

## Installation and Operation Instructions for

# **MASCOT® II**

Wall-Mounted  
Modulating Boiler

Model LMH  
125 MBTU/h

Combination  
Boiler and Water Heater

Model LMC  
125 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 ..... 2  
 1.2 Rating Plate ..... 2  
 1.3 Model Nomenclature..... 2  
 1.4 Start Up / Shut Down Instruction (Decal)..... 3  
 1.5 Unpacking..... 3  
 1.6 Warranty ..... 3  
 1.7 Product Overview ..... 4  
 1.8 Dimensions ..... 5

**SECTION 2.**

**Locating the Appliance**

2.1 Locating the Appliance..... 6  
 2.2 Locating Appliance for Correct Vent Distance  
 from Outside Wall or Roof Termination ..... 6

**SECTION 3.**

**Venting and Combustion Air**

3.1 Combustion Air ..... 8  
 3.1.1 Combustion Air from Room..... 8  
 3.1.2 Ducted Combustion Air ..... 8  
 3.2 Venting (Exhaust) ..... 9  
 3.3.1 Side Wall Vent Terminal..... 10  
 3.3.2 Side Wall Combustion Air Terminal..... 10  
 3.3.3 Vertical Vent Terminal ..... 10  
 3.3.4 Vertical Combustion Air Terminal ..... 10  
 3.3.5 Installations in the Commonwealth  
 of Massachusetts..... 12  
 3.4 Common Vent Test ..... 12

**SECTION 4.**

**Gas Supply and Piping**

4.1 Gas Supply and Piping ..... 14

**SECTION 5.**

**Pump Capacity**

5.1 Mascot II Heating System Pump Capacity ..... 15

**SECTION 6.**

**Water Connections**

6.1 Central Heat System Piping..... 15  
 6.2 Cold Water Make-Up ..... 15  
 6.3 Freeze Protection ..... 16  
 6.4 Suggested Piping Schematics ..... 17  
 6.5 Recognized Chemicals ..... 17  
 6.6 Domestic Hot Water (DHW) Piping (LMC)..... 17  
 6.7 Condensate Drain..... 17

**SECTION 7.**

**Electrical Connections**

7.1 Main Power..... 23  
 7.2 Pump Connections ..... 23  
 7.3 24Vac Transformer Circuit Breaker..... 23  
 7.4 Central Heat - Call for Heat ..... 23  
 7.5 Outdoor Air Temperature Sensor ..... 23  
 7.6 Domestic Hot Water Connection ..... 23  
 7.7 System Sensor  
 (lead lag/cascading operation only) ..... 23  
 7.8 External Control Connections ..... 23  
 7.9 Lead Lag / Cascading Wiring Connections..... 23  
 7.10 Wiring Diagrams ..... 24

**SECTION 8.**

**Control Setup and Operation**

8.1 **USER INTERFACE and  
 Digital Display Navigation** ..... 26  
 8.2 Ignition Control - Sequence of Events ..... 26  
 8.3 Modulation Control..... 27  
 8.4 Pump Control..... 27  
 8.5 High Limit..... 27  
 8.6 Stack Temperature..... 27  
 8.7 Domestic Hot Water Temperature..... 27  
 8.8 Lead Lag/Cascading..... 27  
 8.8.1 Lead Lag Setpoint..... 27  
 8.8.2 Lead Lag Master / Slave Selection ..... 27  
 8.8.3 Lead Lag Address..... 27  
 8.8.4 Lead Lag Hysteresis ..... 27  
 8.8.5 Lead Lag Base Load Setting ..... 27

**SECTION 9.**

**Modes of Operation**

9.1 Hydronic Heating Demand..... 28  
9.2 Hydronic Heating with Outdoor Reset ..... 28  
9.3 Hydronic Heating Using External Modulation Control..... 28  
9.4 Hydronic Heating Using Local Lead-Lag/ Cascading Feature ..... 29  
9.5 Warm Weather Shutdown..... 29  
9.6 Domestic Hot Water Demand (LMC only) ..... 29

**SECTION 10.**

**Set Up Instructions**

10.1 Filling the Boiler System ..... 30  
10.2 Starting the Burner after Set Up ..... 30  
10.2.1 Burner Operation ..... 30  
10.2.2 Boiler Setup and Adjustment ..... 31  
10.3 Shutting Down Mascot II..... 31  
10.4 To Restart Mascot II..... 31

**SECTION 11.**

**Maintenance**

11.1 System Maintenance ..... 33  
11.2 Appliance Maintenance and Component Description..... 33  
11.2.1 Burner..... 33  
11.2.2 Appliance Control ..... 33  
11.2.3 Ignitor Assembly ..... 33  
11.2.4 Flame Sensor ..... 34  
11.2.5 Blower..... 34  
11.2.6 Heat Exchanger Coils ..... 34  
11.2.7 Gas Conversion ..... 34

**SECTION 12.**

**Trouble Shooting**

12.1 Sequence of Operation ..... 35  
12.2 Short Cycling ..... 35  
12.3 Error Codes ..... 35

**SECTION 13**

**Replacement Parts**

13.1 General Information ..... 38  
13.2 Parts List..... 38

# SECTION 1. General Information

## 1.1 Introduction

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

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.

### WARNING

Mascot II 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 Mascot II 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.

## 1.2 Rating Plate

The Rating Plate contains Manufacture Date, Model Number, Serial Number, Output Rating, and all other information pertaining to your Mascot II. The Rating Plate is located behind the center panel which will not open until the lower front panel is opened first.

To open the Mascot II, first loosen the two phillips screws (see Figure 1A) and then open the front bottom panel downward. The center front panel will then also open downward, revealing the Rating Plate.

## 1.3 Model Nomenclature

The Model Number is shown on your Rating Plate and consists of a series of letters and numbers (nomenclature) that further identifies the characteristics of your Mascot II.

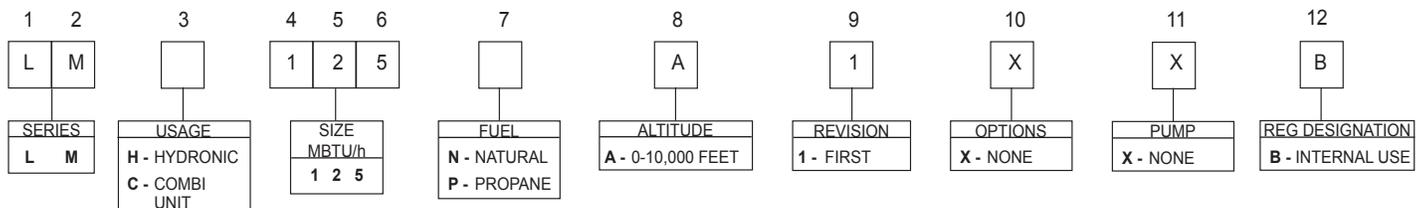
The following nomenclature identifies the individual characters of your model number.

- (1-2) **Model Series Designation**  
L M = Mascot II
- (3) **Usage**  
H = Modulating Boiler  
C = Combination Boiler and Water Heater
- (4-6) **Size**  
1 2 5 = 125,000 BTU/hr input
- (7) **Fuel**  
N = Natural Gas  
P = LP Gas
- (8) **Altitude**  
A = 0-10,000 Feet
- (9) **Revision**  
1 = First version
- (10) **Options Code**  
X = No Options
- (11) **Pump Options**  
X = No Pump
- (12) **Regulatory Designation**  
B = Internal Use

## 1.4 Start Up / Shut Down Instructions (Decal)

The Start Up / Shut Down Instruction (Decal) can be found on the back of the Top Panel (see Figure 1A). This Decal is also referred to as the Operating Instructions Label and/or Warning Label.

### Model Nomenclature



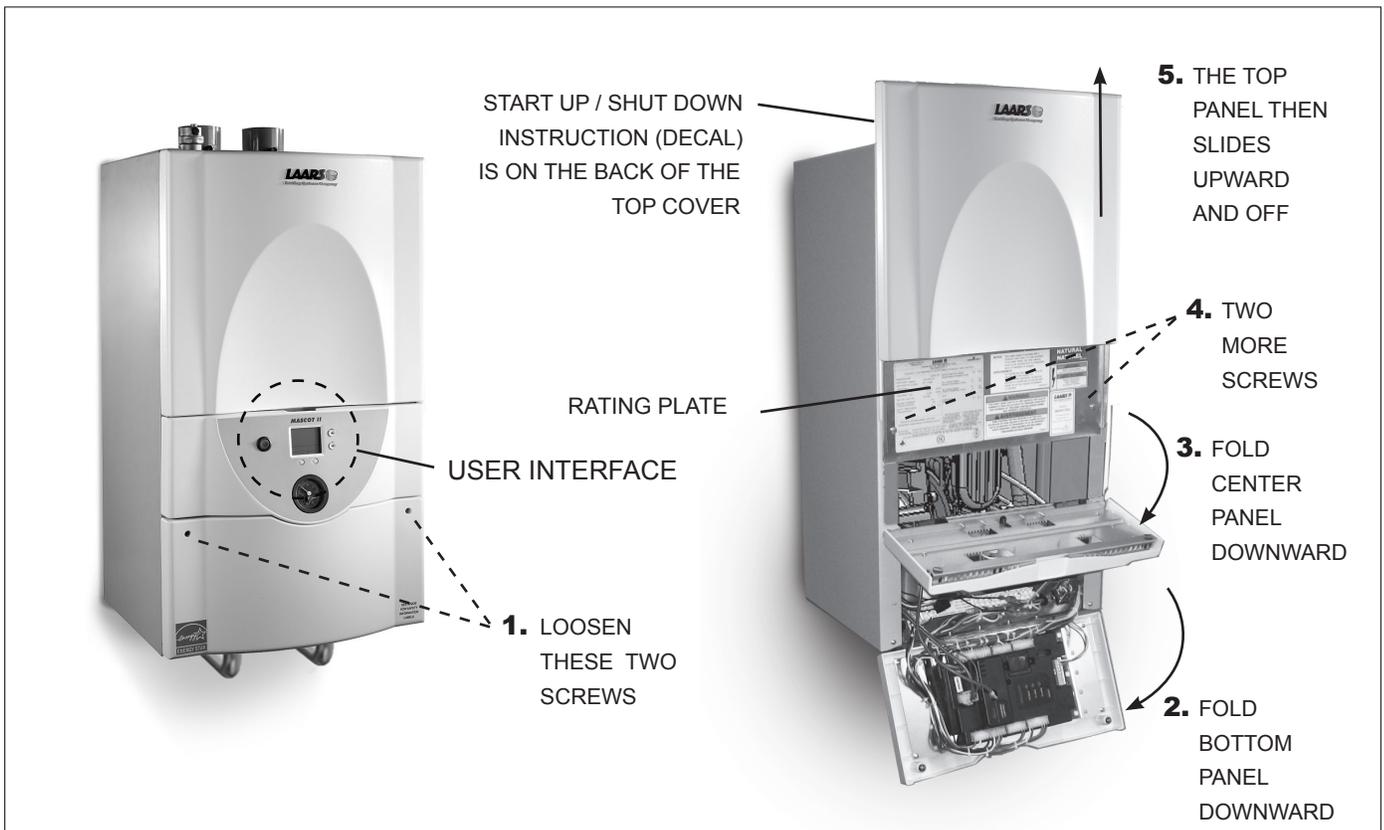


Figure 1A. Opening the Mascot II to locate the Rating Plate and Start Up / Shut Down Instruction (Decal)

To open the Mascot II, first loosen the two phillips screws and then open the front bottom panel downward. The center front panel will then also open downward. Then loosen the 2 phillips screws and slide the top panel upward and off. You will find the Start Up / Shut Down Instruction (Decal) on the back of the Top Panel.

adapter and 30psi PRV flow restrictor), wall mounting bracket (bolts/mounting hardware provided by installer).

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

**NOTE: For the complete Start up and Shut down instructions for the Mascot II, please reference SECTION 10 of this manual.**

**NOTE: To operate the Mascot II using the USER INTERFACE, please reference SECTION 8 of this manual.**

### 1.5 Unpacking

The Mascot II is shipped in a single crate with the following standard components packed with the appliance (see Figure 2):

- 2" PVC Terminal Kit (tee, elbow, screens, PRV

### 1.6 Warranty

LAARS Heating Systems' Mascot II appliances are covered by a limited warranty. The owner should complete the warranty registration at [www.Laars.com](http://www.Laars.com).

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

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.**

### 1.7 Appliance Overview

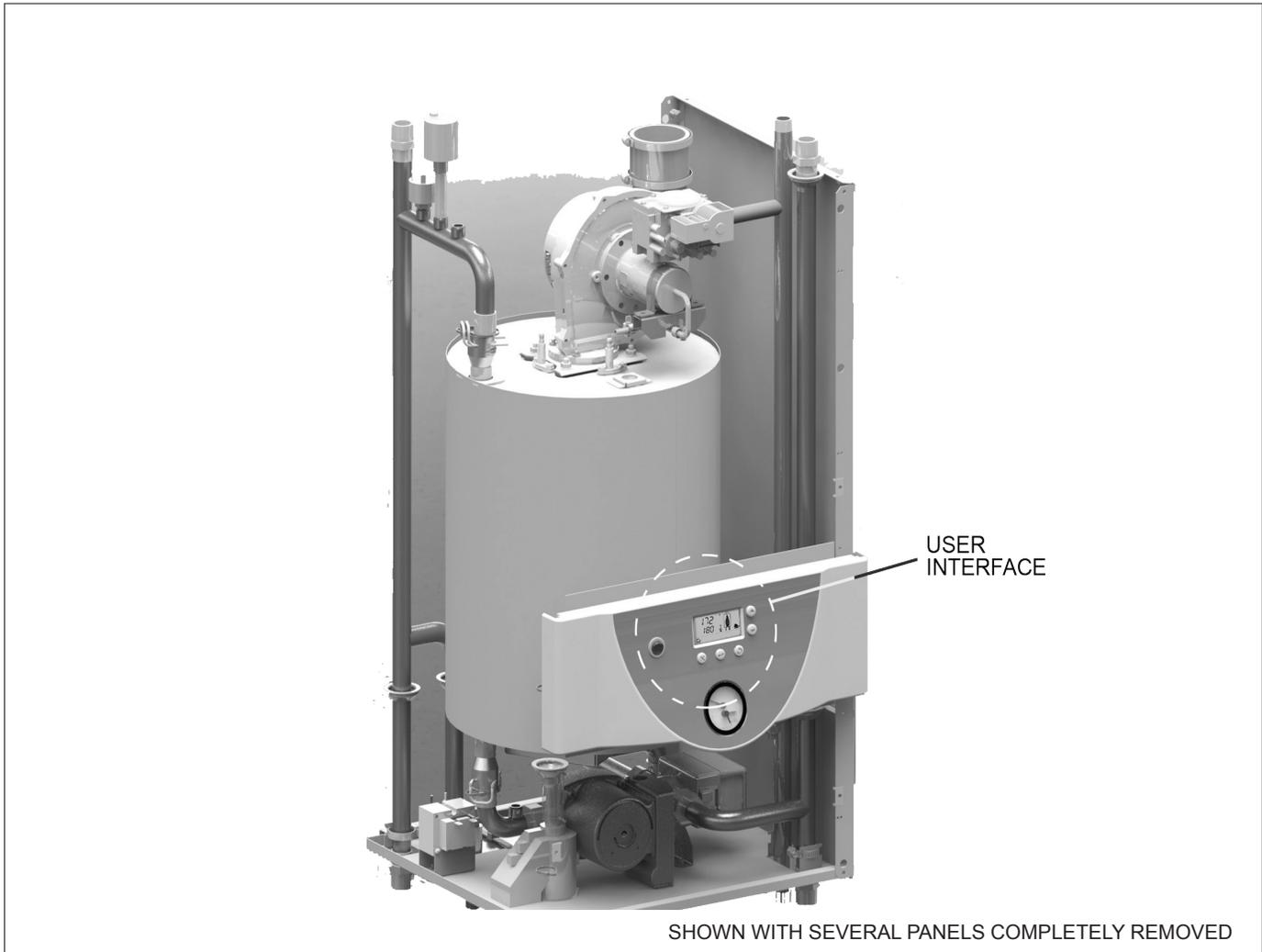
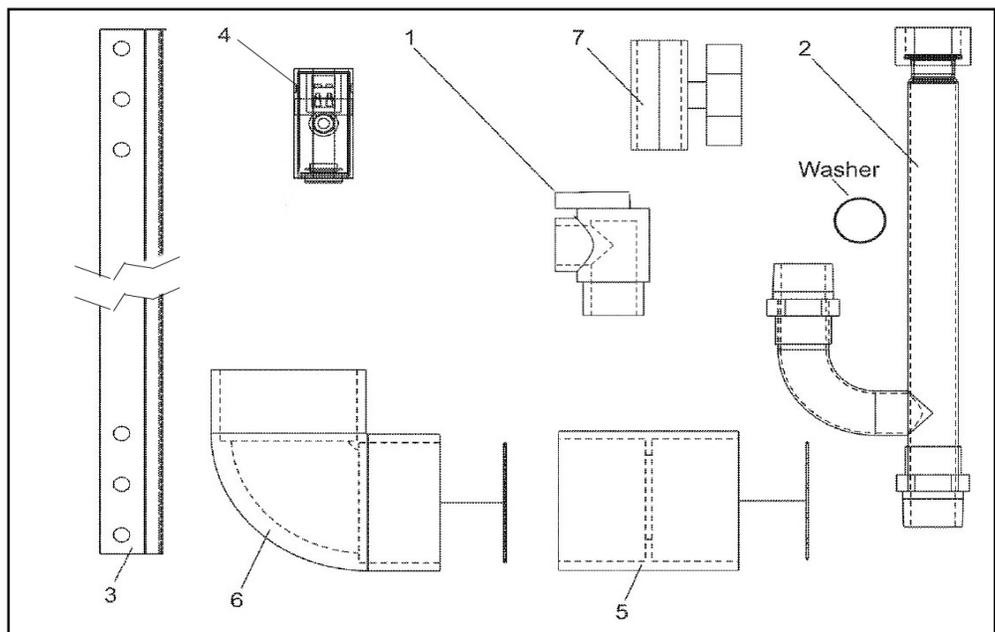


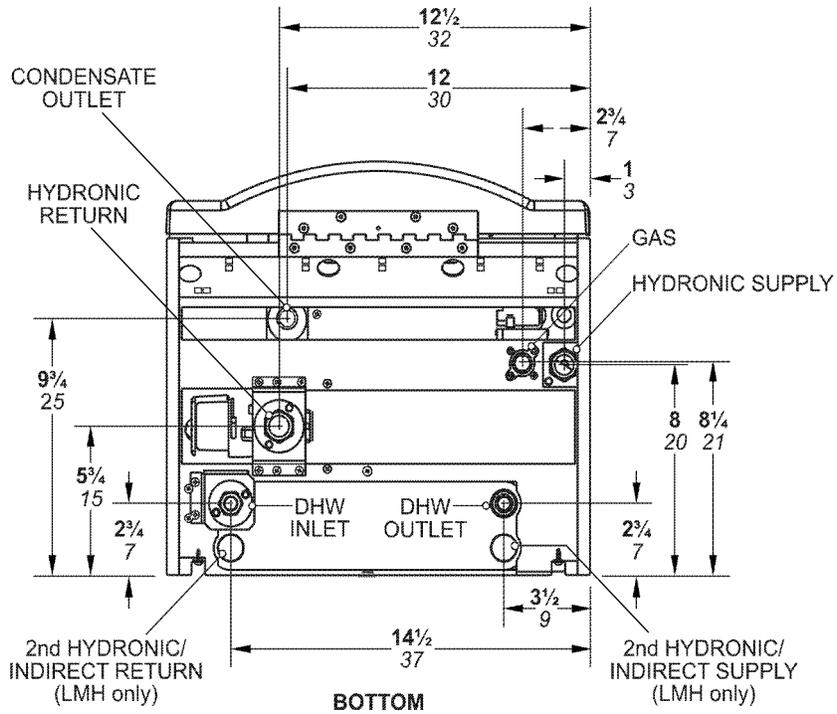
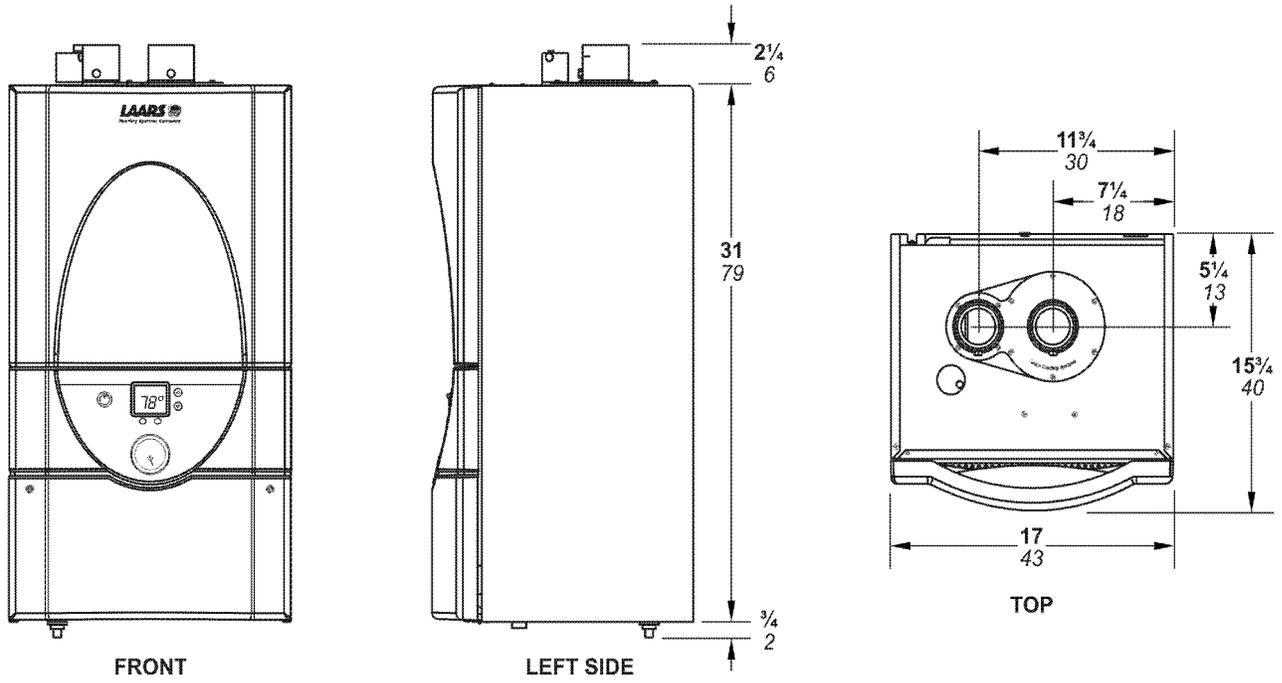
Figure 1B. Location of Components.



