

Installation and Operation Instructions for

Brute®

Modulating Boiler

Model BNTH

Sizes 080–285 MBTU/h

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

⚠ WARNING

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

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

WHAT TO DO IF YOU SMELL GAS

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

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

⚠ AVERTISSEMENT

Assurez-vous de bien 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 ni d'autres vapeurs ou liquides inflammables dans le voisinage de cet appareil ou de tout autre appareil.

QUE FAIRE SI VOUS SENTEZ UNE ODEUR DE GAZ:

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

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

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SECTION 1 GENERAL INFORMATION

1.A Introduction

This manual provides information necessary for the installation, operation, and maintenance of the Bradford White Brute residential boiler. Read it carefully before starting the installation.

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

The Brute is protected against over pressurization. A pressure relief valve is included with each unit. Some may require that the PRV be installed prior to filling the system. Refer to Figure 1 and Figure 2 on page 8 for PRV locations.

1.B Warranty

Bradford White Brutes are covered by a limited warranty. The owner should complete the warranty registration at www.BradfordWhite.com.

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

Some accessory items may be shipped in separate packages. Verify receipt of all packages listed on the packing slip. Inspect everything for damage immediately upon delivery, and advise the carrier of any shortages or damage. Any such claims should be filed with the carrier. The carrier, not the shipper, is responsible for shortages and damage to the shipment whether visible or concealed.

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

1.C Model Identification (Nomenclature)

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

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

B N T = Brute

(4) **Usage**

H = Hydronic

(5-7) **Size**

0 8 0 = 80,000 BTU/hr input

1 0 5 = 105,000 BTU/hr input

1 5 0 = 150,000 BTU/hr input

2 1 0 = 210,000 BTU/hr input

2 8 5 = 285,000 BTU/hr input

(8) **Fuel**

N = Natural Gas

P = LP Gas

(9) **Options Code**

X = U.S.

C = Canada

(10) **Pump Options**

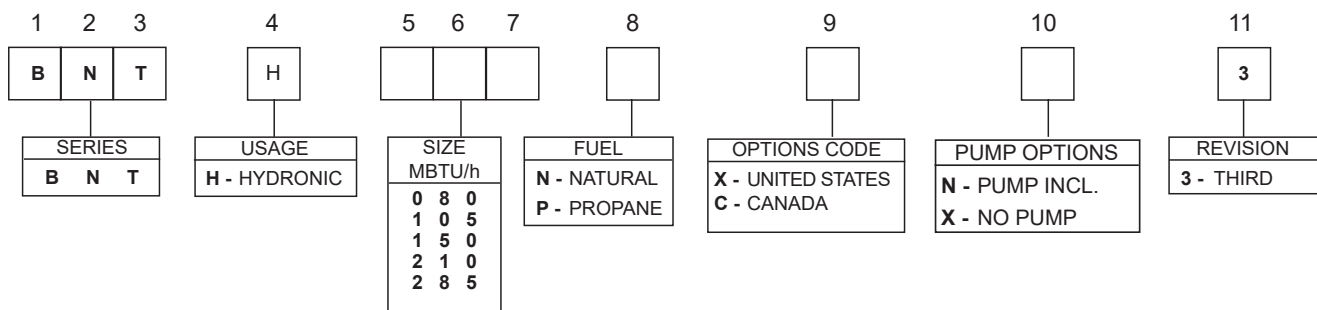
N = Pump included

X = No pump

(11) **Revision**

3 = Third version

Model Nomenclature




1.D Safety Notes

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

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

⚠ WARNING

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



⚠ WARNING

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

⚠ WARNING

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.

⚠ WARNING

Carbon Monoxide Hazard

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

⚠ WARNING

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

AS REQUIRED BY THE STATE OF CALIFORNIA PROPOSITION 65.

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

⚠ WARNING**Electrical Shock Hazard**

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

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

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

⚠ WARNING

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

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

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

1.E Model Overview

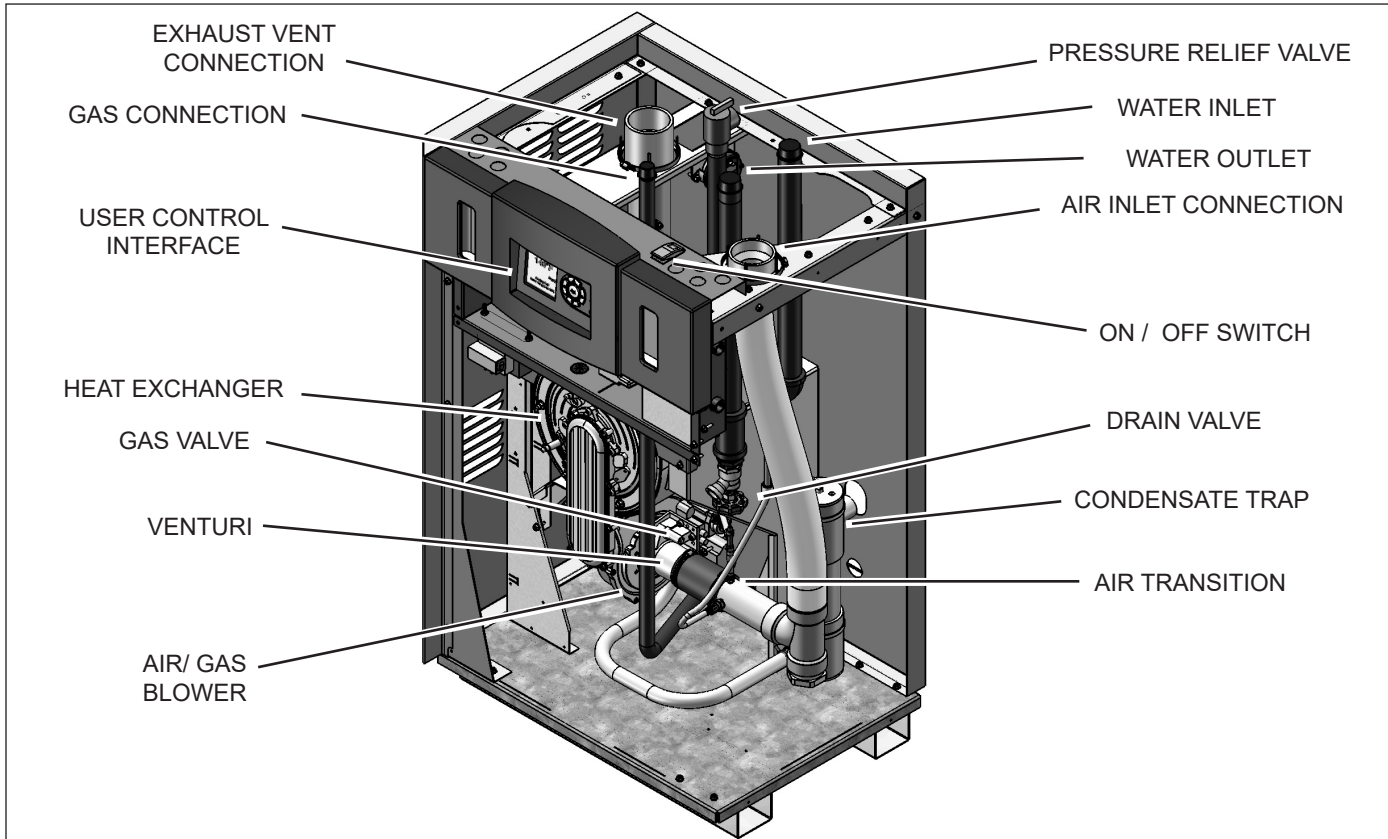


Figure 1. Location of Components, Sizes 80–210

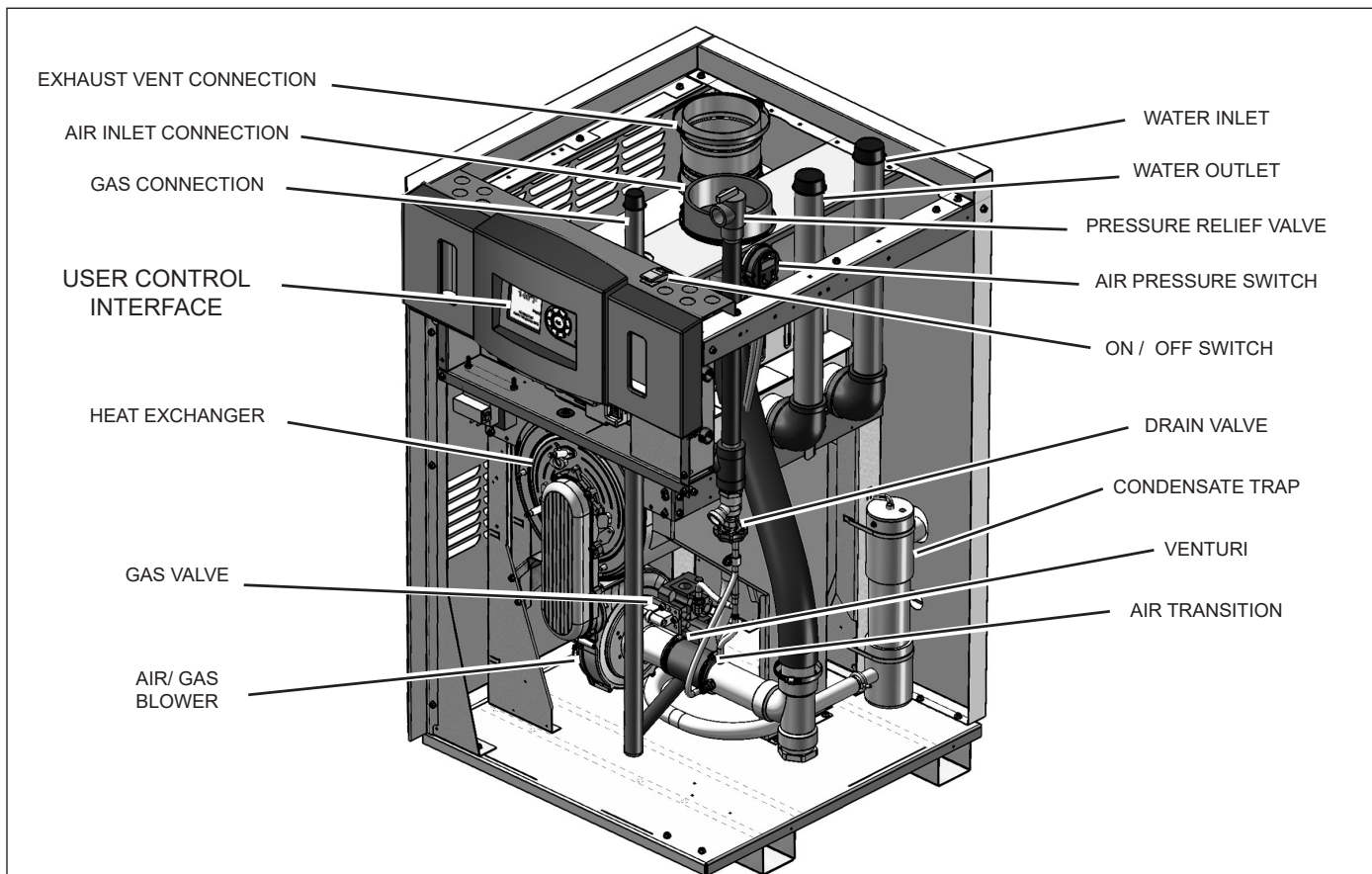
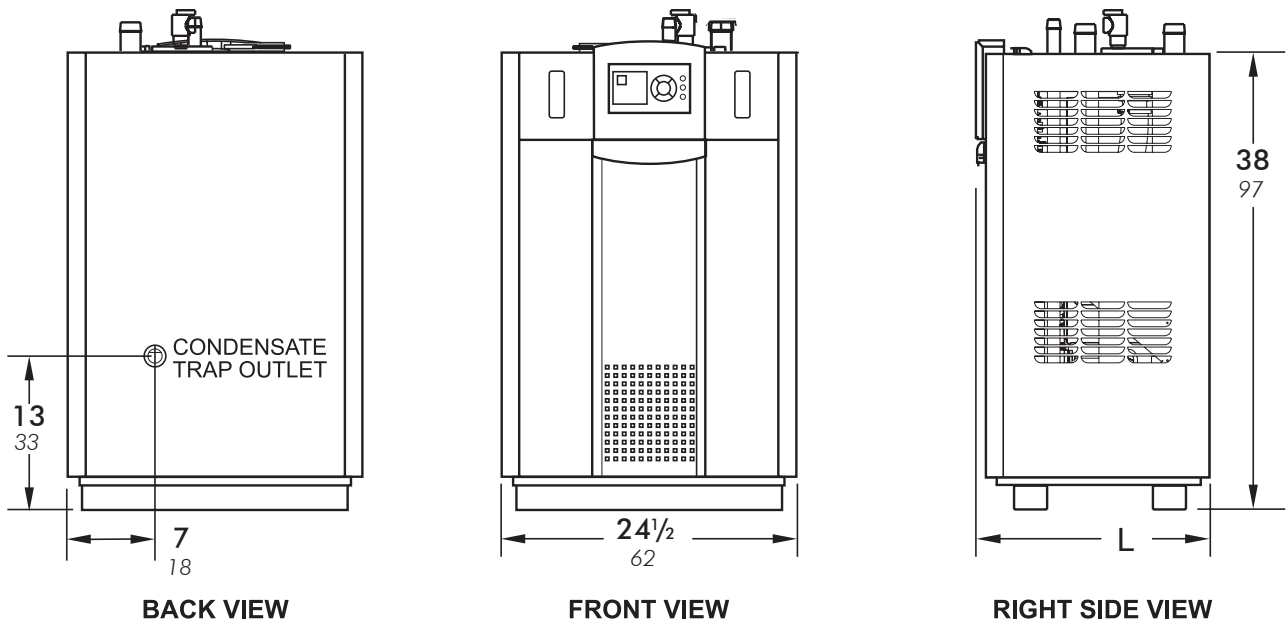
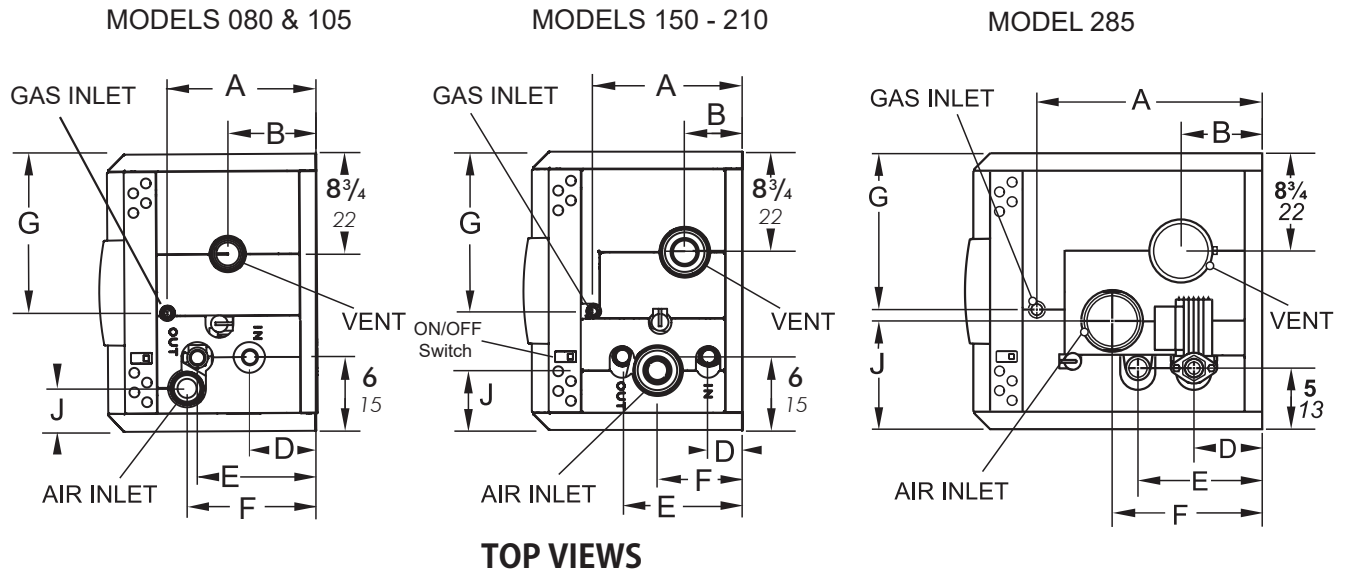


Figure 2. Location of Components, Size 285

1.F Dimensions



Dimensions are nominal and are shown in **inches** *cm*

Optional pump is shown only in the front view

Size	A		B		D		E		F		G		J		L		AIR INLET		VENT	
	in	cm	in	cm	in	cm	in	cm	in	cm	in	cm	IN	CM	IN	CM	IN	CM	IN	CM
80	13½	34	9½	24	7½	19	10¾	28	11¾	30	13¾	35	3½	9	19½	49	2	5.1	2	5.1
105	13½	34	8	21	6	16	10¾	28	11¾	30	14¼	36	3½	9	19½	49	2	5.1	2	5.1
150	13¼	34	5¼	14	¾	8	10¾	28	7½	19	14¼	36	5	13	19½	49	3	7.6	3	7.6
210	20½	52	5¼	14	¾	8	17¾	45	7½	19	14¼	36	5	13	26¾	68	3	7.6	3	7.6
285	20¼	51	7¼	18	¾	15	11	28	13¼	34	14¼	36	9¼	25	26¾	68	4	11	4	11

Table 1. Dimensions

1.G The Installation Kit

This residential unit is shipped in a single crate with a boxed installation kit that contains these components. (See [Figure 3](#))

1. Temperature / pressure gauge kit
2. Air intake terminal
3. Exhaust vent terminal (US only)
4. Jumper Terminal
5. CPVC exhaust pipe section (US only)
6. Alternate size vent/terminal screens
7. Outdoor/system sensor kit

Optional:

8. Circulator pump & wire harness (included with pump mounted units only)

1. Remove all packing and tie-down materials.
2. Check the contents of the box (the Installation Kit) to the items shown in [Figure 3](#).

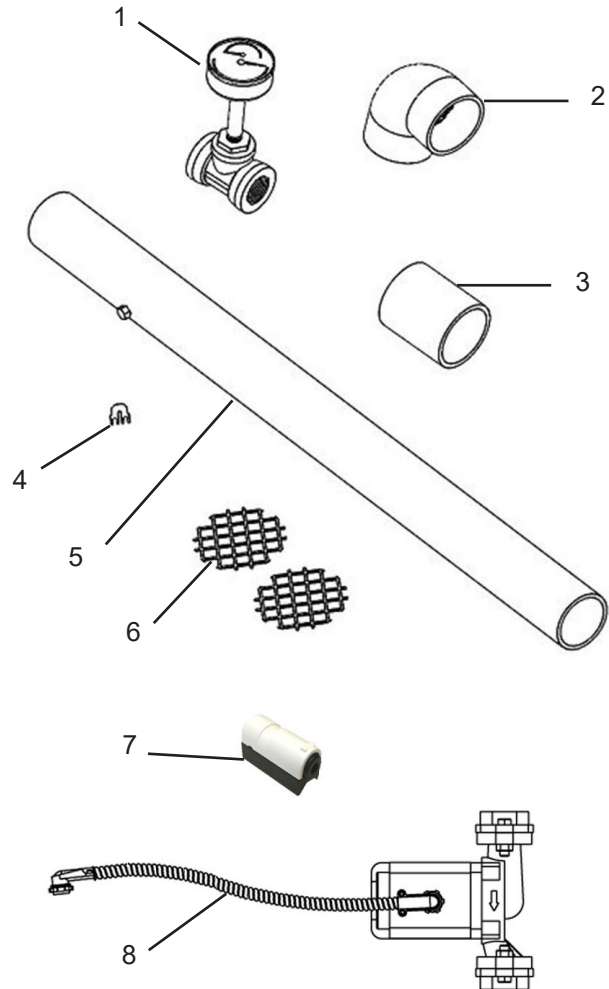


Figure 3. - Contents of Installation Kit

SECTION 2 LOCATING THE UNIT

2.A General Information

This unit is designed for indoor installations only and should be located to provide clearances on all sides for maintenance and inspection. It should not be located in an area where leakage of any connections will result in damage to the area adjacent to the unit or to lower floors of the structure.

When such a location is not available, it is recommended that a suitable drain pan, adequately drained, be installed under the unit.

The unit is design certified by CSA-International for installation on combustible flooring; in basements; in closets, utility rooms or alcoves. **These units must never be installed on carpeting.** The location should be chosen with regard to the vent pipe lengths and external plumbing and on a level surface. 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 2** and **Table 3** should be met when choosing the installation location.

2.B Locating the Unit for Correct Vent Distance from Outside Wall or Roof Termination

The forced draft combustion air blower in the unit has sufficient power to vent properly when the guidelines in **Table 3** are followed.

NOTE: When located on the same wall, this unit's combustion air intake terminal must be installed a minimum of 12" below the exhaust terminal.

For concentric vent terminal kit (optional), follow the installation instructions included with the kit.

UNIT SURFACE	SUGGESTED SERVICE ACCESS CLEARANCE	
	INCHES	CM
Left Side	1	2.5
Right Side	12	31
Top	24	61
Back	6	15
Closet, Front	1	2.5
Alcove, Front	24	61
Vent	Per Vent Manufacturer	
Certified by CSA for zero clearance to combustible materials on all sides.		

Table 2. - Clearances

INTAKE / EXHAUST										
STANDARD SIZE	MIN EQUIV. INTAKE VENT	MIN EQUIV. INTAKE		MIN EQUIV. VENT		MAX EQUIV. VENT		OPTIONAL VENT	MAX EQUIV.	
		FT.	M	FT.	M	FT.	M		FT.	M
80	2"	0*	0	3	1	40	6.1	3"	100	30.5
105	2"	0*	0	3	1	40	6.1	3"	100	30.5
150	3"	0*	0	3	1	100	30.5	n/a	—	—
210	3"	0*	0	3	1	100	30.5	n/a	—	—
285	4"	0*	0	3	1	100	30.5	n/a	—	—

*Appliance needs to vent outdoors using approved vent caps and following all guidelines as noted in our IO manual. Proper protection against debris in the air intake (through using a downward spout and/or screen) to avoid debris pick-up / falling into the appliance is required.

Combustion Intake and Vent must be the same size.

Minimum Combustion Air Intake Pipe Length - 0' (0M) / Minimum Vent Pipe Length - 3' (1M)

Installations in the U.S. require exhaust vent pipe that is a combination of PVC & CPVC complying with ANSI/ASTM D1785 F441 or stainless steel complying with the stainless steel vent suppliers listed in Section 3. 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 or galvanized material.

The installer must comply fully with the manufacturers installation instructions, including use of minimum exhaust length CPVC, to maintain ANSI Z21.13 safety certification.

Closet and alcove installations do not allow the use of PVC under any circumstances

This appliance needs to vent outdoors using approved vent caps and following all guidelines as noted in our IO manual. Proper protection against debris in the air intake (through using a downward spout and/or screen) to avoid debris pick-up / falling into the appliance is required.

To calculate max equivalent length, measure the linear feet of the pipe, and add 5 feet (1.5m) for each 90° elbow used. Add 2 1/2 feet (.76 meters) for each 45 elbow used.

Table 3. - Vent / Air Pipe Sizes

SECTION 3 VENTING AND COMBUSTION AIR

3.A General Venting

This unit requires a special venting system. Refer to venting supplier's instructions for complete parts list and method of installation. The vent manufacturers listed on the following tables have been tested and authorized to safely operate with this unit. Suppliers of stainless steel and polypropylene venting that are not listed on these tables are not permitted for use with this category IV unit.

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.

3.B Combustion Air

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

The unit 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.

MFR MODEL NUMBER (ABBREVIATED)

Example Components	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
Adapter, SS to CPVC		FSA-xxFNSM-xPVCF	
Manufacturer Approved Hanger Straps	Distance between Hanger Straps (Horizontal Run) - 6' MAX. Distance between Hanger Straps (Vertical Run) - 30' MAX.	Distance between Hanger Straps (Horizontal Run) - 6' MAX. Distance between Hanger Straps (Vertical Run) - 12' MAX.	Distance between Hanger Straps (Horizontal Run) - 4' MAX. Distance between Hanger Straps (Vertical Run) - 16' MAX.
Adapter SS to PP		FSAAUx-xPP	2ZDCPVCx**

*4", 6" & 7" only

**up to 6"

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

ALLOWABLE POLYPROPYLENE VENT MANUFACTURERS / TRADE NAMES

MFR MODEL NUMBER (ABBREVIATED)

Example Components	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	ISAGLxxxx	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
Manufacturer Approved Hanger Straps	Distance between Hanger Straps (Horizontal Run) - 3' MAX. Distance between Hanger Straps (Vertical Run) - 6' MAX.	Distance between Hanger Straps (Horizontal Run) - 5' MAX. Distance between Hanger Straps (Vertical Run) - 10' MAX.	Distance between Hanger Straps (Horizontal Run) - 2.5' MAX. Distance between Hanger Straps (Vertical Run) - 16' MAX.	Distance between Hanger Straps (Horizontal Run) - 3' MAX. Distance between Hanger Straps (Vertical Run) - 6' MAX.

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

Table 5. - Allowable Polypropylene Vent Manufacturers / Trade Names

Combustion Air From Room

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

Method 1: Two permanent openings, one commencing within 12" (300mm) of the top and one commencing within 12" (300mm) 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" (300mm) of the top of the enclosure, shall be permitted. The opening shall directly communicate with the outdoors or shall communicate through a vertical or horizontal duct to the outdoors or spaces that directly communicate with the outdoors and shall have a minimum free area of 1 square inch per 3000 Btu/hr (734 square mm/kW) of the total input rating of all equipment located in the enclosure. This opening must not be less than the sum of the areas of all vent connectors in the confined space.

Other methods of introducing combustion and ventilation air are acceptable, providing they conform to the requirements in the applicable codes listed above.

In Canada, consult local building and safety codes or, in absence of such requirements, follow CAN/CSA B149.

Ducted Combustion Air

The combustion air can be taken through the wall, or through the roof. When taken from the wall, it must be taken from out-of-doors by means of the Manufacturer horizontal wall terminal, shown in Table 6. See Table 3 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 Figure10.)

Use ABS, PVC, CPVC or galvanized pipe for the combustion air intake. (See Table 7) The pipe should be sized per Table 3 on page 11. 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. Maximum linear pipe length allowed is shown in Table 3. Subtract 5 allowable linear ft. (1.5m) for every elbow used.

The connection for the intake air pipe is at the top of the unit.

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.

Size	2" PVC			3" PVC			4" PVC	
	Standard	Concentric CA006000	Flush Mount CA010100	Standard CA005900	Concentric 239-44069-01	Flush Mount CA010101	Standard	Flush Mount CA010102
80	incl.	opt.	opt.	opt.	opt.	opt.	n/a	n/a
105	incl.	opt.	opt.	opt.	opt.	opt.	n/a	n/a
150	n/a	n/a	n/a	incl.	opt.	opt.	n/a	n/a
210	n/a	n/a	n/a	incl.	opt.	opt.	n/a	n/a
285	n/a	n/a	n/a	opt.	opt.	opt.	incl.	opt.

Concentric vent terminal = 10 ft. pipe length

Table 6. - PVC Horizontal Intake and Exhaust Vent Terminal Kits

MATERIAL	INSTALLATION STANDARDS	
	UNITED STATES	CANADA
ABS	ANSI/ASTM D1527	Air pipe material must be chosen based upon the intended application of the boiler.
PVC, sch 40	ANSI/ASTM D1785 or D2665	
CPVC, sch 40	ANSI/ASTM F441	
Single wall galv. steel	26 gauge	

Table 7. - Required Combustion Air Pipe Material

3.C Venting

⚠ WARNING

Failure to use polypropylene CPVC or stainless steel venting for the first 20" (285) / 30" (80-210) of vent material or for any part of the venting that is installed inside a closet may lead to property damage, personal injury or death. The proper length of this material is supplied with boiler. Boilers in the U.S. may use pipe included with the boiler.

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

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

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

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.

The flue temperature of the unit changes dramatically with changes in operating water temperature. Therefore, it is necessary to assess the application of the boiler to determine the required certified vent class. If the unit is installed in an application where the ambient temperature is elevated, and/or installed in a closet/alcove, polypropylene, CPVC or stainless steel material is required. If the system temperatures are unknown at the time of installation, Class IIB or higher venting material is recommended.

