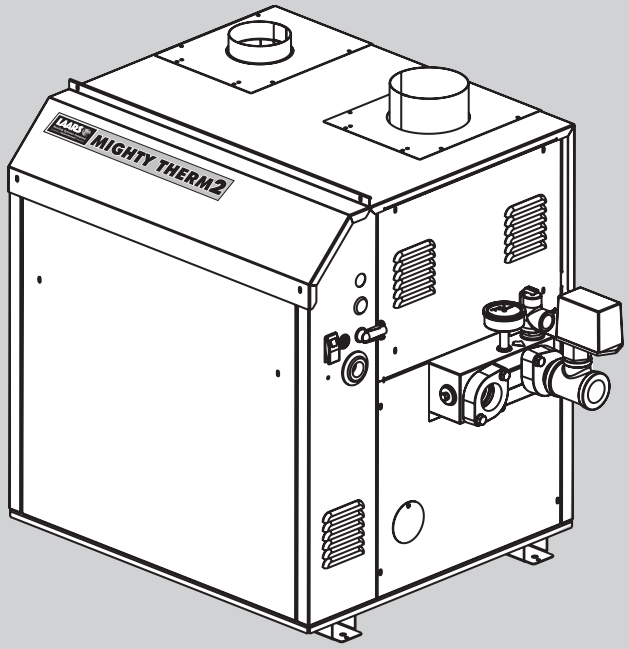
Installation and Operation Instructions for

MIGHTY THERM2®

Hydronic Boiler
Model MT2H
Sizes 300, 400

Water Heater
Model MT2V
Sizes 200, 300, 400



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

H2358000G

LAARS® Heating Systems Company

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SECTION 1 General Information

USING THIS MANUAL – Because the Mighty Therm2 Boilers and Mighty Therm2 Water Heaters are identical appliances, with the exception of materials of manufacture, labels and ultimate use application, this manual provides information for the proper installation, operation and maintenance of both products. Where differences exist between the application of the appliances and their operation, the sections pertinent to only one appliance or the other will be so identified.

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

1.A Introduction

This manual provides information necessary for the installation, operation, and maintenance of Laars Heating Systems' Mighty Therm2 copper tube appliances, sizes 200-400 MBTU/hr (larger models are covered in a separate manual). Read it carefully before installation.

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

The Mighty Therm2 appliance is protected against over pressurization. A pressure relief valve is fitted to all appliances. It is installed on the outlet header, at the water outlet of the appliance.

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.

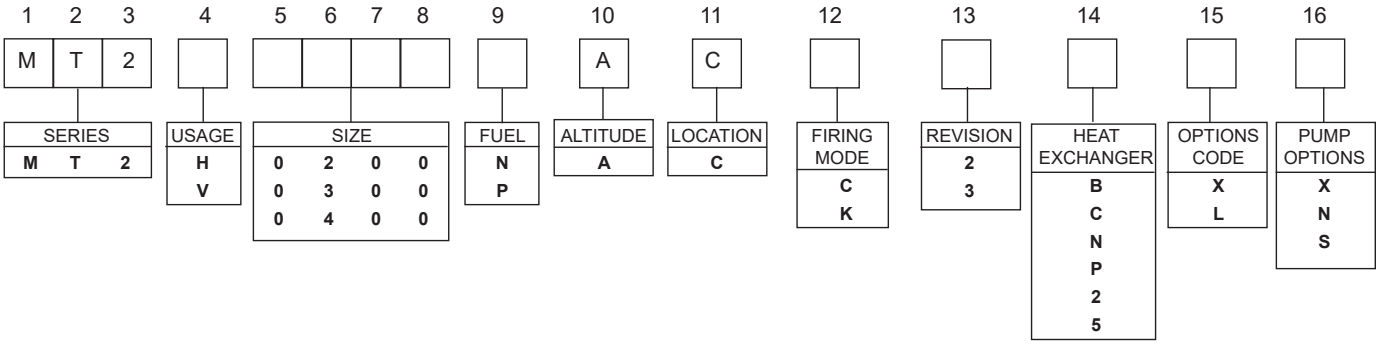
⚠ WARNING

To minimize the risk of electric shock, fire or other hazards which could result in property damage, injury, or death. The hydronic, boiler or water heater **must** be installed in accordance with the procedures detailed in this manual, or the 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 unit, which must conform to the Standard for Controls and Safety Devices for Automatically Fired Boilers, ANSI/ASME CSD-1. Any modifications to the boiler, its gas controls, or wiring may void the warranty. If field conditions require modifications, consult the factory representative before initiating such modifications.

⚠ AVERTISSEMENT

Afin de minimiser les risques d'électrocution, d'incendie ou d'autres dangers qui pourraient entraîner des dommages aux biens, des blessures ou la mort. Le hydronique, une chaudière ou un chauffe-eau doit être installé conformément aux procédures détaillées dans ce manuel, ou le chauffage garantie peut être annulée. L'installation doit être conforme aux exigences de la juridiction locale ayant l'autorité, et, aux ÉTATS-UNIS , à la dernière édition du National gaz combustible Code, ANSI Z223.1/NFPA54. Au Canada, l'installation doit être conforme à la dernière édition du gaz naturel et propane Code d'Installation, CSA B149.1 et/ou codes locaux. Lorsque requis par l'autorité ayant juridiction, installation de l'unité, qui doit être conforme à la norme pour les contrôles et les dispositifs de sécurité automatiquement pour chaudières, ANSI/ASME LA CDD-1. Toute modification apportée à la chaudière, de ses commandes de gaz, ou le câblage peut annuler la garantie.

WARNING:
Cancer and Reproductive Harm
www.P65Warnings.ca.gov.
As required by the State of California Proposition 65.



1.B Model Identification

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

Model Character Designation

1-3 Model Series Designation
M T 2 = Mighty Therm2

4 Usage
H = Hydronic
V = Volume Water

5-8 Size
0 2 0 0 = 199,900 BTU/h input (MT2V only)
0 3 0 0 = 300,000 BTU/h input
0 4 0 0 = 399,900 BTU/h input

9 Fuel
N = Natural Gas
P = Propane

10 Altitude
A = 0-10,000 feet

11 Location
C = Indoor and Outdoor*

12 Firing Mode
C = On-Off (standard)
K = Two-stage (optional)

13 Revision
2 = Revision Level 2 (MT2H only)
3 = Revision Level 3 (MT2V only)

14 Heat Exchanger
B = Glass-lined CI / copper / brz trim (std. MT2V)
C = Glass-lined cast iron / copper (std. MT2H)
N = Glass-lined cast iron / cu-nickel
P = Glass-lined cast iron / cu-nickel / brz trim
2 = Glass-lined cast iron / copper, brz trim, HLW
5 = Glass-lined cast iron / cu-nickel / brz, HLW

15 Options Code
X = Standard unit
L = Low temperature control (std. MT2V)

16 Pump Options
X = No Pump
N = Pump mounted, normal water, Taco
S = Pump mounted, soft water pump (MT2V only), Taco

*Outdoor installation of volume water heaters is not permitted in Canada.

1.C Warranty

Laars Heating Systems' Mighty Therm2 boilers and water heaters are covered by a limited warranty. The owner should fill out the warranty registration card and return it to Laars Heating Systems.

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.D Dimensions

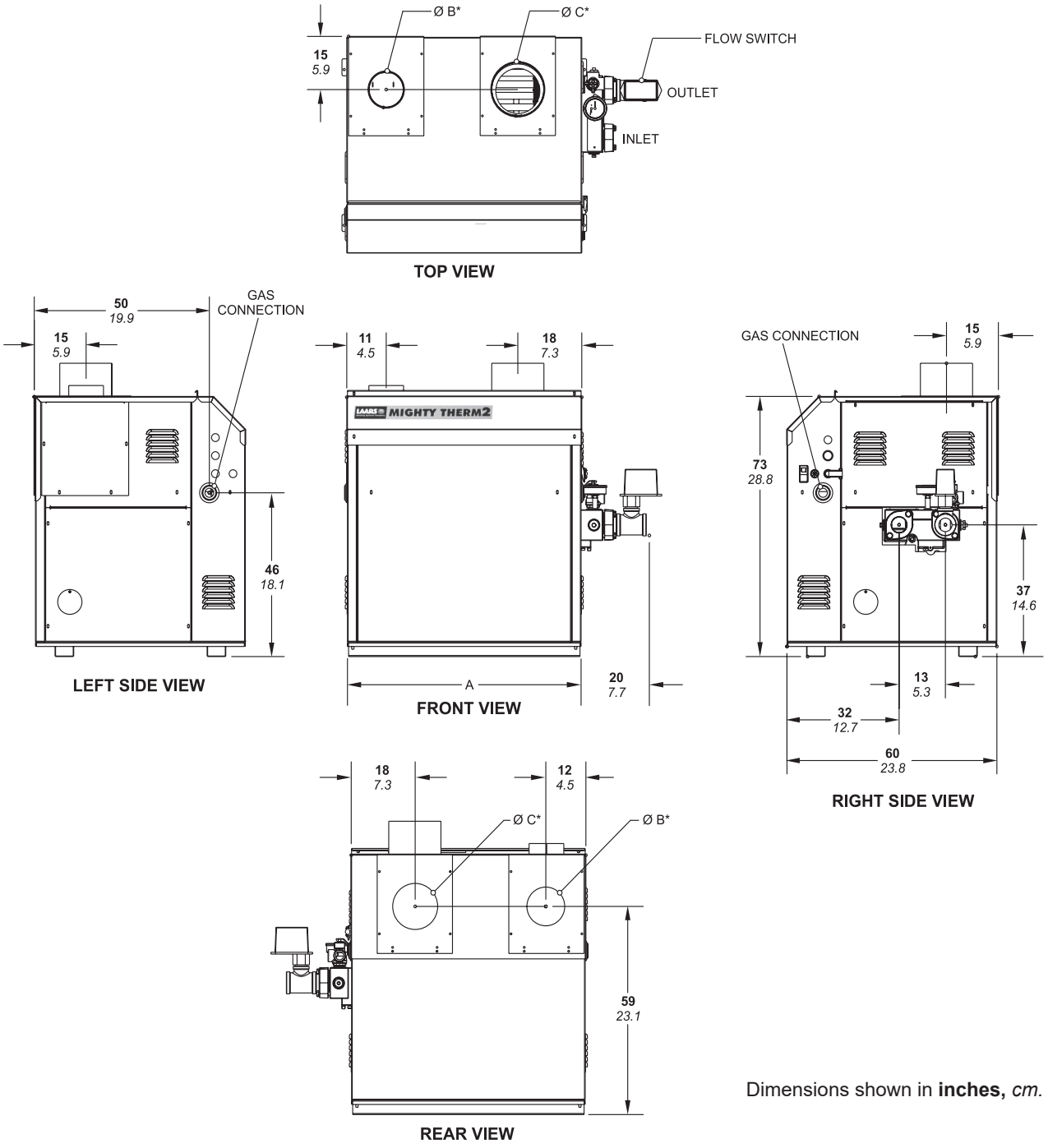
See Figure 1 and Figure 2

1.E 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**. These Boilers or Water Heaters must 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.)

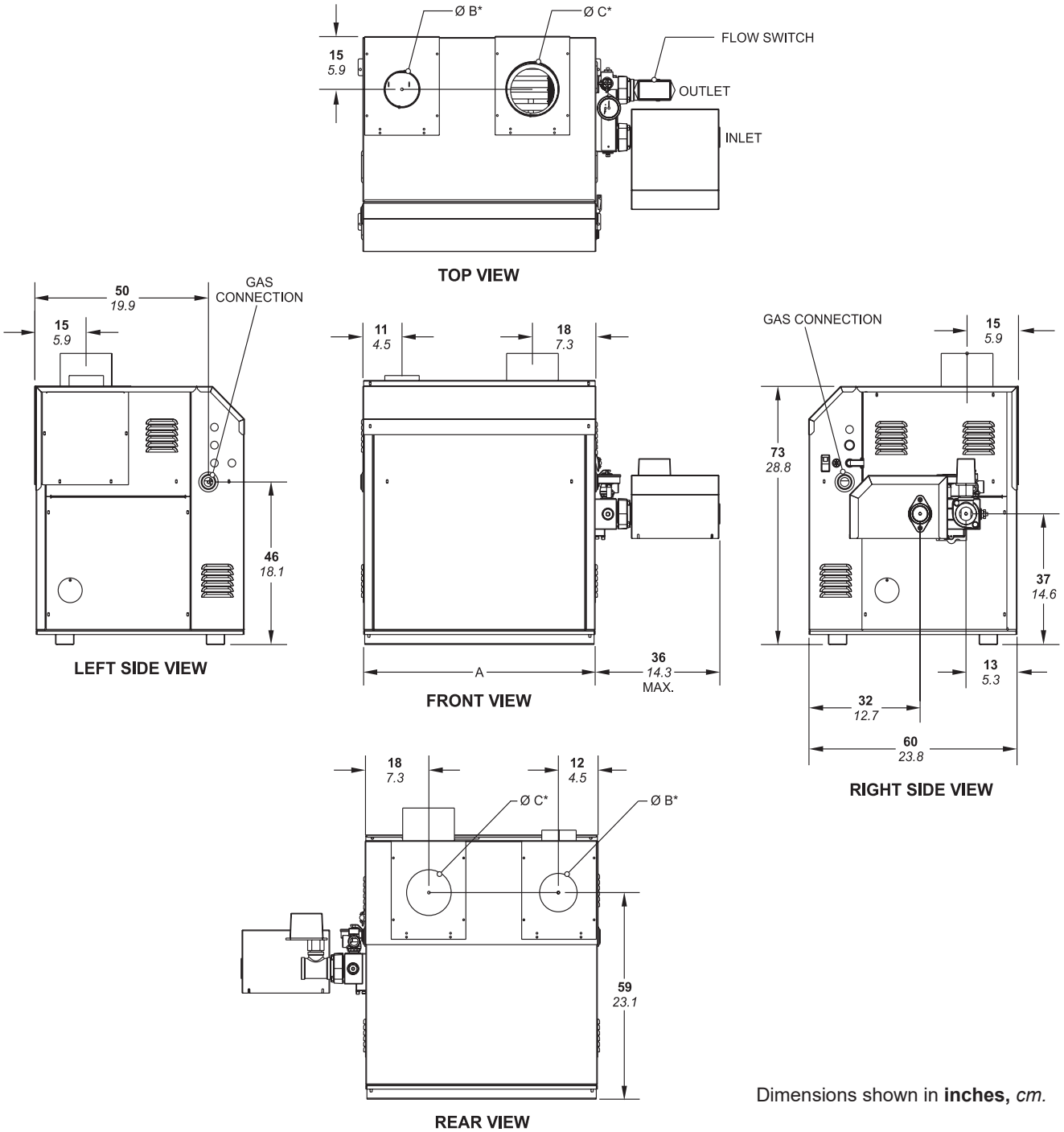


Dimensions shown in **inches,** *cm.*

Model	A		Combustion Air Connection B*		Vent Connection C*		Horizontal (Cat III) Vent Pipe Size	
	in.	*cm*	**in.**	*cm*	**in.**	*cm*	**in.**	*cm*
200	**20.5**	*52*	**4**	*10*	**5**	*13*	**4**	*10*
300	**26.5**	*67*	**4**	*10*	**6**	*15*	**5**	*13*
400	**33.6**	*85*	**6**	*15*	**7**	*18*	**6**	*15*

*Air and vent connections may be on the top or back of this appliance, and are field convertible.

Figure 1. Dimensional Data - Non Pump Mounted.



Dimensions shown in **inches,** *cm.*

Model	A		Combustion Air Connection B*		Vent Connection C*		Horizontal (Cat III) Vent Pipe Size	
	in.	*cm*	**in.**	*cm*	**in.**	*cm*	**in.**	*cm*
200	**20.5**	*52*	**4**	*10*	**5**	*13*	**4**	*10*
300	**26.5**	*67*	**4**	*10*	**6**	*15*	**5**	*13*
400	**33.6**	*85*	**6**	*15*	**7**	*18*	**6**	*15*

*Air and vent connections may be on the top or back of this appliance, and are field convertible.

Figure 2. Dimensional Data - Pump Mounted.