- 1) PRV, 30 PSI
- 5) Exhaust terminal assy
- 2) PRV Pipe w/washer
- 6) Air intake terminal assy
- 3) Wall attach bracket
- 7) Ball valve
- 4) Outdoor sensor
- 8) System sensor (not shown)
- 9) Flow restrictor (not shown)

Figure 2. Contents of Shipping Package.

1.8 Dimensions



Cond. Outlet	Hydronic Return	DHW Inlet	2nd Return	Gas Supply	Hydronic Supply	DHW Outlet	2nd Supply
3/4"	3/4"	1/2"	3/4"	1/2"	3/4"	1/2"	3/4"
PVC	copper	NPT	copper	NPT	NPT	NPT	copper

Figure 3. Dimensional Drawing.

## SECTION 2. Locating the Appliance

### 2.1 Locating the Appliance

#### Mascot II is for indoor, wall-mounted 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 **wall-mounted** installation in basements; in closets, utility rooms or alcoves. The location for the appliance should be chosen with regard to the vent pipe lengths and external plumbing and on a plumb (vertical) wall. 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 Mascot II must be located as close as practical to the vertical section of the vent. If the vent terminal and/or combustion air terminal terminate through a wall, and there is potential for snow accumulation in the local area, both terminals should be installed at an appropriate level above grade or the maximum expected snow line.

The dimensions and requirements that are shown in **Table 1** should be met when choosing the locations for the appliance.

### 2.2 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 Mascot II combustion air intake terminal must be installed a minimum of 12" below the exhaust terminal.

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

APPLIANCE SURFACE	SUGGESTED SERVICE ACCESS CLEARANCE	
	INCHES	CM
Left Side	6	15
Right Side	6	15
Top	6	15
Closet, Front	6	15
Front	24	61
Vent	1	3

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

**Table 1. Clearances.**

SIZE	VENT	INTAKE / EXHAUST				
		MAX EQUIV.		CONCENTRIC VENT	MAX EQUIV.	
		FT.	M		FT.	M
125	2"	40	6.1	3/5"	40	6.1
125	3"*	100	30.5	3/5"	40	6.1

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 UL1738. Installations in Canada require exhaust vent pipe that is certified to ULC S636.

Intake (air) pipe must be PVC or CPVC that complies with ANSI/ASTM D1785 F441, ABS that complies with ANSI/ASTM D1527 or galvanized material.

Installer must comply fully with manufacturer's installation instructions, 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 elbow used.

\* Must use 2x3 adapter within 1 ft. (30cm) of boiler exhaust outlet.

**Table 2. Vent / Air Pipe Sizes.**

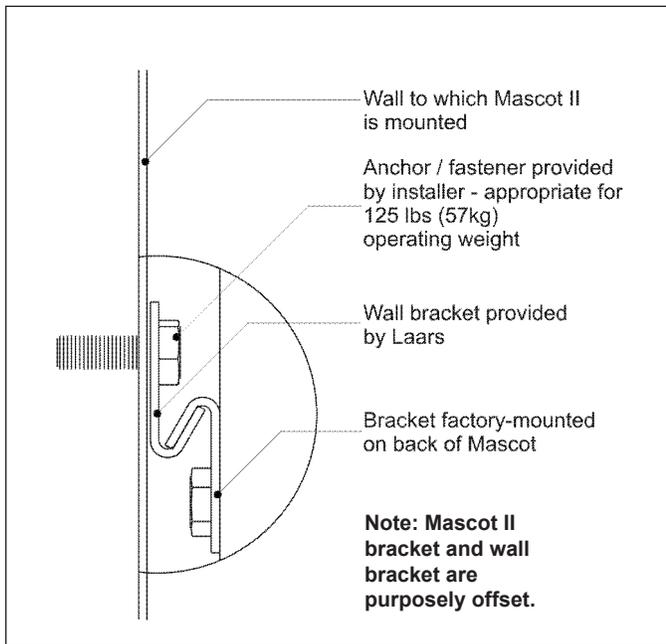


Figure 5. Mounting Detail.

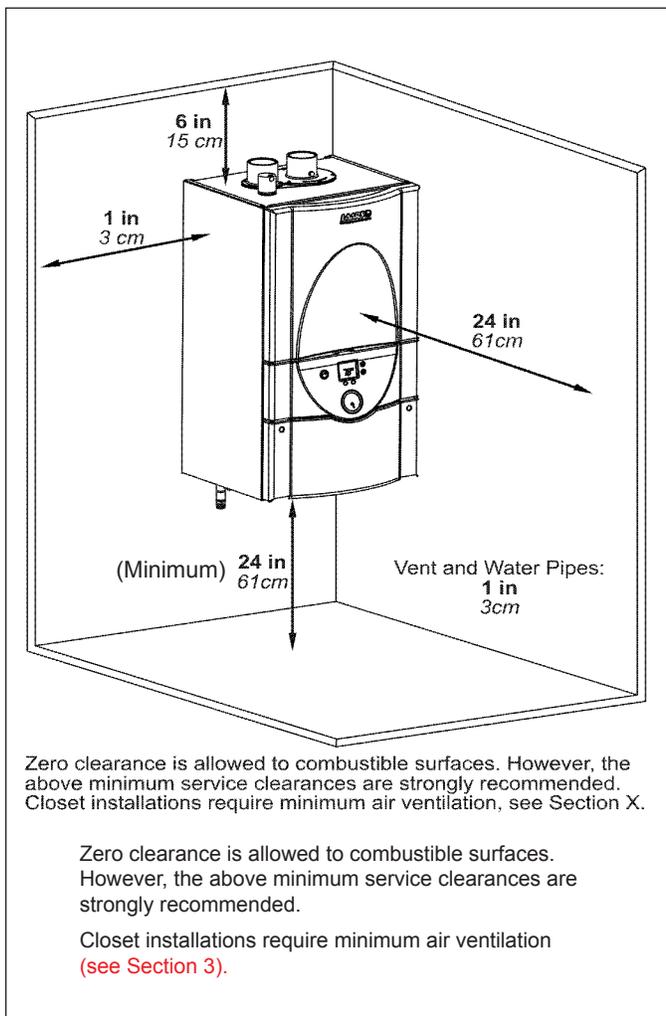


Figure 4. Locating the Appliance.

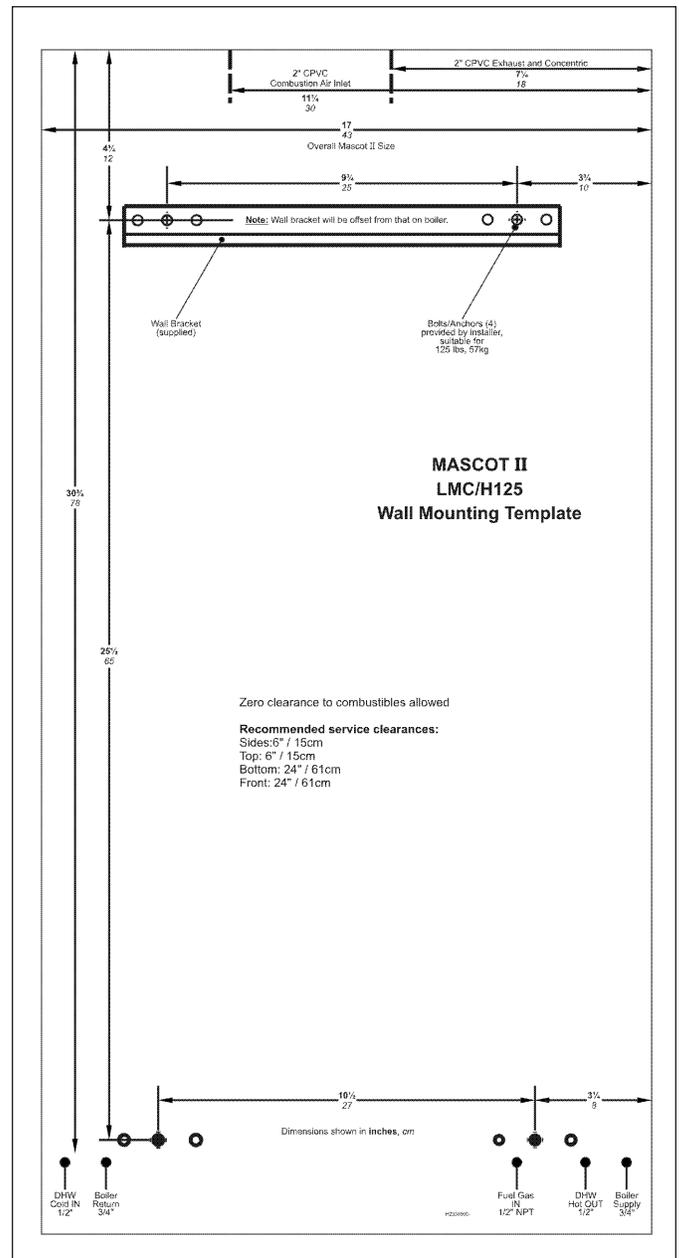


Figure 6. Wall Template (not to scale). Full-size template is included with the unit.

**NOTE:** Mascot II models include 16" on-center mounting holes on upper rear of boiler jacket. These holes are not identified on the mounting template. If mounting conditions are appropriate, the installer may opt to use this alternative method in lieu of the standard wall bracket depicted. Installer must provide appropriate mounting/anchoring hardware.

## SECTION 3. Venting and Combustion Air

**Laars Mascot II includes a standard CPVC vent/combustion air adapter. If field connections require use of PVC/CPVC vent materials, the installer must use proper adhesive to join CPVC and/or PVC pipe and fittings.**

### 3.1 Combustion Air

Mascot II 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 Mascot II 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.**

#### 3.1.1 Combustion Air from Room

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

**Method 1:** Two permanent openings, one commencing within 12" (300mm) of the top and one commencing within 12" (300mm) of the bottom, of

KITS	HORIZONTAL INTAKE AND EXHAUST PVC VENT TERMINAL		
	2" PVC		3" PVC
SIZE	Standard	Concentric CA006000	n/a
125	included	optional	contact Laars

Concentric vent terminal = 10 ft. pipe length.

**Table 3a. PVC Vent Terminal Kits.**

SIZE	CONCENTRIC ADAPTER	WALL TERMINAL	ROOF TERMINAL
125	3CGV-VC	3CGV-AD-LAARS	3CVG-HZC

**Table 3b. Approved Stainless Steel Terminations and Adapters.**

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/CGA B149.

#### 3.1.2 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 3](#). See [Table 2](#) to select the appropriate diameter air pipe. When taken from the roof, a field-supplied rain cap or an elbow arrangement must be used to prevent entry of rain water (see [Figure 7](#)).

Use ABS, PVC, CPVC or galvanized pipe for the combustion air intake (see [Table 4](#)), 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 2](#). 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 (see [Figure 2](#)).

In addition to air needed for combustion, air

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 4. Required Combustion Air Pipe Material.**

shall also be supplied for ventilation, including air required for comfort and proper working conditions for personnel.

### 3.2 Venting (Exhaust)

**⚠ WARNING**

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

**⚠ WARNING**

All venting must be installed according to this manual and any other applicable local codes, including but not limited to, ANSI Z223.1/NFPA 54, CSA B149.1, CSAB149.2 and ULC-S636. Failure to follow this manual and applicable codes may lead to property damage, severe injury, or death.

**The flue temperature of the Mascot II 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 Mascot II is installed in an application where the ambient temperature is elevated, and/or installed in a closet/alcove, CPVC or stainless steel material is required. If the system temperatures are unknown at the time of installation, stainless or CPVC material is recommended.**

The Mascot II is a Category IV appliance and may be installed with PVC and CPVC that complies with ANSI/ASTM D1785 F441, or a stainless steel venting system that complies with UL 1738 Standard (see Table 5).

**INSTALLATIONS IN CANADA require the use of venting material certified to ULCS636. All Gas vents connected to the Mascot II, plastic, stainless steel or otherwise must be certified to this ULC standard. Appropriate selection of vent material is very important for proper performance and safe operation of the Mascot II.**

**The flue temperature of the Mascot II 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 Mascot II is installed in an application where the outlet water temperature exceeds 145°F, and/or installed in a closet, class IIB or higher vent material is required. If the system temperatures are unknown at the time of installation, class IIB or higher venting material is recommended.**

**IN CANADA all venting used must meet the following requirements:**

1. **ULC-S636 certified and marked**
2. **The first 3 feet of venting must be accessible for visual inspection.**
3. **All components used in the vent system must be from a certified manufacturer.**
4. **Vent system components must not be mixed with alternate manufacturers certified components and/or unlisted components.**
5. **The venting must be installed according to the vent manufacturers installation instructions.**

The unit’s vent can terminate through the roof, or through an outside wall.

See Table 2 to select the appropriate vent pipe diameter. Vent pipe must pitch upward, toward the vent terminal, not less than 1/4" per foot, so that condensate will run back to the Mascot II 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 2 for proper diameter vs. length allowed.

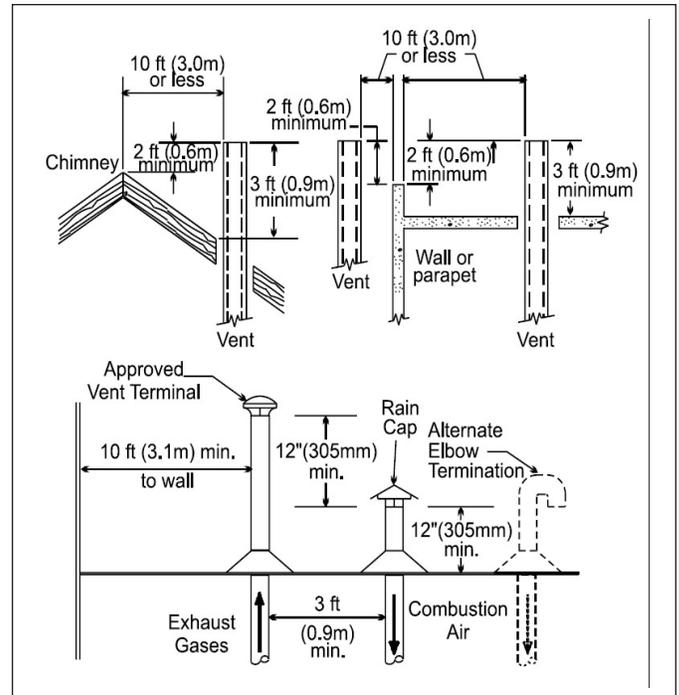


Figure 7. Combustion Air and Vent Through Roof.

MATERIAL	INSTALLATION STANDARDS	
	UNITED STATES	CANADA
Stainless Steel	UL 1738	Venting must be ULC-S636 certified for use as venting material. The venting material must be chosen based upon the intended application of the boiler.
PVC, sch 40	ANSI/ASTM D178	
CPVC, sch 40	ANSI/ASTM F441	

Table 5. Required Exhaust Vent Material.

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

### 3.3 Locating Vent & Combustion Air Terminals

#### 3.3.1 Side Wall Vent Terminal

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

1. **Figure 9** shows the requirements for mechanical vent terminal clearances for the U.S. and Canada.
2. Vent terminals for condensing appliances or appliances with condensing vents are **not** permitted to terminate above a public walkway, or over an area where condensate or vapor could create a nuisance or hazard.
3. Locate the vent terminal so that vent gases cannot be drawn into air conditioning system inlets.
4. Locate the vent terminal so that vent gases cannot enter the building through doors, windows, gravity inlets or other openings. Whenever possible, avoid locations under windows or near doors.
5. **Locate the vent terminal so that it cannot be blocked by snow. The installer may determine that a vent terminal must be higher than the minimum shown in codes, 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 9** 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.

#### 3.3.2 Side Wall Combustion Air Terminal

The LAARS side wall combustion air terminal, or concentric terminal (see **Table 3**), must be used when the heater takes air from a side wall. Consider the following when installing the terminal (see **Figure 9**):

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. **For concentric vent, follow instructions included with vent kit.**
5. Multiple vent kits should be installed such that the horizontal distance between outlet group and inlet group is 36" (90cm) minimum.
6. Vent outlet must be no lower than the center of the air inlet, and must be at least 12" (30cm) away from the air inlet (see **Figure 8**).

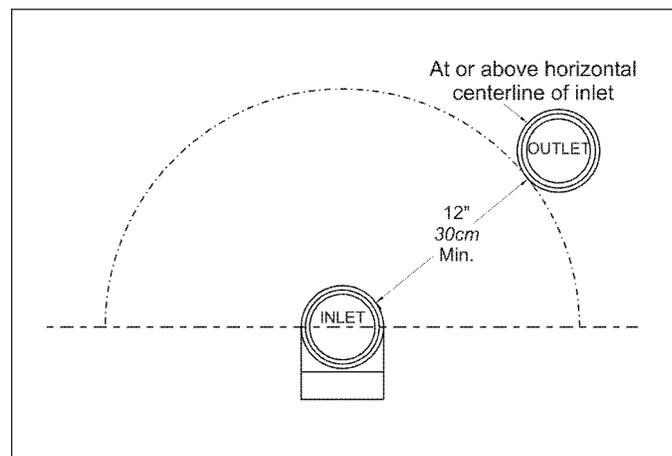
#### 3.3.3 Vertical Vent Terminal

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. When the combustion air is taken from the roof, the combustion air must terminate at least 12" (30cm) below the vent terminal (see **Figure 7**).

#### 3.3.4 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 7**). 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.

#### 3.3.5 Installations in the Commonwealth of



**Figure 8. Minimum Venting Distance.**

	U.S. Installations (see note 1)	Canadian Installations (see note 2)
<b>A=</b> Clearance above grade, veranda, porch, deck, or balcony	12 inches (30 cm) See note 6	12 inches (30 cm) See note 6
<b>B=</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)
<b>C=</b> Clearance to permanently closed window	See note 4	See note 5
<b>D=</b> 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
<b>E=</b> Clearance to unventilated soffit	See note 4	See note 5
<b>F=</b> Clearance to outside corner	See note 4	See note 5
<b>G=</b> Clearance to inside corner	3 feet (91 cm) minimum	See note 5
<b>H=</b> 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
<b>I=</b> Clearance to service regulator vent outlet	See note 4	3 feet (91 cm)
<b>J=</b> 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)
<b>K=</b> Clearance to a mechanical air supply inlet	3 feet (91 cm) above if within 10 feet (3 m) horizontally	6 feet (1.83 m)
<b>L=</b> Clearance above paved sidewalk or paved driveway located on public property	Vent termination not allowed in this location for category IV appliances.	Vent termination not allowed in this location for category IV appliances.
<b>M=</b> 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/CGA-B149 Installation Codes.
3. Permitted only if veranda, porch, deck, or balcony is fully open on a minimum of two sides beneath the floor.
4. For clearances not specified in ANSI Z223.1 / NFPA 54, clearance is in accordance with local installation codes and the requirements of the gas supplier.
5. For clearances not specified in CAN/CGA-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.

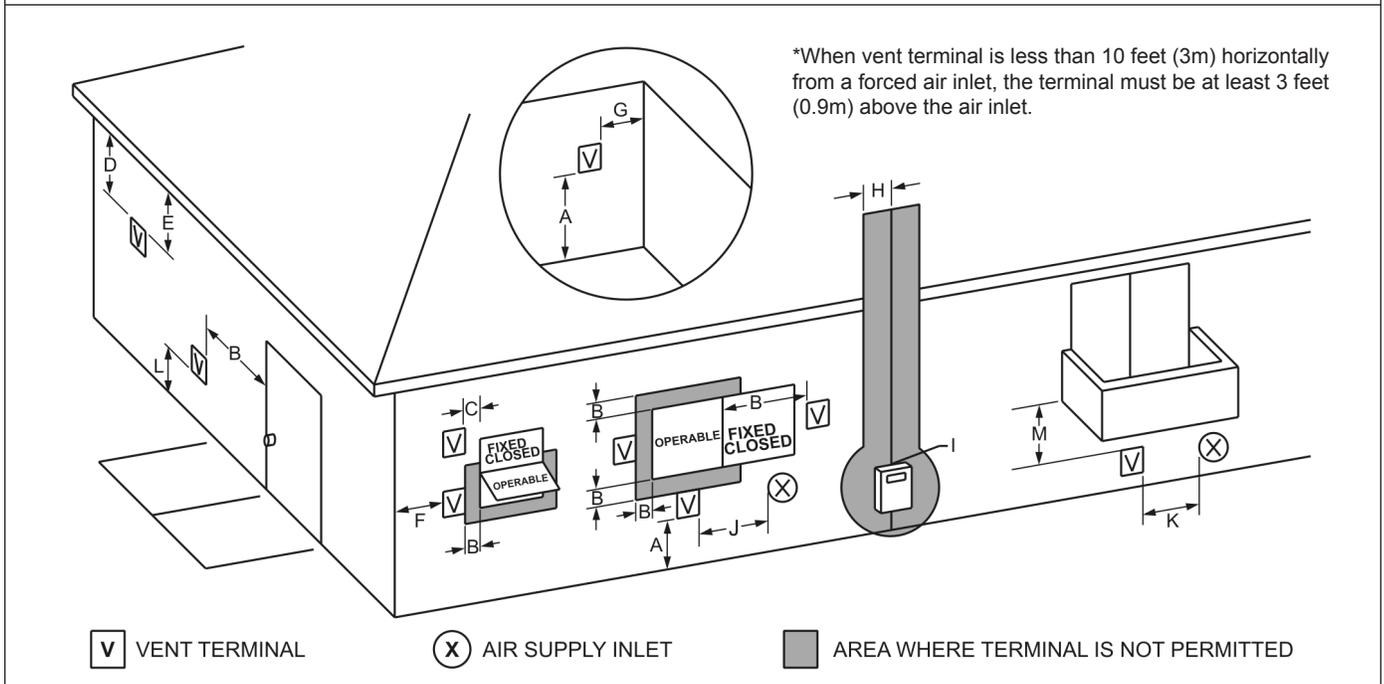


Figure 9. Combustion Air and Vent Through Side Wall.

