



Installation and Operation Instructions for **Brute MagnaTech®**

Modulating Boiler

Model BMGH1600
1,600 MBTU/h

Model BMGH2000
1,999 MBTU/h

Model BMGH2500
2,499 MBTU/h

Model BMGH3000
3,000 MBTU/h

Model BMGH3500
3,500 MBTU/h

Model BMGH4000
4,000 MBTU/h

Water Heater

Model BMGV1600
1,600 MBTU/h

Model BMGV2000
1,999 MBTU/h

Model BMGV2500
2,499 MBTU/h

Model BMGV3000
3,000 MBTU/h

Model BMGV3500
3,500 MBTU/h

Model BMGV4000
4,000 MBTU/h

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

⚠ WARNING

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

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

WHAT TO DO IF YOU SMELL GAS

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

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

⚠ AVERTISSEMENT

Assurez-vous de bien suivre 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 ou ni d'autres vapeurs ou liquides inflammables dans le à proximité 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 dans le bâtiment où vous vous trouvez.
- 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.

Table of Contents

Section 1 - GENERAL INFORMATION

1.1	Introduction	1
1.2	Safety Notes	1
1.3	The Rating Plate (Model Nomenclature)	2
1.4	Warranty	2
1.5	Unit Overviews (all sizes)	3-5
1.6	Dimensions	6
1.7	Unpacking and the Installation Kit	7

Section 2 - LOCATING THE APPLIANCE

2.1	Locating the Appliance	8
2.2	Correct Vent Distance from Outside Wall or Roof Termination	8

Section 3 - VENTING AND COMBUSTION AIR

3.1	General Venting	9
3.2	Combustion Air	10
3.2.1	Combustion Air From Room	10
3.2.2	Ducted Combustion Air	11
3.3	Venting	11
3.3.1	Common Venting	12
3.3.3	Venting Requirements Unique to Canada	12
3.4	Locating the Vent and Combustion Air Terminals	13
3.4.1	Side Wall Vent Terminal	13
3.4.2	Side Wall Combustion Air Terminal	15
3.4.3	Vertical Vent Terminal	15
3.4.4	Vertical Combustion Air Terminal	15
3.4.5	Installations in the Commonwealth of Massachusetts	16
3.5	Common Vent Test	16
3.6	Outdoor Installation	18

Section 4 - GAS SUPPLY AND PIPING

4.0	Gas Supply and Piping	18
-----	-----------------------------	----

Section 5 - WATER FLOW REQUIREMENTS

5.1	Boiler Flow and Head Requirements	20
5.2	Water Heater Flow and Head Requirements	21

Section 6 – WATER CONNECTIONS, BOILER

6.1	Boiler System Piping: Hot Supply Connections	22
6.2	Boiler Cold Water Make-Up	22
6.3	Boiler Freeze Protection	22
6.4	Condensate Drain Trap	23
6.5	Boiler Suggested Piping Schematics	23-27

Section 7 - WATER CONNECTIONS, VOL WATER

7.1	Vol Water Water Quality	28
7.2	Vol Water Suggested Piping Schematics	28-30
7.3	Vol Water Piping Requirements	28
7.4	Vol Water Cold Water Make-Up	29
7.5	Vol Water Freeze Protection	29
7.6	Vol Water Water Flow	30
7.7	Condensate Drain Trap	30

Section 8 – ELECTRICAL CONNECTIONS

8.1	Installation Warnings	31
8.2	Main Power Connections	31
8.3	Pump Connections and Operation	32
8.4	Field Wiring	33
8.5	Field Connections for single systems	34
8.6	Field Connections for Lead Lag systems	34
8.7	Control Panel Layout	35
8.8	Building Automation Systems Connections	36
8.9	Lead Lag Connections	37
8.10	Wiring Diagrams	38-41
8.11	High Voltage Wiring Diagrams	42-48
8.12	Ladder Diagrams	49-55

Section 9 – NAVIGATING THE TOUCH SCREEN

9.1	The Touch Screen	56
9.2	Using the Touch Screen	56
9.3	Verification Process for Safety-Related Parameters	58
9.4	While Operating - Checking Individual Parameters	59
9.5	Configuring Parameters on Individual Controllers	60
9.6	Setting the Date and Time on the System Display	61
9.7	Configuration Menus (ALL)	62
9.7.1	System Identification & Access	62
9.7.2	CH - Central Heat Configuration	62
9.7.3	Outdoor Reset Configuration	62
9.7.4	DHW - Domestic Hot Water Configuration ...	63
9.7.5	Warm Weather Shutdown Configuration	63
9.7.6	Demand Priority Configuration	63
9.7.7	Modulation Configuration	63
9.7.8	Pump Configuration	63
9.7.9	Statistics Configuration	64
9.7.10	High Limits	64
9.7.11	Stack Limits	64
9.7.12	Delta T Limits	64
9.7.13	Frost Protection Configuration	64
9.7.14	Burner Control Ignition	65
9.7.15	System Configuration	65
9.7.16	Sensor Configuration	65
9.7.17	Lag (Slave) Configuration	66
9.7.18	Lead (Master) Configuration	69
9.8	Parameter Defaults and Ranges	69-72
9.9	Configuring a Gateway Control	73
9.10	Variable Speed Flow Control (V.S.P.C.) System .	74
9.11	Combustion Setup Procedure	75

Section 10 - INITIAL STARTUP INSTRUCTIONS

10.1	Filling the Boiler System	78
10.2	Initial Operation	79
10.2.1	Initial Burner Operation	79
10.2.2	Combustion Setup Procedure	79
10.3	Shutting Down the Unit	79
10.4	Restarting the Unit	79

Section 11 – MAINTENANCE

11.1	System Maintenance	80
11.2	Maintenance Notes	80
11.2.1	Burner	80
11.2.2	Modulating Gas Valve/ Venturi	80
11.2.3	Controller	81
11.2.4	Spark Ignition Electrodes	81
11.2.5	Flame Sensor	81
11.2.6A	Blower Model 1600	81
11.2.6B	Blower Model 4000	81
11.2.7	Heat Exchanger Tubes	82
11.2.8	Gas Pressure Switches	82
11.2.9	Battery Back Up for Date and Time	83

Section 12 – TROUBLESHOOTING

12.1	About Lockouts, Holds, and Alerts	84
12.1.1	Responding to a Lockout, Hold, or Alert	84
12.1.2	Viewing the Lockout and Alert Histories	84
12.2	Troubleshooting Table	86-94
12.3	Diagnostic Tests and Input/Output Indicators	95
12.4	Lead/Lag Diagnostics	96
12.5	Statistics	96
12.6	Analysis	96
12.7	Control Snapshot	97
12.8	Operating Sequence	97

Section 13 – REPLACEMENT PARTS

13.1	General Information	98
13.2	Component Illustrations, Parts Lists, and Part Numbers	98-113
13.2.1	Frame and Jacket Assembly	99
13.2.2	Final Assembly	101
13.2.3	Waterway Outlet Assembly	102
13.2.4	Blower Assy, Model 1600	103
13.2.5	Blower Assy, Model 2000	104
13.2.6	Blower Assy, Models 3500 & 3000	105
13.2.7	Blower Assy, Models 3500 & 4000	107
13.2.8	Gas Train Assembly, Models 1600 thru 3000 ...	109
13.2.9	Gas Train Assembly, Models 3500 & 4000 ..	111
13.2.10	Control Panel Assembly	113
13.2.11	Distribution Box Assemblies	114-117

Section 1 GENERAL INFORMATION

1.1 Introduction

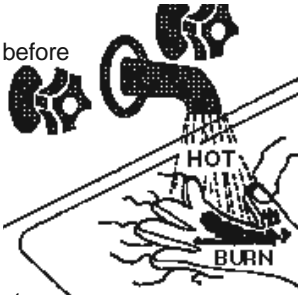
This manual includes information which will help you to install, operate, and maintain the 1600, 2000, 2500, 3000, 3500 and 4000 MBH systems. Please read this manual completely before proceeding with the installation. If you have any questions regarding this equipment, please consult the manufacturer, or a local manufacturer's representative. Many operating problems are caused by improper installation.

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

1.2 Safety Notes

DANGER

- 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 heating appliance.
- Feel water before bathing or showering.
- If this appliance 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).



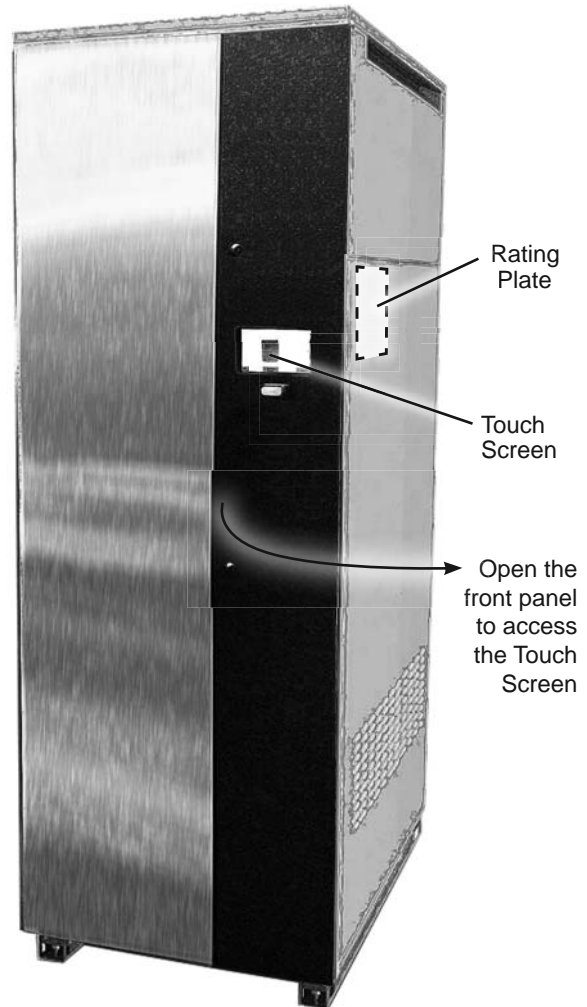
WARNING

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.



The unit is protected against over-pressurization. A pressure relief valve is included with each unit.

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

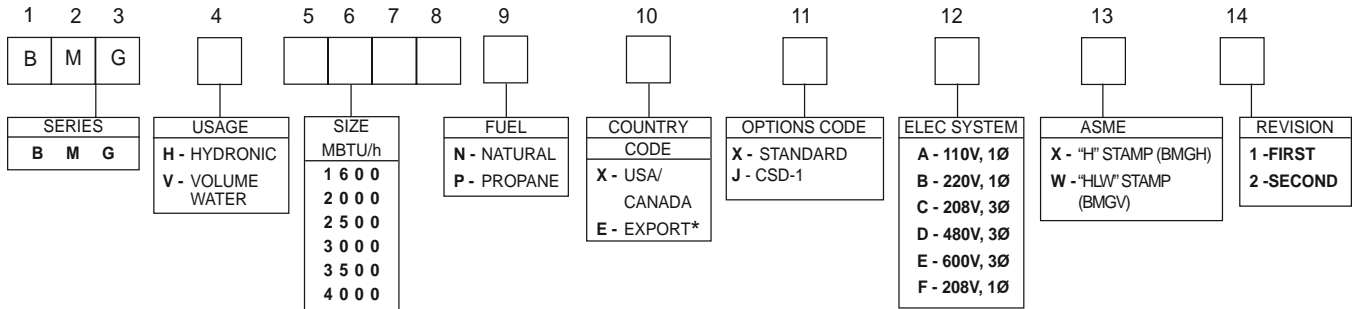
All installations must be made in accordance with
1) American National Standard Z223.1/NFPA54-Latest Edition "National Fuel Gas Code" or
2) CSA B149.1 "Natural Gas and Propane Installation Code" and with the requirement of the local utility or other authorities having jurisdiction. Such applicable requirements take precedence over the general instructions contained herein.

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.

Model Nomenclature



1.3 The Rating Plate (Model Nomenclature)

Consult the rating plate on the unit. The following information describes the model number structure.

(1-3) **Model Series Designation**

B = Bradford White
M G = MagnaTech

(4) **Usage**

H = Hydronic
V = Volume Water

(5-8) **Size**

1 6 0 0 = 1,600,000 BTU/hr input
2 0 0 0 = 1,999,000 BTU/hr input
2 5 0 0 = 2,499,000 BTU/hr input
3 0 0 0 = 3,000,000 BTU/hr input
3 5 0 0 = 3,500,000 BTU/hr input
4 0 0 0 = 4,000,000 BTU/hr input

(9) **Fuel**

N = Natural Gas
P = LP Gas

(10) **Country Code**

X = USA / CANADA
E - Export (CE - non CSA)

(11) **Option Code**

X = Standard Unit
J = CSD1 Version

(12) **Electrical System**

A - 110V, (Single Phase)
B - 220V, (Single Phase)
C - 208V, (Three Phase)
D - 480V, (Three Phase)
E - 600V, (Three Phase)
F - 208V, (Single Phase)

(13) **Additional Options**

X - "H" STAMP (BMGH)
W - "HLW" STAMP (BMGV)

(14) **Revision**

1 = First, 2 = Second

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

Altitude: Gas input rating of the MagnaTech shall be used for elevations up to 2000 ft (600 m). The input rating at elevations above 2000 ft (600 m) shall be reduced at a rate of 4 percent for each 1000 ft (300 m) above sea level before selecting the equipment size.

1.4 Warranty

Bradford White MagnaTech boilers and volume water heaters are covered by a limited warranty. The owner should complete the warranty registration at

<http://www.BradfordWhite.com>

ALL WARRANTY CLAIMS must be made by an authorized Bradford White 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.



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 appliance must be electrically grounded in accordance with these codes.

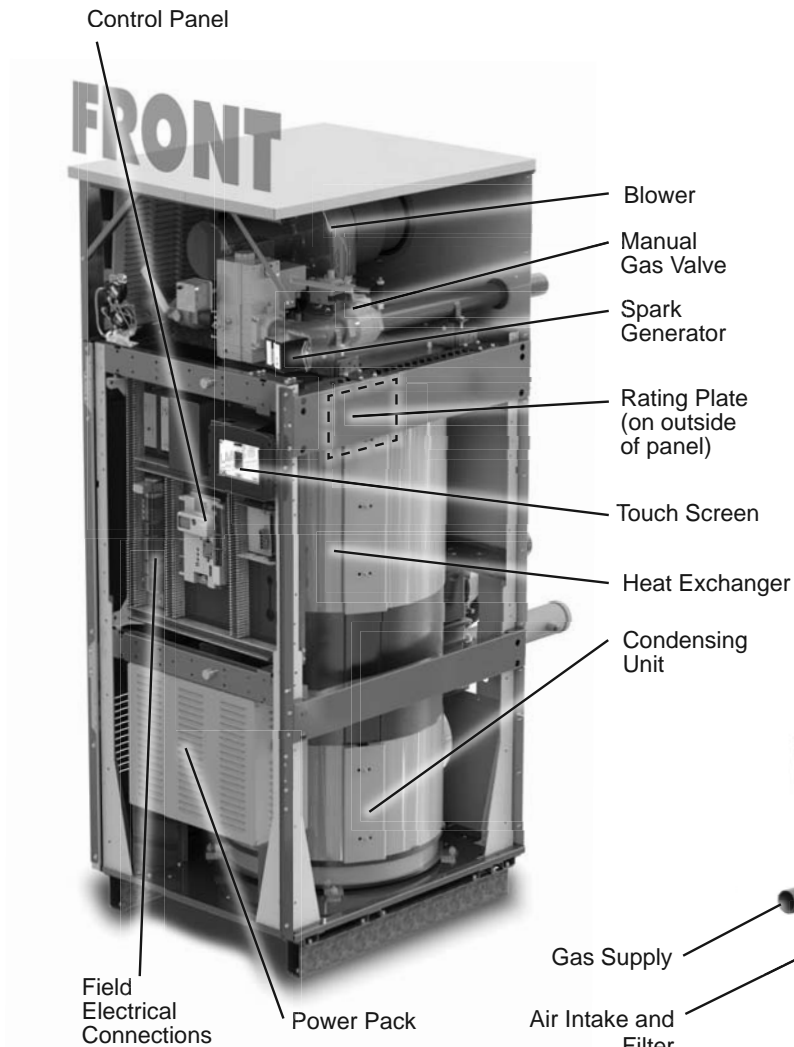


WARNING

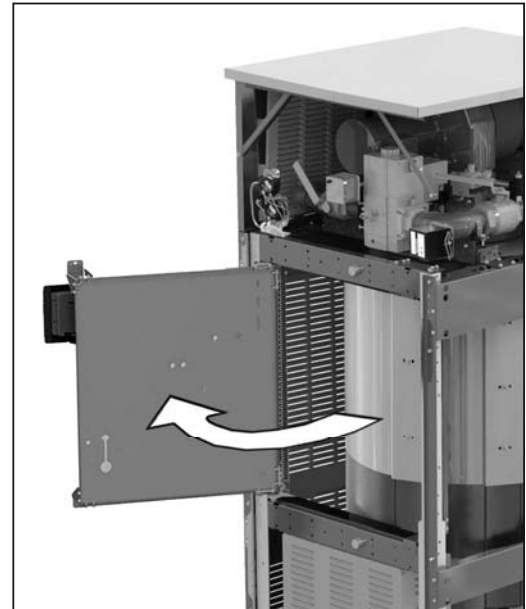
MagnaTech units must be installed in accordance with the procedures detailed in this manual, or the Bradford White warranty will be voided. The installation must conform to the requirements of the local jurisdiction having authority, and, in the United States, to the latest edition of the National Fuel 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 MagnaTech boilers 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.

1.5 Unit Overviews

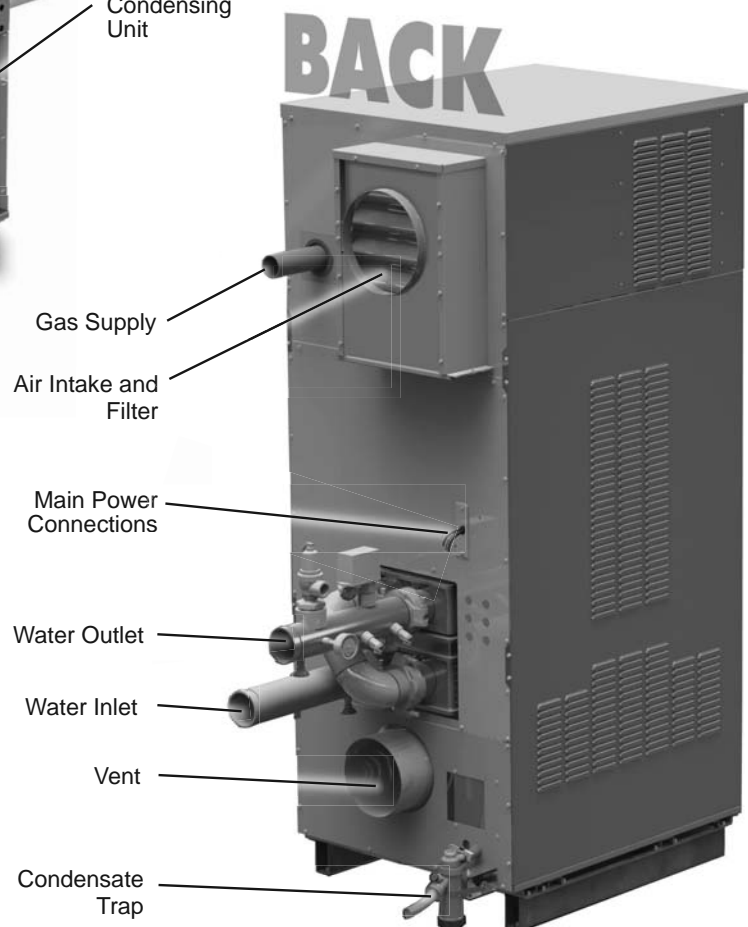
The next 3 pages give a visual reference to the basic component locations of the unit.



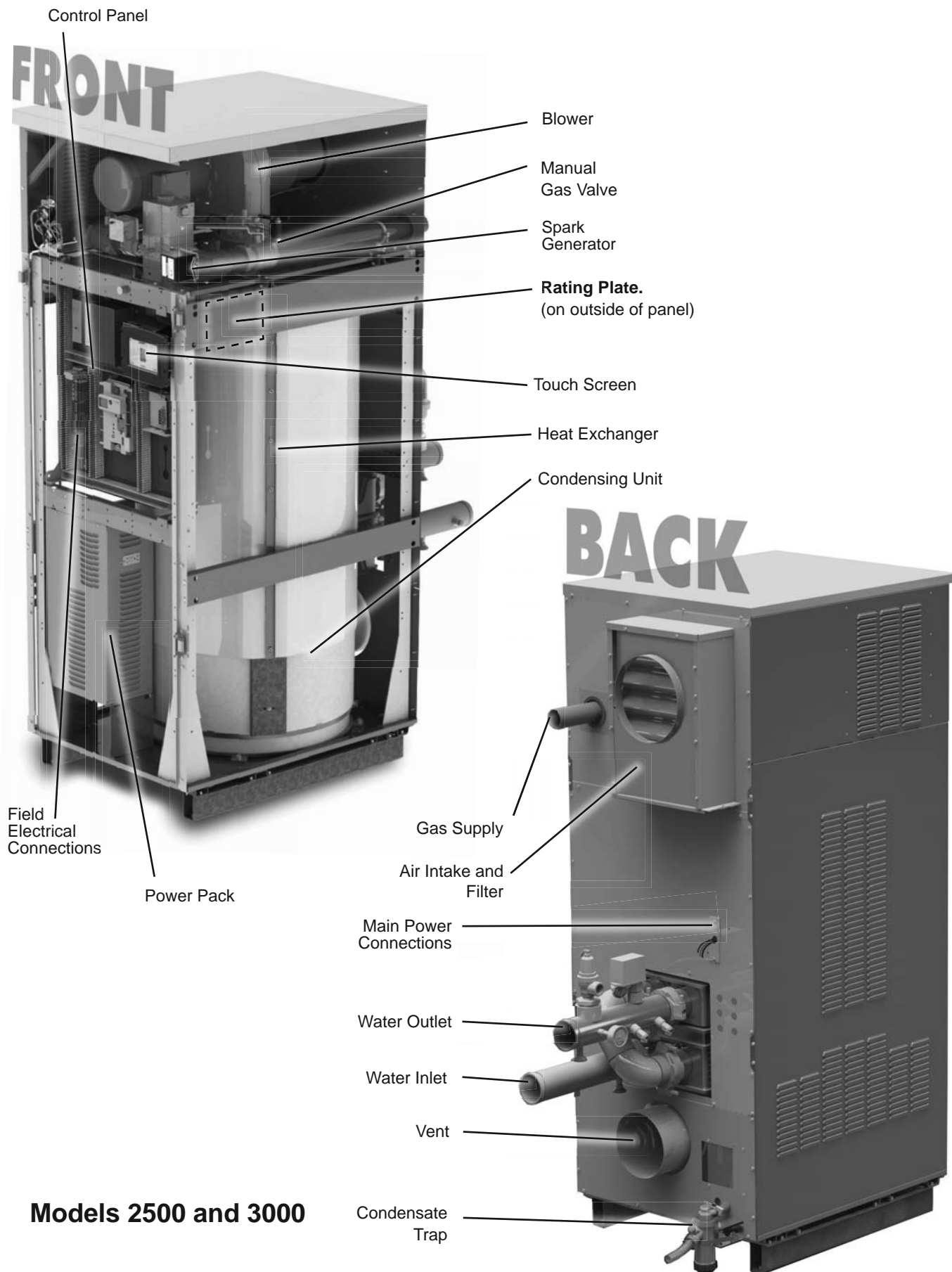
Shown with front doors and left side panels removed.



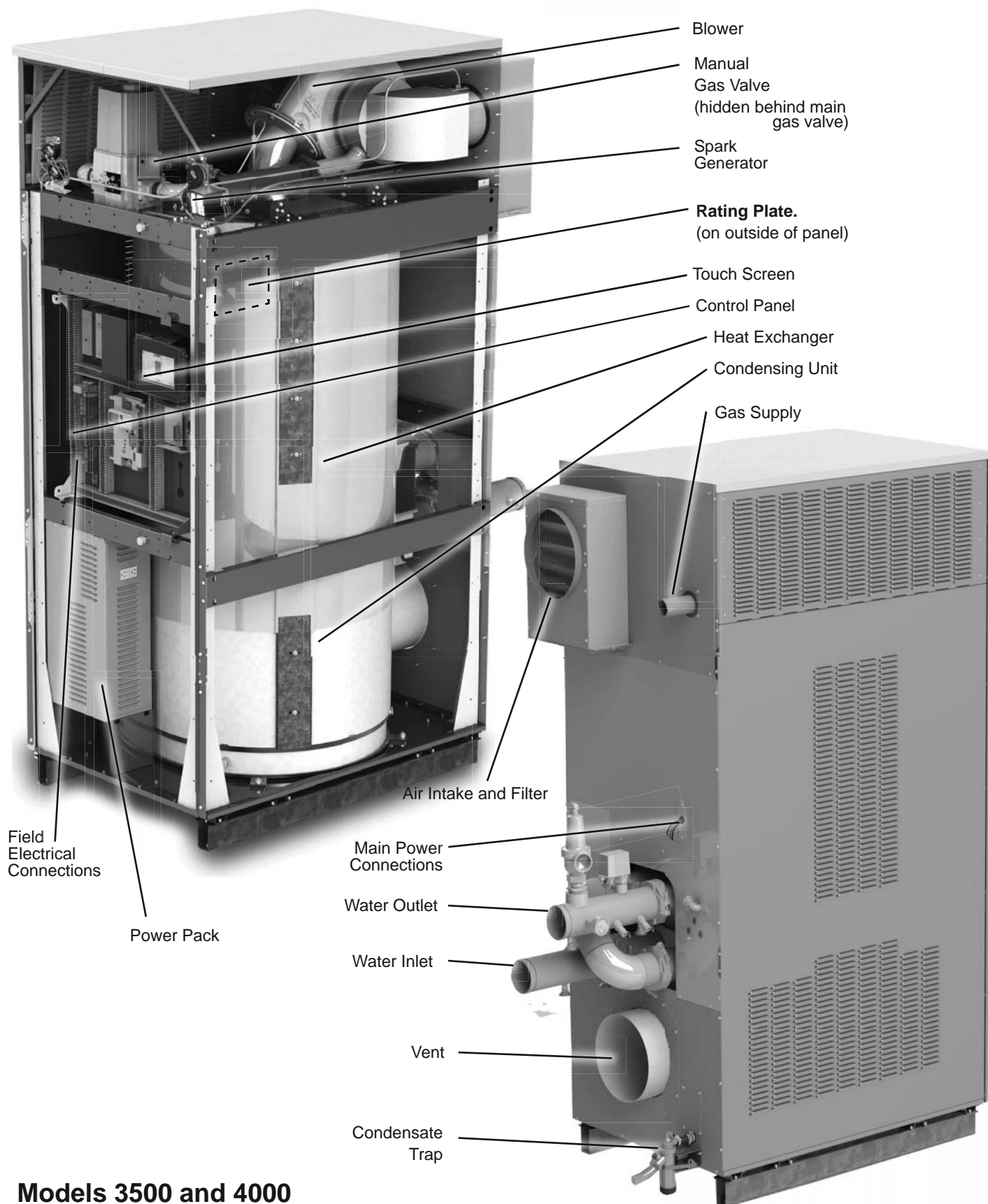
On all models, the Control Panel hinges forward for easy access to wiring and to the heat exchanger.



Models 1600 / 2000



Models 2500 and 3000



Models 3500 and 4000

1.6 Dimensions

Model	A	B	C	D	E	F	G	H
	Inches (cm)							
1600	29.3 (75)	79.8 (203)	38 (96)	57.5 (147)	49.8 (126)	4.8 (12)	60.8 (154)	2.6 (7)
2000	29.3 (75)	79.8 (203)	38 (96)	57.5 (147)	49.8 (126)	4.8 (12)	60.8 (154)	2.6 (7)
2500	30.8 (78)	87 (221)	41.5 (105)	60.5 (154)	60.8 (154)	6.5 (16)	71 (180)	4 (10)
3000	30.8 (78)	87 (221)	41.5 (105)	60.5 (154)	60.8 (154)	6.5 (16)	71 (180)	4 (10)
3500	34.5 (88)	97 (246)	52 (133)	70 (178)	60.8 (154)	6.4 (16)	80.8 (205)	28.8 (73)
4000	34.5 (88)	97 (246)	52 (133)	70 (178)	60.8 (154)	6.4 (16)	80.8 (205)	28.8 (73)

Model	J	K	L	M	N	P	Q	R
	Inches (cm)							
1600	8.4 (21)	68.4 (171)	4 (10)	39.2 (100)	30.4 (77)	16 (41)	23 (58)	10.2 (26)
2000	8.4 (21)	67.4 (171)	4 (10)	39.2 (100)	30.4 (77)	16 (41)	23 (58)	10.2 (26)
2500	9.8 (25)	76.4 (194)	4.3 (11)	44.4 (113)	34.5 (88)	17.7 (45)	27.2 (69)	11.8 (30)
3000	9.8 (25)	76.8 (195)	4.3 (11)	44.4 (113)	34.5 (88)	17.7 (45)	27.2 (69)	11.8 (30)
3500	26.5 (67)	85.6 (217)	6.5 (16)	51.3 (130)	40 (102)	21.6 (55)	30.7 (78)	13 (33)
4000	26.5 (67)	85.6 (217)	6.5 (16)	51.3 (130)	40 (102)	21.6 (55)	30.7 (78)	13 (33)

Model	S	T	U	Vent Ø	Air Inlet Ø	'Knock-down' Height	Water Connection	Gas Connection	Condensate Line
	Inches (cm)								
1600	14 (36)	13 (33)	6.3 (16)	6 (15)	6 (15)	60.8 (154)	3" Groove Lock (or flange)	2" NPT	1"
2000	14 (36)	13 (33)	6.3 (16)	8 (20)	8 (20)	60.8 (154)	3" Groove Lock (or flange)	2" NPT	1"
2500	18.3 (46)	14.8 (38)	6 (15)	8 (20)	8 (20)	71.0 (180)	3" Groove Lock (or flange)	2" NPT	1"
3000	18.3 (46)	14.8 (38)	6 (15)	10 (25)	10 (25)	71.0 (180)	3" Groove Lock (or flange)	2" NPT	1"
3500	16 (41)	17.4 (44)	6.7 (17)	10 (25)	10 (25)	80.8 (205)	4" Groove Lock (or flange)	2" NPT	1"
4000	16 (41)	17.4 (44)	6.7 (17)	12 (30)	12 (30)	80.8 (205)	4" Groove Lock (or flange)	2" NPT	1"

MagnaTech

Models 3500 and 4000 differ from the other sizes in the location of their Air Inlet and Gas Supply.

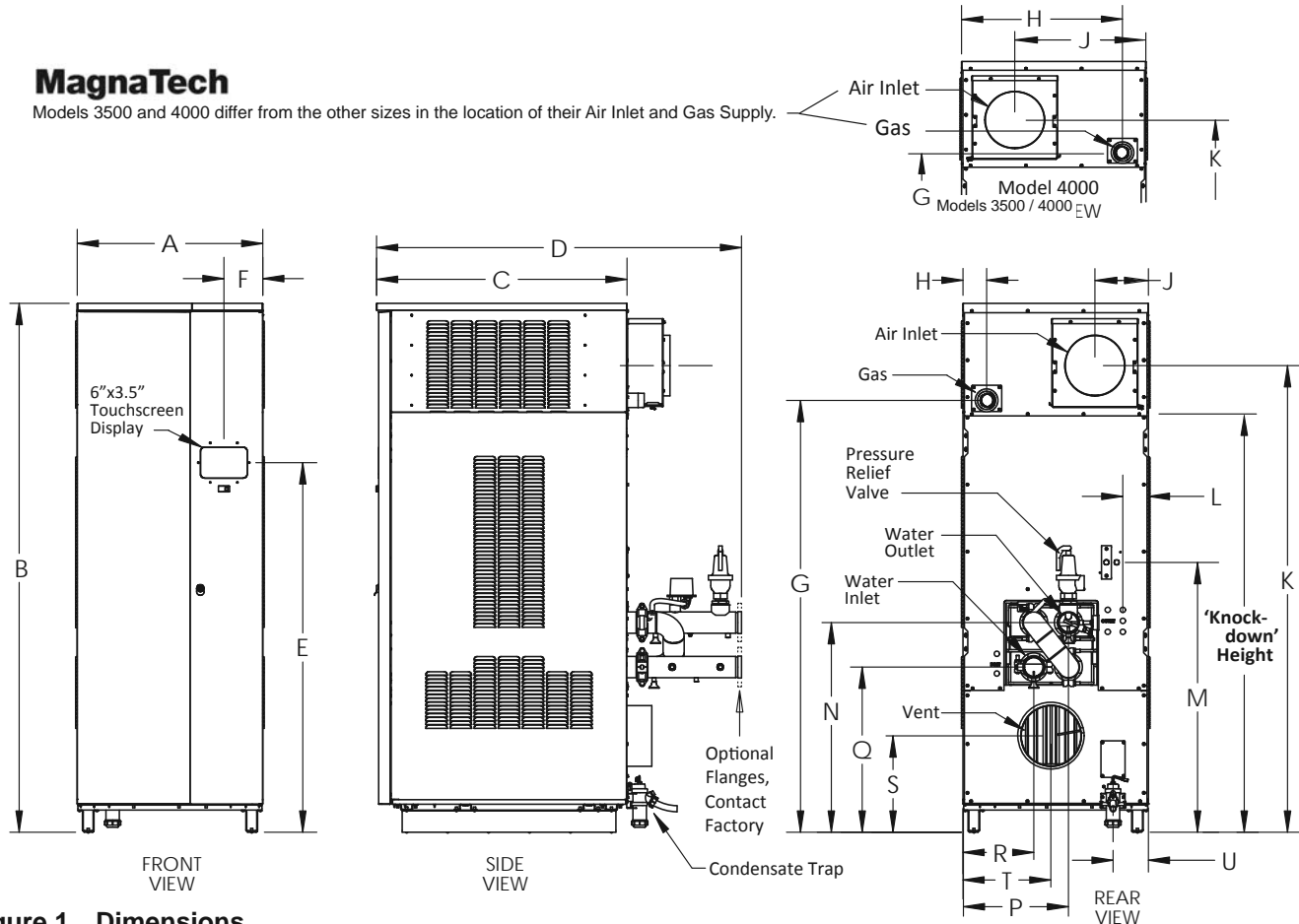


Figure 1. Dimensions

1.7 Unpacking and the Installation Kit

The 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.

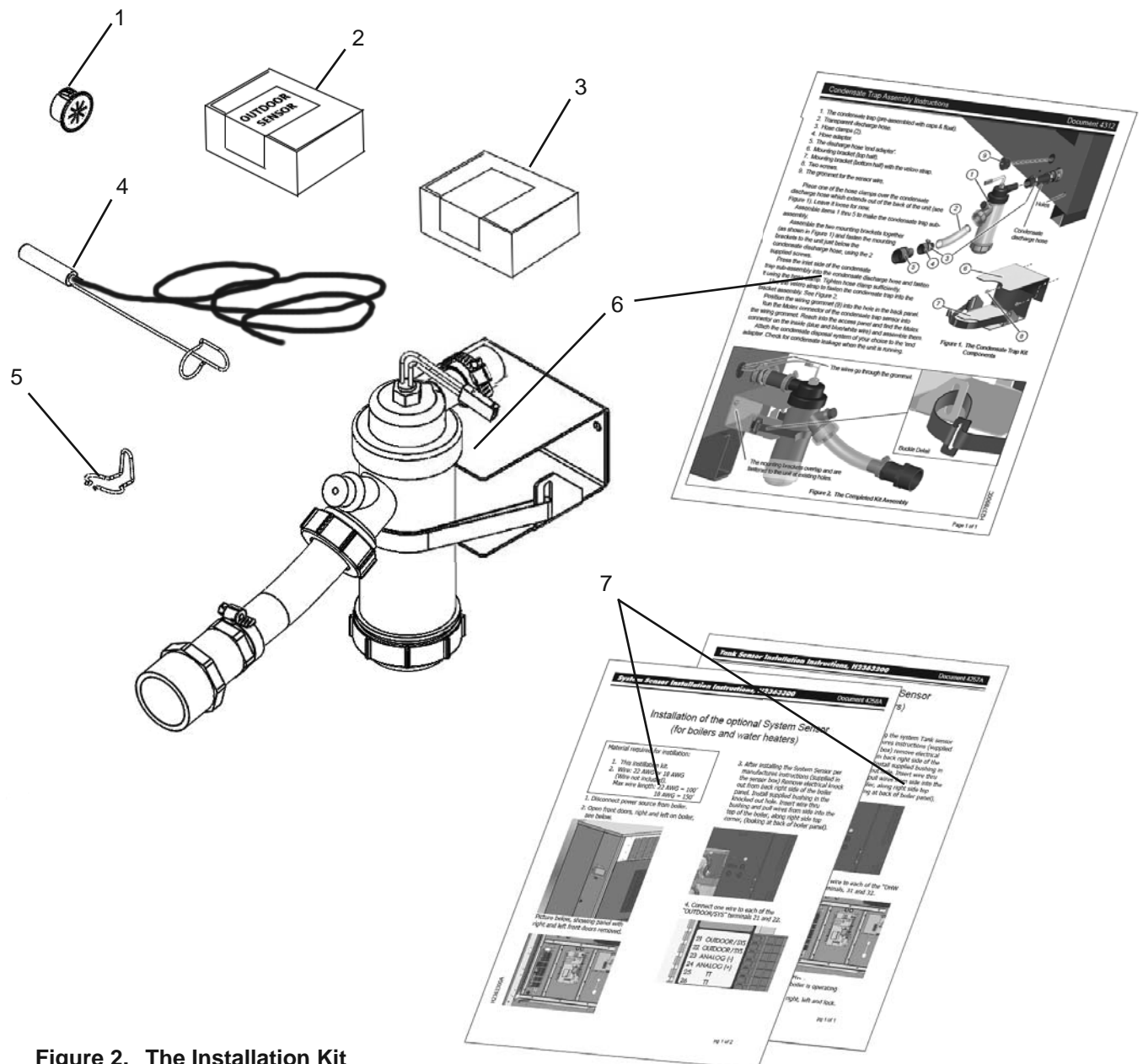
Inspect the contents of the box (The Installation Kit), making sure that all parts are there and not damaged during shipping.

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) and document 4312 Condensate Trap Assembly Instructions.

7. Installation Instructions for Sensors.

NOTE: A condensate neutralizer is NOT included.



Section 2

LOCATING THE APPLIANCE

2.1 Locating the Appliance

The 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 1. Always install the unit on a firm, level surface. It is recommended that the unit is installed on a raised 4" pad so that there is elevation for a condensate neutralizer kit (not included with unit).

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

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

The appliance 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 appliance 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 1. should be met when choosing the locations for the appliance.

2.2 Correct Vent Distance from Outside Wall or Roof Termination

The forced draft combustion air blower in the appliance has sufficient power to vent properly when the guidelines in Table 2 are followed.

Note - When located on the same wall, the Unit combustion air intake terminal must be installed a minimum of 12" (30cm) below the exhaust terminal. There must also be a minimum horizontal distance from intake to the exhaust terminal of 84" (213cm) See Figure 5

APPLIANCE SURFACE	SUGGESTED SERVICE ACCESS CLEARANCE	
	INCHES	CM
Front	24	61
Left Side	8	20
Right Side	8	20
Back	24	61
Top, 1600 & 2000	12	30
Top, 2500 & 3000	15	38
Top, 4000	24	61
APPLIANCE SURFACE	REQUIRED CLEARANCE TO COMBUSTIBLES	
	INCHES	CM
Front	18	45
Left Side	4	15
Right Side	4	15
Back	11	15
Top	1	2.5
Vent	1	2.5

Table 1. Clearances

INTAKE / EXHAUST			
SIZE	DIAMETER	MAX EQUIVALENT FT.	M
1600	6"	100	30
2000 & 2500	8"	100	30
3000 & 3500	10"	100	30
4000	12"	100	30
Combustion Intake and Vent must be the same size.			
Installations in the U.S. require exhaust vent pipe that is CPVC complying with ANSI/ASTM D1785 F441, polypropylene complying with ULC S636, or stainless steel complying with UL1738. Installations in Canada require exhaust vent pipe that is certified to ULC S636.			
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.			
To calculate max equivalent length, measure the linear feet of the pipe, and add 5 feet (1.5 m) for each elbow used.			

Table 2. Vent / Air Pipe Sizes

Section 3

VENTING AND COMBUSTION AIR

3.1 General Venting

This product 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 on the following tables 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 vent category III & IV products.

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.

Example Components	Manufacturer Model Numbers (abbreviated)		
	Selkirk	DuraVent	NovaFlex
	Trade Name / Model		
	Safe-T Vent EZ Seal	FasNSeal	Z Flex
90° Elbow	9x14	FSELB90xx	2SVEExx90
Pipe	9x07	FSVLxxxx	2SVEPxxxx
Boiler Adapter	5x01BOI	FSAAUx	2SVSAxx (OD) 2SVSTTAXx (ID)
Horizontal Termination (bird screen)	9x92	FSBSx	2SVSTPXxx
Vertical Termination (rain cap)	5X00CI	FSRCx	2SVSRCxx
Inlet Air Termination	9xTERM	FSAIHXX*	2SVSTEXxx90
		FSA-xxFNSM-xPVCF	
Adapter SS to PP		FSAAUx-xPP	2ZDCPVCx**
		*4", 6" & 7" only	**up to 6"

Table 3. Allowable Single Wall Stainless Steel Vent Suppliers and Part Numbers

Example Components	Manufacturer Model Numbers (abbreviated)			
	CentroTherm	DuraVent	Selkirk	NovaFlex
	Trade Name / Model			
	InnoFlue	PolyPro	PolyFlue	Z-Dens
Single Wall Pipe	ISVLxxxx	xPPS-x	83x002	ZDPx
Elbow	ISELxxxx	xPPS-E90L	83x08	2ZDEx87
PVC Adapter	ISAMGTxxxx	xPPS-ADL (to 4") xPPS-xxPVCm-xPPF (>4")	83x040	2ZDCPVCx
Horizontal Termination (bird screen)	IASPPxx (2" - 4") IASSSxx (5" - 12")	xPPS-BG (2" - 6")	83x050	2ZDESx
Vertical Termination	IASPPxx (2" - 4") IASSSxx (5" - 12")	xPPS-VKL (<5") xPPS-VTML (5"-8")	83x050	2ZDESx
Air Inlet				2ZDESx

NOTE: "x", "xx", and "xxxx" refer to variations in nominal size. See manufacturer's catalog for a particular application.

Table 4. Allowable Polypropylene Vent Manufacturers / Trade Names

3.2 Combustion Air

Boilers and water heaters 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.

A Units can take combustion air from the space in which it is installed, or the combustion air can be ducted directly to the unit. Ventilation air must be provided in either case.

3.2.1 Combustion Air From Room

In the United States, the most common requirements specify that the space shall communicate with the outdoors in accordance with Method 1 or 2. (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" (300 mm) of the top and one commencing within 12" (300 mm) 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.

	Model 1600	Model 2000	Model 2500	Model 3000	Model 3500	Model 4000
Screen for horizontal galvanized air pipe	D2012104	D2012101	D2012101	D2012102	D2012103	D2012103
Screen for horizontal PVC air pipe	CA012004	CA012001	CA012001	CA012002	CA012003	CA012003
Screen for horizontal polypropylene air pipe	CA012204	CA012201	CA012201	CA012202	CA012203	CA012203
Screen for vertical galvanized air pipe	D2012204	D2012201	D2012201	D2012202	D2012203	D2012203
Screen for vertical PVC air pipe	CA012404	CA012401	CA012401	CA012402	CA012403	CA012403
Screen for vertical polypropylene air pipe	CA012604	CA012601	CA012601	CA012602	CA012603	CA012603

Table 5. Ducted Air Accessories

Material	United States	Canada
ABS	ANSI/ASTM D1527	The air pipe material must be chosen based upon the intended application of the boiler or water heater, 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	

Table 6. Required Combustion Air Pipe Material

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.

3.2.2 Ducted Combustion Air

The combustion air can be taken through the wall, or through the roof. Manufacturer offers accessories to use with ducted air systems, as shown in Table 5.

See Table 6 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 6). The intake must be sized per Table 2. 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 used 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 5

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.

Boiler Model	Vent Connection Size Diameter (provided with boiler)	Vent Connector Size Diameter (Increaser*)
MGH/V1600	6"	14"
MGH/V2000	8"	14"
MGH/V2500	8"	18"
MGH/V3000	10"	18"
MGH/V3500	10"	22"
MGH/V4000	12"	22"

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

Draft must always remain between -0.1" and -0.001" at all firing rates. If pressures outside of this range are measured, consult professional venting engineer for recommendations, such as double-acting barometric dampers to avoid reduced performance or hazardous conditions.

3.3 Venting

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) in non-metallic venting systems is prohibited and that covering non-metallic vent pipe and fittings with thermal insulation is prohibited.

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.

Table 7. Vent Sizing for Category II - Gravity Vent

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

The Unit is a Category II and IV appliance and may be installed with vent materials meeting the standards listed on Table 9.

The unit's 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.

NOTE: For Category II and IV boilers, have horizontal runs sloping upwards not less than 1/4 inch per foot (21 mm/m) from the boiler to the vent terminal; be installed so as to prevent accumulation of condensate; and, where necessary, have 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.

The venting must be correct to allow the condensate to run back to the Unit to drain. Route the vent pipe to the heater 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 (30m).** Each elbow is considered to be 5 feet (1.5m). Manufacturer offers accessory kits to use with horizontal and vertical exhaust vent systems, as shown in Table 8

3.3.1 Common Venting

This unit can be common vented, however, the common venting must be a professionally designed and approved system. See Venting Document 1396. pdf available online.

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

3.3.3 Venting Requirements Unique to Canada

These high efficiency boilers and water heaters are Vent Category II and IV appliances. 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.

	Model 1600	Model 2000	Model 2500	Model 3000	Model 3500	Model 4000
Horizontal vent terminal for stainless steel	D2012004	D2012001	D2012001	D2012002	D2012003	D2012003
Screen for horizontal CPVC vent	CA012104	CA012101	CA012101	CA012102	CA012103	CA012103
Screen for vertical stainless steel vent	D2012304	D2012301	D2012301	D2012302	D2012303	D2012303
Screen for vertical CPVC vent	CA012504	CA012501	CA012501	CA012502	CA012503	CA012503

Table 8. Vent Accessory Kits

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 unit, 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 9. Required Exhaust Vent Material

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 appliances producing flue gas temperature of more than 135°C, but not more than 245°C.

Class II venting systems are suitable for gas-fired appliances 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

Flue Gas Sampling 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 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 3)

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.

Exhaust Vent Terminal -

An exhaust vent terminal must be installed. If an exhaust vent terminal is not available with the certified vent system, 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.

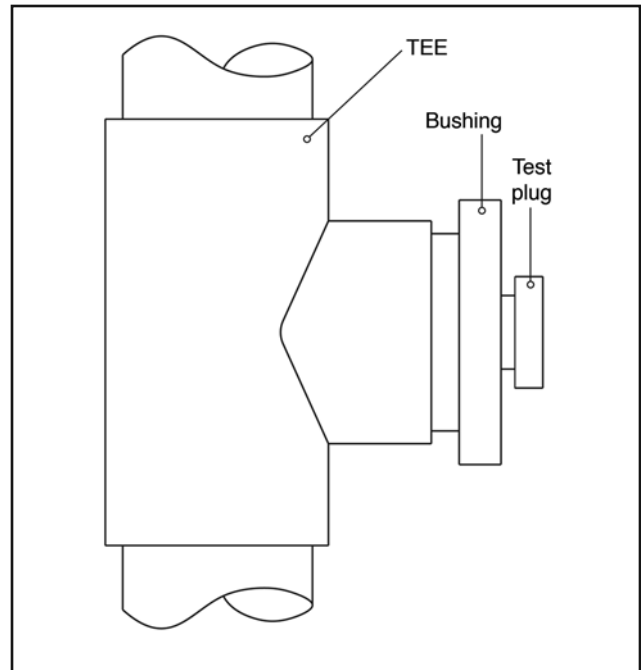


Figure 3. Test Port

3.4 Locating the Vent and Combustion Air Terminals

3.4.1 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.

