

# Instruction Manual

## COMMERCIAL GAS WATER HEATERS

MODEL 154  
SERIES 120/121  
INSTALLATION - OPERATION  
- SERVICE - MAINTENANCE




**WARNING:** If the information in these instructions is not followed exactly, a fire or explosion may result causing property damage, personal injury or death.

- 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 neighbor's 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 the gas supplier.

Thank you for buying this energy efficient water heater.  
We appreciate your confidence in our products.



### **WARNING**



Read and understand this instruction manual and the safety messages herein before installing, operating or servicing this water heater.

Failure to follow these instructions and safety messages could result in death or serious injury.

This manual must remain with the water heater.

### • **For Your Safety** •

AN ODORANT IS ADDED TO THE GAS USED BY THIS WATER HEATER.

KEEP THIS MANUAL IN THE POCKET ON HEATER FOR FUTURE REFERENCE  
WHENEVER MAINTENANCE ADJUSTMENT OR SERVICE IS REQUIRED.

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## SAFE INSTALLATION, USE, AND SERVICE

The proper installation, use, and servicing of this water heater is extremely important to your safety and the safety of others.

Many safety-related messages and instructions have been provided in this manual and on your own water heater to warn

you and others of a potential injury hazard. Read and obey all safety messages and instructions throughout this manual. It is very important that the meaning of each safety message is understood by you and others who install, use, or service this water heater.

	<p>This is the safety alert symbol. It is used to alert you to potential personal injury hazards. Obey all safety messages that follow this symbol to avoid possible injury or death.</p>
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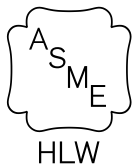
	<p>DANGER indicates an imminently hazardous situation which, if not avoided, will result in injury or death.</p>
	<p>WARNING indicates a potentially hazardous situation which, if not avoided, could result in injury or death.</p>
	<p>CAUTION indicates a potentially hazardous situation which, if not avoided, could result in minor or moderate injury.</p>
	<p>CAUTION used without the safety alert symbol indicates a potentially hazardous situation which, if not avoided, could result in property damage.</p>

All safety messages will generally tell you about the type of hazard, what can happen if you do not follow the safety message, and how to avoid the risk of injury.

The California Safe Drinking Water and Toxic Enforcement Act requires the Governor of California to publish a list of substances known to the State of California to cause cancer, birth defects, or other reproductive harm, and requires businesses to warn of potential exposure to such substances.

**Warning:** This product contains a chemical known to the State of California to cause cancer, birth defects, or other reproductive harm. This appliance can cause low level exposure to some of the substances listed in the Act.

## APPROVALS



**Note:** ASME construction is optional on the water heaters covered in this manual.

# GENERAL SAFETY INFORMATION

## PRECAUTIONS

DO NOT USE THIS WATER HEATER IF ANY PART HAS BEEN EXPOSED TO FLOODING OR WATER DAMAGE. Immediately call a qualified service agency to inspect the water heater and to make a determination on what steps should be taken next.

If the unit is exposed to the following, do not operate heater until all corrective steps have been made by a qualified service agency.

1. External fire.
2. Damage.
3. Firing without water.

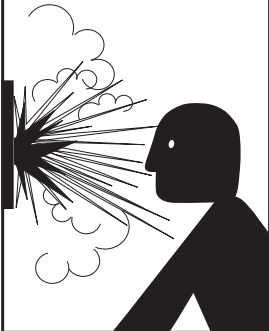
## GROUNDING INSTRUCTIONS

This water heater must be grounded in accordance with the *National Electrical Code* and/or local codes. These codes must be followed in all cases. Failure to ground this water heater properly may also cause erratic control system operation.

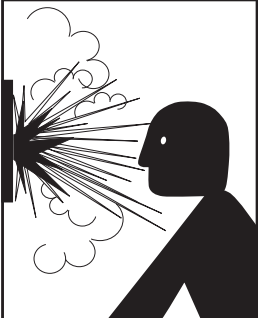
This water heater must be connected to a grounded metal, permanent wiring system; or an equipment grounding conductor must be run with the circuit conductors and connected to the equipment grounding terminal or lead on the water heater.

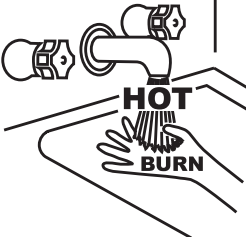
## HYDROGEN GAS FLAMMABLE

Hydrogen gas can be produced in a hot water system served by this water heater that has not been used for a long period of time (generally two weeks or more). Hydrogen gas is extremely flammable. To reduce the risk of injury under these conditions, it is recommended that a hot water faucet served by this water heater be opened for several minutes before using any electrical appliance connected to the hot water system. If hydrogen is present there will probably be an unusual sound such as air escaping through the pipe as the water begins to flow. THERE SHOULD BE NO SMOKING OR OPEN FLAME NEAR THE FAUCET AT THE TIME IT IS OPEN.

	<b>⚠ WARNING</b>
	<b>Explosion Hazard</b> <ul style="list-style-type: none"><li>• Flammable hydrogen gases may be present.</li><li>• Keep all ignition sources away from faucet when turning on hot water.</li></ul>

	<b>⚠ WARNING</b>
	<p>Read and understand this instruction manual and the safety messages herein before installing, operating or servicing this water heater.</p> <p>Failure to follow these instructions and safety messages could result in death or serious injury.</p> <p>This manual must remain with the water heater.</p>

	<b>⚠ WARNING</b>
	<b>Explosion Hazard</b> <ul style="list-style-type: none"><li>• Overheated water can cause water tank explosion.</li><li>• Properly sized temperature and pressure relief valve must be installed in the opening provided.</li></ul>

	<b>⚠ DANGER</b>
	<p>Water temperature over 125°F (52°C) can cause severe burns instantly resulting in severe injury or death.</p> <p>Children, the elderly and the physically or mentally disabled are at highest risk for scald injury.</p> <p>Feel water before bathing or showering.</p> <p>Temperature limiting devices such as mixing valves must be installed when required by codes and to ensure safe temperatures at fixtures.</p>

<b>CAUTION</b>
<b>Improper installation, use and service may result in property damage.</b>
<ul style="list-style-type: none"><li>• Do not operate water heater if exposed to flooding or water damage.</li><li>• Inspect anode rods regularly, replace if damaged.</li><li>• Install in location with drainage.</li><li>• Fill tank with water before operation.</li><li>• Properly sized thermal expansion tanks are required on all closed water systems.</li></ul> <p>Refer to this manual for installation and service.</p>

## **⚠️ WARNING**

### **Fire or Explosion Hazard**

- Do not store or use gasoline or other flammable vapors and liquids in the vicinity of this or any other appliance.
- Avoid all ignition sources if you smell gas.
- Do not expose water heater controls to excessive gas pressure.
- Use only the gas shown on the water heater rating label.
- Maintain required clearances to combustibles.
- Keep ignition sources away from faucets after extended periods of non-use.



Read instruction manual before installing, using or servicing water heater.



## **⚠️ WARNING**

### **Breathing Hazard - Carbon Monoxide Gas**



- Do not obstruct water heater air intake with insulating blanket.
- Gas and carbon monoxide detectors are available.
- Install water heater in accordance with the instruction manual.

Breathing carbon monoxide can cause brain damage or death. Always read and understand instruction manual.

## **CAUTION**

### **Property Damage Hazard**

- All water heaters eventually leak.
- Do not install without adequate drainage.

## **⚠️ WARNING**

### **Electrical Shock Hazard**



- Turn off power at the branch circuit breaker serving the water heater before performing any service.
- Label all wires prior to disconnecting when performing service. Wiring errors can cause improper and dangerous operation.
- Verify proper operation after servicing.
- Failure to follow these instructions can result in personal injury or death.

## **⚠️ WARNING**

### **Fire Hazard**



For continued protection against risk of fire:

- Do not install water heater on carpeted floor.
- Do not operate water heater if exposed to flooding or water damage.

## **⚠️ WARNING**

### **Fire and Explosion Hazard**



- Use joint compound or Teflon tape compatible with propane gas.
- Leak test gas connections before placing water heater in operation.
- Disconnect gas piping at main gas shutoff valve before leak testing heater.
- Install sediment trap in accordance with NFPA 54.

## **⚠️ WARNING**

### **Fire and Explosion Hazard**



- Do not use water heater with any gas other than the gas shown on the rating label.
- Excessive gas pressure to gas valve can cause serious injury or death.
- Turn off gas lines during installation.
- Contact a qualified installer or service agency for installation and service.

## **⚠️ WARNING**

**Jumping out control circuits or components can result in property damage, personal injury or death.**

- Service should only be performed by a qualified service technician using proper test equipment.
- Altering the water heater controls and/or wiring in any way could result in permanent damage to the controls or water heater and is not covered under the limited warranty.



Any bypass or alteration of the water heater controls and/or wiring will result in voiding the appliance warranty.



# INTRODUCTION

**Thank You** for purchasing this water heater. Properly installed and maintained, it should give you years of trouble free service.

## ABBREVIATIONS USED

Abbreviations found in this Instruction Manual include :

- ANSI - American National Standards Institute
- ASME - American Society of Mechanical Engineers
- AHRI - Air Conditioning, Heating and Refrigeration Institute
- NEC - National Electrical Code
- NFPA - National Fire Protection Association
- UL - Underwriters Laboratory
- CSA - Canadian Standards Association

## QUALIFICATIONS

### QUALIFIED INSTALLER OR SERVICE AGENCY

Installation and service of this water heater requires ability equivalent to that of a Qualified Agency (as defined by ANSI below) in the field involved. Installation skills such as plumbing, air supply, venting, gas supply, and electrical supply, are required in addition to electrical testing skills when performing service.

**ANSI Z223.1:** "Qualified Agency" - "Any individual, firm, corporation or company that either in person or through a representative is engaged in and is responsible for (a) the installation, testing or replacement of gas piping or (b) the connection, installation, testing, repair, or servicing of appliances and equipment; that is experienced in such work; that is familiar with all precautions required; and that has complied with all the requirements of the authority having jurisdiction."

If you are not qualified (as defined by ANSI above) and licensed or certified as required by the authority having jurisdiction to perform a given task do not attempt to perform any of the procedures described in this manual. If you do not understand the instructions given in this manual do not attempt to perform any procedures outlined in this manual.

## PREPARING FOR THE INSTALLATION

1. Read the entire manual before attempting to install or operate the water heater. Pay close attention to the **General Safety Information** (page 4). If you don't follow the safety rules, the water heater may not operate safely. It could cause property damage, injury and/or death.

This manual contains instructions for the installation, operation, and maintenance of the water heater. It also contains warnings throughout the manual that you must read and be aware of. All warnings and all instructions are essential to the proper operation of the water heater and your safety.

2. Be sure to turn off power when working on or near the electrical system of the water heater. Never touch electrical components with wet hands or when standing in water.
3. The installation must conform to all instructions contained in this manual and the local code authority having jurisdiction. These shall be carefully followed in all cases. Authorities having jurisdiction should be consulted before installation begins if there are any questions regarding compliance with local, state or national codes.
4. After reading this manual, if you have any questions or do not understand any portion of the instructions, call the toll free number on the back cover of this manual for technical assistance. In order to expedite your request, please have the full Model, Serial and Series numbers of the water heater you are working with available for the technician. This information is located on the water heater's rating label.
5. Carefully plan the placement of the water heater. Correct combustion, vent action, and vent pipe installation are very important in preventing death from possible carbon monoxide poisoning and fires.

Examine the location to ensure that it complies with the requirements in **Rough-In Dimensions** (page 9) and **Locating the Water Heater** (page 10).

6. For installation in California this water heater must be braced or anchored to avoid falling or moving during an earthquake. See instructions for correct installation procedures. Instructions may be obtained from California Office of the State Architect, 1102 Q Street, Suite 5100, Sacramento, CA 95811.
7. Massachusetts Code requires this water heater to be installed in accordance with Massachusetts 248-CMR 2.00: State Plumbing Code and 248-CMR 5.00.

# FEATURES AND COMPONENTS

## THE ELIMINATOR (SELF-CLEANING SYSTEM)

These units include The Eliminator (Self-Cleaning System) installed in the front water inlet. See *Figure 1*. The Eliminator inlet tube can only be used in the front water inlet connection. Do not install the Eliminator inlet tube in either the top or back inlet water connection.

The Eliminator must be oriented correctly for proper function. There is a marked range on pipe nipple portion of the Eliminator, that must be aligned with top of inlet spud. A label above the jacket hole has an arrow that will point to marked portion of pipe nipple if the orientation is correct. If the arrow does not point within the marked range on pipe nipple, adjust the pipe nipple to correct. A pipe union is supplied with the Eliminator to reduce probability of misaligning the Eliminator accidentally while tightening the connection to inlet water supply line. Improper orientation of the Eliminator can cause poor performance of heater and can significantly reduce outlet water temperatures during heavy draws.



Figure 1. Eliminator Self-Cleaning System

**Note:** The Eliminator may have 1, 3 or 7 cross tubes.

## HIGH LIMIT SWITCH

The digital thermostat (*Figure 2*) contains the high limit (energy cutout) switch. The high limit switch interrupts main burner gas flow should the water temperature reach 203°F (95°C).

In the event of high limit switch operation, the water heater cannot be restarted unless the water temperature is reduced to approximately 120°F (49°C). The high limit reset button on the front of the control then needs to be depressed.

Continued manual resetting of high limit control, preceded by higher than usual water temperature is evidence of high limit switch operation. The following is a possible reason for high limit switch operation:

- A malfunction in the thermostatic controls would allow the gas control valve to remain open causing water temperature to exceed the thermostat setting. The water temperature would continue to rise until high limit switch operation.

Contact your dealer or service agent if continued high limit switch operation occurs.

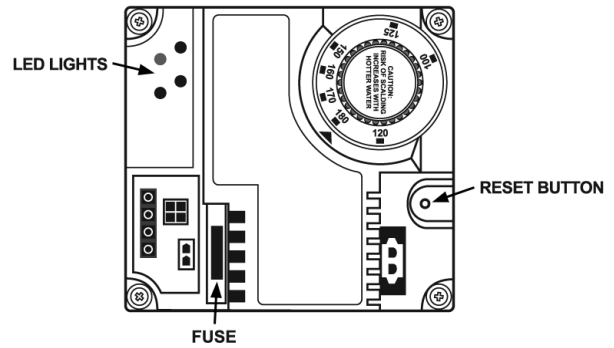


Figure 2. Digital Thermostat

## ELECTRONIC IGNITION CONTROL

Each heater is equipped with a Honeywell ignition module. The solid state ignition control ignites the pilot burner gas by creating a spark at the pilot assembly. See *Figure 3*. Pilot gas is ignited and burns during each running cycle. The main burner and pilot gases are cut off during the OFF cycle. Pilot gas ignition is proven by the pilot sensor. Main burner ignition will not occur if the pilot sensor does not first sense pilot ignition.

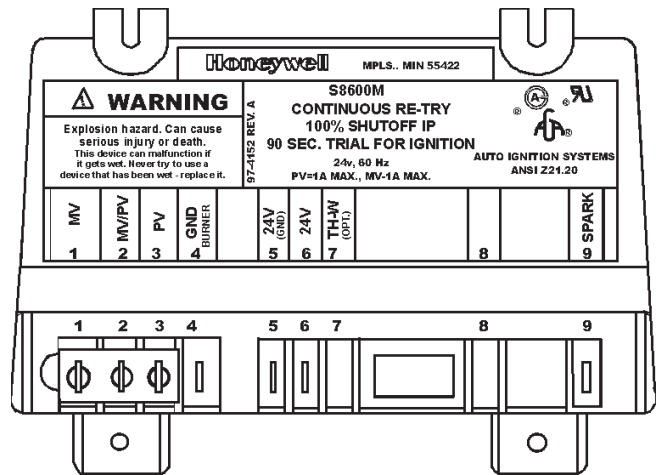


Figure 3. Honeywell Ignition Module

## AUTOMATIC FLUE DAMPER

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This unit is equipped with an automatic flue damper that reduces heat loss during the OFF cycles. The automatic flue damper drive assembly is a field replaceable part and may be obtained by contacting A. O. Smith Corporation at 500 Tennessee Waltz Parkway, Ashland City, TN 37015, 1-800-433-2545.

Each automatic flue damper drive assembly is equipped with a "Service Switch", as shown in *Figure 4*

The "Service Switch" has 2 positions: AUTOMATIC OPERATION and HOLD OPEN DAMPER. For normal operation the switch should be in the AUTOMATIC OPERATION position.

If there is a problem with the damper the "Service Switch" can be placed in the HOLD OPEN DAMPER position. When the switch is placed in the HOLD OPEN DAMPER position the damper disc will rotate to the open position and the heater may be used until vent assembly is repaired or replaced. DO NOT turn the damper disc manually; damage will occur to the drive assembly if operated manually. Refer to TESTING DAMPER OPERATION section of this manual for additional information.

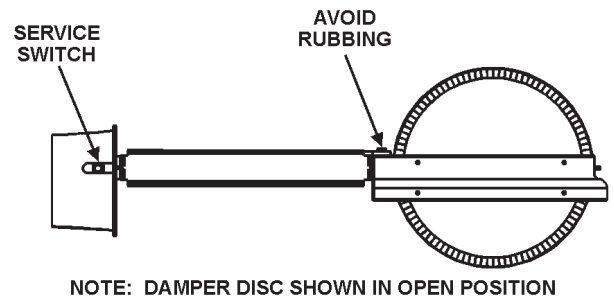


Figure 4. Flue Damper

## UNCRATING

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The heater is shipped with the flue damper already installed. The wiring conduit runs from the thermostat to the damper drive cover. Before turning unit on, check to make sure the wiring conduit is securely plugged into damper drive.



# INSTALLATION CONSIDERATIONS

## ROUGH-IN DIMENSIONS

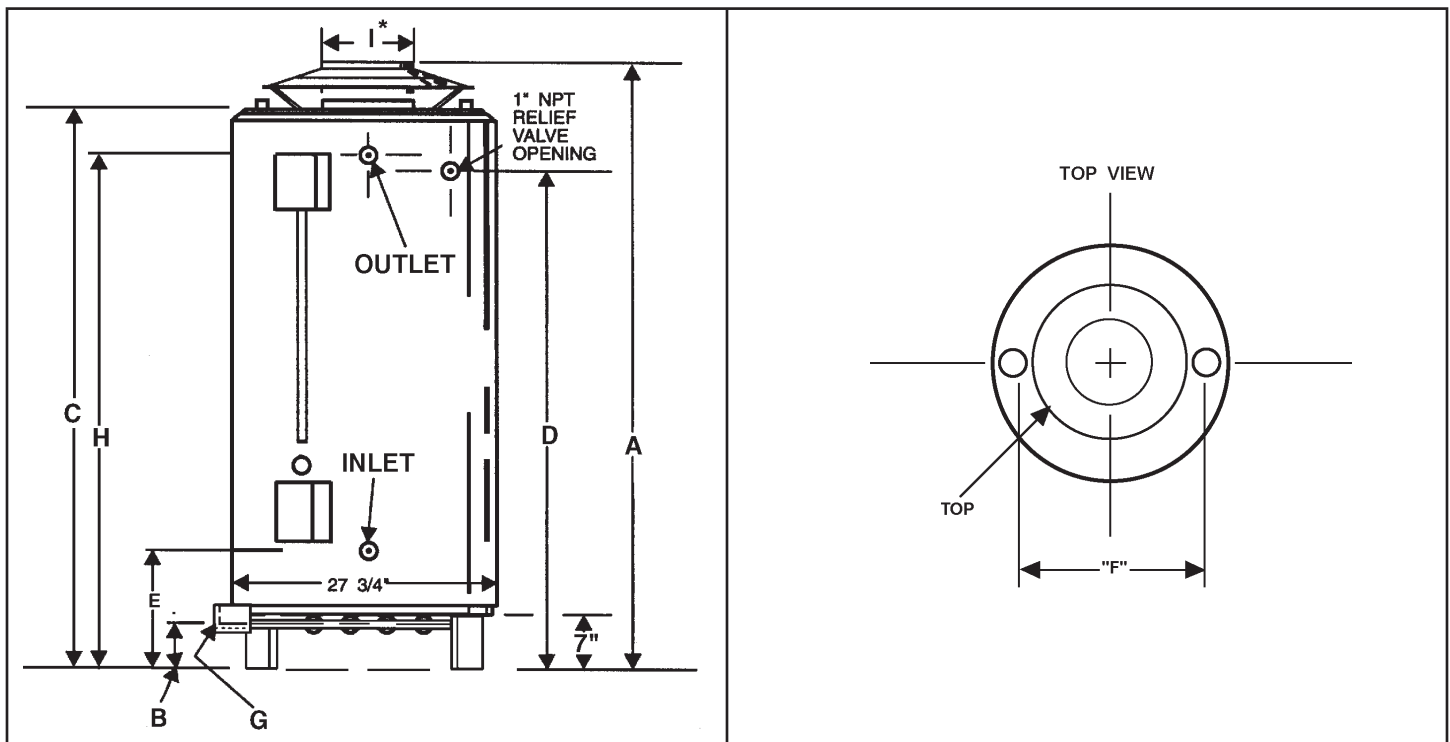


Figure 5. Rough-In Dimensions

Table 1. Rough-In Dimensions

Model	Input Rate BTU/Hr.	Approx Tank Cap.	A	B	C	D	E	F	Gas Inlet G	H	Vent Dia I	J	Connections						Approximate Ship. Weight	
													Inlet			Outlet			Std.	Asme
													Top	Front	Back	Top	Front	Back		
154	154,000 BTU/Hr 45 Kw/Hr	81 Gal 307 L	67-1/2" 171 cm	4-1/2" 12 cm	62" 157 cm	53-5/8" 136 cm	20-1/2" 52 cm	21" 53 cm	1/2" 1/2"	54-5/8" 139 cm	6" 15 cm	27-3/4" 71 cm	1-1/2" NPT 1-1/2" NPT	1-1/2" NPT 1-1/2" NPT	1-1/2" NPT 1-1/2" NPT	1-1/2" NPT 1-1/2" NPT	1-1/2" NPT 1-1/2" NPT	1-1/2" NPT 1-1/2" NPT	470 Lbs 213 Kg	NA

Table 2. Gas Pressure Requirements

Model	*Manifold Pressure		Minimum Supply Pressure		Maximum Supply Pressure		Volts/ Hz		Amperes	
	Natural Gas	Propane Gas	Natural Gas	Propane Gas	Natural Gas	Propane Gas	Natural Gas	Propane Gas	Natural Gas	Propane Gas
All	3.5" W.C. (0.87 kPa)	10.0" WC (2.49 kPa)	4.5" W.C. (1.12 kPa)	11.0" W.C. (2.74 kPa)	14" W. C. (3.48 kPa)	14" W. C. (3.48 kPa)	120/60	120/60	<5	<5

Table 3. Recovery Capacities 120-400/A Models

Model	Input		APPROX. GAL. CAP.	Thermal Efficiency%	U. S. Gallons/hr & liters/hr at temperature rise indicated													
	Btu/hr	kW			°F	30°F	40°F	50°F	60°F	70°F	80°F	90°F	100°F	110°F	120°F	130°F	140°F	
					°C	17°C	22°C	28°C	33°C	39°C	44°C	50°C	56°C	61°C	67°C	72°C	78°C	
154	154,000	45	81 Gal 306 L	80	GPH	498	373	299	249	213	187	166	149	136	124	115	107	
					LPH	1885	1412	1132	943	806	708	628	564	515	469	435	405	

## LOCATING THE WATER HEATER

When installing the heater, consideration must be given to proper location. Location selected should be as close to the stack or chimney as practicable, with adequate air supply and as centralized with the piping system as possible.

### CAUTION

#### Property Damage Hazard

- All water heaters eventually leak.
- Do not install without adequate drainage.

### WARNING

#### Fire or Explosion Hazard

- Do not store or use gasoline or other flammable vapors and liquids in the vicinity of this or any other appliance.
- Avoid all ignition sources if you smell gas.
- Do not expose water heater controls to excessive gas pressure.
- Use only the gas shown on the water heater rating label.
- Maintain required clearances to combustibles.
- Keep ignition sources away from faucets after extended periods of non-use.



Read instruction manual before installing, using or servicing water heater.



