

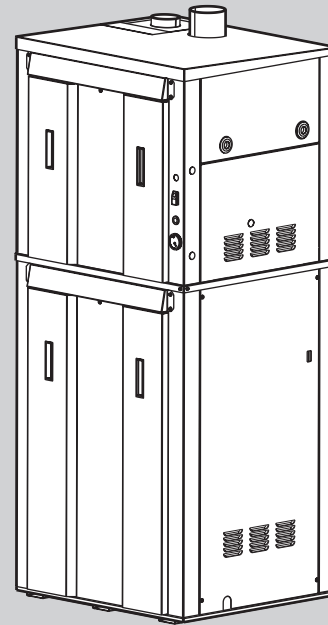
# Installation and Operation Instructions for

## **Mighty Stack**<sup>™</sup>

Water Heater

Model MS-080

Sizes 199, 300, 399



**FOR YOUR SAFETY:** This product must be installed and serviced by a professional service technician, qualified in hot water water 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. For indoor installations, as an additional measure of safety, Laars strongly recommends installation of suitable Carbon Monoxide detectors in the vicinity of this appliance and in any adjacent occupied spaces.

### **⚠ 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 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.

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## SECTION 1.

### General Information

In the Commonwealth of Massachusetts, this appliance must be installed by a licensed plumber or gas fitter.

#### 1.1 Introduction

This manual provides information necessary for the installation, operation, and maintenance of Laars Heating Systems' Mighty Stack copper tube appliances, sizes 199-399 MBTU/hr. Please read 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 issues or questions regarding this equipment. Experience has shown that most operating issues are caused by improper installation.

The Mighty Stack appliance is protected against over pressurization. A pressure relief valve is fitted to the outlet header, at the water outlet of the boiler, and another near the top of the tank.

**IMPORTANT:** The inlet gas pressure to the appliance must not exceed 13 in. w.c. (3.2 kPa).

All installations must be made in accordance with:

- 1) In the U.S., the "National Fuel Gas Code" ANSI Z223.1/NFPA54, Latest Edition and all applicable local codes as required by the Authorities Having Jurisdiction (AHJ), or
- 2) In Canada, the "Natural Gas and Propane Installation Code", CSA B149.1, latest edition and all applicable local codes as required by the AHJ.

All electrical wiring is to be done in accordance with:

- 1). In the U.S., the "National Electrical Code" (NEC), ANSI/NFPA 70, latest Edition and all applicable local codes as required by the AHJ, or
- 2). In Canada, the "Canadian Electrical Code - Part 1", CSA STD. C22.1 and all applicable local codes as required by the AHJ.

This appliance must be electrically grounded in accordance with the applicable codes and standards referenced above.

#### WARNING

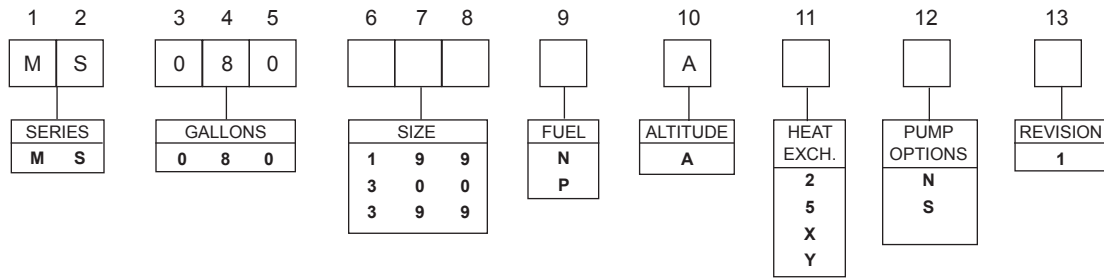
To minimize the risk of electric shock, fire or other hazards which could result in property damage, injury, or death. The Mighty Stack hydronic, water heater or water heater **must** be installed in accordance with the procedures detailed in this manual, or the Laars Heating Systems warranty may be 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 the Natural Gas and Propane Installation Code, CSA B149.1 and/or applicable local codes. Where required by the authority having jurisdiction, the installation of Mighty Stack appliances must conform to the Standard for Controls and Safety Devices for Automatically Fired Water heaters, ANSI/ASME CSD-1. Any modifications to the water heater, its gas controls, or wiring may void the warranty. If field conditions require modifications, consult the factory representative before initiating such modifications.

#### AVERTISSEMENT

Afin de réduire au minimum les risques de commotion électrique, de feu ou d'autre nature, qui pourraient causer des dommages matériels, des blessures ou des accidents mortels, les chaudières à eau chaude ou les chauffe-eau Mighty Stack **doivent** être installés conformément aux directives détaillées contenues dans ce manuel, à défaut de quoi la garantie fournie par Laars Heating Systems serait annulée. L'installation doit être conforme aux exigences de la réglementation locale en vigueur et, aux États-Unis, à l'édition la plus récente du National Fuel Gas Code (Code pour le gaz combustible naturel) ANSI Z223.1/NFPA54. Au Canada, l'installation doit respecter les exigences de la plus récente édition du Code d'installation du gaz naturel et du propane CSA B149.1, et/ou des codes locaux de construction en vigueur. Lorsque la réglementation locale l'exige, l'installation des appareils électroménagers Mighty Stack doit respecter les exigences du Standard for Controls and Safety Devices for Automatically Fired Water heaters (Code pour les équipements de commande et de sécurité des chaudières à combustion automatique), ANSI/ASME CSD-1. Toute modification apportée à la chaudière, aux régulateurs de gaz ou au câblage, peut compromettre la garantie. Si certaines conditions particulières rendent des adaptations nécessaires, consulter un représentant du fabricant avant d'entreprendre ces modifications.

## Model Nomenclature

see Section 1.2 for Model Identification



## 1.2 Model Identification

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

### Model Character Designation

#### 1-2 Model Series Designation

M S = Mighty Stack

#### 3-5 Gallons

080 = 80 Gallons (303 liters)

#### 5-8 Size

1 9 9 = 199,900 BTU/h input

3 0 0 = 299,000 BTU/h input

3 9 9 = 399,900 BTU/h input

#### 9 Fuel

N = Natural Gas

P = Propane

#### 10 Altitude

A = 0-10,000 feet

#### 11 Heat Exchanger / Tank Approvals

2 = HLW Copper Heat Exchanger Only

5 = HLW Cupronickel Heat Exchanger Only

X = HLW (Tank and Copper Heat Exchanger)

Y = HLW (Tank and Cupronickel Heat Exchanger)

#### 12 Pump

N = Normal Water Pump

S = Soft Water Pump

#### 13 Model Revision

1 = Initial Release

## 1.3 Warranty

Laars Heating Systems' Mighty Stack appliances are covered by a limited warranty. The owner should go to the Laars.com website and register for warranty.

All warranty claims must be made to an authorized Laars Heating Systems representative or directly to the factory. 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 are 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.

## 1.4 Dimensions

See Figure 1.

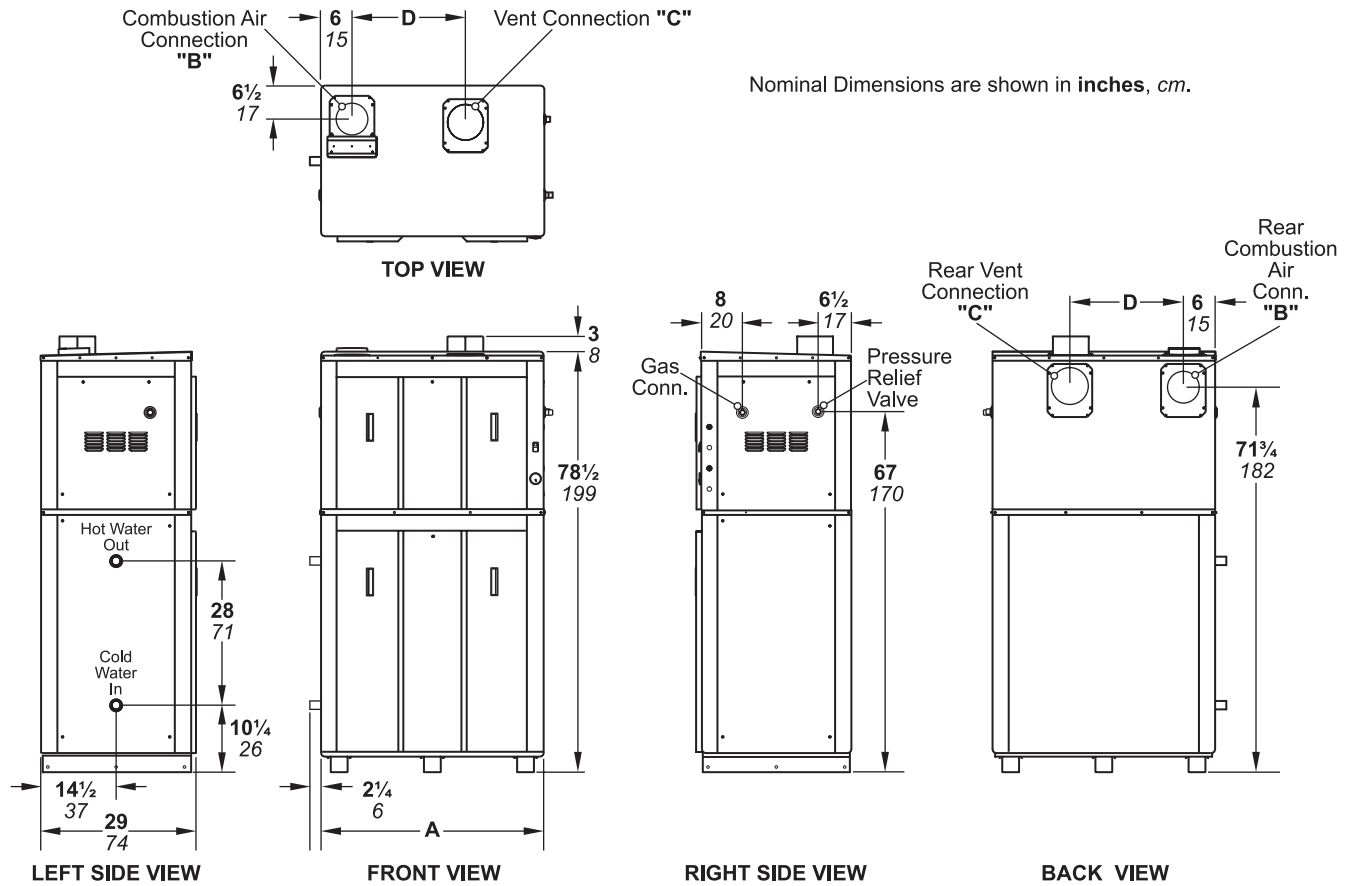
## 1.5 Locating the Appliance

The appliance should be located to provide clearances on all sides for maintenance and inspection. It should not be located in an area where leakage of any connections will result in damage to the area adjacent to the appliance or to lower floors of the structure.

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

The appliance is design certified by CSA-International for installation on combustible flooring; in basements; in closets, utility rooms or alcoves. **Mighty Stack Water heaters omust never be installed on carpeting.** The location for the appliance should be chosen with regard to the vent pipe lengths and external plumbing. The unit shall be installed such that the gas ignition system components are protected from water (dripping, spraying, rain, etc.) during operation and service (circulator replacement, control replacement, etc.). When vented vertically, the Mighty Stack must be located as close as practical to a chimney or outside wall. 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 such that blockage of the terminal from accumulated debris or precipitation is prevented.

The dimensions and requirements that are shown in Table 2 should be met when choosing the locations for the appliance.



Size	A		B		C		D	
	in.	cm	in.	cm	in.	cm	in.	cm
199	<b>33.0</b>	84	<b>4</b>	10	<b>5</b>	13	<b>8.75</b>	22
300	<b>39.0</b>	99	<b>4</b>	10	<b>6</b>	15	<b>15</b>	38
399	<b>43.0</b>	109	<b>6</b>	15	<b>7</b>	18	<b>22</b>	56

\*Air and vent connections may be on top or back of the Mighty Stack, and are field convertible.

**Figure 1. Dimensional Data.**

## 1.6 Locating Appliance for Correct Horizontal Vent/Ducted Air Distance From Outside Wall

The forced draft combustion air blower in the appliance has sufficient power to pull air and vent properly when the guidelines for horizontal air and vent are followed (see Table 1).

**NOTE:** On some models, the vent collar size is larger than the size of the vent pipe that can be used. Vent collar size and horizontal pipe diameters can be found in Table 1. The larger vent collar size is to accommodate Category I (vertical) vent systems.

**NOTE:** When located on the same wall, the Mighty Stack combustion air intake terminal must be installed a minimum of 12" (30cm) below the exhaust vent terminal and separated by a minimum of 36 inches (91cm) horizontally.

The air intake terminal must be installed high enough to avoid blockage from snow, leaves and other debris.

Size	Vent Collar Size		Horizontal Vent Pipe Diameter		Intake Air Collar & Pipe Diameter		Max. Pipe Length		Max. No. of Elbows	Side Wall Vent Terminal Part Number	Side Wall Combustion Air Terminal Part Number
	in	cm	in	cm	in	cm	ft	m			
199	5	13	4	10	4	10	50	15	3	CA003101	CA003201
300	6	15	5	13	4	10	50	15	3	CA003102	CA003201
399	7	18	6	15	6	15	50	15	3	CA003103	CA003202

**Table 1. Horizontal Vent / Combustion Air Parameters.**

Appliance Surface	Required Clearance From Combustible Material		Recommended Service Access Clearance	
	inches	cm	inches	cm
Left Side	1	2.5	24	61
Right Side	1	2.5	24	61
Top	1	2.5	12	30
Back	1	2.5	12**	30**
Front	1	2.5	36	91
Vertical (Category 1) Vent	6*	15.2*		
Horizontal (Category 3) Vent	per UL 1738 venting system supplier's instructions			
*1" (2.5 cm) when b-vent is used. **When vent and/or combustion air connects to the back, recommended clearance is 36" (91cm).				

**Table 2. Clearances.**

## SECTION 2.

### Venting and Combustion Air

#### ⚠ WARNING

For indoor installations, as an additional measure of safety, Laars strongly recommends installation of suitable Carbon Monoxide detectors in the vicinity of this appliance and in any adjacent occupied spaces.

#### ⚠ AVERTISSEMENT

Pour des installations intérieures, Laars recommande fortement, comme mesure de sécurité supplémentaire, l'installation de détecteurs de monoxyde de carbone adaptés dans le voisinage de l'appareil et dans chacune des pièces habitées adjacentes.

### 2.1 Combustion Air

Mighty Stack water heaters must have provisions for combustion and ventilation air in accordance with the applicable sections addressing requirements for air for combustion and ventilation of the National Fuel Gas Code, ANSI Z223.1. In Canada, the applicable sections of the Natural Gas and Propane Installation Code (CSA B149.1) must be followed. In all cases any and all applicable local installation codes must also be followed.