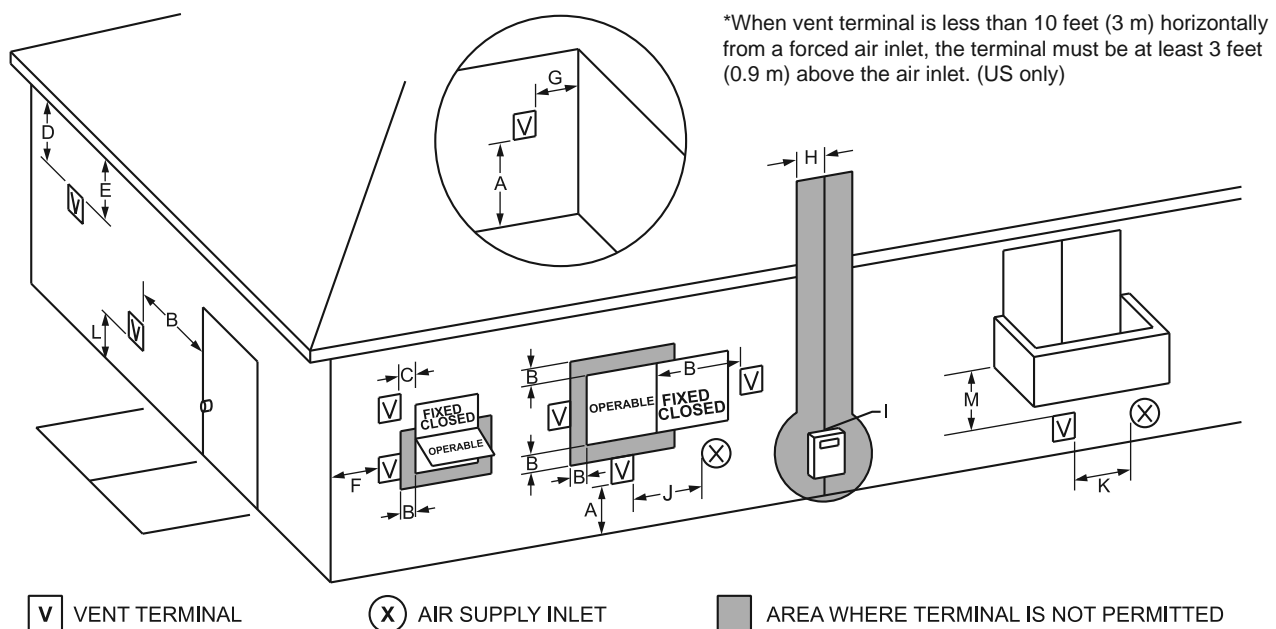
Consider the following when installing the terminal:

1. Figure 5 on page 15 shows the requirements for mechanical vent terminal clearances for the U.S. and Canada.
2. Vent terminals for condensing appliances or appliances 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,**

	U.S. Installations (see note 1)	Canadian Installations (see note 2)
A= Clearance above grade, veranda, porch, deck, or balcony	12 inches (30 cm) See note 6	12 inches (30 cm) See note 6
B= Clearance to window or door that may be opened	Direct vent only: 12 inches (30 cm); Other than Direct vent: 4 ft (1.2m) below or to side of opening; 1 ft (30 cm) above opening	36 inches (91 cm)
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 feet (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 center line extended above meter/regulator assembly	See note 4	3 feet (91 cm) within a height 15 feet above the meter/regulator assembly
I= Clearance to service regulator vent outlet	See note 4	3 feet (91 cm)
J= Clearance to nonmechanical air supply inlet to building or the combustion air inlet to any other appliance	Direct vent only: 36" (91cm) Other than Direct vent: 4 ft (1.2m) below or to side of opening; 1 ft (30 cm) above opening	36 inches (91 cm)
K= Clearance to a mechanical air supply inlet	3 feet (91 cm) above if within 10 feet (3 m) horizontally	6 feet (1.83 m)
L= Clearance above paved sidewalk or paved driveway located on public property	Vent termination not allowed in this location for category IV appliances.	7 ft (2.1 m) See note 5
M= Clearance under veranda, porch, deck, or balcony	See note 4	12 inches (30 cm) See note 5

Notes:

1. In accordance with the current ANSI Z223.1 / NFPA 54 National Fuel Gas Code.
2. In accordance with the current CAN/CSA-B149 Installation Codes.
3. Permitted only if veranda, porch, deck, or balcony is fully open on a minimum of two sides beneath the floor.
4. 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.
5. For clearances not specified in CAN/CSA-B149, clearance is in accordance with local installation codes and the requirements of the gas supplier.
6. **IMPORTANT:** All terminals must be placed so that they remain a minimum 12" above expected snow line. Local codes may have more specific requirements, and must be consulted.

**Figure 4. Combustion Air and Vent Through Side Wall**

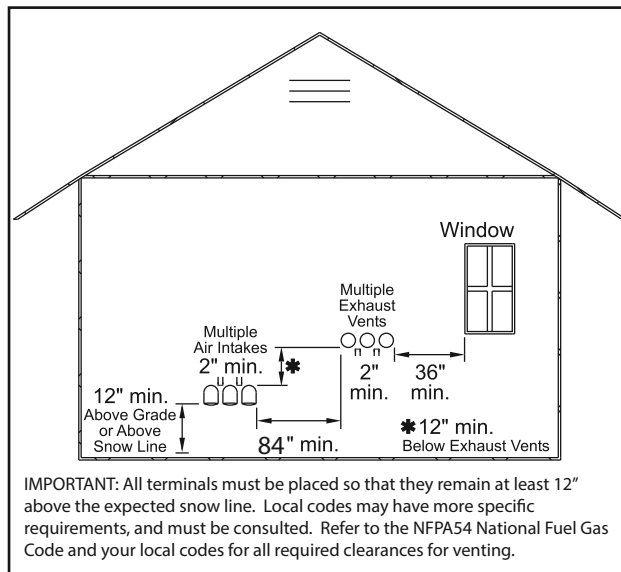


Figure 6. Multiple Side-Wall Terminals, Air and Vent

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 water heater uses ducted combustion air from an intake terminal located on the same wall, see See Figure 6 and Figure 5 for proper spacing and orientation.

3.4.2 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 5 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).

3.4.3 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. The vent terminal offered with the Unit can be used in both vertical and horizontal applications. When the combustion air is taken from the roof, the combustion air must terminate at least 12" (30 cm) below the vent terminal.

3.4.4 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.

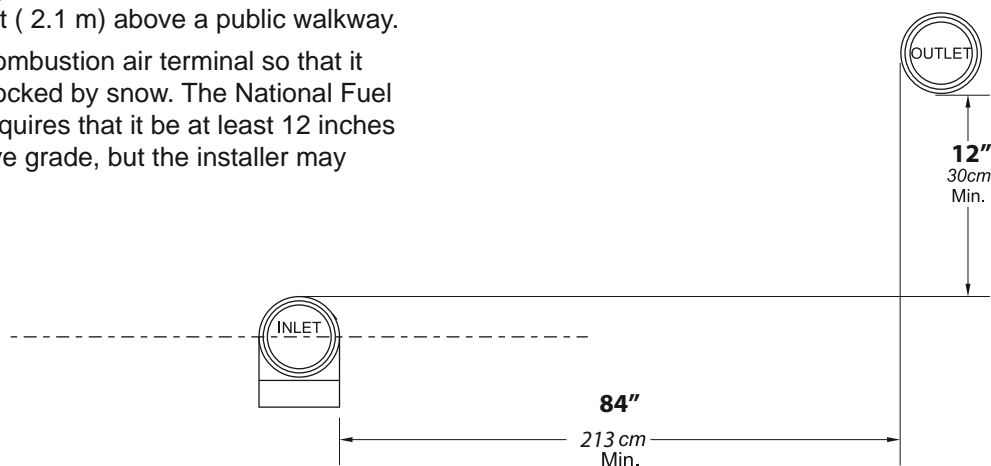


Figure 5. Minimum Venting Distance

3.4.5 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 appliance, the installing plumber or gas-fitter shall observe that a hard-wired carbon monoxide detector with an alarm battery back-up is installed on the floor level where the gas appliance 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 appliance 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."

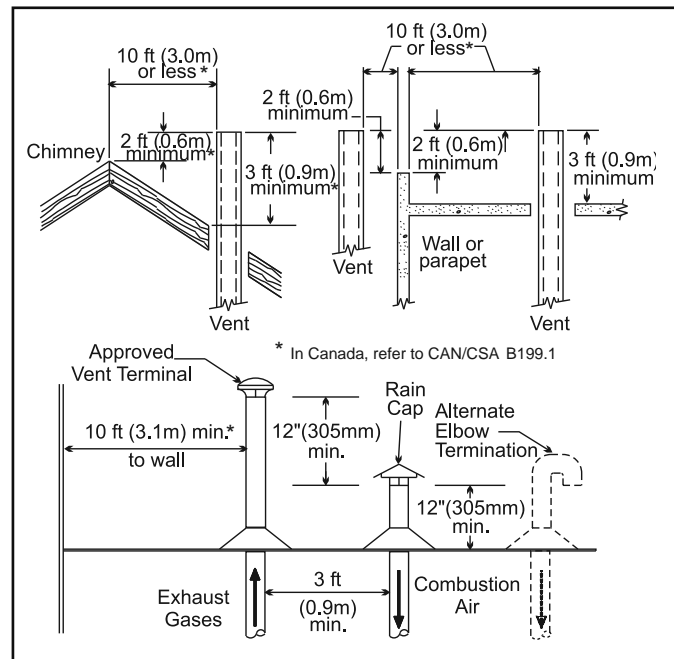


Figure 7. Combustion Air and Vent Through Roof

4. Inspection

The state or local gas inspector of the side-wall horizontally vented gas fueled appliance 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.

3.5 Common Vent Test

Note -This section does not describe a method for common venting the units. It describes what must be done when a unit is removed from a common vent system. Units require special vent systems and fans for common vent. Contact the factory if you have questions about common venting units.

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

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

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 appliances remaining connected to the common venting system are located and other spaces of the building. Turn on any clothes dryers and any appliance not connected to the common venting system. Turn on any exhaust fans, such as range hoods and bathroom exhausts, so they will operate at maximum speed. Do not operate a summer exhaust fan. Close fireplace dampers.
4. Place in operation the appliance being inspected. Follow the lighting instructions. Adjust thermostat so appliance will operate continuously.
5. Test for spillage at the draft hood relief opening after 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 appliance 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 appliance 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 chaudière existante, les mesures suivantes doivent être prises pour chaque appareil toujours raccordé au système d'évacuation commun et qui fonctionne alors que d'autres appareils toujours raccordés au système d'évacuation ne fonctionnent pas:

1. Sceller toutes les ouvertures non utilisées du système d'évacuation.
2. Inspecter de façon visuelle le système d'évacuation pour déterminer la grosseur et l'inclinaison horizontale qui conviennent et s'assurer que le système est exempt d'obstruction, 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 marche les sècheuses, 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 façon que l'appareil fonctionne de façon 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 déterminé, selon la méthode indiquée ci-dessus, que chaque appareil raccordé au système d'évacuation est mis à l'air libre de façon adéquate. Remettre les portes et les fenêtres, les ventilateurs, les registres de cheminées et les appareils au gaz à leur position originale.
7. Tout mauvais fonctionnement du système d'évacuation commun devrait être corrigé de façon 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 modifiée 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.

	Model 1600	Model 2000	Model 2500	Model 3000	Model 3500	Model 4000
Air intake screen for unit placed outdoors	CA0011904	CA011901	CA011901	CA011902	CA0011903	CA0011903
Vent terminal for unit placed outdoors	CA011803	CA011801	CA011801	CA011802	CA011803	CA011803

Table 10. Air & Vent Accessories for units placed outdoors

3.6 Outdoor Installation

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 10. 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.

Section 4 GAS SUPPLY AND PIPING

4.0 Gas Supply and Piping

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

Review the following instructions before proceeding with the installation.

1. Verify that the appliance is fitted for the proper type of gas by checking the rating plate. Units are normally equipped to operate at elevations up to 2000 feet (610m). However, the appliance will function properly without the use of high altitude modification at elevations up to 10,000 feet (3050 m).
2. The gas pressure settings must match fuel type as shown in Table 11
3. Table 12 and Table 13 on page 19 offer some gas pipe 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 liquefied petroleum gas.
8. The appliance and its individual shutoff valve must be disconnected from the gas supply piping during any pressure testing of that system at test pressures in excess of 1/2 PSIG (3.45kpa).

**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.

Note - The unit and all other gas appliances sharing the gas supply line must be firing at maximum capacity to properly measure the inlet supply pressure. The pressure can be measured at the supply pressure port on the gas valve. Low gas pressure could be an indication of an undersized gas meter, undersized gas supply lines and/or an obstructed gas supply line. 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.

	Natural Gas	LP (propane)
Min	4.0 IN - W.C.	8.0 IN - W.C.
Max	10.5 IN - W.C.	14.0 IN - W.C.

Table 11. Gas Pressure by Type

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 appliance and its gas connection must be leak tested before placing it in operation.
11. Purge all air from gas lines

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.

**SCH 40 METAL PIPE CAPACITY FOR 0.60 SPECIFIC GRAVITY
NATURAL GAS**

NOMINAL PIPE SIZE @ 0.30" 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

Notes:

1. Inlet pressure - Less than 2 psi
2. Pressure drop - 0.5 in w.c.
3. Specific gravity - 0.60
4. Schedule 40 metallic pipe

Table 12. Pipe Capacity for Natural Gas

**SCHED 40 METAL PIPE CAPACITY FOR 1.50 SPECIFIC GRAVITY
UNDILUTED PROPANE**

NOMINAL PIPE SIZE @ 11" W.C. INLET AND 0.5" W.C. PRESSURE DROP					
Nominal:	1½	2	2½	3	4
Actual ID:	1.61	2.067	2.469	3.068	4.026
Length (ft)	Capacity in Cubic Feet of Gas per Hour				
10	3,520	6,790	10,800	19,100	39,000
20	2,420	4,660	7,430	13,100	26,800
30	1,940	3,750	5,970	10,600	21,500
40	1,660	3,210	5,110	9,030	18,400
50	1,480	2,840	4,530	8,000	16,300
60	1,340	2,570	4,100	7,250	14,800
80	1,230	2,370	3,770	6,670	13,600
100	1,140	2,200	3,510	6,210	124,700
125	1,070	2,070	3,290	5,820	11,900
150	1,010	1,950	3,110	5,500	11,200
175	899	1,730	2,760	4,880	9,950
200	814	1,570	2,500	4,420	9,010
250	749	1,440	2,300	4,060	8,290
300	697	1,340	2,140	3,780	7,710
350	618	1,190	1,900	3,350	6,840
400	560	1,080	1,720	3,040	6,190

Notes:

1. Inlet pressure - 11.0 in w.c.
2. Pressure drop - 0.5 in w.c.
3. Specific gravity - 1.50
4. Schedule 40 metallic pipe
5. Intended use - Pipe sizing between single or second-stage (low pressure) regulator and appliance.

Table 13. Pipe Capacity for Propane

Section 5

WATER FLOW REQUIREMENTS

5.1 Boiler Flow and Head Requirements

	Output Max/Min	25°F		30°F		35°F		40°F	
		Flow GPM Max/Min**	Head Loss* Feet	Flow GPM Max/Min**	Head Loss* Feet	Flow GPM Max/Min**	Head Loss* Feet	Flow GPM Max/Min**	Head Loss* Feet
1600	1,504,000	122	19.4	100	14	87	10	76	8
	320,000	26		22		19		16	
2000	1,883,000	150	30	128	23.5	109	17.1	95	13.6
	400,000	33		28		24		21	
2500	2,374,000	190	34	158	23.6	136	17.6	119	13.6
	499,980	41		34		30		26	
3000	2,814,000	226	47	190	34.2	164	25.8	142	18.9
	600,000	49		41		35		31	
3500	3,276,000	266	41	222	30.6	190	23.6	166	18.6
	700,000	57		48		41		36	
4000	3,724,000	300	48	255	38.2	218	28.5	190	22.5
	800,000	66		55		47		41	

*Headloss is for boiler only (no piping)

** Lower flow rates may require flow switch adjustment

Table 14. Boiler Flow and Head Requirements (GPM)

Model	14°C		17°C		19°C		22°C	
	Flow LPM	Head Loss* m	Flow LPM	Head Loss* m	Flow LPM	Head Loss* m	Flow LPM	Head Loss* m
1600	462	5.9	379	4.3	329	3	288	2.5
2000	568	9.2	485	7.2	413	5.2	360	4.2
2500	719	10.0	599	7.0	514	5.0	449	4.1
3000	856	14.3	719	10.4	621	7.9	538	5.8
3500	1007	12.0	839	9.0	719	7.0	629	6.0
4000	1136	14.6	965	11.6	825	8.7	719	6.9

*Headloss is for boiler only (no piping)

Table 15. Boiler Flow and Head Requirements (LPM)

5.2 Water Heater Flow and Head Requirements

Water Hardness 1-10 grains per gallon Allowable pH: 6.5 to 9.5						
Model	Flow Rate	Temp Rise	Headloss*	Flow Rate	Temp Rise	Headloss*
	GPM	°F	Ft	LPM	°C	m
1600	152	20	31.0	525	11.1	10.1
2000	152	25	33.0	575	14	10.1
2500	190	25	33.7	719	13.9	10.0
3000	190	30	36.0	719	17	11.0
3500	222	30	30.6	839	17	9.0
4000	224	34	30.0	848	19	9.1

*Headloss is for boiler only (no piping)

Table 16. Normal Water

Water Hardness 11-15 grains per gallon						
Model	Flow Rate	Temp Rise	Headloss *	Flow Rate	Temp Rise	Headloss *
	GPM	°F	Ft	LPM	°C	m
1600	177	17	41.0	670	9.4	12.5
2000	177	21	43.9	670	12	13.4
2500	220	21	46.0	833	11.7	14
3000	220	26	46.0	833	14	14
3500	266	25	40.6	1007	14	12
4000	266	29	41.2	1007	16	12.6

*Headloss is for boiler only (no piping)

Table 17. Hard Water

Section 6 - WATER CONNECTIONS BOILERS

6.1 System Piping: Hot Supply Connections

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

The hot water piping should be supported by suitable hangers or floor stands. Do not support the piping with this appliance. 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.

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, an air vent, an expansion tank, a 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.

Suggested piping diagrams are shown in Figure 9 through Figure 12. These diagrams are meant only as guides. Components required by local codes must be properly installed.

The 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 Figure 11 and Figure 12.

6.2 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 appliance 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.

6.3 Freeze Protection

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 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), glycol concentrations up to 50% can be used. **When concentrations greater than 35% are used, water flow rates must be increased to maintain a 20°F to 25°F temperature rise through the boiler.**

WARNING

Glycol must not be used in domestic hot water applications. Refer to Section 7 for instructions on freeze protection for units (domestic hot water).

Different glycol products may provide varying degrees of protection. 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 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

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.

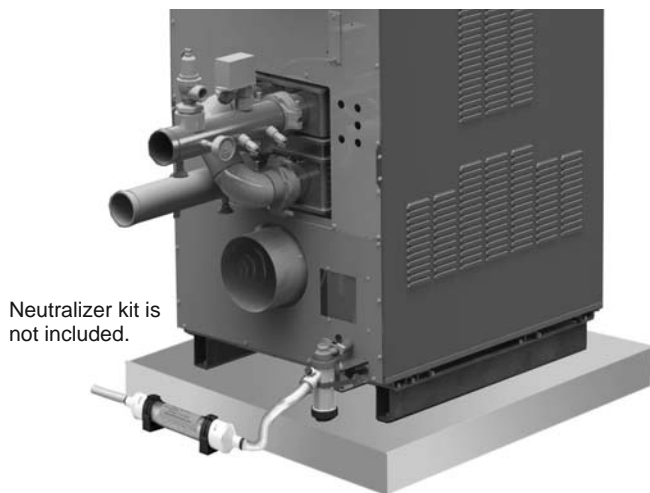


Figure 8. Raised concrete platform

6.4 Condensate Drain Trap

A condensate drain trap is included with the unit and is designed to drain the unit of condensate. See Figure 2 on page 7. The vent condensate should be drained through a drain tee located in the vent line. This will help prevent excessive condensate from entering the unit at the vent.

The condensate drain must be installed to prevent the accumulation of condensate. When a condensate pump is not used, the tubing must continuously slope downward toward the drain with no spiraling.

Connect a 3/4" PVC pipe between the drain connection and a floor drain (or condensate pump if a floor drain is not accessible).

Consult local codes for the disposal method.

A condensate neutralizer is not included with the unit and yet is almost always used. It is advised that the unit be installed on a raised 4" concrete platform so that there is sufficient elevation for the condensate neutralizer below the included condensate trap.

See Figure 8

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.**

6.5 Suggested Piping Schematics

Figure 9 on page 24 through Figure 12 on page 27 show suggested piping configurations for boilers. These diagrams are only meant as guides. All components or piping required by local code must be installed.

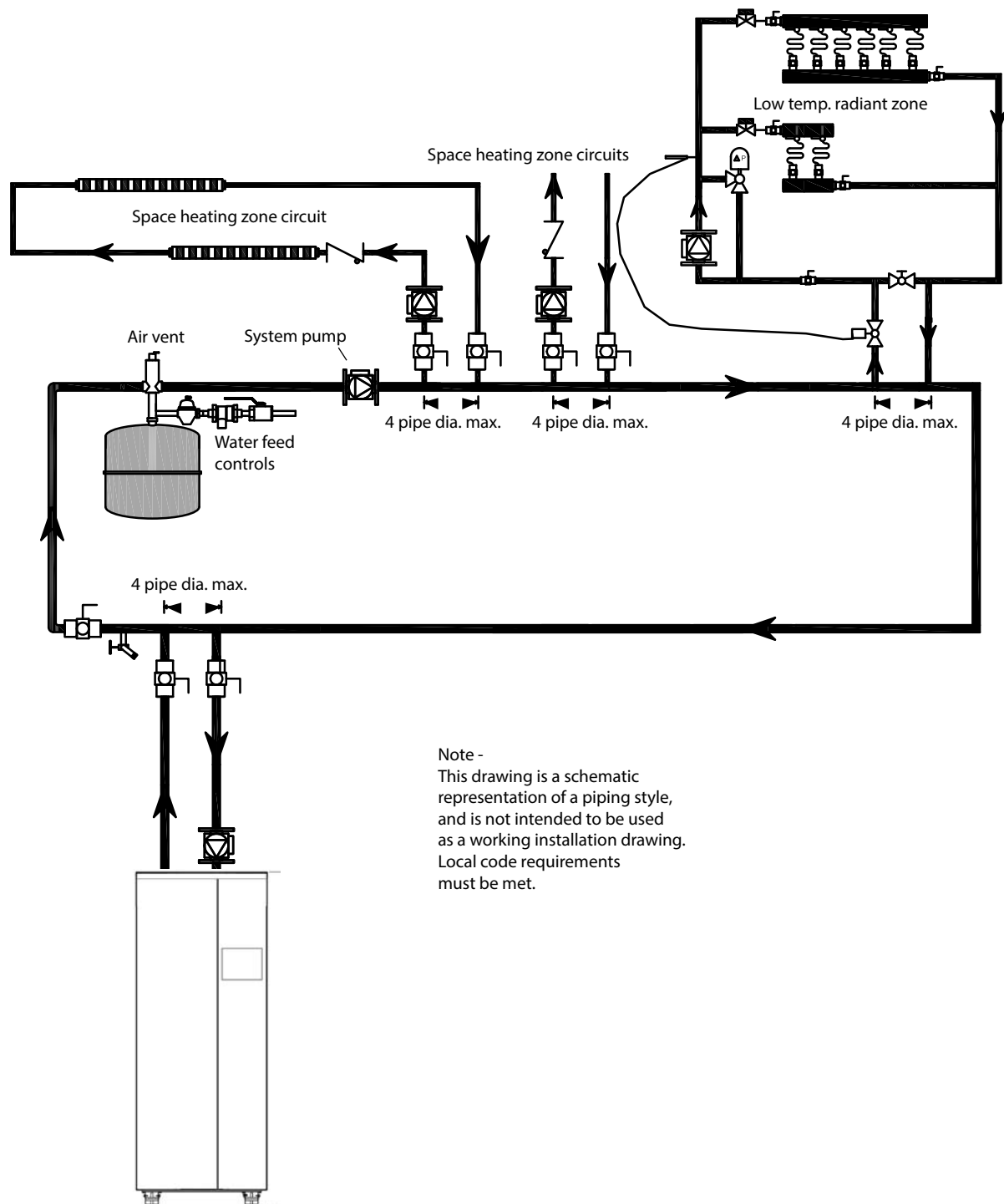


Figure 9. Hydronic Piping — Single Boiler, Multiple Temperature Zones
Zoning with circulators

Note -

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

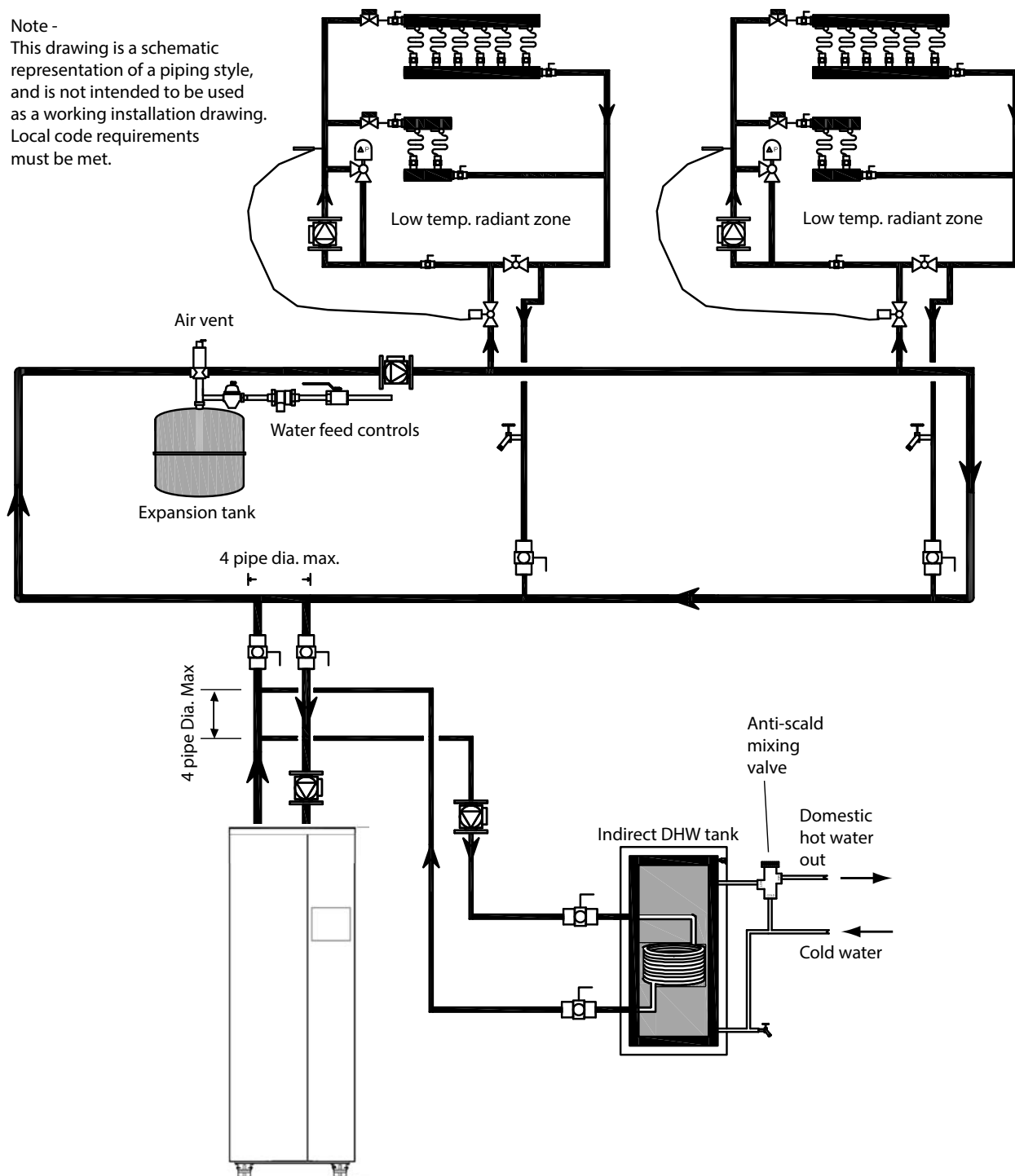


Figure 10. Hydronic Piping — Single Boiler with Low Temperature Zones and Indirect DHW Tank
Indirect tank directly off of boiler

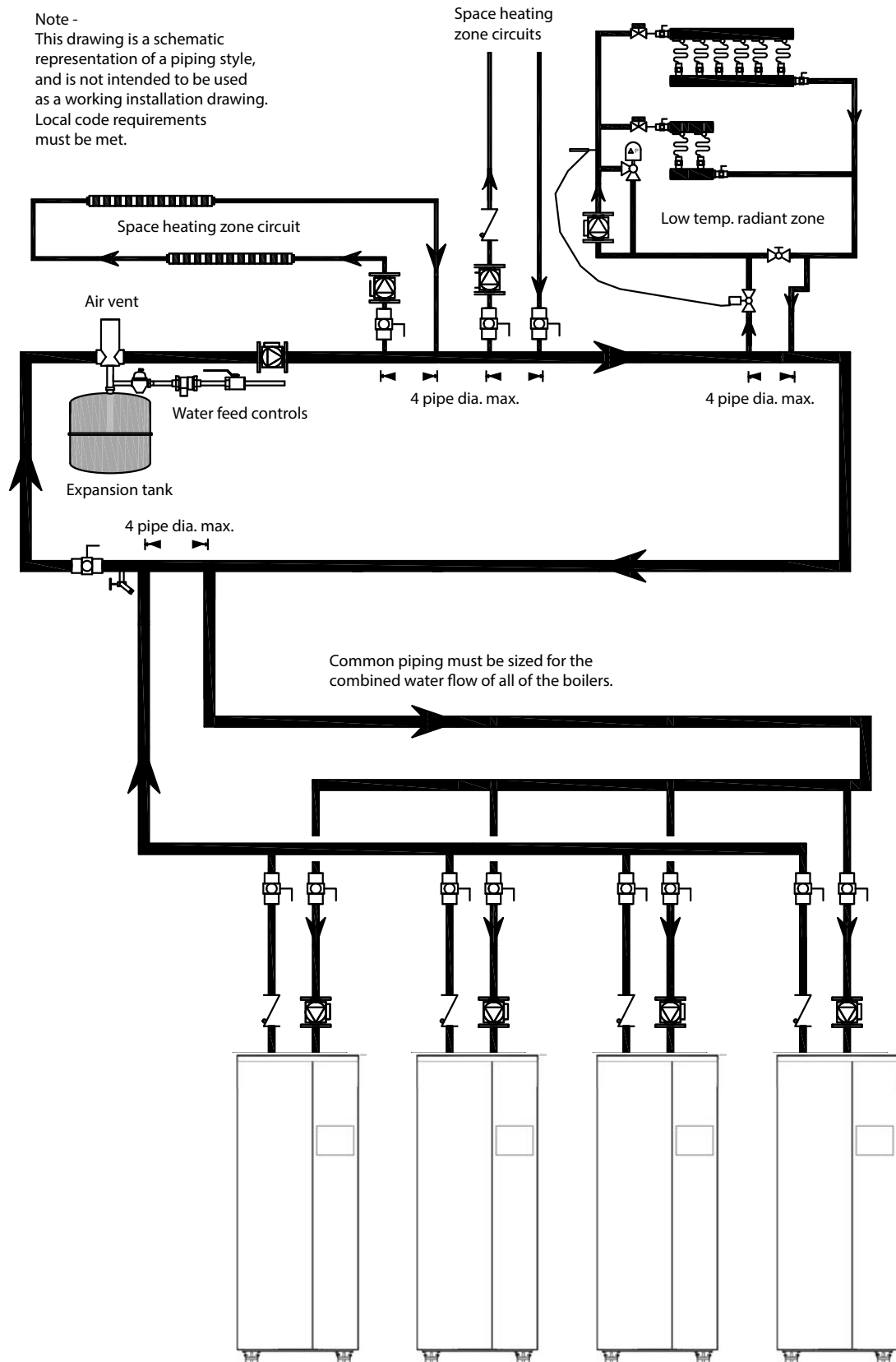


Figure 11. Hydronic Piping — Multiple Boilers, Multiple Temperature Zones, Reverse Return.
Zoning with circulators

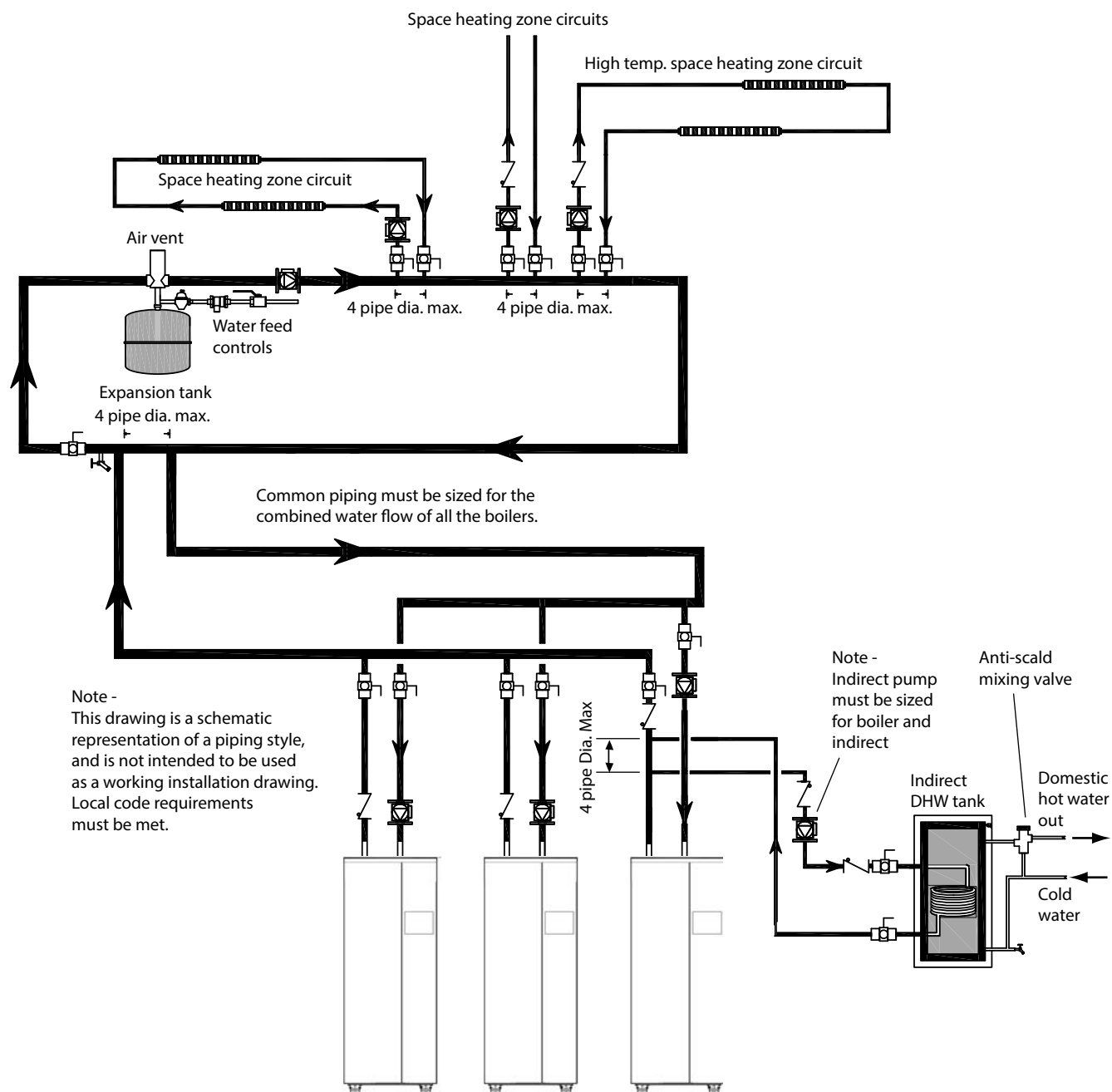


Figure 12. Hydronic Piping — Multiple Boilers, Indirect DHW Off of One Boiler

Section 7 - WATER CONNECTIONS

7.1 Water Quality

Water heaters must be installed in water conditions of 15 gpg hardness or less, with a pH range of 6.5 to 9.5 pH. Values outside of this range may reduce the life expectancy of the product. Operating the in water with higher hardness levels will cause heat exchanger fouling, erosion, or corrosion, leading to premature component failure, reduced efficiency, heat exchanger failure or system failure. Failure of this type will not be warranted. If the water in use exceeds the conditions recommended, water softeners or other devices should be installed to improve water quality.

7.2 Suggested Piping Schematics

Figure 13 through Figure 15 show suggested piping configurations for water heaters. These diagrams are only meant as guides. All components or piping required by local code must be installed.

7.3 Piping Requirements

The water piping should be supported by suitable hangers and floor stands. Do not support the piping with this appliance. The hangers used should allow for expansion and contraction of copper pipe. Rigid hangers may transmit noise through the system resulting from 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 hot water pipes.

Pipe the discharge of the relief valve (full size) to the

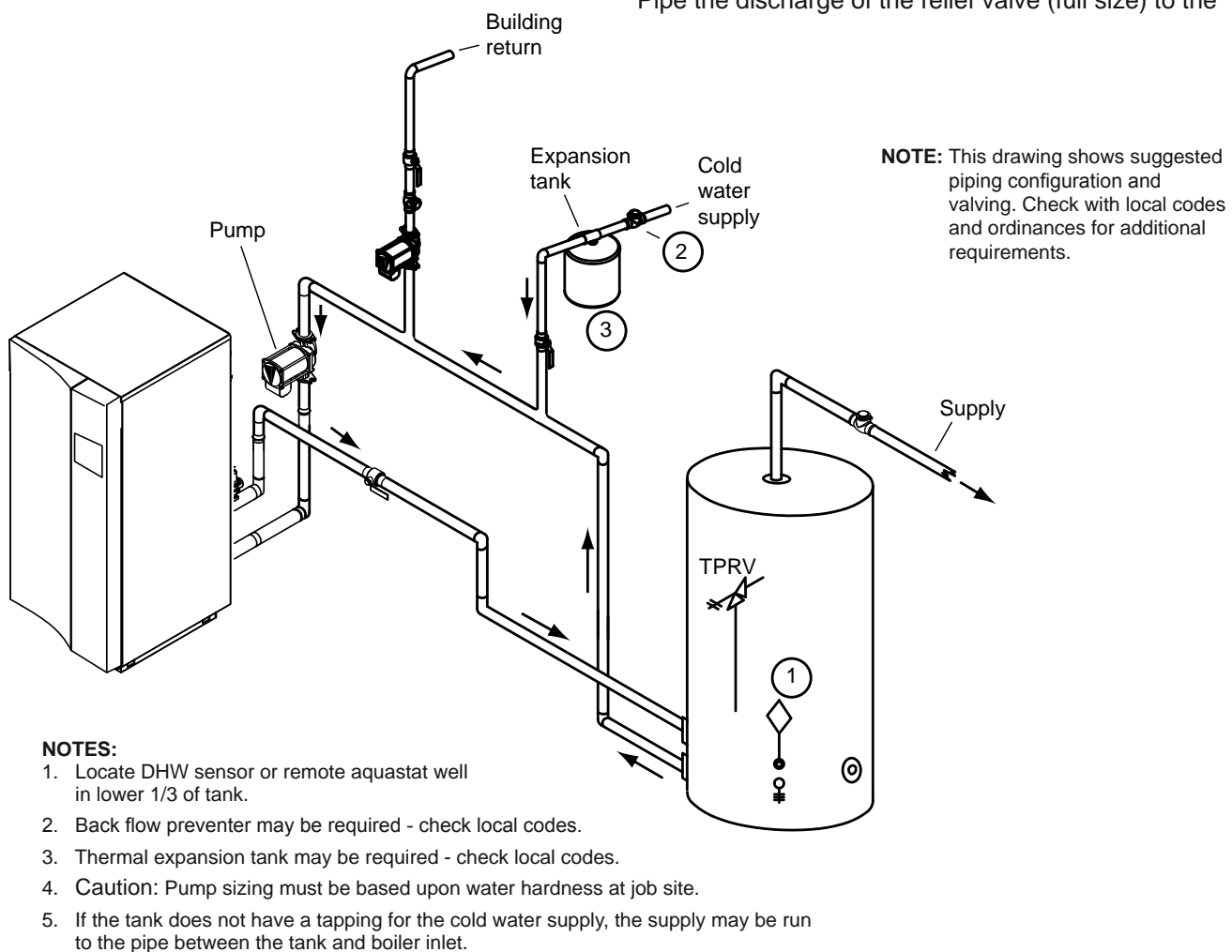


Figure 13. DHW Piping - One Heater, One Vertical Tank

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

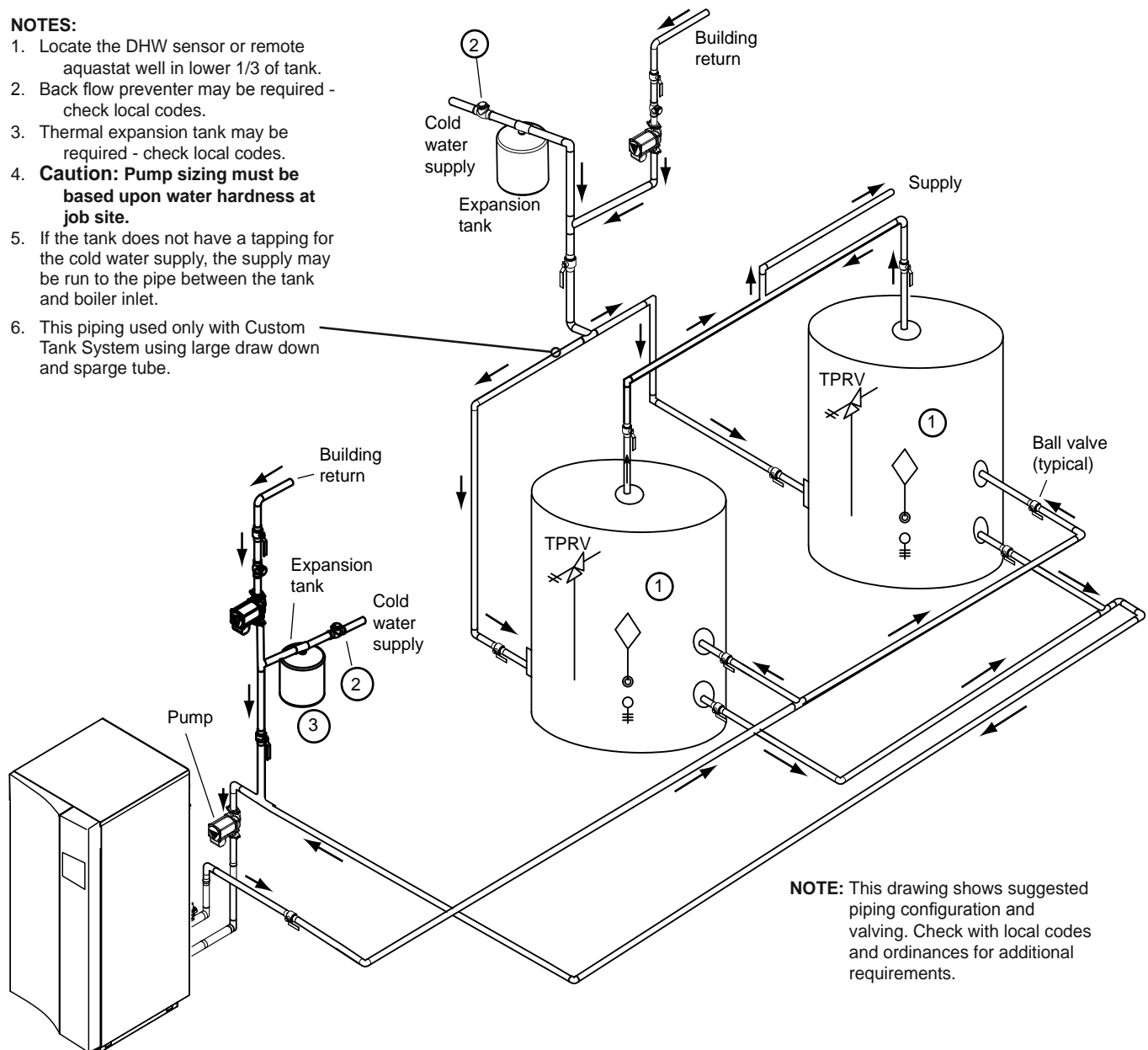
The piping should be installed so that each pump supplies flow only to the heater to which it is attached.

7.4 Cold Water Make-Up

The cold water make-up may be connected to the tank as shown in Figure 13 through Figure 15. If the tank does not have a tapping for the cold water supply, the supply may be run to the pipe between the tank and boiler inlet. Install back-flow preventers and shut-offs where needed or required by code.

NOTES:

1. Locate the DHW sensor or remote aquastat well in lower 1/3 of tank.
2. Back flow preventer may be required - check local codes.
3. Thermal expansion tank may be required - check local codes.
4. **Caution: Pump sizing must be based upon water hardness at job site.**
5. If the tank does not have a tapping for the cold water supply, the supply may be run to the pipe between the tank and boiler inlet.
6. This piping used only with Custom Tank System using large draw down and sparge tube.



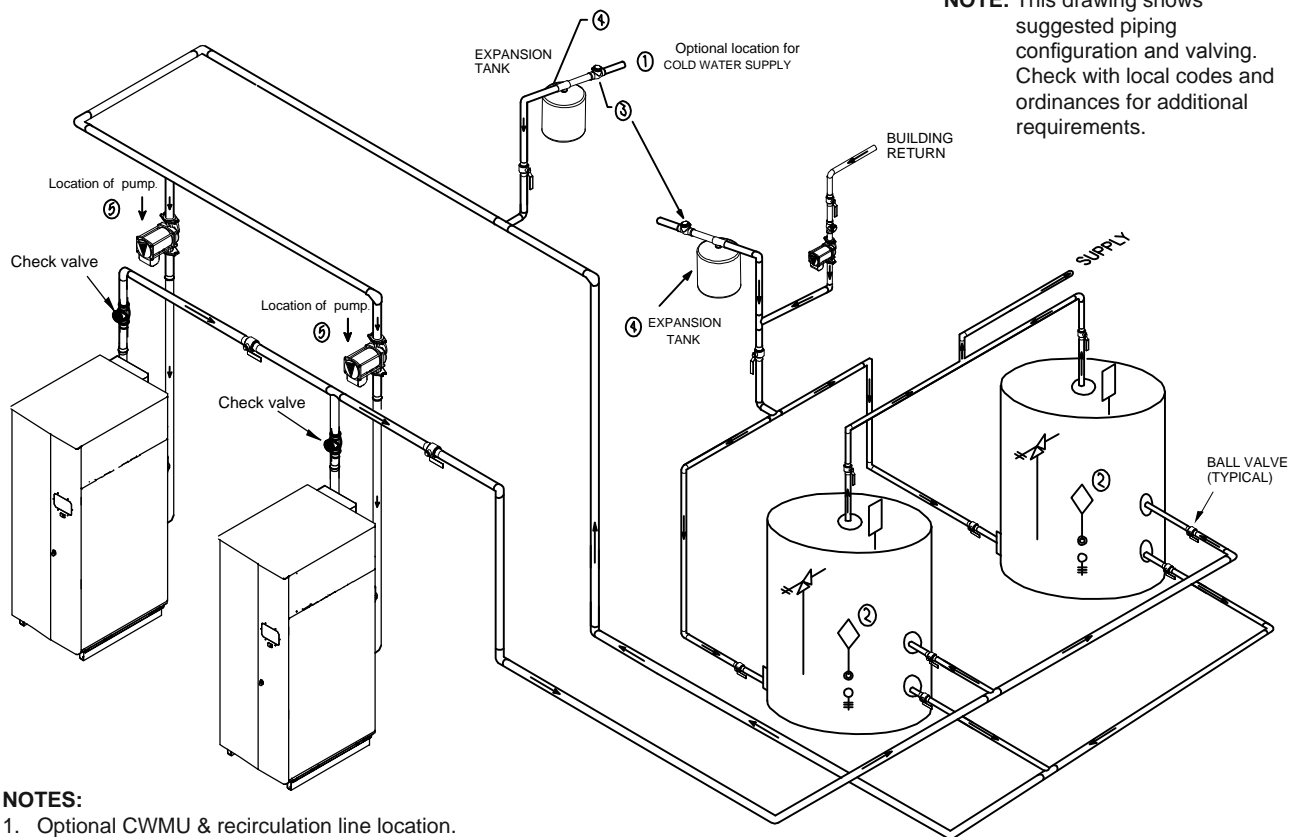
NOTE: This drawing shows suggested piping configuration and valving. Check with local codes and ordinances for additional requirements.