Heater Size	Vent Collar Size		Horizontal Vent Pipe Diameter		Intake Air Collar & Pipe Diameter		Min. Intake Length		Min. Vent Length		Max. Intake / Vent Length		Max. No. of Elbows	Side Vent Terminal Part Number	Side Wall Combustion Air Terminal Part Number
	in	*cm*	**in**	*cm*	**in**	*cm*	**ft**	*m*	**ft**	*m*	**ft**	*m*			
200	**5**	*13*	**4**	*10*	**4**	*10*	**0***	*0*	**3**	*1*	**50**	*15*	3	CA003101	CA003201
300	**6**	*15*	**5**	*13*	**4**	*10*	**0***	*0*	**3**	*1*	**50**	*15*	3	CA003102	CA003201
400	**7**	*18*	**6**	*15*	**6**	*15*	**0***	*0*	**3**	*1*	**50**	*15*	3	CA003103	CA003202

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

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.

during operation and service (circulator replacement, control replacement, etc.). When vented vertically, the appliance 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.

1.F Locating Pump-Mounted Water Heater with Respect to Storage Tank(s)

For best results, a pump-mounted water heater should be located within 15 feet (4.6m) of the storage tank(s). The pump is sized for 30 feet (9.1m) of piping.

If the appliance must be installed with longer piping runs, then larger diameter pipe or tubing may be acceptable. Consult the factory for assistance.

1.G Locating Pump-Mounted Boiler with Respect to Return/Supply Header

For the best results, a pump-mounted unit must be installed within 15 feet (4.6m) of supply and return manifolds or tanks.

If the appliance must be installed with longer piping runs, then larger diameter tubing may be acceptable. Consult the factory for assistance.

1.H 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 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.

SECTION 2 Venting and Combustion Air

⚠ WARNING

For indoor installations, as an additional measure of safety, the manufacturer 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, el fabricante 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.

⚠ CAUTION

CO needs to be less than 150 ppm.

⚠ ATTENTION

Le CO doit être inférieur à 150 ppm

NOTE: The installer must verify that at least one carbon monoxide alarm has been installed within a residential living space or home following the alarm manufacturer's instructions and applicable local codes before putting the appliance into operation. It is important for carbon monoxide alarms to be installed, maintained, and replaced following the alarm manufacturer's instructions and applicable local codes.

REMARQUER : L'installateur est tenu de vérifier qu'au moins une alarme de détection de monoxyde de carbone soit installée dans un espace résidentiel ou dans un domicile conformément aux directives du fabricant de l'alarme et aux codes locaux applicables avant de mettre l'appareil en service.

2.A Combustion Air

These boilers and 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.

This 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.A.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 1 shows data for this sizing method, for each boiler or water heater.

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

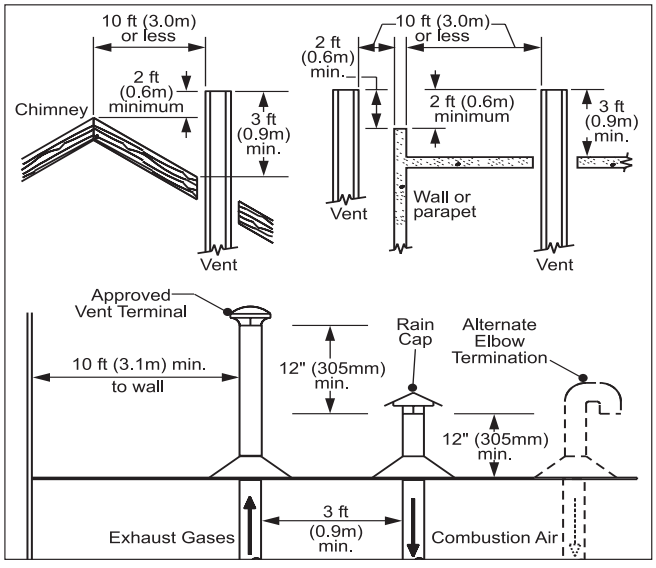


Figure 3. Combustion Air and Vent Through Roof.

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.

Boiler Model	Each Opening*	
	Square inches	Square cm
200	**50**	323
300	**75**	484
400	**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.

2.A.2 Intake Combustion Air

The combustion air can be taken through the wall, or through the roof. When taken from the wall, it must be taken from out-of-doors by means of the manufacturer's 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 3).

Use single-wall galvanized pipe 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. These 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. This appliance loses less than 1 percent of its input rating to the room, but other heat sources may be present.

2.B Venting

2.B.1 Vent Categories

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

All vent systems for this appliance, which discharge horizontally (without the use of a power venter) are considered Category III vent systems.

⚠ WARNING

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

2.B.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, 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.B.3 Common Venting Systems

These units are Category I fan-assisted when vented vertically and adhering to all applicable codes. These 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 a 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 évent 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 évent commun bouché. Si un fonctionnement sécuritaire de tous les appareils reliés à un évent commun et si la prévention des dégagements accidentels de gaz de combustion dans des zones habitées ne peuvent pas être assurés, un évent commun ne doit pas être mis en place et les appareils doivent être munis d'évents 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 unit 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 unit 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 this product, please call the factory at the 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.B.4 Category III Vent

When this appliance 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.

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.

Route the vent pipe to the heater as directly as possible. Seal all joints and provide adequate hangers every 4' or 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.

		Canadian Installations[1]	U.S. Installations[2]
A =	Clearance above grade, veranda, porch, deck, or balcony	12 in (30 cm)	12 in (30 cm)
B =	Clearance to window or door that may be opened	• 6 in (15 cm) for appliances ≤ 10,000 Btuh (3 kW) • 12 in (30 cm) for appliances > 10,000 Btuh (3 kW) and ≤ 100,000 Btuh (30 kW) • 36 in (91 cm) for appliances >100,000 Btuh (30 kW)	• 6 in (15 cm) for appliances ≤ 10,000 Btuh (3 kW) • 9 in (23 cm) for appliances > 10,000 Btuh (3 kW) and ≤ 50,000 Btuh (15 kW) • 12 in (30 cm) for appliances >50,000 Btuh (15 kW)
C =	Clearance to permanently closed window	See Note 4	See Note 5
D =	Vertical clearance to ventilated soffit located above the terminal within a horizontal distance of 2 ft (61 cm) from the center line of the terminal	See Note 4	See Note 5
E =	Clearance to unventilated soffit	See Note 4	See Note 5
F =	Clearance to outside corner	See Note 4	See Note 5
G =	Clearance to inside corner	See Note 4	See Note 5
H =	Clearance to each side of centerline extended above meter / regulator assy	3 ft (91 cm) within a height of 15 ft (4.6 m)	See Note 5
I =	Clearance to service regulator vent outlet	3 ft (91 cm)	See Note 5
J =	Clearance to nonmechanical air supply inlet to building or the combustion air inlet to any other appliance	• 6 in (15 cm) for appliances ≤ 10,000 Btuh (3 kW) • 12 in (30cm) for appliances > 10,000 Btuh (3 kW) and ≤ 100,000 Btuh (30 kW) • 36 in (91 cm) for appliances > 100,000 Btuh (30 kW)	• 6 in (15 cm) for appliances ≤ 10,000 Btuh (3 kW) • 9 in (23cm) for appliances > 10,000 Btuh (3 kW) and ≤ 50,000 Btuh (15 kW) • 12 in (30 cm) for appliances > 50,000 Btuh (15 kW)
K =	Clearance to a mechanical air supply inlet	6 ft (1.83 m)	3 ft (91 cm) above if within 10 ft (3 m) horizontally
L =	Clearance above paved sidewalk or paved driveway located on public property	7 ft (2.13 m)†	7 ft (2.13 m) for mechanical draft systems (Category I appliances). Vents for Category II and IV appliances cannot be located above public walkways or other areas where condensate or vapor can cause a nuisance or hazard*
M =	Clearance under veranda, porch, deck, or balcony	12 in (30 cm)‡	See Note 5

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

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

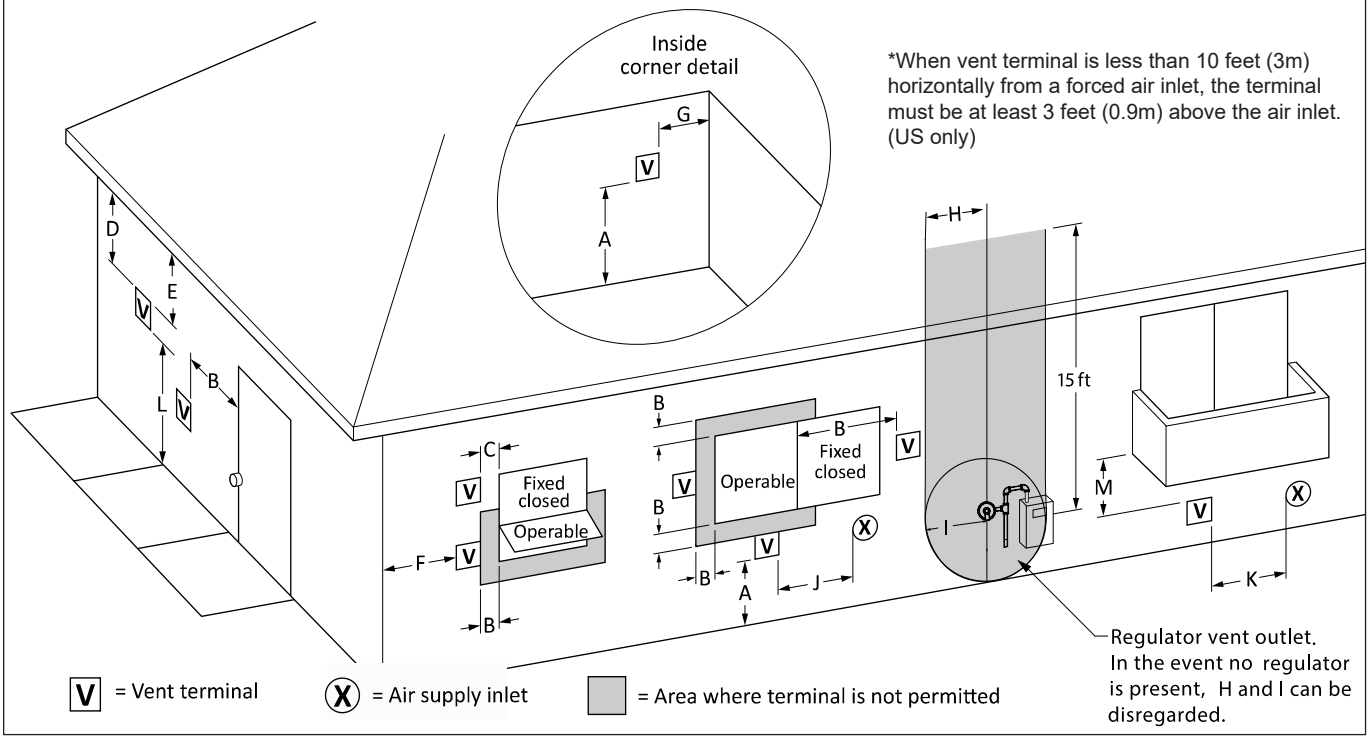


Figure 4. Vent Terminal Clearance.

2.C Locating Vent & Combustion Air Terminals

2.C.1 Side Wall Vent Terminal

The appropriate 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 4 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 boiler or water heater uses ducted combustion air from an intake terminal located 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.C.2 Side Wall Combustion Air Terminal

The manufacturer's suggested side wall combustion air terminal 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 appliance 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 4).

2.C.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 3).

2.C.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 3). 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.D Common Vent Test — Boilers

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

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

1. Seal any unused openings in the common venting system.
2. Visually inspect the venting system for proper size and horizontal pitch and determine there is 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.
7. 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.D Vérification des évents communs — Chaudières

Lorsqu'une chaudière existante est déconnectée du réseau d'évents commun, ce réseau d'évents 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'évents commun utilisé, alors que les autres appareils qui sont encore connectés au réseau commun d'évents ne sont pas en fonctionnement.:

1. *Sceller toutes les ouvertures non utilisées du système d'évacuation.*
2. *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.*
3. *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 sécheuses, tous les appareils non raccordés au système d'évacuation common 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.*
4. *Mettre l'appareil inspecté en marche. Suivre les instructions d'allumage. Réegler le thermostat de façon continue.*
5. *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.*
6. *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.*
7. *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.E 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 appliance.

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" length of pipe, and a rain cap are included for the exhaust vent opening.

If local codes allow, kits are not required for outdoor units. The installer may use 12" 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.

Model (Size)	Outdoor Vent and Air Terminal Kit
200	CA003001
300	CA003002
400	CA003003

Table 6. Vent / Air Kits for Outdoor Units.

*Outdoor installation of volume water heaters is not permitted in Canada.

SECTION 3 Gas Supply and Piping

3.A Gas Supply and Piping

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

This appliances'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. All models are equipped to operate at elevations up to 10,000 feet (3050m). These 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. Verify the inlet gas supply pressure.

	Min	Max
Natural Gas	4" W.C.	10.5" W.C.
Propane	9" W.C.	13" W.C.

3. Refer to Table 7, to 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: This 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.

Distance from Gas Meter or Last Stage Regulator						
Model and Gas Type	**0-100'**	0-31 m	**100-200'**	31-61m	**200-300'**	61-91m
200 natural	**1¼"**	3.2 cm	**1¼"**	3.2 cm	**1¼"**	3.2 cm
200 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
400 natural	**1¼"**	3.2 cm	**1½"**	4.0 cm	**2"**	5.0 cm
400 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.A Boiler

4.A.1 Heating System Piping: Hot Supply Connections — Boiler

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

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

Pipe the discharge of the relief valve (full size) to a drain or in a manner to prevent injury in the event of pressure relief. Install an air purger, an air vent, a diaphragm-type expansion tank, and a hydronic flow check in the system supply loop. Minimum fill pressure must be 12 psig (82.7 kPa). Install shutoff valves where required by code.

Suggested piping diagrams are shown as Figure 5, Figure 6, Figure 7, and Figure 8, and Figure 9. These diagrams are meant only as a guide. Components required by local codes must be properly installed.

4.A.2 Cold Water Make-Up — Boiler

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

NOTE: The boiler, when used in connection with a refrigeration system, must be installed so the chilled medium is piped in parallel with the boiler with appropriate valves to prevent the chilled medium from entering the boiler.

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

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

4.A.3 Water Flow Requirements — Boiler

A hydronic heating (closed loop) application recirculates the same fluid in the piping system. As a result, no new minerals or oxygen are introduced into the system. To ensure a proper operating temperature leading to long boiler life, a flow rate has been established based on the fluid temperature rise for this specific size boiler.

Pump-mounted boilers can be ordered for use in primary secondary piping systems. The pumps used are sized for the head loss through the heater, plus 30 feet (9.1 m) of full-sized piping (same size as boiler outlet) and a normal number of fittings.

Table 8 specifies water flow rates for boilers, which will enable the user to size a pump. The head loss shown is for the heater only, and the user will need to add the head loss of the system piping to properly size the pump.

The minimum inlet water temperature for the appliance is 120°F (49°C) to avoid condensing on the copper coils.

4.A.4 Freeze Protection — Boiler

Boiler installations are not recommended in areas where the danger of freezing exists unless proper precautions are made for freeze protection. A non toxic, heating system, anti-freeze may be added to the hydronic system provided that the concentration does not exceed 50% and the anti freeze contains an anti foamant. When a 50/50 mixture is used, increase the water flow requirements by 15%, and increase the head loss requirements by 20%.

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

IMPORTANT NOTES: Different glycol products may provide varying degrees of protection. Glycol products must be maintained properly in a heating system, or they may become ineffective. Consult the glycol specifications, or the glycol manufacturer, for information about specific products, maintenance of solutions, and set up according to your particular conditions. Never use ethylene glycol (automotive antifreeze).

4.B Water Connections — Water Heater

4.B.1 Water System Piping — Water Heater

Hot water piping should be supported by suitable hangers or floor stands. Do not support piping with this appliance. Due to expansion and contraction of copper pipe, consideration should be given to the type of hangers used. Rigid hangers may transmit noise through the system resulting from the piping sliding in the hangers. It is recommended that padding be used when rigid hangers are installed.

This appliance can be used with several different types of readily available storage tanks. A pump draws water from the storage tank and pumps the water through the heater and back into the tank. Pump-mounted units have a circulating pump built into the water heater. The pumps used are sized for the head loss through the heater, plus 30 feet (9.1 m) of full-sized piping (same size as boiler outlet) and a normal number of fittings. Pumps used on pump-mounted unit are sized for soft/normal or hard water, so make sure a pump-mounted unit matches the water quality of the installation.

Pipe the outlet from the heater's relief valve such that any discharge from the relief valve 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 line must be installed to allow complete drainage of both the valve and the line.

Suggested piping diagrams are shown as Figure 5, Figure 6, Figure 7, and Figure 8, and Figure 9. These diagrams are meant only as a guide. Components required by local codes must be properly installed.