A Mighty Stack appliance may receive combustion air from the space in which it is installed, or it can be ducted directly to the unit from the outside. Proper ventilation air must be provided in either case.

#### 2.1.1 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 inches (30 cm) of the top and one commencing within 12 inches (30 cm) of the bottom, of the enclosure shall be provided. The openings shall communicate directly, or by ducts, with the outdoors or spaces that freely communicate with the outdoors. When directly communicating with the outdoors, or when communicating to the outdoors through vertical ducts, each opening shall have a minimum free area of 1 square inch per 4000 Btu/hr (5.5 square cm/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 (11 square cm/kW) of total input rating of all equipment in the enclosure. Table 3 shows data for this sizing method, for each Mighty Stack model.

**Method 2:** One permanent opening, commencing within 12 inches (30 cm) 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 (7 square cm/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 CSA B149.1, the Natural Gas and Propane Installation Code.

Size	Each Opening*	
	Square inches	Square cm
199	50	323
300	75	484
399	100	645

\*Net Free Area in Square Inches / Square cm  
Area indicated is for one of two openings; one at floor level and one at the ceiling, so the total net free area could be double the figures indicated.

This chart is for use when communicating directly with the outdoors. For special conditions and alternate methods, refer to the latest edition of ANSI Z223.1.

**Note:** Check with louver manufacturers for net free area of louvers. Correct for screen resistance to the net free area if a screen is installed. Check all local codes applicable to combustion air.

Table 3. Combustion Air Openings.

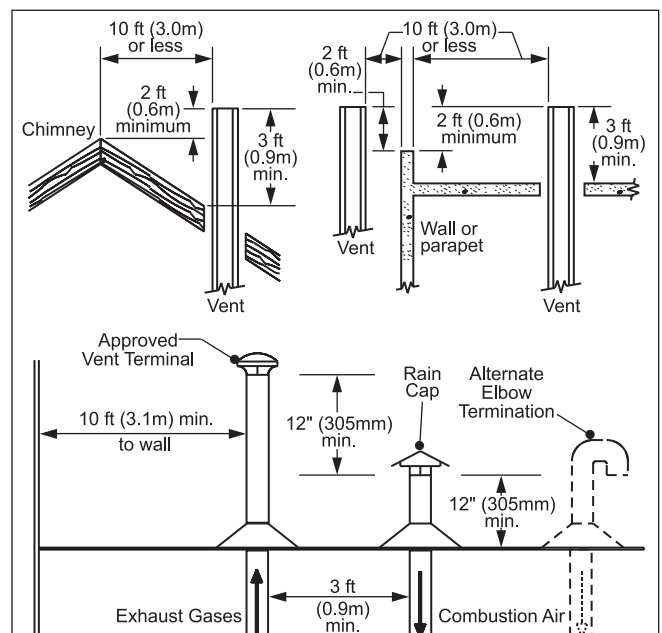


Figure 2. Combustion Air and Vent Through Roof.

### 2.1.2 Intake Combustion Air

The combustion air can be ducted 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 (see Table 1). 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 2).

Use single-wall galvanized pipe, per Table 4, for the combustion air intake (see Table 1 for appropriate size). Route the intake to the heater as directly as possible. Seal all joints with tape. Provide adequate hangers. The unit must not support the weight of the combustion air intake pipe. Maximum linear pipe length allowed is 50 feet (15.2m). Three elbows have been calculated into the 50-foot (15.2m) linear run. Subtract 10 allowable linear feet (3.0m) for every additional elbow used (see Table 1). When fewer than 3 elbows are used, the maximum linear pipe length allowed is still 50 feet (15.2m).

Term	Description
Pipe	Single-wall galvanized steel pipe, 24 gauge minimum (either insulated or non-insulated)
Joint Sealing	Permanent duct tape or aluminum tape

**Table 4. Required Combustion Air Piping Material.**

The connection for the intake air pipe is on the filter box. The Mighty Stack appliances may have venting and combustion air ducting attached to the top or the back. They are shipped with the connections at the top. For attaching either or both pipes to the back, the mounting flanges are reversible by removing the mounting screws and orienting the flanges in the desired position. Replace the screws after positioning flanges. Run a bead of silicone around the collar and slide the pipe over the collar. Secure with sheet metal screws.

In addition to air needed for combustion, air shall also be supplied for ventilation, including all air required for comfort and proper working conditions for personnel. The Mighty Stack loses less than 1 percent of its input rating to the room, but other heat sources may be present.

## 2.2 Venting

### 2.2.1 Vent Categories

Depending upon desired Mighty Stack venting, it may be considered a Category I or a Category III appliance. In general, a vertical vent system will be a Category I system. However, in rare instances, a Mighty Stack's vertical vent system may be considered Category III. In the U.S., the National Fuel Gas Code (ANSI Z223.1), or in Canada the Natural Gas and Propane Installation Code (CSA B149.1), defines a Category I vent system, and includes rules and tables to size these vent systems. If the Mighty Stack's

vertical vent system does not satisfy the criteria for Category I venting, it must be vented as a Category III system.

All Mighty Stack vent systems which discharge horizontally (without the use of a power venter) are considered Category III vent systems.

### 2.2.2 Category I Vent

When vented as a Category I appliance, the vent system must conform to the National Fuel Gas Code (ANSI Z223.1-Latest Edition) in the U.S., or in Canada, to the Natural Gas and Propane Installation Code (CSA B149.1 latest edition). The vent system must be sized and installed for a Category I Fan-Assisted Appliance.

If chimney height is greater than 25 feet (7.6m), or if multiple units are vented into the same vertical vent, a barometric damper must be installed on each appliance, such that the flue draft does not exceed (negative) 0.1 in. w.c.

If using a power venter for any type of Category I venting, the draft should be set between (negative) 0.01 and 0.05 in. w.c.

### 2.2.3 Common Venting Systems

Mighty Stack units are Category I fan-assisted when vented vertically and adhering to all applicable codes. Mighty Stack units are not allowed to be vented into a common horizontal vent system, unless a properly sized vent fan is used, and the common vent system is properly designed by the vent fan manufacturer or a qualified engineer. When common venting Mighty Stack fan-assisted unit with other appliances through one shared vertical duct called a "common vent", special care must be taken by the installer to ensure safe operation. In the event that the common vent is blocked, it is possible, especially for fan-assisted devices, to vent backwards through non-operating appliances sharing the vent, allowing combustion products to infiltrate occupied spaces.

**If the appliances are allowed to operate in this condition, serious injury or death may occur.**

#### WARNING

Operation of appliances with a blocked common vent may lead to serious injury or death. Safety devices must be implemented to prevent blocked common vent operation. If safe operation of all appliances connected to a common vent cannot be assured, including prevention of spillage of flue gasses into living spaces, common venting should not be applied, and appliances should each be vented separately.

**⚠ AVERTISSEMENT**

Le fonctionnement d'appareils connectés à un événement commun bouché peut provoquer de sérieuses blessures corporelles ou la mort. Des dispositifs de sécurité doivent être mis en place pour empêcher que les appareils soient utilisés avec un événement commun bouché. Si un fonctionnement sécuritaire de tous les appareils reliés à un événement commun et si la prévention des dégagements accidentels de gaz de combustion dans des zones habitées ne peuvent pas être assurés, un événement commun ne doit pas être mis en place et les appareils doivent être munis d'événements individuels séparés.

It is for this reason that, in addition to following proper vent sizing, construction and safety requirements from the National Fuel Gas Code, ANSI Z223.1 or in Canada, from the Natural Gas and Propane Installation Code (CSA B149.1) as well as all applicable local codes, it is required that installers provide some means to prevent operation with a blocked common vent. It is suggested that a blocked vent safety system be employed such that if the switch from one appliance trips due to excessive stack spill or back pressure indicating a blocked vent condition, that all appliances attached to the vent be locked out and prevented from operating. Note that the Mighty Stack is equipped with a blocked vent safety (pressure) switch, as shipped. However, this safety switch has only been designed and tested to be effective in installations where the Mighty Stack is vented separately and NOT common vented with other appliances. As an additional precaution, it is recommended that a Carbon Monoxide (CO) alarm be installed in all enclosed spaces containing combustion appliances. If assistance is required in determining how a blocked vent safety system should be connected to a LAARS product, please call Applications Engineering at the Rochester phone number on the back cover of this manual.

Refer to the installation and operating instructions on all appliances to be common vented for instructions, warnings, restrictions and safety requirements. If safe operation of all appliances connected to a common vent cannot be assured, including prevention of spillage of flue gases into living spaces, common venting should not be applied, and appliances should each be vented separately.

**2.2.4 Category III Vent**

When the Mighty Stack is vented with horizontal discharge, it must be installed per this installation manual and the venting system manufacturer's installation instructions. The vent system must be sealed stainless steel, per Table 5.

Route the 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. Horizontal runs must slope downwards not less than ¼ inch per foot (2 cm/m) from the unit to the vent terminal.

*L'appareil ne doit pas supporter le poids de la gaine d'évent. Les parties horizontales doivent être installées avec une pente de 2 cm/m (1/4 inch par pied) descendant de l'appareil vers la sortie de l'évent.*

Reference Table 1 for the size of the Category III vent system. Up to three elbows can be used with 50 linear feet (15.2m) of pipe. Subtract 10 allowable linear feet (3.0m) for every additional elbow used.

**2.3 Locating Vent & Combustion Air Terminals****2.3.1 Side Wall Vent Terminal**

The appropriate Laars side wall vent terminal must be used, and is listed in the installation and operation manual. The terminal provides a means of installing the vent piping through the building wall, and 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 and local applicable codes. Consider the following when installing the terminal:

1. Figure 3 shows the requirements for mechanical vent terminal clearances for the U.S. and Canada.
2. Locate the vent terminal so that vent gases cannot be drawn into air conditioning system inlets.
3. Locate the vent terminal so that vent gases cannot enter the building through doors, windows, gravity inlets or other openings. Whenever possible, locations under windows or near doors should be avoided.
4. 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.
5. Locate the terminal so the vent exhaust does not settle on building surfaces or other nearby objects. Vent products may damage such surfaces or objects.
6. If the water heater or water heater uses ducted combustion air from an intake terminal located

Term	Description
Pipe	Must comply with UL Standard 1738 such as Type AL29-4C Stainless Steel (either insulated or non-insulated).
Joint Sealing	Follow vent manufacturer's instructions.

**Table 5. Required Horizontal Venting Material.**

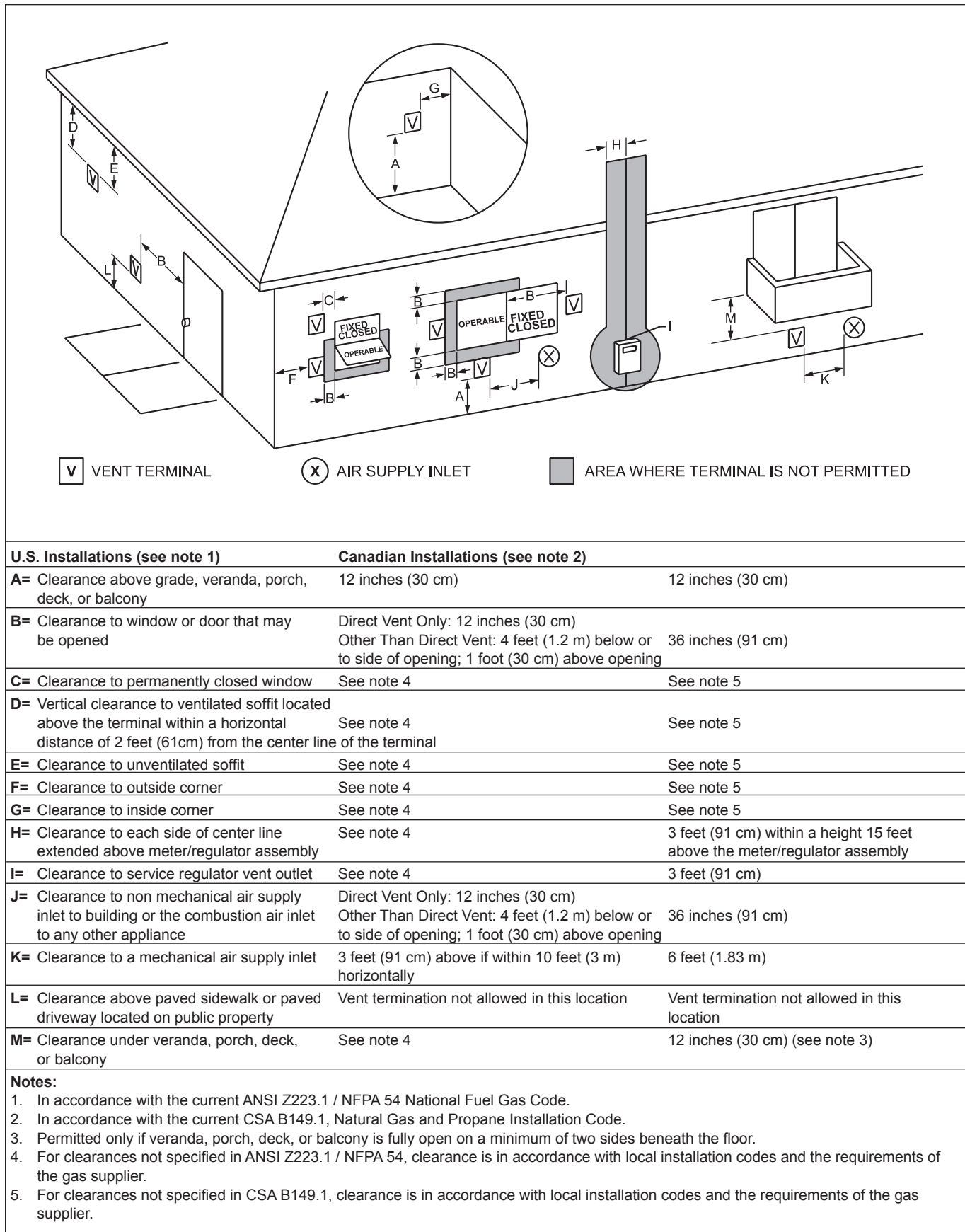


Figure 3. Vent Terminal Clearance.

on the same wall, locate the vent terminal at least 3 feet (0.9m) horizontally from the combustion air terminal, and locate the vent terminal at least 1 foot (0.3m) above the combustion air terminal.

 **WARNING**

The outdoor vent terminal gets hot. Unit must be installed in such a way as to reduce the risk of burns from contact with the vent terminal.

 **AVERTISSEMENT**

La sortie d'évent à l'extérieur devient très chaude. Elle doit être installée de façon à réduire le risque de brûlures au contact de l'extrémité de l'évent.

