

Installation and Operation Instructions for

NEOTHERM[®]

Modulating Boiler

Model NTH

Sizes 080–210 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 vous trouvez.
- Appelez immédiatement votre fournisseur de gaz depuis un voisin. Suivez les instructions du fournisseur.
- Si vous ne pouvez rejoindre le fournisseur de gaz, appelez le service des incendies.

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

Table of Contents

Section 1 -

General Information

1.1 Introduction..... 1
 1.2 Model Identification..... 1
 1.3 Appliance Overview..... 2
 1.4 Warranty..... 3
 1.5 Unpacking..... 3
 1.6 Dimensions..... 4

Section 2 -

Locating the Appliance

2.1 General Information..... 5
 2.2 Locating Appliance for Correct Vent Distance
 from Outside Wall or Roof Termination..... 5

Section 3 -

Venting and Combustion Air

3.1 General Venting..... 6
 3.2 Combustion Air..... 6
 3.3 Venting..... 8
 3.4 Locating Vent & Combustion Air Terminals..... 10
 3.5 Common Vent Test..... 13

Section 4 -

Gas Supply and Piping

4.1 Gas Supply and Piping..... 13

Section 5 -

Pump Requirements

5.1 Boiler Flow and
 Head Requirements..... 14

Section 6

Water Connections

6.1 System Piping: Hot Supply
 Connections..... 15
 6.2 Cold Water Make-Up..... 15
 6.3 Condensate Drain..... 16
 6.4 Freeze Protection..... 16
 6.5 Suggested Piping Schematics..... 16-23
 6.6 Recognized Chemicals..... 16

Section 7-

Navigating the User Interface

7.1 About the User Interface..... 24
 7.2 Navigating the User Interface..... 25
 7.3 The Home Display..... 25
 7.4 Customizing your Home Display..... 25
 7.5 Entering / Changing Control Settings..... 28

Section 8A -

Quick Start Menu

8A.1 Quick Start Menu..... 29

Section 8B -

Basic Installation and Wiring

8B.1 Installation Warnings..... 30
 8B.2 Main Power Connections..... 31
 8B.3 Pump Connections and Operation..... 31

Section 8C -

Detailed Setup Instructions

8C.1 24 VAC Transformer with Integral
 Circuit Breaker..... 32
 8C.2 Hydronic Heating Demand..... 32
 8C.3 Anti-Short-Cycle..... 32
 8C.4 Outdoor Air Temperature Sensor..... 32
 8C.5 Outdoor Reset..... 32
 8C.6 Warm Weather Shutdown..... 34
 8C.7 Domestic Hot Water..... 34
 8C.8 Cascading Lead/ Lag Operation..... 36
 8C.9 Hydronic Heating Using External
 Modulation Control..... 39
 8C.10 Optional Field Connections..... 39
 8C.11 Connections to a
 Building Automation System..... 40
 8C.12 Ladder and Wiring Diagrams..... 41

Section 9 -

First Start-up and Adjustment Instructions

9.1 Filling the Boiler System..... 44
 9.2 First Operation..... 44
 9.3 Boiler Setup and Adjustment..... 45
 9.4 Shutting Down the NeoTherm Unit..... 46
 9.5 Restarting the NeoTherm Unit..... 46

**Section 10 -
Maintenance**

10.1	System Maintenance	47
10.2	Appliance Maintenance and Component Description.....	47
10.3	Gas Conversion.....	50

**Section 11 -
Operating Details and Troubleshooting**

11.1	Normal Startup and Initialization.....	51
11.2	Sequence of Operation	51
11.3	Modulation Control	51
11.4	Pump Control.....	51
11.5	Anti-Short-Cycle	52
11.6	Temperature Sensors	52
11.7	Diagnostics	52
11.8	Error Codes	52

**Section 12 -
Replacement Parts**

13.1	General Information.....	53
13.2	Parts List.....	53

Appendices -

Appendix A	- Software Control Functions.....	62
Appendix B	- Error Messages.....	68

Section 1 - GENERAL INFORMATION

WARNING

NeoTherm units **must** be installed in accordance with the procedures detailed in this manual, or the LAARS Heating Systems 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 NeoTherm boilers must conform to the Standard for Controls and Safety Devices for Automatically Fired Boilers, ANSI/ASME CSD-1. Any modifications to the boiler, its gas controls, or wiring may void the warranty. If field conditions require modifications, consult the factory representative before initiating such modifications.

1.1 Introduction

This manual provides information necessary for the installation, operation, and maintenance of LAARS Heating Systems NeoTherm appliances. Read it carefully before starting the installation.

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

The NeoTherm 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 Figures 1-7 for PRV locations.

DANGER

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

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

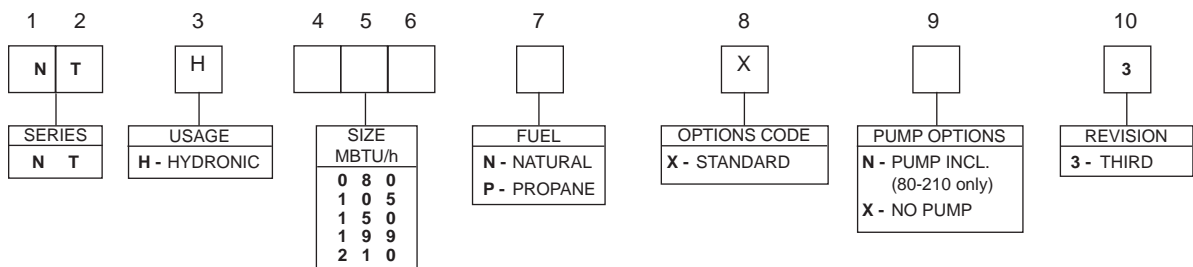
All electrical wiring is to be done in accordance with the local codes, or in the absence of local codes, with: 1) The National Electrical Code ANSI/NFPA No. 70-latest Edition, or 2) CSA STD. C22.1 "Canadian Electrical Code - Part 1". This appliance must be electrically grounded in accordance with these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

1.2 Model Identification (Nomenclature)

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

- (1-2) **Model Series Designation**
N T = NeoTherm
- (3) **Usage**
H = Hydronic
- (4-6) **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
1 9 9 = 199,000 BTU/hr input
2 1 0 = 210,000 BTU/hr input
- (7) **Fuel**
N = Natural Gas
P = LP Gas
- (8) **Options Code**
X = Standard Unit
- (9) **Pump Options**
N = Pump included (80-210 only)
X = No pump (configuration available for all sizes)
- (10) **Revision**
3 = Third version

Model Nomenclature



1.3 Appliance Overview

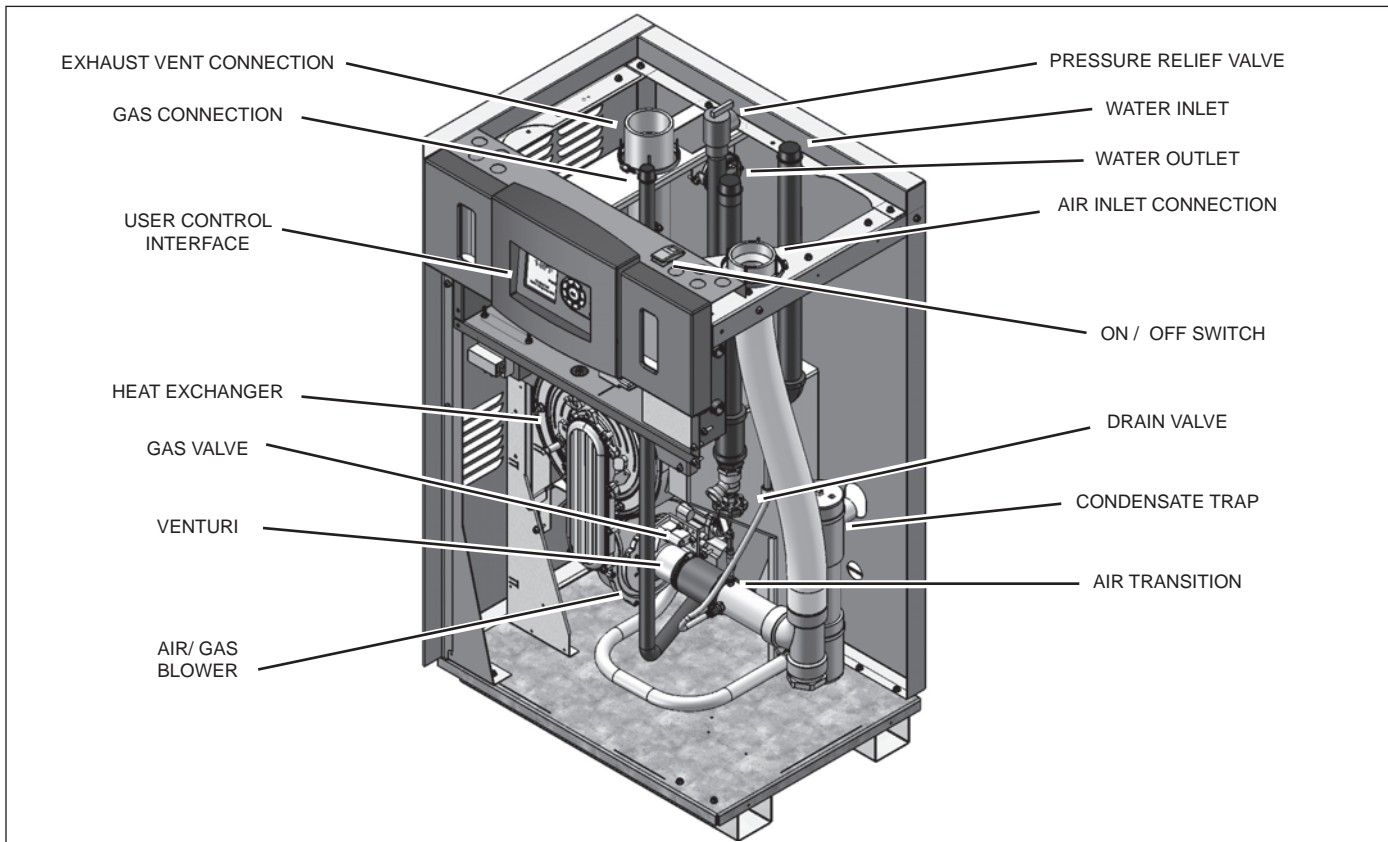


Figure 1. - Location of Components, Sizes 80-105

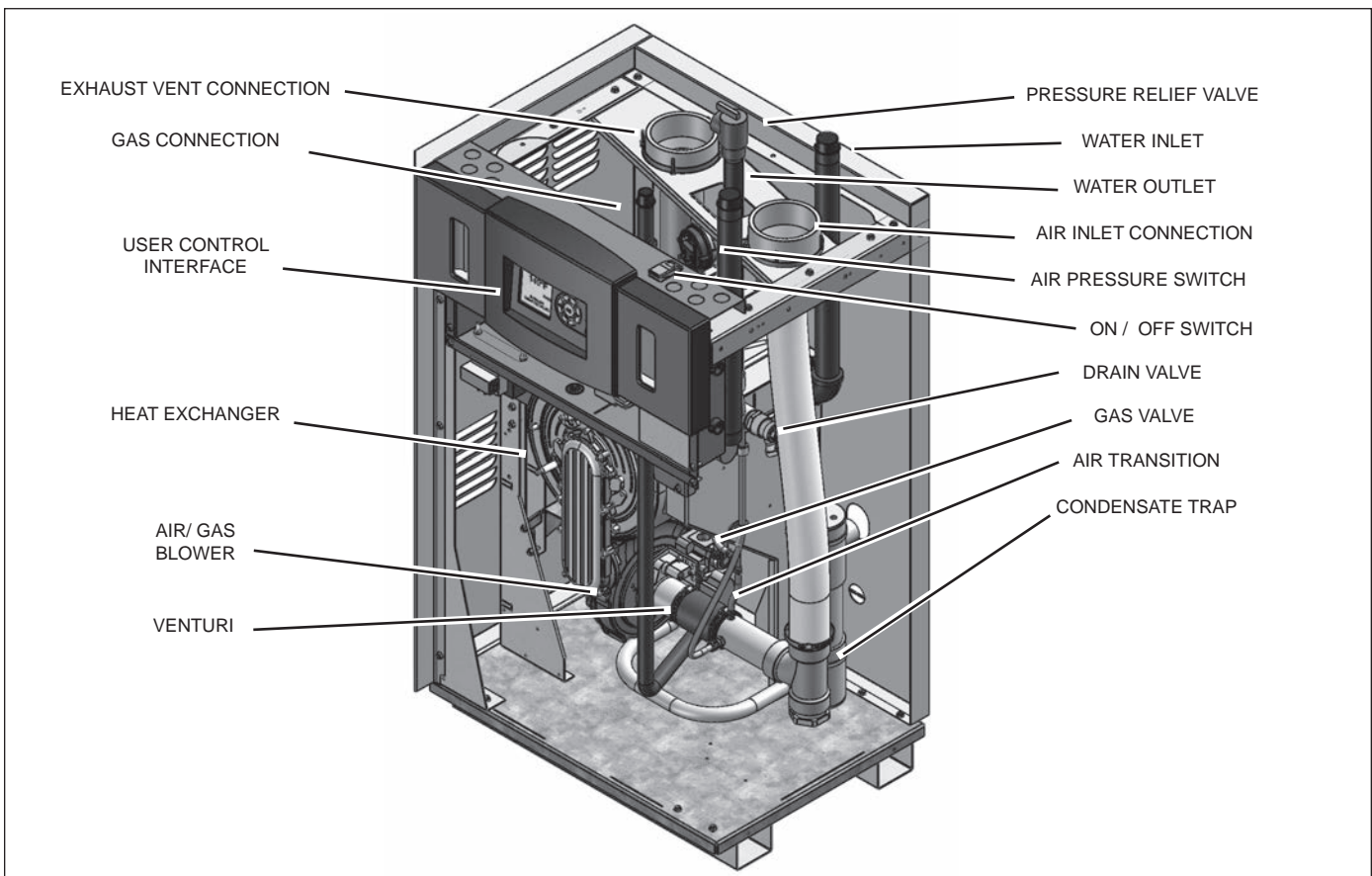


Figure 2. - Location of Components, Sizes 150-210

1.4 Warranty

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

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

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.**

1.5 Unpacking

The NeoTherm unit is shipped in a single crate with the following standard components packed with the appliance. (See [Figure 3](#))

- A. Exhaust vent terminal (US only)
- B. Air intake terminal
- C. Temperature/pressure gauge kit
- D. Circulator pump/wire harness (units with pump)
- E. CPVC exhaust pipe section (80-210) (US only)
- F. Outdoor/system sensor kit
- H. Alternate size vent/terminal screens

1. Remove all packing and tie-down materials.
2. Check the contents of the carton against the items shown.

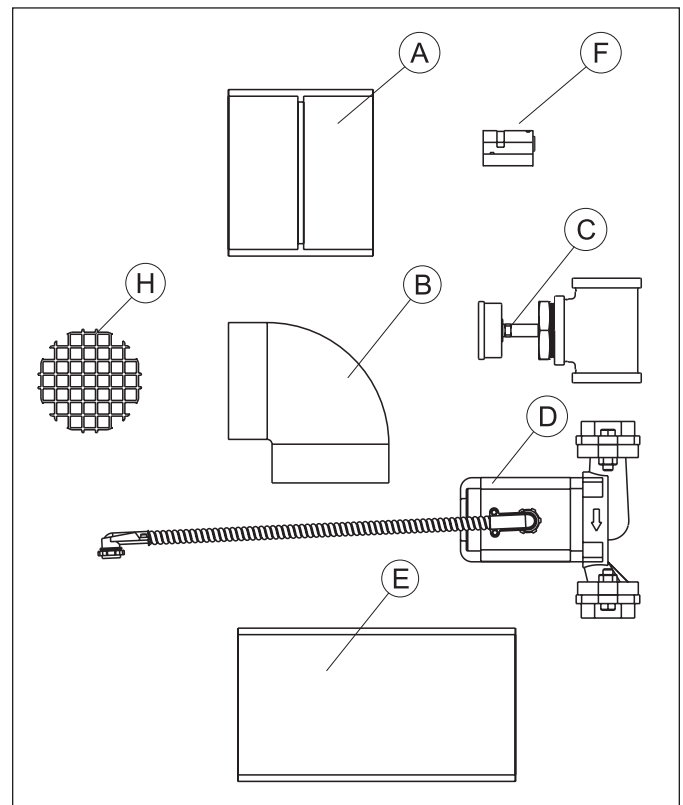
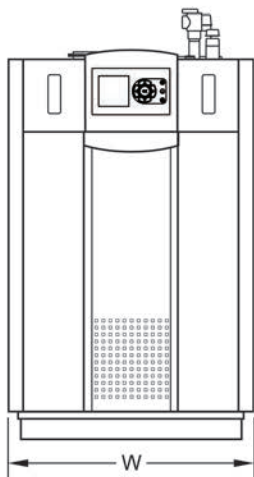
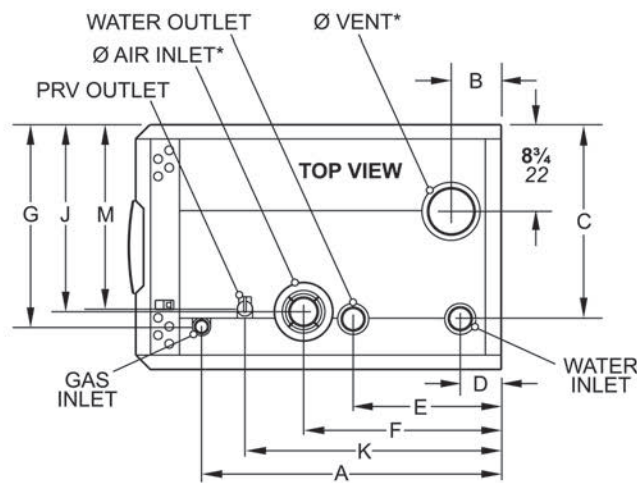


Figure 3. - Contents of Shipping Package

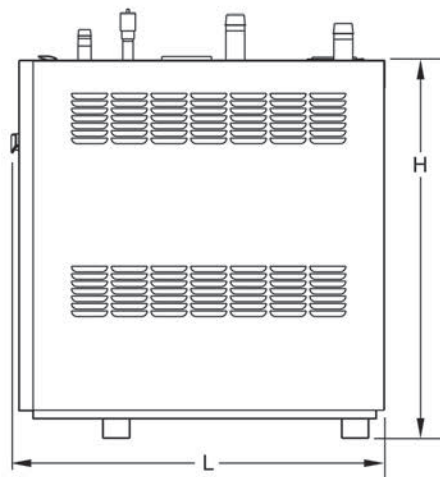
1.6 Dimensions

Size	A		B		C		D		E		F		G		J		K		M		N	
	in	cm	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	18¼	46	7½	19	10¾	28	11¾	30	13¾	35	21	53	10¾	27	15¼	39	13	33
105	13½	34	8	21	18¼	46	6	16	10¾	28	11¾	30	14¼	36	21	53	8¾	22	15¼	39	13	33
150	13¼	34	5¼	14	18¼	46	¾	8	10¾	28	7½	19	14¼	36	19½	49	7½	19	15¼	39	13	33
150	13¼	34	5¼	14	19	48	¾	8	10¾	28	7½	19	14¼	36	19½	49	7½	19	15¼	39	13	33
199	20½	52	5¼	14	19	48	¾	8	17¾	45	7½	19	14¼	36	19½	49	11¾	30	15¼	39	13	33
210	20½	52	5¼	14	18¼	46	¾	8	17¾	45	7½	19	14¼	36	19½	49	11¾	30	15¼	39	13	33

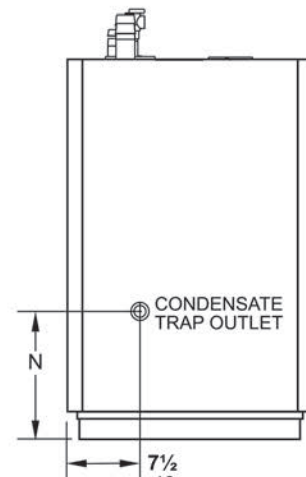
Table 1. - Piping Location Dimensions, Sizes 80-210



FRONT VIEW



RIGHT SIDE VIEW



BACK VIEW

SIZE	W		L		H		AIR INLET		VENT	
	IN	CM	IN	CM	IN	CM	IN	CM	IN	CM
80	25	64	19½	49	38¼	97	2	5.1	2	5.1
105	25	64	19½	49	38¼	97	2	5.1	2	5.1
150	25	64	19½	49	38¼	97	3	7.6	3	7.6
199/210	25	64	26¾	68	38¼	97	3	7.6	3	7.6

Table 2. - Overall Dimensions, Sizes 80-210

Section 2 - LOCATING THE APPLIANCE

2.1 General Information

The NeoTherm unit is designed for indoor installations only.