7.5 Freeze Protection

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, component failure or other issue when freezing is likely, the heater and system must be drained to avoid the risk of damage due to freezing. Glycol must **not** be used in volume water heating applications.

Figure 14. DHW Piping - One Heater, Two Vertical Tanks

**NOTES:**

1. Optional CWMU & recirculation line location.
2. Locate NTV DHW sensor or remote aquastat well in lower 1/3 of tank.
3. Back Flow Preventer may be required. Check local codes.
4. Thermal expansion tank may be required. Check local codes.
5. Factory mounted pumps are sized for a max pipe length of 30' total, 6-90° elbows, full pipe size.
6. CAUTION: Pump sizing must be based upon water hardness at job site.

Figure 15. DHW Piping - Two Heaters, Two Vertical Tanks

7.6 Water Flow

See Section 5 for water flow and head requirements.

Note - The head loss for the piping, fittings, and accessories must be calculated and added to the heater head loss to get the total required pump head. An undersized pump will result in insufficient flow. This can result in scale buildup and failure of the heat exchanger.

7.7 Condensate Drain Trap

A condensate drain trap is included with the unit and is designed to drain the unit of condensate. See Figure 2 on page 7. The vent condensate should be drained through a drain tee located in the vent line. This will help prevent excessive condensate from entering the unit at the vent.

The condensate drain must be installed to prevent the accumulation of condensate. When a condensate pump is not used, the tubing must continuously slope downward toward the drain with no spiraling.

Connect a 3/4" PVC pipe between the drain connection and a floor drain (or condensate pump if a floor drain is not accessible).

Consult local codes for the disposal method.

A condensate neutralizer is not included with the unit and yet is almost always used. It is advised that the unit be installed on a raised 4" concrete platform so that there is sufficient elevation for the condensate neutralizer below the included condensate trap. See Figure 8 on page 23

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.**

Section 8

ELECTRICAL CONNECTIONS

8.1 Installation Warnings

CAUTION

The supply voltage to the 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 24V field interlock, 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 field interlock terminals. Some Unit components are designed to have constant voltage during normal operation. If the Unit's supply voltage is toggled as a call for heat signal, premature failure of these components may result.

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.

8.2 Main Power Connections

This unit is provided with an electrical junction box in the rear panel for main power connections. See Figure 17. 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 3 phase versions. Refer to the rating plate for appropriate voltage and current ratings. See Table 19

As a common industry practice, the manufacturer has color coded the single and three phase wires.

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.

All power connections must be run through the back panel as shown in Figure 17.

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.

8.3 Pump Connections and Operation

The controller in the MagnaTech energizes the appropriate pump contacts when it receives a call for heat. Once the call for heat is satisfied, the pumps will remain on for the defined pump overrun time.

The Boiler, System, and DHW pump terminals are found on the Main control board TB1-15A through 20A. They are fed 120 Volts internally from the main power feed. The current rating of the contacts

is 7.4 amps, and an appropriately sized contactor must be supplied and installed by a qualified technician to ensure proper pump operation. Once the system has been installed, the “Pump Configuration” menu will allow the installer to adjust Pump control, Overrun time and Demand control for the various pumps in the system.

Size	1600			2000					
Voltage	120	240/220	208 1Φ	120	240/220	208 1Φ	208 3Φ	480	600
FLA	6.2	3.4	3.6	18.6	10.1	12.5	7.5	3.5	4.4
MCA	7.8	4.2	4.5	23.3	12.7	15.6	9.4	4.4	5.5
MOP	20	15	15	30	25	25	15	15	15

Size	2500/3000			3500/4000		
Voltage	208 3Φ	480 3Φ	600 3Φ	208 3Φ	480	600
FLA	9.5	4.4	3	9.9	3.6	4.5
MCA	12	6	4	12	5	6
MOP	20	15	15	20	15	15

Full Load Amperage
Minimum Circuit Ampacity
Max Over-current Protection

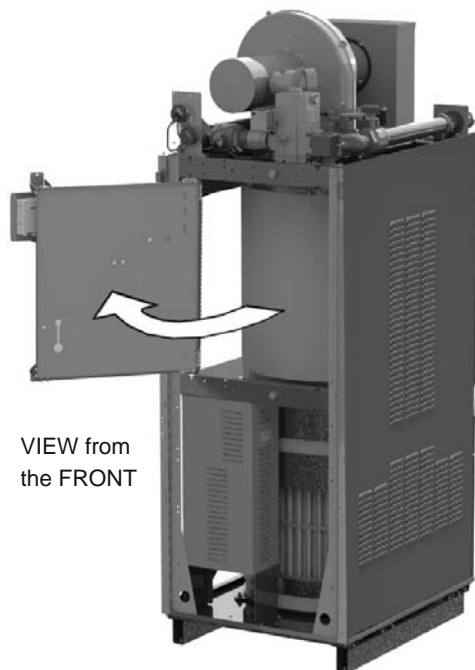
Table 18. Electrical Data

Single Phase				Three Phase			
	120	240	208		600	480	208
L1	Blk	Blk	Blk	L1	P	BR	Blk
L2	Wht	Red	Red	L2	V	O	Red
				L3	T	Y	BL

Table 19. Phase Voltage Color Identification

⚠ Caution

The supply voltage to the unit must not be disengaged, except for service or isolation, or unless otherwise instructed by procedures outlined in this manual. To signal a call for heat, use the correct terminals as instructed in Section 8.



VIEW from
the FRONT

Figure 16. The Control Panel hinges forward

⚠ Notice

When running the Power and Field Connection wirings between the units (Lead Lag, System Sensor, Outdoor Sensor, Building Automation, Etc), ALWAYS Exit and Enter the units through the lower back panels so that during future servicing, the wires are not in the way and do not have to be disconnected in order to remove the top and side panels.

⚠ Attention

Lors de l'exécution du domaine d'alimentation et les fils électriques de connexion entre les unités (Lead Lag, Capteur, système capteur extérieur, domotique, etc), TOUJOURS quitter et entrer les unités à travers la partie inférieure arrière de sorte qu'au cours de l'entretien futur, les fils ne sont pas dans la voie et n'ont pas à être déconnecté afin d'enlever le haut et le côté.

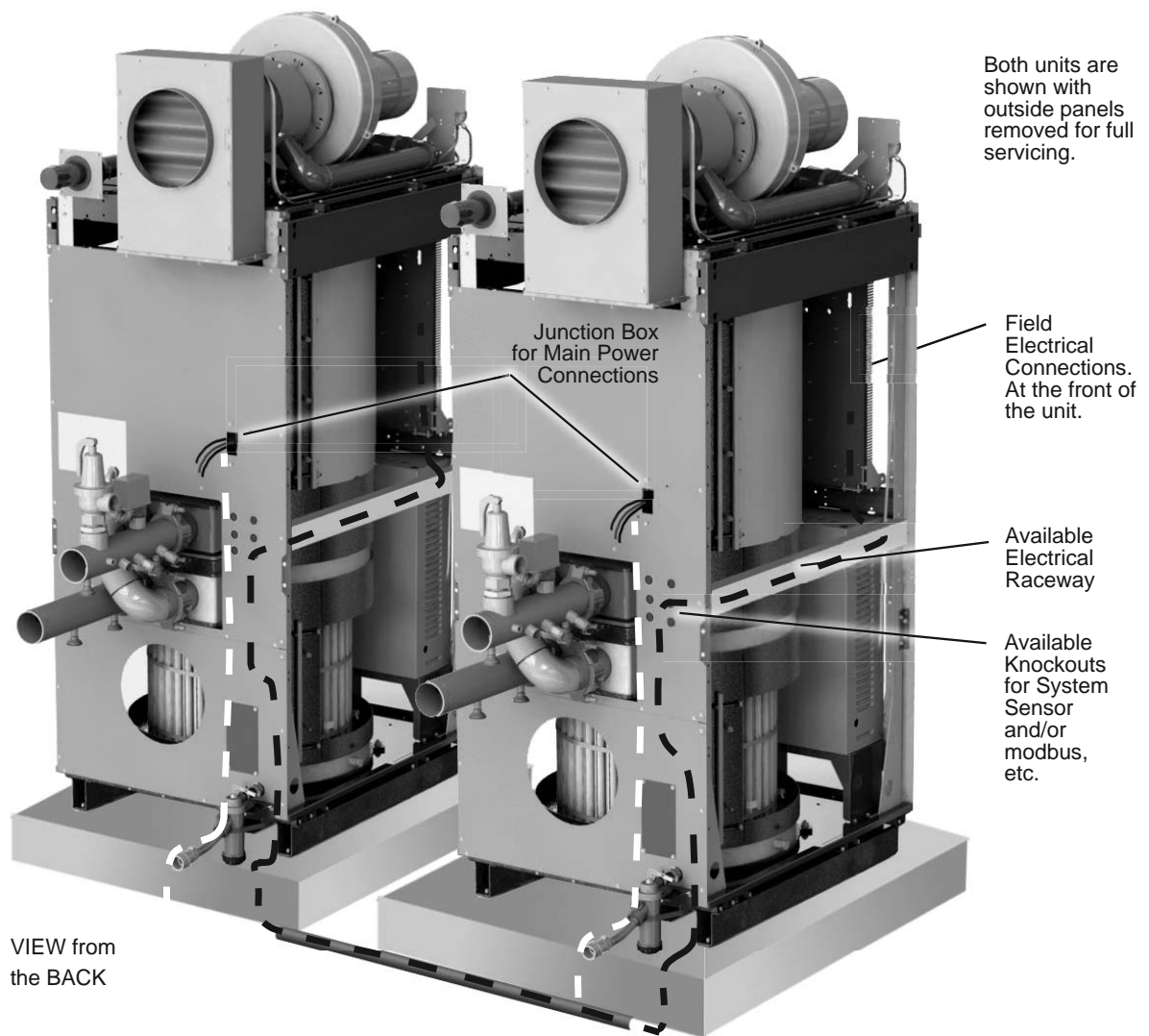


Figure 17. All power and wiring through back panel!

8.4 Field Wiring

Field wiring for cascading and systems sensors must be run along the inside face of the available electrical raceway to the back of the unit.

See Figure 17.

When running the Field Connection wiring between the units in a cascading installation (Lead Lag, System Sensor, Outdoor Sensor, Building Automation, Etc), **ALWAYS** Exit and Enter the unit through the lower back panels. so that during future servicing, the wires do not have to be disconnected in order to remove the top and side panels.

It is up to the electrician to install all power and system wiring as per codes and best practices.

The Control panel pulls forward for easy access of wiring (See Figure 16). Do not run any wiring to the right as this will restrict the opening ability of the Control panel.

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 appliance must be electrically grounded in accordance with these codes.

8.5 Field Connections for Single unit installations.

Power for Field Connections must be made at Terminal Board 1 at the front of the unit (15 thru 45 of TB1). See Figure 18 and Figure 19

For single unit installations, the connections for System Sensor, Outdoor Sensor, Call for Heat, and DHW are as marked on TB1.

8.6 Field Connections for Lead / Lag installations.

For Lead / Lag installations, there are 3 possible installation scenarios.

1. Central Heat Only. Jumper on 25/26.
System Sensor on 21/22.
Outdoor Sensor on Lag (Slave) boiler's 21/22 (OUTDOOR/SYS)
2. DHW Only Jumper on 25/26.
Tank Sensor on 21/22.
NO Outdoor Sensor is used.
3. Central Heat AND
DHW Jumper on 25/26.
System Sensor on 21/22.
DHW Tank Sensor on 31/32
Outdoor Sensor on Lag (Slave) boiler's 21/22 (OUTDOOR/SYS)

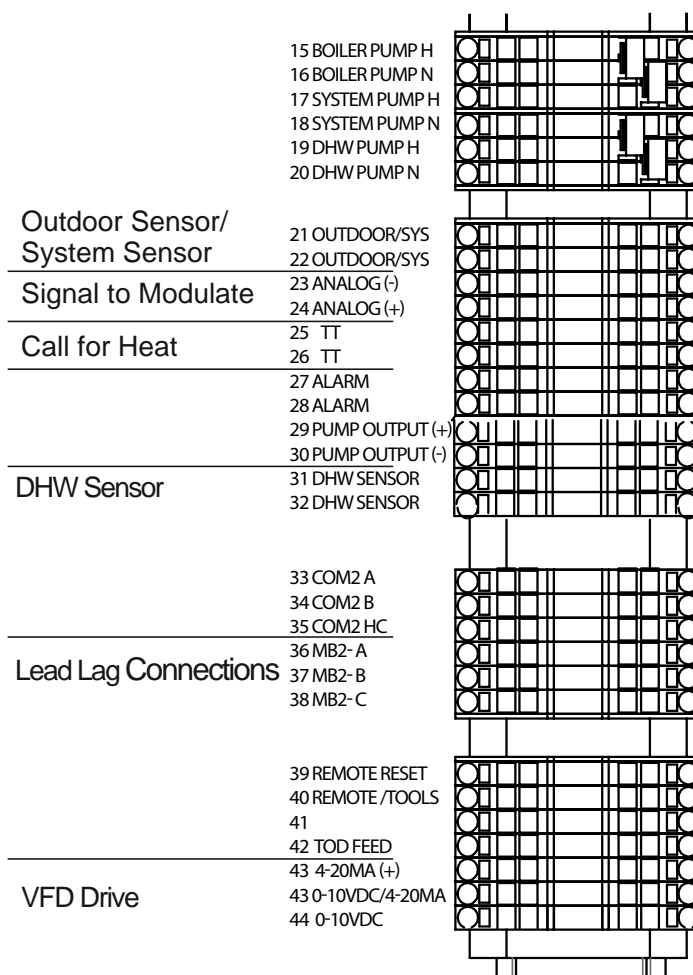


Figure 18. Field Connections (on TB1)

8.7 Control Panel Layout

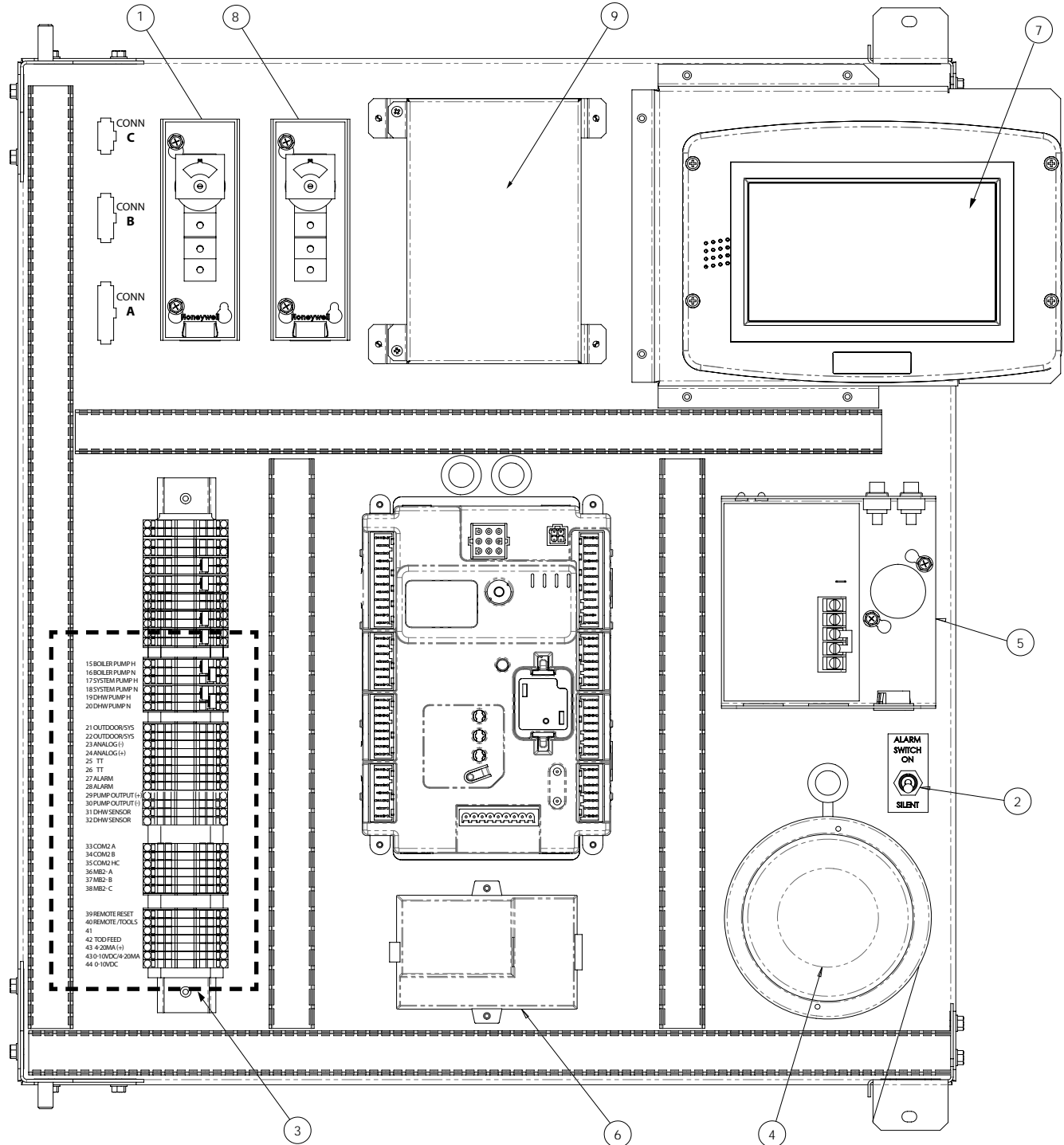


Figure 19. Control Panel Layout

**WARNING**

When servicing the controls, label all wires prior to disconnection. Wiring errors can cause improper and dangerous operation. Verify proper operation after servicing.

VARI-PRIME PRINTED CIRCUIT BOARD KIT	9
AUTO-RESET HIGH LIMIT CONTROL	8
TOUCH SCREEN	7
BAS GATEWAY (optional)	6
LOW WATER CUT-OFF	5
ALARM BELL (optional)	4
TB1 includes FIELD CONNECTIONS	3
ALARM SILENCE SWITCH	2
MANUAL RESET HIGH LIMIT	1

8.8 Building Automation System Connections

This commercial unit can be controlled and monitored with a Gateway BAS using the included Modbus ports. **Doc# 4236.** The Gateway Modbus Control (H2354400) for BACnet MS/TP, BACnet/IP, Modbus TCP/IP, Metasys N2 and LonWorks.

Connect the Gateway Control to the COM2 A, B, and C, as shown in Figure 20.

See page 73 for configuration setup within the touchscreen display.

Lead Unit

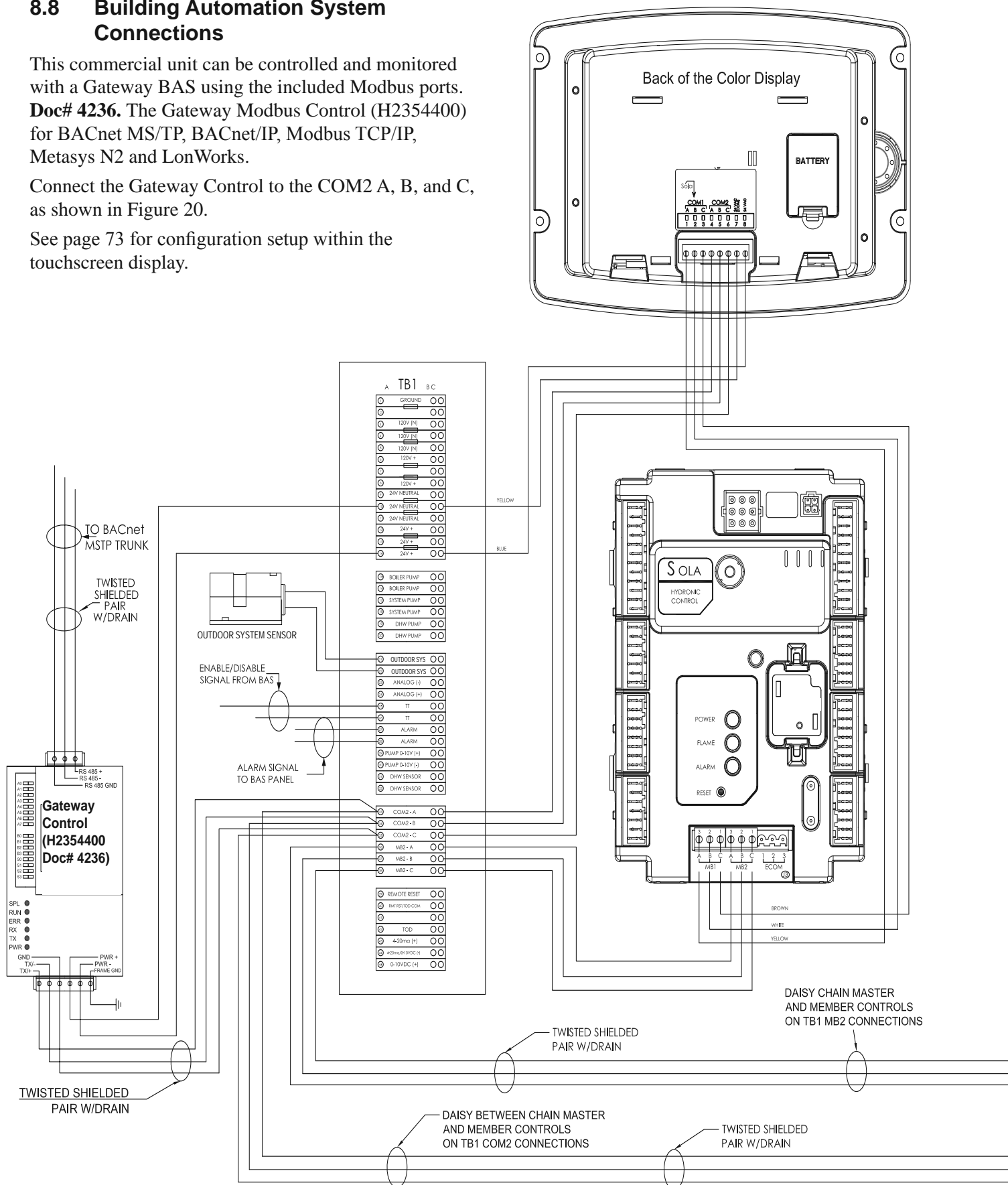


Figure 20. Wiring Diagram for Lead Lag, with Gateway included.

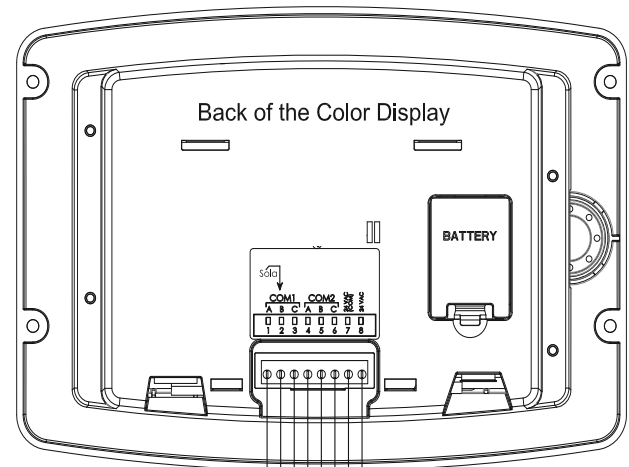
8.9 Lead Lag Connections

This commercial unit can be connected in Lead Lag up to a total of 8 units (controllers). One as the Lead control and up to 7 more as the Lag controllers.

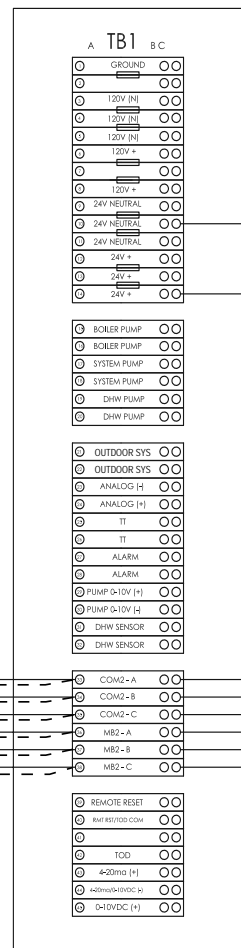
For Lead Lag Connections, COM2 A, B, and C must be connected together AND the MB2 A, B, and C must also be connected together, as shown in Figure 20.

See page 69 for configuration setup within the touchscreen display.

Lag Unit/s

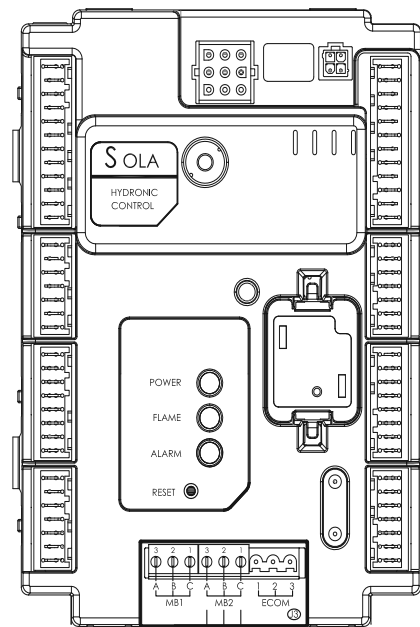


DISCONNECT DISPLAY
POWER AT TB1 TERM 14



YELLOW

BLUE



UNPLUG SLAVE DISPLAY
MODBUS CONNECTION;
LEAVE THE CONNECTOR
PLUG IN PLACE FOR
FUTURE SERVICE

TO LAG UNITS 3 THRU 8 (TYP)

COM2 - A

COM2 - B

COM2 - C

MB2 - A

MB2 - B

MB2 - C

8.10 Wiring Diagrams

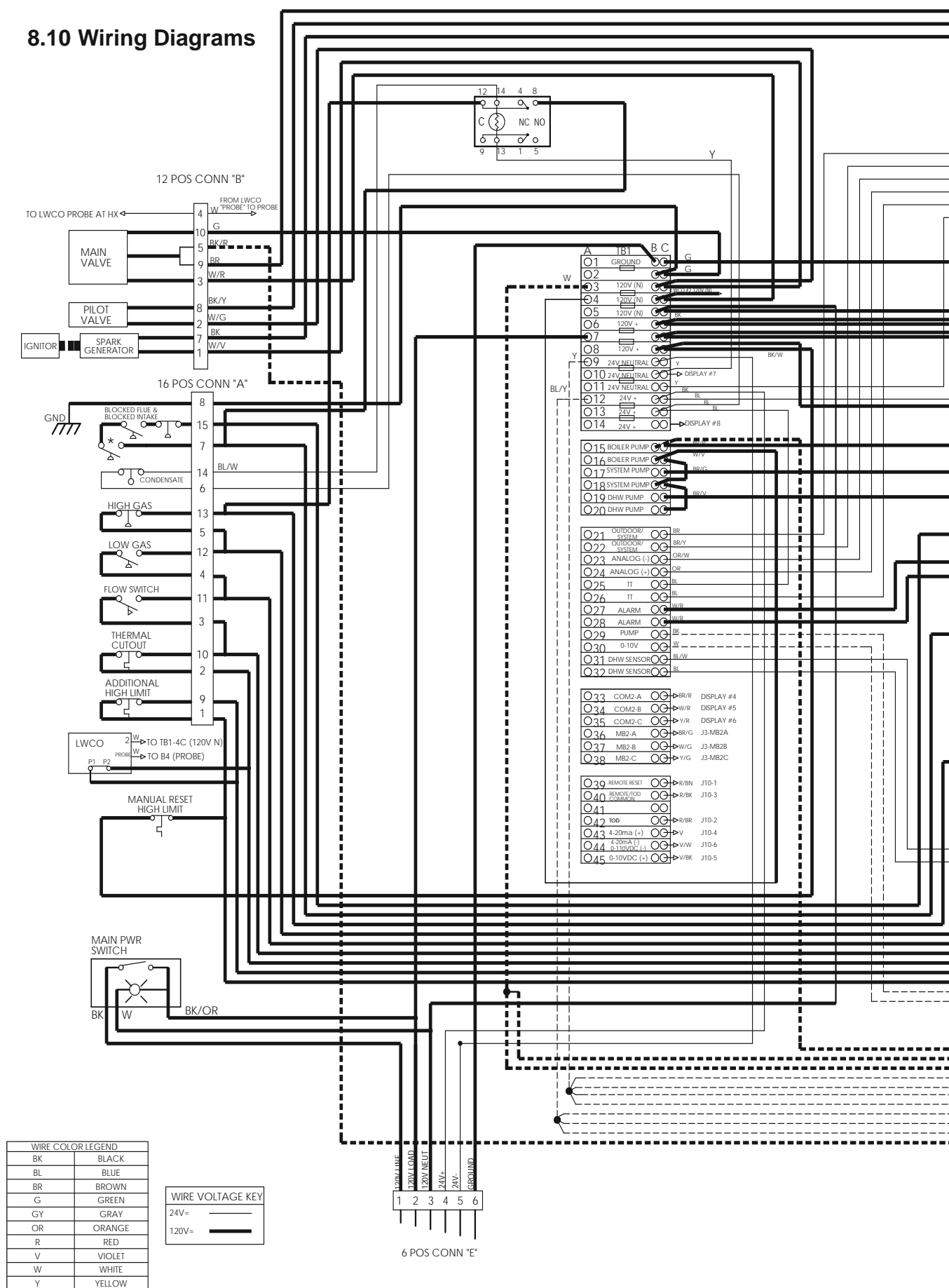
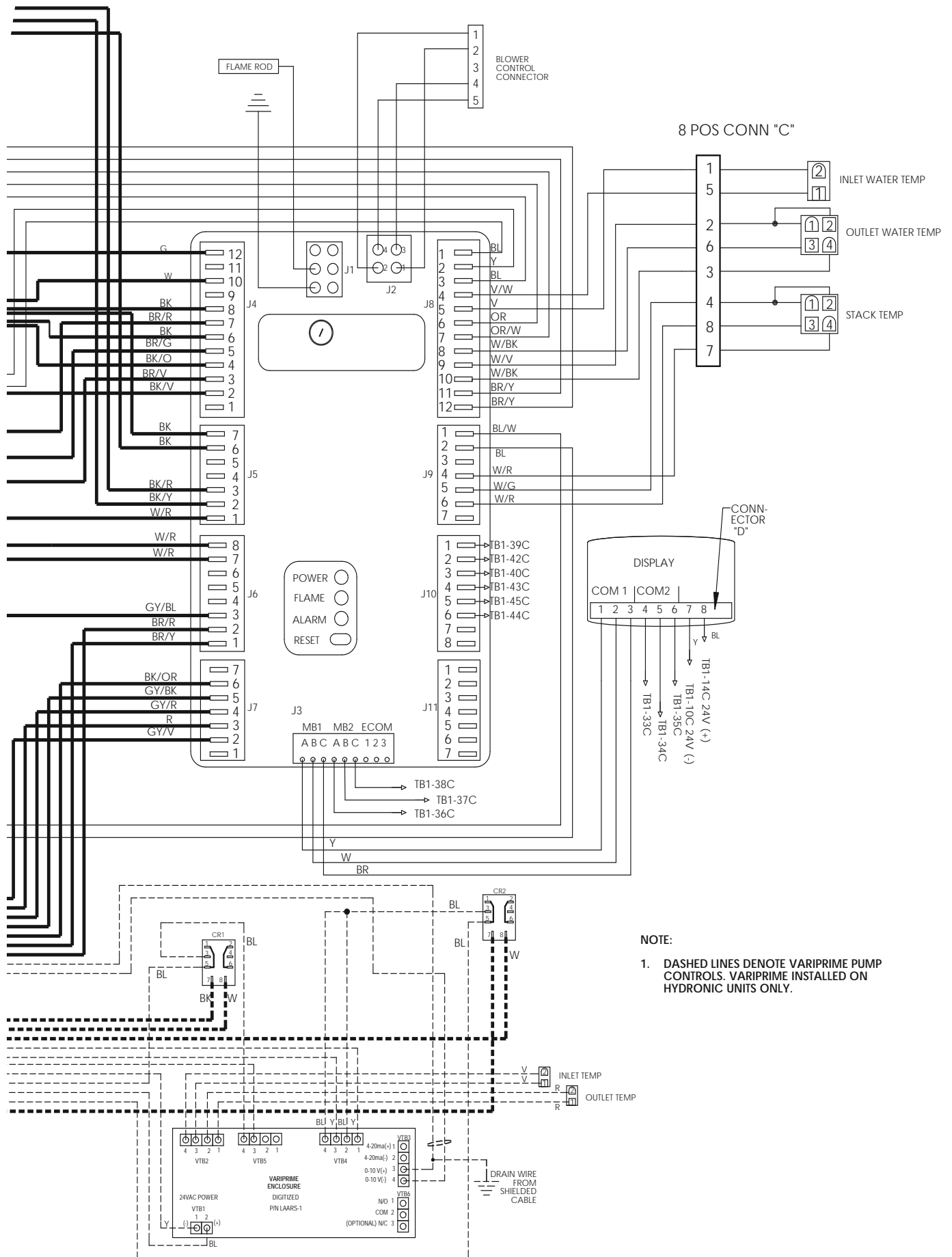


Figure 21. Wiring Diagram, Model 1600 Page 1 of 2



8.10 Wiring Diagrams (continued)

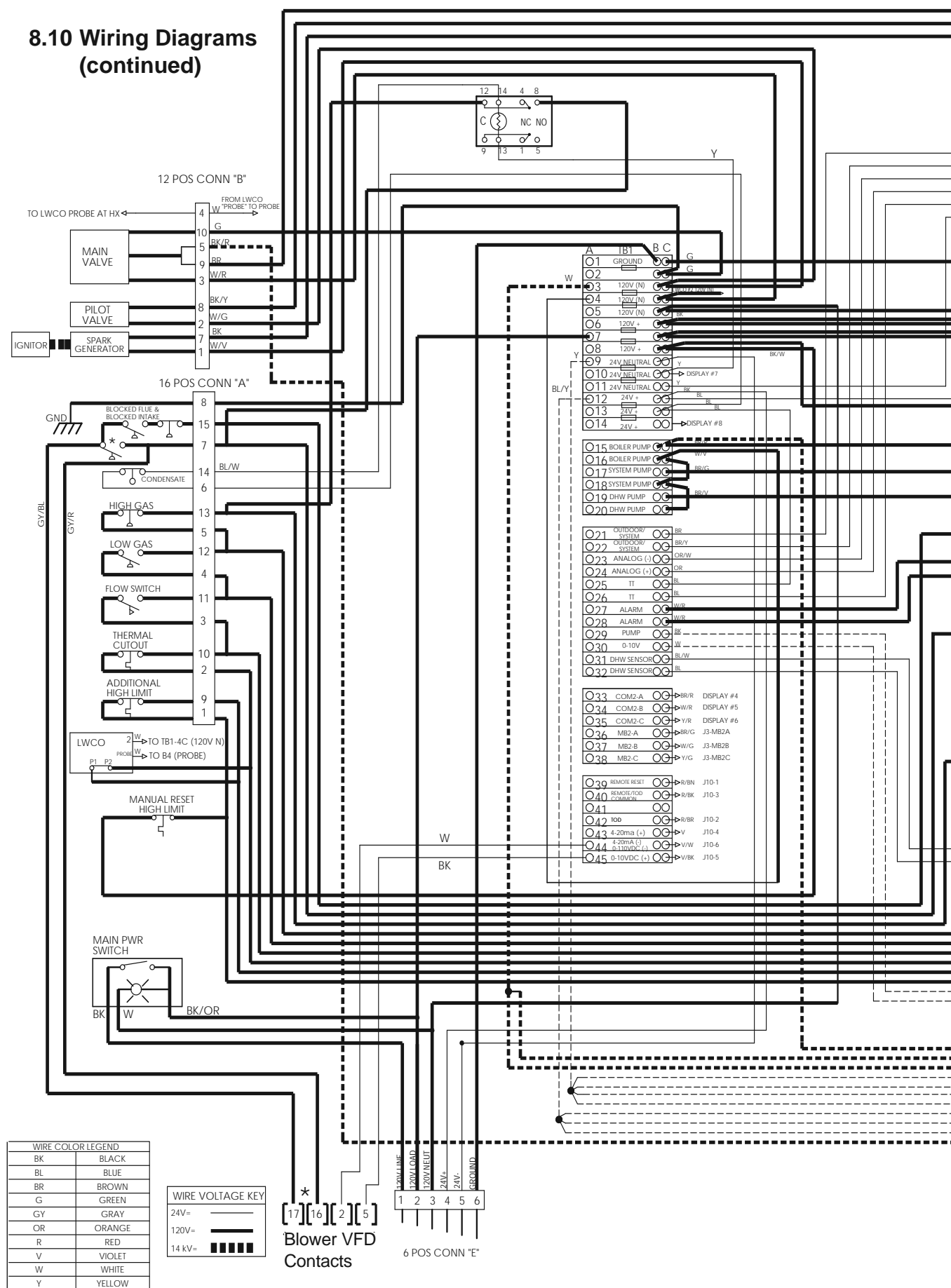


Figure 22. Wiring Diagram, Model 2000 thru Model 4000

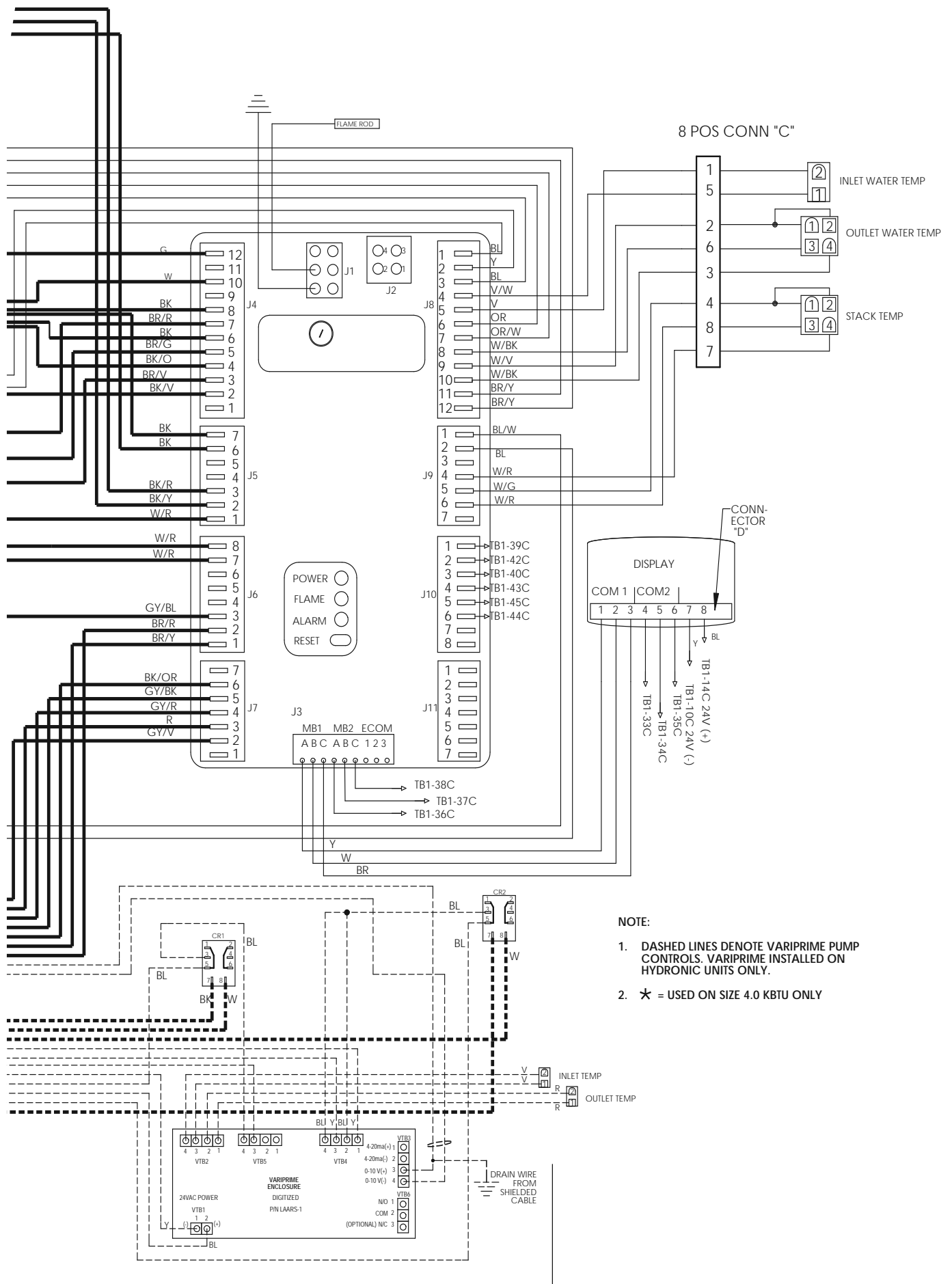
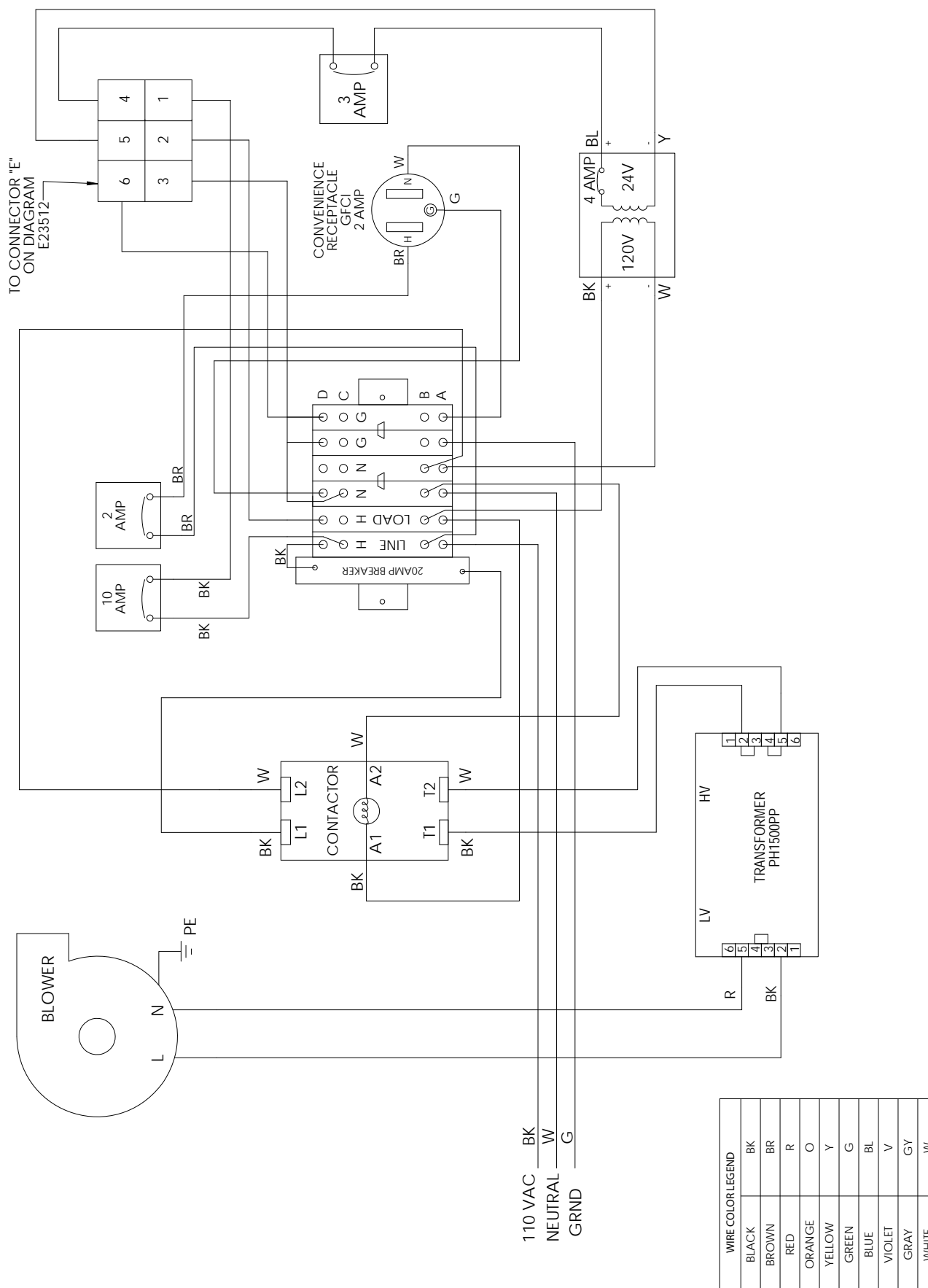