**Important Note: Massachusetts Code Requirement.**

**From Massachusetts Rules and Regulations 248 CMR 5.08:**

- (a) **For all side wall horizontally vented gas fueled equipment installed in every dwelling, building or structure used in whole or in part for residential purposes, including those owned or operated by the Commonwealth and where 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, the following requirements shall be satisfied:**

1. **INSTALLATION OF CARBON MONOXIDE DETECTORS.**  
At the time of installation of the side wall horizontal vented gas fueled equipment, the installing plumber or gasfitter shall observe that a hard-wired carbon monoxide detector with an alarm and battery back-up is installed on the floor level where the gas equipment 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 horizontal vented gas fueled equipment. It shall be the responsibility of the property owner to secure the services of qualified licensed professionals for the 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 detector with alarm and battery back-up may be installed on the next adjacent floor level.
  - b. In the event that the requirements of this subdivision cannot be met at the time of

completion of installation, the owner shall have a period of thirty (30) days to comply with the above requirements; provided, however, that during said thirty (30) day period, a battery operated carbon monoxide detector with an alarm shall be installed.

2. **APPROVED CARBON MONOXIDE DETECTORS.**

Each carbon monoxide detector as required in accordance with the above provisions 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 the horizontally vented gas fueled heating appliance or equipment. The sign shall read, in print size no less than one-half (½) 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 equipment 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 through 4.

(b) **EXEMPTIONS: The following equipment is exempt from 248 CMR 5.08(2)(a) 1 through 4:**

1. The equipment listed in Chapter 10 entitled "Equipment Not Required To Be Vented" in the most current edition of NFPA 54 as adopted by the Board; and
2. Product Approved side wall horizontal vented gas fueled equipment installed in a room or structure separate from the dwelling, building or structure used in whole or in part for residential purposes.

(c) **MANUFACTURER REQUIREMENTS – GAS EQUIPMENT VENTING SYSTEM PROVIDED. When the manufacturer of Product Approved side wall horizontally vented gas equipment provides a venting system design or venting system components with the equipment, the instructions provided by the manufacturer for installation of the equipment and the venting system shall include:**

1. Detailed instructions for the installation of the venting system design or the venting system components; and

2. A complete parts list for the venting system design or venting system.
- (d) MANUFACTURER REQUIREMENTS – GAS EQUIPMENT VENTING SYSTEM NOT PROVIDED. When the manufacturer of a Product Approved side wall horizontally vented gas fueled equipment does not provide the parts for venting the fuel gases, but identifies “special venting systems”, the following requirements shall be satisfied by the manufacturer:**
1. The referenced “special venting system” instructions shall be included with the appliance or equipment installation instructions; and
  2. The “special venting systems” shall be Product Approved by the Board, and the instructions for that system shall include a parts list and detailed installation instructions.
- (e) A copy of all installation instructions for all Product Approved side wall horizontally vented gas fueled equipment, all venting instructions, all parts lists for venting instructions, and/or all venting design instructions shall remain with the appliance or equipment at the completion of the installation.**

### 2.3.2 Side Wall Combustion Air Terminal

The Laars side wall combustion air terminal (listed in Table 1) must be used when the unit takes its combustion air through a duct from a side wall. Consider the following when installing the terminal:

1. Do not locate the air inlet terminal near a source of corrosive chemical fumes (e.g., cleaning fluid, chlorinated compounds, etc.)
2. Locate the terminal so that it will not be subject to damage by accident or vandalism.
3. Locate the combustion air terminal so that it cannot be blocked by snow. The National Fuel Gas Code requires that it be at least 12 inches (30 cm) above grade, but the installer may determine it should be higher, depending upon local conditions.
4. If the Mighty Stack is side-wall vented to the same wall, locate the vent terminal at least 3 feet (0.9m) horizontally from the combustion air terminal, and locate the vent terminal at least 1 foot (0.3m) above the combustion air terminal (see Figure 3).

### 2.3.3 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 2).

### 2.3.4 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 2). 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.

## 2.4 Common Vent Test — Water Heaters

When an existing water heater 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 water heater, 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 non 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 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.
- Any improper operation of the common venting system should be corrected so that the installation conforms with the National Fuel Gas Code, ANSI Z223.1/NFPA 54 and/or CSA B149.1, Natural Gas and Propane 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 in Appendix F in the National Fuel Gas Code, ANSI Z223.1/NFPA 54 and/or CSA B149.1, Natural Gas and Propane Installation Codes.

## 2.4 Vérification des événements communs — Chaudières

*Lorsqu'une chaudière existante est déconnectée du réseau d'événements commun, ce réseau d'événements commun devient probablement trop grand pour les appareils qui lui restent connectés. Lorsqu'une chaudière existante est retirée, les étapes suivantes doivent être accomplies pour chaque appareil qui reste connecté au réseau d'événements commun utilisé, alors que les autres appareils qui sont encore connectés au réseau commun d'événements ne sont pas en fonctionnement.:*

- Sceller toutes les ouvertures non utilisées du système d'évacuation.*
- Inspecter de façon visuelle le système d'évacuation pour déterminer la grosseur et l'inclinaison horizontale qui conviennent et s'assurer que le système est exempt d'obstruction, d'étranglement, de fuite, de corrosion et autres défaillances qui pourraient présenter des risques.*
- Dans la mesure du possible, fermer toutes les portes et les fenêtres du bâtiment et toutes les portes entre l'espace où les appareils toujours raccordés au système d'évacuation sont installés et les autres espaces du bâtiment. Mettre en marche les sècheuses, tous les appareils non raccordés au système d'évacuation commun et tous les ventilateurs d'extraction comme les hottes de cuisinière et les ventilateurs des salles de bain. S'assurer que ces ventilateurs fonctionnent à la vitesse maximale. Ne pas faire fonctionner les ventilateurs d'été. Fermer les registres des cheminées.*
- Mettre l'appareil inspecté en marche. Suivre les instructions d'allumage. Régler le thermostat de façon continue.*
- Faire fonctionner le brûleur principal pendant 5 min ensuite, déterminer si le coupe-tirage déborde à l'ouverture de décharge. Utiliser la flamme d'une allumette ou d'une chandelle ou la fumée d'une cigarette, d'un cigare ou d'une pipe.*
- Une fois qu'il a été déterminé, selon la méthode indiquée ci-dessus, que chaque appareil raccordé au système d'évacuation est mis à l'air*

*libre de façon adéquate. Remettre les portes et les fenêtres, les ventilateurs, les registres de cheminées et les appareils au gaz à leur position originale.*

- Tout mauvais fonctionnement du système d'évacuation commun devrait être corrigé de façon que l'installation soit conforme au National Fuel Gas Code, ANSI Z223.1/NFPA 54 et (ou) aux codes d'installation CSA-B149.1. Si la grosseur d'une section du système devrait être modifié, le système devrait être modifié pour respecter les valeurs minimales des tableaux pertinents de l'appendice F du National Fuel Gas Code, ANSI Z223.1/NFPA 54 et (ou) les codes d'installation CSA-B149.1*

## 2.5 Vent Terminals for Outdoor Units

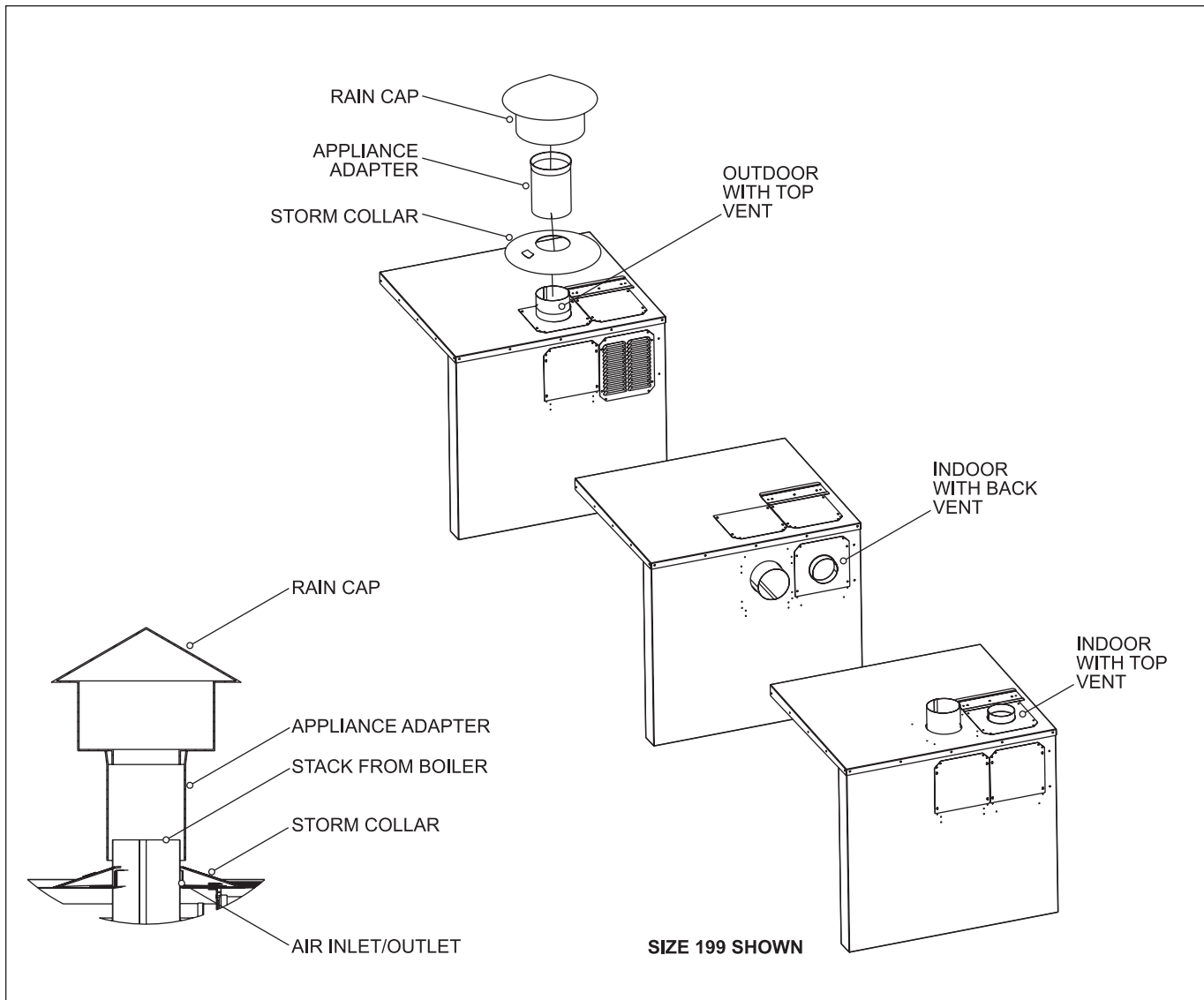
For outdoor applications, the vent and combustion air openings must be covered with proper terminals to prevent rain, snow and other objects from falling into the Mighty Stack.

Outdoor Vent / Air kit part numbers are shown in Table 6. These kits contain parts for both combustion air inlet and exhaust vent connections. An angled sheet metal assembly with louvers replaces the sheet metal assembly with the air collar. An adapter, a 12" (30cm) length of pipe, and a rain cap are included for the exhaust vent opening.

If local codes allow, Laars kits are not required for outdoor units. The installer may use 12" (30cm) of appropriately sized galvanized single wall or b-type vent pipe and a rain cap for the exhaust vent. In addition, an appropriately sized galvanized 90° elbow, positioned with the opening facing down, may be used on the combustion air inlet.

Size	Outdoor Vent and Air Terminal Kit
199	CA009000
300	CA009001
399	CA009002

**Table 6. Vent / Air Kits for Outdoor Units.**

**Figure 4. Venting.**

## SECTION 3.

### Gas Supply and Piping

#### 3.1 Gas Supply and Piping

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

The Mighty Stack's gas train allows the user to pipe the gas from either the right side or the left side of the unit. As shipped, the right side of the gas train is capped off, and there is a manual valve on the left side. If desired, the manual valve on the left side of the gas train may be moved to the right side, and the cap on the right side may be moved to the left.

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. Mighty Stack appliances are equipped to operate at elevations up to 10,000 feet (3050m). Mighty Stack appliances may be adjusted to operate properly at altitudes above 2500 feet (see Section 6.5.2) and the input will be reduced if the heating value of the gas supply is below sea level values.
2. The maximum inlet gas pressure must not exceed 13" w.c. (3.2kPa). The minimum inlet gas pressure is 5 in. w.c. (1.2 kPa).
3. Refer to Table 7, size supply.
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 0.5 psig (3.45 kPa).
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 0.5 psig (3.45 kPa).
10. The appliance and its gas connection must be leak tested before placing it in operation.
11. Purge all air from gas lines.

#### **WARNING**

Do not use open flame to check for leaks. An open flame could lead to explosion, which could result in property damage, serious injury or death.

#### **AVERTISSEMENT**

Ne recherchez pas les fuites avec une flamme nue. Une flamme nue peut provoquer une explosion qui peut causer des dommages matériels, de sérieuses blessures corporelles ou la mort.

**NOTE:** The Mighty Stack 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.

Model and Gas Type	Distance from Gas Meter or Last Stage Regulator					
	0-100'	0-31 m	100-200'	31-61m	200-300'	61-91m
199 natural	1¼"	3.2 cm	1¼"	3.2 cm	1¼"	3.2 cm
199 propane	1"	2.5 cm	1"	2.5 cm	1¼"	3.2 cm
300 natural	1¼"	3.2 cm	1½"	4.0 cm	1½"	4.0 cm
300 propane	1	2.5 cm	1¼"	3.2 cm	1¼"	3.2 cm
399 natural	1¼"	3.2 cm	1½"	4.0 cm	2"	5.0 cm
399 propane	1¼"	3.2 cm	1¼"	3.2 cm	1½"	4.0 cm

**Notes:**

1. These figures are based on 1/2" (0.12 kPa) water column pressure drop.
2. Check supply pressure and local code requirements before proceeding with work.
3. Pipe fittings must be considered when determining gas pipe sizing.

**Table 7. Gas Piping Size.**

## SECTION 4. Water Connections

### 4.1 Water System Piping

Pipe the outlet from the heater's relief valves such that any discharge from the 2 relief valves will be conducted to a suitable place for disposal when relief occurs. Do not reduce line size or install any valves in this line. The lines must be installed to allow complete drainage of both the valve and the line (see Figure 4).

The minimum inlet water temperature for the Mighty Stack is 120°F (49°C) to avoid condensing on the copper coils. It is the responsibility of the installer to properly mix supply water as necessary to keep the return water temperature above 120°F.

**NOTE:** Laars will not warranty claims for failure to provide minimum return water temperature.

### 4.2 Hot Water Supply Piping

If the Mighty Stack water heater is installed in a closed water supply system, such as one having a backflow preventer in the cold water supply line, the relief valve may discharge periodically, due to thermal expansion. Means (such as a properly-sized expansion tank) shall be provided to control thermal expansion. Contact the water supplier or local plumbing inspector on how to control this situation.

### 4.3 Water Flow Requirements

In a water heating application, new water is constantly being introduced. With the new water comes a fresh supply of minerals that can be deposited on the unit's heat exchanger. This is commonly known as scaling. The amount of minerals will depend upon the hardness of the water. Water can also be aggressive, and can erode metals, including copper, if the water is moved too quickly. The water flow requirements for the Mighty Stack water heater are based upon the hardness of the water. The water flow is kept high enough to prevent scaling, but low enough to prevent tube erosion. For extremely soft or hard water, cupro-nickel tubes are available. Contact a Laars representative if you have questions or concerns about water quality.