The appliance 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 appliance or to lower floors of the structure.

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

The appliance is design certified by CSA-International for installation on combustible flooring; in basements; in closets, utility rooms or alcoves. **NeoTherm Boilers must never be installed on carpeting.** The location for the appliance should be chosen with regard to the vent pipe lengths and external plumbing 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 NeoTherm 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 4** should be met when choosing the locations for the appliance.

2.2 Locating Appliance for Correct Vent Distance from Outside Wall or Roof Termination

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

NOTE: When located on the same wall, the NeoTherm combustion air intake terminal must be installed a minimum of 12" below the exhaust terminal. Models 399-850 also require a minimum horizontal distance from intake to exhaust terminal of 36".

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

APPLIANCE SURFACE	SUGGESTED SERVICE ACCESS CLEARANCE	
	INCHES	CM
Left Side	1	2.5
Right Side	12	31
Top	24	61
Back	6	15
Closet, Front (285-500)	6	15
Alcove, Front (285-500)	24	61
Front (600-850)	24	61
Vent	—	—

Certified by CSA for zero clearance to combustible materials on all sides.

Table 3. - Clearances

SIZE	INTAKE / EXHAUST					
	STANDARD VENT	MAX EQUIV. FT.	MAX EQUIV. M	OPTIONAL VENT	MAX EQUIV. FT.	MAX EQUIV. M
	80	2"	40	6.1	3"	100
105	2"	40	6.1	3"	100	30.5
150	3"	100	30.5	n/a	—	—
199/210	3"	100	30.5	n/a	—	—

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 manufacturer's 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

To calculate max equivalent length, measure the linear feet of the pipe, and add 5 feet (1.5m) for each 90°* elbow used.

* For any combination of vent and intake lengths up to 40 equivalent feet, any even or uneven combination of length is allowed. For overall lengths greater than 40 equivalent feet, the exhaust may be up to 20 feet greater than the intake length.

*Add 2 1/2 feet (.76 meters) for each 45 elbow used.

Table 4. - Vent / Air Pipe Sizes

Section 3 - VENTING AND COMBUSTION AIR

3.1 General Venting

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

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

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

MFR MODEL NUMBER (ABBREVIATED)

Example Components	Selkirk	DuraVent	NovaFlex
	Trade Name / Model		
	Safe-T Vent EZ Seal	FasNSeal	Z Flex
90° Elbow	9x14	FSELB90xx	2SVEEx90
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	
Adapter SS to PP		FSAAUx-xPP	2ZDCPVCx**

*4", 6" & 7" only

**up to 6"

Table 5. - Allowable Single Wall Stainless Steel Vent Suppliers and Part Numbers.

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

Table 6. - Allowable Polypropylene Vent Manufacturers / Trade Names

NOTE: 1. "x", "xx", and "xxxx" refer to variations in nominal size. See manufacturer's catalog for a particular application.

3.2 Combustion Air

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

A NeoTherm 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.

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 LAARS horizontal wall terminal, shown in **Table 7**. See **Table 4** 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 8**) The pipe should be sized per Table 2. Route the intake to the boiler as directly as possible. Seal all joints. Provide adequate hangers. The unit must not support the weight of the combustion air intake pipe. Maximum linear pipe length allowed is shown in **Table 4**. 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		
	Standard	Concentric CA006000	Flush Mount CA010100	Standard CA005900	Concentric 239-44069-01	Flush Mount CA010101
80	incl.	opt.	opt.	opt.	opt.	opt.
105	incl.	opt.	opt.	opt.	opt.	opt.l
150	n/a	n/a	n/a	incl.	opt.	opt.
199/210	n/a	n/a	n/a	incl.	opt.	opt.

Concentric vent terminal = 10 ft. pipe length

Table 7. - 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 8. - Required Combustion Air Pipe Material

3.3 Venting

⚠ WARNING

Failure to use polypropylene CPVC or stainless steel venting for the first 30" 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.

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 NeoTherm 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 NeoTherm 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.

The NeoTherm 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 5.](#))

The unit's 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 NeoTherm sizes 80-850. The CPVC vent section included with the NeoTherm may be broken by CPVC fittings if necessary, but never reduced in total length. See [Table 4](#) 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 manufacturer's instructions are not available for the material used, follow the Laars 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 NeoTherm 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 manufacturer's 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 4](#) for proper diameter vs. length allowed.

IMPORTANT NOTE ABOUT COMMON VENTING:
A single vent that is shared by multiple NeoTherm units **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 NeoTherm units unless the vent system meets this requirement. NeoTherm units are never permitted to share a vent with Category I appliances.**

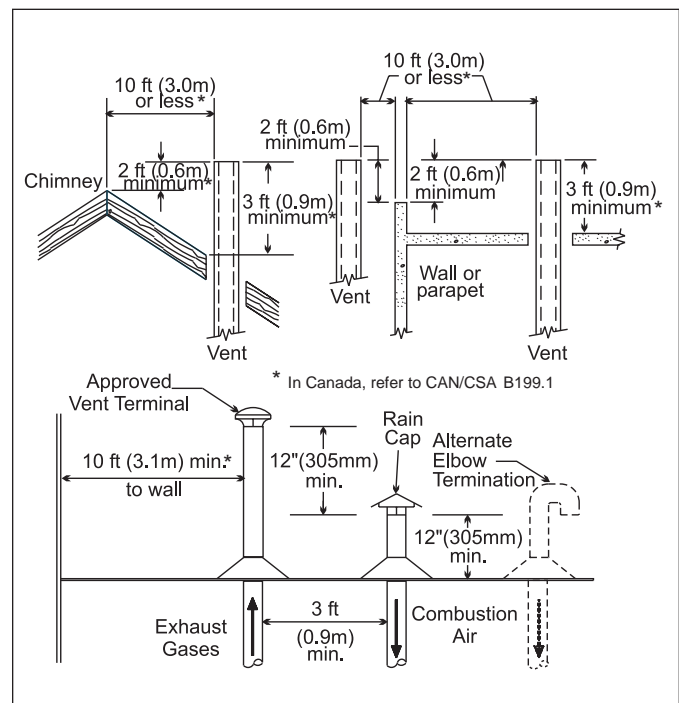


Figure 4. - Combustion Air and Vent Through Roof

INSTALLATION STANDARDS		
MATERIAL	UNITED STATES	CANADA
Stainless Steel	UL 1738	Venting must be ULC-S636 certified for use as venting material. The venting material class must be chosen based upon the 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 9. - Required Exhaust Vent Material

Venting Requirements Unique to Canada

NeoTherm boilers and water heaters 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 manufacturer’s certified installation instructions.

As a result, two items listed in the Unpacking section (Figure 8) are **not included** with NeoTherm 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 (80-500)** (not incl.)
- F. outdoor/system sensor kit
- G. flow switch kit (399-850)
- H. alternate size vent/terminal screens
- J. exhaust vent adapter CPVC/ST ST (750-850)

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

Class I venting systems are suitable for gas-fired appliances producing flue gas temperature of more than 135°C, but not more than 245°C.

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

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

- A Up to and including 65°C
- B Up to and including 90°C
- C Up to and including 110°C, and
- D Up to and including 135°C

IMPORTANT! It is also the responsibility of the installer to ensure that a flue gas sampling port is installed in the vent system. This flue gas sampling port must be installed near the flue connection of the NeoTherm unit: within 2 feet of the flue connection. There is no flue gas sampling port internal to the NeoTherm, so one must be installed in the vent system external to the NeoTherm 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, Laars 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 5.)

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 NeoTherm 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, Laars suggests the use of a coupler fitting from the certified vent system into which the vent terminal screen, included with the NeoTherm 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 NeoTherm instructions.

3.4 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.

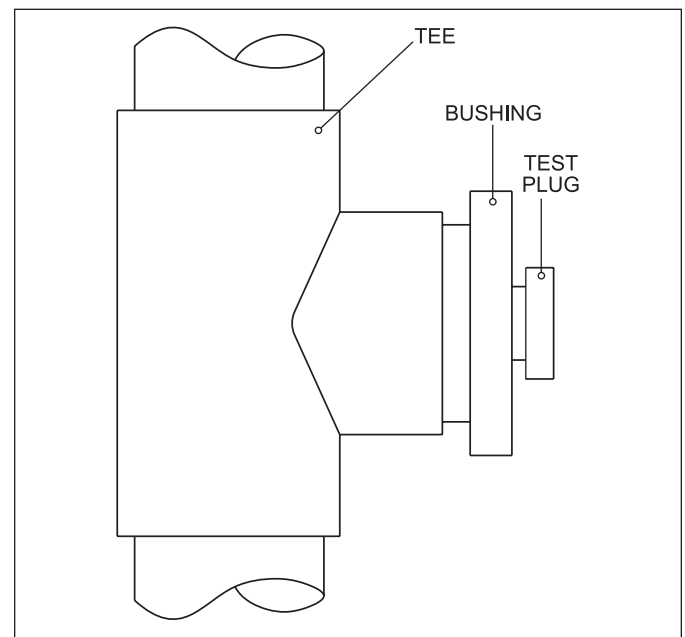


Figure 5. - Test Port - ULC-S636 system

4. Locate the vent terminal so that vent gases cannot enter the building through doors, windows, gravity inlets or other openings. Whenever possible, avoid locations under windows or near doors.
5. **Locate the vent terminal so that it cannot be blocked by snow. The installer may determine that a vent terminal must be higher than the minimum shown in codes, depending upon local conditions.**
6. Locate the terminal so the vent exhaust does not settle on building surfaces or other nearby objects. Vent products may damage surfaces or objects.
7. If the boiler or water heater uses ducted combustion air from an intake terminal located on the same wall, see [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 LAARS side wall combustion air terminal, or concentric terminal must be used when the heater takes air from a side wall. (See [Table 7](#).) Contact Laars 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 NeoTherm 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 8](#).)
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 NeoTherm 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.

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

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

b. In the event that the requirements of the subdivision cannot be met at the time of completion of installation, the owner shall have a period of thirty (30) days to comply with the above requirements, provided, however, that during said thirty (30) day period, a battery operated carbon monoxide detector with an alarm be installed.

	U.S. Installations (see note 1)	Canadian Installations (see note 2)
A= Clearance above grade, veranda, porch, deck, or balcony	12 inches (30 cm) See note 6	12 inches (30 cm) See note 6
B= Clearance to window or door that may be opened	Direct vent only: 12 inches (30cm); Other than Direct vent: 4 ft (1.2m) below or to side of opening; 1 ft (30cm) above opening	36 inches (91 cm) NT 80 only - 12 inches (30 cm)
C= Clearance to permanently closed window	See note 4	See note 5
D= Vertical clearance to ventilated soffit located above the terminal within a horizontal distance of 2 feet (61cm) from the center line of the terminal	See note 4	See note 5
E= Clearance to unventilated soffit	See note 4	See note 5
F= Clearance to outside corner	See note 4	See note 5
G= Clearance to inside corner	See note 4	See note 5
H= Clearance to each side of center line extended above meter/regulator assembly	See note 4	3 feet (91 cm) within a height 15 feet above the meter/regulator assembly
I= Clearance to service regulator vent outlet	See note 4	3 feet (91 cm)
J= Clearance to nonmechanical air supply inlet to building or the combustion air inlet to any other appliance	Direct vent only: 12" (30cm) 80-285; 36" (91cm) 399-850. Other than Direct vent: 4 ft (1.2m) below or to side of opening; 1 ft (30cm) above opening	36 inches (91 cm) NT 80 only - 12 inches (30 cm)
K= Clearance to a mechanical air supply inlet	3 feet (91 cm) above if within 10 feet (3 m) horizontally	6 feet (1.83 m)
L= Clearance above paved sidewalk or paved driveway located on public property	Vent termination not allowed in this location for category IV appliances.	7 ft (2.1 m) See note 5
M= Clearance under veranda, porch, deck, or balcony	See note 4	12 inches (30 cm) (see note 3)

Notes:

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

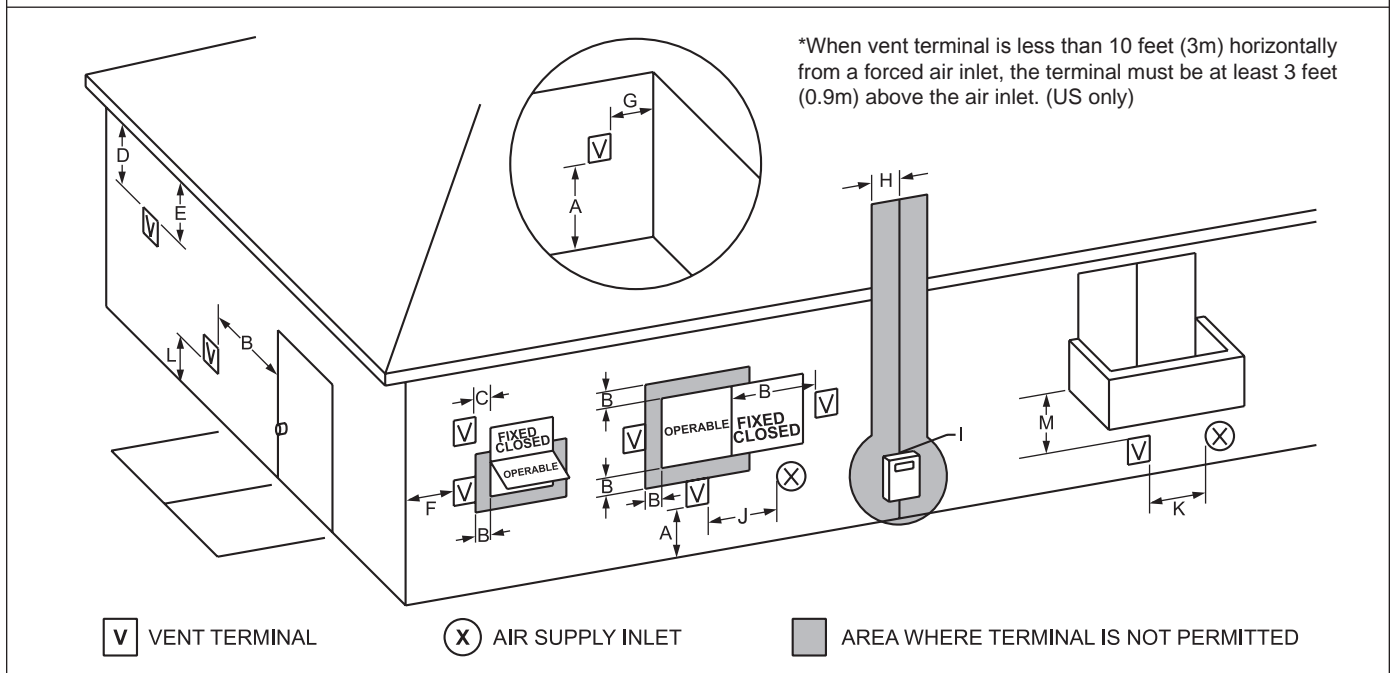


Figure 6. - Combustion Air and Vent Through Side Wall

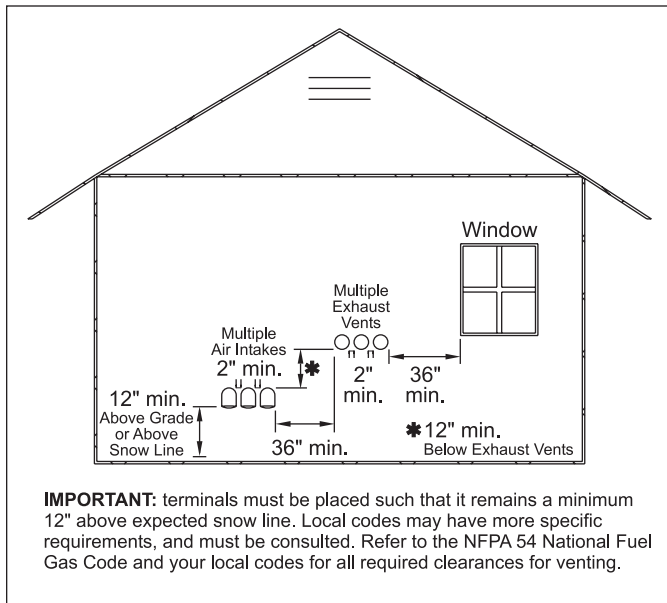


Figure 8. - Multiple Side-Wall Terminals, Air and Vent

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.

3.5 Common Vent Test

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

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

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

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

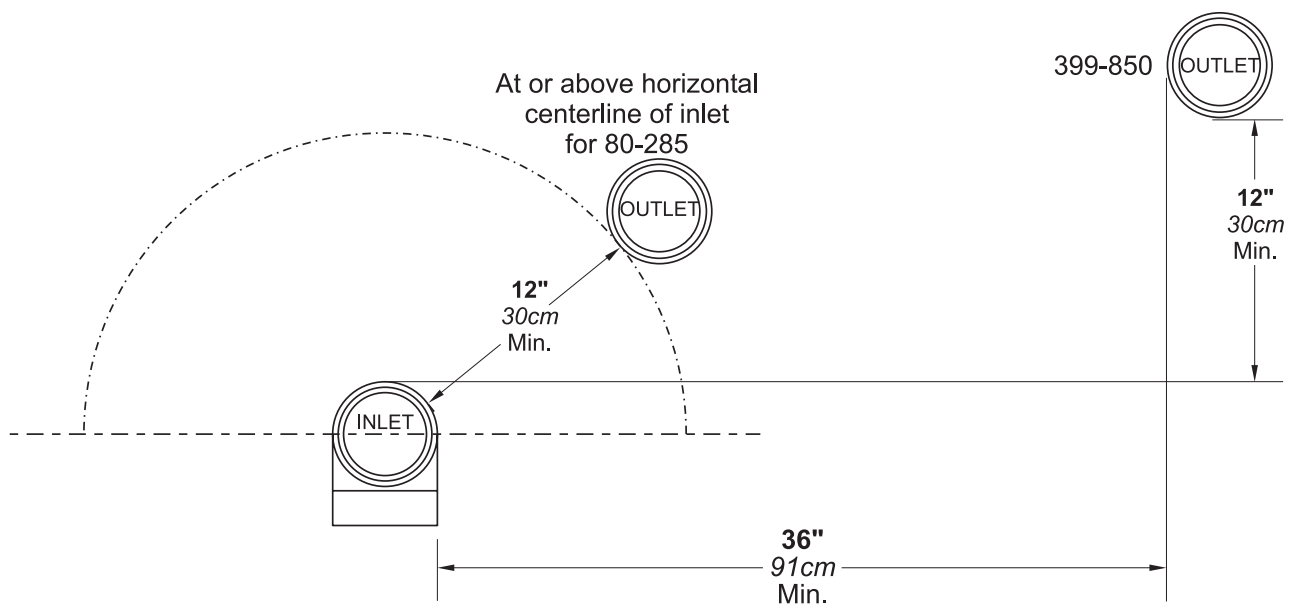


Figure 7. - Minimum Venting Distance

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.

Section 4 - GAS SUPPLY AND PIPING

Gas piping should be supported by suitable hangers or floor stands, not the appliance.

Review the following instructions before proceeding with the installation.

1. Verify that the appliance is fitted for the proper type of gas by checking the rating plate. NeoTherm will function properly without the use of high altitude modification at elevations up to 10,000 feet (3050 m).
2. The maximum inlet gas pressure must not exceed 13" W.C. (3.2kPa). The minimum inlet gas pressure is 4" W.C. (1.0kPa).
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 appliance and its individual shutoff valve must be disconnected from the gas supply piping during any pressure testing of that system at test pressures in excess of 1/2 PSIG (3.45kPa).
9. The unit must be isolated from the gas supply system by closing its individual manual shutoff valve during any pressure testing of the gas supply piping system at test pressures equal to or less than 1/2 PSIG (3.45kPa).
10. The appliance and its gas connection must be leak tested before placing it in operation.
11. Purge all air from gas lines.

WARNING:

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

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

NEOTHERM NATURAL GAS REQUIRED	
SIZE	CU FT / HR.
80	80
105	105
150	150
199/210	199/210

Table 10.

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 6B. Align total length (pipe and fittings) on left side column of Table 6C with highest cubic feet of gas required.

Notes:
Consult and confirm with Applicable Fuel Gas Code before beginning work. Verify gas inlet pressure is between 4 and 13 in W.C. before starting boiler.

EQUIVALENT LENGTHS OF STRAIGHT PIPE FOR TYPICAL SCH 40 FITTINGS						
FITTING	NOMINAL PIPE SIZE					
	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.

