

**OPERATING AND MAINTENANCE MANUAL FOR
POWER BURNER SERIES FORCED DRAFT
COMMERCIAL WATER HEATER**

Hubbell™
ELECTRIC HEATER COMPANY

BASE MODEL “DF”



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-- IMPORTANT --

Always reference the full model number and serial number when calling the factory.

WARNING / CAUTION

- Do not use or store gasoline or any other flammable vapors, liquids, or materials in the vicinity of this or any other appliance.
- Due to the rigors of transportation, all connections should be checked for tightness before heater is placed in operation.
- Safety relief valve must be installed in tapping provided.
- **KEEP AWAY FROM LIVE ELECTRICAL CIRCUITS.**
Do not perform any maintenance, make any adjustments, or replace any components inside the control panel with the high voltage power supply turned on. Under certain circumstances, dangerous potentials may exist even when the power supply is off. To avoid casualties, always turn the power supply safety switch to off, turn the charge or ground the circuit before performing any maintenance or adjustment procedure.
- Installation and service must be performed by a qualified installer, service agency or the gas supplier. City, state, and national codes governing installation of commercial water heaters must be followed and take precedence over recommendations in this manual.
- The manufacturer's warranty on this water heater is in effect only when the water heater is installed and operated in accordance with these instructions and local codes and ordinances or, in the absence of local codes and ordinances, the National Fuel Gas Code (the latest ANSI Z223.1). In Canada, installation should conform to the latest CAN/CGAB149 installation codes and/or local codes. The manufacturer of this water heater will not be held liable for any damage from failure to comply with these installation and operating instructions.

FOR YOUR SAFETY

WHAT TO DO IF YOU SMELL GAS

- **DO NOT** try to light any appliance.
- **DO NOT** touch any electrical switch.
- **DO NOT** use any phone in the 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.
- **WARNING:** If these instructions are not followed exactly, a fire or explosion may result causing property damage, personal injury or death.

PRECAUTIONS

TANK LINING - DAMAGE PREVENTION

The water heater lining has been electronically inspected for continuity prior to final assembly. It was found to be free of defects. In order to protect the lining, do not apply heavy blows or weld to the exterior pressure vessel. Damage to the interior lining will void the warranty and ASME HLW stamp.

TANK MAINTENANCE - REMOVAL OF SEDIMENT AND SCALE

To keep the water heater efficient and in good working condition, inspect and clean two weeks after installation to remove any piping system debris that may have accumulated. Do not acidize this unit. Monthly inspections should be performed to determine a time span for removing any sediment within the unit. This should become the basis for a routine maintenance schedule. It is recommended that high-pressure water be used to purge any accumulation of sediment through the drain valve opening or the hand hole.

ANODE MAINTENANCE

The water heating industry knows that many water heaters are installed in areas where the water supply can be abnormally corrosive due to low pH or an excessive amount of dissolved oxygen. Because of our commitment to provide clear water in all areas, an anode has been provided to help counteract the effects of these factors. Periodic inspection and, if necessary, replacement is required to assure the anodes effectiveness.

WATER QUALITY - pH LEVEL

Materials used in the water heater to prevent corrosion have been selected for their compatibility with most domestic water supplies. However, significantly alkaline water (pH 7.5 or higher) or acidic water (pH 6.5 or lower) can result in abnormal scale formation or seriously attack these materials and cause premature corrosion. If the pH of incoming supply water does not fall between 6.5 and 7.5, it must be treated to prevent damage to internal water heater surfaces and other building plumbing components.

SAFETY TEMPERATURE AND PRESSURE RELIEF VALVE (T&P)

A listed and properly rated combination temperature and pressure relief valve shall be installed in the opening provided and marked for this purpose at the time of installation. Local codes shall govern installation of relief devices. The pressure rating of the relief valve must not exceed the working pressure shown on the rating plate affixed to the front of the water heater. The BTU/H rating of the relief valve must equal or exceed the water heater input shown on the rating plate. The relief valve discharge line must terminate 6 inches above the floor drain or externally to building. The discharge line must be able to withstand water temperature in excess of 210°F.

- **DO NOT** install a valve between tank and the relief valve.
- **DO** Install a discharge line directly to an adequate open drain. The discharge line must be shielded, secured and plumbed to an appropriate drain to prevent scald injury.
- **DO NOT** install a reducing coupling or other restriction in the discharge line.
- **DO NOT** install the discharge line where it may be subject to blocking, plugging or freezing.
- **DO NOT** allow water from discharge line to contact any live electrical part.

Failure to install a listed and properly rated temperature and pressure relief valve could result in hazard to life, bodily injury or property damage and will release the manufacturer of this water heater from any claim which might result from excessive water temperature or pressure.

CAUTION

KEEP CLEAR OF DISCHARGE LINE OUTLET. It is hot enough to cause scald injury, is under pressure and may splash.