Water heaters can be ordered with a standard pump for soft or normal water or with a pump for hard water. The pumps used are sized for the head loss through the heater.

### 4.4 Combined Water Heating (potable) and Space Heating

**NOTE:** These systems are not allowed in the Commonwealth of Massachusetts.

Piping and components connected to this water heater shall be suitable for use with potable water.

Toxic chemicals, such as used for water heater treatment, shall not be introduced into the potable water used for space heating.

This water heater shall not be connected to any heating system or component(s) previously used with a non-potable water heating appliance.

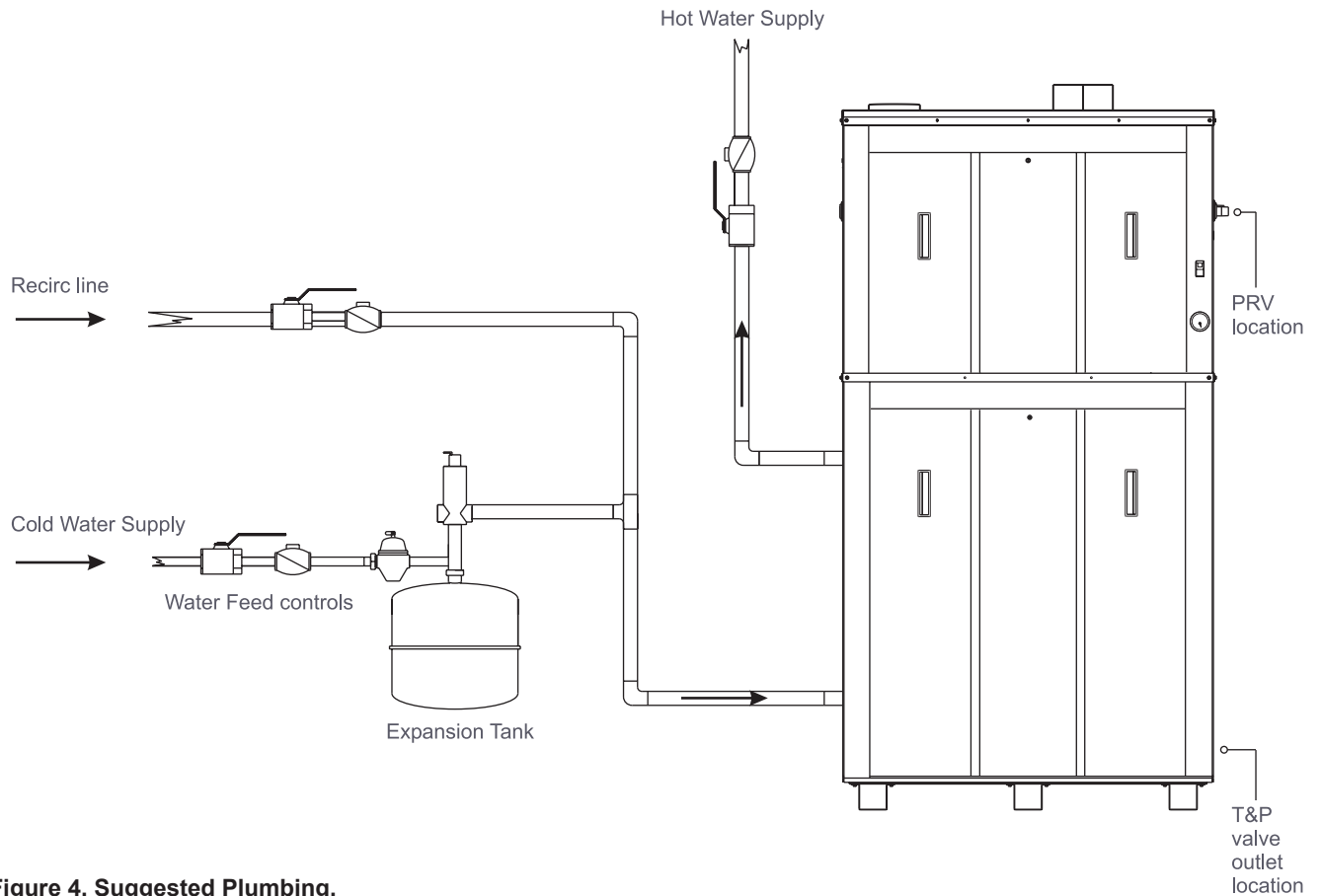
**When the system requires water for heating at temperatures higher than required for other uses, an anti-scald mixing or tempering valve shall be installed to temper the water for those uses in order to reduce scald hazard potential.**

### 4.5 Freeze Protection

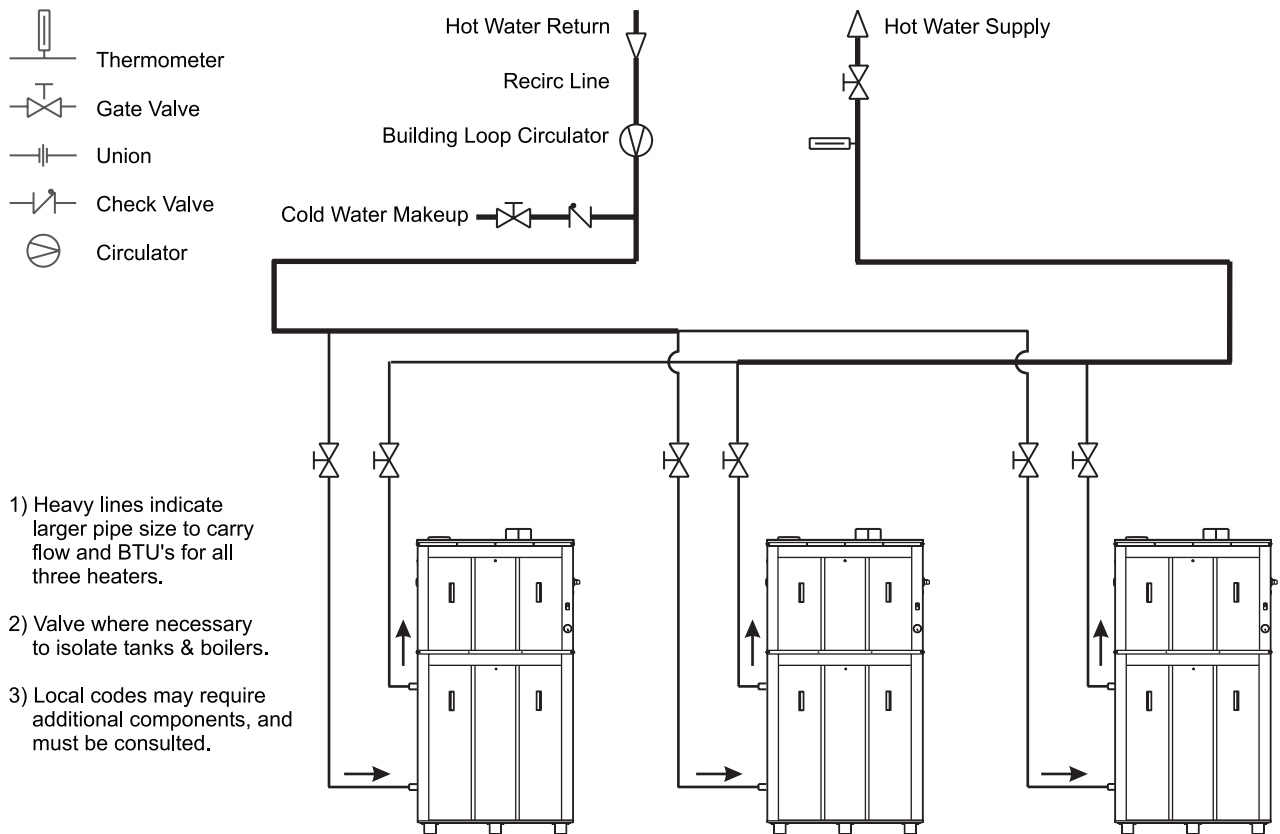
Although Mighty Stack water heaters are design-certified for outdoor installations, such installations are not recommended in areas subject to freezing temperatures, unless proper precautions are taken.

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

Contact the local factory representative or Laars for additional information.



**Figure 4. Suggested Plumbing.**



**Figure 5. Suggested Plumbing, Three Units (in first, out last).**

## SECTION 5.

### 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 water heater. Plastic pipe or dielectric unions may isolate the water heater electrically. Service and maintenance personnel, who work on or around the water heater, may be standing on wet floors and could be electrocuted by an ungrounded water heater.

#### **⚠ AVERTISSEMENT**

L'appareil doit être relié à la terre conformément aux exigences de la réglementation locale ou, en l'absence d'une telle réglementation, à la plus récente édition du National Electrical Code (Code national de l'électricité) ANSI/NFPA 70 aux États-Unis, et à la plus récente édition du Code Canadien de l'électricité 1<sup>ère</sup> partie (Canadian Electrical Code Part 1) CSA C22.1, au Canada. N'utilisez pas les tuyauteries d'eau ou de gaz pour mettre à la terre les pièces métalliques de la chaudière; des tuyauteries en plastique ou des raccords union diélectriques peuvent isoler électriquement la chaudière. Les employés qui sont appelés à travailler sur la chaudière ou autour peuvent être électrocutés par une chaudière qui n'est pas mise à la terre.

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

**NOTE:** All internal electrical components have been pre-wired. No attempt should be made to connect electrical wires to any other location except the wiring box.

### 5.1 Main Power

Connect a 15 amp. fused, 120-volt supply to the main power switch. Both hot and neutral wires are provided for connections inside the water heater jacket. Ground wire can be connected to the grounding screw in the box.

Wiring diagram is shown in Figure 7.

### 5.2 Field Wiring

**Other Field Interlocks:** To install other field-wired switches (proving switches, flow switches, etc.), remove the jumper between the terminals labeled "3" and "4" (see Figure 6).

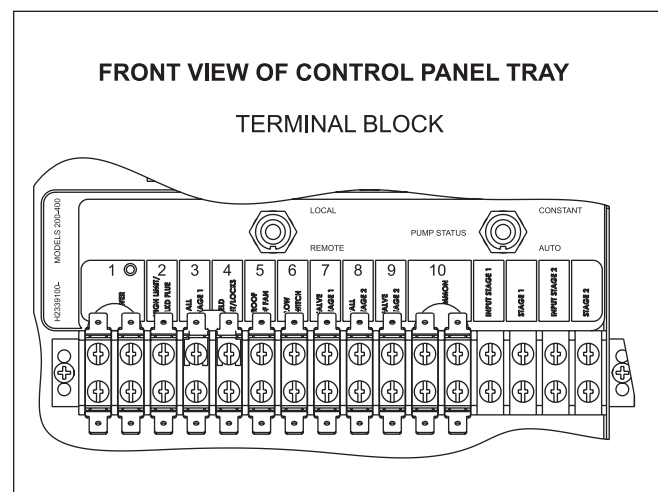


Figure 6. Terminal Block.

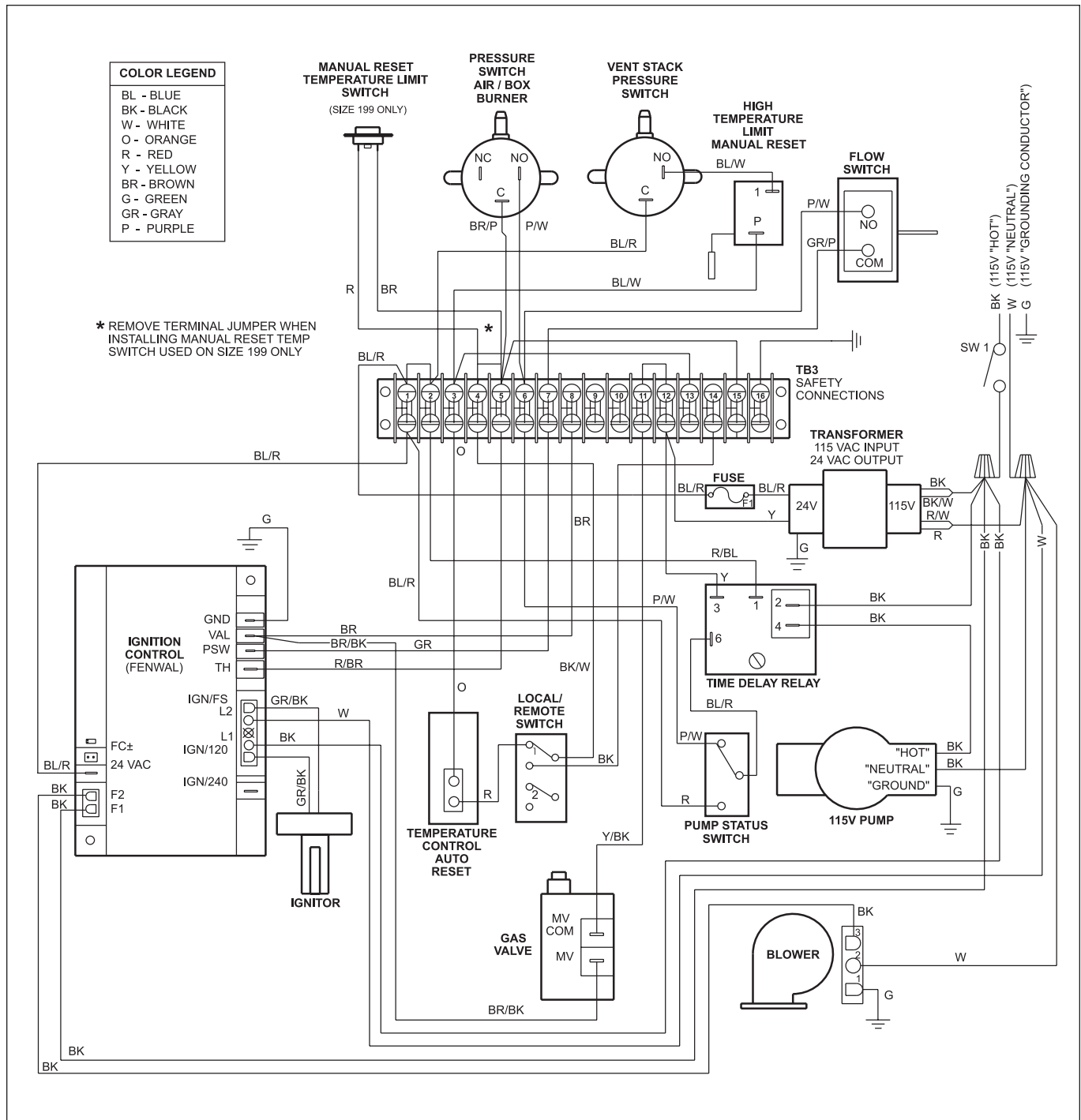


Figure 7. Wiring Diagram, ON/OFF Water Heater.

