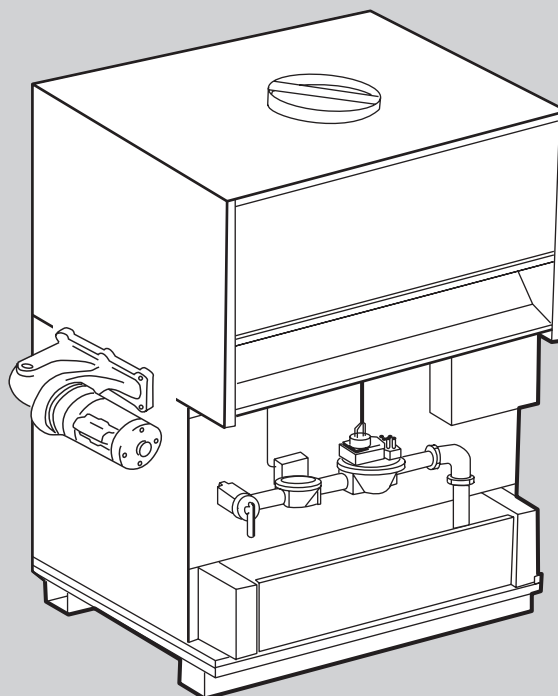
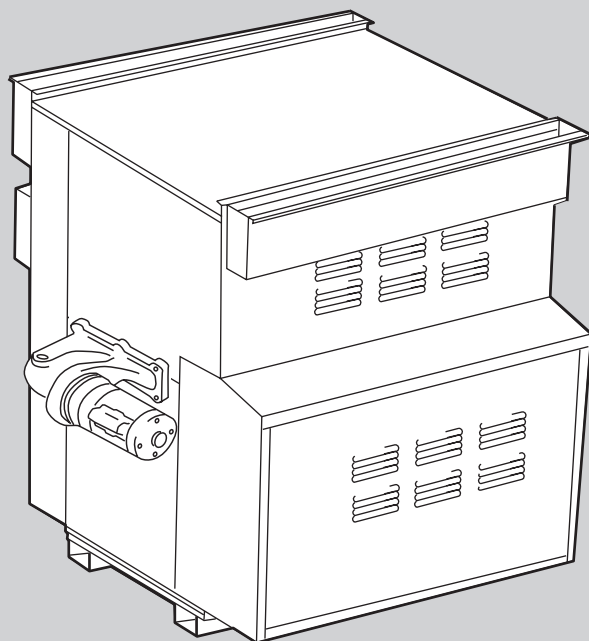


Installation and Operation Instructions for **Copper Brute** Volume Water Heaters



Model B4
Sizes 500-1825

These instructions are to be stored in the pocket provided on the heater.

FOR YOUR SAFETY: This product must be installed and serviced by a professional service technician, qualified in hot water heater installation and maintenance. Improper installation and/or operation could create carbon monoxide gas in flue gases which could cause serious injury, property damage, or death. Improper installation and/or operation will void the warranty.

⚠️ WARNING

If the information in this manual is not followed exactly, a fire or explosion may result causing property damage, personal injury or loss of life.

Do not store or use gasoline or other flammable vapors and liquids in the vicinity of this or any other appliance.

WHAT TO DO IF YOU SMELL GAS

- Do not try to light any appliance.
- Do not touch any electrical switch; do not use any phone in your building.
- Immediately call your gas supplier from a nearby phone. Follow the gas supplier's instructions.
- If you cannot reach your gas supplier, call the fire department.

Installation and service must be performed by a qualified installer, service agency, or gas supplier.

TABLE OF CONTENTS

SECTION 1.

General Information

1.1	Introduction.....	3
1.2	Heater Identification.....	3
1.3	Flow Requirements.....	3
1.4	Water Chemistry.....	4

SECTION 2.

Installation

2.1	Heater Placement.....	4
2.2	Installation of Indoor Heaters.....	4
2.2.1	Combustion Air Supply.....	4
2.2.2	Venting.....	6
2.3	Installation of Outdoor Heaters.....	7
2.4	Gas Supply and Piping.....	7
2.5	Electrical Wiring.....	8
2.6	Water Piping of System.....	8
2.7	Water Expansion.....	9
2.8	Pump Performance and Installation.....	9
2.9	Water Pressure.....	10
2.10	Tank Installation.....	10
2.11	Two-Temperature System.....	11

SECTION 3.

Operation

3.1	Controls - General.....	14
3.1.1	Electronic Ignition Control.....	14
3.1.2	Operating Control.....	14
3.1.3	High Limit Controls.....	14
3.1.4	Flow Switch.....	14
3.1.5	Low Water Cut-Off (Optional).....	14
3.2	Initial Start-Up.....	14
3.3	To Start Up System.....	15
3.3.1	Start Up Heater.....	15
3.3.2	To Set Temperature and High Limit Control.....	15
3.4	To Turn Off Heater.....	16
3.5	To Shut Down System.....	16

SECTION 4.

Maintenance

.....	16
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SECTION 5.

Troubleshooting and Analysis of Service Problems

.....	17
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SECTION 1. General Information

1.1 Introduction

This manual provides information for the installation and operation of Bradford White volume water heaters. It is strongly recommended that all application and installation procedures be reviewed completely before proceeding with the installation. Consult the Bradford White factory, or local factory representative, with any problems or questions regarding this equipment. Experience has shown that most problems are caused by improper installation.

Some accessory items are shipped in separate packages. Verify receipt of all packages listed on the package slip. Inspect everything for possible damage upon delivery, and inform the carrier of any shortages or impairments. 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.

⚠️ WARNING

All volume water heaters must be installed in accordance with the procedures outlined in this manual. The warranty does not apply to heaters not installed or operated in accordance with these procedures. Consult local building and safety codes before proceeding with work. The installation must conform to the requirements of the authority having jurisdiction or, in the absence of such requirements, to the latest edition of the National Fuel Gas Code; ANSI Z223.1, National Electrical Code ANSI/NFPA 70 and/or in Canada CSA B149.1 requirement.

When required by the authority having jurisdiction, the installation must conform to the Standard for Controls and Safety Devices for Automatically Fired Boilers, ANSI/ASME CSD-1. Any modification to the water heater, its gas controls, gas orifices, wiring or draft diverter may void the warranty. If field conditions require such modifications, consult factory.

1.2 Heater Identification

Consult rating plate on the heater. The following example simplifies the heater identification.

1	2	3	4	5	6
B4	1670	I	N	09	C

1. Basic heater model.
2. Input rate X 1000 BTU/hr.
3. Indoor (I) or Outdoor (E) installation.
4. Gas type: Natural (N) or Propane (P).
5. Ignition system: I.I.D. (09) or continuous pilot (16).
6. Firing rate: On/Off (C), 2-stage (K), 4-stage (L).

Bradford White commercial water heaters are available in two models: an indoor version and an outdoor version. Both are available from the factory (see Figure 1).

1.3 Flow Requirements

For proper operation, all low volume hot water heaters must have continuous flow through the heat exchanger when firing. The system pump must be capable of developing sufficient pressure to overcome the resistance of the heater plus the entire circulating system at the designed flow rate.

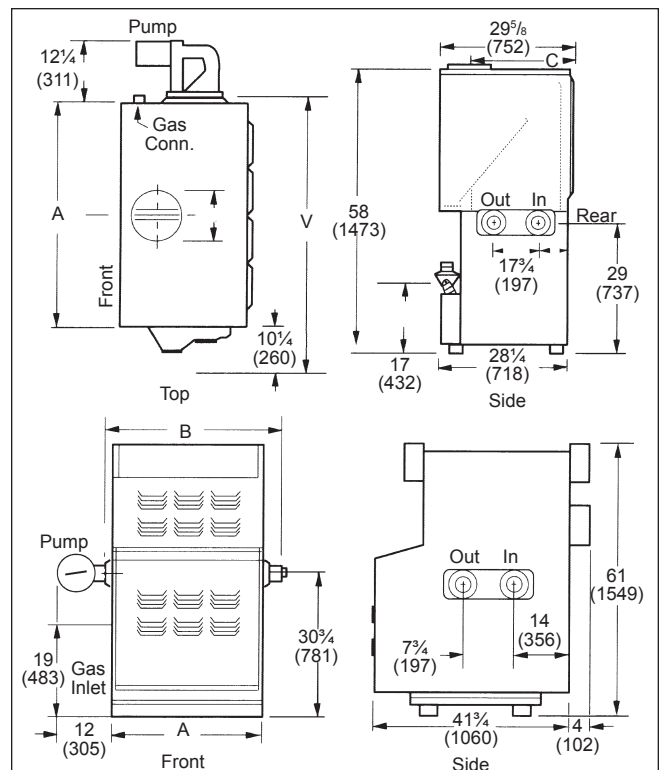


Figure 1. Heater Configuration.

1.4 Water Chemistry

Bradford White equipment is designed for use in a wide variety of water conditions. The water velocity maintained in the heat exchanger tubes is kept high enough to prevent scaling from hard water and low enough to avoid corrosion from soft water. Ninety-five percent of the urban areas in the country have water that is compatible with this equipment, but in some areas a water supply will contain a large quantity of scaling chemicals or the water may be extremely soft and corrosive. In rare situations the water will contain both scaling chemicals and corrosive chemicals such as calcium or sodium chloride. These conditions may be the result of a nearby well or pumping station and the particular condition may not be characteristic of the entire city water system.