The minimum inlet water temperature for this appliance is 130°F (54°C) to avoid condensing on the copper coils.

Model (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**
200	**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**
400	**34**	**6.3**	**27**	**4.0**	**23**	**2.8**	**19**	**2.1**
Metric Equivalent								
Model (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*
200	*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*
400	*129*	*1.9*	*103*	*1.2*	*86*	*0.9*	*74*	*0.6*

Notes: 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 boiler's heat exchanger only.
N/R = not recommended.

Table 8. Water Flow Requirements - MT2H.

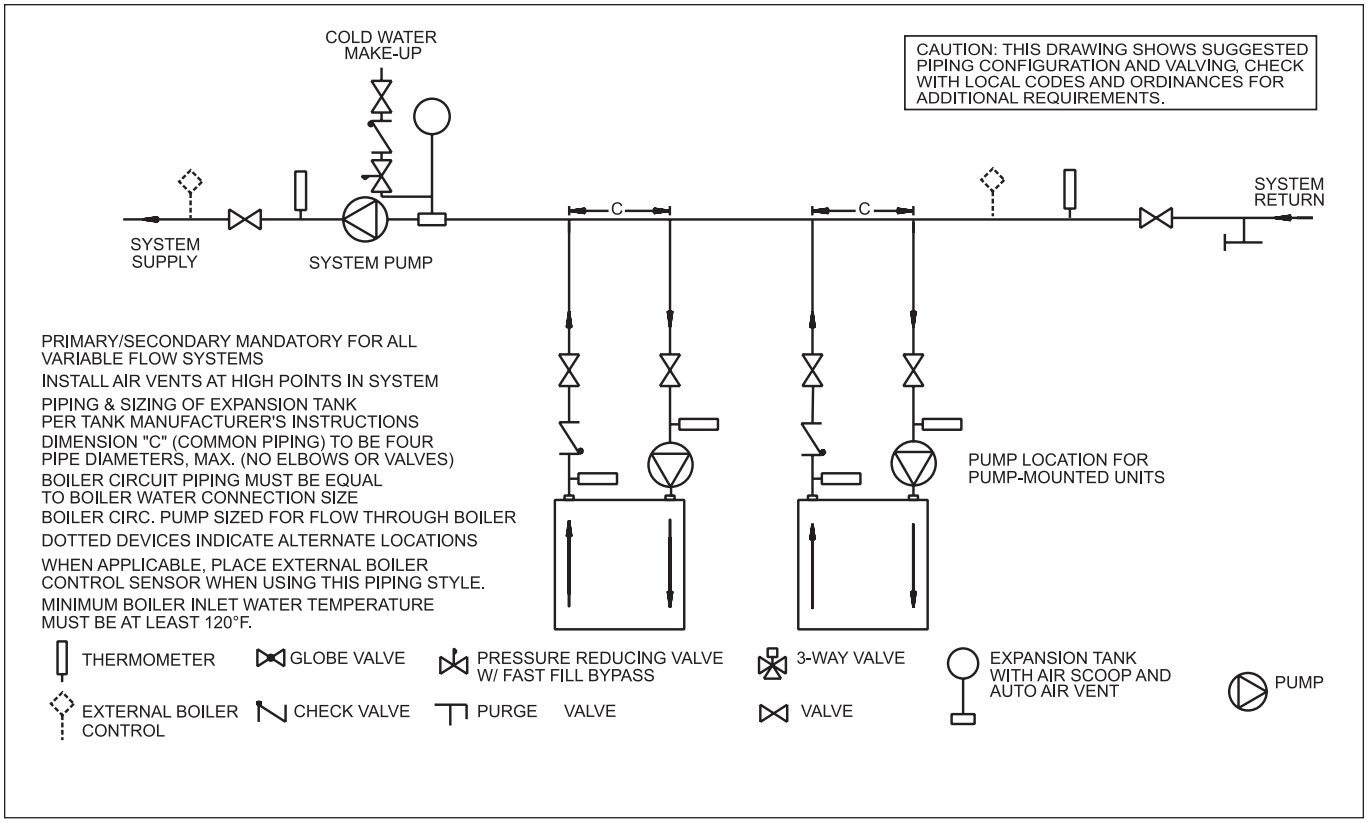


Figure 5. Hydronic Piping — Multiple Boilers, Primary Secondary System.

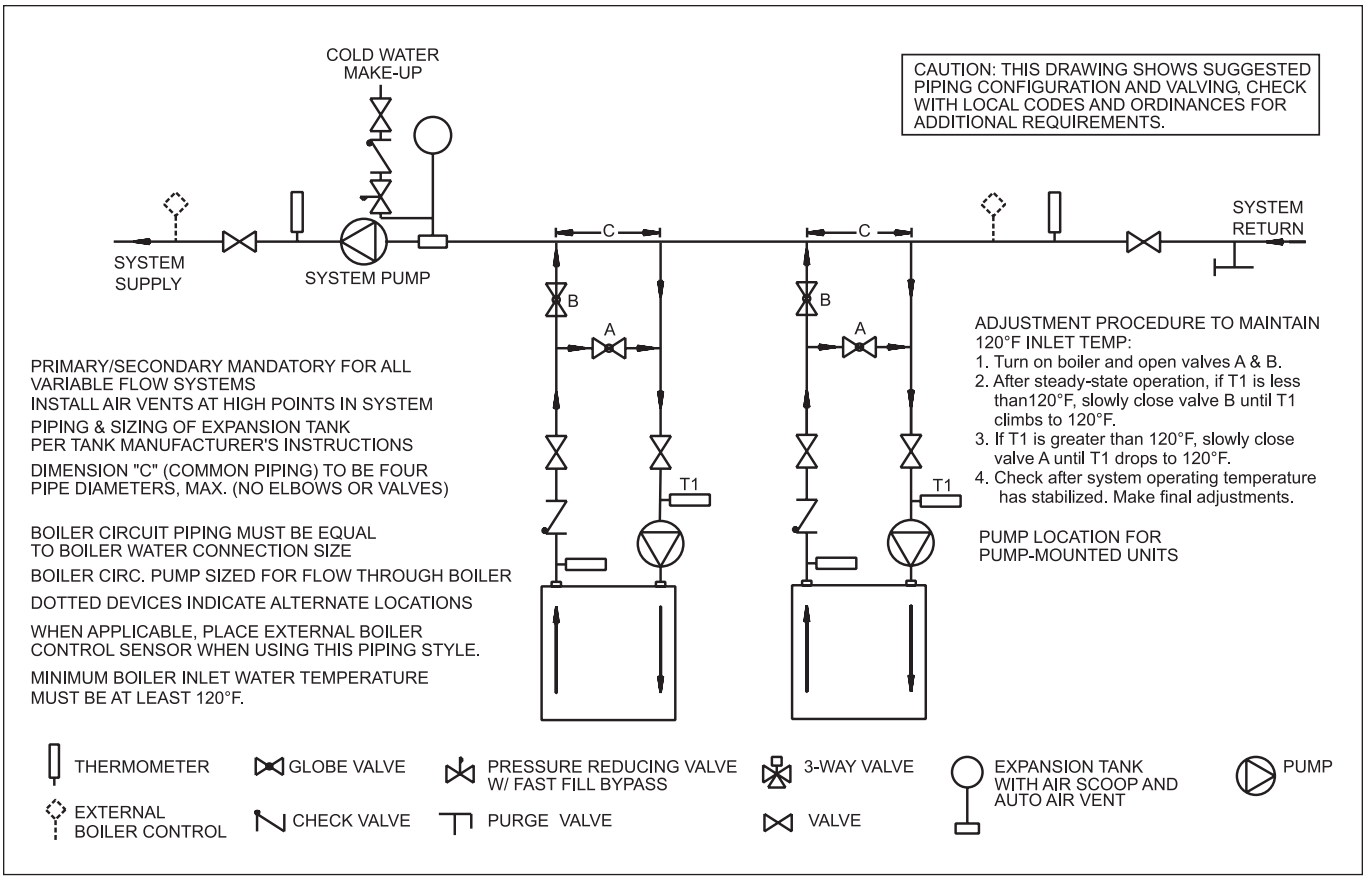


Figure 6. Hydronic Piping — Multiple Boilers, Low Temperature System.

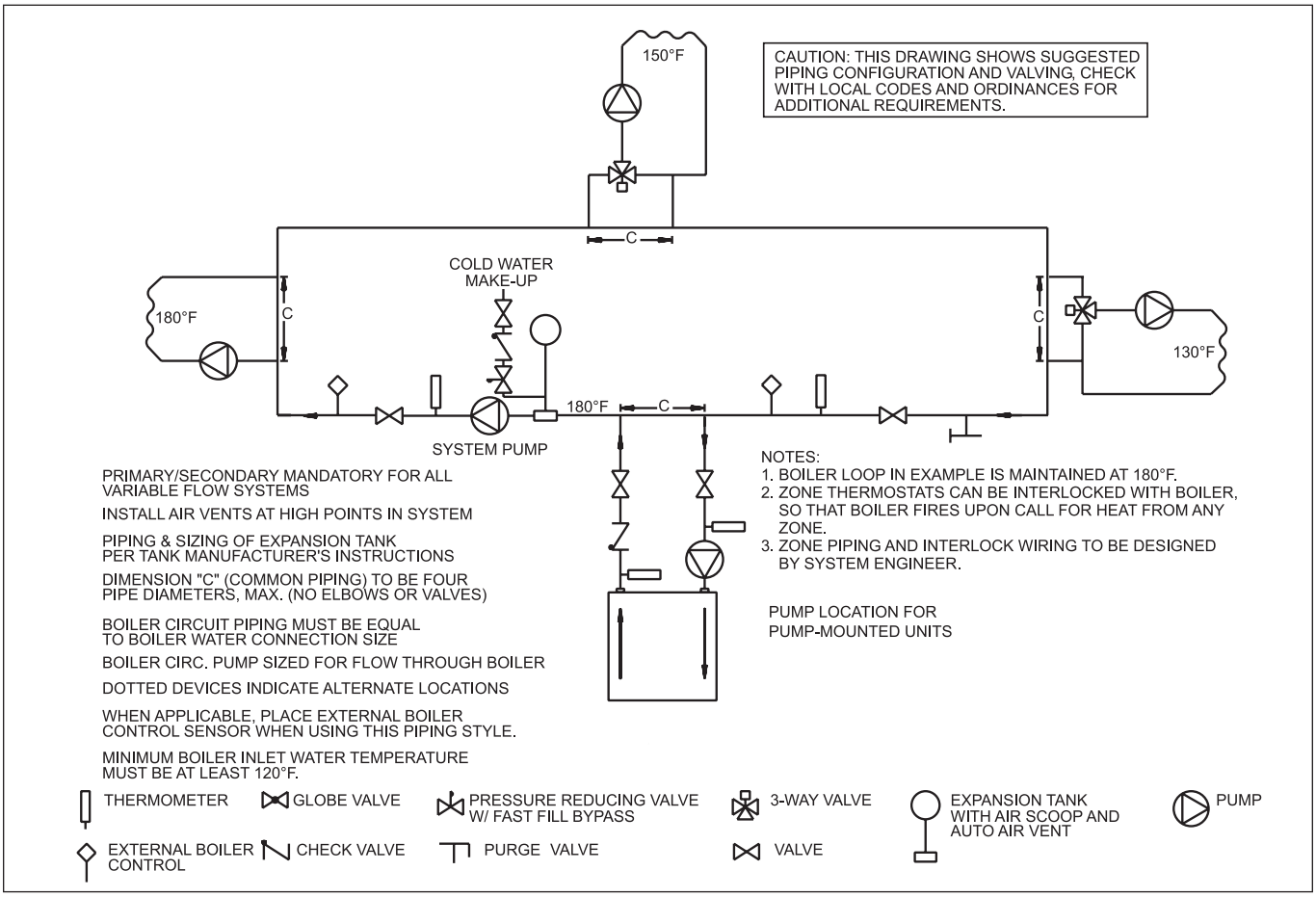


Figure 7. Hydronic Piping — One Boiler, Multi-Temperature System.

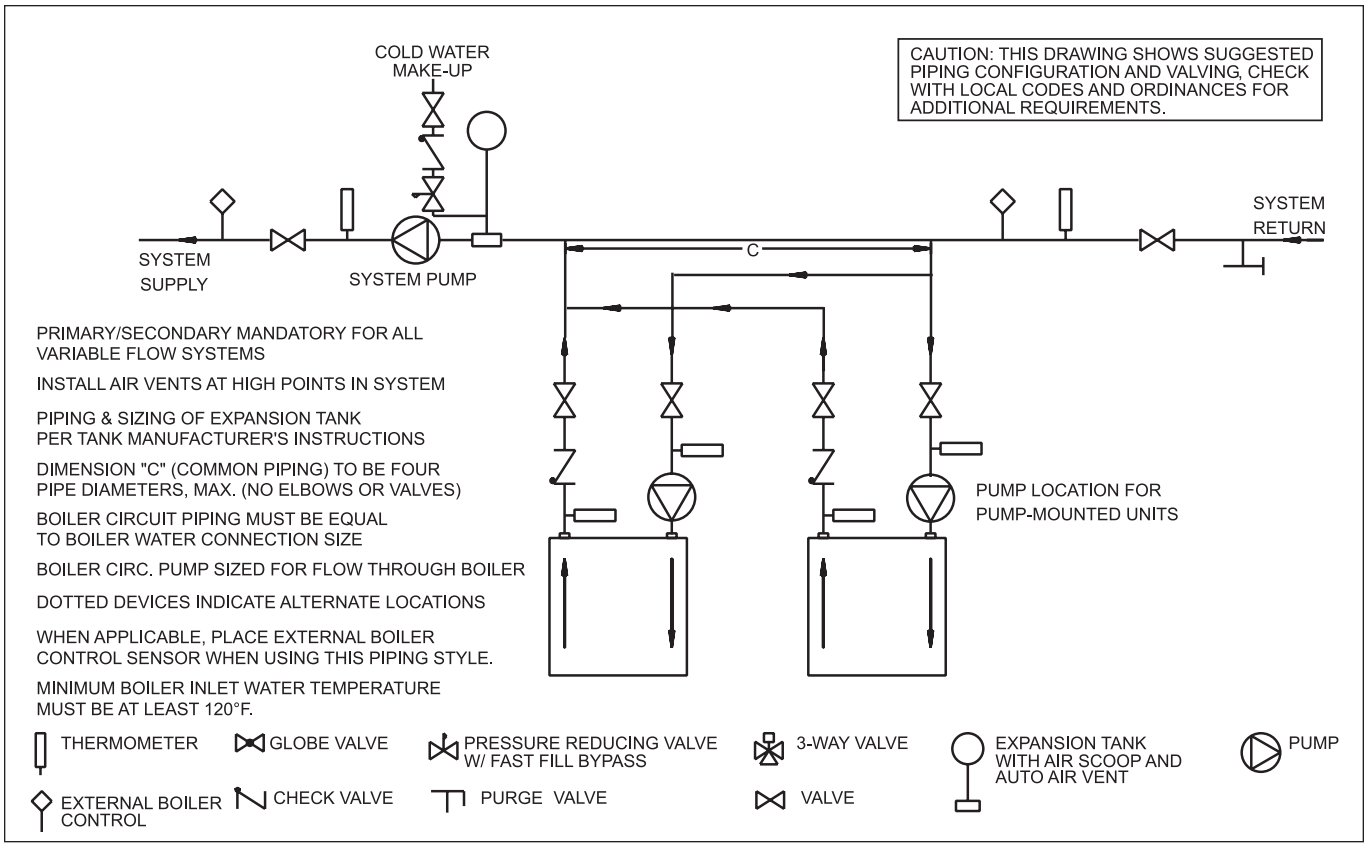


Figure 8. Hydronic Piping — Primary-Secondary, Reverse-Return.