Figure 23. High voltage wiring diagram Model 1600, 120V



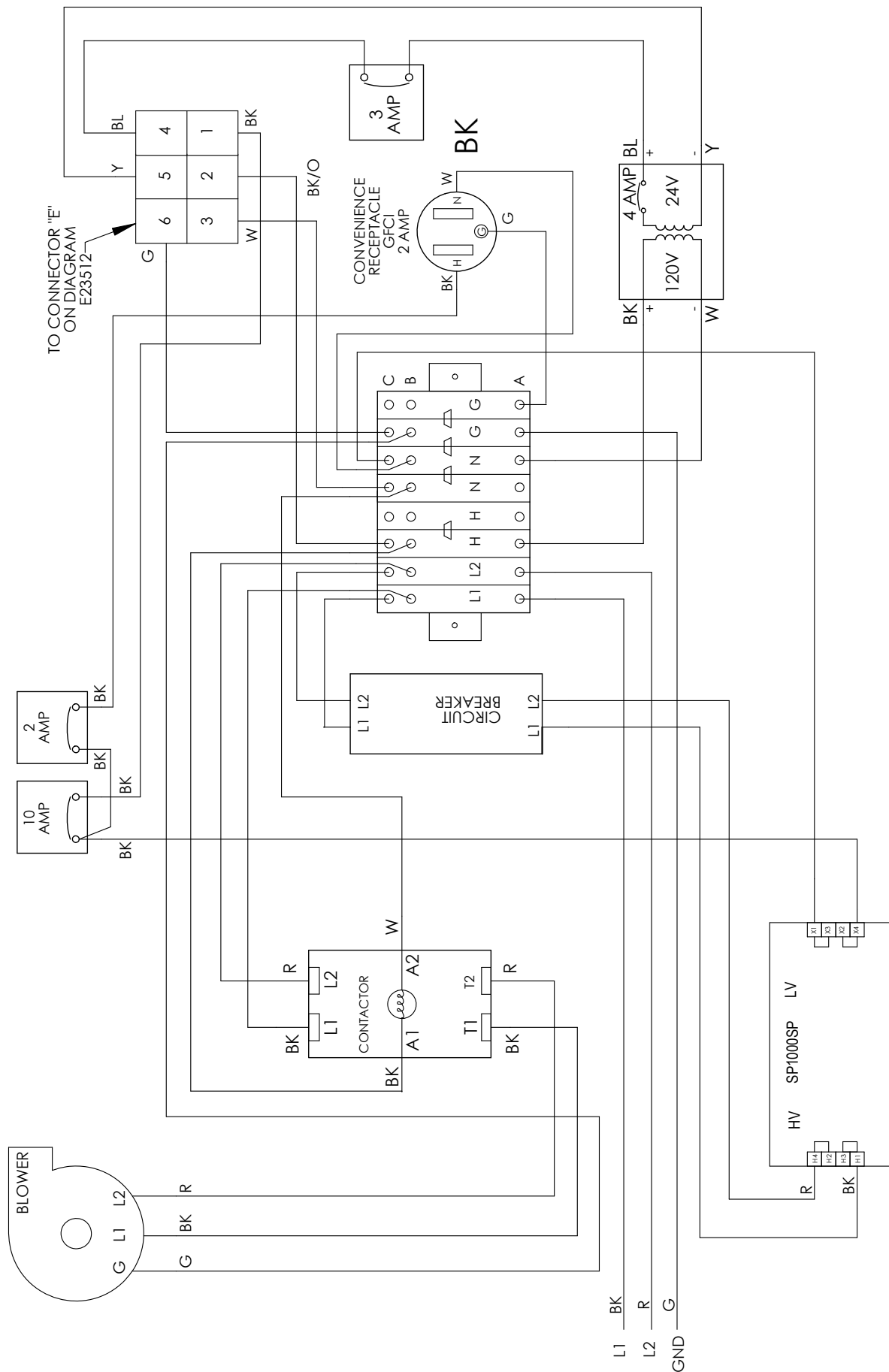


Figure 24. High voltage wiring diagram Model 1600, 208V Single Phase

8.11 High Voltage Wiring Diagrams (continued)

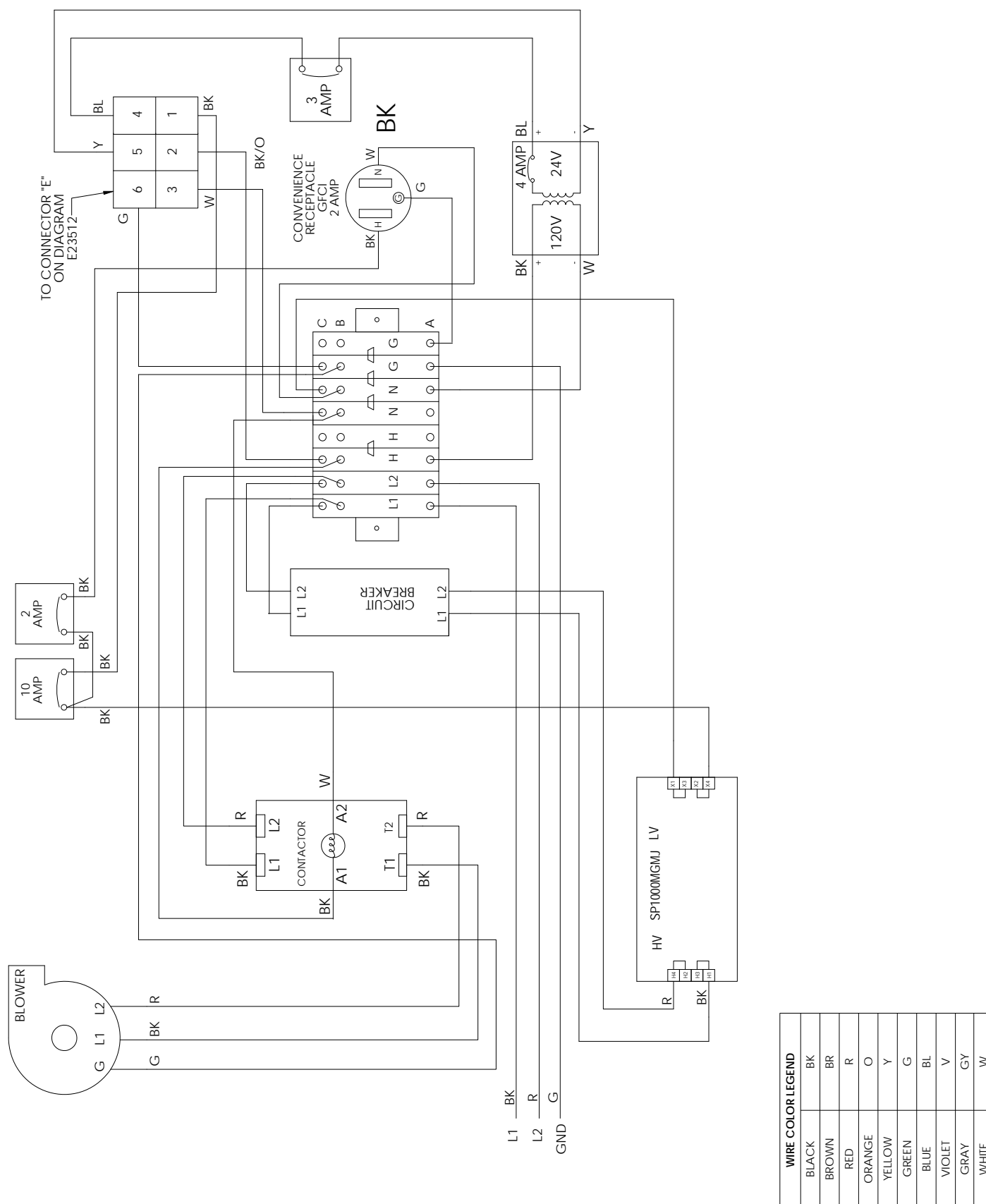


Figure 25. High voltage wiring diagram Model 1600, 240V

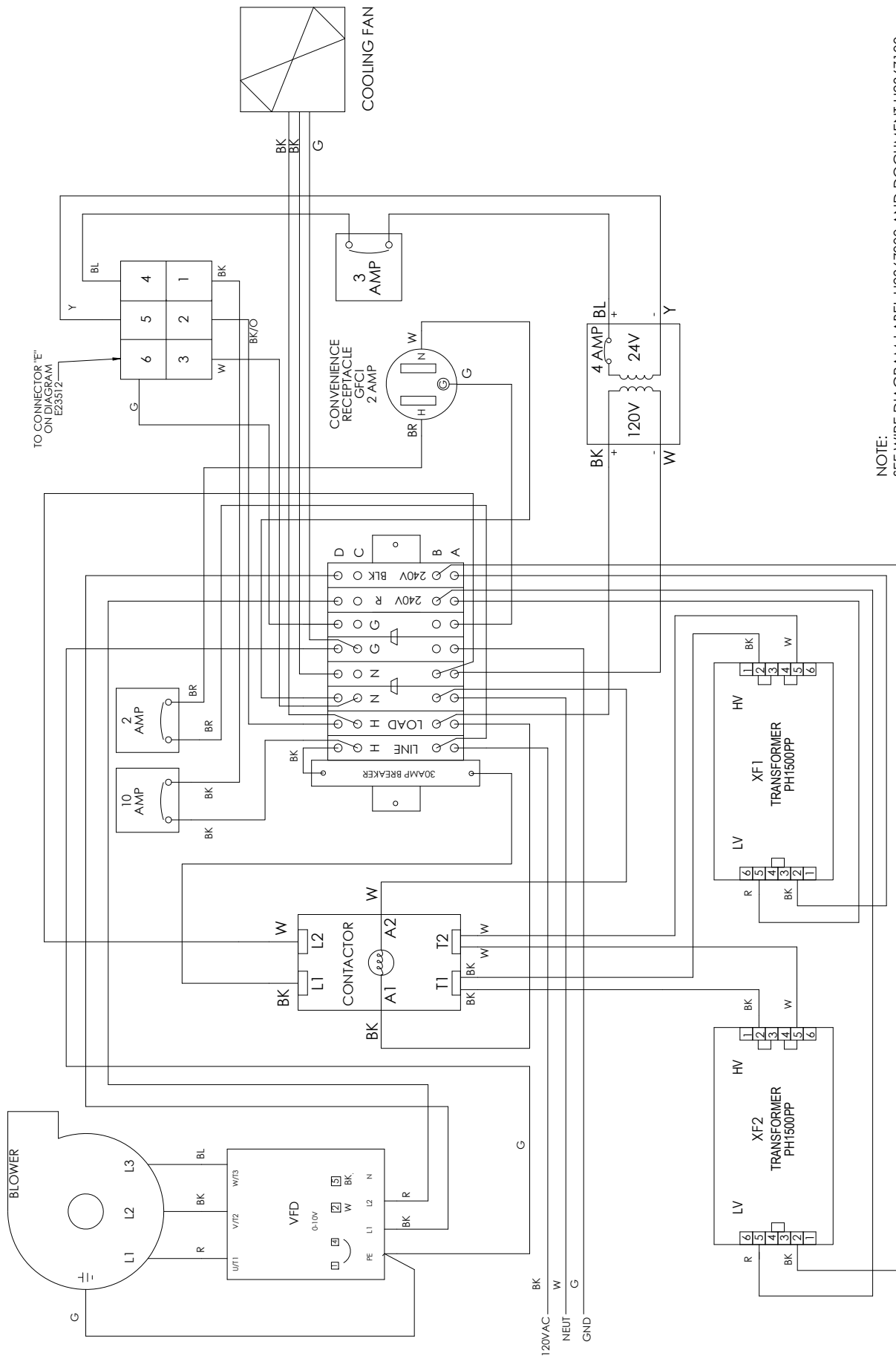


Figure 26. High voltage wiring diagram Model 2000, 120V

8.11 High Voltage Wiring Diagrams (continued)

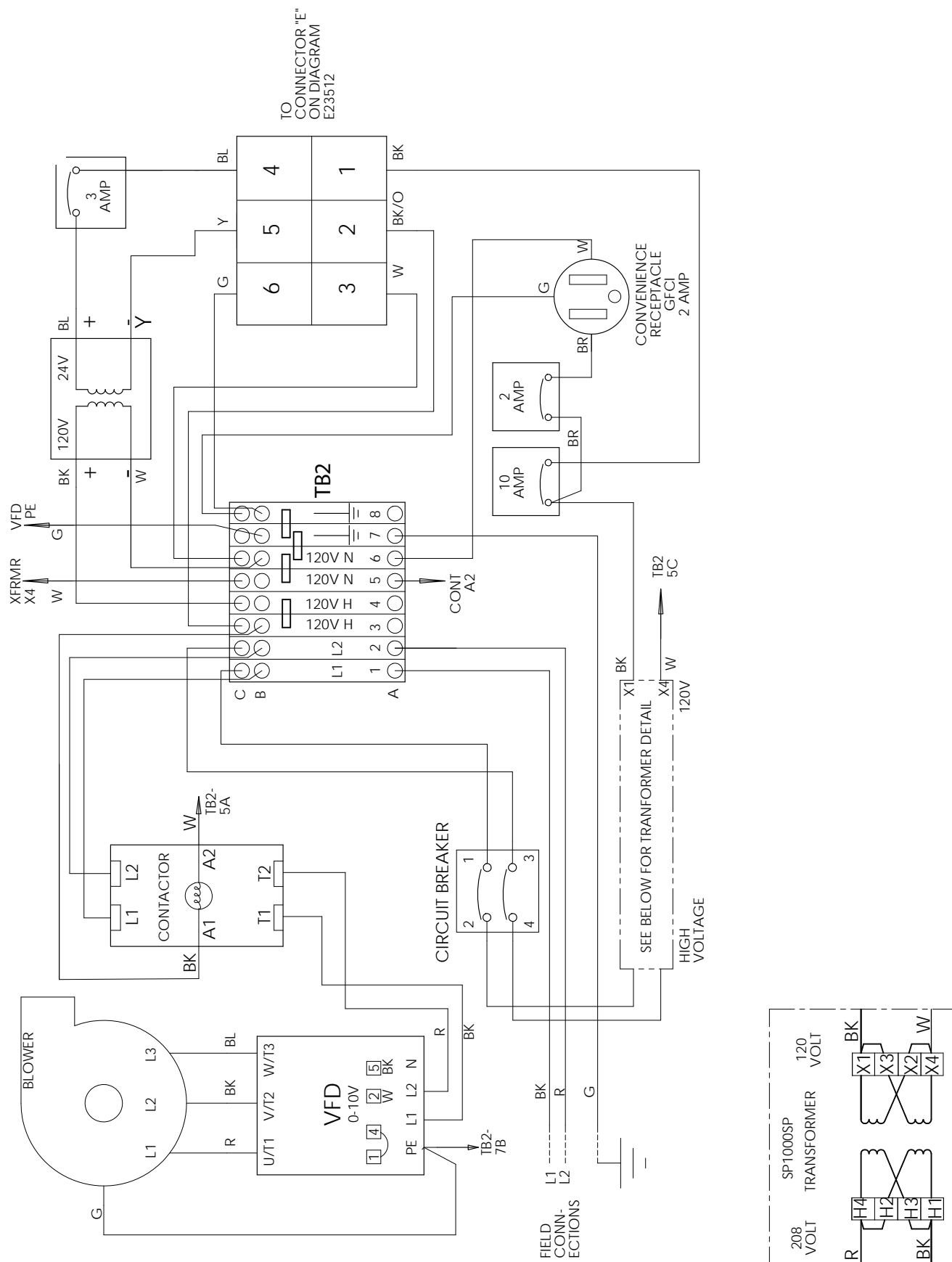


Figure 27. High voltage wiring diagram Model 2000, 208V Single Phase

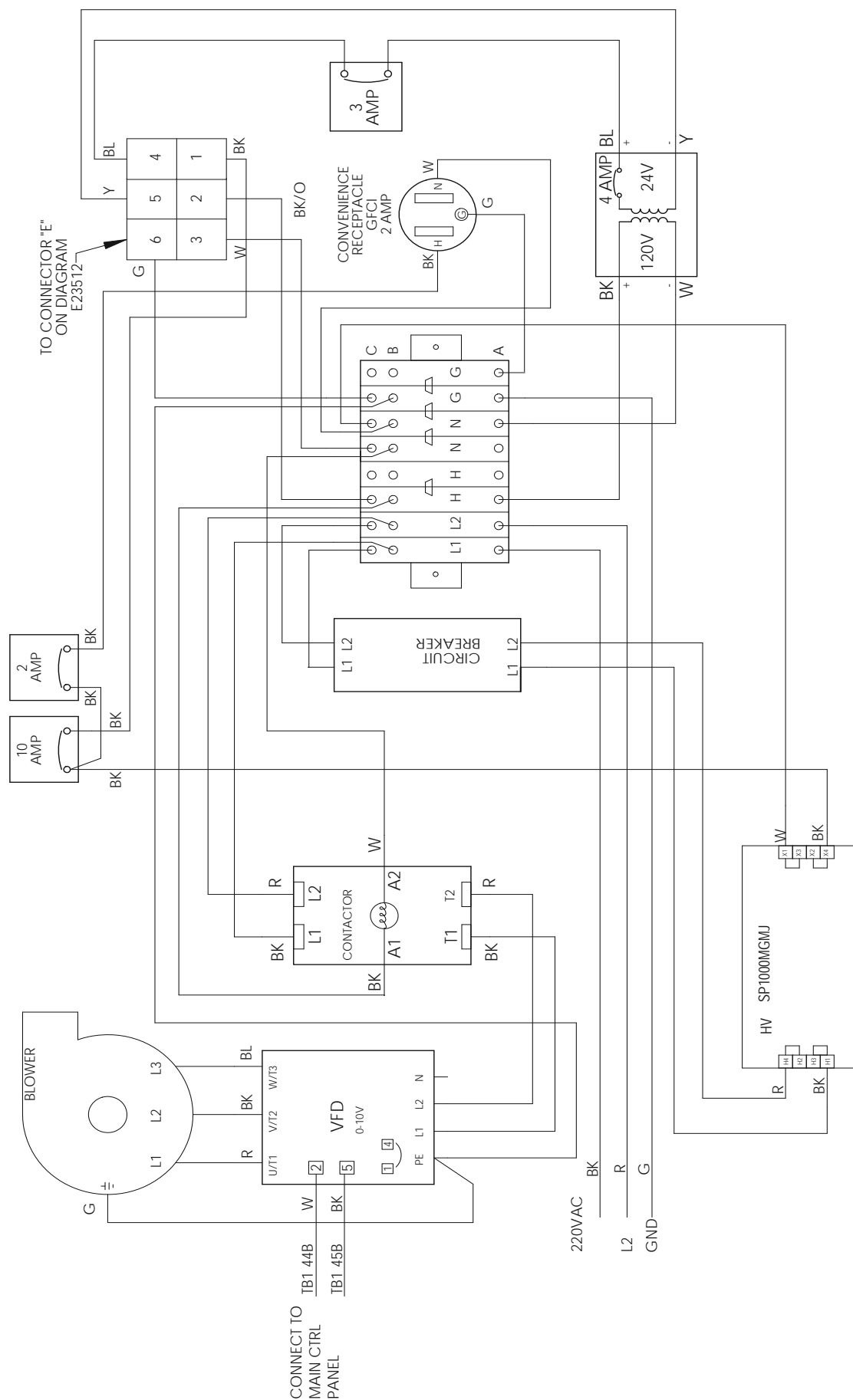


Figure 28. High voltage wiring diagram Model 2000, 240V

8.11 High Voltage Wiring Diagrams (continued)

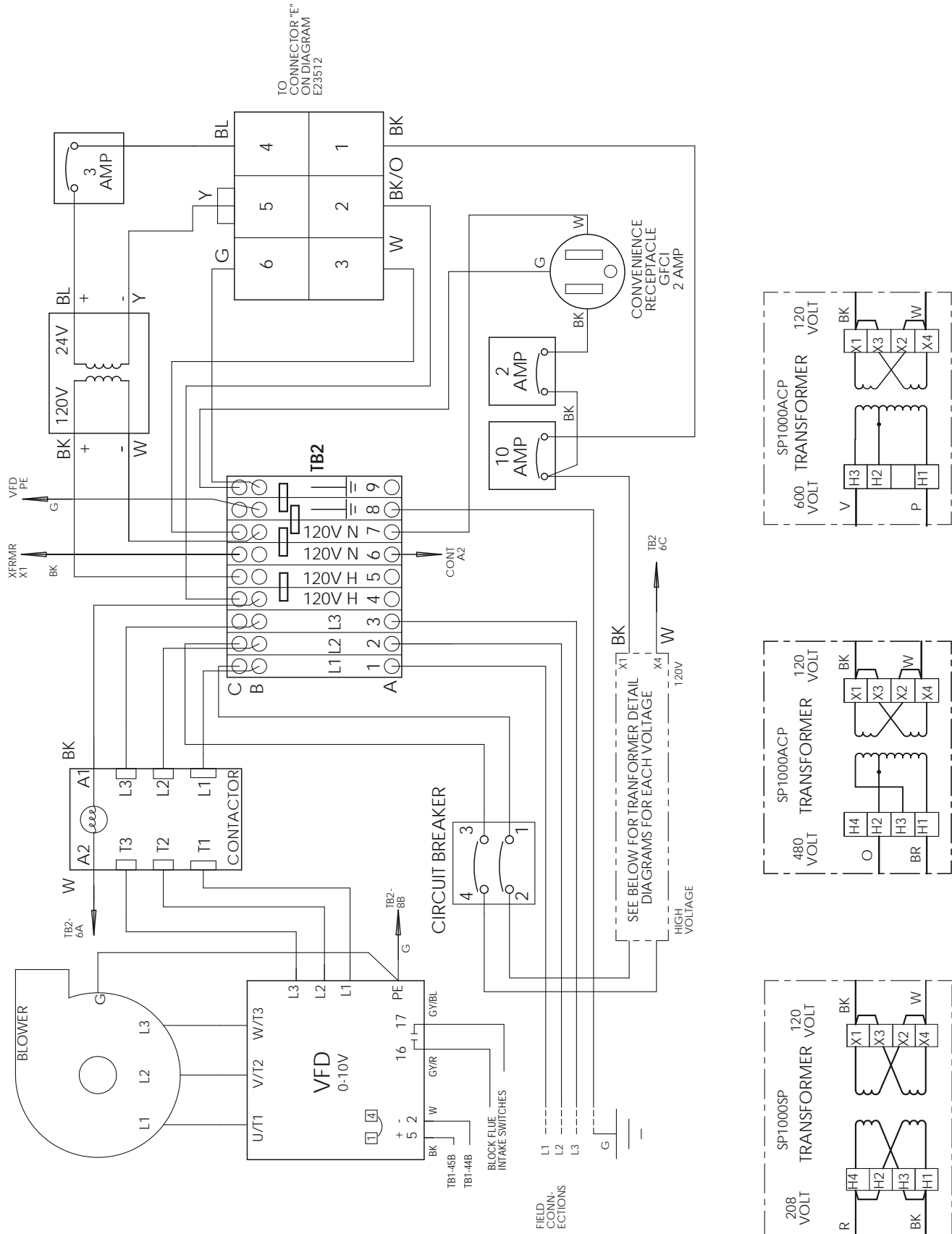


Figure 29. High voltage wiring diagram Model 2000 - 4000 three phase

8.12 Ladder Diagrams

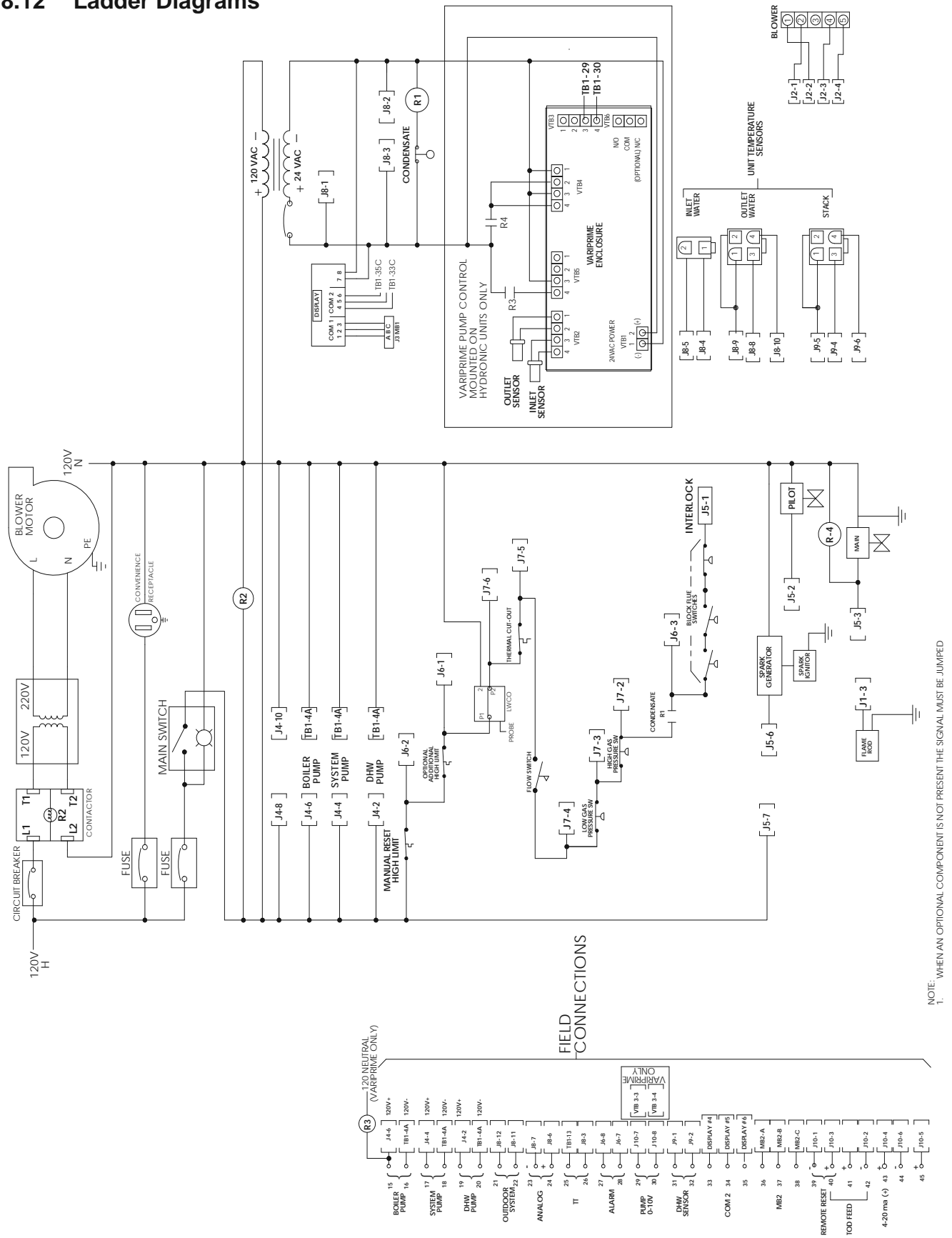


Figure 30. Model 1600 120V ladder diagram

8.12 Ladder Diagrams (continued)

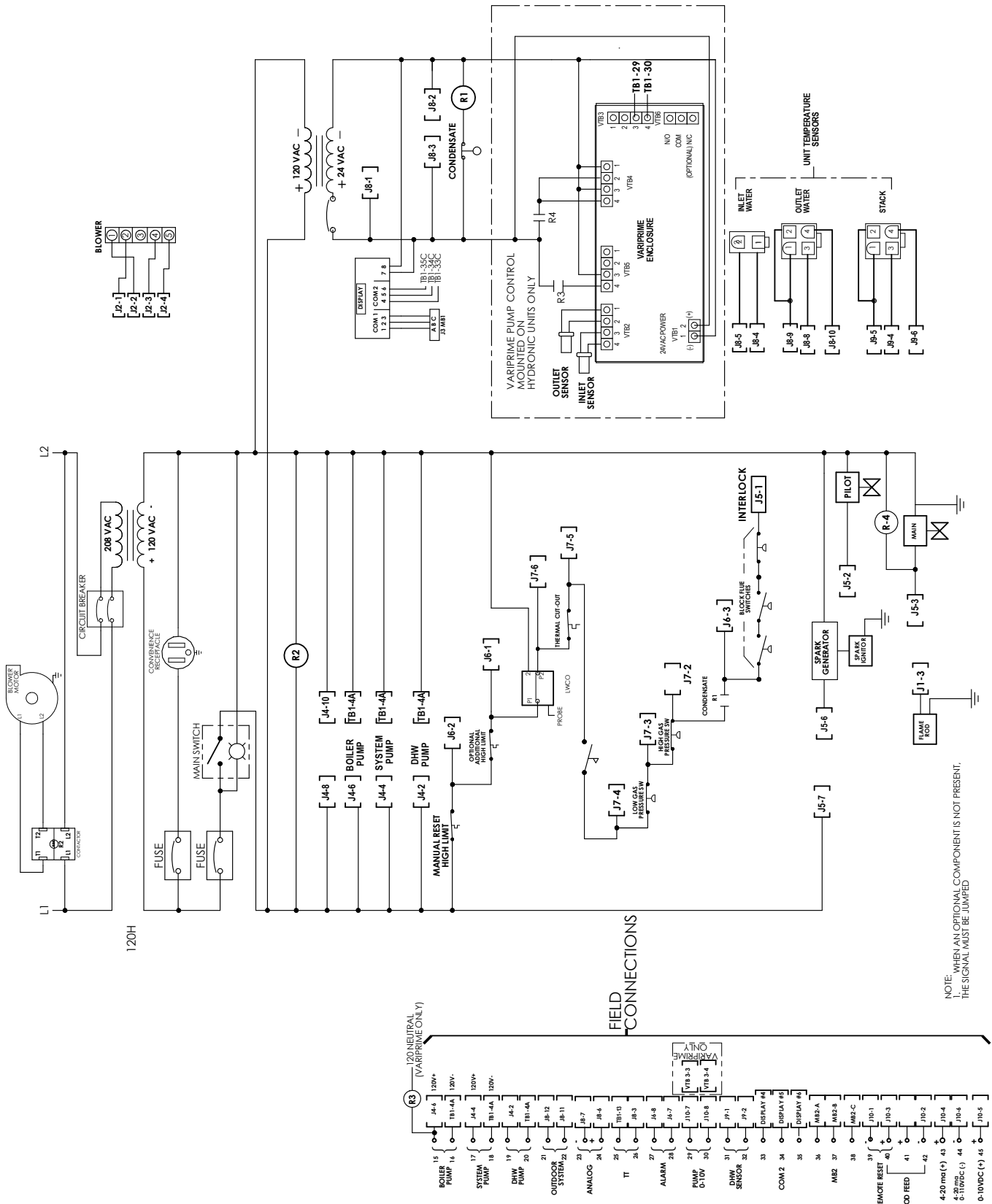


Figure 31. Model 1600, 208V, 1 Phase, ladder diagram

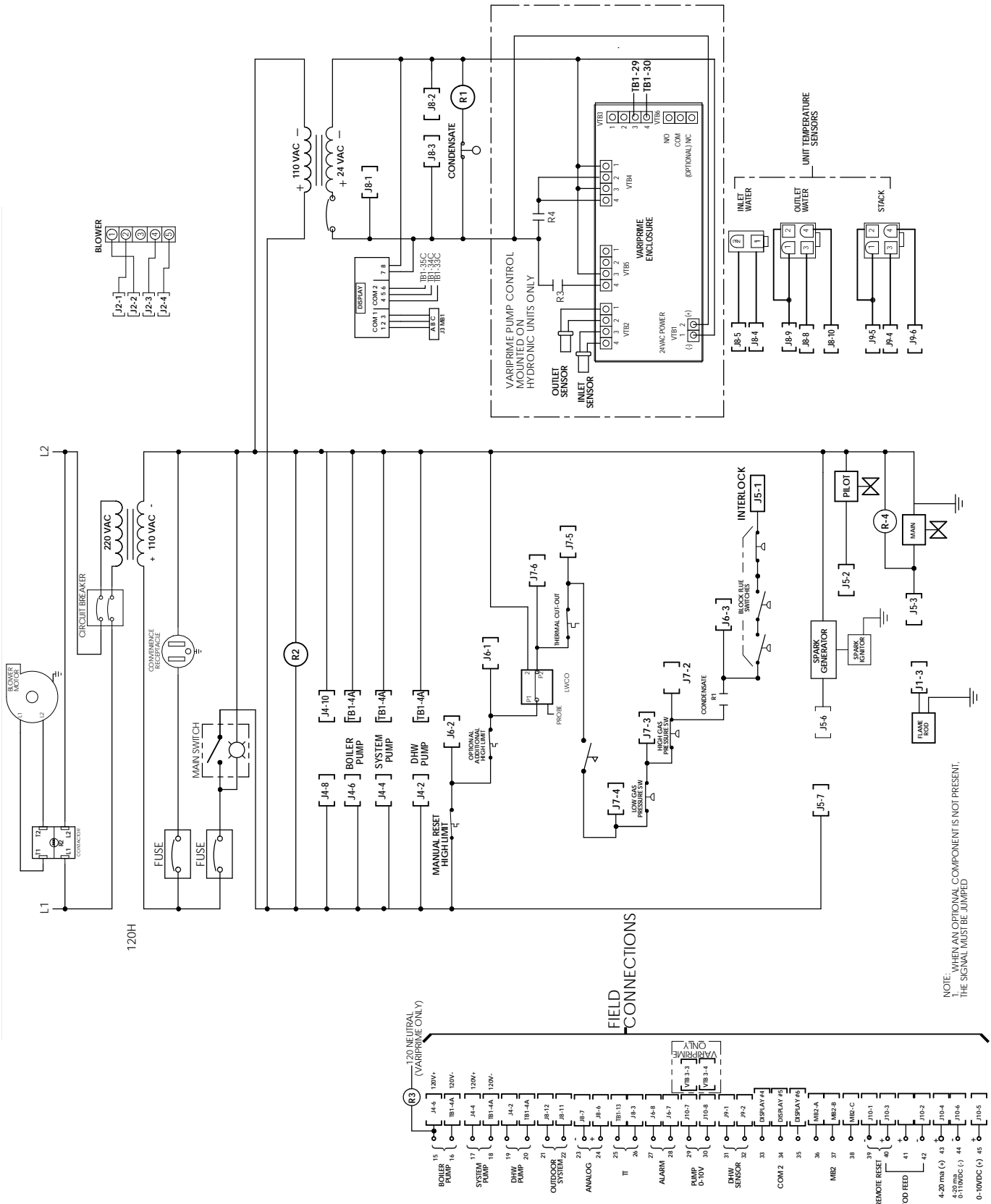


Figure 32. Model 1600 240V ladder diagram

8.12 Ladder Diagrams (continued)

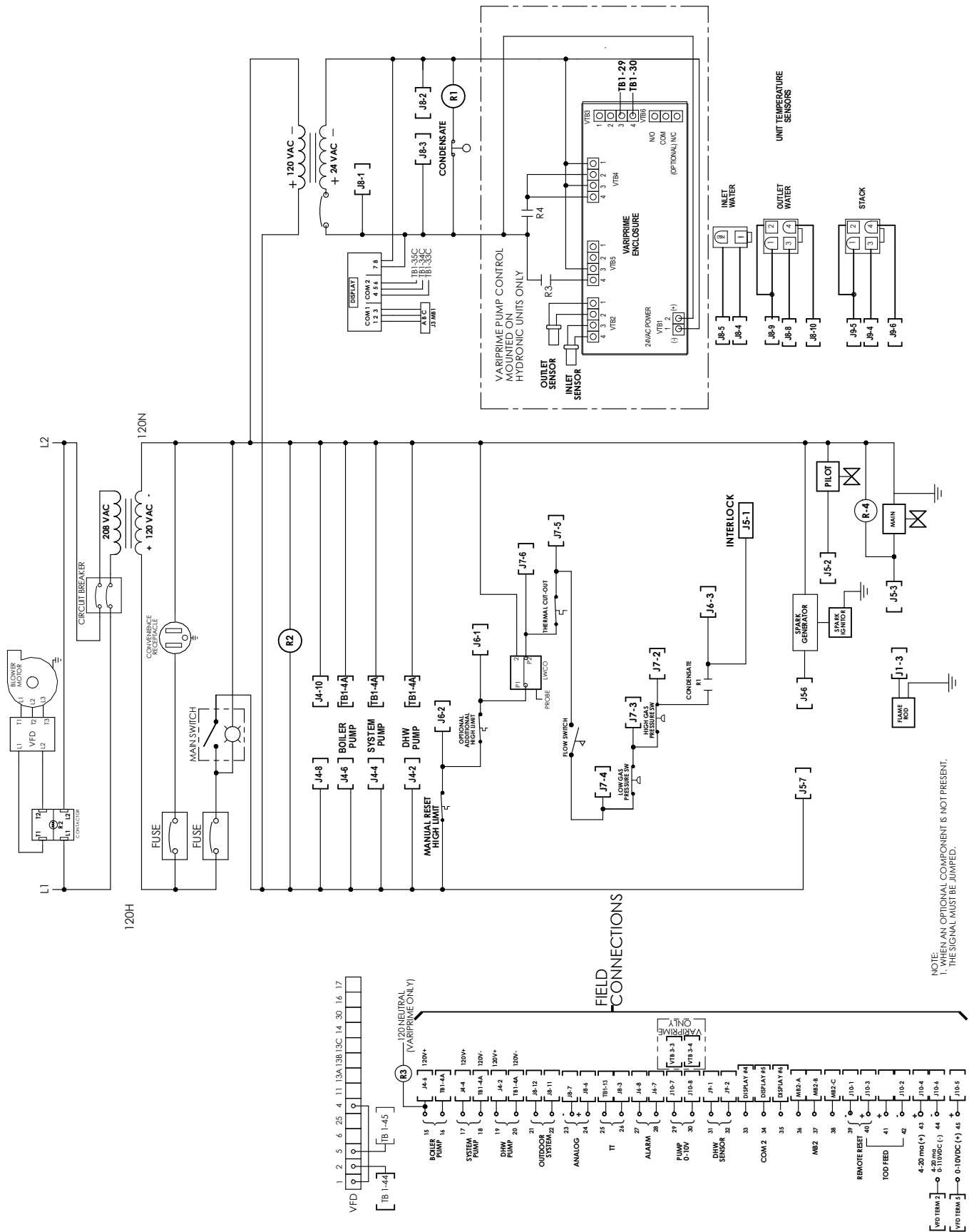


Figure 33. Model 2000, 208V, 1 Phase, ladder diagram



8.12 Ladder Diagrams (continued)

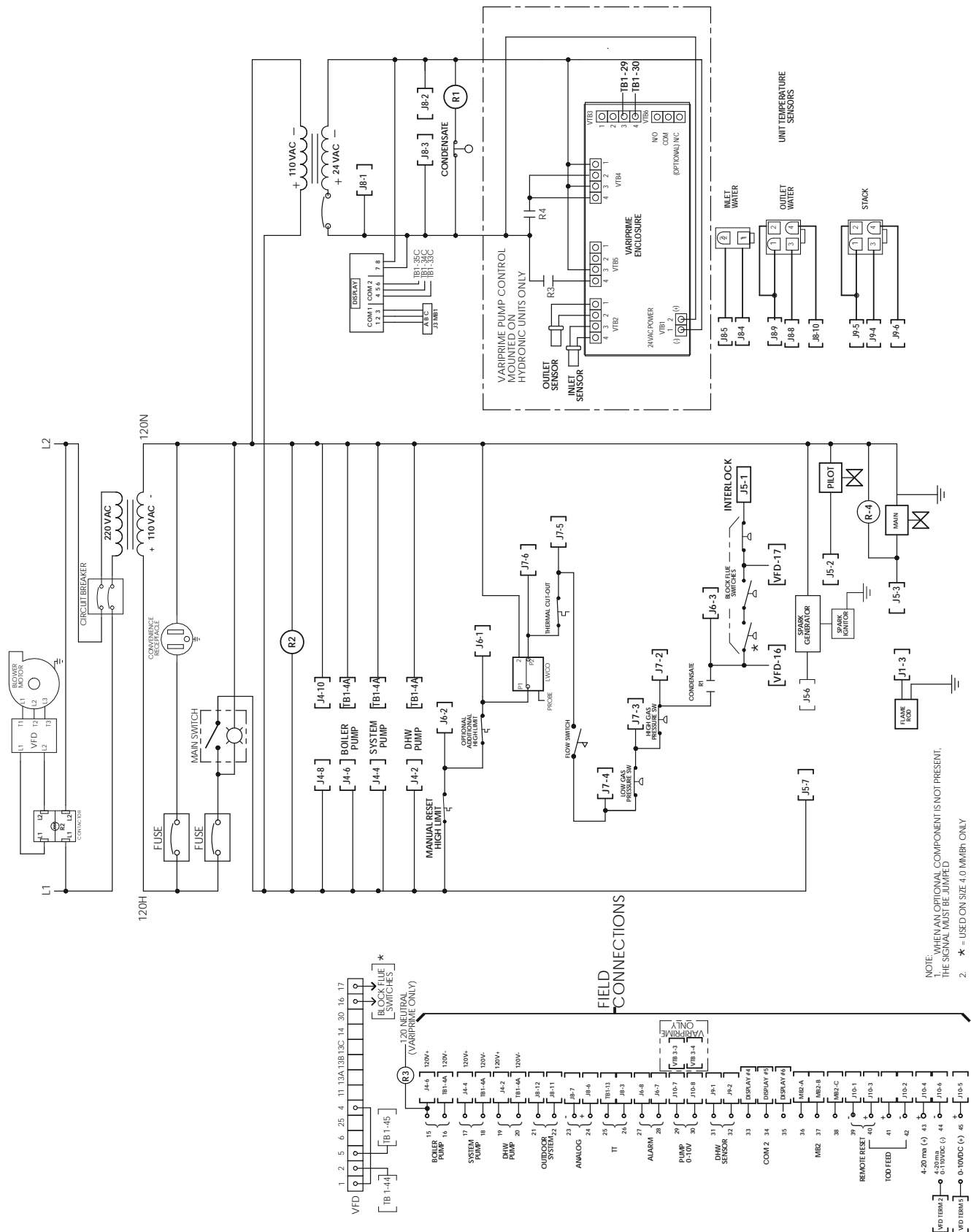


Figure 35. Model 2000, 240V ladder diagram

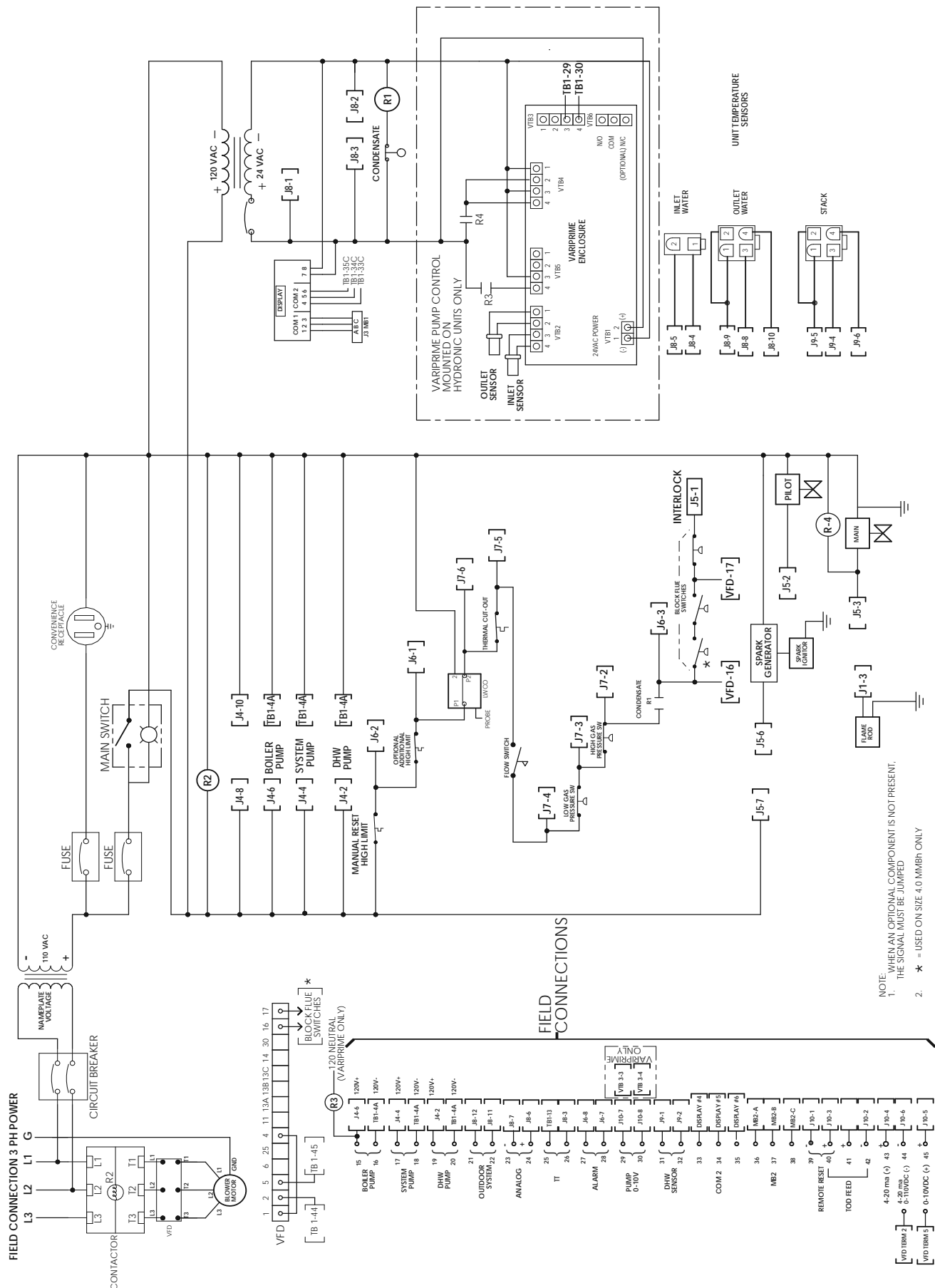


Figure 36. Three-Phase Ladder Diagram

Section 9

NAVIGATING THE TOUCH SCREEN

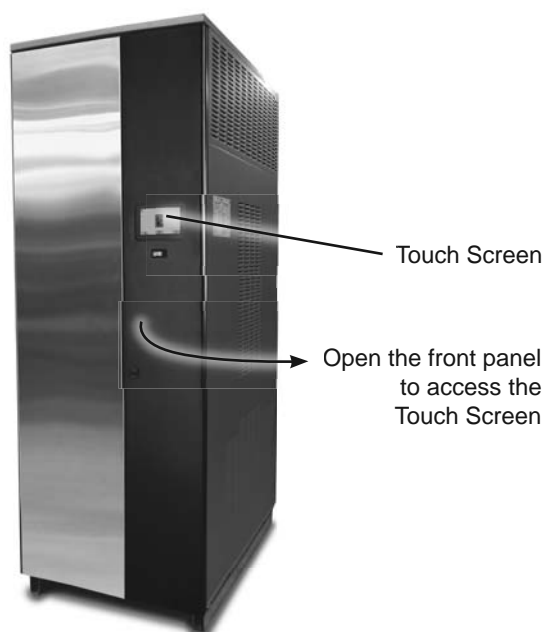


Figure 37. To access the Touch Screen

9.1 The Touch Screen

The Touch Screen is visible behind a protective cover and can be accessed by unlocking and opening the front door. See Figure 37.

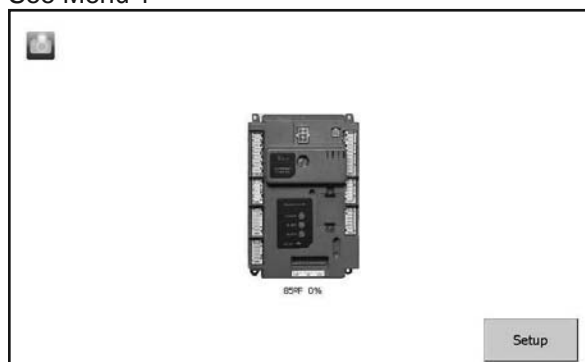
9.2 Using the Touch Screen

ALL of the control functions for the unit can be adjusted by navigating into the Touch Screen.

A screen saver is programmed into the display. Simply touch the screen to wake it up.

While under normal operation, the Touch Screen will automatically present this Home screen.

See Menu 1



Menu 1. Home Screen

The home screen shows a picture of the Unit controller. The color of the controller depends on the status of the Unit, as shown in Figure 38

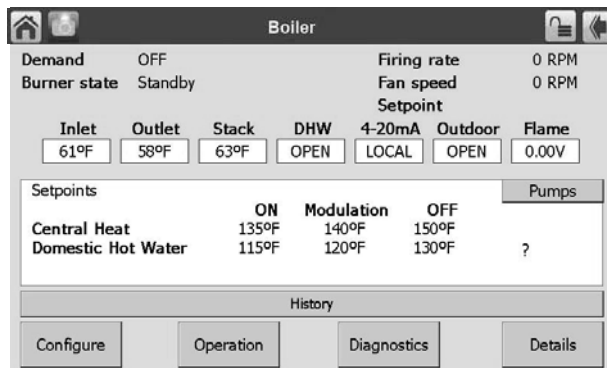


Figure 39. With Front Doors Open.

Color	Status	Control Icon
Blue	Normal operation	
Red	Lockout	
Gray	Standby mode (Burner switch off)	
Gray and crossed out	Communication problem	
Yellow	Hold state. This could be Anti short cycle, fan speed transitions, etc.	