If an installer observes damage from these conditions to any water handling equipment in the area, a factory representative should be contacted immediately for assistance in minimizing maintenance costs. If erosion is present, the pump impeller can be replaced to reduce water velocity. If scaling conditions are bad, tube cleaning maintenance schedules can be established to prevent tube burn-out and cracking. Neglecting the problem could mean serious damage to the heater and water system.

Scaling can be recognized as a layer deposited on the inner walls of the tube which reduces the inner diameter of the tube. Scale can be any color or texture; smooth or rough, granular or amorphous. Signs of erosion are generally pitting, cavitation, ridges and "islands" on the inner walls of the tubes. Since this condition results from extremely soft water sources, or as a result of a water softening program, the internal copper surfaces will be extremely shiny. Other chemicals, such as chlorine or chlorides in the water, will cause dark surfaces of erosion.

In areas where the water supply is extremely corrosive, it is advisable to order the heater with cupro-nickel tubes in the exchanger.

Damage From Scaling, Corrosion, or Erosion is Not Covered by the Warranty.

SECTION 2. Installation

2.1 Heater Placement

The heater must be placed to provide specific clearances on all sides for maintenance and inspection. There must also be minimum distances maintained from combustible surfaces. These clearances also apply to non-combustible materials because the heater requires air circulation for proper operation.

Heater should be mounted on a level surface. An integral combustible flooring base is provided as standard equipment on outdoor models. Indoor

models can be installed on a combustible floor with a special base assembly which is available from the factory, or with a base that complies with local code requirements. See rating plate for part number of the base assembly.

Do not install a heater on carpeting.

Under the National Fuel Gas Code, ANSI Z223.1, it is permissible to place the heater on floors other than non-combustible when the installation complies with the American Insurance Code. Figures 2, 3, 4 and 5 show common installation on combustible flooring.

2.2. Installation of Indoor Heaters

1. Locate the water heater to provide adequate clearance for inspection and service on all sides (see Table 1). We recommend minimums of 24" from front (for proper access to and service of controls) and 18" at water connection end. For alcove installation (see Figure 6).
2. Install the heater on a waterproof floor with an adequate floor drain and a 6" minimum curb on all four sides to protect the building if heater repairs are required. ***The manufacturer will not be held liable for any water damage in connection with this heater.***

2.2.1 Combustion Air Supply

1. Copper Brute water heaters must have provisions for combustion and ventilation air in accordance with section 5.3, Air for Combustion and Ventilation, of the National Fuel Gas Code, ANSI Z223.1, or Sections 7.2, 7.3 or 7.4 of CSA B149.1, Installation Codes, or applicable provisions of the local building codes.
A Copper Brute heater may receive combustion air from the space in which it is installed, or it can be ducted directly to the unit from the outside. Ventilation air must be provided in either case.
2. 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

Clearance From	Indoor (inches)	Outdoor (inches)
Top	30	Unobstructed
Water Conn. Side	12	24
Opposite Side	6	24
Front	Alcove	Unobstructed
Rear	8	24
Vent Pipe*	6	—
Hot Water Pipes	Per Code	Per Code

*1" when using type B Vent (refer to Manufacturer's Instructions)

Table 1. Minimum Heater Clearances From Combustible Surfaces.

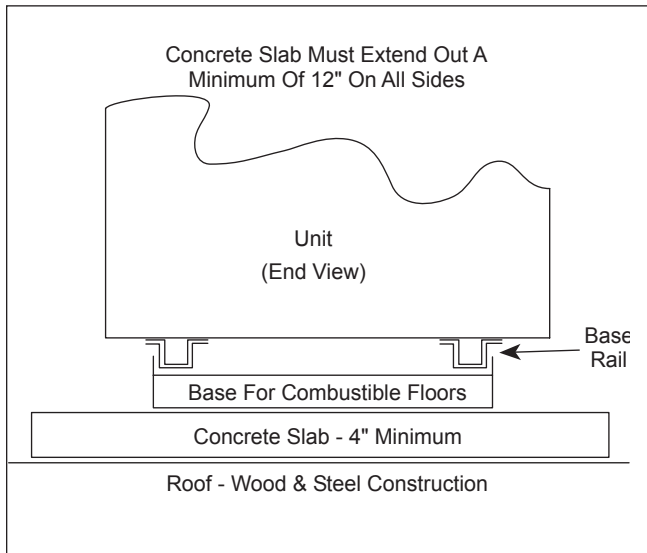


Figure 2. Typical Heater Installation with Base for Combustible Floors, Example A.

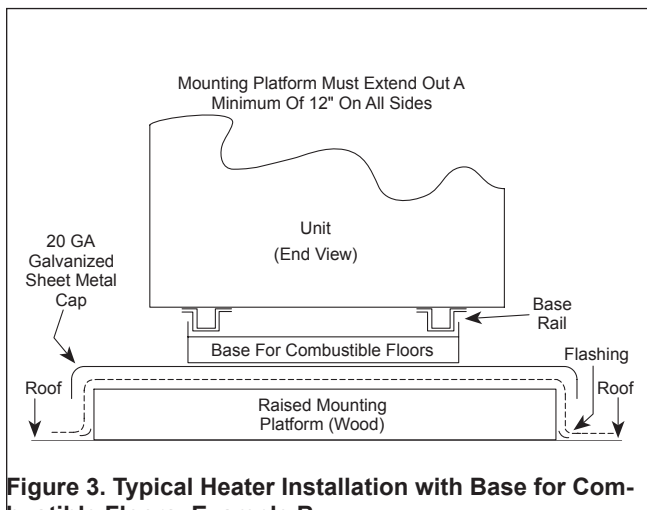


Figure 3. Typical Heater Installation with Base for Combustible Floors, Example B.

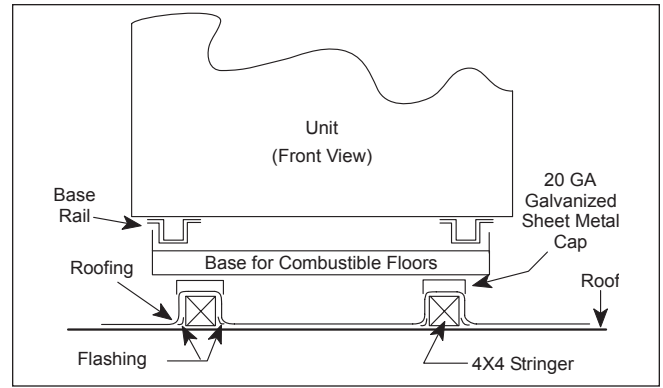


Figure 4. Typical Heater Installation with Base for Combustible Floors, Example C.

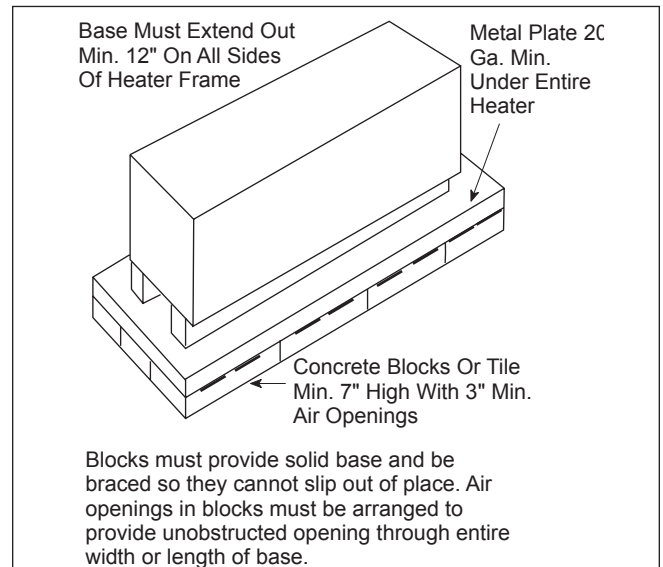


Figure 5. Installation on Concrete Blocks or Tile.

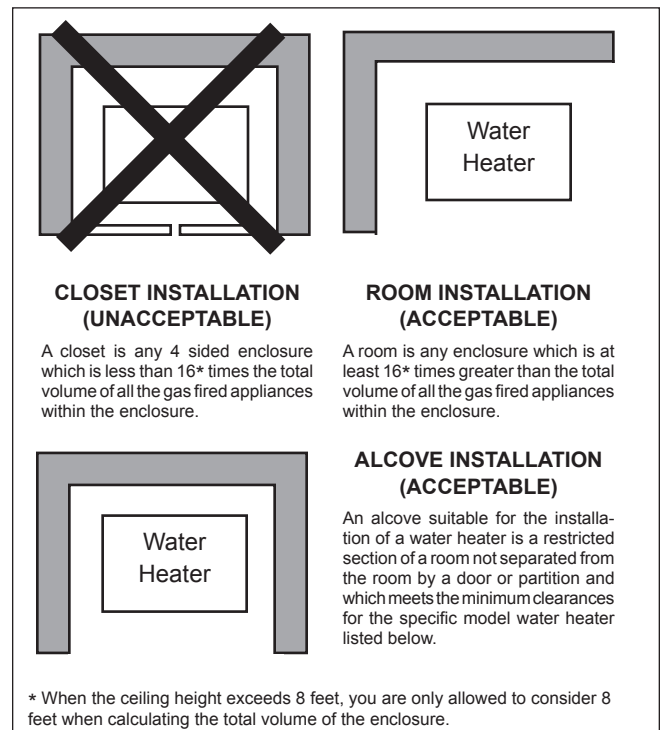


Figure 6. Alcove Installation.

