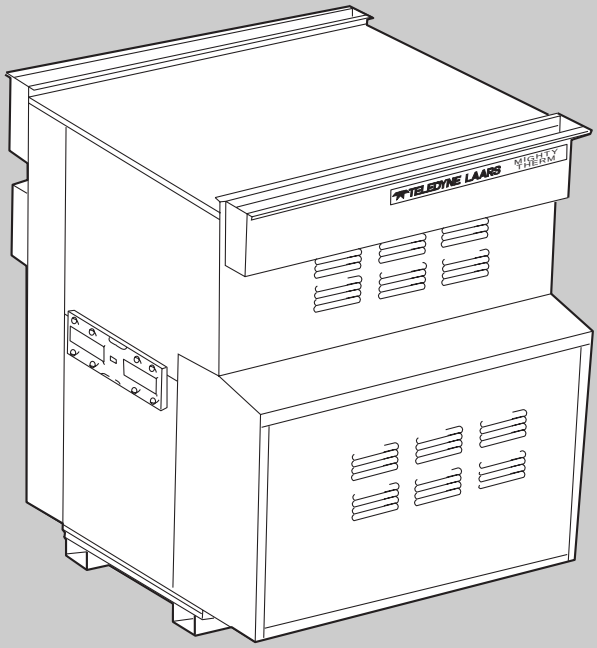
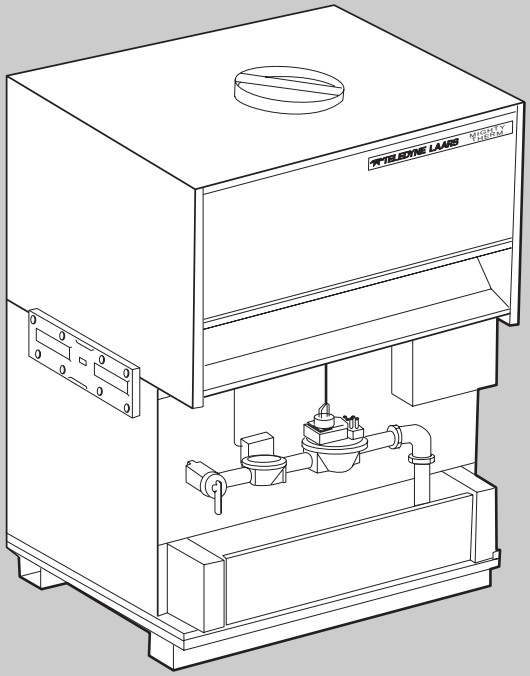
Installation
and Operating
Instructions for

Natco
Fire Coil





Models
VW, PW and IW

Volume Water Heaters
Sizes 500-1825

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

FOR YOUR SAFETY

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

WARNING

Improper installation, adjustment, alteration, service or maintenance can cause injury or property damage. Refer to this manual. For assistance or additional information consult a qualified installer, service agency or the gas supplier.

FOR YOUR SAFETY - 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 neighbor's telephone. Follow the gas suppplier's information.
- If you cannot reach your gas supplier, call the fire department.

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NATCO

Contents

SECTION 1. GENERAL INFORMATION **Page**

1A. Introduction 3
1B. Heater Identification 3
1C. Flow Requirements 4
1D. Water Chemistry 4

SECTION 2. INSTALLATION

2A. Heater Placement 4
2B. Installation of Indoor Heaters 5
2B-1 Combustion Air Supply 5
2B-2 Venting 6
2C. Installation of Outdoor Heaters 7
2D. Gas Supply and Piping 7
2E. Electrical Wiring 8
2F. Water Piping of System 9
2G. Water Expansion 9
2H. Pump Performance and Installation 10
2I. Water Pressure 14
2J. Tank Installation 14
2K. Two-Temperature System 17

SECTION 3. OPERATION

3A. Controls – General 17
3B. Initial Start-up 19
3C. To Start Up System 19
3D. To Turn Off Heater 20
3E. To Shut Down System 20

SECTION 4. MAINTENANCE 20

SECTION 5. TROUBLESHOOTING AND ANALYSIS OF SERVICE PROBLEMS 21

TABLES AND FIGURES

Table I. Boiler Configuration 4
Table II. Minimum Recommended Air Supply To Heater 6
Table III. Gas Piping Sizes 8
Table IV. Pump Performance Requirements 14
Table V. Modu-snap Valve Temperature Settings 18
Figure 1 Boiler Configuration 3
Figure 2 Typical Heater Installation with Base for Combustible Floors (Ex. A) 5
Figure 3 Typical Heater Installation with Base for Combustible Floors (Ex. B) 5
Figure 4 Typical Heater Installation with Base for Combustible Floors (Ex. C) 5
Figure 5 Installation on Concrete Blocks or Tile 5
Figure 6 Alcove Installation 6
Figure 7 Incorrect Outdoor Installation 7
Figure 8 T-Fitting Sediment Trap Installation 8
Figure 9 Pressure Relief Valve Location 9
Figure 10 Tempering Valve Installation 9
Figure 11 Hot Water Supply System for Models VW and PW 11
Figure 12 Hot Water Supply System using Model PW with Dual Tanks, Building Loop Return and Circulating Pump 12
Figure 13 Split System Piping for Model IW 12
Figure 14 Dual Installation Piping Diagram for Model IW 13
Figure 15 Single Installation Piping Diagram for Model IW 13
Figure 16 Two Temperature Hot Water Supply System (Model VW or PW) Vertical/Horizontal Tank 15
Figure 17 Two Temperature Hot Water Supply System w/Vertical Tank for Models VW and PW Water Heaters 16
Figure 18 Controls Location 16
Figure 19 Control Components 18
Figure 20 Pilot Burners (I.I.D.) 18
Figure 21 Gas Manual Valves 19
Figure 22 Pilot Safety Relay 20
Figure 23 Main Burner Flame Pattern 20

Section 1
General Information

1A. Introduction

This manual provides information for the installation and operation of Natco volume water heaters. It is strongly recommended that all application and installation procedures be reviewed completely before proceeding with the installation. Consult the Natco 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.

IMPORTANT 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; ANS1 Z223.1, National Electrical Code ANSI/NFPA 70 and/or in Canada CAN1-B149 requirement.

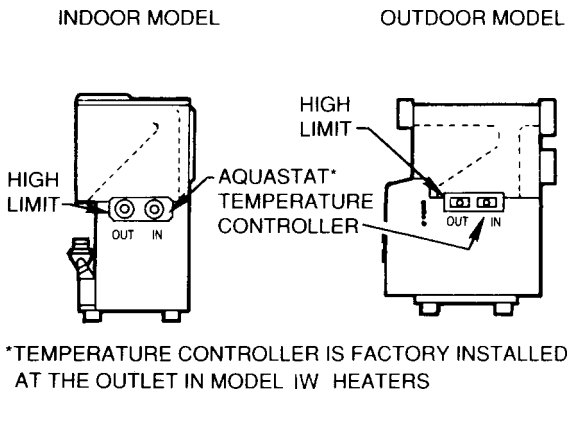


Figure 1 – Boiler Configuration

When required by the authority having jurisdiction, the installation must conform to American Society of Mechanical Engineers safety codes for controls and safety devices for automatically fired heaters No. CSD-1, and in Canada CGA 3.3. Any modification to the water heater, its gas controls, gas orifices, wiring or draft diverter may void the Natco warranty. If field conditions require such modifications, consult factory.

1B. Heater Identification

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

1	2	3	4	5	6
P W	1 6 7 0	I	N	09	L

(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), or Mech. Mod (H).

***Model VW** water heaters for use with separate storage tank. There must be a field installed pump to circulate water between the heater and the storage tank.

***Model PW** water heaters are basically the same as the VW series except that the PW heaters come with integrally mount pumps.

***Model IW** water heaters are tankless instantaneous heaters, complete with mount pump for use in applications having a suitable diversity in heater load.