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.

SCH 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

NOTES:
1. Follow all local and national LP gas codes for line sizing and equipment requirements.
2. Verify that inlet gas pressure remains between 4 and 13 inches of water column before and during operation.
Source: ANSI Z223.1-80 National Fuel Gas Code.

Table 13.

Section 5 - PUMP REQUIREMENTS

5.1 NeoTherm Boiler Flow and Head Requirements

SIZE	TEMPERATURE RISE IN °F									
	20°F		25°F		30°F		35°F		40°F	
	FLOW GPM	H/L FT	FLOW GPM	H/L FT	FLOW GPM	H/L FT	FLOW GPM	H/L FT	FLOW GPM	H/L FT
80	7.6	14.9	6.1	10.1	5.1	7.1	4.3	5.8	3.8	4.6
105	10	23.1	8	17	6.7	12.4	5.7	9.6	5	7.6
150	14.3	28.5	11.4	19	9.5	13.6	8.1	11.2	7.1	8.8
210	20	24.1	16	16.7	13.4	11.6	11.3	9	9.9	6.9

SIZE	TEMPERATURE RISE IN °C									
	11°C		14°C		17°C		19°C		22°C	
	FLOW lpm	H/L m	FLOW lpm	H/L m	FLOW lpm	H/L m	FLOW lpm	H/L m	FLOW lpm	H/L m
80	29	4.5	23	3.1	19	2.2	16	1.8	14	1.4
105	38	7.0	30	5.2	25	3.8	22	2.9	19	2.3
150	54	8.7	43	5.8	36	4.1	31	3.4	27	2.7
210	76	7.3	61	5.1	51	3.5	43	2.7	37	2.1

Table 14. Water Flow Requirements

5.2 NeoTherm Water Heater Flow and Head Requirements

Size	NORMAL WATER*					
	Flow gpm	H/L feet	Temp Rise °F	Flow lpm	H/L m	Temp Rise °C
150	19	49	15	72	14.9	8
199	25	28	15	95	8.5	8

* Maximum water hardness of 10 grains per gallon allowed.
** See section 6B.7 on page 27 for pump information.

Table 15. Water Heater Flow Data

Section 6 WATER CONNECTIONS - NTH BOILER

6.1 NTH System Piping - Hot Supply Connections

NOTE: This appliance 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 appliance. Due to expansion and contraction of copper pipe, consideration should be given to the type of hangers used. Rigid hangers may transmit noise through the system resulting from the piping sliding in the hangers. It is recommended that padding be used when rigid hangers are installed. Maintain 1” (2.5cm) clearance to combustibles for hot water pipes.

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.

NeoTherm’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](#) through [Figure 15](#).

NeoTherm NTV models 150-500 can be ordered with or without a pump included.

NeoTherm NTH models 80-500 can also be ordered with or without a pump included.

NTH SIZE	PIPE SIZE, INCHES
80	1
105	1
150	1
210	1¼

Table 16. - Water Connection Pipe Sizes

NeoTherm with a pump **MUST** be piped in a primary-secondary fashion (using either piping or a hydraulic separator) such that the pump that is mounted on the boiler **ONLY** serves the boiler.

When the pump is supplied by Laars, the NeoTherm boiler must be located within 15 feet (4.6m) of the supply and return header (or the hydraulic separator). Pumps supplied by Laars are sized for a maximum of 30 feet (9.1m) of connection size piping and the headloss of the boiler only. (See [Table 14.](#))

If longer pipe lengths are required, the pump should be sized for the boiler and for the piping it will serve, and should be supplied to the job separately. Even with pumps supplied by others, Laars strongly recommends primary-secondary piping.

6.2 NTH 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.

6.3 Condensate Drain

A condensate drain trap is built into the NeoTherm 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 manufacturer's responsibility.**

6.4 Freeze Protection

NeoTherm 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, Laars 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: Laars 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 manufacturer, for information about specific products, maintenance of solutions, and set up according to your particular conditions.

6.5 NTH Suggested Piping Schematics

Figure 9 through Figure 15 shows suggested piping configurations for NTH boilers. These diagrams are only meant as a guide. All components or piping required by local code must be installed.

6.6 Recognized Chemicals

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

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

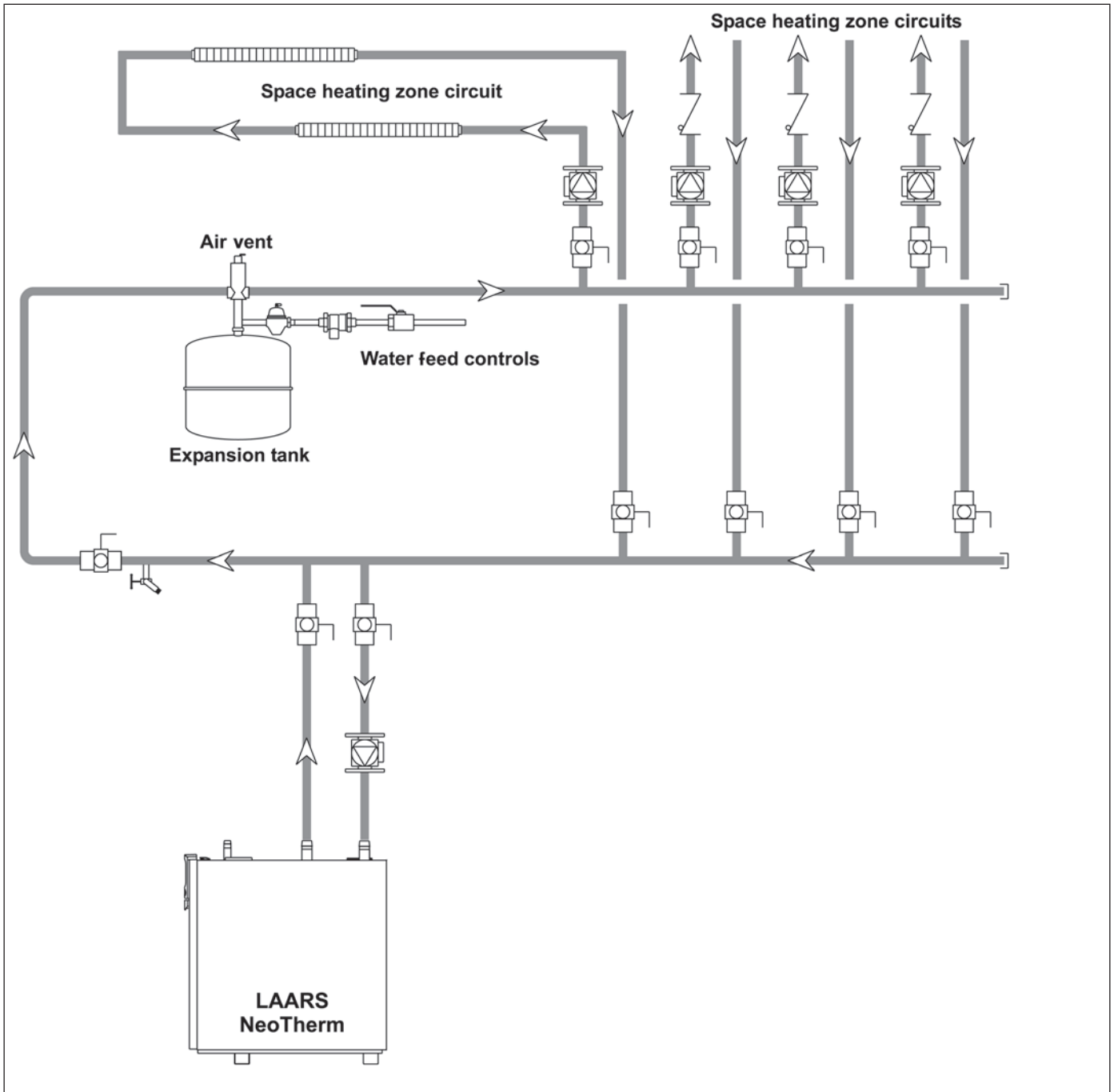


Figure 9. - Hydronic Piping — Single Boiler, Zoning with Circulators

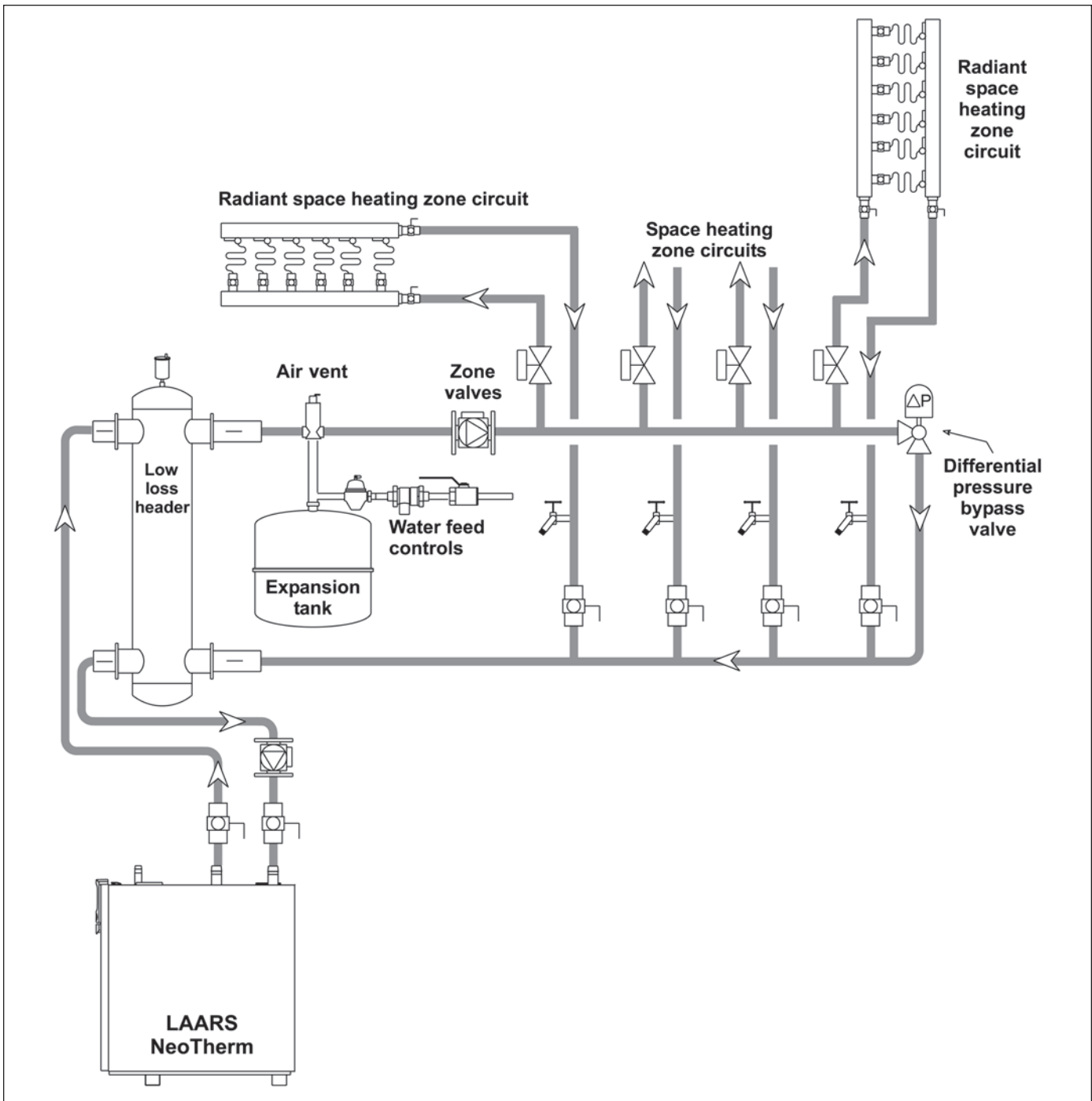


Figure 10. - Hydronic Piping — Single Boiler, Low Temp Radiant Space Heating Using Low Loss Header and Zone Valves

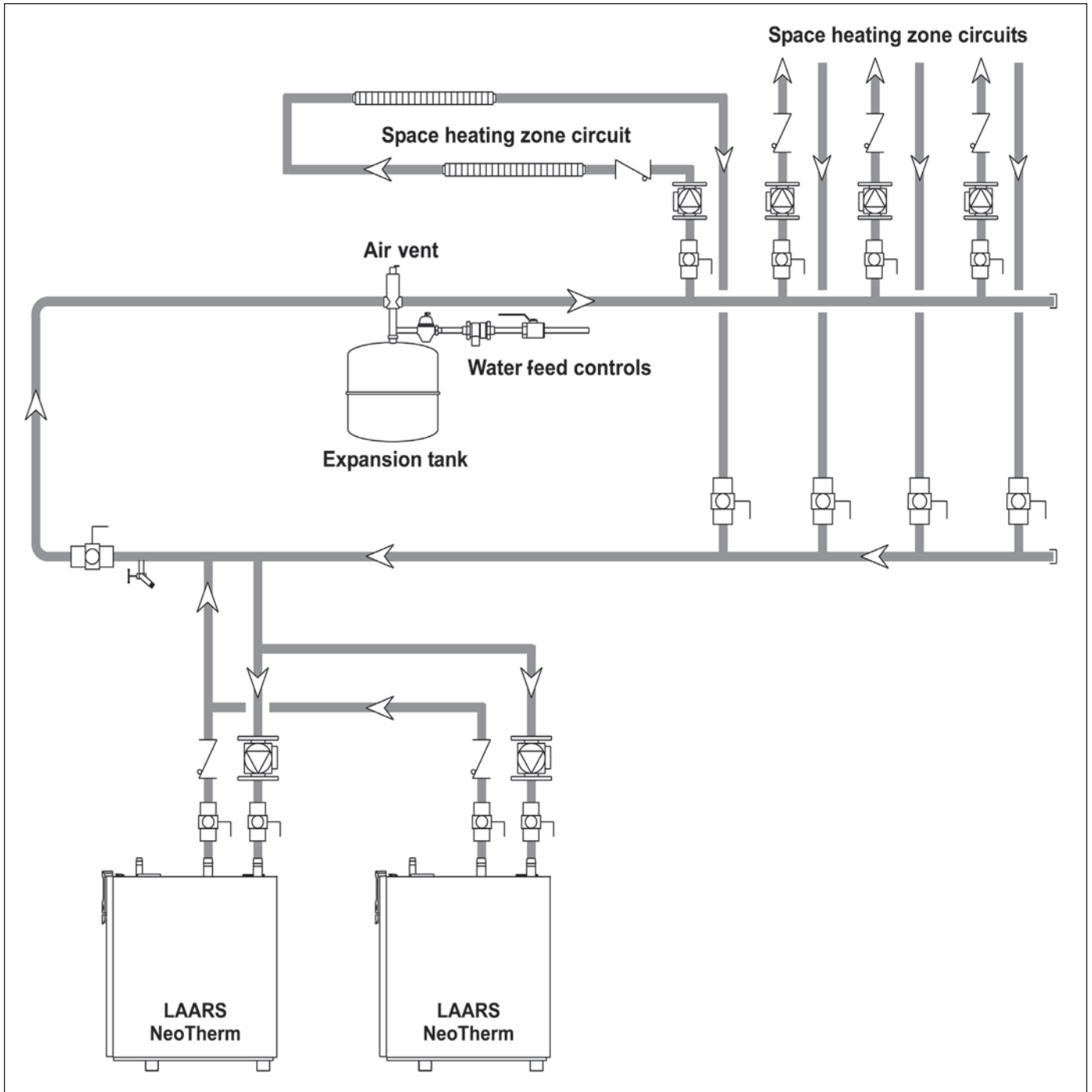


Figure 11. - Hydronic Piping — Multiple Boilers, Zoning with Circulators

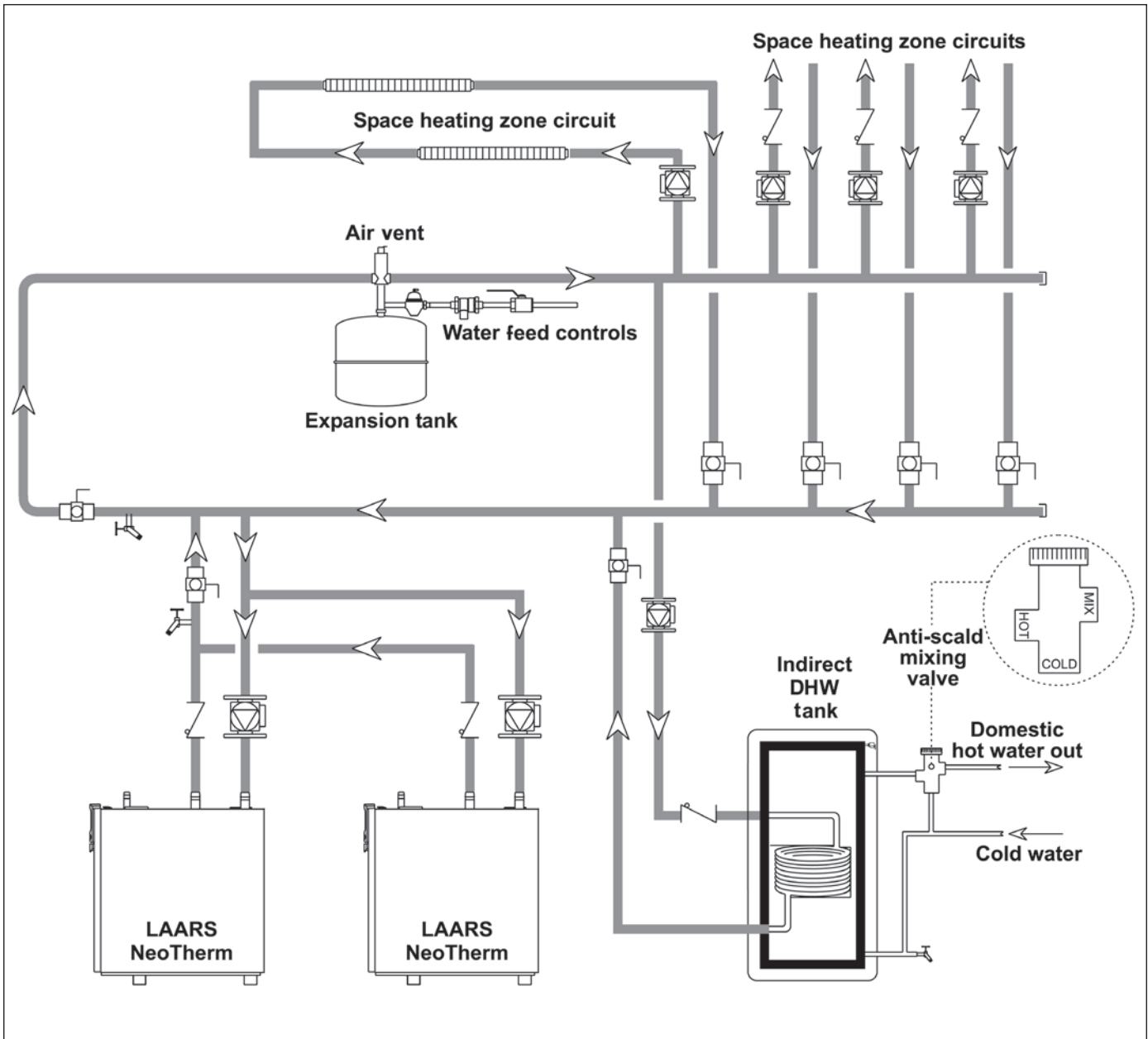


Figure 12. - Hydronic Piping — Multiple Boilers with Indirect DHW Tank Piped from System Loop