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 2 shows data for this sizing method, for each Copper Brute model.

Method 2: One permanent opening, commencing within 12 inches (30 cm) of the top of the enclosure, shall be permitted. The opening shall directly communicate with the outdoors or shall communicate through a vertical or horizontal duct to the outdoors or spaces that directly communicate with the outdoors and shall have a minimum free area of 1 square inch per 3000 Btu/hr (7 square cm/kW) of the total input rating of all equipment located in the enclosure. This opening must not be less than the sum of the areas of all vent connectors in the confined space.

Other methods of introducing combustion and ventilation air are acceptable, providing they conform to the requirements in the applicable codes listed above.

In Canada, consult local building and safety codes or, in absence of such requirements, follow CSA B149.1.

Heater Model	Each Opening* (Square Inches)
500	125
600	150
715	179
850	213
1010	253
1200	300
1430	358
1670	418
1825	457

*Net Free Area in Square Inches

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. For special conditions refer to the latest edition of ANSI Z223.1. or CSA B149.1

Consult factory if not communicating directly through the walls with the outdoors.

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.

IMPORTANT: In beauty shops, barber shops, cleaning establishments and self-service laundries with dry cleaning equipment, it is important that the water heater be installed in a location where combustion and ventilation air is received from a source outside the building. Please refer to the most recent edition of the National Fuel Gas Code, ANSI Z223.1, or in Canada, CSA requirements.

- (a) In the United States:** Exhaust Fans or Vents: Any equipment which exhausts air from the heater room can deplete the combustion air supply or reverse the natural draft action of the venting system. This could cause flue products to accumulate in the heater room. Additional air must be supplied to compensate for such exhaust. The information in Table 2 is not applicable in installations where exhaust fans or blowers of any type are used. Such installations must be designed by qualified engineers.

(b) In Canada: Follow Canadian standard, CSA B149.1 or local codes.
- If a blower or fan is used to supply air to the heater room, the installer should make sure it does not create drafts which could cause nuisance shutdowns of the pilot. If a blower is necessary to provide adequate combustion air to the heater, a suitable switch or equivalent must be wired into the heater control circuit to prevent the heater from firing unless the blower is operating.
- The heater must be completely isolated and protected from any source of corrosive chemical fumes such as trichlorethylene, perchlorethylene, chlorine, etc.

2.2.2 Venting

- Bradford White heaters have built-in draft diverters for natural draft operation and must not be connected to any portion of a mechanical draft system under positive pressure. The flue outlet must be connected to a clear, unobstructed vent of adequate capacity ending above the highest point of the building with an approved vent cap. The venting system should be installed according to the latest edition of ANSI Z223.1 and/or, in Canada, CSA B149.1 requirement and any local codes having jurisdiction.

IMPORTANT NOTE: Do not use sheet metal screws at the snap lock joints of Type B gas vents.

- Do not weld or fasten the vent pipe to the heater draft hood. The weight of the stack must not rest on the heater. The draft hood and heater top must be easily removable for normal heater service and inspection.

Table 2. Minimum Recommended Air Supply to heater.

3. Avoid using long horizontal runs of the vent pipe, and too many 90° elbows, reductions or restrictions. Horizontal runs should have at least a 1/4" rise per foot in the direction of flow. A vent connector should be supported for the design and weight of the material used to maintain clearances and prevent physical damage and separation of joints.
4. Avoid ending heater vents near air conditioning or air supply fans. The fans can pick up exhaust flue products from the heater and return them inside the building, creating a possible health hazard. A minimum of 4 feet horizontal distance must be maintained from electrical meters, gas meters, and relief equipment.
5. Always use double-wall or insulated vent pipe (Type B or equivalent). In cold weather, uninsulated outside vents can chill the rising flue products, blocking the natural draft action of the venting system. This can create a health hazard by spilling flue products into the heater room.
6. Avoid oversize vent piping or extremely long runs of the pipe which may cause excessive cooling and condensation. Rule of Thumb: The total length of the vent, including the connector and any offset, should not exceed 15 feet for every inch of vent diameter. Longer total lengths shown in venting tables are based on maximum capacity, not condensation factors.
7. When the installation of a draft fan is necessary in connecting a venting system to a the heater, the installation should be engineered by competent personnel following good engineering practices. The draft fan supplier should be consulted for correct size. The installation should be in accordance with the latest edition of ANSI Z223.1 and/or, in Canada, CSA B149.1 requirement and any local codes having jurisdiction. When a draft fan is installed, a suitable draft switch must be wired into the heater control circuit at terminal designated "Field Interlock" to prevent firing of the heater unless a positive draft has been established.

2.3 Installation of Outdoor Heaters

1. Locate the heater to provide the minimum clearances as listed in Table 1, "Placement of Heater".
2. Do not place the heater in an enclosure or wall recess. Avoid locations where wind deflection off structures might cause down draft. When such wind conditions are possible, place the heater at least three (3) feet from the structures.
3. Never install the heater under any kind of roof overhang. Do not place the heater below or adjacent to any doors, windows, louvers, grills,

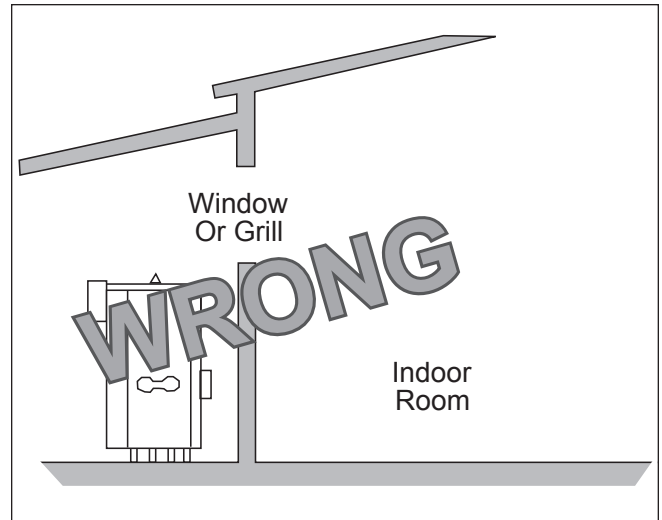


Figure 7. Incorrect Outdoor Installation.

etc. which connect in any way with an inhabited area of a building. This includes other structures such as garages or utility rooms (see Figure 7).

4. Although these models are CSA designed certified for outdoor installations, such installations are not recommended in areas where the danger of freezing exists unless proper precautions are taken for freeze protection.

2.4 Gas Supply and Piping

Review the following instructions before proceeding with the installation.

1. Verify that the heater is fitted for the proper type of gas by checking the rating plate. Bradford White heaters are normally equipped to operate below a 2000 foot altitude. Heaters equipped to operate at higher altitudes have appropriate stickers or tags attached.

Size	Distance from Gas Meter or Last Stage Regulator		
	0-100'	100-200'	200-300'
500	1-1/2"	2"	2"
600	1-1/2"	2"	2-1/2"
715	2"	2"	2-1/2"
850	2"	2-1/2"	2-1/2"
1010	2"	2-1/2"	3"
1200	2-1/2"	3"	3"
1430	2-1/2"	3"	3"
1670	2-1/2"	3"	3"
1825	2-1/2"	3"	3-1/2"

Note: These figures are for Natural Gas (.65 Sp. Gr.), and are based on 1/2" water column pressure drop. Check supply pressure with a manometer, and local code requirements for variations. **For LPG,** reduce pipe diameter one size, but maintain a 1" minimum diameter. A normal number of Tees and elbows have been taken into allowance.

Table 3. Gas Piping Sizes.

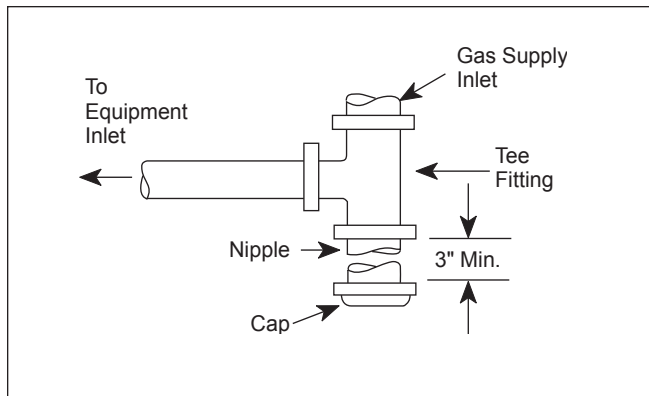


Figure 8. T-Fitting Sediment Trap Installation.