## Massachusetts

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

### 1. Installation of Carbon Monoxide Detectors

At the time of installation of the side wall vented gas fueled appliance, the installing plumber or gasfitter shall observe that a hard-wired carbon monoxide detector with an alarm battery back-up is installed on the floor level where the gas 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

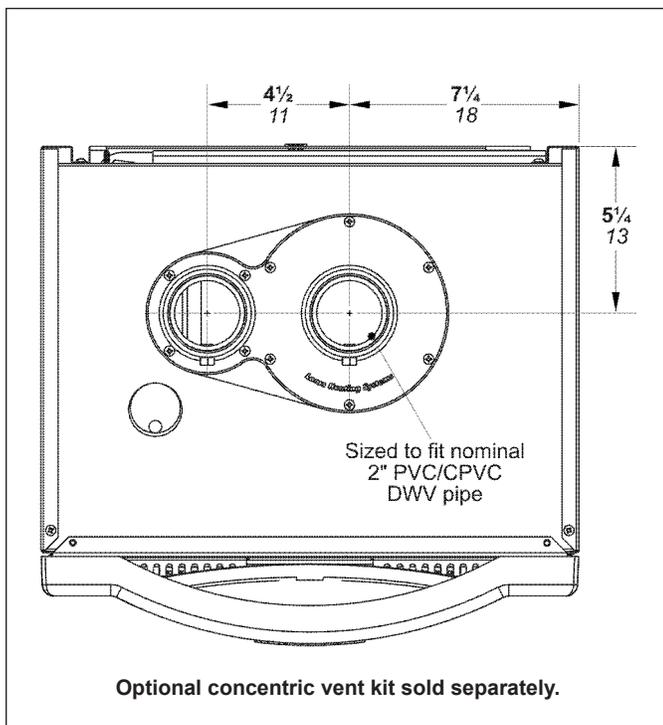


Figure 10. Vent Dimensions, 2-Pipe System.

thirty (30) day period, a battery operated carbon monoxide detector with an alarm be installed.

### 2. Approved Carbon Monoxide Detectors

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

### 3. Signage

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

### 4. Inspection

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

## 3.4 Common Vent Test

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

### 4.1 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. Mascot II 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 **Tables 6A, 6B, 6C and 6D** to size 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 Mascot II 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.

MASCOT II NATURAL GAS REQUIRED	
SIZE	CU FT / HR.
125	125

**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.

**Table 6A.**

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

**Table 6B.**

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"
FT	CUBIC FEET OF GAS PER HOUR	
20	92	190
40	130	
60	105	
80	90	
100		

**Table 6C.**

SCHED 40 METAL PIPE CAPACITY FOR 1.50 SPECIFIC GRAVITY UNDILUTED PROPANE		
NOMINAL PIPE SIZE @ 11" W.C. INLET AND 0.5" W.C. PRESSURE DROP		
SIZE	1/2"	3/4"
LENGTH	MAXIMUM CAPACITY IN THOUSANDS OF BTU PER HOUR	
20	200	418
40	137	287
60	110	231
80	94	197
100	84	175

**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 6D.**

## SECTION 5. Pump Capacity

### 5.1 Mascot II Heating System Pump Capacity

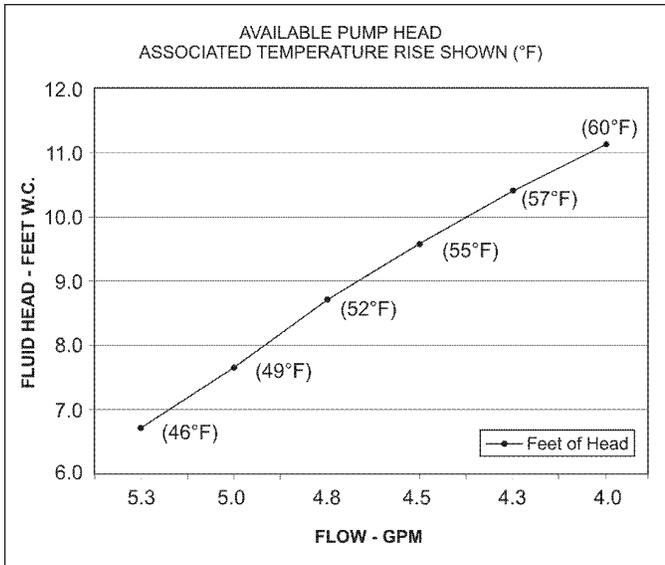


Figure 11. Available Pump Head.

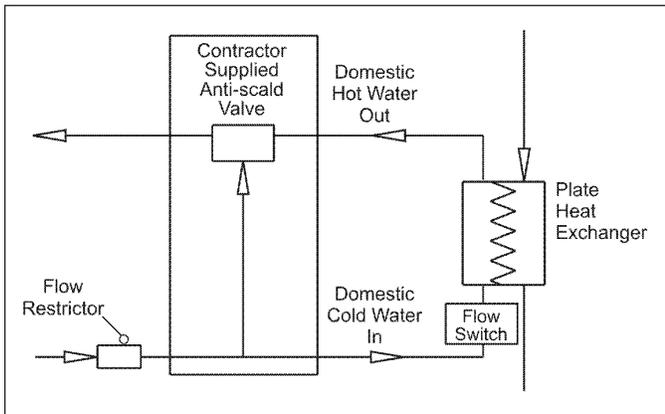


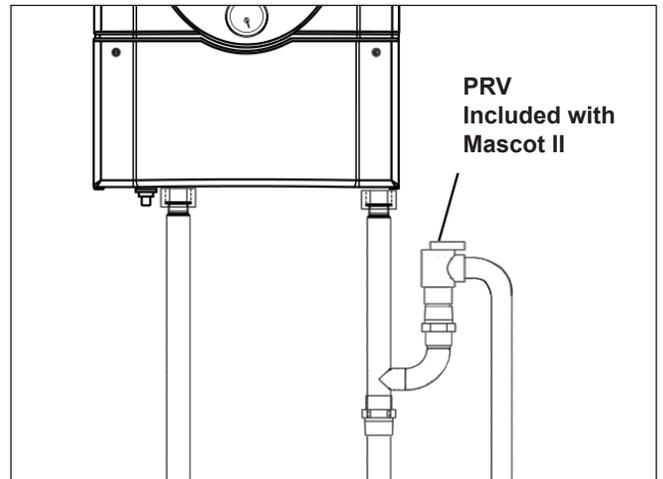
Figure 12. DHW Connections with Anti-Scald Valve and Flow Restrictor.

## SECTION 6. Water Connections

### 6.1 Central Heat System Piping

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

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



**A Pressure Relief Valve** is included with each Mascot II. The PRV must be installed prior to filling the system.

when rigid hangers are installed. Maintain 1" (2.5cm) clearance to combustibles for hot water pipes.

Pipe the discharge of the pressure relief valve (full size) to a drain or in a manner to prevent injury in the event of pressure relief. If system contains more than 24 gallons (91 liters), then an auxiliary expansion tank is required. Minimum fill pressure must be 12psig (82.7kPa). Install shutoff valves where required by code.

Suggested piping diagrams are shown in **Figures 12 through 19**. These diagrams are meant only as a guide. Components required by local codes must be properly installed.

**Mascot II's efficiency is higher with lower return water temperatures.**

Mascot II **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.

Mascot II boiler must be located within 15 feet (4.6m) of the supply and return header (or the hydraulic separator). The pump is sized for a maximum of 30 feet (9.1m) of piping and the headloss of the boiler only.

For custom configurations, the available pump head is provided in **Figure 11**. The system designer should take into account allowable boiler temperature rise of 65°F (36°C).

### 6.2 Cold Water Make-Up

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

SIZE	HEATING CONN SIZE	DHW CONN SIZE
125	3/4"	1/2"

Table 7. Water Connection Pipe Sizes.

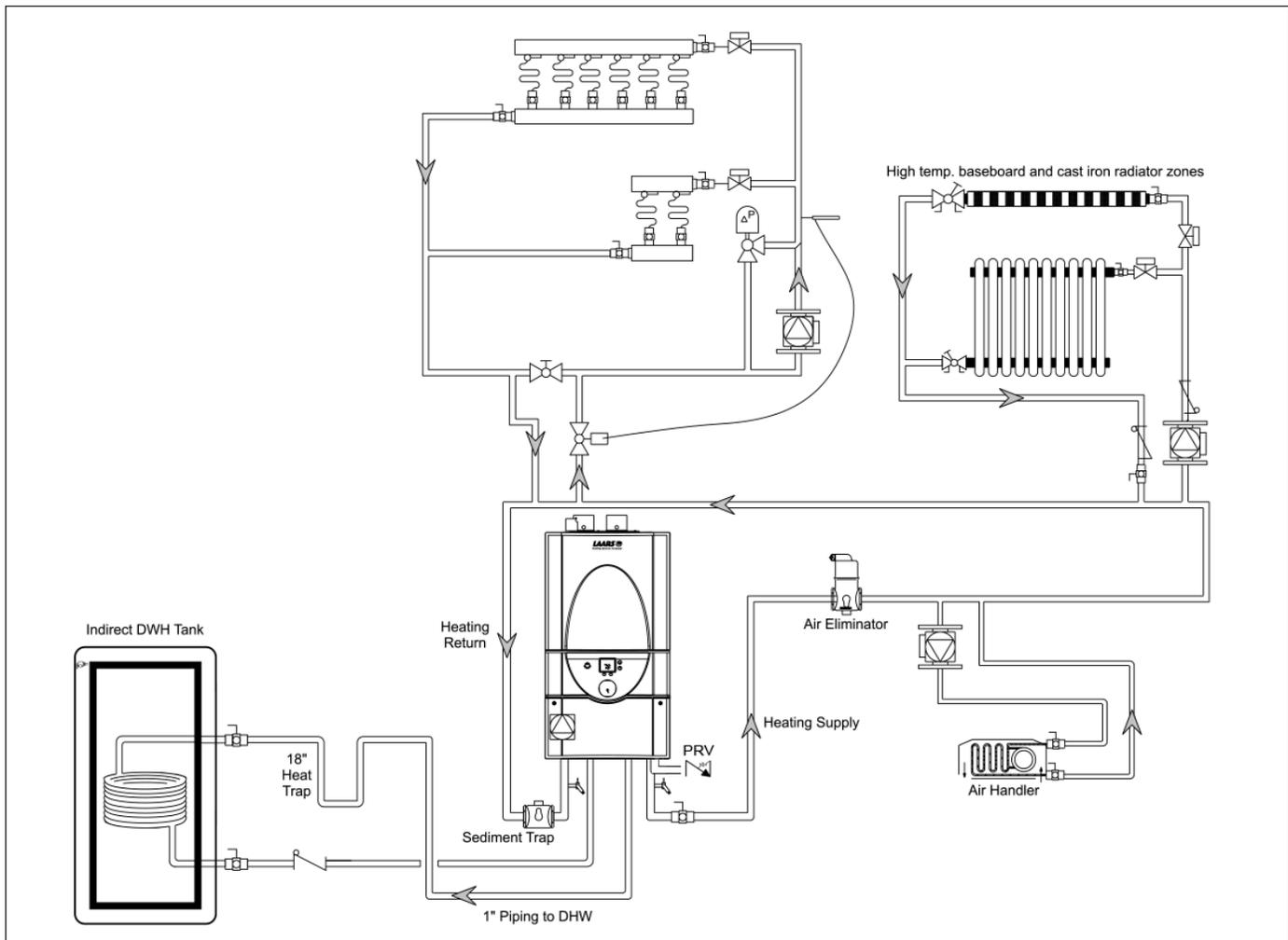


Figure 13. Hydronic Piping — High and low temp zones with indirect water heater (LMH using internal 3-way).

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 at the time of boiler installation.

### 6.3 Freeze Protection

Mascot II 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 or ethylene glycol. To help prevent freezing, Laars recommends the use of inhibited propylene glycol concentrations between 20% and 35% glycol. Typically, this concentration will serve as burst protection for temperatures down to approximately  $-5^{\circ}\text{F}$  ( $-20^{\circ}\text{C}$ ). If temperatures are expected to be lower than  $-5^{\circ}\text{F}$  ( $-20^{\circ}\text{C}$ ), glycol concentrations up to 50% can be used.

**NOTE: Laars supplied pumps are not all capable of maintaining the reduced temperature rise required with glycol concentrations greater than 35%.**

**IMPORTANT NOTES:** 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.

### 6.4 Suggested Piping Schematics

Figures 13 through 19 show suggested piping configurations for Mascot II boilers. These diagrams are only meant as a guide. All components or piping required by local code must be installed.

### 6.5 Recognized Chemicals

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

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

### 6.6 Hot Water Piping

#### 6.6.1 Domestic Hot Water Piping (LMC)

Connect domestic hot and cold water piping to the boiler at locations noted in Figure 13. Expected DHW performance is indicated in Table 8.

Use of flow restrictor is optional to prevent colder water at excessive flow rates. Contact Laars for alternate configurations.

#### 6.6.2 Indirect Water Heater Piping (LMH)

The LMH model can control an indirect water heater zone. Pipe to the locations shown in Figure 13. Zone valve and associated wiring are not required. Setpoint is made via aquastat located on the indirect water heater, or can be controlled at the boiler via a remote sensor.

### 6.7 Condensate Drain

A condensate drain trap is built into the Mascot II. 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 disposal method.



#### Caution

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

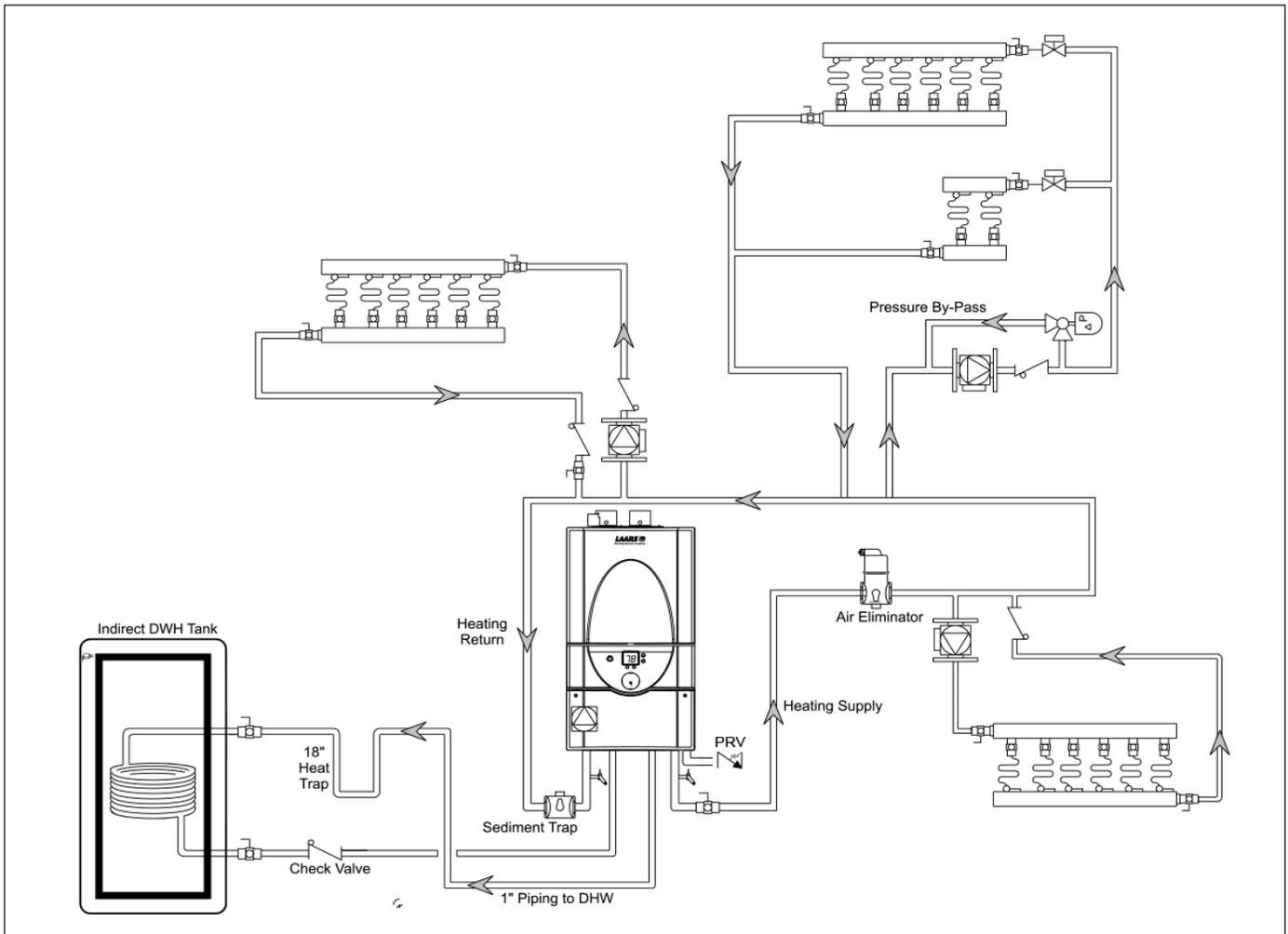


Figure 14. Hydronic Piping — Low temp system with indirect water heater (LMH using internal 3-way).

GPM	INLET TEMPERATURE °F		
	50°F	60°F	70°F
	TEMP RISE °F		
1.0	100	90	81
2.0	90	83	79
3.0	78	76	68
4.0	59	56	51

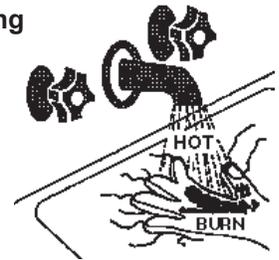
  

LPM	INLET TEMPERATURE °C		
	10°C	16°C	21°C
	TEMP RISE °C		
4	56	50	45
8	50	46	44
11	43	42	38
15	33	31	28

**Table 8. DHW and Pump Performance Data.**

**⚠ Caution**

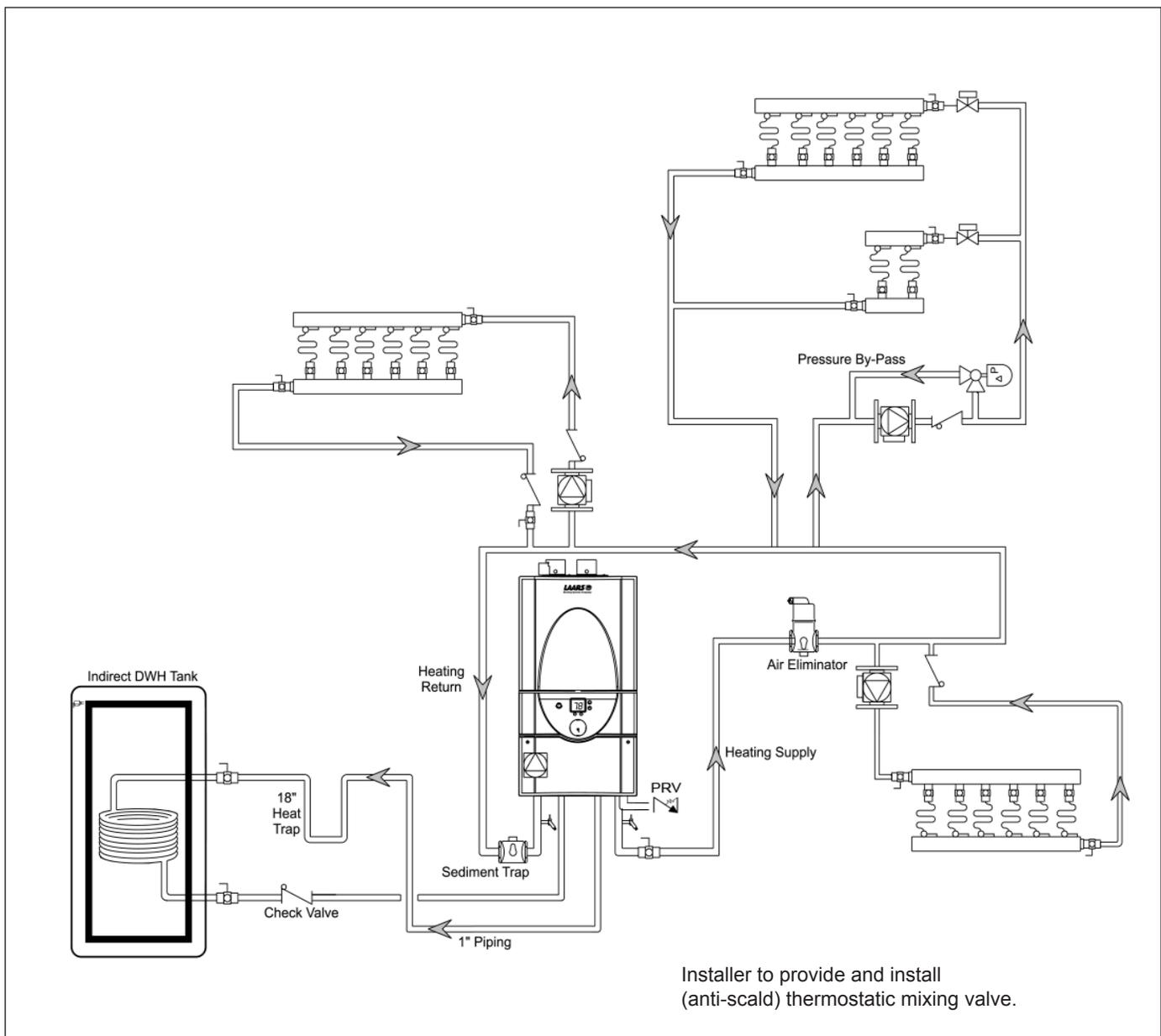
**Scalding Risk:** Laars recommends the use of a thermostatic mixing valve at domestic hot water outlet (boiler location) to reduce potential for scalding.



The following thermostatic mixing valve model has been tested and approved for Mascot II application:

Honeywell AM100-US-1

Contact Laars for additional recommended models.



Installer to provide and install (anti-scald) thermostatic mixing valve.