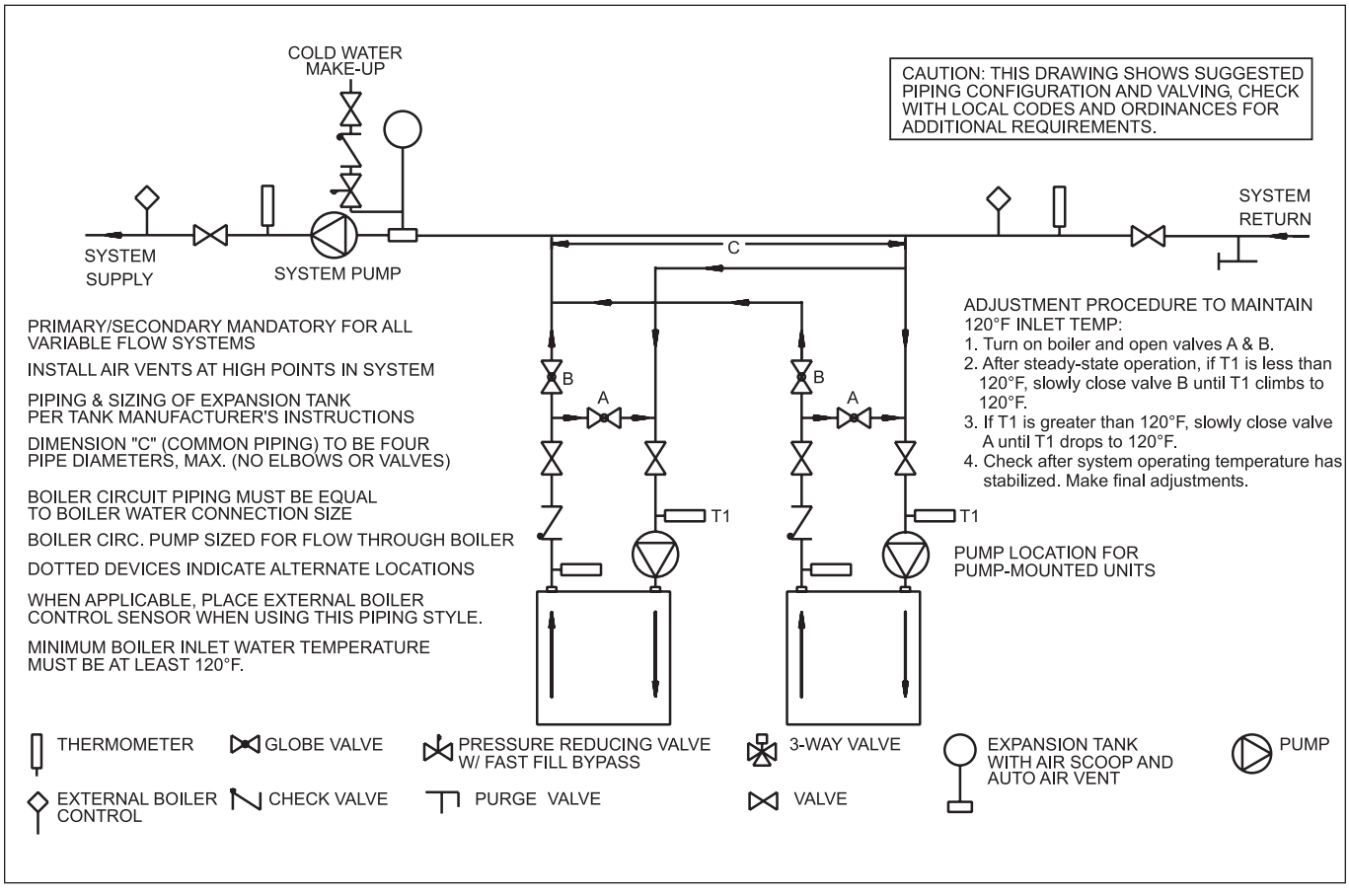


Figure 9. Hydronic Piping — Primary-Secondary, Reverse-Return, Low Temperature.

4.B.2 Hot Water Supply Piping —Water Heater

Follow the tank manufacturer's guidelines for completion of the hot water system connections.

NOTE: A listed temperature and pressure relief valve listed as complying with the Standard for Relief Valves and Automatic Gas Shutoff Devices for Hot Water Supply Systems (ANSI Z21.22/CSA 4.4), of suitable discharge capacity must be installed in the separate storage tank system.

If this 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.B.3 Water Flow Requirements — Water Heater

In a water heating application (an open system), 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 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 manufacturer's representative if you have questions or concerns about water quality.

Pump-mounted water heaters can be ordered with standard pumps for soft or normal water. The pumps used are sized for the head loss through the heater, plus 30 feet (9.1m) of full-sized piping (same size as heater outlet) and a normal number of fittings. For hard water conditions (more than 17 grains per gallon), use a non-pump-mounted heater with a properly-sized field-installed pump.

Table 9 specifies water flow rates for water heaters, which will enable the user to size a pump. The head loss shown is for the heater only, and the user will need to add the head loss of the piping system to properly size the pump.

4.B.4 Combined Water Heating (potable) and Space Heating — Water Heater

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

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

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

This water heater when used to supply potable water 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.B.5 Freeze Protection — Water Heater

Although these 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 manufacturer's representative for additional information.

✻Outdoor installation of volume water heaters is not permitted in Canada.

Model (Size)	gpm			ft			Temp Rise °F			*lpm*			*m*			*Temp. Rise °C*		
	S	**N**	**H**	**S**	**N**	**H**	**S**	**N**	**H**	*S*	*N*	*H*	*S*	*N*	*H*	*S*	*N*	*H*
200	**23**	**35**	**45**	**1.9**	**4.4**	**7.3**	**15**	**10**	**8**	*87*	*132*	*170*	*0.6*	*1.3*	*2.2*	*8*	*6*	*4*
300	**23**	**35**	**45**	**2.0**	**4.5**	**7.4**	**22**	**15**	**11**	*87*	*132*	*170*	*0.6*	*1.4*	*2.3*	*12*	*8*	*6*
400	**23**	**35**	**45**	**2.0**	**4.5**	**7.4**	**30**	**19**	**15**	*87*	*132*	*170*	*0.6*	*1.4*	*2.3*	*17*	*11*	*8*

Notes:
1. S = soft water (1 to 7.5 grains hardness)
2. N = normal water (7.6 to 17 grains hardness)
3. H = hard water (more than 17 grains hardness)
4. gpm = gallons per minute, lpm = liters per minute, ft = head loss in feet, m = head loss in meters
5. Head loss is for heater's heat exchanger only

Table 9. Water Flow Requirements - MT2V.

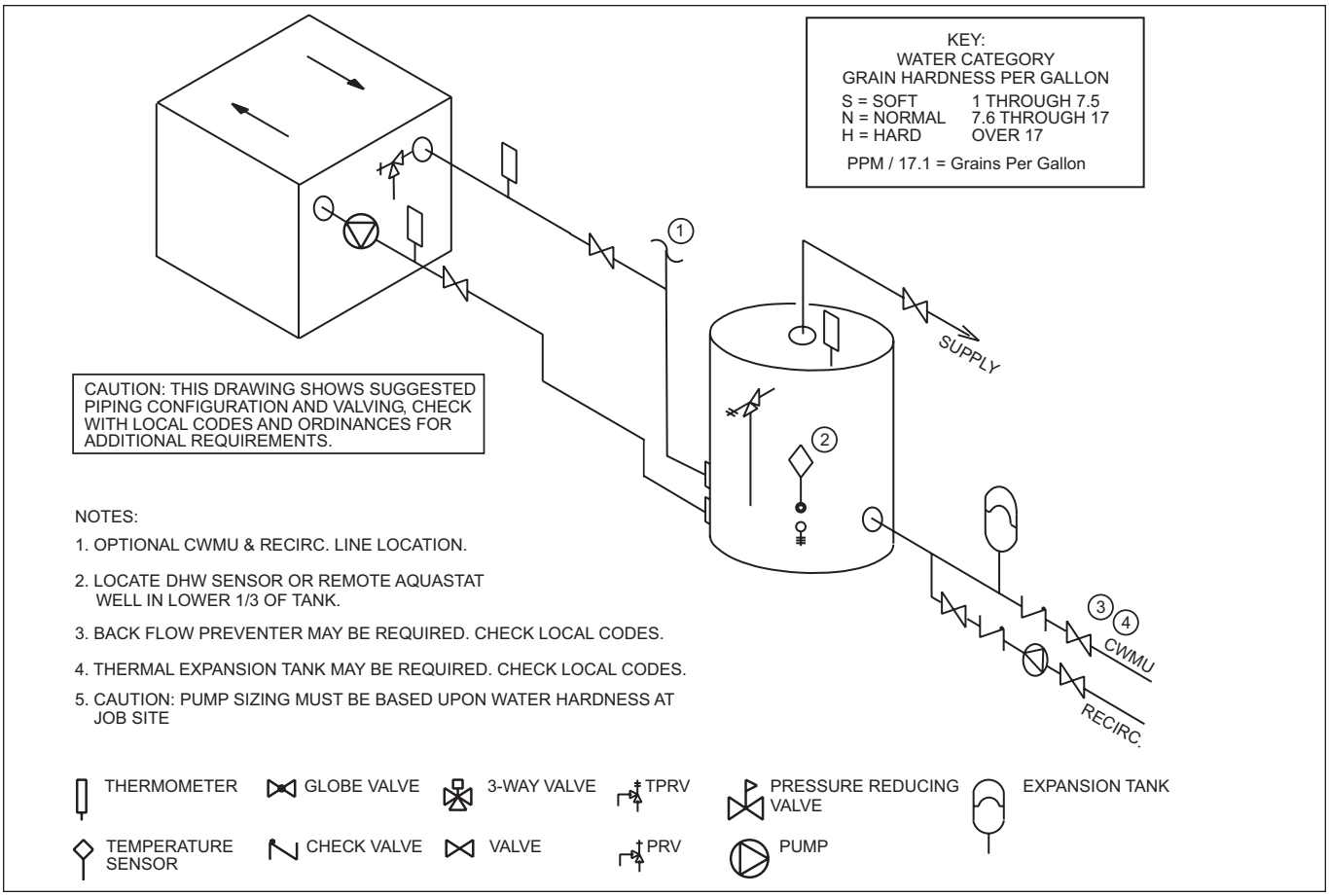


Figure 10. Water Heater Piping — One Heater, One Tank.

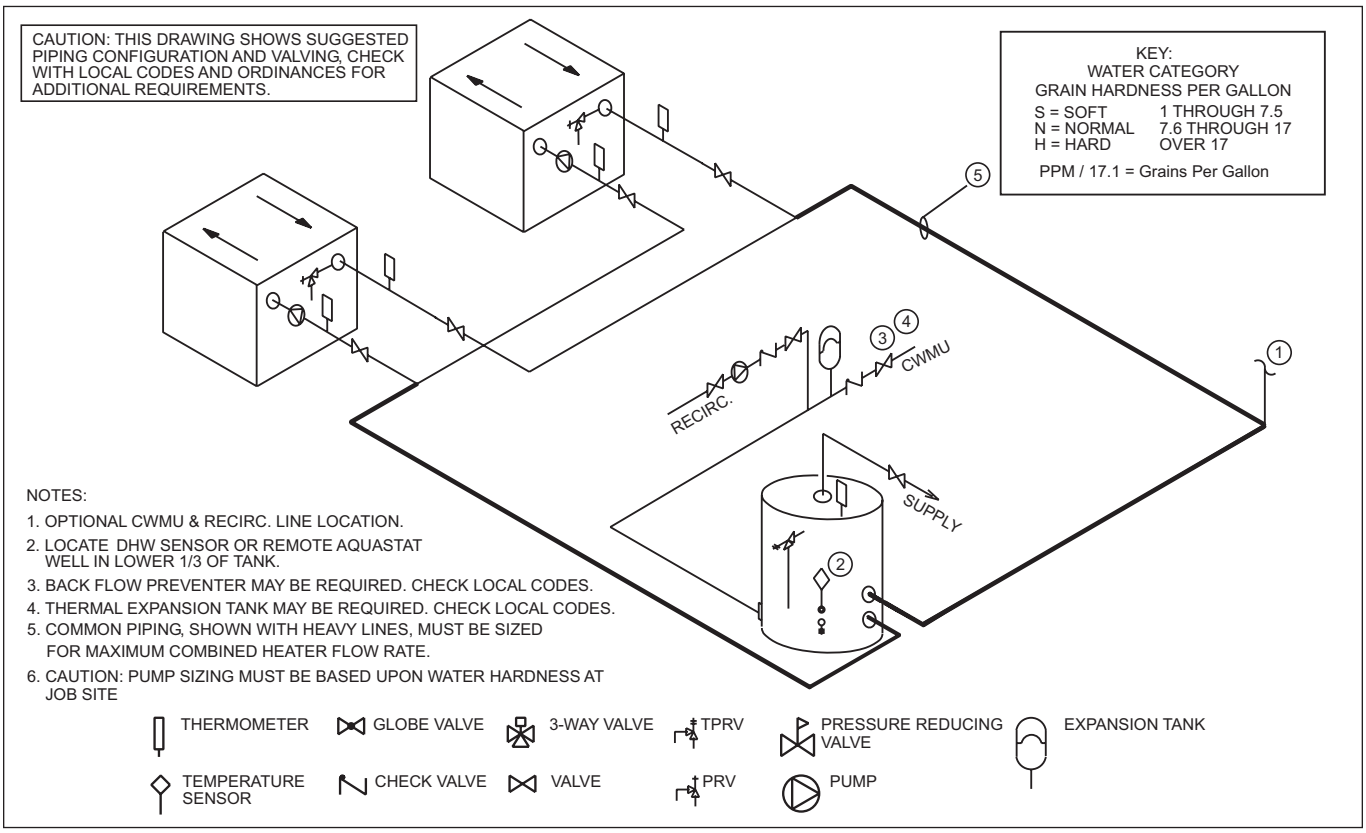


Figure 11. Water Heater Piping — Multiple Heaters, One Tank.

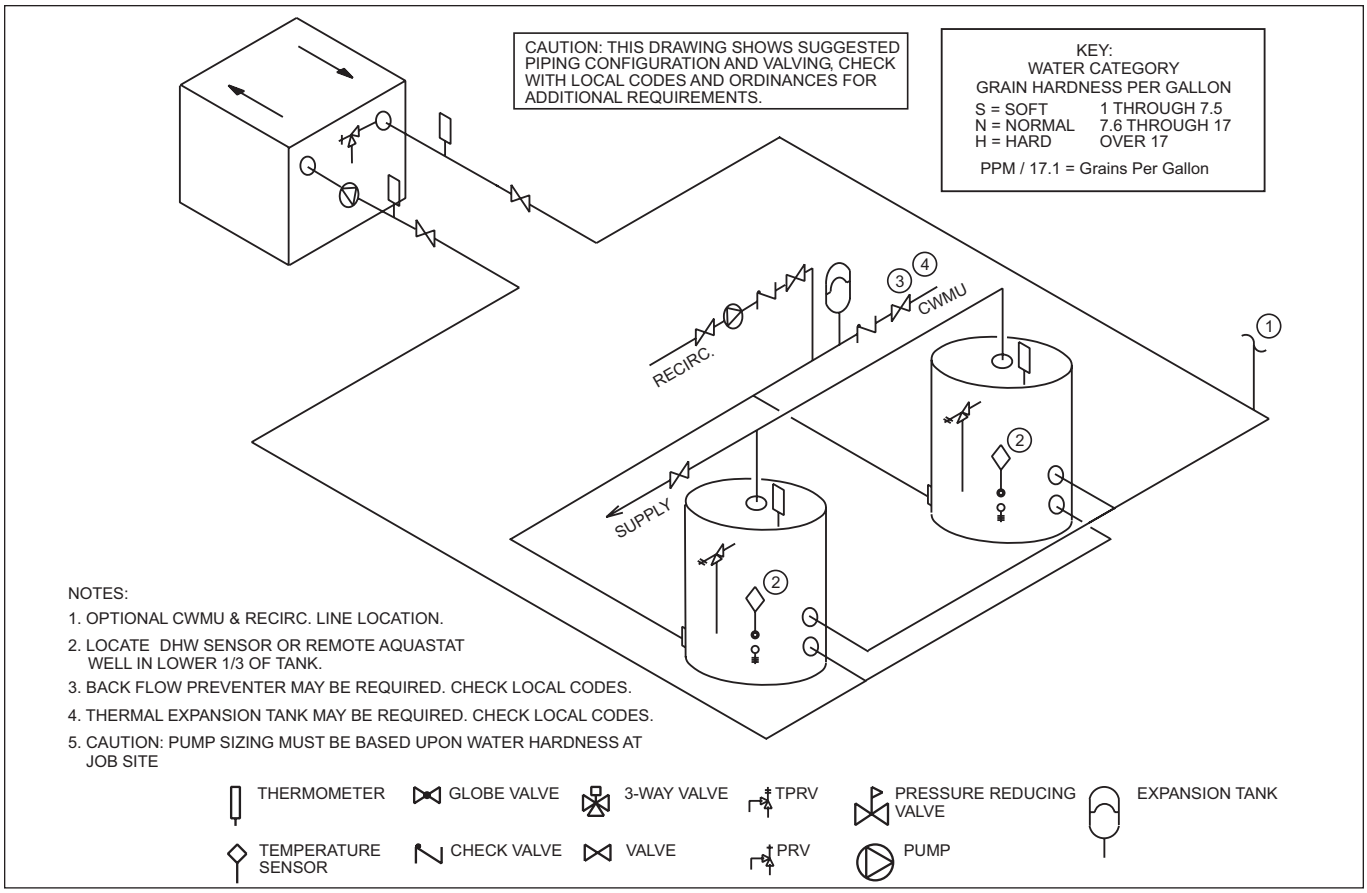


Figure 12. Water Heater Piping — One Heater, Multiple Tanks.