This unit is a Category IV appliance and may be installed with PVC and CPVC that complies with ANSI/ASTM D1785 F441, polypropylene that complies with ULC-S636 Class IIB, or a stainless steel venting system that complies with the vent suppliers and part numbers in Section 3. (See Table 4.)

The units vent can terminate through the roof, or through an outside wall.

When using PVC/CPVC for vent material, venting must be connected to the CPVC section included with unit sizes 80-285. The CPVC vent section included with the unit may

be broken by CPVC fittings if necessary, but never reduced in total length. See Table 3 to select the appropriate vent pipe diameter. When using polypropylene, all vent material must be produced by the same manufacturer, and have a ULC-S636 rating.

All installations should be done following the vent supplier's recommended installation techniques. If manufacturers instructions are not available for the material used, follow the manufacturers recommendations.

The vent pipe must pitch upward, toward the vent terminal, not less than 1/4" per foot, so that condensate will run back to the unit to drain. Route vent pipe to the heater as directly as possible. Seal all joints and provide adequate hangers as required in the venting system manufacturers Installation Instructions. Horizontal portions of the venting system must be supported to prevent sagging and may not have any low sections that could trap condensate. The unit must not support the weight of the vent pipe. Please see Table 3 for proper diameter vs. length allowed.

Venting Requirements Unique to Canada

These boilers are Vent Category 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 manufacturers certified installation instructions.

As a result, two items listed in the Unpacking section (Figure 8) are **not included** with units for Canada (underlined):

- A. **exhaust vent terminal** (not included)
- B. air intake terminal
- C. temperature/pressure gauge kit
- D. circulator pump/wire harness (units with pump)
- E. **CPVC exhaust pipe section** (not incl.)
- F. outdoor/system sensor kit
- H. alternate size vent/terminal screens

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.

MATERIAL	INSTALLATION STANDARDS	
	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 maximum flue gas temperature and the intended application of the boiler.
PVC, sch 40	ANSI/ASTM D1785	
CPVC, sch 40	ANSI/ASTM F441	
Polypropylene	ULC-S636	

Table 8. - Required Exhaust Vent Material

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
- B Up to and including 90°C
- C Up to and including 110°C, and
- D Up to and including 135°C

NOTE: IMPORTANT! It is 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, the Manufacturer suggests using a tee with the branch connection sized to allow for insertion of a flue gas analyzer probe. The branch connection must be resealable with a cap or other by other means to ensure the vent system remains sealed. (See [Figure 8 on page 18.](#))

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.

An exhaust vent terminal must be installed. If an exhaust vent terminal is not available with the certified vent system, the Manufacturer suggests the use of a coupler fitting from the certified vent system into which the vent terminal screen, included with the unit and shown in the Unpacking section, be installed. Be sure to install and terminate both vent and combustion air pipes per the Venting and Combustion Air section of the unit instructions.

3.D Common Venting

High efficiency boilers and water heaters may be common vented using Non-Return Valve kits and Centrotherm InnoFlue polypropylene venting. Go online to www.laars.com and refer to the Common Venting Installation Instructions, document number 1427, for instructions on sizing and installing a common venting system.

If common venting is required on larger model sizes or with different venting materials, it MUST be engineered by a competent venting specialist, and involves the selection of draft inducing equipment, hardware and controls to properly balance flue gas pressures. Do not common vent these units unless the vent system meets this requirement. High efficiency class IV units are never permitted to share a vent with Category I appliances.

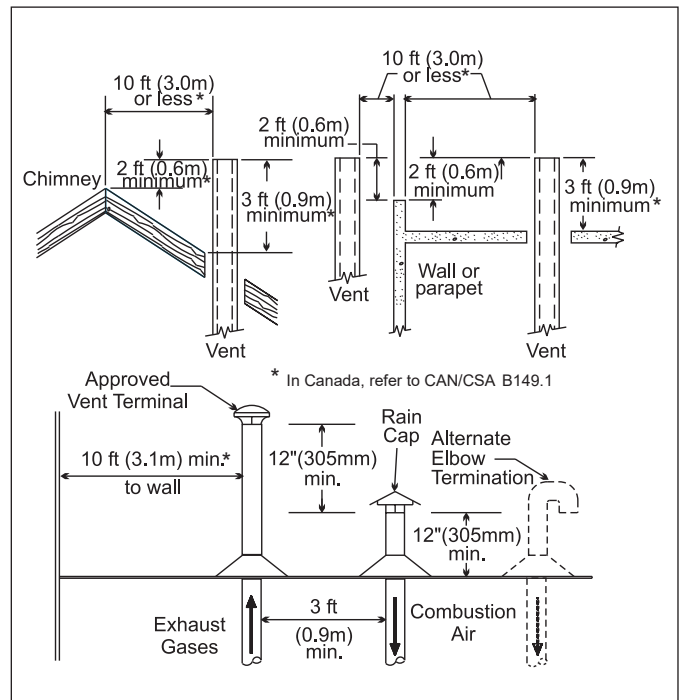


Figure 4. - Combustion Air and Vent Through Roof

3.E Locating Vent and Combustion Air Terminals

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 points listed on the following page when installing the terminal. 1. [Figure 6](#) 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

⚠ WARNING

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

3.E Locating Vent and Combustion Air Terminals (continued)

inlets or other openings. Whenever possible, avoid locations under windows or near doors.

5. **Locate the vent terminal so that it cannot be blocked by snow. The installer may determine that a vent terminal must be higher than the minimum shown in codes, depending upon local conditions.**
6. Locate the terminal so the vent exhaust does not settle on building surfaces or other nearby objects. Vent products may damage surfaces or objects.
7. If the boiler uses ducted combustion air from an intake terminal located on the same wall, see [Figure 6](#) through [Figure 7](#) for proper spacing and orientation.

If the vent termination is located in an area exposed to high winds, an optional PVC tee (the same diameter as the vent pipe) may be used. The tee'd vent termination offers greater protection from wind related operating issues.

Side Wall Combustion Air Terminal

The Manufacturer side wall combustion air terminal, or concentric terminal must be used when the heater takes air from a side wall. (See [Table 6](#).) Contact Manufacturer for AL29-4C termination fittings. Consider the following when installing the terminal. (See [Figure 6](#) through [Figure 7](#).)

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 (2.1m) 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 (30cm) 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, locate the vent terminal at least 1 foot (0.3m) above the combustion air terminal.
5. **For concentric vent, follow instructions included with vent kit.**
6. Multiple vent kits should be installed such that the horizontal distance between the outlet group and the inlet group is 36" (90cm). (See [Figure 5](#).)
7. The vent outlet for models 80-285 must be no lower than the center of the air inlet, and must be at least 12" (30cm) away from the air inlet. Vent outlets for models 399-850 must be at least 12" above the top of the air inlet, and must be at least 36" (90cm) horizontally from the air inlet. (See [Figure 7](#).)

Vertical Vent Terminal

When the unit is vented through the roof, the vent must extend at least 3 feet (0.9m) above the point at which it penetrates the roof. It must extend at least 2 feet (0.6m) higher than any portion of a building within a horizontal distance of 10 feet (3.0m), and high enough above the roof line to prevent blockage from snow. The vent terminal included 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" (30cm) below the vent terminal. (See [Figure 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. (See [Figure 4](#).) The opening on the end of the terminal must be at least 12" (30cm) 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" (30cm) below the vent terminal.

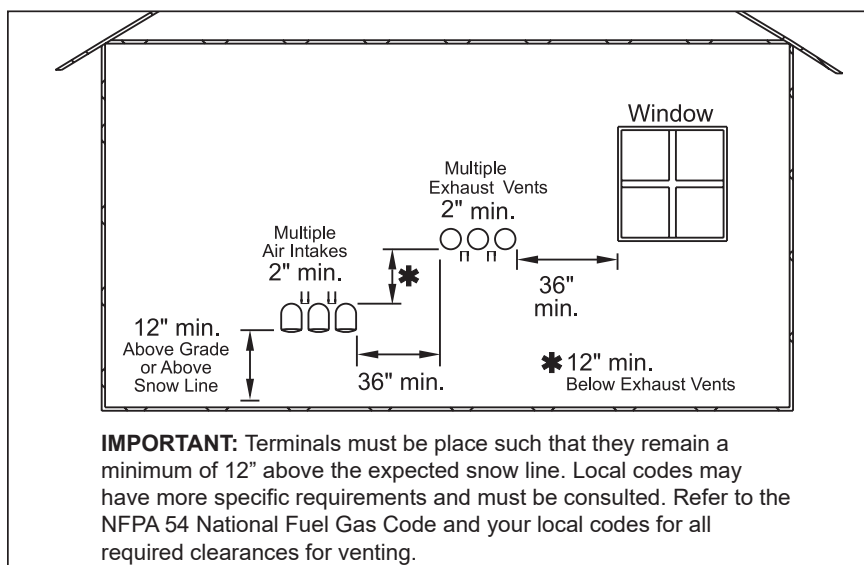


Figure 5. - Multiple Side-Wall Terminals, Air and Vent

		Canadian Installations ¹	U.S. Installations ²
A =	Clearance above grade, veranda, porch, deck, or balcony	12 in (30 cm)	12 in (30 cm)
B =	Clearance to window or door that may be opened	<ul style="list-style-type: none"> • 6 in (15 cm) for appliances ≤ 10,000 Btuh (3 kW) • 12 in (30 cm) for appliances > 10,000 Btuh (3 kW) and ≤ 100,000 Btuh (30 kW) • 36 in (91 cm) for appliances > 100,000 Btuh (30 kW) 	<ul style="list-style-type: none"> • 6 in (15 cm) for appliances ≤ 10,000 Btuh (3 kW) • 9 in (23 cm) for appliances > 10,000 Btuh (3 kW) and ≤ 50,000 Btuh (15 kW) • 12 in (30 cm) for appliances > 50,000 Btuh (15 kW)
C =	Clearance to permanently closed window	See Note 4	See Note 5
D =	Vertical clearance to ventilated soffit located above the terminal within a horizontal distance of 2 ft (61 cm) from the center line of the terminal	See Note 4	See Note 5
E =	Clearance to unventilated soffit	See Note 4	See Note 5
F =	Clearance to outside corner	See Note 4	See Note 5
G =	Clearance to inside corner	See Note 4	See Note 5
H =	Clearance to each side of centerline extended above meter / regulator assy	3 ft (91 cm) within a height of 15 ft (4.6 m)	See Note 5
I =	Clearance to service regulator vent outlet	3 ft (91 cm)	See Note 5
J =	Clearance to nonmechanical air supply inlet to building or the combustion air inlet to any other appliance	<ul style="list-style-type: none"> • 6 in (15 cm) for appliances ≤ 10,000 Btuh (3 kW) • 12 in (30cm) for appliances > 10,000 Btuh (3 kW) and ≤ 100,000 Btuh (30 kW) • 36 in (91 cm) for appliances > 100,000 Btuh (30 kW) 	<ul style="list-style-type: none"> • 6 in (15 cm) for appliances ≤ 10,000 Btuh (3 kW) • 9 in (23cm) for appliances > 10,000 Btuh (3 kW) and ≤ 50,000 Btuh (15 kW) • 12 in (30 cm) for appliances > 50,000 Btuh (15 kW)
K =	Clearance to a mechanical air supply inlet	6 ft (1.83 m)	3 ft (91 cm) above if within 10 ft (3 m) horizontally
L =	Clearance above paved sidewalk or paved driveway located on public property	7 ft (2.13 m)†	7 ft (2.13 m) for mechanical draft systems (Category I appliances). Vents for Category II and IV appliances cannot be located above public walkways or other areas where condensate or vapor can cause a nuisance or hazard*
M =	Clearance under veranda, porch, deck, or balcony	12 in (30 cm)‡	See Note 5

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

Notes:

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

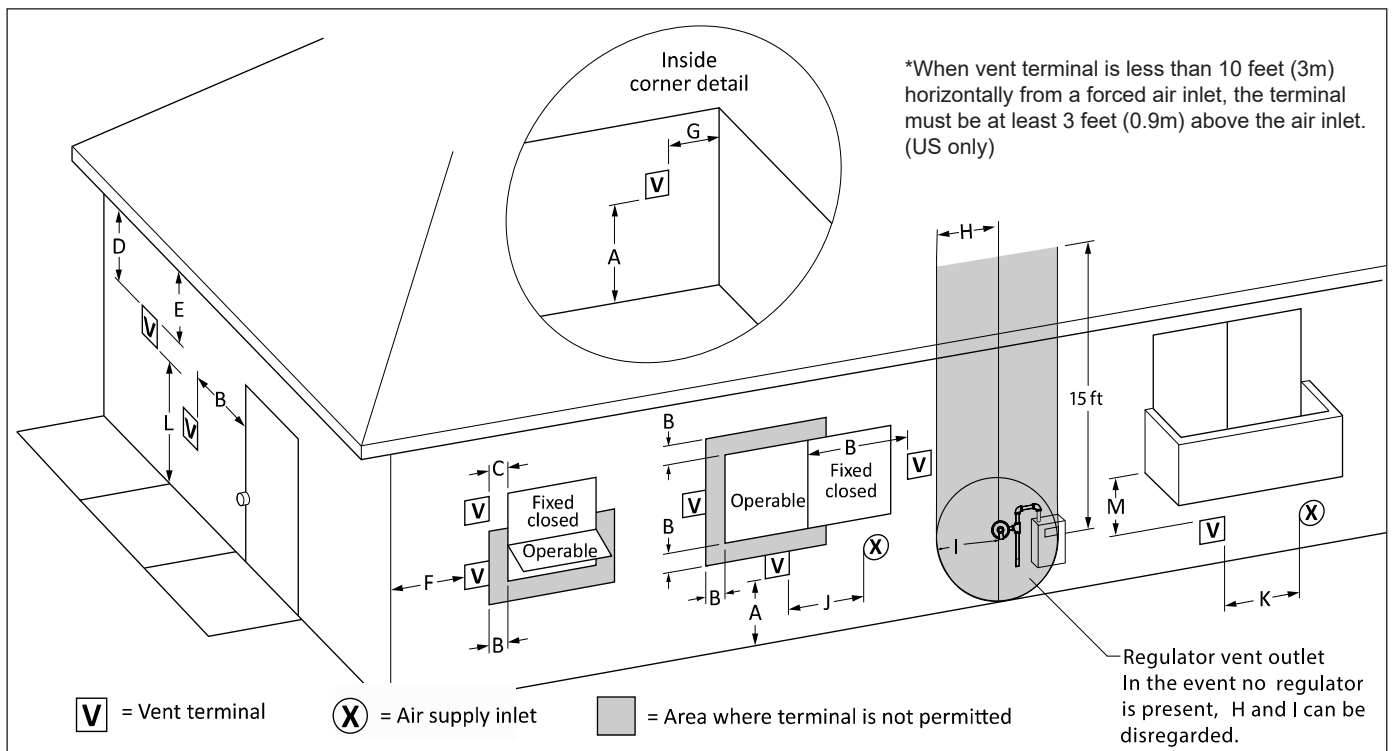


Figure 6. - Combustion Air and Vent Through Side Wall

3.E Locating Vent and Combustion Air Terminals (continued)

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 (beginning on 2nd page following):

1. Installation of Carbon Monoxide Detectors

At the time of installation of the side wall vented gas fueled unit, 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,

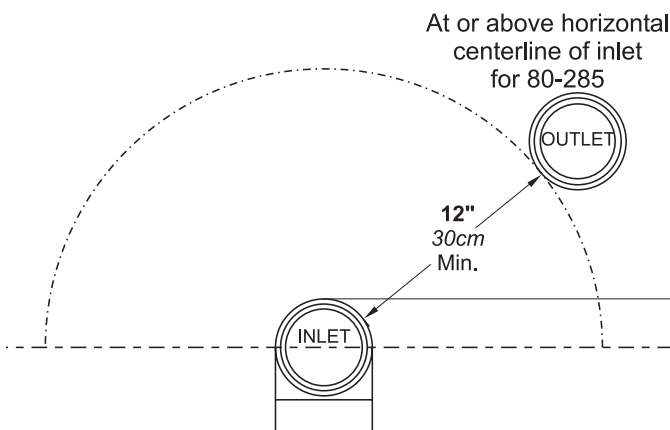


Figure 7. - Minimum Venting Distance

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."

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.

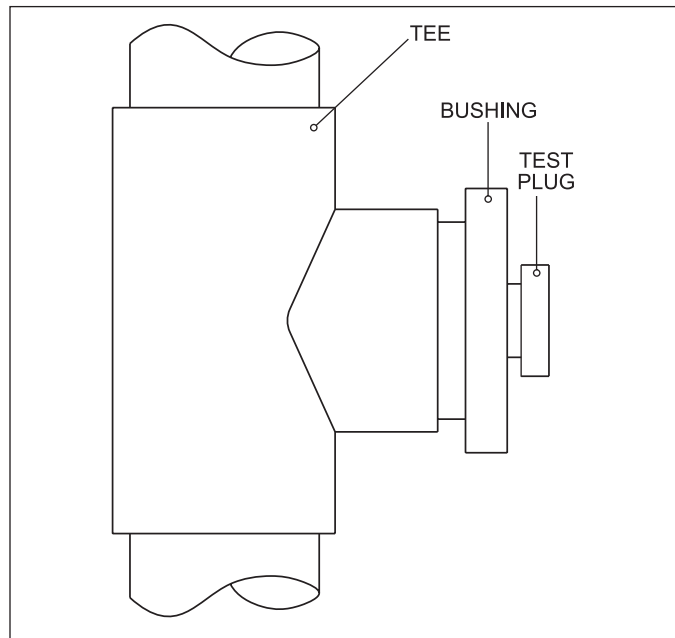


Figure 8. - Test Port - ULC-S636 system

3.F Common Vent Test

NOTE: This section does not describe a method for common venting units. It describes what must be done when a unit is removed from a common vent system. These class IV units require special vent systems and fans for common vent. See Section "3.D Common Venting" on page 15, or contact the factory if you have questions about common venting these units.

WARNING

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

At the time of removal of an existing boiler, the following steps 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 and other deficiencies which could cause an unsafe condition.
3. Insofar as it is practical, close all building doors and windows and all doors between the space in which the appliances remaining connected to the common venting system are located and other spaces of the building. Turn on clothes dryers and any appliance not connected to the common venting system. Turn on any exhaust fans, such as range hoods and bathroom exhausts, so they will operate at maximum speed. Do not operate a summer exhaust fan. Close fireplace dampers.
4. Place in operation the appliance being inspected. Follow the lighting instructions. Adjust the thermostat so the appliance will operate continuously.
5. Test for spillage at the draft hood relief opening after 5 minutes of main burner operation. Use the flame of a match or candle, or smoke from a cigarette, cigar or pipe.
6. After it has been determined that each appliance remaining connected to the common venting system properly vents when tested as outlined above, return doors, windows, exhaust fans, fireplace dampers and any other gas burning appliance to their previous conditions of use.
7. Any improper operation of the common venting system should be corrected so that the installation conforms to the National Fuel Gas Code, ANSI Z223.1/NFPA 54 and/or CSA B149.1, Installation Codes. 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 and guidelines in the National Fuel Gas Code, ANSI Z223.1 NFPA 54 and/or CSA B149.1, Installation Codes.

AVERTISSEMENT

Lorsqu'une chaudière existante est supprimée d'un système de ventilation commun, le système de ventilation commun est susceptible d'être trop grande pour garantir une aération correcte des appareils restant connecté à elle. Lors de la dépose d'une chaudière existante, les étapes suivantes doivent être suivies avec chaque appareil reste connecté à la système de ventilation commun mis en opération, alors que les autres appareils connectés restants à la politique commune de système d'aération ne sont pas en opération.

1. Joint les ouvertures inutilisées dans le système de ventilation commun.
2. Inspecter visuellement le système de ventilation à la taille correcte et espacement horizontal et déterminer il n'y a pas de blocage ou de restriction, de fuite, de corrosion et d'autres lacunes que pourrait causer une condition dangereuse
3. Dans la mesure où cela est pratique, fermer tous les bâtiments de portes et fenêtres et toutes les portes entre l'espace dans lequel les appareils connectés restants à la système de ventilation commun sont situés et d'autres espaces du bâtiment. Allumer les sécheuses et tout appareil non connecté au système de ventilation commun. Mettez sous tension tous les ventilateurs d'échappement d'air, tels que les hottes de cuisine et salle de bains exhausts, afin qu'ils fonctionnent à la vitesse maximum. Ne pas faire fonctionner un ventilateur d'échappement d'été. Fermer cheminée amortisseurs.
4. Place dans le fonctionnement de l'appareil inspecté. Suivez les instructions d'éclairage. Réglez le thermostat de sorte que l'appareil fonctionnera en continu.
5. Test pour les pertes sur les projets d'ouverture de secours de capot après 5 minutes de fonctionnement du brûleur principal. Utilisez la flamme d'une allumette ou une bougie allumée, ou de la fumée d'une cigarette, un cigare ou une pipe.
6. Après qu'il a été déterminé que chaque appareil reste connecté au système de ventilation commun correctement événements lorsque testé comme décrit ci-dessus, le retour des portes, des fenêtres, ventilateurs d'échappement, amortisseurs de cheminée et tout autre appareil de combustion du gaz à leurs conditions d'utilisation précédente.
7. Tout fonctionnement incorrect du système de ventilation commun devrait être corrigée de sorte que l'installation est conforme aux code de gaz combustible National, ANSI Z223.1/NFPA 54 et/ou CSA B149.1, Codes d'installation. Lors du redimensionnement de toute portion de la système de ventilation commun, le système de ventilation commun doit être redimensionné à l'approche de la taille minimale, déterminée en utilisant les tableaux appropriés et des lignes directrices dans le National Code de gaz combustible, ANSI Z223.1 NFPA 54 et/ou CSA B149.1, Codes d'installation.

SECTION 4 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 boiler.

Review the following instructions before proceeding with the installation.

1. Verify that the unit is fitted for the proper type of gas by checking the rating plate. Unit will function properly without the use of high altitude modification at elevations up to 10,000 feet (3050 m).
2. Verify that the Min and Max inlet gas supply pressures are within the parameters shown in Table 9
3. Refer to **Table 10** thru **Table 13** to size the piping.
4. Run gas supply line in accordance with all applicable codes.
5. Locate and install manual shutoff valves in accordance with state and local requirements.
6. 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 unit and its individual shutoff valve must be disconnected from the gas supply piping during any pressure testing of that system at test pressures in excess of 1/2 PSIG (3.45kPa).
9. The unit must be isolated from the gas supply system by closing its individual manual shutoff valve during any pressure testing of the gas supply piping system at test pressures equal to or less than 1/2 PSIG (3.45kPa).
10. The unit and its gas connection must be leak tested before placing it in operation.
11. Purge all air from gas lines.

⚠ WARNING

Open flame can cause gas to ignite and result in property damage, severe injury, or loss of life.

Inlet Gas Supply Pressure		
	Min"	Max
Natural Gas	3.5" W.C.	10.5" W.C.
Propane	8" W.C.	13" W.C.

Table 9. Gas Pressure

To size piping:

Measure linear distance from meter outlet to last boiler. Add total input of all boilers and divide by 1000 to obtain cu ft / hr required. Add total equivalent length of fittings used according to Table 11. Align total length (pipe and fittings) on left side column of Table 12 with highest cubic feet of gas required.

Required			
Propane		Natural Gas	
Size	CUFT/HR	Size	CUFT/HR
80	32	80	80
105	42	105	105
150	60	150	150
210	84	210	210
285	114	285	285

Notes:

Consult and confirm with Applicable Fuel Gas Code before beginning work. Verify gas inlet pressure is correct using Table 9 before starting boiler.

Table 10. To Size Your Gas Piping

EQUIVALENT LENGTHS OF STRAIGHT PIPE FOR TYPICAL SCH 40 FITTINGS						
NOMINAL PIPE SIZE						
FITTING	1/2"	3/4"	1"	1-1/4"	1-1/2"	2"
LINEAR FEET						
90° ELBOW	3.6	4.4	5.2	6.6	7.4	8.5
TEE	4.2	5.3	6.6	8.7	9.9	12

Table 11. Equivalent Lengths of Straight Pipe, SCH 40

SCH 40 METAL PIPE CAPACITY FOR 0.60 SPECIFIC GRAVITY NATURAL GAS						
NOMINAL PIPE SIZE @ 0.30" W.C. PRESSURE DROP						
LENGTH	1/2"	3/4"	1"	1-1/4"	1-1/2"	2"
FT	CUBIC FEET OF GAS PER HOUR					
20	92	190	350	730	1100	2100
40		130	245	500	760	1450
60		105	195	400	610	1150
80		90	170	350	530	990
100			150	305	460	870

Table 12. Nominal Pipe Size @ 0.30" W.C. Press Drop

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						
SIZE	1/2"	3/4"	1"	1-1/4"	1-1/2"	2"
LENGTH	MAXIMUM CAPACITY IN THOUSANDS OF BTU PER HOUR					
20	200	418	787	1616	2422	4664
40	137	287	541	1111	1664	3205
60	110	231	434	892	1337	2574
80	94	197	372	763	1144	2203
100	84	175	330	677	1014	1952

Table 13. Nominal Pipe Size @ 0.11" W.C. and 0.5" Press Drop

NOTE: This 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. Some units are equipped with low and high pressure gas switches that are integrally vent limited. These types of devices do not require venting to atmosphere.

SECTION 5 PUMP REQUIREMENTS

5.A Boiler Flow and Head Requirements

Temperature rise in Fahrenheit (15° - 35°)

	15		20		25		30		35	
	Flow	H/L	Flow	H/L	Flow	H/L	Flow	H/L	Flow	H/L
	gpm	feet	gpm	feet	gpm	feet	gpm	feet	gpm	feet
80	10	26.8	7.6	16.9	6.1	11.7	5.1	8.65	4.3	6.5
105	13.3	38.8	10	23.3	8	15.6	6.7	11.3	5.7	8.48
150	19	39.4	14.3	24.1	11.4	16.3	9.5	11.9	8.1	9.03
210	26.7	28.1	20	15.6	16	9.88	13.4	6.88	11.3	4.86
285	36	29.6	27	19.1	22	13.9	18	10.2	15	7.7

Temperature rise in Celsius (8° - 19°)

	8		11		14		17		19	
	Flow	H/L	Flow	H/L	Flow	H/L	Flow	H/L	Flow	H/L
	lpm	m	lpm	m	lpm	m	lpm	m	lpm	m
80	37.9	8.2	28.8	5.2	23.1	3.6	19.3	2.6	16.3	2.0
105	50.3	11.8	37.9	7.1	30.3	4.8	25.4	3.4	21.6	2.6
150	71.9	12.0	54.1	7.3	43.2	5.0	36.0	3.6	30.7	2.8
210	101.1	8.6	75.7	4.8	60.6	3.0	50.7	2.1	42.8	1.5
285	136.3	9	102.2	5.8	83.3	4.2	68.1	3.1	56.8	2.3

Temperature rise in Fahrenheit (40° - 60°)

	40		45		50		55		60	
	Flow	H/L	Flow	H/L	Flow	H/L	Flow	H/L	Flow	H/L
	gpm	feet	gpm	feet	gpm	feet	gpm	feet	gpm	feet
80	3.8	5.28	3.4	4.3	3	3.6	2.8	3.1	2.5	2.7
105	5	6.7	4.4	5.4	4	4.5	3.6	3.8	3.3	3.2
150	7.1	7.19	6.3	5.9	5.7	4.9	5.2	4.2	4.8	3.6
210	9.9	3.71	8.9	3	8	2.4	7.3	2	6.7	1.6
285	13	6.2	12	5.4	10.8	4.6	9.8	4	9	3.5

Temperature rise in Celsius (22° - 33°)

	22		25		28		31		33	
	Flow	H/L	Flow	H/L	Flow	H/L	Flow	H/L	Flow	H/L
	lpm	m	lpm	m	lpm	m	lpm	m	lpm	m
80	14.4	1.6	12.9	1.3	11.4	1.1	10.6	0.9	9.5	0.8
105	18.9	2.0	16.7	1.6	15.1	1.4	13.6	1.2	12.5	1.0
150	26.9	2.2	23.8	1.8	21.6	1.5	19.7	1.3	18.2	1.1
210	37.5	1.1	33.7	0.9	30.3	0.7	27.6	0.6	25.4	0.5
285	49.2	1.9	45.4	1.6	40.9	1.4	37.1	1.2	34.1	1.1

Table 14. Water Flow Requirements

SECTION 6 WATER CONNECTIONS

6.A Boiler System Piping - Hot Supply Connections

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

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

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

This unit's efficiency is higher with lower return water temperatures. Therefore, to get the most of low return temperature with multiple boilers, pipe as shown in [Figure 9 on page 24](#) through [Figure 14 on page 29](#).