## SECTION 6.

### Operating Instructions

#### 6.1 Filling the Water Heater System

1. Ensure the system is fully connected. Allow system to fill slowly.
2. Start up water heater according to the procedure in this manual.
3. 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. After the pre-purge and ignitor heat-up time, the main gas terminals will be energized, attempting to light, for seven (7) seconds, and then will de-energize. The unit will attempt to light two more times, and then will go into lockout mode. Second, turn the power off and then on again, 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.

Important: 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.

#### AVERTISSEMENT

N'utilisez pas cet appareil si l'une de ses pièces est passée sous l'eau. Appelez tout de suite un technicien en entretien et en réparation pour inspection de l'appareil et remplacement des pièces du système de commande, et des pièces de commande du circuit gaz, qui sont passées sous l'eau.

#### 6.2 Operating Temperature Control

To utilize the water heater's on-board controller, be sure to have the "Local/Remote" selector switch to "Local". Set the controller to the desired operating set point.

High limit should be set 40-50°F (4-10°C) higher than the controller, to avoid nuisance lockout of the manual reset high limit.

Maximum tank temp. allowed is 150°F (66°C).

#### 6.3 External Water Heater Operations

If controlling the stages of the MS-080 from an external source (multiple water heater control, BAS, etc) the "Local/Remote" selector switch above the terminal strip must be placed in the "Remote" position. In this mode, the controller that is mounted

on the MS-080 will no longer have control of the unit. The 24V from the unit waits at the input terminal, and the external control switches this 24V from the input.

#### 6.4 Sequence of Operation

The pump time delay relay will receive a signal to initiate. The pump terminals on the field-wiring terminals strip will energize a pump.

Once the water flow switch makes, if all of the safety interlocks are closed, the ignition module will energize the blower for a 15-second pre-purge, followed by a 40-second period to allow the ignitor to heat.

The ignition control energizes the blower. The blower pressurizes the air box (which supplies air to the burners) and closes the normally-open contact on the airflow pressure switch. The blocked vent pressure switch senses the pressure in the exhaust plenum. This switch opens if the pressure is excessive (as an indicator of a blocked vent). When these two pressure switches are closed, voltage is sent to the PSW terminal on the ignition control, which allows the ignition module to proceed with the ignition sequence.

If the airflow proving circuit is not proven, ignition module will lock out. Section 6.5 describes the result of air flow faults in more detail.

When the ignition control gets the signal at the PSW terminal, it will energize its MV terminal, which sends power to the main valve.

After a 7-second trial for ignition, the ignitor switches to flame sense mode. If a flame is not detected, the gas valve will close and the ignition module will attempt ignition again (up to two more times, for a total of three attempts.) If all three attempts fail, the ignition control will lock out.

If flame is sensed, the burner will continue to fire as long as there is a call for heat, and none of the safety circuit is interrupted.

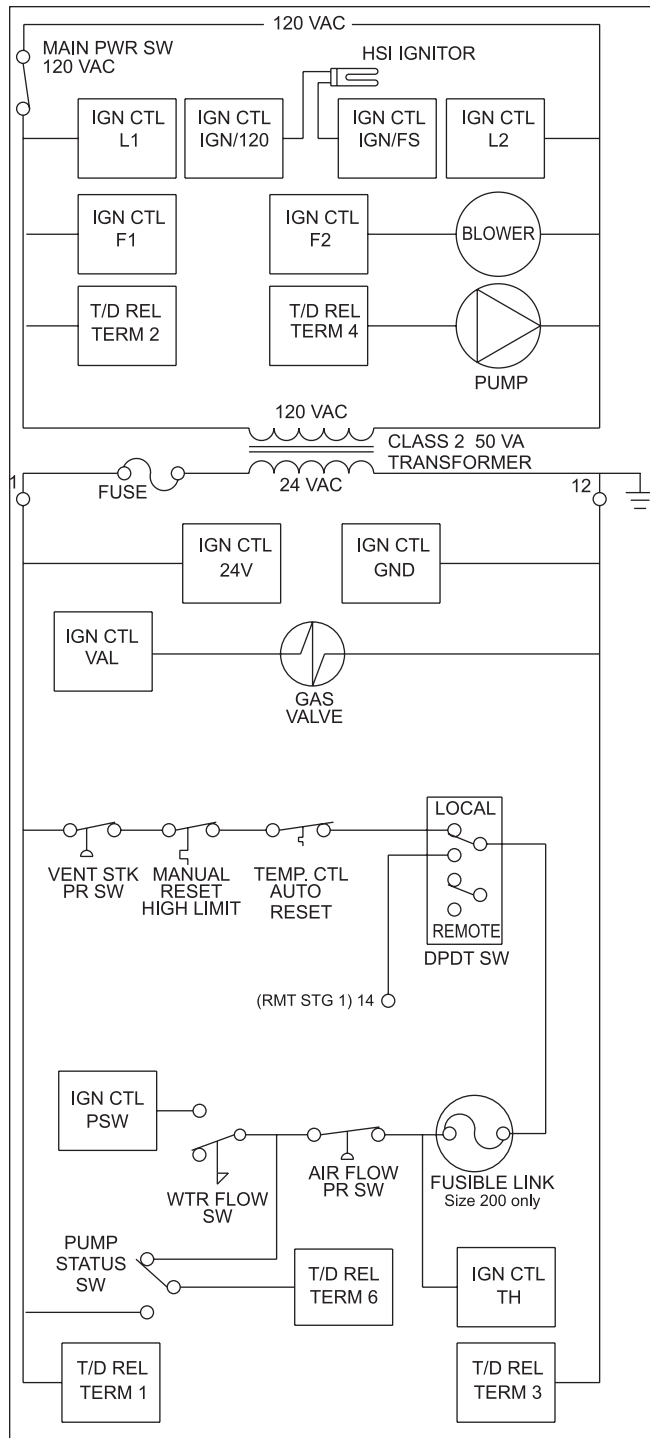
If there is a loss of flame signal during a successful firing sequence, the ignition control will remove power from the gas valve, and then attempt to light up to two more times. If successful, the Mighty Stack will fire normally. If unsuccessful, the ignition control will lock out.

When the call for heat is satisfied, the gas valve(s) closes, and the blower starts a 45 second post-purge. The Mighty Stack pump time delay relay will continue to run for the time delay period (dialed by the user, 0.1 to 10 minutes).

#### 6.5 Ignition Control Reaction to Air Flow / Blocked Vent Pressure Switch

Air flow and blocked vent status are continuously monitored by the Mighty Stack ignition control, at the control's PSW terminal.

At the start of an ignition sequence, if the ignition control sees power at PSW for 30 seconds, but the combustion blower has not yet been energized by the



**Figure 8. Logic Diagram, ON/OFF Water Heater.**

control (F1 and F2). The ignition control will remain in this fault mode, with the blower off. If the power to PSW is removed while there is still a call for heat, the ignition sequence will start again, but the main valves will not be energized until PSW sees power during the ignition sequence.

At the start of an ignition sequence, the control sends the combustion blower output (F1 and F2). If the control does not see power at PSW for more than 30 seconds, the control will remain in this fault mode, with the blower on. If proper airflow is later detected

on PSW, the control begins a pre-purge and a normal trial for ignition.

If the PSW signal is lost while the Mighty Stack is firing, the control will immediately de-energize the gas valve terminal (MV). The blower will remain on for the post-purge period (45 seconds), and the control will continue to monitor the PSW input. If the signal is detected during the post-purge period, a normal trial for ignition will begin, starting with the 15-second pre-purge. If the signal is not detected during the post-purge, the control will lockout with the blower off.

## 6.6 Operating the Burner and Set-Up

### 6.6.1 Set-Up for 0 to 2500 Feet Altitude

The 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 Mighty Stack resulting from improper setup is not covered by the limited warranty.

1. Using this manual, make sure the installation is complete and fully in compliance with the instructions.
2. Determine that the appliance and system are filled with water and all air has been bled from both. Open all valves.
3. Observe all warnings on the Operating Instructions label and turn on gas and electrical power to appliance.
4. Switch on the appliance power switch located on the right side of the unit.
5. The Mighty Stack will enter the start sequence, as long as the unit is being called for heat. The blower and pump come on for pre-purge, then the ignitor warm-up sequence starts and after the ignitor warm-up is complete and all safety devices are verified, the gas valves open. If ignition doesn't occur, check that there is proper gas supply. Wait 5 minutes and start the unit again. During initial start up, air in the gas line may cause the Mighty Stack to "lock out" during the first few trials for ignition. If the ignition control locks out, reset by cycling the power off and on using the main power switch on the right side of the cabinet.
6. When the unit is running, the supply gas pressure must be checked. Inlet gas pressure must not exceed 13 in. w.c. (3.2 kPa). The minimum inlet gas pressure is 5 in. w.c. (1.2 kPa) and 8 in. w.c. (2 kPa) for LP.
7. Once the inlet gas pressure is verified, the outlet gas pressure (manifold gas pressure) must be checked, and adjusted, if necessary. The manifold gas pressure must be 3.0 in. w.c. (0.62 kPa) for natural gas and 9.0 in. w.c. (2.2 kPa) for LP.
8. Complete the setup by checking the CO<sub>2</sub> at the outlet of the unit. The CO<sub>2</sub> should be 8% for natural gas, or 9.2% for LP.

**9. After placing the appliance in operation, the Burner Safety Shutoff Device must be tested.**

To test:

- (a) Close gas shutoff valve with burner operating.
- (b) The flame will go out and blower will continue to run for the post purge cycle. Three attempts to light will follow. Ignition will not occur as the gas is off. The ignition control will lockout, and will have to be reset by cycling the power before the unit will operate.
- (c) Open gas shutoff valve. Restart the appliance. The ignition sequence will start again and the burner will start. The appliance will return to its previous mode of operation.

**6.6.2 High Altitude Adjustment and Set-Up**

High altitude adjustment must not be made on appliances operating at elevations below 2500 ft. (762 m).

No orifice changes are required to adjust the Mighty Stack appliances for high altitude. High altitude adjustment is accomplished by adjustment of the air shutter. A CO<sub>2</sub> or O<sub>2</sub> analyzer is required to make these adjustments.

Start the adjustment process by checking the CO<sub>2</sub> in the “as installed” condition. Adjust the air shutter(s) so that the CO<sub>2</sub> is about 8% or the O<sub>2</sub> is about 6.8% for appliances operating on natural gas. For appliances operating on LP Gas adjust the air shutter(s) so that the CO<sub>2</sub> is about 9.2% or the O<sub>2</sub> is about 6.8%.

If the appropriate CO<sub>2</sub> / O<sub>2</sub> levels cannot be achieved by adjusting the air shutter. Contact the Technical Services Department at number shown on back page.

The amount of derate will vary depending on heating value of the fuel and the elevation at the installation site.

**6.7 Shutting Down the Mighty Stack**

1. Switch off the main electrical disconnect switch.
2. Close all manual gas valves.
3. If freezing is anticipated, drain the Mighty Stack and be sure to also protect building piping from freezing.

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

**6.8 To Restart the Mighty Stack**

If drained, follow Section 6.1 in this manual for proper filling and purging.

1. Switch 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 pre-purge period and ignitor warm-up period, followed by ignition.

**⚠ 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, and contact your heating contractor, gas company, or factory representative.

**⚠ Attention**

Si vous sentez une odeur de gaz ou si le brûleur à gaz ne paraît pas fonctionner de manière normale, fermez la vanne d'isolement, ne fermez aucun interrupteur, et appelez votre entreprise de chauffage, la compagnie de gaz ou un représentant du fabricant.

## SECTION 7. Maintenance

### 7.1 System Maintenance

1. Lubricate the system water-circulating pump, if required, per the instructions on the pump.
2. If a strainer is employed in a pressure reducing valve or the piping, clean it every six months.
3. Inspect the venting system for obstruction or leakage at least once a year. Periodically clean the screens in the vent terminal and combustion air terminal (when used).
4. Keep the appliance area clear and free from combustible materials, gasoline, and other flammable vapors and liquids.
5. If the appliance is not going to be used for extended periods in locations where freezing normally occurs, it should be isolated from the system and completely drained of all water. All systems connected to it should also be drained or protected from freezing.
6. Low water cutoffs, if installed, should be checked every 6 months. Float type low water cutoff should be flushed periodically.
7. Inspect flue passages, and clean with brushes/vacuums, if necessary. Sooting in flue passages indicates improper combustion. Determine the cause and correct.
8. Inspect the vent system and air intake system, and if the vent system is Category III, ensure that all joints are sealed properly. If joints need to be resealed, follow venting manufacturer's instructions to clean and reseal vent system.

### 7.2 Appliance Maintenance and Component Description

Only genuine Laars replacement parts should be used.

#### **Caution**

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

#### **Attention**

Lors d'entretien ou de réparation des commandes, étiquetez tous les câbles avant de les déconnecter. Des erreurs de câblage peuvent provoquer des fonctionnements incorrects et dangereux. Après toute intervention d'entretien ou de réparation, vérifier que l'appareil fonctionne correctement.

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

a qualified service technician inspect the basic items listed below every year.

- a. Ignition control
- b. Ignitor
- c. Water temperature control
- d. Automatic gas valve
- e. Pressure switches and tubing
- f. Blower
- g. High limit
- h. Pump
- i. Relays
- j. Flow switch
- k. Gas train
- l. Control components

#### 7.2.1 Burners

Close main manual gas valve before proceeding. Checking the burners for debris - Remove the ignitor/burner access panel and ignitor, and inspect the burners through the ignitor hole using a flashlight to illuminate. If there is any indication of debris on the burners that is visible, all the burners will need to be inspected more thoroughly. Remove the gas manifold assemblies and the burner assemblies. Inspect the burners. Clean burners, if necessary, by blowing compressed air from the outside of the burners into the center of the burner. A dirty burner may be an indication of improper combustion or dirty combustion air. Determine the cause, and correct. Replace the burners in the reverse order.

#### 7.2.2 Filter

The filter used in the Mighty Stack is washable and has an 80% arrestance rating. Since the filter is washable, it will only need replacement occasionally. If filter replacement is needed, it should only be replaced with a factory part. Inspect the air filter monthly, or more often in dirty environments. If there is debris on the air filter, remove it from the filter frame, and wash it with mild soap and water. Ensure that the filter is completely dry before reinstalling.

#### 7.2.3 Gas Valve

The gas valve is designed to operate with supply pressures of 4-13 in. w.c. (1.0 to 3.2 kPa).

To remove a valve, shut off 120-volt power and the manual gas shutoff valve. Remove the front panels from the unit. Disconnect the wires to the valve. Disengage the unions before and after the valve, and remove the valve. Pull the pipe nipples from the inlet and outlet of the valve, and clean the threads on the pipe nipples for reuse. Apply new tape or pipe dope to the pipe nipples (threaded joints should be coated with piping compound resistant to action of liquefied petroleum gas), and reinstall in reverse order. Turn on manual gas shutoff valve and 120 volt power and check appliance operation and tightness of gas valve connections.