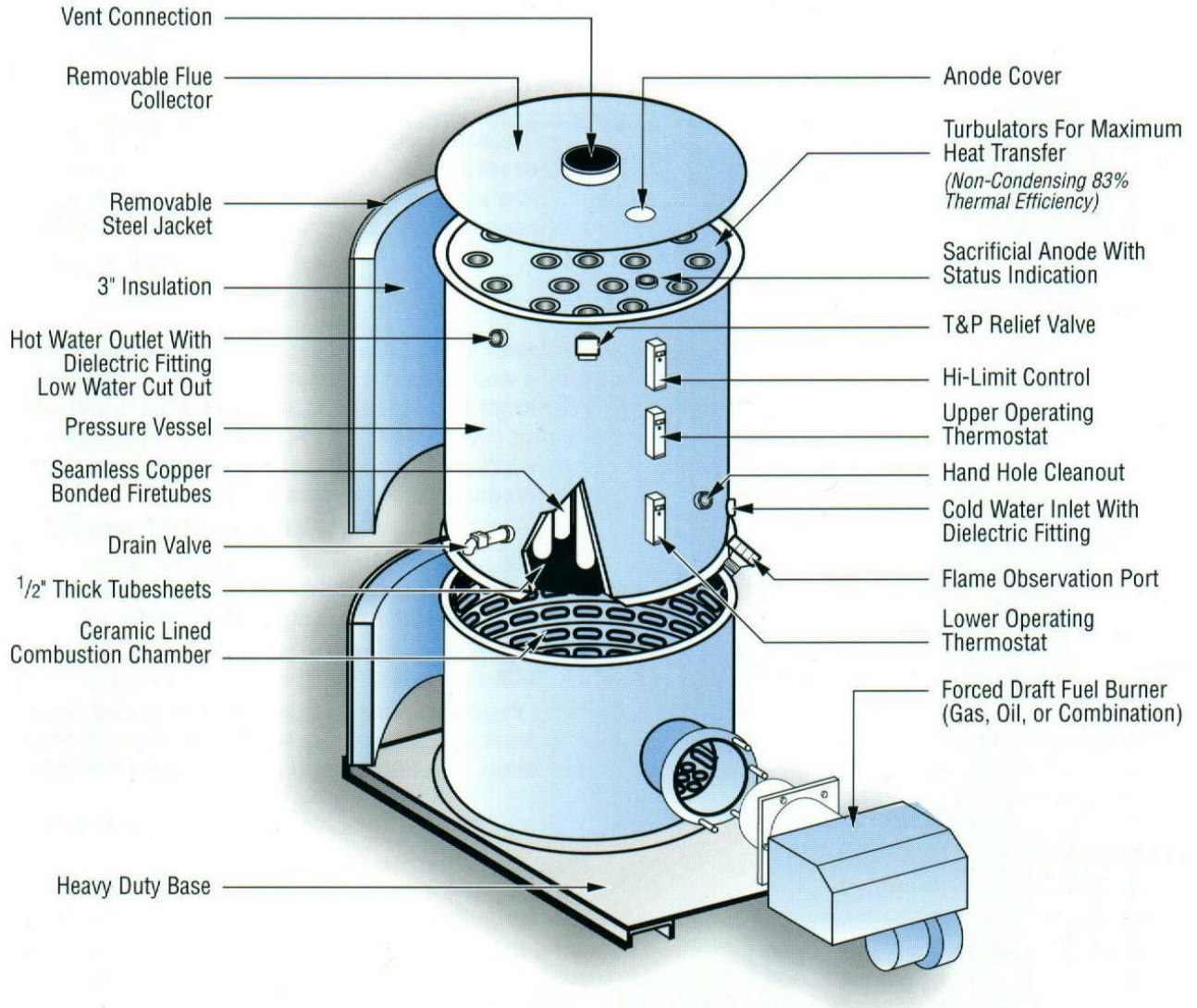
IMPORTANT

- Periodically check combustion products to assure that carbon monoxide is kept below 0.02% (200 PPM) or that the CO₂ is kept between 9 & 9 ½%.
- Drain the water heater for 5 minutes every day to help prevent accumulation of sediment and scale. Periodically check for the presence of scale and sediment. If present, physically loosen and flush using high-pressure water.
- All startup, periodic tuning and service must be performed by a trained technician familiar with the water heater and forced draft burner. It is mandatory that the startup test report, contained in the burner installation and operation manual, be completed and a copy returned to the factory. It is also important that an operating log be maintained to provide a history of water heater performance.

