• Annunciation – “Warning Additional high limit” on Message Screen</td><td>• Verify the system is full of water and all air has been purged from the system.
• Verify the boiler/heater is piped properly into the heating system.
• Check for proper pump operations.
• Check the additional high limit set point.</td></tr>
<tr><td>O_2 Sensor Warning</td><td>• O2 Sensor is disconnected or damaged
• O2 Control Board is disconnected or damaged
• Annunciation – “O_2 Communication Lost” or “O_2 Sensor Not Working”

NOTE: The unit does not need the O_2 sensor for normal operations</td><td>• Check sensor and sensor wiring and repair or replace as necessary.
• Verify wiring of O_2 and repair or replace as necessary</td></tr>
<tr><td>Condensate Level</td><td>• Condensate trap water level is high
• Auto-reset Condition
• Annunciation – “Warning Condensate level” on Message screen</td><td>• Check condensate trap for proper drainage
• Check condensate trap for stuck level switch</td></tr>
</table>

12.B LMV Errors.

In addition to the error messages displayed on the display unit, the LMV Status menu provides an Error Code and corresponding Diagnostic Code associated with failures of the LMV controller. The following table provides an abbreviated list of common LMV errors and corrective actions. LMV parameter changes should only be made by a Laars authorized service technician.

For a complete listing of LMV errors please refer to the LMV Technical Instructions which can be found at http://www.scccombustion.com/pdf/LMV3 Technical Instructions LV3-1000 INDEXED.pdf

Error Code	Diag. Code	Meaning for the LMV3	Corrective Action
Note: Diagnostic codes are additive. If a diagnostic code appears that is not on this list, it is a combination of multiple diagnostic codes.			
no Comm	-	No communication between the LMV3 and the AZL23	Check for a loose connection between the LMV3 and AZL23. If the connection is good, replace the cable connecting the LMV3 to the AZL23. If that does not fix the issue, replace the AZL23.
2	Any #	No flame at the end of safety time (TSA)	A flame failure occurred during lightoff. 1. Check the wiring of the ignition transformer, pilot valve, and main valve(s). 2. Check manual shutoff valves for the pilot gas and main gas. 3. Check the position of the air damper and close it further if necessary. The pilot flame might be getting blown out. 4. Check the flame detector signal in the presence of a known flame source. Replace the flame detector if it does not produce the anticipated signal. 5. Low input voltage to LMV3 could cause a weak flame signal. Check that voltage is 115-125 VAC.
	1	No flame at the end of safety time 1 (TSA1)	
	2	No flame at the end of safety time 2 (TSA2)	
	4	No flame at the end of safety time 1 (TSA1) (software version ≤ V02.00)	
4	Any #	Extraneous light	An extraneous light (flame signal present when input should be de-energized) fault occurred. 1) Ensure that the source of light is not a flame. If it is, take corrective action immediately. 2) Ambient light can cause an extraneous light fault. Ensure the flame scanner is viewing a dark area such as the inside of a boiler. 3) UV scanners typically fail on (give a false flame signal). Remove UV flame scanner and cover the bulb to ensure it is not seeing any light. Check parameter 954 to see if the LMV3 is registering a flame signal. If it is, replace the UV scanner. Diagnostic code 2 - A call for heat was received, but the LMV3 will not start up due to an extraneous light fault. Diagnostic codes 6 and higher - A call for heat was received, but the LMV3 will not start up due to an extraneous light fault. Other inputs besides the flame signal input are in the wrong state as well. The diagnostic code calls out what other inputs are in the wrong state.
	0	Extraneous light during startup	
	1	Extraneous light during shutdown	
	2	Extraneous light during startup - prevention of startup	
	6	Extraneous light during startup, air pressure - start prevention	
	18	Extraneous light during startup, combustion pressure - start prevention	
	24	Extraneous light during startup, air pressure, combustion pressure - start prevention	
	66	Extraneous light during startup, POC - start prevention	
	70	Extraneous light during startup, air pressure, POC - start prevention	
	82	Extraneous light during startup, combustion pressure, POC - start prevention	
	86	Extraneous light during startup, air pressure, combustion pressure, POC - start prevention	
7	Any #	Loss of flame	1) Increase the setting of parameter 186:01 (fuel 0) or 187:01 (fuel 1). This increases the FFRT. A maximum setting of 30 equals a 4 second FFRT. 2) Check the flame detector signal in the presence of a known flame source. Replace the flame detector if it does not produce the anticipated signal.
	0	Loss of flame	
	3	Loss of flame (software version ≤ V02.00)	
	3-255	Loss of flame due to TUV test (loss of flame test)	
22 OFF S	Any #	Safety Loop	An enable signal was received but the LMV will not startup due to a lack of a safety signal from the Laars Linc
50	Any #	Internal error	If the fault occurs continuously, replace the LMV3.
51	Any #	Internal error	
55	Any #	Internal error	
56	Any #	Internal error	
57	Any #	Internal error	
58	Any #	Internal error	
60	Any #	Internal error: No valid load controller source	No valid 4-20 mA signal is present on terminal X64. This could be done on purpose to create a low fire hold. Otherwise, check wiring of 4-20 mA signal and ensure 4-20 mA source is valid. See diagnostic codes for more information.
	0	Internal error: No valid load controller source	Reset the fault. If the fault occurs continuously, replace the LMV3.
	1	Analog output preset valid - prevention of startup	No valid 4-20 mA signal is present on terminal X64 and parameter 204 is set to 1, causing the lockout. Re-establish a valid 4-20 mA signal and reset the fault.
	2	Analog output preset valid - default output low-fire	No fault: No valid 4-20 mA signal is present on terminal X64 and parameter 204 is set to 0, so the LMV3 is operating at low fire. The fault message appears to alert the user that a low fire hold is enabled. To enable modulation, re-establish a valid 4-20 mA signal.
81	1	Interrupt limitation speed input	The LMV3 has detected an interruption on the speed input. Decrease the electrical noise on the speed sensor wires. If the fault occurs continuously, replace the LMV3.
	Any #	Error during VSD's speed standardization	An error occurred while attempting to standardize the speed of the VSD. See diagnostic codes for more information.