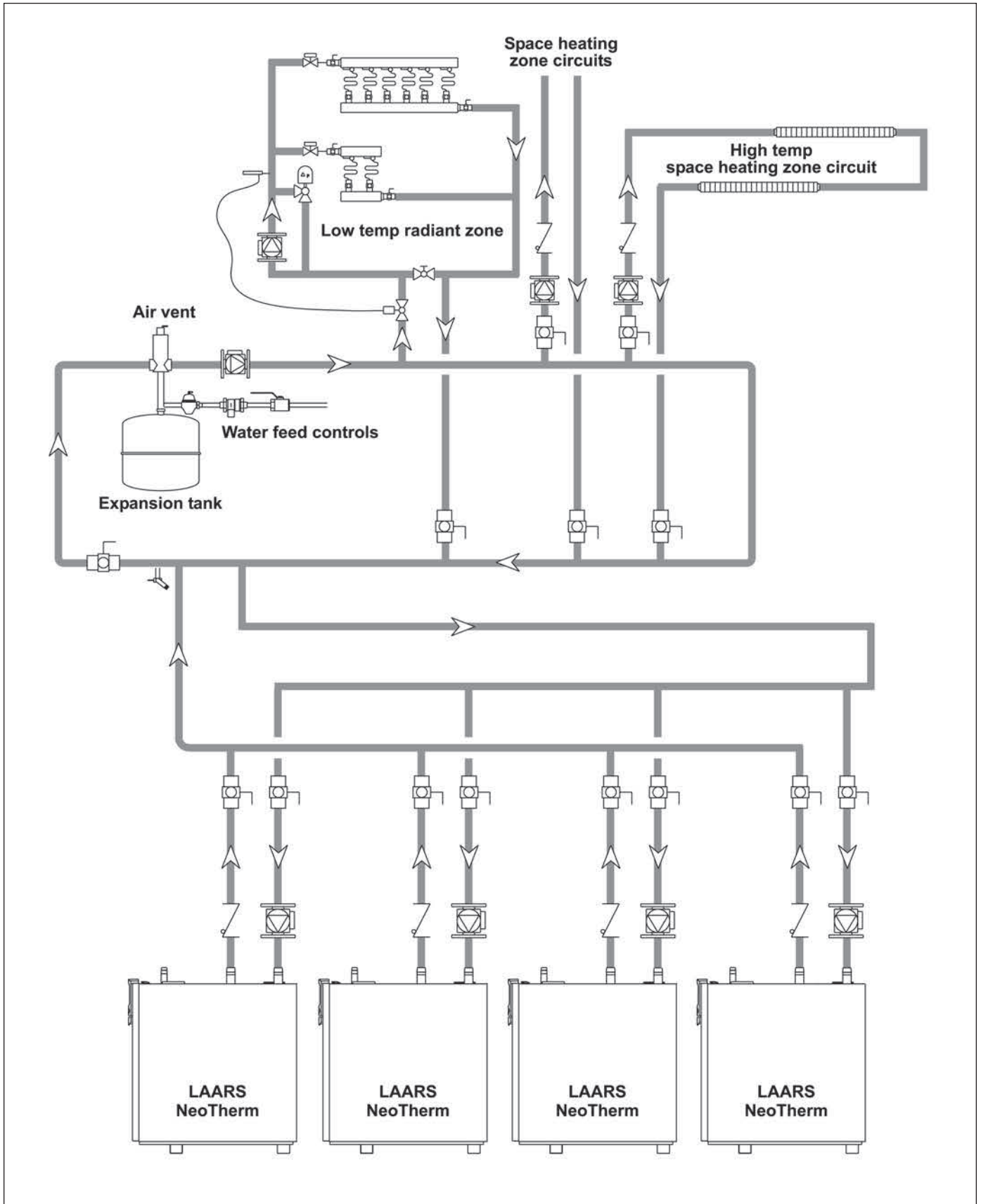


Figure 13. - Hydronic Piping — Multiple Boilers, Reverse Return, Multi-Temp Zones, Zoning with Circulators

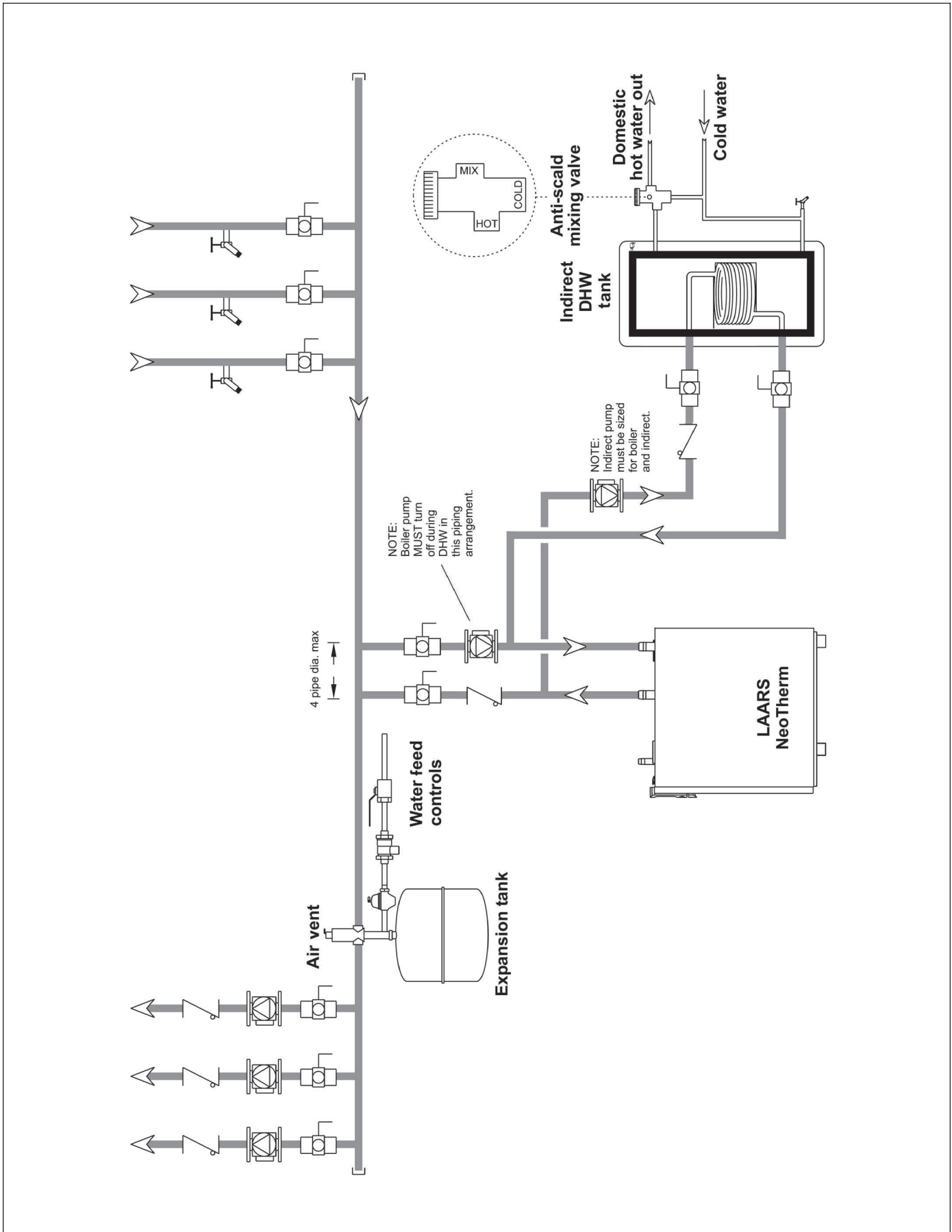


Figure 14. - Hydronic Piping — Heating Zones with Indirect DHW Tank Piped with Zone Pumps
 The indirect DHW tank is piped directly off of the boiler. The boiler pump must shut down during DHW operation.

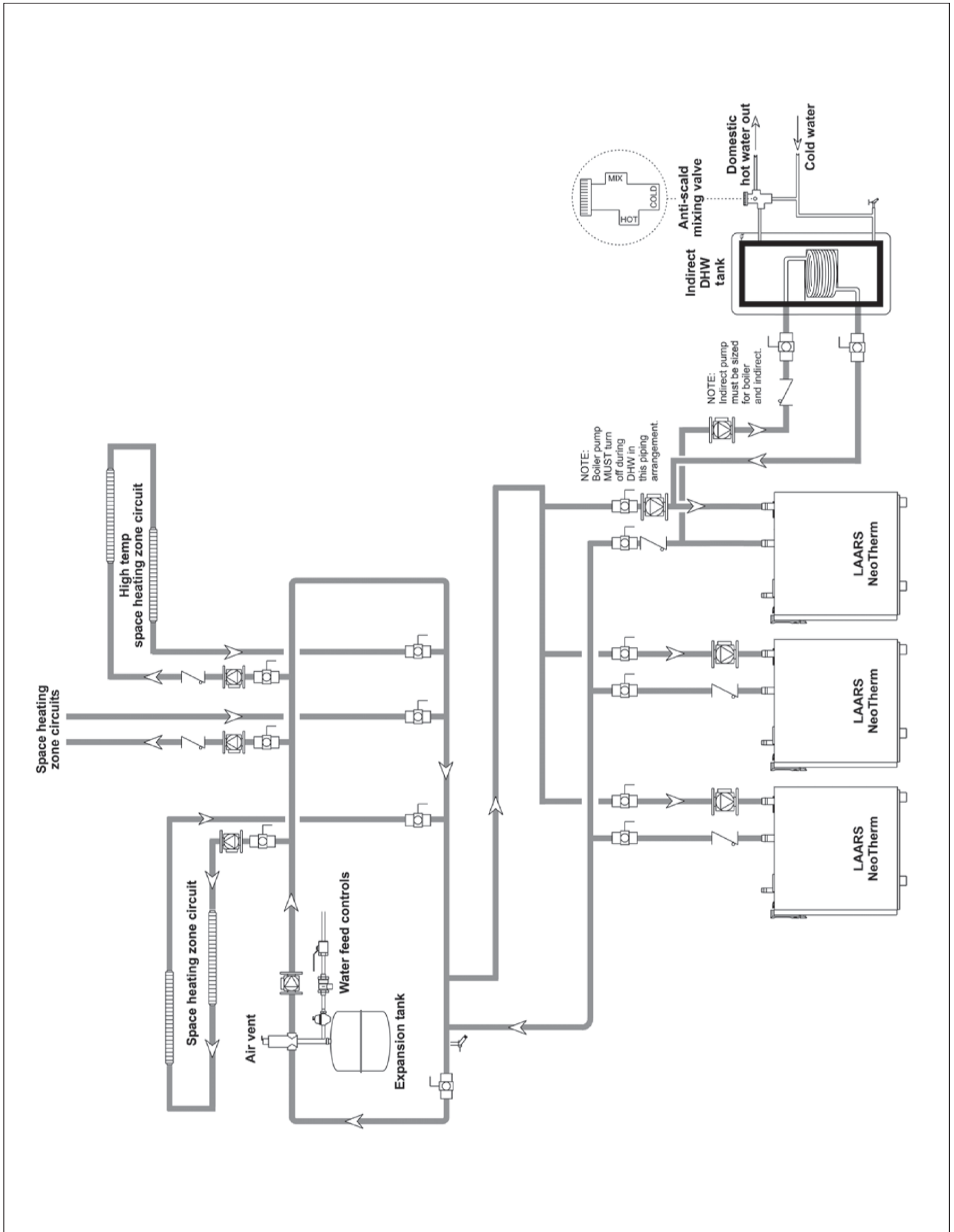


Figure 15. - Hydronic Piping, Multiple Boilers with Indirect DHW Off of One Boiler

The boiler pump must shut down during DHW operation.

Section 7 - THE USER INTERFACE

7.1 About the User Interface

The User Interface of the NeoTherm has two main parts:

- the ‘Display’ area and
- the ‘Buttons’

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

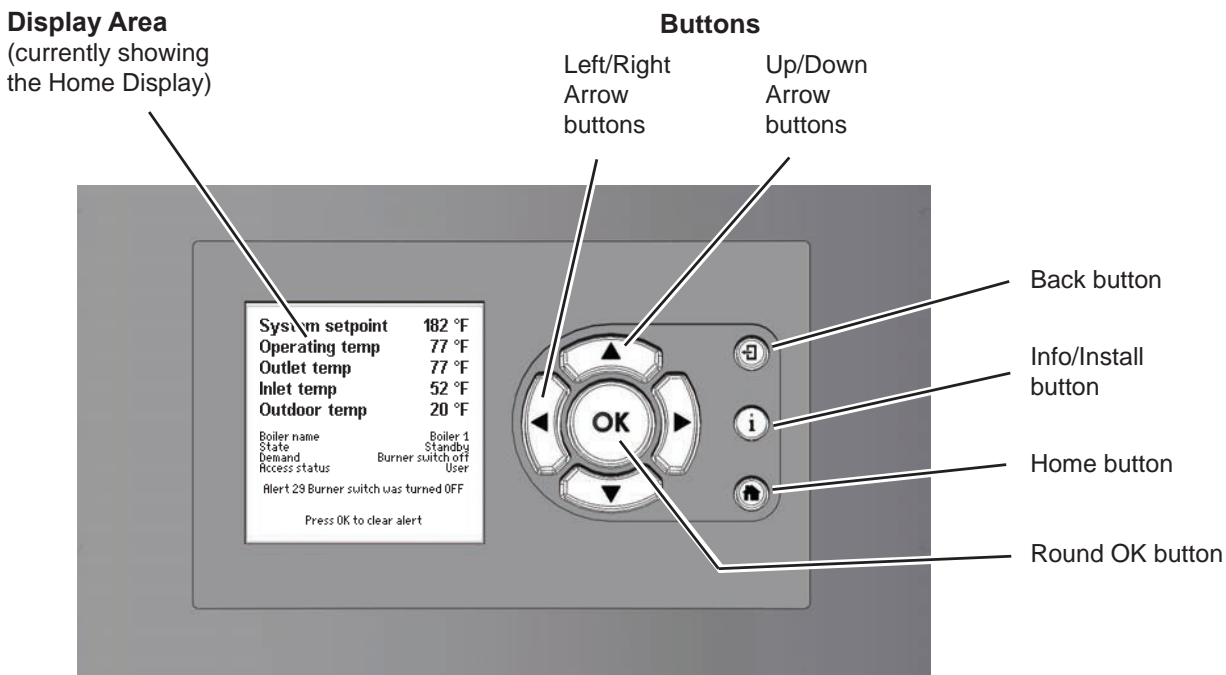


Figure 23. - The User Interface (UI)

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

7.2 Navigating the User Interface

Navigating into the Display area menus 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 Table 10 for more details.

7.3 The Home Display

When the boiler is operating normally, the controller will display the Home display. See Figure 16.



Figure 16. - 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.

7.4 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.

7.5 Entering/Changing Control Settings

Info/Install Display

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 16, press the “I” button (“Info/ Install”). The display will change to show the six sub-menus available. See Figure 17.

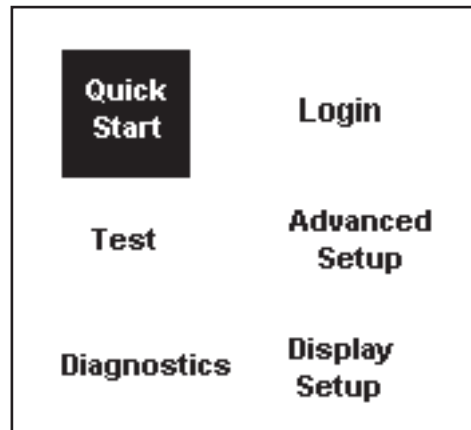


Figure 17. - Info/ Install Display

- 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	<p>This menu gives you an easy way to check or change the most common settings on the unit:</p> <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 <p>See Section 8B for more information.</p>
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 18** shows a typical screen for this type of setting.

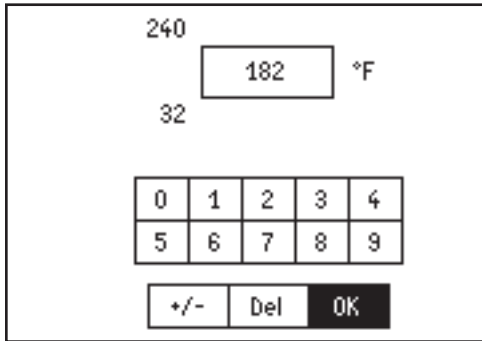


Figure 18. – Changing a Value

- 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 by anyone.

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.

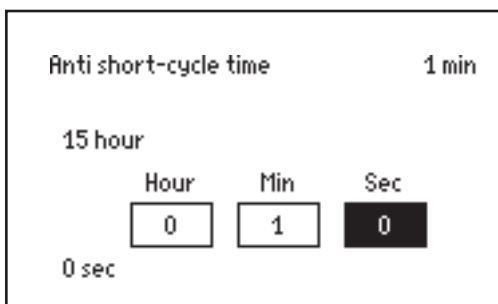


Figure 19. - Changing a Timing Function

- 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. See **Figure 20**.

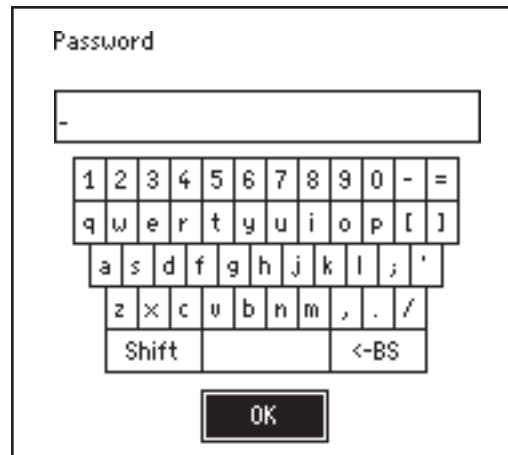


Figure 20. – Login Screen

There are two ways you can reach this screen:

- From the Info/ Install screen (**Figure 17**), 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 Laars 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 21. - 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 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 Fig. 33.

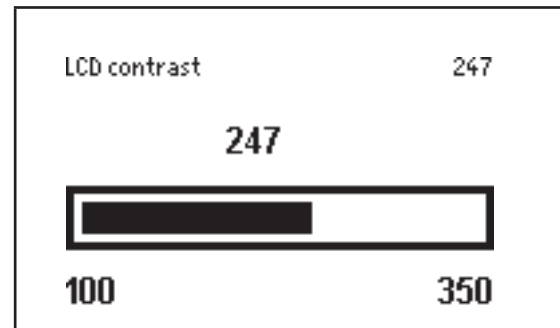


Figure 22. – Changing LCD Contrast

- 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.

Section 8A - QUICK START MENU

Section 8 is divided into three parts. Section 8A includes instructions for using the Quick Start Menu. Section 8B covers basic installation and wiring. Section 8C includes more detailed setup instructions and wiring diagrams.

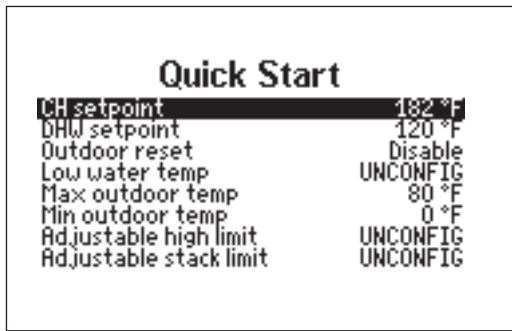


Figure 24. - Quick Start Menu

Changing the CH (Central Heat) Setpoint -

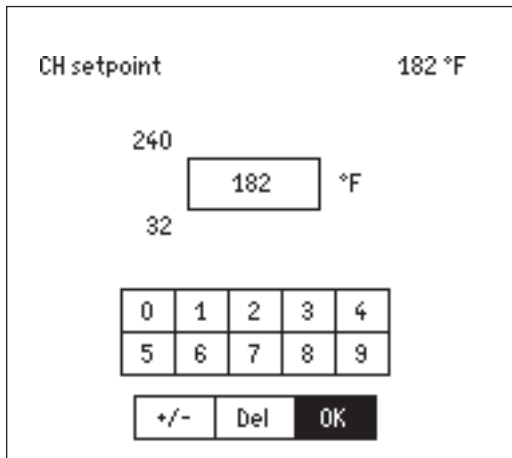


Figure 25. - Changing the CH Setpoint

- 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.

Section 8B - BASIC INSTALLATION AND WIRING

Section 8 is divided into three parts. Section 8A includes instructions for using the Quick Start Menu. Section 8B covers basic installation and wiring. Section 8C includes more detailed setup instructions and wiring diagrams.

8B.1 Installation Warnings

⚠ WARNING

The appliance 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. Electrocution can result in severe injury or death.

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

All electrical connections are made on the terminal blocks that are located inside the control panel. Wiring connections are shown in [Figure 26](#).