****Special Options:** I.I.D. (04) 115 volts or I.I.D. (08) IRI Controls

Natco commercial water heaters are available in two models: an indoor version and an outdoor version. Both are available from the factory. See **Figure 1**.

1C. 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.

1D. Water Chemistry

Natco 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

2A. 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.

Table I. Minimum Boiler Clearances From Combustible Surfaces

Clearance From	Indoor (Inches)	Outdoor (Inches)
Top	30	unobstruct
Water Conn Side	12	24
Opposite Side	6	24
Front	Alcove	unobstruct
Rear	8	24
Vent Pipe*	6	--
Hot Water Pipes	Per Code	Per Code

*Using type B Vent (refer to Manufacturer’s Instructions)

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. 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.

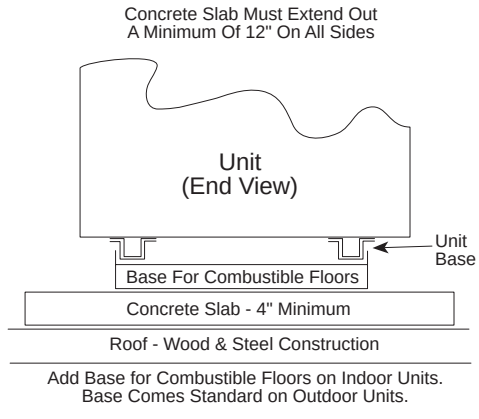


Figure 2 – Typical Heater Installation with Base for Combustible Floors, Example A

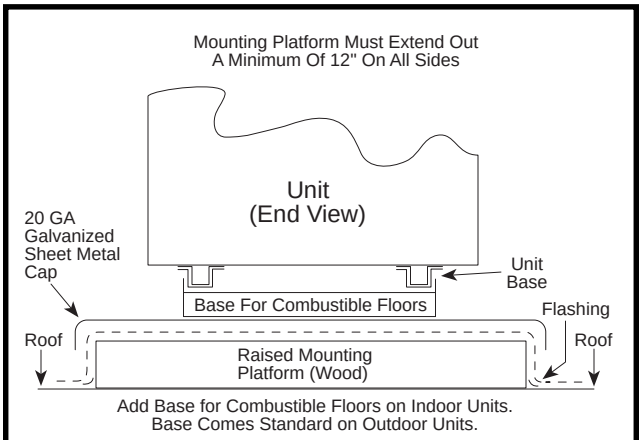


Figure 3 – Typical Heater Installation with Base for Combustible Floors, Example B

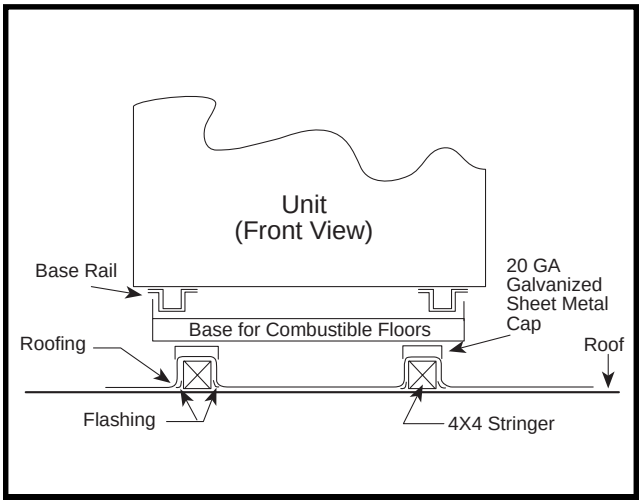
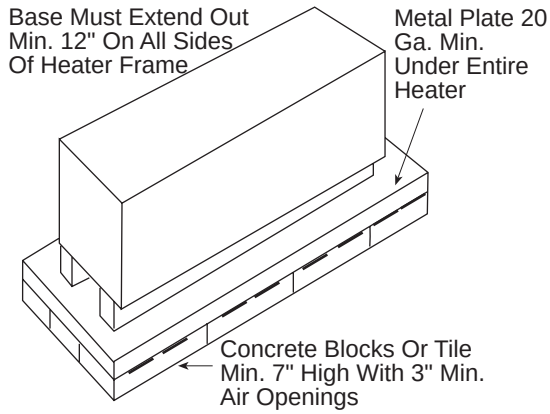


Figure 4 – Typical Heater Installation with Base for Combustible Floors, Example C



Blocks must provide solid base and be braced so they cannot slip out of place. Air openings in blocks must be arranged to provide unobstructed opening through entire width or length of base.

Figure 5 – Installation on Concrete Blocks or Tile

2B. Installation of Indoor Heaters

1. Locate the water heater to provide adequate clearance for inspection and service on all sides. See **Table I**. 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.***

2B-1. Combustion Air Supply

1. The heater location must provide sufficient air supply for proper combustion and ventilation of the surrounding area as outlined in the latest edition of ANSI standard Z223.1, and any local codes that may be applicable. Inadequate combustion air supply may result in incomplete combustion, sooting of the heat exchanger, and unsafe operation of the heater.

2. In general, these requirements specify that small heater rooms should be provided with two permanent air supply openings communicating directly through the wall to outside air; one within

12 inches of the ceiling, and the other within 12 inches of the floor. Each opening should have a minimum free area of one square inch per 4,000 BTUH input of the total input rating of all appliances in the enclosed area. See **Table II** for recommended air supply for each model. An improperly ventilated equipment room can get excessively hot and cause accelerated deterioration of controls and electrical components.

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, CGA requirements.

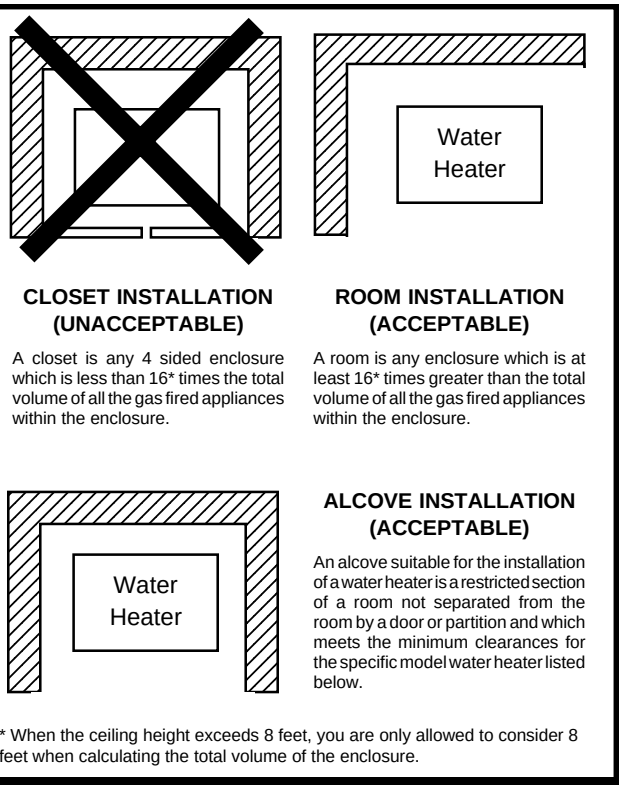


Figure 6 – Alcove Installation

3. 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 II** is not applicable in installations where exhaust fans or blowers of any type are used. Such installations must be designed by qualified engineers.
4. 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.
5. The heater must be completely isolated and protected from any source of corrosive chemical fumes such as trichlorethylene, perchlorethylene, chlorine, etc.

Table II. Minimum Recommended Air Supply to Heater

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, in Canada, CAN1-B149.1 and .2.

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.

2B-2. Venting

1. Natco 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, CAN1-B149 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.

2. 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.

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 Natco 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, CAN1-B149 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.

2C. Installation of Outdoor Heaters

1. Locate the heater to provide the minimum clearances as listed in **Table I**, “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, 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 AGA and CGA 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.