Error Code	Diag. Code	Meaning for the LMV3	Corrective Action
Note: Diagnostic codes are additive. If a diagnostic code appears that is not on this list, it is a combination of multiple diagnostic codes.			
82	1	Timeout of standardization (VSD ramp down time too long)	Standardization timed out because the VSD took too long to ramp down at the end of the standardization. Either decrease the ramp down time in the VSD or increase the setting of parameter 523.
	2	Storage of standardized speed not successful	Press the info button with any other button to cause a manual lockout, then reset the fault and attempt to standardize again.
82	3	Line interruption speed sensor	No pulses from the speed sensor were detected during standardization. 1) Verify that the motor is rotating. 2) Check the wiring between the speed sensor and the LMV3. 3) Check and / or adjust the gap between the speed wheel and the sensor. The gap should be about 1/16" (2mm), or about two turns away from the speed wheel.
	4	Speed variation / VSD ramp up time too long / speed below minimum limit for standardization	A stable speed was not reached after ramping up the VSD, so a standardized speed could not be determined. 1) Either decrease the ramp up time in the VSD or increase the setting of parameter 522. 2) Check for filters, damping, or delays on the input signal to the VSD. The VSD should respond to the input signal in a linear fashion. 3) Ensure that the VSD and LMV3 are configured for the same analog signal (0-10 VDC).
	5	Wrong direction of rotation	1) Check to see if the motor's direction of rotation is correct. Reverse if necesssary. 2) Check to see if the arrow on the speed wheel points in the correct direction of rotation. Reverse if necessary.
	6	Unplausible sensor signals	1) Check the setting of parameter 643 and ensure it is set correctly. For VSD + 3-phase motor, this should be a 0. For most brushless DC blowers, this should be a 1. 2) Check and / or adjust the gap between the speed wheel and the sensor. The gap should be about 1/16" (2mm), or about two turns away from the speed wheel. 3) Check the wiring of the speed sensor. Ensure the reference ground is properly connected. 4) Ensure that other metal parts besides the speed wheel are not being picked up by the sensor when the motor rotates.
	7	Invalid standardized speed	The standardized speed measured does not lie in the permissible range (650-14,000 RPM).
	15	Speed deviation µC1 + µC2	Reset the fault and repeat the standardization.
82	20	Wrong phase of phase manager	Standardization must be performed in standby (phase 12).
	21	Safety loop / burner flange open	Fix any conditions causing a limit in the safety loop / burner flange circuit to be open, then attempt to standardize again.
	22	Air actuator not referenced	Typically caused by trying to standardize while the air actuator is currently referencing. Wait for the actuator to finish referencing and try to standardize again. If the fault persists, see error code 85, diagnostic code 1 for additional troubleshooting.
	23	VSD deactivated	The VSD must be activated before standardization can be performed. Set parameter 542 to a 1 and attempt to standardize again.
	24	No valid operation mode	A fuel train must be selected before standardization can be performed. Select a fuel train via parameter 201 (fuel 0) or 301 (fuel 1), then attempt to standardize again.
	25	Pneumatic air-fuel ratio control	Standardization cannot be performed when using a pneumatic fuel train. Select a different fuel train via parameter 201 (fuel 0) or 301 (fuel 1), then attempt to standardize again.
	128	Running command with no preceding standardization	A call for heat was received and the VSD is activated (parameter 542 = 1), but no standardization has been performed. Perform a standardization by setting parameter 641 to a 1 while in standby phase 12, or deactivate the VSD by setting parameter 542 to 0.
	255	No standardized speed available	Perform a standardization via parameter 641 while in standby (phase 12).
83	Any #	Speed error VSD	A VSD speed error occurred. See diagnostics codes for more information.
	0	Speed error when trim function is active	Increase parameter 662 (neutral zone) and 663 (near zone) or deactivate VSD trim via parameter 530.
	1	Lower control range limitation of control	See error code 80, diagnostic code 1.
	2	Upper control range limitation of control	See error code 80, diagnostic code 2.
	4	Interruption via disturbance pulses	See error code 81, diagnostic code 1.
	8	Curve too steep in terms of ramp speed	See error code 84.

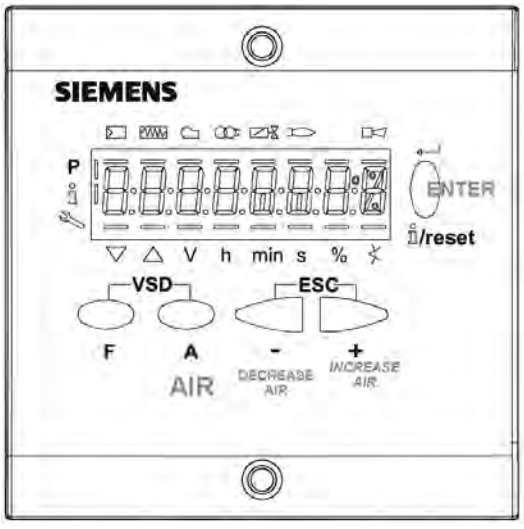
12.B LMV Errors (continued)

Error Code	Diag. Code	Meaning for the LMV3	Corrective Action
Note: Diagnostic codes are additive. If a diagnostic code appears that is not on this list, it is a combination of multiple diagnostic codes.			
83	16	Interruption of speed signal	No speed signal was detected. 1) Ensure that the motor is rotating. If it is not, check the wiring of the VSD / PWM blower. 2) If using a VSD, turn the motor by hand to ensure that the LED on the speed sensor lights up when it sees the speed wheel. If it does not, decrease gap between speed wheel and speed sensor and check the wiring of the speed sensor. If there are no issues, replace speed sensor.
83	32	Quick shutdown due to excessive speed deviation	The speed of the motor was more than 10% different than the anticipated speed for more than 1 second. 1) Check the ramp times of the VSD and LMV3. Increase if necessary. The ramp times in the LMV3 should be at least 20% longer than the ramp times in the VSD. 2) Check the setting of parameter 661.
	64	VSD speed is below minimum speed (phase dependent)	1) Standby (phase 12): Ensure parameter 669:01 (maximum speed) is set to a higher value than parameter 669:00 (minimum speed). 2) Standby (phase 12): Ensure parameter 663 (near zone) is set to a higher value than parameter 662 (neutral zone). 3) Check the absolute speed (parameter 935) to ensure the correct speed is being detected by the LMV3. 4) Prepurge (phase 30): The detected speed was below the minimum prepurge speed (parameter 667), or the setting of parameter 503:01 or 506:01 is below the setting of parameter 667. 5) Operation (phases 40-64): The detected speed was below the minimum operation speed (parameter 669:00), or a VSD curve point was set below the setting of parameter 669:00.
	128	VSD speed exceeds maximum speed (phase dependent)	1) Standby (phase 12): Ensure parameter 226/266/326/366 is set to a higher value than parameter 665 (time outside near zone). 2) Standby (phase 12): Ensure parameter 669:01 (maximum speed) is set to a higher value than parameter 669:00 (minimum speed). 3) Standby (phase 12): Ensure parameter 663 (near zone) is set to a higher value than parameter 662 (neutral zone). 4) Check the absolute speed (parameter 935) to ensure the correct speed is being detected by the LMV3. 5) Ignition (phase 38): The detected speed was above the maximum ignition speed (parameter 668), or the VSD speed setting of P0 is above the setting of parameter 668. 6) Operation (phases 40-64): The detected speed was above the maximum operation speed (parameter 669:01), or a VSD curve point was set above the setting of parameter 669:01.
	255	Failed forced travel test	If the LMV3 remains at the same fire rate for an extended period of time, a minimal load change is forced, and the corresponding feedback from the PWM blower is checked. If this fault occurs, the PWM blower speed change was insufficient in response to the load change.
84	Any #	Curve slope actuators	The difference in position between two adjacent curve points is too large. See diagnostic code for which actuator / VSD has positions that are too far apart. For actuators, either increase the setting of parameter 544, or decrease the distance between curve points. For VSD, either increase the setting of parameter 544, decrease the setting of parameters 522 and 523, decrease the distance between curve points, or decrease parameter 647.
	1	VSD: Curve too steep in terms of ramp speed	
	2	Fuel actuator: Curve too steep in terms of ramp rate	
	4	Air actuator: Curve too steep in terms of ramp rate	
85	Any #	Referencing error on actuators	All SQM33… actuators must travel outside of their 0-90° operating range before starting up the burner in order to "reference" their position. This fault means that the referencing was unsuccessful. 1) Check the setting of parameter 601 (fuel 0) and 608 (fuel 1). Index 00 sets the fuel actuator reference direction and index 01 sets the air actuator reference direction. 2) Check to make sure the actuators are not binding when trying to reference (ensure that overstroking below 0° or above 90° is possible). 3) Check the setting of parameter 613 (fuel 0) and 614 (fuel 1) to ensure the actuator type is set correctly. 4) Make sure that the actuator's are plugged into the correct terminal on the LMV3.
	0	Referencing error of fuel actuator	
	1	Referencing error of air actuator	
	128	Referencing error due to parameter change	
	Any #	Error fuel actuator	An error occurred pertaining to the fuel actuator. See diagnostic codes for more information.