### 7.2.4 Manual Reset High Limit Control

The high limit switch is a manual reset, non-adjustable switch with a remote bulb-type sensor. Switches are set at 200°F (93°C). The control is located behind the front door, on a panel in front of the blower. The probe is in the outlet side of the header.

To reset the switch, unscrew the black cover that is over the reset button, and push the button. Replace the cover after the switch is reset.

To replace, shut off power to the appliance. Remove the cover that is over the button, and remove the nut that is around the button. Pull the control through the panel, and remove the spade terminals. Replace in reverse order.

### 7.2.5 Ignition Control

The ignition control controls the hot surface ignitor and proves that the flame signal is appropriate for powering the gas valves. It also controls the blower's pre-purge and post-purge.

To replace a control, shut off the 120-volt power to the appliance. Remove the cover from the control panel. Remove the electrical connectors from the ignition control. Take out the controller's mounting screws, and pull the controller out. Replace in reverse order.

### 7.2.6 Ignitor

The ignitor used is a 120v "Hot Surface" type. It is energized whenever there is a call for heat and switched off when ignition is established and the flame has been sensed. To replace the ignitor, shut off the 120-volt power to the appliance, remove the ignitor/burner access panel, disconnect the Molex connector, remove the two mounting screws on the ignitor flange, and pull the ignitor out. Install in reverse order, always using a new ignitor gasket with the replacement ignitor.

#### **Caution**

Ignitor gets hot. To avoid injury, handle the ignitor with caution.

#### **Attention**

Le dispositif d'allumage devient très chaud. Manipulez le dispositif d'allumage avec précaution.

### 7.2.7 Transformer

The Mighty Stack's transformer is not capable of supplying control voltage for external devices, which must have their own separate power supply. Should a transformer need replacing, shut off the 120-volt power. Unplug the transformer wires, remove the mounting screws and remove the transformer. Replace transformer in the reverse order.

### 7.2.8 Flow Switch

The Mighty Stack uses a paddle-type flow switch to ensure that the unit has water flow before ignition is allowed. To replace the flow switch, turn off the 120-volt power to the appliance. Isolate the water heater or water heater from the system by closing the isolation valves.

#### **Caution**

Water may be hot enough to scald. Allow water to cool before proceeding.

#### **Attention**

L'eau peut être chaude au point de vous brûler. Laissez refroidir l'eau avant d'intervenir.

Release pressure in the system by actuating the pressure relief valves or field supplied water heater drain valve. Remove cover from the flow switch and disconnect the wires. Unthread the flow switch from piping. Ensure the new flow switch paddles are trimmed to the same size as the original paddles, and reinstall in the reverse order. For water heater and other static pressure systems, restore the system pressure to the original setting, (or 10 psi minimum).

### 7.2.9 Heat Exchanger Coil

#### **WARNING**

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

#### **AVERTISSEMENT**

L'accumulation de suie sur un échangeur thermique sale peut s'enflammer au contact d'une étincelle ou d'une flamme et présenter un risque d'incendie ou d'explosion. Afin d'empêcher que cela se produise, humidifier les dépôts de suie à l'aide d'une brosse mouillée ou par une pulvérisation fine d'eau avant d'effectuer l'entretien de l'échangeur thermique.

The Mighty Stack has a premixed burner system. These systems provide the burners with sufficient air for complete combustion, and black carbon sooting is seldom experienced. If sooting is suspected, view ports for inspection of the heat exchanger are provided on the side of the water heater. In the unlikely event that there is a buildup of black carbon soot or other debris on the heat exchanger, clean per the following:

1. Disconnect the electrical supply to the unit.
2. Turn off the gas supply by closing the manual gas valve on the heater.
3. Disconnect and remove the wires, conduit and

sensors from all components that are attached to the inlet/outlet header.

4. Isolate the heat exchanger from the water supply.
5. Disconnect the header flanges from the inlet and outlet.
6. Allow the heat exchanger to drain. Remove the venting and remove the top, by removing the screws that attach the top to the side panels. Remove the side panels.
7. Remove the heat exchanger from the unit.  
**NOTE:** Heat exchangers are heavy and may require two people to remove to avoid personal injury.
8. Clean the heat exchanger: A light accumulation of soot or corrosion on the outside of the heat exchanger can be easily removed. Use a wire brush to remove loose soot and scale from the heat exchanger.
9. **NOTE:** While the heat exchanger is out of the unit, inspect the firewall refractory insulation. Replace if necessary.
10. Inspect the inside of the copper tubes for scale buildup. Scale can build up on the inner surface of the heat exchanger tubes, which can restrict water flow. If the tubes show signs of scaling, clean the internal surface.
11. Reassemble in the reverse order, and check appliance operation after start-up.

**NOTE: The warranty does not cover damage due to lack of maintenance, lack of water flow, inadequate water temperature, or improper operating practices outlined in this manual.**

## SECTION 8. Trouble Shooting

### 8.1 Resolving Lockouts

There are many causes of lockouts. The three most common causes are: (1) inadequate gas supply, (2) poor combustion, (3) ignitor failure.

1. Inadequate gas supply: Before proceeding, ensure that the gas supply has not been shutoff or the LP tank (LP water heaters) is not empty. Then, restart the water heater and observe the operational cycle. After a 15-second fan pre-purge, the ignitor will heat up for 40 seconds, and then the unit will light. If it does not, check the gas supply pressure to the appliance, after resetting the appliance and attempting another start-up. The gas pressure to the appliance must be above 5 in. w.c. (1.2 kPa) throughout the entire start-up cycle. If it is not, correct the supply problem (check gas valves or supply piping). If the supply pressure is adequate, consult the factory for assistance.
2. Poor Combustion: Poor combustion should be suspected if there is a strong flue gas odor. The odor may result from an improper gas/air ratio (high or low O<sub>2</sub> or CO<sub>2</sub>). Mighty Stack appliances operate best with 45% excess air (8% CO<sub>2</sub> on natural gas, 9.2% CO<sub>2</sub> on LP). Check the CO<sub>2</sub> of the appliance and adjust if necessary.
3. Ignitor failure: If the water heater goes through a normal start cycle but combustion does not occur, ignitor failure should be suspected. Check the ignitor by unplugging the ignitor plug and measuring the ignitor resistance. It should be 50-80 ohms. If the resistance is not 50-80 ohms, replace the ignitor. If the resistance is correct, reset the water heater and check for 120 VAC at the ignitor plug during the start cycle. If there is no voltage, replace the faulty ignitor wire harness or the ignition control.

### 8.2 Delayed Ignition — Possible Causes

A defective burner can cause a delayed ignition. If the gas supply pressure is proper and the gas valves are functioning properly, then burners should be inspected. There should be no distortion or perforations in the burners outside of the active burner port area. Replace if indicated.

### 8.3 High Gas Consumption

Appliances operating with an improper air/fuel ratio are very inefficient and consequently, have very high gas consumption. Because efficiency is high when the CO<sub>2</sub> is high (or O<sub>2</sub> is low), appliances operating with low CO<sub>2</sub> or high O<sub>2</sub> (especially LP appliances) consume more gas. Adjust the CO<sub>2</sub> or O<sub>2</sub> for optimum efficiency. If no combustion analyzing equipment (CO<sub>2</sub> or O<sub>2</sub>) is available then a proper adjustment of the air/fuel ratio (CO<sub>2</sub> or O<sub>2</sub>) cannot be accomplished. The CO<sub>2</sub> should be 8% at high fire for natural gas and 9.2% at high fire for LP. To check the CO<sub>2</sub>, first verify that the supply gas pressure is within 5 to 13 in. w.c. (1.2 to 3.2 kPa). With the Mighty Stack running with all stages firing, set the air box pressure to 1.8 in. w.c. (0.42 kPa) (as a starting point), by adjusting the air shutter(s) at the intake of the fan(s). Check the CO<sub>2</sub>, and adjust the air shutters if further adjustment to the CO<sub>2</sub> is needed.

Size	20°F		25°F		30°F		35°F	
	flow gpm	H/L feet	flow gpm	H/L feet	flow gpm	H/L feet	flow gpm	H/L feet
199	17	1.6	14	1.0	11	0.7	10	0.5
300	26	3.5	20	2.3	17	1.6	15	1.2
399	34	6.3	27	4.0	23	2.8	19	2.1
<i>Metric Equivalent</i>								
Size	11°C		14°C		17°C		19°C	
	flow lpm	H/L m	flow lpm	H/L m	flow lpm	H/L m	flow lpm	H/L m
199	64	0.5	51	0.3	43	0.2	37	0.2
300	97	1.1	77	0.7	64	0.5	55	0.4
399	129	1.9	103	1.2	86	0.9	74	0.6
<b>Notes:</b> gpm = gallons per minute, lpm = liters per minute, H/L = head loss, ft = head loss in feet, m = head loss in meters. Maximum temperature rise is 35°F (19°C), as shown. Head loss is for water heater's heat exchanger only. N/R = not recommended.								

**Table 8. Water Flow Requirements.**

For troubleshooting purposes, Table 8 gives preferred flow rates between the tank and heater. The heater is designed for between 20° and 30°F temperature rise.

## SECTION 9.

### Replacement Parts

Only genuine Laars replacement parts should be used.

#### 9.1 General Information

To order or purchase parts for the Laars Mighty Stack, 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).

#### 9.2 Parts List

Item	Description	Size 199	Size 300	Size 399
<b>COMBUSTION CHAMBER COMPONENTS See Figure 9</b>				
1	Assembly, Base	2C1000	3C1000	4C1000
2	Support, Tile Notch	2C2109	3C2019	4C2109
3	Chamber, Refractory, Heat Exchanger	T2108802	T2108803	T2108804
4	Assembly, Front Panel, Combustion Chamber	2C2023	3C2023	4C2023
5	Panel, Rear, Combustion Chamber	2C2006	3C2006	4C2006
6	Panel, Top, Combustion Chamber	2C2001	3C2001	4C2001
7	Chamber, Right Side, Bottom	2C2201	2C2201	2C2201
8	Chamber, Left Side, Bottom	2C2601	2C2601	2C2601
9	Chamber, Side, Top	2C2002	2C2002	2C2002
10	Panel, Right Side, Air Box	2C2016	2C2016	2C2016
11	Panel, Left Side, Air Box	2C2015	2C2015	2C2015
12	Weldment, Duct, Blower	2C2500	2C2500	2C2500
13	Panel, Top, Air Box	2C2008	3C2008	4C2008
14	Plate, Spacer, Burner/Manifold	2C2017	3C2017	4C2017
15	Panel, Front, Air Box	2C2009	3C2009	4C2009
16	Assembly, Exhaust Vent, 5" Dia.	2C2100	3C2100	4C2100
17	Weldment, Flue	2C2300	2C2300	2C2300
18	Assembly, Air Shutter, Blower	2C5000	2C5000	2C5000
20	Assembly, Filter Housing	40L3900	40L3900	40L3900
	Assembly, Removeable Filter	40L3800	40L3800	40L3800
	Media, Filter	R2073200	R2073200	R2073200
21	Hose, Duct, Flexible, 4" Dia. x 16.50"	P0101402	P0101403	P0101404
22	Blower/Motor	E0254000	E0254000	E0254000
23	Gasket, Blower (Fasco)	S2104400	S2104400	S2104400
25	Assembly, Sight Glass	10956000	10956000	10956000
26	Ignitor, Hot Surface	RW2002300	RW2002300	RW2002300
27	Gasket, Burner	S2104300	S2104300	S2104300
28	Burner, Main, (Pressure Port)	L0063301	L0063301	L0063301
29	Burner, Main	L0063300	L0063300	L0063300
30	Gasket, Blower Duct	S2104500	S2104500	S2104500
31	Kit, Insulation, Combustion Chamber	T2015808	T2015809	T2015810
32	Gasket, Flue Housing	S2104600	S2104600	S2104600
33	Assembly, Heat Exchanger, Copper	20L4230	30L4230	40L4230

Item	Description	Size 199	Size 300	Size 399
<b>JACKET COMPONENTS</b>		<i>See Figure 10</i>		
1	Assembly, Base/Support	20L1000	30L1000	40L1000
2	Weldment, Base, Upper Level	20L1200	30L1200	40L1200
3	Support, Corner (4 req'd)	40L2001	40L2001	40L2001
4	Support, Corner	40L2002	40L2002	40L2002
5	Support, Corner	40L2003	40L2003	40L2003
6	Air Inlet, Weldment	20L2510	20L2510	40L2520
7	Panel, Top/Bottom (2 req'd)	20L3002	30L3002	40L3002
8	Panel, Top/Bottom (2 req'd)	40L3003	40L3003	40L3003
9	Panel, Jacket	20L3007	30L3007	40L3007
10	Panel, Jacket	40L3008	40L3008	40L3008
11	Panel, Jacket	40L3009	40L3009	40L3009
12	Panel, Jacket	40L3010	40L3010	40L3010
13	Panel, Jacket	40L3011	40L3011	40L3011
14	Panel, Top	20L3013	30L3013	40L3013
15	Rear Panel	20L3015	30L3015	40L3015
16	Assembly, Front Panel, Jacket	20L3100	30L3100	40L3100
17	Assembly, Front Panel, Jacket	20L3101	30L3101	40L3101
18	Panel, Cover, Filter Inlet (2 req'd)	40L3701	40L3701	40L3701
19	Latch, Door, Assembly (18 req'd)	20087300	20087300	20087300
<b>HEAT EXCHANGER COMPONENTS</b>		<i>See Figure 11</i>		
1	Assembly, Tube, Heat Exchanger, Copper	R2C4100	R3C4100	R4C4100
	Assembly, Tube, Heat Exchanger, Cupro-Nickel	R2C4120	R3C4120	R4C4120
2	Header, Inlet/Outlet	2F4122	2F4122	2F4122
3	Header, Return	2C4103	2C4103	2C4103
4	Chamber, Header, Heat Exchanger (2 req'd)	2C4001	2C4001	2C4001
5	Baffle, End, Heat Exchanger Tube (2 req'd)	2C4002	2C4002	2C4002
6	Flange, Connection, 1-1/2" NPT (2 req'd)	S0076401	S0076401	S0076401
7	Gasket, Flange, 1-1/2" (2 req'd)	S0076500	S0076500	S0076500
8	Valve, Press. Relief, 3/4" NPT X 3/4" Npt, 125 psi	A0001200	A0001200	A0001200
9	Well, Immersion, Hi-Limit Temperature	E0234201	E0234201	E0234201
	Well, Immersion, 1/2" NPT w/Probe	E2058300	E2058300	E2058300
10	Gasket, 5/8" Tube, 7/32" Thick (20 req'd)	S0070800	S0070800	S0070800
<b>GAS TRAIN COMPONENTS</b>		<i>See Figure 12</i>		
1	Weldment, Gas Manifold, Main	L0063702	L0063703	L0063704
2	Manifold, Gas, On/Off	L0063414	L0063416	L0063418
3	Orifice, LP Gas, 1.35 mm (0.053" dia.)	L0063000	L0063000	L0063000
	Orifice, Nat. Gas, 2.30 mm (0.091" dia.)	L0062900	L0062900	L0062900
5	Gas Valve, Combination, LP, (D.S.I.), 3/4" NPT 3/4" NPT	V0079500	V0079500	V0079500
	Gas Valve, Combination, Nat., (D.S.I.), 3/4" NPT x 3/4" NPT	V0079400	V0079400	V0079400
6	Cover, Gas Inlet, Air Box	2C2018	2C2018	2C2018
7	Manual Gas Valve			

