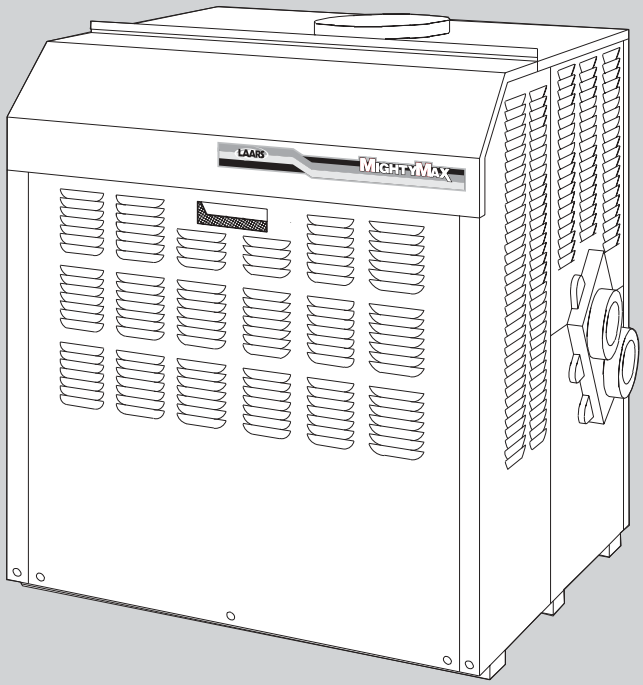
Installation, Operation and Maintenance Instructions for

Mighty Max

Volume Water Heaters

Model VW
Sizes 320M - 1000M



FOR YOUR SAFETY: This product must be installed and serviced by a professional service technician, qualified in hot 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.

⚠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.

LAARS HEATING SYSTEMS

H0192500C

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SECTION 1. General Information

1A. Introduction

This manual provides installation, operation, and maintenance instructions for the Mighty Max Volume Water Heater, Model VW, Sizes 320M, 400M, 520M, 625M, 775M, and 1000M. Review all application and installation procedures completely before proceeding with the installation. Consult the local factory representative or Laars factory with any questions regarding this equipment. Experience has shown that most operating problems are caused by improper installation. The VW heaters are offered in an indoor version and an outdoor version (see Figure 1). Table 1 lists the input/output ratings for each heater size.

The indoor version is convertible for outdoor use with the installation of a conversion kit (see Section 6, Parts List, for part number).

1B. Warranty

The Mighty Max VW heaters are sold with a limited factory warranty. Details are specified on the back cover of this manual.

Make all warranty claims to an authorized Laars representative or directly to the factory. Claims must include the heater serial number and model number (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. Inspect everything for damage immediately upon delivery, and advise the transporter of any shortages or damage. Any such claims should be filed with the transporter. The transporter will not accept a claim from the shipper, Laars.

The warranty does not cover damage caused by improper installation, operation, or field modification.

1C. Technical Assistance

Consult the local factory representative or Laars factory with any questions regarding the specification, installation, and operation of Laars equipment. An experienced technical support staff is ready to assist in assuring the proper performance and application of Laars products.

Heater Size	Input BTU/h	Input *kW*	Output BTU/h	Output *kW*
320M	320,000	*94*	272,000	*80*
400M	399,000	*117*	339,150	*99*
520M	520,000	*152*	442,000	*130*
625M	625,000	*183*	531,250	*156*
775M	775,000	*227*	658,750	*193*
1000M	1,000,000	*293*	850,000	*249*

Table 1. Input/Output Ratings.

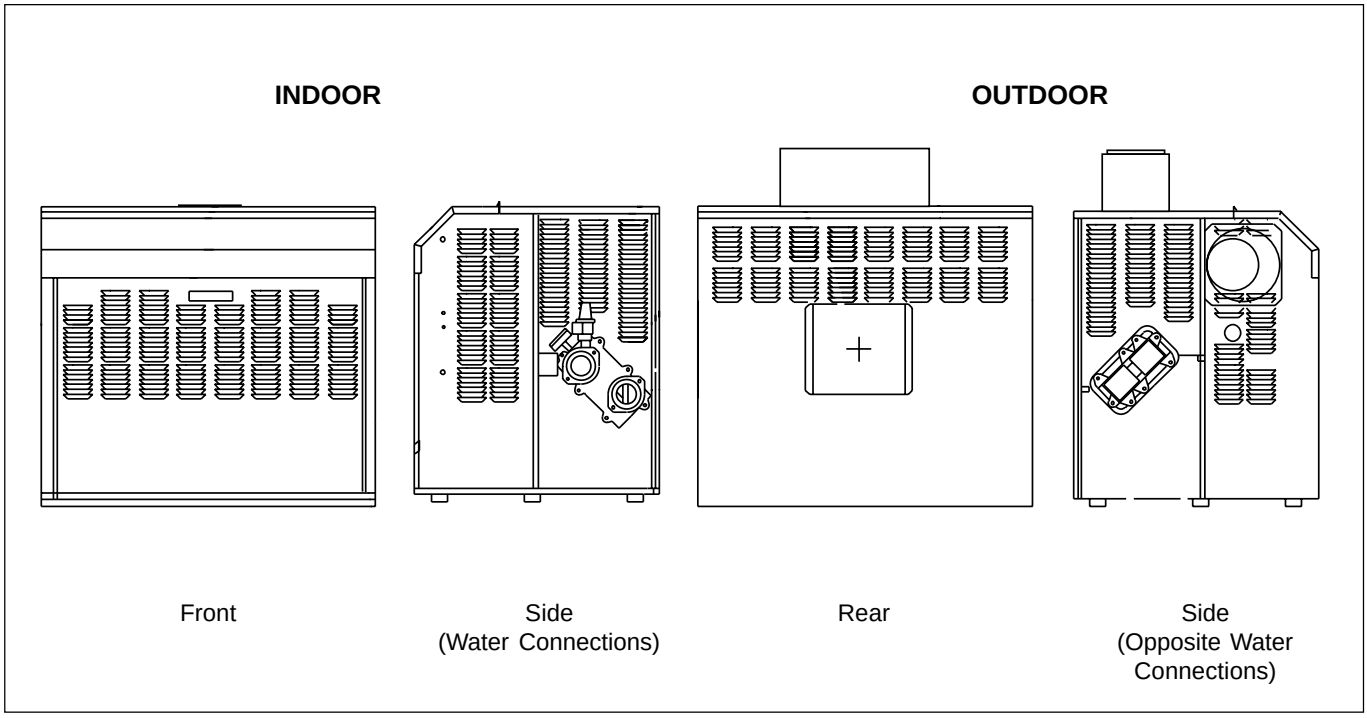


Figure 1. Mighty Max VW Heater Configuration.

SECTION 2.
Installation Instructions

2A. General Information

Install the Mighty Max VW heater in accordance with the procedures in this manual (or the Laars warranty may be voided), local codes, and ordinances. In the absence of such codes, install the heaters in accordance with the latest edition of the National Fuel Gas Code, ANSI Z223.1/National Fire Protection Association (NFPA) 54. In Canada, the installation must be in accordance with CAN1-B149.1 or .2 and local codes. The authority having jurisdiction may require the installation be in accordance with the American Society of Mechanical Engineers (ASME) Safety Codes for Controls and Safety Devices for Automatically Fired Heaters, CSD-1, and in Canada, Canadian Gas Association (CGA) 3.3. Any changes to the heater, its gas controls, gas orifices, or wiring may void the warranty. If field conditions require change, consult the factory.

The Mighty Max VW heater is designed-certified for installation on a combustible floor, if a non-combustible base is first placed under the heater. **Do not install the heater directly on carpeting** without placing a metal or wood panel between the carpeting and the heater. The metal or wood panel must extend beyond the full width and depth of the heater by at least 3 inches (76.2mm) in all directions. If the heater is installed in a carpeted alcove, the entire floor of the alcove must be covered by the metal or wood panel. The panel must be strong enough to carry the total weight of the heater and all piping, pumps, and any other equipment attached to the heater.

Clearance From Combustibles	Indoor Inches	*mm*	Outdoor Inches	*mm*
Top	18	*457*	Unobstructed	
Water Conn. Side	12	*305*	12	*305*
Opposite side	6	*152*	6	*152*
Front	Alcove		Unobstructed	
Rear	6	*152*	6	*152*
Vent	*6	*152*	—	
Flooring	Combustible		Combustible	
Service clearance = 24 inches (610mm) at front of heater. *1" (25mm) if double wall vent is used.				

Table 2. Minimum Heater Clearances From Combustible Surfaces.

2B. Heater Placement

Locate the heater to provide adequate clearances on all sides for maintenance and inspection. There must also be minimum distances maintained from combustible surfaces (see Table 2). The heater must be isolated or otherwise protected from any source of corrosive chemical fumes, such as trichlorethylene, perchlorethylene, chlorine, etc. Install the heater so that the gas ignition system components are protected from water (drippings, spraying, rain, etc.) during operation and service.

2C. Installation of Outdoor Heaters

⚠Caution
Outdoor installations are not recommended in areas where the danger of snow blockage exists.

1. Locate the heater to provide at least the minimum clearances as listed in Section 2B, “Heater Placement.” VW heaters require an outdoor terminal kit when installed outdoors (see Section 6, Parts List).
2. Do not locate the heater in an enclosure or through-wall recess. Avoid locations where wind deflection off structures might cause down-draft. When such wind conditions are possible, locate the heater at least 3 feet (.9m) from structures.
3. Never install the heater under any kind of roof overhang. Do not locate the heater below or adjacent to any doors, windows, louvers, grills, etc. which communicate in any way with an inhabited area of a building, even though such communication might be through another structure such as a garage or utility room (see Figure 2).

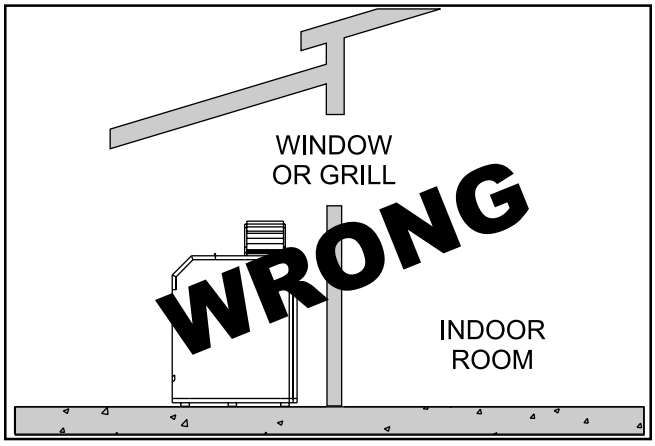
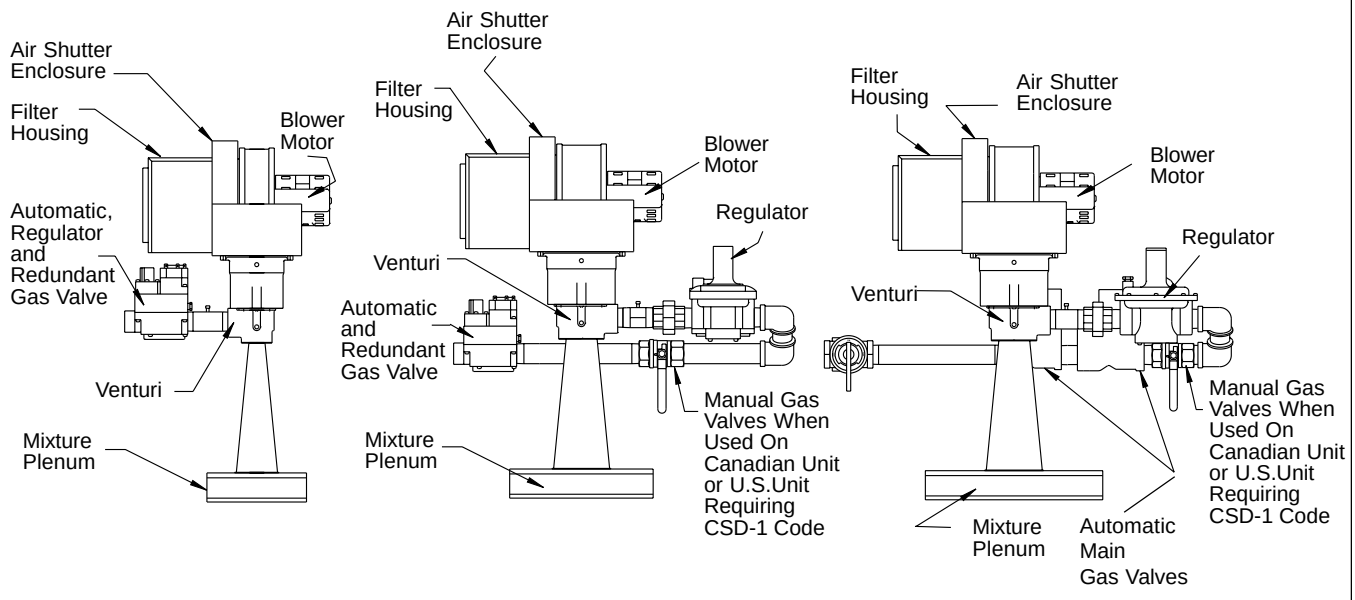


Figure 2. Incorrect Installation of Boiler.



NOTE: The above diagram is a representation, actual venturi assembly may vary depending upon heater size.

Figure 3. Heater Gas Valve Arrangement.

	Distance from Gas Meter or Last Stage Regulator											
	0-100 feet *0-30m*				100-200 feet *30-60m*				200-300 feet *60-90m*			
	Natural		Propane		Natural		Propane		Natural		Propane	
Size	**in.**	***mm***	**in.**	***mm***	**in.**	***mm***	**in.**	***mm***	**in.**	***mm***	**in.**	***mm***
320M	**1.25**	***32***	**1.25**	***32***	**1.50**	***38***	**1.25**	***32***	**1.50**	***38***	**1.50**	***38***
400M	**1.25**	***32***	**1.25**	***32***	**1.50**	***38***	**1.25**	***32***	**2.00**	***51***	**1.50**	***38***
520M	**1.50**	***38***	**1.25**	***32***	**2.00**	***51***	**1.50**	***38***	**2.00**	***51***	**1.50**	***38***
625M	**1.50**	***38***	**1.25**	***32***	**2.00**	***51***	**1.50**	***38***	**2.00**	***51***	**2.00**	***51***
775M	**2.00**	***51***	**1.50**	***38***	**2.00**	***51***	**1.50**	***38***	**2.50**	***64***	**2.00**	***51***
1000M	**2.00**	***51***	**1.50**	***38***	**2.50**	***64***	**2.00**	***51***	**3.00**	***76***	**2.50**	***64***

Notes:
1. These numbers are based on 1/2 inch (13mm) 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 3. Natural Gas and Propane, Pipe Size Requirements.