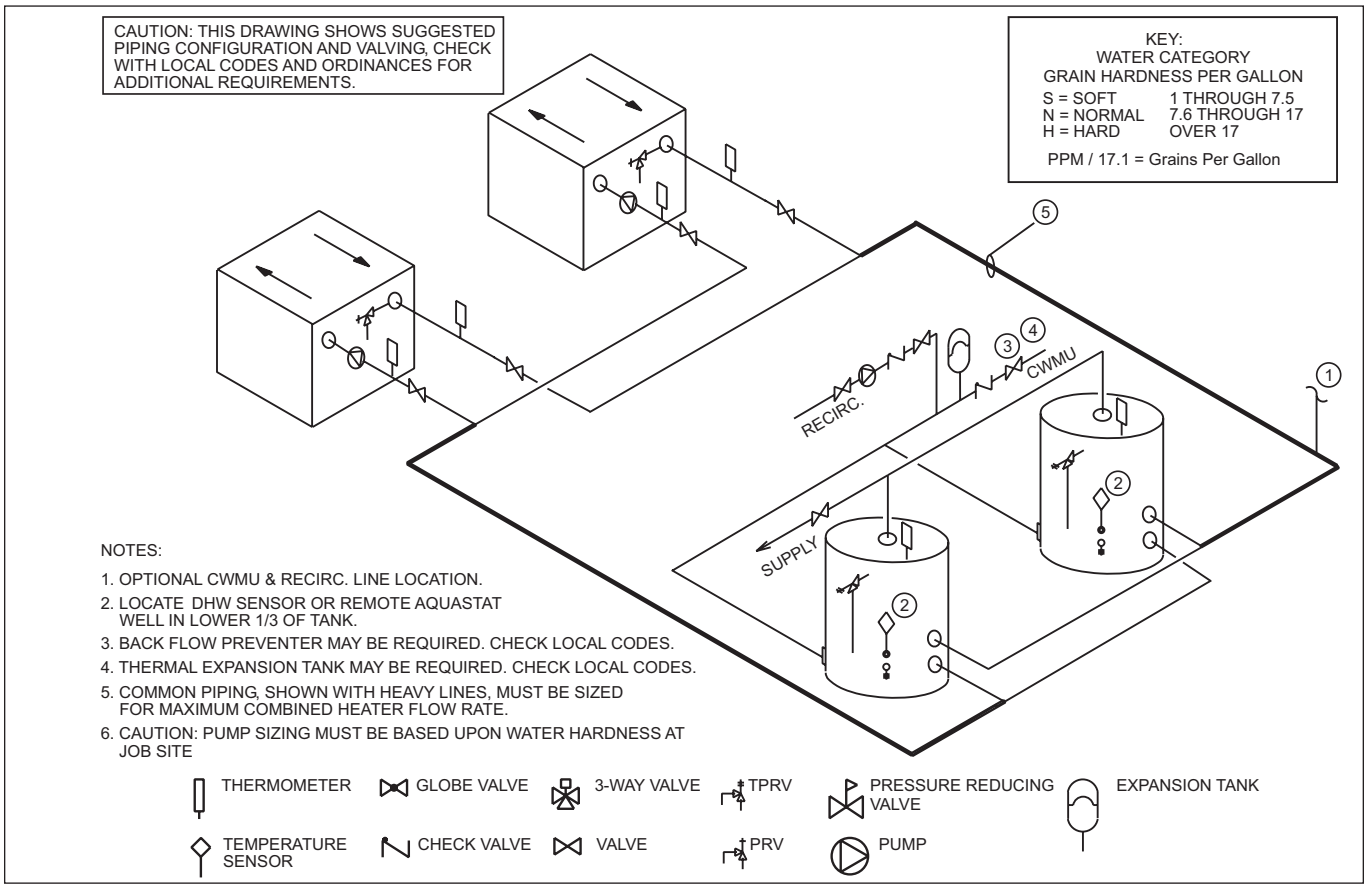


Figure 13. Water Heater Piping — Multiple Heaters, Multiple Tanks.

SECTION 5 Electrical Connections

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.A 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 boiler jacket. Ground wire can be connected to the grounding screw in the box.

5.B Field Wiring

Field Installed Pump. Do not exceed 5 amps or control damage could occur.

5.C Low Water Cutoff

When this boiler is installed above radiation level, it is required that a Low Water Cut-Off (LWCO) be installed unless this requirement is superceded by Jurisdictional requirements. Specific instructions for the installation are the following:

Locate the Field Interlocks on the wiring diagram. These are the electrical connection points for the LWCO. Follow LWCO Manufacturer's Wiring Instructions.

Mechanically, install the LWCO device in a tee fitting in the supply piping above the highest point of the boiler (unless the boiler has an existing fitting for that purpose). Follow LWCO Manufacturer's Instructions for minimum pipe sizing.

Note: This boiler is a water tube boiler that requires water flow through the heat exchanger for proper operation. It does not have an operating water level and must be full at all times. In accordance with ANSI/ASME CSD-1 Section CW-210 and The National Fuel Gas Code ANSI Z223.1/NFPA 54 Section 10.3.5 a water tube boiler shall have a water flow proving device in lieu of a Low Water Cut Off.

⚠ WARNING

The appliance must be electrically grounded in accordance with the requirements of the authority having jurisdiction or, in the absence of such requirements, with the latest edition of the National Electrical Code, ANSI/NFPA 70, in the U.S. and with latest edition of CSA C22.1 Canadian Electrical Code, Part 1, in Canada. Do not rely on the gas or water piping to ground the metal parts of the boiler. Plastic pipe or dielectric unions may isolate the boiler electrically. Service and maintenance personnel, who work on or around the boiler, may be standing on wet floors and could be electrocuted by an ungrounded boiler.

⚠ 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 1ère 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.

5.D Logic Diagrams.

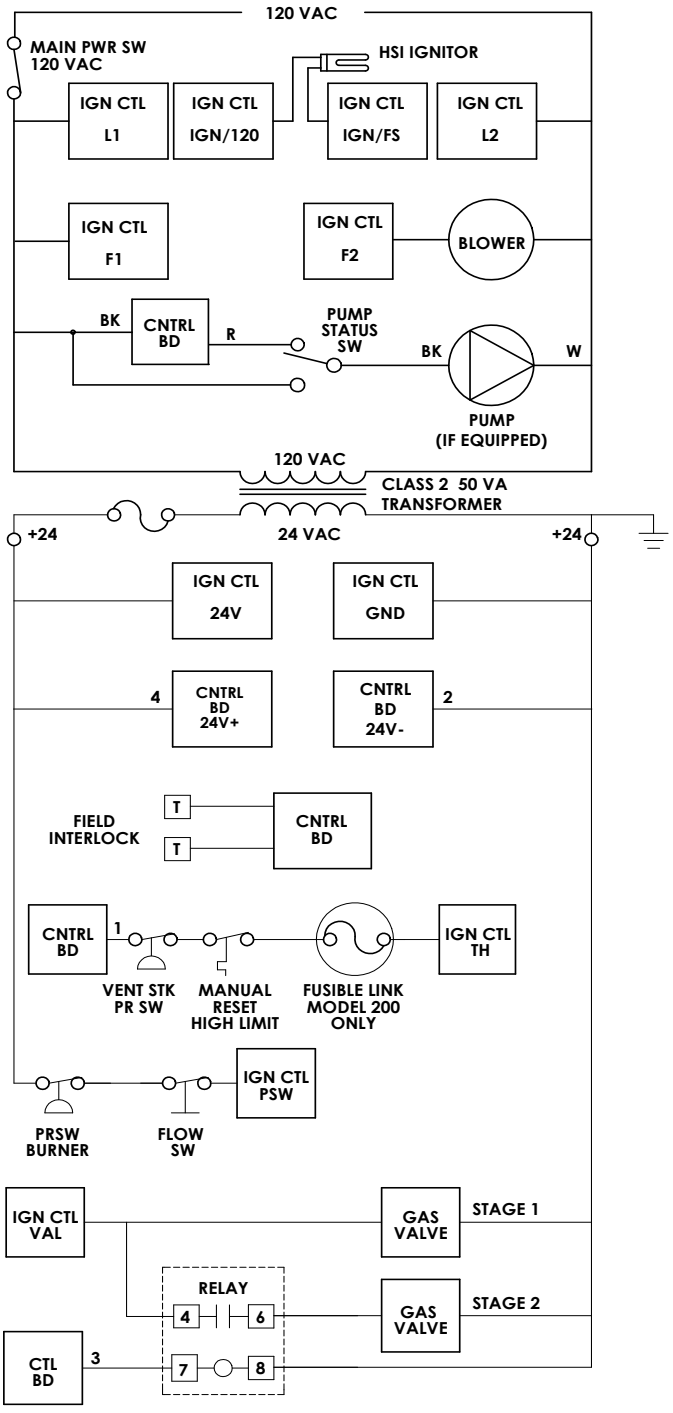


Figure 14. Logic Diagram, Hydronic Boiler

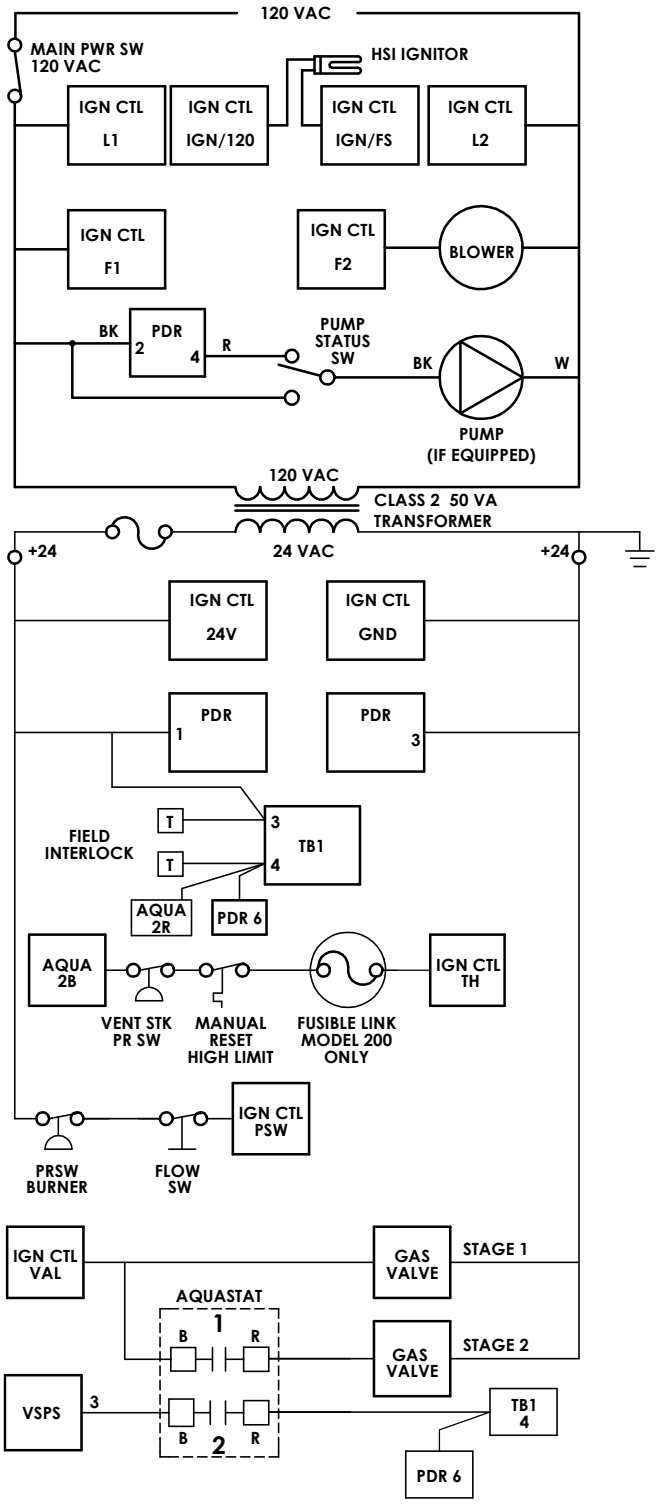


Figure 15. Logic Diagram, Volume Water Heater

5.E Wiring Diagrams.

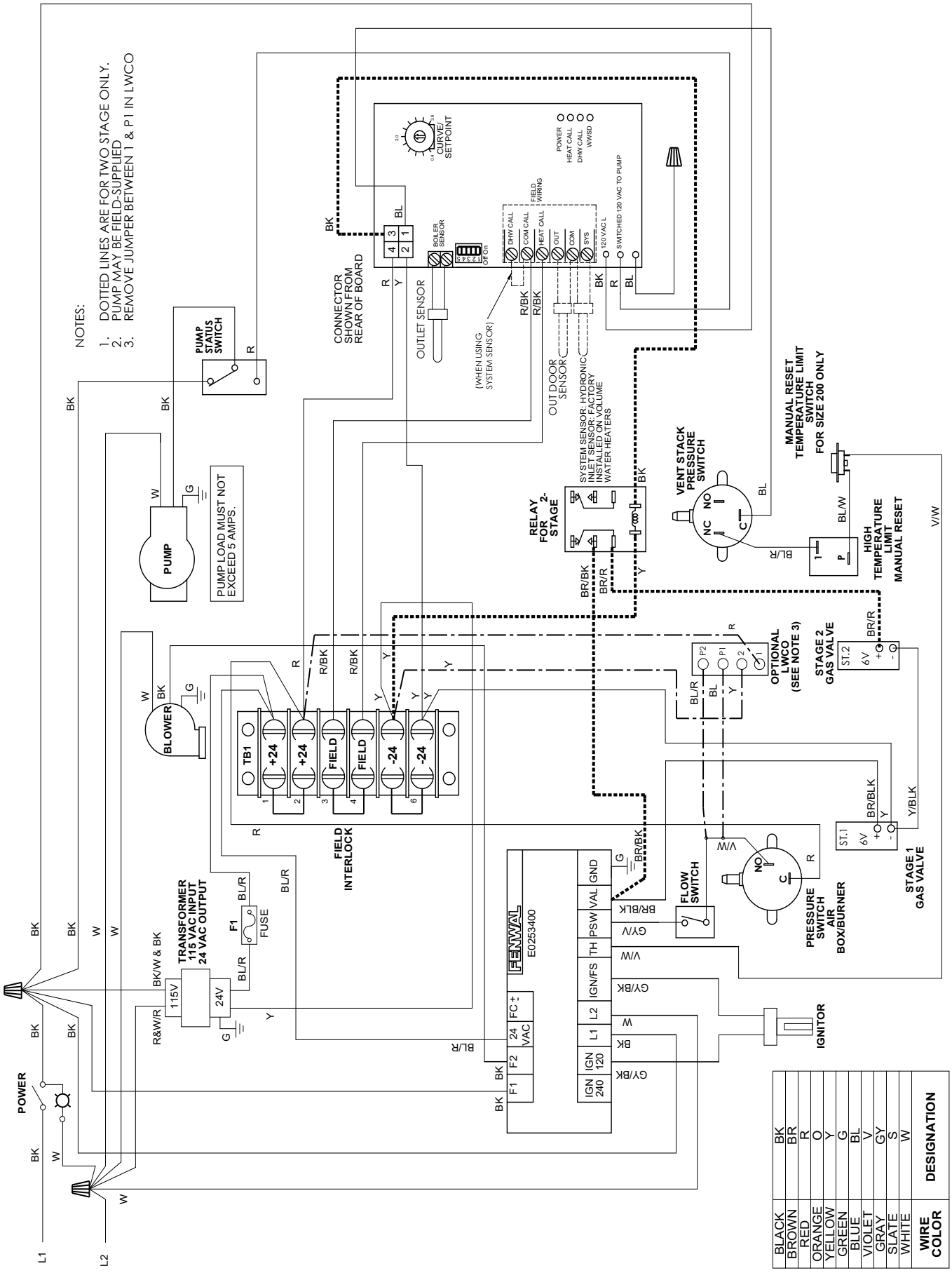


Figure 16. Wiring Diagram, Boiler.