There is a risk in using fuel burning appliances such as gas water heaters in rooms, garages or other areas where gasoline, other flammable liquids or engine driven equipment or vehicles are stored, operated or repaired. Flammable vapors are heavy and travel along the floor and may be ignited by the heater's igniter or main burner flames causing fire or explosion. Some local codes permit operation of gas appliances in such areas if they are installed 18" or more above the floor. This may reduce the risk if location in such an area cannot be avoided.

Do not install this water heater directly on a carpeted floor. A fire hazard may result. Instead the water heater must be placed on a metal or wood panel extending beyond the full width and depth by at least 3 inches in any direction. If the heater is installed in a carpeted alcove, the entire floor shall be covered by the panel. Also, see the DRAINING requirements in *Maintenance* (page 33).

The heater shall be located or protected so it is not subject to physical damage by a moving vehicle.

Flammable items, pressurized containers or any other potential fire hazardous articles must never be placed on or adjacent to the heater. Open containers or flammable material should not be stored or used in the same room with the heater.

The heater must not be located in an area where it will be subject to freezing.

Locate it near a floor drain. The heater should be located in an area where leakage from heater or connections will not result in damage to adjacent area or to lower floors of the structure.

When such locations cannot be avoided, a suitable metal drain pan should be installed under heater. Such pans should be fabricated with sides at least 2" deep, with length and width at least 2" greater than diameter of heater and must be piped to an adequate drain. Pan must not restrict combustion air flow.

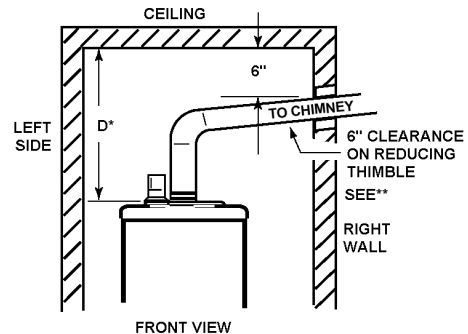
## CLEARANCES

This heater is approved for installation on combustible flooring in an alcove when the minimum clearance from combustion or non-combustible construction is followed as indicated in *Figure 6* (page 10) and *Table 4*.

In all installations the minimum combustible clearances from draft hood surface or vent piping shall be 6" (152mm). Vent piping passing through a combustible wall or ceiling must be a continuous run (no joints) and retain 6" (152mm) clearance unless an approved reducing thimble is used.

A service clearance of 24" (610mm) should be maintained from serviceable parts, such as relief valves, baffles, thermostats, cleanout openings or drain valves.

Model	A (RIGHT SIDE)	B (LEFT SIDE)	C (BACK)	D (CEILING)
154	1" (2.54 cm)	1" (2.54 cm)	1" (2.54 cm)	12" (30.48 cm)



NOTES:  
 \* INCLUDES 6" FROM VENTING AND FLUE BAFFLE SERVICE CLEARANCE.  
 \*\* ALL HORIZONTAL VENT PIPING SHALL HAVE A RISE OF 1/4" PER FOOT MINIMUM, SEE "VENTING".

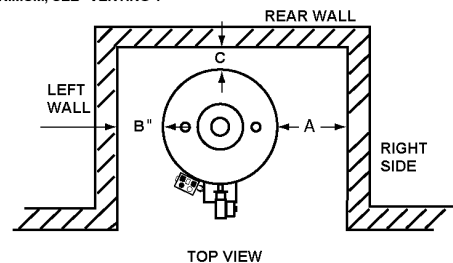


Figure 6. Minimum Clearances to Combustible Materials

## NSF LEG KIT

The NSF Leg Kit (part number 100109227) is needed only for applications that must conform to NSF/ANSI Standard 5. Installation of the NSF leg kit will increase the height of the unit and all connection points by 3 inches. See *Figure 7*.

Follow these steps to install the Leg Kit:

1. Unit needs to be lifted in a way not to damage unit or laid on it's side to access the bottom of the legs.
2. Slide leg extension under leg and the bolt up through the bottom hole located in the bottom of the leg.
3. Once in place, screw nut down and secure.
4. Front of leg should line up with front of leg extension as shown to make sure weight of unit is distributed through the leg extension.

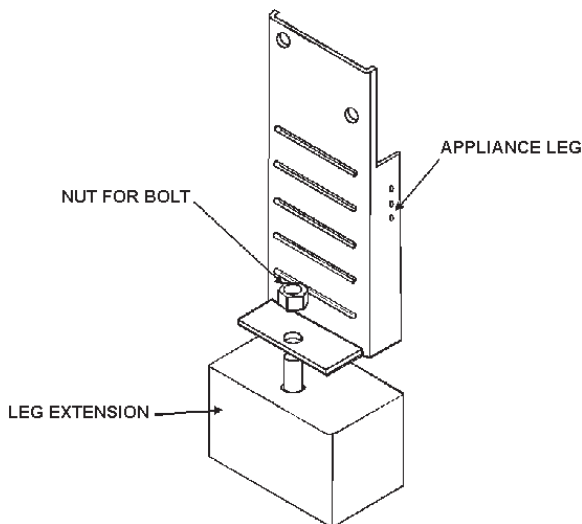


Figure 7. NSF Leg Kit

## INSULATION BLANKET

<b>⚠ WARNING</b>	
<b>Breathing Hazard - Carbon Monoxide Gas</b>	
	<ul style="list-style-type: none"> <li>• Do not obstruct water heater air intake with insulating blanket.</li> <li>• Gas and carbon monoxide detectors are available.</li> <li>• Install water heater in accordance with the instruction manual.</li> </ul>
Breathing carbon monoxide can cause brain damage or death. Always read and understand instruction manual.	

Insulation blankets are available to the general public for external use on gas water heaters but are not necessary with these products. The purpose of an insulation blanket is to reduce the standby heat loss encountered with storage tank heaters. The water heaters covered by this manual meet or exceed the Energy Policy Act standards with respect to insulation and standby heat loss requirements, making an insulation blanket unnecessary.

Should you choose to apply an insulation blanket to this heater, you should follow these instructions. See the *Features and Components* section of this manual for identification of components mentioned below. Failure to follow these instructions can restrict the air flow required for proper combustion, potentially resulting in fire, asphyxiation, serious personal injury or death.

- **DO NOT** apply insulation to the top of the water heater, as this will interfere with safe operation of the draft hood.
- **DO NOT** cover the gas control valve, thermostat or the Temperature-Pressure Relief Valve.
- **DO NOT** allow insulation to come within 2" (5 cm) of the burners, to prevent blockage of combustion air flow to the burners.
- **DO NOT** allow insulation to come within 9 inches (23 cm) of floor, (within 2 inches (5 cm) of bottom cover) to prevent blockage of combustion air flow to the burners..
- **DO NOT** cover the instruction manual. Keep it on the side of the water heater or nearby for future reference.
- **DO** obtain new warning and instruction labels from the manufacturer for placement on the blanket directly over the existing labels.
- **DO** inspect the insulation blanket frequently to make certain it does not sag, thereby obstructing combustion air flow.

## HARD WATER

Where hard water conditions exist, water softening or the threshold type of water treatment is recommended. This will protect the dishwashers, coffee urns, water heaters, water piping and other equipment.

See the Maintenance Section in this manual for sediment and lime scale removal procedures.

## CIRCULATION PUMPS

A circulating pump is used when a system requires a circulating loop or there is a storage tank used in conjunction with the water heater. See *Water Piping Diagrams* (page 43) in this manual for installation location of circulating pumps.

See the circulation pump wiring diagrams, *Figure 8* and *Figure 9*, for electrical hookup information. Install in accordance with the current edition of the *National Electrical Code, NFPA 70*.

All-bronze circulating pumps are recommended for used with commercial water heaters.

Some circulating pumps are manufactured with sealed bearings and do not require further lubrication. Some circulating pumps must be periodically oiled. Refer to the pump manufacturer's instructions for lubrication requirements.

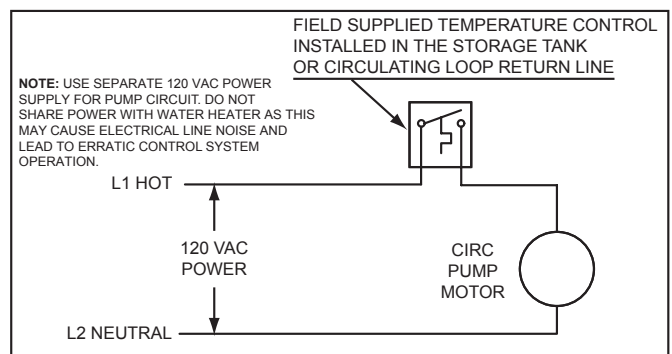


Figure 8. Circulating Pump Wiring Diagram - Storage Tank or

### Building Recirculation

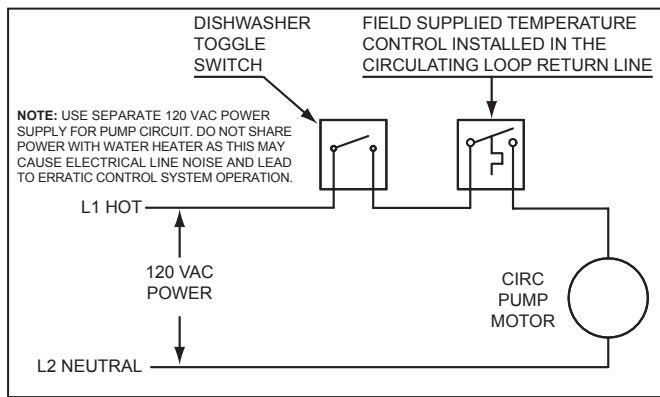




Figure 9. Circulating Diagram - Dishwasher Loop

### HIGH ALTITUDE INSTALLATIONS

Installations above 2000 feet (610 meters) require replacement of burner orifices with ones suitable for your area. Failure to replace orifices will result in improper and inefficient operation of the water heater resulting in the production of increased levels of carbon monoxide gas in excess of safe limits which could result in serious personal injury or death.

	<h2>! WARNING</h2>
	<h3>Fire and Explosion Hazard</h3>
	<ul style="list-style-type: none"> <li>• Under no circumstances should the input exceed the rate shown on the water heater's rating label.</li> <li>• Overfiring could result in fire or explosion.</li> <li>• Gas and carbon monoxide detectors are available.</li> </ul>

<h2>! WARNING</h2>	
<h3>Breathing Hazard - Carbon Monoxide Gas</h3>	
	<ul style="list-style-type: none"> <li>• Under no circumstances should the input exceed the rate shown on the water heater's rating label.</li> <li>• Overfiring could result in damage to the water heater and sooting.</li> <li>• Gas and carbon monoxide detectors are available.</li> </ul>
<p>Breathing carbon monoxide can cause brain damage or death. Always read and understand instruction manual.</p>	

You should contact your gas supplier for any specific requirements in your area.

As the elevation above sea level is increased, there is less oxygen per cubic foot of air. Therefore, the heater input rate should be reduced at high altitudes for satisfactory operation with the reduced oxygen supply. Failure to make this reduction would result in an over firing of the heater causing sooting, poor combustion and/or unsatisfactory heater performance.

Ratings specified by manufacturers for most appliances apply for elevations up to 2000 feet (610m). For elevations above 2000 feet (610), ratings must be reduced at the rate of 4% for each 1000 feet (305m) above sea level. For example, if a heater is rated at 78,000 Btuh (22.9 Kwh) at sea level, to rate the heater at 4000 feet (1219m), you subtract 4 (once for each thousand feet) x .04 (4% input reduction) x 78,000 (original rating) from the original rating.

Therefore, to calculate the input rating at 4,000 feet (1219m):  $4 \times .04 \times 78,000 = 12,480$  Btuh (3.7 Kwh),  $78,000$  (22.9 Kwh) -  $12,480$  (3.7 Kwh) =  $65,520$  Btuh (19.2 Kwh). At 6000 feet (1829m) the correct input rating should be  $59,280$  Btuh (17.4 Kwh).

# INSTALLATION REQUIREMENTS

## GAS SUPPLY SYSTEMS

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Low pressure building gas supply systems are defined as those systems that cannot under any circumstances exceed 14" W.C. (1/2 PSI Gauge). These systems do not require pressure regulation. Measurements should be taken to ensure that gas pressures are stable and fall within the requirements stated on the water heater rating plate. Readings should be taken with all gas burning equipment off (static pressure) and with all gas burning equipment running at maximum rate (dynamic pressure). The gas supply pressure must be stable within 1.5" W.C. from static to dynamic pressure to provide good performance. Pressure drops that exceed 1.5" W.C. may cause rough starting, noisy combustion or nuisance outages. Increases or spikes in static pressure during off cycles may cause failure to ignite or in severe cases damage to appliance gas valves. If your low pressure system does **NOT** meet these requirements, the installer is responsible for the corrections.

High Pressure building supply systems use pressures that exceed 14" W.C. (1/2 PSI Gauge). These systems must use field supplied regulators to lower the gas pressure to less than 14" W.C. (1/2 PSI Gauge). Water heaters require gas regulators that are properly sized for the water heater input and deliver the rating plate specified pressures. Gas supply systems where pressure exceeds 5 PSI often require multiple regulators to achieve desired pressures. Systems in excess of 5 PSI building pressure should be designed by gas delivery professionals for best performance. Water heaters connected to gas supply systems that exceed 14" W.C. (1/2 PSI Gauge) at any time must be equipped with a gas supply regulator.

All models require a minimum gas supply pressure of 3.5" W.C. for natural gas and 8.5" W.C. for propane gas. The minimum supply pressure is measured while gas is flowing (dynamic pressure). The supply pressure should never fall below 3.5" W.C. for natural gas and 8.5" W.C. for propane gas. The supply pressure should be measured with all gas fired appliances connected to the common main firing at full capacity. If the supply pressure drops more than 1.5" W.C. as gas begins to flow to the water heater

then the supply gas system including the gas line and/or the gas regulator may be restricted or undersized. See *Supply Gas Regulator* (page 13). The gas valve on all models has a maximum gas supply pressure limit of 14" W.C. The maximum supply pressure is measured while gas is not flowing (static pressure).

## SUPPLY GAS REGULATOR

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The maximum allowable gas supply pressure for this water heater is 14.0 inches W.C. (3.49 kPa) for natural and propane gas. Install a positive lock-up gas pressure regulator in the gas supply line if inlet gas pressure can exceed these pressures at any time.

If a positive lock-up regulator is required follow these instructions:

1. Positive lock-up gas pressure regulators must be rated at or above the input Btu/hr rating of the water heater they supply.
2. Positive lock-up gas pressure regulator(s) should be installed no closer than 3 equivalent feet (1 meter) and no farther than 8 equivalent feet (2.4 meters) from water heater's inlet gas connection.
3. After installing the positive lock-up gas pressure regulator(s) an initial nominal supply pressure setting of 7.0" W.C. while the water heater is operating is recommended and will generally provide good water heater operation. Some addition adjustment maybe required later to maintain a steady gas supply pressure.
4. When installing multiple water heaters in the same gas supply system it is recommended that individual positive lock-up gas pressure regulators be installed at each unit.

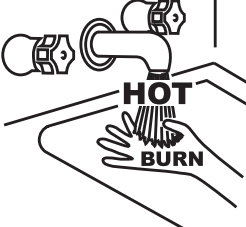
## POWER SUPPLY

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The water heater covered in this manual require a 120 VAC, 1Ø (single phase), 60Hz, 15 amp power supply and must also be electrically grounded in accordance with local codes or, in the absence of local codes, with *National Electrical Code, ANSI/NFPA 70*.

## WATER TEMPERATURE CONTROL AND MIXING VALVES

Water heated to a temperature which will satisfy clothes washing, dish washing, and other sanitizing needs can scald and cause permanent injury upon contact. Short repeated heating cycles caused by small hot water uses can cause temperatures at the point of use to exceed the water heater's temperature setting by up to 20°F (11°C).



**⚠ DANGER** Water temperature over 125°F (52°C) can cause severe burns instantly resulting in severe injury or death.

Children, the elderly and the physically or mentally disabled are at highest risk for scald injury.

Feel water before bathing or showering.

Temperature limiting devices such as mixing valves must be installed when required by codes and to ensure safe temperatures at fixtures.

Some people are more likely to be permanently injured by hot water than others. These include the elderly, children, the infirm and the physically/mentally disabled. **Table 5** shows the approximate time-to-burn relationship for normal adult skin. If anyone using hot water provided by the water heater being installed fits into one of these groups or if there is a local code or state law requiring a certain water temperature at the point of use, then special precautions must be taken.

In addition to using the lowest possible temperature setting that satisfies the demand of the application, a mixing valve should be installed at the water heater or at the hot water taps to further reduce system water temperature. See **Figure 10** (page 14).

Mixing valves are available at plumbing supply stores. Consult a Qualified Installer or Service Agency. Follow mixing valve manufacturer's instructions for installation of the valves.

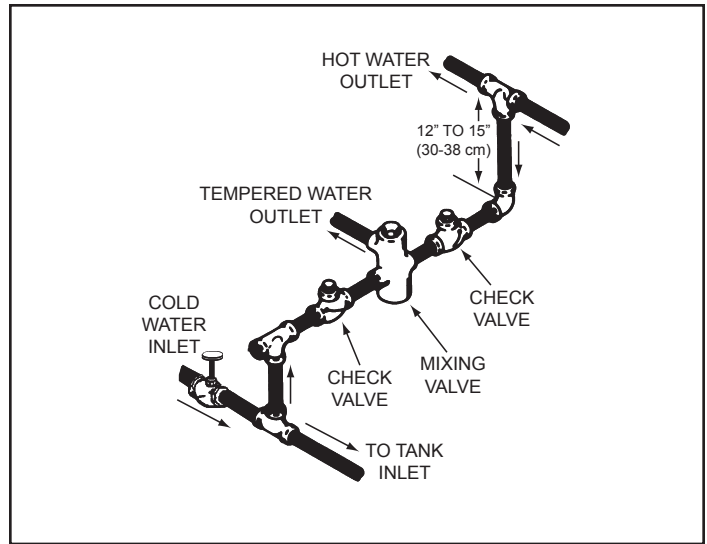
**Table 5. BURN TIME AT VARIOUS TEMPERATURES**

Water Temperature °F (°C)	Time for 1st Degree Burn (Less Severe Burns)	Time for Permanent Burns 2nd & 3rd Degree (Most Severe Burns)
110 (43)	(normal shower temp.)	
116 (47)	(pain threshold)	
116 (47)	35 minutes	45 minutes
122 (50)	1 minute	5 minutes
131 (55)	5 seconds	25 seconds
140 (60)	2 seconds	5 seconds
149 (65)	1 second	2 seconds
154 (68)	instantaneous	1 second

(U.S. Government Memorandum, C.P.S.C., Peter L. Armstrong, Sept. 15, 1978)

## DISH-WASHING MACHINES

All dish-washing machines meeting the National Sanitation Foundation requirements are designed to operate with water flow pressures between 15 and 25 pounds per square inch (103 kPa and 173 kPa). Flow pressures above 25 pounds per square inch (173 kPa), or below 15 pounds per square inch (103 kPa), will result in improperly sanitized dishes. Where pressures are high, a water pressure reducing or flow regulating control valve should be used in the 180°F (82°C) line to the dish-washing machine and should be adjusted to deliver water pressure between these limits.



**Figure 10. Mixing Valve**

The National Sanitation Foundation also recommends circulation of 180°F (82°C) water. The circulation should be just enough to provide 180°F (82°C) water at the point of take-off to the dish-washing machine.

Adjust flow by throttling a full port ball valve installed in the circulating line on the outlet side of the pump. Never throttle flow on the suction side of a pump. See the **Water Piping Diagrams** (page 43).

**Note:** These water heaters meet the NSF Standard 5 for sanitary installations when used with the leg kit part number 100109227.

## CLOSED WATER SYSTEMS

Water supply systems may, because of code requirements or such conditions as high line pressure, among others, have installed devices such as pressure reducing valves, check valves, and back flow preventers. Devices such as these cause the water system to be a closed system.

## THERMAL EXPANSION

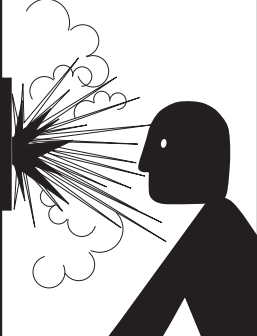
As water is heated, it expands (thermal expansion). In a closed system the volume of water will grow when it is heated. As the volume of water grows there will be a corresponding increase in water pressure due to thermal expansion. Thermal expansion can cause premature tank failure (leakage). This type of failure is not covered under the limited warranty. Thermal expansion can also cause intermittent Temperature-Pressure Relief Valve operation: water discharged from the valve due to excessive pressure build up. This condition is not covered under the limited warranty.

The Temperature-Pressure Relief Valve is not intended for the constant relief of thermal expansion.

A properly sized and pressurized thermal expansion tank must be installed on all closed systems to control the harmful effects of thermal expansion. Contact a local plumbing service agency to have a thermal expansion tank installed.

See *Water Line Connections* (page 23) and the *Water Piping Diagrams* (page 43).

## TEMPERATURE-PRESSURE RELIEF VALVE

	<h1>WARNING</h1>
	<h3>Explosion Hazard</h3> <ul style="list-style-type: none"> <li>• Temperature-Pressure Relief Valve must comply with ANSI Z21.22- CSA 4.4 and ASME code.</li> <li>• Properly sized temperature-pressure relief valve must be installed in opening provided.</li> <li>• Can result in overheating and excessive tank pressure.</li> <li>• Can cause serious injury or death.</li> </ul>

This water heater is provided with a properly rated/sized and certified combination Temperature-Pressure Relief Valve (T&P valve) by the manufacturer. The valve is certified by a nationally recognized testing laboratory that maintains periodic inspection of production of listed equipment of materials as meeting the requirements for *Relief Valves for Hot Water Supply Systems, ANSI Z21.22 • CSA 4.4*, and the code requirements of *ASME*.

If replaced, the new T&P valve must meet the requirements of local codes, but not less than a combination Temperature-Pressure Relief Valve rated/sized and certified as indicated in the above paragraph. The new valve must be marked with a maximum set pressure not to exceed the marked hydrostatic working pressure of the water heater (150 psi = 1,035 kPa) and a discharge capacity not less than the water heater Btu/hr or kW input rate as shown on the water heater's model rating label.

**Note:** In addition to the factory installed Temperature-Pressure Relief Valve on the water heater, each remote storage tank that may be installed and piped to a water heating appliance must also have its own properly sized, rated and approved Temperature-Pressure Relief Valve installed. Contact your local distributor or contact Technical Support for assistance in sizing a Temperature-Pressure Relief Valve for remote storage tanks. See the contact information label on the water heater.

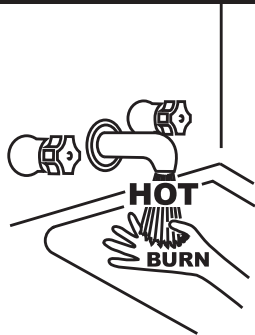
For safe operation of the water heater, the Temperature-Pressure Relief Valve must not be removed from its designated opening nor plugged. The Temperature-Pressure Relief Valve must be installed directly into the fitting of the water heater designed for the relief valve. Install discharge piping so that any discharge will exit the pipe within six inches (15.2 cm) above an adequate floor drain, or external to the building. In cold climates it is recommended that it be terminated at an adequate drain inside the building. Be certain that no contact is made with any live electrical part. The discharge opening must not be blocked or reduced in size under any circumstances. Excessive length, over 30 feet (9.14 m), or use of more than four elbows can cause restriction and reduce the discharge capacity of the valve.

No valve or other obstruction is to be placed between the Temperature-Pressure Relief Valve and the tank. Do not connect discharge piping directly to the drain unless a six inches (15.2 cm) air gap is provided. To prevent bodily injury, hazard to life, or property damage, the relief valve must be allowed to discharge water in adequate quantities if circumstances demand. If the discharge pipe is not connected to a drain or other suitable means, the water flow may cause property damage.