All boilers can be ordered with or without a pump included.

BOILER SIZE	PIPE SIZE, INCHES
80	1
105	1
150	1
210	1¼
285	1¼

Table 15. - Water Connection Pipe Sizes

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

If longer pipe lengths or alternate piping methods are being used, the pump must be sized for the boiler and the piping it will serve. Table 14 on page 21 shows water flow and headloss data for the boiler.

The manufacturer strongly recommends primary-secondary piping.

6.B Boiler Cold Water Make-Up

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

The boiler piping system of a hot water heating boiler connected to heating coils located in air handling appliances where they may be exposed to refrigerated air circulation must be equipped with flow control valves or other automatic means to prevent gravity circulation of the boiler water during the cooling cycle.

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

6.C Condensate Drain

A condensate drain trap is built into the unit.

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

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

Consult local codes for the proper disposal method for the condensate.

⚠ 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 manufacturers responsibility.

6.D Freeze Protection

These units are certified for indoor use only, and are not design-certified for placement outdoors.

Proper precautions for freeze protection are recommended for boiler installations in areas where the danger of freezing exists.

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

Do not use automotive antifreeze. To help prevent freezing, 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.*

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

⚠ CAUTION

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 company, for information about specific products, maintenance of solutions, and set up according to your particular conditions.

6.E Recognized Chemicals

The following companies 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.

1. Sentinel Performance Solutions Group
2. Hercules Chemical Company
3. Dow Chemical Company

6.F Boiler Suggested Piping Schematics

Figure 9 on page 24 through Figure 14 on page 29 shows suggested piping configurations for Boiler boilers. These diagrams are only meant as a guide. All components or piping required by local code must be installed.

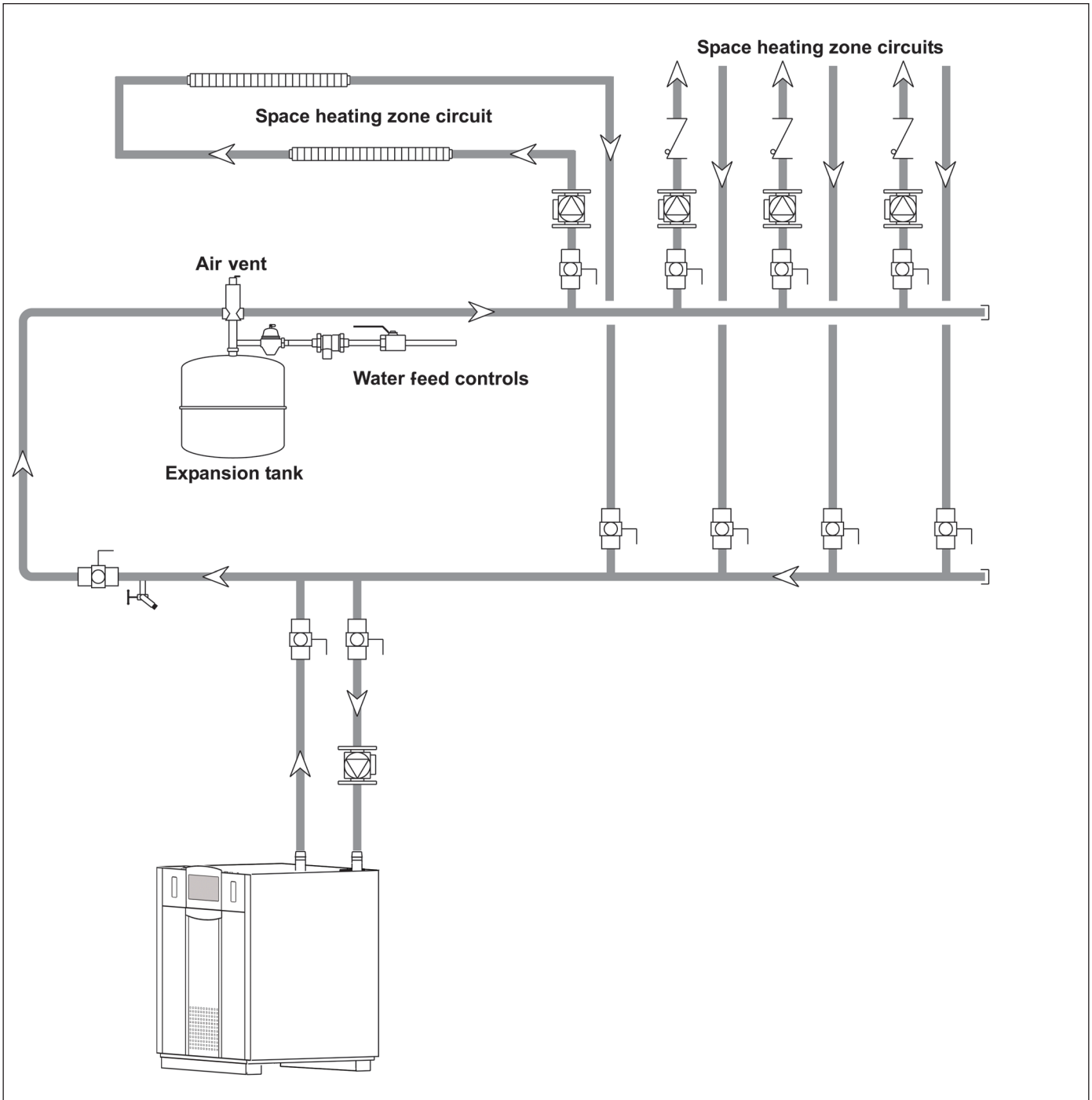


Figure 9. Hydronic Piping — Single Boiler, Zoning with Circulators

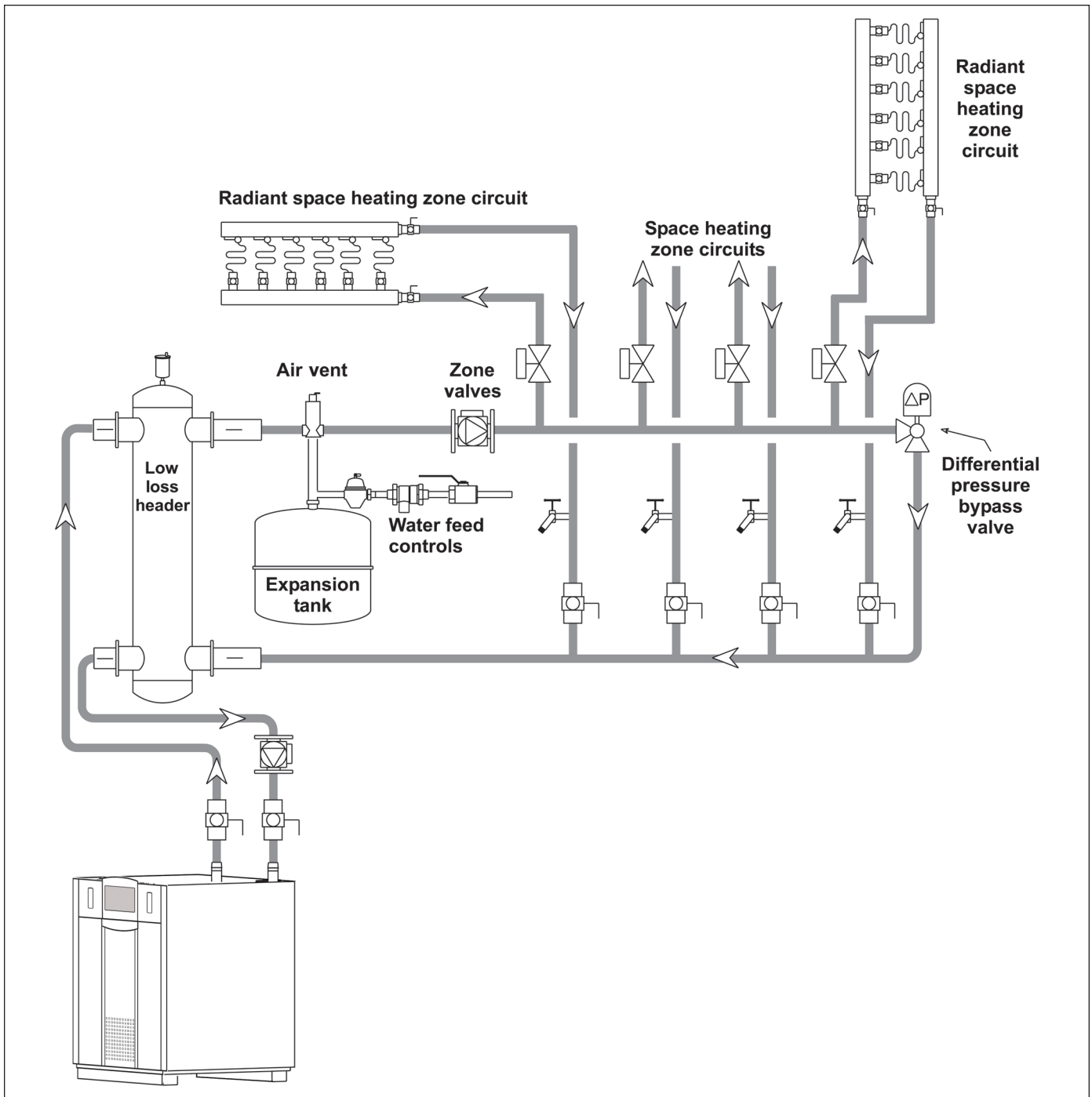


Figure 10. Hydronic Piping — Single Boiler, Low Temp Radiant Space Heating Using Low Loss Header and Zone Valves

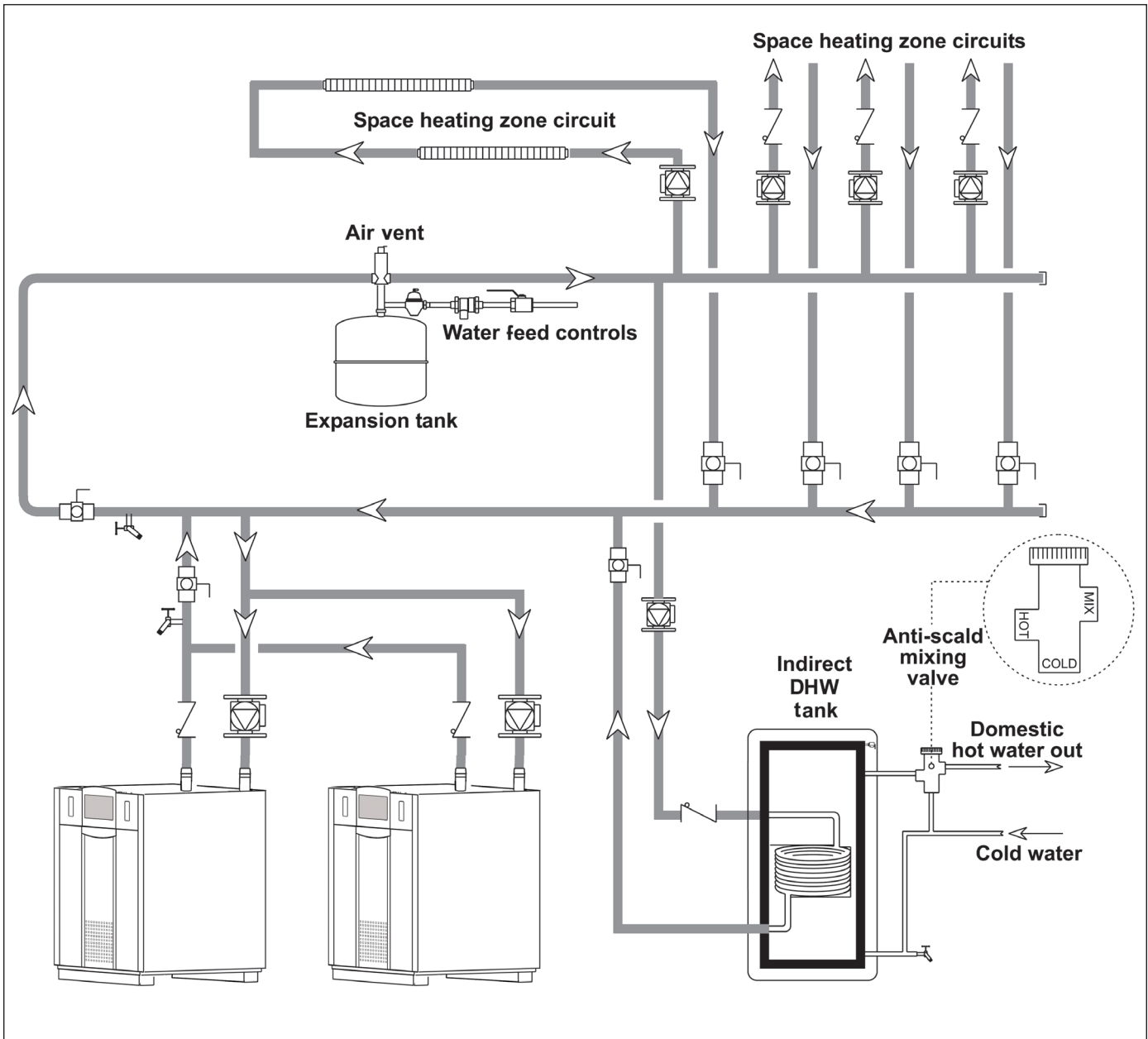


Figure 11. Hydronic Piping — Multiple Boilers with Indirect DHW Tank Piped from System Loop

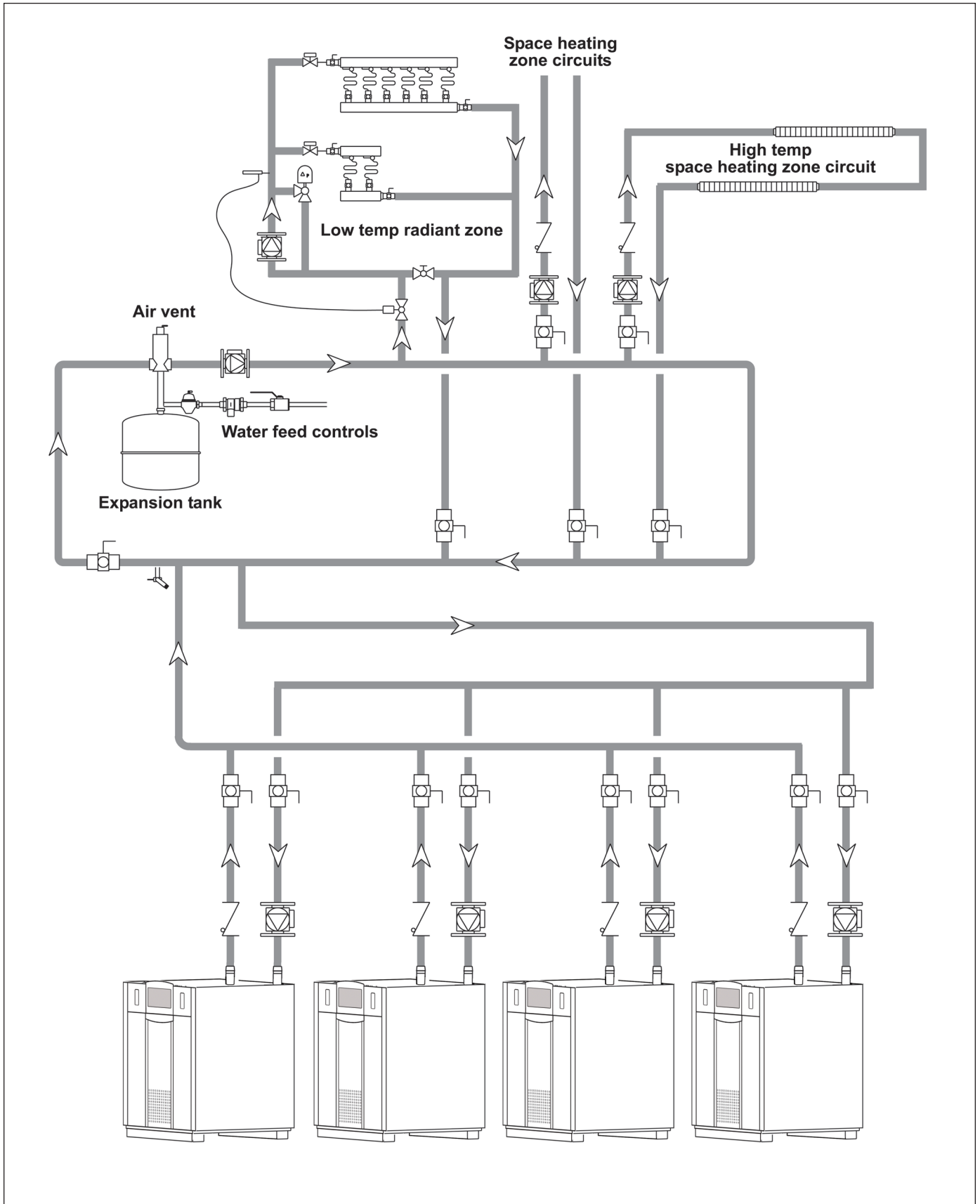


Figure 12. Hydronic Piping — Multiple Boilers, Reverse Return, Multi-Temp Zones, Zoning with Circulators

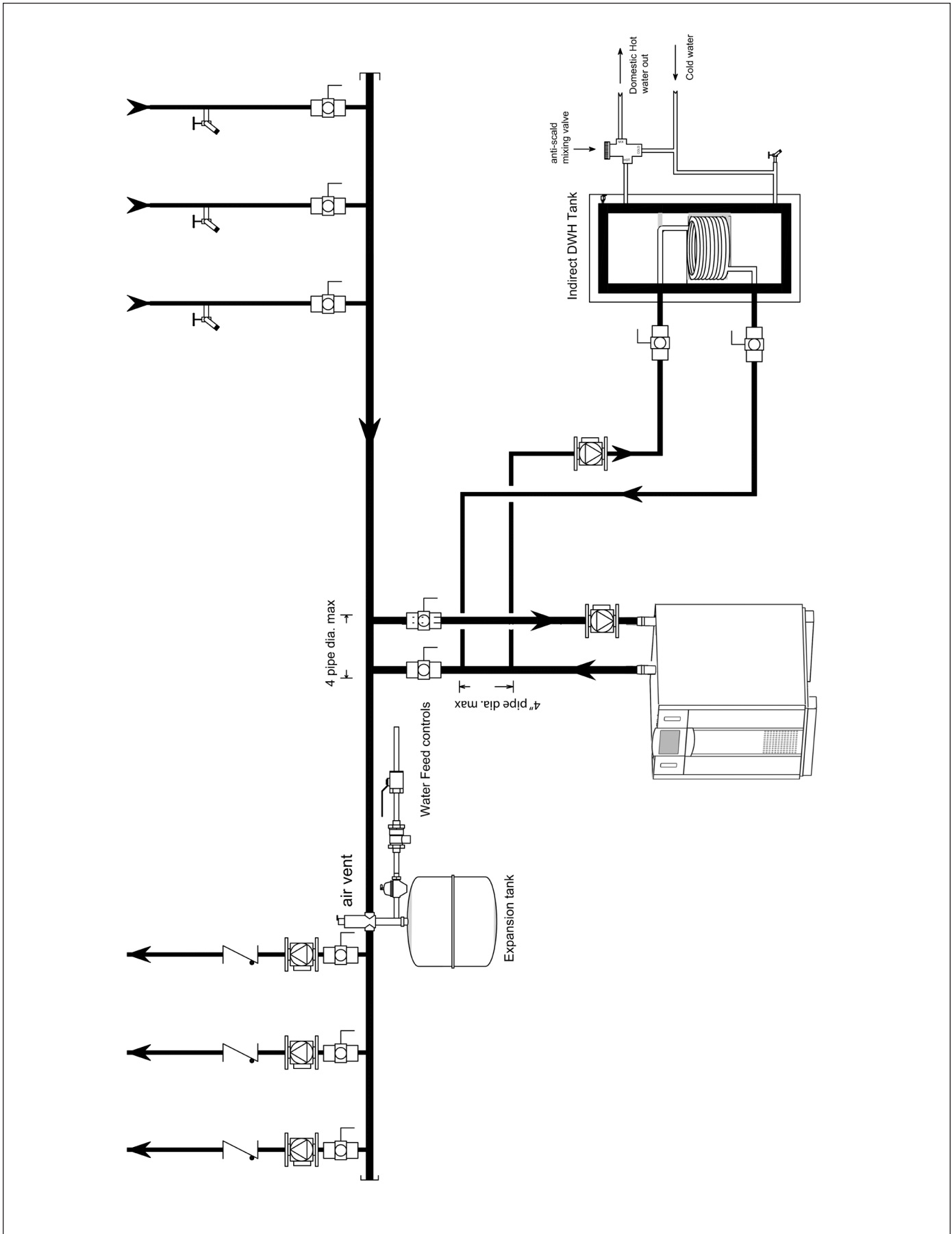


Figure 13. Hydronic Piping — Heating Zones with Indirect DHW Tank Piped with Zone Pumps

The indirect DHW tank is piped directly off of the boiler.

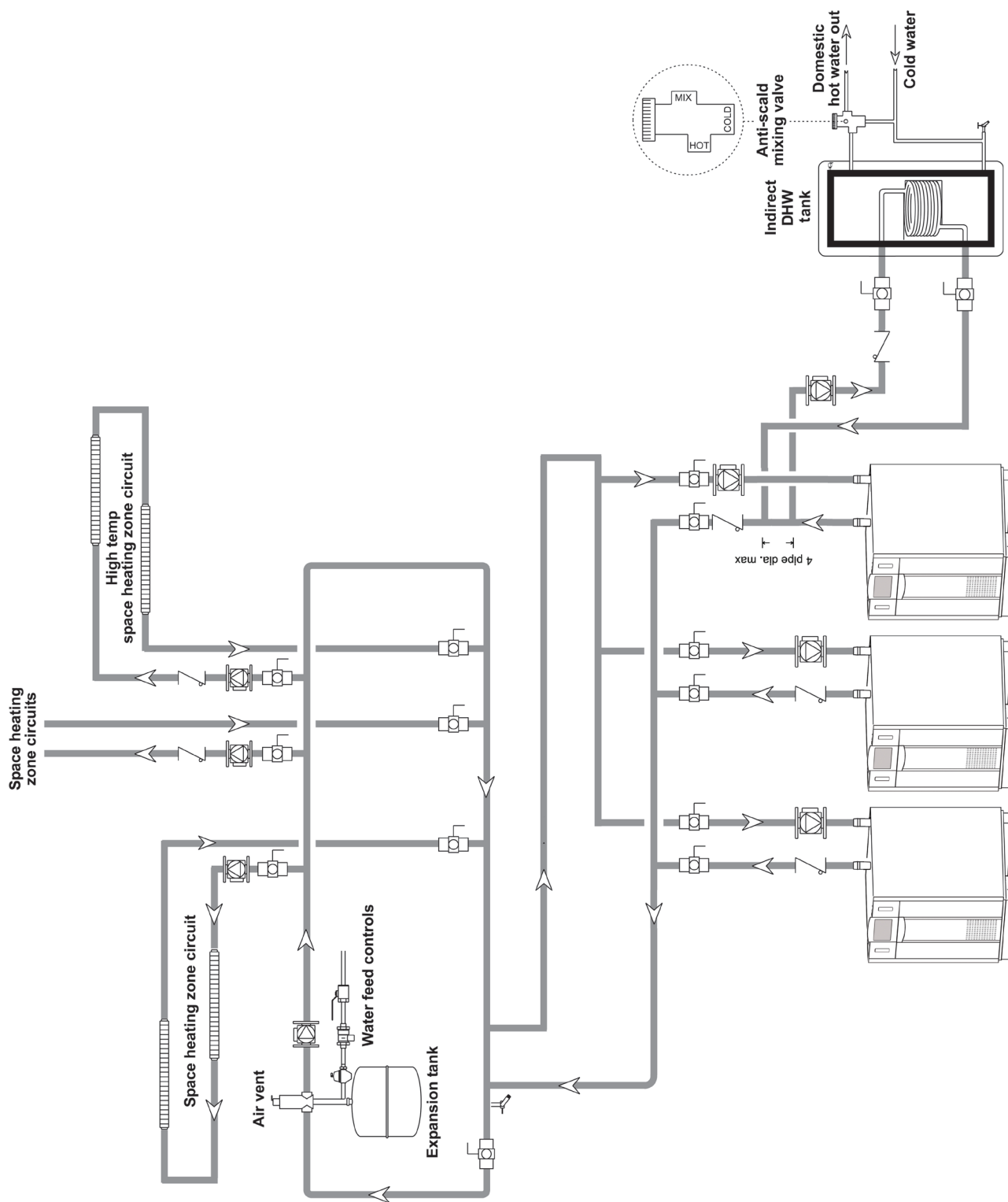


Figure 14. Hydronic Piping, Multiple Boilers with Indirect DHW Off of One Boiler

The indirect DHW tank is piped directly off of the boiler.

SECTION 7 ELECTRICAL AND WIRING DIAGRAMS

7.A Installation Warnings

⚠ WARNING

This 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 boiler. Plastic pipe or dielectric unions may isolate the boiler electrically. Service and maintenance personnel, who work on or around the boiler, may be standing on wet floors and could be electrocuted by an ungrounded boiler. Electrocutation 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. Wiring connections are shown in [Figure 15](#).

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

⚠ 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 components are designed to have constant voltage during normal operation. If this units supply voltage is toggled as a call for heat signal, premature failure of these components may result.

This 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.

7.B Main Power Connections

The size of the main power supply should be determined by [Table 16](#). This table indicates the unit's maximum overcurrent protection (MOP) and Minimum Circuit Ampacity (MCA). An overcurrent protection value should be selected based on these numbers. See [Figure 15](#) for Control Panel Layout of all terminal blocks.

Note: all units with Laars supplied boiler pumps may be powered using the supplied voltage.

Boiler only

Size	80	105	150	210	285
Voltage	120V	120V	120V	120V	120V
FLA	2	2	2	2	2
MCA	2.5	2.5	2.5	2.5	2.5
MOP	4.5	4.5	4.5	4.5	4.5

Boiler and Pump

Size	80	105	150	210	285
Voltage	120V	120V	120V	120V	120V
FLA	2.8	3.8	3.8	4	5.2
MCA	3.5	4.75	4.75	5	6.5
MOP	6.3	8.55	8.55	9	11.7

Table 16. Boiler Electrical Data

7.C Pump Connections and Operation

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

The boiler pump terminals (located on TB5) are fed by 120V (violet and white wires) internally from the main power supply. The maximum allowable current draw is 7.4 amps. If the expected FLA is larger than 7.4, it is required to install and use a separate pump contactor (not included).

The System and DHW pump contacts are dry contacts. Appropriate voltage must be supplied to the System and DHW pumps for proper operation. (See Figure 15.)

These pump connections are located on terminal block 5 (TB5) in the control panel (See Figure 33) and are rated for 120Vac, 7.4 Amps. To use the contacts power must be supplied on one terminal and the other terminal wired to the pump or a relay controlling the pump.

Using on board power for additional pumps is acceptable if the unit's main power supply MOP does not exceed 18 amps. If this is anticipated, additional 120VAC circuits will be required for the pumps.

Once the unit has been installed and set up, the Quick Start menu provides a simple way to change the most common settings used in a typical installation. (If your installation is more complex, refer to Section 8C.) To reach the Quick Start menu, press the "I" button ("Info/Install"), then press the Quick Start menu item.

7.D Hydronic Heating Using External Modulation Control

About External Control -

When this unit is used for hydronic heating with external modulation control, a call for heat must be supplied to the "T-T or Interlock" terminal. Once the call is supplied the control starts the Boiler and System pumps and begins the ignition process. Once in Run, the unit monitors the flame signal, call for heat, safeties, and water temperatures. The boiler setpoint is used to limit the maximum water temperature leaving the boiler only. The modulation rate is controlled by a 4-20mA signal supplied by an external control. (This can also be 0-10Vdc using a converter - Manufacturer part number CA006100.) When setting up a system using an external control, take care to set Anti-Short Cycle feature to prevent "hunting " and possible premature component failure.

7.E Optional Field Connections

Terminal block 8 (TB8) in the control panel is used for the 'Safety Chain' and for connecting optional components such as low water cutoffs, flow switches, additional high limits, and other field-supplied devices that must be interlocked with the boiler. These are non-powered dry contacts only. All safeties or end switches must be wired in series by removing the supplied jumpers.