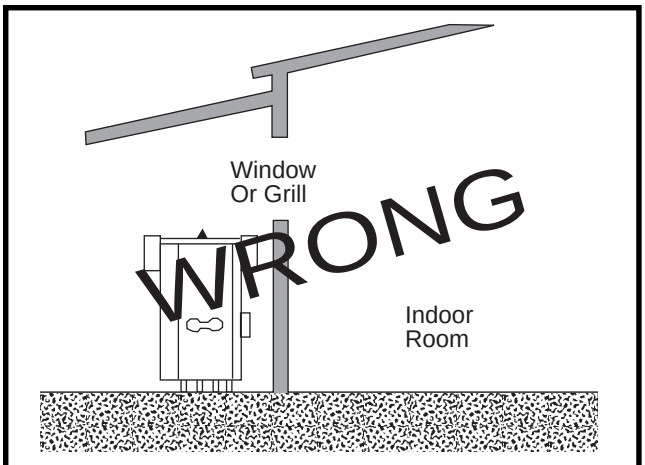


Figure 7 – Incorrect Outdoor Installation

2D. 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. Natco heaters are normally equipped to operate below a 2000 foot altitude. Heaters equipped to operate at higher altitudes have appropriate stickers or tags

attached.

2. Use the figures in **Table III** to provide adequate gas piping from the gas meter to the heater.

Table III. Gas Piping Sizes

Model	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.

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 boiler 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 boiler 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.

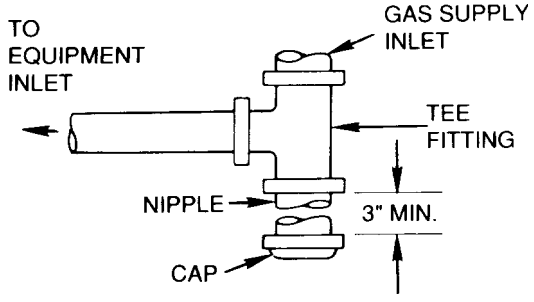


Figure 8 – T-Fitting Sediment Trap Installation

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 and CGA 3.3 Low Pressure Boiler Standard.

8. Before operating the boiler, 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.

2E. 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”.

2F. Water Piping of System

1. Be sure to provide valves at the inlet and outlet of the boiler 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**), 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.

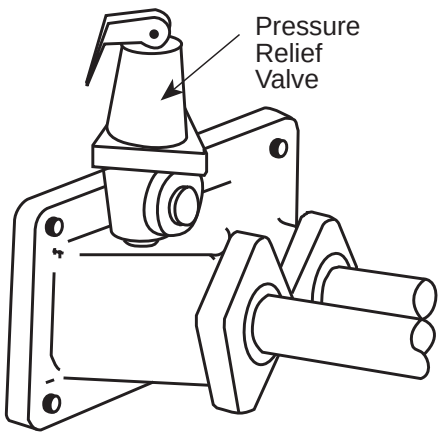


Figure 9 – Pressure Relief Valve Location

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**)

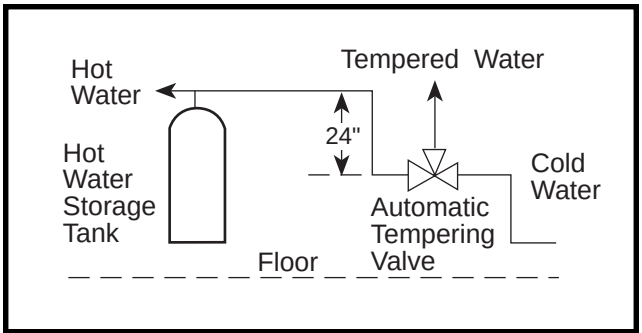


Figure 10 – Tempering Valve Installation

2G. 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.

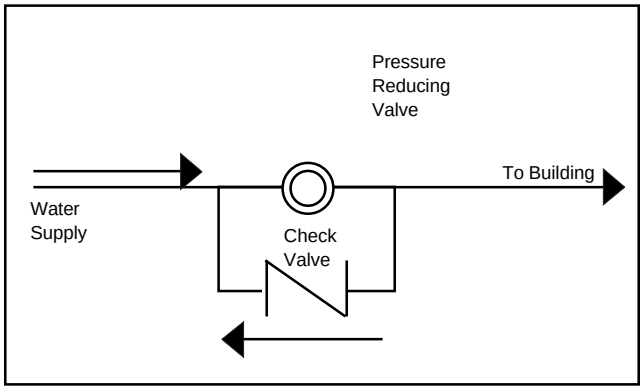
If the relief valve pops frequently a mineral deposit may build up on the valve seat, causing it to

leak.

The following suggestions may solve the problem:

1. 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.

2. Install a check valve around the pressure reducing valve to permit reverse flow. This will allow the expanded water to back flow into 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.

4. Install a properly sized expansion tank.

2H. Pump Performance and Installation

1. The factory provided pump on **PW** heaters and the recommended field provided pump for model **VW** heaters are sized to provide proper circulation through the heater and heater-to-tank circulation loop (see **Figure 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	2-1/2"
1010 through 1825	3"

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

2. The Model **IW** heater is designed for use in a system without a hot water storage tank. The hot water supply line to usage point must have a return leg to the heater (see **Figure13, 14** and **15**). A built-in circulating pump and internal heat exchanger bypass maintains the heater in a standby condition. It also maintains the temperature at the controller setting of the water in the entire building circulating loop whether or not there is any use of hot water.

   A separate circulating pump is required for circulation of water in the building loop. The control system provides variable heat inputs to match periods of higher or lower water consumption.

3. The Model **IW** heater requires a minimum of circulating hot water in the building circulation loop. To prevent excessive temperature fluctuations in the delivered water, the whole building system, including the return loop, must have the equivalent volume of pipe shown below:

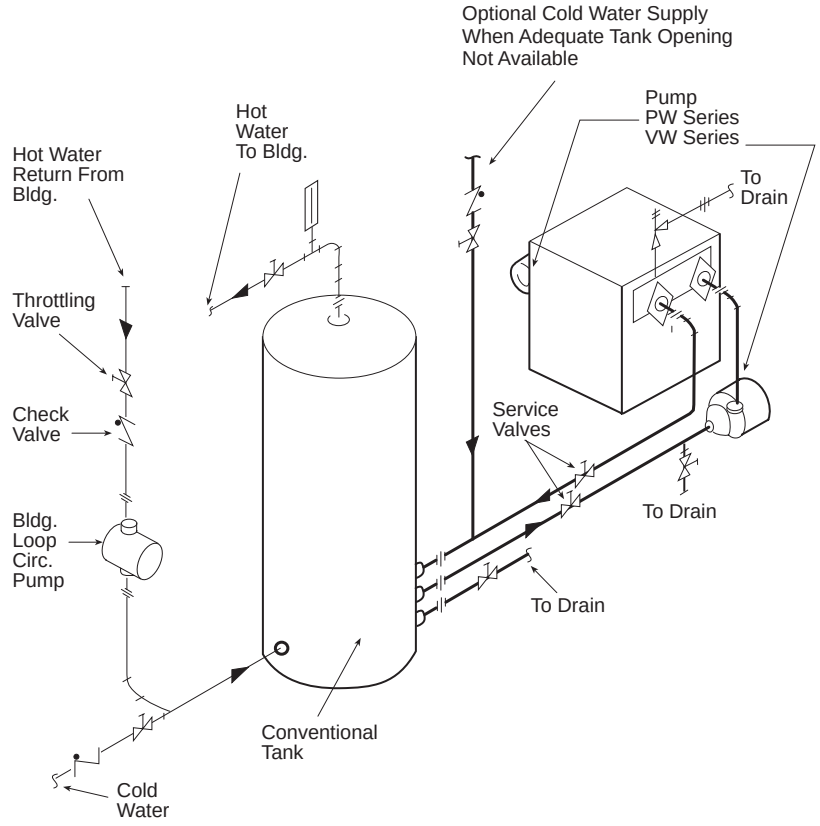
Model IW	Minimum Reservoir Gallons*	Equivalent Pipe Size and Length
500 through 850	6.3	1 1/4" x 100 ft.
1010 through 1220	10.2	1 1/2" x 100 ft.
1430 through 1670	17.0	2" x 100 ft.
1825	27.0	2 1/2" x 100 ft.