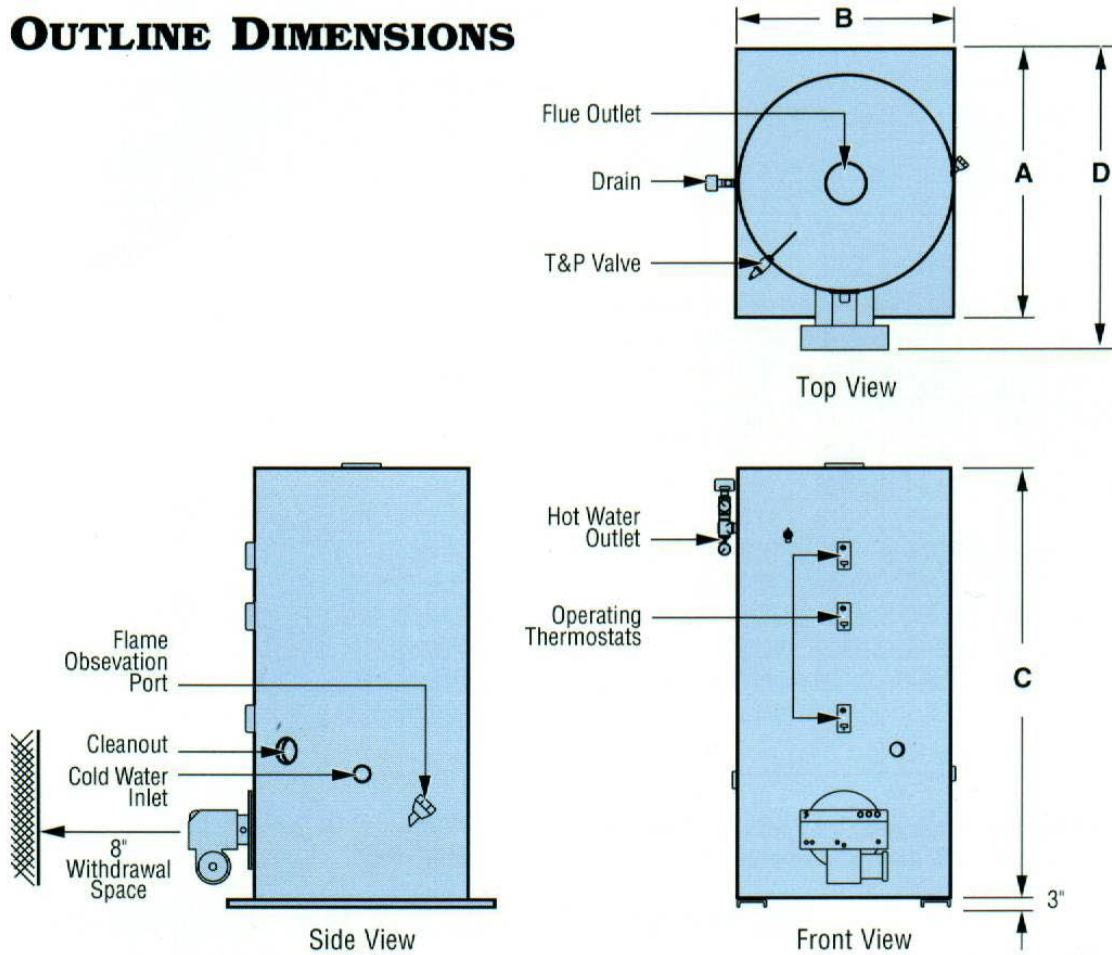
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MODEL DF GENERAL CONFIGURATION



OUTLINE DIMENSIONS



MODEL DF DIMENSIONAL DATA

Base Model	Actual Storage Capacity (Gallons)	Dimensions (Inches)				Inlet / Outlet Size (Inches)	Shipping Weight (lbs.)
		Base		Overall Height "C"	Overall Depth "D"		
		Length "A"	Width "B"				
DF125	125	45	34	86	60	1 1/2	1770
DF150	150	57	44	79	67	1 1/2	2025
DF200	200	57	44	91	67	1 1/2	2185
DF275	275	57	44	103	67	1 1/2	2550
DF325	325	73	55	88	78	2	3540
DF400	400	73	55	100	78	2	3695
DF500	500	85	67	88	92	3	5200
DF600	600	85	67	100	92	3	5480
DF650	650	97	76	88	106-121*	3	6725
DF800	800	97	76	100	106-121*	3	6980
DF1000	1000	117	92	88	121-139*	3	7350
DF1250	1250	117	92	100	121-139*	3	7775

Notes:

1. A 48" clearance is recommended in front of the unit for inspection, maintenance and safety.
 2. Suggested mounting pad to be 4" greater than the base length and width.
 3. Actual storage capacity (not nominal capacity) is shown.
- * Dimension varies depending on the burner size selected.