<h1>CAUTION</h1>
<h3>Water Damage Hazard</h3>
<ul style="list-style-type: none"> <li>• Temperature-Pressure Relief Valve discharge pipe must terminate at adequate drain.</li> </ul>

### T&P VALVE DISCHARGE PIPE REQUIREMENTS

- Shall not be smaller in size than the outlet pipe size of the valve, or have any reducing couplings or other restrictions.
- Shall not be plugged or blocked.
- Shall not be exposed to freezing temperatures.
- Shall be of material listed for hot water distribution.
- Shall be installed so as to allow complete drainage of both the Temperature-Pressure Relief Valve and the discharge pipe.
- Must terminate a maximum of six inches (15.2 cm) above a floor drain or external to the building. In cold climates, it is recommended that the discharge pipe be terminated at an adequate drain inside the building.
- Shall not have any valve or other obstruction between the relief valve and the drain.

<h1>DANGER</h1>	<p>Water temperature over 125°F (52°C) can cause severe burns instantly resulting in severe injury or death.</p> <p>Children, the elderly and the physically or mentally disabled are at highest risk for scald injury.</p> <p>Feel water before bathing or showering.</p> <p>Temperature limiting devices such as mixing valves must be installed when required by codes and to ensure safe temperatures at fixtures.</p>
	


The Temperature-Pressure Relief Valve must be manually operated at least twice a year. Caution should be taken to ensure that (1) no one is in front of or around the outlet of the Temperature-Pressure Relief Valve discharge line, and (2) the water manually discharged will not cause any bodily injury or property damage because the water may be extremely hot. If after manually operating the valve, it fails to completely reset and continues to release water, immediately close the cold water inlet to the water heater, follow the draining instructions in this manual, and replace the Temperature-Pressure Relief Valve with a properly rated/sized new one.

**Note:** The purpose of a Temperature-Pressure Relief Valve is to prevent excessive temperatures and pressures in the storage tank. The T&P valve is not intended for the constant relief of thermal expansion. A properly sized thermal expansion tank must be installed on all closed systems to control thermal expansion. See *Thermal Expansion* and *Closed Water Systems* (page 14).

If you do not understand these instructions or have any questions regarding the Temperature-Pressure Relief Valve. Contact your local distributor or contact Technical Support for assistance. See the contact information label on the water heater.

## CONTAMINATED AIR

Corrosion of the flue ways and vent system may occur if air for combustion contains certain chemical vapors. Such corrosion may result in failure and risk of asphyxiation.

<b>! WARNING</b>	
<b>Breathing Hazard - Carbon Monoxide Gas</b>	
	<ul style="list-style-type: none"> <li>• Install water heater in accordance with the Instruction Manual and NFPA 54 or CAN/CSA-B149.1.</li> <li>• To avoid injury, combustion and ventilation air must be taken from outdoors.</li> <li>• Do not place chemical vapor emitting products near water heater.</li> </ul>
Breathing carbon monoxide can cause brain damage or death. Always read and understand instruction manual.	


Combustion air that is contaminated can greatly diminish the life span of the water heater and water heater components such as igniters and burners. Propellants of aerosol sprays, beauty shop supplies, water softener chemicals and chemicals used in dry cleaning processes that are present in the combustion, ventilation or ambient air can cause such damage.

Do not store products of this sort near the water heater. Air which is brought in contact with the water heater should not contain any of these chemicals. If necessary, uncontaminated air should be obtained from remote or outdoor sources. The limited warranty is voided when failure of water heater is due to a corrosive atmosphere.

## AIR REQUIREMENTS

For safe operation an adequate supply of fresh uncontaminated air for combustion and ventilation must be provided.

An insufficient supply of air can cause recirculation of combustion products resulting in contamination that may be hazardous to life. Such a condition often will result in a yellow, luminous burner flame, causing sooting of the combustion chamber, burners and flue tubes and creates a risk of asphyxiation.

<b>! WARNING</b>	
<b>Breathing Hazard - Carbon Monoxide Gas</b>	
	<ul style="list-style-type: none"> <li>• Install water heater in accordance with the Instruction Manual and NFPA 54.</li> <li>• To avoid injury, combustion and ventilation air must be taken from outdoors.</li> <li>• Do not place chemical vapor emitting products near water heater.</li> </ul>
Breathing carbon monoxide can cause brain damage or death. Always read and understand instruction manual.	

Do not install the water heater in a confined space unless an adequate supply of air for combustion and ventilation is brought in to that space using the methods described in *Confined Space* (page 16).

Never obstruct the flow of ventilation air. If you have any doubts or questions at all, call your gas supplier. Failure to provide the proper amount of combustion air can result in a fire or explosion and cause property damage, serious bodily injury or death.

## UNCONFINED SPACE

An Unconfined Space is one whose volume IS NOT LESS THAN 50 cubic feet per 1,000 Btu/hr (4.8 cubic meters per kW) of the total input rating of all appliances installed in the space. Rooms communicating directly with the space, in which the appliances are installed, through openings not furnished with doors, are considered a part of the unconfined space.

Makeup air requirements for the operation of exhaust fans, kitchen ventilation systems, clothes dryers and fireplaces shall also be considered in determining the adequacy of a space to provide combustion, ventilation and dilution air.

## UNUSUALLY TIGHT CONSTRUCTION

In unconfined spaces in buildings, infiltration may be adequate to provide air for combustion, ventilation and dilution of flue gases. However, in buildings of unusually tight construction (for example, weather stripping, heavily insulated, caulked, vapor barrier, etc.), additional air must be provided using the methods described in *Confined Space* (page 16).

## CONFINED SPACE

A *confined space* is one whose volume IS LESS THAN 50 cubic feet per 1,000 Btu/hr (4.8 cm per kW) of the total input rating of all appliances installed in the space.

Openings must be installed to provide fresh air for combustion, ventilation and dilution in confined spaces. The required size for the openings is dependent on the method used to provide fresh air to the confined space AND the total Btu/hr input rating of all appliances installed in the space.



## **DIRECT VENT APPLIANCES**

Appliances installed in a Direct Vent configuration that derive all air for combustion from the outdoor atmosphere through sealed intake air piping are not factored in the total appliance input Btu/hr calculations used to determine the size of openings providing fresh air into confined spaces.

## **EXHAUST FANS**

Where exhaust fans are installed, additional air shall be provided to replace the exhausted air. When an exhaust fan is installed in the same space with a water heater, sufficient openings to provide fresh air must be provided that accommodate the requirements for all appliances in the room and the exhaust fan. Undersized openings will cause air to be drawn into the room through the water heater's vent system causing poor combustion. Sooting, serious damage to the water heater, and the risk of fire or explosion may result. It can also create a risk of asphyxiation.

## **LOUVERS AND GRILLES**

The free areas of the fresh air openings in the instructions that follow do not take in to account the presence of louvers, grilles or screens in the openings.

The required size of openings for combustion, ventilation and dilution air shall be based on the "net free area" of each opening. Where the free area through a design of louver or grille or screen is known, it shall be used in calculating the size of opening required to provide the free area specified. Where the louver and grille design and free area are not known, it shall be assumed that wood louvers will have 25% free area and metal louvers and grilles will have 75% free area. Non motorized louvers and grilles shall be fixed in the open position.

# VENTING INSTALLATION

## VENTING

THE INSTRUCTIONS IN THIS SECTION ON VENTING MUST BE FOLLOWED TO AVOID CHOKED COMBUSTION OR RECIRCULATION OF FLUE GASES. SUCH CONDITIONS CAUSE SOOTING OR RISKS OF FIRE AND ASPHYXIATION.

Heater must be protected from freezing downdrafts.

Remove all soot or other obstructions from the chimney that will retard a free draft.

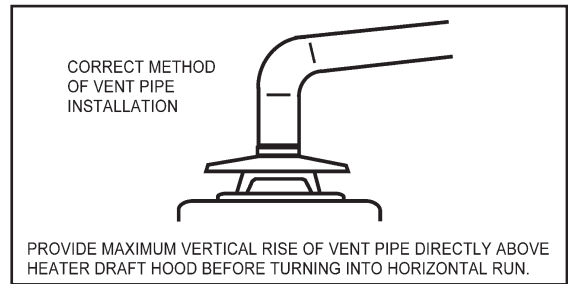
Water heaters covered by these instructions are Category I, Natural Draft appliances. Type B venting is recommended with this heater. For typical venting application see *Table 6* (page 21).

This water heater must be vented in compliance with all local codes, the current revision of the *National Fuel Gas Code (ANSI-Z223.1)* and with the *Category I Natural Draft Venting Tables*.

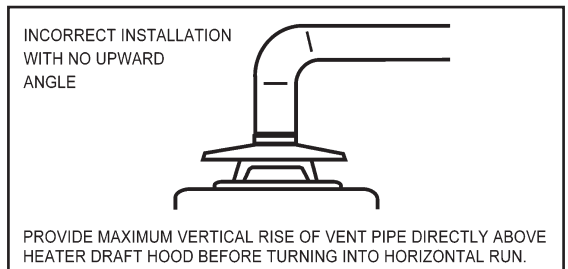
If any part of the vent system are exposed to ambient temperatures below 40°F it must be insulated to prevent condensation.

- Do not connect the heater to a common vent or chimney with solid fuel burning equipment. This practice is prohibited by many local building codes as is the practice of venting gas fired equipment to the duct work of ventilation systems.
- Where a separate vent connection is not available and the vent pipe from the heater must be connected to a common vent with an oil burning furnace, the vent pipe should enter the smaller common vent or chimney at a point above the large vent pipe.

The venting must comply with the current editions of the *National Fuel Gas Code, ANSI Z223.1/NFPA 54*.



**Figure 11. Correct Vent Pipe Installation**



**Figure 12. Incorrect Vent Pipe Installation**

## MULTIPLE HEATER MANIFOLD

Table 6 (page 21) should be used for horizontally manifolding two or more heaters.

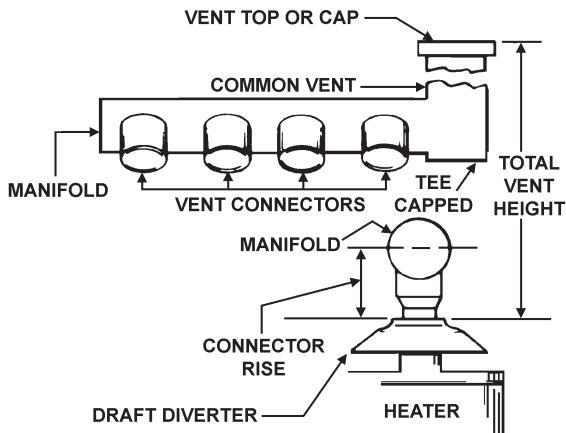


Figure 13. Common Venting Multiple Water Heaters

## FRESH AIR OPENINGS FOR CONFINED SPACES

The following instructions shall be used to calculate the size, number and placement of openings providing fresh air for combustion, ventilation and dilution in confined spaces. The illustrations shown in this section of the manual are a reference for the openings that provide fresh air into confined spaces only. **DO NOT** refer to these illustrations for the purpose of vent installation. See *Venting Installation* for venting installation instructions.

### OUTDOOR AIR THROUGH TWO OPENINGS

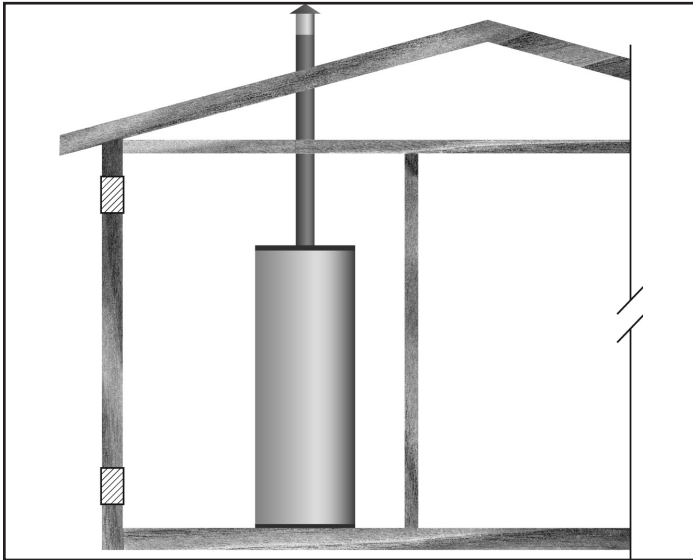


Figure 14. Outdoor Air Through Two Openings

The confined space shall be provided with two permanent openings, one commencing within 12 inches (300 mm) of the top and one commencing within 12 inches (300 mm) of the bottom of the enclosure. The openings shall communicate directly with the outdoors. See *Figure 14*.

Each opening shall have a minimum free area of 1 square inch per 4,000 Btu/hr (550 mm<sup>2</sup> per kW) of the aggregate input rating of all appliances installed in the enclosure. Each opening shall not be less than 100 square inches (645 cm<sup>2</sup>).

### OUTDOOR AIR THROUGH ONE OPENING

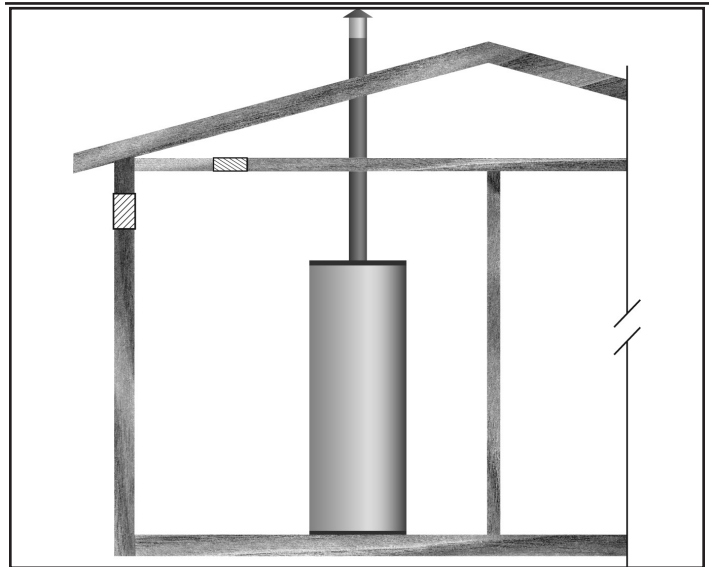


Figure 15. Outdoor Air Through One Opening

Alternatively a single permanent opening, commencing within 12 inches (300 mm) of the top of the enclosure, shall be provided. See *Figure 15*. The water heater shall have clearances of at least 1 inch (25 mm) from the sides and back and 6 inches (150 mm) from the front of the water heater. The opening shall directly communicate with the outdoors or shall communicate through a vertical or horizontal duct to the outdoors or spaces that freely communicate with the outdoors and shall have a minimum free area of the following:

1. One square inch per 3000 Btu/hr (733 mm<sup>2</sup> per kW) of the total input rating of all appliances located in the enclosure
2. Not less than the sum of the areas of all vent connectors in the space

### OUTDOOR AIR THROUGH TWO HORIZONTAL DUCTS

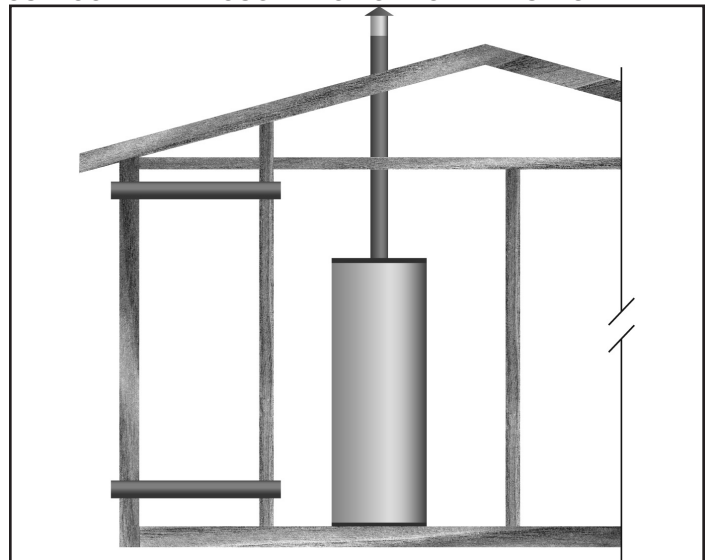


Figure 16. Two Horizontal Ducts

The confined space shall be provided with two permanent horizontal ducts, one commencing within 12 inches (300 mm) of the top and one commencing within 12 inches (300 mm) of the bottom of the enclosure. The horizontal ducts shall communicate directly with the outdoors. See *Figure 16*.

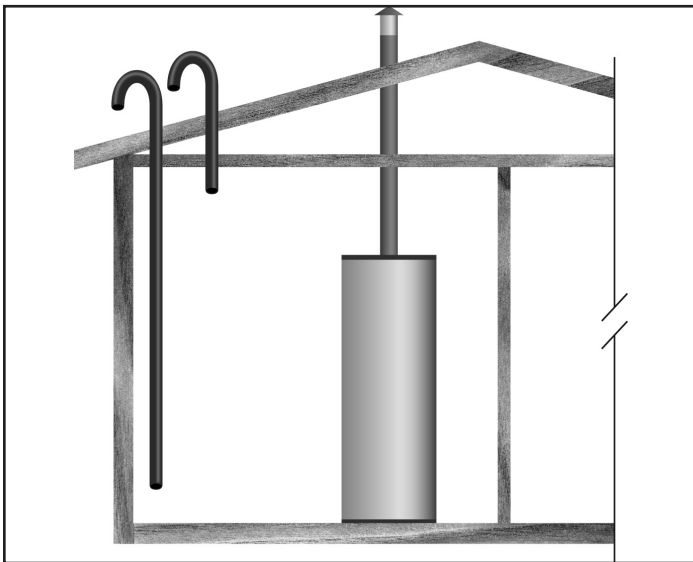
Each duct opening shall have a minimum free area of 1 square inch per 2,000 Btu/hr (1100 mm<sup>2</sup> per kW) of the aggregate input rating of all appliances installed in the enclosure.

When ducts are used, they shall be of the same cross sectional area as the free area of the openings to which they connect. The minimum dimension of rectangular air ducts shall be not less than 3 inches.

#### OUTDOOR AIR THROUGH TWO VERTICAL DUCTS

The illustrations shown in this section of the manual are a reference for the openings that provide fresh air into confined spaces only.

**DO NOT** refer to these illustrations for the purpose of vent installation. See *Venting Installation* (page 18) for venting installation instructions.



**Figure 17. Two Vertical Ducts**

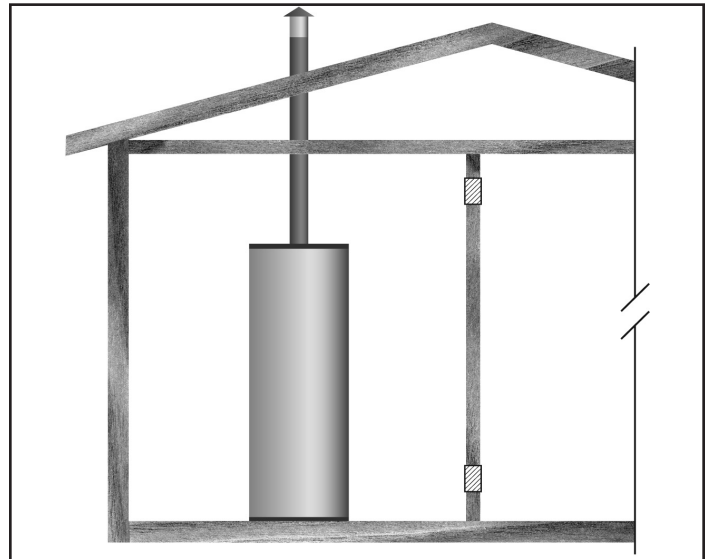
The confined space shall be provided with two permanent vertical ducts, one commencing within 12 inches (300 mm) of the top and one commencing within 12 inches (300 mm) of the bottom

of the enclosure. The vertical ducts shall communicate directly with the outdoors. See *Figure 17*.

Each duct opening shall have a minimum free area of 1 square inch per 4,000 Btu/hr (550 mm<sup>2</sup> per kW) of the aggregate input rating of all appliances installed in the enclosure.

When ducts are used, they shall be of the same cross sectional area as the free area of the openings to which they connect. The minimum dimension of rectangular air ducts shall be not less than 3 inches (7.62 cm).

#### AIR FROM OTHER INDOOR SPACES



**Figure 18. Two Permanent Openings**

The confined space shall be provided with two permanent openings, one commencing within 12 inches (300 mm) of the top and one commencing within 12 inches (300 mm) of the bottom of the enclosure. See *Figure 18*.

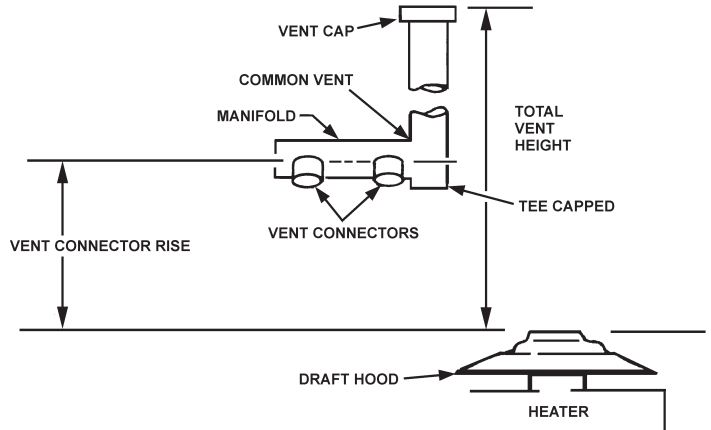
Each opening shall communicate directly with an additional room(s) of sufficient volume so that the combined volume of all spaces meets the criteria for an Unconfined Space.

Each opening shall have a minimum free area of 1 square inch per 1,000 Btu/hr (2200 mm<sup>2</sup> per kW) of the aggregate input rating of all appliances installed in the enclosure. Each opening shall not be less than 100 square inches (645 cm<sup>2</sup>).

Table 6. Technical Data Venting

**TYPE B GAS VENT**  
**Multiple Gas Fired Tank-Type Heaters**

When venting multiple tank type heaters using Type B vent pipe, follow the installation diagram (figure 13) and tables below which give sizing and data based upon *NFPA 54/ANSI Z223. 1992*.