* The gallons shown are the calculated volumes of the pipes.

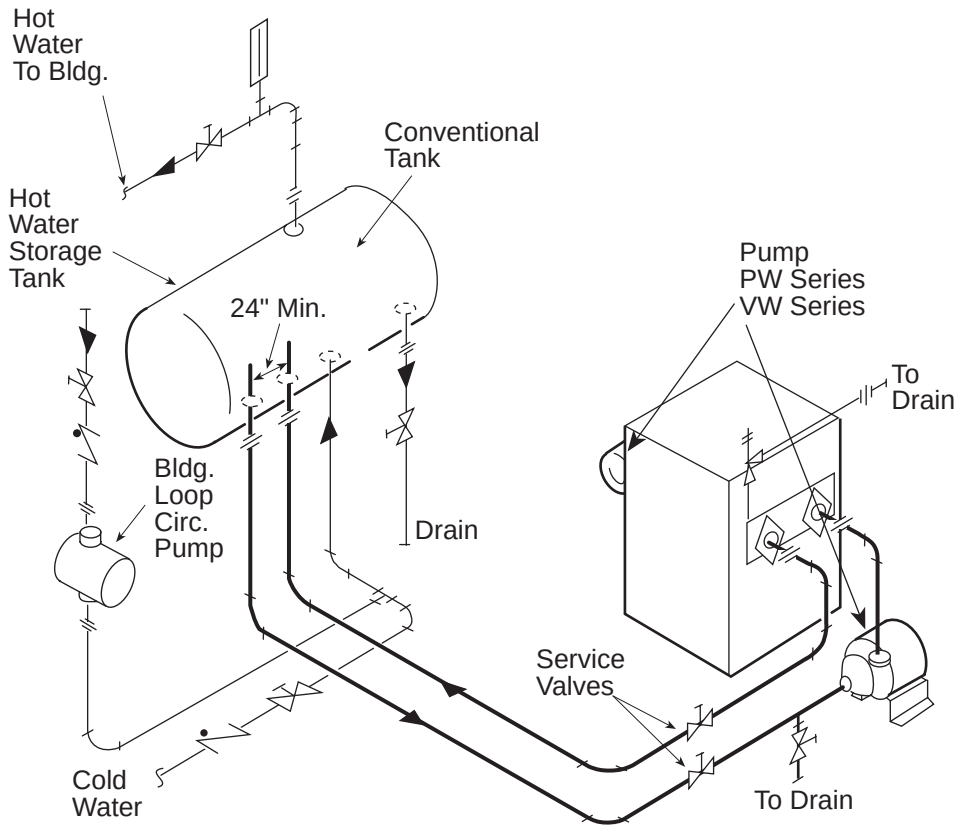
4. Model **VW**, **PW** and **IW** heaters are not suitable for heating swimming pools or any other application where temperature of the water flowing through the heater remains below the dew point (110F).

   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. See the recovery table in the current **Document 2045 (Submittal Data)**.

With Vertical Tank



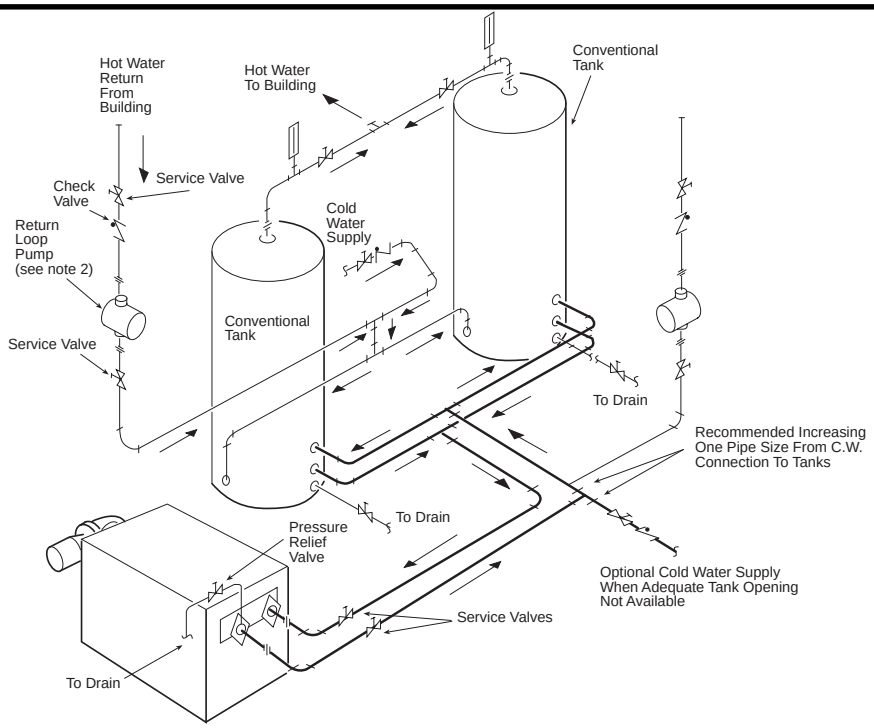
With Horizontal Tank



NOTES:

Heavy line ——— indicates Heater to Tank Circulating Loop.

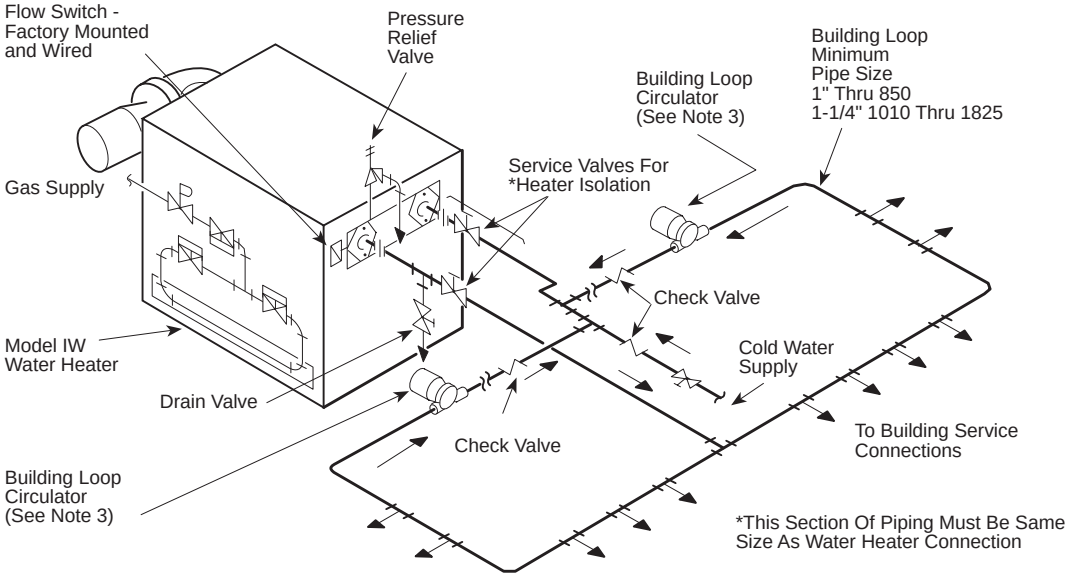
Figure 11 – Hot Water Supply System (Model VW & PW)



NOTES:

1. Heavy line ━━ indicates Heater to Tank Circulating Loop.
2. When a very large volume of water is circulated in the building loop with the use of a separate pump, tee building loop into cold water supply and return to storage tank.