GAS BURNER

Burner Model	Available Heater Tank Sizes (Gallons)	GPH Recovery Rating at °F ΔT					Gas Train Size (Inches)	Flue Size (Inches)	Fuel Input MBH	Motor		
		60°	80°	100°	120°	140°				HP	Amps	Voltage
198	125-275	331	248	198	165	142	1	6	199	1/4	8.6	120-1-60
274	125-275	457	342	274	229	196	1	6	275	1/4	8.6	120-1-60
399	125-400	663	498	399	332	284	1	6	399	1/4	8.6	120-1-60
539	150-400	898	672	539	449	385	1	6	540	1/4	8.6	120-1-60
564	125	939	710	564	470	403	1	6	565	1/4	8.6	120-1-60
698	150-600	1164	871	698	582	499	1	6	700	1/4	8.6	120-1-60
1072	150-800	1787	1338	1072	893	766	1	6	1075	1/3	9.9	120-1-60
1257	150-800	2094	1569	1257	1047	898	1 1/4	6	1260	1/3	9.9	120-1-60
1596	150-275	2660	1992	1596	1330	1140	1 1/2	6	1600	1/3	9.9	120-1-60
2194	325-1250	3657	2750	2194	1828	1567	1 1/2	8	2200	1/3	9.9	120-1-60
2493	325-1250	4156	3113	2493	2078	1781	2	8	2500	3/4	7.1	230-1-60
3072	500-1250	5120	3836	3072	2560	2194	2	8	3080	1 1/2	11.2	230-1-60
3640	650-1250	6067	4546	3640	3034	2600	2	12	3650	1 1/2	6.8	230-3-60
4706	650-1250	7843	5876	4706	3921	3361	2 1/2	12	4718	1 1/2	6.8	230-3-60
5236	1000-1250	8727	6538	5236	4363	3740	2 1/2	14	5250	3	6.8	230-3-60
6283	1000-1250	10472	7846	6283	5236	4488	2 1/2	14	6300	5	10.2	230-3-60

Notes:

1. Standard burners are based on a maximum gas pressure of 14" W.C.
2. Recovery ratings are based on 83% thermal efficiency

GAS/OIL BURNER

Burner Model	Available Heater Tank Sizes (Gallons)	GPH Recovery Rating at °F ΔT					Gas Train Size (Inches)	Flue Size (Inches)	Fuel Input		Motor		
		60°	80°	100°	120°	140°			Gas MBH	Oil GPH	HP	Amps	Voltage
274	125-275	457	342	274	229	196	1	6	275	2.0	1/3	10.2	120-1-60
399	125-400	665	498	399	332	285	1	6	400	2.9	1/3	10.2	120-1-60
539	150-400	898	672	539	449	385	1	6	540	3.8	1/3	10.2	120-1-60
698	150-600	1164	871	698	582	499	1	6	700	5.0	1/3	10.2	120-1-60
1072	150-800	1787	1338	1072	893	766	1	6	1075	7.7	1/3	10.2	120-1-60
1257	150-800	2094	1569	1257	1047	898	1 1/4	6	1260	9.0	1/3	10.2	120-1-60
1596	150-275	2660	1992	1596	1330	1140	1 1/2	6	1600	11.4	3/4	7.7	230-1-60
2194	325-1250	3657	2750	2194	1828	1567	1 1/2	8	2200	15.7	3/4	7.7	230-1-60
2493	325-1250	4156	3113	2493	2078	1781	2	8	2500	17.5	1 1/2	6.8	230-1-60
3072	500-1250	5120	3836	3072	2560	2194	2	8	3080	23.5	1 1/2	6.8	230-1-60
3640	650-1250	6067	4546	3640	3034	2600	2	12	3650	26.0	2	8.4	230-3-60
4706	650-1250	7843	5876	4706	3921	3361	2 1/2	12	4718	33.7	2	8.4	230-3-60
5236	1000-1250	8727	6538	5236	4363	3740	2 1/2	14	5250	37.5	3	10.6	230-3-60
6283	1000-1250	10472	7846	6283	5236	4488	2 1/2	14	6300	45.0	5	14.8	230-3-60

Note:

1. Recovery ratings are based on 83% thermal efficiency

SECTION I - GENERAL DESCRIPTION

GENERAL DESCRIPTION

This is a commercial storage water heater designed and constructed in accordance with UL and ASME requirements. Its thermal efficiency and standby loss exceed the levels established by ASHRAE 90.1 and incorporated by federal EPACT legislation. Given a reasonable amount of maintenance, this water heating product will perform reliably for many years. Its basic design is well proven over time, and operating components have been selected for their reliability and widespread use in the water heating industry. This philosophy also promotes availability of both parts and trained service personnel. It is essential that all aspects of installation, maintenance, routine servicing, troubleshooting and repair be planned with safety as the primary consideration. If the installer or service technician has any questions about this water heater's operation, the factory should be contacted immediately. It is also very important to properly maintain this water heater to obtain long life and maintain its high efficiency.

SECTION II – INSTALLATION

WARNING / CAUTION

For protection against excessive pressures and temperatures, local codes require the installation of a temperature-and-pressure (T&P) relief valve certified by a nationally recognized laboratory that maintains periodic inspection of production of listed equipment of materials, as meeting the requirements for Relief Valves and Automatic Gas Shutoff for Hot Water Supply Systems. ANSI Z21.22-1971.