Error Code	Diag. Code	Meaning for the LMV3	Corrective Action
Note: Diagnostic codes are additive. If a diagnostic code appears that is not on this list, it is a combination of multiple diagnostic codes.			
86	0	Position error	Verify that the valve connected to the fuel actuator is not bound. Ensure that the torque requirements of the valve are less than the output of the fuel actuator. If everything checks out okay, replace the SQM33 actuator.
	1	Line interruption	Check the wiring between the fuel actuator and LMV3 terminal X54. There should more > 0.5 VDC across pins 2 and 5 and across pins 2 and 6. If no fuel actuator exists, choose a fuel train option (parameter 201/301) that does not require a fuel actuator.
	8	Curve too steep in terms of ramp rate	See error code 84.
86	16	Step deviation in comparison with last referencing	The fuel actuator is bound. 1) Check the setting of parameter 613:00 (fuel 0) and 614 (fuel 1) to ensure the actuator type is set correctly. 2) Check to see if the actuator gets bound somewhere along its working range. This can be done changing the home position of the actuator in standby (no alarm). 3) Ensure that the torque of the actuator is sufficient for the application.
87	Any #	Error air actuator	An error occurred pertaining to the air actuator. See diagnostic codes for more information.
	0	Position error	Verify that the valve / damper connected to the air actuator is not bound. Ensure that the torque requirements of the valve / damper are less than the output of the air actuator. If everything checks out okay, replace the SQM33 actuator.
	1	Line interruption	Check the wiring between the air actuator and LMV3 terminal X53. There should more > 0.5 VDC across pins 2 and 5 and across pins 2 and 6. If no air actuator exists, choose a fuel train option (parameter 201/301) that does not require an air actuator.
	8	Curve too steep in terms of ramp rate	See error code 84.
	16	Step deviation in comparison with last referencing	The air actuator is bound. 1) Check the setting of parameter 613:01 to ensure the actuator type is set correctly. 2) Check to see if the actuator gets bound somewhere along its working range. This can be done changing the home position of the actuator in standby (no alarm). 3) Ensure that the torque of the actuator is sufficient for the application.
93	Any #	Error flame signal acquisition	Check the wiring of the QRB... flame detector and reset the fault. If the fault occurs continuously, replace the QRB... flame detector.
	3	Short-circuit of sensor	

12.C LMV Reset

Several faults associated with combustion management result in a lockout of the LMV controller. In most cases these lockouts can be reset from the Display Unit. If the main display unit does not reset the fault, the LMV AZL Hand Held Display Unit, provided with each boiler and mounted in the control panel, can be used to provide a local reset. The reset button is the oval button just to the right of the LED display. This button should be depressed for approximately 2 seconds to initiate a reset. In the event the Lockout can not be cleared please consult factory service.



When in lockout, the AZL will alternate between displaying “Loc:c” and “Loc:d”. The number listed after “Loc:c” is the error code, and the number listed after “Loc:d” is the diagnostic code. For example, an error code 3, diagnostic code 0 will alternate between displaying “Loc:c: 3” and “Loc:d: 0”

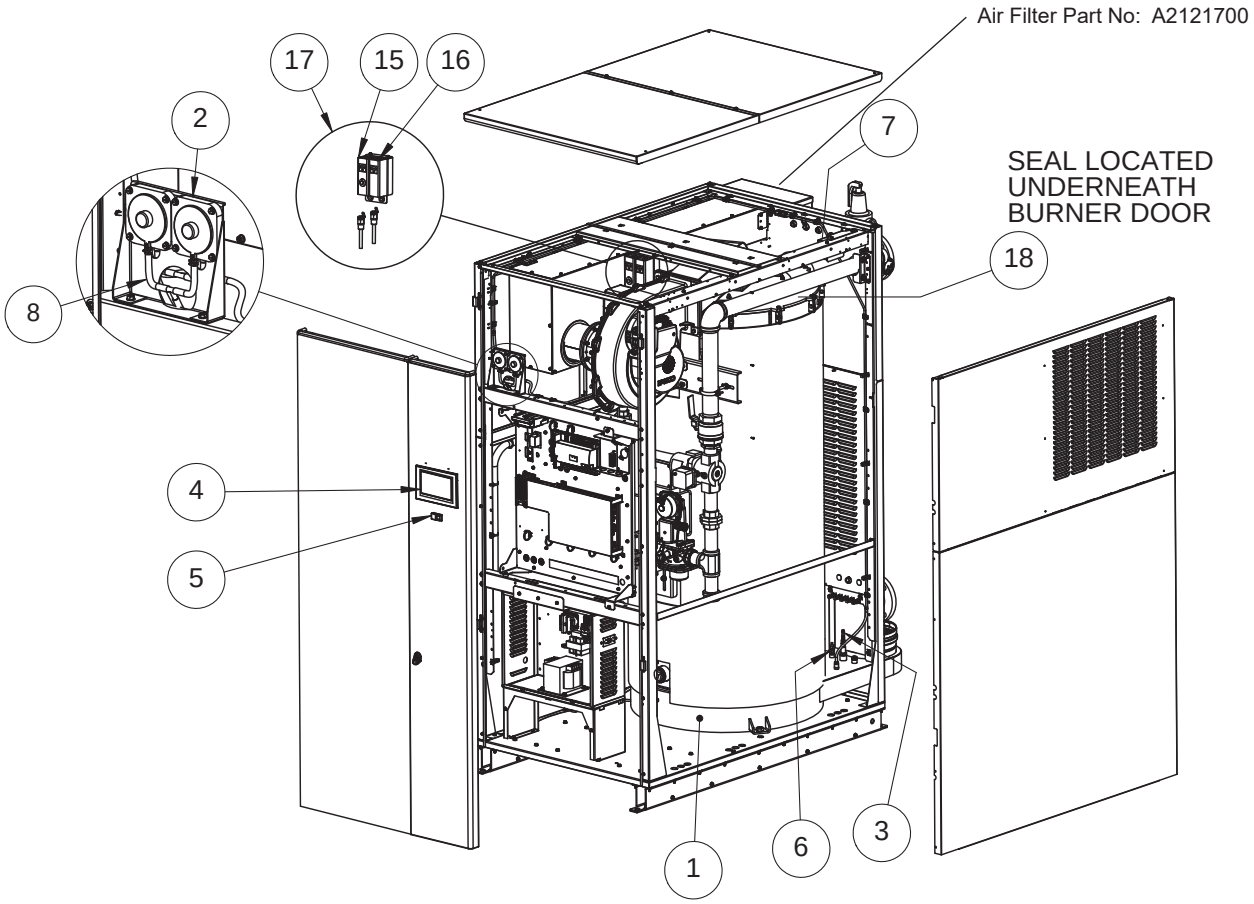
For use in Combustion Setup, operating the LMV is explained in detail in Section 10.B.2 on page 109