Item	Description	Size 199	Size 300	Size 399
<b>CONTROL PANEL COMPONENTS</b>		<i>See Figure 13</i>		
1	Switch, Pressure, Diaphragm, SPST	E0255500	E0255500	E0255500
2	Switch, Pressure, Diaphragm, SPDT	E0240900	E0240900	E0240900
3	Switch, Limit, High Temperature, Volume Water	E2324200	E2324200	E2324200
4	Transformer, 24, 120V, 50VAC	E0180500	E0180500	E0180500
5	Ignition Control, Hot Service Ignition	E0253400	E0253400	E0253400
6	SPDT Toggle Switch	E0109200	E0109200	E0109200
7	Tray, Control Panel	20L7002	30L7002	40L7002
8	Relay, Time Delay, 24 Vac, Delay On Break, Adjustable	E2077700	E2077700	E2077700
9	Ignition Control, HSI, Fenwal	E0253400	E0253400	E0253400
	Switch, Rocker, 10A, 250 VAC 1/2 HP, 15A, 125 VAC 1/2 Hp	E2322700	E2322700	E2322700
	Switch, Temperature, Manual Reset, 250°, SPST, Trip-Free	E2103200	—	—
10	DPDT Toggle Switch, 15 Amps, 3/4 HP	E2056300	E2056300	E2056300
11	Block, Terminal, Double Row, 16-Position	E2327500	E2327500	E2327500
12	Jumper, Terminal Block	E0102000	E0102000	E0102000
13	Label, Terminal, Control Contacts	H2339100	H2339100	H2339100
14	Harness, Main	E2337800	E2337800	E2337800
15	Harness, Wire, On/Off, Switch	E2337900	E2337900	E2337900
<b>PUMP ASSEMBLY COMPONENTS</b>		<i>See Figure 14</i>		
1	Circulator Pump Assembly	A2112200	A2112200	A2112200
	Alternate Soft Water Pump	A2112212	A2112212	A2112212
2	Union, 1-1/4" C x C	36-518	36-518	—
	Union, 1-1/2" Solder Joint, Copper/Brass Nut	—	—	P2020100
3	Adapter, Copper, C x M, 1-1/4" x 1-1/2" NPT	P2049500	P2049500	—
	(6)			
	Adapter, 1-1/2" Male NPT x 1-1/2" soc, Copper	—	—	P2019700
4	Water Flow Switch, Outdoor	E0013000	E0013000	E0013000
5	Tee, 1-1/4" soc x 1" soc x 1-1/4" soc, Copper	P2079700	P2079700	—
	Tee, 1-1/2" soc x 1" soc x 1-1/2" soc	—	—	P2079600
6	Adapter, Copper, 1-1/4" to 1" NPT	P2079800	P2079800	P2079800
7	Flow Switch Paddle	E2105400	E2105400	E2105400
8	Elbow, 1-1/2" NPT x 1-1/2" CU, Cast Brass	—	—	P2079300

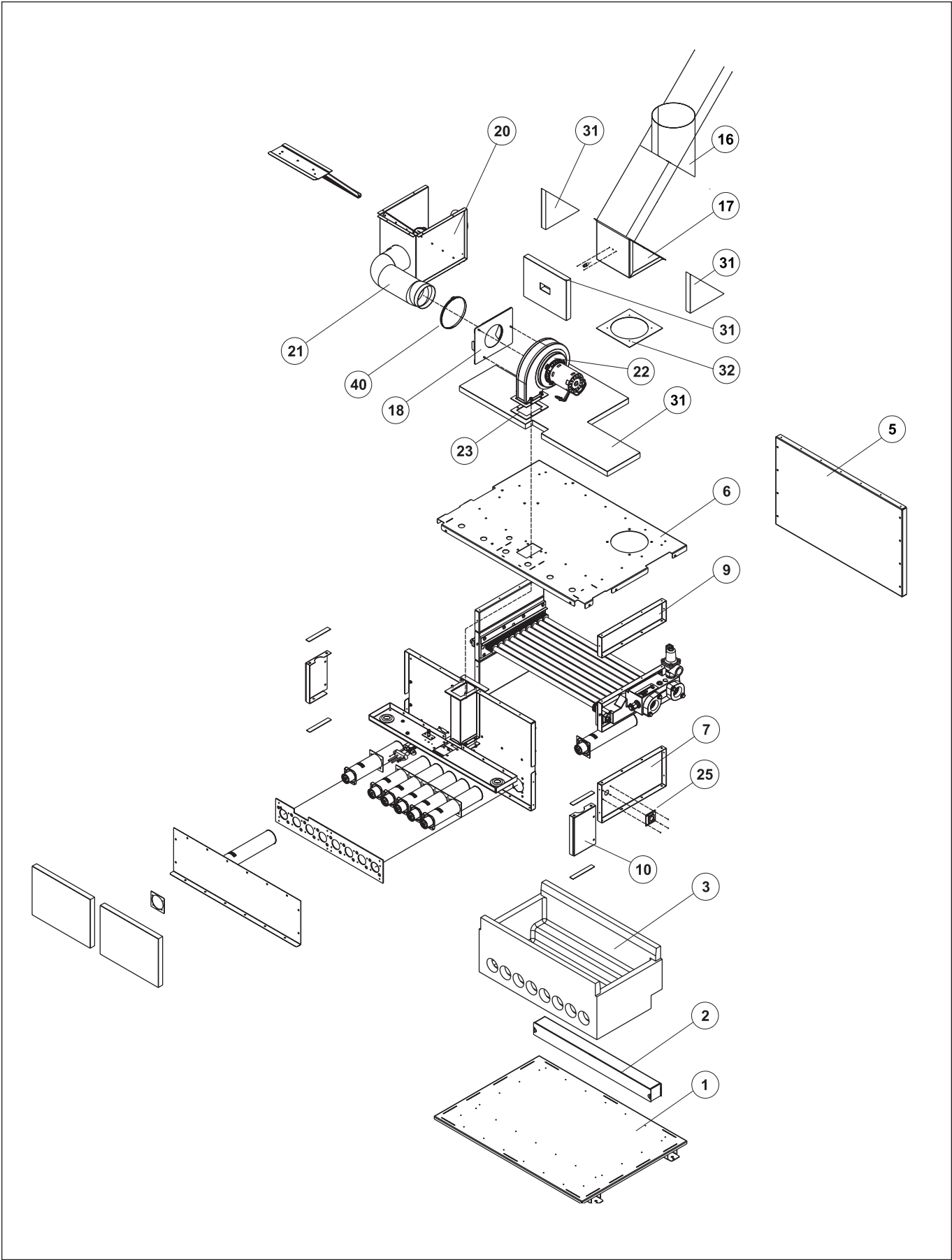


Figure 9. Combustion Chamber Components.

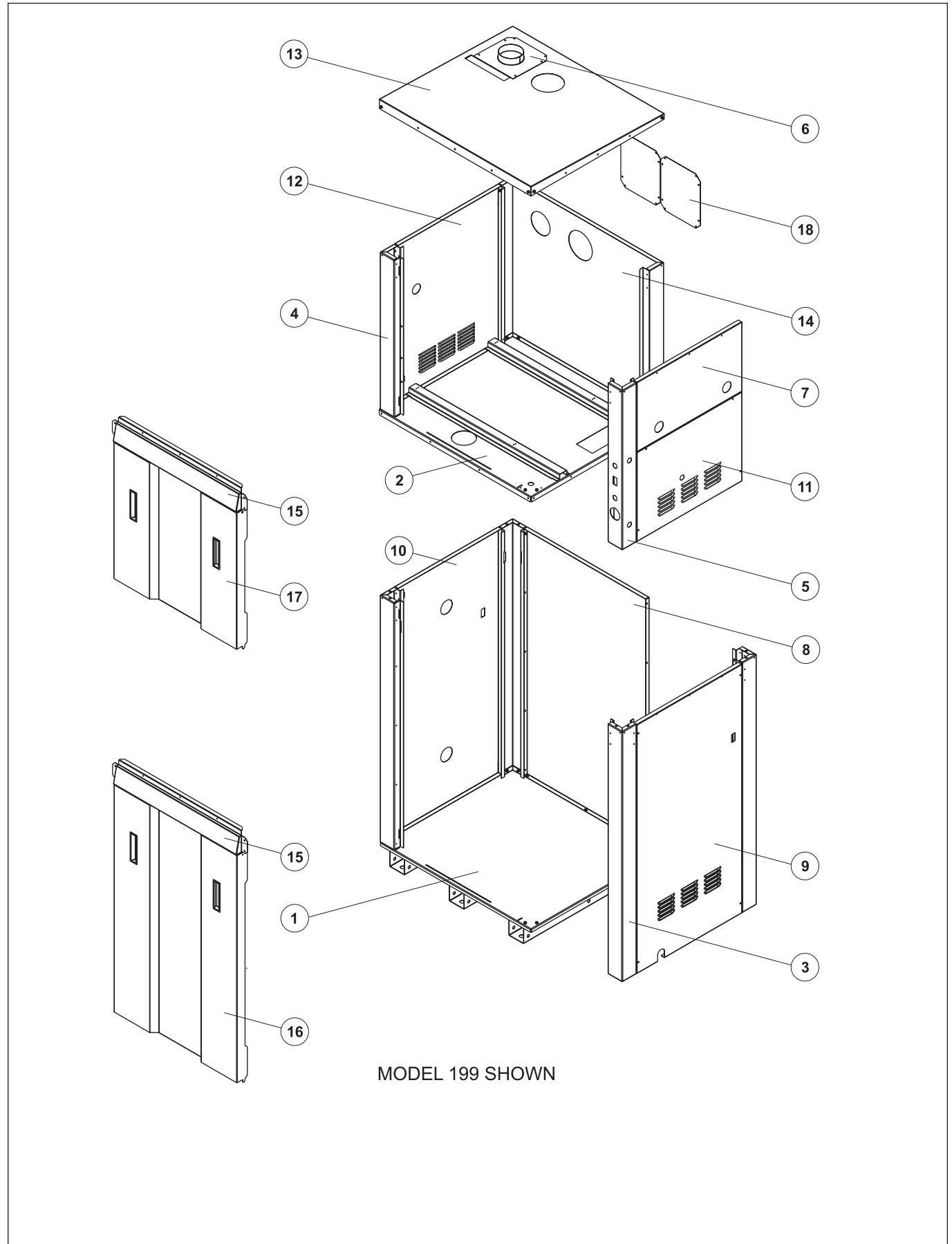


Figure 10. Jacket Components.

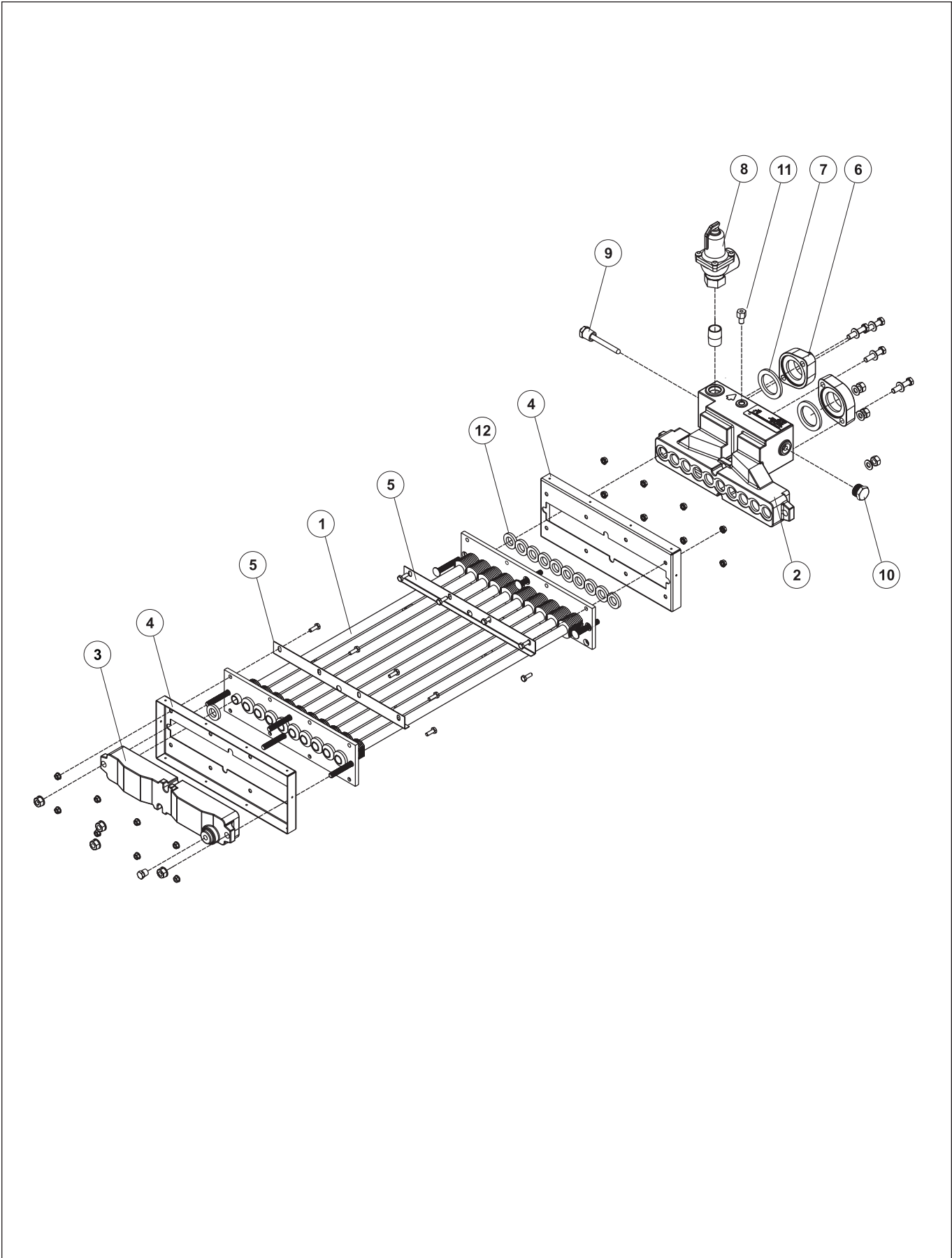


Figure 11. Heat Exchanger Components.