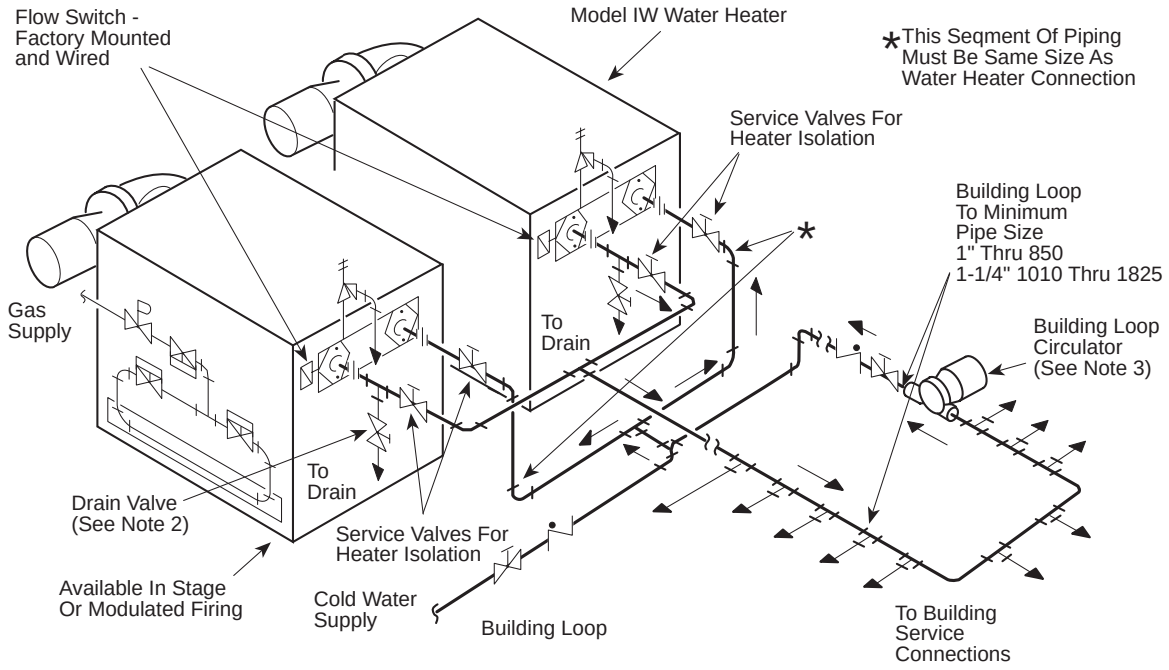
Figure 12 –Hot Water Supply System Using Model PW with Dual Tanks, Building Loop Return and Circulating Pump



CAUTION:

1. This piping arrangement is required on split systems to provide constant hot water temperatures.
2. Pipe size and length must conform to the recommendations for each heater model.
3. A loop circulator is required to maintain forced circulation in the building hot water piping system.

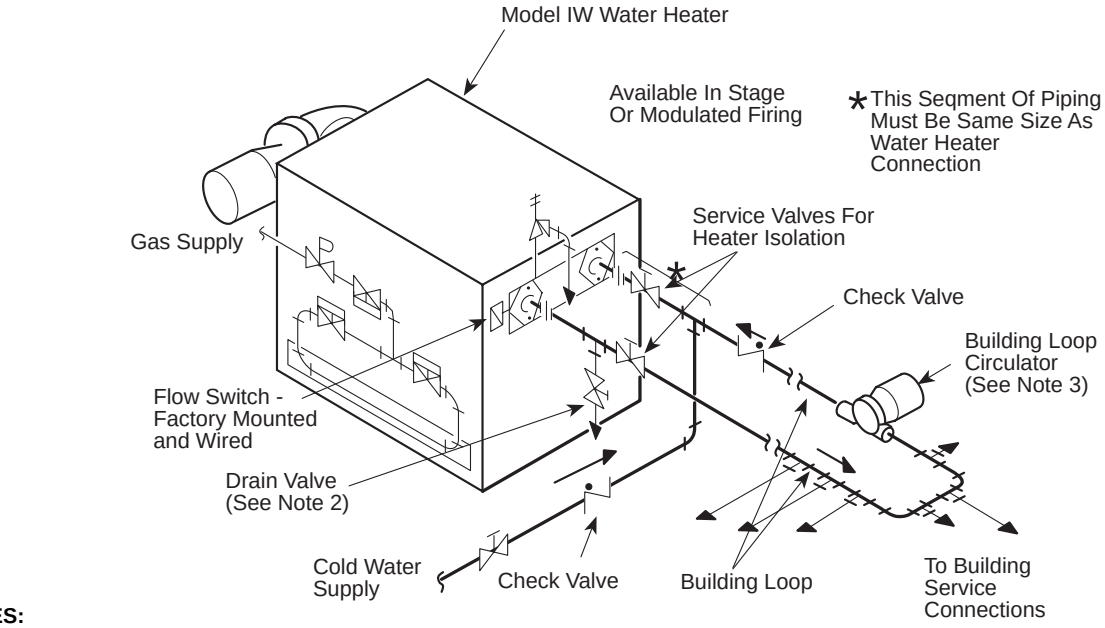
Figure 13 – Split System Piping Diagram, Model IW



NOTES:

1. All water connections 2" N.P.T. models.
2. Drain valve per ASME requirements.
3. A loop circulator is required to maintain forced circulation in the building hot water piping system.

Figure 14 – Dual Installation Piping Diagram, Model IW



NOTES:

1. All water connections 2" N.P.T. models.
2. Drain valve per ASME requirements.
3. A loop circulator is required to maintain forced circulation in the building hot water piping system.

Figure 15 – Single Installation Piping Diagram, Model IW

5. Pump Sizing: A suitable pump must be field-provided for circulation of water between Model VW heaters and the storage tank. This pump must be sized to avoid excessive temperature rise and to provide correct flow for water hardness conditions. Specifications in **Table IV** include allowance for 30 feet of piping and normal fittings between heater and tank.

Table IV. Pump Performance Requirements

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	Grain Hardness per Gal.
Soft	1 through 7.5
Normal	7.6 through 17
Hard	Over 17

* 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)

** To prevent erosion, these models must be ordered with cupro-nickel heat exchanger tubes.

6. Install pump in a cool location. When pump is installed where it is subjected to excessive heat, the life of the pump will be shortened. Heat will embrittle motor insulation and dry out bearing lubricants. If the pump motor is equipped with thermal protection, excessive heat may trip the thermal switch and shut down the pump intermittently. This could result in rapid scaling of the heater.

IMPORTANT: Check oil level in pump before starting. Oil pump every three (3) months. Fill bearing assembly to lower level of overflow vent. Add five (5) or six (6) drops of oil to front and rear of motor. Use 20W non-detergent oil. Pumps located in excessively hot or dusty locations should be oiled once a month. Self lubricating pumps do not require oiling.

7. The pump should be accessible for lubrication, inspection and service.

8. If pump is designed for floor mounting, install securely on concrete block or pad at least six (6) inches above floor level. This will prevent flooding of motor when floor is washed. Be sure that floor mounted pumps are not suspended from piping and that piping is plumbed to avoid strain on the pump casing.

2I. 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. If for any reason the **water supply is turned off temporarily** to service a piece of equipment, the **manual gas valve on the Model IW should be closed** until the water pressure has been restored and the lines bled of accumulated air. If the heater fails to fire when it is turned back on, it may be airlocked. To eliminate the airlock, open the pressure relief valve and allow air to bleed out until water flows. As soon as full circulation is resumed, the entrained air will be carried out through the hot water faucets.

2J. Tank Installation

1. Be sure the floor is waterproof and structurally capable of supporting the tank when it is filled with water.

2. The tank should be placed so that manholes, inspection covers, nameplates and drain valves are accessible.

3. 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.

2K. Two-Temperature System

See **Figure 16** and **Figure 17** for piping schematic. 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 180F is available directly from the tank.