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

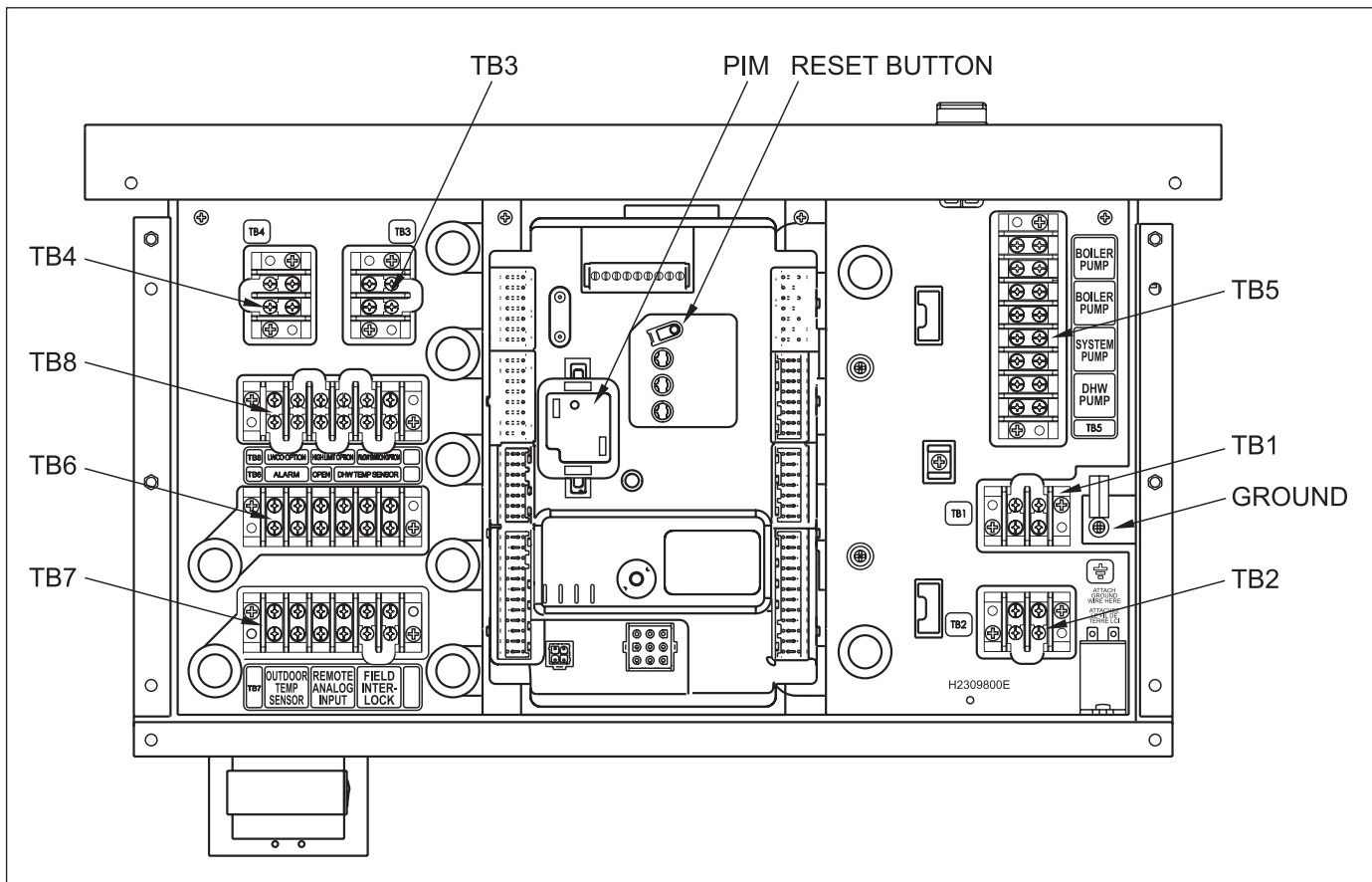


Figure 26. - Control Panel Layout

⚠ Caution

The supply voltage to the NeoTherm 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 NEOTHERM UNIT TO SIGNAL A CALL FOR HEAT. A call for heat/ end call for heat MUST be connected to the field interlock terminals. Some NeoTherm components are designed to have constant voltage during normal operation. If the NeoTherm’s supply voltage is toggled as a call for heat signal, premature failure of these components may result.

The NeoTherm 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 NeoTherm will remain in low fire when it sees 4mA as a modulating signal.

8B.2 Main Power Connections

Connect a 15A fused, 120-volt supply to the main power switch. (The hot leg is connected directly to the switch.) The neutral leg is connected directly to the white wire. The ground wire can be connected to the grounding lug on the control panel. (See [Figure 26](#).)

8B.3 Pump Connections and Operation

The controller in the NeoTherm energizes the 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 (TB5 - max 7.4 FLA) are fed by 120V (violet wire) internally from the main power feed. The System and DHW contacts are dry contacts. Appropriate voltage must be supplied to the System and DHW pumps for proper operation.

The System pump connections are located on terminal block 5 (TB5) in the control panel. (See Figure 34.) The System pump contacts are rated for 120Vac, 7.4 Amps. To use the contacts, power must be supplied on one terminal with the other terminal wired to the pump or a relay controlling the pump.

The DHW pump connections are located on terminal block 5 (TB5) in the control panel 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.

Additional 120VAC circuits may 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.

SIZES	BOILER			PUMP CONNECTIONS RATINGS (Boiler, System Pump and DHW Pump Connections)
	VOLTS	PHASE	AMPS	
80–210 No Pump	120	Single	2*	115V – Maximum 1HP or 7.4A max
80-210 With Pump	120	Single	Less than 6*	115V – Maximum 1HP or 7.4A max

*Minimum 15A circuit required

Table 19. - NTH Electrical Data

Section 8C - DETAILED SETUP INSTRUCTIONS and DIAGRAMS

Section 8 is divided into three parts. Section 8A includes instructions for using the Quick Start Menu. Section 8B covers basic installation and wiring. Section 8C includes more detailed setup instructions and wiring diagrams.

8C.1 24 VAC Transformer with Integral Circuit Breaker

24Vac is supplied by a transformer mounted underneath the control panel. All 24Vac 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).

8C.2 Hydronic Heating Demand

When using the NeoTherm 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 NeoTherm enters Run. If the flame signal is below the threshold, the NeoTherm returns to prepurge and starts the ignition process over. When operating in Run, the NeoTherm 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), 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 “I” to go to “Info/ Install.” Choose “Quick Start,” then go to “CH Setpoint.”

8C.3 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 “I” to go to “Info/ Install.” Choose “Advanced Setup,” then “System Configuration,” then “System Configuration” again.

8C.4 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.

8C.5 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 8C.8.)

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

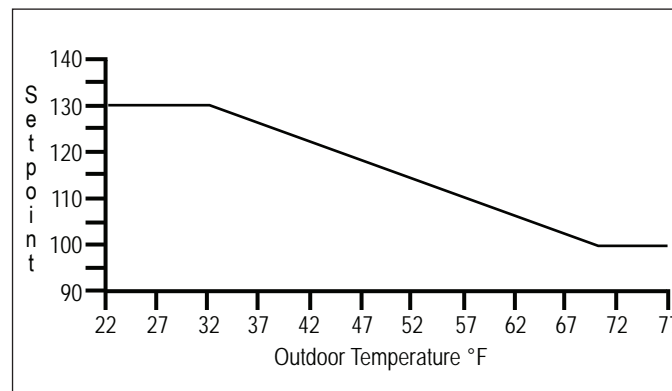


Figure 27. – Outdoor Reset Operation

In the graph shown above, the sloping line 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 (See **Figure 27**). 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.

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 “I” 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 “I” 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 “I” 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 “I” 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 “I” 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 “I” 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 “I” 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 “I” 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.”

8C.6 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 8C.4. (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.

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.” Go to the line for “Warm Weather Shutdown Setpoint”, and set the value.

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

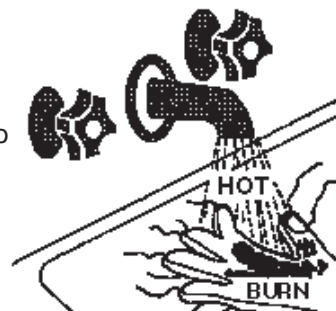
How to get there: On the unit used as the Lead/ Lag Master only - From the “Home” screen, press “I” to go to “Info/ Install.” Choose “Advanced Setup,” then go to “CH Configuration.” Select “Warm Weather Shutdown.” On the line for “Warm Weather Shutdown Setpoint,” and set the value.

8C.7 Domestic Hot Water

A NeoTherm unit 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.

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 appliance is used to produce water that could scald if too hot, such as domestic hot water use, adjust the outlet control (limit) or use temperature limiting valves to obtain a maximum water temperature of 125°F (52°C).



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 NeoTherm 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 NeoTherm 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 appliance when there is a DHW demand.

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

(For a complete explanation of the Lead/Lag system, see Section 8C.8.)

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.

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 NeoTherm 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 NeoTherm 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 appliance 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 “I” 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 “I” to go to “Info/ Install.” Choose “Advanced Setup,” then go to “DHW Configuration.” Select “DHW Priority Time.”

8C.8 Cascading Lead/Lag Operation

About Lead/Lag Operation -

If an installation includes two or more boilers, they may be set up for “Lead/Lag” operation. One boiler will be set up as the “Master”, and the others will operate as “Slaves.” 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. See [Figure 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 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 20](#)), 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 reaction to the changes in demand.

See [Figure 30](#) through [Figure 31](#).

Control Settings for Lead/Lag System - Part 1

1. Power up all of the boilers in the system.

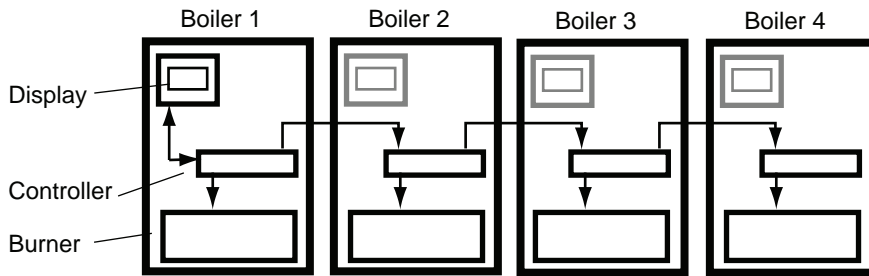


Figure 28. – “Lead/Lag” Operation in a System with Four Boilers. Note - the Displays on Boilers 2 thru 4 will display information pertaining only to that specific boiler.

NOTE: If your NeoTherms 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 7.5 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%

Table 20. - Base Load Settings

- 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.”

- 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

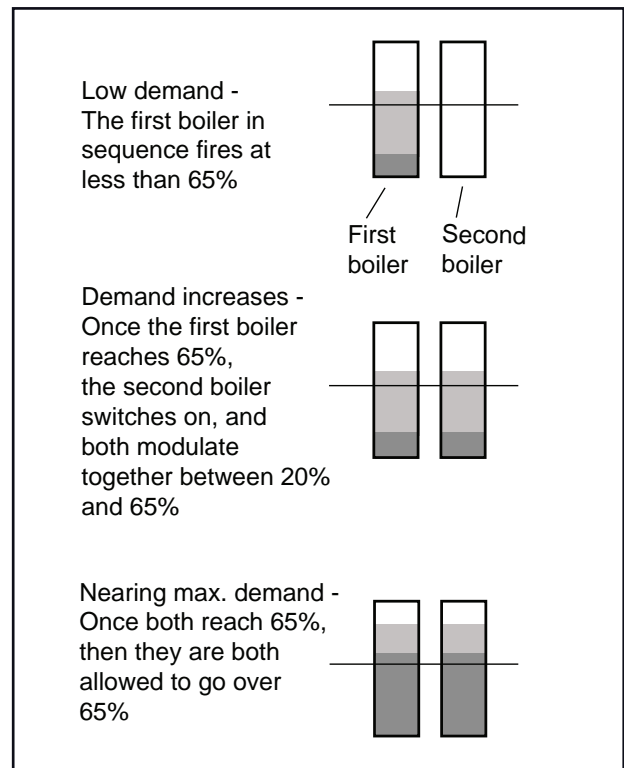


Figure 29. - Lead / Lag Operation, 2 boilers.

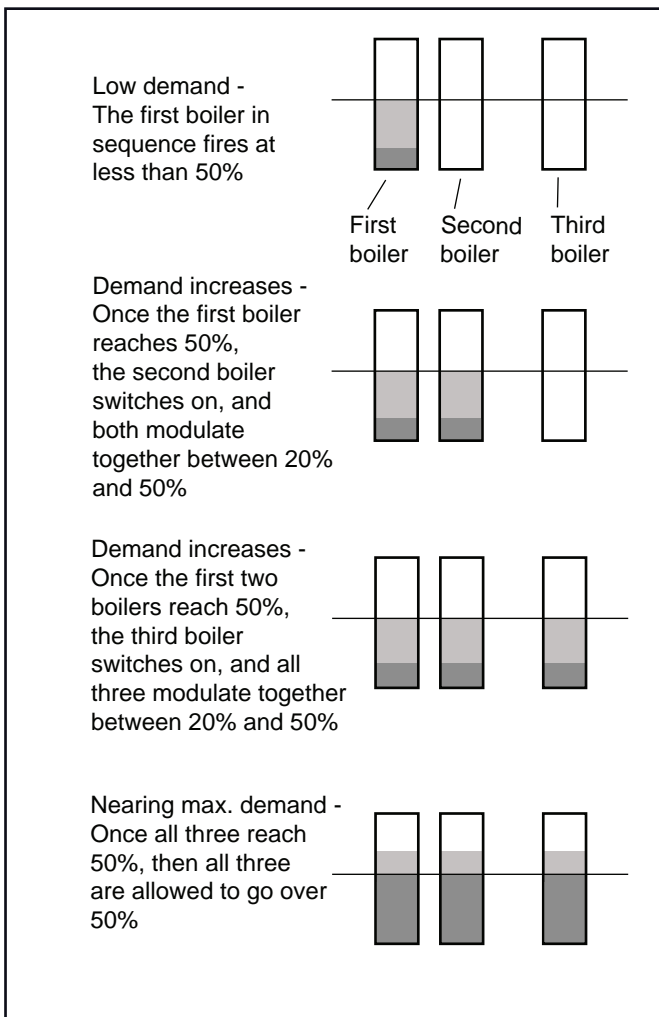


Figure 30. - Lead / Lag Operation, 3 boilers.

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 Slave.

- 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), identify each unit as a slave by turning on “Slave 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 Slave

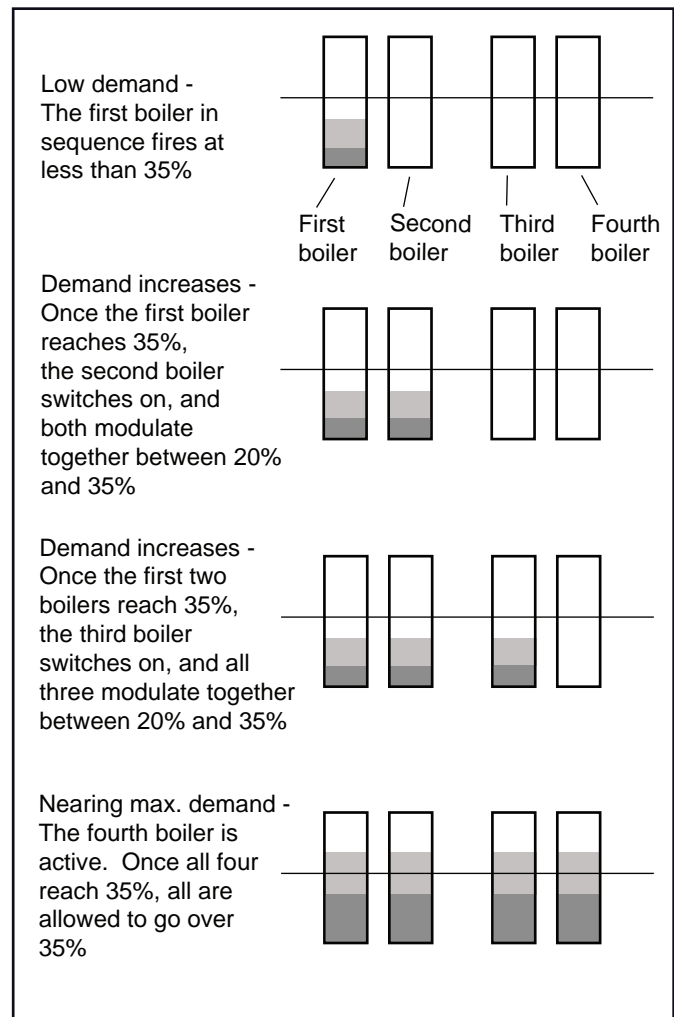


Figure 31. - Lead / Lag Operation, 4 or more boilers.

Configuration.” On the line for “Slave Enable” select “Enable.” When you select Slave 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 32](#).

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

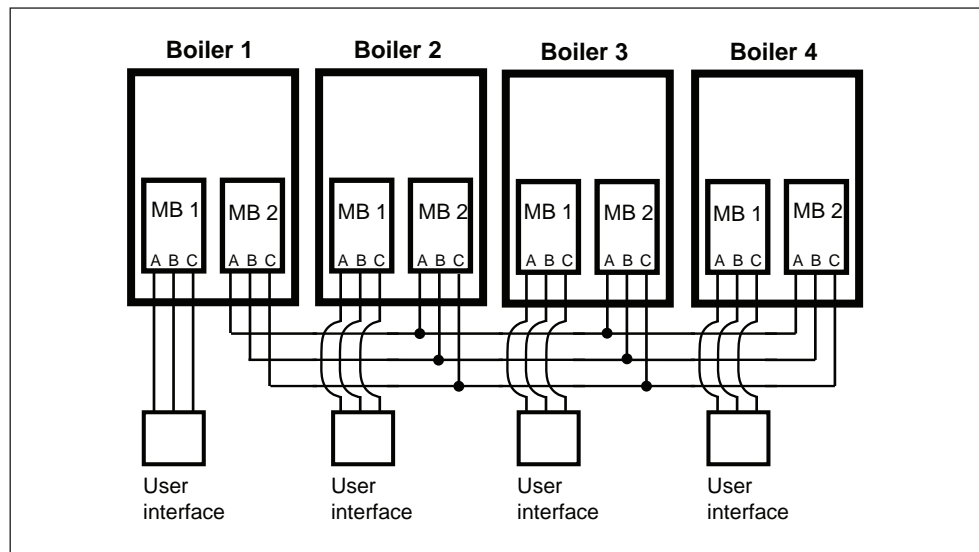


Figure 32. - Lead-Lag / Cascading Wiring Connections

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.

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 "I" 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 "I" 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."

8C.9 Hydronic Heating Using External Modulation Control -

About External Control -

When the NeoTherm 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 NeoTherm 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 - Laars 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.

Connections for External Control -

Connect the 4-20mA signal from an external control or building automation system to terminal block 7 (TB7) in the control panel. The connections are labeled Remote Analog Input. When making the connections, follow the polarity designations shown on the label.

8C.10 Optional Field Connections

Terminal block 8 (TB8) in the control panel can be used 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.

8C.11 Connections to a Building Automation System

NeoTherm boilers can be controlled and monitored through the included Modbus ports. The Modbus wiring should be completed according to the diagrams shown below. If alternate communication protocols are desired, Laars offers “gateways” to allow BACnet, LON, and other communications protocols. For additional information on setting up Modbus and other communication protocols, contact the factory.

Signals from a Building Automation System can be connected to the MB2 Modbus connections on the controller. See **Figure 33**. (MB1 is used to connect to the User Interface (UI).

If multiple boilers are connecting in a cascading Lead/ Lag arrangement, the signals from the Building Automation System must be brought in through a System Display. See **Figure 34**.