2. Use the figures in Table 3 to provide adequate gas piping from the gas meter to the heater.
3. A trap (drip leg) must be provided ahead of the gas controls (see Figure 8). A manual gas shutoff valve must also be provided for service convenience and safety. Check the local codes.
4. The heater and its individual shutoff valve must be disconnected from the gas supply piping system during any pressure testing of that system at test pressures in excess of 1/2 psig. The heater must be isolated from the gas supply piping system by closing its individual manual gas shutoff valve during any pressure testing of the gas supply piping system at test pressures equal to or less than 1/2 psig.
5. Provide gas supply pressure to the heater as follows:

	Natural Gas	LPG
Min. (inches water column)	Per Rating Plate	
Max. (inches water column)	9	14

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

6. The correct burner manifold gas pressure is stamped on the rating plate. The regulator is preset at the factory and normally requires no further adjustment.
7. The gas manifold and control assembly was tested and conform to the safe lighting and other performance criteria specified in the latest editions of ANSI Z21.13, Low Pressure Boiler Standard.

8. Before operating the heater, the complete gas supply system and all connections must be tested for leaks using a soap solution. **Do not use raw flame.**

⚠ Caution

Since some leak test solutions (including soap and water) may cause corrosion or stress cracking, the piping must be rinsed with water after testing, unless it has been determined that the leak test solution is noncorrosive.

2.5 Electrical Wiring

⚠ WARNING

The heater must be electrically grounded in accordance with the most recent edition of the National Electrical Code, ANSI/NPA 70. In Canada, all electrical wiring to the heater should be in accordance with the Canadian Electrical Code, CSA C22.1 Part 1. Do not rely on the gas or water piping to ground the metal parts of the heater. Oftentimes, plastic pipe or dielectric unions isolate the heater electrically. Service and maintenance personnel who work on or around the heater may be standing on wet floors and could be electrocuted by an underground heater.

1. Check heater wiring and pump for correct voltage, frequency and phase. If the pump circuit is other than 115V, check to see that the heater is provided with an appropriate transformer.
2. Wire the heater and pump exactly as shown in the wiring diagram supplied with the heater.
3. The pump and heater must be electrically interlocked so the heater cannot come on unless the pump is running.
4. All field installed electrical safety devices and all field installed devices (draft switches, relays, timers, outdoor temperature reset devices, etc.) can be connected to the heater wiring at points shown in the wiring diagram designated “Field Interlock”.

2.6 Water Piping of System

1. Be sure to provide valves at the inlet and outlet of the heater so it can be readily isolated for service. A butterfly or similar type of valve is recommended.
2. The pressure relief valve installed in the tapped opening provided in the outlet header (see

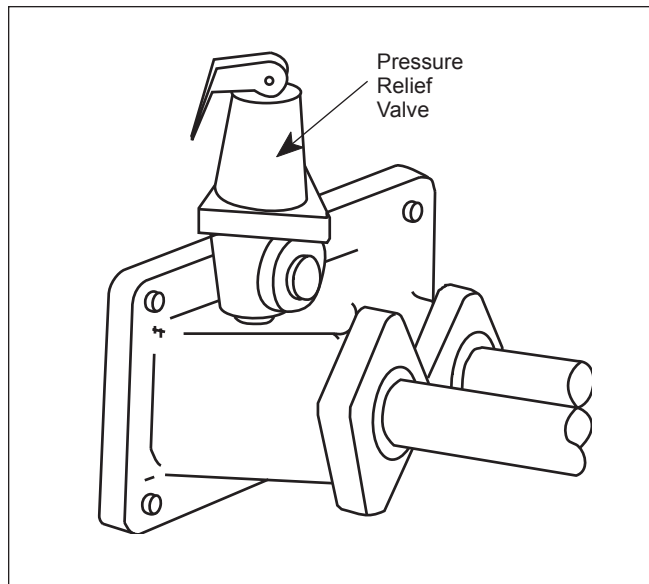


Figure 9. Pressure Relief Valve Location.

Figure 9), must be piped, but not fastened, to a drain or floor sink. The drain pipe must be the same size as the valve outlet and must pitch downward from the valve.

Special attention must be given to relief valve settings in installations where the heater is located on the ground floor of a tall building. The static pressure of the system is elevated and could cause the relief valve to leak. *Where no special setting of the relief valve is ordered, the factory will furnish a 125 psi setting.* Never reduce the relief valve openings.

3. Pressure relief valve lever must be tripped at least once a year to insure that waterways are clean. When manually operating lever, water will discharge through drain line. Precautions must be taken to avoid contact with hot water and water damage.
4. The weight of all water and gas piping should be supported by suitable hangers or floor stands.
5. Check piping diagrams with local applicable plumbing, heating and building safety codes.
6. All two-temperature systems using temperature valves must have forced recirculation in the low temperature building loop.
7. A check valve installed at the hot water inlet to the tempering valve will prevent cold water from being drawn in reverse through the tempering valve into the hot water.
8. When installing a tempering valve, place at bottom of antithermosyphon loop at least 24" high to prevent excessive hot water from entering mixed water supply. Bring the cold water supply up from the floor to the valve (see Figure 10).

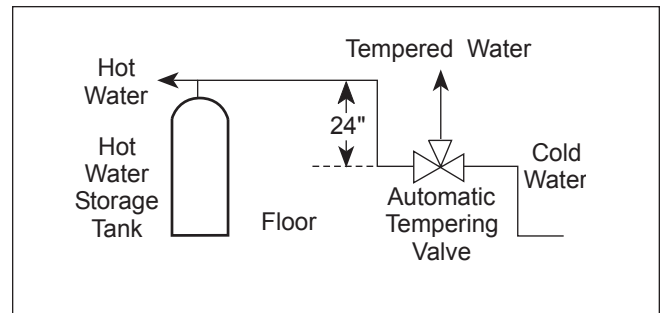


Figure 10. Tempering Valve Installation.

2.7 Water Expansion

When cold water is heated the water expands. If no water is being used during the heat-up period the expanded water will normally back up into the city mains.

A water pressure reducing valve installed in the incoming cold water line may act as a check valve and prevent the expanded water from moving backward. This will cause pressure to rise in the heater, which will be relieved by the pressure relief valve.

If the relief valve pops frequently a mineral deposit may build up on the valve seat, causing it to leak.

The following suggestions may solve the problem:

1. Install a properly sized expansion tank.
2. Replace the installed water pressure reducing valve with a suitable valve having a back flow port. These valves have a back flow port which allows water to flow backwards when the pressure in the system exceeds the pressure in the mains.
3. Install an auxiliary small relief valve set at 25 psi less than the main relief valve. The valve must be piped to a drain and may require occasional cleaning. It will bleed off the expanded water and protect the main pressure relief valve from becoming fouled.

2.8 Pump Performance and Installation

1. The factory provided pumps on all Copper Brute heaters are sized to provide proper circulation through the heater and heater-to-tank circulation loop (see Figures 11 and 12). If the heater-to-tank circulating loop **does not contain more than 6 elbows or 30 feet of pipe**, use pipe fittings in the loop no smaller than the following:

Model	Pipe Size
500 through 850	2"
1010 through 1825	2-1/2"

If the heater-to-tank circulating loop contains **more than 6 elbows or 30 feet of pipe**, use pipe or fittings in the loop no smaller than the following:

Model	Pipe Size
500 through 850 1010 through 1825	2-1/2" 3"

Pump performance requirements are provided in Table 4 for reference purposes.

To assure free circulation, do not use globe valves, side outlet tee connections or other restrictive fittings in heater-to-tank loop.

- Copper Brute heaters are not suitable for heating swimming pools or any other application where temperature of the water flowing through the heater remains below the dew point (110°F).

In applications requiring the rapid use of measured volumes of water, the recovery of the heater between the time intervals of use must equal the volume used.

2.9 Water Pressure

It is very important that water pressure in the system be maintained above 30 psi. If the system pressure should drop below this, the vapor pressure of water in the suction side of the pump can cause hammer and cavitation in the pump and damage the heater through lack of water circulation.

2.10 Tank Installation

- Be sure the floor is waterproof and structurally capable of supporting the tank when it is filled with water.
- The tank should be placed so that manholes, inspection covers, nameplates and drain valves are accessible.
- Be sure the tank is suitable for the water in the system. Some water is corrosive and requires a protected tank with a special lining.
- If the tank is glass-lined, it should be equipped with a suitable magnesium anode. It is good practice to replace the anode when it is approximately 50% used. The factory warranty on a glass-lined tank will be void if a satisfactory anode is not in place at the time of a failure or if it is consumed by cathodic action.
- Make sure the tank connections in the heater-tank circulating loop are the proper size as listed in **Section 2.8**. If tapings are smaller than the recommended pipe size, a larger pump may be required. Consult the factory if in doubt.