Section 3 Operation

3A. Controls - General

1. Electronic Ignition Controls:

   a. Intermittent Ignition:

      Pilots are automatically lit when the operating aquastat calls for heat (System #4 and #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 8/10 of a second.

   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.

2. Operating Controls:

   a. Electrically Operating Controls:

      Single, two-stage, four-stage or modulating aquastats are provided in models VW, PW and IW heaters to control the desired service water tempera-ture. The temperature sensing bulb is located either in the heater inlet or outlet header.

   b. Modu-snap Valves:

      These valves are furnished in addition to the main electric gas valve (standard on model

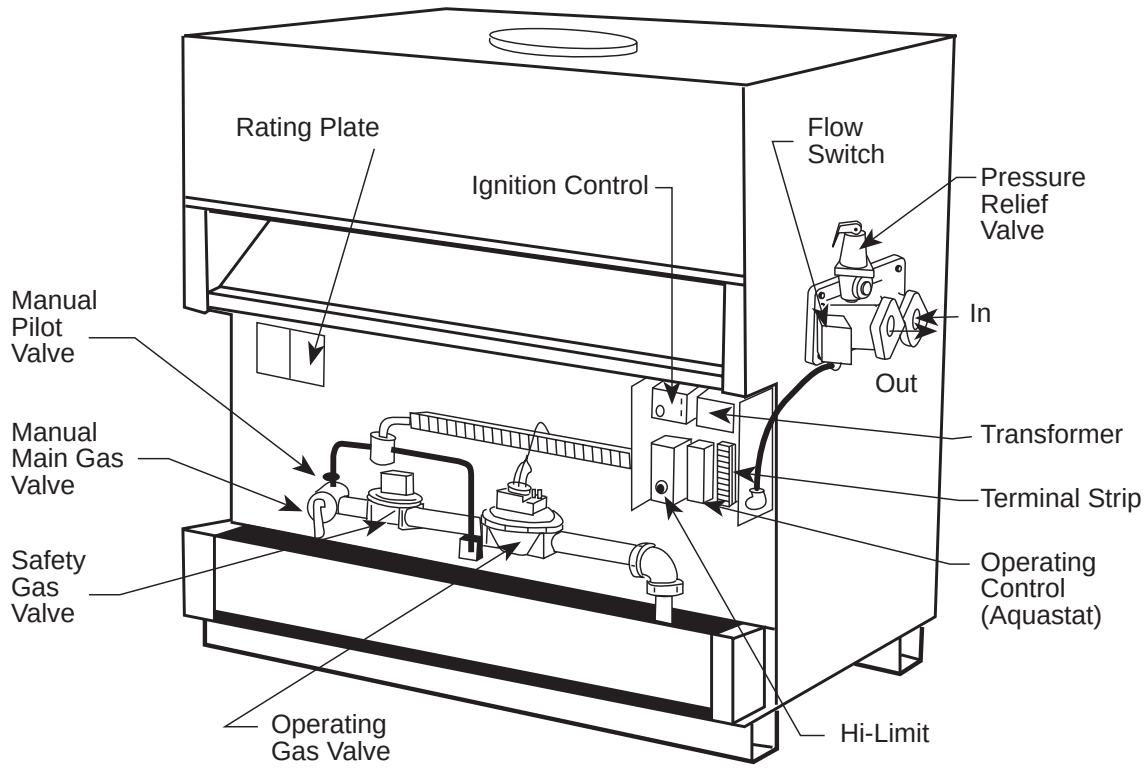
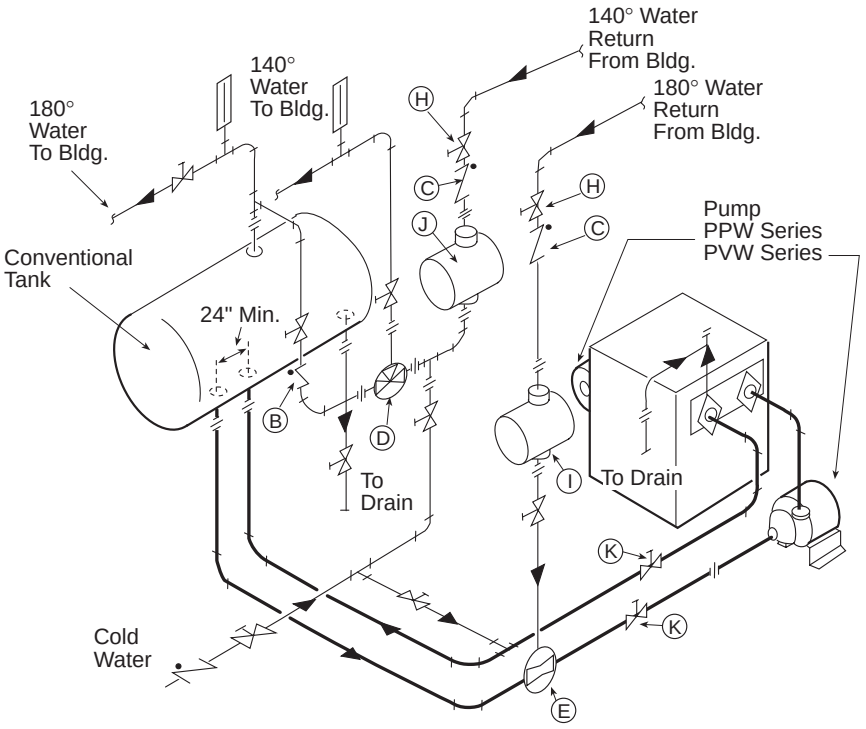
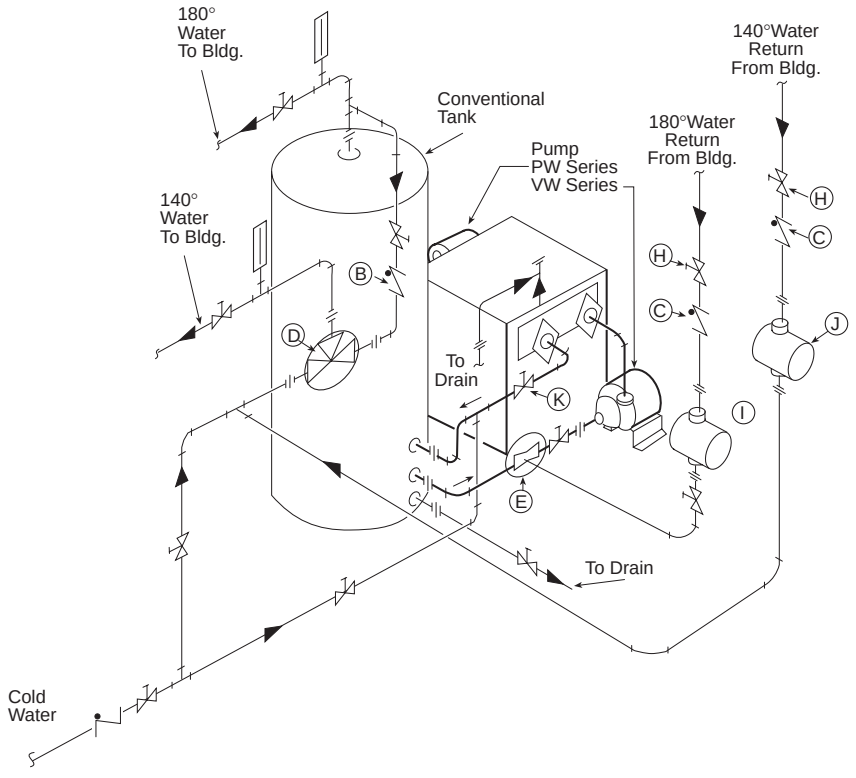


Figure 18 – Controls Location



With Horizontal Tank

Legend
B – Check Valve in Hot Water Supply to Tempering Valve
C – Check Valve in Return Line from Building Loop
D – Tempering Valve
E – Venturi (Suction) Tee
H – Throttling Valves in Building Loop Returns
I – Circulating Pump for 180° Building Loop
J – Circulating Pump for 140° Building Loop
K – Service Valves to isolate Heater and Pump for Service