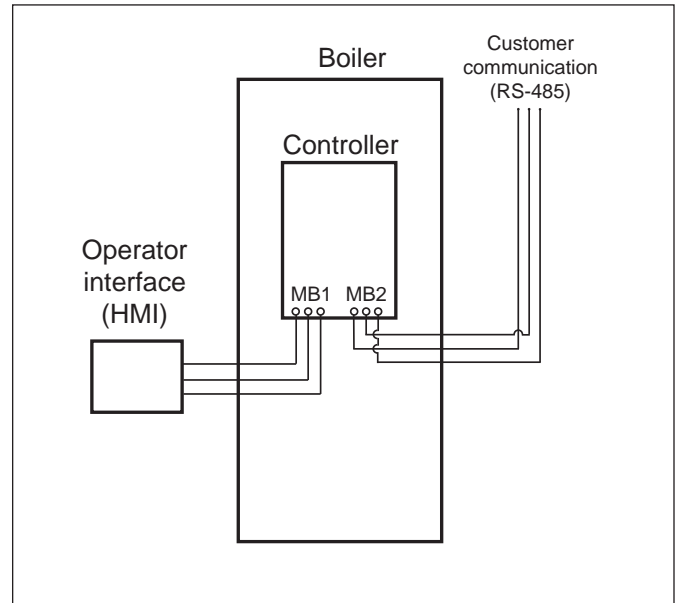


Figure 33. - BAS Connections to a Single Boiler

8C.12 Ladder and Wiring Diagrams

(See **Figure 35**)

⚠ WARNING

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

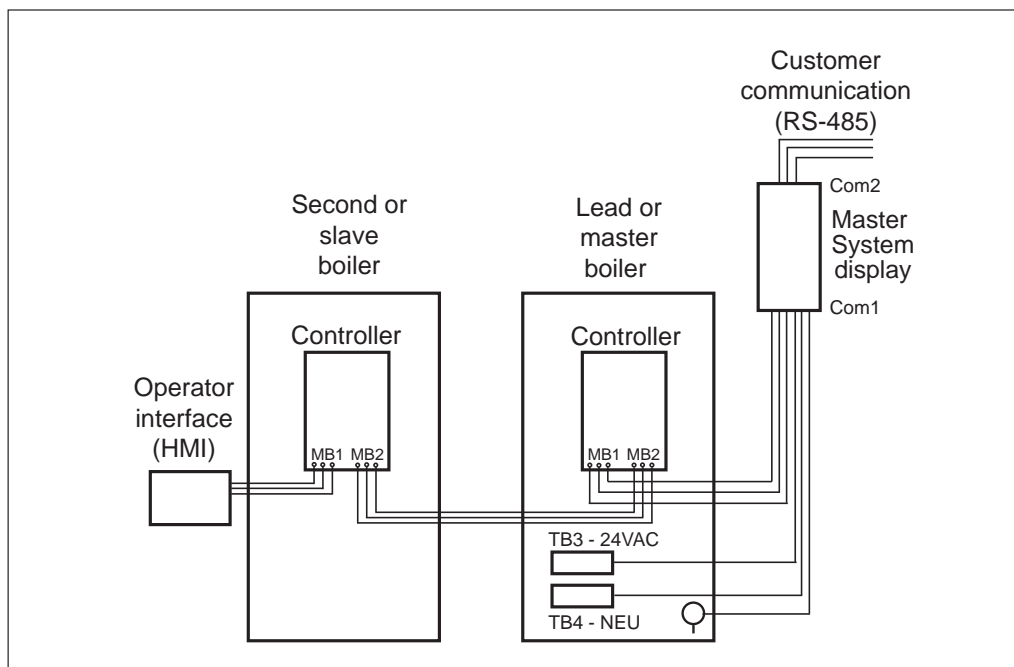


Figure 34. - BAS Connections to a Lead/ Lag System

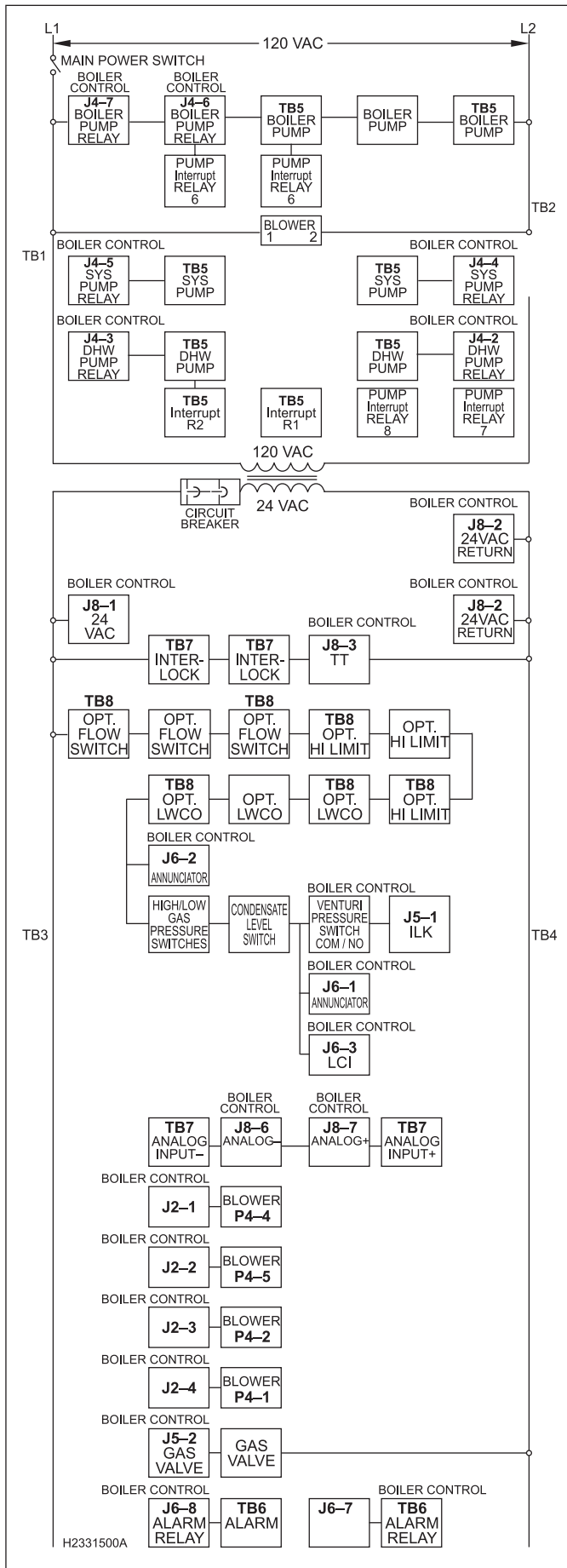


Figure 35. - Ladder Diagram

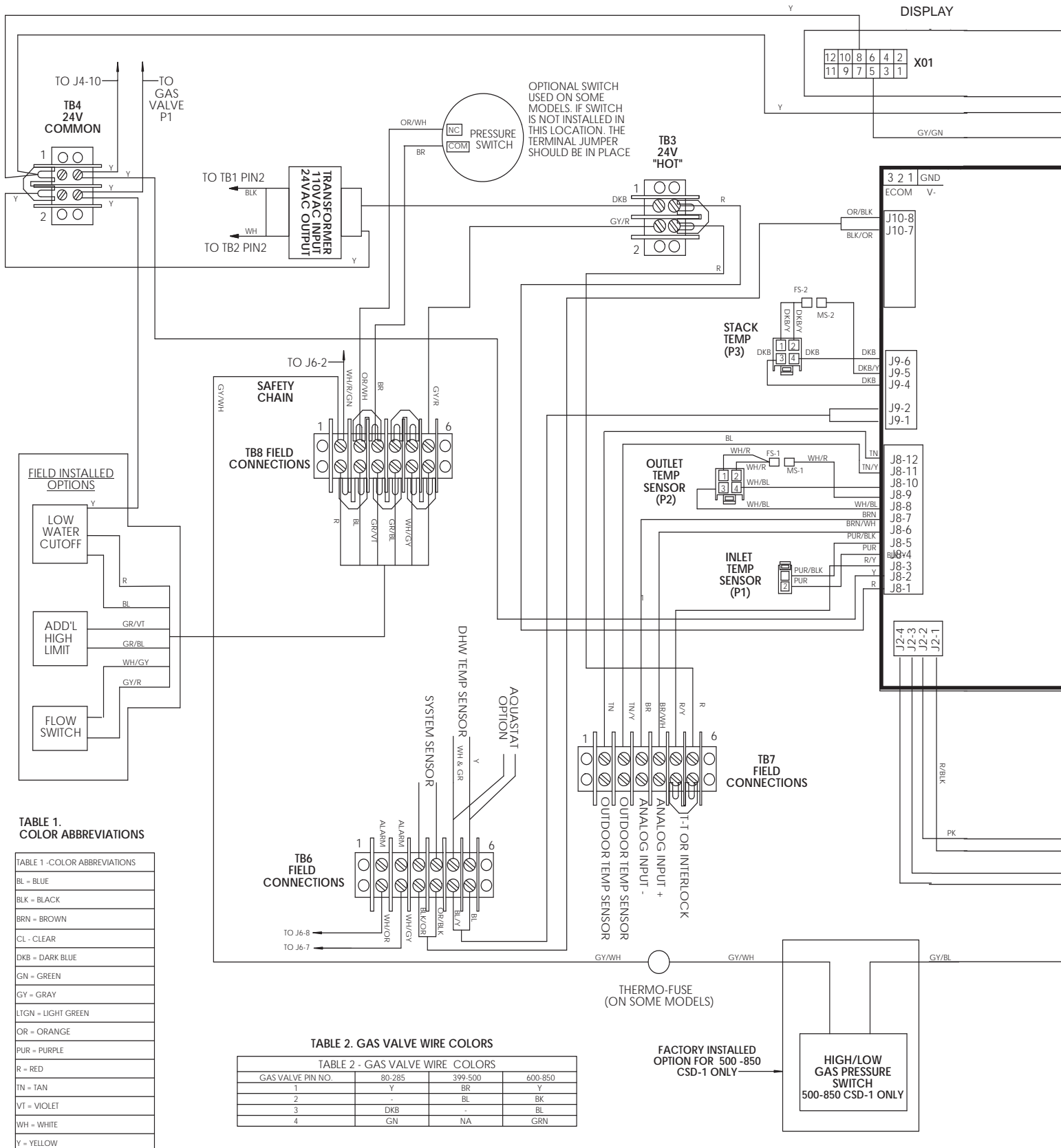
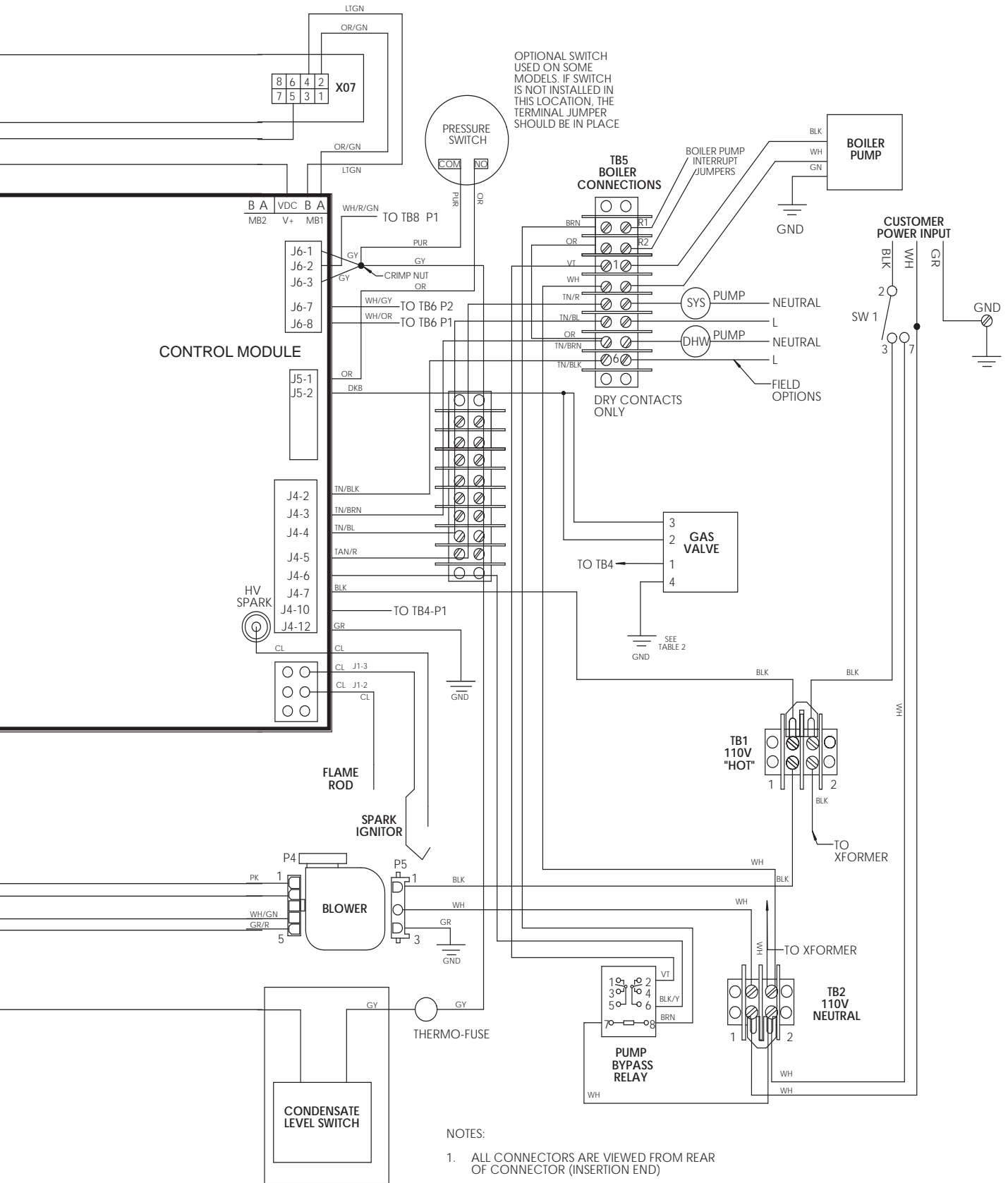


Figure 36. - Wiring Diagram, All Sizes



OPTIONAL SWITCH USED ON SOME MODELS. IF SWITCH IS NOT INSTALLED IN THIS LOCATION, THE TERMINAL JUMPER SHOULD BE IN PLACE

NOTES:

1. ALL CONNECTORS ARE VIEWED FROM REAR OF CONNECTOR (INSERTION END)

Section 9 - FIRST START-UP AND ADJUSTMENT INSTRUCTIONS

9.1 Filling the Boiler System

1. Ensure the system is fully connected. Close all bleeding devices and open the make-up water valve. Allow the system to fill slowly.
2. If a make-up water pump is employed, adjust the pressure switch on 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 located on the left side of NeoTherm unit, on top of the water manifold.

5. Cycle the boiler pump on and off 10 times, 10 seconds on and 10 seconds off, to remove all air from the heat exchanger. 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.
9. 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.
11. Shut down the entire system and vent all radiation units and high points in the system piping, as described in Step 4.
12. Close the make-up water valve 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.
13. 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.

14. Prime the condensate trap with water. (This is not required for NTH 600, 750, and 850 units.)
15. Refer to local codes and the make-up water valve manufacturer's instructions as to whether the make-up water valve should be left open or closed.
16. After placing the unit in operation, the ignition system safety shutoff device must be tested.

First, shut off the manual gas valve, and call the unit for heat. The main gas terminals will be energized, 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.

17. Within three days of start-up, recheck all air bleeders and the expansion tank as described in Steps 4 and 8 above.

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

WARNING

Do not use this appliance if any part has been under water. Laars Heating Systems requires boilers and water heaters to be replaced, not repaired, if they have been partially or completely submerged.

9.2 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 appliance and system are filled with water and all air has been bled from both. Open all valves.

3. Observe all warnings on the Operating Instructions label and turn on the gas and electrical power to the appliance.
4. The NeoTherm 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 NeoTherm, and check that there is proper gas supply. Wait 5 minutes before restarting.
5. Turn the NeoTherm on.
6. **After placing the appliance in 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.
 - Open the gas shutoff valve. Reset the boiler control by pressing the Reset button on the control or on the display. Restart the appliance. The ignition sequence will start again and the burner will start. The appliance will return to its previous mode of operation.

 DANGER

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.

9.3 Adjusting CO₂

1. Measure the CO₂/O₂ in the flue products at **high fire**. The NeoTherm 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 "I" 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 21 and Table 22. 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**. NeoTherm can be forced to low fire to allow for easier setup.

How to get there: From the "Home" screen, press "I" 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 21 and Table 22. 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.

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 21. R (Residential, sizes 80 - 285 Mbtu) CO₂ Range and Differential Pressure

GAS TYPE	HIGH FIRE, CO ₂	LOW FIRE, CO ₂	MANIFOLD PRESSURE
Natural	8.8 to 9.0%	0.5% lower than high fire setting	-.005" to -.015" wc
Propane	9.8 to 10.0%		

Table 22. R (Commercial, sizes 399 - 850 Mbtu) CO₂ Range and Manifold Pressure

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.

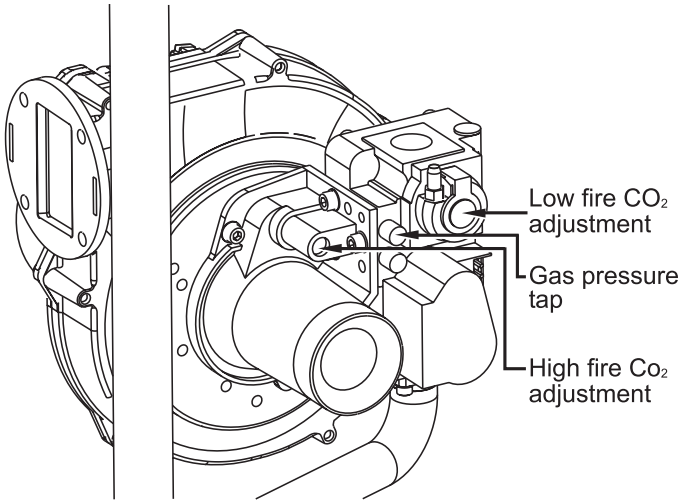


Figure 37. - NeoTherm Gas Valves 80–285

9.4 Restarting the NeoTherm 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 and ignitor warm-up period, followed by ignition.

9.5 Shutting Down the NeoTherm Unit

1. Turn off the main electrical disconnect switch.
2. Close all manual gas valves.
3. If you think the NeoTherm 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.

⚠ Caution

This step must be performed by a qualified service technician.

Model Number	Input, MBH		Heating Capacity, MBH	Net AHRI Rating Water, MBH	AFUE, %
	Min	Max			
NTH080	16	80	74	64	95.0
NTH105	21	105	96	83	95.0
NTH150	30	150	138	120	95.0
NTH210	42	210	194	171	95.0

Figure 38. - AHRI Rating



Section 10

MAINTENANCE

WARNING

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

10.1 System Maintenance

Do this once a year, unless otherwise noted.

1. Lubricate the system water-circulating pump, if required, per the instructions on the pump.
2. If a strainer is employed in a pressure reducing valve or the piping, clean it every six months.
3. Inspect the venting system for obstruction or leakage at least once a year. Periodically clean the screens in the vent terminal and combustion air terminal (when used).
4. Keep the area around the appliance clear and free of combustible materials, gasoline, and other flammable vapors and liquids.
5. If the appliance is not going to be used for extended periods in locations where freezing normally occurs, it should be isolated from the system and completely drained of all water.
6. Low water cutoffs, if installed, should be checked every year. Float-type low water cutoffs should be flushed periodically.
7. Inspect and clean the condensate collection, float switch and disposal system yearly.
8. When a means is provided to neutralize the condensate, ensure that the condensate is being neutralized properly.
9. Inspect the flue passages, and clean with a brush or vacuum if necessary. Sooting in flue passages indicates improper combustion. Determine the cause for this 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 any existing sealing material, and clean the joint(s) with alcohol. Apply new sealing material, and reassemble.

10.2 Appliance Maintenance and Component Description

Use only genuine LAARS 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. Appliance control | 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 appliance setup according to Section 9.

Appliance Control

The NeoTherm 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 appliance and shut off all manual gas valves to the appliance. Remove the front door to the appliance 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 appliance in 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 39](#)). To remove the ignitor assembly, shut off the 120 Volt power supply to the appliance. Turn off all manual gas valves connecting the appliance 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.

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.

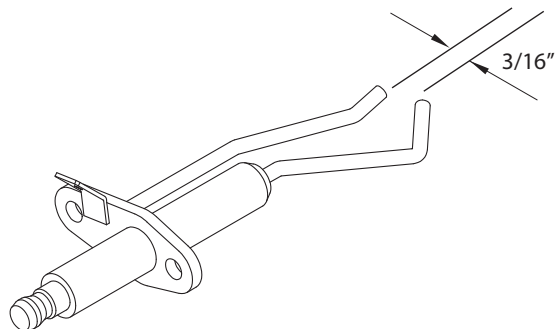


Figure 39. - Ignitor

Transformer with Integral Circuit Breaker

The appliance has a 24Vac transformer with integral 4 amp circuit breaker installed to supply the control voltage required for the appliance. The transformer is sized to provide power for the NeoTherm 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 appliance. 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 appliance 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 appliance in operation according to the instructions in Section 10. Check all gas connections for leaks. Confirm that all fasteners are tight.

Optional Gas Pressure Switches

The high and low gas pressure 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. The gas

pressure switches used are integrally vent limited, and do not require venting to atmosphere. To remove a switch, remove the screw on the plastic housing and pull the clear cover off. Disconnect the two wires from the screw terminals. Twist the switch off the pipe nipple. Reassemble in reverse order. For natural gas, set the low gas pressure switch to 3" w.c. For propane, set the low gas pressure switch to 5" w.c. For natural and propane, set the high gas pressure switch to 14".

10.3 Gas Conversion

NeoTherm 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 - only proper gas valve adjustment. Please contact the Laars factory for specific information regarding the gas conversion of a particular appliance. 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 appliance.

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

Table 23. - Propane Gas Conversion Kits

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

Table 24. - Natural Gas Conversion Kits

Section 11 - OPERATING DETAILS AND TROUBLESHOOTING

11.1 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 40](#).