Model	Water Category	Flow Rate (GPM)	Head* Loss (ft.)	Temp. Rise Across Heater, (°F)
500	Soft	45	5.0	17
	Normal	68	9.9	11
	Hard	90	15.7	8
600	Soft	45	5.1	20
	Normal	68	10.0	14
	Hard	90	15.9	10
715	Soft	45	5.3	24
	Normal	68	11.0	16
	Hard	90	17.8	12
850	Soft	45	5.4	30
	Normal	68	11.1	20
	Hard	90	18.1	15
1010	Soft	45	3.9	35
	Normal	68	7.5	23
	Hard	90	11.7	18
1200	Soft**	68	7.8	27
	Normal	68	7.8	27
	Hard	90	12.2	21
1430	Soft**	68	8.1	32
	Normal	68	8.1	32
	Hard	90	12.6	24
1670	Soft**	68	8.3	37
	Normal	68	8.3	37
	Hard	90	13.0	28
1825	Soft**	90	13.5	30
	Normal**	90	13.5	30
	Hard	90	13.5	30
Water Category Soft Normal Hard		Grain Hardness per Gal. 1 through 7.5 7.6 through 17 Over 17		
<small>* Pressure drop includes loss through 30 feet of pipe and normal fittings when heater is installed with storage tank. Pipe and fittings are assumed to be 2" on Models (500-850) and 2 1/2" on Models (1010-1825)</small>				
<small>** To prevent erosion, these models must be ordered with cupro-nickel heat exchanger tubes.</small>				

Table 4. Pump Performance Requirements.

- Install a pipe in the tank drain fitting that goes to a floor sink, and install a drain valve. If a floor sink is not available, install a hose bib.
- Hot water tanks in an existing installation are likely to have a deposit of silt on the bottom. Therefore, it is important to extend the pump suction pipe in the tank to a position near the top. Pipe the return from the heater to the bottom of the tank.
- Incorrect installation can cause rapid failure of water tanks due to electrolysis. Tanks must be installed with dielectric connections to electrically isolate the tank from stray current. Note that the use of brass or bronze connectors does not replace the need for dielectric connections.

2.11 Two-Temperature System

See Figures 13 and 14 for piping schematics. This system is designed to maintain the tempered water circulating loop at the desired temperature during idle periods as well as when there is a

demand for hot water. It is recommended for general purpose water supply including shower and bathing applications. Water at 180°F is available directly from the tank.

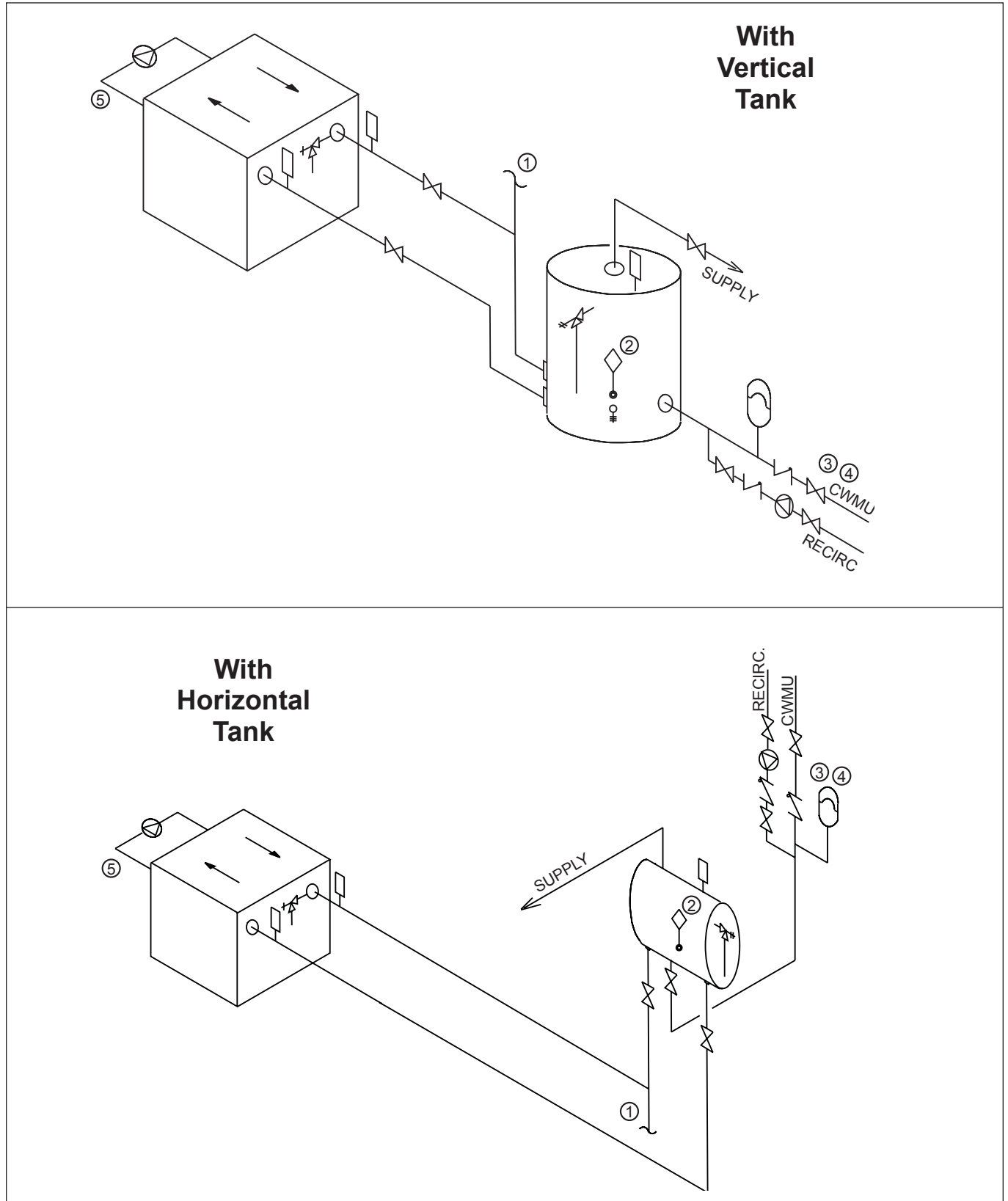


Figure 11. Hot Water Supply System

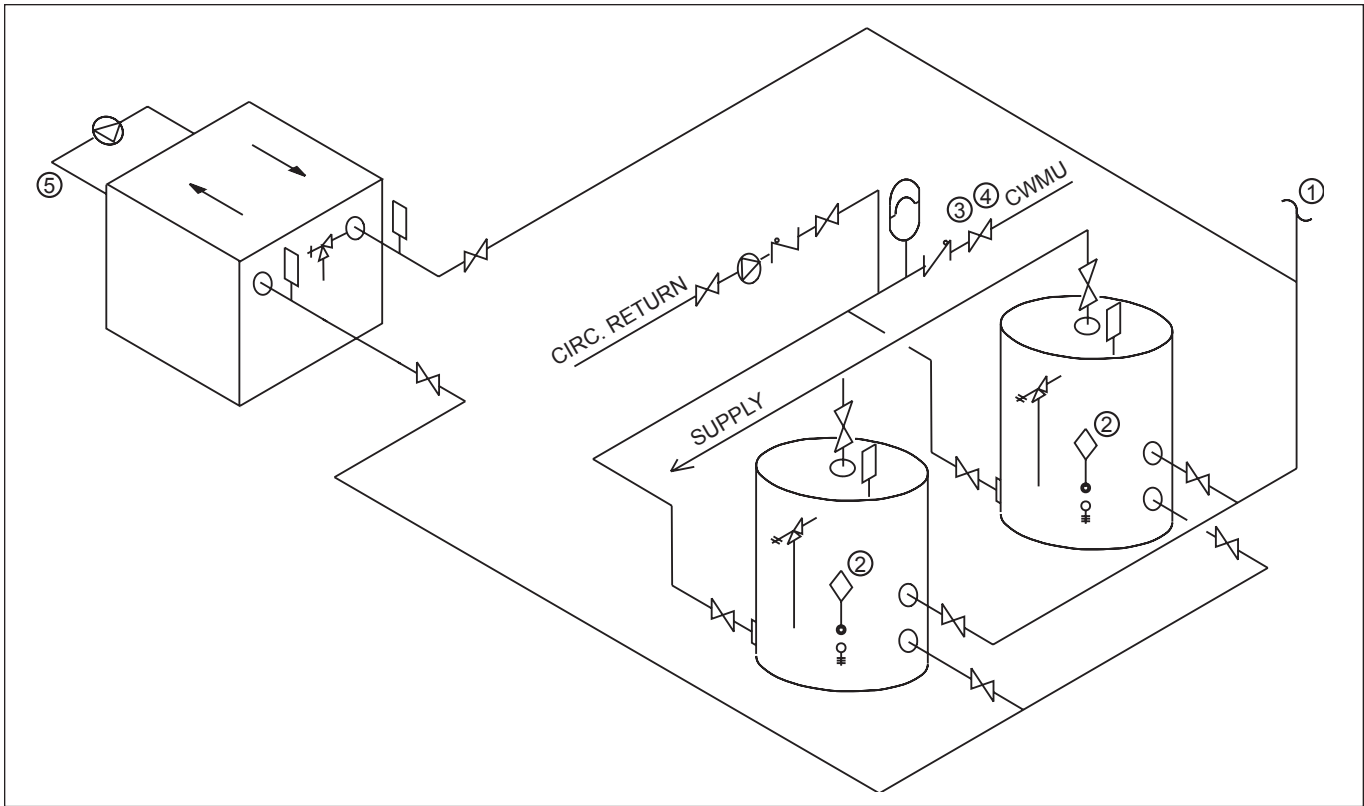


Figure 12. Hot Water Supply System with Dual Tanks, Building Loop Return and Circulating Pump.