**Figure 15. Hydronic Piping — Low temp system.**

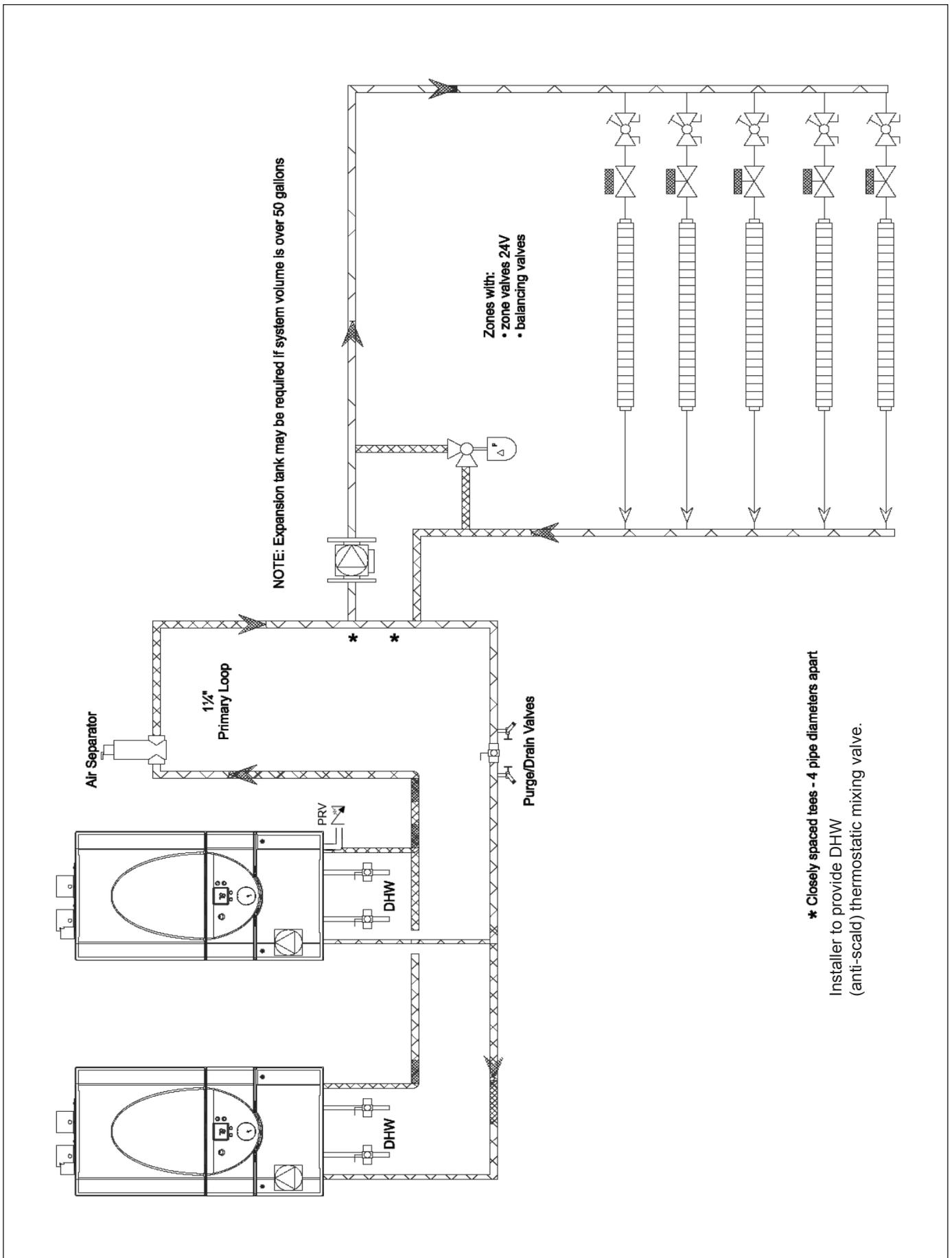


Figure 16. Hydronic Piping — Multi boilers for large homes with long / multiple baseboard zones.

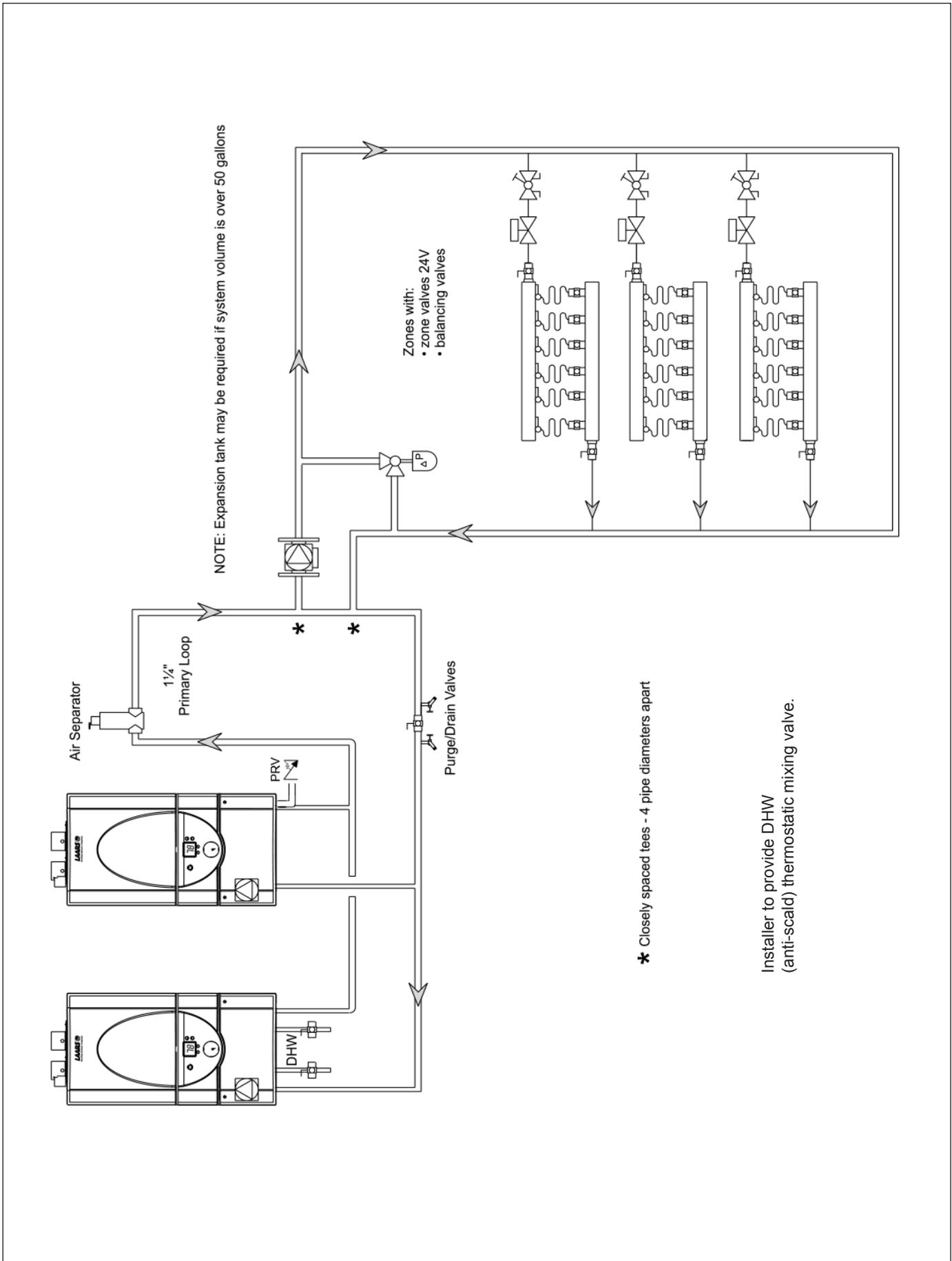


Figure 17. Hydronic Piping — Multi boilers for large homes with long / multiple radiant zones.

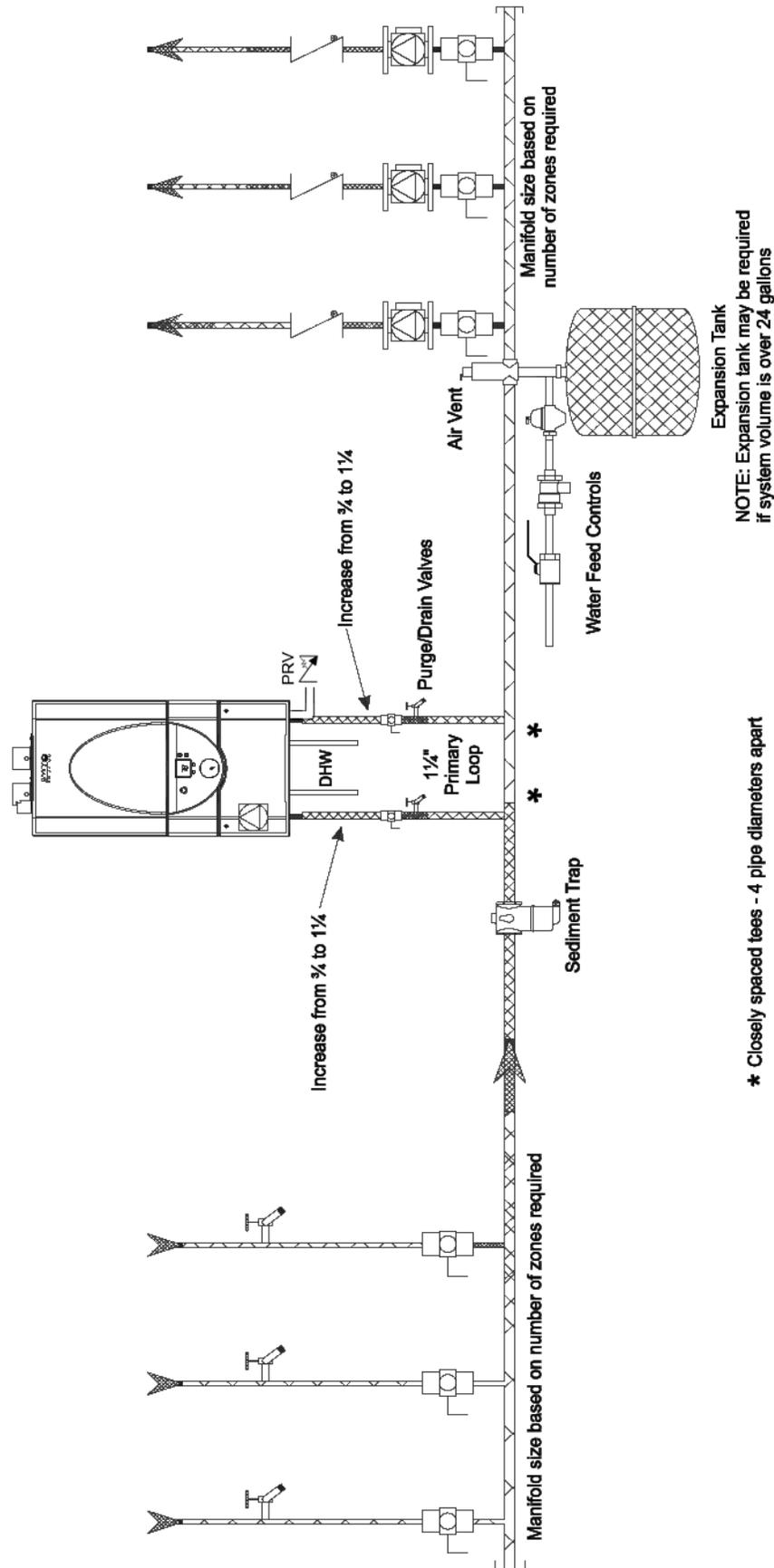


Figure 18. Hydronic Piping — Heating zones piped with zone pumps.

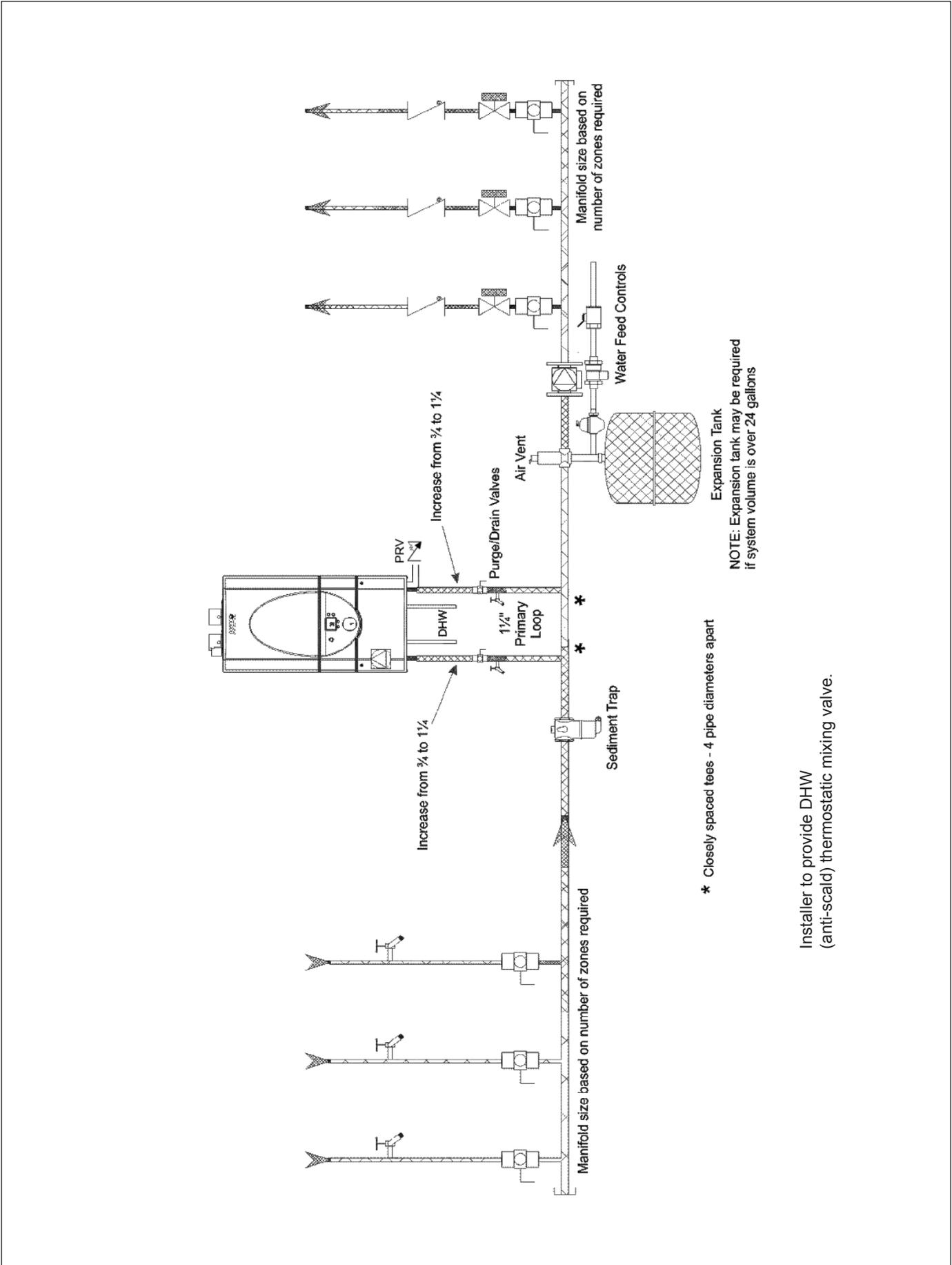


Figure 19. Hydronic Piping — Heating zones piped with zone valves.

## SECTION 7. Electrical Connections

### 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 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.

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

Wiring connections are shown in [Figures 21-22](#).

**Important Note:** DO NOT MAKE/BREAK MASCOT II LINE VOLTAGE TO SIGNAL CALL FOR HEAT. A "call for heat / end call for heat" MUST be connected to the field interlock terminals. Some Mascot II components are designed to have constant voltage during normal operation. If the Mascot II's supply voltage is toggled as a call for heat signal, premature failure of these components may result.

If using remote 4-20mA control, Mascot II does not recognize 4mA as a signal to shut off. If the call for heat is not connected between the field interlock terminals, Mascot II will remain in low fire when it sees 4mA as a modulating signal.

### Caution

Mascot II supply voltage must not be disengaged, except for service or isolation, or unless otherwise instructed by procedures outlined in this manual. To signal a call for heat, use the 24V field-interlock, as shown in the wiring diagram(s).

### 7.1 Main Power

Plug power cord into a non-switched 115V electrical outlet with 15A circuit protection. FLA is 2A. There is an internal 10A breaker to protect internal system components.

### 7.2 Pump Connections

Mascot II energizes the integral boiler pump (and

three-way valve if central heat) upon a call for heat. Once the call for heat is satisfied the pump will remain on for the defined pump overrun time.

**NOTE:** System pump contacts are dry contacts. Appropriate voltage must be supplied to the System pump for proper operation.

System pump connections are located in the control panel (see [Figure 20](#)). 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.

### 7.3 24Vac Transformer with Circuit Breaker

24Vac is supplied by a transformer mounted behind the upper door. All 24Vac power is supplied through a 2A circuit breaker located behind middle door.

### 7.4 Central Heat - Call for Heat

Connect the Call for Heat to terminals #1 and #2 (connections labeled "T-T or interlock").

### 7.5 Outdoor Air Temperature Sensor

Connect the outdoor air temperature sensor to connections labeled "Outdoor temp sensor." The outdoor air temperature sensor is used for warm weather shutdown and outdoor reset.

### 7.6 Domestic Hot Water Connection

For LMH and indirect water heater, connect aquastat for remote sensor to terminals 7 & 8 (see [Figures 20 and 22](#)).

### 7.7 System Sensor

(lead lag/cascading operation only)

Connect the system sensor to connections labeled "system sensor."

### 7.8 External Control Connections

Connect 4-20mA signals from external controls or building automation systems. When making the connections, follow the polarity designations shown on the label.

### 7.9 Lead Lag / Cascading Wiring Connections

Connect each boiler in the cascade system together by daisy chaining each control from Modbus port 1 (MB1) of the first boiler to the second and so on. This can be done using 22awg or thicker shielded twisted pair wire with drain. Two twisted pairs or three conductors are needed.

- a. To daisy-chain the boilers connect a wire from Modbus port 1 (MB1) terminal A of the first boiler to Modbus port 1 (MB1) terminal A of the second boiler.

- b. If there are more boilers in the system connect a wire from Modbus port 1 terminal A of boiler 2 to Modbus port 1 terminal A of boiler 3.
- c. Repeat these steps until all Modbus port 1 terminal A connections are wired.
- d. Repeat the above steps for Modbus port 1 terminal B and C connections to complete the wiring.
- e. Connect the drain wire from the twisted pair wire to ground on one end of the wire only.

**7.10 Wiring Diagrams** (see *Figures 21-22*)



**Caution**

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

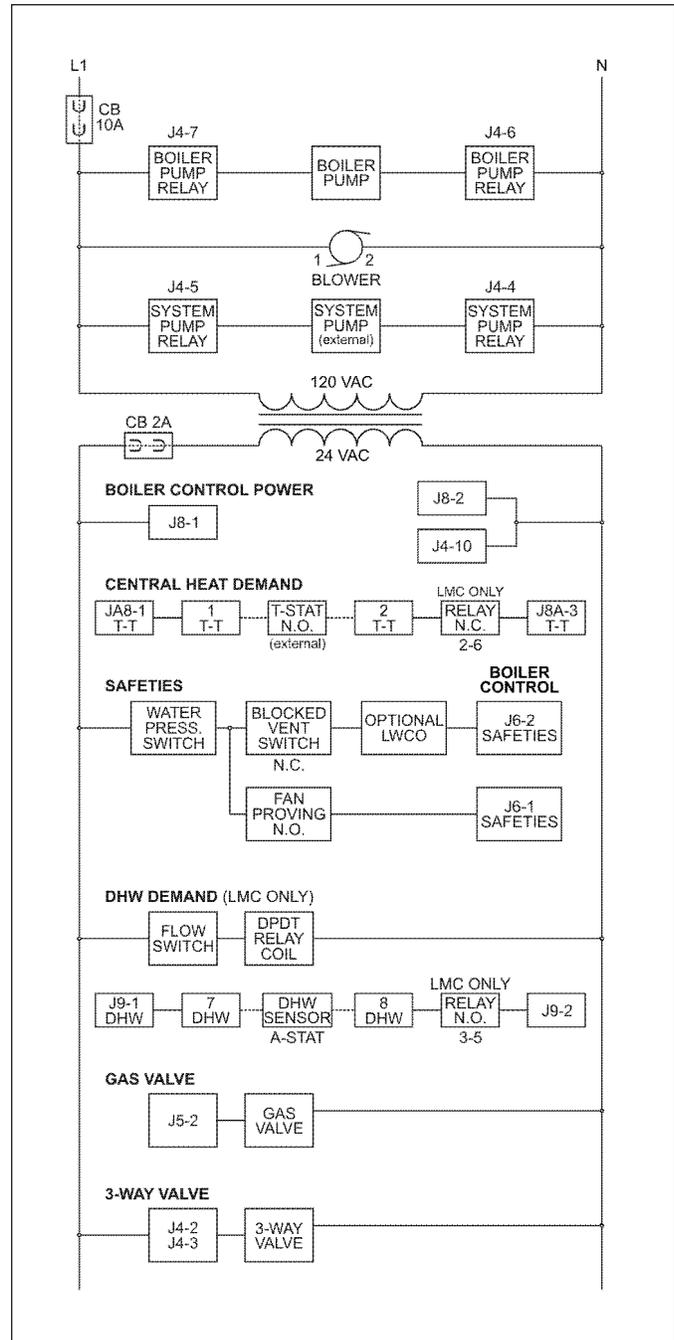


Figure 21. Ladder Diagram.