2D. Freeze Protection

Although Mighty Max VW heaters are design-certified by International Approval Services (IAS) (formerly AGA CGA) for outdoor installations, such installations are not recommended in areas subject to freezing temperatures unless proper precautions are taken. Consult the local factory representative or Laars for additional information.

2E. Installation of Indoor Water Heaters

Combustion Air Supply and Ventilation:

There are a variety of options available to the installer when it comes to venting and combustion air; venting can be vertical or horizontal, it can originate at the top of the heater or the back, and combustion air can be obtained from the room where the heater is installed or ducted directly to the heater from outdoors (see Sections 2H through 2K for details).

2F. Gas Supply and Piping

Review the following instructions before continuing the installation.

1. Gas piping installation must be in accordance with the latest edition of ANSI Z223.1/NFPA 54. In Canada, the installation must be in accordance with CAN1-B149.1 or .2 and all local codes that apply (see Figure 3 for heater gas valve arrangement).

2. Check the rating plate to make sure the heater is fitted for the type of gas being used. Laars heaters are normally equipped to operate below a 2000 foot (610m) altitude. Heaters equipped to operate at high altitudes have appropriate stickers or tags attached.

3. The figures in Table 3 should be used to size the gas piping from the gas meter to the heater. Check local codes for BTU/h capacity required.

4. Install a sediment trap (drip leg) ahead of the gas controls (see Figure 4). Fit the trap with a threaded cap which can be removed for cleaning.

5. When required by code, install a second manual gas shutoff valve. Do not remove manual shutoff valve supplied with the heater.

6. Disconnect the heater and its individual shutoff valve from the gas supply piping system during pressure testing of the system at pressures higher than 1/2 psi (3.5 kPa). Isolate the heater from the gas supply piping system by closing its individual manual gas shutoff valve during any pressure testing of the gas supply piping system at test pressures equal to or less than 1/2 psi (3.5 kPa).

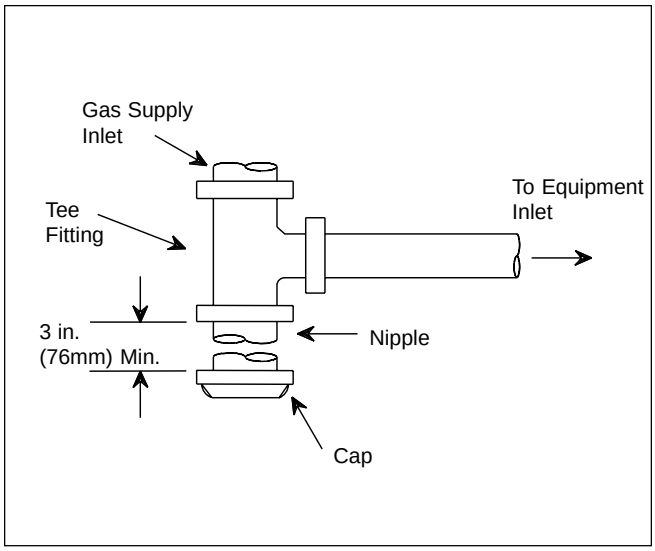


Figure 4. T-Fitting Sediment Trap Installation.

7. Gas supply pressures to the heater are listed in Table 4.

NOTE: The heater and all other gas appliances sharing the heater gas supply line must be firing at maximum capacity to properly measure the inlet supply pressure. Low gas pressure could be an indication of an undersize gas meter and/or obstructed gas supply line.

Supply Pressure Water Column	Natural Gas		Propane Gas	
	in.	*mm*	in.	*mm*
Minimum	5	*127*	9	*229*
Maximum	9	*229*	14	*356*

Table 4. Gas Supply Pressure Requirements.

8. Do not exceed the maximum inlet gas pressures specified. Excessive pressure will result in damage to the heater's gas controls. The minimum pressures specified are for gas input adjustment.
9. The correct differential gas pressure is stamped on the rating plate. The regulator is preset at the factory, but may need adjustment for altitude per Section 3.
10. Before operating the heater, test the complete gas supply system and all connections for leaks using a soap solution.

⚠ Caution

Since some leak test solutions (including soap and water) may cause corrosion or stress cracking, rinse the piping with water after testing.

2G. Water System Piping

2G-1. Water Chemistry

Laars equipment is designed to be used in a variety of water conditions. The water velocity in the heat exchanger tubes is kept high enough to prevent scaling from hard water, yet low enough to avoid erosion by soft water. The water in 95 percent of the urban centers in the United States is compatible with this equipment, but in some areas a water supply will contain a large quantity of scaling chemicals or the water may be extremely soft or erosive. In rare situations the water will contain both scaling chemicals and erosive chemicals such as calcium or sodium chloride. These conditions may be caused by well water or a nearby pumping station, and the particular condition may not be characteristic of the entire city water system.

NOTE: It is possible to have hard and soft water in the same city. Check with the local water company.

If an installer sees damage to any water handling equipment at the installation site, it should be repaired as soon as possible to help reduce maintenance costs. If there is erosion, resize the pump to reduce water velocity before the tube ruptures. If scaling is bad, set up a heat exchanger tube-cleaning maintenance schedule to prevent heat exchanger tube cracking and wear. Not fixing the condition may cause serious damage to the heater and the water system.

Scaling is a layer on the inner surface of the heat exchanger tubes which restricts the flow of water. Scale can be any color or texture, smooth or rough, granular or amorphous. Erosion is usually identified by pitting, cavitation, ridges and “islands” on the inner surfaces of the heat exchanger tubes. If this is caused by extremely soft water, or a water softener in the system, the internal copper surfaces will be very shiny. Other chemicals, such as chlorine or chlorides in the water, will cause dark patches of erosion.

NOTE: Laars does not warrant heat exchangers damaged by scaling, corrosion, or erosion.

2G-2. Water Piping

VW heaters are intended for heating large volumes of water at constant flow rates, usually for storage in a tank. Heaters in this type of application are sometimes called circulating water heaters.

Figure 5 shows the VW heater with tank and two pumps. One pump (recirculation) only circulates the hot water through the building plumbing. The other pump (heater) circulates water between the tank and the heater. This heater circulating pump is essential for proper operation of the heater (see Section 2G-5).

The heater circulating pump must be sized to provide enough flow to prevent damage to the heat exchanger, and must handle the hardness or softness of the water being heated. Generally, hard water must be pumped at higher velocity; however, soft water will erode holes in the heat exchanger tubing if pumped too fast.

The Mighty Max VW heater comes standard with copper tubes, but in areas where the water supply is soft or corrosive, the heat exchanger should be factory ordered with cupronickel tubes. Consult the local factory representative or Laars factory for additional information.

2G-3. Pressure Buildup in Water System

The water utility supply meter may contain a check valve, back flow preventer, or water pressure reducing valve. This will create a closed water supply system. Contact the water supplier or local plumbing inspector on how to control this situation.

During the heating cycle of the heater, the water expands creating a pressure buildup in the water system. The pressure and temperature relief valve may discharge hot water under these conditions, causing a loss/waste of energy and a buildup of lime on the relief valve seat.

NOTE: Do not plug the relief valve.

There are two methods to prevent the water heater pressure relief valve from discharging hot water in a closed water system:

1. Install a pressure relief valve on the cold water supply line. Make sure that the discharge of this valve is directed to an open drain and protected from freezing.
2. Install a properly sized thermal expansion tank on the cold water supply line.

2G-4. Temperature and Pressure Relief Valve

For protection against excessive pressure, the water heater is equipped with a pressure relief valve.

When the water heater is connected to a separate storage vessel, a temperature and pressure relief valve must be installed on the storage vessel. The temperature and pressure relief valve must be design-certified by a nationally recognized testing laboratory that maintains periodic inspection of listed equipment or materials, in accordance with the requirements for Relief Valves and Automatic Gas Shutoff Devices for Hot Water Supply Systems, ANSI Z21.22. (in Canada, in accordance with the requirements for the Standard for Temperature and Pressure Relief Valves and Vacuum Relief Valves, CAN1-4.4).

The temperature and pressure relief valve must have a BTU/h (kW) capacity rating that is greater than the BTU/h (kW) input of the water heater. The temperature and pressure relief valve must be marked with a maximum working pressure not to exceed the

maximum working pressure shown on the rating plate of the water heater, or the maximum working pressure of the separate storage vessel, whichever is the lower pressure. The temperature and pressure relief valve must have a *maximum* working temperature not to exceed 210°F (99°C).

Do not place any shutoff valves between the temperature and pressure relief valve and the storage vessel.

The relief valves discharge water in large quantities should circumstances demand.

The discharge pipe:

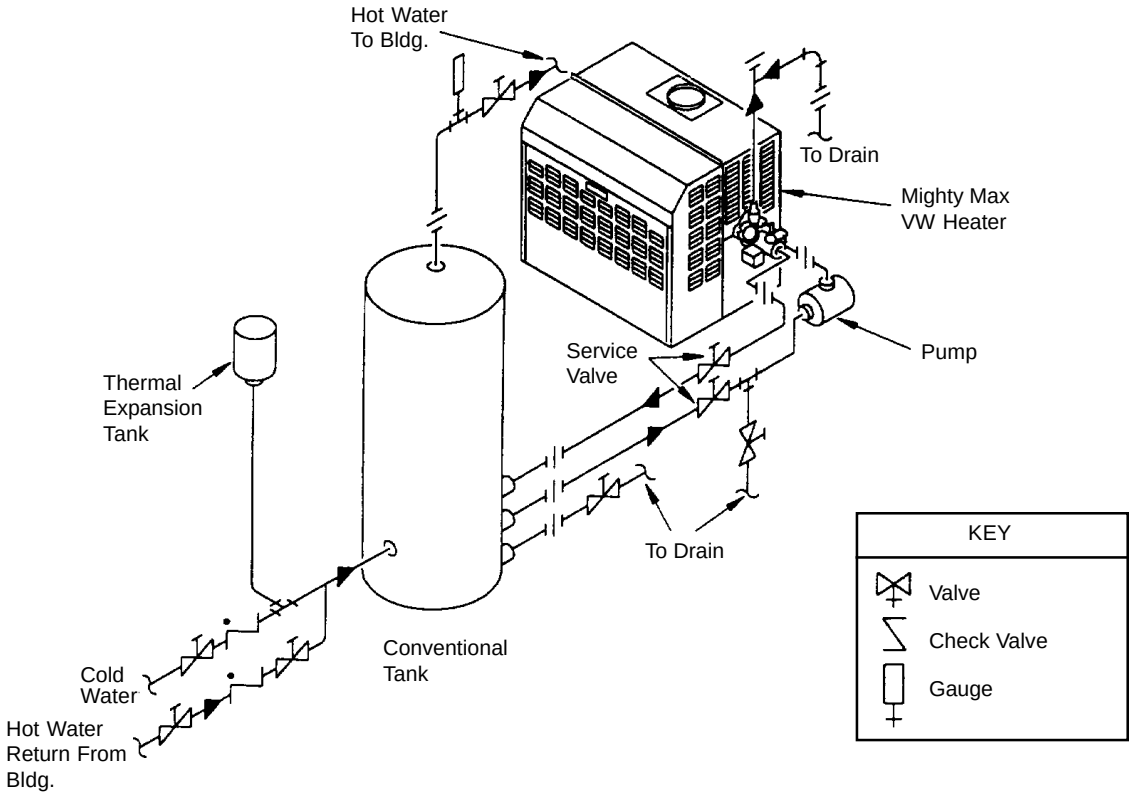
1. Must not be connected directly to a drain. The Discharge pipe must terminate 6 inches (152mm) above a floor drain or external to the building. If the discharge pipe is not directed to a drain or other suitable means, the water flow may cause property damage.
2. Must not be smaller than the pipe size of the relief valve.
3. Must be of material capable of withstanding 210°F (99°C) without distortion.
4. Must be installed to allow complete drainage of both the relief valve and discharge pipe.
5. Must not have any valve between the relief valve and the end of the discharge pipe.

Do not thread, cap, plug, or block the end of the discharge pipe. Do not install a reducing coupling or other restrictions in the discharge pipe.

⚠WARNING

Hot water can scald! Hot water can produce third degree burns in 6 seconds at 140°F (60°C) and in 30 seconds at 130°F (54°C).

Manually operate the relief valves at least once a year. To prevent water damage, discharge pipe must terminate at an adequate drain. Standing clear of the outlet (discharge water may be hot), lift and release the lever handle on the relief valve to make the valve operate freely.



NOTE: Intermittent pump must be used with EM_2 and remote temperature control.

Figure 5. Water Piping Diagram.

2G-5. Pump Requirements

Table 5 specifies water flow rates for the Mighty Max VW heaters, and the pumping head required for typical piping configurations. Table 5 allows for 30 feet (9.1m) of piping and typical fittings (see Figure 5). Piping with a shorter length or larger diameter may reduce the head requirement and pump power consumption. Contact a Laars representative for assistance.

The correct flow rate can be verified by checking the temperature rise of water as it passes through the heater. To check the temperature rise, measure the difference in water temperature between the heater inlet and outlet to determine flow. For example: If a Size 320M VW heater is installed and normal water is used; the inlet water temperature is 160°F (71°C); the outlet water temperature is 171°F (77°C). Then there is a 11°F (6°C) degree temperature rise. Per Table 3, this is essentially correct for normal water. If a higher temperature rise is measured, flow must be increased by changing the piping or pump.

2G-6. Combined Space Heating/Potable Water Heating Systems

When using the Mighty Max VW heater as a source of heat for a combined space heating/potable water heating system, be sure to follow the instructions of the space heating system.

Do not use water piping, fittings, valves, pumps, and any other components which are not compatible with potable water.

Do not connect the heater, which will be used to supply potable water, to any heating system or components previously used with a nonpotable water heating system.

Do not add boiler treatment or any chemicals to the heating system piping, since the piping contains water for potable use.

Do not use solder containing lead in the potable water lines.

If the space heating system requires water temperatures greater than the water temperature for potable hot water use, a tempering valve (see Figure 6) or other means should be installed in the potable hot water supply line to limit the risk of scald injury.