With Vertical Tank

Legend
B – Check Valve in Hot Water Supply to Tempering Valve
C – Check Valve in Return Line from Building Loop
D – Tempering Valve
E – Venturi (Suction) Tee
H – Throttling Valves in Building Loop Returns
I – Circulating Pump for 180° Building Loop
J – Circulating Pump for 140° Building Loop
K – Service Valves to isolate Heater and Pump for Service

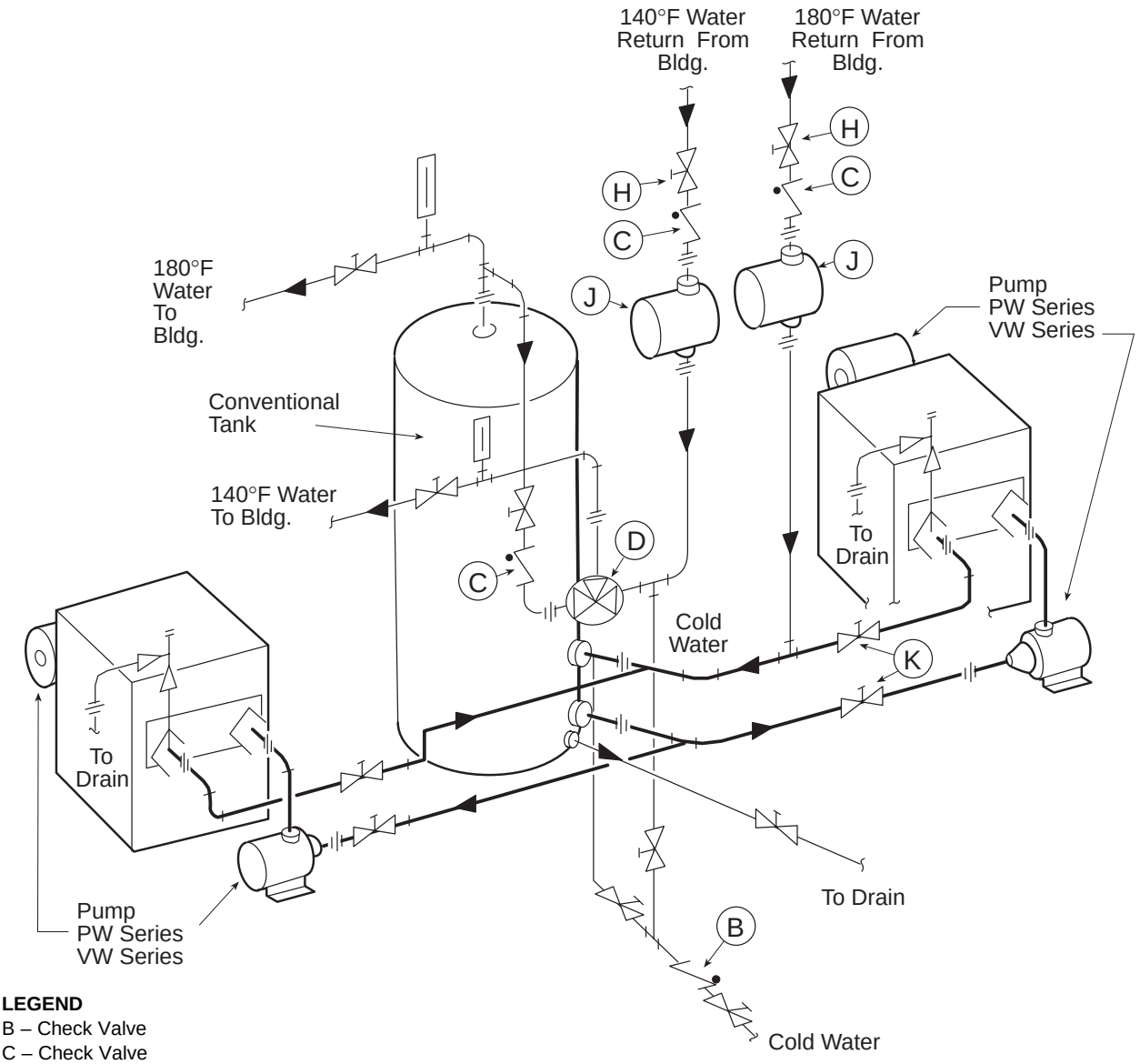
Figure 16 – Two-Temperature Hot Water Supply System (Model VW or PW)

4. 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.

5. Make sure the tank connections in the heater-tank circulating loop are the proper size as listed in **Section 2H**. If tappings are smaller than the recommended pipe size, a larger pump may be required. Consult the factory if in doubt.

6. 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.

7. 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.



LEGEND
B – Check Valve
C – Check Valve
D – Tempering Valve
H – Throttling Valves in Building Loop Returns
J – Circulating Pump for Return Loop
K –Service Valves to Isolate Heater and Pump for Service

Figure 17 – Two-Temperature Hot Water Supply System with Vertical Tank for Models VW and PW Water Heaters

Dial No.	1	2	3	4	5	6	7	8	9+
Temp °F	120	128	135	143	150	158	165	173	180+

Table V – Modu-Snap Temperature Settings

IW). Each valve has a remote capillary bulb immersed in a well at the outlet header to maintain a constant outlet temperature. The valves can be staged to give greater flexibility of control. Consult **Table V** for desired temperature setting.

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.

4. Flow Switch:

   Standard on all models: Models VW and PW, the switch is mounted in the outlet "tee" connection. Model IW, 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.

5. Low Water Cut Off:

   The low water cut off automatically shuts off heater whenever water level drops below probe. Located at heater inlet (model IW and PW) and at return header (model VW).

3B. 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.