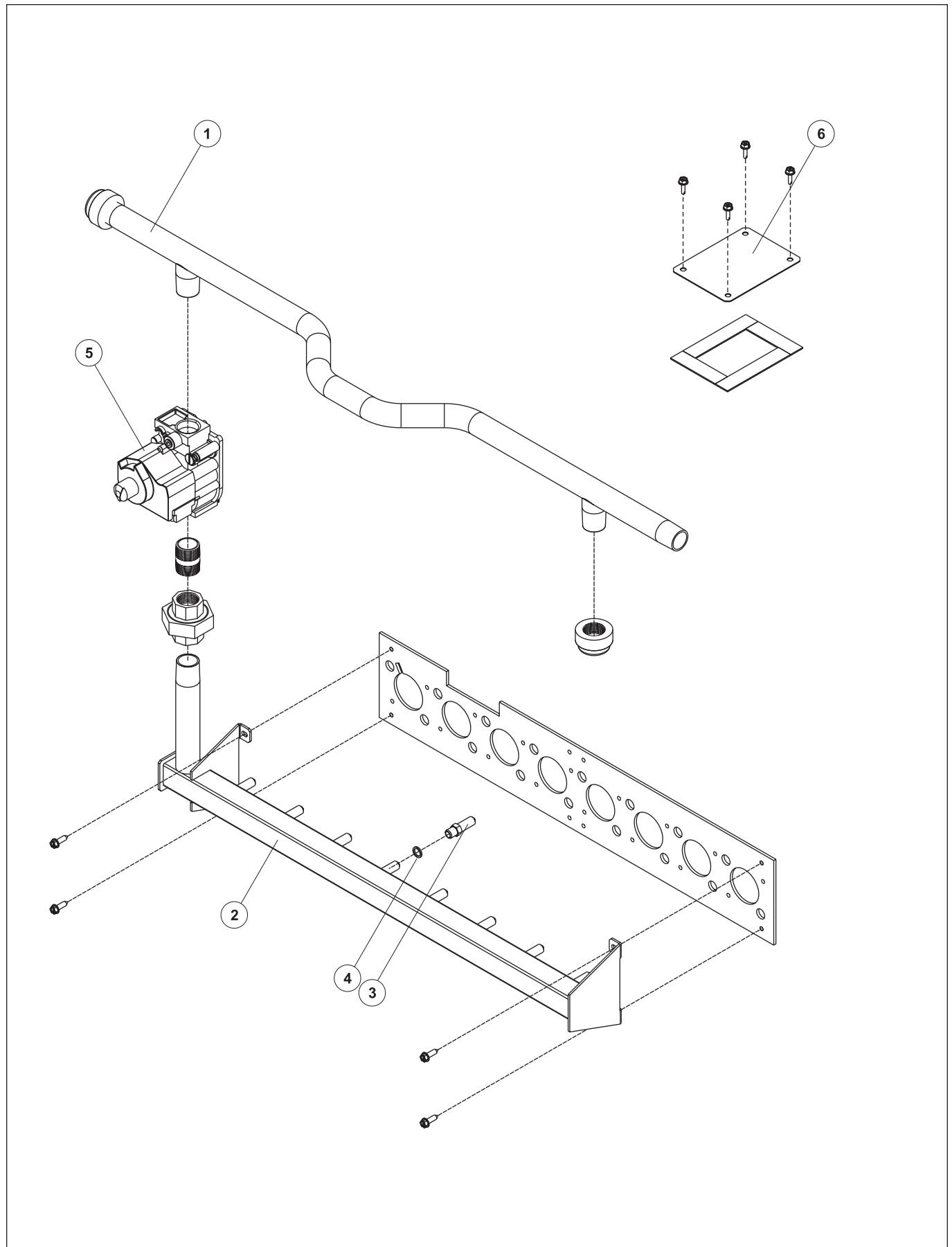


Figure 12. Gas Train Components.

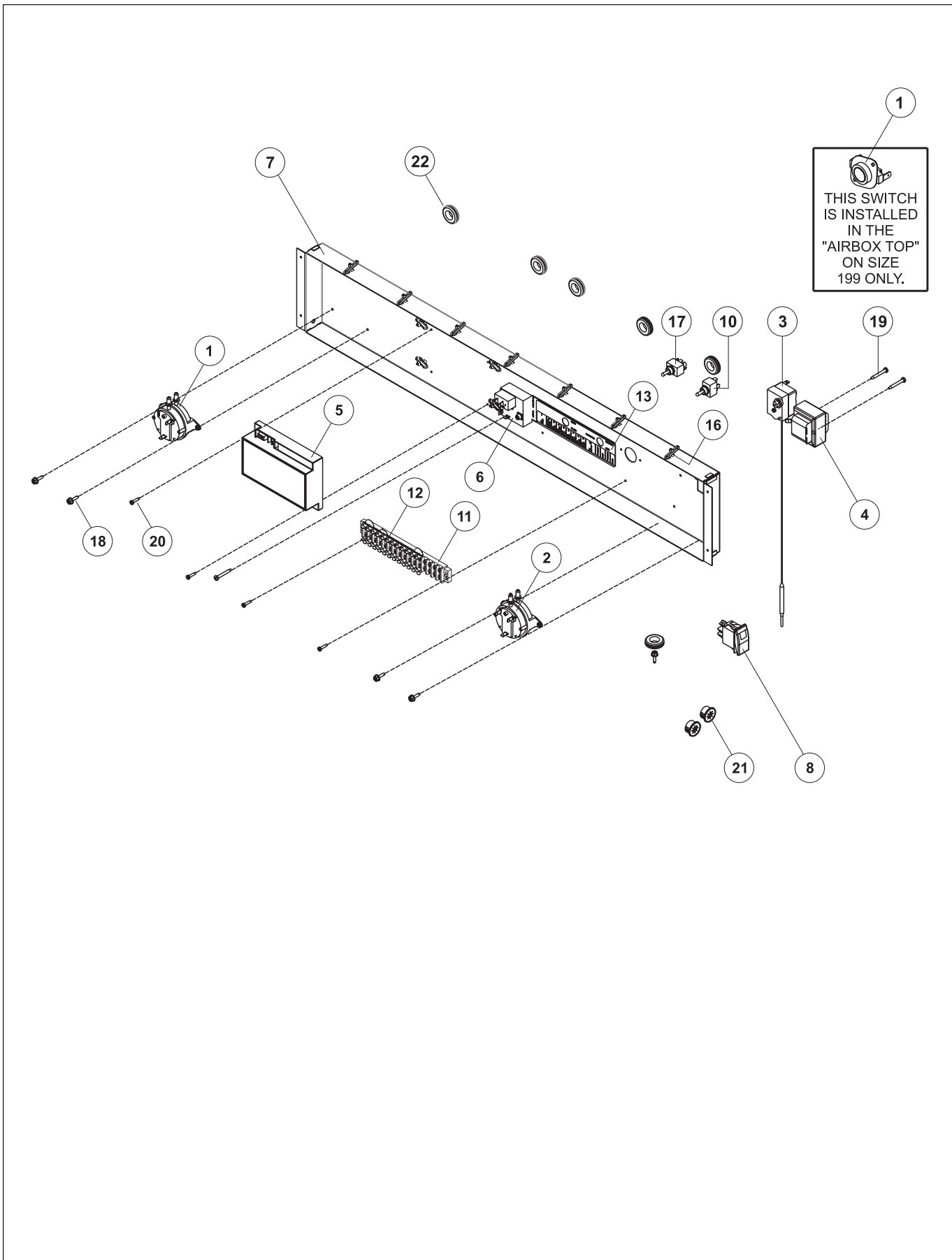


Figure 13. Control Panel Components.

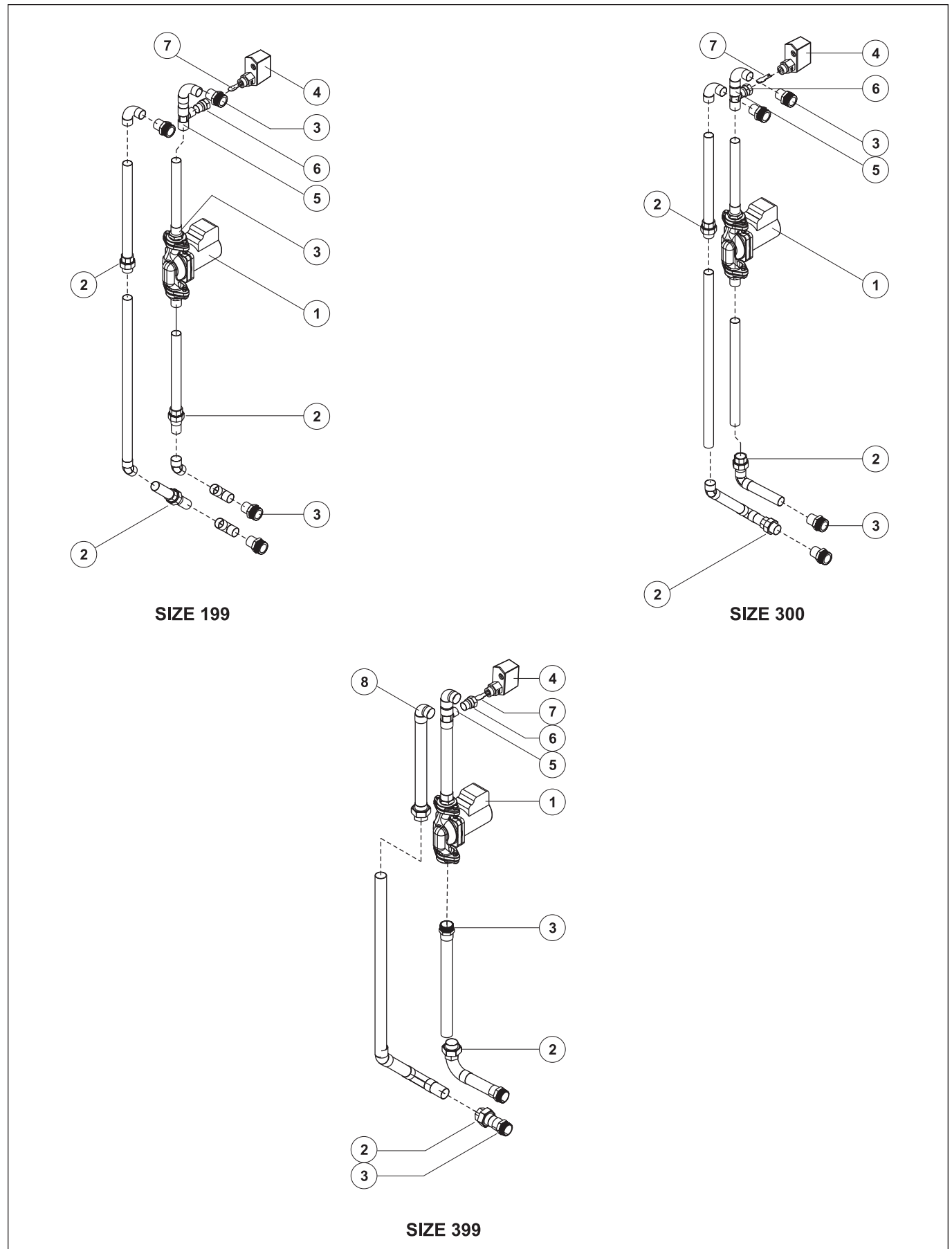
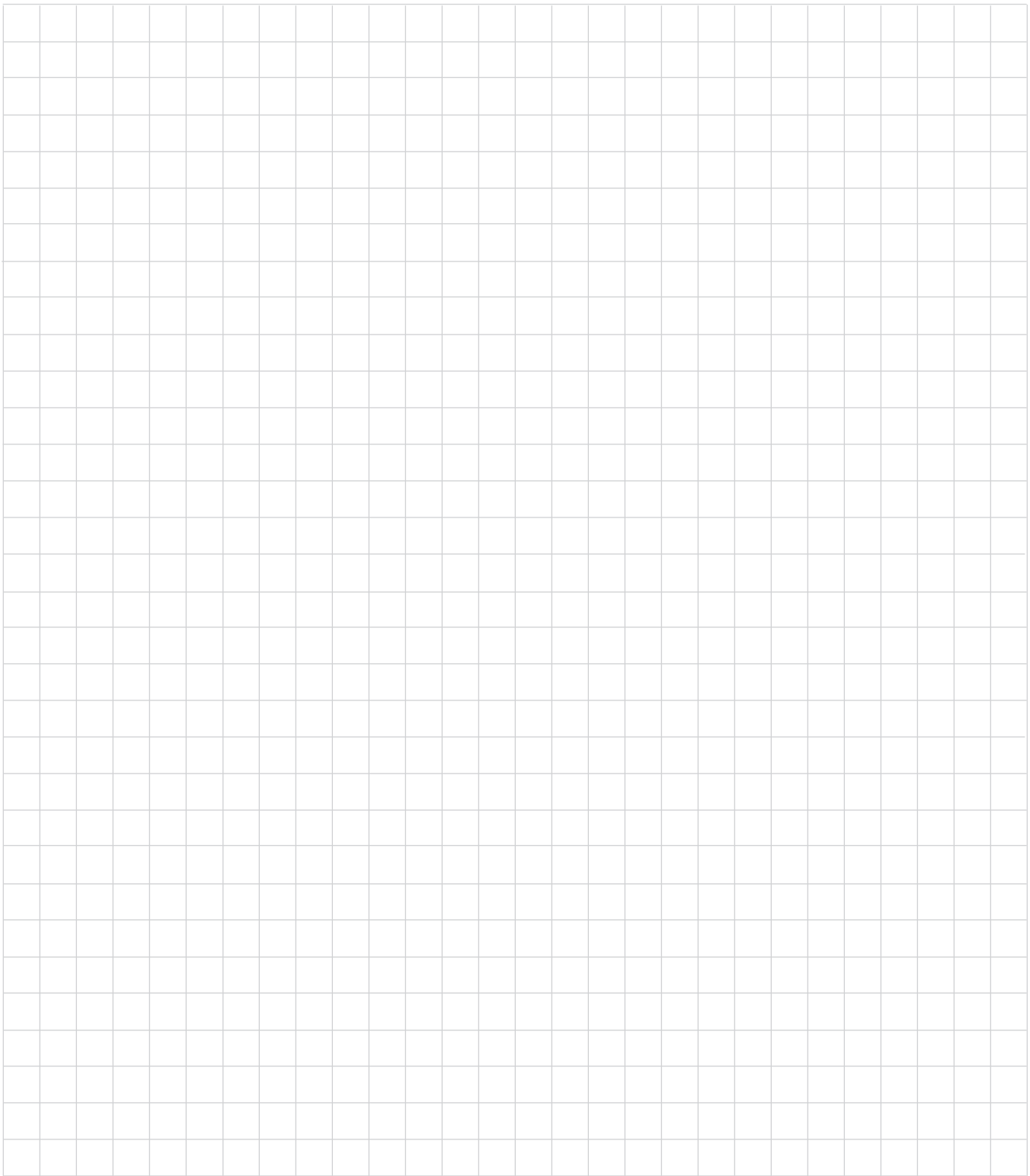


Figure 14. Pump Assembly Components.



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



H2350400-

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