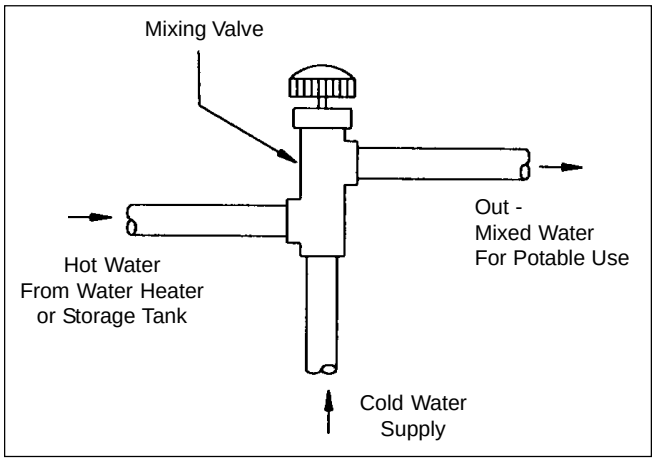


Figure 6. Installation of Tempering Valve.

Model	Pipe Size		Soft or Normal Water						Hard Water					
			Flow		Headloss		Temp, Rise		Flow		Headloss		Temp. Rise	
	in.	*mm*	gpm	*L/m*	ft.	*m*	°F	*°C*	gpm	*L/m*	ft.	*m*	°F	*°C*
0320M	1.5	*38*	51	*193*	25.9	*8*	10.5	*6*	68	*257*	46.0	*14*	7.9	*4*
	2.0	*51*	51	*193*	13.9	*4*	10.5	*6*	68	*257*	24.7	*8*	7.9	*4*
0400M	1.5	*38*	51	*193*	26.0	*8*	13.1	*7*	68	*257*	46.3	*14*	9.8	*5*
	2.0	*51*	51	*193*	14.1	*4*	13.1	*7*	68	*257*	25.0	*8*	9.8	*5*
0520M	2.0	*51*	85	*322*	22.4	*7*	10.2	*6*	114	*431*	39.5	*12*	7.7	*4*
	2.5	*64*	85	*322*	14.0	*4*	10.2	*6*	114	*431*	24.9	*8*	7.7	*4*
0625M	2.0	*51*	85	*322*	22.4	*7*	12.3	*7*	114	*431*	39.8	*12*	9.2	*5*
	2.5	*64*	85	*322*	14.2	*4*	12.3	*7*	114	*431*	25.2	*8*	9.2	*5*
0775M	2.0	*51*	85	*322*	22.6	*7*	15.2	*8*	114	*431*	40.2	*12*	11.4	*6*
	2.5	*64*	85	*322*	14.4	*4*	15.2	*8*	114	*431*	25.6	*8*	11.4	*6*
1000M	2.5	*64*	85	*322*	14.6	*4*	20.0	*11*	114	*431*	26.1	*8*	14.9	*8*
	3.0	*76*	85	*322*	11.3	*3*	20.0	*11*	114	*431*	18.8	*6*	14.9	*8*

Note: 1. Pressure dop includes allowance for 30 feet 9.1m of piping and normal fittings. If piping is shorter or of larger diameter, pump power may be reduced substantially. Contact Laars Representative for assistance.

2. Heaters for soft water application should be equipped with cupronickel heat exchangers.
   Soft Water: 0 to 7.5 Grains/gallon
   Normal Water: 7.5 to 17 Grains/gallon
   Hard Water: More than 17 Grains/gallon

Table 5. Pump Requirements for Mighty Max VW Heaters.

Some jurisdictions may require a backflow preventer in the cold water line. In such cases, the temperature and pressure relief valve may discharge water due to expansion. An expansion tank approved for potable water will eliminate this condition. Follow the manufacturer's instructions for installation of the expansion tank.

2H. Venting and Combustion Air Information

Provisions for venting and supply of air for venting and combustion must be done in accordance with these instructions and applicable requirements of the latest edition of ANSI Z223.1/NFPA 54. In Canada, installation must be in accordance with CAN/CGA B149.1 or .2, and applicable local codes.

There are a variety of ways to provide venting and combustion air for the VW heater (see Figure 7).

The Mighty Max VW heater is certified as a true direct vent unit when installed according to the instructions for horizontal venting and ducted combustion air. This can be done even if the runs are vertical.

2I. Top-to-Rear Vent Collar Conversion

The Mighty Max VW heater is shipped with the vent collar on top of the heater. Follow this procedure to convert it for rear connection (see Figure 8).

1. Remove the adapter plate from the top panel.
2. On the heater jacket, remove the top panel and ease its lip from under the edge of the bonnet to gain access to the flue collector.
3. Remove the vent collar/stack from the flue collector. Do not damage the vent collar/stack during removal.
4. Remove the blank plate from the rear of the heater jacket.
5. Remove the blank plate from the rear section of the flue collector. Be careful not to lose the insulation attached to the plate.

Term	Description
Pipe	Type 304, Type 316, or 29-4C stainless steel, 24 gauge minimum
Joint Sealing	3M Type 433 sealing tape with 400°F (204°C) rating or high temperature silicone sealer with 500°F (260°C) rating, Dow No. 736
Insulation	R5 minimum with protective cover

Table 6. Required Horizontal Venting Material.

6. Apply high temperature sealant and install the blank plate (previously removed from the rear section of the flue collector) on top of the flue collector.
7. Install the blank plate (previously removed from the rear of the boiler jacket) over the stack opening on the top panel of the boiler.
8. Apply high temperature sealant (see Table 6) to vent/collar stack and install on the rear of the flue collector.
9. Slip the adapter plate over the vent collar/stack and install it onto the rear heater jacket (see Figure 8).

2J. Venting

Venting must be in accordance with these instructions and applicable requirements of the latest edition of ANSI Z223.1/NFPA 54. In Canada, installation must be in accordance with the latest edition of CAN/CGA B149.1 or .2, and applicable local codes.

2J-1. Vertical Venting - Category I

The Mighty Max VW heater has a “fan-assisted” combustion system, so vertical vents must be installed in accordance with the special code requirements for Category I - Fan-Assisted Appliances. These requirements can be found in the latest edition of ANSI Z223.1/NFPA 54, Appendix G, Table 1, and in Canada, CAN/CGA B149.1 or .2, Amendment No. 1. These codes permit installation as a single appliance or in combination with other Category I appliances. However, there are very important requirements for minimum and maximum vent diameter and length. Make sure vertically-vented installations comply with these codes.

NOTE: If a vent cannot be installed in accordance with the requirements of these codes, it must be installed as a horizontal vent, even if it is mainly vertical.

2J-2. Vertical Venting - Non-Category I

When venting does not meet the code requirements for Category I - Fan-Assisted Vertical Vents, it can develop positive pressure. Such venting must be installed in accordance with this section or Section 2J-3.

The following requirements must be used for Non-Category I venting:

1. Laars specified vent pipe material (Table 6) and sizes (Table 7).
2. Pipe insulation and sealing tape.

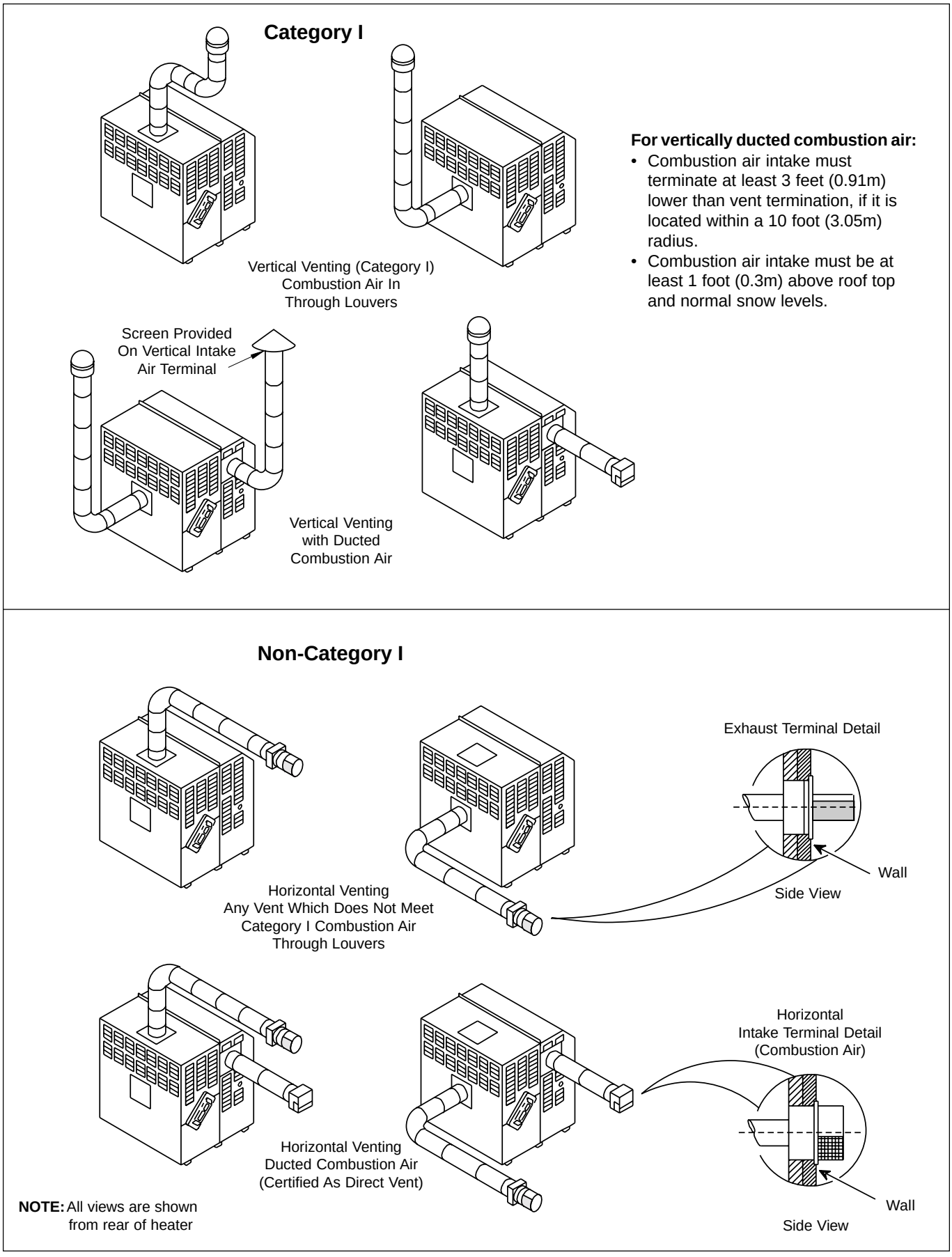


Figure 7. Venting and Combustion Air Options.

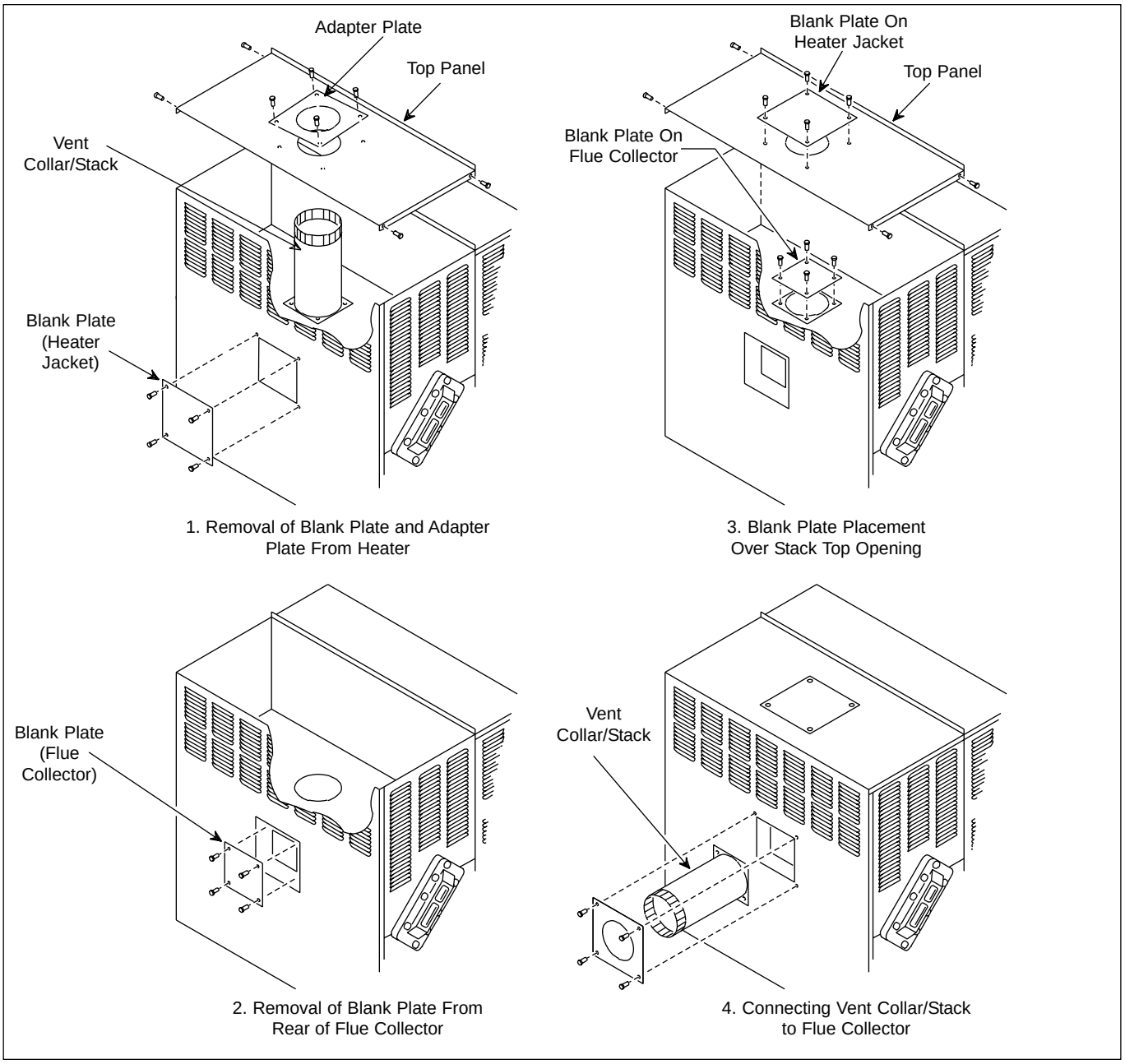


Figure 8. Top-To-Rear Vent Collar.