See Figure 15

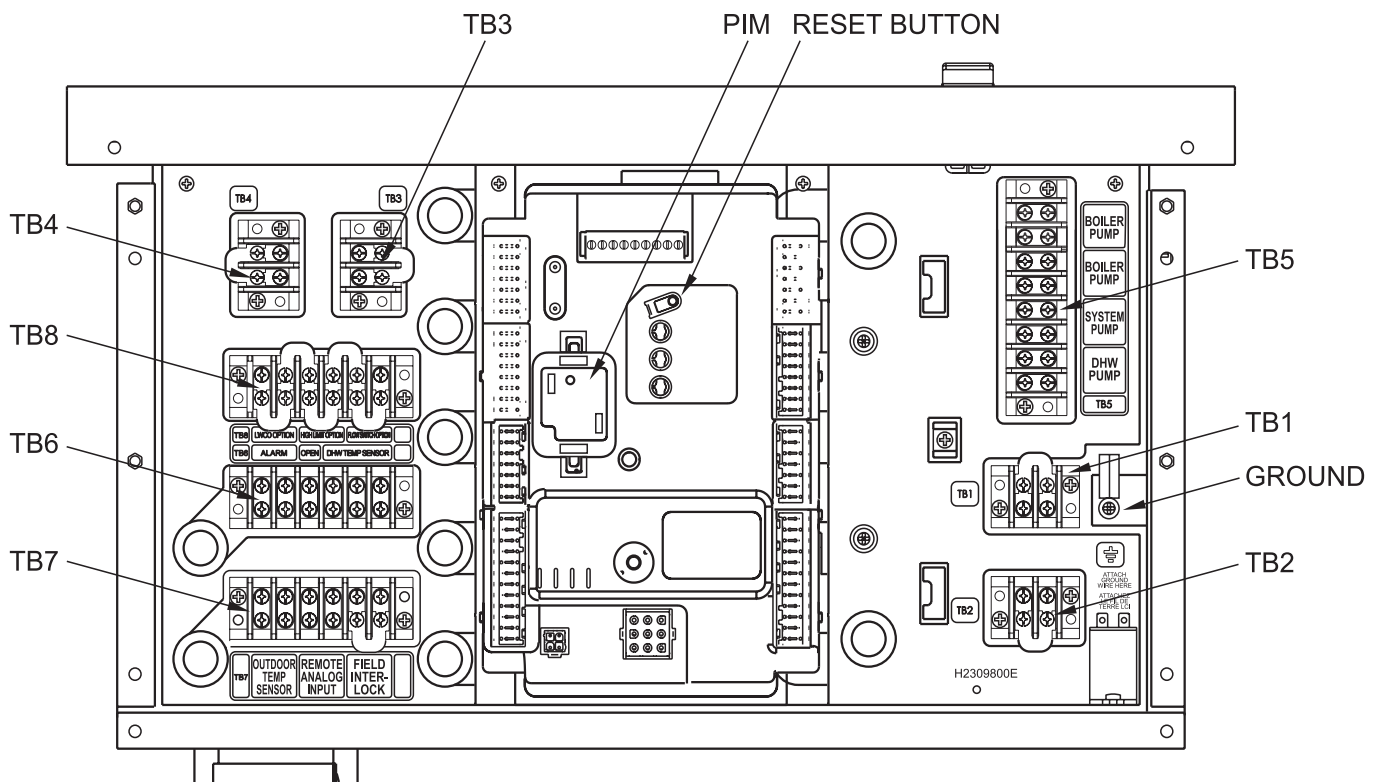


Figure 15. Control Panel Layout

7.F Lead Lag Connections

These boilers can be connected in a lead / lag series up to a total of 8 residential Units. One as the Lead control and 7 more as the following controllers.

For general info and menu set-up for Lead Lag using your units Touchscreen, See page 47 'About Lead Lag'.

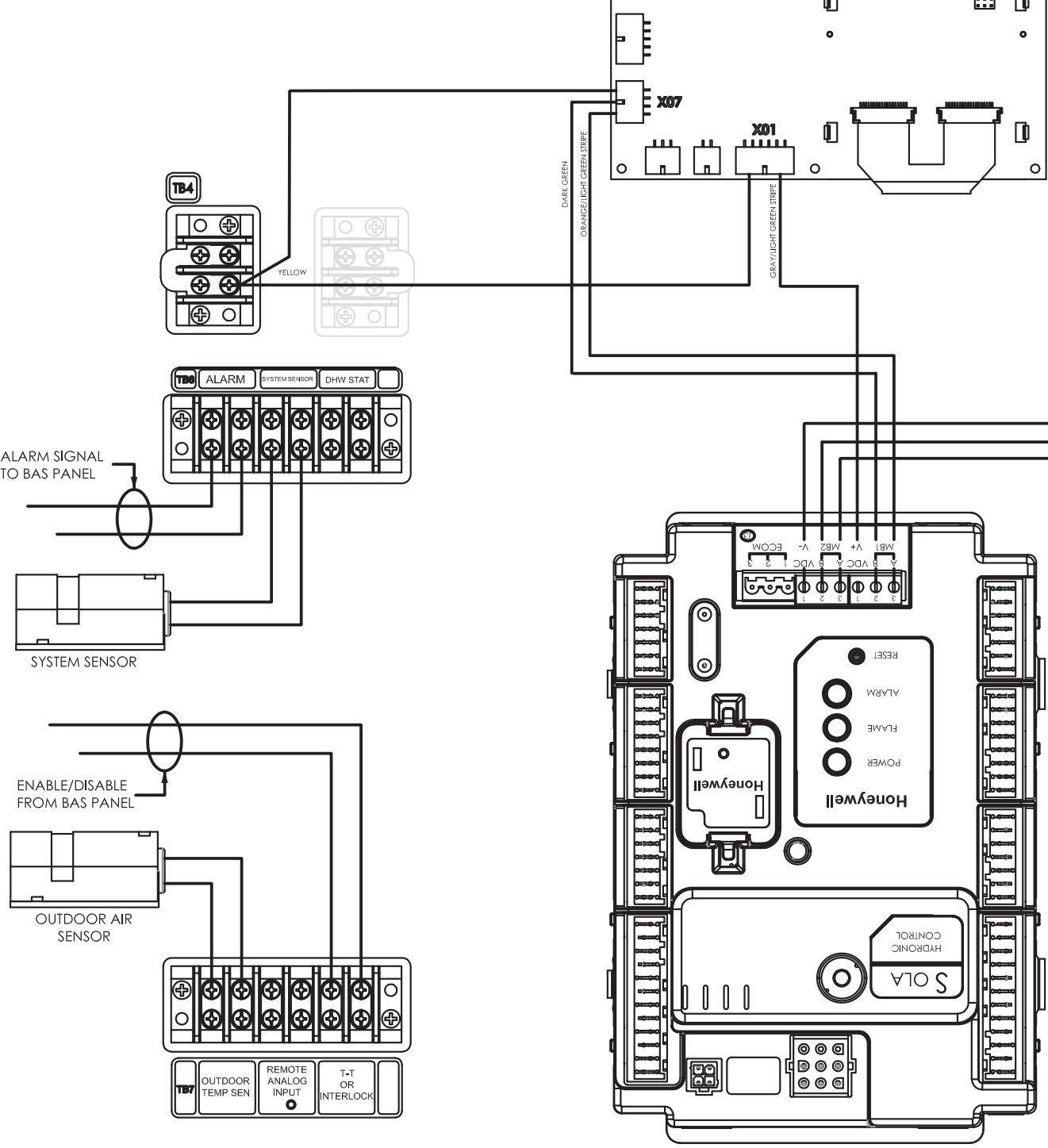


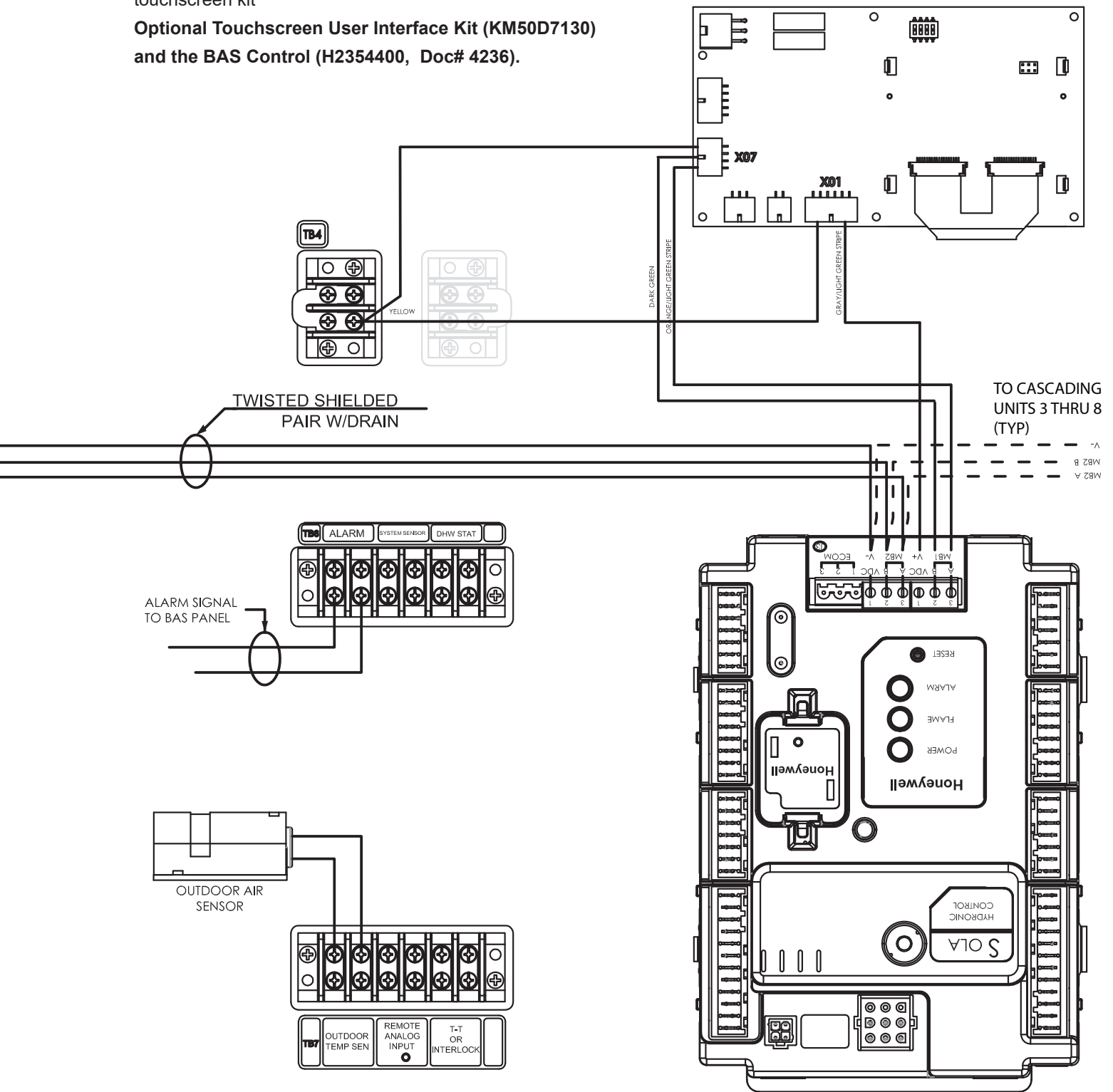
Figure 16. Wiring Diagram for Lead Lag Connections

These boilers can be controlled and monitored using a BAS (Building Automation Systems) control, but only if one of the EMEA User Interfaces is replaced with the available color touchscreen. Call your Manufacturers Representative for the touchscreen kit

Optional Touchscreen User Interface Kit (KM50D7130) and the BAS Control (H2354400, Doc# 4236).

Following Boiler

BACK OF THE EMEA Display



7.G System Wiring Diagram

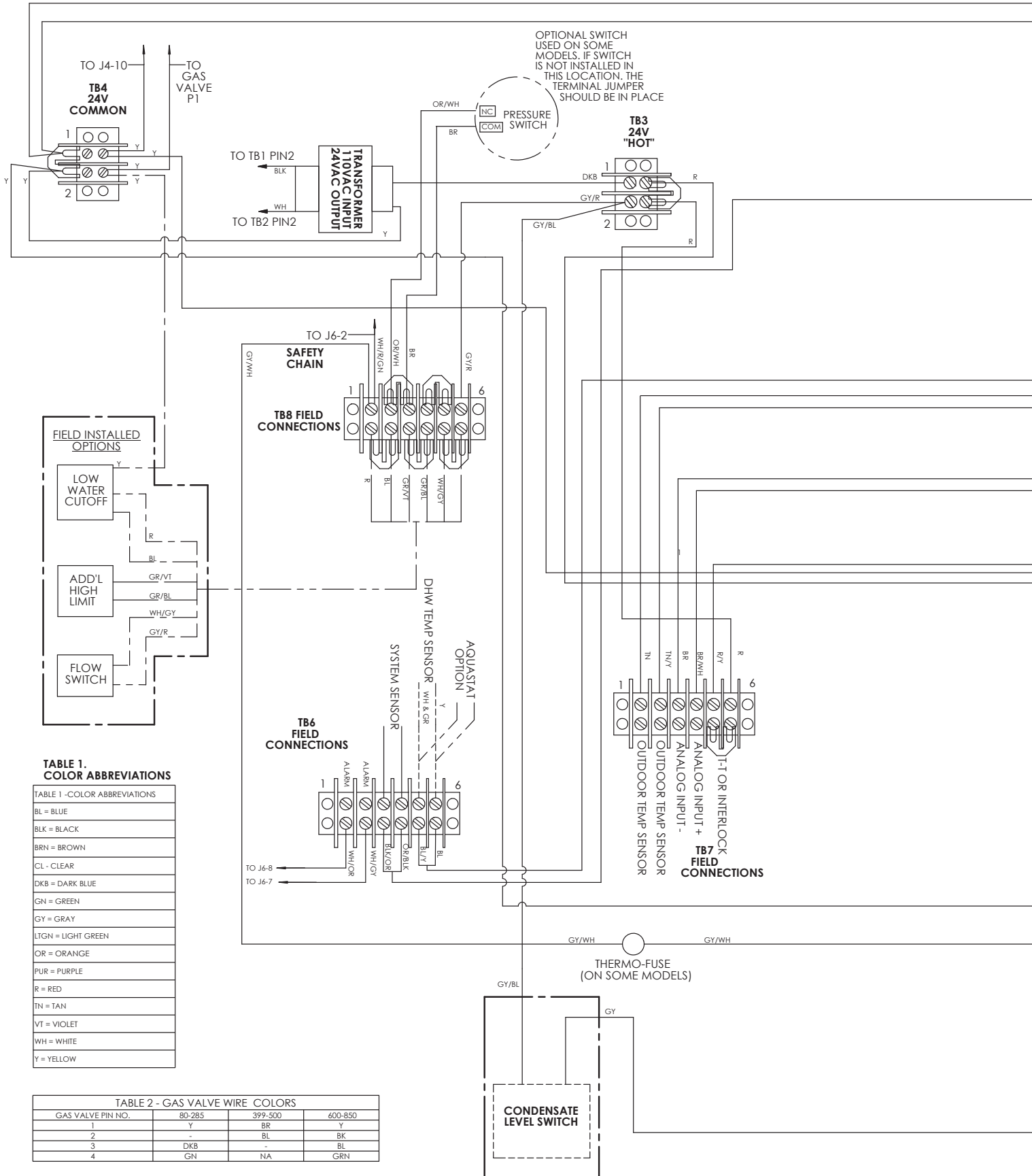


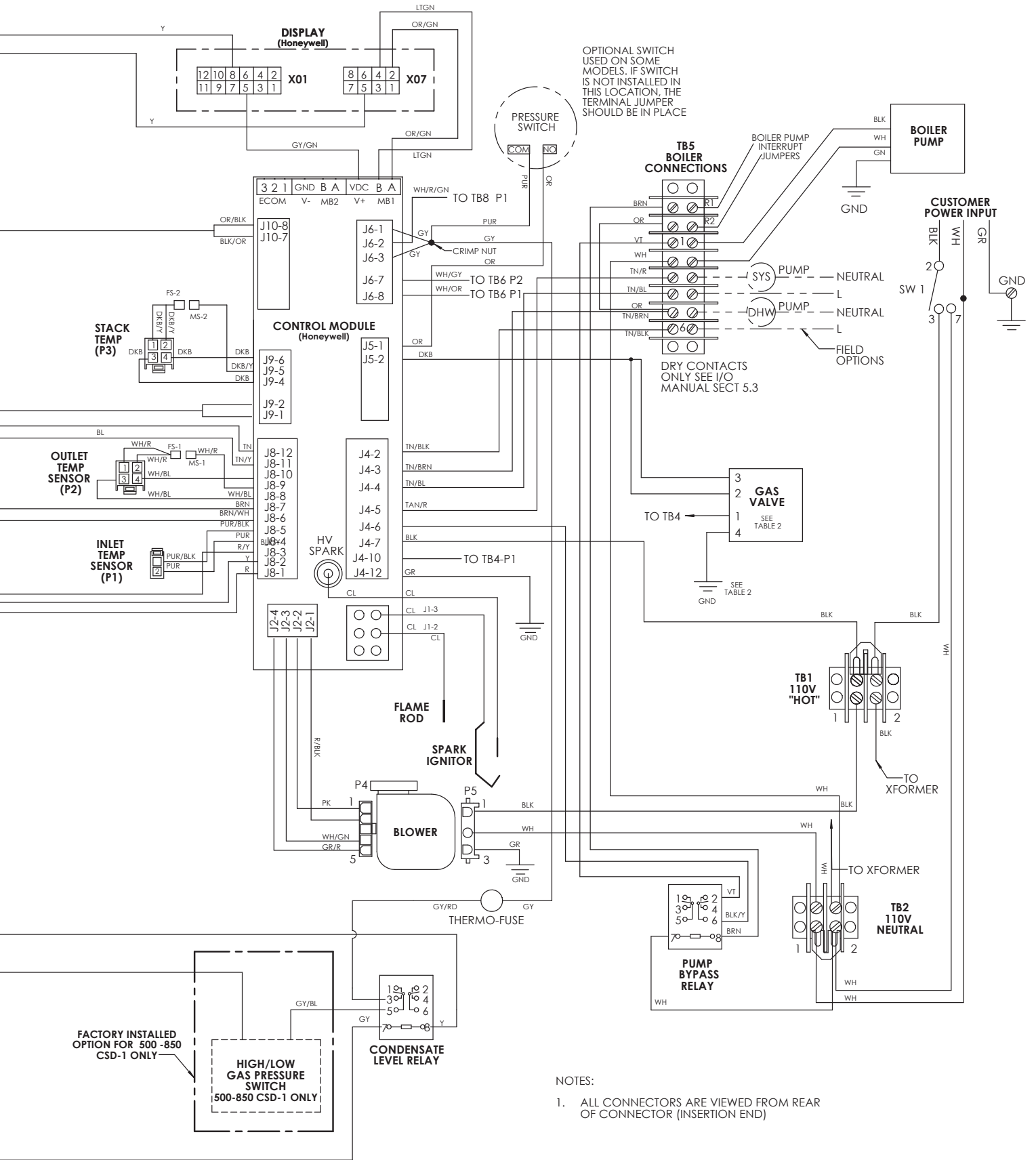
TABLE 1. COLOR ABBREVIATIONS

TABLE 1 - COLOR ABBREVIATIONS	
BL	= BLUE
BLK	= BLACK
BRN	= BROWN
CL	= CLEAR
DKB	= DARK BLUE
GN	= GREEN
GY	= GRAY
LTGN	= LIGHT GREEN
OR	= ORANGE
PUR	= PURPLE
R	= RED
TN	= TAN
VT	= VIOLET
WH	= WHITE
Y	= YELLOW

TABLE 2 - GAS VALVE WIRE COLORS

GAS VALVE PIN NO.	80-285	399-500	600-850
1	Y	BR	Y
2	-	BL	BK
3	DKB	-	BL
4	GN	NA	GRN

Figure 17. - Wiring Diagram, All Sizes



7.H Ladder Diagram

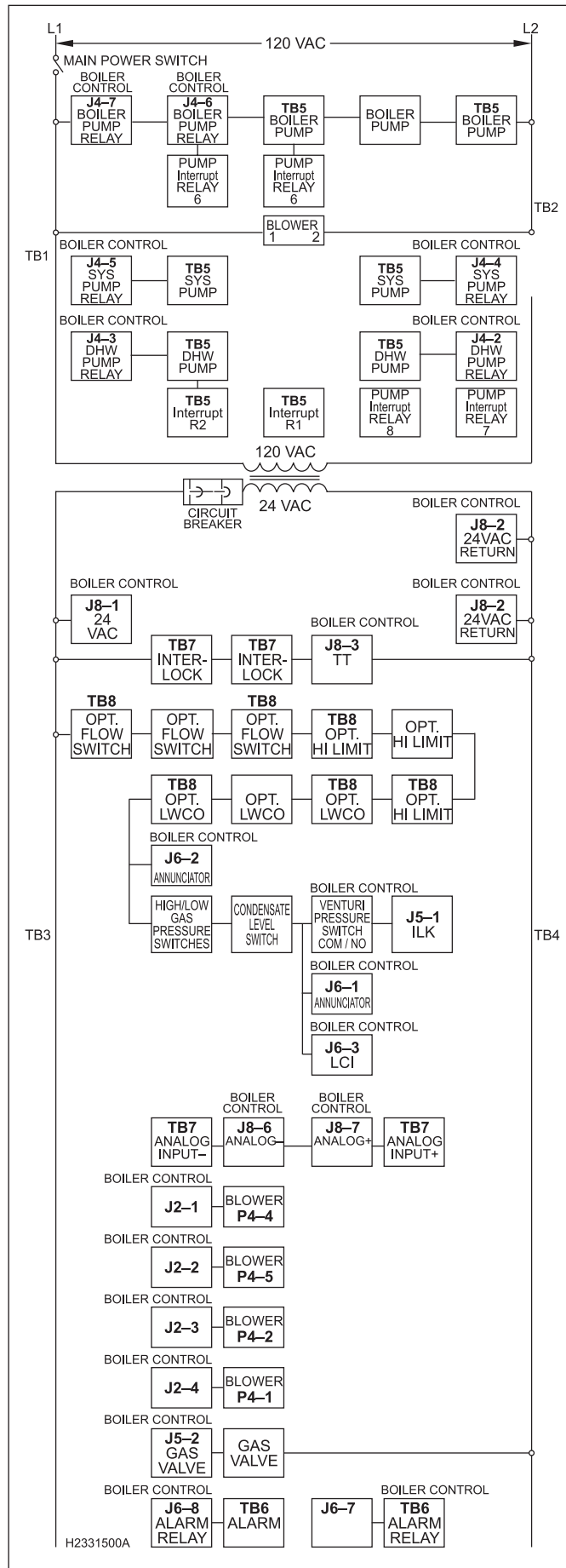


Figure 18. - Ladder Diagram

SECTION 8 THE USER INTERFACE

8.A About the User Interface

The User Interface has two main parts:

- the 'Display' area and
- the 'Buttons'

The User Interface displays operating and setup information sent from the electronic burner controller and allows the user to set all parameters of the electronic burner controller.

8.B Navigating the User Interface

Navigating into the Display Area is as easy as it looks. The Info/Install button will be the primary button that you will use to start, and the OK button is what you press to select and approve the parameters that you have set on the display. The arrow keys are for moving up and down, left and right within the menus. The Back button gets you back to the previous screen. And the Home button gets you back to the Home Display.

See Figure 19 for more details.

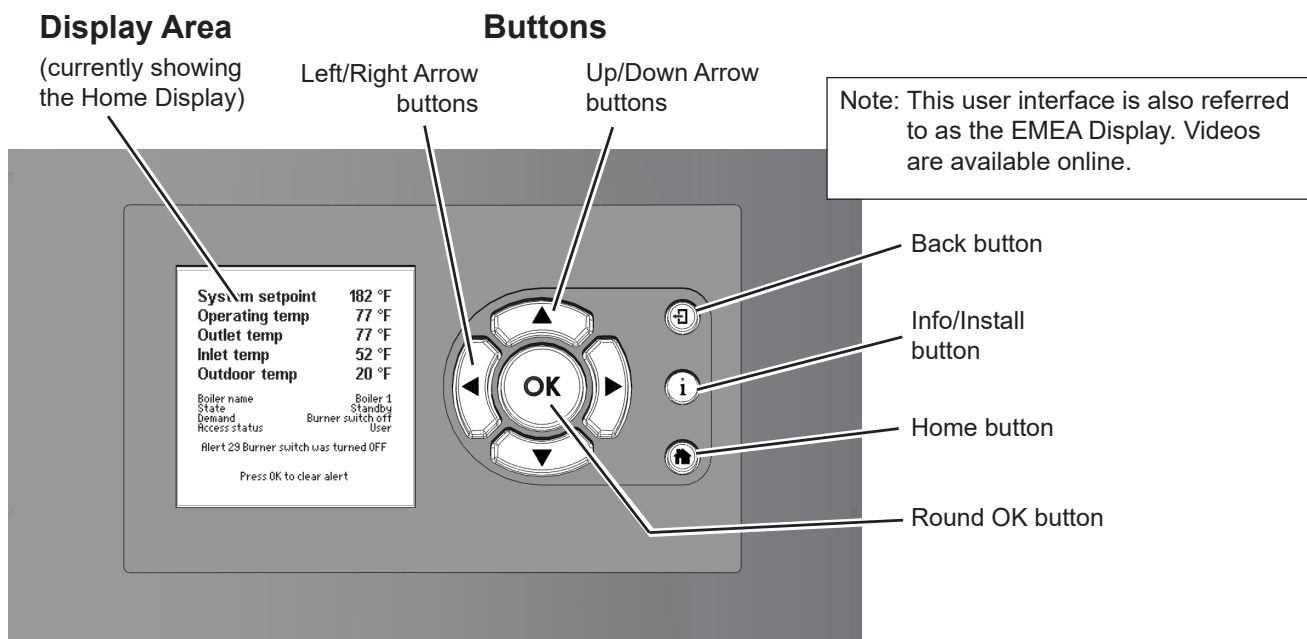


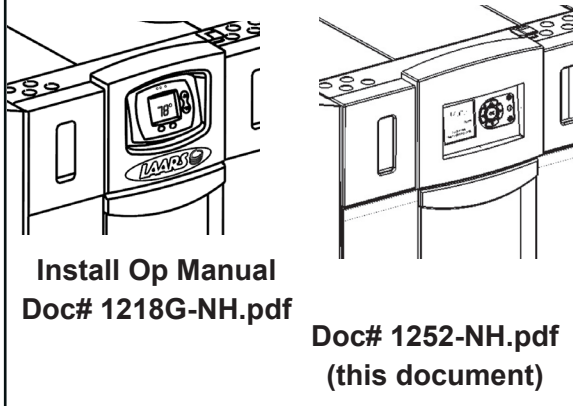
Figure 19. The User Interface

Display Area	This area displays several different kinds of information, including current operating information, setup parameters, and messages from the SOLA controller.
Up/ Down Arrow buttons	Use these to go to the choice you want to select in the display area, then press the round OK button.
Left/ Right Arrow buttons	Use these to go to the choice you want to select in the display area, then press the round OK button.
Back button	Use this to go back to the previous display.
Info/ Install button	Press this button at any time to go to the sub-menus that allow you to set up and monitor the controller.
Home button	Press this button at any time to go back to the Home display. (See the section on "Home Display.")
Round OK button	Use the round OK button to confirm a value or action. Note – Sometimes the system will present the Keyboard display screen, which also includes a separate "OK" area. This is not the same as the round OK button – the two have different functions.)

Table 17. - Button Functions on User Interface

The 'User Interface' was updated for the 2013 model year to the EMEA display shown in Figure 19.

For older units with the white user interface, you will need to download the 1218G-NH.pdf from the 'Discontinued Documents' on the manufacturers website.



8.C The Home Display

When the boiler is operating normally, the controller will display the Home display. See Figure 20.