Figure 38. Unit Status Colors

To check the operation of the appliance, press the large Control Icon on the Home screen. The system will present a Status Summary screen for the appliance:



Menu 2. Status Summary

Screen Menu Icons



There are several icons at the top of the Touch Screen Menus (and most of the other screens) that will help you move around the system:

Home	Upper left-hand corner	Return to Home page
Camera	Upper left-hand corner	Screen-shot of current menu as a JPG file
Bell	Upper left-hand corner	System in Lockout, Reset required
Padlock	Upper right-hand corner	Shows whether a password has been entered so parameters can be changed
Back	Upper right-hand corner	Return to previous screen

Sometimes a screen is used to present a list, and often the list is too long to present on a single screen view. To see the rest of the list, pull down on the bar on the right side of the screen, or use the up- and down-arrows.

To make a change, or to get more information about one of the items on the list, press on the line for that item.

To change some parameters, a password is required. The control system includes three levels of password protection:

OEM Password Setup and parameter changes available only to the factory.

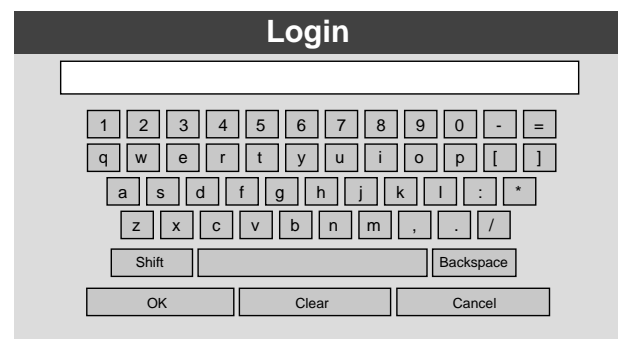
Installer Password Setup and parameter changes made when the system is installed, and some diagnostic and troubleshooting functions. The installer level password is "Int" (lower case "LNT.")

User Level (no password required)

Non-critical adjustments and functions, including adjusting the Central Heat and Domestic Hot Water setpoints, monitoring the input and output variables, reading parameters from the controller, and reading the error log

(For some special safety-related functions, besides entering the correct password, the system will ask you to go through an additional "verification" process. For more information, see the section on "Configuration.")

When a password is necessary, the system will present the keyboard screen. See Menu 3.

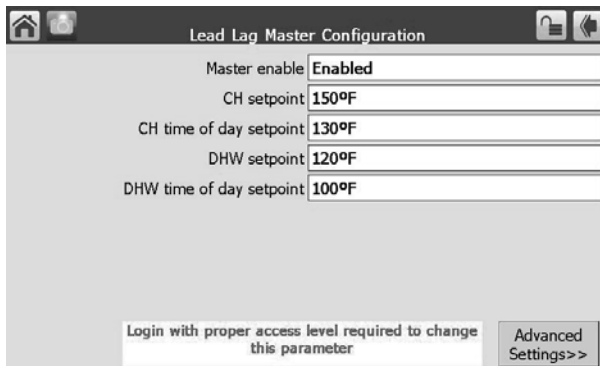


Menu 3. Keyboard Screen

The passwords used by this system are "case sensitive" – it matters whether a letter in the password is capitalized or not. Pressing the Shift key toggles between capital and lower case letters. "BS" stands for "Back Space," and also works as a Delete key.

Anyone can *view* all of the parameters. However, to *change* most of the parameters, you will need a password.

At the bottom of the screen, the system indicates that you need to enter a password.



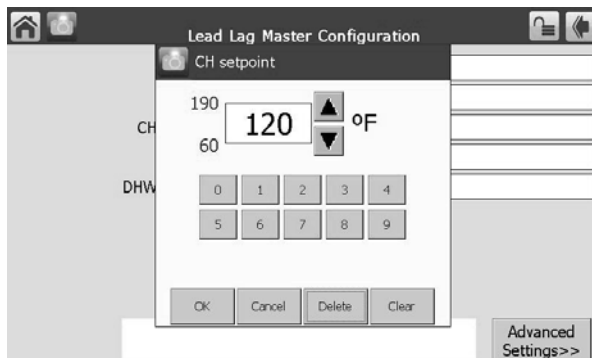
Menu 4. Login Required

The screen used to Login is similar to the Keyboard screen.

It may be difficult for some operators to press the keys on this screen. In this case, use the back of a plastic pen, or a stylus, or a pencil eraser. (Do not use sharp metal tools – these may damage the plastic surface of the screen.)

Each time you press a key, the system will respond with a beep. If you are entering a password, an asterisk (*) will appear for each character you enter. The beeps and asterisks will help you enter the correct number of characters for your password.

When changing a numerical value, the system presents a numerical entry screen, as shown below.

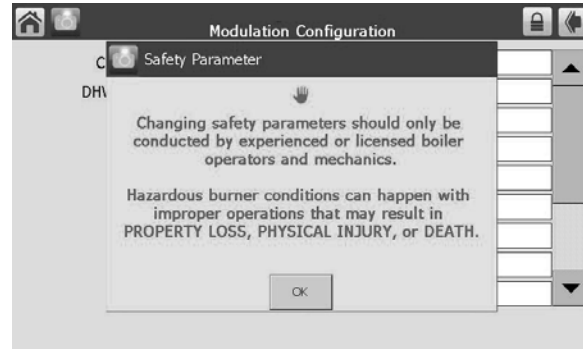


Menu 5. Numeric Entry Screen

9.3 Verification Process for Safety-Related Parameters

The verification process allows the user to confirm that all the changes made are correct and that there have not been any inadvertent changes made.

1. When you start to change a parameter that is related to safety, the system will present a warning which looks like this:



Menu 6. Parameter Safety Warning

⚠ WARNING

Changing safety parameters should only be conducted by experienced, licensed boiler operators and mechanics. Hazardous burner conditions can happen with improper operations that may result in PROPERTY LOSS, PHYSICAL INJURY, or DEATH.

Press OK to continue. The system will ask you to login before you make a change. (For more information on logging in, see Section 8.2.)

2. If you make a change in any group that could affect the safe operation of the unit, the control system will ask you to “verify” the change before it is accepted.
3. Once all parameters have been changed, return to the configure menu. In the lower right hand corner of the screen you will see ‘VERIFY’ Press VERIFY, then press BEGIN to start verification.

Notes –

- Once you change one of these safety-related parameters, you **must** finish the verification process for the group that includes the parameter, **or the control system will not let the boiler operate**. You can wait to do the verification until you have changed parameters in other groups, but before you return the boiler to service, you must complete the verification process for all groups that have been changed.
- At the end of the verification process, you must press the Reset button on the front of the controller. See Figure 40. You have to do this within 30 seconds, or the verification will be cancelled. To make it easy to reach the Reset button, open the door on the front of the boiler and slide out the control panel **before** beginning the verification.

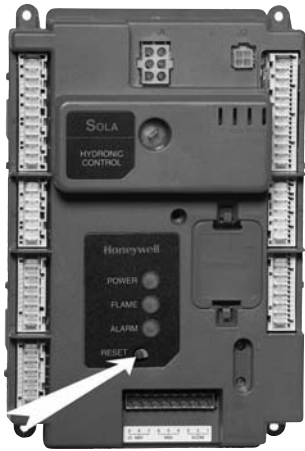


Figure 40. Reset Button on Controller

4. The system will present a listing for each group of parameters that need verification. See Menu 7.



Menu 7. Safety Parameter Confirmation

5. For each group, check the list carefully. Press Yes if all of the parameters in the group have been entered correctly. For each group, you are given 30 seconds to select Yes/No. A count-down timer is shown at the bottom of the screen.
If you made changes in other safety-related groups, verify the entries in those groups in the same way. Do this until the following screen shows



Menu 8. Safety Parameter Reset

6. When the process is complete, the system will tell you to reset the control system. The Reset button is located on the front of the controller. You must press the Reset button within 30 seconds, or the verification will be cancelled. A count-down timer is shown at the bottom of the screen.

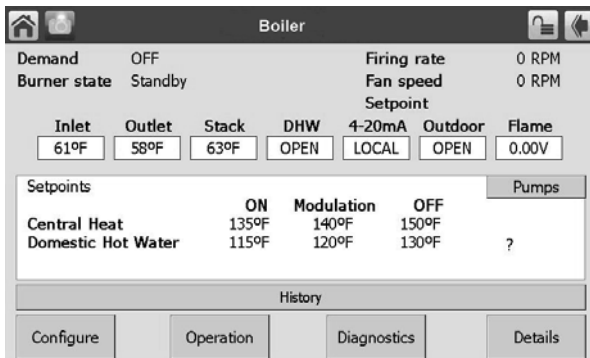
9.4 Checking Individual Parameters

1. From the 'home' screen (Menu 9), press the icon for the controller.



Menu 9. 'home' screen

2. The Status Summary page for the controller will appear. This shows the current operating condition of the controller, and also shows some of the configuration settings. See Menu 10



Boiler

Demand	OFF	Firing rate	0 RPM
Burner state	Standby	Fan speed	0 RPM

Inlet	Outlet	Stack	DHW	4-20mA	Outdoor	Flame
61°F	58°F	63°F	OPEN	LOCAL	OPEN	0.00V

Setpoints				Pumps
Central Heat	ON	Modulation	OFF	
	135°F	140°F	150°F	
Domestic Hot Water	115°F	120°F	130°F	?

History

Configure Operation Diagnostics Details

Menu 10. Status Summary Screen

Notice the four buttons at the bottom of each Status Summary screen:

- **Configure** – Allows an installer to change some of the setup parameters used by the system. A password may be required.
- **Operation** – Used to adjust the setpoints, change the fan speed, turn a burner on or off, or turn the pumps on or off.
- **Diagnostics** – Allows you to run diagnostic tests, or check the inputs and outputs used by the system.
- **Details** – Allows you to check the status of all of the setup parameters on the control system.

9.5 Configuring Parameters

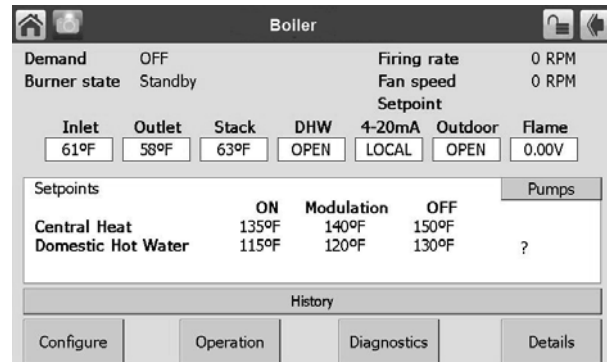
In this section, we will give you a quick explanation of how to change parameters on the controller.

1. From the Home Page screen (Menu 11), press the icon for the controller.



Menu 11. Home Page Screen

2. The Status Summary page for that controller will appear. See Menu 12



Boiler

Demand	OFF	Firing rate	0 RPM
Burner state	Standby	Fan speed	0 RPM

Inlet	Outlet	Stack	DHW	4-20mA	Outdoor	Flame
61°F	58°F	63°F	OPEN	LOCAL	OPEN	0.00V

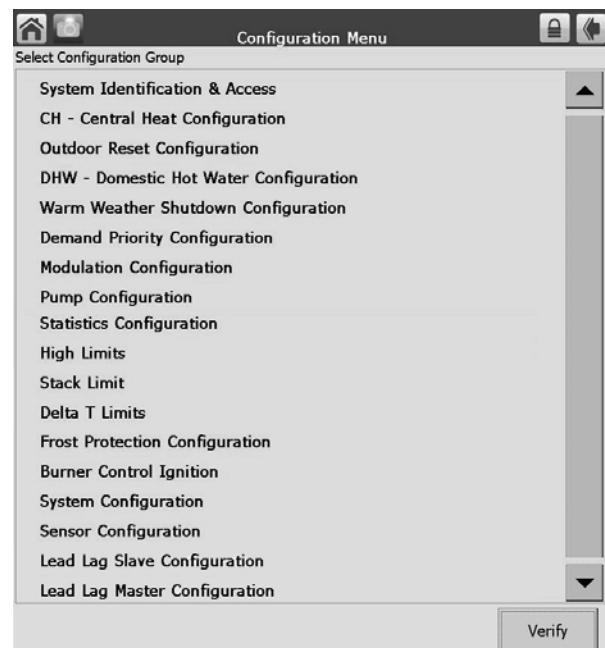
Setpoints				Pumps
Central Heat	ON	Modulation	OFF	
	135°F	140°F	150°F	
Domestic Hot Water	115°F	120°F	130°F	?

History

Configure Operation Diagnostics Details

Menu 12. Status Summary Screen

3. Press the Configure button to start a configuration session for the controller.



Configuration Menu

Select Configuration Group

- System Identification & Access
- CH - Central Heat Configuration
- Outdoor Reset Configuration
- DHW - Domestic Hot Water Configuration
- Warm Weather Shutdown Configuration
- Demand Priority Configuration
- Modulation Configuration
- Pump Configuration
- Statistics Configuration
- High Limits
- Stack Limit
- Delta T Limits
- Frost Protection Configuration
- Burner Control Ignition
- System Configuration
- Sensor Configuration
- Lead Lag Slave Configuration
- Lead Lag Master Configuration

Verify

Menu 13. Configuration Screen

This screen lists all of the configuration groups that will be outlined in Section 9.

9.6 Setting the Date and Time on the System Display

The display includes an internal clock, which keeps track of the date and time. This setting is important, because log entries for Lockouts and Alerts include time listings. If the Date and Time setting for the boiler is not correct, the listings in the Lockout and Alert logs will be incorrect.

The display has a removable battery (CR2032) to store time, date, lockout, and alerts in the event of a power failure.

To set the clock:

1. Start at the 'home' screen.



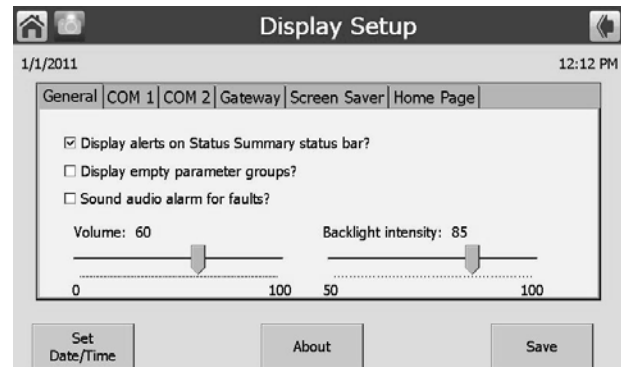
Menu 14. 'Home' screen

2. Press the Setup button on the lower right corner of the screen. The system will present the Setup screen.



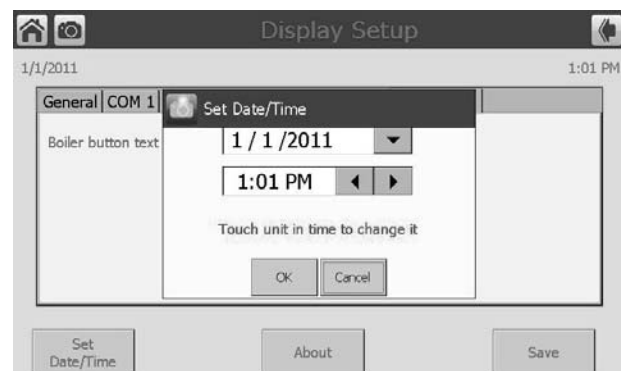
Menu 15. Setup Screen

3. Press the Display Setup button at the bottom of the screen.



Menu 16. Display Setup Screen

4. Press 'Set Date/Time' button.



Menu 17. Date and Time

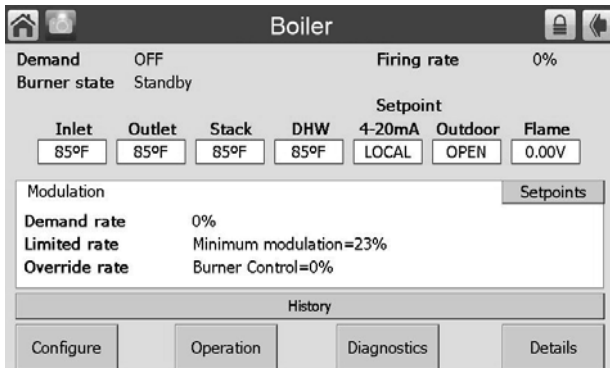
5. Use the arrows to change the date and time, and then press the OK button.

9.7 Configuration Menus



Menu 18. Home Screen

To navigate to the Configuration Menu Screen, first touch the controller icon on the home screen to access the Status Summary screen,



Menu 19. Status Summary Screen

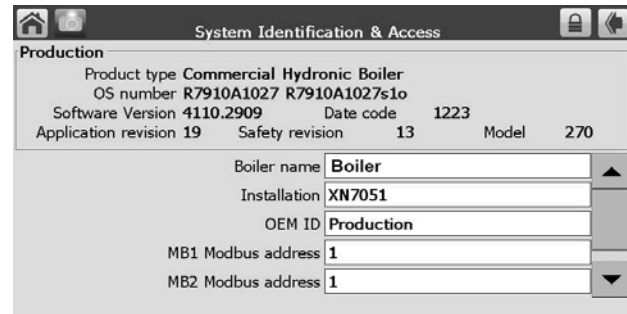
From the Status Summary Screen, touch the 'Configure' button on the bottom left, to access the Configuration Menu.



Menu 20. Configuration Menu

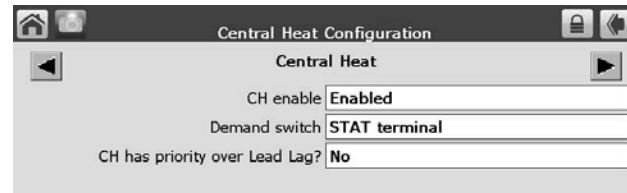
The following sections give overviews of each configuration sub menu.

9.7.1 System Identification & Access



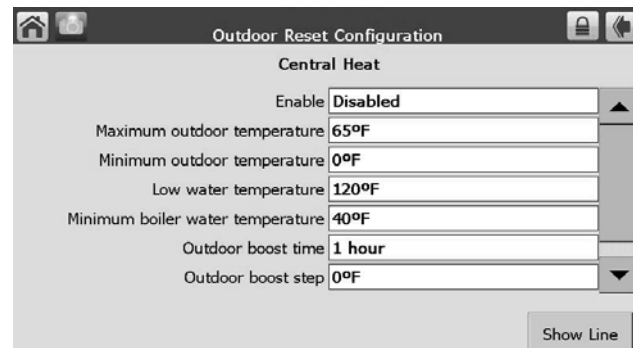
This menu will display information regarding software, date codes, model numbers and program name, as well as giving the installer access to re-name the boiler and to change the modbus addresses for lead lag operation.

9.7.2 CH - Central Heat Configuration



When using the unit for hydronic heating, a call for heat must be supplied to the "T-T" terminals found on TB1-25A and 26A. Once a call for heat is established, the control will start the appropriate (selected) pumps, and begin the ignition process. From the "Home" screen touch the Sola icon, then press "Configure". Choose 'CH-Central Heat Configuration to make adjustments to setpoint, and modulation for a single boiler CH demand.

9.7.3 Outdoor Reset Configuration



A factory supplied Outdoor air temperature sensor is used with the Outdoor Reset and Warm Weather Shutdown features.

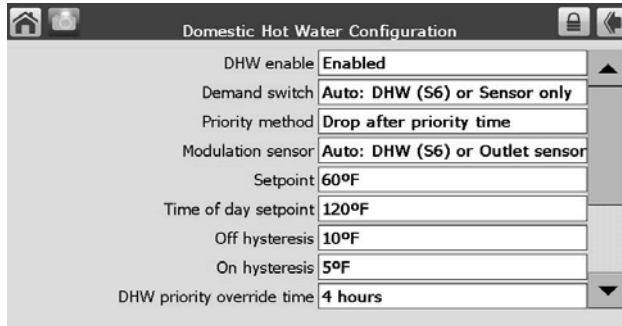
Wiring

For single boiler operation, the outdoor sensor will be connected to TB1-21A and 22A.

For Lead Lag operation of multiple boilers, the outdoor sensor will be connected to TB1-21A and 22A on the Lag Boiler, and the system sensor (supplied with boiler) will be connected to TB1-21A and 22A on the Lead boiler.

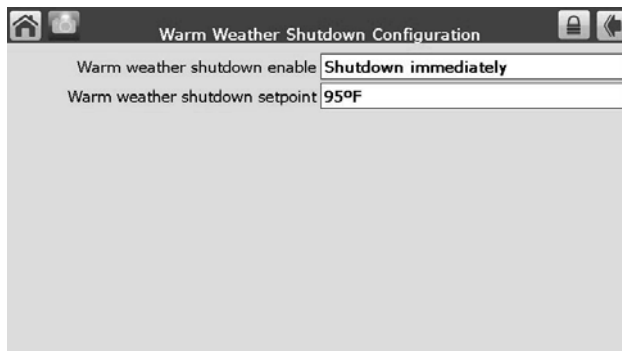
For Lead Lag operation of a single boiler, an Envirocom outdoor sensor (sold separately) will be installed on the Solas ECOM port and the system sensor will be installed on TBI-21A and 22A.

9.7.4 DHW - Domestic Hot Water Configuration



DHW - Domestic Hot Water is used to configure the DHW temperature parameters for water heaters (MGV) and for indirect water heaters that are used with boiler (MGH) systems.

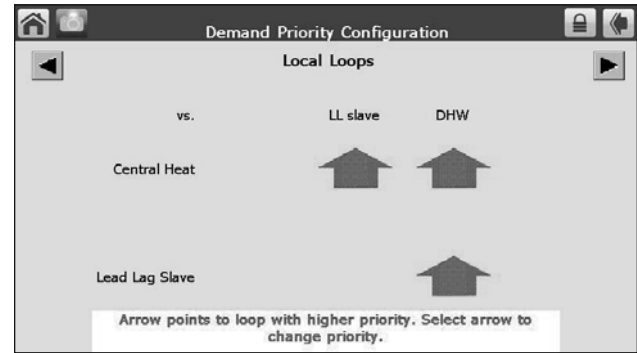
9.7.5 Warm Weather Shutdown Configuration



Connect the outdoor reset sensor as described in Section 8.3

From this menu you will be able to enable/disable the Warm Weather Shutdown feature and adjust the set point.

9.7.6 Demand Priority Configuration

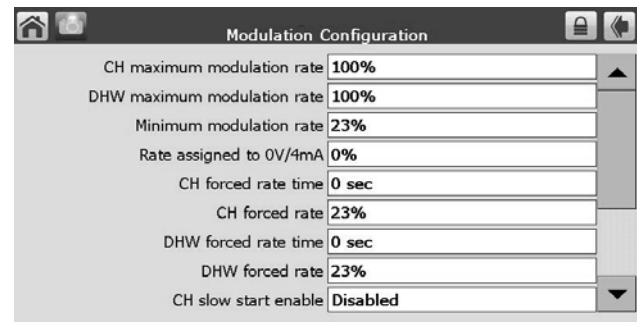


From the Demand Priority Configuration, the installer can adjust the priority of the different demand types.

- Central Heat
- Domestic Hot Water
- Lead Lag

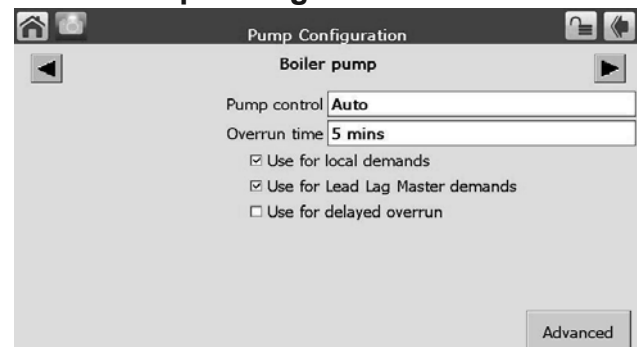
The control uses arrows as indicators to point to the loop with higher priority.

9.7.7 Modulation Configuration



From this menu the installer has the ability to adjust the range of modulation for the CH, and DHW demands. Unit is designed with a 5:1 turn down ratio. Any change to the minimum and maximum modulation rates will affect the overall ratio of the boiler. The installer level password will allow changes to these parameters. Consult the factory if an adjustment is needed to any of these parameters.

9.7.8 Pump Configuration



The controller in the Unit energizes the appropriate pump contacts when it receives a call for heat. Once the call for heat is satisfied, the pumps will remain on for the defined pump overrun time.

The Boiler, System, and DHW pump terminals are found on the Main control board TB1-15A through 20A. They are fed 120 Volts internally from the main power feed. The current rating of the contacts is 7.4 amps, and an appropriately sized contactor must be supplied and installed by a qualified technician to ensure proper pump operation. Once the system has been installed, the “Pump Configuration” menu will allow the installer to adjust Pump control, Overrun time and Demand control for the various pumps in the system.

9.7.9 Statistics Configuration

Statistics Configuration	
Burner cycles	0
Burner run time	0
DHW pump cycles	1
Boiler pump cycles	1
System pump cycles	0
Clear All	

The statistics configuration menu allows the installer to view Burner Cycles, Burner Run Time, DHW Pump Cycles, Boiler Pump Cycles, and System Pump Cycles. This menu is ‘Read-Only’

9.7.10 High Limits

High Limits	
*Outlet high limit response	Lockout
*Outlet high limit setpoint	195°F
*THIS PARAMETER REQUIRES SAFETY VERIFICATION	

The outlet High limit can be adjusted using the installer password. After a change is made, the control will lockout and require a Safety Verification (see Section 9.3 for more details on Safety Verification).

Installers do not have access to change the Outlet High Limit Response. That is only accessible to the factory.

9.7.11 Stack Limits

Stack Limit	
*Stack limit delay	30 mins
*Stack limit response	Recycle & delay
*Stack limit setpoint	200°F
*THIS PARAMETER REQUIRES SAFETY VERIFICATION	

Stack limit delay, response and setpoint can be changed ONLY BY THE FACTORY.

9.7.12 Delta T Limits-

Delta T Limits	
Inlet to outlet flow	
Delta T inlet/outlet enable	Delta T
Delta T inlet/outlet degrees	60°F
Delta T delay	10 mins
Delta T response	Recycle & delay
Delta T retry limit	5

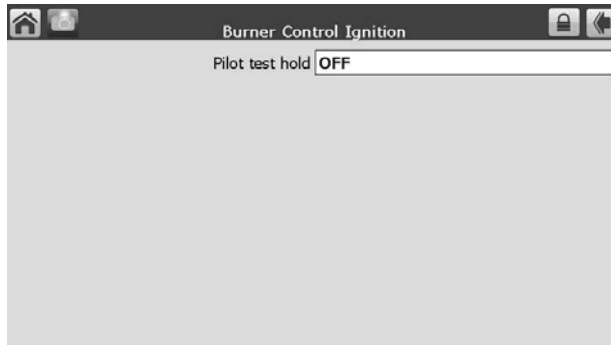
Unit is shipped with a factory set Delta T (temperature rise) limit of 60 degrees F. The installer has the ability to adjust the Delta T inlet/outlet degree set point, Delta T delay, Delta T response, and the Delta T retry limit using the installer level password. Only the factory may disable this function.

9.7.13 Frost Protection

Frost Protection Configuration	
DHW pump frost overrun time	1 min

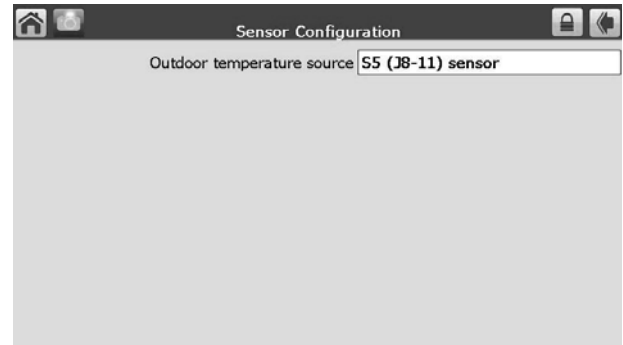
Frost protection will assist in keeping the Unit from freezing when the unit is not able to fire, but is still able to run the pumps. The frost overrun time can be changed.

9.7.14 Burner Control Ignition



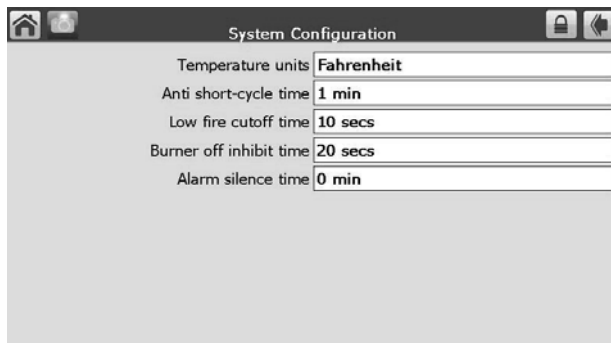
The Pilot test hold function allows the installer to set the pilot flame to the required pressures listed in Table 22, without turning on the Main valve. With a call for heat enabled the unit will start the normal sequence of operation to light the pilot only. Once pilot pressure has been properly set, the installer must disable call for heat and turn this feature “OFF”. The next time a call for heat is supplied the unit will light normally.

9.7.16 Sensor Configuration



The outdoor temperature can be read from the outdoor sensor that is shipped with the Unit, or from an Envirocom outdoor sensor (sold separately). The Sensor Configuration screen allows the installer to tell the control which sensor is being used.

9.7.15 System Configuration



The installer can set the control to display temperature units in °F or °C, can adjust the anti short -cycle time, the low fire cutoff time, burner off inhibit time, and can set the time allowed for an alarm to sound before being silenced.

9.7.17 Lag (Slave) Configuration

About Lead Lag Operation -

Units = For Boilers or Water Heaters.

If an installation includes two or more units, they may be set up for “Lead Lag” operation. One unit will be set up as the “Lead”, and the others will operate as “Lags.” Figure 42 shows an installation with eight units (A Lead Lag system can include up to eight units.) The units controllers are connected in a “daisy chain” using a Modbus connection.

NOTE: Lead & Lag within the touchscreen display is referred to Master & Slave. These are industry terms and are used interchangeably by different control system manufacturers.

A single System sensor is used to monitor the demand for heat. The input from this sensor is used by the Master controller to control the modulation rates of all of the operating units.

Lead Lag Modulation Cycle -

Note - We will explain the modulation cycle here, in case you need to understand how the Lead Lag system actually operates. If you are installing the unit(s) and want to skip this section, just remember that, as the heating demand increases, the Lead Lag system puts more units on-line. As the heating demand is reduced, the Lead Lag system shuts off some of the units.

The signal from the System sensor is sent to the unit operating as the Lead. A Run sequence is initiated when the system temperature falls to the Lead Lag Central Heat setpoint. (Actually this is the LL CH setpoint less the On Hysteresis value. The default setting for On Hysteresis is 5°F, but this is adjustable.)

Notice that, when a unit is operating as part of a Lead Lag system, it does not use the normal CH setpoint – it uses the special LL CH setpoint on the Lead unit.

The unit acting as the Lead decides which unit is assigned to start first. This assignment is rotated

across all of the available units so that any one unit does not run significantly longer than the others. The Lead Lag controller tracks the run times for all of the units, and uses this to calculate the starting order for the units. This means that each time the system starts up, a different unit may start first.



Caution

You should set the Modbus addresses before you connect the Modbus wiring. If the wiring is attached before the Modbus addresses on the controls are changed, there will be multiple controls with the same address, and the system will not work.

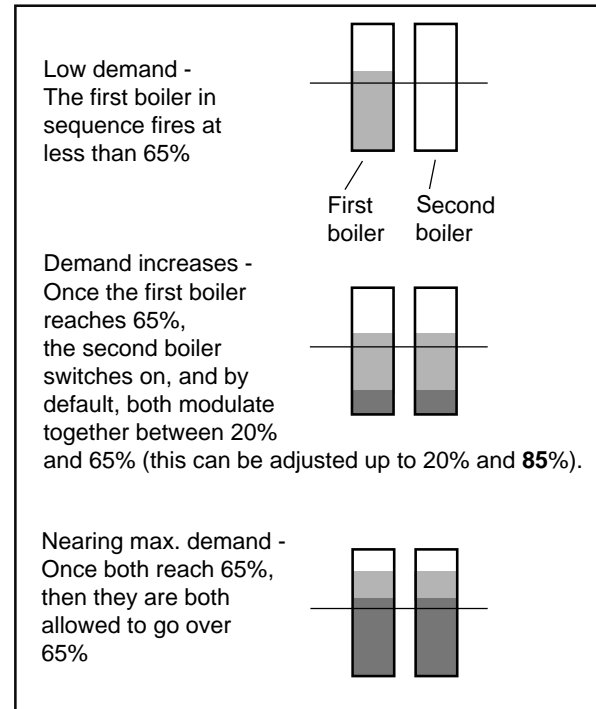


Figure 41. Lead Lag Operation, 2 boilers.

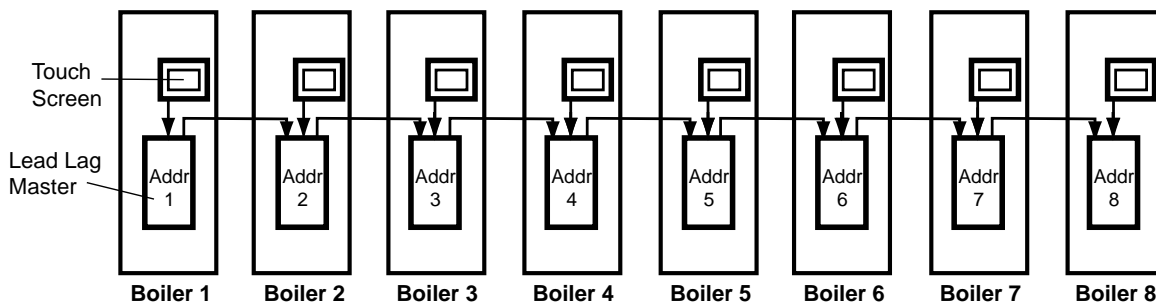


Figure 42. “Lead Lag” Operation in a System with Eight Units. Note: The Displays on Units 2 thru 8 will display information pertaining only to that specific unit.

Number of boilers installed	Base load value
1	NA
2	65%
3	50%
4	35%
5	35%
6	35%
7	35%
8	35%

Table 20. Base Load Settings**WARNING**

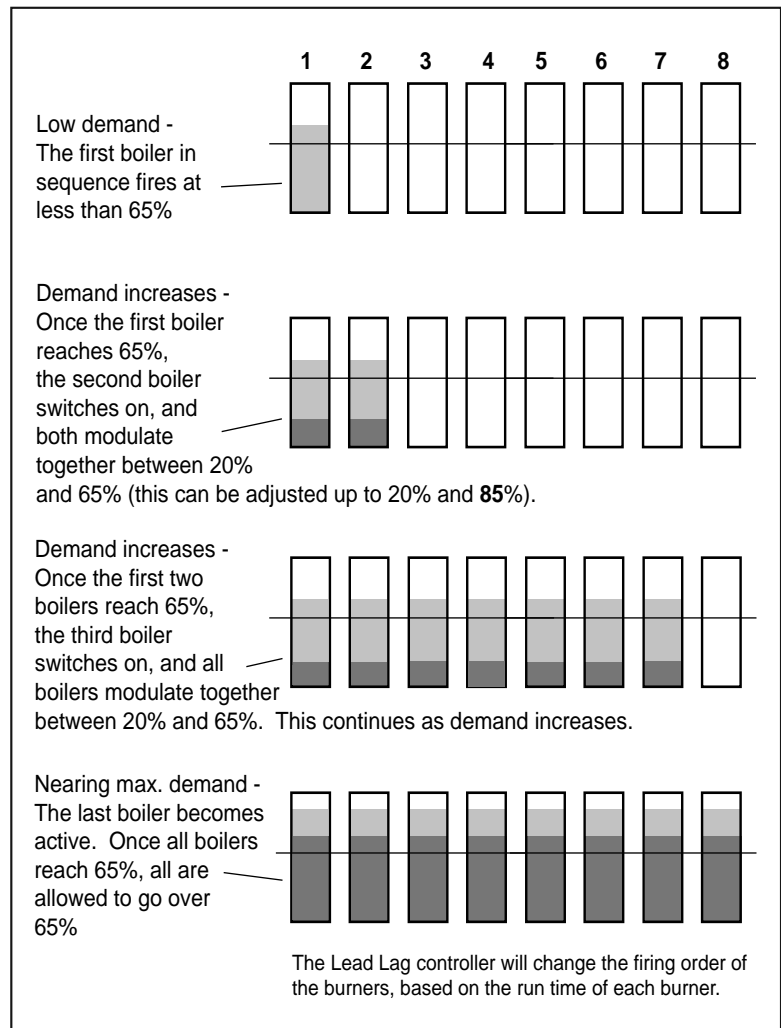
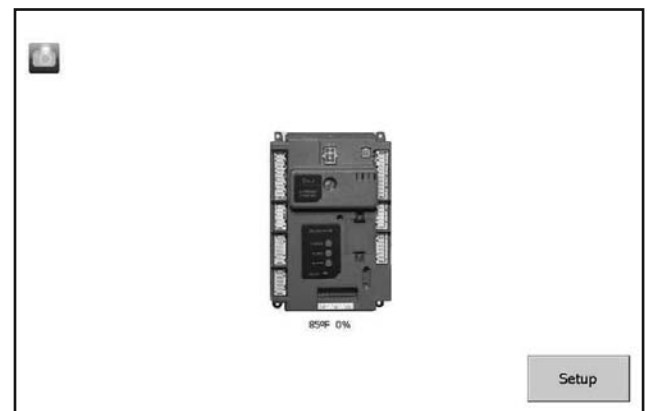
If the Modbus addresses are not assigned properly, the system could fail to operate correctly, or it might operate in an unsafe manner. This could lead to property damage, personal injury or death.

- When the Run sequence is initiated, the unit with the least amount of runtime will fire.
- If the heating demand increases so that the firing rate of that first unit rises to your unit configurations Base Load Value (see **Table 20**), the next unit in the sequence will start up and begin firing at 20 to 35% fan speed (depending on your configuration). After this, the entire configuration of units will modulate up or down together, in reaction to the changes in demand.

See **Figure 41** and **Figure 43**

Control Settings for Lead Lag System - Part 1

1. Power up all of the units in the system.
2. In an installation with several units, you must give each unit a different name, so that the controller of the Lead unit can communicate with the other units. All of the units come from the factory with a Modbus address of "1," so you will need to change some of these addresses. On each unit, go to the screen for "System ID and Access," and enter a unique name.
3. The unit operating as the Lead must be 'Master Enabled' first and then set up address "1," and the other units should each be 'Slave Enabled' and have unique Modbus address numbers typically 2 thru X (total number of units)

**Figure 43. Lead Lag Operation, 3 or more boilers**

On the units, touch the controller Icon on the Home Screen.

Boiler

Demand OFF Firing rate 0%

Burner state Standby

Setpoint

Inlet	Outlet	Stack	DHW	4-20mA	Outdoor	Flame
85°F	85°F	85°F	85°F	LOCAL	OPEN	0.00V

Modulation

Demand rate 0%

Limited rate Minimum modulation=23%

Override rate Burner Control=0%

History

Configure Operation Diagnostics Details

Select 'Configure'.

Configuration Menu

Select Configuration Group

- System Identification & Access
- CH - Central Heat Configuration
- Outdoor Reset Configuration
- DHW - Domestic Hot Water Configuration
- Warm Weather Shutdown Configuration
- Demand Priority Configuration
- Modulation Configuration
- Pump Configuration
- Statistics Configuration
- High Limits
- Stack Limit
- Delta T Limits
- Frost Protection Configuration
- Burner Control Ignition
- System Configuration
- Sensor Configuration
- Lead Lag Slave Configuration
- Lead Lag Master Configuration

Verify

In the Configuration Menu, Scroll down and select 'Lead Lag Slave Configuration'.

Lead Lag Slave Configuration

Slave enable Disabled

Slave mode Equalize run time

Slave sequence order 0

Modbus address 1

Identify each unit (including the Lead unit) as a Lag unit by turning on "Slave Enable."

You will be prompted to sign in. This can be done by pressing the 'LOCK' symbol at the top right

Login

Int

1 2 3 4 5 6 7 8 9 0 - =

q w e r t y u i o p []

a s d f g h j k l ; *

z x c v b n m , . /

Shift Backspace

OK Clear Cancel

type in 'LNT' and press OK.

Then you can select Slave Enable.

Lead Lag Slave Configuration

Slave enable Disabled

Slave enable

- ☒ Enable slave for built-in Lead Lag master
- ☐ Enable slave for third party Lead Lag master
- ☐ Disabled

OK Cancel

Login with proper access level required to change this parameter

Select 'Enable Slave for built-in Lead Lag Master'.

Then select OK

Then select a Modbus address (number) for that unit.

Lead Lag Slave Configuration

Lead Lag Modbus address

250

1 2

0 1 2 3 4

5 6 7 8 9

OK Cancel Delete Clear

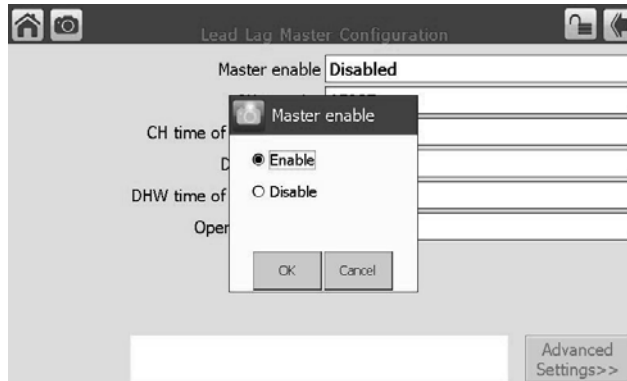
Then select OK

Repeat on all units, keeping them in a sensible sequential order. '

9.7.18 Lead (Master) Configuration

All Connections to the Lag units must be made prior to configuring the Lead unit.

Set up the Lead (Master) controller by going to the Lead unit and opening up the Lead (Master) Configuration in that units Configuration Menu. Select Master Enable



Select OK and then Back out to the Main Menu.

Wiring Connections for Lead Lag -

Now you can make the Modbus wiring connections between the units.

See Figure 20 on page 36

The controller in each unit includes two wiring terminals for the Modbus system, labeled “MB1” and “MB2.” MB1 has the wiring connections to the User Interface display on each unit, and MB2 is used to communicate with the other units in the Lead Lag system.

To reach the controller, open the cabinet of the unit by turning the door lock and then opening the doors.

The wiring from the controller on the first unit runs to the controller on the next unit. Use 22 AWG or thicker shielded twisted-pair wire with drain. Two twisted pairs or three conductors are needed. Wire A on MB2 of unit 1 must be connected to A on MB2 of unit 2, wire B on unit 1 goes to B on unit 2, and wire C on unit 1 goes to C on unit 2. Repeat this wiring for any other units in the system. Connect all of the drain wires and ground the drain wire on one end of the assembly only.