Heater Size	Pipe Diameter		Max Pipe Length		Max No. of Elbows	Side Wall Vent Terminal Part Number	Side Wall Combustion Air Terminal Part Number
	in.	*mm*	ft.	*m*			
320M	6	*152*	50	*15*	5	D2004500	20260701
400M	7	*178*	50	*15*	5	D2004600	20260702
520M	8	*203*	50	*15*	5	D2004700	20260703
625M	8	*203*	50	*15*	5	D2004700	20260704
775M	9	*229*	50	*15*	5	D2004800	20260705
1000M	10	*254*	50	*15*	5	D2006200	20526906

IMPORTANT: Maximum pipe length allowed is 50 feet (15m), regardless of the number of elbows. Maximum number of elbows allowed is 5. Vent pipe minimum clearance from combustible surfaces is 6 inches (152mm).

Table 7. Vent Piping Specifications (Combustion Air Exhaust).

3. Routing vent pipe through spaces which, except for the terminal, remain above 60°F (16°C) during heater operation.

2J-3. Horizontal Venting - Non-Category I

When venting is horizontal, or cannot meet the code requirements for Category I - Blower-Assisted Vertical Vents, it can develop positive pressure and must be installed in accordance with this section.

The following requirements must be used for Horizontal Venting - Non-Category I:

1. Laars specified vent piping materials (Table 6) and sizes (Table 7).
2. Laars side wall vent hood.
3. Pipe insulation and sealing tape.
4. Routing vent pipe through spaces which, except for the terminal, remain above 60°F (16°C) during heater operation.

2J-4. Side Wall Vent Terminal

The side wall vent hood must be used when the heater is vented through a side wall. It provides a means of installing 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 CAN/CGA B149.1 or .2 and local applicable codes (see Figure 9). Consider the following when installing the terminal:

1. Locate the vent terminal so that it will not be damaged by pedestrians and other traffic, and so the discharge is not objectionable. The National Fuel Gas Code requires a through-wall vent terminal be at least 7 feet (2.1m) above grade if located at a public walkway.
2. Locate the vent terminal so that vent gases cannot be drawn into air conditioning system inlets. The National Fuel Gas Code requires that it be at least 6 feet (1.8m) above any such inlet that is within 10 feet (3m).
3. Locate the vent terminal so that vent gases cannot enter the building through doors, windows, gravity inlets or other openings. The National Fuel Gas Code requires that it be located at least 4 feet (1.2m) below, 4 feet (1.2m) horizontally from, or 3 feet (0.9m) above such openings.
4. Locate the vent terminal so that it cannot be blocked by snow. The National Fuel Gas code requires that it be at least 12 inches (305mm) above grade, but the installer may determine it should be higher depending on local conditions.
5. Locate the terminal so the vent exhaust does not settle on building surfaces and other nearby objects. Vent products may damage such surfaces or objects. But the actual construction of the vent terminal and the flow of vent products must not be altered.
6. Locate the terminal at least 6 feet (1.8m) horizontally from any gas or electric metering, regulating, or relief equipment, or building opening.

2K. Air for Combustion and Ventilation

The heater requires air for combustion and the space around the heater requires ventilation. Combustion air can be provided by standard practices as specified in the installation codes (ANSI Z223.1/ NFPA 54, in Canada, CAN/CGA B149.1 or .2 and local applicable codes), or ducted directly to the heater. Ventilation air must be provided in either case.

2K-1. Air From Room

Standard requirements for providing air for combustion and ventilation are provided by ANSI Z223.1/NFPA 54 and in Canada by CAN/CGA B149.1 or .2. These codes require passages be provided for air flow into the space where the heater is installed. The size of these passages is based on the firing rate of the heater and the path of air flow into the space. In general, installations which take air from inside the building require larger passages than those which take air directly through an outside wall.

Failure to provide adequate combustion and ventilation air can cause the heater, and other appliances occupying the same space, to operate with dangerous and inefficient combustion, and can cause overheating of the space. Be sure to provide air passages in accordance with ANSI Z223.1/NFPA 54, in Canada, CAN/CGA B149.1 or .2 and local applicable codes, and do not permit any other condition, such as an exhaust blower, to affect the air supply for combustion and ventilation.

2K-2. Ducted Combustion Air

Combustion air can be brought directly to the heater through a duct of suitable size and length (see Table 7). Consult Laars about installations not covered by Table 7.

Combustion air must be taken from out-of-doors by means of the Laars side wall terminal.
Locate the terminal within 10 feet (3m) of the heater vent exhaust terminal, but no closer than 3 feet (0.9m) (centerline distance).

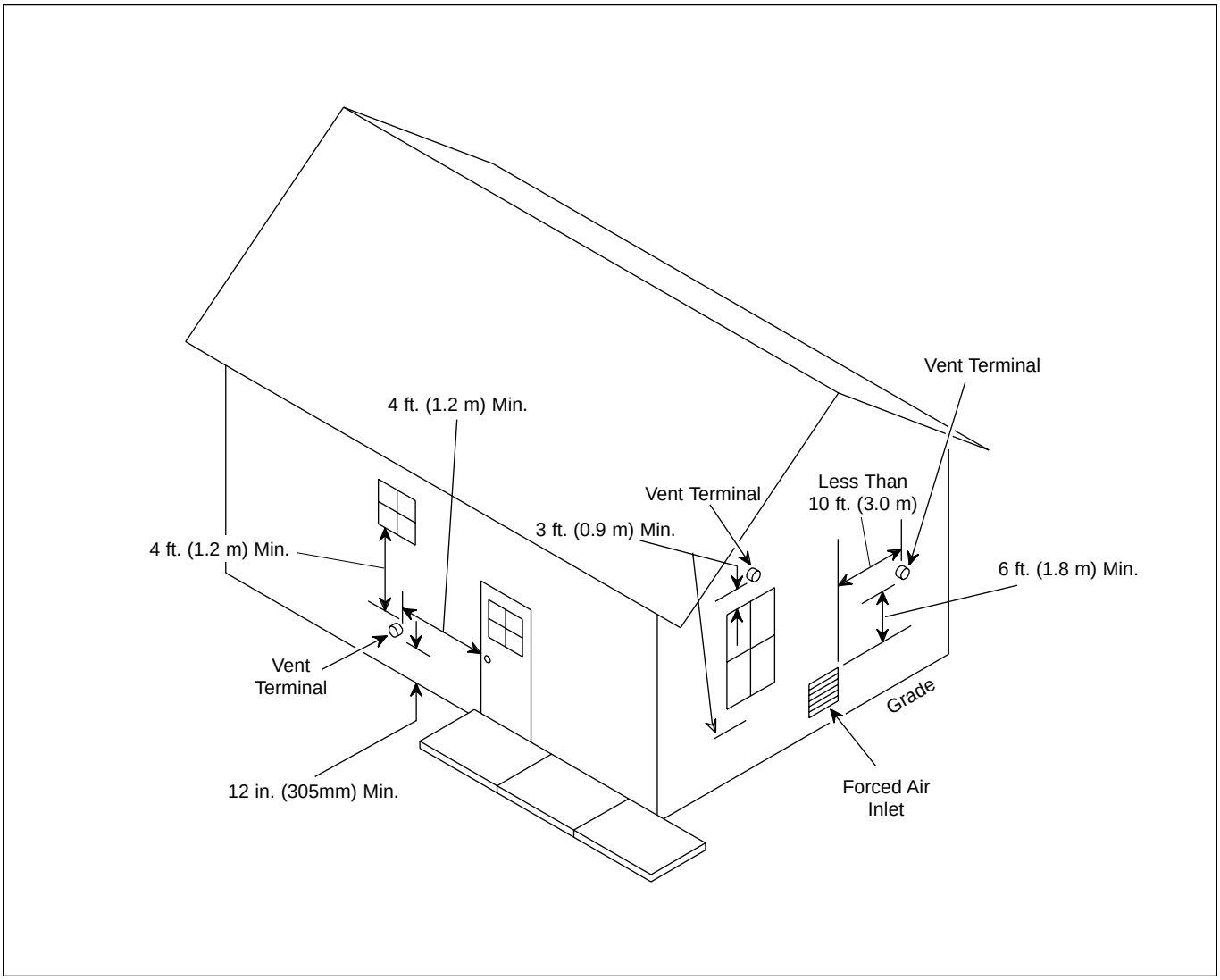


Figure 9. Building Exterior.

Do not locate the air inlet terminal near a source of corrosive chemical fumes (e.g., cleaning fluid, chlorine compounds, etc.). Locate it 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.

Use single-wall galvanized pipe for the combustion air duct. Route the duct to the heater as directly as possible. Seal all joints with tape. Provide adequate hangers. The heater must not support the weight of the combustion air duct.

When combustion air is ducted to the heater, other provisions must be made for heater room ventilation. VW heaters lose less than 1 percent of their input rating to the room, but other heat sources may be present. Provide enough ventilation air to meet comfort specifications. Make sure the ventilation air is not directed at the heater, water piping or other equipment which could be damaged by freezing.

2K-3. Conversion for Ducted Combustion Air

The conversion to ducted combustion air requires the parts listed in Table 8. Follow these procedures to convert the heater (see Figure 10):

1. Remove the louvered plate from the left side of the heater.
2. Remove the adapter plate from the shipping container.
3. Install the blower motor housing collar in gasket.
4. Slip one end of the inlet pipe over the collar on the adapter plate.
5. Slide the inlet pipe and adapter plate into the heater opening until the pipe is aligned with the blower motor.
6. Slip the end of the inlet pipe over the blower motor housing collar.
7. Secure the adapter plate to the side of the heater with the 4 screws.

Boiler Size	Assembly Number
320	20258101
400	20258102
520	20258103
625	20258104
775	20258105
1000	20258106

Table 8. Combustion Air Assembly.

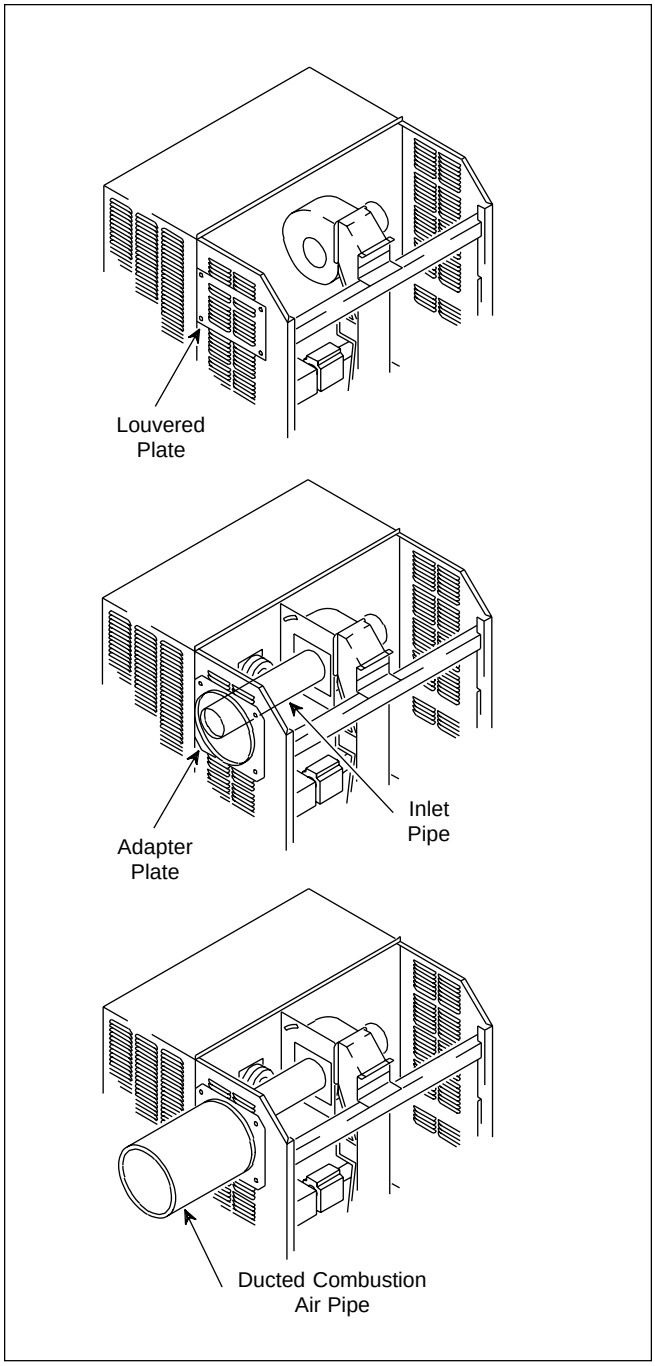


Figure 10. Ducted Combustion Air Conversion.

2K-4. Combustion Air Piping

Run piping of the appropriate size between the air intake terminal and the heater (see Table 7). Table 9 lists the materials for piping the heater.

Term	Description
Pipe	Single-wall galvanized steel pipe, 24 gauge minimum.
Joint Sealing	Permanent duct tape or aluminum tape
Insulation	Not required, but recommend R5 insulation for cold installations (consult American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE) handbook

Table 9. Required Combustion Air Piping Material.

2L. Electrical Wiring

⚠WARNING

Electrically ground the heater in accordance with the latest edition of ANSI/NFPA 70. In Canada, use CSA C22.1. Do not rely on the gas or water piping to ground the metal parts of the heater. Often, plastic pipe or dielectric unions isolate the heater electrically. Service and maintenance personnel who work on or around the heater may be standing on wet floors and could be electrocuted by an un-grounded heater.

1. Check heater wiring and pump for correct voltage, frequency, and phase.
2. Wire the heater and pump exactly as shown in the wiring diagram supplied with the heater (see Figure 11).
3. Electrically interlock the pump and heater so the heater cannot come on unless the pump is running.
4. Connect all field-installed devices (relays, timers, temperature devices, etc.) to the heater wiring at points labeled “Field Interlock” (see Figure 11).