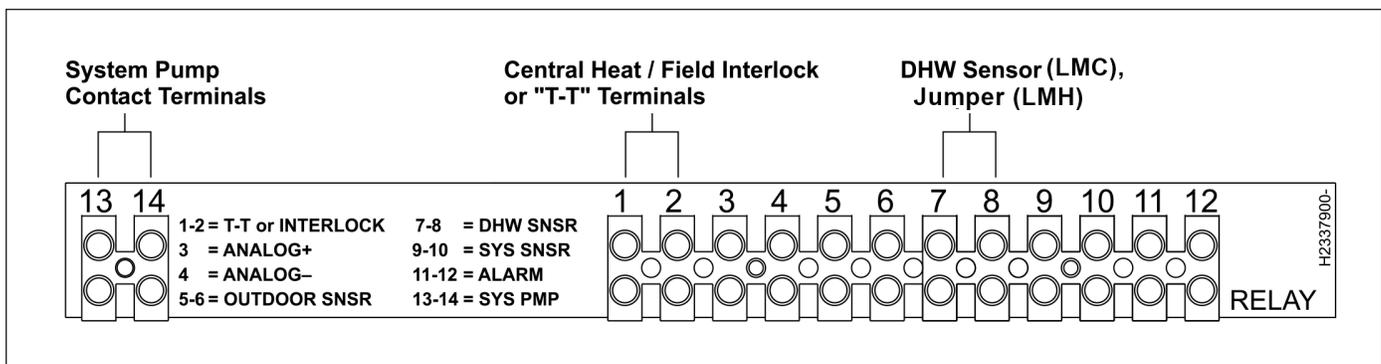
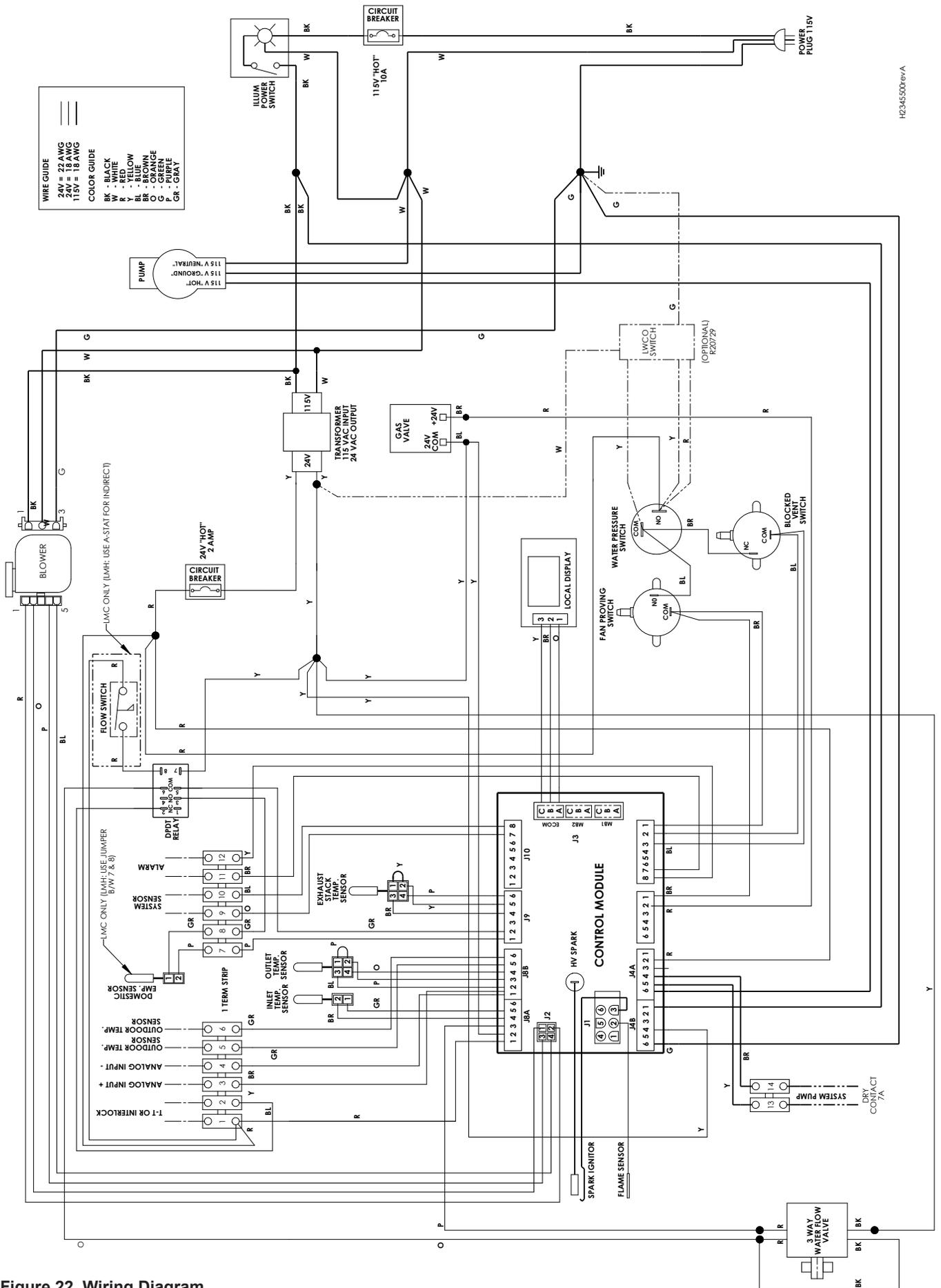


Figure 20. System Pump Connections on Control Panel.



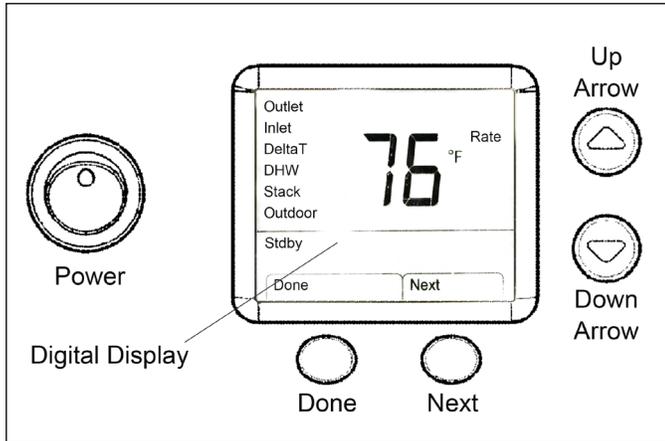
H2345500ev/A

Figure 22. Wiring Diagram.

## SECTION 8. Control Setup and Operation

The Mascot II control is an integrated electronic control that replaces many of the individual components found on older appliances. The control acts as the ignition control, pump control, high limit and cascading/lead lag control and is setup using the digital display on the appliance.

### 8.1 Digital Display Navigation



**Figure 23. The USER INTERFACE.**

The Digital Display is centered in the middle of the User Interface and has 3 separate modes of control. They are USER, SETUP and DIAGNOSTIC. The names of these modes clearly labels the intent of the different levels of control. A USER might be the homeowner or a service technician. SETUP displays all the controls needed when setting up or expanding the boiler. And DIAGNOSTIC is intended for a trained Mascot II technician. The menu structure and variables in each are shown in [Table 9](#), [Table 10](#), and [Table 11](#).

USER Mode is the home screen shown on the control. If the display is not in USER Mode wait for the display timeout period to be reached or press the Done button to return to the USER Mode.

SETUP Mode is accessed by holding the up and down arrow keys simultaneously for 3 seconds.

DIAGNOSTIC Mode is accessed by holding the NEXT button for 3 seconds

Once in a particular Mode, navigation consists of pressing the next button to scroll from item to item and then pressing the up and down arrows to change values. Once the value is adjusted, the NEXT or DONE button can be pressed.

MENU ITEM	FUNCTION	RANGE	DEFAULT
Outlet water temperature	Displays the current outlet water temperature & allows the setpoint to be adjusted	55-180°F	120°F
Inlet water temperature	Displays the current inlet water temperature	—	—
Delta T	Displays the current temperature rise across the heat exchanger	—	—
Stack temperature	Displays the current stack temperature	—	—
Outdoor temperature	Displays the current outdoor air temperature	—	—
Firing Rate	Displays an indicator of the current firing rate based upon fan RPM. The actual firing rate may vary.	—	—

**Table 9. USER Mode Menu.**

MENU ITEM	DEFINITION
F or C	Selects temperature units
LBTHODLOD	Outdoor reset enable/disable - enables menu items
LBT	Low boiler setpoint during outdoor reset
HOD	High outdoor temperature setpoint
LOD	Low outdoor temperature setpoint
RMT Add	Used for Lead/Lag (follow menus)
LL	Lead/Lag enable/disable - enables menu items
HS	Hysteresis - temp range between on/off cycles
bL	Base Load % - input rate before next boiler fires
Sd	Warm weather shut-down temperature
ASC	Anti short cycle - minutes of delay between startup
bAC	Future use - Press DONE to exit menu.
PAS	Future use - Press DONE to exit menu.

**NOTE:** When enabling/disabling functions, select "Done" and wait 30 seconds before scrolling.

**Table 10. SETUP Mode Parameters.**

MENU ITEM	DESCRIPTION
mA	Display the flame sense signal
Alert codes	Displays the current alert code
Lockout code	Displays the current lockout code
Outlet limit	Displays outlet temperature limit
DHW limit	Displays Domestic Hot Water limit setting
DHW actual	Displays Actual DHW temperature
Stack limit	Displays Stack limit setting
Min. firing rate	Displays the minimum firing rate allowed
Min. forced firing rate	Allows the user to force the boiler to fire at the minimum firing rate
Max forced firing rate	Allows the user to force the boiler to fire at the maximum firing rate
Rate indicator	Displays a indicator of the firing rate based off of the fan RPM. Actual firing rate may vary depending upon setup.

**Table 11. DIAGNOSTIC Mode Menu.**

## 8.2 Ignition Control- Sequence of Events

1. Call for heat
2. Safety chain check
3. Fan starts.
4. Prepurge timer is started.
5. Pre ignition time of 2 seconds to check the flame sensor operation and status.
6. Trial for ignition period, 4 seconds. The direct spark ignition switches to constant spark for three seconds, during which 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 in the appropriate number of retries the control will lockout with a 109 error code.
7. Call for heat complete
8. Gas valve off
9. Fan and pump over run times active to purge the system

The sequence is the same for DHW or Central Heat modes. Upon a call for Central Heat, the 3-way valve will shift position, allowing boiler water to enter the building's heating loop.

## 8.3 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. The burner modulates to achieve the setpoint temperature, away from the actual off point.

## 8.4 Pump Control

The boiler pump is active anytime there is a call for heat applied to the control. When there is a central heat call supplied the system pump relay is active. If there is a DHW call supplied while the central heat call is active the system pump turns off. This happens because of domestic hot water priority, which forces the control to satisfy the domestic water demand prior to the hydronic demand. When the last heat demand is satisfied the boiler pump enters an overrun time.

## 8.5 High Limit

The control uses a dual thermistor sensor to monitor the Mascot II'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 Mascot II to prevent the high limit from tripping. The high limit setpoint is not adjustable.

## 8.6 Stack Temperature

The stack temperature is a dual thermistor sensor and is limit rated. The control compares each of the temperature readings to determine accuracy. The stack sensor is used as a limiting feature to avoid excessive temperatures in the venting.

## 8.7 Domestic Hot Water Temperature

The domestic hot water temperature sensor is used to control DHW temperature. The DHW setpoint can be adjusted through the USER menu structure.

DHW setpoint is displayed during DHW mode. For LMH model, an aquastat will be used in lieu of a sensor to control temperature of an indirect tank.

## 8.8 Lead Lag/Cascading

Lead Lag/Cascading allows multiple boilers to be connected together and controlled from one common sensor input. Up to 8 boilers can be connected together in a single system. To setup Lead/Lag or cascading operation there are several settings in the "setup" menu structure that must be adjusted for the specific installation, each is covered in the following sections.

### 8.8.1 Lead Lag Setpoint

The lead lag setpoint is set from the "user" menu using the "LL" variable. This is the temperature the boiler is attempting to maintain at the system sensor. This setting doesn't control the boiler outlet temperature, so the water temperature at the boiler outlet may be much hotter than the system temperature setpoint. Adjust the LL setpoint to the desired operating temperature of the system.

### 8.8.2 Lead Lag Master/Slave Selection

In the SETUP menu structure, the "LL" menu allows the lead lag system to be turned on and the boiler to be configured as a master or slave control. In each lead lag system there can only be one master control, so proper selection is important to avoid operating issues. To set the boiler to lead lag "master" operation the LL menu should be set to "LDR". To set the boiler to slave, "SLA" should be selected.

### 8.8.3 Lead Lag Address

The Lead Lag address must be set for each boiler connected to the lead lag system. Each boiler must have a unique address selected for the system to work properly. Typically, the lead or master boiler should be set to address one and the remaining boilers should be set to values 2–8 depending upon how many boilers are installed in the system.

### 8.8.4 Lead Lag Hysteresis

The lead lag system uses a hysteresis value set in the setup menu, called, "HS". The hysteresis and setpoint values control the on and off points of the boiler. If the lead lag setpoint is adjusted to 120°F with a hysteresis value of 5°F the boiler will turn off when the water temperature reaches 125°F and will turn back

on when the water temperature reaches 115°F. Set the hysteresis values to match the boiler to the system operating characteristics. Setting this value correctly will help reduce the chance of short cycling.

### 8.8.5 Lead Lag Base Load Setting

The lead lag system uses a base load setting that is set through the "setup" menu called "bL". The base load setting identifies the firing rate that the operating boiler must achieve before the next boiler in the system is allowed to operate. The default setting is 50% to avoid short cycling and operating the boilers at higher, less efficient, firing rates.

NAME VALUE	FUNCTION	DEFAULT
CH on differential	Burner demand begins when the outlet water temperature reaches "Outlet water temperature setpoint" minus "CH on differential"	5°F
CH off differential	Burner demand ends when the outlet water temperature reaches "Outlet water temperature setpoint" plus "CH off differential"	5°F
DHW on differential	Burner demand begins when the outlet water temperature reaches "Outlet water temperature setpoint" minus "DHW on differential"	2°F
DHW off differential	Burner demand ends when the outlet water temperature reaches "Outlet water temperature setpoint" plus "DHW off differential"	7°F
Pump overrun	Operates the pump for the overrun time after the burner demand has ended	1 minute
High limit	Locks the boiler out when the high limit temperature is reached (requires manual reset)	200°F
Flame threshold	Flame signals lower than the flame threshold interrupt burner operation	0.8Vdc

**Table 12. Default Control Settings.**

## SECTION 9. Modes of Operation

The Mascot II control allows the boiler to operate in many different modes of operation. The mode must be selected based upon the requirements of the installation. The following sections describe the basic operation of the Mascot II in each of the different modes. Familiarize yourself with each mode and how the operation of the boiler varies, depending upon the installation and inputs the control is monitoring.

### 9.1 Hydronic Heating Demand

When using the Mascot II 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, shifts the 3-way valve position 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 is reached. The trial for ignition period lasts 4 seconds during which 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 Mascot II enters "run". If the flame signal is below the threshold the Mascot II returns to prepurge and starts the ignition process over. In "run" the Mascot II monitors the flame signal, call for heat, safeties, and water temperatures and modulates as needed between 100% and 20% of rate to satisfy the call for heat.

### 9.2 Hydronic Heating with Outdoor Reset

Outdoor reset varies the control point setpoint based on the actual outdoor temperature. The reset function works as shown in [Figure 24](#). When the outdoor air temperature reaches the "high outdoor temperature setpoint (HOD), the control point setting is adjusted to the low boiler temperature setpoint (LBT). When the outdoor air temperature reaches the low outdoor temperature setpoint (LOD), the control setpoint is adjusted to the CH/Outlet water setpoint temperature. HOD, LOD and LBT can be adjusted by accessing SETUP mode. CH setpoint is adjustable from the USER menu structure.

### 9.3 Hydronic Heating Using External Modulation Control

When using the Mascot II for hydronic heating with external modulation control a call for heat must be supplied to the "T-T" terminal. Once the call is supplied the control starts the boiler and system pumps and begins the ignition process. In "run" the Mascot II 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 (0-10Vdc using converter) signal supplied by an external control. When setting up a system using an external control care must be taken to set the external control algorithms to prevent the boiler from short cycling or "hunting " to prevent premature component failure.

**NOTE:** A call for DHW will override external control.

### 9.4 Hydronic Heating Using Local Lead-Lag/Cascading Feature

When using single or multiple Mascot II's in lead-lag configuration, the system sensor is used to monitor the demand and modulation rates of the operating system (see Section 7 for wiring instructions).

*Let's consider the following example:*

Three Mascot II boilers (let's call them "Lead", "Slave1" and "Slave2") tied together via Modbus 1 connection, with appropriate RMT Address (1, 2, 3). System sensor input is used to indicate common secondary loop temperature.

- System setpoint = 150°F
- HS (hysteresis) = 10°F (default)
- BL (base load) = 50% (default)
- Anti-short-cycle = 5 minutes

Run sequence is initiated when system temperature falls to 140°F (setpoint less hysteresis value). Lead boiler will start. All firing rates will depend on several application characteristics, including flow rate, system load, water volume, etc. Boilers will start at a rate of 35%. If the load is such that Lead's rate increases to 50%, "Slave1" will go through its startup sequence and begin firing at 35%. At this point, both boilers (Lead and Slave1) will continue to respond simultaneously to the load/system characteristics, by modulating up or down together, in relation to the relative system setpoint and load characteristics.

**Scenario 1:** If the system loop temperature rises quickly, and moves above setpoint, then the boilers will

simultaneously drop their firing rate. If when reaching the point where both boilers drop toward their minimum firing rate (20%), then the first slave will drop out. Slave1 will remain unavailable until its ASC timer has expired (5 minutes). If the load were to increase such to drive all active boilers to 50% firing rate or more, during the ASC time, Slave2 will begin its startup sequence and begin to fire at 35%, etc.

**Scenario 2:** If the system loop temperature continues to drop (load increases), then the two boilers will increase firing rate together. At 50%, Slave2 will begin its firing sequence and be added to the group.

**All three boilers will continue to fire simultaneously at equal input rates or...**

1. Modulation rate approaches minimum firing rate (20%), in which case Slave2 will first drop out, and then Slave1, accordingly.
2. System temperature reaches 10°F (HS- hysteresis value) above setpoint (e.g. 160°F), in which case remaining boiler will shut off.
3. Any of the boilers approach its high limit temperature the individual boiler will modulate back.

### 9.5 Warm Weather Shutdown

Warm weather shutdown overrides a central heat call for heat when the outdoor air temperature is greater than the warm weather shutdown setpoint. Warm weather shutdown is always active whenever there is an outdoor sensor attached to the control. To avoid warm weather shutdown the warm weather shutdown temperature should be increased as necessary. The warm weather shutdown setpoint can be adjusted in SETUP mode, using the SD menu.

### 9.6 Domestic Hot Water Demand

For Combi (LMC), DHW demand is triggered by a flow switch located near the DHW cold water inlet. When water begins to flow (open faucet, shower, etc.), the boiler will fire, based on the water temperature requirements. It may cycle on and off under very low flow rates. Minimum flow is 0.5 gpm.

For LMH, an optional indirect water heater can be piped-in using Mascot's integral 3-way valve as a zone valve. An aquastat in the indirect water heater connected in place of the flow switch will signal demand for DHW. The service person should note the minor wiring differences on Figure 22.

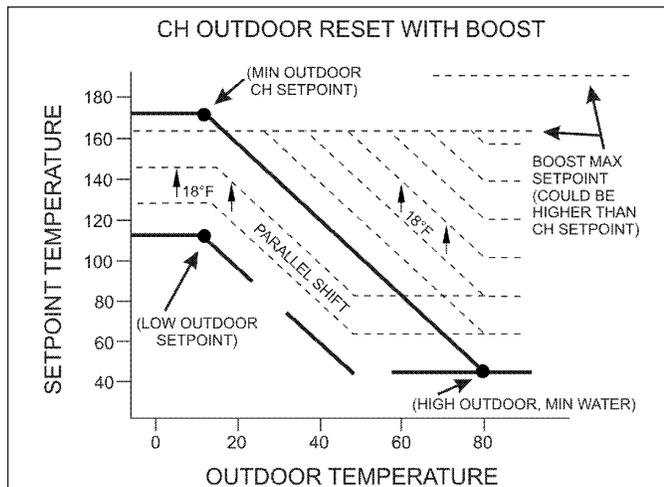


Figure 24. Outdoor Reset Setpoint Temperatures.

## SECTION 10. Set Up Instructions

### 10.1 Filling the Boiler System

1. Ensure the system is fully connected. Close all bleeding devices and open make-up water valve. Allow system to fill slowly.
2. Move manual lever on 3-way valve actuator to "open" position, allowing air to purge from boiler loop. Valve is normally in DHW position until there is a call for Central Heat via "T-T" contacts. If make-up water pump is employed, adjust pressure switch on pumping system to provide a minimum of 12 psi (81.8 kPa) at the highest point in the heating loop.
3. If a water pressure regulator is provided on the make-up water line, adjust the pressure regulator to provide at least 12 psi (81.8 kPa) at the highest point in the heating loop.
4. Open bleeding devices on all radiation units at the high points in the piping throughout the system, unless automatic air bleeders are provided at such points.  
*Note that there is an air bleed located on the left side of Mascot II, on top of the jacket.*
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 system and appliance pump for a minimum of 30 minutes with the gas shut off.
6. Using manual lever located on left side of 3-way valve actuator, move from "open" position back to closed position repeatedly. This process forces air out of the internal DHW loop.

#### WARNING

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

7. Recheck all air bleeders as described in Step 4.
8. Start up boiler according to the procedure in this manual. Operate the entire system, including the pump, boiler, and radiation units for one (1) hour.
9. Shut down the entire system and vent all radiation units and high points in the system piping, as described in Step 4.
10. Close make-up water valve and check strainer in pressure reducing valve for sediment or debris from the make-up water line. Reopen make-up water valve.
11. Check gauge for correct water pressure and also check water level in the system. If the height indicated above the boiler insures that water is at the highest point in the circulating loop, then the

system is ready for operation.

12. 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.
13. 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. Main gas terminals will be energized, attempting to light, for four (4) seconds, and then will de-energize. The unit will go into lockout after the required number of trial for ignition periods.  
Second, turn the power off, press the manual reset button on the boiler control, or the user display, open the manual gas valve and allow the unit to light. While the unit is operating, close the manual gas valve and ensure that power to the main gas valve has been cut.
14. Within three (3) 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. Immediately call a qualified service technician to inspect the appliance and to replace any part of the control system and any gas control that may have been under water.

### 10.2 Starting the Burner after Set Up

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.

#### 10.2.1 Burner Operation

**REQUIRED TOOLS:** differential pressure gauge capable of reading negative 0.01 inches W.C. (0.002kPa), screw drivers, and 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 (Start Up / Shut Down Instruction ) Decal, located on the back of the Top Front Cover, and turn on gas and electrical power to appliance.**

4. Mascot II will enter the start sequence. Blower and pump will energize for pre-purge, then the ignition sequence starts. After all safety devices are verified, the gas valve opens. If ignition doesn't occur, turn off the Mascot II, check that there is proper gas supply. Wait 5 minutes and start the unit again.
5. Turn Mascot II on.
6. **After placing the appliance in operation, the Burner Safety Shutoff Device must be tested:**
  - (a) Close gas shutoff valve with burner operating.
  - (b) Flame will go out and blower will continue to run for the post purge cycle. One or three additional attempts to light will follow including pre-purge, ignitor on, valve/flame on and post purge. Ignition will not occur as the gas is off. The ignition control will lockout.
  - (c) Open 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.

**⚠ Caution**

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

**10.2.2 Boiler Setup and Adjustment**

1. Measure the CO<sub>2</sub> in the flue products at high fire. The Mascot II can be forced to high fire to allow for easier setup. Refer to **Section 8.1, Table 11** for instructions on how to access the forced rate menu. The CO<sub>2</sub> readings should be between the range shown in **Table 13**. If the CO<sub>2</sub> is not within the range shown, adjustments may be made. To adjust the high fire CO<sub>2</sub>, locate the high fire adjuster screw according to the appropriate figure. Slowly make adjustments in 1/16 of a revolution increments until the CO<sub>2</sub> is within the range identified.
2. Measure the CO<sub>2</sub> in the flue products at low fire. Mascot II can be forced to low fire to allow for easier setup. Refer to **Section 8.1, Table 11** for instructions on how to access the forced rate menu. CO<sub>2</sub> readings should be between the range shown in **Table 13**. If the CO<sub>2</sub> is not within the range shown, adjustments may be made. To adjust the low fire CO<sub>2</sub>, locate the low fire adjuster screw according to the appropriate figure. Slowly make adjustments in 1/16 of a revolution increments until the CO<sub>2</sub> is within the range identified

- (see **Figure 25**).
3. Repeat steps 1 and 2 to confirm that the CO<sub>2</sub> ranges are within the required ranges. High and Low Fire CO<sub>2</sub> settings should be approximately equal. Adjust if necessary.