9.8 Parameter Defaults and Ranges

Config Group	Parameter Name	Available settings or Ranges	Default
CH Config- Central Heat	CH Enable	Enable / Disable	Enable
CH Config- Central Heat	Demand Switch	STAT Terminal / Sensor Only	STAT Terminal
CH Config- Central Heat	CH has Priority over Lead Lag	YES / NO	No
CH Config- Setpoint	Setpoint Source	Local / S2 (J8-6) 4-20 mA	Local
CH Config- Setpoint	Setpoint	40F- 200F	140 F
CH Config- Setpoint	Time of Day Setpoint	40F- 200F	140 F
CH Config- Setpoint	Off Hysteresis	2F- 30F	10F
CH Config- Setpoint	On Hysteresis	2F- 30F	15F
CH Config- Setpoint	4 mA Water Temperature	40F- 200F	120F
CH Config- Setpoint	20 mA Water Temperature	40F- 200F	140F
CH Config- Modulation	Modulation Sensor	Outlet Inlet S5 (J8-11) sensor None	Outlet
CH Config- Modulation	Modulation Rate Source	Local S2 (J8-6) 4-20 mA with Sensor on/off S2 (J8-6) 4-20 mA with Burner on/off	Local
CH Config- Modulation	P Gain	0-100	20
CH Config- Modulation	I Gain	0-100	10
CH Config- Modulation	D Gain	0-100	0
Outdoor Reset Config	Enable	Disable / Enable	Disabled
Outdoor Reset Config	Maximum Outdoor Temperature	-40F - 120F	65F
Outdoor Reset Config	Minimum Outdoor Temperature	-40F - 100F	0
Outdoor Reset Config	Low Water Temperature	40F - 200F	120F
Outdoor Reset Config	Minimum Boiler Water Temp	40F - 180F	40F
DHW Config	DHW Enable	Enable / Disable	Enabled
DHW Config	Demand Switch	Sensor Only STAT Terminal Auto: DHW (S6) or EnviroCOM DHW Auto: DHW (S6) or Sensor only DHW Sensor with On/Off Temperatures	Auto:DHW (S6) or Sensor Only

Table 21. Parameter and Range Table

9.8 Parameter Defaults and Ranges (continued)

DHW Config	Priority Method	Boost During Priority Time Drop After Priority Time	Drop After Priority Time
DHW Config	Modulation Sensor	DHW Sensor Outlet Sensor Inlet Sensor Auto: DHW (S6) or Inlet Sensor Auto: DHW (S6) or Outlet Sensor	Auto:DHW (S6) or Outlet Only
DHW Config	Setpoint	40F - 200F	60F
DHW Config	Time of Day Setpoint	40F - 200F	120F
DHW Config	Off Hysteresis	2F - 30F	10F
DHW Config	On Hysteresis	2F - 30F	5F
DHW Config	DHW Priority Override Time	0 min 0 sec - 1092 min 0 sec	240 min or (4 Hrs)
DHW Config	DHW Priority vs CH	CH > DHW DHW > CH	DHW > CH
DHW Config	DHW Priority vs Lead Lag	DHW > Lead Lag Lead Lag > DHW	DHW > Lead Lag
DHW Config	P Gain	0-100	20
DHW Config	I Gain	0-100	10
DHW Config	D Gain	0-100	0
Config Group	Parameter Name	Available settings or Ranges	Default
Warm Weather Shutdown Config	Warm Weather Shutdown Enable	Shutdown Immediately Disabled	Shutdown Immediately
Warm Weather Shutdown Config	Warm Weather Shutdown Setpoint	35F - 140F	95F
Demand Priority Config	Local Loops	Arrow Points to Loop with Higher Priority.	CH < LL Slave CH < DHW LL Slave < DHW
Demand Priority Config	Lead Lag	Arrow Points to Loop with Higher Priority.	CH < DHW
Modulation Config	CH Maximum Modulation Rate	60% - 100%	100%
Modulation Config	DHW Maximum Modulation Rate	60% - 100%	100%
Modulation Config	Minimum Modulation Rate	22% - 50%	25%
Pump Config- Boiler Pump	Pump Control	Auto / On	Auto
Pump Config- Boiler Pump	Overrun Time	0 min 0 sec - 15 min 0 sec	5 min 0 sec
Pump Config- Boiler Pump	Use for Local Demands	Check Box	checked
Pump Config- Boiler Pump	Use for Lead Lag Master Demands	Check Box	checked
Pump Config- Boiler Pump	Use for Delayed Overrun	Check Box	not checked
Pump Config- DHW Pump	Pump Control	Auto \ On	Auto
Pump Config- DHW Pump	Overrun Time	0 min 0 sec - 15 min 0 sec	0 min 10 sec
Pump Config- DHW Pump	Use for Local Demands	Check Box	checked
Pump Config- DHW Pump	Use for Lead Lag Master Demands	Check Box	checked
Pump Config- DHW Pump	Use for Delayed Overrun	Check Box	not checked
Pump Config- System Pump	Pump Control	Auto \ On	Auto
Pump Config- System Pump	Overrun Time	0 min 0 sec - 15 min 0 sec	0 min 10 sec
Pump Config- System Pump	Use for Local Demands	Check Box	checked
Pump Config- System Pump	Use for Lead Lag Master Demands	Check Box	checked
Pump Config- System Pump	Use for Delayed Overrun	Check Box	not checked
High Limits	Outlet High Limit Setpoint	100F - 210F	195F
Delta T Limits	Delta T inlet/outlet degrees	10F - 70F	60F
Delta T Limits	Delta T Delay	1 min 0 sec - 60 min 0 sec	1 min 0 sec
Delta T Limits	Delta T Response	Recycle & Delay Recycle & Delay with Retry Limit Lockout	Recycle & Delay
Delta T Limits	Delta T Retry Limit	1-10	5
Frost Protection Config	CH Frost Protection Enable	Enable / Disable	Enabled
Frost Protection Config	DHW Frost Protection Enable	Enable / Disable	Enabled
Frost Protection Config	Lead Lag Frost Protection Enable	Enable / Disable	Enabled
Frost Protection Config	Lead Lag Frost Protection Rate	0% - 100%	0%
Burner Control Ignition	Pilot Test Hold	On \ Off	Off
System Config	Temperature Units	Fahrenheit - F Celsius - C	Fahrenheit - F

Parameter and Range Table (cont)

System Config	Anti- Short Cycle Time	0 min 0 sec - 15 min 0 sec	1 min 0 sec
System Config	Low Fire Cutoff Time	0 min 0 sec - 5 min 0 sec	0 min 0 sec
System Config	Burner Off Inhibit Time	0 min 0 sec - 5 min 0 sec	0 min 20 sec
System Config	Alarm Silence Time	0 min 0 sec - 10 min 0 sec	0 min 0 sec
Sensor Config	Outdoor Temperature Source	S5 (J8-11) Sensor EnviraCOM Outdoor Sensor Unconfigured	S5 (j8-11) Sensor
Config Group	Parameter Name	Available settings or Ranges	Default
Lead Lag Slave Config	Slave Enable	Enable / Disable	Disabled
Lead Lag Slave Config	Slave Mode	Equalize Run Time Use First Use Last	Equalize Run Time
Lead Lag Slave Config	Slave Sequence Order	0-8	0
Lead Lag Slave Config	Modbus Address	1-250	2
Lead Lag Master Config	Master Enable	Enable / Disable	Disabled
Lead Lag Master Config	CH Setpoint	40F - 200F	150F
Lead Lag Master Config	CH Time of Day Setpoint	40F - 200F	130F
Lead Lag Master Config	DHW Setpoint	40F - 195F	120F
Lead Lag Master Config	DHW Time of Day Setpoint	40F - 195F	100F
Lead Lag Master Config- Adv Settings - Central Heat	Demand Switch	STAT Terminal Modulation Sensor Disable	STAT Terminal
Lead Lag Master Config- Adv Settings - Central Heat	Setpoint Source	Local S2 (J8-6) 4-20 mA	Local
Lead Lag Master Config- Adv Settings - Central Heat	Setpoint	40F - 200F	150F
Lead Lag Master Config- Adv Settings - Central Heat	Time of Day Setpoint	40F - 200F	130F
Lead Lag Master Config- Adv Settings - Central Heat	4 mA Water Temperature	40F - 195F	120F
Lead Lag Master Config- Adv Settings - Central Heat	20 mA Water Temperature	50F - 200F	140F
Lead Lag Master Config- Advanced Settings - DHW	Demand Switch	STAT Terminal DHW (S6) Sensor Shorted Disabled	Disabled
Lead Lag Master Config- Advanced Settings - DHW	Setpoint	40F - 195F	120F
Lead Lag Master Config- Advanced Settings - DHW	Time of Day Setpoint	40F - 195F	100F
Lead Lag Master Config- Advanced Settings - DHW	Priority Method	Boost During Priority Time Drop After Priority Time	Drop After Priority Time
Lead Lag Master Config- Advanced Settings - DHW	DHW Priority Override Time	0 min 0 sec - 1092 min 0 sec	240 min or (4 Hrs)
Lead Lag Master Config- Advanced Settings - DHW	DHW Has Priority Over CH?	CH > DHW DHW > CH	DHW > CH
Lead Lag Master Config- Adv Settings - Frost Protect	Enable	Enable Disable	Enabled
Lead Lag Master Config- Adv Settings - Frost Protect	Frost Protection Rate	0% - 100%	0%
Lead Lag Master Config- Adv Settings- WWSD	Enable	Shutdown Immediately Disabled	Shutdown Immediately
Lead Lag Master Config- Adv Settings- WWSD	Setpoint	35F - 140F	95F
Lead Lag Master Config- Adv Settings-Algorithms	Lead Selection Method	Sequence Order Measured Run Time	Measured Run Time
Lead Lag Master Config- Adv Settings-Algorithms	Lag Selection Method	Sequence Order Measured Run Time	Measured Run Time
Lead Lag Master Config- Adv Settings-Algorithms	Lead Rotation Time	0 min 0 sec - 1080 hrs 0 min 0 sec	168 hrs 0 min 0 sec (7 days)
Lead Lag Master Config- Adv Settings-Rate Allocation	Base Load Common	20% - 100%	65%
Config Group	Parameter Name	Available settings or Ranges	Default

9.8 Parameter Defaults and Ranges (continued)

Lead Lag Master Config- Adv Settings - Outdoor Reset	Enable	Enable Disable	Disabled
Lead Lag Master Config- Adv Settings - Outdoor Reset	Maximum Outdoor Temperature	40F - 150F	65F
Lead Lag Master Config- Adv Settings - Outdoor Reset	Minimum Outdoor Temperature	-40F - 90F	40F
Lead Lag Master Config- Adv Settings - Outdoor Reset	Low Water Temperature	40F - 160F	120F
Lead Lag Master Config- Adv Settings - Outdoor Reset	Minimum Boiler Water Temp	40F - 190F	120F
Lead Lag Master Config- Adv Settings - Outdoor Reset	Outdoor Boost Time	15 min 0 sec - 600 min 0 sec	240 min or (4 Hrs)
Lead Lag Master Config- Adv Settings - Outdoor Reset	Outdoor Boost Step	0F - 50F	0F
Lead Lag Master Config- Adv Settings - Outdoor Reset	Outdoor Boost Maximum Off Point	40F - 200F	200F
Lead Lag Master Config- Adv Settings-Add Stage	Method 1	Error Threshold Firing Rate Threshold Disable	Error Threshold
Lead Lag Master Config- Adv Settings-Add Stage	Detection Time 1	0 min 15 sec - 240 min 0 sec	0 min 15 sec
Lead Lag Master Config- Adv Settings-Add Stage	Error Threshold	0F - 50F	5F
Lead Lag Master Config- Adv Settings-Add Stage	Rate Offset	0% - 100%	20%
Lead Lag Master Config- Adv Settings-Add Stage	Interstage Delay	0 min 0 sec - 120 min 0 sec	5 min 0 sec
Lead Lag Master Config- Adv Settings-Drop Stage	Method 1	Error Threshold Firing Rate Threshold Disable	Error Threshold
Lead Lag Master Config- Adv Settings-Drop Stage	Detection Time 1	0 min 0 sec - 15 min 0 sec	0 min 2 sec
Lead Lag Master Config- Adv Settings-Drop Stage	Error Threshold	0F - 50F	2F
Lead Lag Master Config- Adv Settings-Drop Stage	Rate Offset	0% - 100%	20%
Lead Lag Master Config- Adv Settings-Drop Stage	Interstage Delay	0 min 0 sec - 15 min 0 sec	0 min 2 sec
Lead Lag Master Config- Adv Settings-Drop Stage	Boiler Off Option	All Boilers Off Drop Lead Boiler on Error Threshold	Disabled
Lead Lag Master Config- Adv Settings-Drop Stage	All Boilers Off Threshold	50F - 210F	210F
Lead Lag Master Config- Adv Settings-Modulation	Off Hysteresis	0F - 30F	10F
Lead Lag Master Config- Adv Settings-Modulation	On Hysteresis	2F - 30F	5F
Lead Lag Master Config- Adv Settings-Modulation	P Gain	0-100	20
Lead Lag Master Config- Adv Settings-Modulation	I Gain	0-100	10
Lead Lag Master Config- Adv Settings-Modulation	D Gain	0-100	0

Parameter and Range Table (cont)

9.9 Configuring for a Gateway Control. (Building Automation System)

Building Automation Systems Control: BACnet MS/TP, BACnet/IP, Modbus TCP/IP, Metasys N2 and LonWorks.

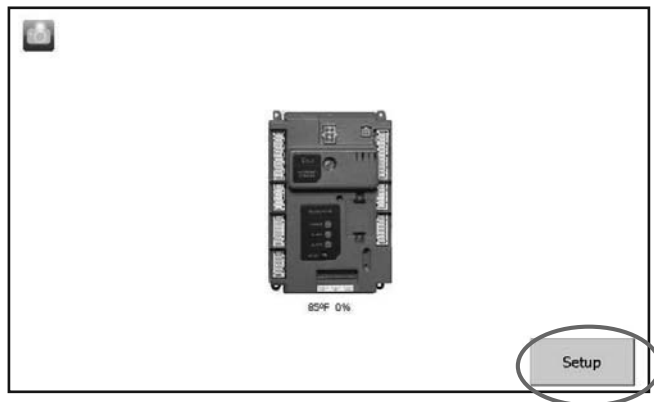
If communication protocols are desired, this commercial unit can be controlled and monitored through the included Modbus ports.

The Modbus wiring must be completed according to the diagrams shown in Section 8.

See Figure 20 on page 36.

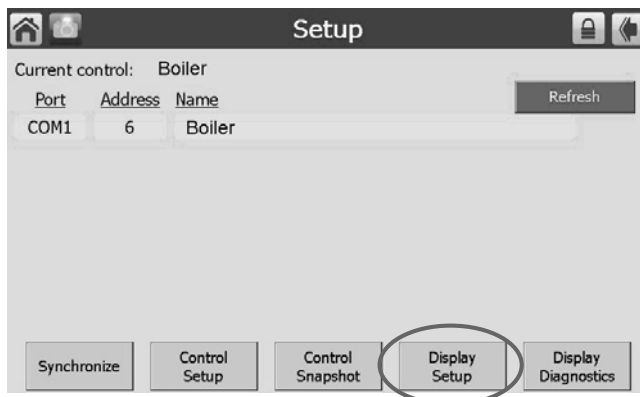
For additional information on purchasing and setting up Modbus and other communication protocols, contact your Manufacturer's Representative.

Configuring for the Gateway.



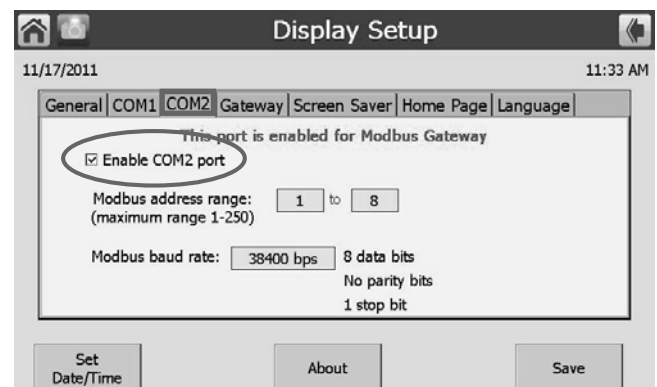
Menu 21. Home Screen

Starting at the Home Screen, tap onto the Display Setup button on the bottom right of the lead units screen.



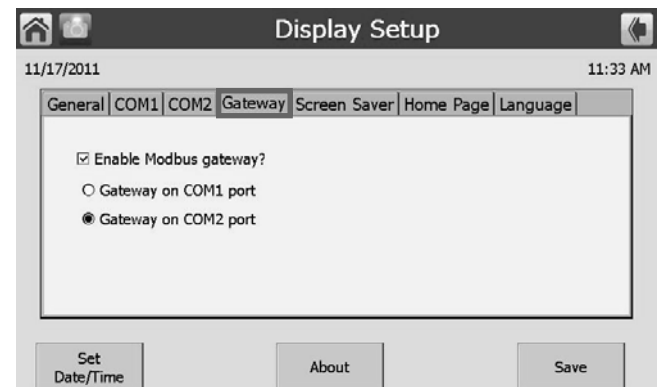
Menu 22. Setup Menu

From the Setup menu, tap the Display Setup button.



Menu 23. Display Setup -COM2

Select the COM2 tab and make sure that the COM2 port is enabled.



Menu 24. Display Setup -Gateway

Select the Gateway tab and make sure that the Gateway on COM2 port is enabled. Then return to the Homescreen.

9.10 Variable Speed Flow Control (V.S.P.C.) System

V.S.P.C. is a variable pump control that is standard equipment on all boilers. Pump speed is controlled to maintain a user-chosen temperature rise between the inlet and outlet of the Unit.

General PCB Operation

1. The desired Delta T can be set to any of the following values by moving or adding jumpers to the JP2 terminal on the control: See Figure 44

- 15 deg F/8 deg C
- 20 deg F/10 deg C
- 25 deg F/13 deg C
- 30 deg F/ 16 deg C

By adding a second jumper, one on “15 deg F” and one on “20 deg F”, it is possible to achieve 35 deg F /19 deg C.

By adding a second jumper, one on “15 deg F” and one on “25 deg F”, it is possible to achieve 40 deg F/22 deg C.

2. As shipped, the V.S.P.C. has a jumper on the JP4 terminal, to operate a 0-10 VDC output. If a 4-20 mA output is needed, move the jumper to the JP5 terminal. Figure 44

3. V.S.P.C. can operate in °F or °C. A jumper on the JP1 terminal allows the user to choose the temperature scale.

4. If Main Gas valve is “OFF” AND a call for heat is “TRUE” then the PCB overrides the PID control and runs the pump output at 100% (10 VDC, or 20 mA).

5. Once the Main Gas valve is energized the PCB will maintain pump output at 100% for 60 seconds to allow the system to stabilize. Once the 60 second timer has expired, the PCB will then run the pump output speed based on the jumper setpoint. .

6. When “T-T” is satisfied, the PCB will run pump at 100% output for the duration of the pump overrun time.

7. A jumper on the “JP1” terminal on the V.S.P.C. PCB will allow the variable speed pump control to operate in degrees Fahrenheit or Celsius. (Factory set for Fahrenheit).

8. The V.S.P.C. PCB has a low end cap to prevent nuisance low flow trips. The cap is factory programmed to 2 VDC.

9. Factory settings are:

- Degrees - Fahrenheit
- Output Signal- 0 -10VDC
- Delta T setpoint - 30 °F/17 °C

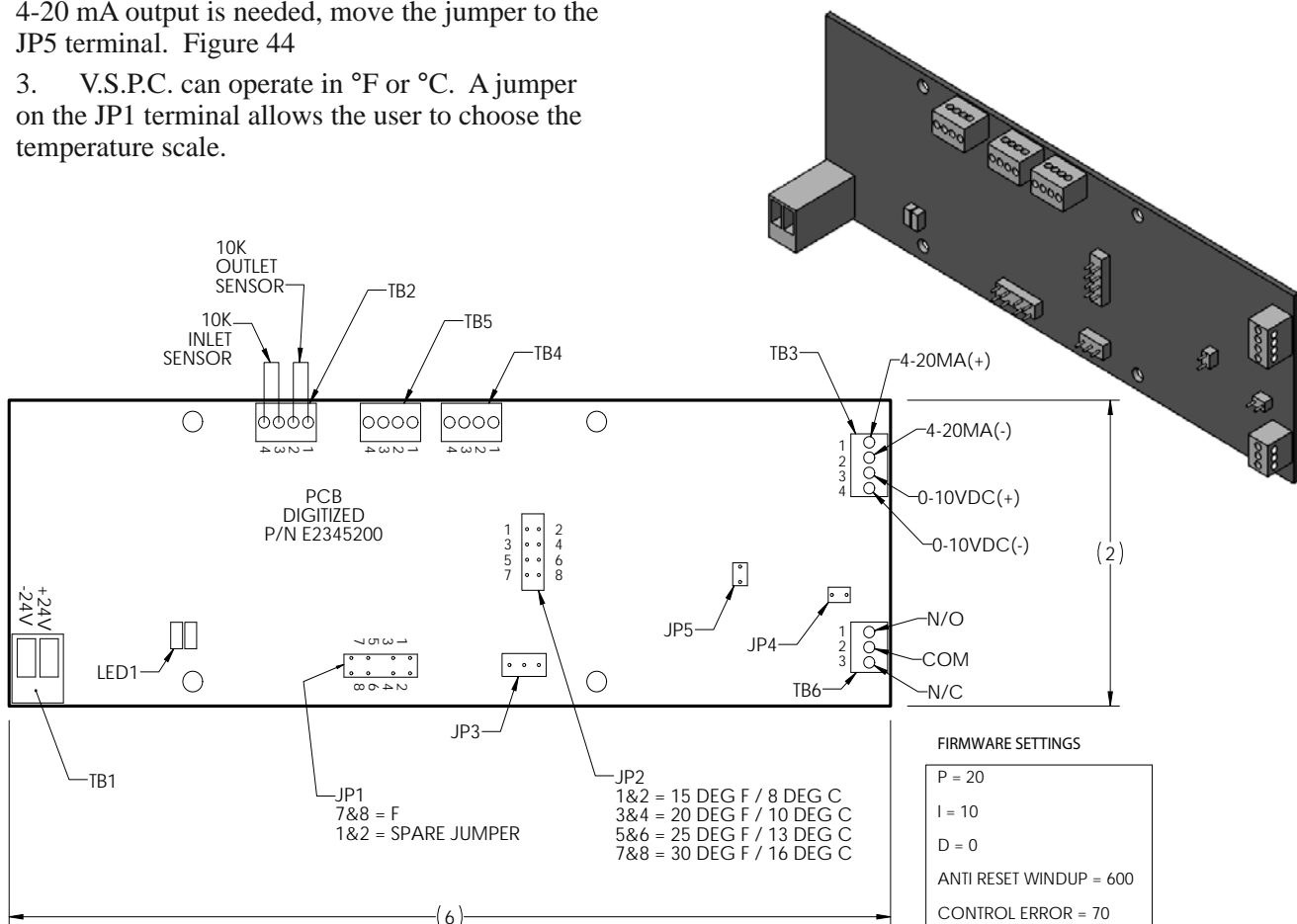


Figure 44. V.S.P.C. Digital Circuit Board

9.11 Combustion Setup Procedure

In this section, we will explain how to set up the gas valve so the boiler will run efficiently at both the High Fire and Low Fire conditions.

Required tools: Screwdrivers, Torx bits, Allen Wrench Set, Combustion Analyzer

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.

1. On the Main Gas Valve, locate the adjustments for high fire throttle, and low fire offset.

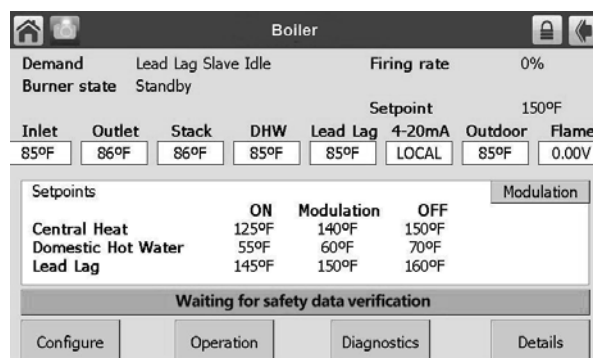
Refer to Table 23 for appropriate CO2 ranges.

2. Press the Control Icon at the center of the Home Screen.



Menu 26. 'Home' screen

3. The system will present the Status Summary screen.



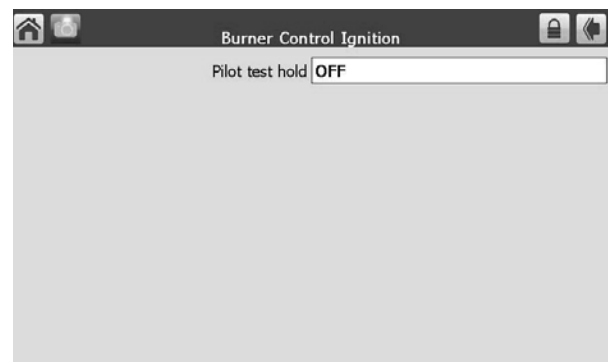
Menu 27. Status Summary Screen

4. Press the 'Configure' button in the lower left corner.



Menu 28. Configuration Menu

5. From the "Configuration" menu, select the line "Burner Control Ignition."



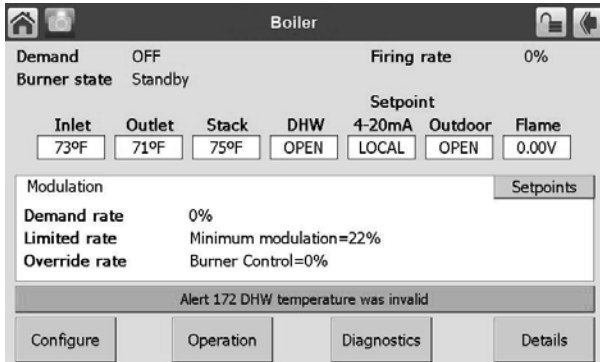
Menu 29. Burner Control Ignition

Once there select "Pilot Test Hold" and turn this feature "ON." This feature will allow the pilot to stay lit for setup and will NEVER fire the main burner. Give the unit a call for heat and the boiler will begin its sequence of operation (Refer to Section 12.8 for sequence of operation, and Table 22 for required pilot valve pressures.)

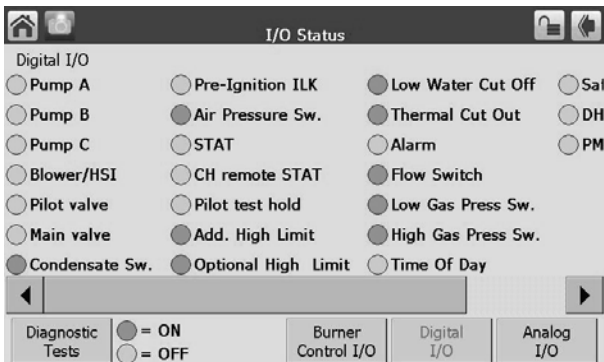
6. Once the pilot has lit, adjust pilot regulator pressure to that described in Table 22. With pilot still lit, view the flame through the sight glass. An adjustment to the pilot regulator may be needed if a yellow flame is visible. Use the regulator adjustment to adjust pilot flame to a nice blue hue while ensuring that the pressure in the pilot valve (See Table 22).
7. Once the desired pilot has been established, turn the call for heat OFF and return to "Burner Control Ignition" in the "Configure" menu to

turn "OFF" the pilot test hold.

8. Unit is equipped with a zero governing, negative regulator valve. The valve throttle should be adjusted only at high fire, and the offset adjustment is only to be done at low fire. From the "Home" screen touch the control icon, then touch, Diagnostics. On the I/O status screen press "Diagnostic Tests" and enter the installer password by pressing the padlock in the upper right corner.

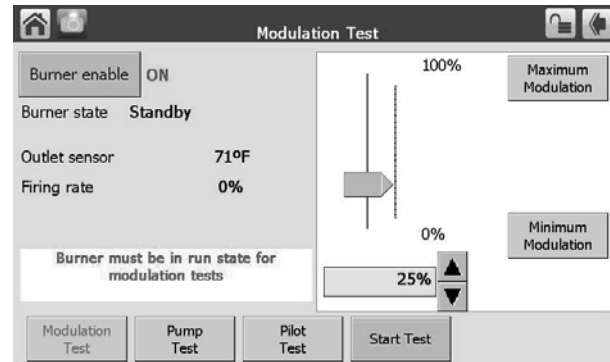


Menu 30. Burner Status



Menu 31. I/O Status

9. From here you can manually adjust the fan speed by pressing either the "Maximum Modulation" or "Minimum Modulation" buttons, then the "Start Test" button. In this mode the boiler will run at the selected firing rate for a period of five minutes or until the "Stop Test" button is pressed. The fan speed control feature is only active when the boiler is in "Run" mode. To setup high fire select "maximum modulation", then "Start Test" buttons. Wait for the boiler to enter run and the fan speed to reach the maximum RPM. Using a combustion analyzer, dial in the high fire throttle to obtain the correct CO₂ and CO measurements. (refer to Table 23 for correct CO₂ ranges).



Menu 32. Modulation Test

10. Once high fire is setup correctly select "Minimum Modulation" and wait for the fan speed to reach minimum RPM. When at low fire adjust the offset screw to adjust the low fire CO₂ to the correct values. (refer to Table 23 for correct CO₂ ranges)
11. After the setup for High and Low fire have been completed, head back to the "Firing Rate" menu, and select "Automatic". This MUST be done to ensure proper boiler operation.

Model	Propane Orifice (inches)	Propane Pressure	Natural Pressure
1600	0.035	3" - 4"	3" - 4"
2000	0.040	3" - 4"	3" - 4"
2500	0.035	3" - 4"	3" - 4"
3000	0.035	3" - 4"	3" - 4"
3500	0.047	2" - 3"	3" - 4"
4000	0.047	2" - 3"	3" - 4"

Table 22. Required Pilot Gas Pressures

Model	Gas Type	High Fire CO ₂	Low Fire CO ₂	Pressure Differential
1,600	Natural	9.0% ± 0.2	0.25% lower than high fire CO ₂	0.5" to 1.2" wc*
	Propane	10.0% ± 0.2	0.25% lower than high fire CO ₂	0.5" to 1.2" wc*
2,000	Natural	9.0% ± 0.2	0.25% lower than high fire CO ₂	0.5" to 1.2" wc*
	Propane	10.0% ± 0.2	0.25% lower than high fire CO ₂	0.5" to 1.2" wc*
2,500	Natural	9.0% ± 0.2	0.25% lower than high fire CO ₂	0.9" to .09" wc
	Propane	10.0% ± 0.2	0.25% lower than high fire CO ₂	0.9" to .09" wc
3,000	Natural	9.0% ± 0.2	0.25% lower than high fire CO ₂	0.5" to 1.2" wc
	Propane	10.0% ± 0.2	0.25% lower than high fire CO ₂	0.5" to 1.2" wc
3,500	Natural	9.0% ± 0.2	0.25% lower than high fire CO ₂	0.5" to 1.2" wc*
	Propane	10.0% ± 0.2	0.25% lower than high fire CO ₂	0.5" to 1.2" wc*
4,000	Natural	9.0% ± 0.2	0.25% lower than high fire CO ₂	0.5" to 1.2" wc*
	Propane	10.0% ± 0.2	0.25% lower than high fire CO ₂	0.5" to 1.2" wc*

* - Only check the pressures if there are problems getting the CO₂ and CO values in range.

Table 23. CO₂ Range and Pressure Differential

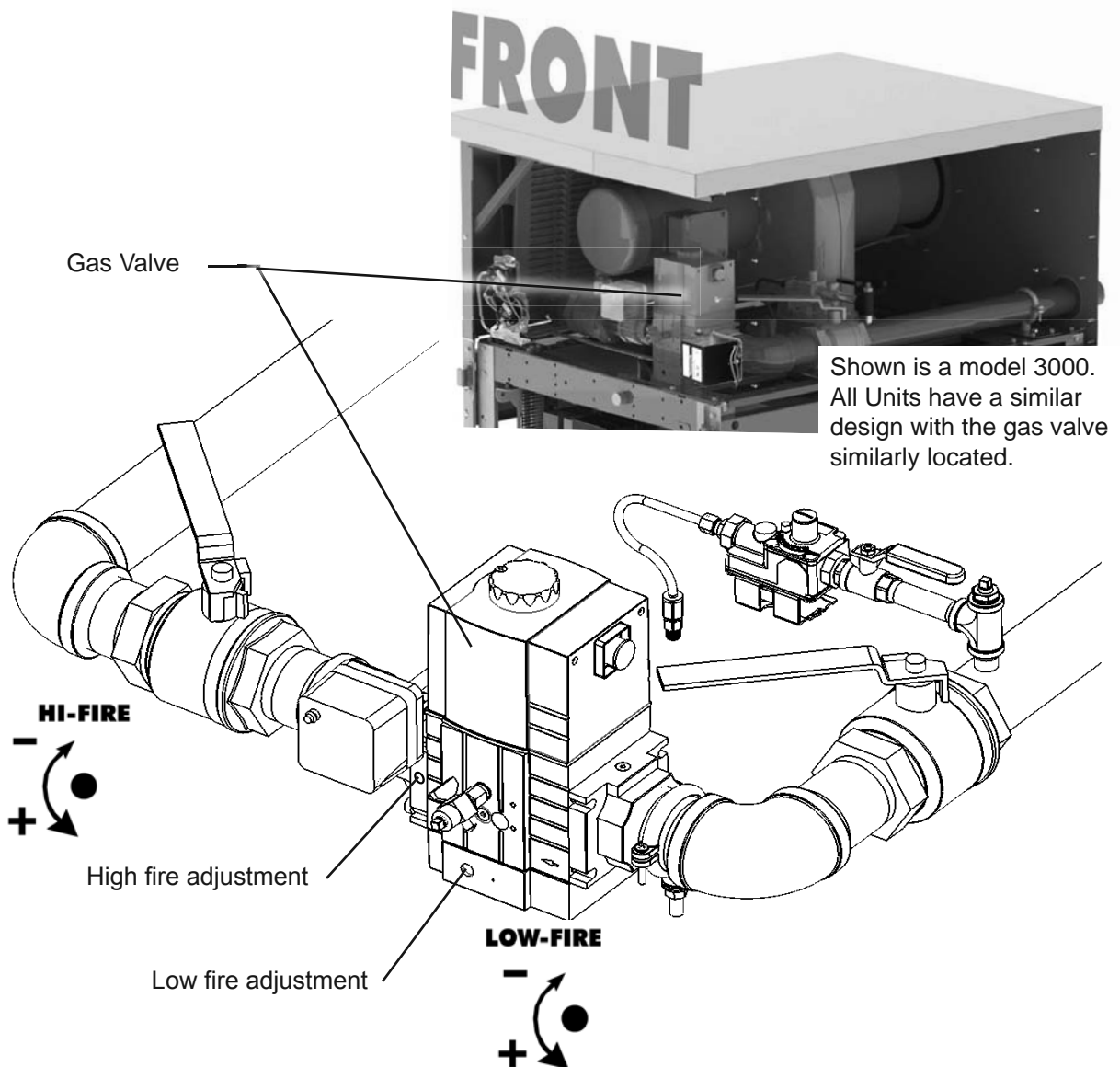


Figure 45. High and Low Fire Adjustments on the Gas Valve

Section 10

INITIAL STARTUP INSTRUCTIONS

10.1 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. Open any bleeding devices on all radiation units at the high points in the piping throughout the system, unless automatic air bleeders are provided at those points.
- Note** - There are three air bleeds located on top of the water manifold.



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. Recheck all air bleeders as described in Step 4.
8. 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 $\frac{1}{4}$ of the total, with the balance filled with air.
9. Start up the boiler following the procedure in this manual. Operate the entire system, including the pump, boiler, and radiation units for one hour.
10. Recheck the water level in the expansion tank. If the water level exceeds $\frac{1}{4}$ of the volume of the expansion tank, open the tank drain, and drain to that level.
11. Shut down the entire system and vent all radiation units and high points in the system piping, as described in Step 4.
12. 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.
13. 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.
14. 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.
15. Press the reset on the low pressure switch.
16. After placing the unit in operation, the ignition system safety shutoff device must be tested.

First, shut off the manual gas valve, and call the unit for heat. The main gas terminals will be energized, attempting to light, for five seconds, and then will de-energize. The unit will go into lockout after the required number of trial 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.
17. Within three days of start-up, recheck all air bleeders and the expansion tank as described in Steps 4 and 8 above.

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



WARNING

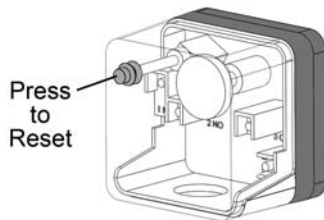
Do not use this appliance if any part has been under water. Immediately call a qualified service technician to inspect the appliance and to replace any part of the control system and any gas control that may have been under water.

10.2 Initial Operation

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

10.2.1 Initial Burner Operation

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



4. The unit will enter the start sequence. The blower and pump will energize for pre-purge, then the ignition sequence will start. After all safety devices are verified, 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.
5. If ignition starts normally, leave the unit turned on.
6. After placing the unit in operation, the Burner Safety Shutoff Device must be tested:
 - (a) Close the gas shutoff valve with the burner operating.
 - (b) The flame will go out, and the blower will continue to run for the post purge cycle. A few additional attempts to light will follow including pre-purge, ignitor on, valve/flame on and post purge. Ignition will not occur because the gas is turned off. The ignition control will lockout.
 - (c) Open the gas shutoff valve. Reset the boiler control by pressing the Reset button on the control. Restart the appliance. The ignition sequence will start again and the burner will start. The appliance will return to its previous mode of operation.

Caution

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.

10.2.2 Combustion Setup Procedure

See the detailed instructions in Section 9.10.

WARNING

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

10.3 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.

10.4 Restarting the Unit

If the system has been drained, see Section 10.1 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.

Section 11

MAINTENANCE

11.1 System Maintenance

Do the following once a year:

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, if installed, should be checked every year. Float type low water cutoffs should be flushed periodically.
7. Inspect and clean the condensate collection, float switch and disposal system yearly.
8. When a means is provided to neutralize condensate, 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, completely remove the existing sealing material, and clean with alcohol. Apply new sealing material, and reassemble.
11. Once a year, the items listed below should be inspected by a qualified service technician:

a. Appliance control	g. Flow switch
b. Automatic gas valve	h. Low water cutoff
c. Air filter	i. Burner
d. Pressure switches	j. Heat exchanger
e. Blower	k. Ignitor
f. Pump	

Do the following once every six months:

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



WARNING

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

11.2 Maintenance Notes

Use only genuine Manufacturer 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.

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

11.2.1 Burner

Check the burner for debris. Remove the blower assembly to access the blower adapter plate. Remove the 4 bolts connecting the blower to the arm. Remove the 5 blower adapter 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 clean with glass cleaner. A dirty burner may be an indication of improper combustion or dirty combustion air. Determine the cause of the problem, and correct it. If the burner gaskets are damaged, replace them when replacing the burner.

11.2.2 Modulating Gas Valve/ Venturi

The modulating gas valve consists of a valve body that incorporates the On/Off gas flow control and a negative pressure regulator. It provides the air/gas ratio control in combination with the fuel/air mixer to the unit. It is designed to operate with gas supply pressure between 4 and 13 inches w.c.. To remove the gas valve or fuel/air mixer, 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 front doors of the boiler, and the top panels, to gain access to the gas valve and fuel/air mixer. Disconnect the four flange bolts connecting the gas manifold pipe to the gas valve. Remove the electrical connections to the gas valve. Remove the bolts connecting the fuel/air mixer flange to the blower. This allows the entire gas valve and fuel/air mixer assembly to be removed as an assembly to facilitate inspection and cleaning.

After the valve has been removed, reassemble in reverse order making sure to include all gaskets and O-rings. Turn on the manual gas valves and check for gas leaks. Turn on the main power. Place the unit in operation following the instructions in Section 10. Once the boiler is operating, check for leaks again and confirm all fasteners are tight.

Check the setup for the unit according to the instructions in Section 9.

11.2.3 Controller

Each unit has an integrated 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.

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.

11.2.4 Spark Ignition Electrodes

The spark ignition electrode is a dual rod assembly. The ground rod is fastened to the mounting bracket of 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 open the front door of the boiler to gain access to the top portion of the unit. Remove the high tension ignition wire from the spark electrode. Remove the two nuts and spacer holding the spark electrode assembly in place. Pull the spark ignition electrodes out of the boiler slowly making sure to move the assembly as need, 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.

11.2.5 Flame Sensor

The flame sensor is a single rod system. The minimum flame signal that will allow the unit to fire is 0.8 volts. 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. Open the front doors of the boiler to gain access to the flame sensor electrode. Remove the flame sensor wire from the electrode. Remove the two 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 get become very hot. If you touch these parts accidentally, this can cause burns or injury.

11.2.6A Blower 1600

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 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 fuel/air mixer to the blower inlet. Remove the hardware that is connecting the blower outlet to the unit's adapter plate. 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/fuel mixer.

11.2.6B Blower 2000-4000

The combustion air blower is a high pressure centrifugal blower with a variable speed motor driven by a factory installed VFD located in the high voltage box. The speed of the motor is determined by the controls logic which is delivered to the VFD by a 0-10VDC 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. To replace or remove the blower, turn off main power, remove hardware that connects the Fuel/Air mixer to the blower, then remove the hardware that connects the blower to the adapter plate. If the fan is determined to be defective, replace the existing fan with a new one by reversing the steps listed above. Be sure to install all the required gaskets and o-rings between blower, adapter plate, and Fuel/Air mixer.

11.2.7 Heat Exchanger Tubes

Black carbon soot buildup on the external surfaces of the heat exchanger is caused by one or more of the following; incomplete combustion, combustion air problems, venting problems or heater short cycling. Soot buildup or other debris on the heat exchanger may restrict the flue passages.

If black carbon soot buildup on the heat exchanger is suspected, disconnect the electrical supply to the unit, and turn off the gas supply by closing the manual gas valve on the unit. Access the heat exchanger through the heat exchanger shrouds. Removal of the outer baffles may be required for proper inspection. Use a flashlight. If there is a buildup of black carbon soot or other debris on the heat exchanger, clean per the following:

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.

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. Clean the heat exchanger by brushing away any light accumulations of soot and debris. Use a non metallic brush with soft bristles to avoid damaging the surfaces of the heat exchanger tubes.
7. Once the tubes have 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.

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

8. To place the unit back in operation, install all removed components in the reverse

WARNING

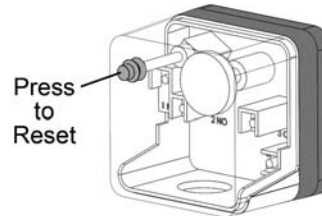
Failure to rinse the debris from the heat exchanger and temporary drain line may lead to clogged condensate lines, traps and neutralizers. Condensate pumps (if used) may also be damaged from the debris left behind, possibly causing property damage.

order. Be sure all gaskets are in place as the components are installed. Replace any damaged gaskets. Do **not** reuse damaged gaskets.

9. Place the appliance in operation according to Section 9, checking all gas connections for leaks. Confirm all fasteners are tight.

11.2.8 Gas Pressure Switches

The high and low pressure gas switches are 120 Volt 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 pressure gas 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 wires from the screw terminals. Twist the switch off the pipe nipple. Reassemble in reverse order.

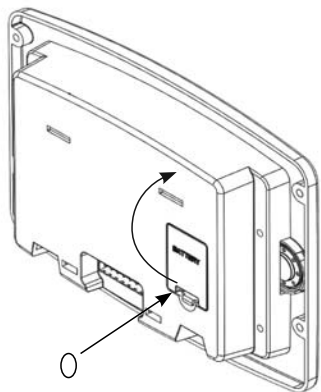
Set the low pressure gas switch to 3" w.c.

Set the high pressure gas switch to 15"w.c.."

11.2.9 Battery Back Up for Date and Time

The touchscreen does have an internal battery for back-up of the date and time settings.

The battery is a CR2032 'coin type' battery and has an expected service life of 6 years. If the battery needs to be replaced, there is a battery cover on the back of the touchscreen display and it can be easily reached when the panel that the Touchscreen is mounted to, is pulled forward.



Section 12

TROUBLESHOOTING

12.1 Lockouts, Holds, and Alerts

The control system on the Unit responds to three kinds of trouble indications:

- **LOCKOUT:** A “lockout” is caused by a serious problem that might involve a safety issue. Once the controller enters a lockout, the burners will shut down, and will not be allowed to run again until the cause of the problem is corrected, and the control is manually reset. The controller will also lockout if you change a safety-related parameter, and the unit will require ‘Safety Verification’ before the control will be allowed to operate. (For more information on verification, see Section 9) During a lockout condition, the image of the affected controller on the ‘home’ screen will appear in red. A bell symbol will appear in the upper left-hand corner of the control screen. The system maintains a “history” of the 15 most recent lockouts.
- **HOLD:** The system may enter a “hold” for a period of time before locking out. This allows the controller to see if the error becomes resolved prior to the hard lockout. Holds may also show during ignition sequence and normal operation, as the control moves from one task to another.
- **ALERT:** An “alert” indicates that some feature of the control system’s operation was not correct, delayed or waiting for a response. This indicates a change in state of the control system and doesn’t necessarily mean there is a problem. For example, Alerts occur as the fan speed transitions from the pre-purge to the startup. This indicates that the control system is waiting for a condition to be satisfied. No Reset is required to recover from an alert. The system maintains a “history” of the 15 most recent alerts. Sometimes it can be helpful to check this list as a troubleshooting aid.

12.1.1 Responding to a Lockout, Hold, or Alert

1. If a problem occurs while the system is starting up, the system will declare a Hold. A brief explanation of the cause of the Hold will appear in an orange bar across the bottom of the screen. If you tap the orange bar, the system will present more information about the Hold. Correct the cause of the problem, and press the button on the screen to clear the Hold.
2. If a serious problem continues, the system will Lockout. A brief explanation of the cause of the

Lockout will appear in an orange bar across the bottom of the screen. If you tap the orange bar, the system will present more information about the Lockout.

Correct the cause of the problem, and press the Reset button.

3. If an Alert occurs while the system is running, the system will present a note across the bottom of the screen. If you tap the orange bar, the system will present more information about the Alert. Press the OK button to indicate that you have seen the Alert.
4. If an audible alarm on the display is active, you can use the Silence button to stop it.

12.1.2 Viewing the Lockout and Alert Histories

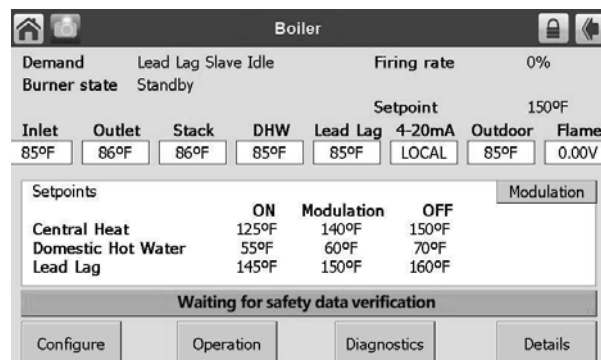
If your boiler is in a Lockout status, the Home Screen will be look like Menu 33

1. To view the Lockout/Alert history, start at the ‘home’ screen Menu 33.



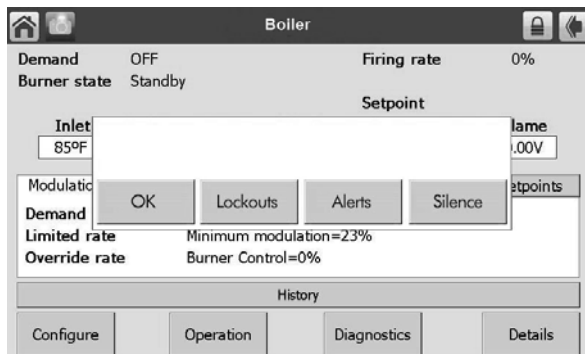
Menu 33. ‘Home’ screen (shown in Lockout)

2. Touch the Control Icon in the center of the screen and the Status Summary Screen will appear.



Menu 34. Status Summary Menu

3. Press the long Yellow Alert or Yellow Lockout Bar (the long bar will be a long Grey 'History' Bar if not currently in Alert or Lockout).



Menu 35. OK, Lockouts, Alerts, or Silence.

Choose which history list you would like to see.

OK: brings you back to the status summary screen.

LOCKOUTS brings you to a list of the last 15 lockout events.

ALERTS brings you to a list of the last 15 alerts.

SILENCE allows you to silence an alarm.

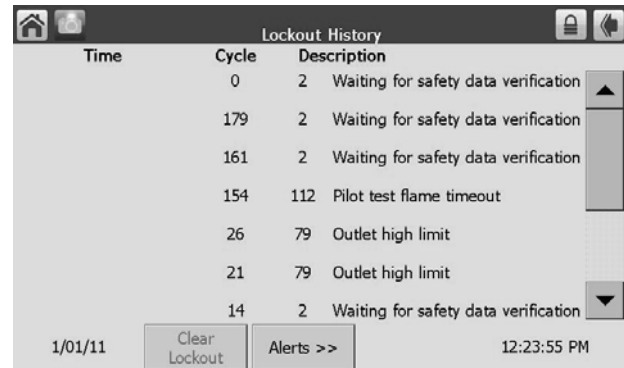
From here you can select 'OK' to back out of current screen or 'Lockouts' to bring up a list of the last 15 Lockout occurrences. Press 'Alerts' to bring up a list of the last 15 Alerts, and 'Silence Alarm' in the event of a lockout condition. By silencing the alarm, the audible alert has been disabled. However, the Lockout is still active. Reset of the control is needed once the condition has been repaired.

If you choose 'ALERTS', this menu will appear.



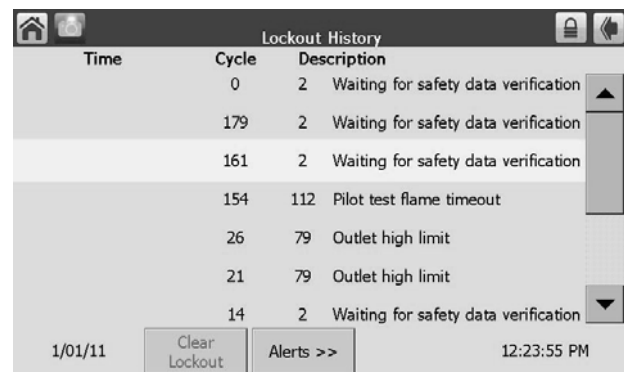
Menu 36. Alert History

If you choose 'LOCKOUTS', this menu will appear.



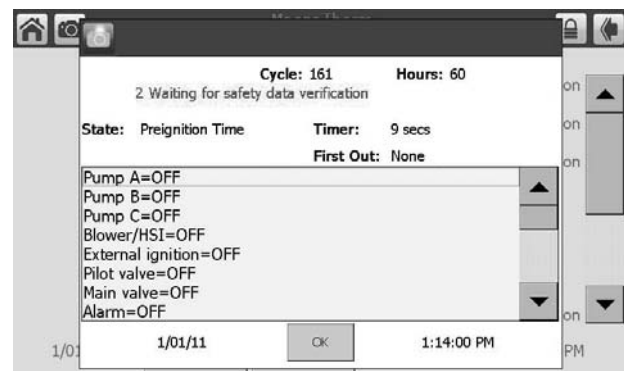
Menu 37. Lockout History

4. You can see more detailed information of an alert or lockout by touching the special entry on the screen.



Menu 38. Lockout History (showing selected)

Note: The most recent Lockout or Alert will be at the top of the menu list.



Menu 39. Lockout Detail

Return back to the Status Summary Menu by pressing the 'Back' arrow.

12.2 Troubleshooting Table

This table includes a listing of the fault codes that may be displayed. Some of these can be corrected by changing a parameter, while other conditions are more complicated, and will require a service technician.

The first column lists the code number that will appear at the beginning of the Lockout or Hold message in the orange bar at the bottom of the screen. The second column lists the text as it will appear on the Touch Screen. The third column shows whether the condition will cause a Hold, or Lockout, or both. The fourth column lists some suggestions for corrective action.