**MODEL 120**

Input: 120,000 Btuh

Total Vent Height (Feet)

Draft Hood: 5"		Total Vent Height (Feet)								
		6	8	10	15	20	30	50	100	
	<b>Input Btuh</b>	<b>Vent Connector Diameter (inches)</b>								
	120,000	7	7	7	6	6	6	6	6	
	120,000	6	6	6	6	6	6	6	5	
	120,000	6	6	6	6	6	5	5	5	
<b>Number of Heaters</b>	<b>Combined Input in Thousands of Btuh</b>	<b>Manifold and Common Vent Diameter (In inches)</b>								
2	240	10	8	8	7	7	7	6	7	
3	360	10	10	10	10	8	8	7	7	
4	480	12	12	12	10	10	10	8	8	

**MODEL 154**

Input: 154,000 Btuh

Total Vent Height (Feet)

Draft Hood: 6"		Total Vent Height (Feet)								
		6	8	10	15	20	30	50	100	
	<b>Input Btuh</b>	<b>Vent Connector Diameter (in inches)</b>								
	154,000	8	8	7	7	7	7	7	7	
	154,000	7	7	7	7	7	6	6	6	
	154,000	7	7	7	6	6	6	6	6	
<b>Numbers of Heaters</b>	<b>Combined Input in Thousands of Btuh</b>	<b>Manifold and Common Vent Diameter (in inches)</b>								
2	308	10	10	10	8	8	7	7	7	
3	462	12	12	12	10	10	10	8	8	
4	616	14	14	12	12	12	10	1	10	

**MODEL 180, 197, 199, 200**

Input: 180,000, 199,000 Btuh

Total Vent Height (Feet)

Draft Hood: 6"		Total Vent Height (Feet)								
		6	8	10	15	20	30	50	100	
	<b>Input Btuh</b>	<b>Vent Connector Diameter (in inches)</b>								
	180,000	8	8	8	8	8	7	7	7	
	199,000	-	-	8	8	8	8	8	7	
	180,000	8	8	7	7	7	7	7	7	
	199,000	8	8	8	8	7	7	7	7	
	180,000	7	7	7	7	7	7	6	6	
	199,000	8	8	7	7	7	7	7	6	
<b>Number of Heaters</b>	<b>Combined Input in Thousands of Btuh</b>	<b>Manifold &amp; Common Vent Diameter</b>								
2	360	10	10	10	10	8	8	7	7	
	398	12	10	10	10	10	8	8	7	
3	540	14	12	12	12	10	10	10	8	
	597	14	14	12	12	12	10	10	10	
4	720	14	14	14	12	12	12	10	10	
	796	16	14	14	14	12	12	12	10	

Table 6. Technical Data Venting

MODEL 250, 251										
Input: 250,000/251,000 Btuh			Total Vent Height (Feet)							
Draft Hood: 6"			6	8	10	15	20	30	50	100
Number of Heaters	Input Btuh	Rise	Vent Connector Diameter (inches)							
	250/251,000	1 Ft.	-	-	-	-	-	-	8	8
	250/251,000	2 Ft.	-	-	-	8	8	8	8	8
	250/251,000	3 Ft.	-	8	8	8	8	8	7	7
Number of Heaters		Combined Input in Thousands of Btuh	Manifold and Common Vent Diameter (In inches)							
2	500/502		14	12	12	10	10	10	10	8
3	750/753		16	14	14	14	12	12	10	10
4	1000/1004		18	16	16	14	14	14	12	12
MODEL 275										
Input: 275,000 Btuh			Total Vent Height (Feet)							
Draft Hood: 6"			6	8	10	15	20	30	50	100
Number of Heaters	Input Btuh	Rise	Vent Connector Diameter (inches)							
	275,000	2 Ft.	-	-	-	-	-	8	8	8
	275,000	3 Ft.	-	-	-	8	8	8	8	8
	275,000	3 Ft.	-	-	-	8	8	8	8	8
Number of Heaters		Combined Input in Thousands of Btuh	Manifold and Common Vent Diameter (In inches)							
2	500/502		14	12	12	10	10	10	10	8
3	750/753		16	14	14	14	12	12	10	10
4	1000/1004		18	16	16	14	14	14	12	12
MODEL 305										
Input: 305,000 Btuh			Total Vent Height (Feet)							
Draft Hood: 8"			6	8	10	15	20	30	50	100
Number of Heaters	Input Btuh	Rise	Vent Connector Diameter (inches)							
	305,000	1 Ft.	-	-	10	10	10	10	10	10
	305,000	2 Ft.	10	10	10	10	10	10	8	8
	305,000	3 Ft.	10	10	10	10	10	8	8	8
Number of Heaters		Combined Input in Thousands of Btuh	Manifold and Common Vent Diameter (In inches)							
2	610		14	14	12	12	12	10	10	10
3	915		16	16	16	14	14	12	12	12
4	1220		18	18	16	16	16	14	14	12
MODEL 365, 400										
Input: 365,000, 399,000 Btuh			Total Vent Height (Feet)							
Draft Hood: 8"			6	8	10	15	20	30	50	100
Number of Heaters	Input Btuh	Rise	Vent Connector Diameter (inches)							
	365,000	1 Ft.	-	-	-	-	-	10	10	10
	399,000	1 Ft.	-	-	-	-	-	-	10	10
	365,000	2 Ft.	12	12	10	10	10	10	10	10
	399,000	2 Ft.	12	12	12	12	10	10	10	10
	365,000	3 Ft.	10	10	10	10	10	10	10	10
399,000	3 Ft.	12	10	10	10	10	10	10	10	
Number of Heaters		Combined Input in Thousands of Btuh	Manifold and Common Vent Diameter (In inches)							
2	730		14	14	14	12	12	12	10	10
	798		16	14	14	14	12	12	10	10
3	1095		18	18	16	16	14	14	12	12
	1197		18	18	18	16	16	14	14	12
4	1460		20	20	18	18	16	16	14	12
	1596		22	20	20	18	18	16	14	14

**MECHANICAL VENTING**

**SINGLE UNIT INSTALLATION**

When mechanical venting of this heater is desired, the following kit is available.

A. O. Smith part number 100110445

Where an approved power venter is to be installed to operate in conjunction with the water heater thermostat, the following codes must be adhered to. Field wiring should conform to the current edition of the *National Electrical Code NFPA 70* and/or local codes.

**VENT INSTALLATION**

Seal all joints between the power venter and the vent termination. This is to prevent leakage of exhaust products into the room(s) due to positive pressure of blower.

The "Sequence of Operation" description will be the same with mechanical venting except;

- When the water heater thermostat calls for heat:

Thermostat contacts "Close" and the power venter blower (120 VAC) is energized. Sufficient draft must be established for the "Draft Prover Switch (N.O.)" to "Close". When the draft prover switch "Closes" the relay coil of the flue damper is energized.

**MULTIPLE UNIT INSTALLATION**

For multiple unit installations, contact A. O. Smith, Technical Support Center at 1-800-527-1953.

# WATER HEATER INSTALLATION

## WATER LINE CONNECTIONS

The water piping installation must conform to these instructions and to all local code authority having jurisdiction. Good practice requires that all heavy piping be supported.

Read and observe all requirements in the following sections before installation of the water piping begins:

- *Water Temperature Control and Mixing Valves* (page 14).
- *Dish-washing Machines* (page 14).
- *Temperature-Pressure Relief Valve* (page 15).
- *Closed Water Systems and Thermal Expansion* (page 14).
- For multiple water heater installations, see *Water Piping Diagrams* (page 43).

## WATER (POTABLE) HEATING AND SPACE HEATING

All piping components connected to this unit for space heating applications shall be suitable for use with potable water.

Toxic chemicals, such as those used for boiler treatment, shall NEVER be introduced into this system.

This unit may NEVER be connected to any existing heating system or component(s) previously used with a non-potable water heating appliance.

When the system requires water for space heating at temperatures higher than required for domestic water purposes, a tempering valve must be installed. Please refer to *Water Piping Diagrams* (page 43) for suggested piping arrangements.

These water heaters cannot be used in space heating applications only

## THERMOMETERS (NOT SUPPLIED)

Thermometers should be obtained and field installed as shown in the installation diagrams.

Thermometers are installed in the system as a means of detecting the temperature of the outlet water supply.

## WATER PIPING DIAGRAMS

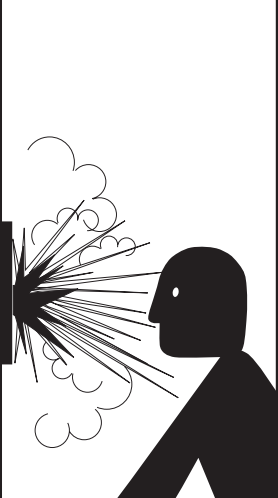
This manual provides detailed water piping diagrams for typical methods of application for the water heaters. See *Water Piping Diagrams* (page 43).

The water heater may be installed by itself, or with a separate storage tank. When used with a separate storage tank, the circulation may be either by gravity or by means of circulating pump. Adjust flow by throttling a full port ball valve installed in the circulating line on the outlet side of the pump. Never throttle flow on the suction side of a pump. See *Water Piping Diagrams* (page 43).

**Note:** In addition to the factory installed Temperature-Pressure Relief Valve (T&P valve) on the water heater, each remote storage tank that may be installed and piped to a water heating appliance must also have its own properly sized, rated and approved Temperature-Pressure Relief Valve installed.

Call the toll free technical support phone number listed on the back cover of this manual for further assistance in sizing a T&P valve for remote storage tanks.

## T&P VALVE DISCHARGE PIPE

	<b>WARNING</b>
	<b>Explosion Hazard</b> <ul style="list-style-type: none"><li>• Temperature-Pressure Relief Valve must comply with ANSI Z21.22- CSA 4.4 and ASME code.</li><li>• Properly sized temperature-pressure relief valve must be installed in opening provided.</li><li>• Can result in overheating and excessive tank pressure.</li><li>• Can cause serious injury or death.</li></ul>

This water heater is provided with a properly rated/sized and certified combination temperature - pressure (T&P) relief valve by the manufacturer. See *Temperature-Pressure Relief Valve* (page 15) for information on replacement and other requirements.

<b>CAUTION</b>
<b>Water Damage Hazard</b> <ul style="list-style-type: none"><li>• Temperature-Pressure Relief Valve discharge pipe must terminate at adequate drain.</li></ul>

Install a discharge pipe between the T&P valve discharge opening and a suitable floor drain. Do not connect discharge piping directly to the drain unless a 6" (15.2 cm) air gap is provided. To prevent bodily injury, hazard to life, or property damage, the relief valve must be allowed to discharge water in adequate quantities should circumstances demand. If the discharge pipe is not connected to a drain or other suitable means, the water flow may cause property damage.

## T&P VALVE DISCHARGE PIPE REQUIREMENTS:

- Shall not be smaller in size than the outlet pipe size of the valve, or have any reducing couplings or other restrictions.
- Shall not be plugged or blocked.
- Shall not be exposed to freezing temperatures.
- Shall be of material listed for hot water distribution.
- Shall be installed so as to allow complete drainage of both Temperature-Pressure Relief Valve and the discharge pipe.
- Must terminate a maximum of six inches above a floor drain or external to the building. In cold climates, it is recommended that the discharge pipe be terminated at an adequate drain inside the building.
- Shall not have any valve or other obstruction between the relief valve and the drain.

## INSTALLATION DIAGRAMS - TOP INLET/OUTLET USAGE

Use of the top inlet water connection requires an inlet dip tube (refer to figure 19). The tube is supplied in the heater. Follow caution labels if applying heat to this fitting. Do not allow pipe dope to contact the plastic tube during installation.

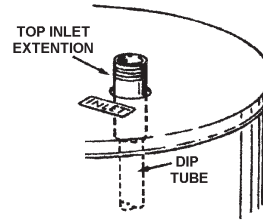


Figure 19. Tube Inlet Installation

## WATER HEATER WIRING

All electrical work must be installed in accordance with the current edition of the *National Electrical Code ANSI/NFPA No. 70* and must conform to all local code authority having jurisdiction. AN ELECTRICAL GROUND IS REQUIRED TO REDUCE RISK OF ELECTRICAL SHOCK OR POSSIBLE ELECTROCUTION.

If any of the original wire as supplied with the water heater must be replaced, use only type 105°C thermoplastic or equivalent 2500C type F must be used for the flame sensor and igniter leads.

The controls of this water heater are polarity sensitive. Be certain to properly wire the hot and neutral connections.

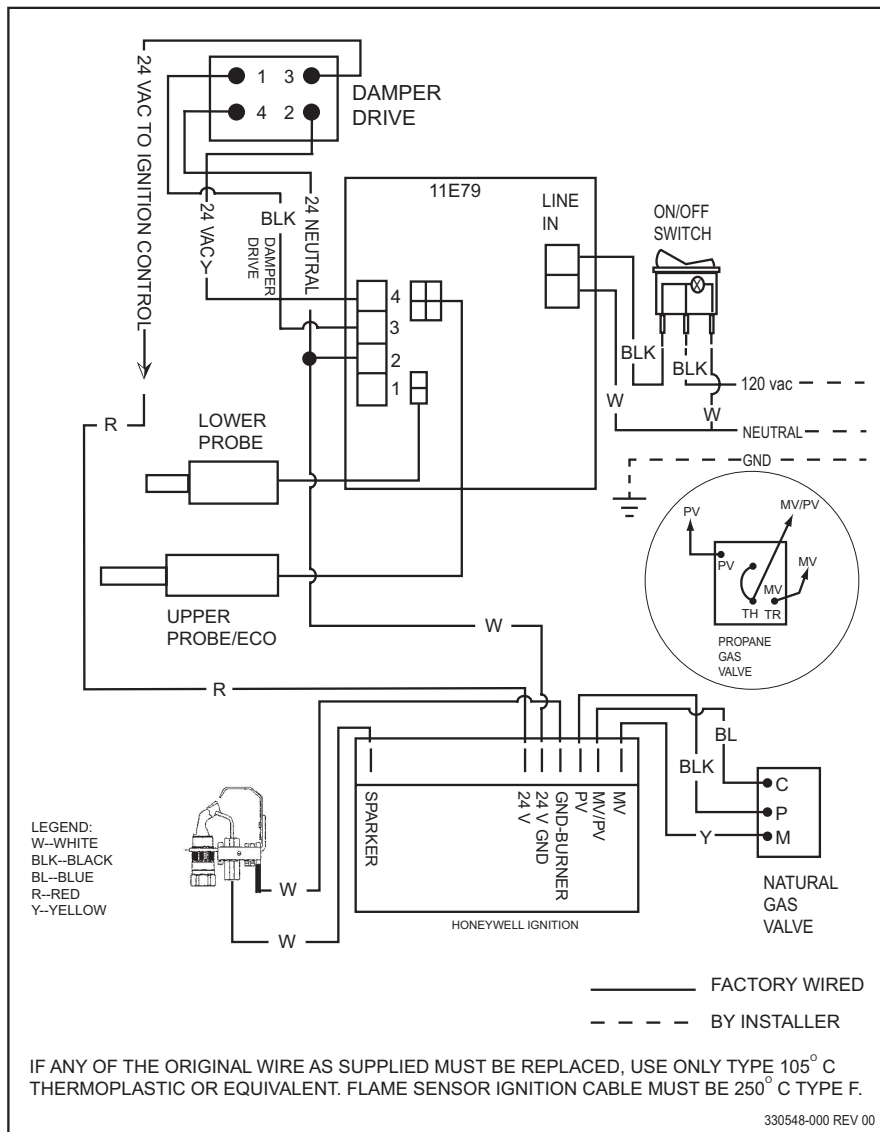


Figure 20. Wiring Diagram



## SUPPLY GAS LINE INSTALLATION

Contact your local gas service company to ensure that adequate gas service is available and to review applicable installation codes for your area.

Size the main gas line in accordance with **Table 7**. The figures shown are for straight lengths of pipe at 0.5 in. W.C. pressure drop, which is considered normal for low pressure systems. Note: Fittings such as elbows, tees and line regulators will add to the pipe pressure drop. Also refer to the latest version of the **National Fuel Gas Code ANSI Z223.1 / NFPA 54**.

Schedule 40 Steel or Wrought Iron Pipe is the preferred material for the gas line of this water heater. It is imperative to follow the sizing recommendations in the latest version of the **National Fuel Gas Code** if Corrugated Stainless Steel Tubing (CSST) is used as the gas line for this water heater.

The heater is not intended for operation at higher than 14.0" W.C.- natural gas, (1/2 pound per square inch gage) supply gas pressure. Exposure to higher supply pressure may cause damage to the gas valve which could result in fire or explosion. If overpressure has occurred such as through improper testing of gas lines or emergency malfunction of the supply system, the gas valve must be checked for safe operation. Make sure that the outside vents on the supply regulators and the safety vent valves are protected against blockage. These are parts of the gas supply system, not the heater. Vent blockage may occur during ice storms.

### ⚠ WARNING

#### Fire and Explosion Hazard

- Do not use water heater with any gas other than the gas shown on the rating label.
- Excessive gas pressure to gas valve can cause serious injury or death.
- Turn off gas lines during installation.
- Contact a qualified installer or service agency for installation and service.

Table 7. Gas Supply Pipe Lengths (in feet)					
(Maximum Equivalent Pipe Length - Natural Gas Only)					
Input rate (BTU/hr)	Schedule 40 Steel or Wrought Iron Pipe				
	1/2"	3/4"	1"	1 1/4"	1 1/2"
154,000	10	40	150	200	200
Fitting Type*	Equivalent length in feet				
45°El	0.7	1.0	1.2	1.6	1.9
90°El	1.6	2.1	2.6	3.5	4.0
Tee	3.1	4.1	5.2	6.9	8.0
*Screwed Fittings Natural Gas 0.60 Specific Gravity, 0.50" W.C. Pressure Drop					

It is important to guard against gas valve fouling from contaminants in gas ways. Such fouling may cause improper operation, fire or explosion.

If copper supply lines are used they must be internally tinned and certified for gas service. Before attaching the gas line, be sure that all gas pipe is clean on the inside.

To trap any dirt or foreign material in the gas supply line, a sediment trap must be incorporated in the piping (see **Figure 21**). The sediment trap must be readily accessible and not subject to freezing conditions. Install in accordance with recommendations of serving gas suppliers. Refer to the latest version of the **National Fuel Gas Code ANSI Z223.1 / NFPA 54**.

To prevent damage, care must be taken not to apply too much torque when attaching gas supply pipe to gas valve inlet.

Apply joint compounds (pipe dope) sparingly and only to the male threads of pipe joints. Do not apply compounds to the first two threads. Use compounds resistant to the action of liquefied petroleum gases.

### GAS METER SIZE – NATURAL GASES ONLY

Be sure the gas meter has sufficient capacity to supply the full rated gas input of the water heater as well as the requirements of all other gas fired equipment supplied by the meter. If gas meter is too small, ask the gas company to install a larger meter having adequate capacity.

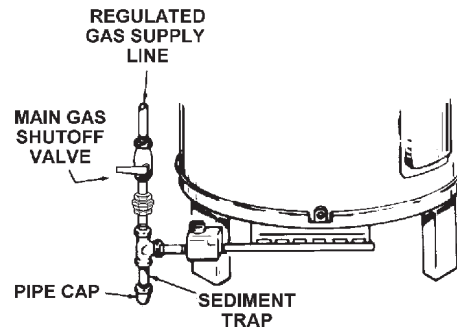


Figure 21. Gas Piping And Sediment Trap Installation

### Gas Line Leak Testing

Any time work is done on the gas supply system perform a leak test to avoid the possibility of fire or explosion.

### ⚠ WARNING

#### Fire and Explosion Hazard

- Use joint compound or Teflon tape compatible with propane gas.
- Leak test gas connections before placing water heater in operation.
- Disconnect gas piping at main gas shutoff valve before leak testing heater.
- Install sediment trap in accordance with NFPA 54.

1. For test pressures exceeding 1/2 psi (3.45 kPa), disconnect the water heater and its Main Gas Shutoff Valve from the gas supply piping system during testing. See *Figure 21*. The gas supply line must be capped when disconnected from the water heater.
2. For test pressures of 1/2 psi (3.45 kPa) or less, the water heater need not be disconnected, but must be isolated from the supply gas line by closing the Main Gas Shutoff Valve during testing.
3. Paint all supply gas line joints and connections upstream of the water heater with a rich soap and water solution to test for leaks. Bubbles indicate a gas leak. Do not use matches, candles, flame or other sources of ignition for this purpose.
4. Repair any leaks before placing the water heater in operation.

#### **PURGING**

Gas line purging is required with new piping or systems.

Purging should be performed per the current edition of *NFPA 54* the *National Fuel Gas Code*.

## OPERATION

### **WARNING**

#### **Fire or Explosion Hazard**

- Gas line purging is required with new piping or systems in which air has entered.
- To avoid risk of fire or explosion purge discharge must not enter into confined areas or spaces where ignition can occur.
- The area must be well ventilated and all sources of ignition must be deactivated or removed.



Read instruction manual before installing, using or servicing water heater.



The water heaters covered by this manual are equipped with an electronic control system that automatically sequences the Igniter, the 24 VAC Gas Valve, the Burner ignition, and flame sensing.

Before attempting start up, thoroughly study and know the exact **Sequence of Operation**. See written **Sequence of Operation** and the Sequence Of Operation Flow Chart, **Figure 22** (page 28).

Be certain that the water heater is full of water, that air is purged from the gas and water lines and that there are no leaks in the gas and water lines. Ensure all inlet water valves are open.

#### **FILLING THE WATER HEATER**

Follow these steps to fill the water heater prior to start up.

1. Close the heater drain valve.
2. Open a nearby hot water faucet to permit air in system to escape.
3. Fully open the cold water inlet valve allowing the piping and water heater to fill with water.
4. Close hot water faucet opened in Step 2 as water starts to flow.

Read **Sequence of Operation** section of this manual prior to lighting and operating this water heater.

With above conditions satisfied, start the unit in accordance with the instructions on the **Lighting & Operation Label** attached to the heater. See **Lighting & Operation Label** (page 29).

#### **PRIOR TO START UP**

Installation and start up of this water heater requires abilities and skills equivalent to that of a licensed tradesman in the field involved. See **Qualifications** (page 6).

Do not place the water heater in operation if any part has been under water. Immediately call a qualified service technician to inspect the water heater and to replace any part of the control system and any gas control which has been under water.

Light the water heater in accordance with the **Lighting & Operation Label** (page 29) on the water heater and in this manual.

## SEQUENCE OF OPERATION

The following information will describe the Sequence of Operation for this water heater.

1. Switch power on to unit.
2. Thermostat calls for heat.
3. Ignition Control performs diagnostic self check on system components.
4. The Ignition Control begins the trial for ignition.
5. The Ignition Control turns on the Spark Igniter and opens the Pilot Gas Valve.
6. The Ignition Control monitors the Flame Sensor during the ignition trial period.
7. If the Ignition Control does not sense the pilot flame during the ignition trial period, the Ignition Control shuts the Pilot Gas Valve and turns off the Spark Igniter. Depending on the water heater model, the Ignition Control will either retry the ignition trial at step 4 or lockout the ignition sequence. If the ignition sequence is locked out, the power to the unit must be cycled to restart the Ignition Control.
8. If the pilot flame is proved during the ignition trial period, the Ignition Control turns off the Spark Igniter and opens the Main Gas Valve.
9. The Ignition Control allows a 2 second pilot flame stabilization period to insure that the pilot flame is not extinguished by the main burner light-off process.
10. The Ignition Control monitors the Flame Sensor during the heating cycle. If the flame signal is lost, the Ignition Control shuts the Main Gas Valve and Pilot Gas Valve and re-starts the ignition process at step 4.
11. Once the unit is satisfied, the Ignition Control will shut off the Main Gas Valve and the Pilot Gas Valve and the unit will be in standby mode until another call for heat is initiated by the thermostat.

See the flow chart, **Figure 22** (page 28), for more information.

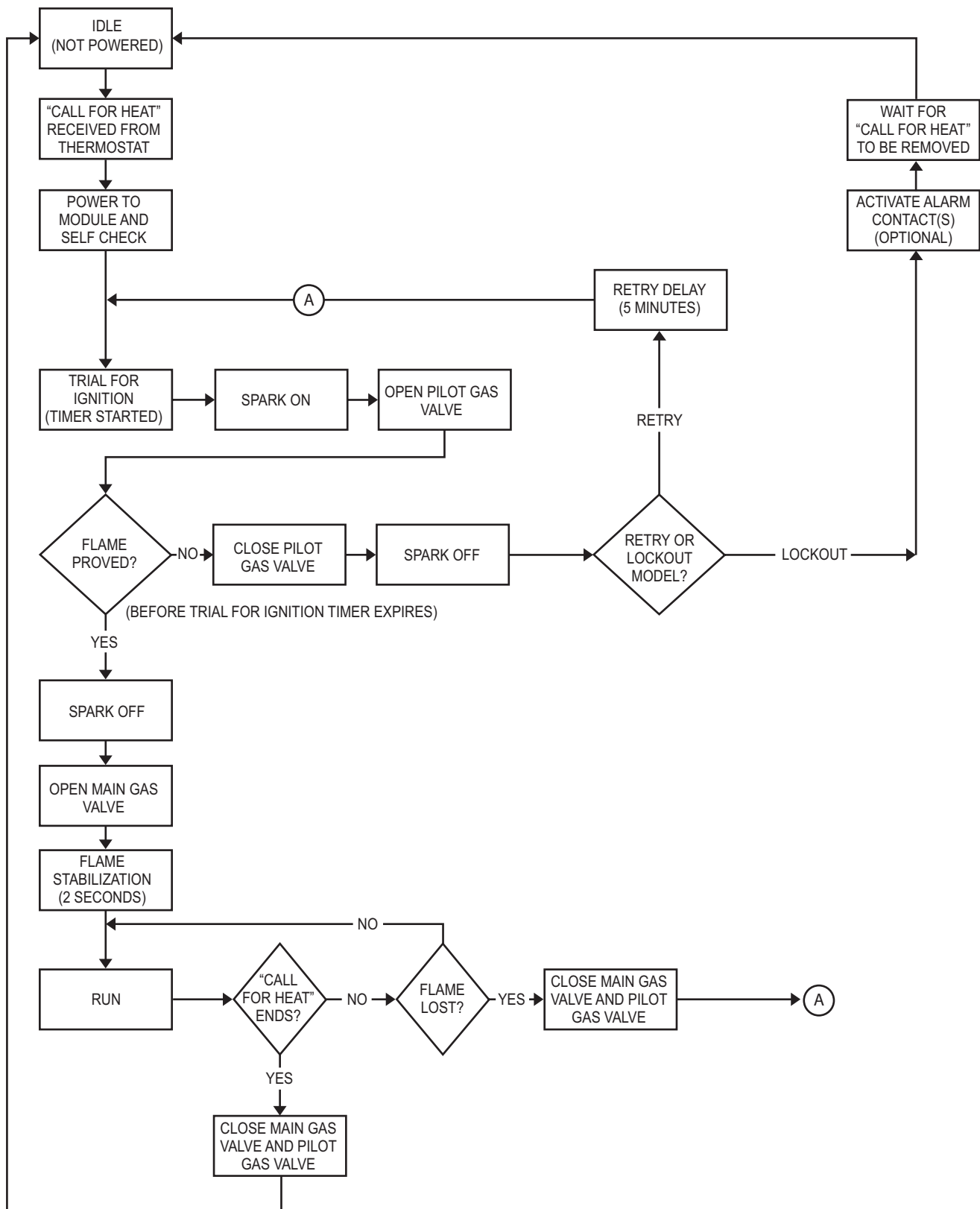


Figure 22. Sequence Of Operation Flow Chart

Description of this flow chart can be found in *Sequence of Operation* (page 27).