**If any your CO<sub>2</sub> readings cannot be adjusted to the specified ranges (see **Table 13**), 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.

**10.3 Shutting Down Mascot II**

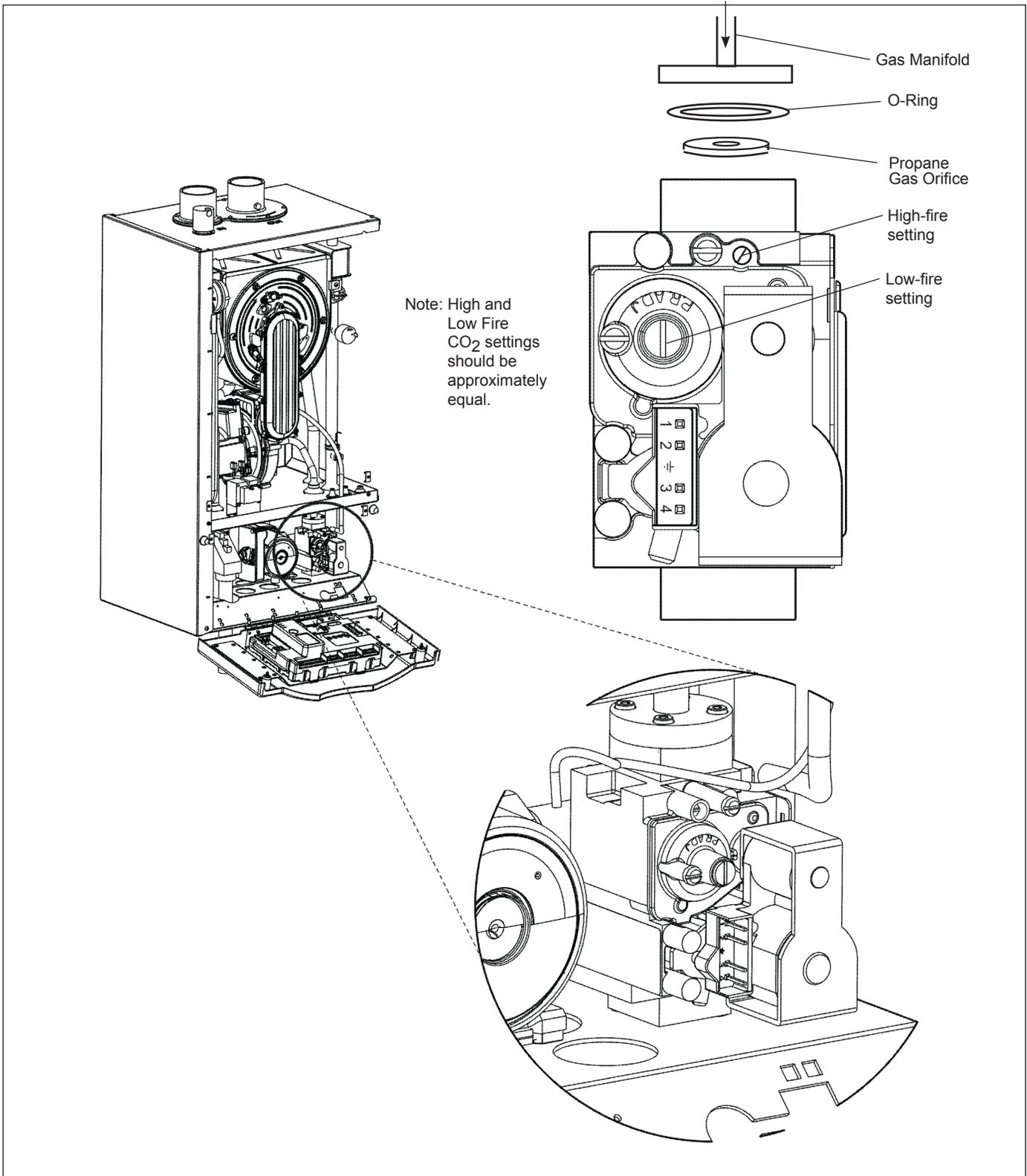
1. Turn off the main electrical disconnect switch.
2. Close all manual gas valves.
3. If freezing is anticipated, drain Mascot II and be sure to also protect building piping from freezing. All water must be removed from heat exchanger and condensate trap or else damage from freezing may occur.

**This step to be performed by a qualified service person.**

**10.4 To Restart Mascot II**

**If drained, follow **Section 10.1** in this manual for proper filling and purging.**

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. Burner will go through a prepurge period and ignitor warm-up period, followed by ignition.



**Figure 25. Adjustment Screws and Settings for CO<sub>2</sub>**

GAS TYPE	CO <sub>2</sub> (%) RANGE
Natural	8.8 — 9.8
Propane	9.8 — 10.8

**Table 13. CO<sub>2</sub> Range and Pressure Settings.**

## SECTION 11. Maintenance

### WARNING

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

### 11.1 System Maintenance

(yearly, unless otherwise noted)

1. If a strainer is employed in a pressure reducing valve or the piping, clean it every six months.
2. 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).
3. Keep the appliance area clear and free from combustible materials, gasoline, and other flammable vapors and liquids.
4. 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.
5. Low water cutoffs, if installed, should be checked every year. Float type low water cutoffs should be flushed periodically.
6. Inspect and clean the condensate collection system yearly.
7. When a means is provided to neutralize condensate, ensure that the condensate is being neutralized properly.
8. Removal of burner door and inspection of combustion coil and flue passages is required at least once a year. Clean with a soft bristle brush / vacuum or wash with water if necessary. Sooting and buildup on the coils is an indication of improper set up and poor combustion. Determine the cause and make corrections.
9. Inspect the vent system and air intake system, and ensure that all joints are sealed properly. If joints need to be resealed, completely remove existing sealing material, and clean with alcohol. Apply new sealing material, and reassemble.

### 11.2 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.

Mascot II gas and electric controls 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                |                     |

#### 11.2.1 Burner

Check the burner for debris. Remove the blower arm assembly to access the burner. Remove the 4 bolts connecting the blower to the arm (see Figure 32). Remove the 5 bolts, which hold the burner arm in place. Pull burner up and out. Clean burner, if necessary, by blowing compressed air from the outside of the burner into the center of the burner, and wipe the inside of the burner clean with glass cleaner. A dirty burner may be an indication of improper combustion or dirty combustion air. Determine the cause, and correct. If damaged, replace the burner gasket 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 fit.

#### 11.2.2 Appliance Control

Mascot II 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 control panel plastic bezel. 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 above in the reverse order making sure to connect all wires in the proper location. Place the appliance in operation following the steps outlined in Section 10.

#### 11.2.3 Ignitor Assembly

The ignitor assembly is a two rod system that consists of a ground rod and a sense rod. 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. Remove and replace the old ignitor assembly gasket. Reinstall a new ignitor assembly in the reverse order if the old assembly is determined defective. Replace gasket if necessary.

### 11.2.4 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. Reinstall a new flame sensor electrode in the reverse order if the old electrode is determined defective.



#### Caution

Igniters and sensors get hot and can cause burns or injury.

### 11.2.5 Blower

The combustion air blower is a high-pressure centrifugal blower with a variable speed motor. Speed of the motor is determined by the control logic. 120 Volts remain on to the blower at all times. If a blower change is required, 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 above. Make sure to install all of the required O-rings and gaskets between the blower arm and the blower and blower face and venturi flange.

### 11.2.6 Heat Exchanger Coils

Black carbon soot buildup on the external surfaces of the heat exchanger is caused by one or more of the following; incomplete combustion, combustion air problems, venting problems and 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 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 per the following:



#### Caution

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

1. Shut off the 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/burner assembly from the heat exchanger.
6. Disconnect the condensate drain line.
7. Attach a longer hose to drain and run to a bucket.
8. Clean the heat exchanger by brushing light accumulations of soot and debris. Use a brush with soft bristle (non metal) to avoid damaging the surface 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, which is being diverted into a separate container.

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



#### WARNING

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

11. Install all components removed in the reverse order to place the appliance back in operation. Make sure all gaskets are in place as components are installed. Replace any damaged gaskets. Do NOT reuse damaged gaskets.
12. Place the appliance in operation according to **Section 10** checking all gas connections for leaks. Confirm all fasteners are tight.

### 11.2.7 Gas Conversion

Mascot II units can be converted from natural to propane gas or from propane to natural gas easily in the field. 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 gas type of the appliance. These stickers are included with the boiler during shipment.



#### WARNING

This conversion shall be installed by a qualified service agency in accordance with the manufacturer's instructions and all applicable codes and requirements of the authority having jurisdiction. If the information in these instructions is not followed exactly, a fire, an explosion or production of carbon monoxide may result causing property damage, personal injury or loss of life. The qualified service agency is responsible for the proper and complete installation of this kit. The installation is

not proper and complete until the operation of the converted appliance is checked as specified in the manufacturer's instruction supplied with the kit.

**⚠ AVERTISSEMENT**

*Ce conversion doit être installé par un organisme de service conformément aux instructions du fabricant et tous les codes et les exigences de l'autorité compétente. Si les informations contenues dans ces instructions n'est pas suivi à la lettre, un incendie, une explosion ou de la production de monoxyde de carbone mais résultat causant des dommages matériels, des blessures ou des pertes de vie. Le service est responsable pour la bonne et complète l'installation de ce kit. L'installation n'est pas correcte et complète jusqu'à ce que le fonctionnement de l'appareil converti est vérifiée comme spécifié dans le manuel d'instruction fourni avec le kit.*

**Conversion to/from LP Gas Instructions:**

**Kit # R2075500**

1. Remove the front covers.
2. Follow the shutdown procedure as indicated in the Lighting/Shutdown Instructions shown on inside front cover or side of appliance.
3. Turn off the gas supply to the boiler.  
Arrêtez l'approvisionnement en gaz à chaudière.
4. Turn off the main electrical supply to the boiler.  
Arrêtez l'alimentation électrique principale à chaudière.
5. Confirm that the actual gas supply is propane (confirm natural gas if converting to natural gas).
6. Install correct "Propane Gas" sticker over the "Natural Gas" sticker (or vice versa).
7. Fill out Gas Conversion Sticker completely and install adjacent to the rating plate sticker (behind the door panel).
8. Remove Gas Pipe from the outlet of the Gas Valve.  
(Note: You do not have to remove the gas valve from the unit).
9. Insert (or remove) Propane Gas Orifice (Part# 12H6010) from valve outlet.
10. Ensure the gas O-Ring is in the Gas Pipe Flange Groove.
11. Re-Install Gas pipe.
12. Purge Old gas from the line.
13. Confirm Gas supply is on.
14. Connect power supply.
15. Start boiler per lighting procedure shown on inside front cover or side of appliance.
16. Check for Gas Leaks at gas valve/pipe.
17. With a combustion analyzer, check CO<sub>2</sub> and CO levels at both maximum and minimum input.

18. Adjust as needed to achieve proper levels. **Refer to sections 10.2.2 and 10.2.3 of this manual for the proper adjusting procedures.**
19. Re-Install front covers.



Warning: serious injury or death could occur if CO<sub>2</sub> levels are not adjusted properly.



Warning: serious injury or death could occur if not installed properly.

**SECTION 12.  
Trouble Shooting**

**12.1 Sequence of Operation**

Mascot II is a cold start appliance that should start only on a call for heat from a tank aquastat, room thermostat, zone valve end switch or other space temperature control device (flow switch for DHW).

1. Upon a call for heat: (a) the internal pump and system pump will start; (b) the blower will begin a short pre-purge.
2. Following the prepurge cycle the direct spark ignition will spark and will begin a 4 second trial for ignition. The unit is allowed one or three ignition retries.
3. The gas valve will then be energized and a reduced rate ignition will occur. The unit will remain in a reduced rate start-up period for several seconds.
4. After the reduced rate start time is over, the unit will be in normal operation. Firing rate will modulate based on the heating load via the temperature controller settings and readings.
5. When the call for heat is complete, or the unit reaches its setpoint temperature, the gas valve will close, and the fan will continue to run for its post-purge. If a pump delay time is used, the pump will continue to run for the specified amount of time (adjustable from 0.1 to 10 minutes).

**12.2 Short Cycling**

Because Mascot II is a modulating boiler, and its input will decrease when there is a reduction in 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 or piping layout. When in DHW mode under low load conditions, the boiler will normally cycle more often, but should not cycle frequently during call for central heating.

**12.3 Error Codes - See *Table 14*.**

CODE#	PROBLEM	PROBABLE CAUSE	SOLUTION
<b>COMMON LOCKOUT CODES</b>			
27	Internal error	Flame rod to ground	Check wiring / probe grounded, dirty probe
47	Flame rod to ground leakage	Faulty flame detector	Clean or replace flame detector
49	24VAC voltage low/high	Faulty transformer	Check/correct supply line voltage; replace faulty transformer
52	Motor tachometer fault	Faulty fan / fan wiring fan circuit	Check fan harness wiring for continuity; replace faulty fan circuit
53	AC inputs phase reversed		Reverse 24V hot/neutral - use common ground
61	Anti short cycle	Call for heat will be held until timer resets	Change ASC timer setting
62	Fan speed not proved	Dirty / defective fan	Clean or replace fan; check wiring
63	LCI off	Safety chain interrupt	Check flow switch, aux high limit, LWCO, gas pressure switches, condensate level and correct problem
69	Outlet high limit	High limit tripped	Determine cause: low/no flow, valves closed, settings and correct
79	Outlet high limit		
80	DHW high limit	High limit reached	Check pump, time delay, valves closed, etc. and correct overtemp
81	Delta T inlet/outlet limit		
82	Stack limit	High limit reached	Could be caused by high ambient temperature, or high return water temperature
88	Outlet T-rise limit		
90	Heat exchanger high limit	High limit reached	Diagnose / repair cause of high temperature
91	Inlet sensor fault		
92	Outlet sensor fault		
93	DHW sensor fault	Faulty sensor or wiring	Check wiring / replace sensor; condition can be caused by short
95	Stack sensor fault		
96	OAT temperature sensor fault temperature sensor	Faulty outdoor air is open or shorted	Check wiring and sensor for short; replace sensor
105	Flame detected	Flame exists at burner out of sequence	Clean burner of soot or other debris that could when it should not be maintain flame
106	Flame lost in MFEP	Unstable flame during lighting / flame proving	Check venting, gas supply pressure, burner, fan, etc.
107	Flame lost early in Run		
108	Flame lost in Run	sequence	
109	Ignition failed	Problem with ignitor, or other ignition-related device	Check / replace ignitor, wiring; check for shorting in ignitor cable
113	Flame circuit timeout	Flame not established within expected time limit	Check all combustion components; purge gas; check ignition source
122	Lightoff rate proving failed		
123	Purge rate proving failed		
128	Fan speed failed / prepurge	Fan did not reach expected RPM	Check fan wiring; replace fan
129	Fan speed failed / preignition		
130	Fan speed failed / ignition		
131	Fan movement detected during standby	Fan should not be moving when not powered	Check for common venting problems or otherwise forced air
132	Fan speed failed during run	Fan lost or gained speed during run sequence away from control spec	Fan overheating or otherwise failing; check cable; replace fan
137	ILK failed to close	No power at interlock ILK	Check J5 pin 1 for power - if no power, confirm safeties are closed
49	Maximum cycle count	Control operates correctly,	

continued next page &gt;

CODE#	PROBLEM	PROBABLE CAUSE	SOLUTION
<b>ALERT CODES</b>			
	was reached	however the cycle count will not increment any higher than 999,999 cycles	Replace controller or adjust the count using blue display
50	Maximum hours count was reached	Control operates correctly, however the hours count will not increment any higher than 999,999 hours	
248	CH outdoor temperature was invalid		
251	CH ODR max outdoor temperature setpoint was invalid	Confirm outdoor reset settings. An invalid	
252	CH ODR min outdoor temperature setpoint was invalid	adjustment has been made	
253	CH ODR min water temperature setpoint was invalid		
254	CH ODR temperature range was too small (min. 12°C / 22°F)	Increase Outdoor air temperature min and max values to a difference greater than 22°F (12°C)	Adjust setting to within appropriate range
255	CH setpoint minus ODR min water temperature was too small (min. 12°C / 22°F) Increase setpoint or decrease min water temp.	Increase Outdoor water temperature min and max values to a difference greater than 22°F (12°C)	
565	Heat exchanger T-rise limit was exceeded	Heat exchanger temperature rise exceed	Check for correct water flow
<b>MISCELLANEOUS</b>			
	Boiler will not stay lit	Indicates lack of flame signal, check fault code on display	Check flame detector wiring; clean / replace flame detector
	Boiler bangs, knocks, hisses	Insufficient water flow / pump failure; improper piping	Check for proper flow, follow piping guidelines in manual; replace pump; improper glycol percentage (see Section 6)
	Flame pulsates, venting noise or has difficulty lighting	Insufficient / improper venting; dirty burner; air in gas line; dirty heat exchanger	Ensure venting complies with Section 3

**Table 14. Error Codes.**

## SECTION 13.

### Replacement Parts

Use only genuine LAARS replacement parts.

#### 13.1 General Information

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

#### 13.2 Parts List

ITEM	DESCRIPTION	SIZE 125
<b>PANEL ASSEMBLIES – See Figures 27-30</b>		
1	Panel, front, top, assy	12H3005
1A	Panel, top, upper	12H7001
1B	Screw, captive, .19 x .54 fast lead, phil pan hd	F2028100
1C	Screw, #8-32 x 3/8", phil pan hd	F2027100
1D	Gasket, strip, foam, adhesive, 3/8 x 1/8	S2113900
1E	Panel, front, top, subassy	12H3015
1F	Washer, retaining, .50 OD, nylon	F2028200
2	Panel, front, middle, assembly, LMH	12H3003
	Panel, front, middle, assembly, LMC	12H3033
2A	Panel, front, middle, plastic	12H7002
2B	Gauge, press/temp, remote	A2117600
2C	Switch, Rocker, 120V, amber	E2335000
2D	Display module, electronic	RE2333500
2E	Hinge, front panel, middle	12H3008
2F	Circuit Breaker, 10 Amp, 120V	E2318900
2G	Circuit Breaker, 2A, 120V	E2335100
2H	Support, middle panel	12H3017
2I	Screw, #6 x 3/8" thd forming for plastic	1-418
2J	Screw, #8-32 x 3/8", phil pan hd	F2027100
2K	Rivet, pop, 3/16 diameter	F2015900
2L	Latch, magnet, .56 dia, 3.1 lbs	F2028300
2M	Harness, wire, power switch/circuit breaker	E2334501
2N	Harness, wire, display/+24V circuit breaker	E2334502
3	Panel, front, bottom, assembly	12H3004
3A	Control, programmed	12H7050
3B	Bracket, mounting, control	12H7004
3C	Panel, front, bottom, plastic	12H7003
3D	Hinge, front panel, bottom	12H3007
3E	Rivet, pop, 3/16 diameter	
3F	Screw, #8-32 x 3/8", phil pan hd	
3G	Washer, retaining, .50 od, nylon	
3H	Screw, captive, .19 x .54 fast lead, phil pan hd	
4	Panel, left side	12H3019
5	Panel, right side	12H3018

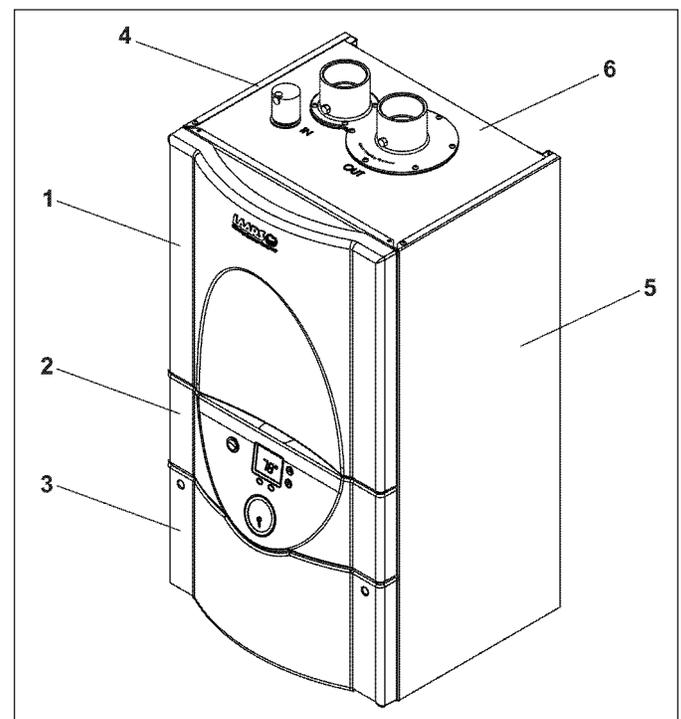
ITEM	DESCRIPTION	SIZE 125
<b>BASE JACKET ASSEMBLY - see Figure 31</b>		
6	Base, jacket, assembly	12H3001
6A	Base, jacket	12H3011
6B	Screw, 8-32unc x 1.5l	F2001900
6C	Bracket, wall attach	12H3012
6D	Screw, hex head, 1/4-20 unc x .75" lg.	F2011600
6E	Nut, flange, serrated, hex head, 1/4"	10-103
6F	Bracket, hx, right side	12H3010
6G	Bracket, hx, left side	12H3016
6H	Screw, #8-18 x 1/2, phil pan hd	F2027000
6I	Switch, pressure, air/gas, inlet	E2334900
6J	Transformer, 40Va, 115V/24V	R0021300
6K	Bracket, transformer	12H3009
6L	Rivet, pop, 3/16 diameter	F2015900
<b>HEAT EXCHANGER CABINET - see Figure 32</b>		
7A	Grommet, pipe, wire, multi size, rubber	S2114000
7B	Heat exchanger	S2113800
7BB	Gasket, vent adapter	12H5501
7C	Washer, clamping, hx bracket	12H3023
7D	Washer, M5, lock, internal tooth	F2023700
7E	Screw, M5-0.8 X 14mm, soc Hd	F2025300
7G	Gasket, blower fan	S2105400
7H	Screw, #8-18 x 1/2, phil pan hd	F2027000
7I	Vent, air, auto, 1/4" bspp	P2074500
7J	Pipe, air vent	12H4010
7K	Sensor, temperature, water, 1/4" npt	RE2320600
7L	Rivet, pop, 3/16 diameter	F2015900
7M	Terminal, 1/4" push-on, male, red	E0005501
7N	Heat exchanger	S2113800
7O	Blower, combustion air	RA2107500
7P	Washer, sealing, .410 OD	F2027700
7Q	Plate, venturi	12H5002
7R	Screw, m5 x 8, soc hd cap	F2029300
7S	O-ring, 2 1/8 id x 3/32 thick	S2116000
7T	Adapter, vent, cpvc	12H5500
7U	Plug, hex, 1/8" npt	500-168
7V	Sensor, temperature, air, 1/4" bsp, 1.85 l	RE2319700
7W	Sensor, temperature, water, duplex	RE2319900