Code	Description	Lockout or Hold	Procedure
1	Unconfigured safety data	L	1. New device, complete device configuration and safety verification. 2. If fault repeats, replace module
2	Waiting for safety data verification	L	1. Device in Configuration mode and safety parameters need verification and a device needs reset to complete verification. 2. Configuration ended without verification, re enter configuration, verify safety parameters and reset device to complete verification. 3. If fault repeats, replace module.
3	Internal fault: Hardware fault	H	Internal fault 1. Reset module 2. If fault repeats, replace module.
4	Internal fault: Safety Relay key feedback error	H	
5	Internal fault: Unstable power (DC DC) output	H	
6	Internal fault: Invalid processor clock	H	
7	Internal fault: Safety relay drive error	H	
8	Internal fault: Zero crossing not detected	H	
9	Internal fault: Flame bias out of range	H	
10	Internal fault: Invalid burner control state	L	
11	Internal fault: Invalid burner control state flag	L	
12	Internal fault: Safety relay drive cap short	H	
13	Internal fault: PII (Pre-Ignition Interlock) shorted to ILK (Interlock)	H or L	
15	Internal fault: Safety relay test failed due to feedback ON	L	

16	Internal fault: Safety relay test failed due to safety relay OFF	L	Internal fault 1. Reset module 2. If fault repeats, replace module.
17	Internal fault: Safety relay test failed due to safety relay not OFF	L	
18	Internal fault: Safety relay test failed due to feedback not ON	L	
19	Internal fault: Safety RAM write	L	
20	Internal fault: Internal fault: Flame ripple and overflow	H	
21	Internal fault: Flame number of sample mismatch	H	
22	Internal fault: Flame bias out of range	H	
23	Internal fault: Bias changed since heating cycle starts	H	
24	Internal fault: Spark voltage stuck low or high	H	
25	Internal fault: Spark voltage changed too much during flame sensing time	H	
26	Internal fault: Static flame ripple	H	
27	Internal fault: Flame rod shorted to ground detected	H	
28	Internal fault: A/D linearity test fails	H	
29	Internal fault: Flame bias cannot be set in range	H	
30	Internal fault: Flame bias shorted to adjacent pin	H	
31	Internal fault: SLO electronics unknown error	H	
32-46	Internal fault: Safety Key 0 through 14	L	
47	Flame Rod to ground leakage	H	
48	Static flame (not flickering)	H	
49	24 VAC voltage low/high	H	
			1. Check the module and display connections. 2. Check the module power supply and make sure that frequency, voltage and VA meet the specifications.

50	Modulation fault	H	Internal sub-system fault.
51	Pump fault	H	1. Review alert messages for possible trends.
52	Motor tachometer fault	H	2. Correct possible problems.
53	AC input phases reversed	L	1. Check the module and display connections. 2. Check the module power supply and make sure that both frequency and voltage meet the specifications. 3. On 24 VAC applications, assure that J4 terminal 10 and J8 terminal 2 are connected together.
59	Internal Fault: Mux pin shorted	L	Internal Fault. 1. Reset module. 2. If fault repeats, replace module.
61	Anti short cycle	H	Will not be a lockout fault. Hold Only.
62	Fan speed not proved	H	
63	Rollout switch, is regarding the SAFETY DEVICES (OFF) To diagnose, test all of the following: Flow Switch Additional High Limit (Field Supplied) Low Water Cut Off Low pressure gas switch – Inlet Side of Gas Valve High Pressure gas switch – Outlet Side of Gas Valve Condensate Level Switch	H	1. Reset the low gas pressure valve and the high gas pressure valve. 2. Check for power at all Safety Components. 3. Check wiring and correct any faults. 4. Check all safety interlocks connected to the safety circuit to assure proper function. 5. If code persists, contact Tech Support.
64	PII (Pre-Ignition Interlock) OFF	H or L	1. Check wiring and correct any faults. 2. Check Preignition Interlock switches to assure proper functioning. 3. Check the valve operation. 4. Reset and sequence the module; monitor the PII status. 5. If code persists, replace the module.
67	ILK (Interlock) OFF	H or L	1. Check wiring and correct any possible shorts. 2. Check Interlock (ILK) switches to assure proper function.
68	ILK (Interlock) ON	H or L	3. Verify voltage through the interlock string to the interlock input with a voltmeter. 4. If steps 1-3 are correct and the fault persists, replace the module.
70	Wait for leakage test completion	H	1. Internal Fault. Reset module. 2. If fault repeats, replace module.
78	Demand Lost in Run	H	1. Check wiring and correct any possible errors. 2. If previous steps are correct and fault persists, replace the module.

79	Outlet high limit	H or L	1. Check wiring and correct any possible errors. 2. Replace the outlet high limit. 3. If previous steps are correct and fault persists, replace the module.
80	DHW (Domestic Hot Water) high limit	H or L	1. Check wiring and correct any possible errors. 2. Replace the DHW high limit. 3. If previous steps are correct and fault persists, replace the module.
81	Delta T limit	H or L	1. Check inlet and outlet sensors and pump circuits for proper operation. 2. Recheck the Delta T Limit to confirm proper setting. 3. If previous steps are correct and fault persists, replace the module.
82	Stack limit	H or L	1. Check wiring and correct any possible errors. 2. Replace the Stack high limit. 3. If previous steps are correct and fault persists, replace the module.
91	Inlet sensor fault	H	1. Check wiring and correct any possible errors. 2. Replace the Inlet sensor. 3. If previous steps are correct and fault persists, replace the module.
92	Outlet sensor fault	H	1. Check wiring and correct any possible errors. 2. Replace the Outlet sensor. 3. If previous steps are correct and fault persists, replace the module.
93	DHW (Domestic Hot Water) sensor fault	H	1. Check wiring and correct any possible errors. 2. Replace the DHW sensor. 3. If previous steps are correct and fault persists, replace the module.
94	Header sensor fault	H	1. Check wiring and correct any possible errors. 2. Replace the header sensor. 3. If previous steps are correct and fault persists, replace the module.
95	Stack sensor fault	H	1. Check wiring and correct any possible errors. 2. Replace the stack sensor. 3. If previous steps are correct and fault persists, replace the module.
96	Outdoor sensor fault	H	1. Check wiring and correct any possible errors. 2. Replace the outdoor sensor. 3. If previous steps are correct and fault persists, replace the module.
97	Internal Fault: A2D mismatch.	L	Internal Fault. 1. Reset module. 2. If fault repeats, replace module.
98	Internal Fault: Exceeded VSNSR voltage tolerance	L	
99	Internal Fault: Exceeded 28V voltage tolerance	L	

100	Pressure Sensor Fault	H	<ol style="list-style-type: none"> 1. Verify the Pressure Sensor is a 4-20 ma source. 2. Check wiring and correct any possible errors. 3. Test Pressure Sensor for correct operation. 4. Replace the Pressure sensor. 5. If previous steps are correct and fault persists, replace the module.
105	Flame detected out of sequence	H or L	<ol style="list-style-type: none"> 1. Check that flame is not present in the combustion chamber. Correct any errors. 2. Make sure that the flame detector is wired to the correct terminal. 3. Make sure the F & G wires are protected from stray noise pickup. 4. Reset and sequence the module, if code reappears, replace the flame detector. 5. Reset and sequence the module, if code reappears, replace the module.
106	Flame lost in MFEP	L	<ol style="list-style-type: none"> 1. Check main valve wiring and operation - correct any errors. 2. Check the fuel supply. 3. Check fuel pressure and repeat turndown tests.
107	Flame lost early in run	L	<ol style="list-style-type: none"> 4. Check ignition transformer electrode, flame detector, flame detector siting or flame rod position. 5. If steps 1 through 4 are correct and the fault persists, replace the module.
108	Flame lost in run	L	<ol style="list-style-type: none"> 1. Check main valve wiring and operation - correct any errors. 2. Check the fuel supply. 3. Check fuel pressure and repeat turndown tests.
109	Ignition failed	L	<ol style="list-style-type: none"> 4. Check ignition transformer electrode, flame detector, flame detector siting or flame rod position. 5. If steps 1 through 4 are correct and the fault persists, replace the module.
110	Ignition failure occurred	H	Hold time of recycle and hold option. Will not be a lockout fault. Hold Only. Internal hardware test. Not a lockout.
111	Flame current lower than weak threshold	H	Hold time of recycle and hold option. Will not be a lockout fault. Hold Only. Internal hardware test. Not a lockout.
113	Flame circuit timeout	L	Flame sensed during Initiate or off cycle, hold 240 seconds, if present after 240 seconds, system will lockout.
119	Control Interaction Fault	H	Flap valve identifications configured incorrectly.

122	Lightoff rate proving failed	L	<ol style="list-style-type: none"> 1. Check wiring and correct any potential wiring errors. 2. Check VFD's (Variable-speed Fan Drive) ability to change speeds. 3. Change the VFD 4. If the fault persists, replace the module.
123	Purge rate proving failed	L	<ol style="list-style-type: none"> 1. Check wiring and correct any potential wiring errors. 2. Check VFD's (Variable-speed Fan Drive) ability to change speeds. 3. Change the VFD 4. If the fault persists, replace the module.
128	Fan speed failed during prepurge	H or L	<ol style="list-style-type: none"> 1. Check wiring and correct any potential wiring errors. 2. Check the VFDs (Variable-speed Fan Drive) ability to change speeds. 3. Change the VFD 4. If the fault persists, replace the module.
129	Fan speed failed during preignition	H or L	<ol style="list-style-type: none"> 1. Check wiring and correct any potential wiring errors. 2. Check the VFDs (Variable-speed Fan Drive) ability to change speeds. 3. Change the VFD 4. If the fault persists, replace the module.
130	Fan speed failed during ignition	H or L	<ol style="list-style-type: none"> 1. Check wiring and correct any potential wiring errors. 2. Check the VFDs (Variable-speed Fan Drive) ability to change speeds. 3. Change the VFD 4. If the fault persists, replace the module.
131	Fan movement detected during standby	H	<ol style="list-style-type: none"> 1. Check wiring and correct any potential wiring errors. 2. Check the VFDs (Variable-speed Fan Drive) ability to change speeds. 3. Change the VFD 4. If the fault persists, replace the module.
132	Fan speed failed during run	H	<ol style="list-style-type: none"> 1. Check wiring and correct any potential wiring errors. 2. Check the VFDs (Variable-speed Fan Drive) ability to change speeds. 3. Change the VFD 4. If the fault persists, replace the module.
137	ILK (Interlock) failed to close	H	<ol style="list-style-type: none"> 1. Check wiring and correct any possible shorts. 2. Check Interlock (ILK) switches to assure proper function. 3. Verify voltage through the interlock string to the interlock input with a voltmeter. 4. If steps 1-3 are correct and the fault persists, replace the module.

149	Flame detected	H or L	Holds if flame detected during Safe Start check up to Flame Establishing period.
150	Flame not detected	H	Sequence returns to standby and restarts sequence at the beginning of Purge after the HF switch opens if flame detected during Safe Start check up to Flame Establishing period.
154	Purge Fan switch On	H or L	1. Purge fan switch is on when it should be off. 2. Check wiring and correct any errors. 3. Inspect the Purge Fan switch J6 terminal 3 and its connections. Make sure the switch is working correctly and is not jumpered or welded.
155	Purge fan switch OFF	H or L	4. Reset and sequence the relay module. 5. If the fault persists, replace the relay module.
156	Combustion pressure and flame ON	H or L	1. Check that flame is not present in the combustion chamber. Correct any errors. 2. Make sure that the flame detector is wired to the correct terminal.
157	Combustion pressure and flame OFF	L	3. Make sure the F & G wires are protected from stray noise pickup. 4. Reset and sequence the module, if code reappears, replace the flame detector. 5. Reset and sequence the module, if code reappears, replace the module.
158	Main valve ON	L	1. Check Main Valve terminal wiring and correct any errors.
159	Main valve OFF	L	2. Reset and sequence the module. If fault persists, replace the module.
160	Ignition ON	L	1. Check Ignition terminal wiring and correct any errors.
161	Ignition OFF	L	2. Reset and sequence the module. If fault persists, replace the module.
164	Block intake ON	L	1. Check wiring and correct any errors. 2. Inspect the Block Intake Switch to make sure it is working correctly. 3. Reset and sequence the module.
165	Block intake OFF	L	4. During Standby and Purge, measure the voltage across the switch. Supply voltage should be present. If not, the Block Intake Switch is defective and needs replacing. 5. If the fault persists, replace the relay module.
172	Main relay feedback incorrect	L	Internal Fault. 1. Reset module. 2. If fault repeats, replace module.
174	Safety relay feedback incorrect	L	
175	Safety relay open	L	
176	Main relay ON at safe start check	L	
178	Safety relay ON at safe start check	L	

184	Invalid BLOWER / SPARK output setting	L	<ol style="list-style-type: none"> 1. Return to Configuration mode and recheck selected parameters, reverify and reset module. 2. If fault repeats, verify electrical grounding. 3. If fault repeats, replace module.
185	Invalid Delta T limit enable setting	L	
186	Invalid Delta T limit response setting	L	
187	Invalid DHW (Domestic Hot Water) high limit enable setting	L	
188	Invalid DHW (Domestic Hot Water) high limit response setting	L	
189	Invalid flame sensor type setting	L	
192	Invalid igniter on during setting	L	
193	Invalid ignite failure delay setting	L	
194	Invalid ignite failure response setting	L	
195	Invalid ignite failure retries setting	L	
196	Invalid ignition source setting	L	
197	Invalid interlock open response setting	L	
198	Invalid interlock start check setting	L	
199	Invalid LCI (Limit Control Input) enable setting	L	
200	Invalid lightoff rate setting	L	
201	Invalid lightoff rate proving setting	L	
202	Invalid MFEP (Main Flame Establishing Period) time setting	L	
203	Invalid MFEP (Main Flame Establishing Period) flame failure response setting	L	
204	Invalid NTC sensor type setting	L	
205	Invalid Outlet high limit response setting	L	
207	Invalid PII (Pre-Ignition Interlock) enable setting	L	
210	Invalid Postpurge time setting	L	
211	Invalid Power up with lockout setting	L	
212	Invalid Preignition time setting	L	
213	Invalid Prepurge rate setting	L	
214	Invalid Prepurge time setting	L	
215	Invalid Purge rate proving setting	L	
216	Invalid Run flame failure response setting	L	
217	Invalid Run stabilization time setting	L	
218	Invalid Stack limit enable setting	L	
219	Invalid Stack limit response setting	L	
220	Unconfigured Delta T limit setpoint setting	L	
221	Unconfigured DHW (Domestic Hot Water) high limit setpoint setting	L	
222	Unconfigured Outlet high limit setpoint setting	L	
223	Unconfigured Stack limit setpoint setting	L	

224	Invalid DHW (Domestic Hot Water) demand source setting	L	<ol style="list-style-type: none"> 1. Return to Configuration mode and recheck selected parameters, reverify and reset module. 2. If fault repeats, verify electrical grounding. 3. If fault repeats, replace module.
225	Invalid Flame threshold setting	L	
226	Invalid Outlet high limit setpoint setting	L	
227	Invalid DHW (Domestic Hot Water) high limit setpoint setting	L	
228	Invalid Stack limit setpoint setting	L	
229	Invalid Modulation output setting	L	
230	Invalid CH (Central Heat) demand source setting	L	
231	Invalid Delta T limit delay setting	L	
232	Invalid Pressure sensor type setting	L	
234	Invalid Outlet high limit enable setting	L	
235	Invalid Outlet connector type setting	L	
236	Invalid Inlet connector type setting	L	
237	Invalid DHW (Domestic Hot Water) connector type setting	L	
238	Invalid Stack connector type setting	L	
239	Invalid Header connector type setting	L	
240	Invalid Outdoor connector type setting	L	

12.3 Diagnostic Tests and Input/Output Indicators

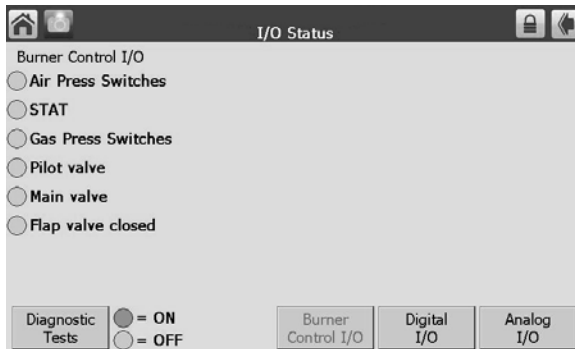
Two kinds of screens are grouped together in this section:

- Detailed indications of the input and output signals
- Diagnostic tests of the pumps and burner modulation

Note that these functions apply to just one selected controller.

To access the diagnostic functions, from the home screen, touch the control icon, then touch the 'Diagnostics' button.

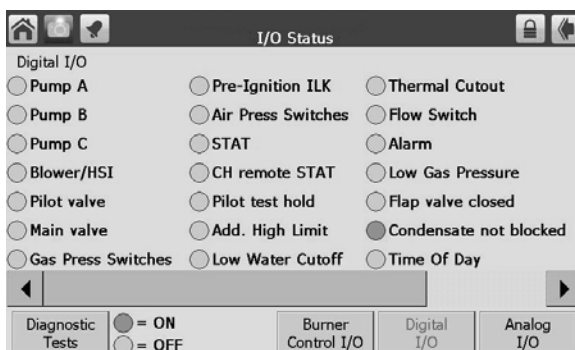
1. The buttons at the bottom of the screen select the types of inputs and outputs displayed. The Burner Control I/O button leads to Menu 40



Menu 40. Burner Control I/O Screen

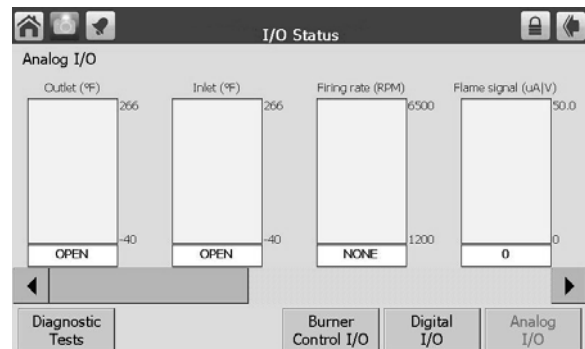
A green dot indicates a function that is "on."

2. Press the Digital I/O button to see parameters with the functions that are either "on" or "off." See Menu 41.



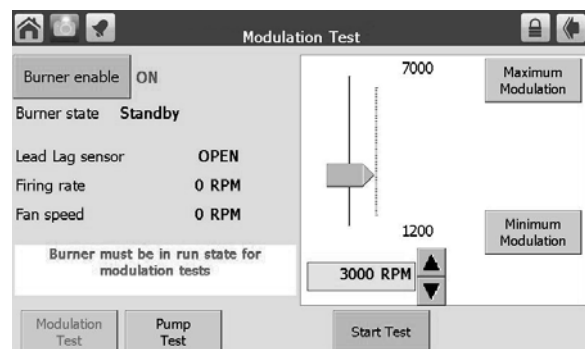
Menu 41. Digital I/O Screen

3. The button for Analog I/O displays items that change continuously between two limits. See Menu 42



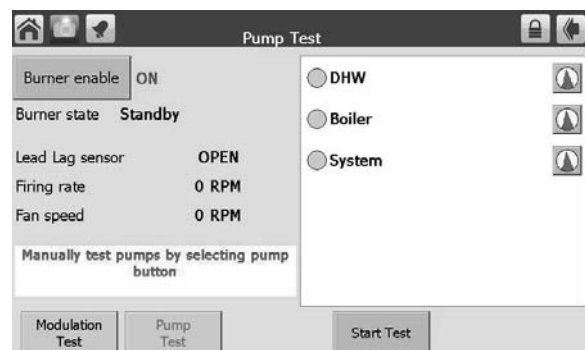
Menu 42. Analog I/O Screen

4. Press the button for Diagnostic Tests. The Modulation test allows you to change the rate at which the burner fires, and watch the results. See Menu 43



Menu 43. Modulation Test

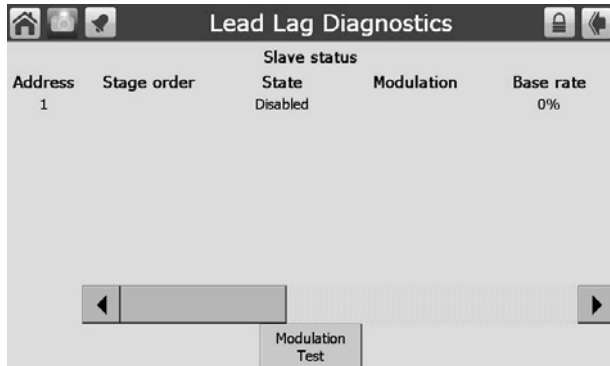
5. Press the Pump Test button. The Pump test shows detailed information about the three pumps that may be used by the system.



Menu 44. Pump Test

12.4 Lead Lag Diagnostics

The control system includes a diagnostic screen that lists some information on the Lag (Slave) units in the system. See Menu 45

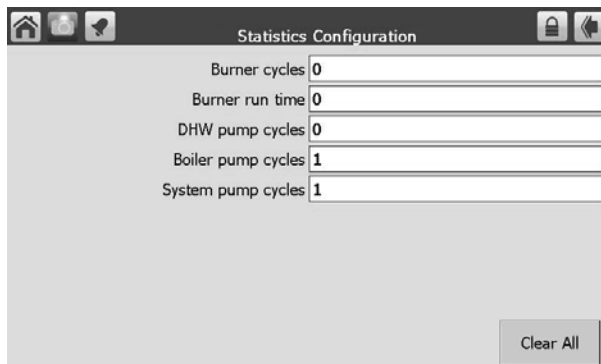


Menu 45. Lead Lag Diagnostics (Slave status)

Use the left- and right-arrows to see all of the columns in the display.

12.5 Statistics

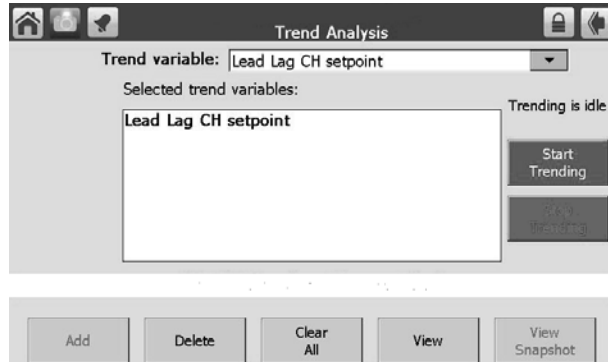
The controller can present some summary information about the operation of the system – number of pump cycles, number of burner cycles, etc.



Menu 46. Statistics Configuration Screen

12.6 Analysis

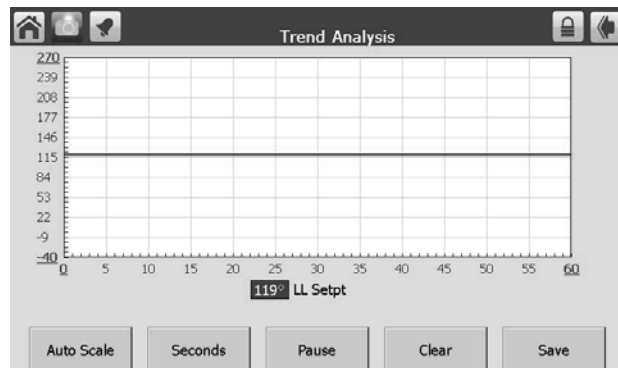
The control system includes an Analysis branch that can display the behavior over a period of time for several different parameters: fan speed, outlet temperature, inlet temperature, etc.



Menu 47. Analysis Setup Screen

To use this function, select the parameter you want to track from the pull-down list. The system will present a graph that tracks that variable.

To see the graph for the currently-selected function, press the View button.

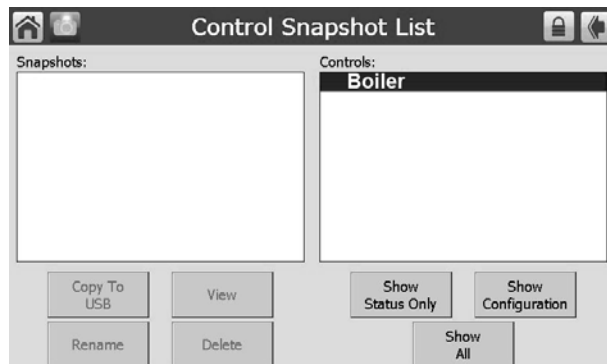


Menu 48. Trend Analysis Graph

The time scale can be adjusted by pressing the Seconds button in the lower left-hand corner.

12.7 Control Snapshot

The software allows you to take a “snapshot” of the current state of the controller, including setup information and operating information. This information can be helpful during troubleshooting. Menu 49 shows the Control Snapshot screen.



Menu 49. Control Snapshot List Screen

Select one of the controllers listed on the right side of the screen. Press one of the buttons below the right column to see the snapshot. See Menu 50.



Menu 50. Typical Control Snapshot

The Show Status button captures the current status of the I/O of the control only. Show Configuration captures the current parameter settings and the control setup. You can save the snapshot, give it a name, or send a copy to the USB port.

12.8 Operating Sequence

When there is a call for heat, the unit will close pump contacts to energize the customer supplied relay/contactor to start water flow. Once the LCI circuit (flow switch, gas pressure switches, LWCO, and High Limit aquastats) are completed the unit will start the blower and begin the ignition sequence. The unit is equipped with a low and high fire air pressure switch. The unit will pre-purge at 65% fan for 30 seconds and prove fan through the blocked intake switch. Once fan is proven, the blower will proceed to 24% and the 10 second Pre-ignition timer will start to allow the spark to begin. Once the Pre-ignition timer has expired the control will open the Pilot solenoid and the Pilot Flame Establishing Period (PFEP) will start for 10 seconds to establish flame. Once flame has been established and the 10 second timer has expired the control will open the main valve and the Main Flame Establishing Period will begin for a period of 5 seconds. If flame is established within those 5 seconds then unit will proceed to Run, if flame does not establish the unit will post-purge to 100% for 30 seconds and the sequence for ignition will begin again. For Non CSD-1 units retry for ignition is 3 times before Lockout 109 (Ignition Failure) occurs. For CSD-1 units there is a single retry before Lockout 109 occurs.

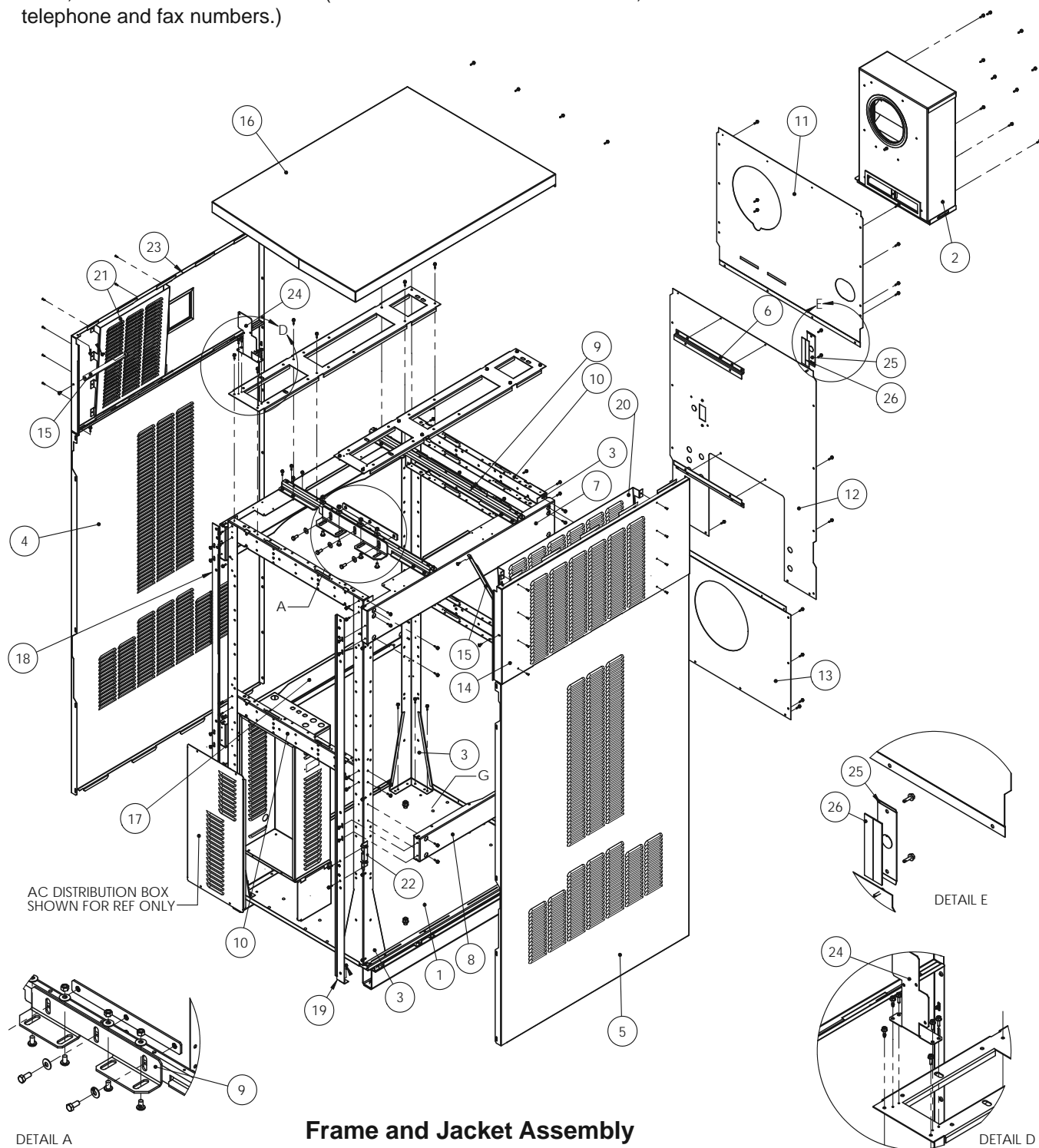
Section 13

REPLACEMENT PARTS

Use only genuine Manufacturer replacement parts.

13.1 General Information

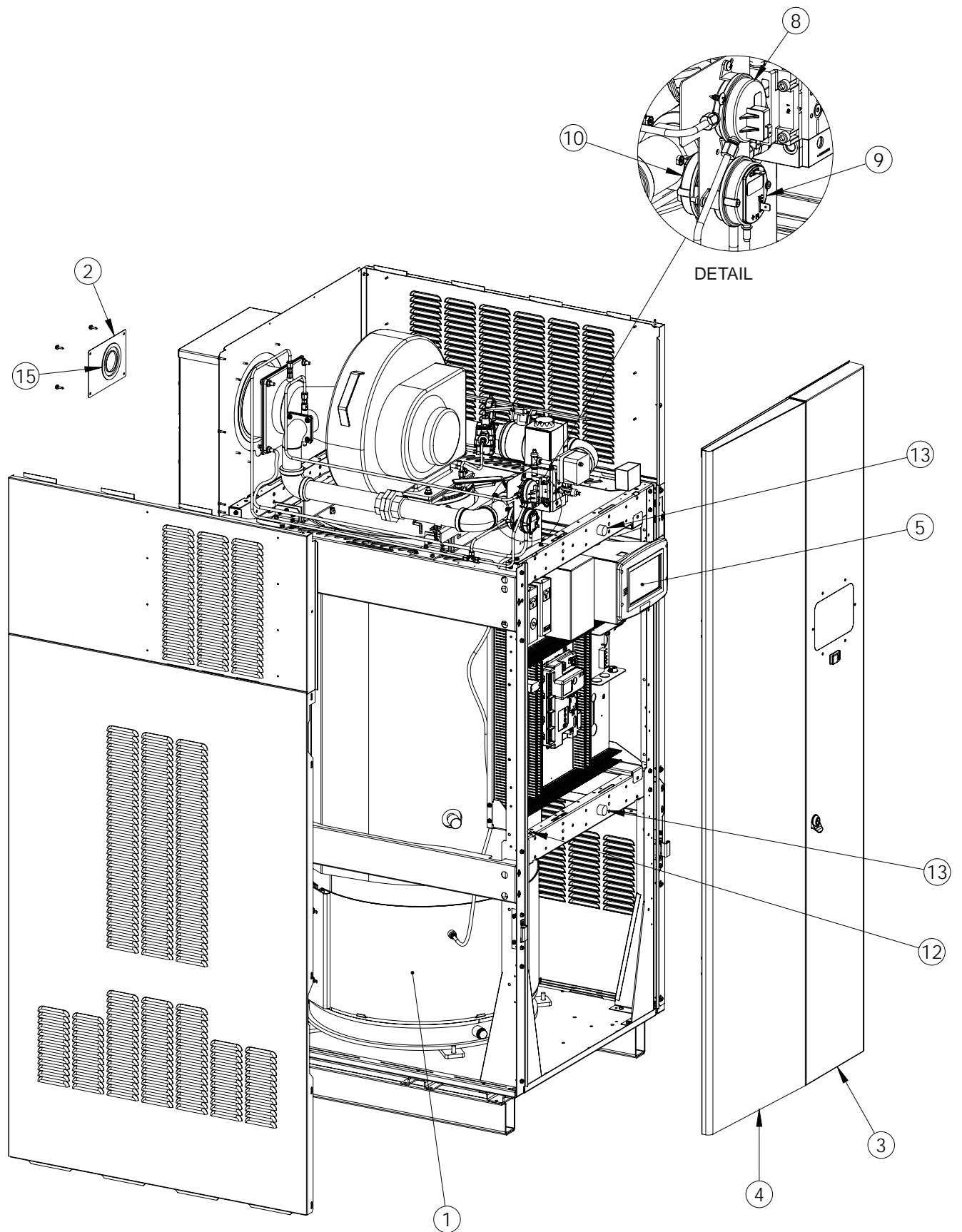
To order or purchase parts for the Manufacturer Unit, contact your nearest Manufacturer dealer or distributor. If they cannot supply you with what you need, contact Customer Service. (See the back cover for addresses, and for telephone and fax numbers.)



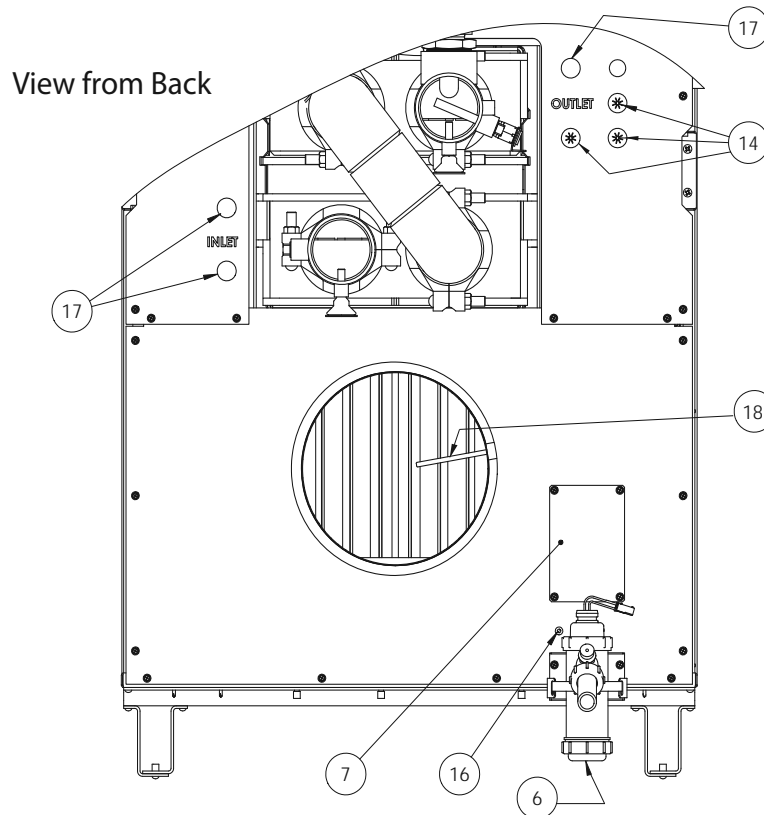
13.2 Component Illustrations, Parts Lists, and Part Numbers

13.2.1 Frame and Jacket Assembly, Part Numbers

		1600	2000	2500	3000	3500	4000
Item #	Description	Part No.	Part No.	Part No.	Part No.	Part No.	Part No.
1	Base assembly	16N1000	20N1000	30N1000	30N1000	40N1000	40N1000
2	Filter	A2121700	A2121700	A2121700	A2121700	A2121700	A2121700
2a	Filter assembly (includes filter)	16N2600	20N2600	25N2600	30N2600	40N2600	40N2600
3	Stanchion	20N3010	20N3010	30N3001	30N3001	40N3001	40N3001
4	Panel, left bottom	20N3002	20N3002	30N3002	30N3002	40N3002	40N3002
5	Panel, right bottom	20N3004	20N3004	30N3004	30N3004	40N3004	40N3004
6	Extension brace, rear	30N3007	30N3007	30N3007	30N3007	30N3007	30N3007
7	Brace, upper side	20N3008	20N3008	30N3008	30N3008	40N3008	40N3008
8	Brace, lower right side	20N3047	20N3047	30N3011	30N3011	40N3047	40N3047
9	Frame mounting bracket	20N3005	20N3005	30N3012	30N3012	40N3005	40N3005
10	Brace	20N3013	20N3013	30N3013	30N3013	40N3013	40N3013
11	Panel, upper rear	16N3019	20N3019	30N3019	30N3019	40N3019	40N3019
12	Panel, center rear	16N3020	20N3020	30N3020	30N3020	40N3020	40N3020
13	Panel, lower rear	16N3021	20N3021	25N3021	30N3021	40N3021	40N3021
14	Panel, right	20N3036	20N3036	30N3036	30N3036	40N3036	40N3036
15	Strut, upper panel support	30N3043	30N3043	30N3043	30N3043	30N3043	30N3043
16	Panel, top	16N3045	20N3045	30N3045	30N3045	40N3045	40N3045
17	Brace, lower left side	20N3047	20N3047	30N3049	30N3049	40N3047	40N3047
18	Hinge mounting bracket, left	20N3163	20N3163	30N3050	30N3050	40N3163	40N3163
19	Hinge mounting bracket, right	20N3164	20N3164	30N3051	30N3051	40N3164	40N3164
20	Panel, right, rain splatter	30N3053	30N3053	30N3053	30N3053	40N3050	40N3050
21	Panel, left, rain splatter	30N3054	30N3054	30N3054	30N3054	40N3050	40N3050
22	Bracket, hinge brace	30N3055	30N3055	30N3055	30N3055	30N3055	30N3055
23	Panel, top left	20N3035	20N3035	30N3057	30N3057	40N3035	40N3035
24	Bracket, pressure switch	20N3053	20N3053	20N3053	20N3053	20N3053	20N3053
25	Cover, field connections	17J3025	17J3025	17J3025	17J3025	17J3025	17J3025
26	Gasket, .75" x .06" x 2 feet	R2074402	R2074402	R2074402	R2074402	R2074402	R2074402

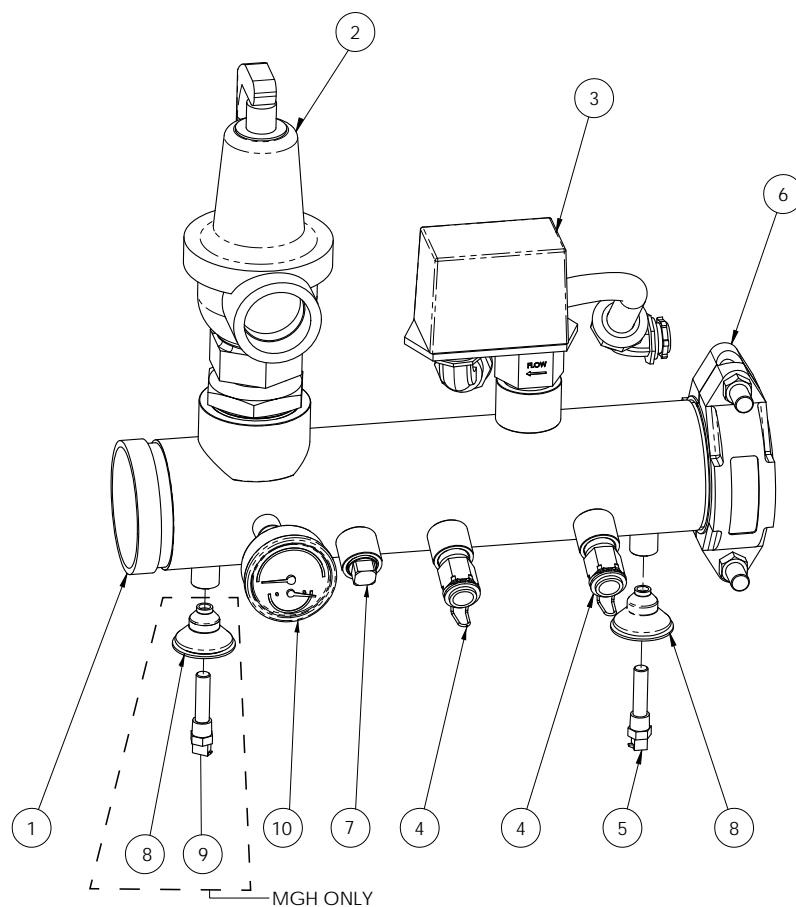


Final Assembly



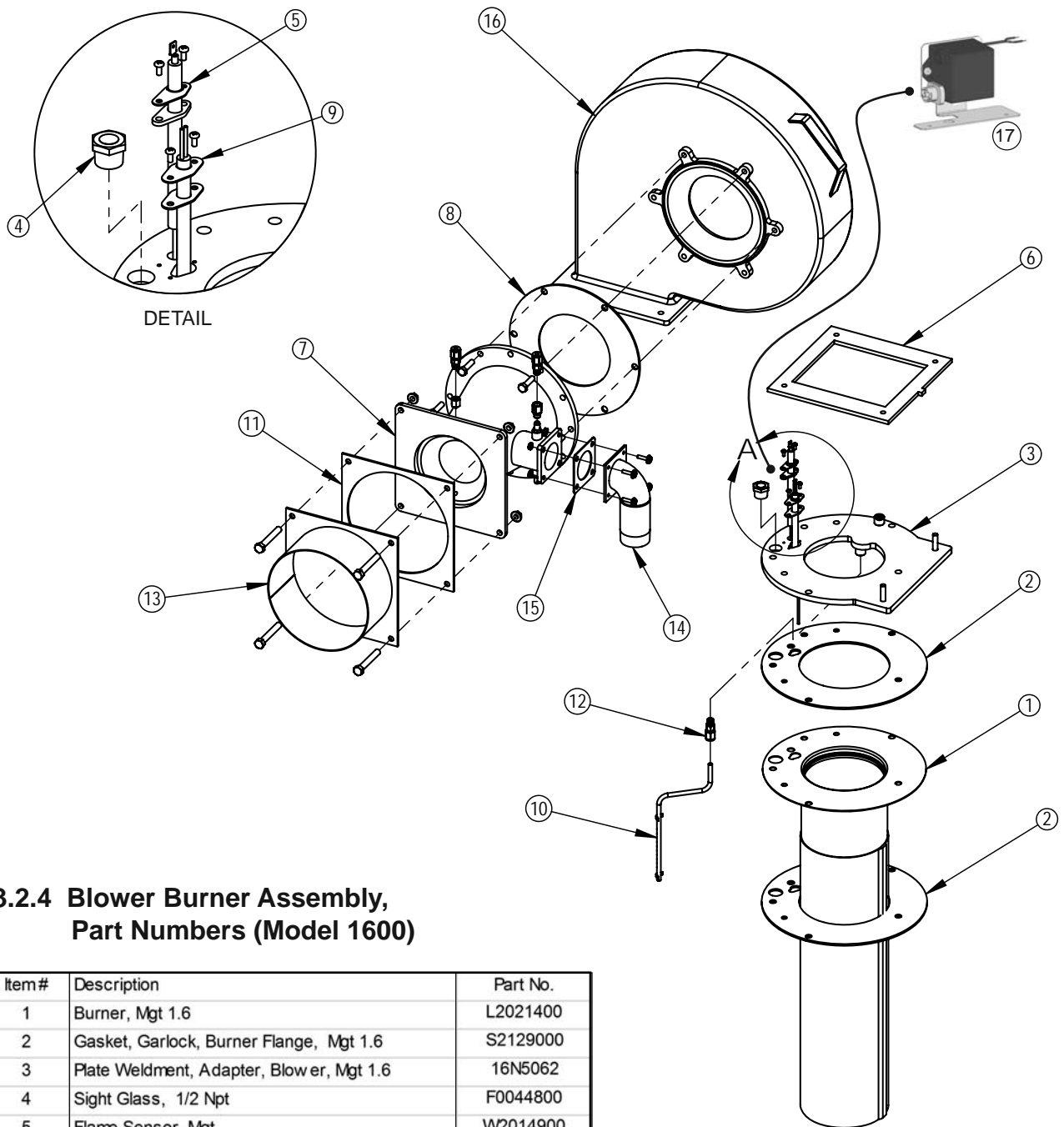
13.2.2 Final Assembly, Part Numbers

Item #	Description	1600 Part No.	2000 Part No.	2500 Part No.	3000 Part No.	3500 Part No.	4000 Part No.
1	Heat Exchanger Assembly	R16N2070	R20N2070	R30N2070	R30N2070	R40N2070	R40N2070
2	Plate, rear panel, gas pipe	20N3034	30N3034	30N3034	30N3034	30N3034	30N3034
3	Door, right	20N3100	20N3100	30N3100	30N3100	40N3100	40N3100
4	Door, left	20N3150	20N3150	30N3150	30N3150	40N3150	40N3150
5	Control panel assemblies:						
	MGH	20N7080	20N7080	30N7080	30N7080	40N7080	40N7080
	MGH with CSD-1	20N7081	20N7081	30N7081	30N7081	40N7081	40N7081
	MGV	20N7082	20N7082	30N7082	30N7082	40N7082	40N7082
	MGV with CSD-1	20N7083	20N7083	30N7083	30N7083	40N7083	40N7083
6	Condensate trap assembly	20N2010	20N2010	30N2010	30N2010	40N2010	40N2010
7	Panel, drain access	40N3048	40N3048	40N3048	40N3048	40N3048	40N3048
8	Pressure switch	E2363100	E2362200	E2362201	E2361900	E2361900	E2361900
9	Pressure switch	E2344901	E2362000	E2363400	E2362301	E2362300	E2362300
10	Pressure switch	E2362200	N/A	N/A	N/A	E2362302	E2362302
11	Outlet box (not shown)	E2350900	E2350900	E2350900	E2350900	E2350900	E2350900
12	Spacer	F2035400	F2035400	F2035400	F2035400	F2035400	F2035400
13	Silicone rubber bumper	F2039700	F2039700	F2037900	F2037900	F2037900	F2037900
14	Bushing, nylon	S0064900	S0064900	S0064900	S0064900	S0064900	S0064900
15	Grommet, 2" pipe	S2116500	S2116500	S2116500	S2116500	S2116500	S2116500
16	Grommet, push-in	S2123600	S2123600	S2123600	S2123600	S2123600	S2123600
17	Plug, button, 7/8"	F0032300	F0032300	F0032300	F0032300	F0032300	F0032300
18	Flue Gas Sensor	E2340000	E2340000	E2340000	E2340000	E2340000	E2340000