## FOR YOUR SAFETY READ BEFORE OPERATING



### WARNING

If you do not follow these instructions exactly, a fire or explosion may result causing property damage, personal injury, or loss of life.



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

B. BEFORE OPERATING smell all around the appliance area for gas. Be sure to smell next to the floor because some gas is heavier than air and will settle on the floor.



### "WHAT TO DO IF YOU SMELL GAS"

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

C. Use only your hand to switch the gas valve on or off. Never use tools. If the on/off switch will not move, don't try to repair it. Call a qualified service technician. Force or attempted repair may result in a fire or explosion.

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

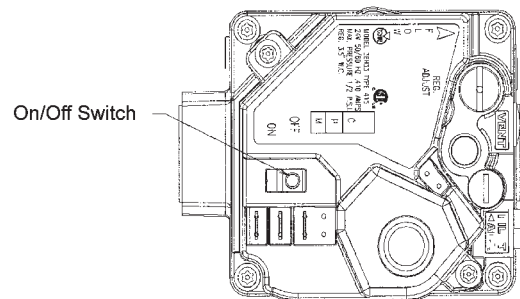
## OPERATING INSTRUCTIONS

1.  STOP! Read the safety information above on this label.
2. Set thermostat to lowest setting.
3. Turn off all electric power to the appliance.
4. This appliance is equipped with an ignition device which automatically lights the burner. Do not try to light the burner by hand.
5. Move "Off/On" switch to the "Off" position. Wait five(5) minutes to clear out any gas. If you then smell gas,  STOP!. Follow "B" in the safety information above on this label. If you don't smell gas, go on to next step.
6. Move "Off/On" switch to the "On" position.

7. Turn on all electric power to the appliance.

8. Set thermostat to desired setting.

9. If the appliance will not operate, follow the instructions "To Turn Off Gas To Appliance" and call your service technician or gas supplier.



## TO TURN OFF GAS APPLIANCE

1. Set the thermostat to lowest setting.
2. Turn off all electric power to appliance if service is to be performed.
3. Move "Off/On" switch to the "Off" position. do not force.

## FOR YOUR SAFETY READ BEFORE OPERATING



### WARNING

If you do not follow these instructions exactly, a fire or explosion may result causing property damage, personal injury, or loss of life.







- A. This appliance does not have a pilot. It is equipped with an ignition device which automatically lights the burner. Do not try to light the pilot by hand.
- B. BEFORE OPERATING smell all around the appliance area for gas. Be sure to smell next to the floor because some gas is heavier than air and will settle on the floor.

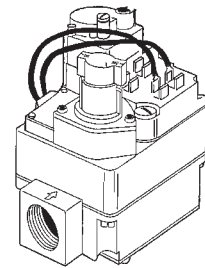
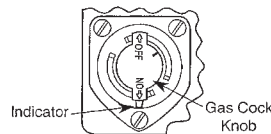
### "WHAT TO DO IF YOU SMELL GAS"

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


- C. Use only your hand to push in or turn the gas control knob. Never use tools. If the knob will not push in or turn by hand, don't try to repair it. Call a qualified service technician. Force or attempted repair may result in a fire or explosion.
- D. Do not use this appliance if any part has been under water. Immediately call a qualified service technician to inspect the appliance and to replace any part of the control system and any gas control which has been under water.

## OPERATING INSTRUCTIONS

1.  STOP! Read the safety information above on this label.
2. Set thermostat to lowest setting.
3. Turn off all electric power to the appliance.
4. This appliance is equipped with an ignition device which automatically lights the burner. Do not try to light the burner by hand.
5. Turn top knob of the gas control valve clockwise  to the "OFF" position. Note: It may be necessary to slightly depress knob while turning. Do not force knob.
6. Wait five (5) minutes to clear out any gas. If you then smell gas,  STOP!! Follow "B" in the safety information above on this label. If you do not smell gas, go to the next step.
7. Turn gas control top knob counter clockwise  to "ON" position. Do not force knob.
8. Turn on all electrical power to the appliance.
9. Set thermostat to desired setting.
10. If the appliance will not operate, follow the instructions "To Turn Off Gas To Appliance" and call your service technician or gas supplier.



## TO TURN OFF GAS APPLIANCE

1. Set the thermostat to lowest setting.
2. Turn off all electric power to appliance if service is to be performed.
3. Turn top knob of gas control valve clockwise  to "OFF" position. Do not force.

## ADJUSTMENTS

---

ON INITIAL STARTUP, SOME ADJUSTMENTS MAY BE NECESSARY.

Check Manifold and inlet gas pressures. See *Gas Supply Systems* (page 13) and (page 31).

Check Pilot Burner. See *Pilot Burner* (page 36).)

### TESTING DAMPER OPERATION

With the Service Switch in the AUTOMATIC OPERATION position, check the operation of the flue damper three (3) times with the water operating controls for proper operating sequence:

- The damper disc must be open (in the vertical position) before the ignition and combustion process begins.
- The damper disc must be in the open position when the main burner is firing.
- The gas control valve must close and the main burner must have ceased firing before the damper disc begins its return to the closed (horizontal) position.

If during testing of the operation of the damper you find that there is a problem with the operation of the water heater when the Service Switch is in the AUTOMATIC OPERATION position: Reset the Service Switch to the HOLD OPEN DAMPER position and check operation again.

If the water heater does operate when placed in the HOLD OPEN DAMPER position:

- Refer to the *Effikal RVGP-KSF-Series Flue Damper Trouble Shooting Guide* (page 40).
- If the water heater does not operate with the Service Switch in either position:
- Refer to *Troubleshooting* (page 39) and *Table 11. Troubleshooting Checklist* (page 41).

## CHECKING THE VENTING

---

The following steps shall be followed with each appliance connected to the venting system placed in operation, while any other appliances connected to the venting system are not in operation.

1. Seal any unused openings in the venting system.
2. Inspect the venting system for proper size and horizontal pitch, as required in the *National Fuel Gas Code, ANSI Z223.1* and these instructions. Determine that there is no blockage or restriction, leakage, corrosion and other deficiencies which could cause an unsafe condition.
3. So far as is practical, close all building doors and windows and all doors between the space in which the water heater(s) connected to the venting system are located and other spaces of the building. Turn on all appliances not connected to the venting system. Turn on all exhaust fans, such as range hoods and bathroom exhausts, so they shall operate at maximum speed. Close fireplace dampers.
4. Follow the lighting instruction. Place the water heater being inspected in operation. Adjust thermostat so water heater shall operate continuously.
5. Test for draft hood spillage at the relief opening after 5 minutes of main burner operation.
6. After it has been determined that each appliance connected to the venting system properly vents when tested as outlined above, return doors, windows, exhaust fans, fireplace dampers and any other gas burning appliance to their previous conditions of use.
7. If improper venting is observed during any of the above tests, the venting system must be corrected.

### FAILURE TO CORRECT BACK DRAFTS MAY CAUSE AIR CONTAMINATION AND UNSAFE CONDITIONS.

- If the back draft cannot be corrected by the normal method or if a suitable draft cannot be obtained, a blower type flue gas exhauster must be employed to assure proper venting and correct combustion.

## CHECKING THE INPUT

For installation locations with elevations above 2000 feet, refer to HIGH ALTITUDE INSTALLATIONS section of this manual for input reduction procedure.

1. Attach a pressure gauge or a manometer to the manifold pressure tap on the gas control valve and refer to **Table 8**, for correct manifold pressure.
2. Use this formula to “clock” the meter. Be sure that other gas consuming appliances are not operating during this interval.

$$(3600/T) \times H = \text{Btuh}$$

T = Time in seconds to burn one cubic foot of gas.

H = Btu's per cubic foot of gas.

Btuh = Actual heater input.

Example: (Using 250 heater)

$$T = 15.1 \text{ seconds}$$



$$H = 1050 \text{ Btu}$$

$$\text{Btuh} = ?$$

$$(3600/15.1) \times 1050 = 250,000 \text{ (Compare with 250 model and rating.)}$$

Input Rate (BTUH)	Type of Gas	BTUH Per Cu. Ft.	Time Req'd to Consume 1 Cu. Ft. Of Gas
154,000	NATURAL	1050	24.5 SEC.
	PROPANE	2500	58.4 SEC.

Should it be necessary to adjust the gas pressure to the burners to obtain the full input rate, the steps below should be followed:

3. Remove the regulator adjustment sealing cap and adjust the pressure by turning the adjusting screw with a screwdriver.
  -  Clockwise to increase gas pressure and input rate.
  -  Counterclockwise to decrease gas pressure and input rate.
4. “Clock” the meter as in step 2 above.
5. Repeat steps 3 and 4 until the specified input rate is achieved.
6. Turn the gas control knob to PILOT. Remove the pressure gauge and replace the sealing cap and the Allen wrench set screw in the pressure tap opening.

UNDER NO CIRCUMSTANCES SHOULD THE GAS INPUT EXCEED THE INPUT SHOWN ON THE HEATER MODEL AND RATING PLATE. OVER-FIRING COULD RESULT IN DAMAGE OR SOOTING OF THE HEATER.



# MAINTENANCE

## VENTING SYSTEM

Examine the venting system every six months for obstructions and/or deterioration of the vent piping.

Remove all soot or other obstructions from chimney which will retard free draft.

## REMOTE STORAGE TANK TEMPERATURE CONTROL

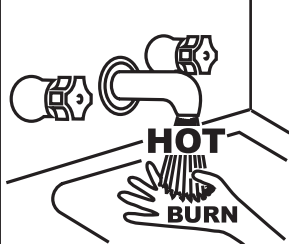
The water temperature in the remote storage tank (if used) is controlled by the storage tank temperature control. The sensing element is mounted in the hot water storage tank. See *Water Piping Diagrams* (page 43).

A change in water temperature in the storage tank lower than the tank temperature control setting will cause the sensor to activate the circulating pump. The pump then circulates the water through the heater where the thermostat senses the drop in water temperature and activates main burner operation of the water heater.

If the storage tank temperature control is out of calibration, replace with new control.

SHOULD OVERHEATING OCCUR OR THE GAS SUPPLY FAIL TO SHUT OFF, TURN OFF THE MANUAL GAS CONTROL VALVE TO THE Water heater.

## TEMPERATURE-PRESSURE RELIEF VALVE TEST

	<p><b>⚠ DANGER</b></p> <ul style="list-style-type: none"><li>• Burn hazard.</li><li>• Hot water discharge.</li><li>• Keep clear of Temperature-Pressure Relief Valve discharge outlet.</li></ul>
---	--

It is recommended that the Temperature-Pressure Relief Valve should be checked to ensure that it is in operating condition every 6 months.

When checking the Temperature-Pressure Relief Valve operation, make sure that (1) no one is in front of or around the outlet of the Temperature-Pressure Relief Valve discharge line, and (2) that the water discharge will not cause any property damage, as the water may be extremely hot. Use care when operating valve as the valve may be hot.

To check the pressure relief valve, lift the lever at the end of the valve several times. See *Figure 23*. The valve should seat properly and operate freely.

If after manually operating the valve, it fails to completely reset and continues to release water, immediately close the cold water inlet to the water heater and drain the water heater. See *Draining and flushing* (page 34). Replace the Temperature-Pressure Relief

Valve with a properly rated/sized new one. See *Temperature-Pressure Relief Valve* (page 15) for instructions on replacement.

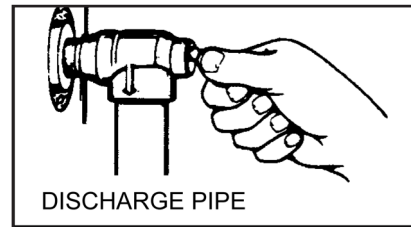


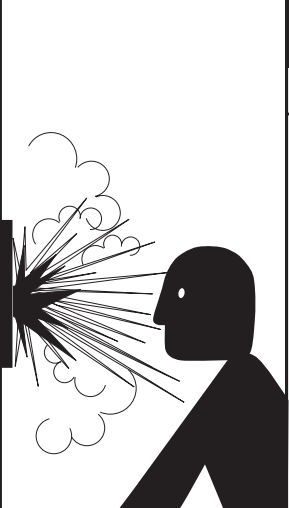
Figure 23. Temperature-Pressure Relief Valve.

If the Temperature-Pressure Relief Valve on water heater weeps or discharges periodically, this may be due to thermal expansion.

**Note:** Excessive water pressure is the most common cause of Temperature-Pressure Relief Valve leakage. Excessive water system pressure is most often caused by "thermal expansion" in a "closed system." See *Closed Water Systems* and *Thermal Expansion* (page 14). The Temperature-Pressure Relief Valve is not intended for the constant relief of thermal expansion.

Temperature-Pressure Relief Valve leakage due to pressure build up in a closed system that does not have a thermal expansion tank installed is not covered under the limited warranty. Thermal expansion tanks must be installed on all closed water systems.

DO NOT PLUG THE TEMPERATURE-PRESSURE RELIEF VALVE OPENING. THIS CAN CAUSE PROPERTY DAMAGE, SERIOUS INJURY OR DEATH.

	<p><b>⚠ WARNING</b></p> <p><b>Explosion Hazard</b></p> <ul style="list-style-type: none"><li>• Temperature-Pressure Relief Valve must comply with ANSI Z21.22-CSA 4.4 and ASME code.</li><li>• Properly sized temperature-pressure relief valve must be installed in opening provided.</li><li>• Can result in overheating and excessive tank pressure.</li><li>• Can cause serious injury or death.</li></ul>
--	--

## ANODE ROD INSPECTION

The anode rod is used to protect the tank from corrosion. Most hot water tanks are equipped with an anode rod. The submerged rod sacrifices itself to protect the tank. Instead of corroding tank, water ions attack and eat away the anode rod. This does not affect water's taste or color. The rod must be maintained to keep tank in operating condition.

# CAUTION

## Property Damage Hazard

- Avoid water heater damage.
- Inspection and replacement of anode rod required.

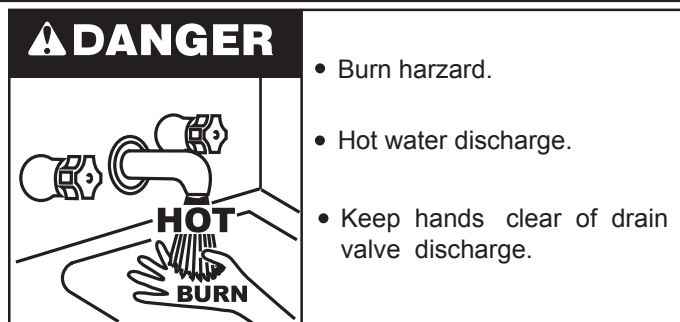
Anode rod deterioration depends on water conductivity, not necessarily water condition. A corroded or pitted anode rod indicates high water conductivity and should be checked and/or replaced more often than an anode rod that appears to be intact. Replacement of a depleted anode rod can extend the life of your water heater. Inspection should be conducted by a qualified technician, and at a minimum should be checked annually after the warranty period.

Artificially softened water is exceedingly corrosive because the process substitutes sodium ions for magnesium and calcium ions.

The use of a water softener may decrease the life of the water heater tank.

The anode rod should be inspected after a maximum of three years and annually thereafter until the condition of the anode rod dictates its replacement. Anode replacement is not covered by warranty. NOTE: artificially softened water requires the anode rod to be inspected annually.

### DRAINING AND FLUSHING



It is recommended that the water heater storage tank be drained and flushed every 6 months to reduce sediment buildup. The water heater should be drained if being shut down during freezing temperatures. See *Features and Components* (page 7) in this manual for the location of the water heater components described below.

#### TO DRAIN THE WATER HEATER STORAGE TANK:

1. Turn off the electrical supply to the water heater.
2. Turn off the gas supply at the Main Gas Shutoff Valve if the water heater is going to be shut down for an extended period.
3. Ensure the cold water inlet valve is open.
4. Open a nearby hot water faucet and let the water run until the water is no longer hot.
5. Close the cold water inlet valve to the water heater.
6. Connect a hose to the water heater drain valve and terminate it to an adequate drain.
7. Open the water heater drain valve and allow all the water to drain from the storage tank.

8. Close the water heater drain valve when all water in the storage tank has drained.
9. Close the hot water faucet opened in Step 4.
10. If the water heater is going to be shut down for an extended period, the drain valve should be left open.

#### TO FLUSH THE WATER HEATER STORAGE TANK:

1. Turn off the electrical supply to the water heater.
2. Ensure the cold water inlet valve is open.
3. Open a nearby hot water faucet and let the water run until the water is no longer hot. Then close the hot water faucet.
4. Connect a hose to the drain valve and terminate it to an adequate drain.
5. Ensure the drain hose is secured before and during the entire flushing procedure. Flushing is performed with system water pressure applied to the water heater.
6. Open the water heater drain valve to flush the storage tank.
7. Flush the water heater storage tank to remove sediment and allow the water to flow until it runs clean.
8. Close the water heater drain valve when flushing is completed.
9. Remove the drain hose.
10. Fill the water heater - see *Filling the Water Heater* (page 27).
11. Turn on the electrical supply to place the water heater back in operation.
12. Allow the water heater to complete several heating cycles to ensure it is operating properly.

#### REMOVING LIME DEPOSITS FROM TANK TYPE COMMERCIAL WATER HEATERS

The amount of calcium carbonate (lime) released from water is in direct proportion to water temperature and usage. See *Figure 24*. The higher the water temperature or water usage, the more lime deposits are dropped out of the water. This is the lime scale which forms in pipes, heaters and on cooking utensils.

Lime accumulation not only reduces the life of equipment but also reduces efficiency of the heater and increases fuel consumption.

The usage of water softening equipment greatly reduces the hardness of the water. However, this equipment does not always remove all of the hardness (lime). For this reason it is recommended that a regular schedule for deliming be maintained.

The time between cleaning will vary from weeks to months depending upon water conditions and usage.

The depth of lime buildup should be measured periodically. Heaters equipped with cleanouts will have about 2" of lime buildup when the level of lime has reached the bottom of the cleanout opening. A schedule for deliming should then be set up, based on the amount of time it would take for a 1" buildup of lime. It is recommended that the water heater initially be inspected after 6 months.

#### EXAMPLE 1:

Initial inspection after 6 months shows 1/2" of lime accumulation. Therefore, the heater should be delimed once a year.

## EXAMPLE 2:

Initial inspection after 6 months shows 2" of lime accumulation. Therefore, the heater should be delimed every 3 months.

POUNDS OF LIME DEPOSITED VS. TEMPERATURE AND WATER USAGE

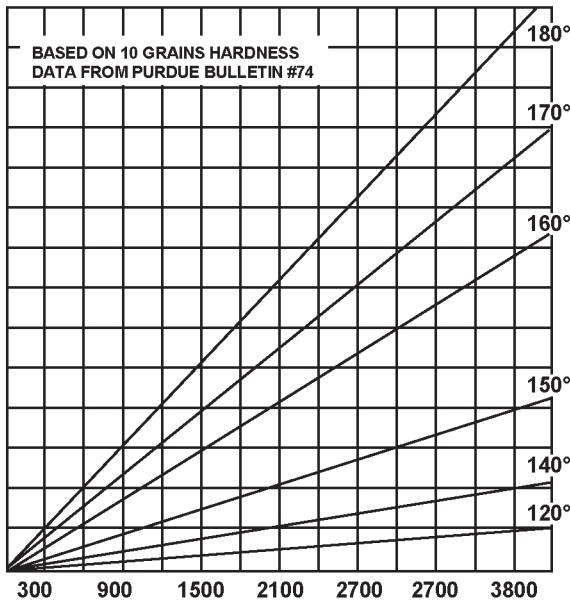


Figure 24. Lime Accumulation after Six Months

## DELIMING SOLVENTS

UN•LIME is recommended for deliming. UN•LIME is a patented food grade acid which is safe to handle and does not create the harmful fumes which are associated with other products.

UN•LIME may be obtained from your dealer, distributor or water heater manufacturer. Order Part Number 100110459, 1 gallon, packed 4 gallons per case or Part Number 100110460, 5 gallon container.

Hydrochloric base acids are not recommended for use on glass lined tanks.

Observe handling instructions on label of product being used.

## TANK CLEANOUT PROCEDURE

The following practices will ensure longer life and enable the unit to operate at its designed efficiency:

1. Once a month the heater should be flushed. Open the drain valve and allow two gallons of water to drain from the heater. Inlet water valve should remain open to maintain pressure in tank.
2. A cleanout opening is provided for periodic cleaning of the tank. Gas must be shut off and heater drained before opening cleanout.

To clean heater through cleanout opening, proceed as follows:

1. Drain heater.
2. Remove outer cover plate from lower side of heater jacket.
3. Remove six (6) hex head screws securing tank cleanout plate and remove plate.
4. Remove lime, scale, or sediment using care not to damage the glass lining.

5. Inspect cleanout plate gasket, if new gasket is required, replace with part no. 100109686.
6. Install cleanout plate. Be sure to draw plate up tight by tightening screws securely.
7. Replace outer jacket cover plate.

In some water areas the sediment might not be removed by this method and may result in the water heater making rumbling or boiling noises. To dissolve and remove these more stubborn mineral deposits, UN•LIME Professional Delimer should be used.

## DELIMING USING FLO-JUG METHOD

UN•LIME in the 5 gallon size is recommended for deliming of all models. Contact your local dealer, distributor or, water heater manufacturer:

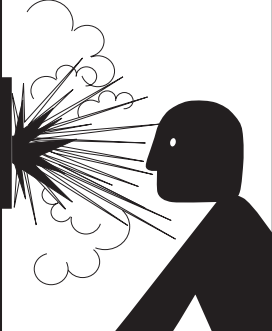
Telephone: (800) 433-2545

Fax: (800) 433-2515

Website: [www.hotwater.com/parts](http://www.hotwater.com/parts)

## PREPARE THE WATER HEATER

To delime the water heater using the Flo-Jug method, first prepare the heater for deliming.

	<b>WARNING</b>
	<b>Explosion Hazard</b>
	<ul style="list-style-type: none"><li>• Flammable hydrogen gases may be present.</li><li>• Keep all ignition sources away from faucet when turning on hot water.</li></ul>

Do not smoke or have open flame or sparks in vicinity of heater. Do not mix UN•LIME with other chemicals. Do not allow contact with magnesium, aluminum or galvanized metals.

	<b>CAUTION</b>
	<b>Chemical Hazard</b>
	<ul style="list-style-type: none"><li>• Product contains phosphoric acid.</li><li>• Keep out of reach of children.</li><li>• Use rubber or neoprene gloves.</li></ul>

Contains phosphoric acid. In case of external contact, flush with cool water. If irritation persists, get medical attention. If swallowed, give 1 or 2 glasses of water or milk and call physician.

Get immediate medical attention for eyes. Keep out of reach of children.

**Note:** THE USE OF RUBBER OR NEOPRENE GLOVES IS RECOMMENDED, ESPECIALLY IF YOU HAVE ANY OPEN SORES OR CUTS TO AVOID UNNECESSARY IRRITATION OR DISCOMFORT.