ITEM DESCRIPTION	SIZE 125
<b>BURNER COMPONENTS - see Figure 33</b>	
1 Burner, main	R2069102
2 Gasket, burner	RS2108500
3 Tile, refractory, front, combustion chamber	RT2109000
4 Ignitor, spark, w/gasket	R2069300
5 Flame sensor, w/gasket	R2069200
6 Burner door with gaskets	RS2108300
7 Air/gas channel	RS2108400
8 Screw, air/gas channel	RS2109400
10 Heat exchanger	RS2111200
11 Gasket, ignitor	RW2013300
12 Burner door, w/gaskets	62108300
13 Repair kit, rear refractory tile	R50D2021
14 Gaskets-only (burner door)	
15 Screw, ignitor/flame sensor, M4-.7X8MM	
16 Ignitor gasket	RW2013300
17 Flame/sensor gasket	RW2013400
<b>PUMP ASSEMBLY - see Figure 34</b>	
8 Pump assembly	
8A Bracket, control valve	12H4012
8B Trap, condensate, small capacity	A2117500
8C Screw, M4 x 10, soc hd cap	F2029400
8D Valve, gas	V2020600
8E Bumper, rubber, 21/32" base dia. x 1/2" height, 5/32" thru hole	S2114800
8F Washer, sealing, 0.93 OD x 0.62 ID contact	
8G Pipe, 3 way valve to dhw	factory
8H Bracket, 3 way valve	12H4019
8I Screw, #8-18 x 1/2, phil pan hd	F2027000
8J Bracket, capture, hex	12H4022
8K Valve, three way, with actuator	A2117802
8L Pump	A2117700
8M Screw, 6-20 x 1/2" I self tapping	F0024200
8N Sensor, temperature, dhw, 1/4" npt	E2337500
8O Exchanger, heat, plate	
8P Tie, cable, 14-3/4 long x 0.31" wide, heat stabilized	F2029100
8Q Flow switch, water	E2337400
8R Pipe, tailpiece, 1" npt M x 3/4 tube, cu	12H4023
8S O-ring, -120, 1" ID x 1-3/16" OD	S2116300
8T Pipe, pvc, 3/4" sch 40	P2067603
8U Terminal, 1/4" push-on, male, red	E0005501
8V Terminal, 1/4" push-on, female, red	E0005502
8W Orifice, Gas, M2 125	12H6010
8X O-Ring, Flange, Gas Valve	30-227

ITEM DESCRIPTION	SIZE 125
<b>PLUMBING COMPONENTS - see Figure 35</b>	
P1 Tank, expansion, rect, 10 liter	A2117400
P2 Bracket weldment, expansion tank	12H3020
P3 Grommet, pipe, wire, multi size, rubber	S2114000
P4 Pipe, gas	12H4011
P5 O-ring, 20.04 mm ID x 27.10 mm OD	S2115100
P6 Pipe, pump to hx inlet	12H4004
P7 Pipe, hx outlet to dhw	12H4001
P8 Switch, press, 3-30 psi, 1/4" bspp	P2074600
P9 Gasket, expansion tank	12H3006
P10 Tee, 1/4" barb, plastic	10-596
P11 Washer, sealing, .59 OD x .32 ID x .06 poly	F2027500
P12 Pipe, expansion tank	12H4006
P13 Washer, sealing, 0.93 OD x 0.62 ID	F2025502
P14 Washer, sealing, .410 OD	F2027700
P15 Switch, pressure, 3.80" w.c. set point	E2336500
P16 Hose, drain, condensate	12H2500
P17 Tie, cable, heat stabilized, 5"	F2028400
P18 Tube, silicone, .188 ID x .318 OD x 23" long	Q0078800
P19 Cotter pin, horse shoe, 1/8, zinc pl	F2029000

**Not Shown:**

Harness, wire, main	E2337600
Connector assembly	12H7009
Relay, 24vac, Dpdt 8	12H7008
Harness, wire, main, heat only 2	12H7010
Harness, wire, main, lmc	E2337600
Wire, spark ignition	12H7005
Wire assy, flame sensor	12H7006
Plug, 3 prong, with cord, 14 awg 7	E2334500



**Figure 27. Outside Panels.**

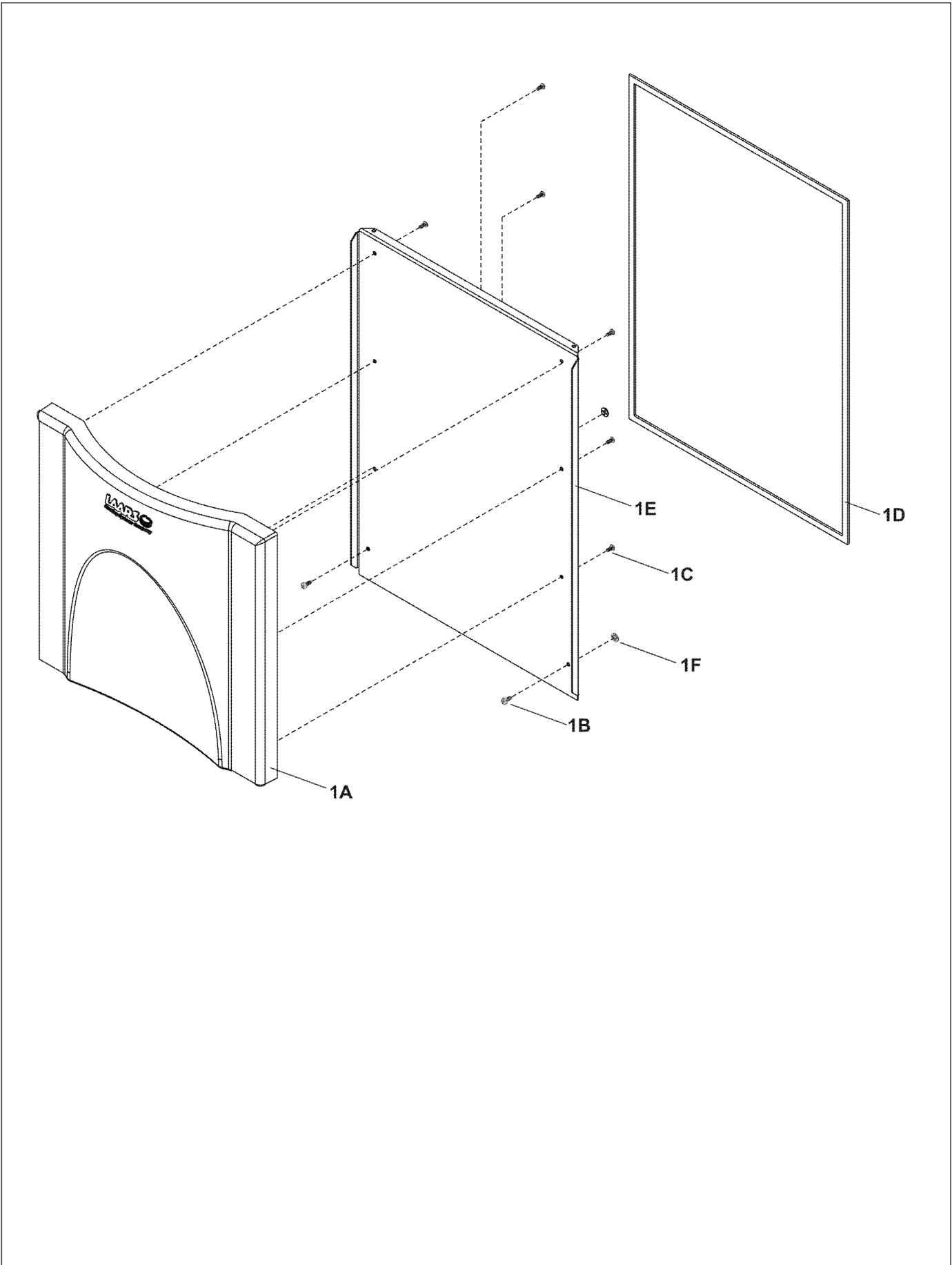


Figure 28. Panel Assembly, Door Top.

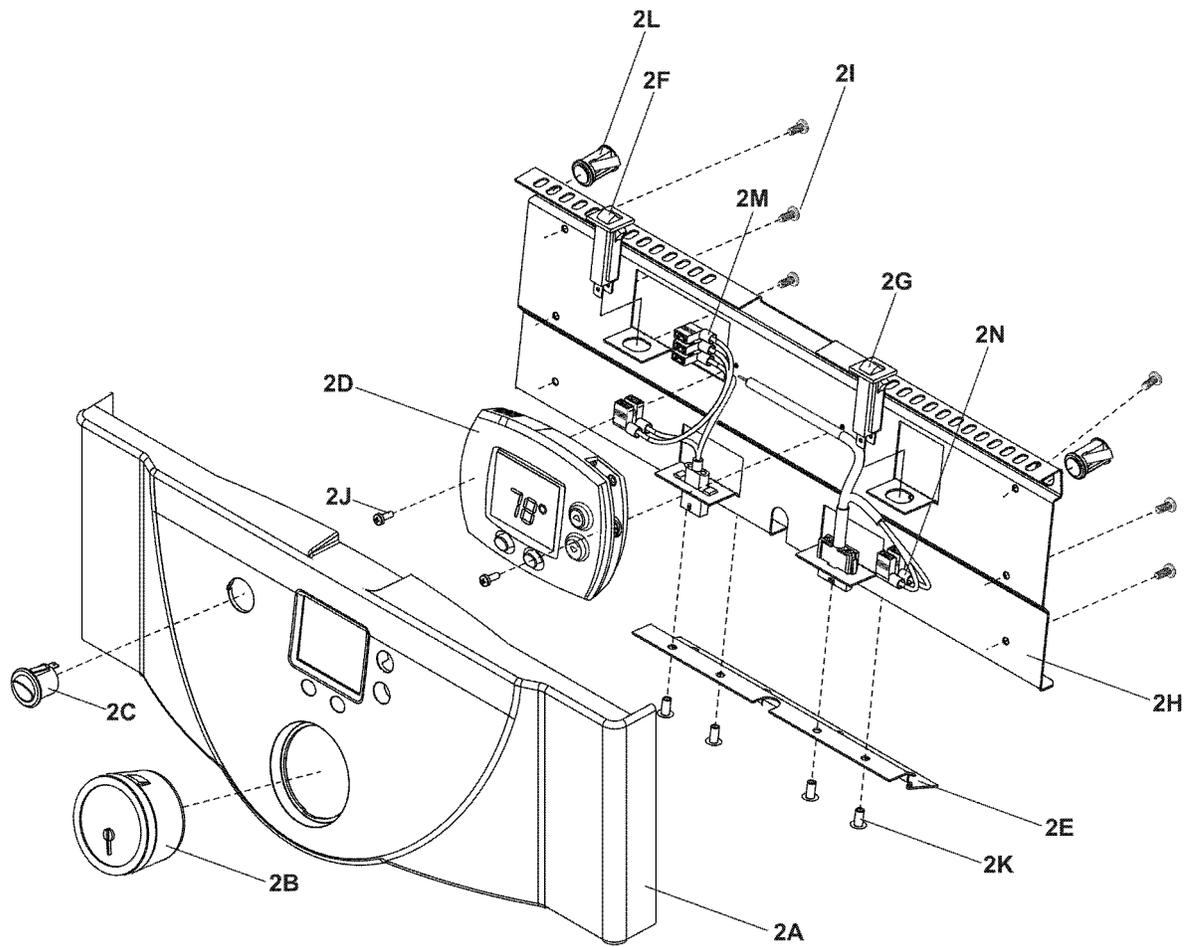
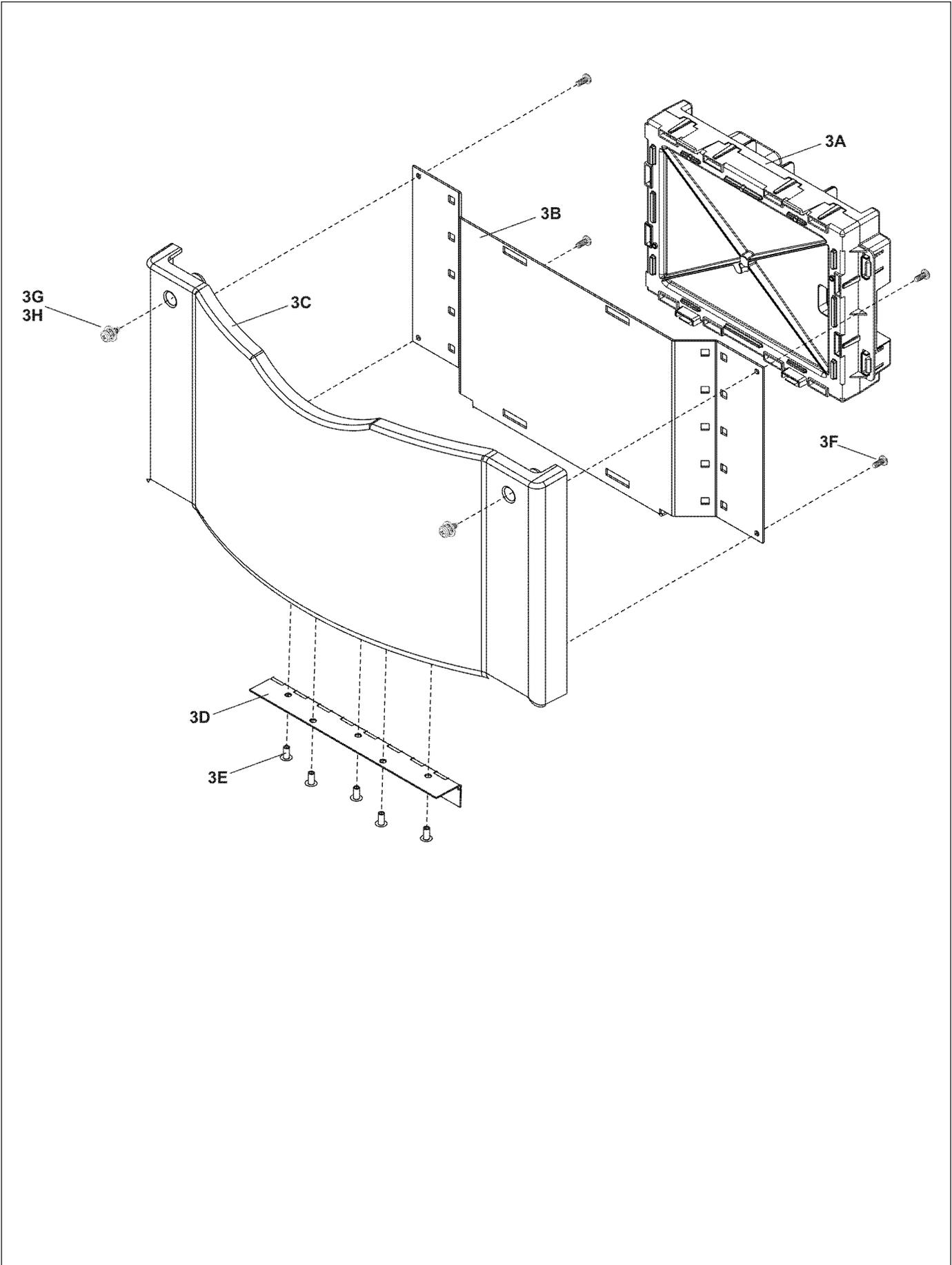


Figure 29. Panel Assembly, Door Middle.



**Figure 30. Panel Assembly, Door Bottom.**

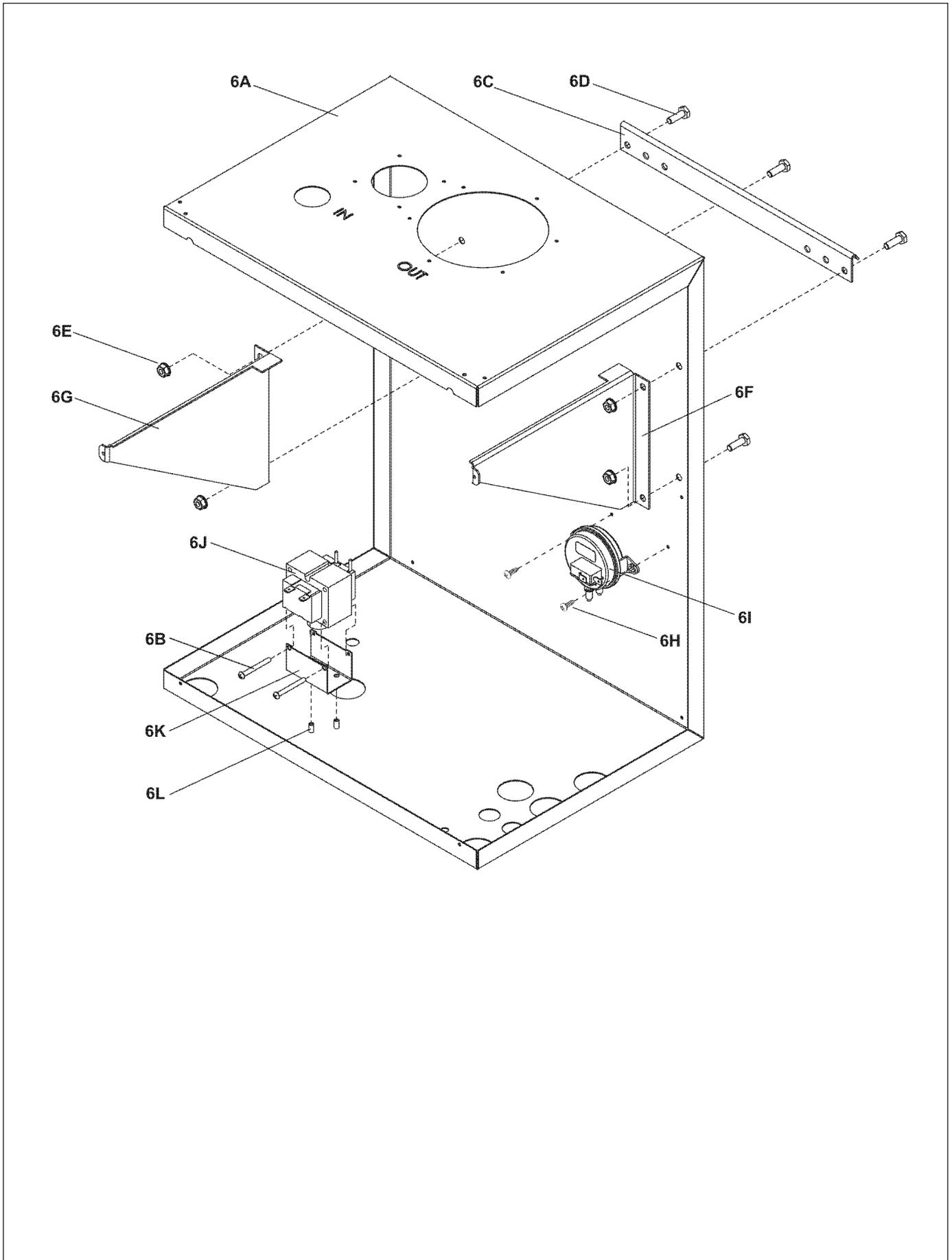


Figure 31. Base Jacket Assembly.

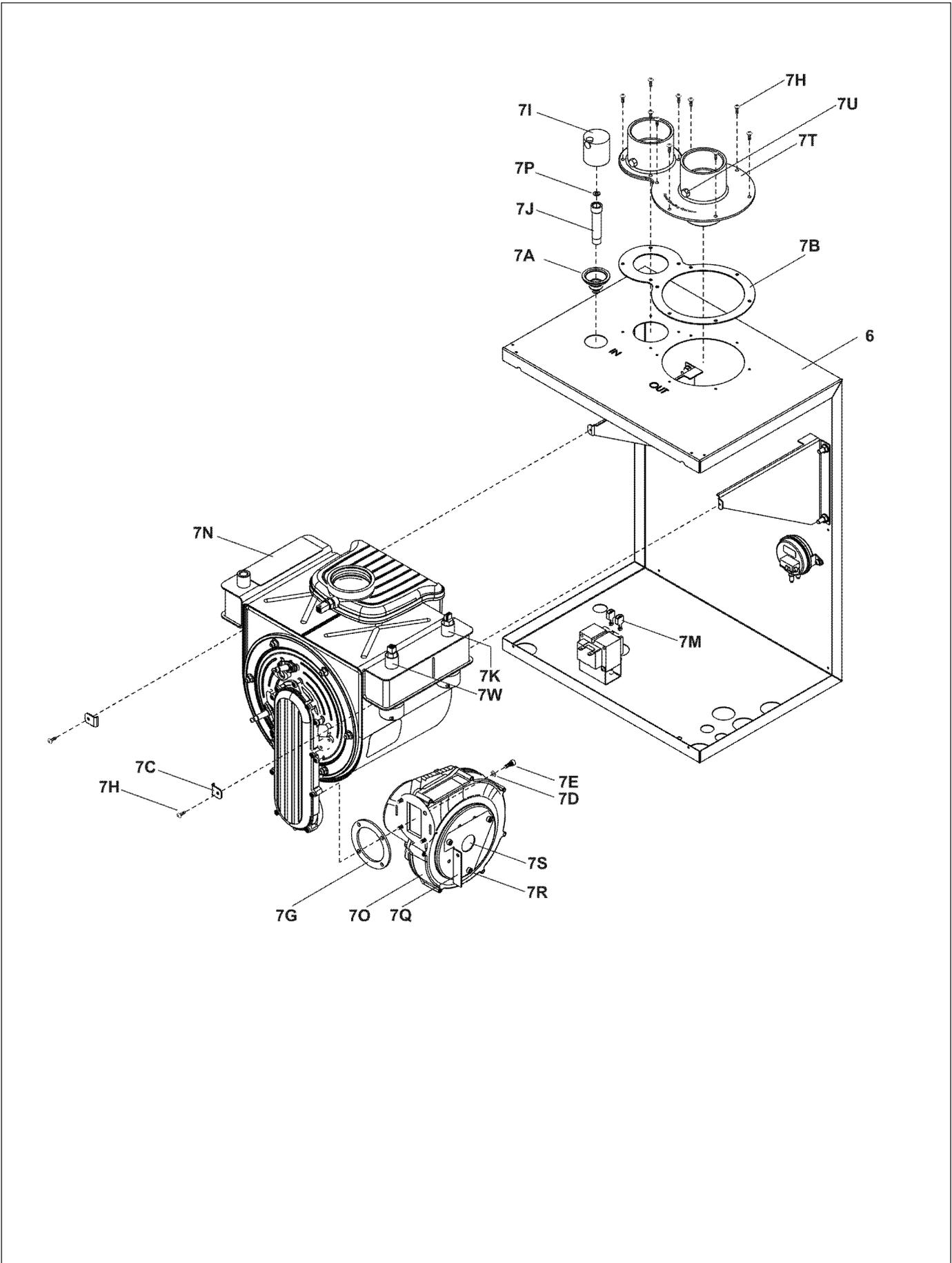


Figure 32. Heat Exchanger Cabinet, Fan.