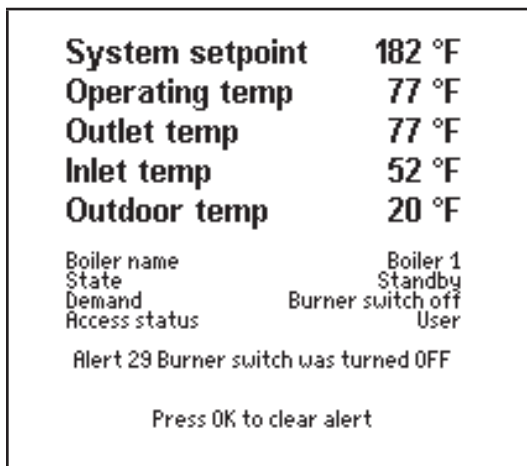


Figure 20. - Home Display

The Home Display has three sections:

- **The upper section** (customizable) displays the most important operating information for the unit. In the example shown here, the display is showing the system setpoint, the operating temperature, the outlet and inlet temperatures for the water entering and leaving the boiler, and the outdoor temperature.
- **The central section** shows some additional operating and setup information. In this case, this area lists the boiler name, boiler state, current demand, and the current password level (the "access status").
- **The lower section** shows any current lockouts, holds, or alerts.

8.D Customizing your Home Display

To customize the upper section of your Home Display

- Press "I" Info/Install button
- Scroll to highlight "Display Setup", press OK
- Highlight the line you would like to change,(example "Line 2 Operating Temp"), press OK
- Scroll to highlight the parameter that you do want displayed and then press OK. The new parameter is now displayed on the Home Display.

Repeat this step for the other parameters, if desired.

8.E Entering/Changing Control Settings Info/Install Display (including PASSWORDS)

The Info/Install Display is where you will start every time. All of your Controls, Diagnostics, Setups, and more, are accessed starting with the Info/Display screen.

- From the Home display shown in Figure 20, press the "I" button ("Info/ Install"). The display will change to show the six sub-menus available. See Figure 21.

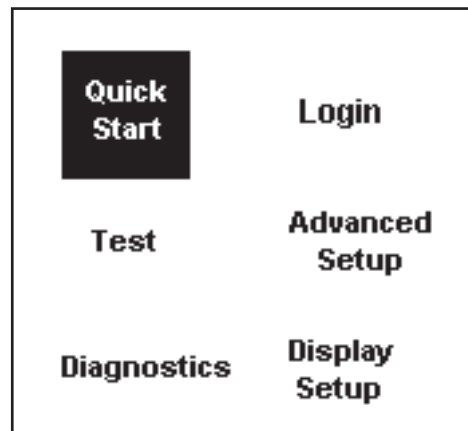


Figure 21. - Info/ Install Display

- To move from one choice to another, use the Left- and Right-Arrow buttons or the Up- and Down-Arrow buttons.
- Once you have highlighted the choice you want, press the round OK

Table 18 shows the functions listed under each of the sub-menus. For details, see Sections 8A and 8C.

Changing a Value

The procedure for changing a control value used by the system is listed below. (In this example, we will use the screen for the CH Setpoint.)

- Use the Up- and Down-Arrow buttons to step down through the list until you have highlighted the correct line on the display.

Quick Start	This menu gives you an easy way to check or change the most common settings on the unit: <ul style="list-style-type: none"> • CH setpoint • DHW setpoint • Outdoor reset • Low water temperature • Maximum outdoor temperature • Minimum outdoor temperature • Adjustable high limit • Adjustable low limit See Section 8B for more information.
Login	If you want to change a setup value or function, and the system requires a password, you can enter it here. See the section on “Login Display.”
Test	These parameters let you turn the burner on and off, and control the fan and pump speeds. See the section on “Test Menu.”
Advanced Setup	The sub-menus listed here allow you to set up most of the functions on the controller. In the section on “Advanced Setup” we will explain how to reach all of the setup functions. (For many of these functions, the system will require a password before it will allow you to make changes.)
Diagnostics	Use the Diagnostics to check the status of the sensors and the digital inputs and outputs. The system also records a history of lockouts and alarms. See the section on “Diagnostics.”
Display Setup	You can use this option to adjust the contrast of the display or change the items which appear at the top of the Home display. See the section on Display Setup.

Table 18. - Functions on Info/ Install Menu

- Press the round OK button to select that line. **Figure 22** shows a typical screen for this type of setting. by anyone.

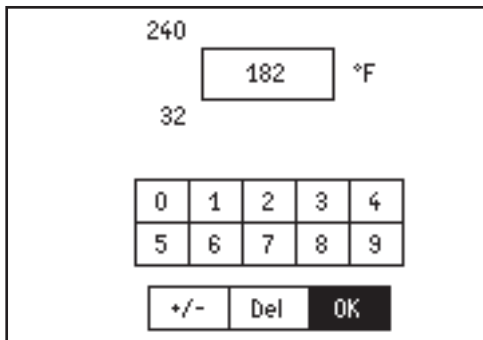


Figure 22. – Changing a Value

- The current setting for the setpoint appears in the box at the top of the screen. In this example, this is 182°F.
- The numbers near the left edge of the screen show the allowable range for this value. In this case, the setpoint can be set anywhere between 240°F and 32°F.
- Press the Up- and Down-Arrow buttons to scroll the setpoint until you see the correct value in the box.
- When the value is correct, press the round OK button.

You will notice that the system did not ask you for a password, so this is one of the values that can be changed

Entering a Time

The controller uses several different timing functions, and you can change some of these. (In this example, we will use the screen for the Anti Short-Cycle Time.

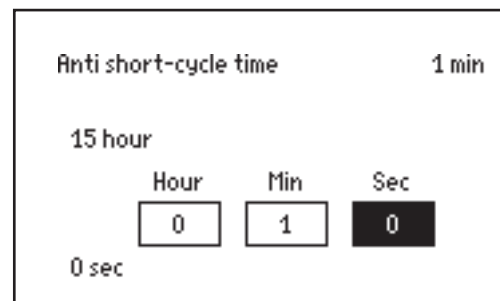


Figure 23. - Changing a Timing Function

- The current setting appears in the upper right-hand corner of the screen. In this example, this is 1 minute.
- The numbers near the left edge of the screen show the allowable range for this value. In this case, the time can be set anywhere between 0 seconds

(function turned off) and 15 hours.

In this example we will change the time delay to 5 minutes.

- Press the Left- and Right-Arrow buttons to move to the box you want. In this case, we want to change the middle box - the box for Minutes.
- Use the Up- and Down-Arrow buttons to change the value in that box.
- You can change the numbers in the other boxes in the same way.
- When the new setting is correct, press the round OK button.

Entering a PASSWORD or Name

The system uses a different type of screen to enter a password or name. If you want to change a setup value or function, and the system requires a password, you can enter it using the Login screen.

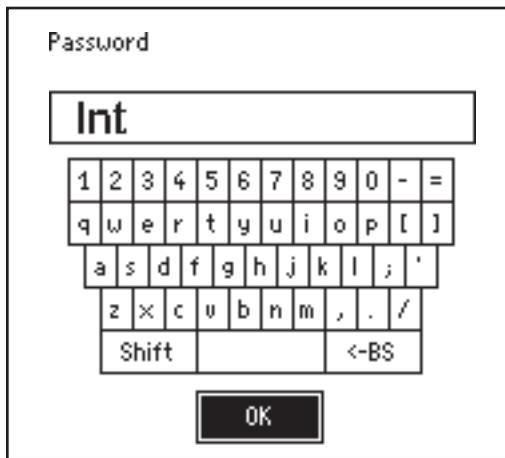


Figure 24. – Login Screen

There are two ways you can reach this screen:

- From the Info/ Install screen (Figure 21), select Login.
- If you try to change a function that requires a password, the unit will automatically bring you to the Password screen.

The controller for this unit uses three levels of password protection:

User Level Some of the settings can be changed or read by anyone, without a password. These non-critical adjustments and functions include setting the Central Heat and Domestic Hot Water setpoints, monitoring the input and output variables, reading parameters from the controller, and reading the error log.

Installer Level Settings that might affect the safe operation of the unit can only be changed by a trained technician who enters a password. These include 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”).

OEM Level Some of the settings can only be changed at the Manufacturer factory.

Once you enter a password, the password access remains valid until you exit to the normal no-password state. If you do not make any edits for 10 minutes, the password access will be cancelled.

The areas on the Login display are arranged a bit like a computer keyboard.

- To enter a letter or number, use the Up-, Down-, Left- and Right-Arrow buttons to highlight the character you want to use, then press the round OK button. You will see the character appear in the line at the top of the screen.
- Notice that, in the example shown here, all of the letters are lower-case (not capitals). If you want to use an upper-case letter, first move to the area for Shift and press the round OK button. Now, any letters that you enter will appear as capitals. To go back to lower-case letters, go back to the area for Shift and press the round OK button again.
- The blank area at the bottom of the screen is a space bar.
- The “BS” (BackSpace) area acts as a delete key. To delete a letter, move down and highlight the “BS” area. Now, each time you press the round OK button, the system will delete one character from the right end of the line.
- When the characters in the line at the top of the screen are correct, move to the OK space at the bottom of the screen, and press the round OK button. This will send the new “string” of characters to the controller.

Turning a Function On and Off

Some of the values can be enabled or disabled. See the example below.

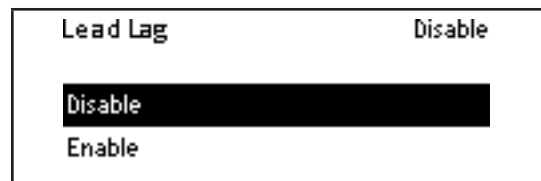


Figure 25. - Enable/ Disable Screen

- Use the Up- and Down-Arrows to highlight the line you want, then press the round OK button.

Changing a Value Using a “Slider”

There is another type of control screen that you may see. This type of screen uses a “slider” to set the value. This system is used on the LCD Contrast screen (available under Display Setup.) See "Figure 26. – Changing LCD Contrast".

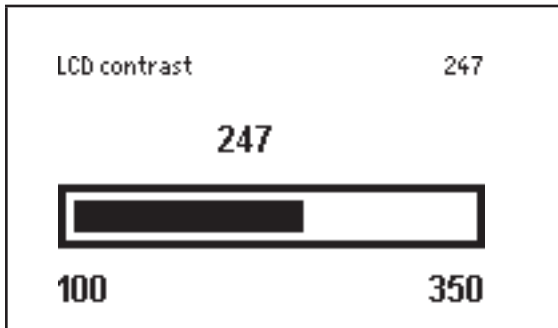


Figure 26. – Changing LCD Contrast

- Use the Left- and Right-Arrow buttons to move the bar and adjust the contrast.
- When the setting is correct, press the round OK button.

8.F Quick Start

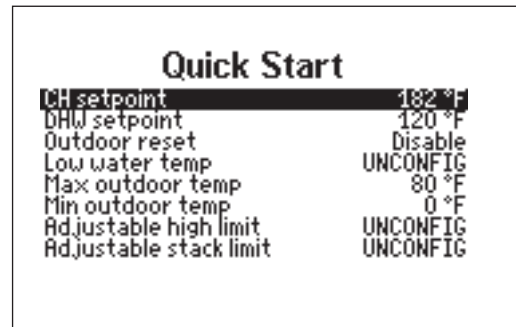


Figure 27. - Quick Start Menu

Changing the CH (Central Heat) Setpoint -

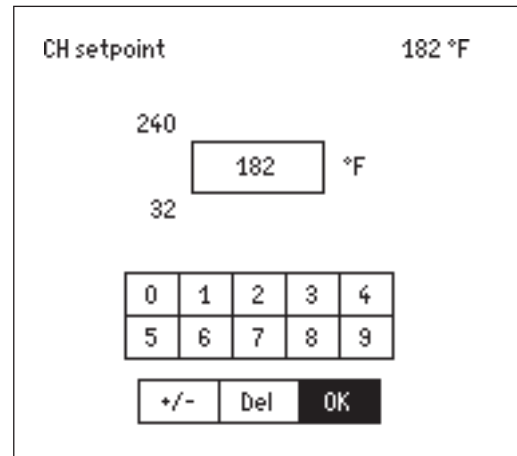


Figure 28. - Changing the CH Setpoint

- On the Quick Start menu, use the Up- and Down-Arrows to go to the line for CH Setpoint. Press the large OK button to select the line.
- Use the Up- and Down-Arrow buttons to select the value you want.
- Press the round OK button to enter the new value.

Changing the DHW (Domestic Hot Water) Setpoint -

See the procedure described above for the CH setpoint.

Outdoor Reset Functions -

The next four lines in the display are used to set up the Outdoor Reset functions:

- Outdoor Reset Enable/Disable - Note: This function can be Enabled/Disabled only by a factory trained technician.
- Low Water Temperature - Use the Up- and Down-Buttons to select the function, use Up- and Down- to select the new value, then press the round OK button.
- Maximum Outdoor Temperature - Use the Up- and Down-Buttons to select the function, use Up- and Down- to select the new value, then press the round OK button.
- Minimum Outdoor Temperature - Use the Up- and Down-Buttons to select the function, use Up- and Down- to select the new value, then press the round OK button.

For a complete explanation of the setup for Outdoor Reset, see Section 8C.5.

Adjustable High Limit -

The absolute high limit setting for the water outlet temperature for this unit is set at the factory to 195°F (90.5°C). If you wish, you can also set a second or “adjustable” limit setting that is lower.

Use the Up- and Down-Buttons to select the function, use Up- and Down- to select the new value, then press the round OK button.

Adjustable Stack Limit -

The absolute high limit setting for the stack for this unit is set at the factory to 195°F (90.5°C). If necessary, you can set the unit to use a second or “adjustable” limit setting that is lower.

Use the Up- and Down-Buttons to select the function, use Up- and Down- to select the new value, then press the round OK button.

Configuration and Setup

8.G 24 VAC Transform with Integral Circuit Breaker

24 VAC is supplied by a transformer mounted underneath the control panel. All 24 VAC power is supplied through a circuit breaker that is part of the transformer. The transformer is then connected to terminal blocks 3 and 4 (TB3 and TB4).

See Figure 29.

8.H Hydronic Heating Demand

When using the unit for hydronic heating, a call for heat must be supplied to the “T-T or Interlock” terminal. Once the call is supplied, the control starts the Boiler and System pumps, and begins the ignition process. The ignition process consists of a prepurge, trial for ignition, and run period. The prepurge period starts on a call for heat once the fan RPM reaches a preset level. The trial for ignition period follows once the start-up RPM of the fan has been reached. The trial for ignition period lasts four seconds. During this period the direct spark ignition system and gas valve are energized. At the end of the trial for ignition period, the flame signal is compared with the preset flame threshold value. If the flame signal is higher than the flame threshold, the Unit enters Run. If the flame signal is below the threshold, the Unit returns to prepurge and starts the ignition process over. When operating in Run, the Unit monitors the flame signal, call for heat input, safety switches, and water temperatures and modulates as needed between 100% and 20% of rate to satisfy the call for heat.

Connect the call for heat to terminal block 7 (TB7), See Figure 29, connections labeled “T-T or interlock” in the control panel.

The CH Setpoint can be set from the Quick Start menu.

How to get there: From the “Home” screen, press “1” to go to “Info/ Install.” Choose “Quick Start,” then go to “CH Setpoint.”

8.I Anti-Short-Cycle (ASC)

The anti short cycle function helps to prevent short-cycling when the call for heat switches on and off quickly.

To reach the anti-short-cycle function, select Info/ Advanced Setup/ System Config./ System Config.

How to get there: From the “Home” screen, press “1” to go to “Info/ Install.” Choose “Advanced Setup,” then “System Configuration,” then “System Configuration” again.

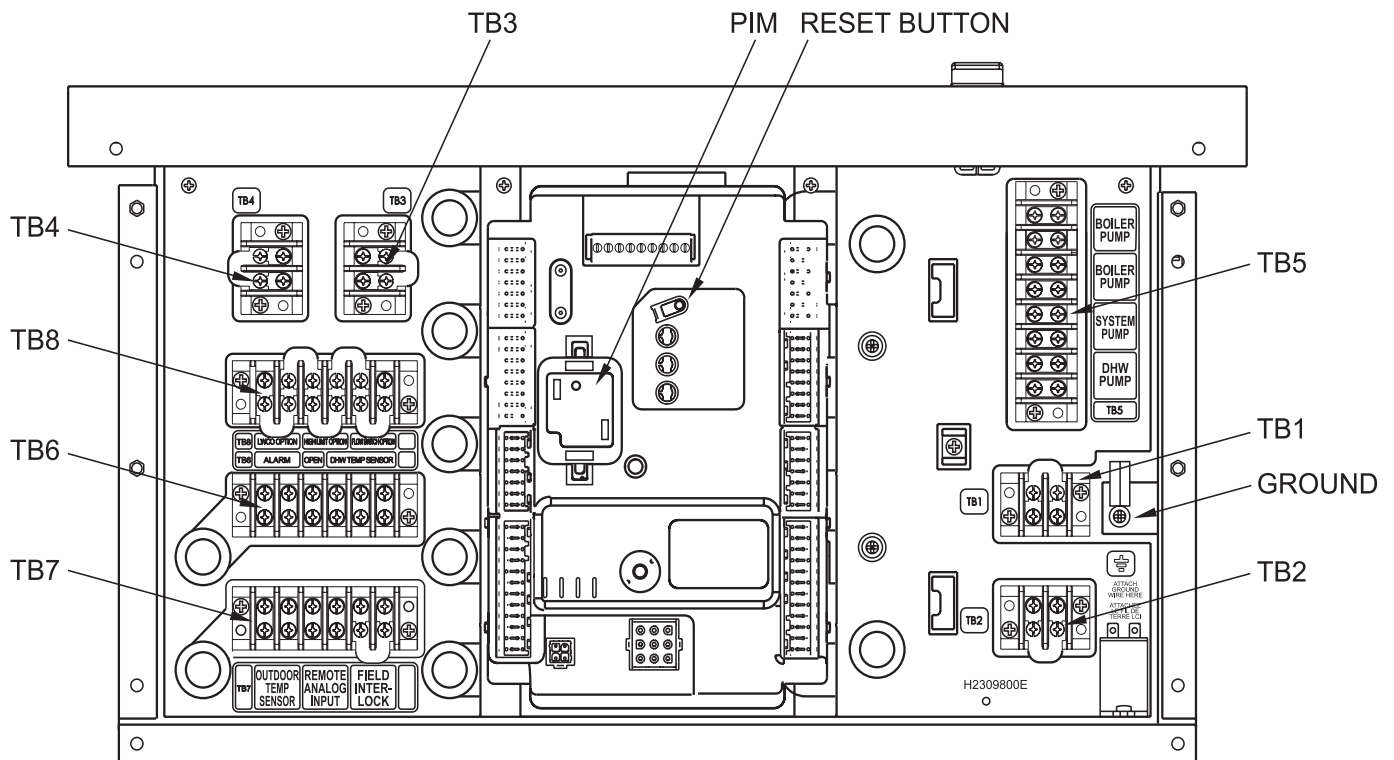


Figure 29. - Control Panel Layout

8.J Outdoor Air Temperature Sensor

The outdoor air temperature sensor is used with the Outdoor Reset and Warm Weather Shutdown functions. Connect the outdoor air temperature sensor to terminal block 7 (TB7), using the connections labeled Outdoor Temp Sensor.

8.K Outdoor Reset

About Outdoor Reset -

The Outdoor Reset feature calculates a correction for the hydronic (Central Heat) setpoint depending on the outdoor temperature. This allows the system to compensate for changes in the outdoor temperature and run more efficiently. (If the unit will operate as part of a Lead Lag system, the Outdoor Reset function will adjust the Lead Lag setpoint. For details, see “Cascading Lead Lag Operation” - Section 8.14.)

The graph below shows how the system will behave at different outdoor temperatures:

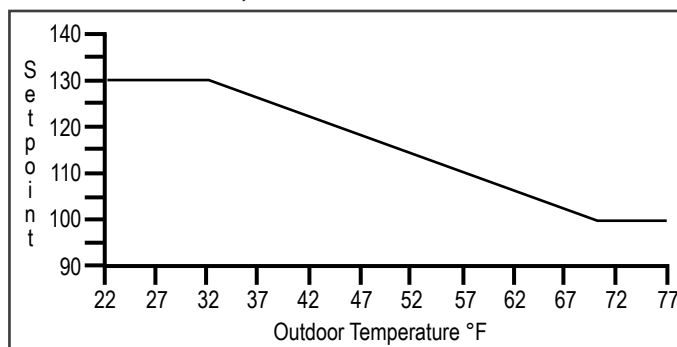


Figure 30. – Outdoor Reset Operation

The sloping line in Figure 30 shows the setpoint which is actually used by the system. Without Outdoor Reset, this would be a constant 130°F (or whatever other value you choose), regardless of the outdoor temperature. The line in the graph would run straight across the display. However, with the Outdoor Reset feature turned on, the system will adjust for changes in the outdoor temperature. Let’s take a detailed look at the way the setpoint is adjusted.

- For cold outdoor temperatures (below 32°F), the setpoint remains unchanged (130°F).
- As the temperature begins to rise above 32°F, the Outdoor Reset function causes the setpoint to be lowered. At these warmer temperatures, the heating load on the system is not as great, so the system does not have to reach as high a temperature to handle the load.
- As you can see from the display, at an outdoor temperature of about 70°F, the system stops adjusting the setpoint. Above 70°F, the setpoint is constant at 100°F (or another value that you choose).

When Outdoor Reset is enabled, and the outdoor temperature falls between the maximum and minimum outdoor temperatures (70° and 32° in the example above), the setpoint will be adjusted down by about .8° for every 1° increase in the outdoor temperature. For example, if the outdoor temperature rises by 10°, the Outdoor Reset function will adjust the setpoint down by about 5°. This ratio between outdoor temperature and water temperature is adjustable.

Here are instructions for setting up the Outdoor Reset function. Notice that these instructions will be different, depending on whether you have a single boiler or more than one boiler (using Lead Lag operation).

Wiring Connections -

Connect the outdoor temperature sensor:

If your system has just one boiler –

Connect the sensor across terminals 1 and 2 on TB-7.

See Figure 29 on page 43.

If your system has more than one boiler, and is controlled using the Lead/ Lag function –

Connect the sensor across terminals 1 and 2 on TB-7 on the boiler which will be used as the Lead Lag Master.

Setting Up the Control Functions -

1. Enable the Outdoor Reset function:
Note: This function can be Enabled/Disabled only by a factory trained technician.

2. Set the maximum outdoor temperature:

If the outdoor temperature reaches this value or above, the system will use the Low Water Temp value as the setpoint. In the example shown earlier, the Max. Outdoor Temp. is set to 70°F. If the outdoor temperature rises above 70°F, the system will use 100°F (the Low Water Temp.) as the setpoint.

If your system has just one boiler –

How to get there: From the “Home” screen, press “1” to go to “Info/ Install.” Choose “Advanced Setup,” then go to “CH Configuration.” Select “Outdoor Reset Configuration.” Set the value on the line for “Max. Outdoor Temp.”

If your system has more than one boiler, and is controlled using the Lead/ Lag function –

How to get there: From the “Home” screen, press “1” to go to “Info/ Install.” Choose “Advanced Setup,” then go to “Lead/ Lag Configuration.” Select “Lead/ Lag Outdoor Reset.” Set the value on the line for “Max. Outdoor Temp.”

3. Set the minimum outdoor temperature:

If the outdoor temperature drops to this value or below, the system will not compensate for the outdoor temperature. In the example shown earlier, the Min. Outdoor Temp. is set to 32°F. If the outdoor temperature is below 32°F, the system will use the normal system setpoint (130°F in this example).

If your system has just one boiler –

How to get there: From the “Home” screen, press “1” to go to “Info/ Install.” Choose “Advanced Setup,” then go to “CH Configuration.” Select “Outdoor Reset Configuration.” Set the value on the line for “Min. Outdoor Temp.”

If your system has more than one boiler, and is controlled using the Lead/ Lag function –

How to get there: From the “Home” screen, press “1” to go to “Info/ Install.” Choose “Advanced Setup,” then go to “Lead/ Lag Configuration.” Select “Lead/ Lag Outdoor Reset.” Set the value on the line for “Min. Outdoor Temp.”

4. Set the low water temperature:

If the outdoor temperature reaches the Max. Outdoor Temp. or higher, the system will use the Low Water Temp value as the new setpoint. In the example shown earlier, the Max. Outdoor Temp. is set to 70°F. If the outdoor temperature reaches 70°F or above, the system will use the Low Water Temp. value (example - 100°F) as the setpoint.

If your system has just one boiler –

How to get there: From the “Home” screen, press “1” to go to “Info/ Install.” Choose “Advanced Setup,” then go to “CH Configuration.” Select “Outdoor Reset Configuration.” Set the value on the line for “Low Water Temp.”

If your system has more than one boiler, and is controlled using the Lead/ Lag function –

How to get there: From the “Home” screen, press “1” to go to “Info/ Install.” Choose “Advanced Setup,” then go to “Lead/ Lag Configuration.” Select “Lead/ Lag Outdoor Reset.” Set the value on the line for “Low Water Temp.”

5. Set the minimum boiler water temperature:

If a value is entered here, the temperature in the boiler will never be allowed to drop below this temperature. This will protect the boiler against possible damage due to expansion of ice inside the unit. (Notice that this is different from the “low water temperature” described above.)

If your system has just one boiler –

How to get there: From the “Home” screen, press “1” to go to “Info/ Install.” Choose “Advanced Setup,” then go to “CH Configuration.” Select “Outdoor Reset Configuration.” Set the value on the line for “Min. Boiler Water Temp.”

If your system has more than one boiler, and is controlled using the Lead/ Lag function –

How to get there: From the “Home” screen, press “1” to go to “Info/ Install.” Choose “Advanced Setup,” then go to “Lead/ Lag Configuration.” Select “Lead/ Lag Outdoor Reset.” Set the value on the line for “Min. Water Temp.”

8.L Warm Weather Shutdown

About Warm Weather Shutdown -

The Warm Weather Shutdown feature tells the unit to stop firing if the outdoor temperature rises above a temperature you set. Notice that this affects the central heat or hydronic function only. If a call for domestic hot water arrives, the unit will still fire and respond to that. Warm Weather Shutdown requires the connection of an outdoor temperature sensor. See Section 8.10. (If Outdoor Reset is active, the same sensor can be used for both functions.)

Here are instructions for setting up the Warm Weather Shutdown function. Notice that these instructions will be

different, depending on whether your system has a single boiler or more than one boiler (using Lead Lag operation).

Wiring Connections -

Connect the outdoor temperature sensor.:

If your system has just one boiler –

Connect the sensor across terminals 1 and 2 on TB-7.
See Figure 29 on page 43.

If your system has more than one boiler, and is controlled using the Lead/ Lag function –

Connect the sensor across terminals 1 and 2 on TB-7 on the boiler which will be used as the Lead Lag Master.

Setting Up the Control Functions -

1. Enable the Warm Weather Shutdown function:

If your system has just one boiler –

How to get there: From the “Home” screen, press “I” to go to “Info/ Install.” Choose “Advanced Setup,” then go to “CH Configuration.” Select “Warm Weather Shutdown.” On the line for “Warm Weather Shutdown,” select “Immediately.”

If your system has more than one boiler, and is controlled using the Lead/ Lag function –

How to get there: On the unit used as the Lead/ Lag Master only - From the “Home” screen, press “I” to go to “Info/ Install.” Choose “Advanced Setup,” then go to “CH Configuration.” Select “Warm Weather Shutdown.” On the line for “Warm Weather Shutdown,” select “Immediately.”

2. Enter the setpoint for this feature:

If your system has just one boiler –

How to get there: From the “Home” screen, press “I” to go to “Info/ Install.” Choose “Advanced Setup,” then go to “CH Configuration.” Select “Warm Weather Shutdown Setpoint,” and set the value.

If your system has more than one boiler, and is controlled using the Lead/ Lag function –

How to get there: On the unit used as the Lead/ Lag Master only - From the “Home” screen, press “I” to go to “Info/ Install.” Choose “Advanced Setup,” then go to “CH Configuration.” Select “Warm Weather Shutdown Setpoint,” and set the value.

8.M Domestic Hot Water

This boiler can be configured to supply domestic hot water (DHW) as a stand-alone “volume” unit (DHW models) or as a secondary function while the unit also provides hydronic heating. The piping used to supply domestic hot water (DHW) can be set up in several different ways. See Section 6 for details. In this section, we will describe the

wiring and control setup for several different types of DHW supplies.

DHW Temperature Setting -

Regardless of the type of DHW setup, the setpoint adjustment is made the same way.

How to get there: From the “Home” screen, press “I” to go to “Info/ Install.” Choose “Advanced Setup,” then go to “DHW Setpoint.”