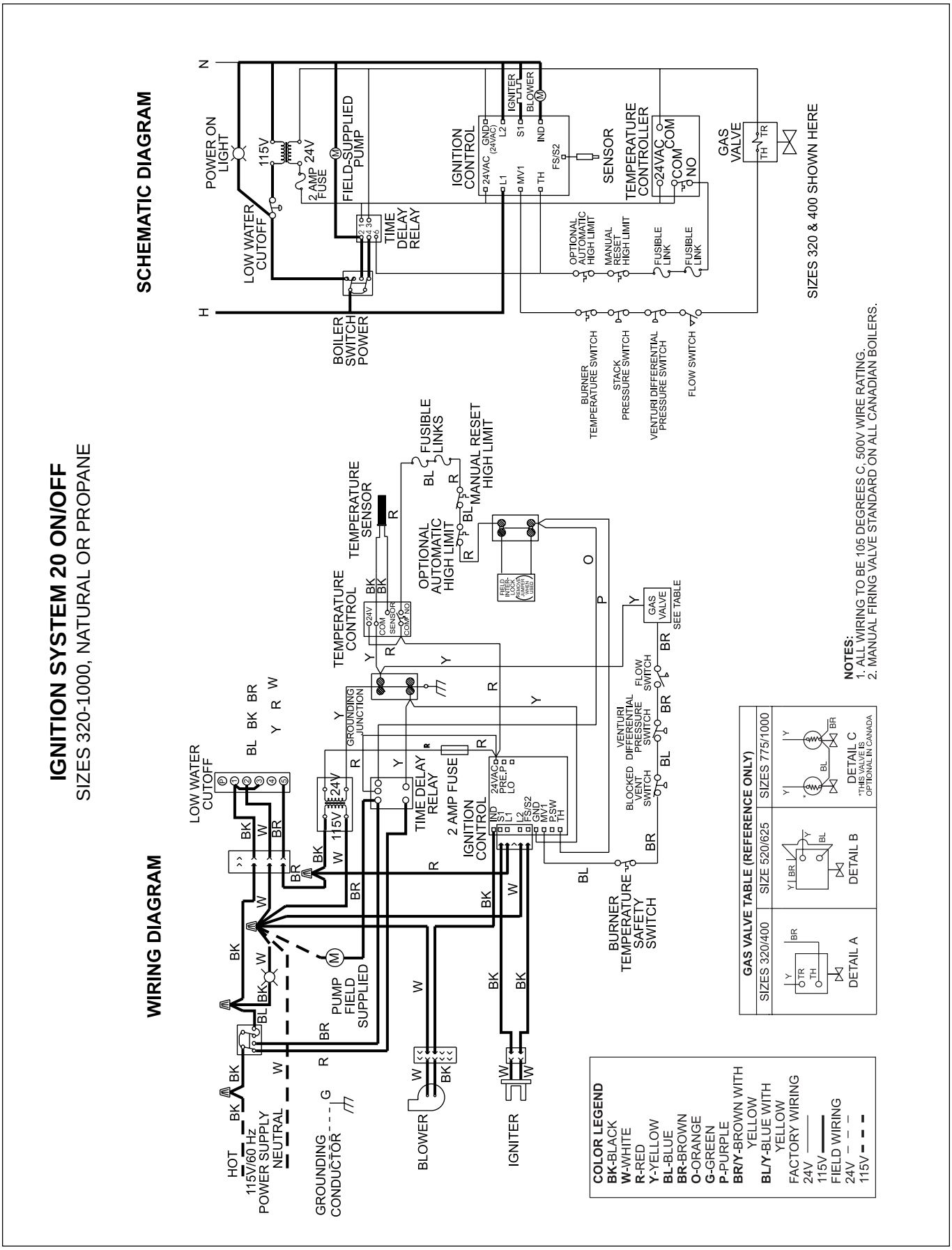


Figure 11. Wiring Diagram.

SECTION 3. Operation

⚠WARNING
Do not use this appliance if any part has been under water. Immediately call a qualified service technician to replace the appliance.

3A. Start Up Requirements

Lighting: Safe lighting and other performance criteria were met with the gas manifold and control assembly provided on the boiler when it underwent tests specified in ANSI Z21.10.3 Standard.

Before placing the heater in operation, check the automatic safety shutoff devices. Once the heater is connected to the gas piping and after all of the requirements in Section 2 have been met, follow this procedure:

1. Before beginning the tests, make sure the main manual gas valve, and any other boiler firing valves, are in the OFF position.

NOTE: The gas valve is turned off as follows:

- Size 775/1000 Valve is OFF when handle is at right angle to gas pipe.
- Sizes 520/625 Turn clockwise to OFF and
- Sizes 320/400 Press in gas control knob slightly and turn clockwise to OFF. Knob cannot be turned unless it is pushed in slightly. Do not force it.

2. Make sure the power switch on the heater is in the ON position. Reset all safety devices (high limit, pressure switch, Low-Water-Cutoff, etc.).

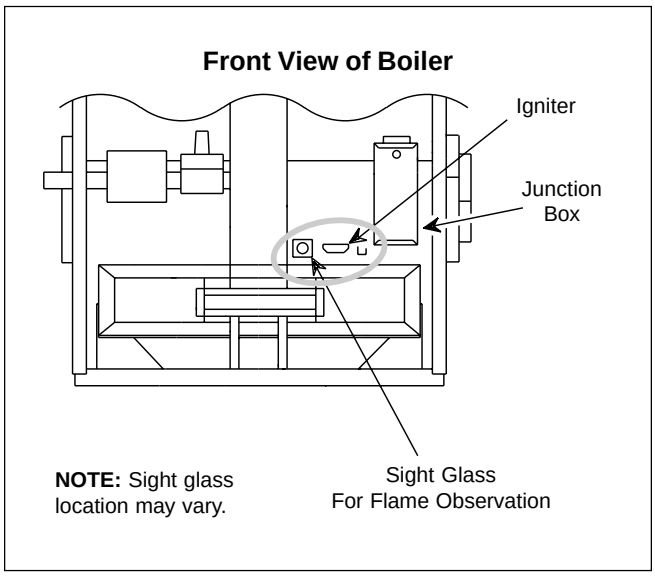


Figure 12. Periodic Flame Observation.

3. Normal Operating Sequence
When the circulation pump is running, the heater will turn itself on and off in response to the water temperature. When the water cools below the set temperature, the following sequence occurs:

   a. The aquastat powers the ignition control.

   b. The ignition control turns on the combustion fan. After about a 15 second pre-ignition purge, while the fan clears the combustion chamber, the igniter is turned on. The igniter takes about 25 seconds to heat up. You can see a glow through the view port (see Figure 12).

NOTE: The manual gas valve must be ON for the burner to ignite. This valve is turned ON as follows:

- Size 775/1000 Valve is ON when handle is parallel to as pipe.
- Sizes 320/400 Turn counterclockwise

  520/625 to ON.

   c. When the igniter is hot, the ignition control turns on the gas valve and the burner ignites. You can see the burner flame through the view port (see Figure 12).

   d. The heater operates until the aquastat senses that the water is hot enough, and the burner shuts off. The combustion fan runs for about one minute to blow all combustion products out of the boiler.

If the igniter fails to ignite the burner in step 3 (for example, if there is air in the gas line), the ignition control shuts off the gas valve after a few seconds of operation. The purge and ignition sequence is automatically repeated. If there is no ignition in three tries, the ignition control “locks out” until the problem is corrected. Contact a qualified service technician.

3B. Hi-Limit Checkout

After running the boiler for a long enough period to bring the water temperature within the range of the hi-limit, slowly back off the high limit setting until the boiler shuts off. The main burners should re-ignite when the hi-limit is turned back up to its original setting and the hi-limit is reset.

3C. Venturi and Gas Pressure Regulator System

3C-1. Overall Operation

The gas control system of the Mighty Max heater is similar to that of a carburetor of a gasoline

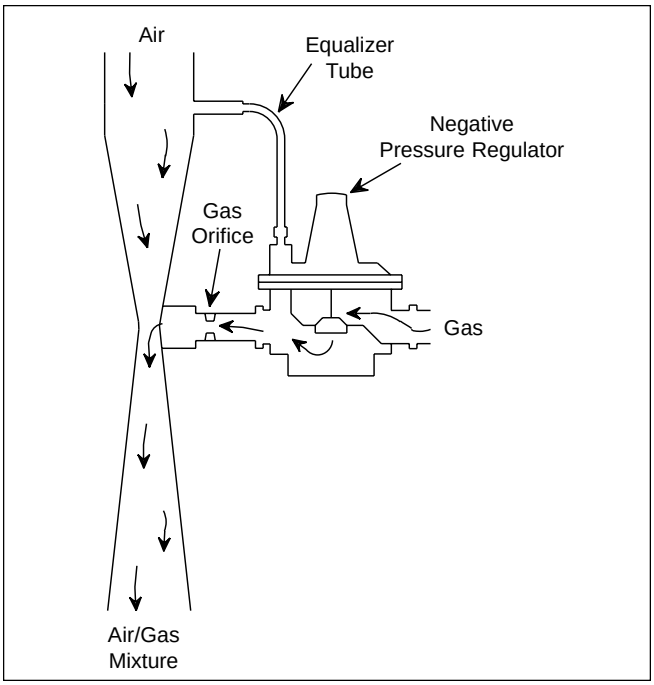


Figure 13. Typical Venturi System.

engine (see Figure 13): a venturi pulls the gas into the combustion air stream. In this system, changes in combustion air flow automatically change the gas flow.

The flow of air through the venturi creates a pressure difference. At the narrowest point of the venturi, the throat, high velocity creates a low pressure condition which pulls gas in through an orifice.

For a correct gas/air ratio, the gas pressure must be the same as the air pressure, but with a slight negative offset. A special gas regulator (called a "negative pressure regulator") which has an equalizer tube connected to the venturi inlet, maintains the required gas pressure.

When the system is operating, a combustion fan forces air into the venturi, creating pressure at the inlet. The gas regulator sets gas pressure, and gas is pulled through the orifice. The sizes of the venturi throat and gas orifice are factory set to provide the correct air/gas ratio.

3C-2. Venturi Adjustment

The field checkout involves measuring gas and venturi pressures, and observing the flame through the sight glass. If necessary, the gas input rate can be measured by timing the gas meter.

Use a single, inclined manometer or digital manometer with a 4.0 inch water column range. Install shutoff valves at the gas orifice (regulator outlet) tap (red), at the venturi inlet tap (blue) and at the venturi throat tap (yellow). After installing the shutoff valves, be certain they are closed.

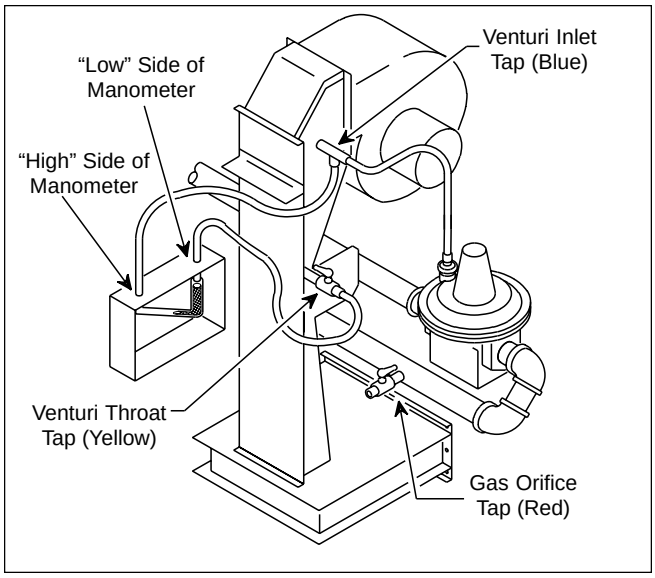


Figure 14. Measurement of Venturi Throat Pressure Differential.

1. With the heater off, connect the positive side of the manometer to the shutoff valve on the venturi inlet tap (blue). Open the shutoff valve.
2. Loosen the nut on the blower damper to allow for adjustment. Turn the boiler on so that the blower is running and the heater is not firing. In this unfired condition, adjust the damper until the venturi inlet pressure (blue tap) is 1.2 inches water column.
3. Approximately 40 seconds after the blower starts the gas valves will open. The heater is now firing. If the heater is not running, check all manual gas valves and heater safety devices. Ensure proper gas supply pressures according to the table in Section 2.
4. Now that the heater is firing, use the blower damper to readjust the venturi inlet pressure according to the installation's altitude in Table 10 (+1.6"w.c. at sea level).

Elevation Ft.	Venturi Inlet Pressure (Blue Tap) "WC H_20"	Gas Pressure Offset "WC H_20"	Throat Differential Pressure "WC H_20"
SEA LEVEL	+1.6	+0.4	+2.6
1000	+1.5	+0.4	+2.5
2000	+1.5	+0.4	+2.4
3000	+1.4	+0.4	+2.3
4000	+1.4	+0.3	+2.2
5000	+1.3	+0.3	+2.2
6000	+1.3	+0.3	+2.1
7000	+1.2	+0.3	+2.0
8000	+1.2	+0.3	+1.9
9000	+1.1	+0.3	+1.9
10000	+1.1	+0.3	+1.8

Table 10. Venturi Pressure Settings.

5. Leaving the positive side of the manometer connected to the venturi inlet tap (blue), connect the negative side of the manometer to the shutoff valve on the gas orifice tap (red). Open the shutoff valve to take a pressure reading. This reading is called the gas pressure offset. Using the regulator only, adjust the gas pressure offset according to the installation's altitude in Table 5 (+0.4" w.c. at sea level). REPLACE THE REGULATOR CAP BEFORE TAKING GAS PRESSURE READINGS. Turn the regulator screw clockwise to decrease the gas pressure offset, turn the regulator screw counter-clockwise to increase the offset.
6. Using the toggle switch, turn the heater off. Turn the heater back on and check the gas pressure offset after the heater has fired. If the gas offset pressure is not according to Table 10, adjust the regulator as needed.
7. While the heater is still running, close the shutoff valve on the gas orifice tap (red), then remove the manometer hose from the shutoff valve. Connect the negative side of the manometer to the shutoff valve on the venturi throat tap (yellow). This reading is called the venturi throat differential pressure and should appear according to altitude in Table 10 (+2.6" w.c. at sea level). If it does not appear according to Table 10, contact a qualified service technician.

After setting all pressures, turn the heater off and replace each shutoff valve with the factory installed threaded plugs. The venturi has now been adjusted for proper operation.

3D. To Start Up System

(See Section 3A for Startup Requirements)

1. Be certain the system pump is running.
2. Set the thermostat or aquastat to its lowest setting.
3. Turn off electric power to the appliance.
4. Remove the control access panel.
5. Turn off the manual gas valve.
6. Wait five (5) minutes to clear out any gas, then smell for gas, including near the floor. Be sure to smell next to the floor because some gas is heavier than air and will settle on the floor.