## DELIME THE WATER HEATER

1. Turn off fuel and/or power supply to heater. Also, turn off power to any electrical device or equipment, which is attached, or part of the system.
2. Open hot water side of faucet closest to heater and allow water to run until it is cool enough to handle safely.
3. Close cold water inlet valve to heater.
4. Connect hose to drain valve at bottom of heater and start draining heater into suitable floor drain area.
5. Remove pressure relief valve while heater is draining. NOTE: Do not replace pressure relief valve until deliming is completed. Pressure relief valve opening will also act as a vent in case of possible contact between the delimer and the anode rod(s), which may produce flammable hydrogen-air mixtures.
6. If pressure relief valve appears to be limed-up, place it in a clean glass or plastic container adequate in size so that you can pour enough UN•LIME® into container to cover the valve and allow space for foaming. When foaming stops, run fresh cool water into the container and rinse the pressure relief valve for a few minutes.
7. If heater does not drain completely after a reasonable length of time, turn off the main water supply valve to stop water from entering the tank due to a by-pass problem or defective cold water inlet valve. Also, check for clogged drain valve opening. Heater must be completely drained before introducing UN•LIME.
8. Remove the cleanout cover and place a clean plastic bucket next to the cleanout opening.

Partially open the cold water inlet valve to allow time to accomplish the following and then close the valve.

While the water is being run through the tank, insert a stiff wire, copper tube flattened at one end or an opened wire coat hanger through the cleanout opening and scrape out any loose deposits of scale or sediment. This is an economical way to avoid unnecessary usage of the deliming solution.

Repeat the opening and closing of the cold water inlet valve as necessary but be sure the heater is completely drained when ready to introduce the UN•LIME.

Upon completion, reinstall the cleanout cover and use a new cleanout cover gasket (part number 100109686).

Remove the drain valve.

9. Install the long plastic male adapter insert fitting into the drain valve opening of heater after applying Teflon tape or paste to threads. Tighten firmly by hand and use wrench or adjustable pliers to check for secure connection. Do not over tighten to avoid damage to threads and fittings.

## PREPARE THE UP-N-DOWN TRANSFER KIT

The next step is the preparation on the Up-N-Down Transfer Kit, if you have not already done so:

1. With the 5 gallon Up-N-Down container in the vertical position, unscrew the plastic vent cap in the handle and pierce the plastic membrane over the vent boss under the cap to allow the container to vent.

**Note:** If your container does not have the vent cap and vent boss, drill a 3/16" hole in the handle. When you have finished delimiting you will be able to plug this drilled vent with the stainless steel screw that is supplied with the kit.

2. Remove the container's cap and cut the plastic membrane located in the 3/4" IPT opening in the cap. Take care to not damage the threads.
3. Find the 3/4" male adapter, apply teflon tape to the threaded end and screw it into the 3/4" IPT opening in the cap.
4. Put cap with male adapter back on the container and slide 3/4" hose over end of male adapter and fasten in place using hose clamp provided.

## DELIME USING FLO-JUG METHOD

1. Slide the hose clamp over end of hose and slide hose over the male adapter in the water heater drain opening and secure in place using hose clamp.
2. Lift container to the "Pour" Position (see *Figure 25*), being careful to keep the vent in the handle above the liquid level and pour the UN•LIME into the heater.
3. Lower container, you may have to place the container on its empty carton to prevent the UN•LIME from flowing back into the container.
4. Let UN•LIME remain in the heater for 5 minutes and then lower the container to the "Drain" Position. See *Figure 25*.
5. Delimiting activity is indicated by foaming on the surface of the UN•LIME. If there is delimiting activity, repeat steps 2 thru 4.

Normally, lime removal will be completed within one hour. Severe build-up of lime may take longer than an hour to complete descaling.

**Note:** To check UN•LIME for continued use, place some scale or white chalk in a glass with a small amount of UN•LIME. If the material is vigorously dissolved by the UN•LIME, it can be reused; if not, the UN•LIME should be replaced.

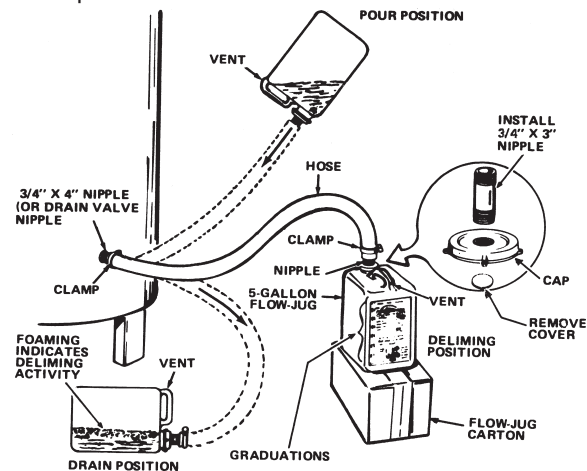


Figure 25. Flo-Jug Delimiting Method

## PILOT BURNER

At least once a year, check the pilot burner (*Figure 26*) and the main burner, *Figure 28*, for proper operation. See *Figure 27* for the location of the Pilot Burner and the Main Burners. For access to pilot, unfasten two screws to burner cover and remove. Locate

the burner with pilot and remove screw holding burner to manifold. Unfasten pilot tubing from valve and slide out burner and pilot.

Servicing of the pilot burner includes keeping pilot free of lint, cleaning the burner head, the primary air opening and the orifice of the pilot burner.

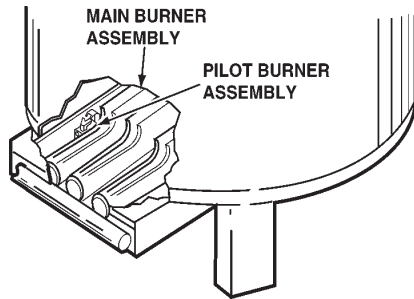


Figure 26. Checking the Pilot Burner

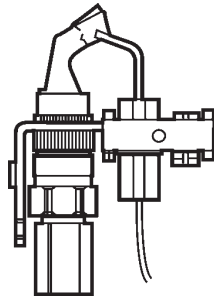


Figure 27. Locating the Pilot and Main Burners

The pilot burner flame is affected by the following:

1. Low gas pressure.
  - Adjust pilot flame by means of the pilot gas adjustment located on the gas control valve. See *Figure 29* and *Figure 30*.
  - The pilot flame should envelop sensing device with 5/8" (1.6cm) flame. See *Figure 28*. Remove pilot adjustment cover screw shown in *Figure 29* and *Figure 30*. Turn inner adjustment screw clockwise to decrease, or counterclockwise to increase pilot flame. Be sure to replace cover screw on gas control valve after adjustment to prevent possible gas leakage.
2. Clogged pilot burner orifice.
  - Clean or replace orifice. A clogged orifice will restrict gas flow.

Pilot sensing device must sense a flame before sparking will stop.

Loose wires or a draft may cause intermittent or abnormal sparking. To eliminate this condition, first correct loose wiring condition, and then, if necessary, increase pilot flame.

## MAIN BURNER

The main burner shown in *Figure 28*, should display the following characteristics:

- Cause rapid ignition and carry over of flame across entire burner.

- Give reasonably quiet operation during ignition, burning and extinction.
- Cause no excessive lifting of flame from burner ports.

If the preceding burner characteristics are not evident, check for accumulation of lint or other foreign material that restricts or other foreign material that restricts or blocks air openings to burner or heater.

To clean main burners:

1. Remove main burners from unit.
2. Check that burner venturi and ports are free of foreign matter.
3. Clean burners with bristle brush and/or vacuum cleaner
  - **DO NOT** distort burner ports or pilot location.
4. Reinstall burners in unit. Make sure front and rear of burners are installed correctly in burner support brackets.

Also check for good flow of combustion and ventilating air to the unit.

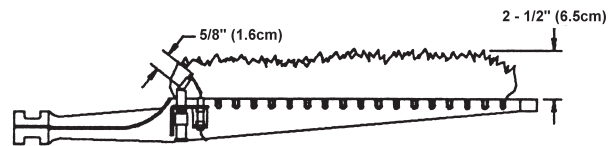


Figure 28. Typical Pilot and Main Burner Flames

## GAS CONTROL VALVE

*Figure 29* and *Figure 30* show the two types of combination gas control valves used on this heater.

If gas control valve becomes defective, repairs should not be attempted. A new valve should be installed in place of defective one.

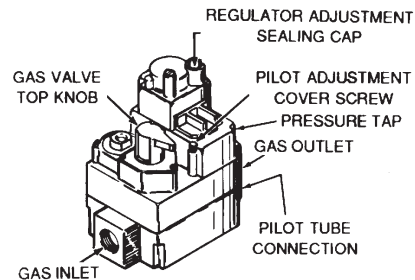


Figure 29. LP Gas Valve

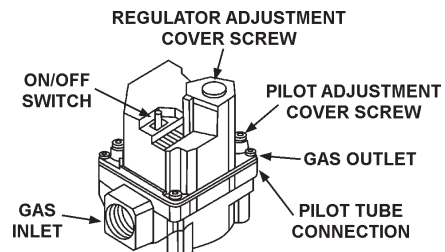


Figure 30. Natural Gas Valve

## SERVICE

The installer may be able to observe and correct certain problems which may arise when the unit is put into operation. HOWEVER, it is recommended that only a qualified service technician or qualified agencies, using appropriate test equipment, be allowed to service the heater.

As preliminary step, check wiring against diagram, check for grounded, broken or loose wires. Check all wire ends to be sure that they are making good contact.

### **ELECTRICAL SERVICING**

**LABEL ALL WIRES PRIOR TO DISCONNECTION WHEN SERVICING CONTROLS. WIRING ERRORS CAN CAUSE IMPROPER AND DANGEROUS OPERATION.**

**VERIFY PROPER OPERATION AFTER SERVICING.**

# TROUBLESHOOTING

## IGNITION MODULE

Before calling your service agent, the following checklist should be examined to eliminate obvious problems from those requiring replacement or servicing.

- Check that “main manual gas shut-off valve” is fully open and that gas service has not been interrupted.
  - Check that after following the water *Operating Instructions*, the “Top Knob” of the gas control valve is in “ON” position.
  - Check electrical supply to the water heater for possible blown (or tripped) fusing or power interruption.
- Is the water temperature in tank below the thermostat dial setting on the thermostat (calling for heat)?
  - It is possible that the high limit (E.C.O.) has functioned to shut off the water heater. See FEATURES - Water Temperature Control in the *Operating Instructions* for reset procedure. Contact your serviceman if limit continues to function to shut off water heater.

**Table 9. Troubleshooting Flash Codes**

Green LED Flash Code <sup>a</sup>	Indicates	Next System Action	Recommended Service Action
OFF	No "Call for Heat	Not applicable	None
Flash Fast	Power up - internal check	Not applicable	None
Heartbeat	Normal startup - ignition sequence started (including prepurge	Not applicable	None
4 Secons ON the "x" flashes	Device in run mode. "x" = Flame current to the nearest $\mu$ A.	Not applicable	None
2	5 minute Retry Delay - Pilot flame not detected during trial for ignition	Initiate new trial for ignition after retry delay completed.	If system fails to light on next trial for ignition, check gas supply, pilot burner, spark- and flame-sense wiring, flame-rod contaminated or out of position, burner ground connection.
3	Recycle - Flame failed during run	Initiate new trial for ignition. Flash code will remain through the ignition trial until flame is proved.	If system fails to light on next trial for ignition, check gas supply, pilot burner, flame-sense wiring, contamination of flame rod, burner ground connection.
4	Flame sensed out of sequence	If situation self-corrects within 10 seconds, control returns to normal sequence. If flame out of sequence remains longer than 10 seconds, control will resume normal operation 1 hour after error is corrected.	Check for pilot flame. Replace gas valve if pilot flame present. If no pilot flame, cycle "Call for Heat." If error repeats, replace control.
6	Control Internal Error	Control remains in wait mode. When the fault corrects, control resumes normal operation.	Cycle "Call for Heat." If error repeats, replace control.
7	Flame rod shorted to ground	Control remains in wait mode. When the fault corrects, control resumes normal operation.	Check flame-sense lead wire for damage or shorting. Check that flame rod is in proper position Check flame rod ceramic for cracks, damage or tracking.
8	Low secondary voltage supply	Control remains in wait mode. When the fault corrects, control resumes normal operation.	Check transformer and AC line for proper input voltage to the control. Check with full system load on the transformer.
<p>A Flash Code Descriptions:</p> <ul style="list-style-type: none"> <li>- Flash Fast: rapid blinking.</li> <li>- Heartbeat: constant 1/2 second bright, 1/2 second dim cycles.</li> <li>- 4 second solid on pulse followed by "x" 1 second flashes indicates flame current to the nearest <math>\mu</math>A</li> <li>- A single flash code number signifies that the LED flashes X times at 2 Hz, remains off for two seconds, and them repeats the sequence.</li> </ul>			

## FLUE DAMPER

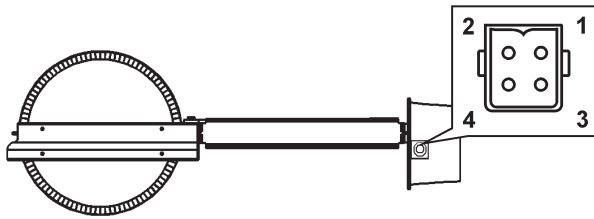
Do not turn damper open manually or motor damage will result, use the service switch. All readings are taken from harness

receptacle. Do not push meter leads into harness receptacle. This opens the pins and will create connection problems. See the following *Effikal RVGP-KSF-Series Flue Damper Trouble Shooting Guide* (page 40).

**EFFIKAL RVGP-KSF-SERIES FLUE DAMPER TROUBLE SHOOTING GUIDE**

Do not turn damper open manually or motor damage will result, use the service switch. All readings are taken from harness

receptacle. Do not push meter leads into harness receptacle. This opens the pins and will create connection problems.



**Figure 31. Damper Disc Shown in Open Position**

Table 10. Effikal Damper Pinouts & Wire Colors		
Effikal Wires	Function	Adapter Wire Colors In*
1. Brown	24 VAC HOT	Black
2. Orange	Signal In	Yellow
3. Yellow	Signal Out	Red
4. Black	24 VAC Common	White

24 V.A.C.	NORMAL SEQUENCE OF OPERATION
<p><b>A. FLUE DAMPER OPEN OR OPENING (Unit is calling for heat and damper disc should be in vertical position)</b>  <b>VOLTAGE ACROSS:</b></p> <p>4 &amp; 1 All Times that High Limit is closed</p> <p>4 &amp; 2 Calling for Heat Open or Opening</p> <p>4 &amp; 3 During Combustion Damper Open+</p>	
<p><b>B. FLUE DAMPER CLOSED (Unit is not calling for heat and damper disc should be in horizontal position)</b>  <b>NOTE: POSITION 4 IS COMMON AND POSITION 3 IS HOT 24 VAC VOLTAGE ACROSS:</b></p> <p>4 &amp; 1 All Times that High Limit is closed</p> <p><b>NO VOLTAGE ACROSS:</b></p> <p>4 &amp; 3 or 4 &amp; 2 1. Thermostat not calling for heat.</p>	

**⚠ WARNING**

Do not negate the action of any existing safety or operational controls.

ABNORMAL OPERATION	
<p><b>A. NOTHING WORKING; NO VOLTAGE ACROSS: 4 &amp; 1; 4 &amp; 2; 4 &amp; 3:</b></p>	<ol style="list-style-type: none"> <li>High Limit has tripped and is OPEN. Determine reason for tripping of high limit</li> <li>Bad Transformer</li> <li>Loose or broken connections</li> <li>Blown fuse or circuit breaker</li> <li>Disconnect switch off</li> <li>Harness not plugged into water heater receptacle</li> </ol>
<p><b>B. DAMPER HAS OPENED, NO COMBUSTION VOLTAGE ACROSS</b></p>	<ol style="list-style-type: none"> <li>Check for power at ignition module terminals. If 24VAC power is present damper is working properly.</li> <li>Defective component in water heater after the flue damper.</li> <li>If 24 VAC is not present at the ignition module, look for loose or broken connections between damper and ignition module.</li> <li>If the connections from damper to ignition module seem proper, replace damper assembly. If a damper assembly is not available, place the service switch in the hold open position. This should keep the damper in the open position and allow the customer to have automatic heat, until a replacement damper can be installed.</li> </ol>
<p><b>C. DAMPER ROTATES CONTINUOUSLY</b></p>	<ol style="list-style-type: none"> <li>Change the entire damper assembly</li> </ol>
<p><b>D. DAMPER STICKS</b></p>	<ol style="list-style-type: none"> <li>Make sure no screws obstruct the damper blade.</li> <li>Make sure damper pipe assembly is not egg shaped.</li> <li>Make sure damper rod is not rubbing on pipe assembly.</li> </ol> <p align="center">See figure on front page of this insert sheet</p>

**Important:** DAMPER MUST BE OPEN BEFORE COMBUSTION TAKES PLACE. If all steps have been tried and damper problems persists call

A.O. Smith Technical Center at 1-800-527-1953.



**Table 11. Troubleshooting Checklist**

COMPLAINT	CAUSE	REMEDY	
		USER	QUALIFIED SERVICE AGENCY
Water not hot enough.	Thermostat set too low.	Set thermostat dial to a higher temperature.	
	Upper and/or lower temperature probe out of calibration.	Call qualified service agency.	Check continuity and resistance (Ohms) of upper and lower thermostat probes. Replace probes if out of specification.
Insufficient hot water	Thermostat set too low.	Set thermostat dial to a higher temperature.	
	Upper and/or lower temperature probe out of calibration.	Call qualified service agency.	Check continuity and resistance (Ohms) of upper and lower thermostat probes. Replace probes if out of specification..
	Main manual gas shutoff valve partially closed.	Open main manual gas shutoff valve to fullest extent.	
	Heater too small for demand.	Space usage to give heater time to restore water temperature.	
	Heater recovery is slower.	Call qualified service agency.	Check gas input. If incorrect, adjust gas pressure or replace main burner orifice.
	Draft hood not installed or one or more baffles.	Call qualified service agency.	Install draft hood or baffles as furnished with unit.
Water temperature too hot.	Thermostat set too high.	Set thermostat to a lower setting.	
Heater makes sounds: sizzling.	Condensation on outside of tank - normal.		
Rumbling.	Sediment accumulation on bottom of tank.	Drain a quantity of water through drain valve. If rumbling persists, call a qualified service agency.	Delime heater.
Ticking or metallic sounds.	Expansion and contraction-normal.		
Pounding / water hammer.	Air chambers in piping have become waterlogged. Thermal expansion tank damaged, improperly charged, or improperly sized.	Drain piping system and refill. Heater must be off while this is being done. Check thermal expansion tank charge pressure when the water system pressure is zero.	Follow the manufacturer's instructions for proper charging of the thermal expansion tank.
Combustion noises.	Too much primary air.	Adjust shutters.	
	Overtired heater. Incorrect burners or orifice for types of gas used.	Call qualified service agency.	Check and correct as necessary.
Water leaks.	Drain valve not closed tightly.	If drain valve cannot be closed tightly, replace.	
	If leakage source cannot be corrected or identified, call qualified service agency.	Shut off gas supply to heater and close cold water inlet valve to heater.	Repair or in case of suspected tank leakage, be certain to confirm before replacing heater.
Gas odors.	Heater is overtired.	Shut off gas supply to heater and call qualified service agency.	Check for sooted flue passage.
			Check for obstructed vent line.
			Check backdraft or lack of draft.
			Draft hood may be improperly installed or not sized properly.
	Possible gas leaks.	Shut off gas supply to heater and call gas company at once.	

# FOR YOUR INFORMATION

## START UP CONDITIONS

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### SMOKE/ODOR

It is not uncommon to experience a small amount of smoke and odor during the initial start-up. This is due to burning off of oil from metal parts, and will disappear in a short while.

### STRANGE SOUNDS

Possible noises due to expansion and contraction of some metal parts during periods of heat-up and cool-down do not necessarily represent harmful or dangerous conditions.

Condensation causes sizzling and popping within the burner area during heating and cooling periods and should be considered normal. See *Condensation* next in this manual.

### CONDENSATION

Whenever the water heater is filled with cold water, some condensate will form while the burner is on. A water heater may appear to be leaking when in fact the water is condensation.

This usually happens when:

- A new water heater is filled with cold water for the first time.
- Burning gas produces water vapor in water heaters, particularly high efficiency models where flue temperatures are lower.
- Large amounts of hot water are used in a short time and the refill water in the tank is very cold.

Moisture from the products of combustion condense on the cooler tank surfaces and form drops of water which may fall onto the burner or other hot surfaces to produce a “sizzling” or “frying” noise.

## OPERATIONAL CONDITIONS

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### HOT WATER ODOR

In each water heater there is installed at least one anode rod for corrosion protection of the tank. Certain water conditions will cause a reaction between this rod and the water. The most common complaint associated with the anode rod is one of a “rotten egg smell” in the hot water. The smell is a result of four factors which must all be present for the odor to develop:

- A concentration of sulfate in the supply water.
- Little or no dissolved oxygen in the water.

- A sulfate reducing bacteria which has accumulated within the water heater (this harmless bacteria is nontoxic to humans).
- An excess of active hydrogen in the tank. This is caused by the corrosion protective action of the anode rod.

Smelly water may be eliminated or reduced in some water heater models by replacing the anode rod(s) with one of less active material, and then chlorinating water heater tank and all water lines.

Contact the local water heater supplier or service agency for further information concerning an Anode Rod Replacement Kit and this chlorination treatment.

If smelly water persists after anode rod replacement and chlorination treatment, we can only suggest that chlorination or aeration of the water supply be considered to eliminate the water problem.

Do not remove the anode rod leaving the tank unprotected. By doing so, all warranty on the water heater tank is voided.

### AIR IN HOT WATER FAUCETS

**HYDROGEN GAS:** Hydrogen gas can be produced in a hot water system that has not been used for a long period of time (generally two weeks or more). Hydrogen gas is extremely flammable and explosive. To prevent the possibility of injury under these conditions, we recommend the hot water faucet, located farthest away, be opened for several minutes before any electrical appliances which are connected to the hot water system are used (such as a dishwasher or washing machine). If hydrogen gas is present, there will probably be an unusual sound similar to air escaping through the pipe as the hot water faucet is opened.

There must be no smoking or open flame near the faucet at the time it is open.

### HIGH WATER TEMPERATURE SHUT OFF SYSTEM

This water heater is equipped with a manual reset type high limit (Energy Cutout) switch. The high limit switch interrupts the main burner gas flow should water temperature reach 203°F (95°C).










In the event of high limit switch operation, the water heater cannot be restarted unless the water temperature is reduced to approximately 120F (49C). The high limit reset button on the front of the thermostat then needs to be depressed. See *Figure 2* for the location of the reset button.