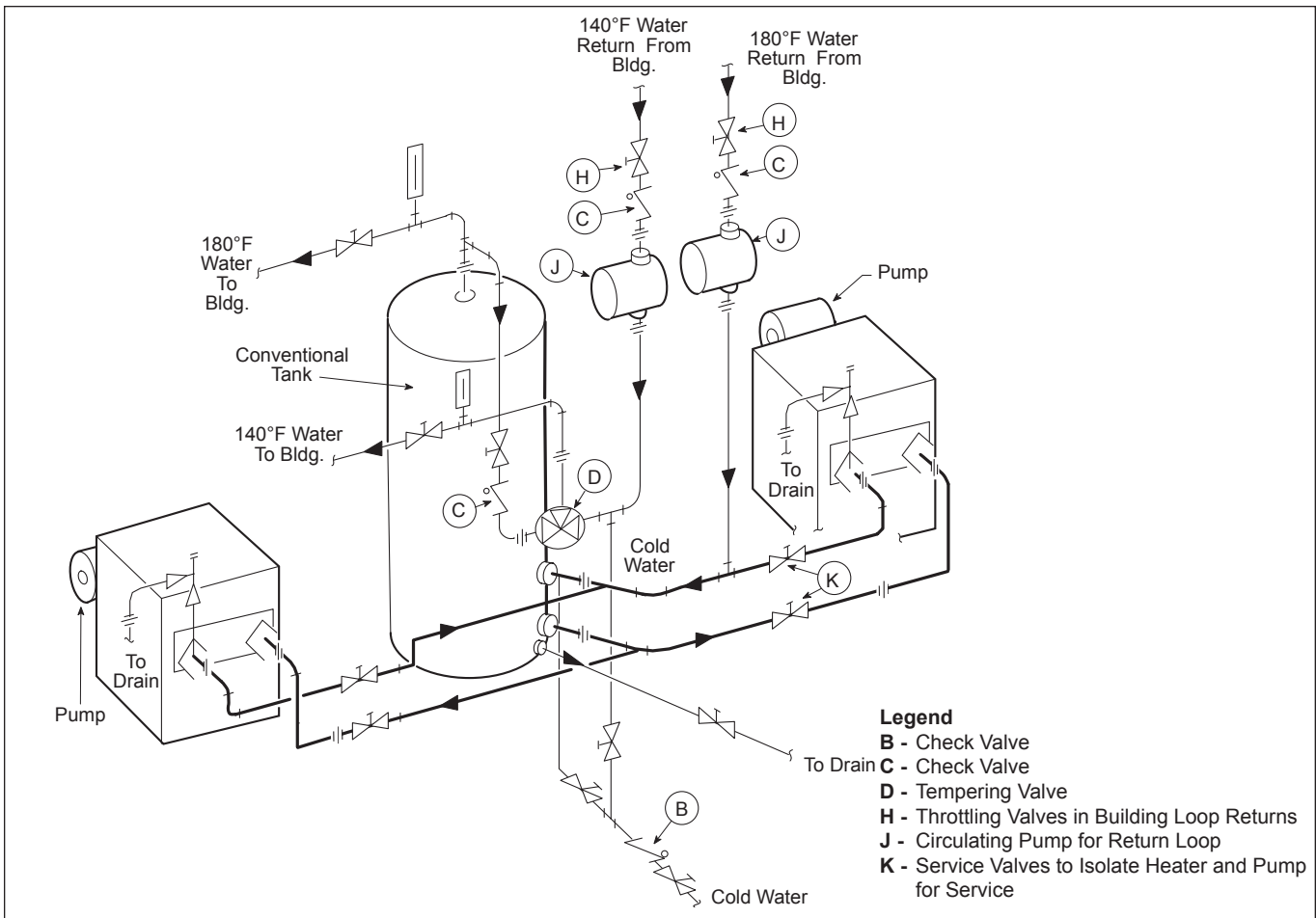


Figure 13. Two-Temperature Hot Water Supply System with Vertical Tank.

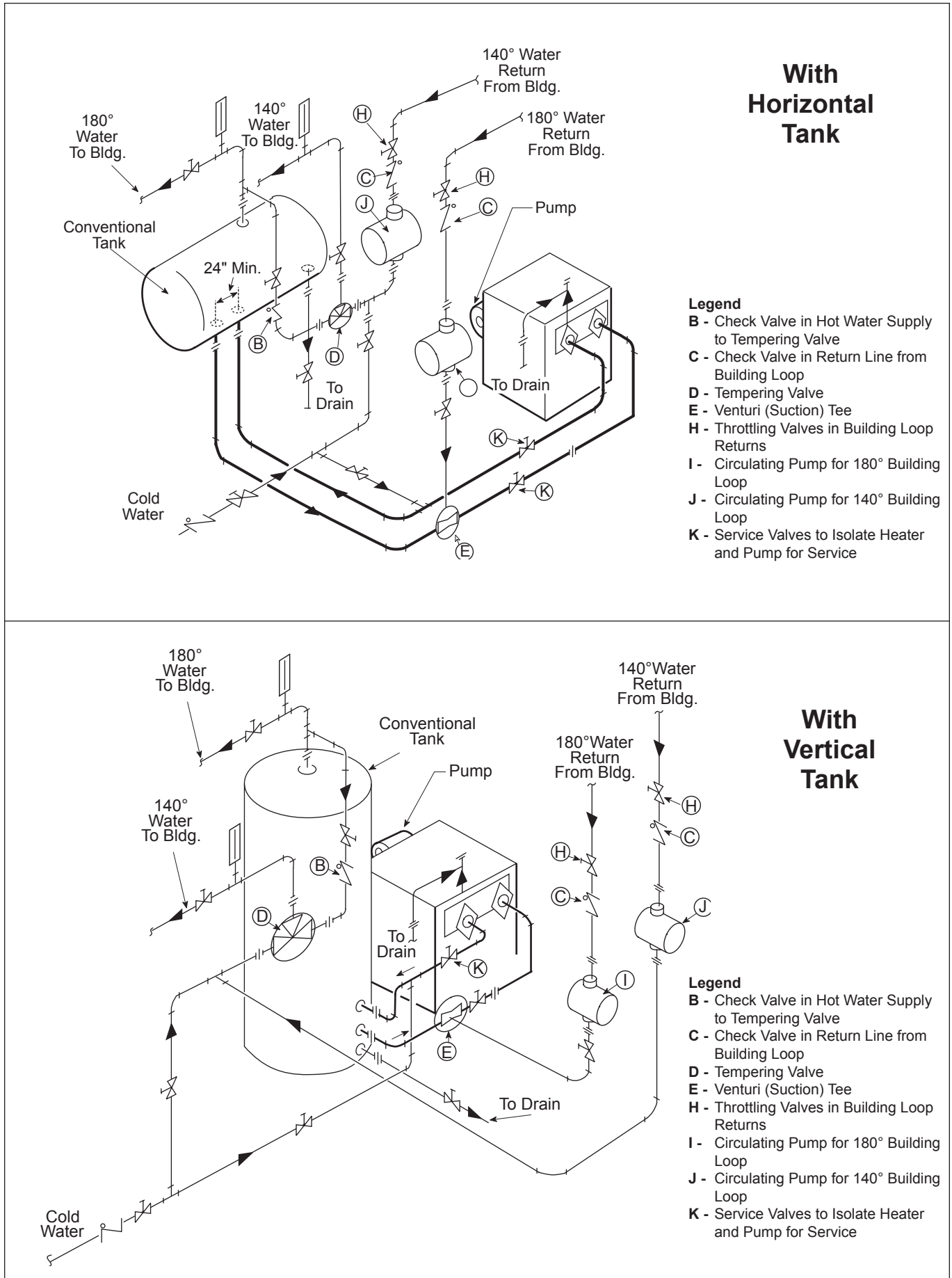


Figure 14. Two-Temperature Hot Water Supply System.

SECTION 3. Operation

3.1 Controls - General

See Figure 15 for control locations.

3.1.1 Electronic Ignition Controls:

a. Intermittent Ignition:

Pilots are automatically lit when the operating aquastat calls for heat (System #9).

The unit performs its own safety check and opens the main valves only after the pilot is proven to be lit. Whenever the pilot flame is interrupted, the main gas valve closes within 0.8 seconds.

b. Electronically Supervised Standing Pilot System (System #16):

When pilot flame fails, the ignition control module responds in less than 0.8 seconds and provides 100% safety shutdown.

3.1.2 Operating Controls:

Electrically Operating Controls:

Copper Brute units are equipped with operating temperature. The temperature sensing bulb is located in the heater inlet.

3.1.3 High Limit Controls:

The manual reset high limit switches are provided as standard equipment on all heaters. Automatic reset switches are optionally provided. The temperature sensing bulb of the switch is always located in the heater outlet. Burners will automatically shut down whenever overheating of water occurs.

3.1.4 Flow Switch:

Standard on all models, the switch is mounted directly in the header outlet. The flow switch shuts down all burners in case of low water condition or pump failure.

3.1.5 Low Water Cut Off: (Optional)

The low water cut off automatically shuts off the heater whenever the water level drops below the probe. The probe is located at the heater inlet.

3.2 Initial Start-Up

Before placing the heater in operation, be certain that the heater is filled with water and all air is purged from the system. Once the heater is connected to the gas supply, the automatic safety shutoff devices must be checked.