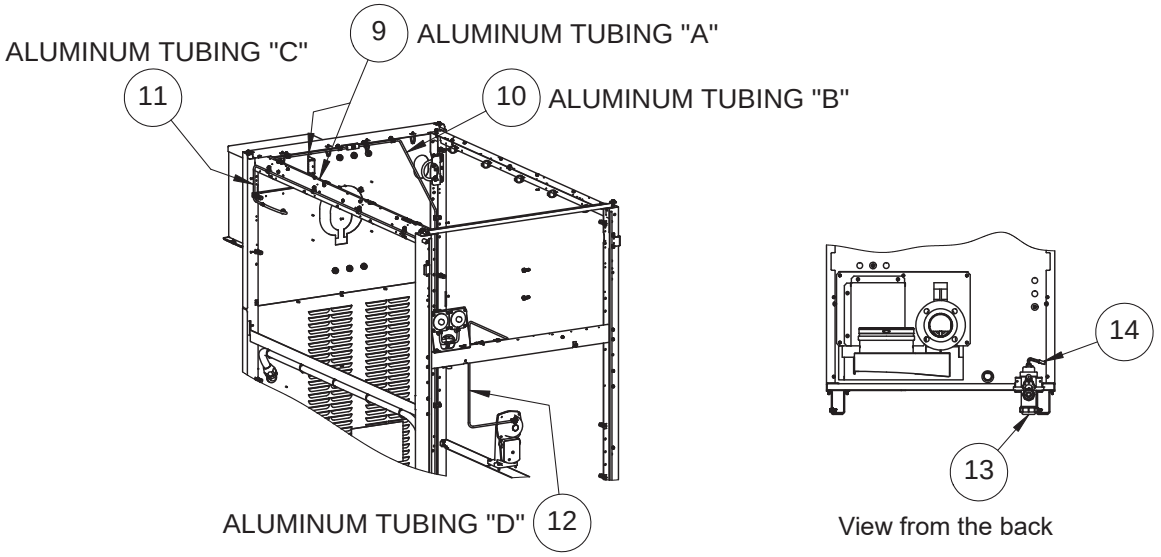
SECTION 13 Replacement Parts

Use only genuine manufacturer's replacement parts.

To order or purchase parts, contact your nearest manufacturers dealer or distributor. (See the back cover of this manual for the manufacturers website).

13.A Frame and Jacket Assembly Parts



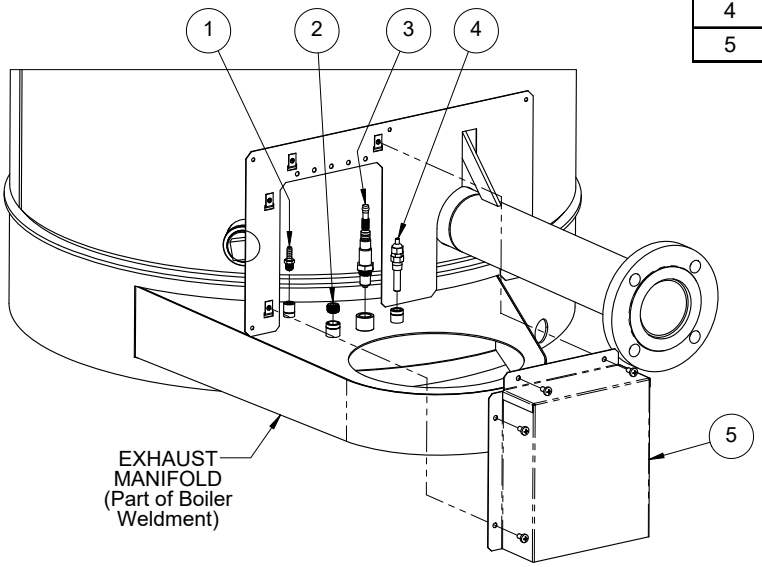


Frame and Jacket Part Numbers

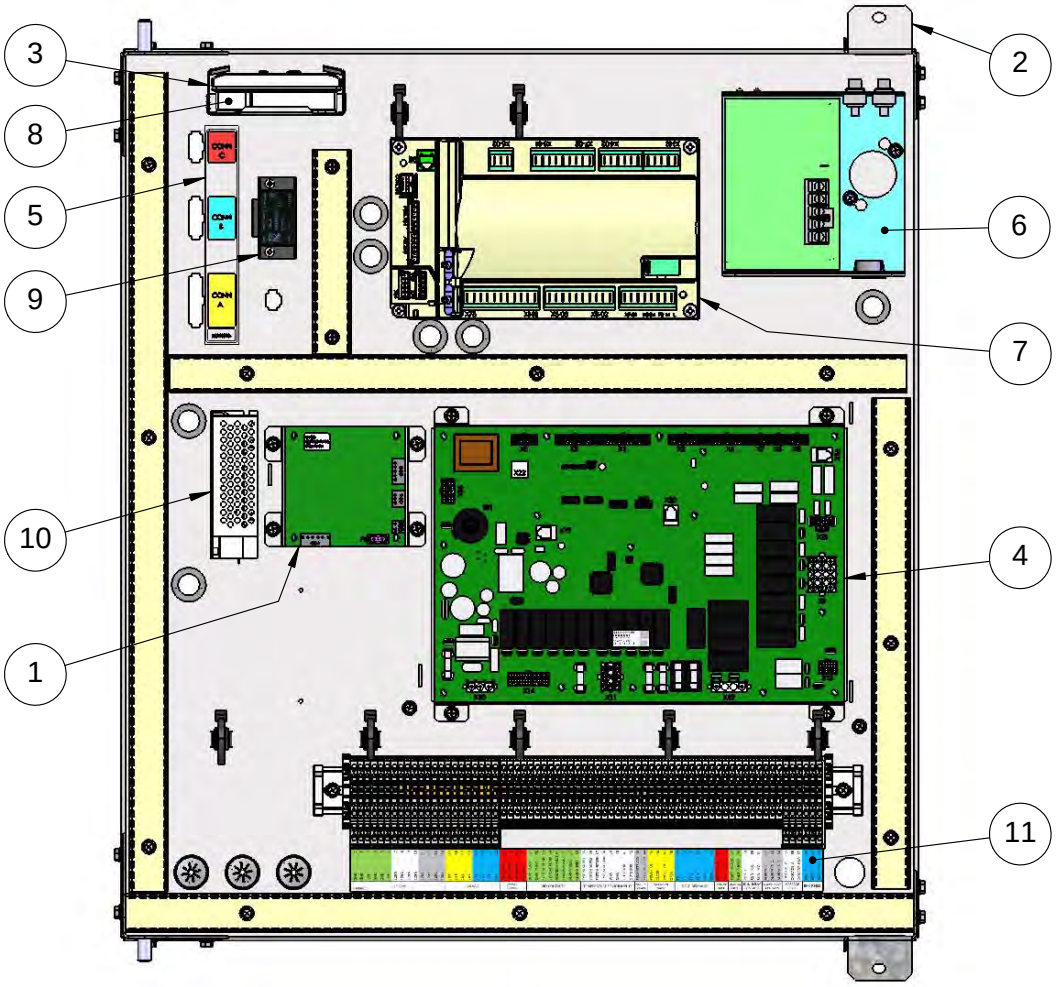
ITEM NO.	DESCRIPTION	1000 PART NO.	1500 PART NO.	2000 PART NO.	3000 PART NO.
1	HEAT EXCHANGER ASSEMBLY	R10T2000	R15T2000	R20T2000	R30T2000
2	LOW AIR PRESSURE SENSOR, SHINEUI	E2389700			
3	SENSOR, OXYGEN (LAMBDA), BOSCH LSU 4.9	E2376700			
4	DISPLAY, TOUCH SCREEN, 7 IN DIAG, HTD	RE2404904			
5	SWITCH, ROCKER	RE2322700			
6	SENSOR, TEMPERATURE, STACK	E2400300			
7	GENERATOR, SPARK, IGNITOR, SOLID STATE	R2086900			
8	TUBING, SILICONE, 3/16" ID X 72" LONG	Q0078821		Q0078821	
9	ALUM. TUBING "A" (SENSOR TO FLUE - SECTION 1)	Q2023704		Q2023707	
10	ALUM. TUBING "B" (SENSOR TO FLUE - SECTION 2)	Q2023701		Q2023708	
11	ALUM. TUBING "C" (SENSOR TO FILTER BOX)	Q2023702		Q2023706	
12	ALUM. TUBING "D" (SENSOR TO VALVE)	Q2023703	Q2023705	Q2023709	Q2023710
13	CONDENSATE TRAP ASSEMBLY	15T2010	15T2010	30T2010	30T2010
14	SWITCH, CONDENSATE	40N2008			
15	HIGH LIMIT, MANUAL RESET	E2217800			
16	HIGH LIMIT, AUTO RESET	RE2217700			
17	HIGH LIMIT ASSEMBLY	CA017400			
18	SEAL, BURNER DOOR	S2137701	S2137702	S2137703	S2137704