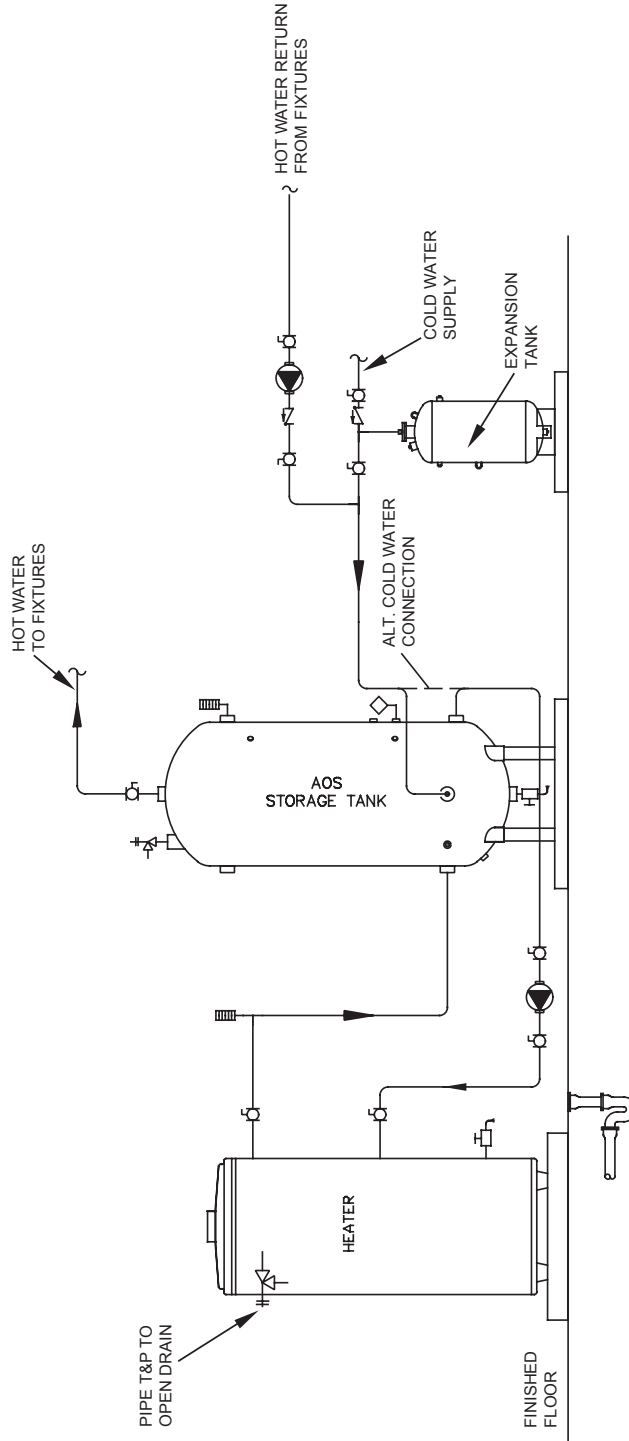
# WATER PIPING DIAGRAMS

## MULTI FLUE - (1 UNIT) WITH VERTICAL STORAGE TANK

**WARNING: THIS DRAWING SHOWS SUGGESTED PIPING CONFIGURATION AND OTHER DEVICES; CHECK WITH LOCAL CODES AND ORDINANCES FOR ADDITIONAL REQUIREMENTS.**

### LEGEND

	TEMPERATURE & PRESSURE RELIEF VALVE		FULL PORT BALL VALVE
	PRESSURE RELIEF VALVE		CHECK VALVE
	CIRCULATING PUMP		TEMPERATURE GAGE
	TANK TEMPERATURE CONTROL		WATER FLOW SWITCH
	DRAIN		












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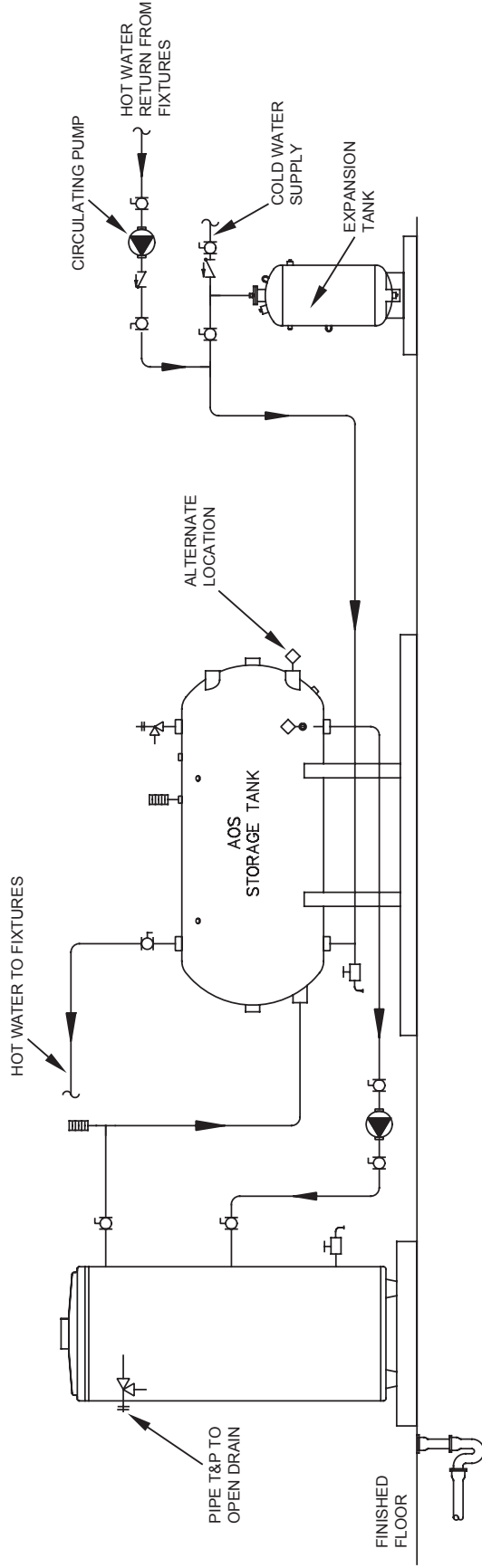
1. Preferred piping diagram.
2. The temperature and pressure relief valve setting shall not exceed pressure rating of any component in the system.
3. Service valves are shown for servicing unit. However, local codes shall govern their usage.
4. The Tank Temperature Control should be wired to and control the pump between the water heater(s) and the storage tank(s).
5. The water heater's operating thermostat should be set 5 degrees F higher than the Tank Temperature Control.

**MULTI FLUE - (1 UNIT) WITH HORIZONTAL STORAGE TANK**

**WARNING: THIS DRAWING SHOWS SUGGESTED PIPING CONFIGURATION AND OTHER DEVICES; CHECK WITH LOCAL CODES AND ORDINANCES FOR ADDITIONAL REQUIREMENTS.**

**LEGEND**










	TEMPERATURE & PRESSURE RELIEF VALVE		FULL PORT BALL VALVE
	PRESSURE RELIEF VALVE		CHECK VALVE
	CIRCULATING PUMP		TEMPERATURE GAGE
	TANK TEMPERATURE CONTROL		WATER FLOW SWITCH
	DRAIN		

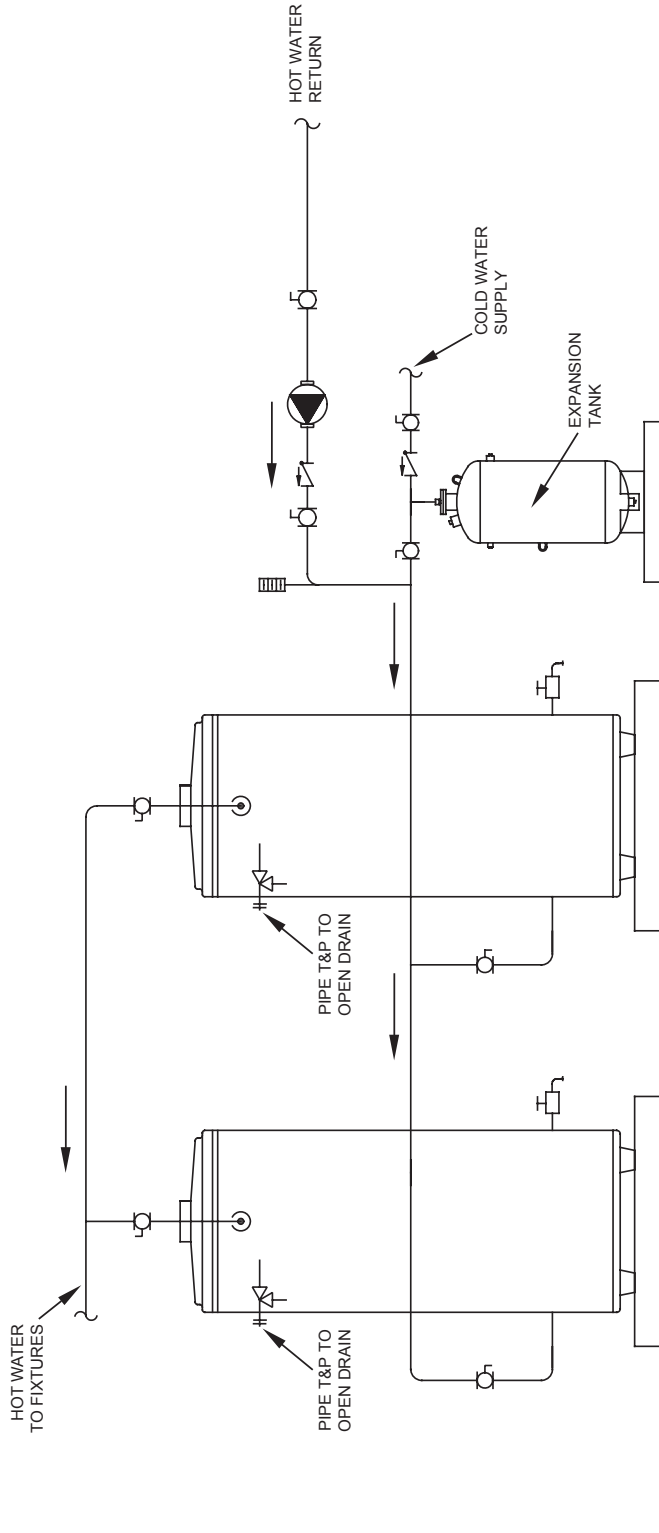


**MULTI FLUE - (2 UNITS)**

**WARNING: THIS DRAWING SHOWS SUGGESTED PIPING CONFIGURATION AND OTHER DEVICES; CHECK WITH LOCAL CODES AND ORDINANCES FOR ADDITIONAL REQUIREMENTS.**

**LEGEND**

	TEMPERATURE & PRESSURE RELIEF VALVE		FULL PORT BALL VALVE
	PRESSURE RELIEF VALVE		CHECK VALVE
	CIRCULATING PUMP		TEMPERATURE GAGE
	TANK TEMPERATURE CONTROL		WATER FLOW SWITCH
	DRAIN		












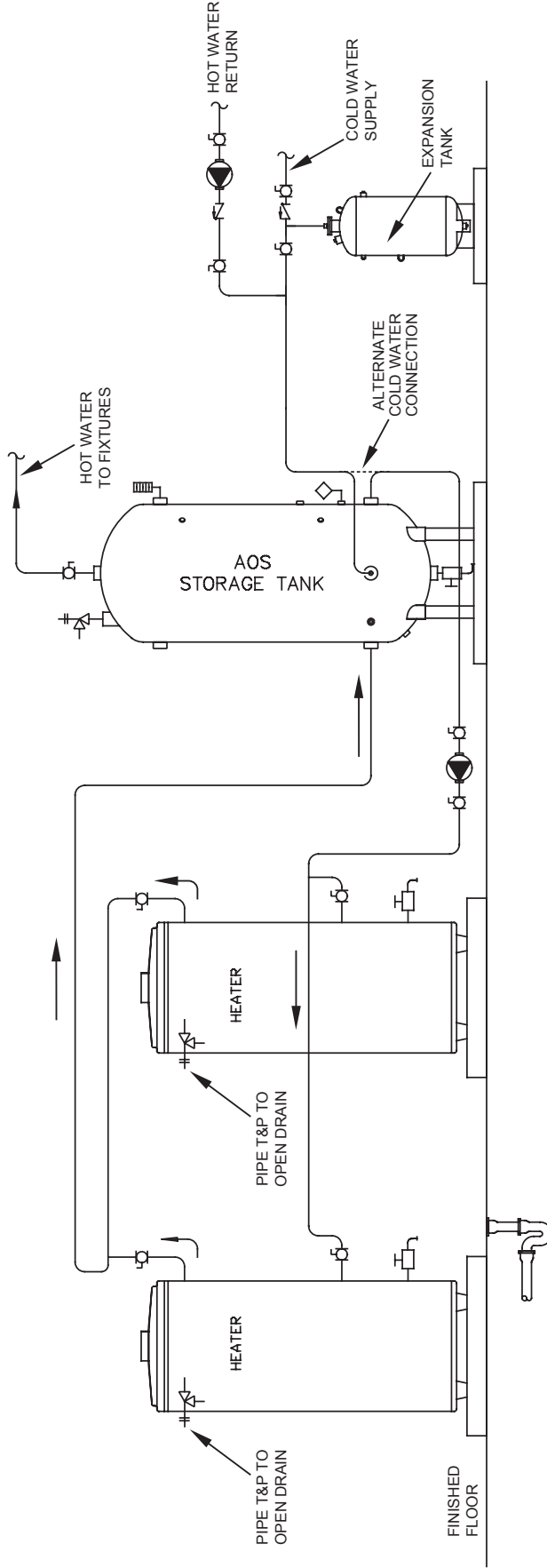
- NOTES:**
1. Preferred piping diagram.
  2. The temperature and pressure relief valve setting shall not exceed pressure rating of any component in the system.
  3. Service valves are shown for servicing unit. However, local codes shall govern their usage.

**MULTI FLUE - (2 UNITS) WITH VERTICAL STORAGE TANK**

**WARNING: THIS DRAWING SHOWS SUGGESTED PIPING CONFIGURATION AND OTHER DEVICES; CHECK WITH LOCAL CODES AND ORDINANCES FOR ADDITIONAL REQUIREMENTS.**

**LEGEND**

	TEMPERATURE & PRESSURE RELIEF VALVE		FULL PORT BALL VALVE
	PRESSURE RELIEF VALVE		CHECK VALVE
	CIRCULATING PUMP		TEMPERATURE GAGE
	TANK TEMPERATURE CONTROL		WATER FLOW SWITCH
	DRAIN		



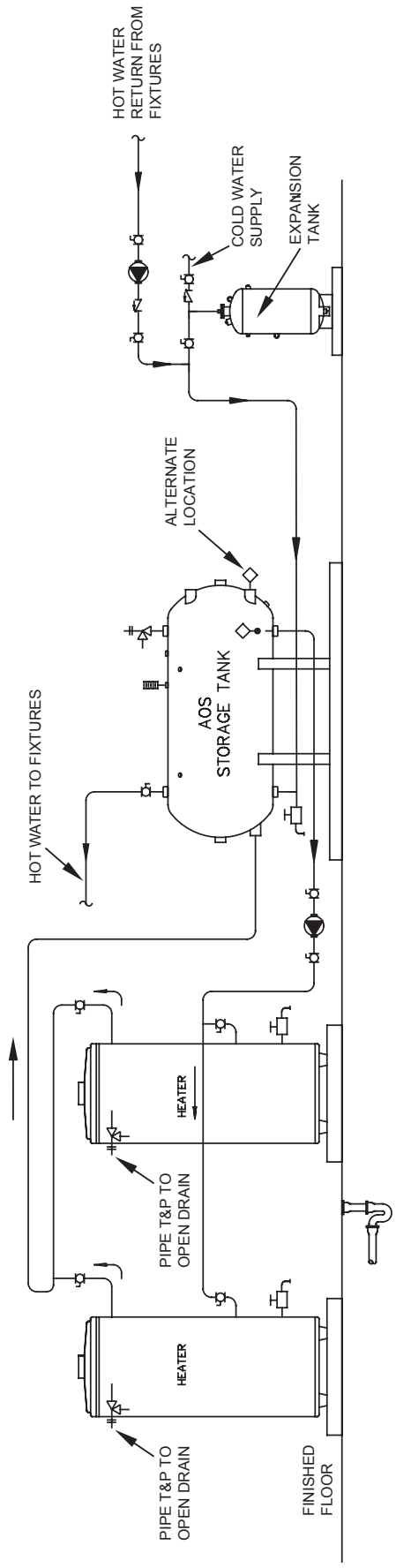
- NOTES:**
1. Preferred piping diagram.
  2. The temperature and pressure relief valve setting shall not exceed pressure rating of any component in the system.
  3. Service valves are shown for servicing unit. However, local codes shall govern their usage.
  4. The Tank Temperature Control should be wired to and control the pump between the water heater(s) and the storage tank(s).
  5. The water heater's operating thermostat should be set 5 degrees F higher than the Tank Temperature Control.

**MULTI FLUE - (2 UNITS) WITH HORIZONTAL STORAGE TANK**

**WARNING: THIS DRAWING SHOWS SUGGESTED PIPING CONFIGURATION AND OTHER DEVICES; CHECK WITH LOCAL CODES AND ORDINANCES FOR ADDITIONAL REQUIREMENTS.**

**LEGEND**

- TEMPERATURE & PRESSURE RELIEF VALVE
- PRESSURE RELIEF VALVE
- CIRCULATING PUMP
- TANK TEMPERATURE CONTROL
- DRAIN
- FULL PORT BALL VALVE
- CHECK VALVE
- TEMPERATURE GAGE
- WATER FLOW SWITCH












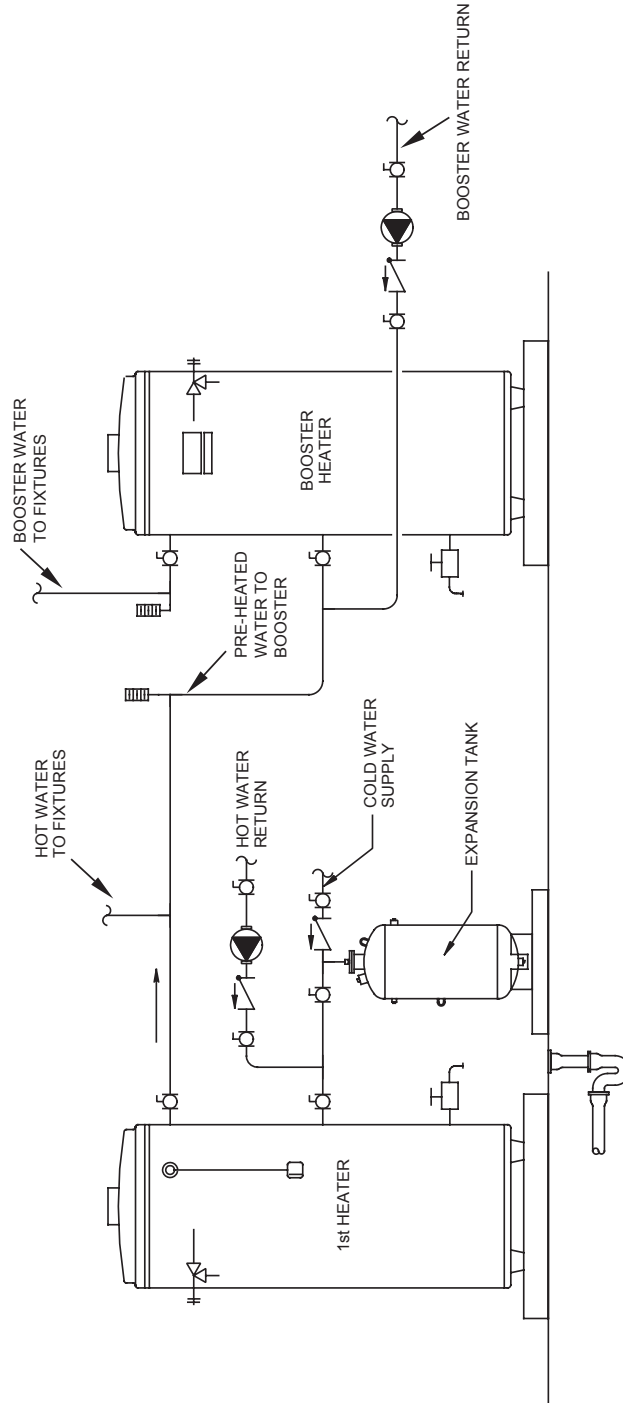
- NOTES:**
1. Preferred piping diagram.
  2. The temperature and pressure relief valve setting shall not exceed pressure rating of any component in the system.
  3. Service valves are shown for servicing unit. However, local codes shall govern their usage.
  4. The Tank Temperature Control should be wired to and control the pump between the water heater(s) and the storage tank(s).
  5. The water heater's operating thermostat should be set 5 degrees F higher than the Tank Temperature Control.

**MULTI FLUE (2 UNITS) TWO TEMPERATURE**

**WARNING: THIS DRAWING SHOWS SUGGESTED PIPING CONFIGURATION AND OTHER DEVICES; CHECK WITH LOCAL CODES AND ORDINANCES FOR ADDITIONAL REQUIREMENTS.**

**LEGEND**

	TEMPERATURE & PRESSURE RELIEF VALVE		FULL PORT BALL VALVE
	PRESSURE RELIEF VALVE		CHECK VALVE
	CIRCULATING PUMP		TEMPERATURE GAGE
	TANK TEMPERATURE CONTROL		WATER FLOW SWITCH
	DRAIN		












**NOTES:**

1. Preferred piping diagram.
2. The temperature and pressure relief valve setting shall not exceed pressure rating of any component in the system.
3. Service valves are shown for servicing unit. However, local codes shall govern their usage.

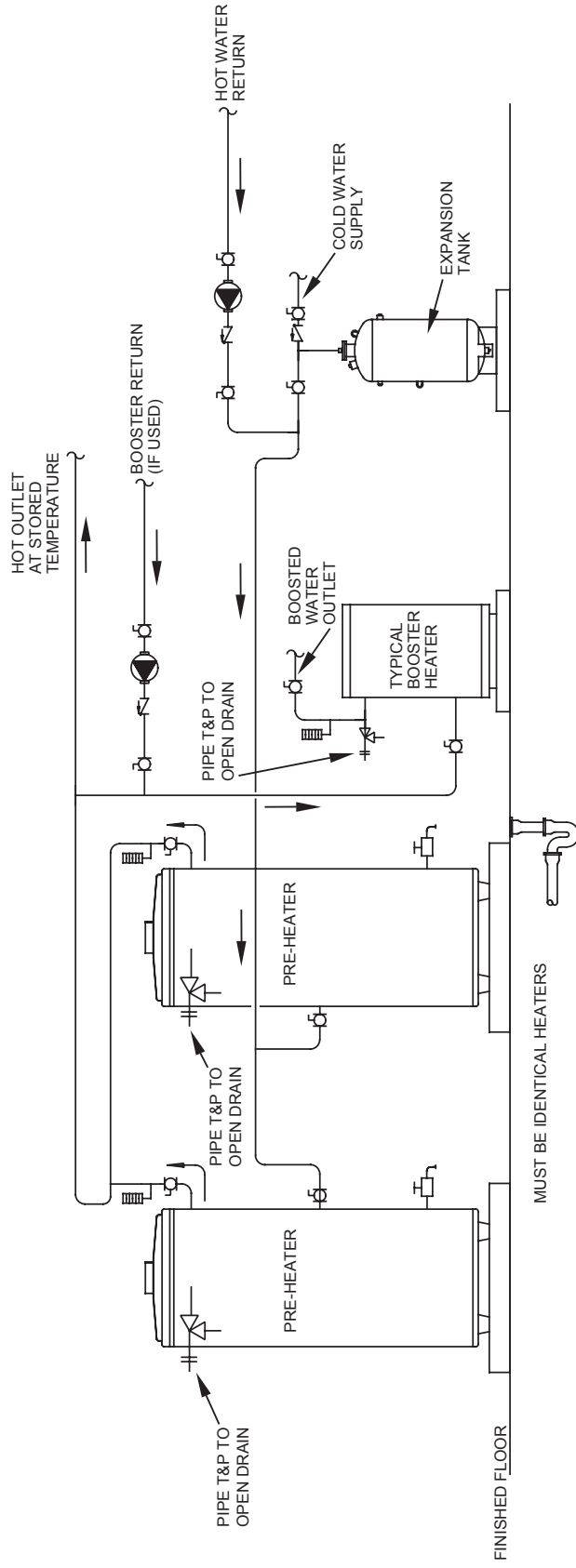


# LEGEND

	TEMPERATURE & PRESSURE RELIEF VALVE		FULL PORT BALL VALVE
	PRESSURE RELIEF VALVE		CHECK VALVE
	CIRCULATING PUMP		TEMPERATURE GAGE
	TANK TEMPERATURE CONTROL		WATER FLOW SWITCH
	DRAIN		

## MULTI FLUE (2 UNITS) WITH BOOSTER TWO TEMPERATURE

**WARNING:** THIS DRAWING SHOWS SUGGESTED PIPING CONFIGURATION AND OTHER DEVICES; CHECK WITH LOCAL CODES AND ORDINANCES FOR ADDITIONAL REQUIREMENTS.