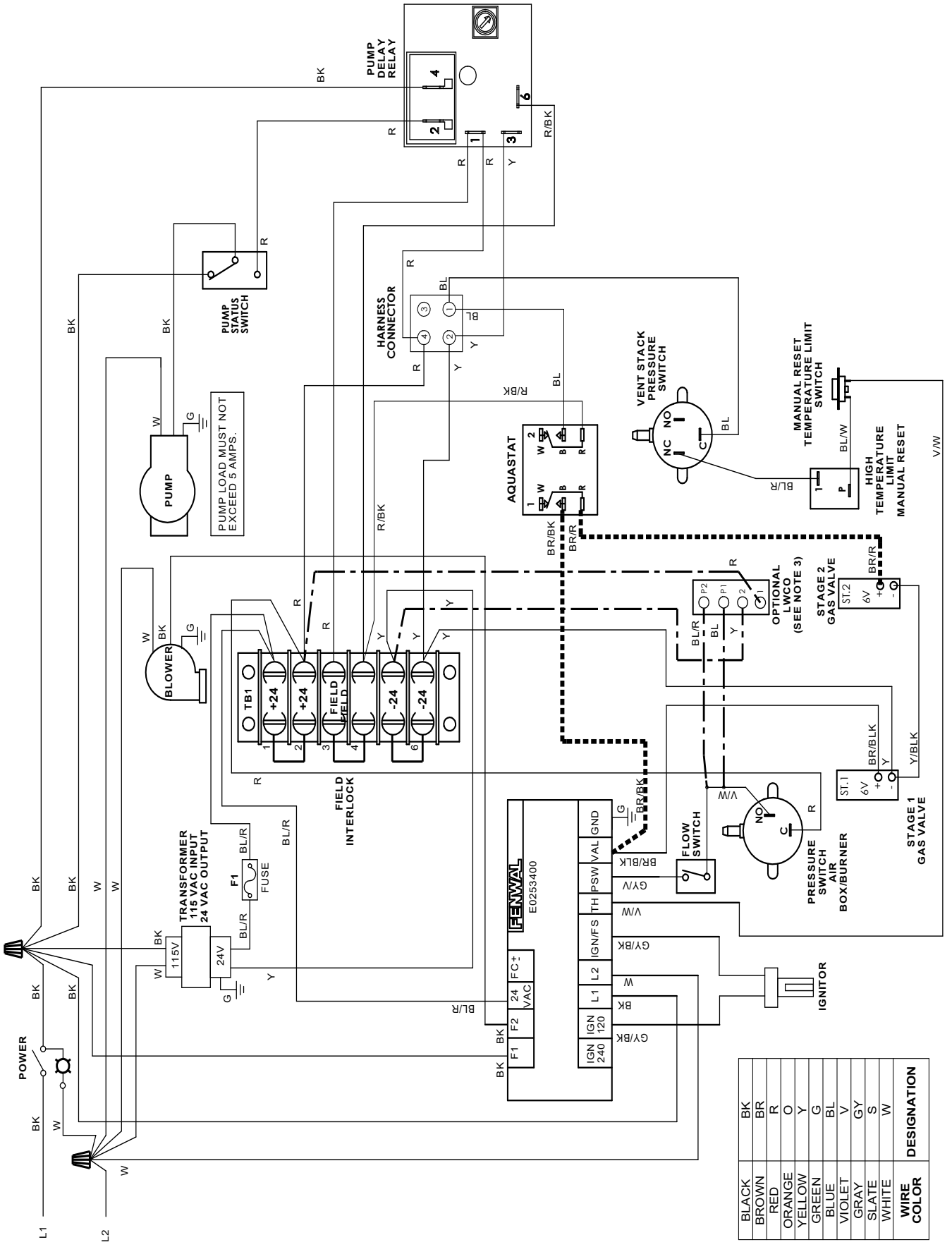


Figure 17. Wiring Diagram, Volume Water Heater.

SECTION 6 Operating Instructions

6.A Filling the Boiler System

1. Ensure the system is fully connected. Close all bleeding devices and open make-up water valve. Allow system to fill slowly.
2. If make-up water pump is employed, adjust pressure switch on pumping system to provide a minimum of 12 psi (81.8 kPa) at the highest point in the heating loop.
3. If a water pressure regulator is provided on the make-up water line, adjust the pressure regulator to provide at least 12 psi (81.8 kPa) at the highest point in the heating loop.
4. Open bleeding devices on all radiation units at the high points in the piping throughout the system, unless automatic air bleeders are provided at such points.
5. Run system circulating pump for a minimum of 30 minutes with the boiler shut off.
6. Open all strainers in the circulating system, check flow switch operation, and check for debris. If debris is present, clean out to ensure proper circulation.
7. Recheck all air bleeders as described in Step 4.
8. Check liquid level in expansion tank. With the system full of water and under normal operating pressure, the level of water in the expansion tank should not exceed ¼ of the total, with the balance filled with air.
9. Start up boiler according to the procedure in this manual. Operate the entire system, including the pump, boiler, and radiation units for one (1) hour.
10. Recheck the water level in the expansion tank. If the water level exceeds ¼ of the volume of the expansion tank, open the tank drain, and drain to that level.
11. Shut down the entire system and vent all radiation units and high points in the system piping, as described in Step 4.
12. Close make-up water valve and check strainer in pressure reducing valve for sediment or debris from the make-up water line. Reopen make-up water valve.
13. Check gauge for correct water pressure and also check water level in the system. If the height indicated above the boiler insures that water is at the highest point in the circulating loop, then the system is ready for operation.
14. Refer to local codes and the make-up water valve manufacturer's instructions as to whether the make-up water valve should be left open or closed.
15. 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.
16. Within three (3) days of start-up, recheck all air bleeders and the expansion tank as described in Steps 4 and 8 above.

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

⚠ WARNING

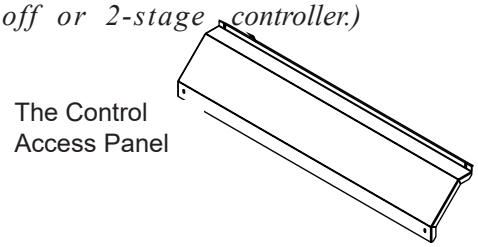
Do not use this appliance if any part has been under water. Immediately call a qualified service technician to inspect the appliance and to replace any part of the control system and any gas control that may have been under water.

⚠ 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.B Operating Temperature Control

(Note: All models can be ordered with either an on/off or 2-stage controller.)



6.B.1 Operating Temperature Control on Hydronic Boilers

Summary of Dip Switch Settings:

#1 Two Stage (Off) / Single Stage (On)
#2 Setpoint (Off) / Outdoor Reset (On) (Note: Outdoor Reset is required for residential operation)
#3 WWSD Inactive (Off) / Active 70°F (On)
#4 Boiler Maximum 210°F (Off) / 190°F (On)
#5 Pump Post Purge Inactive (Off) / Active 3 min. (On)

LEDs State Description

1. Power
2. Heat – On = call for heat; Flashes for Boiler sensor error
3. DHW – On = call for DHW; Flashes for outdoor sensor error
4. WWSD – On = Outdoor Reset AND WWSD Active AND control in WWSD; Flashes for outdoor sensor error, operation continues with fixed boiler target of 140°F.

When a call for HEAT and/or DHW is present the pump contact (5A max) will be energized. Post purge can be selected via dip switch #5, Pump Post Purge Inactive (Off) /Active 3 min. (On). In the On position the pump will continue to run for 3 min after the last call has been satisfied. When the dip switch is Off there is no post purge of the pump, the pump turns off immediately after the last call is removed. The manufacturer strongly recommends using a pump post purge. During WWSD and a call for HEAT is present the pump will remain off.

Pump Exercising The control exercises the boiler pump every 3 days of inactivity. While the control is exercising the pump all LEDs will turn off and the power LED will flash for 10 seconds.

Staging (where applicable – factory setting): Dip switch #1 is used to select the number of stages: 2-Stage (Off) / Single Stage (On).

For 2-stage operation, the first stage is cycled on Proportional error and the second stage is cycled based on PI according to a fixed algorithm. No user adjustment is necessary.

Note: All stages are turned off when the water outlet temperature reaches the Maximum setting that is elected via dip switch #4, Boiler Maximum 210°F (Off) / 190°F (On). Commercial boilers have dip switch #2 set for 'Off' to allow setpoint control. Utilize dial to set desired outlet temp.

NOTE:

This boiler is equipped with a feature that saves energy by reducing the boiler water temperature as the heating load decreases. This feature is equipped with an override which is provided primarily to permit the use of an external energy management system that serves the same function. THIS OVERRIDE MUST NOT BE USED UNLESS AT LEAST ONE OF THE FOLLOWING CONDITIONS IS TRUE:

- An external energy management system is installed that reduces the boiler water temperature as the heating load decreases.
- This boiler is not used for any space heating.
- This boiler is part of a modular or multiple boiler system having a total input of 300,000 BTU/hr or greater.
- This boiler equipped with a tankless coil.

Auto Boiler Target Setpoint: Space Heating: The boiler target temperature is automatically determined from Space Heating and DHW requirements. Space heating is based on outdoor reset. When both a Heat Call and a DHW Call are present at the same time, the control operates to provide the higher boiler target temperature.

Heating Curve (Outdoor Temperature Reset) The control uses a linear heating curve to calculate a target setpoint. The following data are used to calculate the target setpoint from the outdoor temperature.

1. The heating curve or reset ratio (RR) is set by the potentiometer with a range of 0.4 to 3.6.
2. The room temperature is fixed at 70 deg F.
3. Boiler target = 70 deg F + RR x (70 deg F - outdoor temp)

<table>
<tr><td>Outdoor</td><td colspan="3">Heating Curve=Reset Ratio (RR)=</td></tr>
<tr><td>Temp F</td><td>1.0</td><td>2.0</td><td>3.0</td></tr>
<tr><td></td><td colspan="3">Boiler Target F</td></tr>
<tr><td>-30</td><td>170</td><td rowspan="3">210</td><td rowspan="5">210</td></tr>
<tr><td>-20</td><td>160</td></tr>
<tr><td>-10</td><td rowspan="7">150</td></tr>
<tr><td>0</td><td rowspan="2">210</td></tr>
<tr><td>10</td><td>190</td></tr>
<tr><td>20</td><td>170</td><td rowspan="4">150</td><td>190</td></tr>
<tr><td>30</td><td>160</td></tr>
<tr><td>40</td><td rowspan="2">130</td></tr>
<tr><td>50</td></tr>
<tr><td>60</td><td colspan="3"></td></tr>
<tr><td>70</td><td colspan="3">WWSD OFF</td></tr>
</table>

Boiler Target Temperature Calculation:
Boiler Target = 70 deg F +RR x (70–Outdoor Temp)

Table 10. Boiler Target Temperature

DHW Operation The boiler target for DHW calls is fixed at 180 deg F.
Note: There is no control of a DHW pump, so the boiler pump runs with the call for DHW.

Limiting The boiler target is limited to a minimum and a maximum target to ensure that the water temperature does not exceed the limits.

1. Target Min - The boiler target minimum is the point at which the stages will start to turn on to maintain a minimum water temperature. The Boiler Minimum water temperature is 130 deg F, regardless of other calculated targets. To ensure that the water temperature is greater than the Boiler Minimum water temperature the target is increased to allow the stages to cycle on by the Boiler Minimum water temperature, Boiler Minimum target is set to Boiler Minimum +

differential/2.

2. Target Max - The boiler target maximum is the point at which the stages will start to turn off to maintain a maximum water temperature. The Boiler Maximum water temperature is set by setting dip switch #4: Boiler Maximum 210°F (Off) / 190°F (On).

To ensure that the water temperature is less than the Boiler Maximum water temperature the target is decreased to allow the stages to cycle off by the Boiler Maximum water temperature, Boiler Maximum target is set to Boiler Maximum - differential/2.

Automatic Differential The control has the ability to adjust the low and high of it's temperature range (the differential) to prevent short cycling and maximize the lifetime of components. As the load increases, the differential will decrease to minimize temperature swings. As the load decreases, the differential will increase to prevent short cycling.

The term 'automatic' refers to the control adjusting the water temperature to allow the burner to fire only when the control determines that the inferred heat load cannot be met by the residual heat of the water in the boiler.

WWSD Operation Warm Weather Shutdown - WWSD feature is selected via dip switch #3, WWSD Inactive (Off) / Active 70°F (On). WWSD point is fixed at 70°F. Control exits WWSD when the outdoor temp falls to 65°F. When there is a call for HEAT and the control is in WWSD the HEAT call will be ignored. When there is a call for DHW and the control is in WWSD the DHW call will be satisfied. WWSD LED turns on when control detects WWSD.

Summary of Input Sensors:

1. Outdoor sensor - monitors the outside air temperature for outdoor reset mode

2. Boiler outlet sensor -monitors the water temperature of the boiler outlet supply

3. System Supply sensor - monitors the water temperature of the system supply

The boiler outlet sensor is required at all times. If the boiler outlet sensor has any fault then the control will flash an error and turns all stages off. The system supply sensor is optional and utilizes primary / secondary piping. If the system supply sensor has a fault then the control flashes an error message and operates using the boiler outlet sensor (system supply = boiler outlet).

Using the system Sensor:

The system sensor can be used to control the setpoint of a primary loop in a primary/secondary system, or can be used to control an indirect water tank temperature. To setup the use of the system sensor, do the following:

1. Connect the system sensor on the SYS and COM terminals.
2. Install the sensor into a well in the location used to control water temperature.
3. Set DIP switch jumper positions as follows:

1	ON
2	OFF
3	OFF
4	ON
5	OFF

Table 11. DIP Switch Settings

4. The system pump will only operate with a call for heat. The HH or CH terminals must be jumpered to run the pump constantly.
5. The boiler setpoint may now be controlled by the potentiometer knob on the control.
6. The operating setpoint is 150°F min to 210°F max.
7. The setpoint differential will be automatically adjusted by the controller. The actual temperature may overshoot the setpoint initially, but the control logic will minimize this throughout the operating cycles of the boiler.

6.B.2 Operating Temperature Control on Volume Water Heaters

Volume water heaters use a simple aquastat for 2-stage or on/off control. When setting your set point temperature keep in mind the control is sensing the inlet water temperature. The manual reset high limit, which is fixed at 200F, senses the outlet temperature. Based on the flow characteristics of the installation, the controller will need to be set no higher than 175F (200F - Delta T = Max set point). To avoid nuisance lockouts, reduce the set point even further.

On a 2-stage controller, set the desired operating set point. The controller has an interstage differential that can be adjusted from 3°F to 10°F, which allows the user to have some control over how stage 2 and stage 1 call for heat. See Figure 18

6.C External Boiler Operations

Use the field interlock terminals located in the control box area. Remove the jumper and attach your "T-T" or "CH" demand here.

6.D Sequence of Operation

If a field-supplied pump is properly wired to the unit, or if the unit is pump-mounted, the pump will be energized.

Once the water flow switch makes, if all of the safety interlocks are closed, the ignition module will energize the blower(s) for a 15-second pre-purge,

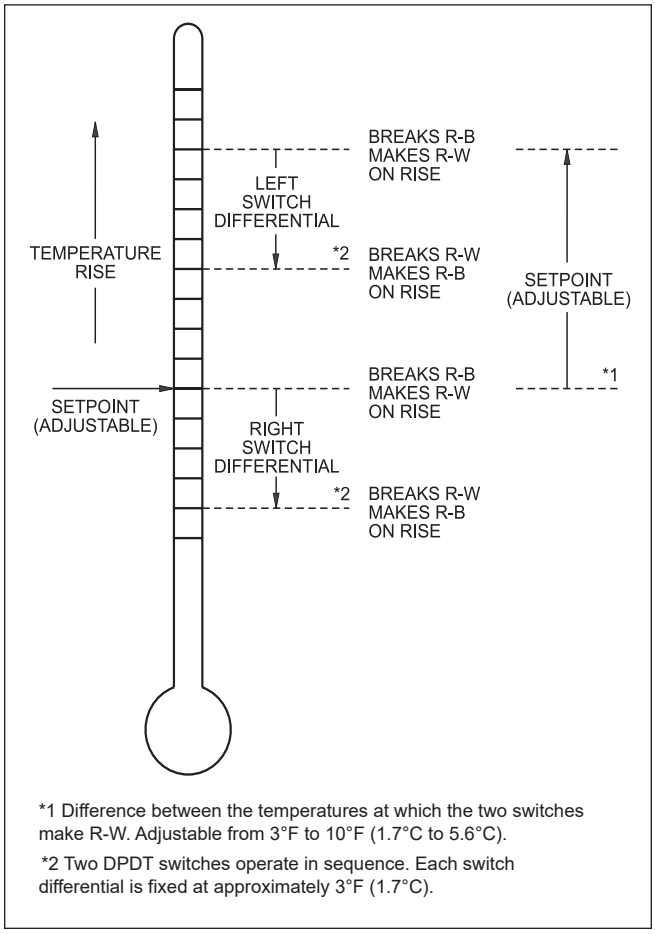


Figure 18. Two stage aquastat

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 stage one (or on/off) 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 call for stage 2 on a 2-stage unit, that valve will be energized.