⚠Caution

This appliance is equipped with an ignition device which automatically lights the burner. Do not try to light the burner by hand.

WHAT TO DO IF YOU SMELL GAS

- Do not try to light any appliance.
- Do not touch any electric switch; do not use any phone in your building.
- Immediately call your gas supplier from a neighbor's phone. Follow the gas supplier's instructions.

If you don't smell gas, go to the next step.

7. Turn on manual gas valves.
8. Reset all safety devices (manual resets on high limit, low water cutoff, etc.).
9. Replace control access panel.
10. Turn on all electric power to the boiler.
11. Set thermostat to desired setting.
12. If the boiler will not operate, follow the instructions to turn off gas to heater and call your service technician or gas supplier.

a. Turn off main electrical switch.
b. Close all manual gas valves.

3D-1. Setting Temperature Controls

To set the temperature and high-limit controls:

a. Set the temperature controller at the system design temperature.
b. For heaters with the temperature controller bulb at the heater inlet, set the high-limit 40ºF to 50ºF above temperature controller setting.
c. For heaters with the temperature controller bulb at the heater outlet, set the high-limit 15ºF to 25ºF above temperature controller setting.

3E. To Shut Down System

To shut down the boiler, turn off all manual gas valves and electrical disconnect switch.

NOTE: There is a filter which needs to be cleaned prior to setting pressures. See section labeled "Filter Service" before proceeding

3F. Venturi Combustion Flow System

Verifying proper operation of the combustion flow system has two aspects - air flow and gas flow. Air flow is checked by measuring pressures at service taps on the venturi. Gas flow is checked by evaluating venturi pressures and the regulator offset pressure.

In a venturi flow system the difference between various pressures is far more important than their "gauge" value relative to the room. The gas pressure offset and the gas orifice pressure differential are especially important concepts. The following section describes this setup procedure.

3F-1. Pressure Measurement Ports

Air flow enters the venturi through the filter box and blower assembly. It is pushed through a converging section and into the throat, where pressure is reduced substantially. Gas flow is pulled into the throat through an orifice. The orifice is located between the throat and the regulator. Air and gas are combined in the throat and mix thoroughly as they proceed through the venturi tailpipe to the burner.

Service taps are provided at three places. One is located on the chamber with the gas connection, this tap is called the gas plenum tap. The other is located above the gas plenum tap, this port is called the venturi inlet tap. The third tap, gas orifice tap, is located on the red orifice holder directly before the gas connects to the venturi. These taps have service plugs in them. Do not remove any of the plastic fittings or plastic tubing. To evaluate system operation requires accurate measurement at these taps. An inclined manometer with a zero to 6 inches water column range is ideal. Other instruments may be used, but the “positive/negative” nature of the readings must be well understood. Gas pressure offset measurements are at very low levels (0.4" WC), the instrumentation must be capable of determining it accurately.

3F-2. Venturi Adjustment

Note that an equalizer tube is connected from a port on the side of the venturi inlet to the port of the regulator. This is a very important component which allows the regulator to track air pressure even when abnormal conditions occur, such as blockage of the combustion air. Before firing, confirm that this tube and the venturi pressure switch tubes are in place and firmly connected.

The field checkout involves measuring gas and venturi pressures, and observing the flame through the sight glass. If necessary, the gas input rate can be measured by timing the gas meter.

Install shutoff valves at the gas orifice (regulator outlet) tap (red), at the venturi inlet tap and at the gas plenum tap. Do not remove any of the plastic fittings or plastic tubing. After installing the shutoff valves, be certain they are closed.

a. Unfired Venturi Differential Pressure

NOTE: Turn off the main manual gas valve.

The difference in pressure between the venturi inlet tap and the gas plenum tap (see Figure 15). This measurement is taken by connecting the positive side of the manometer to the venturi inlet tap and connecting the negative side of the manometer to the gas plenum tap. This measurement is taken with the boiler not firing. It is a temporary setting used to start the boiler and check for air flow problems.

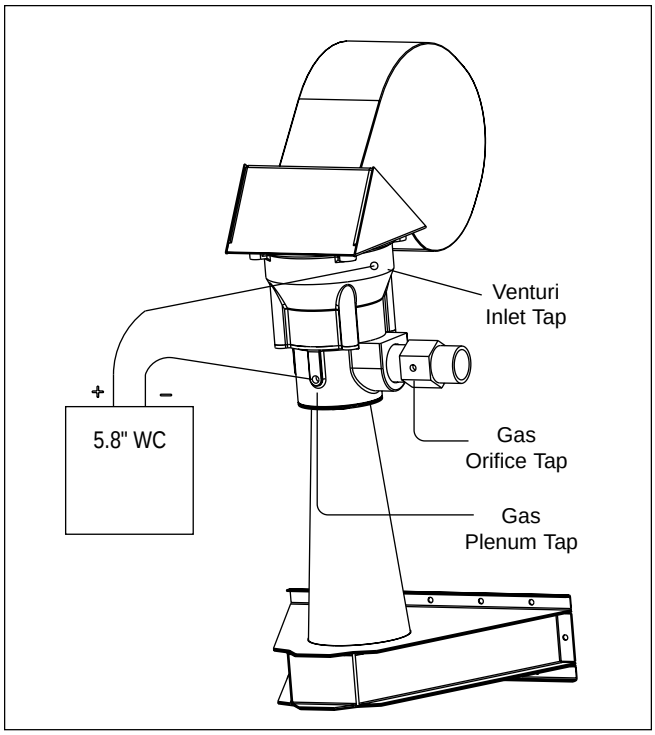


Figure 15. Unfired Venturi Differential Pressure.

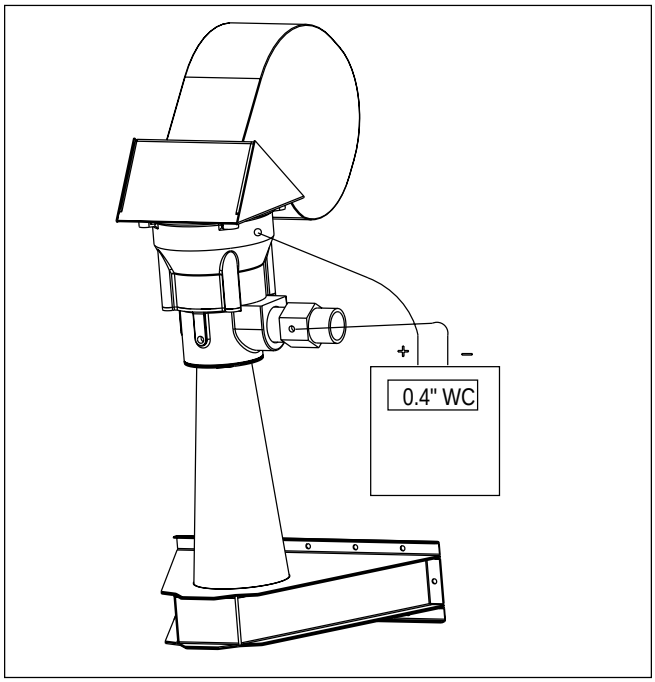


Figure 16. Gas Offset Pressure.

b. Gas Offset Pressure

The difference in pressure between the venturi inlet tap and the outlet of the gas regulator (see Figure 16). This measurement is taken by connecting the positive side of the manometer to the venturi inlet tap and connecting the negative side of the manometer to the gas orifice tap. This measurement is an indication of the gas to air ratio and must be performed while the unit is firing.

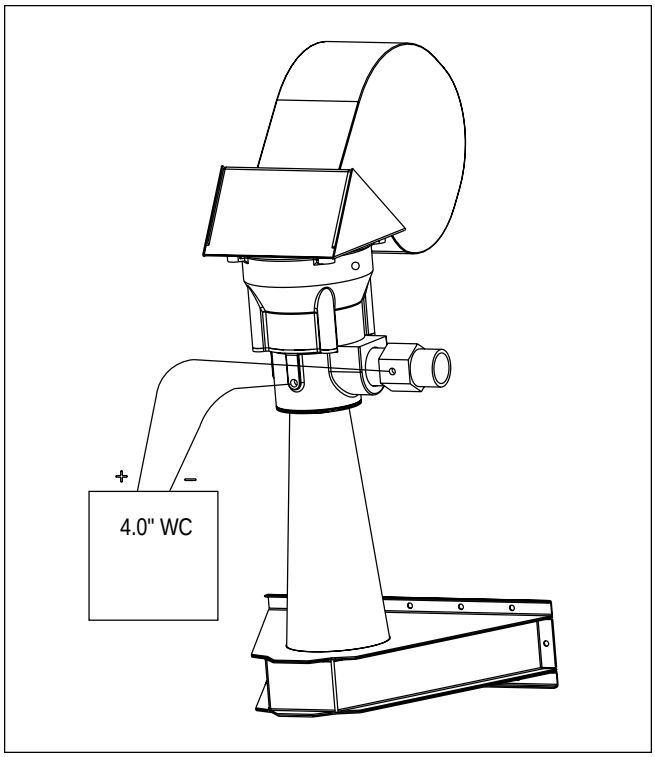


Figure 17. Gas Orifice Differential Pressure.

c. Gas Orifice Differential Pressure

This measurement is the pressure drop across the gas orifice. This measurement is taken by connecting the positive side of the manometer to the gas orifice tap and the negative side of the manometer to the gas plenum tap (see Figure 17). This measurement in conjunction with the gas orifice size is an indication of the gas firing rate and must be performed while the unit is firing.

By setting the gas offset pressure and gas orifice differential pressure according to Table 11, the correct input rate and gas to air ratio is achieved.

3F-3. Venturi Setup Procedure

1. Loosen the nut on the blower shutter to allow for adjustment. Turn the heater on so that the blower is running and the heater is not firing. Measure the *unfired venturi differential pressure*. In this unfired condition, adjust the shutter until the unfired venturi differential pressure is according to Table 11, "Unfired Venturi Differential" (5.8 ± .3 inches wc at sea level). If this pressure range can not be achieved, check for blockage in the combustion air inlet, boiler and venting system. If there is no obvious cause contact a qualified Laars service technician.
2. Approximately 40 seconds after the blower starts the gas valves will open. The heater is now firing. If the heater is not running, check all manual gas valves and heater safety devices. Ensure proper gas supply pressures according to Table 4 in Section 2.

ELEVATION, FT	GAS OFFSET PRESSURE inch W.C.	GAS ORIFICE DIFFERENTIAL PRESSURE inch W.C.	UNFIRED VENTURI DIFFERENTIAL inch W.C.
SEA LEVEL	+0.4	+4.0	+5.8
2000	+0.4	+3.7	+5.3
4000	+0.4	+3.4	+4.9
6000	+0.4	+3.2	+4.6
8000	+0.4	+2.9	+4.2
10000	+0.4	+2.7	+3.9

Table 11. Venturi Pressure Settings.

3. Measure the *gas offset pressure*. Using the regulator only, adjust the gas offset pressure according to the installation's altitude in Table 11 (+0.4 inches wc. at sea level). REPLACE THE REGULATOR CAP BEFORE TAKING GAS PRESSURE READINGS. Turn the regulator screw clockwise to decrease the gas offset pressure, turn the regulator screw counterclockwise to increase the offset.
4. Using the toggle switch, turn the heater off. Turn the heater back on and check the gas offset pressure while the heater is firing. If the gas offset pressure is not according to Table 11, adjust the regulator as needed.
5. Measure the *gas orifice differential pressure*. This pressure must be adjusted according to Table 11 (4.0 ± .2 inches wc at sea level). Use the blower shutter to adjust the gas orifice differential.
6. By adjusting the gas orifice differential, the gas offset pressure will change. Therefore you must repeat steps 3-5 until the gas offset and gas orifice differential pressures are according to Table 11.
7. After setting all pressures, turn the heater off and replace each shutoff valve with the factory installed threaded plugs. The venturi has now been adjusted for proper operation.

SECTION 4
Maintenance

4A. General Instructions

1. Oil the water circulating pump in accordance with the manufacturer's instructions.
2. Oil the blower motor bearings every 6 months.

3. If a strainer is used in a pressure reducing valve or in the piping, clean it every 6 months in accordance with the manufacturer's instructions.
4. At startup and every 6 months after, look at the main burner flame for proper performance. The burner should not require maintenance in normal operation. If any malfunction indicates that the burner needs service (e.g., a flame that is yellow, or entire burner surface glowing red), call a professional service technician. Flame characteristics may be inspected during the first 30 seconds after ignition. Characteristics of a good flame are:
   a. Blue flame color
   b. Dark-colored burner surface with occasional glowing fibers on surface. **NOTE:** After 30 seconds of operation the combustion chamber will heat up and prevent reliable flame observation.
5. Inspect the venting system for blockage, leakage, and corrosion at least once a year.
6. Keep the heater area clear of combustible material, gasoline, and other flammable liquids and vapors.
7. Be sure all combustion air and ventilation openings are not blocked.
8. After installation and first startup, check the heat exchanger for black carbon soot buildup after the following periods of operation: 24 hours, 7 days, 30 days, 90 days, and once every 6 months thereafter.

4B. Heat Exchanger

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. As soon as any buildup is seen, correct the cause of the buildup. **Scale can build up on the inner surface of the heat exchanger tubes and restrict the water flow**. Inspect the heat exchanger in accordance with Section 4B-1.

If the heat exchanger needs cleaning see Section 4B-2.

4B-1. Inspection of the Heat Exchanger

⚠WARNING
Improper installation or maintenance can cause nausea or asphyxiation from carbon monoxide in flue gases which could result in severe injury, property damage, or death.

4B-1a. External Heat Exchanger Inspection

1. Disconnect electrical supply to the heater.
2. Turn off the gas supply by closing the manual gas valve on the heater.
3. On indoor models, remove the vent pipe, top jacket section, flue collector.
4. On outdoor models, remove outdoor vent terminal, top jacket section, flue collector.
5. After removing the flue collector, inspect the finned copper tubing using a flashlight.
6. If there is a buildup of black carbon soot or other debris on the heat exchanger tubes which may restrict flue gas passage, refer to section 4B-2a.
7. If there is no buildup of black carbon soot or other debris which may restrict flue gas passage through the heat exchanger, reassemble the heater.