13.B Exhaust Manifold Part Numbers

Item #	Description	Part Number
1	Adapter, 1/4 Barb ~1/4 NPT, SST	P2089300
2	Plug, 3/8" NPT, SST	P2134000
3	Sensor, O^2	E2376700
4	Sensor, Stack	E2400300
5	Cover, Sensor, Exhaust Manifold	15T3027



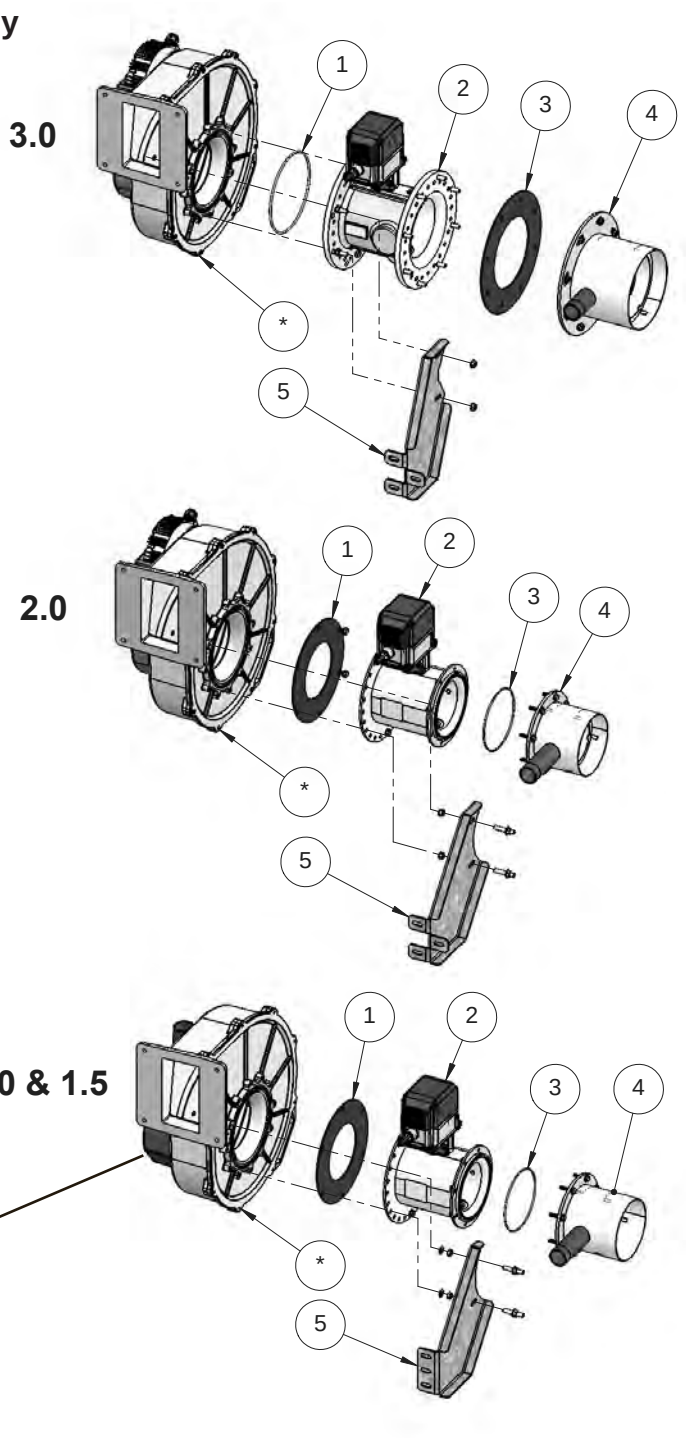
13.C Control Panel Assembly Part Numbers



ITEM NO.	DESCRIPTION	ALL SIZES PART NO.
1	CONTROLLER ASSY, O2 SENSOR	30N7089
2	PANEL ASSY, CONTROL, SHEET METAL	30N7092
3	CABLE, DIAGNOSTIC HANDSET, 7 FT LONG	E2393000
4	CONTROLLER ASSY	R30T7096
5	LABEL, CONTROL PANEL, MGT	H2363500
6	SWITCH, CUTOFF, LOW WATER	RE2075100
7 *	LMV (Pre-Programmed and Model Serial # Specific)	RXT7110 - 9000
8	HANDSET, DISP & OPER, AZL23.00A9, SIEMENS	E2374600
9	TRANSFORMER ASSY, FLAME ROD	30N7102
10	POWER SUPPLY WITH JUMPER, AC/DC CONV., 12V 50W	30N7103
11	LABEL, TERMINAL BLOCK, SIT CONTROLS, MGT HTD	H2406100

* Boiler Serial Number required when ordering.

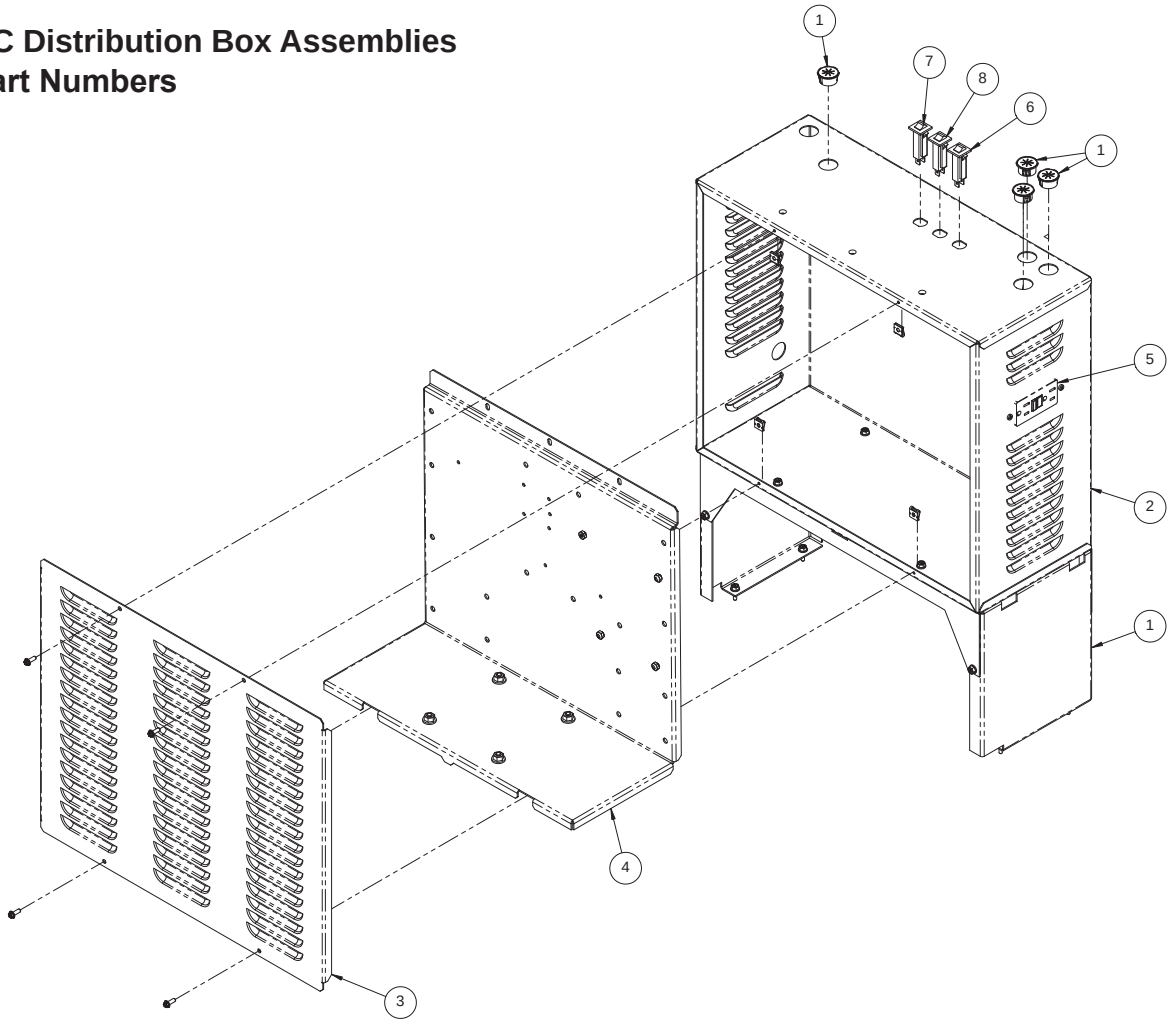
13.D Blower and Burner Assembly Part Numbers. ALL Sizes