If there is a loss of flame signal during a successful firing sequence, the ignition control will remove power from the gas valves, and then attempt to light up to two more times. If successful, the appliance 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, and the pump starts the post-purge (where applicable).

6.E Ignition Control Reaction to Air Flow / Blocked Vent Pressure Switch

Air flow and blocked vent status are continuously monitored by the appliance's 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 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.

If the PSW signal is lost while the appliance 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.F Operating the Burner and Set-Up

6.F.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 appliance 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 appliance 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 appliance 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 10.5 in. w.c. (2.6 kPa) for Natural Gas and 13 in. w.c. (3.2 kPa) for LP. The minimum inlet gas pressure is 4 in. w.c. (1.0 kPa) for Natural Gas and 9 in. w.c. (2.4 kPa) for LP. See Table 12
7. Once the inlet gas pressure is verified, the outlet gas pressure from each valve (manifold gas pressure) must be checked, and adjusted, if necessary. The manifold gas pressure must be 3.0 in. w.c. (0.7 kPa) for natural gas and 9.0 in. w.c. (2.4 kPa) for LP. Also See Table 12
8. Set the air box pressure to 1" w.c. adjusting air shutter on the blower as a starting point. Then adjust the shutter to get the required CO_2%. Closing the shutter will increase CO_2%.
   Opening the shutter will lower the CO_2%
9. Complete the setup by checking the CO_2 at the outlet of the unit. The CO_2 should be 8% for natural gas, or 9.2% for LP.
10. **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.
11. Check all heat exchanger water connections, flange and header gaskets for watertight integrity 24 hours after commissioning. If there are any signs of water leakage, re-torque fasteners or re-seat threaded connections as necessary to eliminate leakage.

	Supply MIN		Supply MAX		Manifold	
	w.c.	*kPa*	w.c.	*kPa*	w.c.	kPa
Nat	4	*1.0*	10.5	*2.6*	3	0.7
LP	9	*2.4*	13	*3.2*	9	*2.4*

Table 12. Gas Pressure in inches (w.c.)

6.F.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 this appliance for high altitude. High altitude adjustment is accomplished by adjustment of the air shutter. A CO_2 or O_2 analyzer is required to make these adjustments.

Start the adjustment process by checking the CO_2 in the "as installed" condition. Adjust the air shutter(s) so that the CO_2 is about 8% or the O_2 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_2 is about 9.2% or the O_2 is about 6.8%.

If the appropriate CO_2 / O_2 levels cannot be achieved by adjusting the air shutter. Contact the phone number shown on the back page.

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

6.G Shutting Down the Unit

1. Switch off the main electrical disconnect switch.
2. Close all manual gas valves.
3. If freezing is anticipated, drain the appliance and be sure to also protect building piping from freezing.
   This step to be performed by a qualified service person.

6.H To Restart the Unit

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 parait 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.A 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, when installed on a residential hot water heating system, the probe should be removed and cleaned every five years. When installed on a commercial application, the probe should be removed and cleaned annually.
7. The Pressure Relief Valve should be inspected and tested every year.
8. Inspect flue passages, and clean with brushes/ vacuums, if necessary. Sooting in flue passages indicates improper combustion. Determine the cause and correct.
9. 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.B Appliance Maintenance and Component Description

Only genuine manufacturer's 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 (if required)
i. Relays
j. Flow switch
k. Gas train
l. Control components

7.B.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.B.2 Filter

The filter used in this unit 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.B.3 Gas Valves

The gas valves are 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 union 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.B.4 Manual Reset High Limit Control

The high limit switch is a manual reset, non-adjustable switch with a remote bulb-type sensor. Switches for water heaters and low temperature boiler models are set at 200°F. Switches for standard boilers are set at 240°F.

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.B.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.B.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.B.7 Transformer

This appliance's transformer is not capable of supplying control voltage for external devices such as zone valves, 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.B.8 Flow Switch

This appliance 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 boiler 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 boiler 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 boiler and other static pressure systems, restore the system pressure to the original setting, (or 10 psi minimum).

7.B.9 Heat Exchanger Coil

This appliance 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 boiler. 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 caused by lack of required maintenance, lack of water flow, or improper operating practices.

⚠ 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.

SECTION 8 Trouble Shooting

8.A 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 boilers) is not empty. Then, restart the boiler 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 Natural gas pressure to the appliance must be above 4 in. w.c. (1.0 kPa) throughout the entire start-up cycle. See Table 12. 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_2 or CO_2). These appliances operate best with 45% excess air (8% CO_2 on natural gas, 9.2% CO_2 on LP). Check the CO_2 of the appliance and adjust if necessary.
3. Ignitor failure: If the boiler 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 boiler 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.B 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.C Short Cycling — Boiler

Boiler short cycling is caused when the load on the boiler system swings rapidly causing frequent cycling between call for heat and satisfied conditions. This condition is greatly reduced on two stage units. If short cycling is a problem, it may be due to an oversized boiler, incorrect set points or a load distribution problem. If desired temperature response is not achievable without short cycling it may be necessary to install a buffer tank in the system. Contact your manufacturer's representative to discuss possible remedies.

8.D Short Cycling — Water Heater

Short cycling will generally occur only in combination space heating and water heating applications when the water heater is operating in the space-heating mode. If the heating load drops below the minimum input of the water heater for an extended period, the water heater will have a tendency to short cycle. If short cycling is frequently experienced, regardless of the control's attempt to limit it, the heating load should be redistributed to control it.

If short cycling occurs in a water heater application, it is probably caused by undersized piping between the water heater and the storage tank or by some other factor that restricts proper water flow through the water heater. The cause should be determined and corrected.

8.E 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_2 is high (or O_2 is low), appliances operating with low CO_2 or high O_2 (especially LP appliances) consume more gas. Adjust the CO_2 or O_2 for optimum efficiency. If no combustion analyzing equipment (CO_2 or O_2) is available then a proper adjustment of the air/fuel ratio (CO_2 or O_2) cannot be accomplished. The CO_2 should be 8% at high fire for natural gas and 9.2% at high fire for LP. To check the CO_2, first verify that the supply gas pressure is within 4.0 to 13 in. w.c. (1.0 to 3.2 kPa). See Table 12

With this unit 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_2, and adjust the air shutters if further adjustment to the CO_2 is needed.

SECTION 9 Replacement Parts

Only genuine manufacturer's replacement parts should be used.

9.A General Information

To order or purchase parts for the this boiler or water heater, contact your nearest manufacturer's dealer or distributor. If they cannot supply you with what you need, contact Customer Service (see back cover for phone numbers and website).

9.B Parts List

Item	Description	Model 200	Model 300	Model 400
	COMBUSTION CHAMBER COMPONENTS ***See Figure 19***			
1	Base Assembly	2C1000	3C1000	4C1000
2	Support, Tile Notch	2C2019	3C2019	4C2019
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	Panel, Chamber, Right Side, Bottom	2C2201	2C2201	2C2201
8	Panel, Chamber, Left Side, Bottom	2C2601	2C2601	2C2601
9	Panel, 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, Vertical	2C2100	3C2100	4C2100
17	Weldment, Flue	2C2300	2C2300	2C2300
18	Assembly, Air Shutter, Blower	2C5000	2C5000	2C5000
19	Assembly, Filter Housing	2C3800	2C3800	2C3800
20	Media, Filter	R2073200	R2073200	R2073200
21	Clip, Retaining, Filter Media	F2022300	F2022300	F2022300
22	Hose, Duct, Flexible, 4" Dia.	P0101402	P0101403	P0101404
23	Blower/Motor	E0254000	E0254000	E0254000
24	Gasket, Blower	S2104400	S2104400	S2104400
25	Assembly, Sight Glass	R10956000	R10956000	R10956000
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

Item	Description	Model 200	Model 300	Model 400
	JACKET COMPONENTS ***See Figure 20***			
40	Panel, Front, Jacket	R2C3320	R3C3320	R4C3320
41	Panel, Rear, Jacket	2C3220	3C3220	4C3220
42	Panel, Top, Jacket	2C3021	3C3021	4C3021
43	Panel, Jacket, Control Access	2F3019	3F3019	4F3019
44	Panel, HX Side Access, Jacket	2C3620	2C3620	2C3620
45	Panel, Right Side, Upper, Jacket	2C3621	2C3621	2C3621
46	Panel, Right Side, Jacket	2C3520	2C3520	2C3520
47	Panel, Left Side, Jacket	2C3420	2C3420	2C3420
48	Panel, Lower Access, Jacket	2C3622	2C3622	2C3622
49	Panel, Filter Side, Upper, Jacket	2C3623	2C3623	2C3623
50	Panel, Filter Access, Jacket	2C3010	2C3010	2C3010
51	Weldment, Cover, Air Inlet	2C3700	2C3700	4C3700
52	Panel, Cover, Exhaust	2C3701	3C3702	4C3701
53	Plate, Cover, Sight Glass	10338600	10338600	10338600
54	Side Panel, Pump Cover, Jacket	2C3015	2C3014	2C3014
55	Cover, Pump	2C3016	2C3016	2C3016
	HEAT EXCHANGER COMPONENTS ***See Figure 21***			
60	Assembly, Tube, Heat Exchanger, Copper	R2C4100	R3C4100	R4C4100
	Assembly, Tube, Heat Exchanger, Copper-Nickel	R2C4120	R3C4120	R4C4120
61	Header, Inlet/Outlet	2F4122	2F4122	2F4122
62	Header, Return	2C4103	2C4103	2C4103
63	Chamber, Header, Heat Exchanger	2C4001	2C4001	2C4001
64	Baffle, End, Heat Exchanger Tube	2C4002	2C4002	2C4002
65	Flanges, Set of 2, 1-1/2" NPT, Cast Iron	S0077700	S0077700	S0077700
66	Gasket, Connection Flange, 1-1/2"	S0076500	S0076500	S0076500
67	Valve, Pressure Relief, 3/4" NPT X 75 PSI	RA2138800	RA2138800	RA2138800
	Valve, Pressure Relief, 3/4" NPT X 125 PSI	RA2138900	RA2138900	RA2138900
68	Gauge, Temperature/Pressure	RA0079000	RA0079000	RA0079000
69A	Well, Immersion	E2058300	E2058300	E2058300
69B	Well, Immersion, Hi-Limit Temperature	E0234201	E0234201	E0234201
70	Probe, Thermistor	E2103300	E2103300	E2103300
71	Switch, Water Flow	RE0013000	RE0013000	RE0013000
72	Pump, Circulator, Hydronic Pump, Circulator, Volume Water	 RA2139200	A0076800 RA2139200	A0076800 RA2139200
73	Gasket, 5/8" Tube, 7/32" Thk. Heat Exch. (each)	S0070800	S0070800	S0070800
	Gaskets, Set of 20, Heat Exch	R0050801	R0050801	R0050801

Item	Description	Model 200	Model 300	Model 400
	GAS TRAIN COMPONENTS ***See Figure 22***			
80	Weldment, Gas Manifold, Main	L0063702	L0063703	L0063704
81	Manifold, Gas, On/Off	L0063414	L0063416	L0063418
82	Manifold, Gas, 2 Stage Left Bank	L0063404	L0063413	L0063414
83	Manifold, Gas, 2 Stage Right Bank	L0063402	L0063403	L0063405
84	Orifice, Nat. Gas	L0062900	L0062900	L0062900
	Orifice, LP Gas	L0063000	L0063000	L0063000
85	Spacer, Gas Orifice	F2022400	F2022400	F2022400
86	Gas Valve, Combination, Nat. (DSI) 3/4" NPT x 3/4" NPT	V0079400	V0079400	V0079400
	Gas Valve, Combination, LP (DSI) 3/4" NPT x 3/4" NPT	V0079500	V0079500	V0079500
87	Cover, Gas Inlet, Air Box	2C2018	2C2018	2C2018
Item	**Description**	**Model 200**	**Model 300**	**Model 400**
	CONTROL PANEL COMPONENTS ***See Figure 23***			
92	Bracket, Mounting, Hi-Limt/Pressure Switch	2C7004	2C7004	2C7004
93	Switch, Pressure, Diaphragm, SPST	E0255500	E0255500	E0255500
94	Switch, Pressure, Diaphragm, SPDT	RE0240900	RE0240900	RE0240900
95	Switch, Limit, High Temperature, Hydronic		E2304800	E2304800
	Switch, Limit, High Temperature, Volume Water	E2324200	E2324200	E2324200
96	Transformer, 24, 120 V, 50VAC	E0180500	E0180500	E0180500
97A	(for Boiler) PCB, TCM MT2H		RE2344301	RE2344301
97B	(for Water Heater) MT2V 2-Stage	E0093200	E0093200	E0093200
97C	(for Water Heater) MT2V 1-Stage	E0014400	E0014400	E0014400
98A	Relay, 24VAC, DPDT	E2327800	E2327800	E2327800
98B	Pump Relay (for Volume Water)	E2077700	E2077700	E2077700
99	Tray, Control Panel	2F7001	3F7001	4F7001
101	Toggle Switch, SPDT	R2007700	R2007700	R2007700
102	Ignition Control	E0253400	E0253400	E0253400
103	Switch, Rocker, 15A, 125 VAC, 1/2 HP	RE2322700	RE2322700	RE2322700
104	Terminal Block	E2327700	E2327700	E2327700
105	Cover, Transformer	2C7005	2C7005	2C7005
106	Label, Terminal Block	H2356600	H2356600	H2356600
108	Stablilzer, Control Panel	2C7006	2C7006	2C7006
not shown	Harness, Main	E2348700	E2348700	E2348700

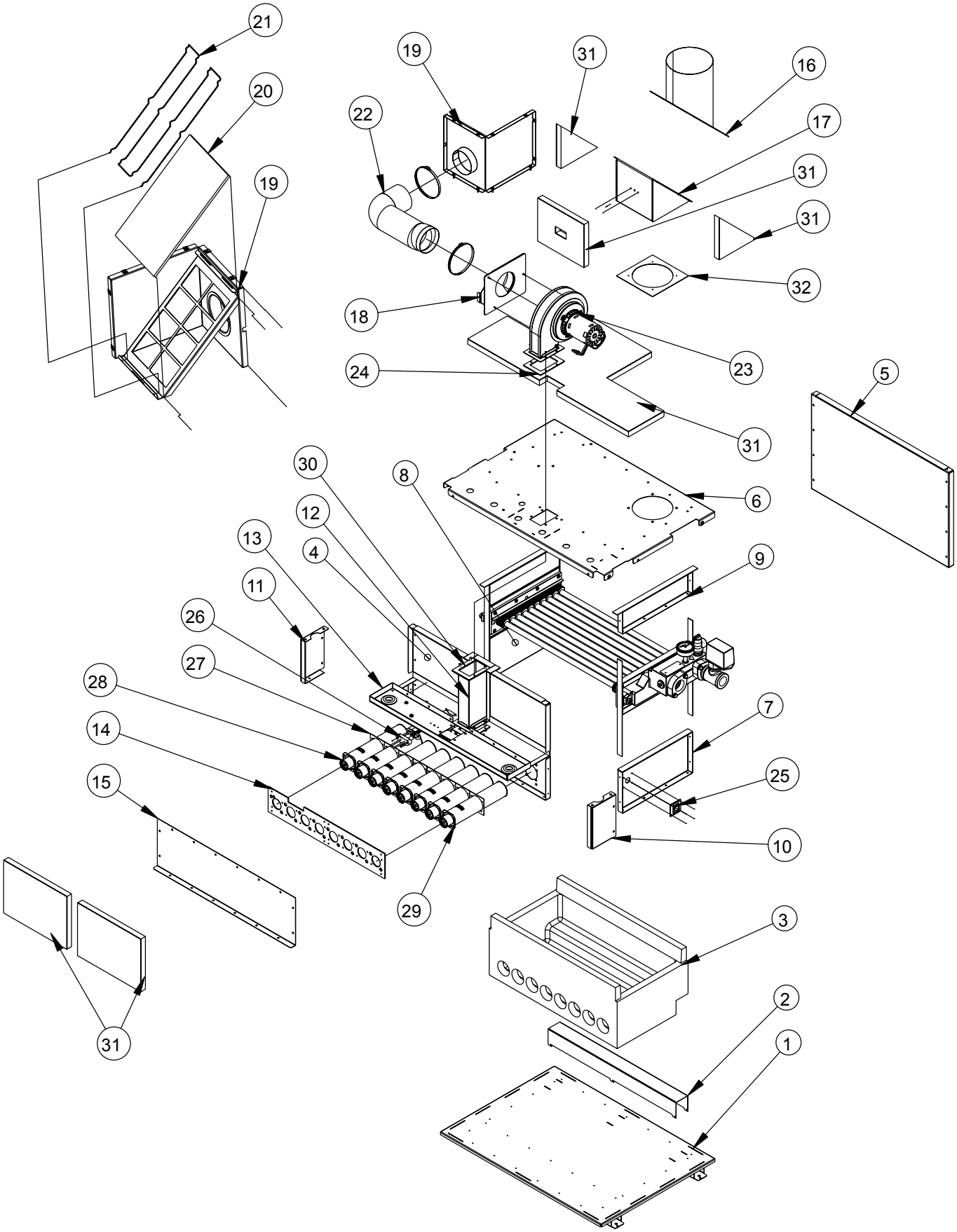


Figure 19. Combustion Chamber Components.