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

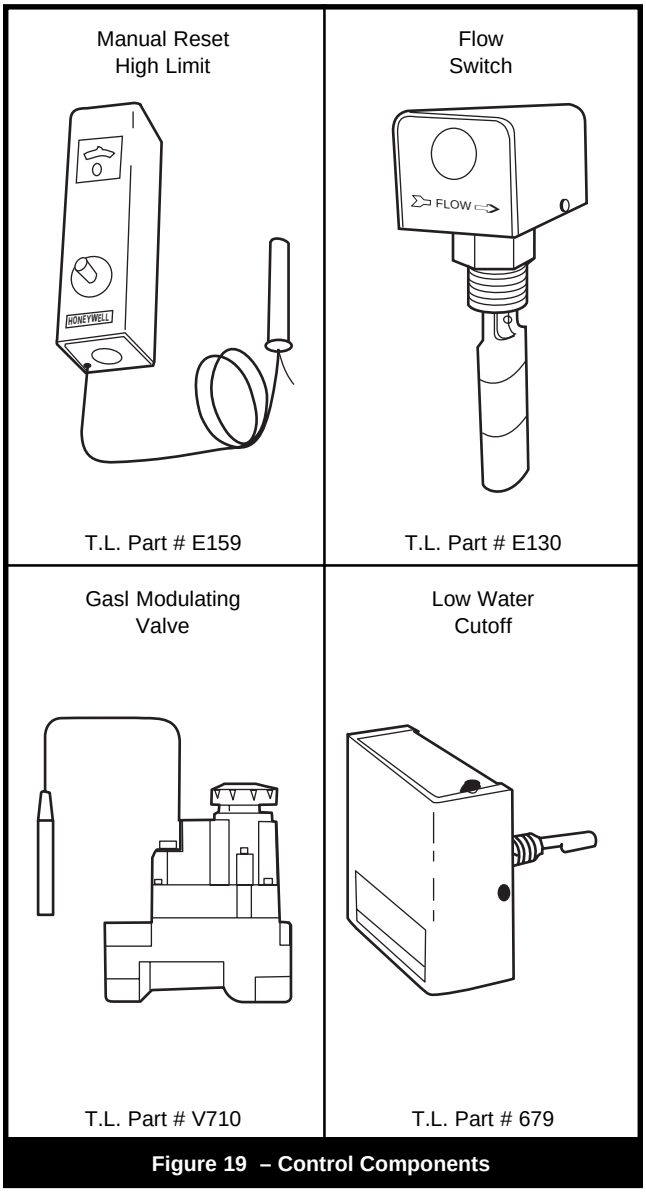


Figure 19 – Control Components

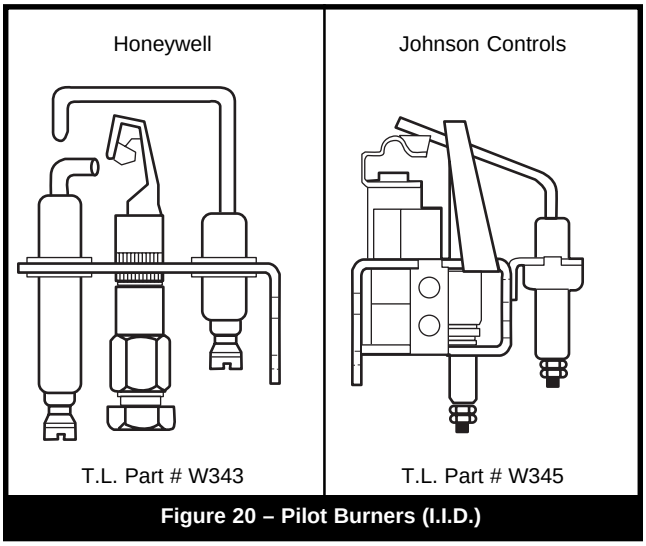


Figure 20 – Pilot Burners (I.I.D.)

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:

Systems 4 and 9 - (Intermittent ignition), natural gas only: 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. 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), standard on propane gas: 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 inter- ruption 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.

3C. To Start Up System:

1. Start Up Boiler
   Be certain system pump is running, then proceed as follows:

   a. Turn off main electrical switch.

   b. Turn off all manual gas valves and wait five minutes. (**Figure 21**)

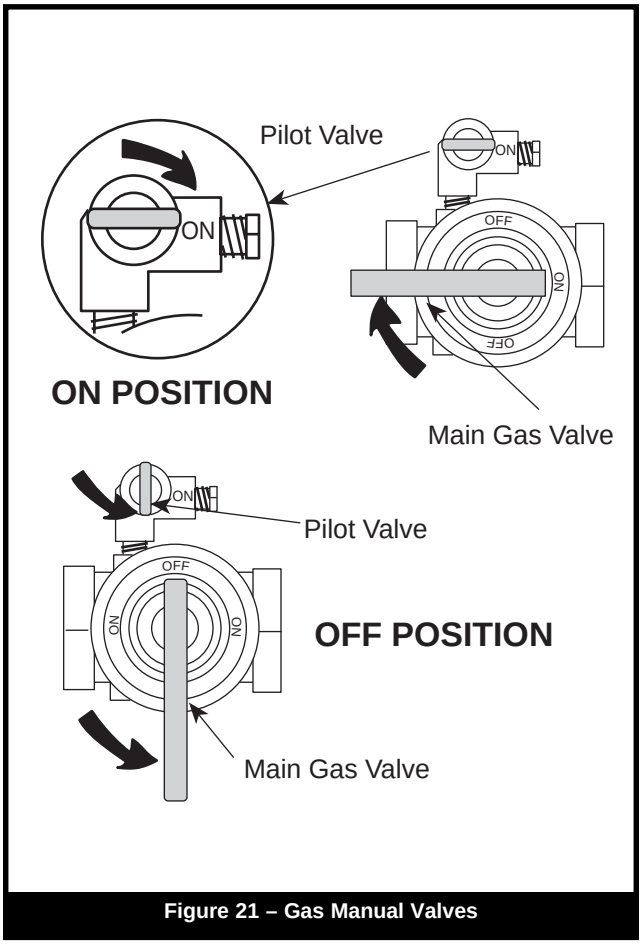


Figure 21 – Gas Manual Valves

   c. Set operating control to lowest setting.

   d. Slowly turn manual gas valve to “ON”.

   e. Reset all safety valve switches (manual reset high limit and low water cut off).

   f. Open manual pilot valve. Turn on main electrical switch.

   g. 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 22**, 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.

2. To set the temperature and high-limit controls:

   a. Set the temperature controller at the system design temperature.

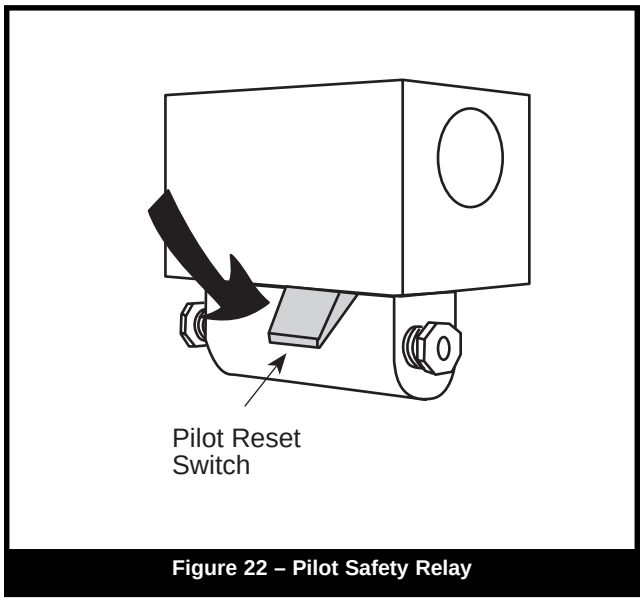


Figure 22 – Pilot Safety Relay

b. For heaters with the temperature controller bulb at the inlet, set the high-limit 40 to 50 F above temperature controller setting.

c. If the temperature control sensing bulb is in the heater outlet, set the high-limit switch 15 to 25 F above the temperature controller setting.

d. **Model IW Water Temperature Adjustment**

Set the temperature controller (modu-snap valve) dial to the desired service water temperature (see **Table V**). Keep in mind that there is no storage tank with the Model IW heater, therefore it will produce its maximum capacity **regardless of the temperature setting**. Excessive hot water use will cause a drop in the temperature, but increasing the controller setting **will not change the delivered water temperature**. It could create the very dangerous hazard of scalding a user in the bath or shower. Make sure the water temperature settings comply with local codes.

3D. To Turn Off Heater:

1. Turn off main electric switch.

2. Close all manual gas valves.

3E. 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 23**). 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.

5. Keep heater area clear and free from combustible material, gasoline and other flammable vapors and liquids (see **Table I 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

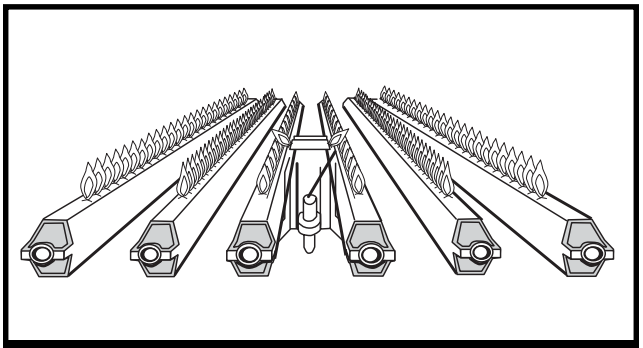


Figure 23 – Main Burner Flame Pattern

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) 100-240F.

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 indicated, replace coil or operator.

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. Examinie all tubes and water-ways. 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 hard-ness. Check water flow, replace pump for modified flow if necessary.

III. 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 waterlogged (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 that tank is adequate.

IV. 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 louvre 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 being 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.

V. WATER DRIPPING IN FIREBOX

Possible Cause	What To Do
Tub 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 boiler.

H2107400A

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