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

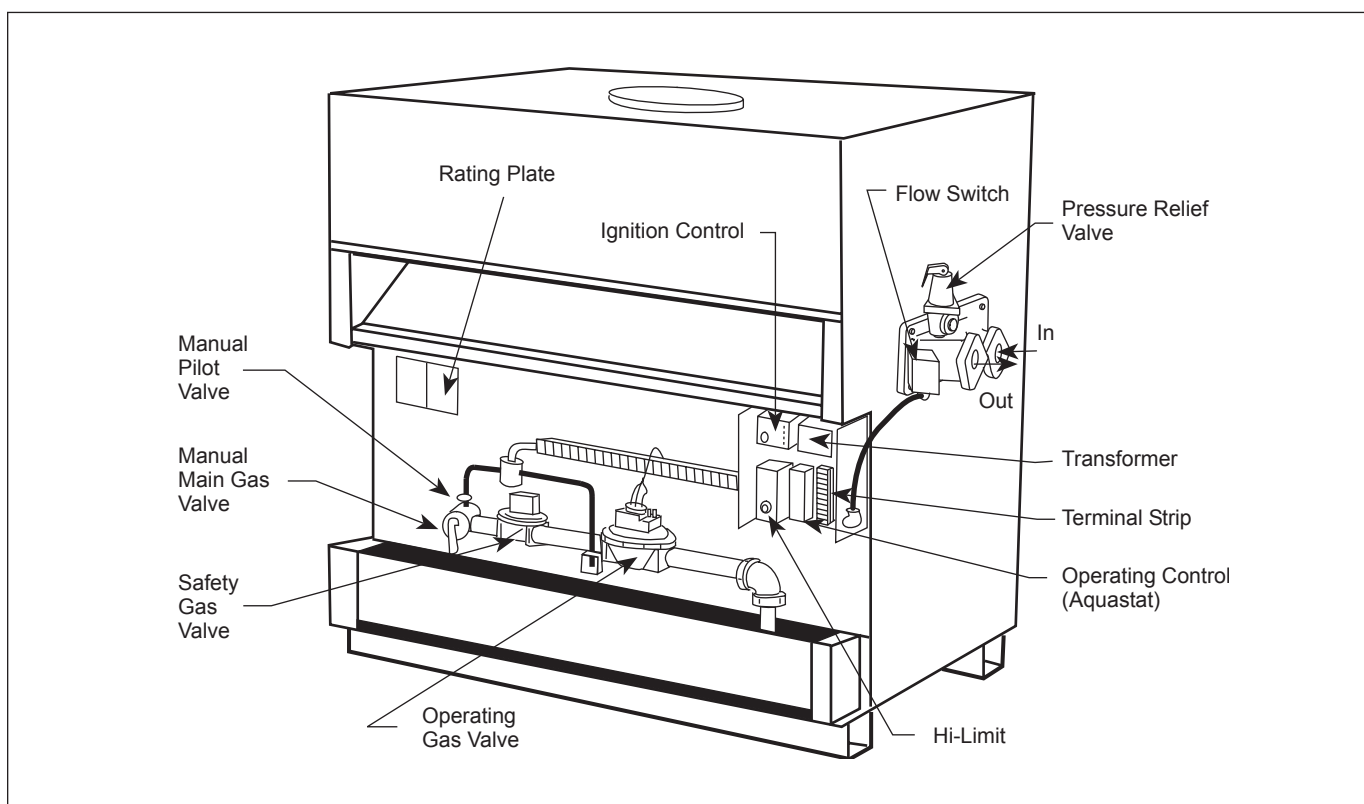


Figure 15. Control Components.

2. Make sure the heater's power switch is in the "ON" position. After placing the manual pilot gas valve in the open position and resetting all safety devices, (high limit, pressure switch, low-water cutoff, etc.) pilot(s) can be lit following the procedure located on the heater rating plate.
3. Once the pilot(s) is lit and has been established for five minutes, the flame failure response time should be checked as follows:

System 9 - (Intermittent ignition): With this system pilots are automatically lit when the operating controls call for heat. If the pilot flame fails for any reason, the main valve is shut off within one second and the pilot spark ignition is initiated until the pilot flame has been reestablished. On propane systems, unit locks out for safety. This sequence should be checked by turning off the manual pilot gas valve, and, at the same time, monitoring the audible sparking at the pilot burner and signal interruption to the main valve.

⚠ Caution

Propane gas is heavier than air and sinks to the ground. Exercise extreme care in lighting the heater when so equipped.

System 16 - (Electronically supervised standing pilot system): Extinguish the pilot flame by placing the manual pilot valve in the closed position, and at the same time, begin recording the time it takes for the output signal from the electronic ignition control to be interrupted. The signal interruption can be detected either with a test light or a voltmeter. The response time should never exceed one second.

4. With the pilots lit, initial activation of the main burners can be achieved by slowly opening the main manual valve. The result should be a smooth lighting of the main burners.

Hi-Limit Checkout:

After running the heater for a long enough period, bring the water temperature within the range of the hi-limit and slowly back off the high limit setting until the heater shuts off. The main burners should reignite when the hi-limit is reset and turned back up to its original setting. The heater should now run until it shuts off automatically on operating aquastat.

3.3 To Start Up System:

3.3.1 Start Up Heater

Be certain system pump is running, then proceed as follows:

1. Turn off main electrical switch.
2. Turn off all manual gas valves and wait five minutes (see Figure 16).
3. Set operating control to lowest setting.
4. Slowly turn manual gas valve to "ON".

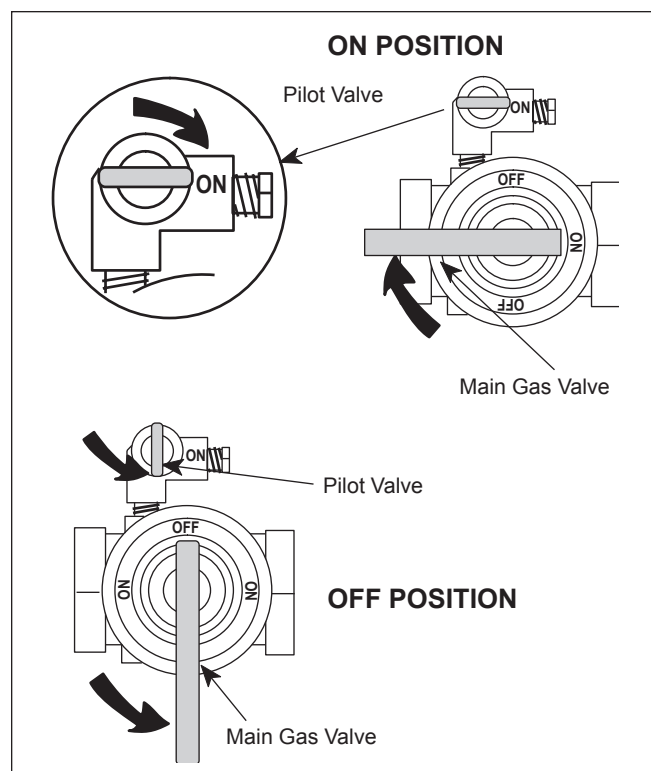


Figure 16. Gas Manual Valves.

5. Reset all safety valve switches (manual reset high limit and low water cut off).
6. Open manual pilot valve. Turn on main electrical switch.
7. Set temperature controller to desired temperature. Pilot will light automatically to ignite main burners whenever the aquastat calls for heat.

For standing pilot system, press on pilot relay knob, see Figure 17, light pilot and keep relay knob depressed for one minute then release. Once the pilot is lit, the power is supplied through the aquastat to the main gas valve.

3.3.2 To set the temperature and high-limit controls:

When using a tank aquastat:

Set the tank aquastat to the desired tank temperature. Set the heater temperature control 20°F higher than tank aquastat. Set the manual reset high limit 50°F higher than tank aquastat. Example: If desired temperature is 140°F, set the tank aquastat at 140°F, set the heater temperature control at 160°F, and set the manual reset high limit at 190°F. If the heater is equipped with a pump time delay, the three-position switch on the side of the heater can be put into the "Auto Pump" position, so that the pump will only run when the tank aquastat calls for heat. Then, when the call for heat is satisfied, the heater will turn off, but the pump will run for the set amount of delay time (adjustable between 0.1 and 10 minutes).

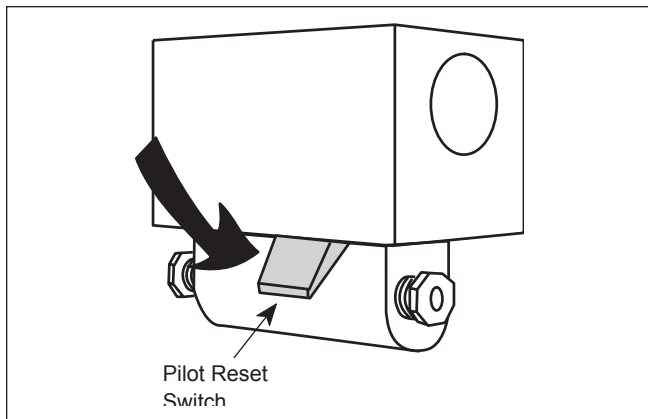


Figure 17. Pilot Safety Relay.