Hydronic Heating with Domestic Hot Water (DHW) Priority -

When using the unit for hydronic heating with domestic hot water priority, a call for heat must be supplied to the “T-T or Interlock” terminal. Once the call is supplied, the control starts the Boiler and System pumps and begins the ignition process. Once in Run, the unit monitors the flame signal, call for heat, safeties, and water temperatures modulating as needed between 100% and 20% of rate to satisfy the call for heat. When a DHW demand is applied during a hydronic call for heat, the priority feature forces the boiler to switch to the DHW demand for the priority time. The DHW priority demand forces the control to operate to the DHW setpoint, de-energizes the System pump and energizes the DHW pump.

The domestic hot water temperature sensor or an aquastat is used to monitor the DHW demand. The control uses the DHW sensor to control the operation and modulation rate of the unit when there is a DHW demand.

Hydronic Heating Using Local Lead-Lag/Cascading Feature with Indirect Hot Water -

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.
- Set the water temperature carefully as described below.
- Feel the water before bathing or showering.
- If this unit is used to produce water that could scald if too hot, such as domestic hot water use, adjust the outlet control (limit) or use temperature limiting valves to obtain a maximum water temperature of 125°F (52°C).



(For a complete explanation of the Lead Lag system, see Section 8.14.)

When using the Lead Lag boiler system to provide indirect domestic hot water heating, the DHW demand should be supplied to the Master boiler through the existing DHW terminals. The Lead Lag system will change the operating mode of just the Master boiler to supply water at the DHW setpoint. The remaining boilers on the system will continue to supply hydronic heating.

When the system is supplying both hydronic heat and domestic hot water at the same time, both the System pump and DHW pump contacts are closed, so special attention must be paid to allow for proper operation. In applications serving both hydronic and domestic heating, during a DHW call the Boiler pump on the Master boiler may need to be turned off. The DHW pump will provide flow through the boiler and indirect tank when there is a DHW call. (This means the DHW pump must be sized properly.) To turn off the boiler pump in this application, the “boiler pump interrupt” jumper must be installed. The terminal block location is terminal block 5 (TB5) at the contacts labeled “boiler pump interrupt” in the control panel.

Sensor Connection for Domestic Hot Water -

Connect the DHW sensor or aquastat.

If your system has just one boiler –

Connect the sensor across terminals 5 and 6 on TB6.
See Figure 29 on page 43.

If your system has more than one boiler, and is controlled using the Lead/ Lag function –

On the unit used as the Lead/ Lag Master only, connect the sensor across terminals 5 and 6 on TB6.

Domestic Hot Water Heating Using External Modulation Control -

When the Unit is used for DHW heating with external modulation control, a call for heat must be supplied to the “T-T or Interlock” terminal. By supplying a call to the “T-T or interlock” terminal, the operating temperature setpoint defaults to the hydronic heating setpoint, so all of the temperature adjustments must be made to the hydronic setpoint. When the unit receives the call, the control starts the Boiler and System pumps and begins the ignition process. Once in Run, the Unit monitors the flame signal, call for heat, safeties, and water temperatures. The heater setpoint is used to limit the maximum water temperature leaving the boiler only. The modulation rate is controlled by a 4-20mA signal supplied by an external control. (This can also be 0-10Vdc using a converter.) When setting up a system using an external control, take care to set Anti-Short Cycle feature to prevent “hunting” and possible premature component failure.

Boiler Pump Interrupt Function -

The boiler pump interrupt feature is used in some applications when the boiler is being used for both hydronic and domestic hot water heating. The interrupt jumper is used to turn off the boiler pump during a domestic hot water demand. For this to work properly the system must be plumbed and pumped to allow the DHW pump to supply the flow and head requirements for both the boiler and indirect water heater. It is not necessary to use the interrupt jumper in all applications.

To turn off the Boiler pump in this situation, the “boiler pump interrupt” jumper should be installed between R1 and R2 on TB5.

If your system includes several boilers, is controlled using the Lead Lag system, and the indirect DHW tank is connected to the boiler acting as the Lead Lag master, install the boiler interrupt jumper on the Lead Lag master only.

WARNING

Failure to plumb, pump and install the unit correctly when using this feature may lead to reduced or no water flow through the heat exchanger, causing premature failure of the heat exchanger, personal injury or death. Please consult the factory with any questions regarding the use of this feature.

Setup for DHW Control Functions -

1. Set up the correct priority for the DHW function in relation to Central Heat or Lead/ Lag demands. If a call for heat and a DHW demand arrive at the same time, which will have the higher priority?

If your system has just one boiler –

How to get there: From the “Home” screen, press “I” to go to “Info/ Install.” Choose “Advanced Setup,” then go to “DHW Configuration.” Select “DHW Priority vs Central Heat.”

If your system has more than one boiler, and is controlled using the Lead/ Lag function –

How to get there: On the unit used as the Lead Lag Master, from the “Home” screen, press “I” to go to “Info/ Install.” Choose “Advanced Setup,” then go to “DHW Configuration.” Select DHW Priority vs Lead Lag.”

2. Set the setpoint for the DHW function.

If your system has just one boiler –

How to get there: From the “Home” screen, press “I” to go to “Info/ Install.” Choose “Advanced Setup,” then go to “DHW Configuration.” Select “DHW Setpoint.”

If your system has more than one boiler, and is controlled using the Lead/ Lag function –

How to get there: On the unit used as the Lead Lag Master, from the “Home” screen, press “I” to go to “Info/ Install.” Choose “Advanced Setup,” then go to “DHW Configuration.” Select “DHW Setpoint.”

3. Set the DHW priority time. If the DHW function has the priority, the priority will continue during the priority time.

If your system has just one boiler –

How to get there: From the “Home” screen, press “1” to go to “Info/ Install.” Choose “Advanced Setup,” then go to “DHW Configuration.” Select “DHW Priority Time.”

If your system has more than one boiler, and is controlled using the Lead/ Lag function –

How to get there: On the unit used as the Lead Lag Master, from the “Home” screen, press “1” to go to “Info/ Install.” Choose “Advanced Setup,” then go to “DHW Configuration.” Select “DHW Priority Time.”

8.N About Lead Lag Operation

If an installation includes two or more boilers (up to 8 residential units), they may be set up for “Lead Lag” operation. One boiler will be set up as the “Master”, and the others will operate as “Followers.” Figure 38 shows an installation with four boilers. (A Lead Lag system can include up to eight boilers.) The boiler controllers are connected in a “daisy chain” using a Modbus connection.

For the full wiring diagram for lead lag, See Figure 16 on page 32.

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 boilers.

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 boilers on-line. As the heating demand is reduced, the Lead Lag system shuts off some of the boilers.

The signal from the System sensor is sent to the unit operating as the Lead Lag Master. 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 boiler 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 Lag Master.

The unit acting as the Lead Lag Master decides which boiler is assigned to start first. This assignment is rotated across all of the available boilers so that any one boiler does not run significantly longer than the others. The Lead Lag controller tracks the run times for all of the boilers, and uses this to calculate

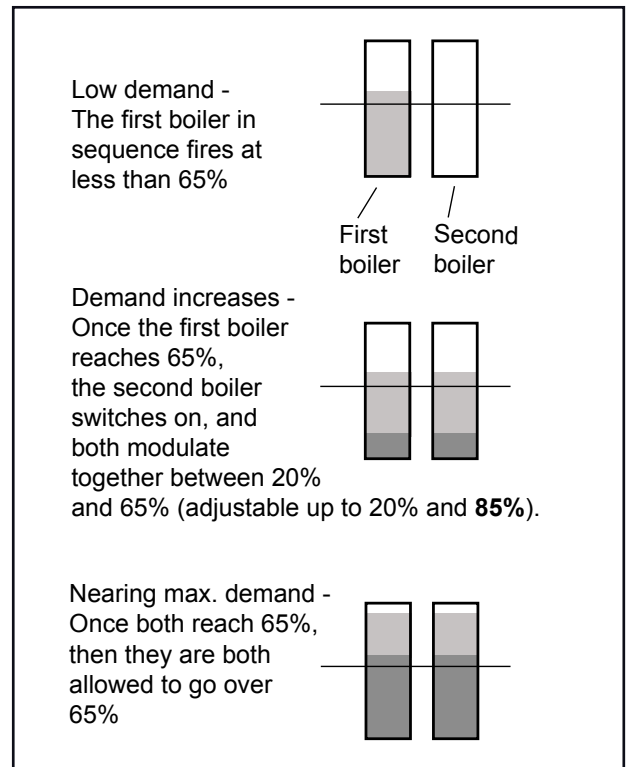


Figure 31. Lead / Lag Operation, 2 boilers.

the starting order for the boilers. This means that each time the system starts up, a different boiler may start first.

- When the Run sequence is initiated, the boiler with the least amount of runtime will fire.
- If the heating demand increases so that the firing rate of that first boiler rises to your boiler configurations Base Load Value (see Table 19), the next boiler 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 boilers will modulate up or down together, in

8.N About Lead Lag Operation (continued)

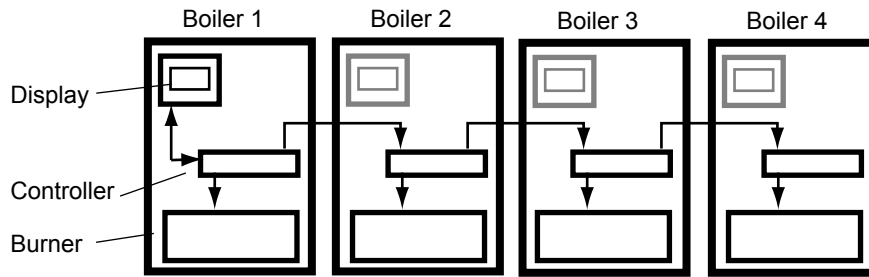


Figure 32. “Lead Lag” Operation in a System with Four Boilers. Note - the Displays on Boilers 2 thru 4 will display information pertaining only to that specific boiler.

NOTE: If your units are Lead Lag configured, you will find it very useful to customize your Home Display to show LL Operating Temp and LL Setpoint Temp.

Please refer to Section 8.D to learn how to customize your Home Display. Various parameters can be displayed on the Home Display to suit your needs.

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

reaction to the changes in demand.
 See **Figure 33** through **Figure 34**.

Table 19. - Base Load Settings

Control Settings for Lead Lag System - Part 1

1. Power up all of the boilers in the system.
2. In an installation with several boilers you can give each boiler a different name. On each unit, go to the screen for “System ID and Access,” and enter a unique name.

How to get there: From the “Home” screen, press “I” to go to “Info/Install.” Choose “Advanced Setup,” then go to “System Configuration,” then “System ID and Access,” and select “Boiler Name.”

3. The controller in each of the boilers needs a unique “Modbus address” so the Lead Lag Master can communicate with it. All of the units come from the factory with a Modbus address of “1,” so you will need to change some of these addresses. The unit operating as the Lead Lag Master should have address “1,” and the other boilers should each have unique Modbus address numbers.

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.

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.

How to get there: On each boiler: From the “Home” screen, press “I” to go to “Info/Install.” screen. Choose “Advanced Setup,” then select “System Configuration.” Then select “System ID & Access,” and select “MB1 Modbus Address.” Change it to its new unique Modbus address (1-8), then select “MB2 Modbus Address” and change it to the same address as the changed “MB1 Modbus Address” DO NOT CHANGE THE MENU LINE “ModBus Address”. It will automatically change when you change the “MB1 Modbus Address”

4. The next job is to identify each boiler as a Lead Lag Master or Follower.
 - On the boiler that will be used as the Lead Lag Master, identify the unit that will operate as the master by turning on “Master Enable.”
- How to get there: From the “Home” screen, press “I” to go to “Info/Install.” Choose “Advanced Setup,” then go to “Lead/ Lag Configuration.” Select “Lead Lag Master Configuration.” On the line for “Master Enable,” select “Enable.”*
- On all of the boilers (including the Lead Lag Master),

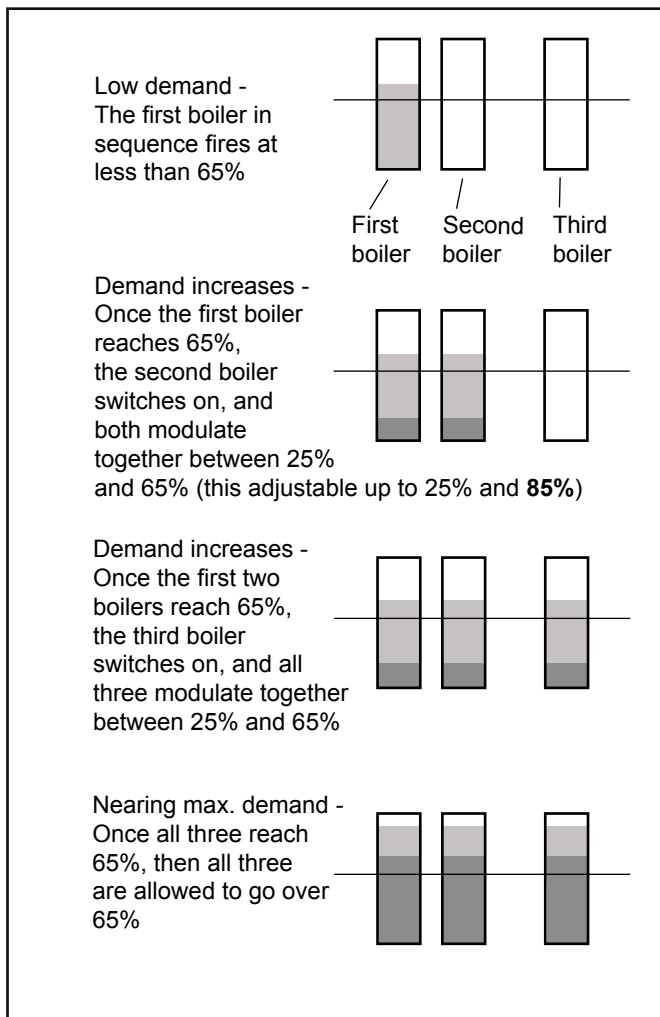


Figure 33. Lead / Lag Operation, 3 boilers.

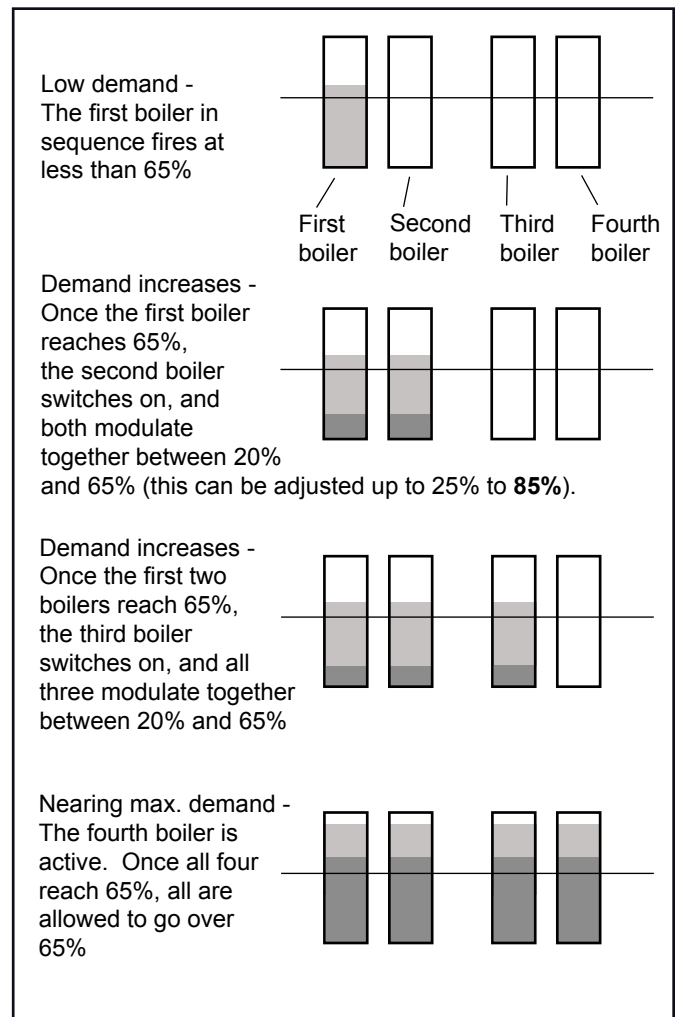


Figure 34. Lead / Lag Operation, 4 or more boilers.

identify each unit as a Follower by turning on “Follower Enable.”

How to get there: From the “Home” screen, press “1” to go to “Info/Install.” Choose “Advanced Setup,” then go to “Lead/Lag Configuration”. Select “Lead Lag Follower Configuration.” On the line for “Follower Enable” select “Enable.” When you select Follower Enable these options will be displayed “Enable via Modbus Master” or “Enable via Sola Master”. Choose “Enable via Sola Master”.

Wiring Connections for Lead Lag -

Now you can make the Modbus wiring connections between the units. The controller in each boiler 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 boilers in the Lead Lag system. See Figure 16.

To reach the controller, open the cabinet of the boiler by removing the plastic bezel.

The wiring from the controller on the first boiler runs to

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

8.N About Lead Lag Operation (continued)

Control Settings for Lead Lag System - Part 2

1. On the Lead Lag Master, set the setpoint used by the Lead Lag system.

How to get there: From the "Home" screen, press "1" to go to "Info/Install." Choose "Advanced Setup," then go to "Lead/ Lag Configuration." Select "Lead Lag Master Configuration," and go to the line for "Setpoint."

2. On the Lead Lag Master, set the Base Load to match the number of boilers in the system. We mentioned the Base Load setting in the explanation of the "Lead Lag Modulation Cycle." Whenever the heating demand causes the active burner(s) to run faster than the Base Load value, the Lead Lag system will put an additional burner on line. The Base Load value depends on the number of boilers in the system:

Note that you only need to enter the Base Load value on the Lead Lag Master.

How to get there: From the "Home" screen, press "1" to go to "Info/Install." Choose "Advanced Setup," then go to "Lead/ Lag Configuration." Select "Lead Lag Master Configuration." Go to the line for "Base Load Common Rate."

8.O Adjusting CO₂

1. Measure the CO₂/O₂ in the flue products at **high fire**. The Unit can be forced to high fire to allow for easier setup. The controller has a feature that makes it easy to go directly to the high fire condition. The unit will operate at high fire for 5 minutes, then modulate down automatically.

How to get there: From the "Home" screen, press "1" to go to "Info/ Install." Choose "Test," then go to "Forced Rate." Select "Set High Fire," then select "Start Test."

The CO₂ readings should be between the values shown in Table 20. If the CO₂ is not within the range shown, adjustments may be made. To adjust the high fire CO₂, locate the high fire adjuster screw according to the appropriate figure. Slowly make adjustments in 1/16 of a revolution increments until the CO₂ is within the range identified.

2. Measure the CO₂/O₂ in the flue products at **low fire**. Unit can be forced to low fire to allow for easier setup.

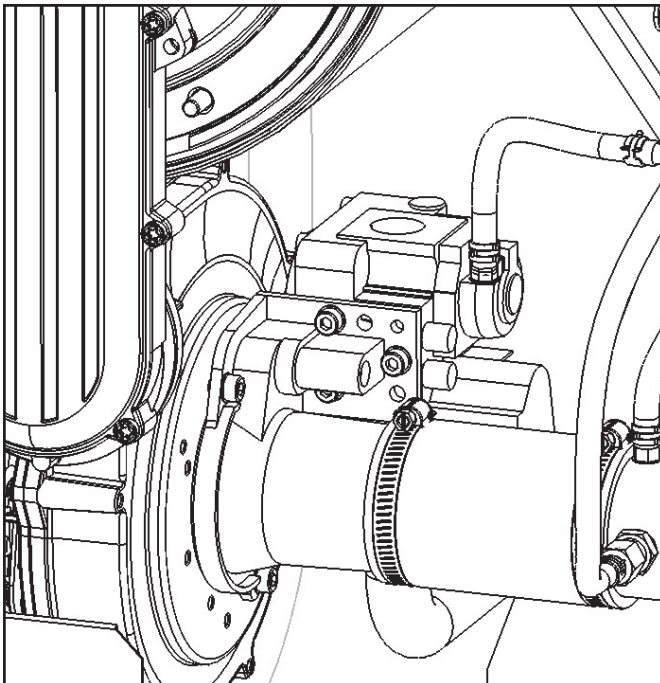
How to get there: From the "Home" screen, press "1" to go to "Info/ Install." Choose "Test," then go to "Forced Rate." Select "Set High Fire," then select "Start Test."

The CO₂ readings should be between the values shown in Table 20. If the CO₂ is not within the range shown, adjustments may be made. To adjust the low fire CO₂, locate the low fire adjuster screw according to the appropriate figure. Slowly make adjustments in 1/16 of a revolution increments until the CO₂ is within the range identified.

3. Repeat steps 1 and 2 to confirm that the CO₂ ranges are within the required ranges. Adjust if necessary.
4. Confirm that the differential pressure is still within the appropriate range.
5. **If any of the measurements cannot be adjusted to the specified ranges or the CO levels are above 150ppm when adjusted, please consult the factory for further information.**

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.



The Gas Valve in the 80 thru 285 is at the front of the unit and can be reached after the front panel is pulled forward and then off.

Always be patient with your combustion analyzer when making adjustments to the valve at both Hi-Fire and Low-Fire.

Be sure to put the cap back onto the valve when you are done making your adjustments at the gas valve.

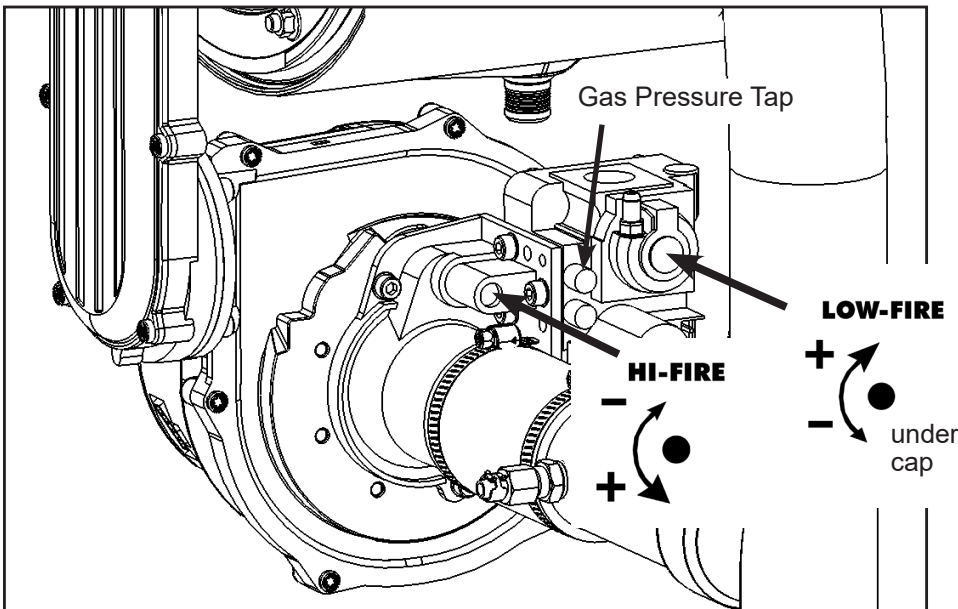


Figure 35. - Unit Gas Valve 80 - 285 Mbtu

GAS TYPE	HIGH FIRE, CO ₂	LOW FIRE, CO ₂	DIFFRNTL PRESSURE (inches wc)
Natural	8.8 to 9.8%	0.5% lower than high fire setting	3.6" to 3.9"
Propane	9.8 to 10.2%		

Table 20. CO₂ Range and Differential Pressure

SECTION 9 FIRST START-UP AND ADJUSTMENT INSTRUCTIONS

9.A Filling the Boiler System

1. Ensure the system is fully connected. Close all bleeding devices and open the make-up water valve. Allow the system to fill slowly.
2. If a make-up water pump is employed, adjust the pressure switch on the 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 all of the bleeding devices on all radiation units at the high points in the piping throughout the system, unless automatic air bleeders are provided at these points.

Note - There is an air bleed (air vent with slotted top) located on the left side of heat exchanger, on top of the water manifold.

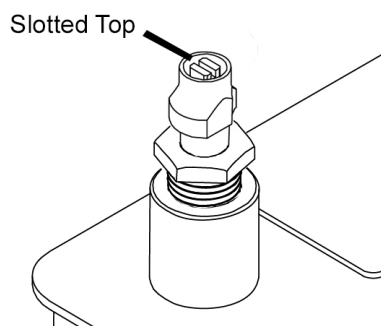


Figure 36. Air Vent

5. To remove all air from the heat exchanger, cycle the boiler pump on and off 10 times, 10 seconds on and 10 seconds off. Then run the system and appliance pumps for a minimum of 30 minutes with the gas shut off.

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 any debris is present, clean it out to ensure proper circulation.
7. Recheck all air bleeders as described in Step 4.
8. Start up the boiler according to the procedure listed in this manual. Operate the entire system, including the pump, boiler, and radiation units for one hour.
9. Shut down the entire system and vent all radiation

units and high points in the system piping, as described in Step 4.

10. Close the make-up water valve and check the strainer in the pressure reducing valve for sediment or debris from the make-up water line. Reopen the make-up water valve.
11. Check the gauge for correct water pressure and also check the water level in the system. If the height indicated above the boiler insures that water is at the highest point in the circulating loop, then the system is ready for operation.
12. Prime the condensate trap with water.
13. Refer to local codes and the make-up water valve manufacturers instructions as to whether the make-up water valve should be left open or closed.
14. 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, and attempt to light, for four seconds, and then will de-energize. The unit will go into lockout after the required number of trial for ignition periods.

Next, turn the power Off, and then On again. Press the manual reset button on the boiler control, 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.

15. Within three days of start-up, recheck all air bleeders and the expansion tank as described in Steps 4.

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

WARNING

Do not use this boiler if any part has been under water. Manufacturer requires boilers to be replaced, not repaired, if they have been partially or completely submerged.

9.B First Operation

CAUTION

The initial setup must be checked before the unit is put in 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.

REQUIRED TOOLS: Differential pressure gauge capable of reading negative 0.01 inches W.C. (0.002kPa), screw drivers, Torx bits, combustion analyzer.

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. If the unit has optional pressure gas resets then the low pressure gas switch will need to be reset by pushing the button.
3. Observe all warnings on the Operating Instructions label and turn on the gas and main electrical power (circuit breaker) to the unit.
4. Turn the Unit on at the On/Off switch.
5. The Unit will begin the start sequence. The blower and pump will energize for the pre-purge period, then the ignition sequence will start. After all safety devices have been verified, the gas valve will open. If ignition doesn't occur, turn off the Unit, and check that there is proper gas supply. Wait 5 minutes before restarting.
6. **After placing the unit into operation, the Burner Safety Shutoff Device must be tested:**
 - Close the gas shutoff valve with the burner operating.
 - The flame will go out and the blower will continue to run for the post purge cycle. One or three additional attempts to light will follow. Each cycle will include pre-purge, ignitor on, valve/flame on, and post purge. Ignition will not occur because the gas is off. The ignition control will lockout after a single try or a third try depending on the controller model.
 - Open the gas shutoff valve. Reset the boiler control by pressing the Reset button on the control or on the display. Restart the unit. The ignition sequence will start again and the burner will start. The unit will return to its previous mode of operation.

WARNING

If you detect any odor of gas, or if the gas burner does not appear to be functioning in a normal manner, CLOSE THE MAIN SHUTOFF VALVE. Do not shut off the switch. Contact your heating contractor, gas company, or factory representative.

9.C Restarting the Unit

If the unit has been drained, see Section 9.1 in this manual for instructions on filling and purging the unit properly.

1. Turn off the main electrical disconnect switch.
2. Close all manual gas valves.
3. **WAIT FIVE (5) 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 electrical power.
8. The burner will go through a prepurge period, followed by ignition.

9.D Shutting Down the Unit

1. Turn off the main electrical disconnect switch.
2. Close all manual gas valves.
3. If you think the Unit might freeze, drain it. All water must be removed from the heat exchanger, or damage from freezing may occur. Also be sure to protect the piping in the building from freezing.

WARNING

This step must be performed by a qualified service technician.

SECTION 10 MAINTENANCE

WARNING

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

10.A System Maintenance

Do this once a year, unless otherwise noted.

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, need to be checked every 5 years. 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. The Pressure Relief Valve should be inspected and tested every year.