The National Fuel Gas Code, (ANSI Z223.1 and Can 1 -B1 49.1 or B1 49.2), expressly prohibits the following:

1. Installation of water heater in a bathroom, bedroom, or any occupied room normally kept closed.
2. Installation of a water heater in a garage unless the unit is installed so that the burner and ignition devices are at least eighteen (18) inches above floor level and protected to avoid damage by a moving vehicle.

If unit is painted or insulated on the job site, care should be taken not to paint or insulate over the A.S.M.E. nameplate. This plate should be accessible and legible at all times to inspectors, and information from this plate must be used when ordering parts from the factory.

HANDLING

Some models have been constructed with lifting lugs to permit lifting with a crane. Fork lift movement (rear access only) is also acceptable.

To lift with a crane, remove flue outlet adapter and connect a lifting cable to the two lifting lugs attached to the top tubesheet. Be sure lifting cable and crane can support the shipping weight as shown on Bill of Lading.

The skids are compatible with the forks of most fork lift equipment. When moving a heater into place, pick water heater up from rear (do not pick up from front or sides) with forks inside the skids. Picking up heater on outside of skids may allow forks to puncture bottom of combustion chamber.

INSPECTION

Inspect the water heater and burner for possible damage that may have occurred in shipping or during storage. Check rating plate on the water heater and burner for compliance with specifications. Be sure the electrical supply, gas and/or oil supply lines are adequate for the installation.

LOCATION

NOTE: Do not run uninsulated water pipes in front of or directly above a fresh air opening. If an exhaust fan is installed in the mechanical room, the combustion air inlet must allow for the fan's exhaust air volume. An undersized opening may cause down drafts resulting in poor combustion, sooting and carbon monoxide.

1. Position the water heater in a clean and dry location as close as possible to the greatest use of hot water (and the oil storage tank if used). Minimum clearances for servicing are listed on a label near the burner. Greater clearances may be required by local code.
2. An adequate uncontaminated air supply for combustion is needed. If air is directly obtained from outdoors, a free area of 1 square foot per 1,000 CF/Hr¹ of input is required. If air is obtained from an adjacent indoor area, 1 square inch per 1,000 BTU/Hr of input is required. If oil-fired, 1 gallon per hour equals 140,000 BTU/Hr. Combustion air inlets should be located on an outside wall, away from prevailing winds, and be sized to accommodate all fuel burning equipment located in the mechanical room. Combustion air calculations should assume simultaneous operation of all fuel burning equipment in the equipment room.
3. The water heater should not be installed in an area where combustible liquids or vapors may be present that could be ignited by the burner. The installation area should not contain air contaminated with chlorinated hydrocarbons, perchlorethylene or any strong oxidizing agent. Combustion air containing these agents will seriously damage the burner and vessel parts thus voiding all warranties. If required, combustion air should be ducted *from outside* the building to avoid such contaminants. Burners require special construction for outside combustion air applications. Consult factory for details.
4. The water heater should be located on a pitched floor near a suitable drain, or other provisions must be made to prevent damage to areas of the building subject to water damage should the heater or plumbing leak. A drain is required for relief valve discharge as well as routine cleaning and flushing of the tank. The heater must be installed in a level position. Shim under skids if necessary.

WATER CONECTIONS

NOTE: The most effective means for preventing deterioration from accelerated corrosion due to galvanic and stray current is the installation of dielectric fittings/unions. The installation of these fittings is the responsibility of the installing contractor.