When a tank aquastat is not used:

The pump on the heater must run continuously, so the heater's temperature control will sense the tank's water temperature. Set the heater temperature control to the desired tank temperature. Set the manual reset high limit 50°F higher than the heater temperature control. Example: If desired temperature is 140°F, set the heater temperature control at 140°F, and set the manual reset high limit at 190°F.

3.4 To Turn Off Heater:

1. Turn off main electric switch.
2. Close all manual gas valves.

3.5 To Shut Down System:

To shut down heater, turn off all manual gas valves and electrical disconnect switches. Whenever danger of freezing exists, shut off water supply and remove drain plug in the bottom of front header cover. Drain every part of system subject to freezing temperature.

SECTION 4. Maintenance

1. Lubricate the water circulating pump (see instructions found on the pump).
2. If a strainer is employed in a pressure reducing valve or in piping, clean it every six (6) months.
3. At start-up and every six (6) months thereafter, the pilot and main burner flame should be observed for proper performance (see Figure 18). See attached lighting and shut-down instructions for proper pilot flame pattern). If flame has the appearance of "sooting" tips, check for debris near orifices. Call serviceman.
4. Inspect the venting system for obstruction, leakage and corrosion at least once each year.

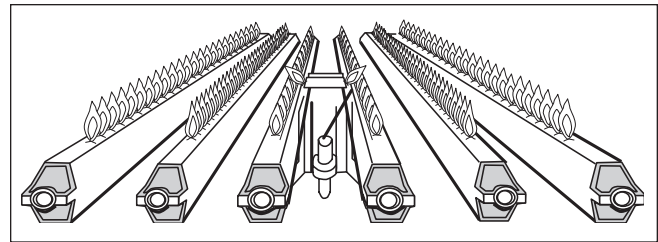


Figure 18. Main Burner Flame Pattern.

5. Keep heater area clear and free from combustible material, gasoline and other flammable vapors and liquids (see Table 1 for minimum clearances).
6. Be certain all combustion air and ventilation openings are unobstructed.
7. Check for fouling on the external surfaces of the heat exchanger every six months. (**NOTE:** After installation and first start-up, check the heat exchanger for fouling after the following periods of operation: 24 hours, 7 days, 30 days, 90 days, and once every six months thereafter).

Fouling on the external surfaces of the heat exchanger is caused by incomplete combustion and is a sign of combustion air and/or venting problems. As soon as any fouling is observed, the cause of the fouling should be corrected (see Section 5, Troubleshooting Guide). The heat exchanger can be checked by locating a mirror under the burners with a flashlight. An alternate method is to remove the venting and top panel as necessary to inspect from above. Also check the vent system for defects at this time.

- a. If cleaning is required, shut off all electrical and gas supply to the heater.
- b. To expose the heat exchanger:

Indoor Models:

Remove flue pipe, top of unit, rear upper jacket, flue collector rear panel and heat exchanger baffles.

Outdoor Models:

Remove vent top assembly, rear upper jacket, flue collector rear panel and heat exchanger baffles.

- c. Remove all burners:

It is usually more convenient to remove the burner tray assembly. Disconnect sensor wire, ignition cable (or thermocouple generator) and pilot gas line. Disconnect manifold inlet union(s). Remove the four (4) retaining screws. Grasp burner/pilot assembly firmly at the front. Push it back, disengaging it from the gas orifice. Lower the front of the burner (to avoid damaging pilot shield) then remove the burner tray.

⚠ Caution

Black carbon or green soot on a dirty heat exchanger can, under certain conditions, be ignited by a random spark or open flame. To prevent this unlikely occurrence, dampen the soot deposits with wet brush or fine water spray before servicing or cleaning the heat exchanger.

With a wire brush, remove soot and loose scale from heat exchanger. Clean fallen debris from bottom of heater. Make sure burner ports are clear and pilot assembly is free of debris.

- d. Reassemble in reverse order: Be sure the heat exchanger baffles are replaced.
- 8. The gas and electric controls installed on heaters are engineered for both dependable operation and long life, but the safety of this equipment completely depends on their proper functioning. It is strongly recommended that the basic items be checked by a competent serviceman every year and replaced when necessary. The basic controls are:
 - a. Water temperature controls.
 - b. Pilot safety system.
 - c. Automatic electric gas valve(s).
 - d. Flow sensing safety device.
- 9. Low water cutoffs should be inspected every six (6) months, including flushing of float types.

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

- 10. Both modulating and stage valve are adjusted at the factory for minimum permissible rates and should not be readjusted.

SECTION 5. Troubleshooting and Analysis of Service Problems

- 1. For proper service and problem diagnosis of the heater and heater system, the following tools are required:
 - a. Gas pressure test kit with range from zero to 14 W.C. Either a slack tub manometer or an accurate gas pressure gauge is acceptable with proper adapters which will connect to the available fittings in the line and on the gas valve.
 - b. Multi-meter with the following ranges:
 - 0 to 500 volts A.C.
 - 0 to 1000 ohms continuity.

- c. Tube cleaning kit consisting of reamer, stainless steel brush, speed handle and handle extensions.
- d. Heater thermometer (with 1/2" NPT well) 100-240°F.
- 2. In addition, the heater should be equipped with a system pressure gauge with proper ranges for heater operation.

I. HEATER WILL NOT FIRE.

Possible Cause	What To Do
A. Electric power is off	A. Check to see that main power switch is "ON." Use testing device to trace power to heater junction box.
B. Operating or safety control has opened circuit to electric gas valve.	B. Turn off power. Use continuity across terminals of each operating and safety control switch up to the electric gas valve. Replace effective control.
C. Pilot flame is out.	C. Relight pilot per instruction.
D. Manual reset device has tripped.	D. Follow instructions for start-up. Reset Pilot safety and all manual reset safety switches and reset manual safety gas valve.
E. No gas pressure to burners.	E. Trace gas line to service shutoff cock. If service cock is open, trace gas line to meter. If no pressure is present at meter, call for public utility service. If gas is present in heater inlet, check pressures in following sequence: (1) downstream from pressure regulator. (2) downstream from electric gas valve. Replace or adjust as necessary.
F. Electric gas valve operator is burned out or shortened.	F. Disconnect wiring harness at gas valve terminals. Check continuity to actuator coil. If open circuit or short is

II. HEATER IS POUNDING, KNOCKING OR EMITTING STEAM FROM RELIEF VALVES.

Possible Cause	What To Do
A. Low or no water flow.	A. This condition is usually caused by lack of adequate water flow through heater. Check the following: 1. Is the heater wired into the pump circuit so that the heater cannot fire unless the pump is running? 2. Check to see that all valves in system are open to be sure that water can circulate through the heater and the system. 3. If the system has automatic water valves (2-way or 3-way) that can cut off the water flow through the heater check to see that they are equipped with end-switches which shut the heater down when the water flow through the heater is reduced by 70% from full flow. 4. Examine pump for clogged impeller.
B. Low or no system pressure.	B. Clean strainer in pressure reducing valve. Look for closed valve water line or a leak in the system.
C. Clogged "Y" strainer.	C. Remove strainer element and clean screen.
D. Debris from system piping is blocking tubes.	D. Remove header covers. Examine all tubes and waterways. Use new gaskets when reassembling. Clean out tubes.
E. Scale has formed in tubes.	E. This is always caused by the inflow of raw water into the system. Clean tubes with tube cleaning kit. Determine hardness. Check water flow, replace pump for modified flow if necessary.

III. WATER DRIPPING IN FIREBOX.

Possible Cause	What To Do
Tube in heat exchanger has overheated and ruptured.	A tube failure is almost always caused by (a) scale formation in the tube or (b) inadequate water flow through the heater.

IV. PRESSURE RELIEF VALVES LEAKING INTERMITTENTLY OR STEADILY.

Possible Cause	What To Do
A. Static pressure in system exceeds setting of relief valve.	A. Calculate height of water in system above heater. Install new valve with psi setting 25% above required static system working pressure. Do not exceed 160 psi.
B. Expansion tank is water-logged (if installed).	B. Drain expansion tank, then reopen it to the system. Look for leaks in expansion tank or fittings. Calculate required volume of expansion tank in relation to system to determine if tank is adequate.

V. SOOT IN FLUEWAYS OR IN TUBES, OR NOXIOUS FUMES INDICATIVE OF BAD COMBUSTION.

Possible Cause	What To Do
A. Combustion air supply to heater room is inadequate.	A. Check air supply opening. Look for debris in screen or louver which covers combustion air opening, or for material blocking the opening.
B. Stack or vent is blocked or restrictive.	B. Look for blocked stack and excessive number of elbows in stack or excessive length of horizontal runs.
C. Severe down draft is causing spillage of flue products into room.	C. Check for (1) proper vent cap on stack; (2) adequate height of stack above roof; (3) equipment exhausting air from inside of building; and (4) proper installation of draft diverter.
D. Gas pressure to burners is excessive.	D. Check gas pressure with nanometer, and adjust with heater firing at full rate.
E. Heater not fitted for the fuel supplied.	E. See nameplate for correct fuel.
F. Heater installed at high altitude without proper derating.	F. Installations at altitudes in excess of 2000 ft. above sea level are subject to jurisdiction of the local inspection authorities.

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