10.B Maintenance and Component Description

Use only genuine Manufacturer replacement parts.

CAUTION

Label all wires prior to disconnection when servicing controls. 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 equipment depends on their proper functioning. Only a qualified service technician should inspect the basic items listed below every year:

- | | |
|------------------------|---------------------|
| a. Unit controls | f. Flow switch |
| b. Automatic gas valve | g. Low water cutoff |
| c. Pressure switches | h. Burner |
| d. Blower | i. Heat exchanger |
| e. Pump | |

Burner

Check the burner for debris. Remove the blower arm assembly to access the burner. Remove the four bolts connecting the blower to the arm. (See Figure 47.) Remove the five bolts which hold the burner arm in place. Pull the burner up and out. Clean the burner, if necessary, by blowing compressed air from the outside of the burner into the center, and wipe the inside clean with glass cleaner. A dirty burner may be an indication of improper combustion or dirty combustion air. Determine the cause of this, and correct it. If the burner gasket is damaged, replace it when replacing the burner.

NOTE: When installing the burner, make sure the flange is aligned with the mating surface, as each is keyed to control the fit.

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 Venturi to the unit. It is designed to operate with a gas supply pressure between 4 and 13 inches w.c. To remove the gas valve and/or Venturi, shut off the 120 Volt power supply to the boiler. Turn off all manual gas valves connecting the boiler to the main gas supply line. Remove the front door of the boiler to gain access to the gas valve and Venturi. 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 Venturi flange to the blower. This allows the entire gas valve and Venturi assembly to be removed to facilitate inspection and cleaning.

Reassemble the valve/Venturi assembly 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 120 Volt power. Place the unit in operation following the instructions in Section 9. Once the boiler is operating, check for leaks again and confirm that all fasteners are tight.

Check the unit setup according to Section 9.

Unit Control

This unit has an integrated control 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 trouble shooting practices prior to replacing the control. If control replacement is required, turn off all power to the unit and shut off all manual gas valves to the unit. Remove the front door to the unit and the plastic bezel and the control panel. 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, push in on the two tabs on the left side of the board to unlatch the clips from the control panel. Rotate the control around the fastening points on the right side of the control to remove the hooks from the control panel. To replace the control, repeat the steps listed above in the reverse orders making sure to connect all wires in the proper locations. Place the unit into operation following the steps outlined in Section 9.

Ignitor Assembly

The ignitor assembly is a two rod system that consists of a ground rod and a spark rod (See [Figure 37](#)). To remove the ignitor assembly, shut off the 120 Volt power supply to the unit. Turn off all manual gas valves connecting the unit to the main gas supply line. Remove the front door of the boiler to gain access to the ignitor assembly. Remove the two wires connected to the assembly. Then remove the two bolts connecting the ignitor assembly to the burner door. If the old ignitor assembly is determined to be defective, install a new ignitor assembly (check that the spark gap is 3/16"). Replace the gasket if necessary.

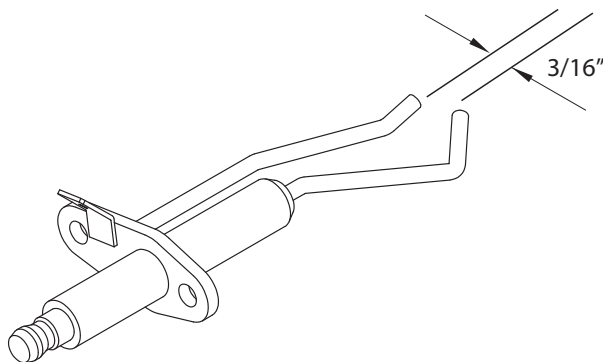


Figure 37. - Ignitor

Flame Sensor

The flame sensor is a single rod system. To replace the flame sensor electrode, shut off the 120 Volt power supply to the boiler. Turn off all manual gas valves connecting the boiler to the main gas supply line. Remove the front door of the boiler to gain access to the flame sensor electrode. Remove the flame sensor wire from the electrode. Remove the two bolts fastening the electrode to the burner doors. Remove and replace the old flame sensor gasket. If the old electrode is determined to be defective, install a new flame sensor electrode in the reverse order.

⚠ CAUTION

The ignitor and sensor may be hot, and can cause burns or injury.

Transformer with Integral Circuit Breaker

This unit has a 24Vac transformer with integral 4 amp circuit breaker installed to supply the control voltage required for the unit. The transformer is sized to provide power for the unit only, and should not be used to supply power to additional field devices. If additional loads are added, or a short occurs during installation, the integral circuit breaker may trip. If this happens, be sure to reset the circuit breaker before replacing the transformer.

The transformer is mounted underneath the control panel. If the transformer must be replaced, turn off the 120Vac power to the unit. Remove the transformer wires from the terminal blocks. Remove the fasteners holding the transformer, then remove the transformer. Replace with a new transformer in the reverse order.

If the transformer is replaced with a part other than the OEM transformer, be sure to add circuit protection if it is not integral to the new transformer.

⚠ WARNING

Failure to include proper circuit protection may lead to premature component failure, fire, injury or death.

Blower

The combustion air blower is a high-pressure centrifugal blower with a variable speed motor. The speed of the motor is determined by the control logic. 120 Volt power remains on to the blower at all times. If the blower must be changed, turn off the 120 Volt power and gas supply to the unit. Take the front panel off. Disconnect the 120 Volt and control signal connections from the blower. Disconnect the bolts connecting the Venturi to the blower housing. Disconnect the fan outlet bolts from the burner door blower arm. If the fan is determined to be defective, replace the existing fan with a new one, reversing the steps listed above. Be sure to install all of the required O-rings and gaskets between the blower arm and the blower and blower face and venturi flange.

Heat Exchanger Coils

Black carbon soot buildup on 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 burner door at the front of the boiler, and inspect the tubing using a flashlight. If there is a buildup of black carbon soot or other debris on the heat exchanger, clean using this procedure:

⚠ WARNING

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 120 Volt power supply to the boiler
2. Turn off all manual gas valves connecting the boiler to the main gas supply line.
3. Remove the four bolts connecting the blower flange to the burner door arm.
4. Remove the nuts located on the outside diameter of the burner door to the heat exchanger.
5. Remove the burner door and burner assembly from the heat exchanger.
6. Disconnect the condensate drain line.
7. Attach a longer hose to the drain and run it to a bucket.
8. Clean the heat exchanger by brushing away any light accumulations of soot and debris. Use a brush with soft bristles (non metallic) to avoid damaging the surfaces of the heat exchanger tubes.
9. 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. This will be diverted into the separate container.

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

⚠ WARNING

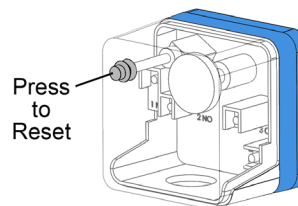
Failure to rinse the debris from the heat exchanger and temporary drain line may lead to clogged condensate lines, traps and neutralizers. Condensate pumps (if used) may also be damaged by the debris left behind, possibly causing property damage.

10. Install all components removed in the reverse order to place the unit back in operation. Be sure all gaskets are in place as the components are installed. Replace any damaged gaskets. Do **not** reuse damaged gaskets.
11. Place the unit into operation according to the instructions in Section 10. Check all gas connections for leaks. Confirm that all fasteners are tight.

Optional Pressure Gas Switches

The high and low pressure gas switches are 24V manual reset switches that act to cut power to the gas valves if the gas pressure is too low or too high for proper operation.

If your boiler is equipped with the Optional pressure gas switches, then the Low Pressure Switch will need to be reset.



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 two wires from the screw terminals. Twist the switch off the pipe nipple. Reassemble in reverse order. For natural gas, set the low pressure gas switch to 3" w.c. For propane, set the low pressure gas switch to 5" w.c. For natural and propane, set the high pressure gas switch to 14".

10.C Gas Conversion

These units can easily be converted from natural to propane gas or from propane to natural gas in the field. Some units require the addition of a gas orifice along with proper gas valve adjustment. Other units require no additional parts at all- only a proper gas valve adjustment. Please contact your Manufacturers Rep for specific information regarding the gas conversion of a particular unit or model. If a gas conversion is performed, the unit must be identified with the appropriate gas labels and a conversion sticker to allow technicians performing maintenance in the future to properly identify the type of gas being used in the unit.

size (mbtu)	Kit number
80	CA006201
105	CA006202
150	CA006203
210	CA006204
285	CA006205

Table 21. - Propane Gas Conversion Kits

size (mbtu)	Kit number
80	CA006206
105	CA006206
150	CA006206
210	CA006206
285	CA006206

Table 22. - Natural Gas Conversion Kits

SECTION 11 OPERATING DETAILS AND TROUBLESHOOTING

11.A Normal Startup and Initialization

When power to the unit is turned on, the controller will automatically go through a startup and initialization procedure. At first the interface will display some information about the control software. See [Figure 38](#).



Figure 38. – First Initialization Display

Next, the interface will search for the SOLA controller that will actually control the boiler. See [Figure 39](#).

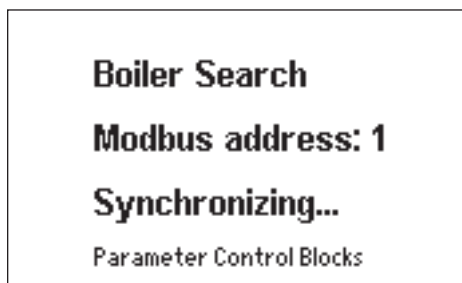


Figure 39. – Second Initialization Display

Once the interface makes the connection to the controller, it will display the address it is using to communicate (the “Modbus address”). The interface will download a series of values from the SOLA controller (or “synchronize” with the controller).

When the synchronization is finished, the display will change to the Home screen shown in [Figure 20](#).

11.B Sequence of Operation

This unit is a cold-start appliance. It should start only when it receives a call for heat from a tank aquastat, room thermostat, zone valve end switch or other space temperature control device.

1. The unit receives a call for heat.
2. The controller checks the safety chain.
3. The fan starts and waits to achieve prepurge RPM.
4. The prepurge timer is started once the prepurge RPM is achieved.
5. There is a pre-ignition time of two seconds to check the flame sensor operation and status. During this

period an intermittent spark can be seen.

6. Next there is a trial for ignition period of four seconds. The direct spark ignition switches to constant spark for three seconds. During this time the gas valve is open. For the last second of the ignition period, direct spark is de-energized and the flame sensor checks for established flame. If flame is sensed, the control enters Run to satisfy the demand. If flame is not established, the control enters a retry, starting from step 2. If flame has not been established after the preset number of retries, the control will lockout with a 109 error code.
7. The call for heat signal is removed.
8. The gas valve shuts off.
9. The fan and pump continue to run for the over-run times to purge the system.

This is the basic operating sequence for a DHW or hydronic call for heat.

11.C Modulation Control

The control uses a PID algorithm to adjust the firing rate of the boiler as the control point is approached. The goal of the control is to operate at a minimum firing rate to match the load on the unit. This is done by using a setpoint, and on/ off differentials. The control modulates to achieve the setpoint temperature, which could be several degrees away from the actual off point. The off point is calculated by adding the setpoint plus the off differential. The setpoint and differentials used in operation are dependent upon the type of call for heat being applied. If there is a DHW call, the DHW setpoint and off differentials are used. If there is a hydronic call, the CH setpoint and off differentials are used. When the setpoint plus the off differential is reached, the control prevents the unit from firing until the water temperature reaches the setpoint minus the on differential.

11.D Pump Control

The control can operate three pumps. The boiler pump is active any time there is a call for heat applied to the control. The DHW and system pumps are active based upon the call and priority of the heat demand being supplied. When there is a hydronic call supplied, the system pump is active. If there is a DHW call supplied while the hydronic call is active, with DHW priority enabled, the system pump turns off and the DHW pump turns on. Domestic hot water priority forces the control to attempt to satisfy the domestic water demand before the hydronic demand. Once the last heat demand has been satisfied, the boiler pump enters an overrun time.

11.E Anti-Short-Cycle (ASC)

Because the unit is a modulating boiler, and its input will decrease when there is a reduction in the heating load, short cycling is greatly reduced. If the heating load drops below the minimum input of the boiler for an extended period, the boiler will have a tendency to short cycle.

This can be a symptom of improper control strategy or setpoints, or a load distribution problem. The controller in the Unit includes an anti-short cycle (ASC) function. The timer for the ASC can be set to delay the boiler start for a specified time after a call for heat is completed.

11.F Temperature Sensors

High Limit Sensor -

The control uses a dual thermistor sensor to monitor the Units maximum temperature. The high limit sensor is installed in the outlet water. A dual thermistor sensor is used, so that the two temperatures can be monitored and compared to confirm accuracy. The control will automatically reduce the firing of the Unit to prevent the high limit from tripping. The high limit setpoint is factory set at 195°. However, if desired you can set a lower limit using the Adjustable High Limit function available from the Quick Start menu.

Outlet Water Temperature -

The outlet water temperature is sensed by a dual thermistor sensor, and is limit-rated. The control compares the two temperature readings to determine accuracy. The outlet sensor is used as the primary control point for high limit, temperature operation, and modulation.

Inlet Water Temperature -

The inlet water temperature uses a single thermistor sensor. The heat exchanger temperature rise (delta T) is calculated using the inputs from the outlet and inlet sensor temperatures.

Stack Limit -

The stack temperature is sensed by a dual thermistor sensor, and is limit-rated. The control compares both of the temperature readings to determine accuracy. The stack sensor is used as a limiting feature to avoid excessive temperatures in the vent.

11.G Diagnostics

Use the Diagnostics to check the status of the sensors and the digital inputs and outputs. The system also records a history of lockouts and alarms.

Analog Sensors -

You can use this display to check on operating temperatures, fan speed, firing rate, etc. (The word “analog” refers to values that can change continuously between zero and a higher value.) The values shown here are “Read Only” – you can’t change them from this display.

Digital Input/Output -

This display shows whether different functions, inputs and outputs are either on or off. The functions listed here include pumps, valves, alarms, etc. The values shown here are “Read Only” – you can’t change them from this display.

History -

The system records the most recent lockouts or alerts. (If there is a current lockout or alert, a note about this will also appear at the bottom of the Home screen.)

- A “lockout” is a condition that will prevent the unit from starting or running.
- An “alert” indicates a condition that is not normal. If it continues, the control system might move to a “lockout,” or the problem might be corrected.

11.H Error Codes

See Appendix B. on page 72

SECTION 12 REPLACEMENT PARTS

Use only genuine Manufacturer replacement parts.

12.A General Information

To order or purchase parts for these high efficiency residential units, contact your nearest manufacturers dealer or distributor. See the back cover for the manufacturers website and information.

12.B Parts List

ITEM DESCRIPTION	SIZE 80	SIZE 105	SIZE 150	SIZE 210	SIZE 285
Jacket Components – See Figure 40					
1 Front Panel Assembly	R60D3200	R60D3200	R60D3200	R60D3200	R60D3200
2 Front Panel Handle	R50D3204	R50D3204	R50D3204	R50D3204	R50D3204
3 Rear Panel	R50D3101	R50D3101	R50D3101	R50D3101	R50D3101
4 Left Side Panel	R8D3002	R10D3002	R15D3002	R20D3002	R20D3002
5 Right Side Panel	R15D3001	R15D3001	R15D3001	R30D3001	R30D3001
6 Left Top Panel	8D3327	10D3327	R15D3303	R20D3303	R20D3303
7 Middle Left Top Panel	8D3328	10D3328	15D3402	20D3403	30D3311
7A Middle Right Top Panel	8D3329	10D3329	15D3403	20D3402	30D3313
8 Right Top Panel	8D3330	10D3330	15D3401	R20D3301	R30D3301
9 Jacket Angle Support	R8D3102 (Right Side)	R8D3102 (Right Side)	R15D3102 (2)	R30D3102 (2)	R30D3102 (2)
	R15D3102 (Left Side)	R15D3102 (Left Side)			
10 Jacket Support, Left Stanchion	R50D3003	R50D3003	R50D3003	R50D3003	R30D3003
11 Jacket Support, Right Stanchion	R50D3004	R50D3004	R50D3004	R50D3004	R50D3004
12 Front Bezel	R50D7121	R50D7121	R50D7121	R50D7121	R50D7121
13 Display mounting frame	R50D7122	R50D7122	R50D7122	R50D7122	R50D7122
(12&13) Complete Assembly	R50D7120	R50D7120	R50D7120	R50D7120	R50D7120

Internal Components – See Figure 42

20 Base Assembly	R15D1100	R15D1100	R15D1100	R30D1100	R30D1100
21 Left Rear Support Stanchion	R50D1001	R50D1001	R50D1001	R50D1001	R50D1001
22 Left Front/Right Rear Support Stanchion	R50D1002	R50D1002	R50D1002	—	R50D1002 (2)
23 Cantilevered Base Stanchion	R15D1002	R15D1002	R15D1002	R40D1001	R40D1001
24 Brace, Front, HX Stanchion	20D1005	20D1005	20D1005	20D1005	85D1005
24A Brace, Rear, HX Stanchion	R50D1005	R50D1005	20D1007	20D1007	R50D1005
25 Mounting Rail	R15D1004	R15D1004	R15D1004	R30D1004	R30D1004 (2)
27 Condensate Trap Assy	R20D4020	R20D4020	R20D4020	R20D4020	R50D4020
28 Heat Exch. Rail Clip	R50D1006 (2)	R50D1006 (2)	—	—	R50D1006 (2)

ITEM DESCRIPTION	SIZE 80	SIZE 105	SIZE 150	SIZE 210	SIZE 285
30 PVC Reducer	—	—	RP2053000	RP2053000	RP2052900
30a CPVC Reducer or Coupling	RD2010501	RD2010501	RP2065600	RP2065600	-
30b 2" Dia. Pipe, CPVC	RD2010212	RD2010212	RD2010213	RD2010213	-
31 Hose Barbed Adapter	RP2067100	RP2067100	RP2056100	RP2056100	RP2056100
33 Air Inlet/Exhaust Bracket	R8D3005	10D3005	R20D3120	R20D3120	30D3505

Gas Train Components – See Figure 41

40 Combustion Air Blower	RA2113700	RA2113700	RA2107500	RA2114200	RA2114200
41 Gas Valve/Venturi	RV2017900	RV2017901	RV2017902	RV2017903	RV2017904
42 On/Off Rectifier Module	E2324300	E2324300	E2324300	E2324300	E2324300
47 Gas Valve O-Ring	R30-227	R30-227	R30-227	R30-227	R30-227
51 Duct/Venturi Transition	R10D5021	R10D5021	R10D5021	R10D5013	R30D5013
52 Gas Supply Pipe	RP2051700	RP2051400	RP2051400	RP2051400	RP2051500
55 Air Inlet Flex Hose	D0091403	RD0091403	RD0091403	D0091401	D0091401

Heat Exchanger Components – See Figure 43

60 Heat Exchanger	RS2106900	RS2105500	RS2105800	RS2105700	RS2111100
N.S. Pump (Not Shown)	A2114900	A0076700	A0076700	14-55802	A2114400
62 Low Water Cutoff Switch	—	—	—	—	—
63 Inlet Water Temp Sensor	RE2320600	RE2320600	RE2320600	RE2320600	RE2320600
64 Duplex Outlet Water Temperature Sensor	RE2319900	RE2319900	RE2319900	RE2319900	RE2319900
65 Duplex Stack Temperature Sensor	RE2319700	RE2319700	RE2319700	RE2319700	RE2319800
66 Pressure Relief Valve, 30 psi	R51-182	R51-182	R51-182	R51-182	RA2113602 (75 PSI)
67 Air Vent	R1-592	R1-592	R1-592	R1-592	R1-592
68 Burner Door w/gasket	RS2112801	RS2112801	RS2112801	RS2112801	RS2112801
68A Burner Door Gasket(rubber)	R2069400	R2069400	R2069400	R2069400	R2069400
69 Burner Gasket	RS2108500	RS2108500	RS2108500	RS2108500	RS2108500
69A Gasket Set (burner gasket, ignitor gasket, sensor gasket & burner door gasket)	RS2109100	RS2109100	RS2109100	RS2109100	RS2109100
70 Front Refractory Tile	RT2109001	RT2109001	RT2109001	RT2109001	RT2109001
71 Rear Refractory Tile	R50D2021	R50D2021	R50D2021	R50D2021	R50D2021
72 Main Burner w/gasket	R2069101	R2069102	R2069103	R2069104	R2069105
73 Flame Sensor w/gasket	R2069200	R2069200	R2069200	R2069200	R2069200
74 Ignitor w/gasket	R2069300	R2069300	R2069300	R2069300	R2069300
74A Ignitor Gasket	RW2013300	RW2013300	RW2013300	RW2013300	RW2013300
74B Screw, Ignitor/ Flame Sensor	S2112700	S2112700	S2112700	S2112700	S2112700
74C Flame/Sensor Gasket	RW2013400	RW2013400	RW2013400	RW2013400	RW2013400

ITEM DESCRIPTION	SIZE 80	SIZE 105	SIZE 150	SIZE 210	SIZE 285
75 Air/Gas Channel	RS2108400	RS2108600	RS2108600	RS2108700	RS2108700
75A Screw, Air/Gas Channel	RS2109400 (5)	RS2109400 (5)	RS2109400 (5)	RS2109400 (5)	RS2109400 (5)
76 Drain	R10-143	R10-143	R10-143	R10-143	R10-143
77 Sight Glass	R50D2020	R50D2020	R50D2020	R50D2020	R50D2020

Electrical Components – See Figure 44

80 Control Panel Enclosure	R50D7001	R50D7001	R50D7001	R50D7001	R50D7001
81 Transformer	RE2108700	RE2108700	RE2108700	RE2108700	RE2108700
82 High Voltage Shield	R50D7002	R50D7002	R50D7002	R50D7002	R50D7002
83 Top Panel Bracket	R50D7003	R50D7003	R50D7003	R50D7003	R50D7003
84 Electronic Control Module, Standard	RXD7199	RXD7199	RXD7198	RXD7198	RXD7198
85 Rocker Switch	RE2322700	RE2322700	RE2322700	RE2322700	RE2322700
86 Control Display	RE2347200	RE2347200	RE2347200	RE2347200	RE2347200
87 Wire Harness	R50D7412	R50D7412	R50D7412	R50D7414	R50D7408
89 Air Pressure Switch	RE2334700	RE2334700	RE2334700	RE2334701	RE2334700
N.S. Pump Harness/Conduit (Not Shown)	50D7601	50D7601	50D7601	50D7600	50D7602

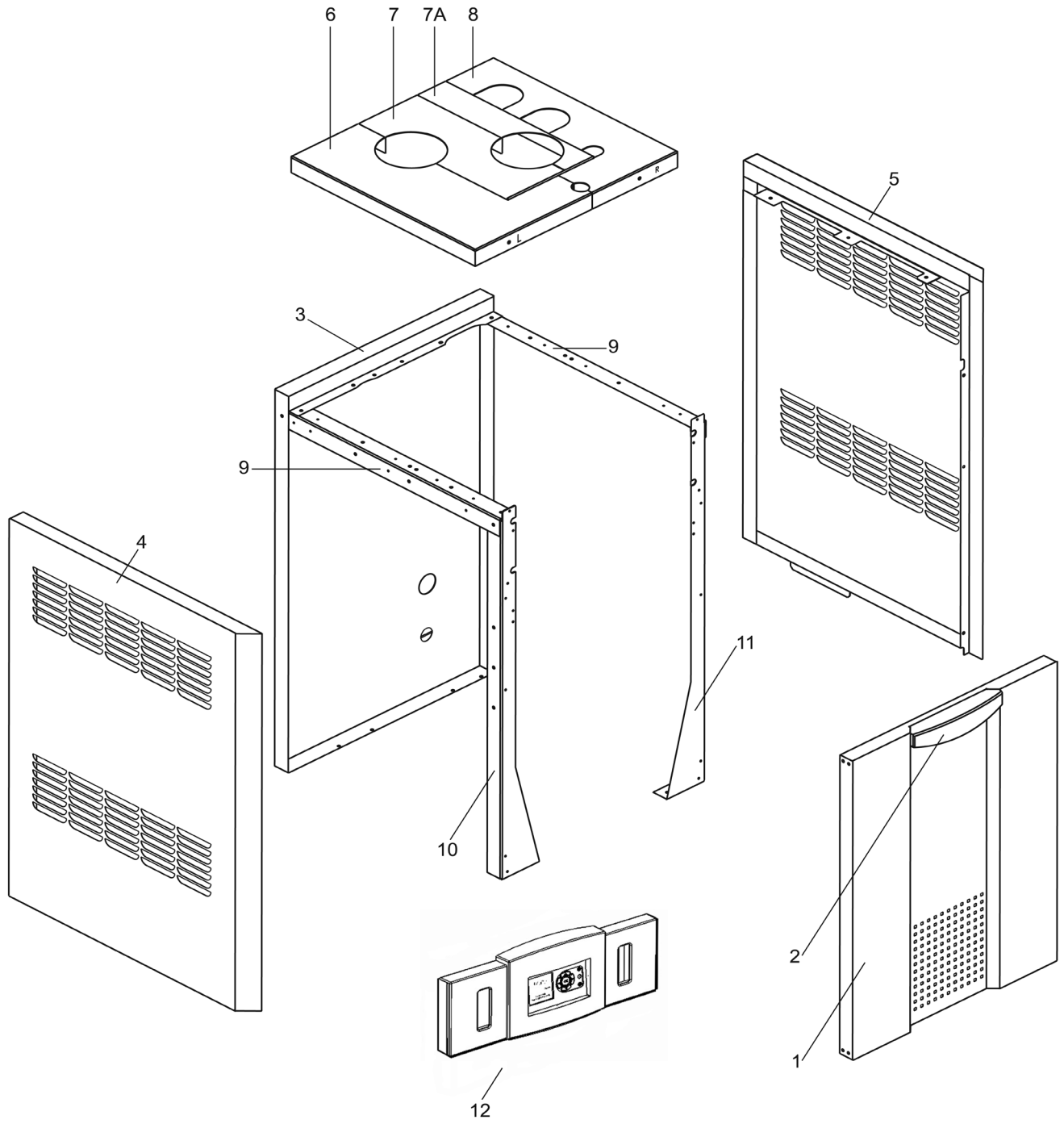


Figure 40. - Jacket Components

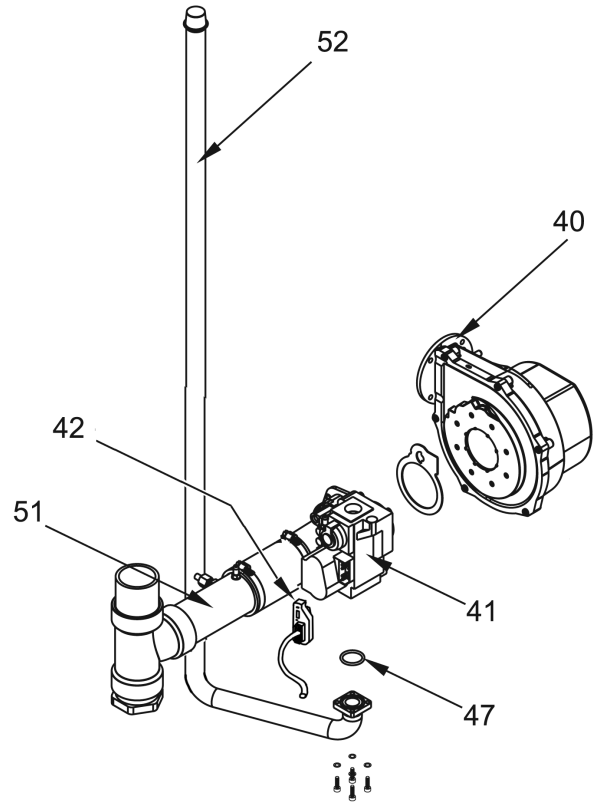
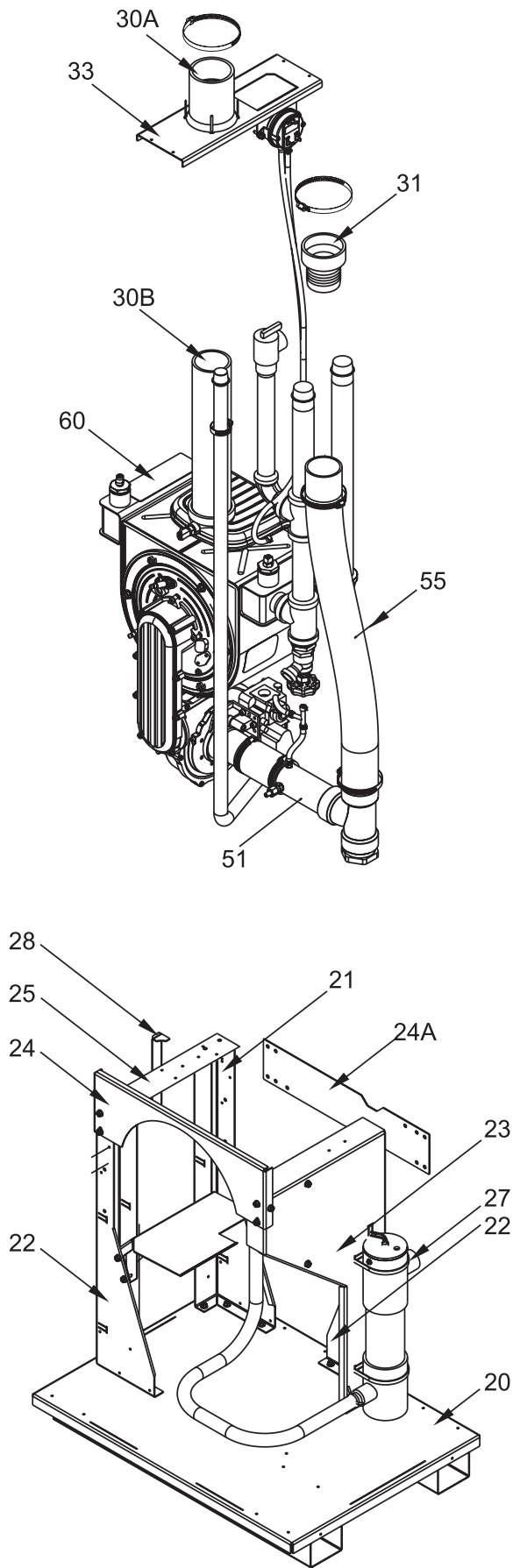