4B-1b. Internal Heat Exchanger Inspection

1. Remove the inlet/outlet header of the heat exchanger.
2. Remove the return cover of the heat exchanger.
3. Inspect the internal surface of the copper tubes for signs of scale buildup and erosion.
4. If buildup exists clean per 4B-2b.

4B-2a. Cleaning the Heat Exchanger - External

NOTE: The heat exchangers are heavy and may require two people to remove to avoid personal injury.

⚠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. Disconnect the 120 Vac electrical supply to the heater.
2. Turn off the gas supply by closing the manual gas valve on the heater.
3. Disconnect and remove the wires and conduit from the low water cutoff.
4. Remove the top jacket section, venting and the flue collector as mentioned in Section 4B-1 “Inspection of the Heat Exchanger”.
5. Isolate the heat exchanger from water supply.
6. Drain the heat exchanger.

7. Disconnect the flange and adapter tee from the heat exchanger inlet and outlet.
8. Remove temperature sensing probes from the inlet/outlet header.
9. Remove the heat exchanger from the heater.
10. Remove the heat baffles from the heat exchanger.
11. Clean the heat exchanger: A light accumulation of soot or corrosion on the outside of the heat exchanger can be easily removed after the heat baffles are removed. Use a wire brush to remove loose soot and scale from the heat exchanger. Do not use water or compressed air for cleaning.

NOTE: While the heat exchanger is out of the heater, inspect the firewall refractory insulation blocks for cracks, wear and breakage. Replace if necessary.

4B-2b. Cleaning the Heat Exchanger - Internal

1. Remove the inlet/outlet header of the heat exchanger.
2. Remove the return cover of the heat exchanger.
3. Clean the internal surface. (Laars offers a tube cleaning kit part number R0010000.)
4. Reassemble in the reverse order.

4C. Gas and Electric Controls

The gas and electric controls on the heaters are designed for both dependable operation and long life. Safe operation of the heater depends on their proper functioning. A professional service technician should check the following basic items every year, and replace when necessary.

NOTE: The warranty does not cover damage caused by lack of required maintenance or improper operating practices.

1. Water temperature controls.
2. Ignition control system.
3. Automatic electric gas valve(s).
4. Flow sensing safety device.
5. Low water cutoffs, including flushing or float types. (Every six months).

Other maintenance requirements include:

1. Periodic cleaning of filters, when supplied.
2. Lubrication of moving parts (when applicable), with the correct type and amount of lubricant.
3. Periodic examination of the venting system.
4. Periodic cleaning of vent terminal screens, where applicable.
5. Cleaning flue gas passageways.

4D. Filter

4D-1. Filter Function

A filter has been designed into the operation of this Mighty Max boiler. Its function is to filter the combustion air before it is delivered to the burner system. The filter is manufactured out of a polyurethane foam and may be cleaned with a mild soap and water solution. Clean the filter only after the filter has been removed from the filter housing (see Figure 18).

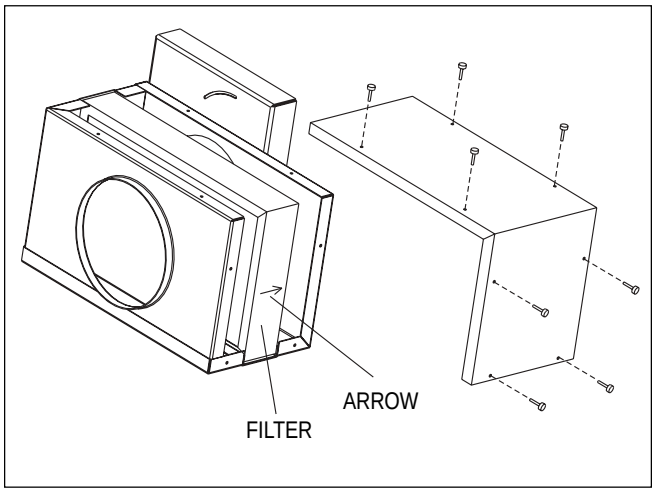


Figure 18. Filter Exposed for Cleaning.

4D-2. Filter Service

(The filter does not need cleaning if this is a first time heater start-up).

1. Turn the heater off using the toggle switch.
2. Remove the door panel and bonnet from the jacket.
3. Remove the screws on the filter housing to expose the filter as shown in Figure 18.
4. Inspect the filter for discoloration due to contamination or any other forms of debris. If contamination or debris exists, wash the filter in a soap/water solution then rinse with water only. It is important that the filter be dry before placing it back in the filter housing.

⚠Caution

The filter has arrows which indicate the direction of the air flow. Failure to install the filter correctly may cause blower failure and dangerous operation.

The filter must be inspected for contamination one week after start-up. Depending upon the severity of contamination, a suitable cleaning schedule may be

developed. The factory recommends cleaning the filter at least once every 30 days. In high contamination areas, such as construction sites, factories, etc., the filter may need to be cleaned daily. Failure to do so could result in lower heat output and potential unsafe operation.

SECTION 5 Troubleshooting

5A. Sequence of Operation

To troubleshoot the heater properly you must first understand the sequence of operation of the heater:

1. Upon a call for heat a 24 Vac signal is sent through fusible links and high limit(s) to the ignition control "TH" terminal.
2. The "IND" terminal of the ignition control is energized for a 15 second pre-ignition purge period during which the combustion blower purges the combustion chamber.
3. After the purge period there is a 20 to 35 second igniter heat up period. The glow of the igniter can be seen through the heater sight glass.
4. Then there is a seven second trial for ignition. During this time the gas valves are energized and the main burner ignites. The gas valves will remain energized throughout the call for heat as long as the ignition control igniter senses a stable flame.
5. After the call for heat is satisfied the ignition control closes the gas valves and operate the blower for a thirty (30) second post purge cycle. This clears the combustion chamber of combustion products.

The ignition is attempted three times. If ignition is not successful, the control shuts down and "locks out". It remains in the lockout condition until the heater is turned off then back on or 120 Vac power to the heater is interrupted.

5B. Venturi and Gas Pressure Regulator System

Field Checkout

See Section 3B "Venturi and Gas Pressure Regulator System" for proper setup procedure.

5C. Electrical Components

This section describes guidelines for checking the operation of electrical components installed on the heater. Refer to the wiring diagram for correct connection locations.

5C-1. General Troubleshooting

This section describes guidelines for checking the electrical components of the heater. Experience has shown that most complaints about heaters failing to fire have nothing to do with the heater itself. Usually, one of the protective switches in the heater system has shut down operation.

Any of the following can prevent proper operation. Check these items first:

1. Be sure the heater has been properly installed (see Section 2).
2. Make sure the pump is not airlocked, clogged or otherwise inoperative.
3. Make sure the gas valve is on and there is sufficient gas pressure in the line. All external gas valves must be open.

> **⚠ Caution**
> The ignition control and igniter operate on 120V power. Keep this in mind while servicing the heater, and take care to avoid electrical shock.

4. Verify that the electrical circuit serving the boiler is ON
5. Make sure the toggle switch on the right side of the boiler is ON.
6. Check the fuse inside the black, twist-lock fuse holder. If it is burned, replace it with a 2-amp fuse (part number E0084400).
7. With the power off inspect all electrical connections and wiring. Finding a loose connection or charred wire can save a lot of time and money.
8. Make sure the temperature controller is set high enough to call for heat.
9. Make sure none of the manual reset controls, i.e., low water cutoff, high limit, etc., have tripped. Reset any tripped switches

If the pump is circulating water and the foregoing items check out okay, the trouble may be in the boiler control system.

IMPORTANT: Disconnect power to the heater before removing or replacing any component or wire connection. If the power is not disconnected, "jumping" the gas valve or accidentally grounding the wire harness or component terminals to the heater frame or jacket could cause the ignition control fuse to blow.

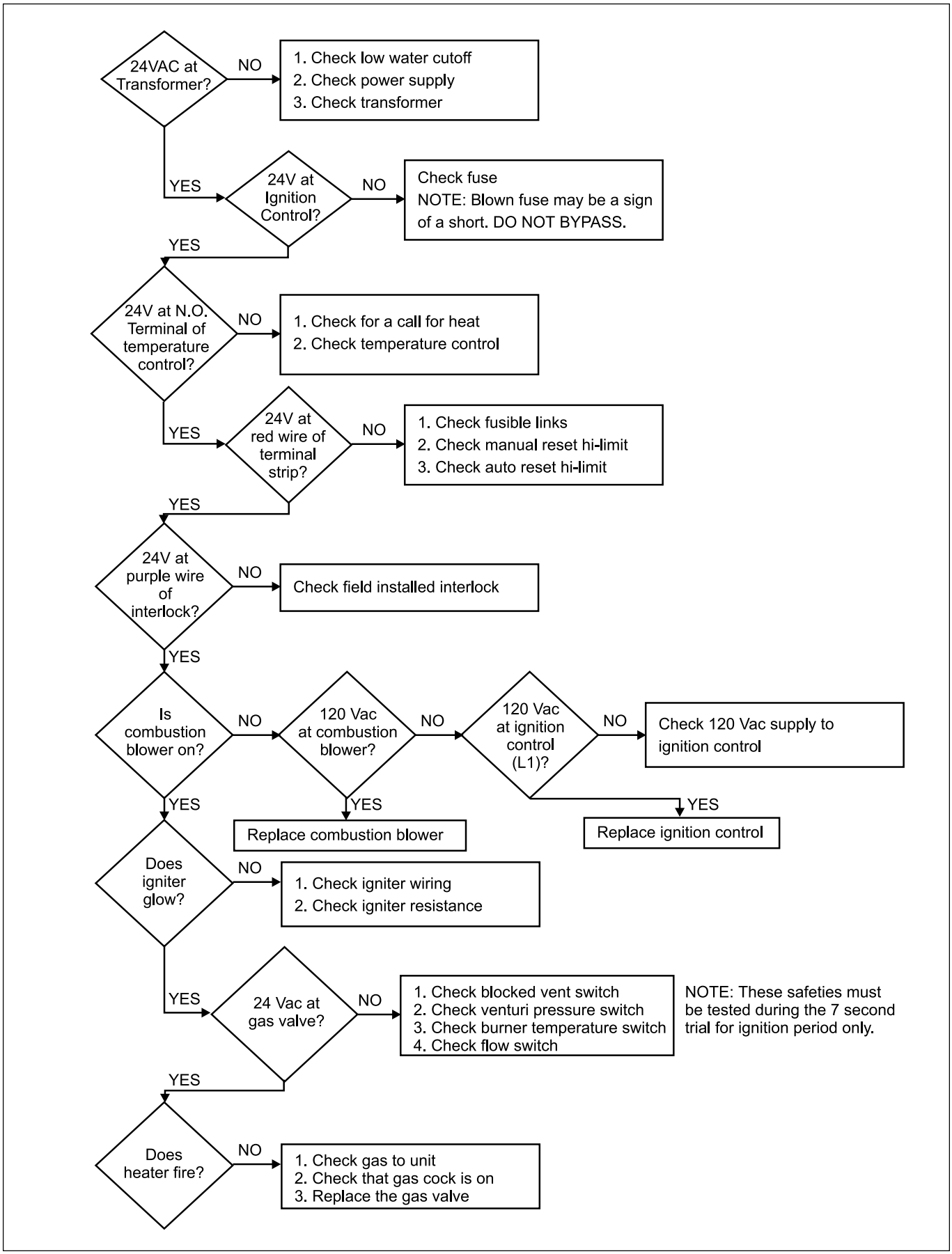


Figure 19. Troubleshooting Chart.

5C-2. Electrical Troubleshooting

Troubleshooting procedures should only be performed by professional service technicians qualified in heater maintenance.

Some electrical components are wired in parallel, so it is necessary to troubleshoot in the order that they appear on the wiring diagram or the troubleshooting flow chart (see Figure 19).

The following steps should be used when troubleshooting the heater:

1. Remove the lower front panel (see Figure 20).

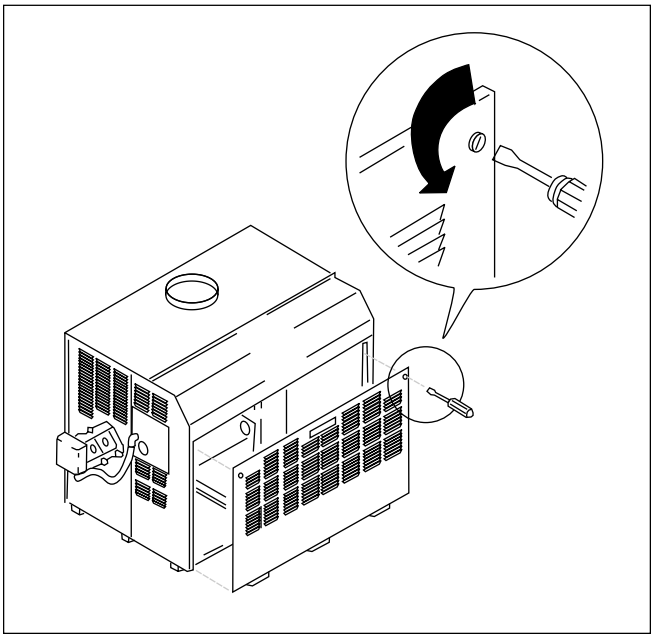


Figure 20. Lower Front Panel Removal.

2. Turn the manual gas valve on the heater off.
3. If the heater has locked out turn the toggle switch off for 5 seconds then back on to reset the heater.
4. Use the troubleshooting flow chart (Figure 19) to determine what components and wiring should be tested first.
5. Test each component by checking for 24 Vac or 120 Vac entering and exiting the device. If there is voltage entering the safety device, but none leaving then there is an open circuit and it must be determined why it is open. When testing components between "MV1" of the ignition control and the gas valve install a meter and let the heater cycle through one complete sequence of operation. During the sequence of operation these safeties will only be energized for the seven second trial for ignition.
6. Turn the manual gas valve on the heater on and fire the heater.