Blower part numbers are identified by size, on next page.

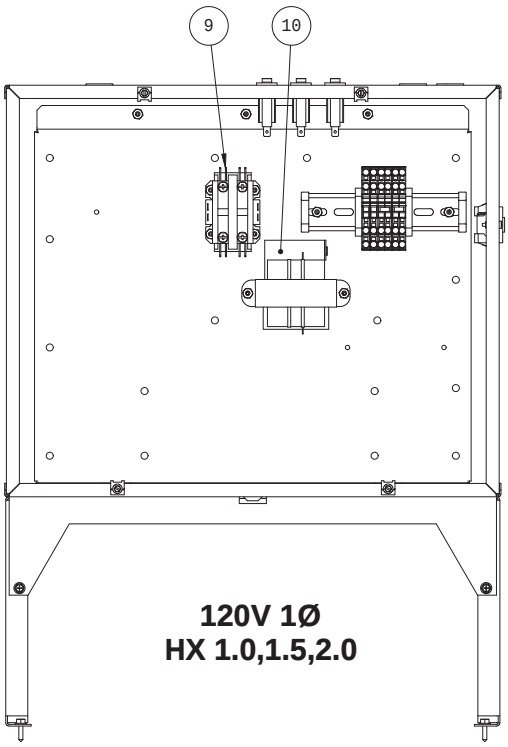
Blower & Air-Gas Mixer, CFT 1.0 - 3.0					
ITEM NO.	DESCRIPTION	PART NO./BOILER SIZE			
		1.0	1.5	2.0	3.0
1	O-RING, OUTLET, ACTUATOR	-			300S5039
	GASKET, OUTLET, ACTUATOR	20N5095			-
2	VALVE-ACTUATOR ASSY, GAS, SIEMENS	V2028300			V2027900
3	O-RING, INLET, ACTUATOR	S2135700			-
	GASKET, INLET, ACTUATOR	-			S2125300
4	INTAKE WELDMENT, AIR	15T5121		20N5121	30T5121
5	BRACKET, INDEXING, BLOWER	10T2001	15T2001	20T2001	30T2001

13.E AC Distribution Box Assemblies Part Numbers

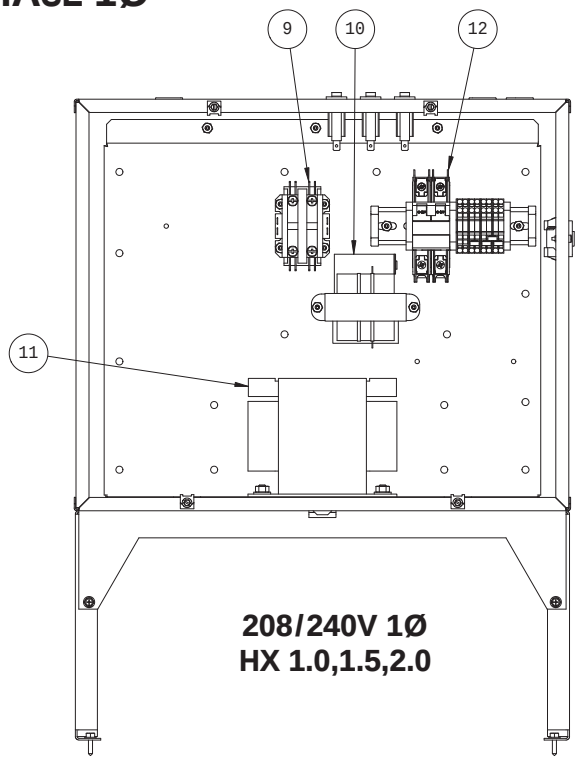


ITEM#	DESCRIPTION	VOLTAGE & PHASE						BOILER SIZE
		120V 1Ø	208V 1Ø	240V 1Ø	208V 3Ø	480 3Ø	600V 3Ø	
1	SUPPORT, BOX, AC DISTRIBUTION, MGT	20N7311						ALL
2	BOX, AC DISTRIBUTION, MGT	20N7312						
3	COVER, BOX, AC DISTRIBUTION, MGT	20N7313						
4	PANEL, AC DISTRIBUTION BOX	15T7316	15T7317		15T7318		15T7319	
5	GFCI RECEPTACLE, NEMA 5-15, IVORY, BOX MOUNT	E2355400						
6	CIRCUIT BREAKER, 3AMP	E2311800						
7	CIRCUIT BREAKER, 2AMP	E2335100						
8	CIRCUIT BREAKER, 10AMP	E2372700						
9	RELAY, 115 VAC, DPST	E2311100	E2311100	E2311100	-			
10	TRANSFORMER, 120-24, CET, 75 VA	RE2370700						
11	TRANSFORMER	-	E2355500	E2355900	E2355500	E2352600		
12	CIRCUIT BREAKER, 2-POLE, DIN RAIL MOUNT	-	E2359700		E2355600	E2355100	E2360100	
13	CONTACTOR, 3P, 120V COIL	-			E2355200	E2353000		
14	CIRCUIT BREAKER, 3-POLE, DIN RAIL MOUNT	-					E2383500	
15	WIRE HARNESS ASSY, HI VOLT CIRCUIT BRKRS TO XFRMR/CONT/CNTRL (NOT SHOWN)	15T7401	15T7403	15T7405	-			1.0 - 1.5
		15T7402	15T7404	15T7406				2.0
		-			15T7407	15T7408	15T7409	2.0
					15T7410	15T7411	15T7412	3.0
16	BLOWER COMBUSTION AIR (shown on previous page)	A2133800			-	-		1.0 - 2.0
		-			A2133900	A2133901		2.0 - 3.0