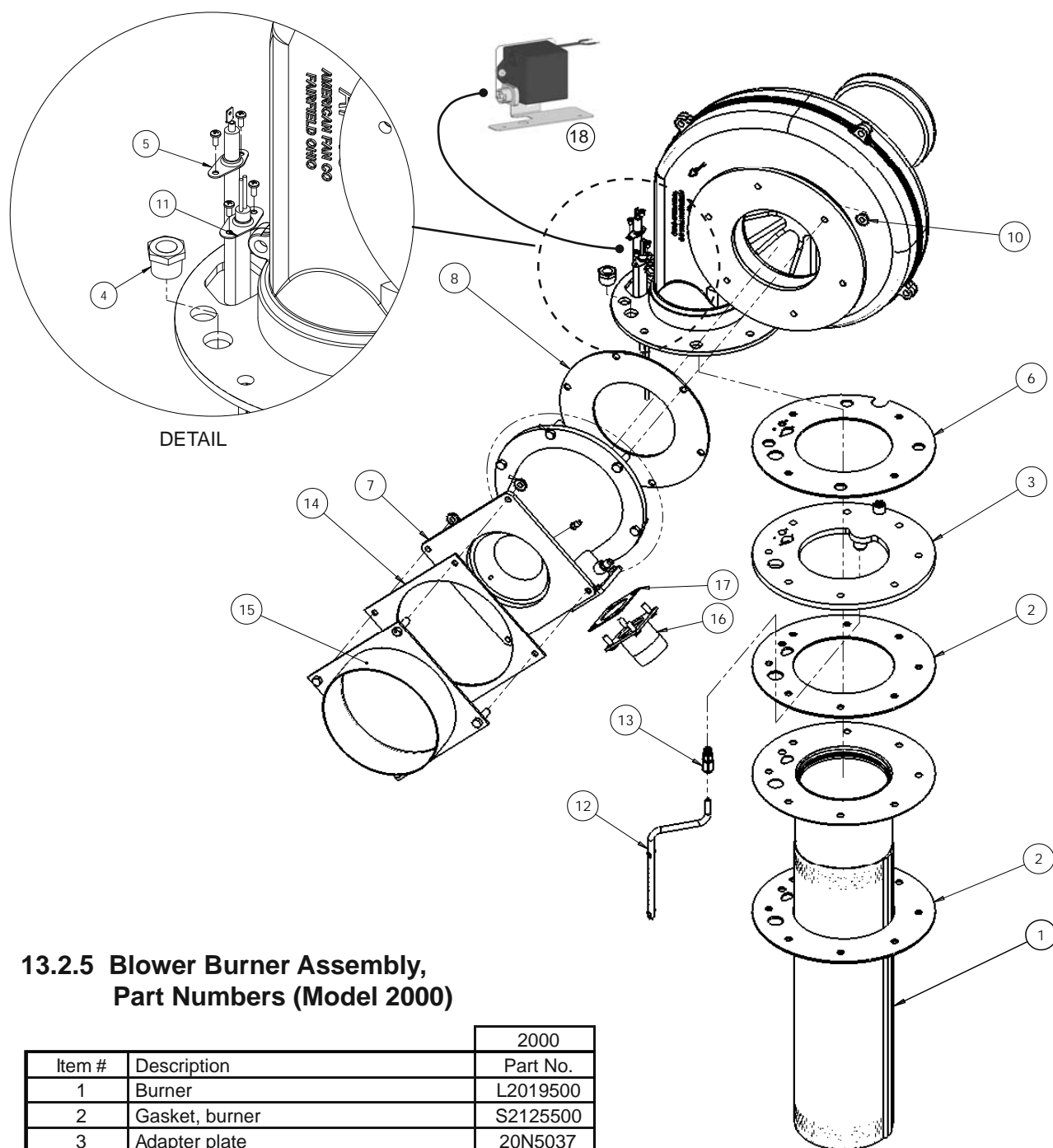
13.2.3 Waterway Outlet Assembly, Part Numbers

Item #	Description	1600	2000	2500	3000	3500	4000
		Part No.	Part No.	Part No.	Part No.	Part No.	Part No.
1	Pipe, outlet manifold	20N4023	20N4023	30N4020	30N4020	40N4020	40N4020
2	PRV 75# (MGH) PRV 125# (MGV)	A0002700 A0064400	A0002700 A0064400	A0000300 A0000200	A0000300 A0000200	A208000 A0000200	A208000 A0000200
3	Flow switch Flow switch paddle	RE0013000 E2255800	RE0013000 E2255800	RE0013000 E2255800	RE0013000 E2255800	RE0013000 E2255900	RE0013000 E2255900
4	Well, immersion, 1/2"NPT	RE2058300	RE2058300	RE2058300	RE2058300	RE2058300	RE2058300
5	Sensor, water temperature, duplex	RE2319900	RE2319900	RE2319900	RE2319900	RE2319900	RE2319900
6	Coupling, flexible victaulic	P2086500	P2086500	P2086500	P2086500	P2086600	P2086600
7	Plug						
	MGH	N/A	N/A	P2088300	P2088300	P2088300	P2088300
	MGV	N/A	N/A	P2080300	P2080300	P2080300	P2080300
8	Grommet, rubber	S2114000	S2114000	S2114000	S2114000	S2114000	S2114000
9	Sensor, water temperature (MGH)	RE2320600	RE2320600	RE2320600	RE2320600	RE2320600	RE2320600
10	Gauge, temp & pressure	RA0079000	RA0079000	RA0079000	RA0079000	RA0079000	RA0079000



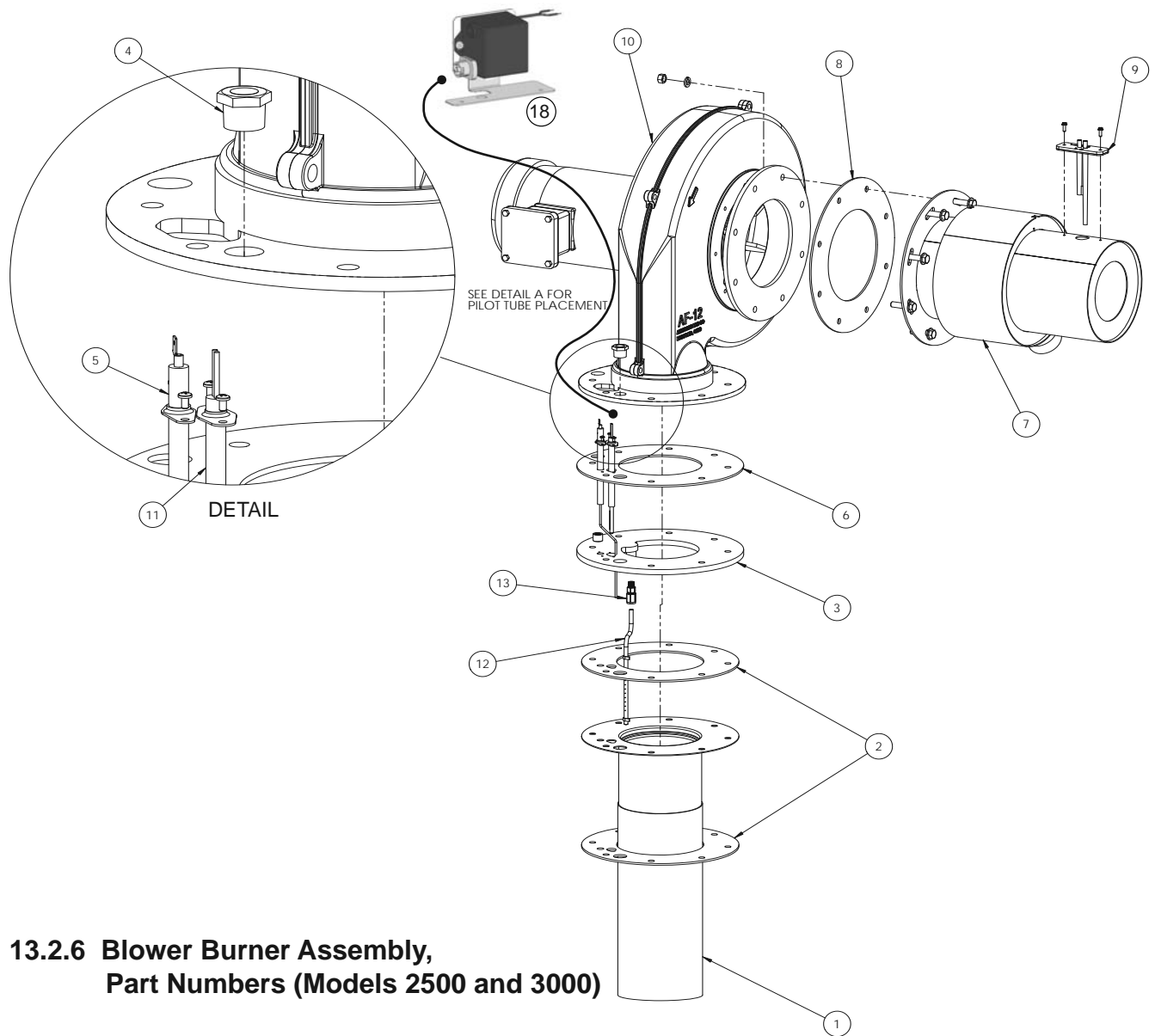
13.2.4 Blower Burner Assembly, Part Numbers (Model 1600)

Item #	Description	Part No.
1	Burner, Mgt 1.6	L2021400
2	Gasket, Garlock, Burner Flange, Mgt 1.6	S2129000
3	Plate Weldment, Adapter, Blower, Mgt 1.6	16N5062
4	Sight Glass, 1/2 Npt	F0044800
5	Flame Sensor, Mgt	W2014900
6	Gasket, Fan Outlet	S2011100
7	Venturi, Honeywell Vmu500A	A2123300
8	Gasket, Af-10 Blower Intake,	20N5095
9	Igniter,	W2014100
10	Weldment, Pilot Tube,	20N5088
11	Gasket, Filter Box Flange,	20N5094
12	Adapter, 1/8" Npt M X 1/4" Tube, Ss	P2097800
13	Pipe & Flange Weldment, Blower, Mgt 1.6	16N5092
14	Pipe & Flange Weldment, Gas Intake, 1.6 Mgt.	16N5074
15	Gasket, Venturi/Gas Valve, Cork	S2104900
16	Blower, Gas, Fan/Motor	A2132700
17	Spark Generator	20N3060



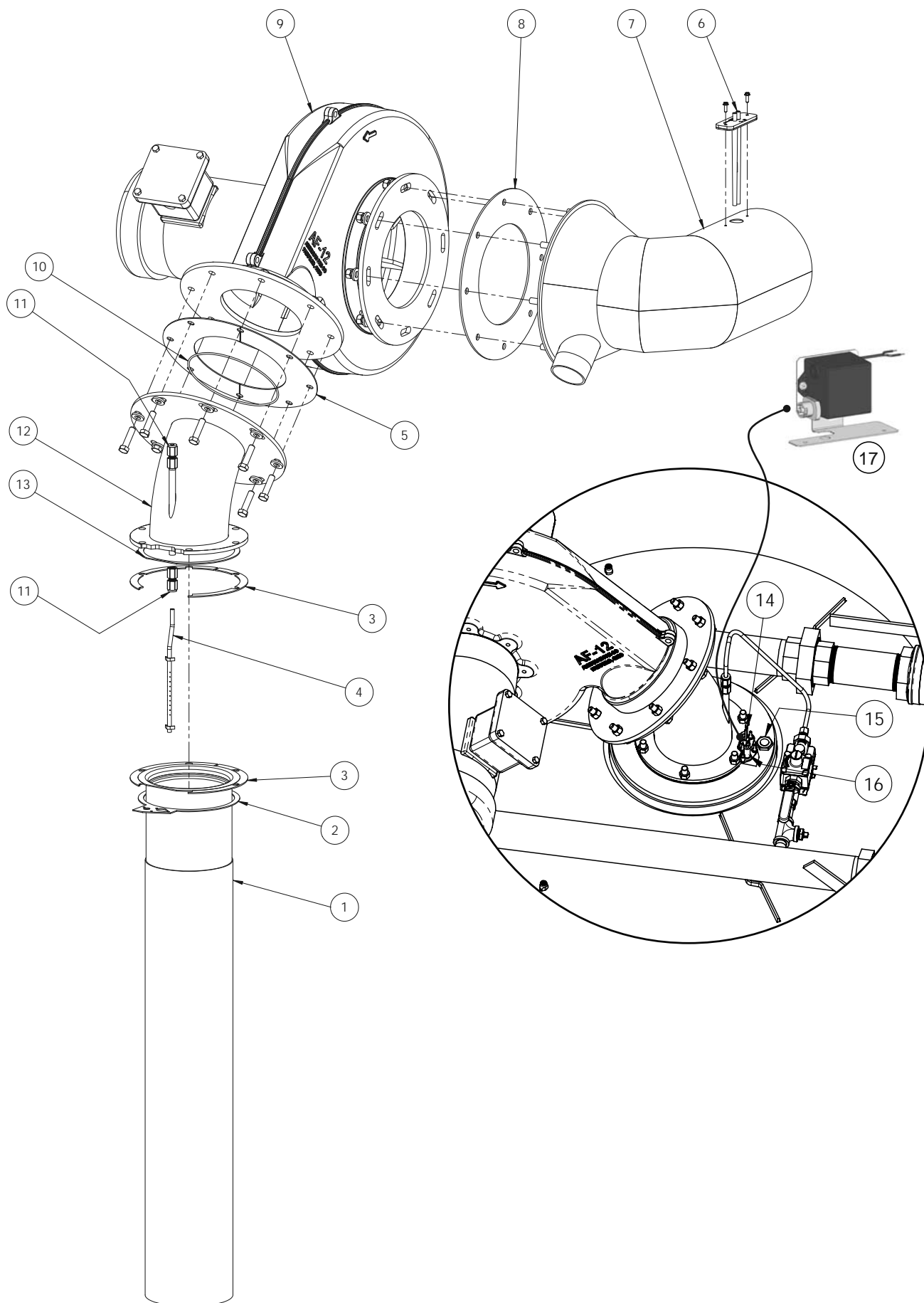
13.2.5 Blower Burner Assembly, Part Numbers (Model 2000)

		2000
Item #	Description	Part No.
1	Burner	L2019500
2	Gasket, burner	S2125500
3	Adapter plate	20N5037
4	Sight glass	RF0044800
5	Flame sensor	W2014900
6	Gasket, blower outlet flange	S2125600
7	Venturi / Air intake assembly	A2123300
8	Gasket, blower intake	20N5095
9	Flow sensor, diff pressure	N/A
10	Blower	See Section 13.2.11
11	Ignitor	W2014100
12	Pilot tube	20N5088
13	Compression fitting	P2085000
14	Gasket, filter box flange	20N5094
15	Pipe & flange weldment	20N5092
16	Pipe & flange weldment	20N5090
17	Gasket, venturi / gas valve	S2104900
18	Spark Generator	20N3060



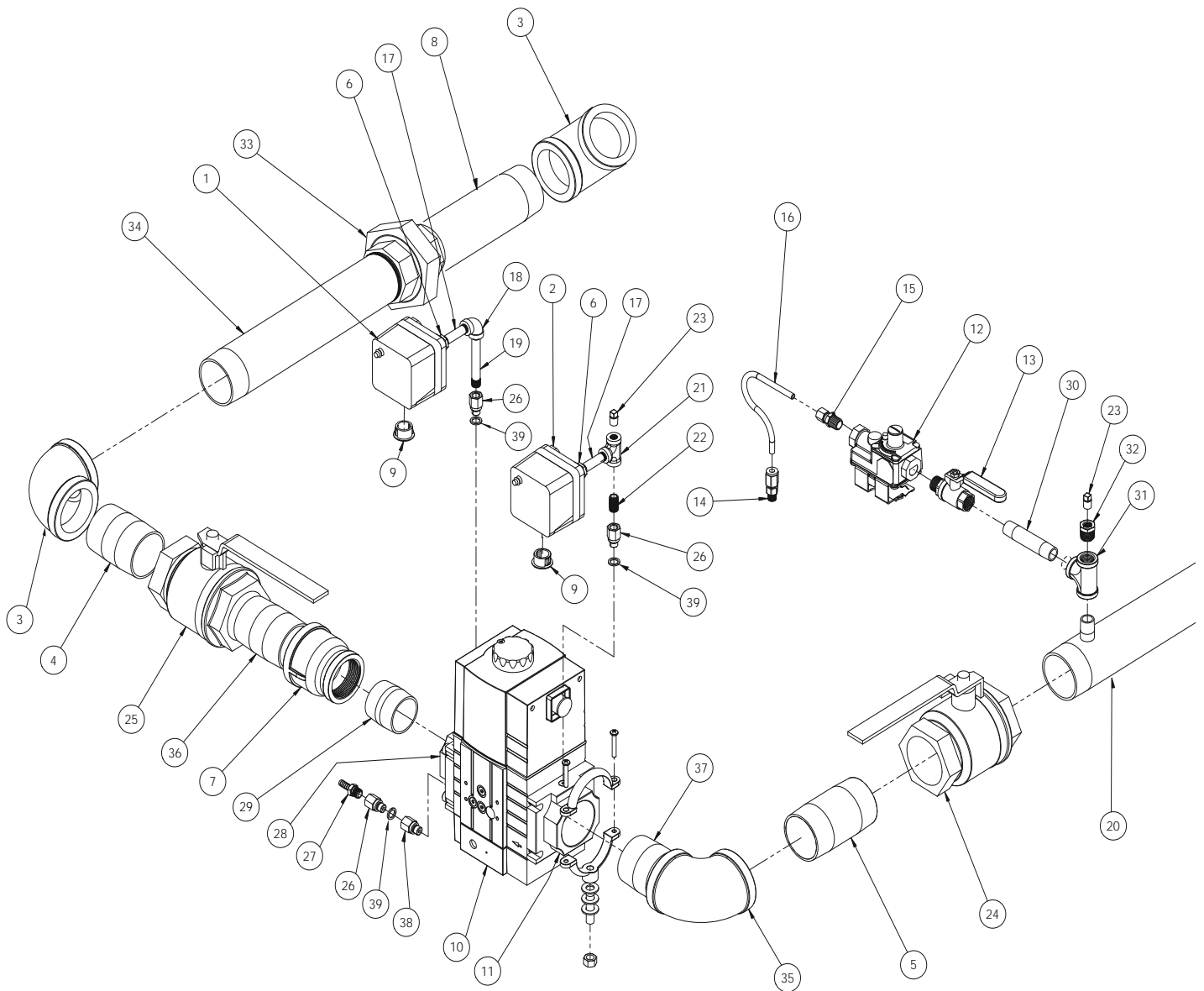
13.2.6 Blower Burner Assembly, Part Numbers (Models 2500 and 3000)

Item #	Description	2500 Part No.	3000 Part No.
1	Burner	L2020600	L2020600
2	Gasket, burner	S2125100	S2125100
3	Adapter plate	30N5037	30N5037
4	Sight glass	RF0044800	RF0044800
5	Flame sensor	W2014900	W2014900
6	Gasket, blower outlet flange	S2125200	S2125200
7	Venturi / Air intake assembly	30N5092	30N5092
8	Gasket, blower intake	S2125300	S2125300
9	Flow sensor, diff pressure	A2121601	A2121601
10	Blower	See Sections 13.2.11 and 13.2.12	
11	Ignitor	W2014100	W2014100
12	Pilot tube	30N5093	30N5093
13	Compression fitting	P2085000	P2085000
14	Gasket, filter box flange	N/A	N/A
15	Pipe & flange weldment	N/A	N/A
16	Pipe & flange weldment	N/A	N/A
17	Gasket, venturi / gas valve	N/A	N/A
18	Spark Generator	20N3060	30N3060

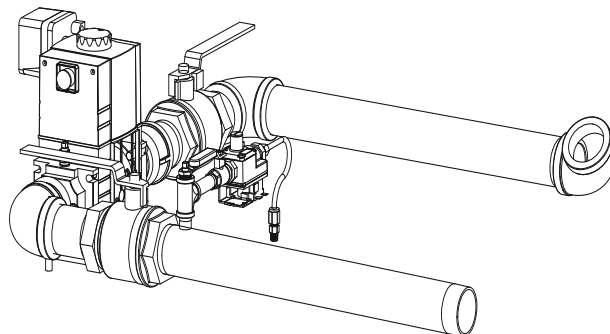


13.2.7 Blower Burner Assembly, Part Numbers (Models 3500 and 4000)

Item #	Description	3500	4000
		Part No.	Part No.
1	Burner	L2019900	L2019900
2	Gasket, burner	S2124100	S2124100
3	Gasket, spacer	40N5092	40N5092
4	Pilot tube	40N5090	40N5090
5	Gasket, blower outlet flange	40N5093	40N5093
6	Flow sensor, diff pressure	A2121600	A2121600
7	Gas/air intake assembly	40N5069	40N5069
8	Gasket, blower intake	S2125300	S2125300
9	Blower	See Sections 13.2.11 and 13.2.12	
10	O-Ring	S2124800	S2124800
11	Adapter 1/4" tube x 1/8" female	P2090200	P2090200
12	Blower tube	40N5077	40N5077
13	Gasket, burner	S2124600	S2124600
14	Ignitor	W2014100	W2014100
15	Sight glass	RF0044800	RF0044800
16	Flame sensor	W2014900	W2014900
17	Spark Generator	40N3060	40N3060

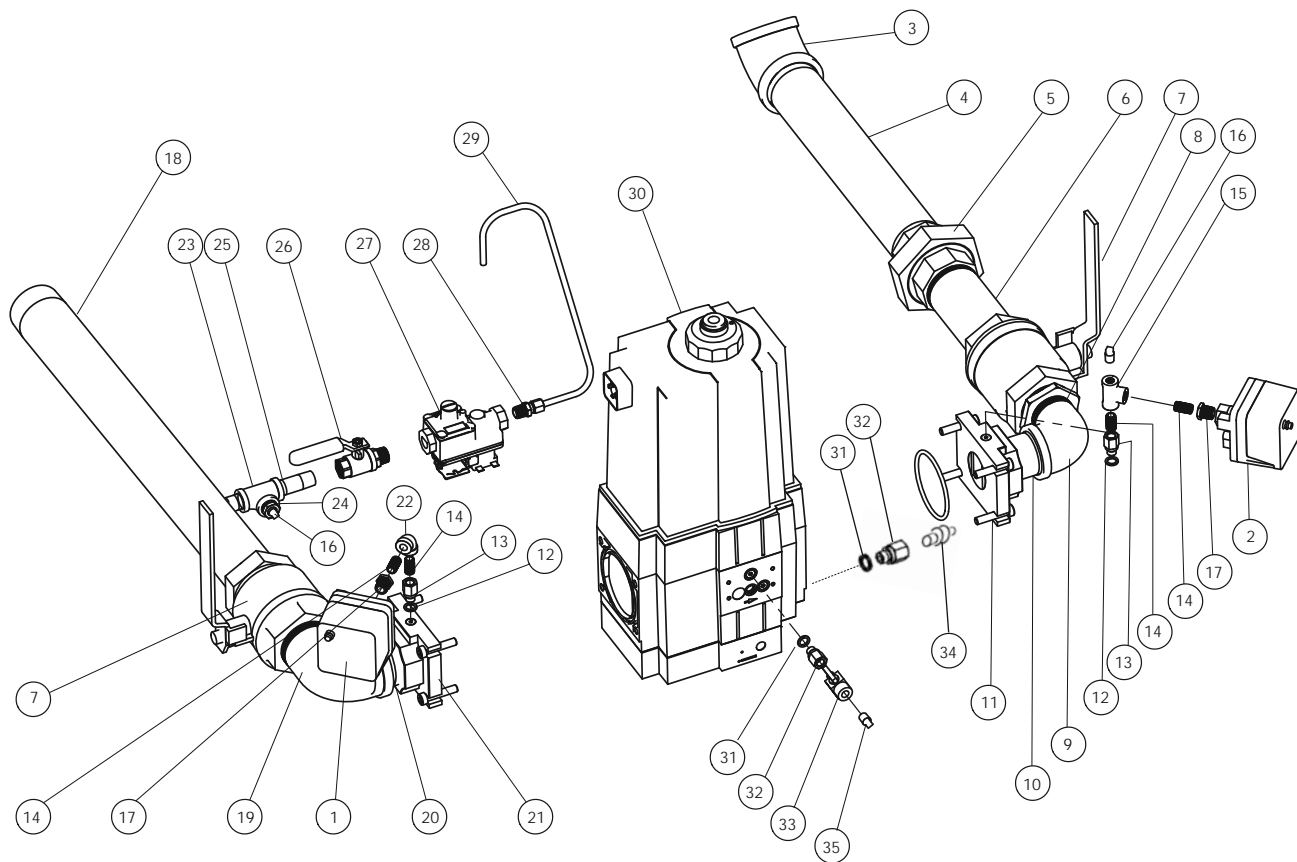


Gas Train Assembly (Models 1600, 2000, 2500 and 3000)

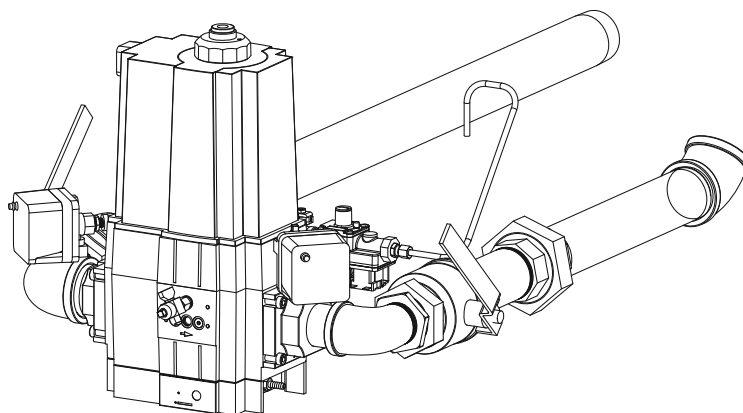


13.2.8 Gas Train Assembly, Part Numbers (Models 1600, 2000, 2500 and 3000)

Item #	Description	1600	2000	2500	3000
		Part No.	Part No.	Part No.	Part No.
1	Pressure switch, low gas	R2004100	R2004100	R2004100	R2004100
2	Pressure switch, high gas	R2004000	R2004000	R2004000	R2004000
3	Elbow	P0008400	P0008600	P0008700	P0008700
4	Nipple	P0015700	P0019800	P0021200	P0021200
5	Nipple, 2"NPTx4"	P2095800	P0022600	P0022600	P0022600
6	Bushing, reducing, 1/4x1/8	P2032400	P2032400	P2032400	P2032400
7	Adapter, 2"NPTx1-1/2"NPT	P0003900	N/A	P2085700	P2085700
8	Nipple	P0053400	P2092800	P2091600	P2091600
9	Bushing, nylon	S0064900	S0064900	S0064900	S0064900
10	Gas valve, main	V2023000	V2021200	V2021200	V2021200
11	Flange, gas valve	V2024400	V2021900	V2021900	V2021900
12	Pilot regulator	V2022100	V2022100	V2022100	V2022100
13	Ball valve, 3/8"	V2022200	V2022200	V2022200	V2022200
14	Compression fitting, 1/4" tube	NA	P2085000	P2085000	P2085000
15	Compression fitting, 1/4" tube x 1/4NPT	P0004100	P0004100	P0004100	P0004100
16	Pilot tube	16N6027	20N5086	30N6027	30N6027
17	Nipple, 1/8"x2"	P0011300	P0011300	P0011300	P0011300
18	Elbow, 1/8"	P2008900	P2008900	P2008900	P2008900
19	Nipple, 1/8"	P0011100	P0011100	P0011100	P0011100
20	Nipple/tee weldment	30N6031	30N6031	30N6031	30N6031
21	Tee, 1/8"	P0027100	P0027100	P0027100	P0027100
22	Nipple, 1/8" x close	P0011100	P0011100	P0011100	P0011100
23	Plug	70-236	70-236	70-236	70-236
24	Ball valve	V2003300	V2003300	R2011600	R2011600
25	Ball valve	V2003000	V2003200	R2011600	R2011600
26	Adapter, 1/8 FNPT x 1/8 ISO male	P2089600	P2089600	P2089600	P2089600
27	Adapter, 1/4 tube barb to 1/8 NPT male	P2097800	P2089300	P2089300	P2089300
28	Flange, adjustable shutter	V2023200	V2022400	V2022000	V2022000
29	Nipple, 1-1/2" x close	P0015500	N/A	P0019100	P0019100
30	Nipple, 3/8"x3"	P2090500	P2090500	P2090500	P2090500
31	Tee, 3/8x3/8x3/8	P2090600	P2090600	P2090600	P2090600
32	Bushing, reducing, 3/8x1/8	P2090700	P2090700	P2090700	P2090700
33	Union	P0030500	P0030700	N/A	N/A
34	Nipple	P0053400	P2072800	N/A	N/A
35	Elbow	P0008700	P0008700	P0008700	P0008700
36	Nipple	P0015700	P0015500	P0021200	P0021200
37	Nipple	P2095900	P0021200	P0021200	P0021200
38	Nozzle Orifice, 0.2 mm	P2105100	N/A	N/A	N/A
39	Washer, Sealing	S2123500	S2123500	S2123500	S2123500



Gas Train Assembly (Models 3500 and 4000)

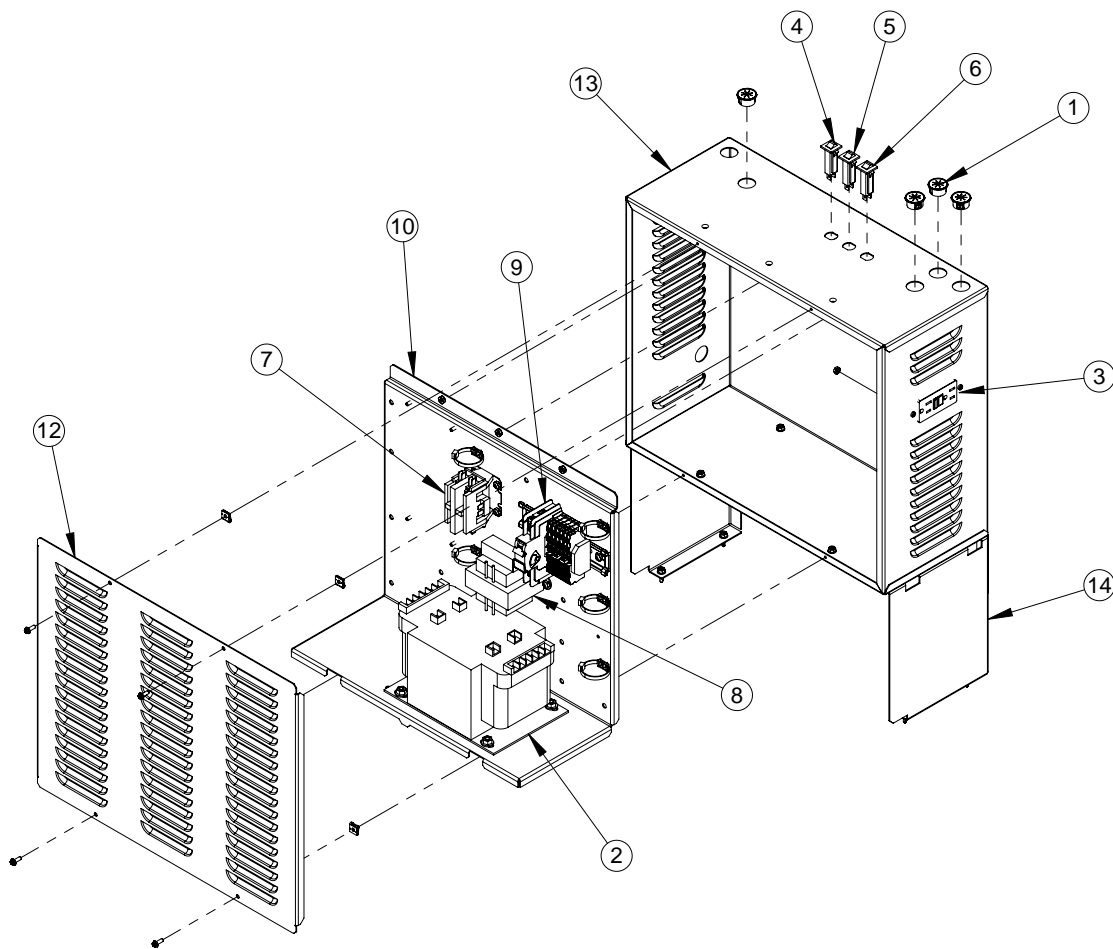


13.2.9 Gas Train Assembly, Part Numbers (Models 3500 and 4000)

Item #	Description	3500	4000
		Part No.	Part No.
1	Pressure switch, low gas	R2004100	R2004100
2	Pressure switch, high gas	R2004000	R2004000
3	Elbow, 45°, 2"	P2090900	P2090900
4	Nipple, 2"x14"	P2091000	P2091000
5	Union, 2"	P0030800	P0030800
6	Nipple, 2"x6"	P0021700	P0021700
7	Ball valve	R2011600	R2011600
8	Bushing, 2"x1-1/2"	P0001400	P0001400
9	Elbow, 90°, 1-1/2"	P0009600	P0009600
10	Nipple, 1-1/2"x2.5"	P2906600	P2045300
11	Flange, adjustable shutter	V2022000	V2022000
12	Washer, sealing	S2123500	S2123500
13	Adapter, 1/8 FNPT x 1/8 ISO Male	P2089600	P2089600
14	Nipple, 1/8 x close	P0011100	P0011100
15	Tee, 1/8"	P0027100	P0027100
16	Plug, 1/8"	70-236	70-236
17	Bushing, 1/4"x1/8"	P2032400	P2032400
18	Pipe, gas inlet	40N6034	40N6034
19	Elbow, 90°, 2"	P2091100	P2091100
20	Nipple, 2"x2"	P0021100	P0021100
21	Flange, 2"	V2021900	V2021900
22	Elbow, 90°, 1/8"	P2008900	P2008900
23	Tee, 3/8"	P2090600	P2090600
24	Bushing, 3/8"x1/8"	P2090700	P2090700
25	Nipple, 3/8"x2"	P2089000	P2089000
26	Ball valve, 3/8"	V2022200	V2022200
27	Pilot regulator	V2022100	V2022100
28	Compression fitting, 1/4" tube x 1/4NPT	P0004100	P0004100
29	Pilot tube	40N6025	40N6025
30	Valve, Gas, Dungs	V2021200	V2022300 NAT V2021200 PROP
31	Washer, Sealing, 1/8 BSPP Fitting Dungs	S2123500	S2123500
32	Adapter, Fem to Male, 1/8 FNPT X 1/8 ISO	P2089600	P2089600
33	Valve, Manual, Brnz, 1/8 MNPTx1/8 FNPT	W2000300	W2000300
34	Adapter, 1/4" Barb	P2089300	P2089300
35	Pipe Plug, Malleable Iron, Black, 1/8 NP	70-236	70-236

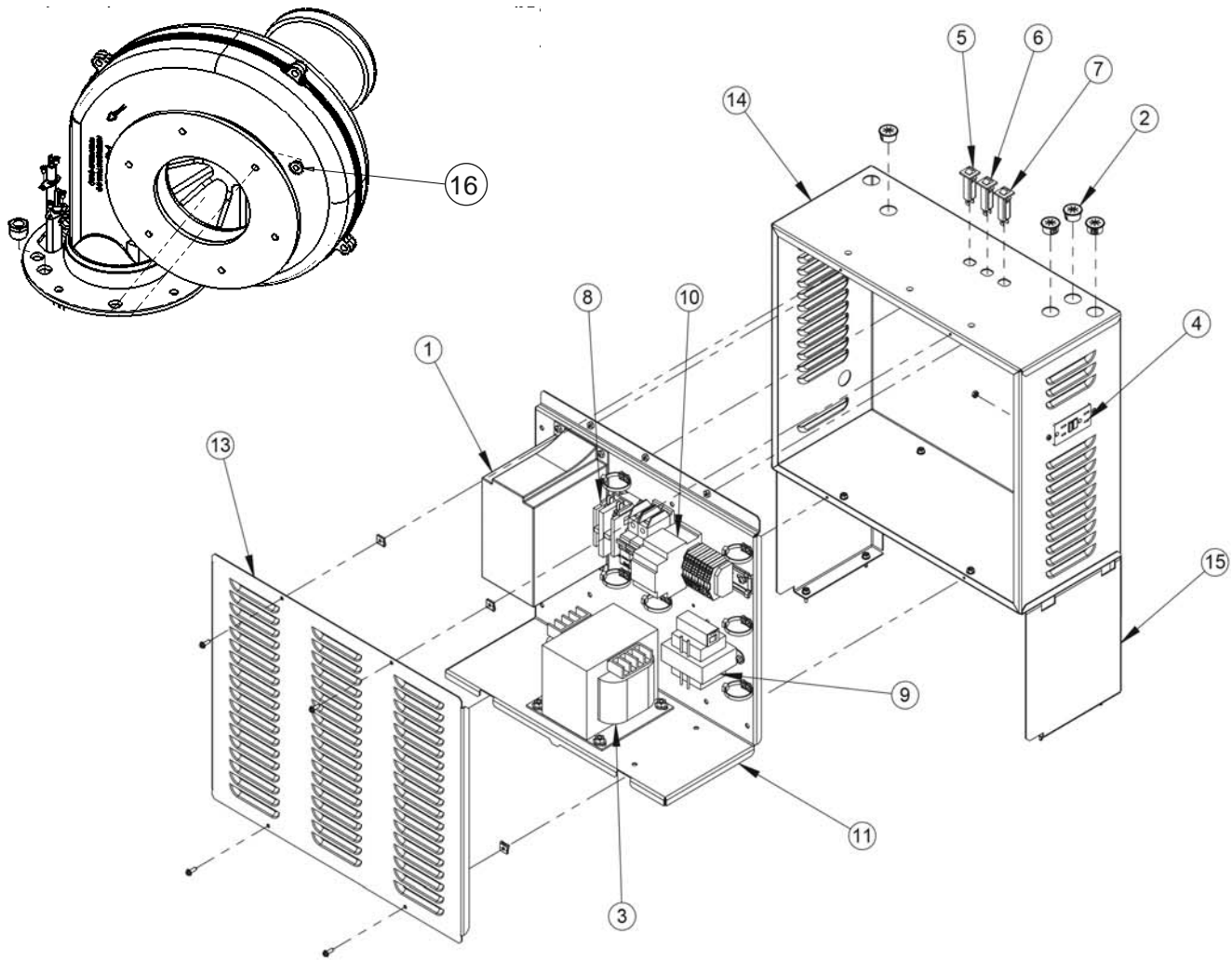


		1600	2000	2500	3000	3500	4000
Item #	Description	Part No.	Part No.	Part No.	Part No.	Part No.	Part No.
1	DIN rail assembly	30N7040	30N7040	30N7040	30N7040	30N7040	30N7040
2	Low water cutoff	RE2075100	RE2075100	RE2075100	RE2075100	RE2075100	RE2075100
3	Bushing, 7/8 nylon, open	E2074300	E2074300	E2074300	E2074300	E2074300	E2074300
4	Relay, 24VAC, DPDT	E2327800	E2327800	E2327800	E2327800	E2327800	E2327800
5	Display, touch control	E2339800	E2339800	E2339800	E2339800	E2339800	E2339800
6	Bushing, 7/8 nylon, split	S0064900	S0064900	S0064900	S0064900	S0064900	S0064900
7	High limit, manual reset	E2217800	E2217800	E2217800	E2217800	E2217800	E2217800
8	High limit, auto reset	E2217700	E2217700	E2217700	E2217700	E2217700	E2217700
9	Plug, terminal block	E2346300	E2346300	E2346300	E2346300	E2346300	E2346300
10	Vari-Prime control (MGH)	30N7067	30N7067	30N7067	30N7067	30N7067	30N7067
11	Control panel sheet metal assembly	30N7050	30N7050	30N7050	30N7050	40N7050	40N7050
22	Control module, programmed						
	Standard CSD-1	RXN7051 RXN7052	RXN7051 RXN7052	RXN7055 RXN7056	RXN7051 RXN7052	RXN7055 RXN7056	RXN7051 RXN7052



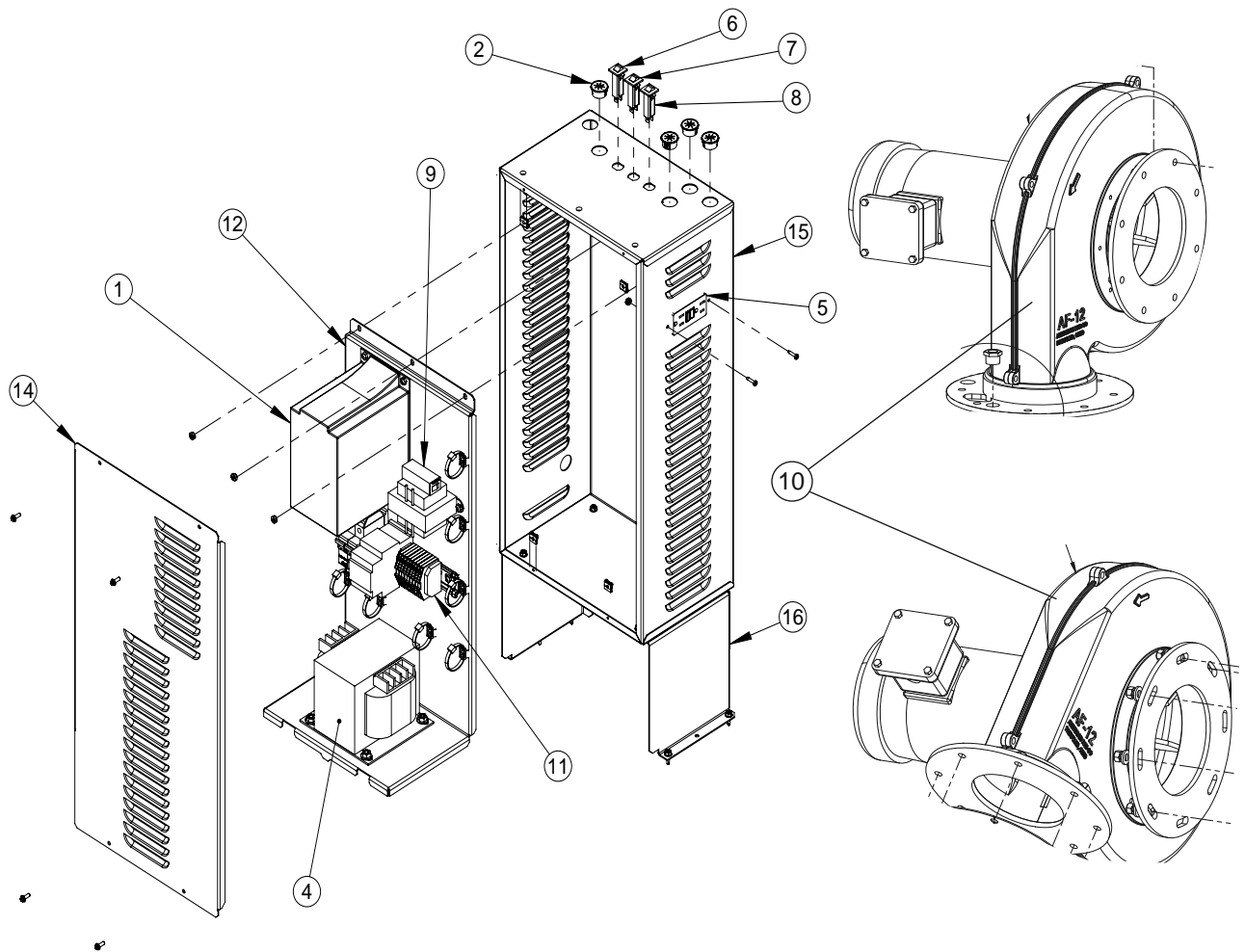
13.2.11 AC Distribution Box Assemblies and Part Numbers (Model 1600)

Item #	Description	1600	
		120V	220V
1	Bushing, Nylon, 7/8, Slit	S0064900	S0064900
2	Transformer	E2359300	E2355900
3	GFCI Receptacle, Nema 5-15, Ivory, Box Mount	E2355400	E2355400
4	Circuit Breaker, 2A	E2335100	E2335100
5	Circuit Breaker, 10 Amp	E2318900	E2318900
6	Circuit Breaker, 3A	E2311800	E2311800
7	Relay, 115 VAC, DPST	E2311100	E2311100
8	Transformer, 120/24, 75VA	E2108700	E2108700
9	Din Rail Assembly, AC Distribution Box,	40N7064	40N7065
10	Panel, AC Distribution Box	20N7316	20N7317
11	Wire Harness Assy, Hi Volt Circuit Brkr To Xfmr/Cont/Cntrl	16N7401	16N7402
12	Cover, Box, Input Power, MGT	20N7313	20N7313
13	Box, Power Input	20N7312	20N7312
14	Box, Support, Input Power	20N7311	20N7311



13.2.12 AC Distribution Box Assembly and Blower Part Numbers (Model 2000)

Item#	Description	2000				
		120V	220V	208V	480V	600V
1	VFD With Program, MGT 2.0	XN715001	XN715001	XN715002	XN715003	XN715003
2	Bushing, Nylon, 7/8, Slit	S0064900	S0064900	S0064900	S0064900	S0064900
3	Transformer	E2359300	E2355900	E2355500	E2352600	E2352600
4	GFCI Receptacle, Nema 5-15, Ivory, Box Mount	E2355400	E2355400	E2355400	E2355400	E2355400
5	Circuit Breaker, 2A	E2335100	E2335100	E2335100	E2335100	E2335100
6	Circuit Breaker, 10 Amp	E2318900	E2318900	E2318900	E2318900	E2318900
7	Circuit Breaker, 3A	E2311800	E2311800	E2311800	E2311800	E2311800
8	Relay, 115 VAC, DPST	E2311100	E2311100	-	-	-
9	Transformer, 120/24, 75VA	E2108700	E2108700	E2108700	E2108700	E2108700
10	Din Rail Assembly, AC Distribution Box, MGT 220V	40N7064	40N7065	40N7063	40N7062	40N7066
11	Panel, AC Distribution Box	20N7316	20N7317	20N7318	20N7318	20N7318
12	Wire Harness Assy, Hi Volt Circuit Brkrs To Xfrmr/Cont/Cntrl	20N740001	20N740002	20N740003	20N740004	20N740005
13	Cover, Box, Input Power, MGT	20N7313	20N7313	20N7313	20N7313	20N7313
14	Box, Power Input	20N7312	20N7312	20N7312	20N7312	20N7312
15	Box, Support, Input Power	20N7311	20N7311	20N7311	20N7311	20N7311
16	Blower, Combustion Air	A2123800	A2123800	A2123800	A2123800	A2124200



13.2.13 AC Distribution Box Assembly and Blower Part Numbers (Models 2500 to 4000)

		2500			3000			3500			4000		
		208V	480V	600V	208V	480V	600V	208V	480V	600V	208V	480V	600V
1	VFD With Program	XN715008	XN715009	XN715010	XN715005	XN715006	XN715007	XN715011	XN715012	XN715013	XN715005	XN715006	XN715007

		2500 & 3000			3500 & 4000		
		208V	480V	600V	208V	480V	600V
2	Bushing, Nylon, 7/8, Slit	S0064900	S0064900	S0064900	S0064900	S0064900	S0064900
3	Bushing, Reducing, 1 Inch Conduit	E2357600	E2357600	E2357600	E2357600	E2357600	E2357600
4	Transformer	E2355500	E2352600	E2352600	E2355500	E2352600	E2352600
5	GFCI Receptacle, Nema 5-15, Ivory, Box Mount	E2355400	E2355400	E2355400	E2355400	E2355400	E2355400
6	Circuit Breaker, 2A	E2335100	E2335100	E2335100	E2335100	E2335100	E2335100
7	Circuit Breaker, 10 Amp	E2318900	E2318900	E2318900	E2318900	E2318900	E2318900
8	Circuit Breaker, 3A	E2311800	E2311800	E2311800	E2311800	E2311800	E2311800
9	Transformer, 120/24, 75VA	E2108700	E2108700	E2108700	E2108700	E2108700	E2108700
10	Blower, Combustion Air	A2123700	A2123700	A2124100	A2123900	A2123900	A2124300
11	Din Rail Assembly, AC Distribution Box, MGT	40N7063	40N7062	40N7066	40N7063	40N7062	40N7066
12	Panel, AC Distribution Box	40N7061	40N7061	40N7061	40N7061	40N7061	40N7061
13	Wire Harness Assy, Hi Volt Circuit Brkr's To Xfrmr/Cont/Cntrl	30N745001	30N745002	30N745003	40N745001	40N745002	40N745003
14	Cover, Box, Input Power, MGT	30N3028	30N3028	30N3028	30N3028	30N3028	30N3028
15	Box, Power Input	30N3024	30N3024	30N3024	30N3024	30N3024	30N3024
16	Box, Support, Input Power	30N3023	30N3023	30N3023	30N3023	30N3023	30N3023

Notes:		
--------	--	--

Dimensions and specifications subject to change without notice in accordance with our policy of continuous product improvement.



H2359201H