### NOTES:

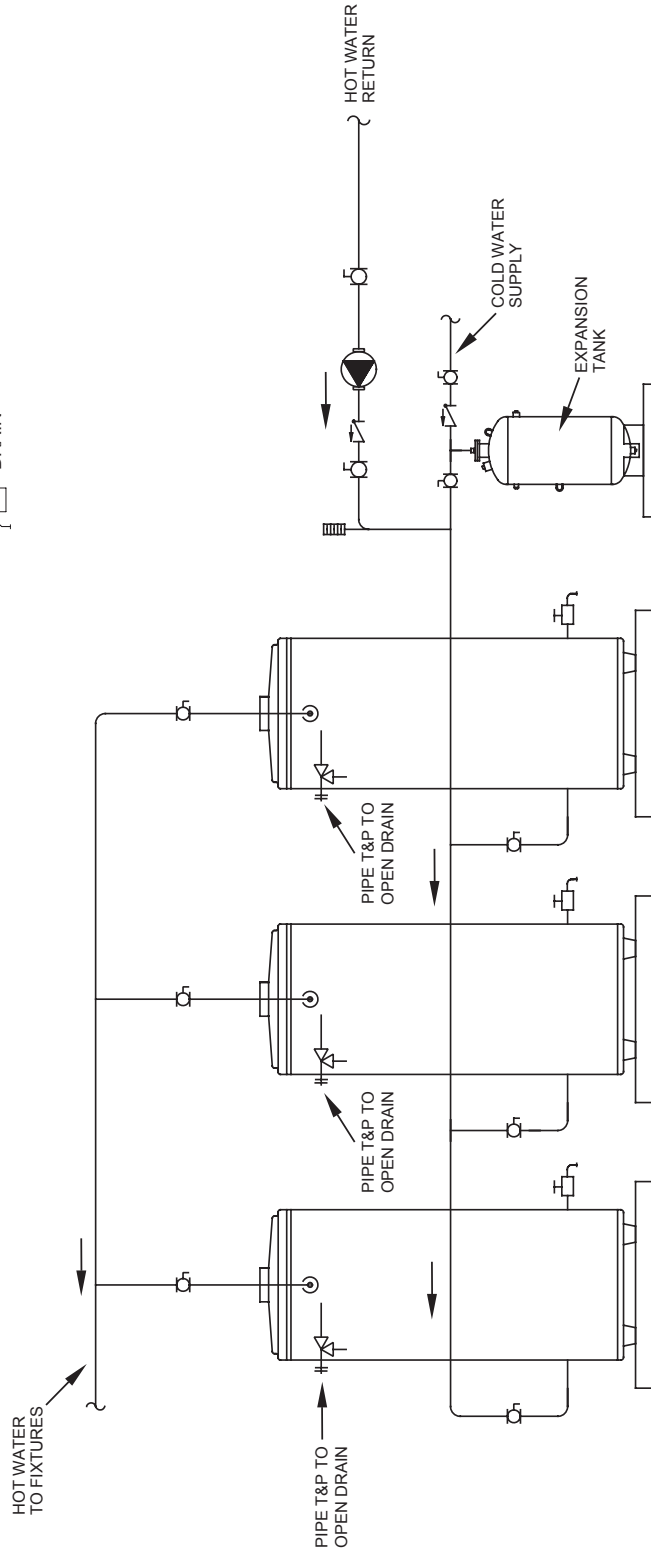
1. Preferred piping diagram.
2. The temperature and pressure relief valve setting shall not exceed pressure rating of any component in the system.
3. Service valves are shown for servicing unit. However, local codes shall govern their usage.

**MULTI-FLUE (3 UNITS)**

WARNING: THIS DRAWING SHOWS SUGGESTED PIPING CONFIGURATION AND OTHER DEVICES; CHECK WITH LOCAL CODES AND ORDINANCES FOR ADDITIONAL REQUIREMENTS.

**LEGEND**










	TEMPERATURE & PRESSURE RELIEF VALVE		FULL PORT BALL VALVE
	PRESSURE RELIEF VALVE		CHECK VALVE
	CIRCULATING PUMP		TEMPERATURE GAGE
	TANK TEMPERATURE CONTROL		WATER FLOW SWITCH
	DRAIN		



**NOTES:**

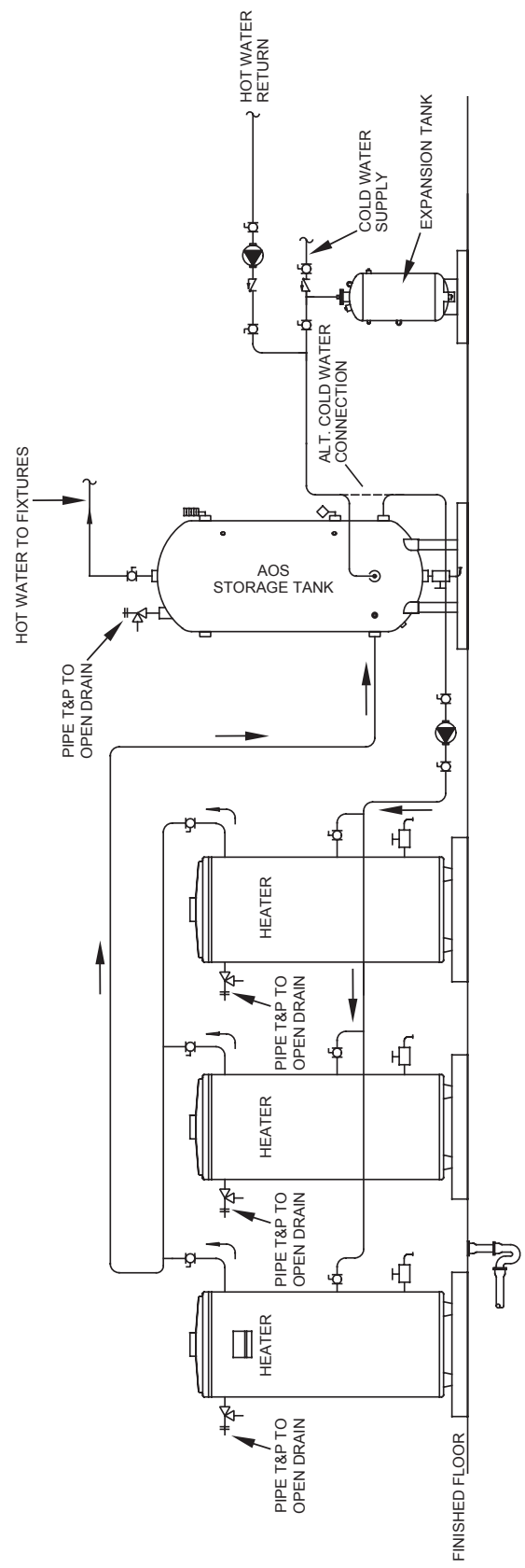
1. Preferred piping diagram.
2. The temperature and pressure relief valve setting shall not exceed pressure rating of any component in the system.
3. Service valves are shown for servicing unit. However, local codes shall govern their usage.

# LEGEND

	TEMPERATURE & PRESSURE RELIEF VALVE		FULL PORT BALL VALVE
	PRESSURE RELIEF VALVE		CHECK VALVE
	CIRCULATING PUMP		TEMPERATURE GAGE
	TANK TEMPERATURE CONTROL		WATER FLOW SWITCH
	DRAIN		

## MULTI-FLUE (3 UNITS) WITH VERTICAL STORAGE TANK

**WARNING: THIS DRAWING SHOWS SUGGESTED PIPING CONFIGURATION AND OTHER DEVICES; CHECK WITH LOCAL CODES AND ORDINANCES FOR ADDITIONAL REQUIREMENTS.**












### NOTES:

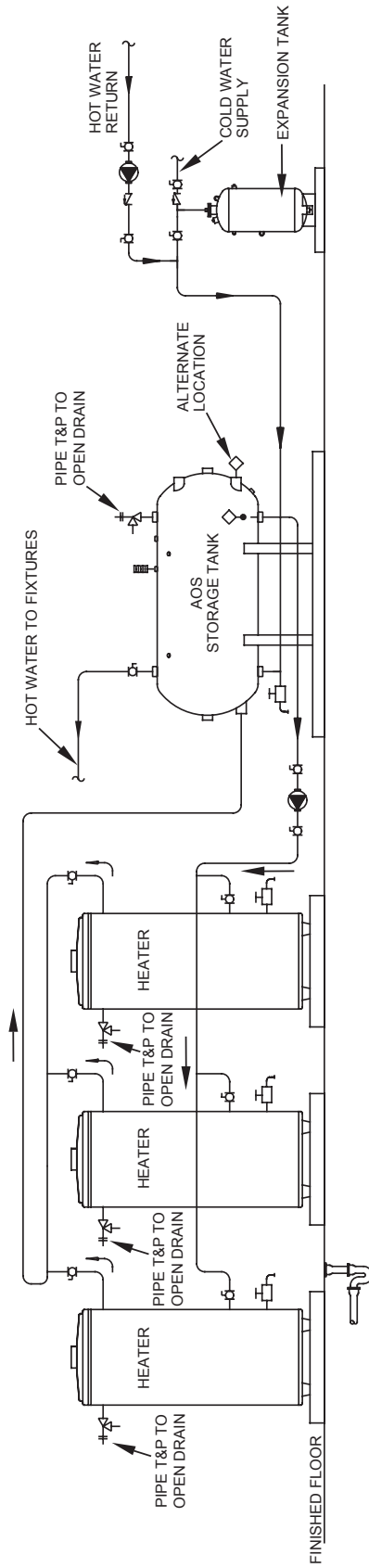
1. Preferred piping diagram.
2. The temperature and pressure relief valve setting shall not exceed pressure rating of any component in the system.
3. Service valves are shown for servicing unit. However, local codes shall govern their usage.
4. The Tank Temperature Control should be wired to and control the pump between the water heater(s) and the storage tank(s).
5. The water heater's operating thermostat should be set 5 degrees F higher than the Tank Temperature Control.

**MULTI-FLUE (3 UNITS) WITH HORIZONTAL STORAGE TANK**

**WARNING: THIS DRAWING SHOWS SUGGESTED PIPING CONFIGURATION AND OTHER DEVICES; CHECK WITH LOCAL CODES AND ORDINANCES FOR ADDITIONAL REQUIREMENTS.**

**LEGEND**

	TEMPERATURE & PRESSURE RELIEF VALVE		FULL PORT BALL VALVE
	PRESSURE RELIEF VALVE		CHECK VALVE
	CIRCULATING PUMP		TEMPERATURE GAGE
	TANK TEMPERATURE CONTROL		WATER FLOW SWITCH
	DRAIN		












**NOTES:**

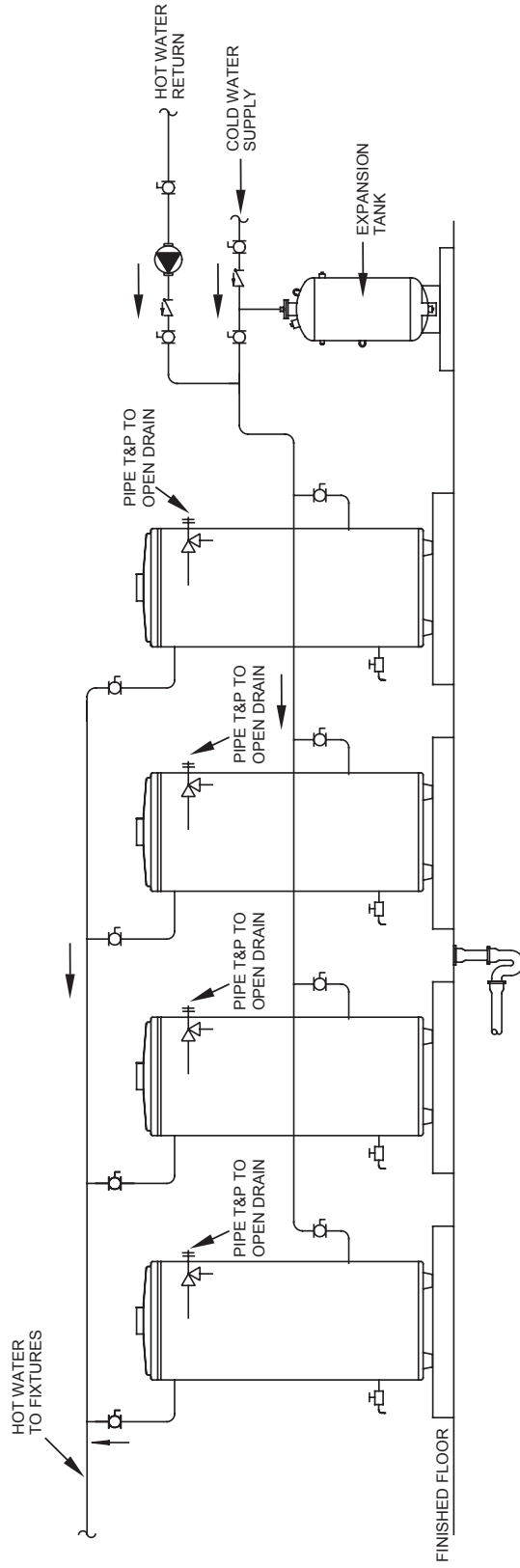
1. Preferred piping diagram.
2. The temperature and pressure relief valve setting shall not exceed pressure rating of any component in the system.
3. Service valves are shown for servicing unit. However, local codes shall govern their usage.
4. The Tank Temperature Control should be wired to and control the pump between the water heater(s) and the storage tank(s).
5. The water heater's operating thermostat should be set 5 degrees F higher than the Tank Temperature Control.

**MULTI FLUE FLUE (4 UNITS)**

**WARNING: THIS DRAWING SHOWS SUGGESTED PIPING CONFIGURATION AND OTHER DEVICES; CHECK WITH LOCAL CODES AND ORDINANCES FOR ADDITIONAL REQUIREMENTS.**

**LEGEND**

	TEMPERATURE & PRESSURE RELIEF VALVE		FULL PORT BALL VALVE
	PRESSURE RELIEF VALVE		CHECK VALVE
	CIRCULATING PUMP		TEMPERATURE GAGE
	TANK TEMPERATURE CONTROL		WATER FLOW SWITCH
	DRAIN		



**NOTES:**










1. Preferred piping diagram.
2. The temperature and pressure relief valve setting shall not exceed pressure rating of any component in the system.
3. Service valves are shown for servicing unit. However, local codes shall govern their usage.

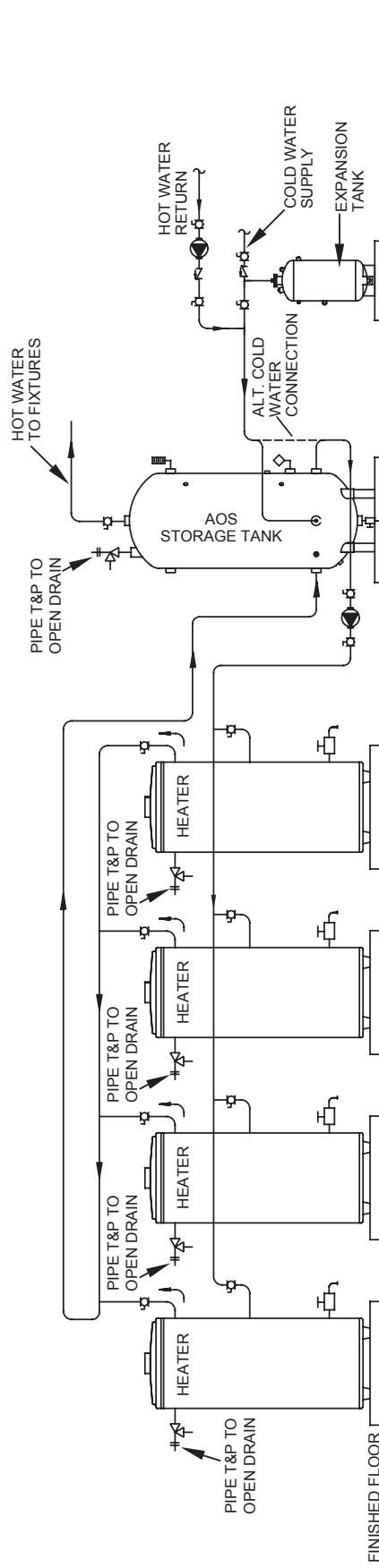


## MULTI-FLUE (4 UNITS) WITH VERTICAL STORAGE TANK

WARNING: THIS DRAWING SHOWS SUGGESTED PIPING CONFIGURATION AND OTHER DEVICES; CHECK WITH LOCAL CODES AND ORDINANCES FOR ADDITIONAL REQUIREMENTS.

## LEGEND

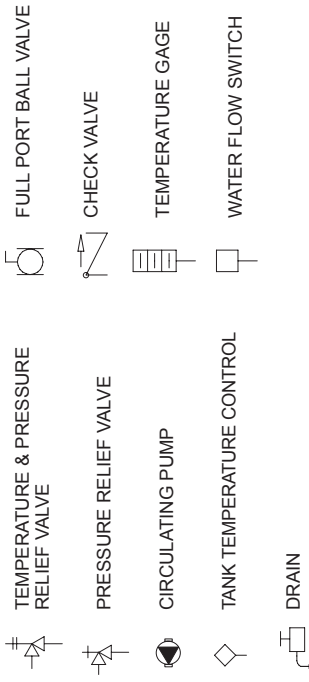
	TEMPERATURE & PRESSURE RELIEF VALVE		FULL PORT BALL VALVE
	PRESSURE RELIEF VALVE		CHECK VALVE
	CIRCULATING PUMP		TEMPERATURE GAGE
	TANK TEMPERATURE CONTROL		WATER FLOW SWITCH
	DRAIN		



### NOTES:

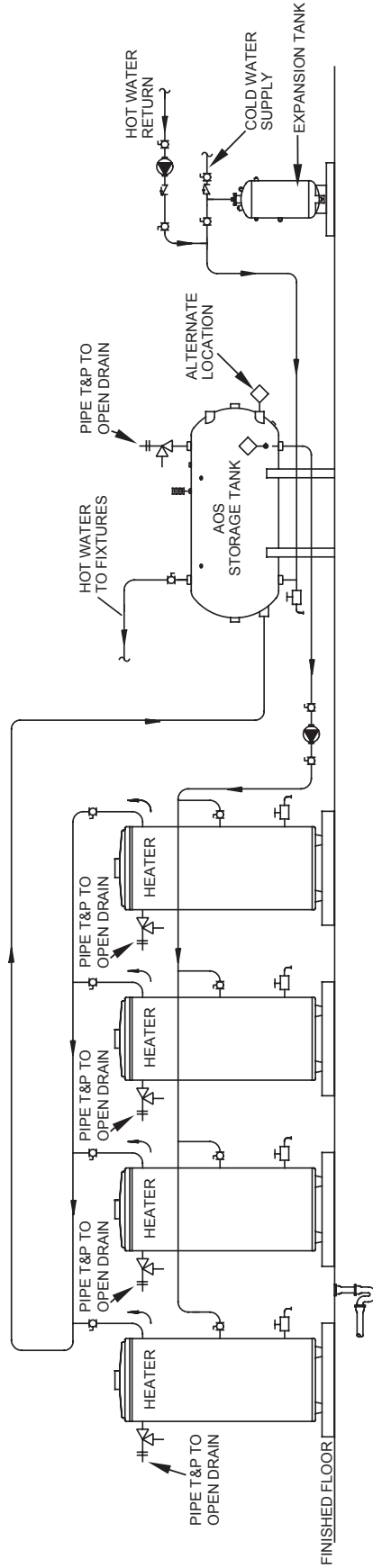
1. Preferred piping diagram.
2. The temperature and pressure relief valve setting shall not exceed pressure rating of any component in the system.
3. Service valves are shown for servicing unit. However, local codes shall govern their usage.
4. The Tank Temperature Control should be wired to and control the pump between the water heater(s) and the storage tank(s).
5. The water heater's operating thermostat should be set 5 degrees F higher than the Tank Temperature Control.

# LEGEND



## MULTI-FLUE (4 UNITS) WITH HORIZONTAL STORAGE TANK

**WARNING: THIS DRAWING SHOWS SUGGESTED PIPING CONFIGURATION AND OTHER DEVICES; CHECK WITH LOCAL CODES AND ORDINANCES FOR ADDITIONAL REQUIREMENTS.**



### NOTES:

1. Preferred piping diagram.
2. The temperature and pressure relief valve setting shall not exceed pressure rating of any component in the system.
3. Service valves are shown for servicing unit. However, local codes shall govern their usage.
4. The Tank Temperature Control should be wired to and control the pump between the water heater(s) and the storage tank(s).
5. The water heater's operating thermostat should be set 5 degrees F higher than the Tank Temperature Control.





# MANIFOLD KITS

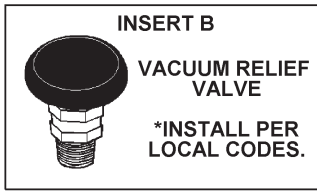


Figure 32. Vacuum Relief Valve

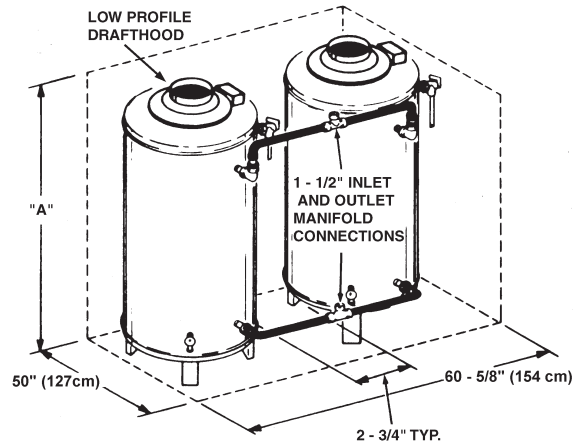


Figure 33. Two-Unit Manifold Kit (100109228)

Table 12. Rough-In Dimensions	
Models	Dimensions "A" Inches (cm)
	Low Profile Vertical Hood "A"
154	67.50" (171cm)

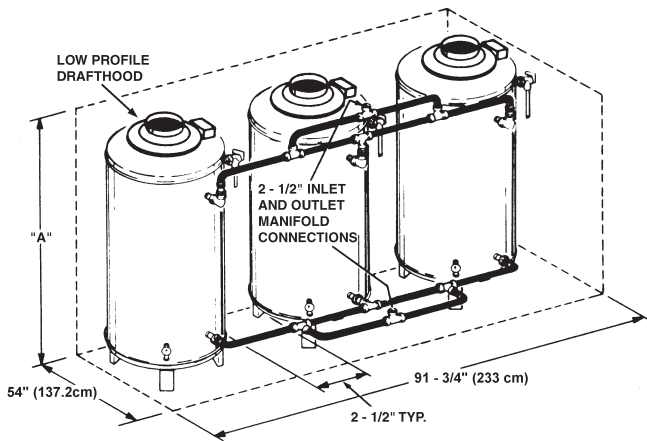


Figure 34. Three-Unit Manifold Kit (100109229)

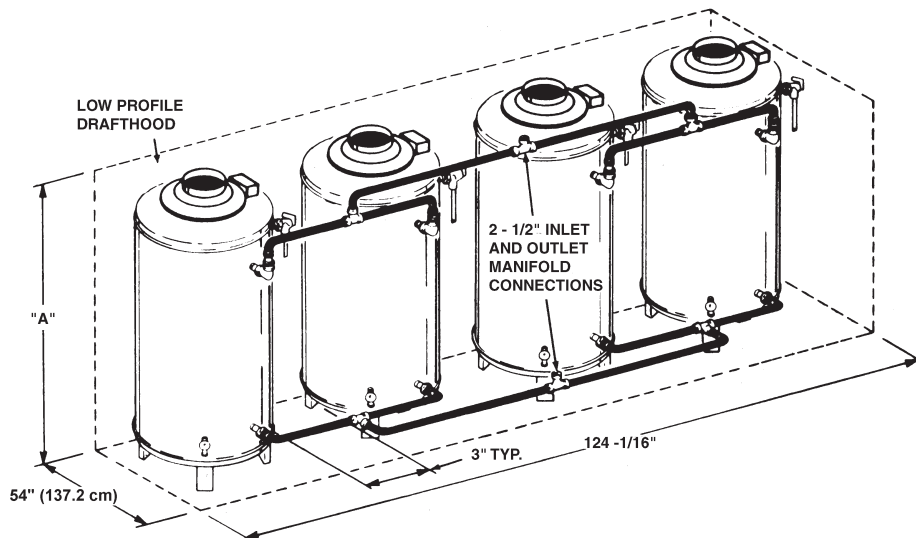


Figure 35. Four-Unit Manifold Kit (100109230)