SINGLE PHASE 1Ø

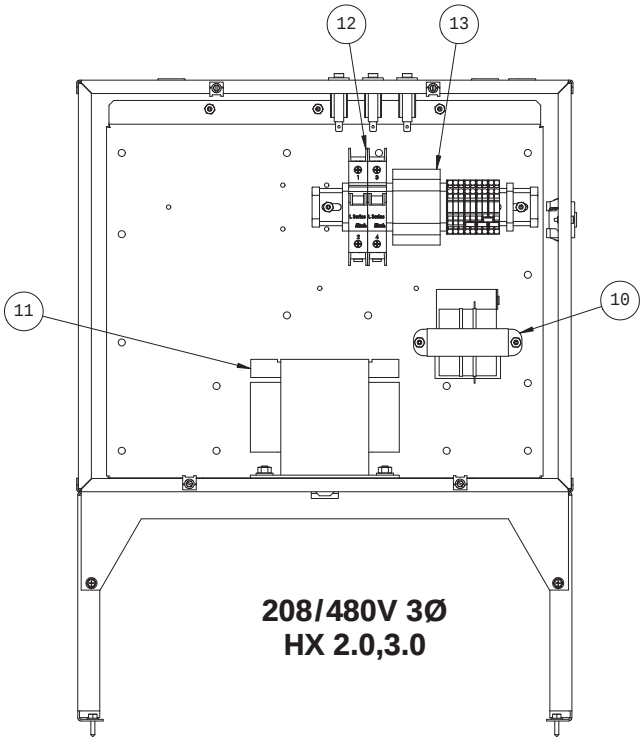


120V 1Ø
HX 1.0,1.5,2.0

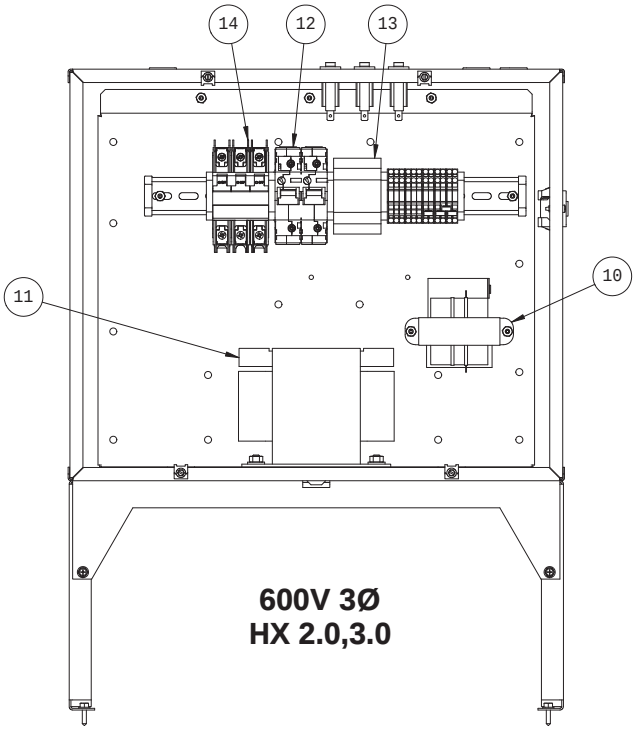


208/240V 1Ø
HX 1.0,1.5,2.0

THREE PHASE 3Ø

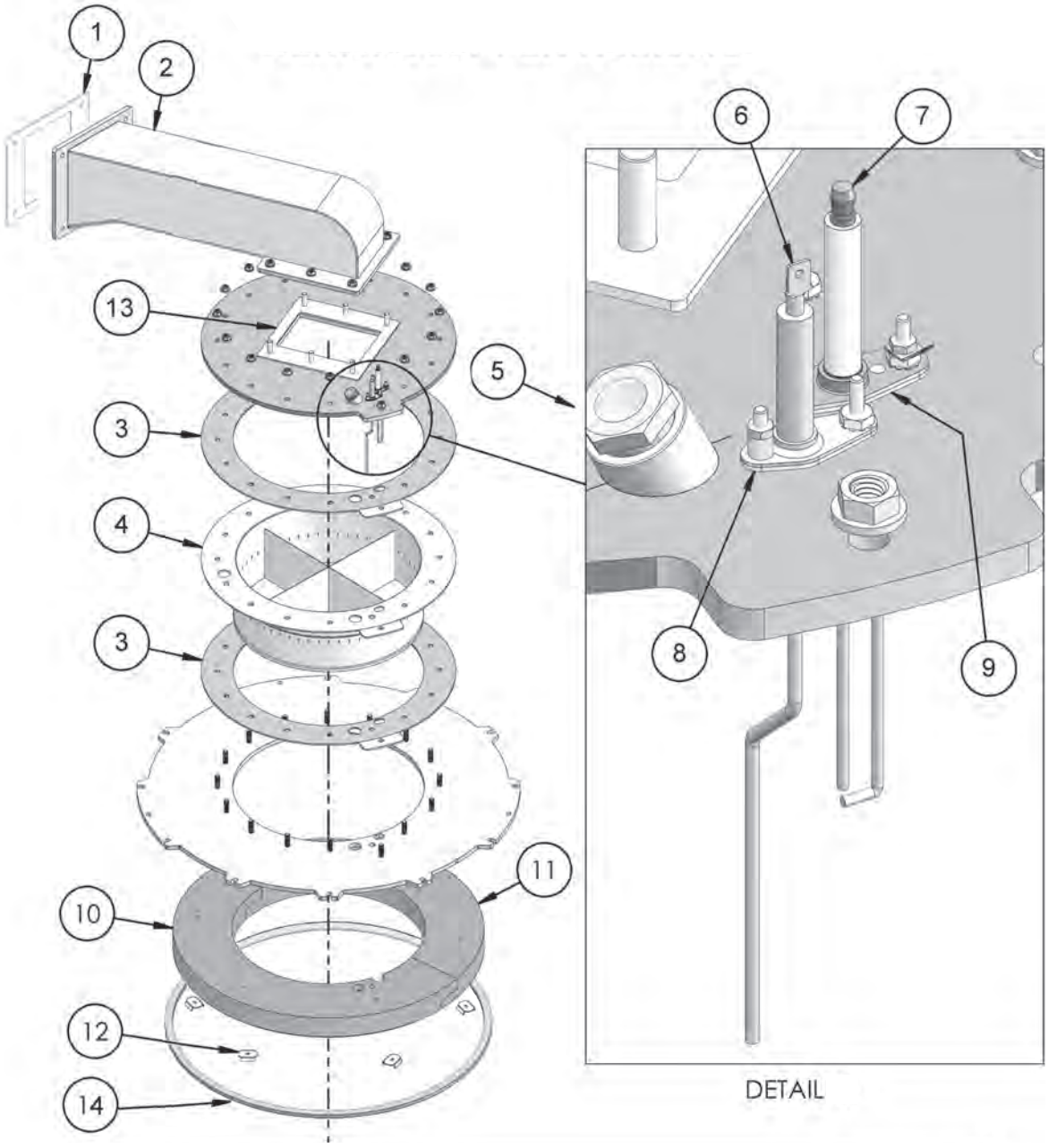


208/480V 3Ø
HX 2.0,3.0



600V 3Ø
HX 2.0,3.0

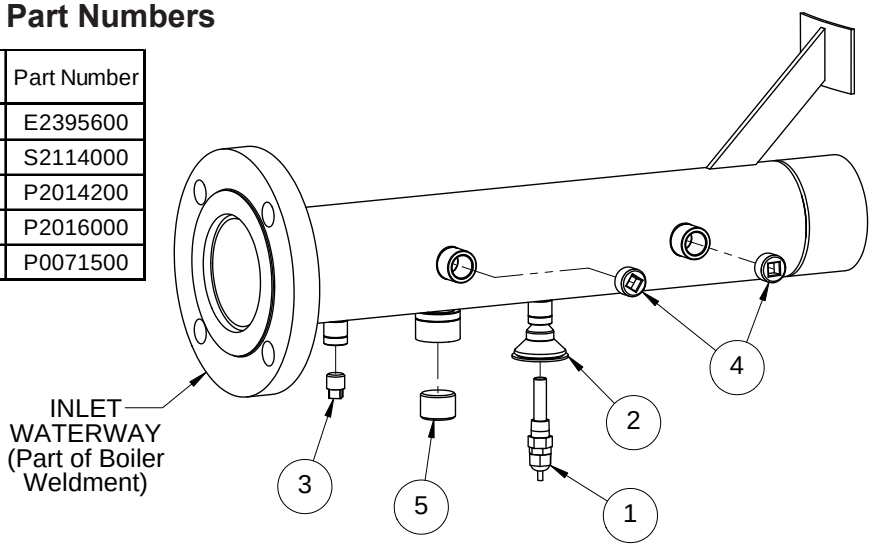
13.F Burner Door Part Numbers



Burner Door Parts, CFT 1.0 - 3.0					
ITEM NO.	DESCRIPTION	PART NO./BOILER SIZE			
		1.0	1.5	2.0	3.0
1	GASKET, OUTPUT, BLOWER	S2135300			
2	TRANSITION ASSY, BLOWER	15T5080		30T5080-1	
3	GASKET, BURNER	S2136300		S2136400	
4	BURNER	L2022200	L2022201	L2022100	L2022101
5	SIGHT GLASS	F0044800			
6	SENSOR KIT, FLAME, MGT FT (Gasket incl)	RW2015900			
7	IGNITER KIT, SPARK, MGT FT (Gasket incl)	RW2016000			
8	GASKET, FLAME SENSOR	S2120700			
9	GASKET, IGNITER	S2130200			
10	REFRACTORY, SIDE 1	T2116200	T2115600	T2115800	T2116000
11	REFRACTORY, SIDE 2	T2116300	T2115700	T2115900	T2116100
12	ANCHOR WASHER, REFRACTORY	F2013802			
13	GASKET, HEAT EXCHANGER, BLOWER	S2135301			
14	GASKET, HEAT EXCHANGER, TOP PLATE	S2137701	S2137702	S2137703	S2137704

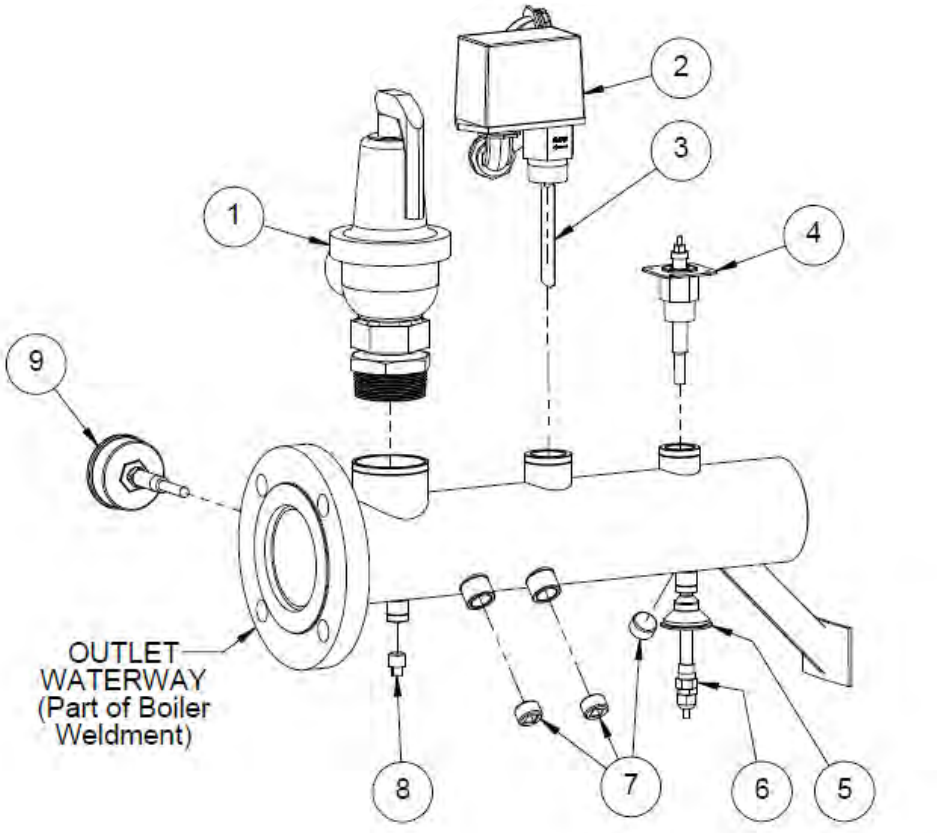
13.G Waterway Inlet Assembly Part Numbers

Item #	Description	Part Number