Figure 40. – First Initialization Display

Next, the interface will search for the SOLA controller that will actually control the boiler. See [Figure 41](#).

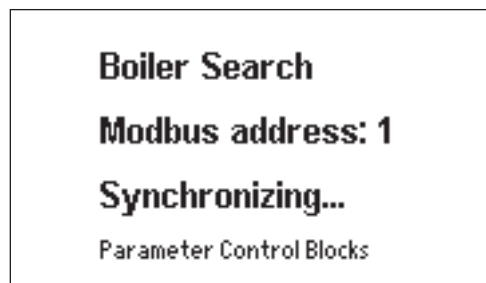


Figure 41. – Second Initialization Display

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 16](#).

11.2 Sequence of Operation

The NeoTherm 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 of the appliance for a DHW or hydronic call for heat.

11.3 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 appliance. 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.

11.4 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.

11.5 Anti-Short-Cycle (ASC)

Because the NeoTherm 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 NeoTherm 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.

11.6 Temperature Sensors

High Limit Sensor -

The control uses a dual thermistor sensor to monitor the Neotherm's 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 NeoTherm 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.

11.7 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.

11.8 Error Codes

See Appendix B.

**Section 12 -
REPLACEMENT PARTS**

Use only genuine LAARS replacement parts.

12.1 General Information

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

12.2 Parts List

ITEM	DESCRIPTION	SIZE 80	SIZE 105	SIZE 150	SIZE 210 199
Jacket Components – See Figure 50					
1	Front Panel Assembly	R60D3200	R60D3200	R60D3200	R60D3200
2	Front Panel Handle	R50D3204	R50D3204	R50D3204	R50D3204
3	Rear Panel	R50D3101	R50D3101	R50D3101	R50D3101
4	Left Side Panel	R8D3002	R10D3002	R15D3002	R19D3002/ R20D3002
5	Right Side Panel	R15D3001	R15D3001	R15D3001	R30D3001
6	Left Top Panel	8D3327	10D3327	R15D3303	R20D3303
7	Middle Left Top Panel	8D3328	10D3328	15D3402	20D3403
7A	Middle Right Top Panel	8D3329	10D3329	15D3403	20D3402
8	Right Top Panel	8D3330	10D3330	15D3401	R20D3301
9	Jacket Angle Support	R8D3102 (Right Hand) R15D3102 (Left Hand)	R8D3102 (Right Hand) R15D3102 (Left Hand)	R15D3102 (2)	R30D3102 (2)
10	Jacket Support, Left Stanchion	R50D3003	R50D3003	R50D3003	R50D3003
11	Jacket Support, Right Stanchion	R50D3004	R50D3004	R50D3004	R50D3004
12	Front Bezel	R50D7121	R50D7121	R50D7121	R50D7121
13	Display mounting frame	R50D7122	R50D7122	R50D7122	R50D7122
(12&13)	Complete Assembly	R50D7120	R50D7120	R50D7120	R50D7120
Internal Components – See Figure 51					
20	Base Assembly	R15D1100	R15D1100	R15D1100	R30D1100
21	Left Rear Support Stanchion	R50D1001	R50D1001	R50D1001	R50D1001
22	Left Front/Right Rear Support Stanchion	R50D1002	R50D1002	R50D1002	—
23	Cantilevered Base Stanchion	R15D1002	R15D1002	R15D1002	R40D1001
24	Brace, Front, HX Stanchion	20D1005	20D1005	20D1005	20D1005
24A	Brace, Rear, HX Stanchion	R50D1005	R50D1005	20D1007	20D1007
25	Mounting Rail	R15D1004	R15D1004	R15D1004	R30D1004

ITEM DESCRIPTION	SIZE 80	SIZE 105	SIZE 150	SIZE 210 199
27 Condensate Trap Assy	R20D4020	R20D4020	R20D4020	R20D4020
28 Heat Exch. Rail Clip	R50D1006 (2)	R50D1006 (2)	—	—
30 PVC Reducer	—	—	RP2053000	RP2053000
30a CPVC Reducer or Coupling	RD2010501	RD2010501	RP2065600	RP2065600
30b 2" Dia. Pipe, CPVC	RD2010212	RD2010212	RD2010213	RD2010213 NTV
31 Hose Barbed Adapter	RP2067100	RP2067100	RP2056100	RP2056100
33 Air Inlet/Exhaust Bracket	R8D3005	10D3005	R20D3120	R20D3120
Gas Train Components – See Figure 52				
40 Combustion Air Blower	RA2113700	RA2113700	RA2107500	RA2114200
41 Gas Valve/Venturi	RV2017900	RV2017901	RV2017902	RV2017903
42 Gas Valve	—	—	—	—
43 Gas/Air Venturi	—	—	—	—
44 Manual Gas Valve	—	—	—	—
44A Manual Gas Valve	—	—	—	—
45 Gas Valve Flange Kit	—	—	—	—
46 Gas Valve/Venturi Cork Gasket	—	—	—	—
47 Gas Valve O-Ring	R30-227	R30-227	R30-227	R30-227
48 Venturi O-Ring	—	—	—	—
49 High Gas Pressure Switch	—	—	—	—
50 Low Gas Pressure Switch	—	—	—	—
51 Duct/Venturi Transition	R10D5021	R10D5021	R10D5021	R10D5013
52 Gas Supply Pipe	RP2051700	RP2051400	RP2051400	RP2051400
53 Gas Pipe, 3/4" NPT Formed Nipple	—	—	—	—
55 Air Inlet Flex Hose	D0091403	RD0091403	RD0091403	D0091401
56 Air Inlet Collector	—	—	—	—
57 Electrical Connector w/Cable	—	—	—	—
58 Elbow Adapter	—	—	—	—
59 Blower Gasket W/Fasteners	—	—	—	—
Heat Exchanger Components – See Figure 53				
60 Heat Exchanger	RS2106900	RS2105500	RS2105800	RS2105700 NTH S2111000 NTV
61 Pump Assembly	R8D4110	R10D4110	R10D4110	R20D4140 NTH
62 Low Water Cutoff Switch	—	—	—	—
63 Inlet Water Temp Sensor	RE2320600	RE2320600	RE2320600	RE2320600
64 Duplex Outlet Water Temperature Sensor	RE2319900	RE2319900	RE2319900	RE2319900

ITEM DESCRIPTION	SIZE 80	SIZE 105	SIZE 150	SIZE 210 199
65 Duplex Stack Temperature Sensor	RE2319700	RE2319700	RE2319700	RE2319700
66 Pressure Relief Valve, NTH	R51-182 (30 PSI)	R51-182 (30 PSI)	R51-182 (30 PSI)	R51-182 (30 PSI)
Pressure Relief Valve, NTV			A2114802 (125 PSI)	A2114802 (125 PSI)
67 Air Vent	R1-592	R1-592	R1-592	R1-592
68 Burner Door w/gasket	RS2112801	RS2112801	RS2112801	RS2112801
68A Burner Door Gasket (rubber)	R2069400	R2069400	R2069400	R2069400
69 Burner Gasket	RS2108500	RS2108500	RS2108500	RS2108500
69A Gasket Set (burner gasket, ignitor gasket, sensor gasket & burner door gasket)	RS2109100	RS2109100	RS2109100	RS2109100
70 Front Refractory Tile	RT2109001	RT2109001	RT2109001	RT2109001
71 Rear Refractory Tile	R50D2021	R50D2021	R50D2021	R50D2021
72 Main Burner w/gasket	R2069101	R2069102	R2069103	R2069104
73 Flame Sensor w/gasket	R2069200	R2069200	R2069200	R2069200
74 Ignitor w/gasket	R2069300	R2069300	R2069300	R2069300
74A Ignitor Gasket	RW2013300	RW2013300	RW2013300	RW2013300
74B Screw, Ignitor/ Flame Sensor	m4-.7X8mm S2112700	m4-.7X8mm S2112700	m4-.7X8mm S2112700	m4-.7X8mm S2112700
74C Flame/Sensor Gasket	RW2013400	RW2013400	RW2013400	RW2013400
75 Air/Gas Channel (80-600) Air Adapter (750-850)	RS2108400	RS2108600	RS2108600	RS2108700
75A Screw, Air/Gas Channel	RS2109400 (5)	RS2109400 (5)	RS2109400 (5)	RS2109400 (5)
76 Drain	R10-143	R10-143	R10-143	R10-143
77 Sight Glass	R50D2020	R50D2020	R50D2020	R50D2020
Electrical Components – See Figure 54				
80 Control Panel Enclosure	R50D7001	R50D7001	R50D7001	R50D7001
81 Transformer	RE2108700	RE2108700	RE2108700	RE2108700
82 High Voltage Shield	R50D7002	R50D7002	R50D7002	R50D7002
83 Top Panel Bracket	R50D7003	R50D7003	R50D7003	R50D7003
84 Electronic Control Module, Standard	<i>Contact Customer Service at 800 900-9276 x11</i>			
84 Electronic Control Module, CSD-1	<i>Contact Customer Service at 800 900-9276 x11</i>			
85 Rocker Switch	RE2322700	RE2322700	RE2322700	RE2322700
86 Control Display	RE2347200	RE2347200	RE2347200	RE2347200
87 Wire Harness	R50D7412	R50D7412	R50D7412	R50D7414
89 Air Pressure Switch	RE2334700	RE2334700	RE2334700	RE2334701
90 Water Flow Switch	—	—	—	—