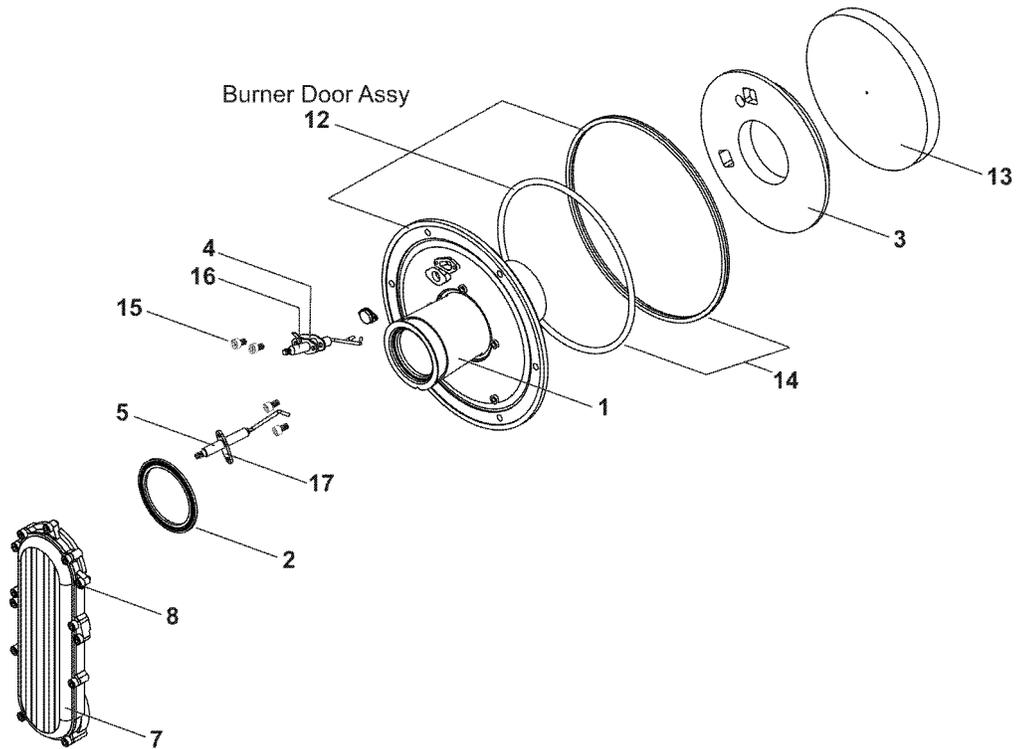


Figure 33. Heat Exchanger Burner Components.

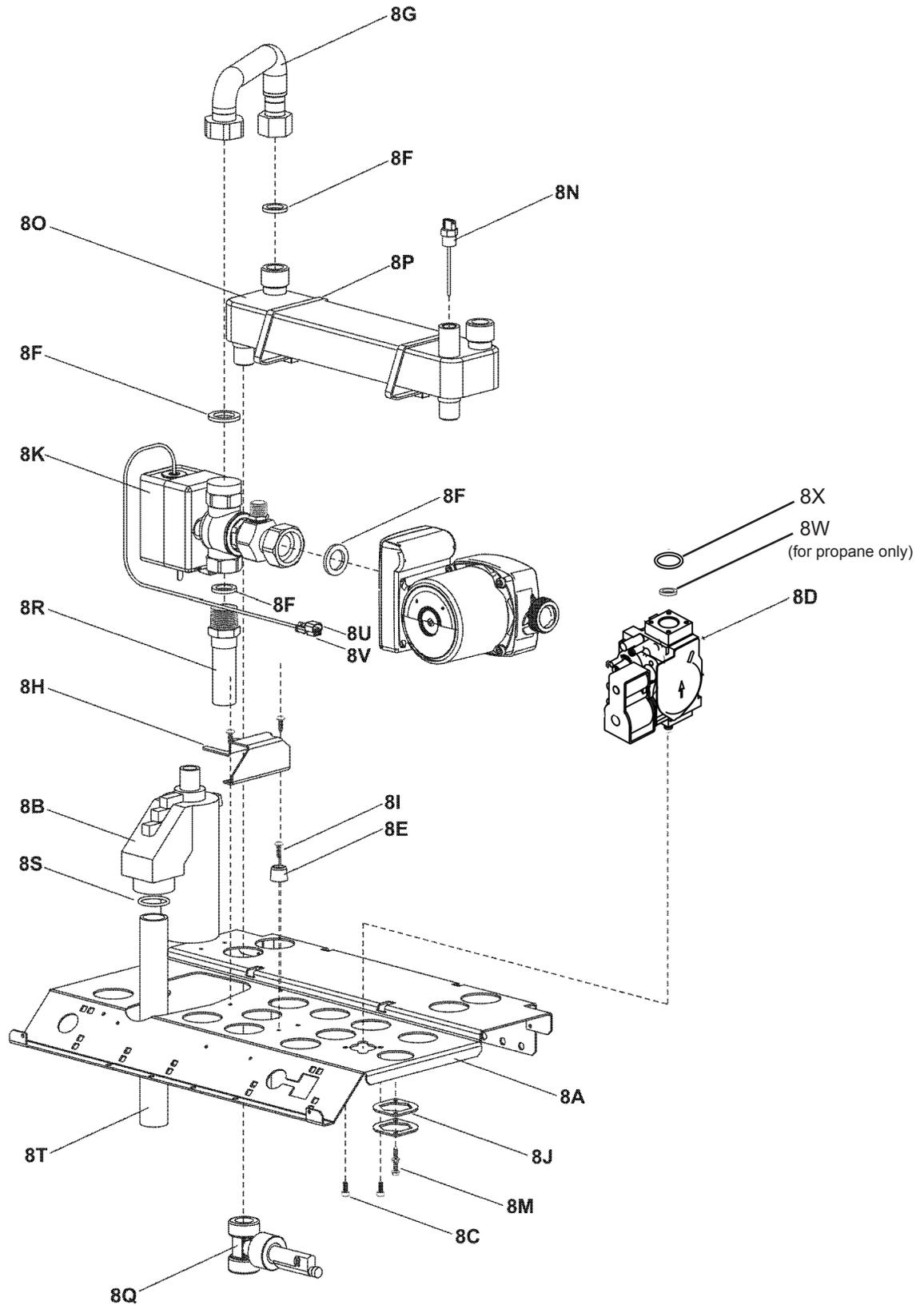


Figure 34. Pump Assembly Components.

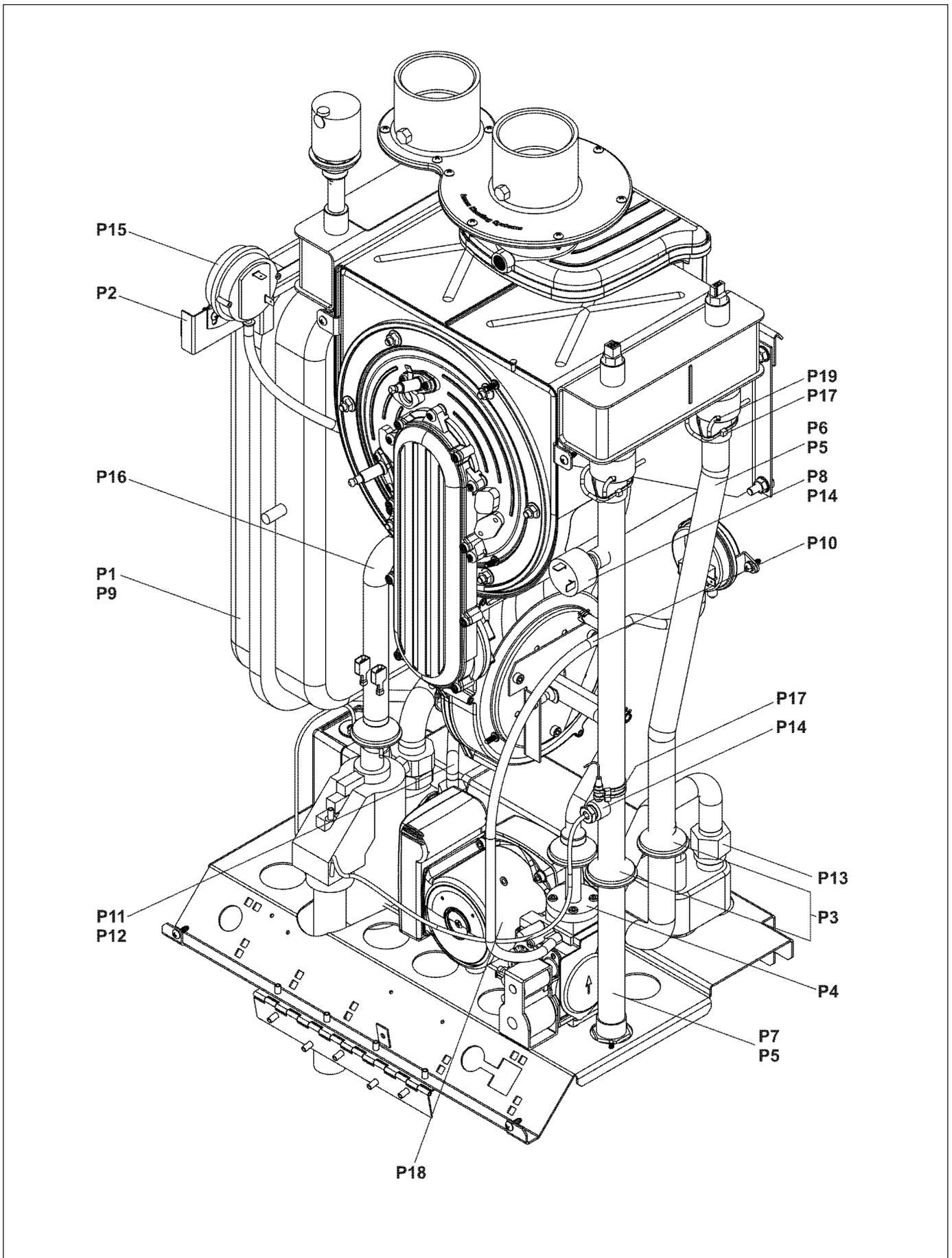
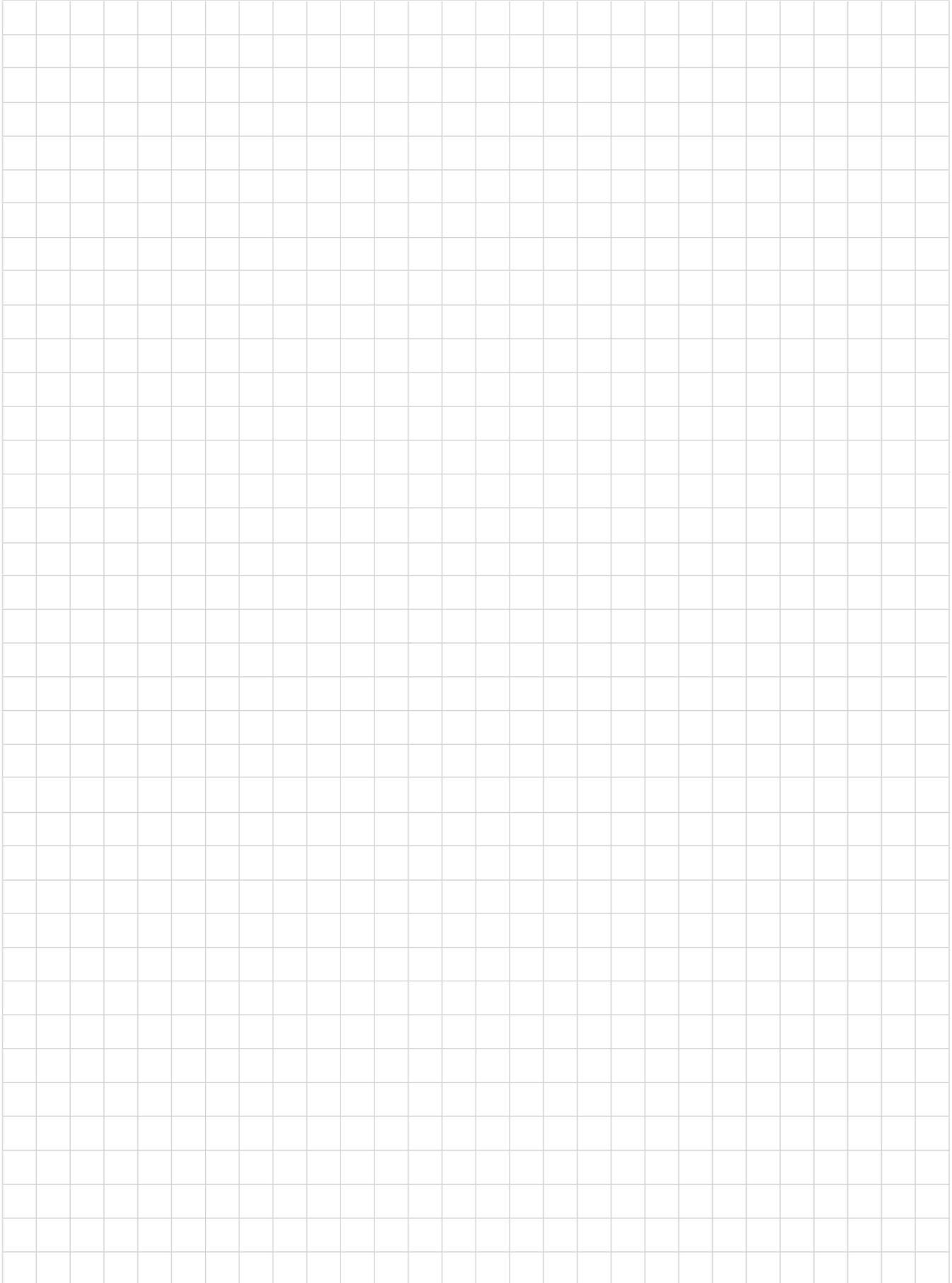
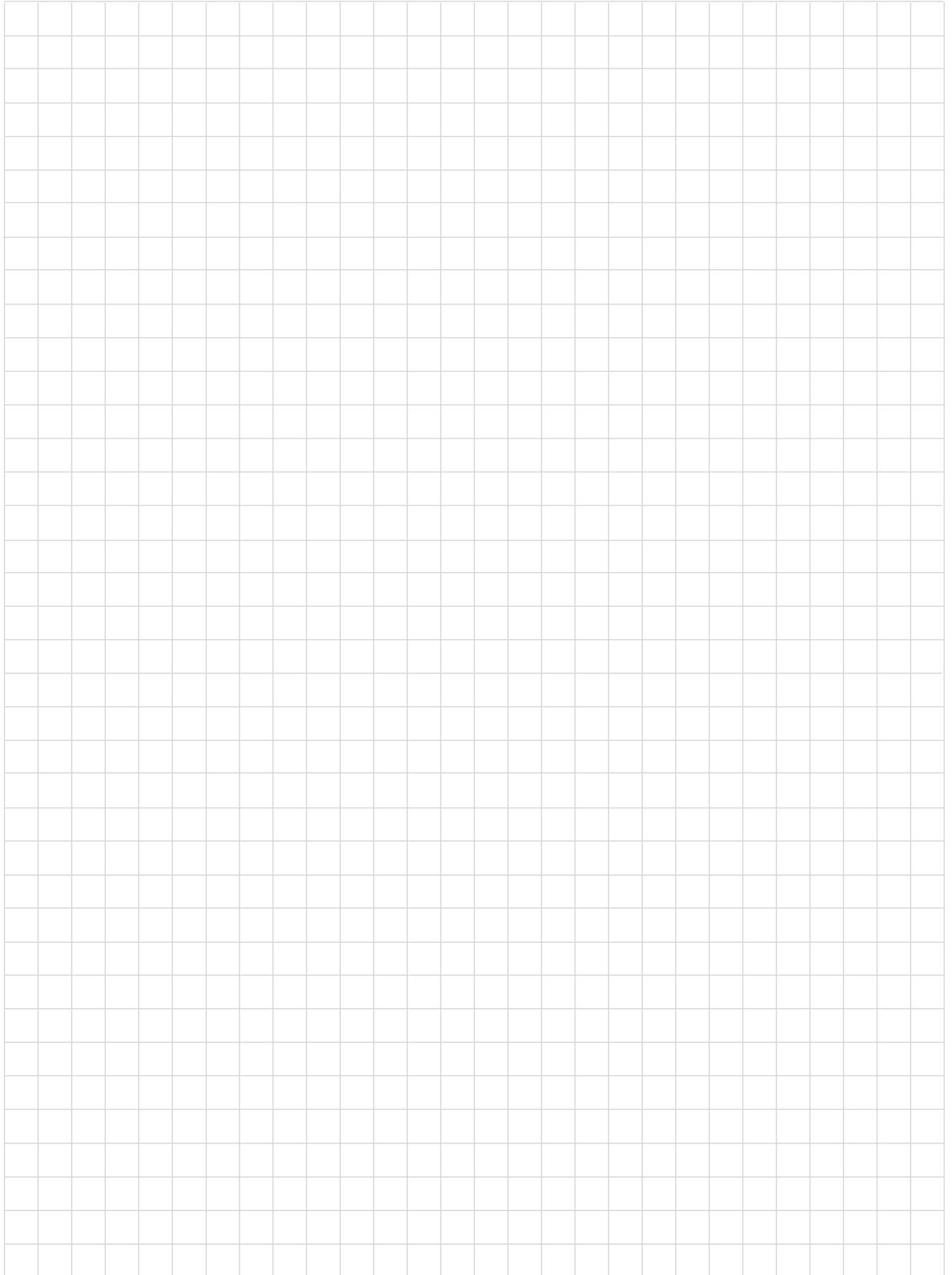
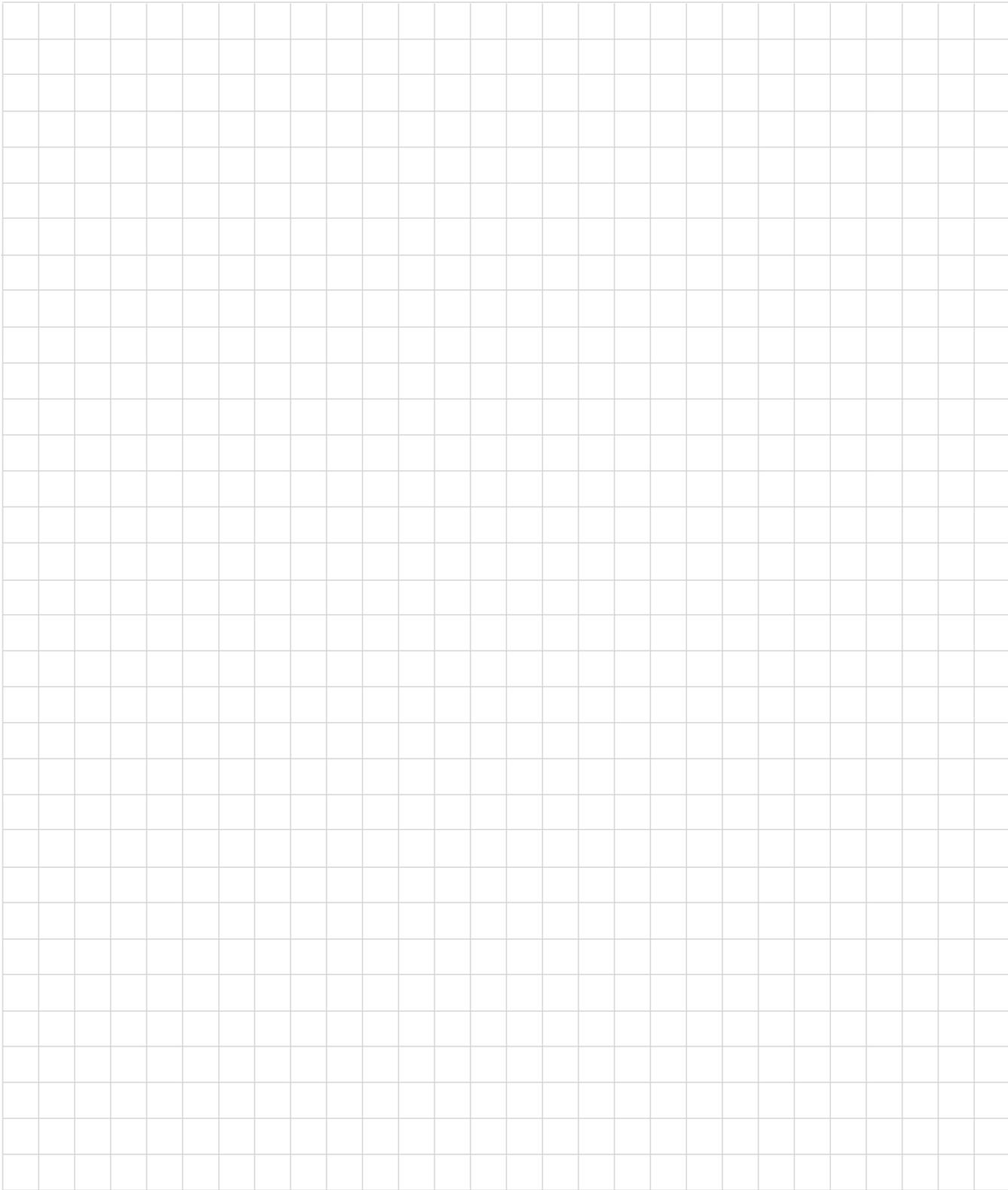


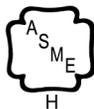
Figure 35. Plumbing Components.







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



H2338-100E