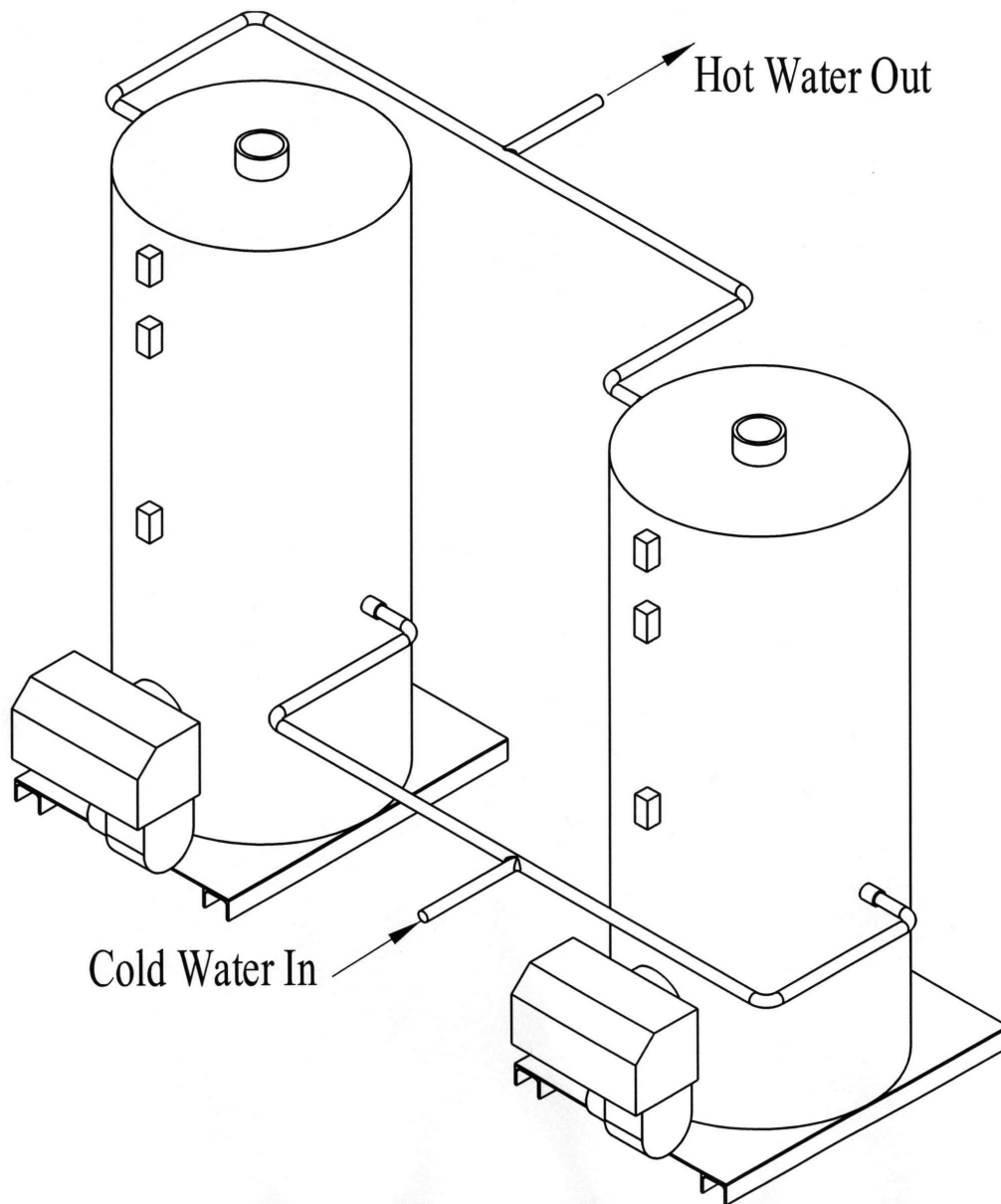
Water connections are made to the cold water inlet and hot water outlet as shown on the supplied water heater drawing. Dielectric fittings are provided to minimize the formation of galvanic corrosion (some jurisdictions require the use of dielectric fittings). Shut-off valves and unions should

¹ 1,000 CF/Hr of Gas = 1,000,000 BTU/Hr = 7.14 GPH of #2 fuel oil

be installed so the heater may be disconnected for servicing if necessary. Hot water and return circulation lines should be insulated. The cold water supply line should be insulated if subjected to freezing temperatures. When a check valve is installed in the cold water line to the water heater, a diaphragm type expansion tank suitable for potable water shall be installed in the system.

PIPING MULTIPLE WATER HEATERS

A parallel connection, see the following diagram, allows heated water from multiple heaters to flow into the system to serve peak loads that can occur in a short time period. Pressure drop is reduced and total storage capacity is available for immediate use.



ELECTRICAL CONNECTIONS

Electrical connections to the water heater should conform to the National Electrical Code or the code legally authorized in your locality. A fused disconnect switch should be used in the burner control circuit. The contractor shall run the properly sized electrical service to the terminals indicated on burner wiring diagram. Refer to burner manufacturer's manual for specific electrical requirements.

VENTING

This non-condensing water heater is designed to exhaust into its own independent vent or into an existing vent system that serves other appliances. In all cases, a negative pressure must be maintained within the venting system to prevent the leakage of combustion products.

Several basic venting rules must always be followed.

1. The vent must be independently supported so its weight does not bear on the water heater's flue collector.
2. The vent must never be sized smaller than the flue collector outlet. It can be up to two sizes larger but, in all cases, must be sized in accordance with National Fuel Gas Code Requirements given the particular installations vent configuration and water heater input rate.
3. When a relatively high negative draft occurs in a vent, a draft regulator sized to the vent diameter should be installed and adjusted to begin opening at a negative draft of -0.1 in. W.C. A draft regulator should be installed no further than two feet away from the water heater flue outlet.
4. A vent must never be welded to the flue collector outlet.
5. All vents must be constructed in accordance with the National Fuel Gas Code and terminated on the outside of the building using a UL listed vent cap. Horizontal venting through an outside wall is acceptable, but an induction blower may be needed to maintain a negative draft in the vent.

If the water heater is vented into an existing overhead vent (or breaching), it is recommended the vent be designed for positive pressure in case there is positive pressure in the overhead vent.