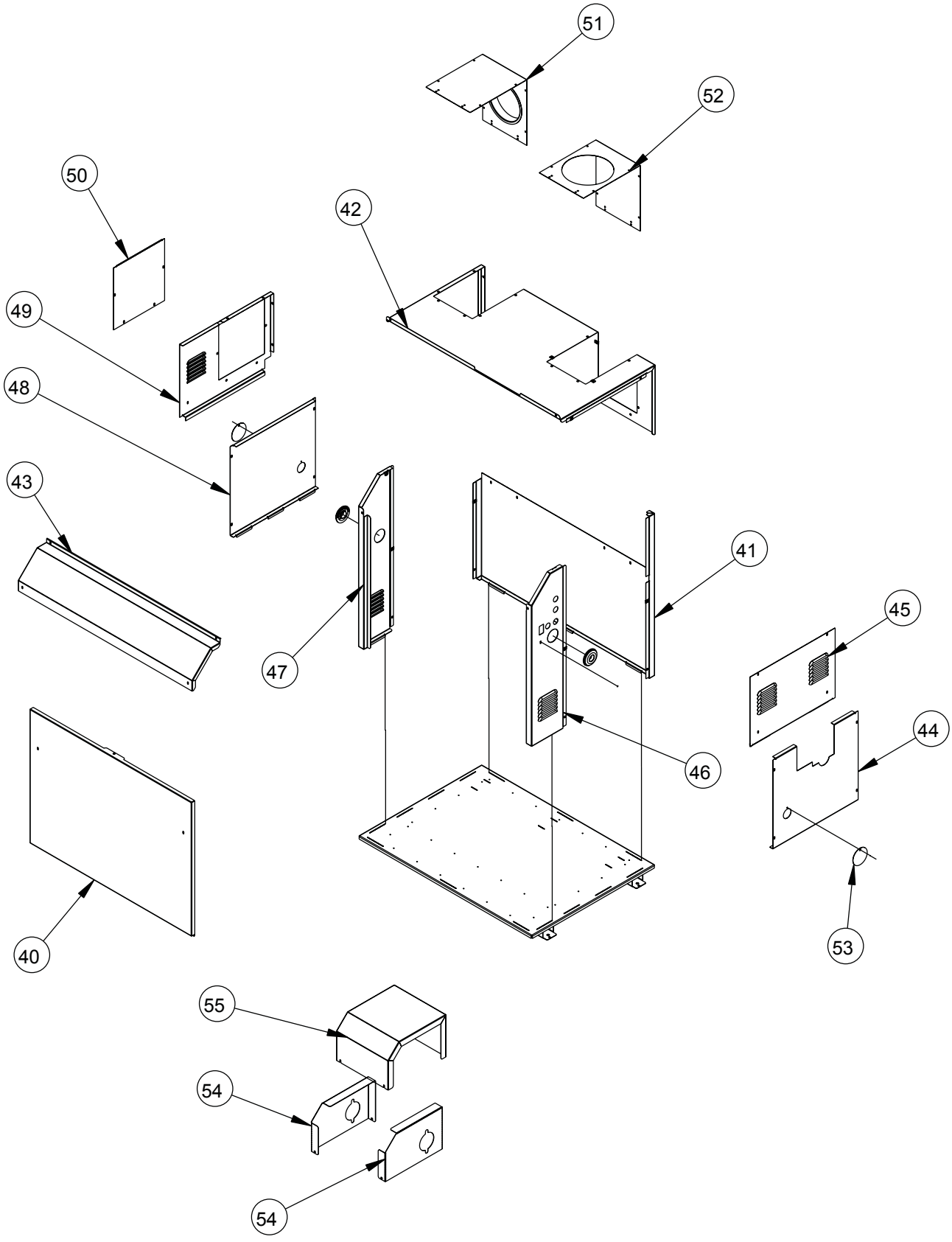


Figure 20. Jacket Components.

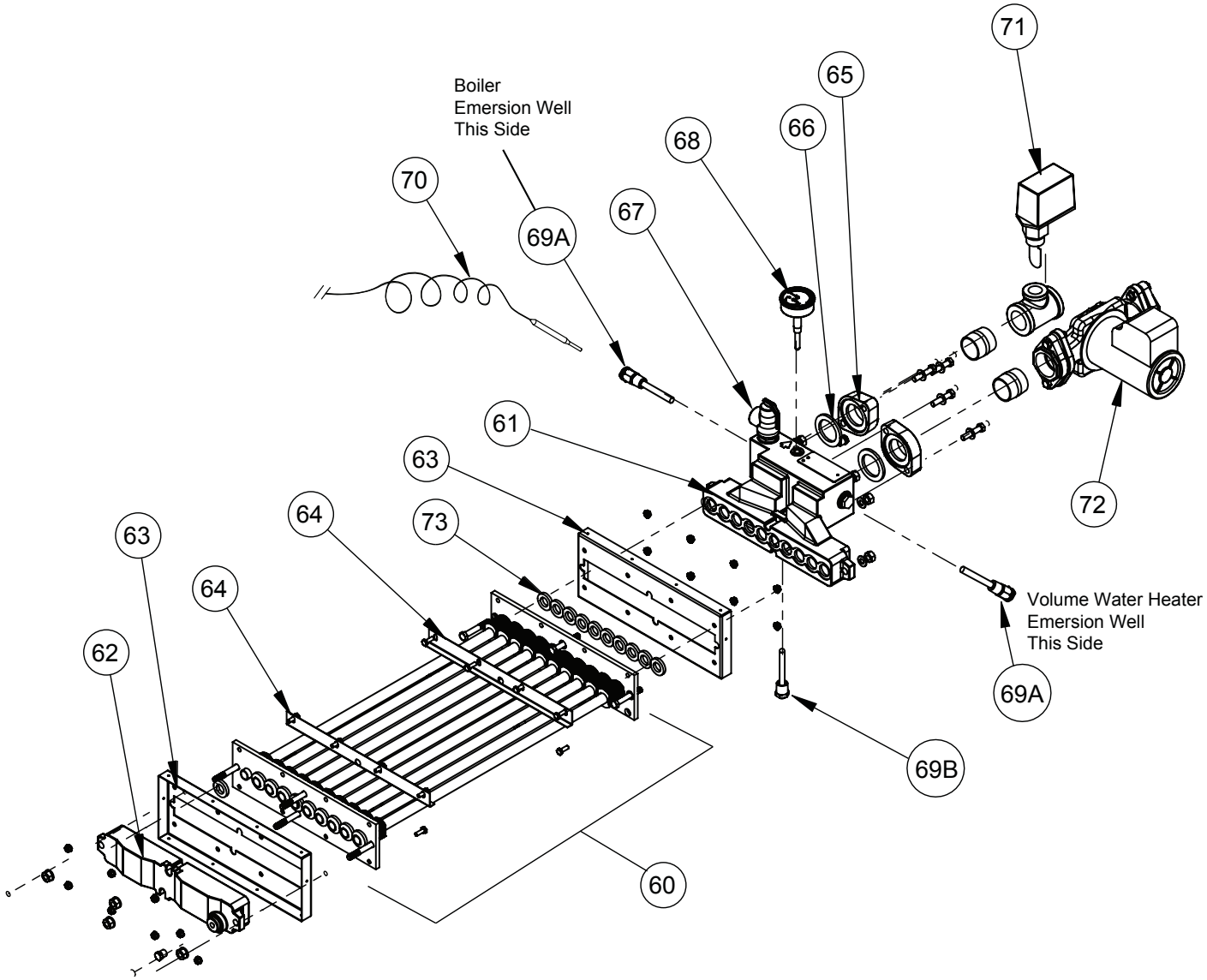


Figure 21. Heat Exchanger Components.

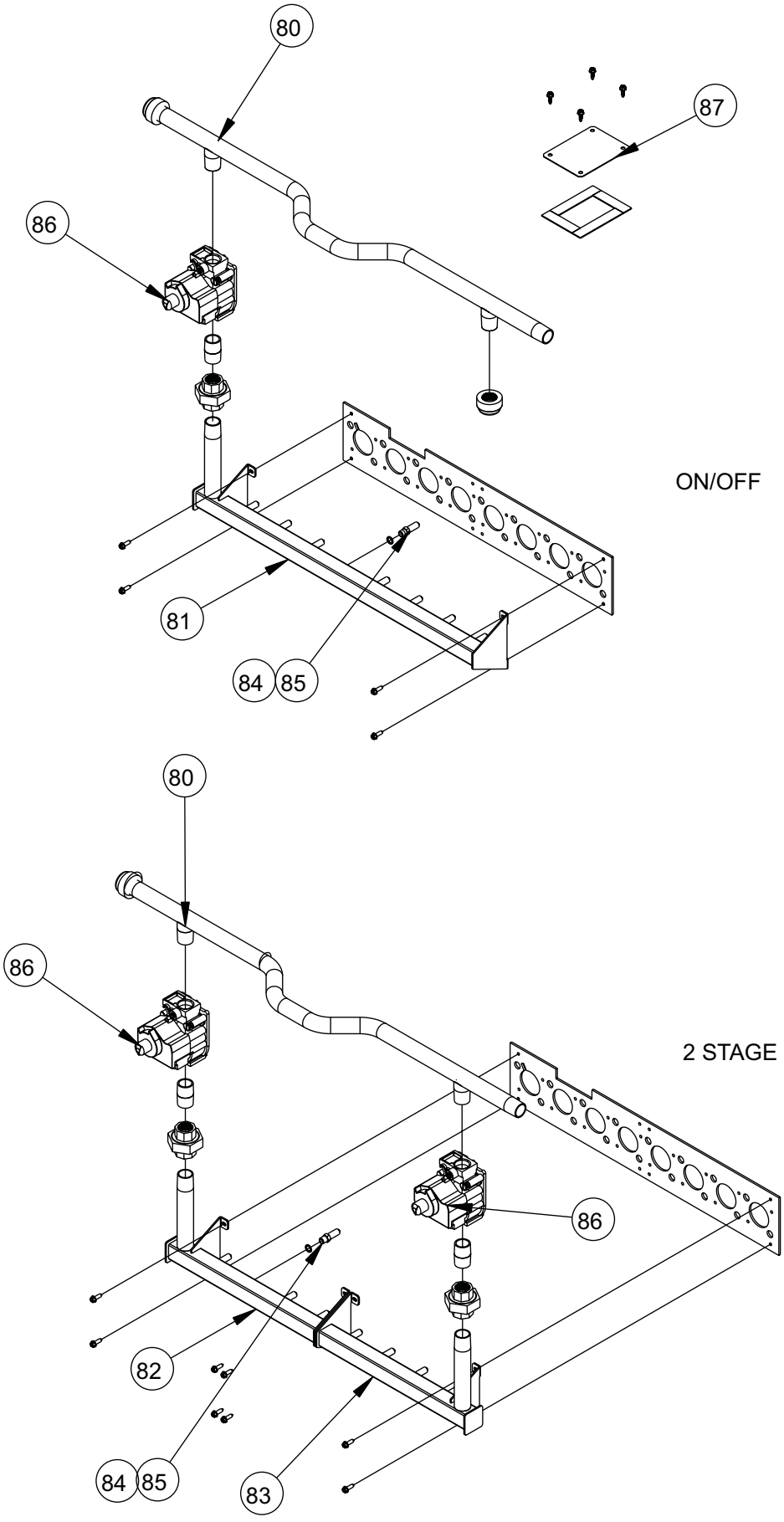


Figure 22. Gas Train Components.

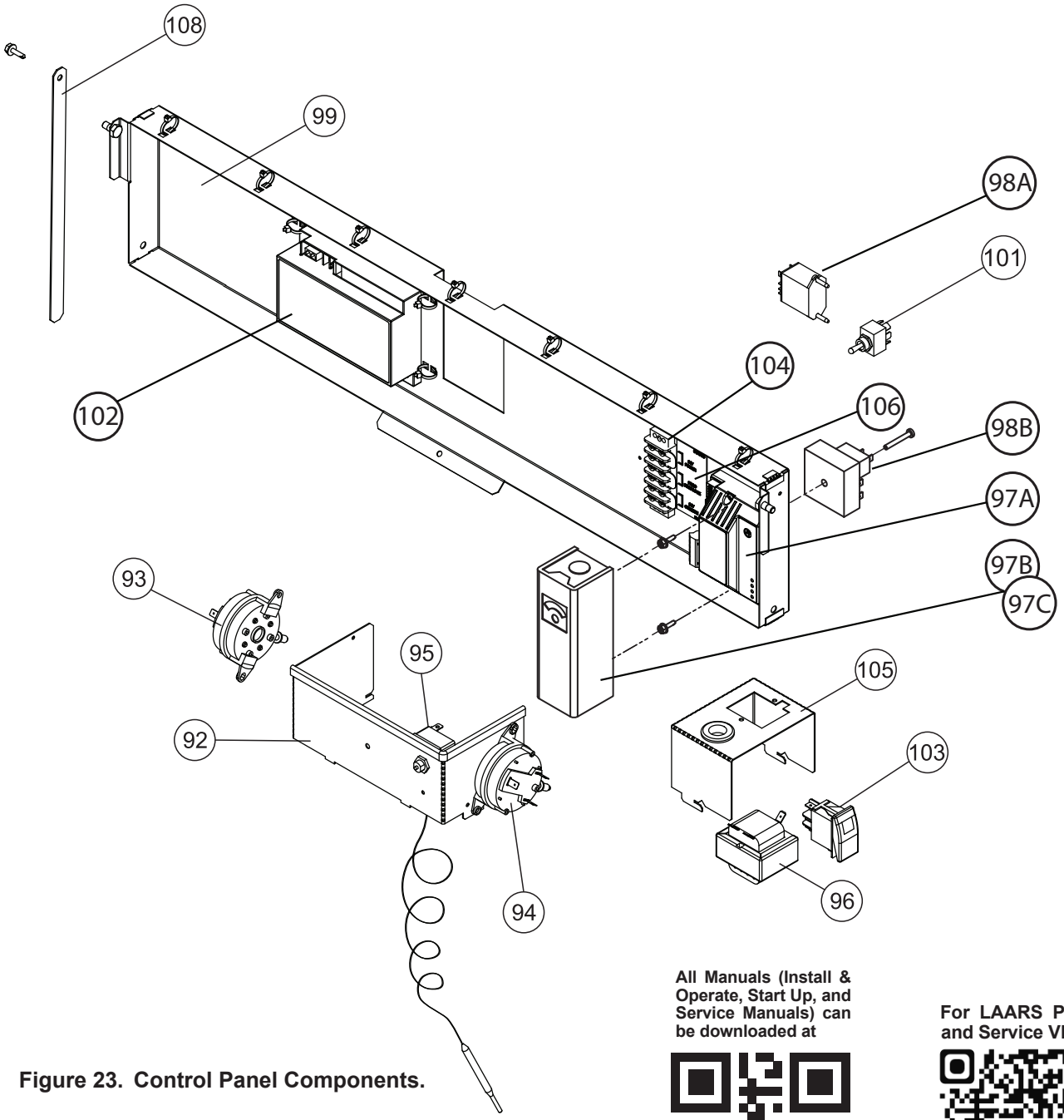


Figure 23. Control Panel Components.

All Manuals (Install & Operate, Start Up, and Service Manuals) can be downloaded at

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

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