1	Sensor, Water Temp, 10K	E2395600
2	Grommet, Pipe, Rubber	S2114000
3	Plug, 1/4" NPT	P2014200
4	Plug, 1/2" NPT	P2016000
5	Plug, 3/4" NPT	P0071500



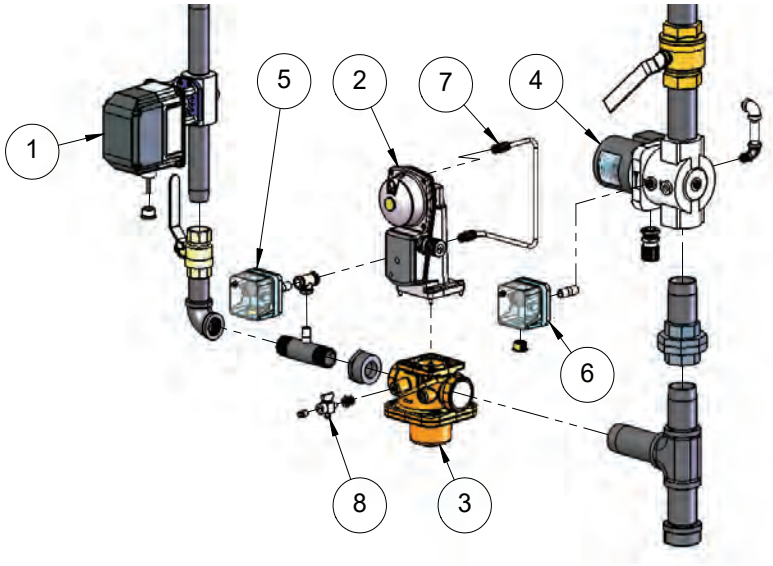
13.H Waterway Outlet Assembly Part Numbers

Item #	Description	Part Number by Boiler Size			
		1000	1500	2000	3000
1	PRV 75# PSI	RA2138701		RA2138702	RA2138703
2	Flow Switch	RE0013000			
3	Flow Switch Paddle	E2255800			
4	Sensor, p/o Switch, Low Water Cut-off	RE2075100			
5	Grommet, Pipe, Rubber	S2114000			
6	Sensor, Water Temp, 10K-20K	E2395500			
7	Plug, 1/4" NPT	P2014200			
8	Plug, 1/2" NPT	P2016000			
9	Gauge, Temperature & Pressure	RA0079000			



13.I Gas Train Part Numbers

ITEM NO.	DESCRIPTION	PART NO./BOILER SIZE			
		1.0	1.5	2.0	3.0
1	VALVE-ACTUATOR ASSY, GAS, VA SERIES, VKG	V2025500			V2025600
2	ACTUATOR, ELECTRO-HYDRAULIC, SKP25.011U1	V2025400			
3	BODY, VALVE, GAS	V2015900	V2025200		V2025300
4	VALVE, GAS, SOLENOID, NC SAFETY SHUTOFF	V2026400			V2026200
5	SWITCH, HIGH GAS PRESSURE	R2004000			
6	SWITCH, LOW GAS PRESSURE	R2004100			
7	TUBE ASSY, SENSING	10T6003	15T6003	20T6003	30T6003
8	TEST VALVE, MANUAL	W2000300			



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