GAS CONNECTION PIPING FOR GAS AND COMBINATION GAS/OIL BURNERS

WARNING / CAUTION

LP UNITS; liquefied petroleum (L.P.) gas is heavier than air and will remain at floor level if there is a leak. Basements, crawl spaces, closets and areas below ground level will serve as pockets for accumulation of leaking L.P. gas. Before operating the water heater, sniff at floor level. **IF YOU SMELL GAS**, follow applicable instructions on cover page. **DO NOT OPERATE APPLIANCE UNTIL LEAKAGE IS CORRECTED AND AREA IS PURGED OF ANY GAS ACCUMULATION.**

Be sure gas supply lines have been cleaned of all debris which could enter the regulators or the burner system and cause malfunctions or unsafe conditions. Pipe connection compounds must be used AT ALL TIMES. DO NOT use Teflon tape as a thread sealant.

1. The gas supply line must be sized, considering pressure drop, to furnish gas at a pressure necessary for the burner to develop rated capacity and the CFH to handle all fuel burning equipment attached to the line. A drip leg should be installed ahead of the burner piping connection. See burner manufacturer's manual for piping detail.
2. Piping or tubing from regulator vents shall be routed outside the building and must be the same diameter as the regulator venting ports. Provide no traps in the vent lines and terminate away from all doors, windows and air intakes serving HVAC equipment. Vent termination shall face downward with a screen mesh cover to prevent insects and debris from entering. If regulator vents are combined, use tubing or pipe equal to the total cross sectional area of the individual vents. **Normally open vent valves must be separately vented.**

NOTE: High and low gas pressure switches must be vented separately from those of the main and pilot regulators. Termination of vents shall be the same as for regulators.

3. **Before gas is turned on**, be sure the gas line has been checked for leaks. Check to see that there are no open fittings and that the burner main manual valve and pilot manual valve are closed.

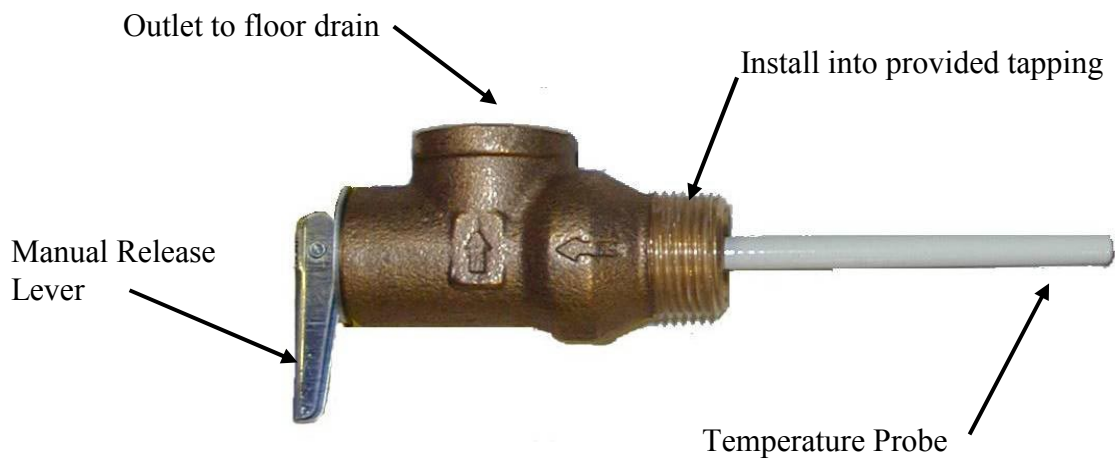
OIL TANK AND PIPING

1. Tank construction and installation must meet all local codes and should meet the specifications recommended by Underwriters Laboratories.
2. **REFER TO YOUR BURNER STARTUP MANUAL FOR OIL PUMPING AND PIPING DETAILS.**

3. A Rule of Thumb to determine total suction for suction line sizing is to add 10% to suction determined from the burner manufacturer's instruction manual.
4. It is good practice to size the oil pump return-line (to the tank) the same size as the selected suction line.

PRESSURE AND TEMPERATURE SAFETY RELIEF VALVE

1. Install the combination temperature and pressure safety relief valve in the tapping provided. Note that this is required by law for safety considerations.



2. Install a relief valve overflow pipe to a nearby floor drain. CAUTION: No valve of any type should be installed between the relief valve and tank or in the drain line.

SECTION III – START UP AND OPERATION

WARNING / CAUTION

Temperatures above 130°F (54° C) can cause scalding. Scalding temperatures are especially hazardous to young children, aged or handicapped persons. A serious or disabling injury can occur. Note that a mixing valve installed at the hot water outlet can reduce the risk of scalding at such points of use as lavatories, sinks and bathing facilities

Excessively hot water may suggest that the upper operating thermostat has failed. If you determine an operating control thermostat has failed, it should be replaced IMMEDIATELY by a qualified service technician.

If the burner turns on and off every 3 to 4 minutes on a regular basis, the lower control thermostat setting may have to be decreased. Such a "short cycling" condition accelerates wear of burner components which can lead to early failure.