⚠ Caution

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

SECTION 6
Parts List for Mighty Max VW Heater

6A. General Information

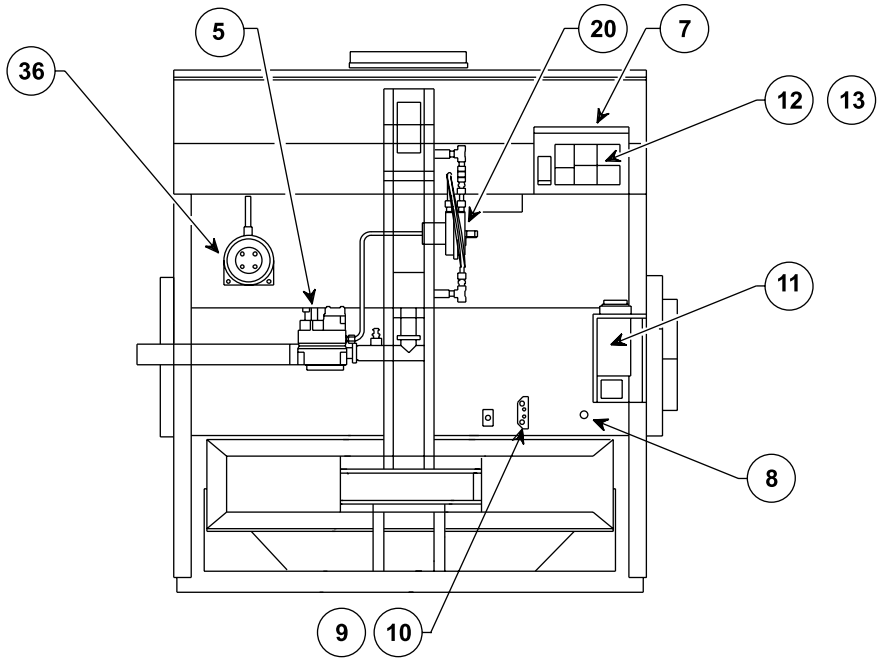
To order or purchase parts for the Laars Mighty Max VW heater, contact your nearest Laars contractor or distributor. If they cannot supply you with what you need, contact:

Customer Service Department
Laars Heating Systems
6000 Condor Drive
Moorpark, California, 93021
Telephone (805) 529-2000

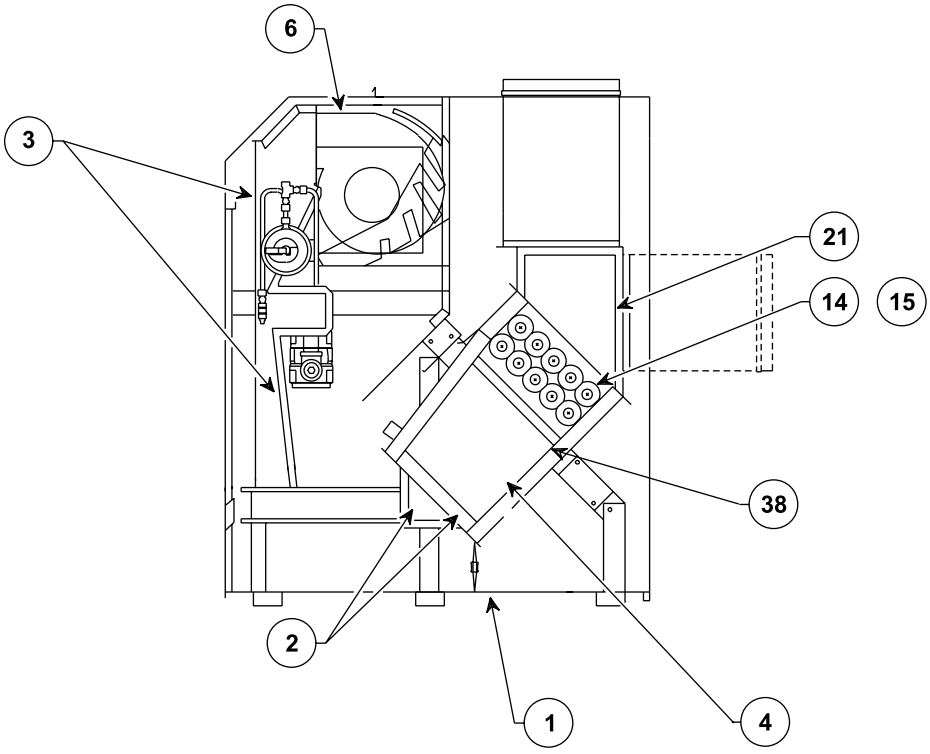
20 Industrial Way
Rochester, New Hampshire, 03867
Telephone (603) 335-6300

In Canada, contact:
Customer Service Department
Laars Heating Systems
480 S. Service Road West
Oakville, Ontario, Canada L6K 2H4
Telephone (905) 844-8233

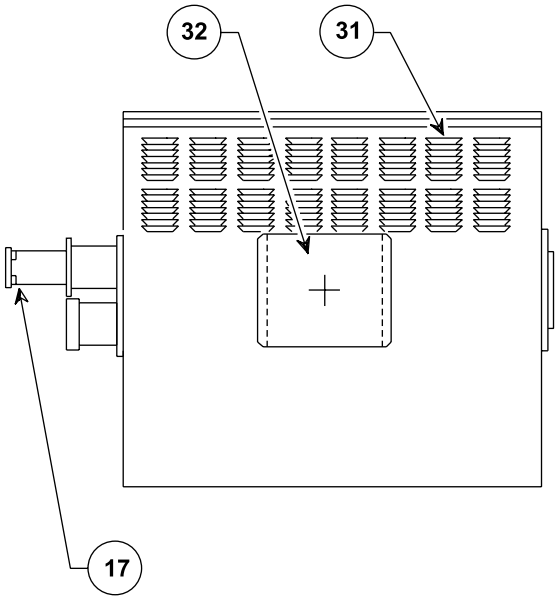
Item	Description	Part Number
1.	Base Assembly	
	320M	20157801
	400M	20157802
	520M	20157803
	625M	20157804
	775M	20157805
	1000M	20157806
2.	Burner and Burner Plenum Weldment	
	320M	20268401
	400M	20268402
	520M	20268403
	625M	20268404
	775M	20268405
	1000M	20268406
3.	Venturi Assembly	
	320M	20158601
	400M	20158602
	520M	20158603
	625M	20158604
	775M	20158605
	1000M	20266400



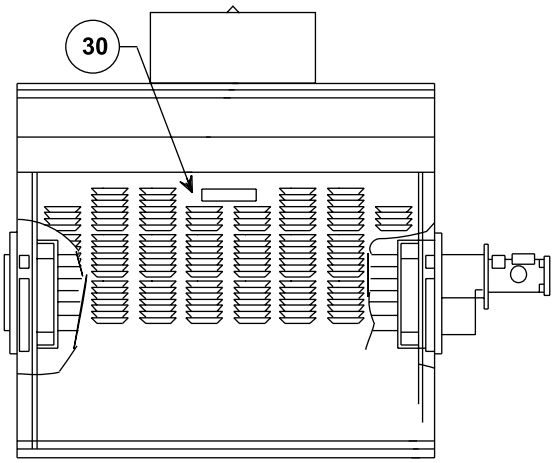
Front View



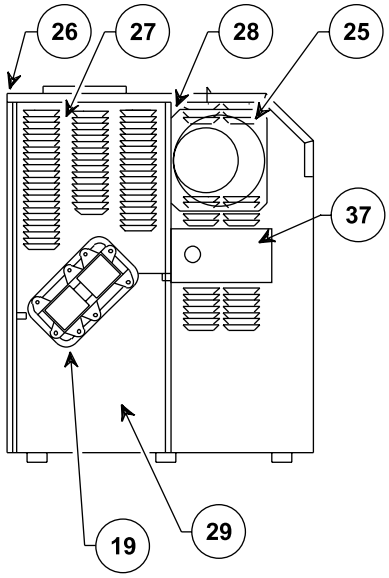
Right Side View

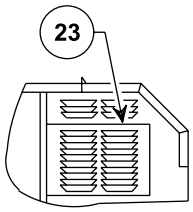


Rear View

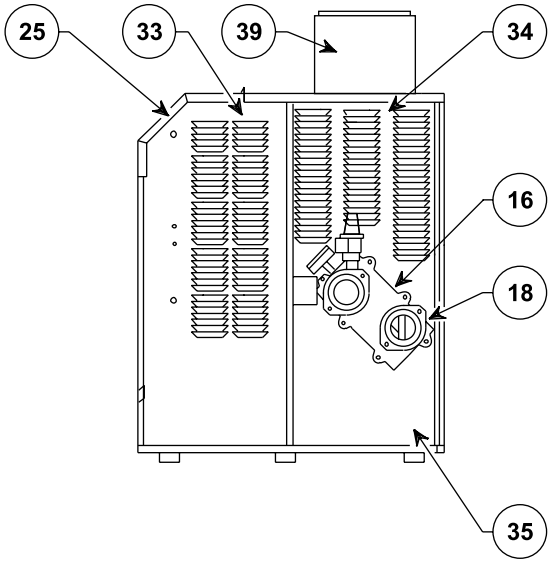


Front View





Left Side View



Right Side View

Item	Description	Part Number
4.	Combustion Chamber Weldment	
	320M	20159101
	400M	20159102
	520M	20159103
	625M	20159104
	775M	20159105
	1000M	20159106
5.	Gas Train Assembly	
	320M	20254901
	400M	20254902
	520M, 625M	20260100 (U.S.)
		20260101 (Canada)
	775M	20260200 (U.S.)
		20260201 (Canada)
	1000M	20265600 (U.S.)
		20265601 (Canada)
	Gas Valve	
	320M, 425M	V2003900
	520M, 625M	V2003700
	775M, 1000M	V0046700
	Pressure Regulator	
	520M, 625M	V2003800
	775M, 1000M	V2003600
	Orifice Holder	
	320M, 400M	P2017500
	520M, 625M	P2017700
	775M	P2018500
	1000M	P2022200
6.	Motor, Blower	
	320M thru 520M Nat. & Prop. Gas	A2088100
	625M, 775M Nat. & Prop. Gas	A2087500
	1000M Nat. & Propane Gas	A2003900
7.	Electrical Controls	
	High limit Control	E0015900
	Toggle Switch	E0109200
	Indicator Light	E0071300
	Fusible Link	E0099403
	Transformer	E0086100
	Fuse Holder	E2000300
	Fuse, 2 Amp	E2043600
	Flow Switch	E0013000
	Burner Temperature Switch	E2076100
	Low Water Cutoff	E2075100
	Pump Time Delay	E2077700
8.	Sight Glass	F0044800
9.	Igniter, Hot Surface	W0038001
10.	Gasket, Igniter Hot Surface	20409800
11.	Control, Remote Ignition	E2101300
12.	Control, Temperature	E2101400
13.	Display, Temperature	E2101600
14.	Heat Exchanger Assy., 2 pass, Copper Tubes	
	520M	20256003
	625M	20256004
	775M	20256005
	1000M	20256006

Item	Description	Part Number
	Heat Exchanger Assy., 2 pass, Cupronickel tubes	
	520M	20104603
	625M	20104604
	775M	20104605
	1000M	20104606
15.	Heat Exchanger Assy., 4 pass, Copper Tubes	
	320M	20259601
	400M	20259602
	Heat Exchanger Assy., 4 pass, Cupronickel tubes	
	320M	20104701
	400M	20104702
16.	Cover, Machined In/Out	20150200
17.	Plate, Mach. Adapter	
	320M, 400M	20150302
	520M, 625M, 775M	20150306
	1000M	20150307
18.	Flange, Machined	
	320M, 400M	20255400
	520M, 625m, 775M	20255401
	1000M	10391304
19.	Cover, Machined Rear	20150100
20.	Pressure Switch, Differential 320-775	E0115200
	Pressure Switch, Differential 1000	E0161400
21.	Flue Collector Assembly (with gaskets)	
	320M	20155401
	400M	20155402
	520M	20155403
	625M	20155404
	775M	20155405
	1000M	20155406
22.	Jacket Assembly (Not Shown)	
	320M	20255201
	400M	20255202
	520M	20255203
	625M	20255204
	775M	20255205
	1000M	20255206
23.	Covering Plate (side)	20256500
24.	Collar, Jacket 320-775	20258300
	Collar, Jacket 1000	20266300
25.	Bonnet	
	320M	20156801
	400M	20156802
	520M	20156803
	625M	20156804
	775M	20156805
	1000M	20156806
26.	Panel Top,	
	320M	20157501
	400M	20157502
	520M	20157503
	625M	20157504
	775M	20157505
	1000M	20157506
27.	Panel, Top Side, Left	20152800

Item	Description	Part Number
28.	Panel, Side, Left	20152700
29.	Panel, Bottom Side, Left	20152900
30.	Panel, Access	
	320M	20157401
	400M	20157402
	520M	20157403
	625M	20157404
	775M	20157405
	1000M	20157406
31.	Panel, Back	
	320M	20157201
	400M	20157202
	520M	20157203
	625M	20157204
	775M	20157205
	1000M	20157206
32.	Plate, Blank (back)	
	320M	20256201
	400M	20256202
	520M, 625M	20256203
	775M	20256204
	1000M	20256205
33.	Panel, Side, Right	20157100
34.	Panel, Top Side, Right	20157000
35.	Panel, Bottom Side, Right	20156900
36.	Blocked Vent Safety Switch	E2103000
37.	Cover Plate For Gas Conn.	
	320M, 400M	20262701
	520M, 625M	20262702
	775M, 1000M	20262703

Item	Description	Part Number
38.	Tile Assembly	
	320M	20255101
	400M	20255102
	520M	20255103
	625M	20255104
	775M	20255105
	1000M	20255106
39.	Outdoor Terminal Kit	
	320M	20254701
	400M	20254702
	520M	20254703
	625M	20254703
	775M	20254704
	1000M	20254705
40.	Side Wall Vent Terminal (When Used) (Not Shown)	
	320M	D2004500
	400M	D2004600
	520M	D2004700
	625M	D2004700
	775M	D2004800
	1000M	D2006200
41.	Sidewall Comb. Air Terminal (When Used) (Not Shown)	
	320M	20260701
	400M	20260702
	520M	20260703
	625M	20260704
	775M	20260705
	1000M	20526906
	Filter	A2088700
	Filter Gasket	S2006100
	Filter Housing Gasket, Top	S2006200
	Filter Housing Gasket, Side	S2006300

H0192500C

LAARS HEATING SYSTEMS

Waterpik Technologies, Inc.
6000 Condor Drive, Moorpark, CA 93021 • 805.529.2000 • FAX 805.529.5934
20 Industrial Way, Rochester, NH 03867 • 603.335.6300 • FAX 603.335.3355
480 S. Service Road West, Oakville, Ontario, Canada L6K 2H4 • 905.844.8233 • FAX 905.844.2635
www.laars.com