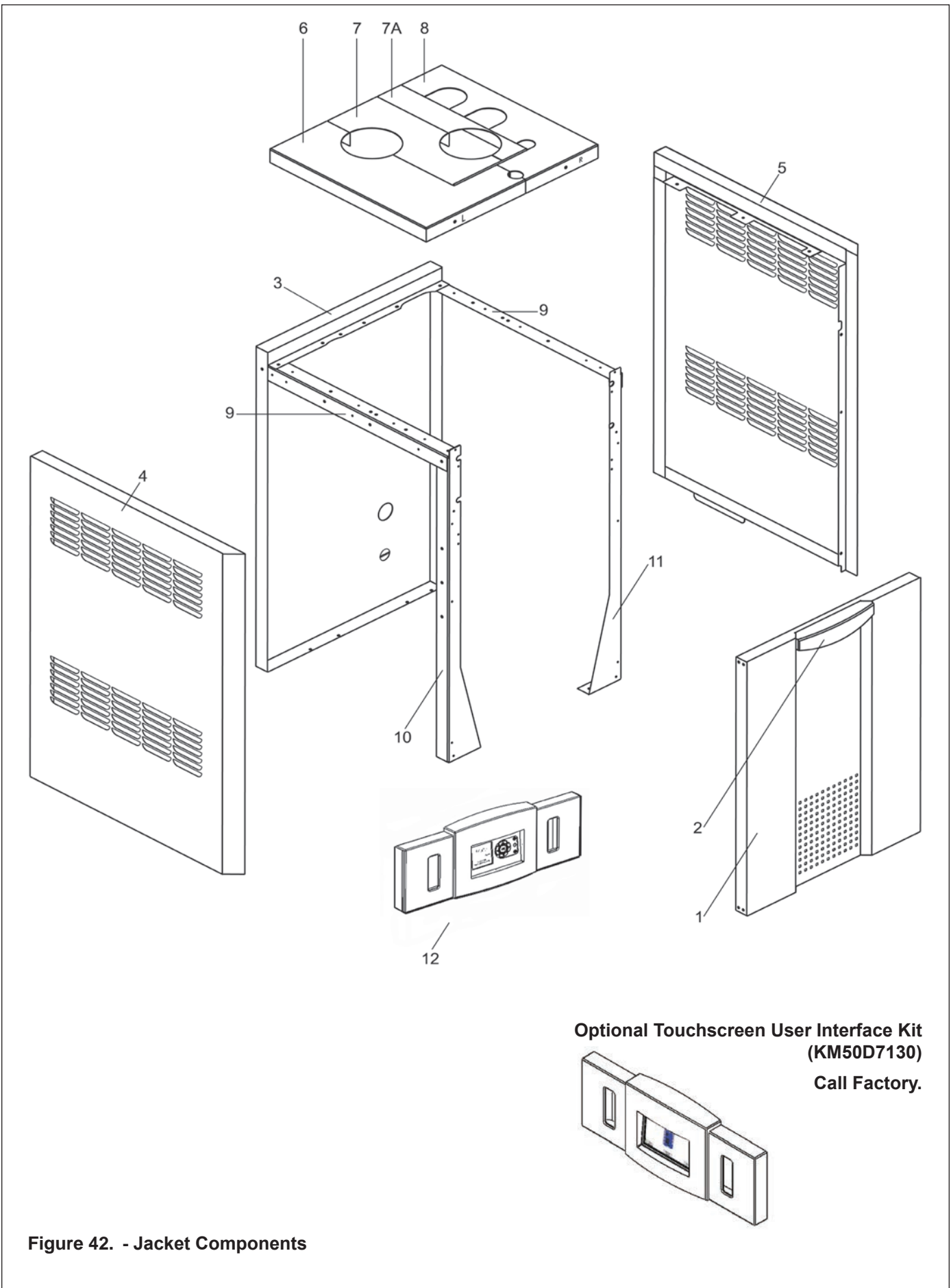


Figure 42. - Jacket Components

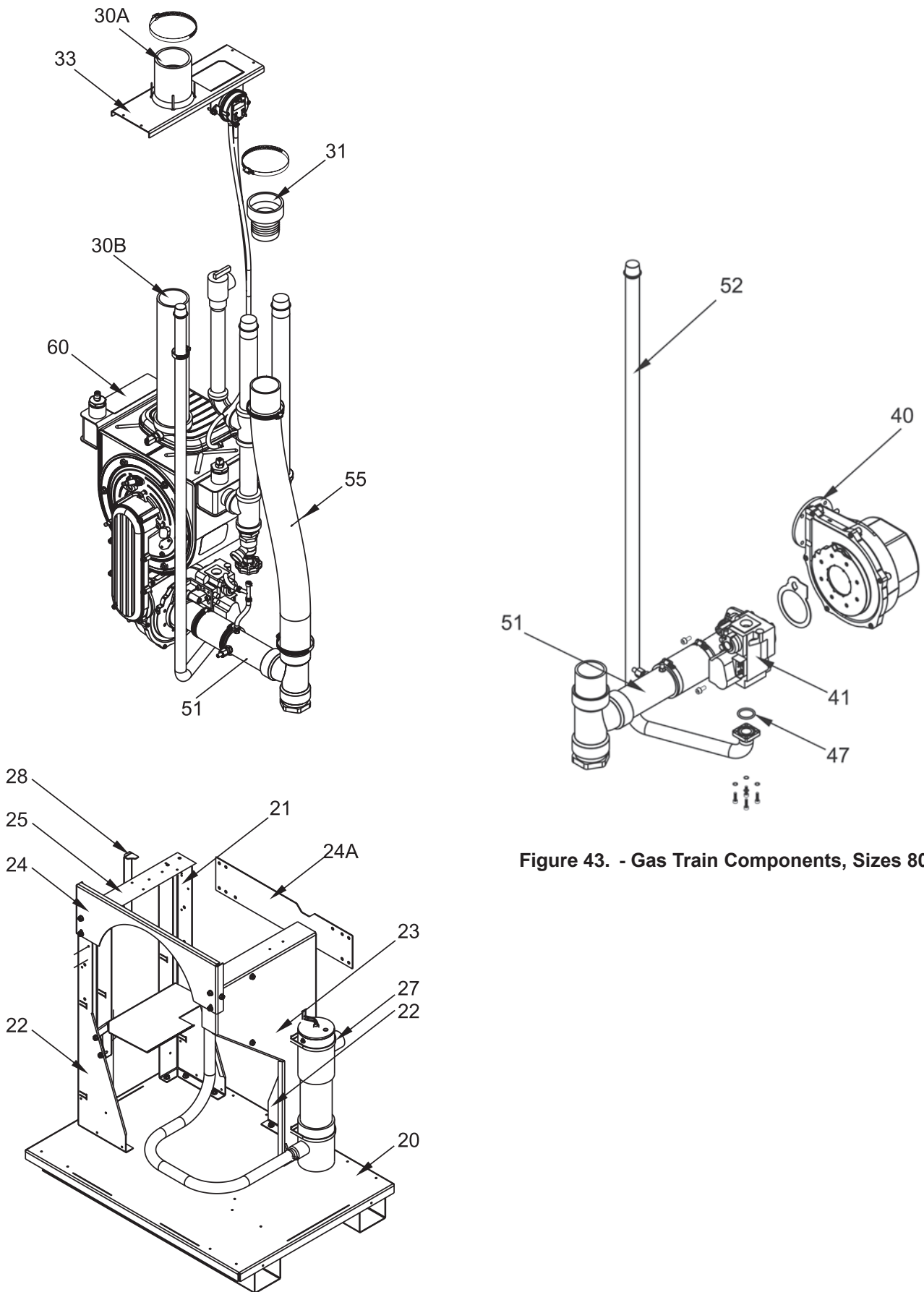


Figure 43. - Gas Train Components, Sizes 80-210

Figure 44. - Internal Components, Sizes 80-210

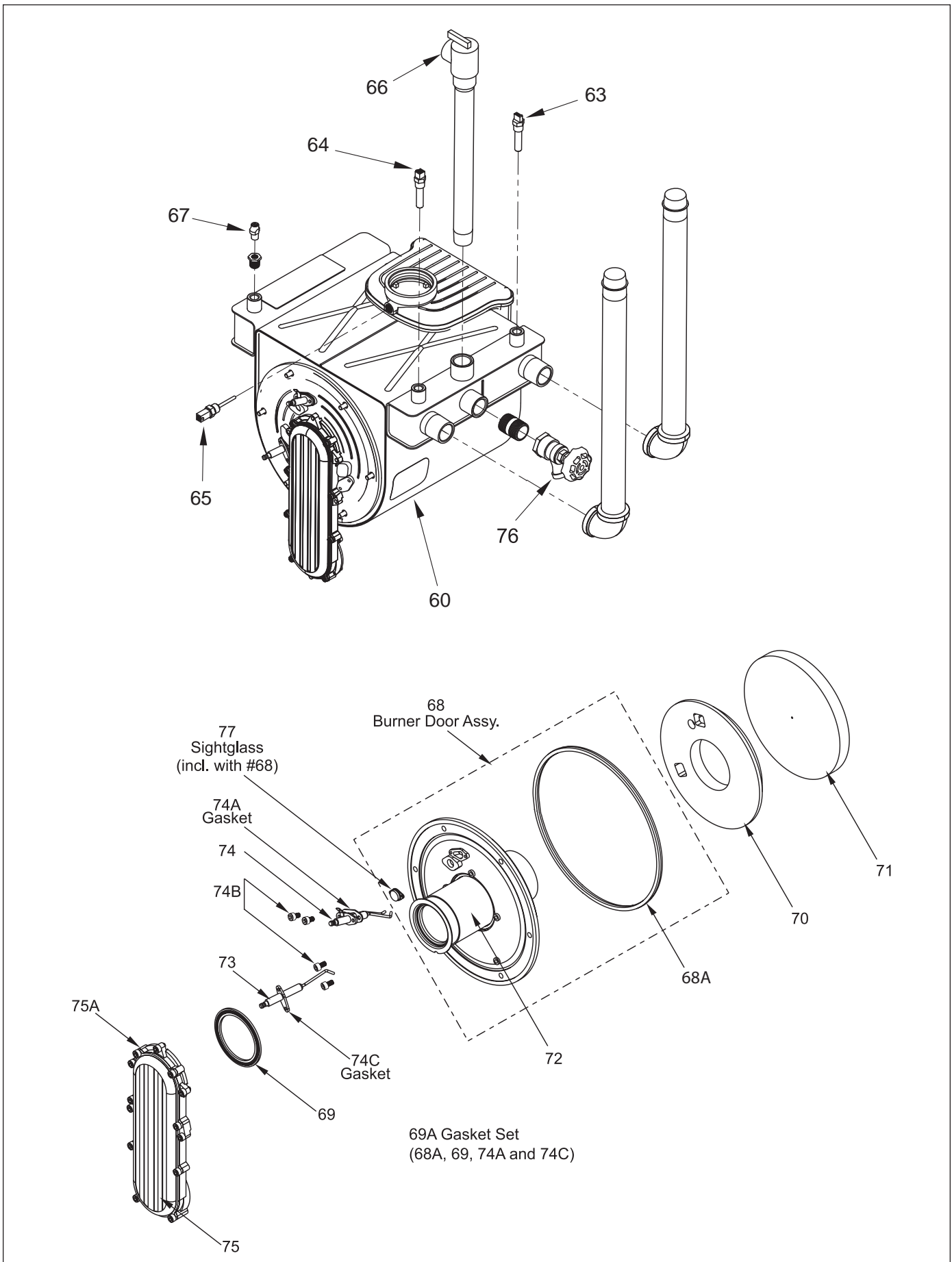


Figure 45. - Heat Exchanger Components

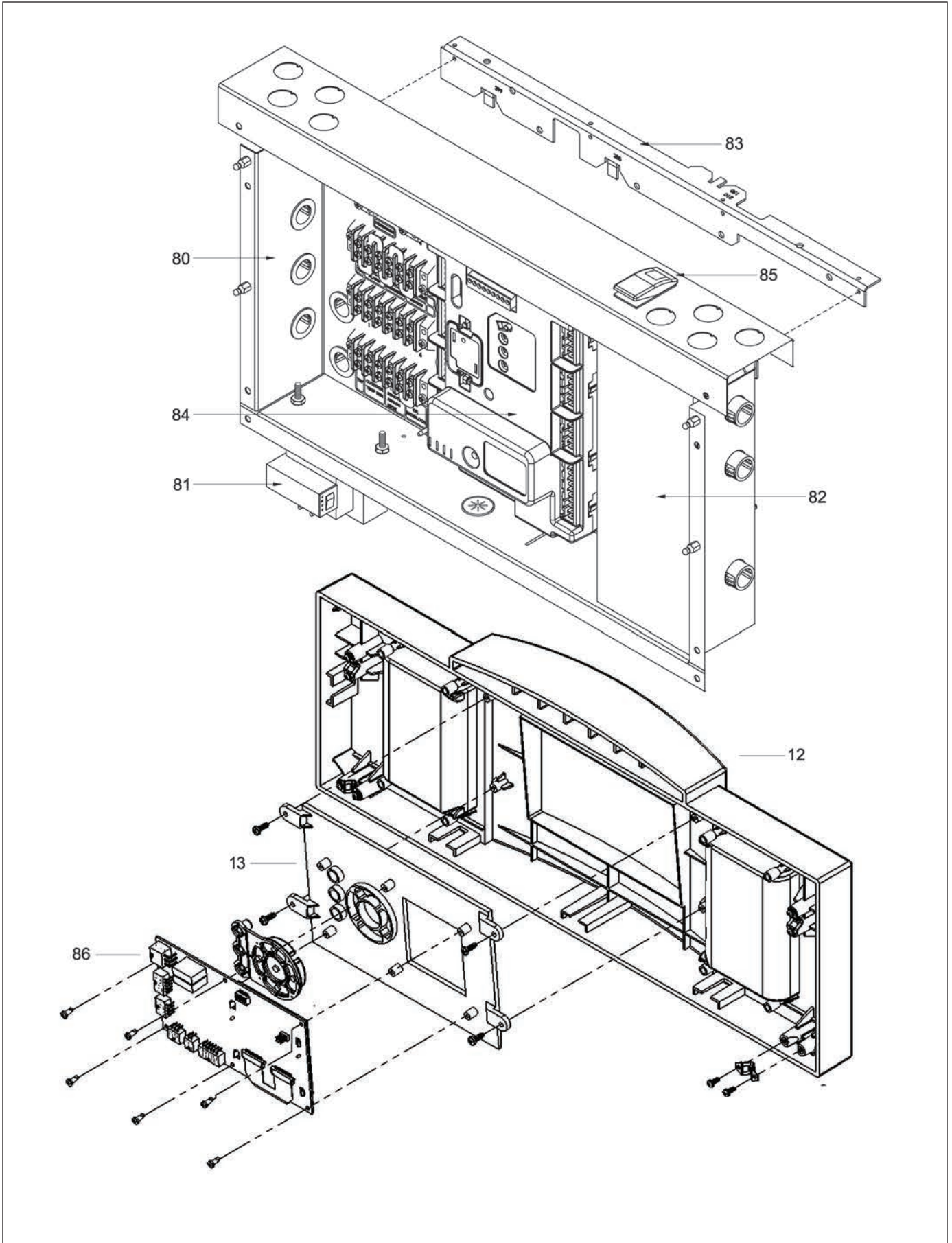


Figure 46. - Electrical Components

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 Laars 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.
Slave 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 slaves. 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 Slave Config.
Slave 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 Slave 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	Internal fault 1. Reset module 2. If fault repeats, replace module.
5	Internal fault: Unstable power (DC) output	H	Internal fault 1. Reset module 2. If fault repeats, replace module.
6	Internal fault: Invalid processor clock	H	Internal fault 1. Reset module 2. If fault repeats, replace module.
7	Internal fault: Safety relay drive error	H	Internal fault 1. Reset module 2. If fault repeats, replace module.
8	Internal fault: Zero crossing not detected	H	Internal fault 1. Reset module 2. If fault repeats, replace module.
9	Internal fault: Flame bias out of range	H	Internal fault 1. Reset module 2. If fault repeats, replace module.
10	Internal fault: Invalid burner control state	L	Internal fault 1. Reset module 2. If fault repeats, replace module.
11	Internal fault: Invalid burner control state flag	L	Internal fault 1. Reset module 2. If fault repeats, replace module.

Code	Description	L or H	Procedure
12	Internal fault: Safety relay drive cap short	H	Internal fault 1. Reset module 2. If fault repeats, replace module.
13	Internal fault: PII (Pre-Ignition Interlock) shorted to ILK (Interlock)	H or L	Internal fault 1. Reset module 2. If fault repeats, replace module.
15	Internal fault: Safety relay test failed due to feedback ON	L	Internal fault 1. Reset module 2. If fault repeats, replace module.
16	Internal fault: Safety relay test failed due to safety relay OFF	L	Internal fault 1. Reset module 2. If fault repeats, replace module.
17	Internal fault: Safety relay test failed due to safety relay not OFF	L	Internal fault 1. Reset module 2. If fault repeats, replace module.
18	Internal fault: Safety relay test failed due to feedback not ON	L	Internal fault 1. Reset module 2. If fault repeats, replace module.
19	Internal fault: Safety RAM write	L	Internal fault 1. Reset module 2. If fault repeats, replace module.
20	Internal fault: Internal fault: Flame ripple and overflow	H	Internal fault 1. Reset module 2. If fault repeats, replace module.
21	Internal fault: Flame number of sample mismatch	H	Internal fault 1. Reset module 2. If fault repeats, replace module.
22	Internal fault: Flame bias out of range	H	Internal fault 1. Reset module 2. If fault repeats, replace module.
23	Internal fault: Bias changed since heating cycle starts	H	Internal fault 1. Reset module 2. If fault repeats, replace module.
24	Internal fault: Spark voltage stuck low or high	H	Internal fault 1. Reset module 2. If fault repeats, replace module.
25	Internal fault: Spark voltage changed too much during flame sensing time	H	Internal fault 1. Reset module 2. If fault repeats, replace module.
26	Internal fault: Static flame ripple	H	Internal fault 1. Reset module 2. If fault repeats, replace module.

Code	Description	L or H	Procedure
27	Internal fault: Flame rod shorted to ground detected	H	Internal fault 1. Reset module 2. If fault repeats, replace module.
28	Internal fault: A/D linearity test fails	H	Internal fault 1. Reset module 2. If fault repeats, replace module.
29	Internal fault: Flame bias cannot be set in range	H	Internal fault 1. Reset module 2. If fault repeats, replace module.
30	Internal fault: Flame bias shorted to adjacent pin	H	Internal fault 1. Reset module 2. If fault repeats, replace module.
31	Internal fault: SLO electronics unknown error	H	Internal fault 1. Reset module 2. If fault repeats, replace module.
32-46	Internal fault: Safety Key 0 through 14	L	Internal fault 1. Reset module 2. If fault repeats, replace module.
47	Flame Rod to ground leakage	H	Internal fault 1. Reset module 2. If fault repeats, replace module.
48	Static flame (not flickering)	H	Internal fault 1. Reset module 2. If fault repeats, replace module.
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. 1. Review alert messages for possible trends. 2. Correct possible problems.
51	Pump fault	H	Internal sub-system fault. 1. Review alert messages for possible trends. 2. Correct possible problems.
52	Motor tachometer fault	H	Internal sub-system fault. 1. Review alert messages for possible trends. 2. Correct possible problems.
53	AC input phases reversed	L	1. Check the module and display connections. 2. Check the module power supply and make sure that both frequency and voltage meet the specifications. 3. On 24 VAC applications, assure that J4 terminal 10 and J8 terminal 2 are connected together.
59	Internal Fault: Mux pin shorted	L	Internal Fault. 1. Reset module. 2. If fault repeats, replace module.
61	Anti short cycle	H	Will not be a lockout fault. Hold Only.
62	Fan speed not proved	H	Will not be a lockout fault. Hold Only.

Code	Description	L or H	Procedure
63	LCI (Limit Control Input) OFF (Safety Chain Open)	H	<ol style="list-style-type: none"> 1. Check wiring and correct any faults. 2. Check Interlocks connected to the LCI to assure proper function. 3. Reset and sequence the module; monitor the LCI status. 4. If code persists, replace the module
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. 4. If steps 1-3 are correct and the fault persists, replace the module.
68	ILK (Interlock) ON	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. 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.

Code	Description	L or H	Procedure
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	<p>Internal Fault.</p> <ol style="list-style-type: none"> 1. Reset module. 2. If fault repeats, replace module.
98	Internal Fault: Exceeded VSNSR voltage tolerance	L	<p>Internal Fault.</p> <ol style="list-style-type: none"> 1. Reset module. 2. If fault repeats, replace module.
99	Internal Fault: Exceeded 28V voltage tolerance	L	<p>Internal Fault.</p> <ol style="list-style-type: none"> 1. Reset module. 2. If fault repeats, replace module.
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 main valve wiring and operation - correct any errors. 2. Check the fuel supply. 3. Check fuel pressure and repeat turndown tests. 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.
107	Flame lost early in run	L	<ol style="list-style-type: none"> 1. Check main valve wiring and operation - correct any errors. 2. Check the fuel supply. 3. Check fuel pressure and repeat turndown tests. 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.

Code	Description	L or H	Procedure
108	Flame lost in run	L	<ol style="list-style-type: none"> 1. Check main valve wiring and operation - correct any errors. 2. Check the fuel supply. 3. Check fuel pressure and repeat turndown tests. 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	<ol style="list-style-type: none"> 1. Check the main valve wiring and operation - correct any errors. 2. Check the fuel supply. 3. Check fuel pressure and repeat turndown tests. 4. Check ignition transformer electrode, flame detector, flame detector siting or flame rod position. 5. If steps 1 through 4 are correct and the fault persists, replace the module.
110	Ignition failure occurred	H	Hold time of recycle and hold option. Will not be a lockout fault. Hold only. Internal hardware test. Not a lockout.
111	Flame current lower than weak threshold	H	Hold time of recycle and hold option. Will not be a lockout fault. Hold only. Internal hardware test. Not a lockout.
113	Flame circuit timeout	L	Flame sensed during initiate or off cycle. Produces a Hold for 240 seconds. If still present after 240 seconds, system will lockout.
122	Lightoff rate proving failed	L	<ol style="list-style-type: none"> 1. Check wiring and correct any potential wiring errors. 2. Check VFD's (Variable-speed Fan Drive) ability to change speeds. 3. Change the VFD 4. If the fault persists, replace the module.
123	Purge rate proving failed	L	<ol style="list-style-type: none"> 1. Check wiring and correct any potential wiring errors. 2. Check VFD's (Variable-speed Fan Drive) ability to change speeds. 3. Change the VFD 4. If the fault persists, replace the module.
128	Fan speed failed during prepurge	H or L	<ol style="list-style-type: none"> 1. Check wiring and correct any potential wiring errors. 2. Check the VFDs (Variable-speed Fan Drive) ability to change speeds. 3. Change the VFD 4. If the fault persists, replace the module.
129	Fan speed failed during preignition	H or L	<ol style="list-style-type: none"> 1. Check wiring and correct any potential wiring errors. 2. Check the VFDs (Variable-speed Fan Drive) ability to change speeds. 3. Change the VFD 4. If the fault persists, replace the module.
130	Fan speed failed during ignition	H or L	<ol style="list-style-type: none"> 1. Check wiring and correct any potential wiring errors. 2. Check the VFDs (Variable-speed Fan Drive) ability to change speeds. 3. Change the VFD 4. If the fault persists, replace the module.
131	Fan movement detected during standby	H	<ol style="list-style-type: none"> 1. Check wiring and correct any potential wiring errors. 2. Check the VFDs (Variable-speed Fan Drive) ability to change speeds. 3. Change the VFD 4. If the fault persists, replace the module.

Code	Description	L or H	Procedure
132	Fan speed failed during run	H	<ol style="list-style-type: none"> 1. Check wiring and correct any potential wiring errors. 2. Check the VFDs (Variable-speed Fan Drive) ability to change speeds. 3. Change the VFD 4. If the fault persists, replace the module.
137	ILK (Interlock) failed to close	H	<ol style="list-style-type: none"> 1. Check wiring and correct any possible shorts. 2. Check Interlock (ILK) switches to assure proper function. 3. Verify voltage through the interlock string to the interlock input with a voltmeter. 4. If steps 1-3 are correct and the fault persists, replace the module.
149	Flame detected	H or L	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 on when it should be off. 2. Check wiring and correct any errors. 3. Inspect the Purge Fan switch J6 terminal 3 and its connections. Make sure the switch is working correctly and is not jumpered or welded. 4. Reset and sequence the relay module. 5. If the fault persists, replace the relay module.
155	Purge fan switch Off	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. 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	<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.
157	Combustion pressure and flame Off	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.
158	Main valve On	L	<ol style="list-style-type: none"> 1. Check the main valve terminal wiring and correct any errors. 2. Reset and sequence the module. If fault persists, replace the module.

Code	Description	L or H	Procedure
159	Main valve Off	L	<ol style="list-style-type: none"> 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	<ol style="list-style-type: none"> 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	<ol style="list-style-type: none"> 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	<ol style="list-style-type: none"> 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. 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.
165	Block intake Off	L	<ol style="list-style-type: none"> 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. 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	<p>Internal fault.</p> <ol style="list-style-type: none"> 1. Reset module. 2. If fault repeats, replace module.
174	Safety relay feedback incorrect	L	<p>Internal fault.</p> <ol style="list-style-type: none"> 1. Reset module. 2. If fault repeats, replace module.
175	Safety relay open	L	<p>Internal fault.</p> <ol style="list-style-type: none"> 1. Reset module. 2. If fault repeats, replace module.
176	Main relay On at safe start check	L	<p>Internal fault.</p> <ol style="list-style-type: none"> 1. Reset Module. 2. If fault repeats, replace module.
178	Safety relay On at safe start check	L	<p>Internal fault.</p> <ol style="list-style-type: none"> 1. Reset module. 2. If fault repeats, replace module.
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	<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.
186	Invalid Delta T 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.

Code	Description	L or H	Procedure
187	Invalid DHW (Domestic Hot Water) high limit enable setting	L	1. Recheck selected parameters, reverify and reset module. 2. If fault repeats, verify electrical grounding. 3. If fault repeats, replace module.
188	Invalid DHW (Domestic Hot Water) high limit response setting	L	1. Recheck selected parameters, reverify and reset module. 2. If fault repeats, verify electrical grounding. 3. If fault repeats, replace module.
189	Invalid flame sensor type setting	L	1. Recheck selected parameters, reverify and reset module. 2. If fault repeats, verify electrical grounding. 3. If fault repeats, replace module.
192	Invalid igniter on during setting	L	1. Recheck selected parameters, reverify and reset module. 2. If fault repeats, verify electrical grounding. 3. If fault repeats, replace module.
193	Invalid ignite failure delay setting	L	1. Recheck selected parameters, reverify and reset module. 2. If fault repeats, verify electrical grounding. 3. If fault repeats, replace module.
194	Invalid ignite failure response setting	L	1. Recheck selected parameters, reverify and reset module. 2. If fault repeats, verify electrical grounding. 3. If fault repeats, replace module.\
195	Invalid ignite failure retries setting	L	1. Recheck selected parameters, reverify and reset module. 2. If fault repeats, verify electrical grounding. 3. If fault repeats, replace module.
196	Invalid ignition source setting	L	1. Recheck selected parameters, reverify and reset module. 2. If fault repeats, verify electrical grounding. 3. If fault repeats, replace module.
197	Invalid interlock open response setting	L	1. Recheck selected parameters, reverify and reset module. 2. If fault repeats, verify electrical grounding. 3. If fault repeats, replace module.
198	Invalid interlock start check setting	L	1. Recheck selected parameters, reverify and reset module. 2. If fault repeats, verify electrical grounding. 3. If fault repeats, replace module.
199	Invalid LCI (Limit Control Input) enable setting	L	1. Recheck selected parameters, reverify and reset module. 2. If fault repeats, verify electrical grounding. 3. If fault repeats, replace module.
200	Invalid lightoff rate setting	L	1. Recheck selected parameters, reverify and reset module. 2. If fault repeats, verify electrical grounding. 3. If fault repeats, replace module.
201	Invalid lightoff rate proving setting	L	1. Recheck selected parameters, reverify and reset module. 2. If fault repeats, verify electrical grounding. 3. If fault repeats, replace module.
202	Invalid MFEP (Main Flame Establishing Period) time setting	L	1. Recheck selected parameters, reverify and reset module. 2. If fault repeats, verify electrical grounding. 3. If fault repeats, replace module.
203	Invalid MFEP (Main Flame Establishing Period) flame failure response setting	L	1. Recheck selected parameters, reverify and reset module. 2. If fault repeats, verify electrical grounding. 3. If fault repeats, replace module.

Code	Description	L or H	Procedure
204	Invalid NTC sensor type 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.
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	<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.
210	Invalid Postpurge time 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.
211	Invalid Power up with lockout 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.
212	Invalid Preignition time 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.
213	Invalid Prepurge rate 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.
214	Invalid Prepurge time 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.
215	Invalid Purge rate proving 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.
216	Invalid Run flame failure 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.
217	Invalid Run stabilization time 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.
218	Invalid Stack limit enable 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.
219	Invalid Stack 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.
220	Unconfigured Delta T limit setpoint 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.
221	Unconfigured DHW (Domestic Hot Water) high limit setpoint 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.

Code	Description	L or H	Procedure
222	Unconfigured Outlet high limit setpoint setting	L	1. Recheck selected parameters, reverify and reset module. 2. If fault repeats, verify electrical grounding. 3. If fault repeats, replace module.
223	Unconfigured Stack limit setpoint setting	L	1. Recheck selected parameters, reverify and reset module. 2. If fault repeats, verify electrical grounding. 3. If fault repeats, replace module.
224	Invalid DHW (Domestic Hot Water) demand source setting	L	1. Recheck selected parameters, reverify and reset module. 2. If fault repeats, verify electrical grounding. 3. If fault repeats, replace module.
225	Invalid Flame threshold setting	L	1. Recheck selected parameters, reverify and reset module. 2. If fault repeats, verify electrical grounding. 3. If fault repeats, replace module.
226	Invalid Outlet high limit setpoint setting	L	1. Recheck selected parameters, reverify and reset module. 2. If fault repeats, verify electrical grounding. 3. If fault repeats, replace module.
227	Invalid DHW (Domestic Hot Water) high limit setpoint setting	L	1. Recheck selected parameters, reverify and reset module. 2. If fault repeats, verify electrical grounding. 3. If fault repeats, replace module.
228	Invalid Stack limit setpoint setting	L	1. Recheck selected parameters, reverify and reset module. 2. If fault repeats, verify electrical grounding. 3. If fault repeats, replace module.
229	Invalid Modulation output setting	L	1. Recheck selected parameters, reverify and reset module. 2. If fault repeats, verify electrical grounding. 3. If fault repeats, replace module.
230	Invalid CH (Central Heat) demand source setting	L	1. Recheck selected parameters, reverify and reset module. 2. If fault repeats, verify electrical grounding. 3. If fault repeats, replace module.
231	Invalid Delta T limit delay setting	L	1. Recheck selected parameters, reverify and reset module. 2. If fault repeats, verify electrical grounding. 3. If fault repeats, replace module.
232	Invalid Pressure sensor type setting	L	1. Recheck selected parameters, reverify and reset module. 2. If fault repeats, verify electrical grounding. 3. If fault repeats, replace module.
234	Invalid Outlet high limit enable setting	L	1. Recheck selected parameters, reverify and reset module. 2. If fault repeats, verify electrical grounding. 3. If fault repeats, replace module.
235	Invalid Outlet connector type setting	L	1. Recheck selected parameters, reverify and reset module. 2. If fault repeats, verify electrical grounding. 3. If fault repeats, replace module.
236	Invalid Inlet connector type setting	L	1. Recheck selected parameters, reverify and reset module. 2. If fault repeats, verify electrical grounding. 3. If fault repeats, replace module.