Figure 41. - Gas Train Components, Sizes 80-285

Figure 42. - Internal Components, Sizes 80-285

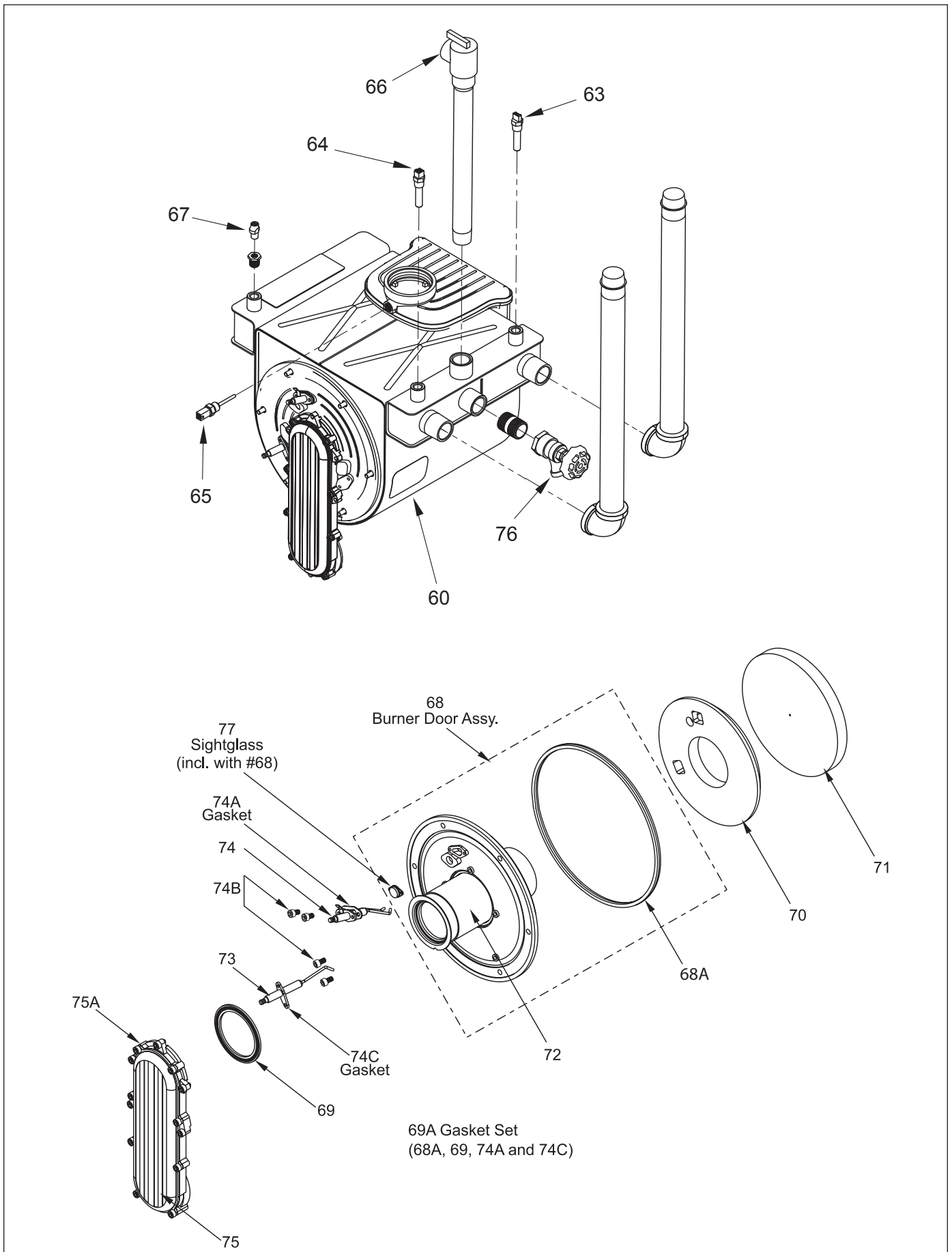


Figure 43. - Heat Exchanger Components

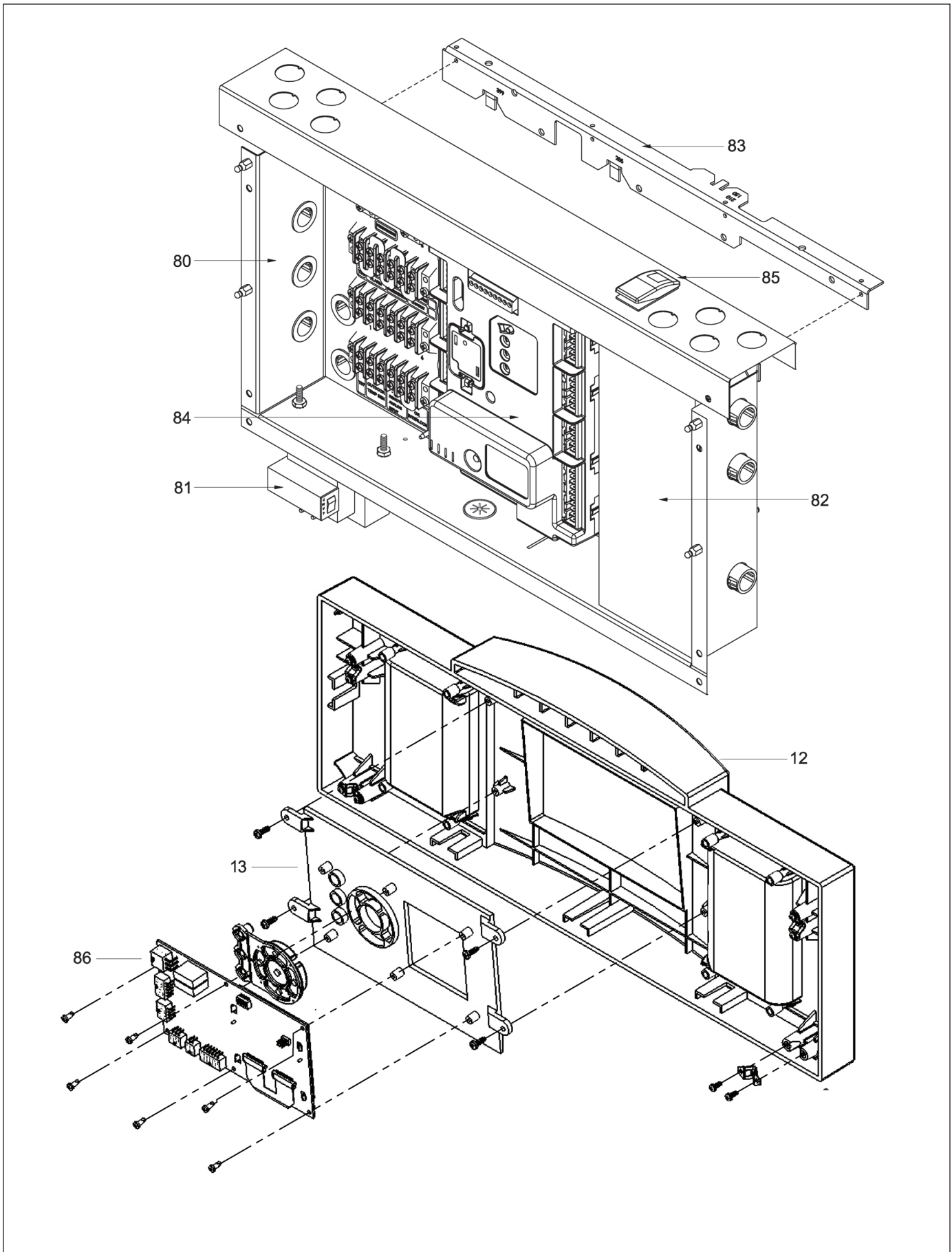


Figure 44. - Electrical Components

APPENDIX A

SOFTWARE CONTROL FUNCTIONS

This table includes a listing of all of the control functions that can be used by the operator or installer. Functions that require a password are indicated in the second column.

Name	PW?	Function	How to get there
Adjustable high limit	Y	The absolute high limit for the water outlet is pre-set at the factory. If desired, you can set a lower value here.	Quick Start
Adjustable stack limit	Y	The absolute high limit for the stack temperature is pre-set at the factory. If desired, you can set a lower value here.	Quick Start
Alert log	-	This displays the 15 most recent alerts.	Info/ Diagnostics/ History
Analog sensors	-	This shows the current condition of selected sensors – temperatures, fan speed, flame signal, etc.	Info/ Diagnostics
Anti short-cycle time	-	This feature can be set to prevent the burner from firing and then shutting off quickly in response to a call for heat that changes state quickly.	Info/ Advanced Setup/ System Config./ System Config.
Base load common rate (LL)	-	When using the Lead/ Lag system to control multiple boilers – As the heating load increases, this value sets the point where the controller will fire the next boiler. See the section on “About Lead/ Lag.”	Info/ Advanced Setup/ Lead Lag Configuration/ LL Master Config.
Boiler pump control	Y	The boiler pump can be turned on manually, or it can be set to operate automatically.	Info/ Test/ Manual Pump Operation Info/ Advanced Setup/ System Config./ Pump Config.
Boiler pump cycle count	Y	A new value can be written here if the pump or controller is replaced.	Info/ Advanced Setup/ System Config./ Statistics Config.
Boiler pump overrun time	Y	This indicates how long the boiler pump will remain on after demand from any source ends.	Info/ Advanced Setup/ System Config./ Pump Config.
Burner cycle count	Y	This is incremented on each entry to Run. A new value can be written here if the burner or controller is replaced.	Info/ Advanced Setup/ System Config./ Statistics Config.
Burner name	Y	This parameter allows the installer to give each boiler unit a unique name.	Info/ Advanced Setup/ System Config./ System ID and Access
Burner off inhibit time	Y	Set to “No Value.”	Info/ Advanced Setup/ System Config./ System Config.
Burner run time	Y	This measures the time spent in the Run state. A new value can be written here if the burner or controller is replaced.	Info/ Advanced Setup/ System Config./ Statistics Config.
CH setpoint	-	This setpoint is used to control the hydronic (Central Heat) function.	Quick Start Info/ Advanced Setup/ CH Configuration
D gain (CH)	Y	This gain is applied to the Differential term of the PID equation for the CH loop.	Info/ Advanced Setup/ CH Configuration
D gain (DHW)	Y	This gain is applied to the Differential term of the PID equation for the DHW loop.	Info/ Advanced Setup/ DHW Configuration
D gain (LL)	Y	When using the Lead/ Lag system to control multiple boilers – This gain is applied to the Differential term of the PID equation for the hydronic heating loop.	Info/ Advanced Setup/ Lead Lag Configuration/ LL Master Config.

Name	PW?	Function	How to get there
Demand switch (CH)	-	Set to "STAT terminal."	Info/ Advanced Setup/ CH Configuration
DHW pump control	Y	The boiler pump can be turned on manually, or it can be set to operate automatically.	Info/ Test/ Manual Pump Operation Info/ Advanced Setup/ System Config./ Pump Config.
DHW pump cycle count	Y	A new value can be written here if the pump or controller is replaced.	Info/ Advanced Setup/ System Config./ Statistics Config.
DHW pump overrun time	Y	This indicates how long the DHW pump will remain on after demand from any source ends.	Info/ Advanced Setup/ System Config./ Pump Config.
DHW setpoint	-	This setpoint is used to control the Domestic Hot Water function.	Quick Start Info/ Advanced Setup/ DHW Configuration
Digital I/O	-	This shows the status of selected switches and valves that are either On or Off.	Info/ Diagnostics
Display setup	-	Use this to change the lines that appear at the top of the Home display, and to set the brightness of the display.	Info/ Display Setup
General configuration	-	Used by the Manufacturer factory.	Info/ Advanced Setup/ System Config./ System Config.
I gain (CH)	Y	This gain is applied to the Integral term of the PID equation for the CH loop.	Info/ Advanced Setup/ CH Configuration
I gain (DHW)	Y	This gain is applied to the Integral term of the PID equation for the DHW loop.	Info/ Advanced Setup/ DHW Configuration
I gain (LL)	Y	When using the Lead/ Lag system to control multiple boilers – This gain is applied to the Integral term of the PID equation for the hydronic heating loop.	Info/ Advanced Setup/ Lead Lag Configuration/ LL Master Config.
Installer password	Y	This can only be changed by a user with the OEM-level password.	Info/ Advanced Setup/ System Config./ System ID and Access
LCD contrast	-	Use this to change the brightness of the display.	Info/ Display Setup
Lockout history	-	This displays the 15 most recent lockouts.	Info/ Diagnostics/ History
Low water temp. (CH)	-	Used with Outdoor Reset – Above the point where Outdoor Reset stops adjusting for a higher outdoor temperature (the Max. Outdoor Temperature value), this parameter is used as the setpoint.	Quick Start Info/ Advanced Setup/ CH Configuration/ Outdoor Reset Config.
Low water temp. (LL)	-	When using the Lead/ Lag system to control multiple boilers, with Outdoor Reset enabled – Above the point where Outdoor Reset stops adjusting for a higher outdoor temperature (the Max. Outdoor Temperature value), this parameter is used as the setpoint.	Info/ Advanced Setup/ Lead Lag Configuration/ LL Outdoor Reset
Manual burner operation	Y	During testing, use this to turn the burner on and off.	Info/ Test
Master enable (LL)	-	When using the Lead/ Lag system to control multiple boilers – One of the controllers must be set up as the Lead Lag Master to supervise the Lead Lag system. The master function must be disabled on all of the other controllers. See the section on "About Lead Lag."	Info/ Advanced Setup/ Lead Lag Configuration/ LL Master Config.

Name	PW?	Function	How to get there
Max. outdoor temp. (CH)	-	Used with Outdoor Reset – This is the maximum outdoor temperature at which the Outdoor Reset feature will be active. Above this point, the Low Water Temp. will be used as the setpoint.	Quick Start
			Info/ Advanced Setup/ CH Configuration/ Outdoor Reset Config.
Max. outdoor temp. (LL)	-	When using the Lead/ Lag system to control multiple boilers, with Outdoor Reset enabled – This is the maximum outdoor temperature at which the Outdoor Reset feature will be active.	Info/ Advanced Setup/ Lead Lag Configuration/ LL Outdoor Reset
MB1 Modbus address	-	Allows for a specific address assignment for each control in the system (1-8).	Info/ Advanced Setup/ System Config./ System ID and Access
MB2 Modbus address	-	Allows for a specific address assignment for each control in the system (1-8).	Info/ Advanced Setup/ System Config./ System ID and Access
Min. boiler water temp. (CH)	-	Used with Outdoor Reset – If a value is entered here, the temperature in the boiler will never be allowed to drop below this temperature. This will protect the boiler against possible damage due to expansion of ice inside the unit. (Notice that this is different from the “Low Water Temperature” described above.)	Info/ Advanced Setup/ CH Configuration/ Outdoor Reset Config.
Min. outdoor temp. (CH)	-	Used with Outdoor Reset – This is the maximum outdoor temperature at which the Outdoor Reset feature will be active. Below this point, the system will use the normal CH setpoint.	Quick Start
			Info/ Advanced Setup/ CH Configuration/ Outdoor Reset Config.
Min. outdoor temp. (LL)	-	When using the Lead/ Lag system to control multiple boilers, with Outdoor Reset enabled – This is the maximum outdoor temperature at which the Outdoor Reset feature will be active. Below this point, the system will use the normal LL setpoint.	Info/ Advanced Setup/ Lead Lag Configuration/ LL Outdoor Reset
Min. water temp. (LL)	-	When using the Lead/ Lag system to control multiple boilers, with Outdoor Reset enabled – If a value is entered here, the temperature in the boiler will never be allowed to drop below this temperature. This will protect the boiler against possible damage due to expansion of ice inside the unit. (Notice that this is different from the “Low Water Temperature” described above.)	Info/ Advanced Setup/ Lead Lag Configuration/ LL Outdoor Reset
Modbus address	-	When using the Lead/ Lag system to control multiple boilers – Each controller must have a unique Modbus address.	Info/ Advanced Setup/ System Config./ System ID and Access
Modulation sensor	-	Used with external modulation control – The choices are Outlet/ Inlet/ S5, S10, and None.	Info/ Advanced Setup/ CH Configuration
OEM ID	Y	Cannot be changed by the Installer.	Info/ Advanced Setup/ System Config./ System ID and Access
OEM password	Y	Cannot be changed by the installer.	Info/ Advanced Setup/ System Config./ System ID and Access
Off hysteresis (CH)	-	For hydronic heating (Central Heat) – The control system will not shut off the boiler until the temperature at the System sensor rises to the CH setpoint plus a hysteresis value (normally about 10°F).	Info/ Advanced Setup/ CH Configuration

Name	PW?	Function	How to get there
Off hysteresis (DHW)	-	When producing Domestic Hot Water – The control system will not shut off the boiler until the temperature at the System sensor rises to the DHW setpoint plus a hysteresis value (normally about 10°F).	Info/ Advanced Setup/ DHW Configuration
Off hysteresis (LL)	-	When using the Lead/ Lag system to control multiple boilers – The control system will not shut off the boilers until the temperature at the System sensor rises to the Lead Lag CH setpoint plus a hysteresis value (normally about 10°F).	Info/ Advanced Setup/ Lead Lag Configuration/ LL Master Config.
On hysteresis (CH)	-	For hydronic heating (Central Heat) – The control system will not fire the boiler until the temperature at the System sensor drops to the CH setpoint minus a hysteresis value (normally about 10°F).	Info/ Advanced Setup/ CH Configuration
On hysteresis (DHW)	-	When producing Domestic Hot Water – The control system will not fire the boiler until the temperature at the System sensor drops to the DHW setpoint minus a hysteresis value (normally about 10°F).	Info/ Advanced Setup/ DHW Configuration
On hysteresis (LL)	-	When using the Lead/ Lag system to control multiple boilers – The control system will not fire the boilers until the temperature at the System sensor drops to the Lead Lag CH setpoint minus a hysteresis value (normally about 10°F).	Info/ Advanced Setup/ Lead Lag Configuration/ LL Master Config.
Outdoor reset (CH)	-	Enable = Outdoor Reset feature turned on	Quick Start Info/ Advanced Setup/ CH Configuration/ Outdoor Reset Config.
Outdoor reset enable (LL)	-	When using the Lead/ Lag system to control multiple boilers – Enable = Outdoor Reset feature turned on	Info/ Advanced Setup/ Lead Lag Configuration/ LL Outdoor Reset
P gain (CH)	Y	This gain is applied to the Proportional term of the PID equation for the hydronic (Central Heat) loop.	Info/ Advanced Setup/ CH Configuration
P gain (DHW)	Y	This gain is applied to the Proportional term of the PID equation for the Domestic Hot Water loop.	Info/ Advanced Setup/ DHW Configuration
P gain (LL)	Y	When using the Lead/ Lag system to control multiple boilers – This gain is applied to the Proportional term of the PID equation for the hydronic loop.	Info/ Advanced Setup/ Lead Lag Configuration/ LL Master Config.
Priority time	Y	If this parameter is non-zero, then a Domestic Hot Water demand takes priority over other demand sources for the specified time. The priority override timing is reset when demand from the DHW source turns off.	Info/ Advanced Setup/ DHW Configuration
Priority vs Central Heat	Y	If a CH call and a DHW call arrive at the same time, which has priority?	Info/ Advanced Setup/ DHW Configuration
Priority vs Lead Lag	Y	When using the Lead/ Lag system to control multiple boilers – If a call for hydronic heat and a DHW call arrive at the same time, which has priority?	Info/ Advanced Setup/ DHW Configuration

Name	PW?	Function	How to get there
Pump exercise interval	Y	The system can be set to exercise the pumps at set intervals. Enter a non-zero value to turn on the function.	Info/ Advanced Setup/ System Config./ Pump Config.
Pump exercise time	Y	If the pump exercise feature is enabled, this value sets the length of time that each pump will be exercised.	Info/ Advanced Setup/ System Config./ Pump Config.
Set high fire	Y	This is used during combustion setup to set the "high fire" condition.	Info/ Test/ Forced Rate
Set low fire	Y	This is used during combustion setup to set the "low fire" condition.	Info/ Test/ Forced Rate
Setpoint (LL)	-	When using the Lead/ Lag system to control multiple boilers – This setpoint is used to control the hydronic (Central Heat) function.	Info/ Advanced Setup/ Lead Lag Configuration/ LL Master Config.
Setpoint source (CH)	Y	Set to "Local."	Info/ Advanced Setup/ CH Configuration
Setpoint source (LL)	Y	When using the Lead/ Lag system to control multiple boilers – Set to "Local."	Info/ Advanced Setup/ Lead Lag Configuration/ LL Master Config.
Follower enable (LL)	-	When using the Lead/ Lag system to control multiple boilers – One of the controllers must be set up as the Lead Lag Master to supervise the Lead Lag system. The controllers on all of the other boilers must be enabled as Followers. See the section on "About Lead Lag." The choices are: Disable/ Enable via Modbus Master/ Enable via SOLA Master	Info/ Advanced Setup/ Lead Lag Configuration/ LL Follower Config.
Follower mode (LL)	Y	When using the Lead/ Lag system to control multiple boilers – Set to "Equal Run Time."	Info/ Advanced Setup/ Lead Lag Configuration/ LL Follower Config.
Start test	Y	This is used during combustion setup to start the test firing.	Info/ Test
System pump control	Y	The System pump can be turned on manually, or it can be set to operate automatically.	Info/ Test/ Manual Pump Operation Info/ Advanced Setup/ System Config./ Pump Config.
System pump overrun time	Y	This indicates how long the System pump will remain on after demand from any source ends.	Info/ Advanced Setup/ System Config./ Pump Config.
Temperature units	-	Fahrenheit or Celsius	Info/ Advanced Setup/ System Config./ System Config.
Warm weather shutdown	Y	The system can be set to shut down if the outdoor temperature rises above a certain value.	Info/ Advanced Setup/ CH Configuration/ Warm Weather Shutdown
Warm weather shutdown setpoint	-	If warm weather shutdown is enabled – If the outdoor temperature is higher than this value, the system will be shut off for Central Heating functions.	Info/ Advanced Setup/ CH Configuration/ Warm Weather Shutdown

APPENDIX B ERROR MESSAGES

This table includes a listing of the faults that might be generated by the controller, and displayed on the Operator Interface. Some of these can be corrected by an installer 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. The second column lists a short description of the condition. 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	L or H	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) 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	

17	Internal fault: Safety relay test failed due to safety relay not OFF	L	Internal fault 1. Reset module 2. If fault repeats, replace module.	
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. Internal sub-system fault.

53	AC input phases reversed	L	<ol style="list-style-type: none"> 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	<p>Internal Fault.</p> <ol style="list-style-type: none"> 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	Will not be a lockout fault. Hold Only.
63	<p>SAFETY CHAIN (OFF)</p> <p>To diagnose, test all of the following safety devices if they are installed:</p> <p>Condensate Level Switch – All Models</p> <p>Heat Exchanger Fusible Link – All Models</p> <p>Optional Flow Switch</p> <p>Additional High Limit (Field Supplied)</p> <p>Optional Pressure Switch</p> <p>Optional Low Water Cut Off</p> <p>Low Pressure gas switch – Inlet Side of Gas Valve (Standard Equipment on CSD-1 Models)</p> <p>High Pressure gas switch – Outlet Side of Gas Valve (Standard Equipment on CSD-1 Models)</p>	H	<ol style="list-style-type: none"> 1. Reset the low gas pressure valve and the high gas pressure valve. 2. Check for power at Terminal Block 8 (TB8 for the 'Safety Chain' components. See Figure 15 on page 31 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	<ol style="list-style-type: none"> 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	<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.
68	ILK (Interlock) ON	H or L	<ol style="list-style-type: none"> 4. If steps 1-3 are correct and the fault persists, replace the module.
70	Wait for leakage test completion	H	<ol style="list-style-type: none"> 1. Internal Fault. Reset module. 2. If fault repeats, replace module.
78	Demand Lost in Run	H	<ol style="list-style-type: none"> 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	<ol style="list-style-type: none"> 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	<ol style="list-style-type: none"> 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	<ol style="list-style-type: none"> 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	<ol style="list-style-type: none"> 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	<ol style="list-style-type: none"> 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	<ol style="list-style-type: none"> 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	<ol style="list-style-type: none"> 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	<ol style="list-style-type: none"> 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	<ol style="list-style-type: none"> 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	<ol style="list-style-type: none"> 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.
98	Internal Fault: Exceeded VSNSR voltage tolerance	L	<ol style="list-style-type: none"> 1. Reset module. 2. If fault repeats, replace module.
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 the 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 the main valve wiring and operation - correct any errors. 2. Check the fuel supply.
107	Flame lost early in run	L	<ol style="list-style-type: none"> 3. Check fuel pressure and repeat turndown tests.
108	Flame lost 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.
109	Ignition failed	L	
110	Ignition failure occurred	H	Hold time of recycle and hold option. Will not be a lockout fault.
111	Flame current lower than weak threshold	H	Hold only. Internal hardware test. Not a lockout.
113	Flame circuit timeout	L	Flame sensed during initiate or off cycle. Produces a Hold for 240 seconds. If still present after 240 seconds, system will lockout.
122	Lightoff rate proving failed	L	
123	Purge rate proving failed	L	<ol style="list-style-type: none"> 1. Check wiring and correct any potential wiring errors.
128	Fan speed failed during prepurge	H or L	<ol style="list-style-type: none"> 2. Check VFD's (Variable-speed Fan Drive) ability to change speeds. 3. Change the VFD
129	Fan speed failed during preignition	H or L	
130	Fan speed failed during ignition	H or L	<ol style="list-style-type: none"> 4. If the fault persists, replace the module.
131	Fan movement detected during standby	H	
132	Fan speed failed during run	H	
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	Create a Hold if a flame is 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	<ol style="list-style-type: none"> 1. Purge fan switch is off when it should be on. 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	<ol style="list-style-type: none"> 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. 3. Make sure the F & G wires are protected from stray noise pickup.
157	Combustion pressure and flame Off	L	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 the main valve terminal wiring and correct any errors. 2. Reset and sequence the module. If fault persists, replace the module.
159	Main valve Off	L	1. Check the main valve terminal wiring and correct any errors. 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. 2. Reset and sequence the module. If fault persists, replace the module.
161	Ignition Off	L	1. Check the ignition terminal wiring and correct any errors. 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/ HSI output setting	L	<ol style="list-style-type: none"> 1. 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	<ol style="list-style-type: none"> 1. Recheck selected parameters, reverify and reset module. 2. If fault repeats, verify electrical grounding. 3. If fault repeats, replace module.
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	
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	