IMPORTANT

THE MANUFACTURER'S START UP REPORT MUST BE COMPLETED AND RETURNED. FAILURE TO DO SO WILL VOID THE WARRANTY.

ALWAYS CONTACT A TRAINED SERVICE TECHNICIAN TO PERFORM START UP. SHOULD FACTORY ASSISTANCE BE REQUIRED, PLEASE HAVE THE WATER HEATER SERIAL NUMBER AVAILABLE.

Combination gas/oil burners require a supply of oil for oil pump lubrication even when operating on gas.

Some oil burners require a supply of either natural or L.P gas to operate the pilot. Check burner construction for the presence of gas pilot tubing and a pilot gas pressure regulator.

START UP

1. Fill water heater and drain to remove any residue that may have accumulated during the installation process. Remove hand hole cover and remove any material not flushed through drain. Reinstall hand hole cover, fill with water and open a nearby hot water faucet to bleed out any entrapped air. Be sure all tank connections are tight. Leaking water causes corrosion and insulation damage.

2. The burner manufacturer's installation and operation manual, included with this manual, contains a detailed start up procedure that should be studied and followed precisely.

NOTE: Rated gas input for this water heater can be established by adjusting manifold gas pressure to the value listed on the burner data plate. Rated oil input can be established by adjusting oil pressure to the burner at 300 psi (pressure may have to be slightly reduced to obtain clean, smoke-free combustion).

TEMPERATURE ADJUSTMENT

The upper operating control thermostat shuts off the burner when its temperature setting is reached. The lower operating control thermostat can be adjusted to vary the temperature that activates the burner. The unit is also equipped with a high limit safety control preset at 180°F. For energy efficient operation of your water heater, the recommended upper temperature setting is approximately 130°F. Facilities with small children or invalids may require a 120°F or lower temperature setting to reduce the risk of scald injury. Some states require a lower temperature setting. Check with your gas supplier for local requirements governing the temperature setting.

Remember that no water heating system will provide an exact temperature at all times. Allow a few days of operation to determine the correct temperature setting consistent with your needs.

A lower temperature setting can cause condensation, but that does not mean your tank is leaking. Many reported tank leaks on installation are proven to be condensation. To avoid unnecessary inconvenience and expense, make sure the tank is leaking before calling a service person.

SECTION IV - SCHEDULED MAINTENANCE AND SERVICING

WARNING / CAUTION

Before performing any maintenance procedure, turn off the water heater main disconnect switch before performing any cleaning or service. Also close both the pilot and main manual shutoff valves.

Keep the equipment room clean. Clean the burner at regular intervals. The blower inlet can collect dust and debris from the air during operation. Clean blower wheel and flame scanner when necessary. The burner should be cleaned each year according to the burner manufacturer's recommended procedures. **A DIRTY BLOWER WHEEL WILL REDUCE EFFICIENCY AND MAY CAUSE POOR COMBUSTION, SOOTING OR THE PRODUCTION OF CARBON MONOXIDE.**

IMPORTANT

A preventive maintenance program should be established to help assure a long, trouble-free water heater life. **AN ANNUAL INSPECTION SHOULD BE PERFORMED AND DOCUMENTED. A COPY OF THE INSPECTION REPORT MUST BE FORWARDED TO THE MANUFACTURER. FAILURE TO DO SO WILL VOID THE WARRANTY.**

RECOMMENDED PERIODIC INSPECTION

DAILY

1. Inspect area around water heater for moisture. If present, determine if cause is condensation or leakage.
 - a. If cause is condensation - May be due to very cold incoming water. Consider installation of intra-tank circulator; contact manufacturer for details.
 - b. If cause is leakage - May be due to leaking fitting; repair as soon as possible. If tank leak is suspected, contact manufacturer.
2. Inspect vent for corrosion. If present, replace corroded vent section as soon as possible. Determine if cause is low temperature of combustion products (less than 280° F net flue temperature), or the presence of contaminated combustion air. Correct either condition immediately.

MONTHLY

1. Drain heater, remove hand hole cover and inspect for sediment accumulation. Remove any sediment and inspect more frequently to determine an appropriate schedule for sediment removal. **NOTE: FAILURE OF THE WATER HEATER DUE TO SEDIMENT OR SCALE ACCUMULATION IS NOT COVERED BY THE WARRANTY.**
2. Test combustion products for the presence of carbon monoxide (CO) above a 200 ppm concentration. If necessary, adjust burner to reduce CO concentration.

RECOMMENDED PERIODIC TESTING

TESTING ITEM	HOW OFTEN	COMPLETED BY	REMARKS
Gauges, monitors and operating log	Daily	Operator	Make visual inspection and record readings
Instrument and equipment settings	Daily	Operator	Make visual check against recommended specifications
Firing rate	Weekly	Operator	Verify factory settings
	Semiannually	Service Tech	Verify factory settings
	Annually	Service Tech	Check with combustion test
Flue, vent, stack or outlet dampers	Monthly	Operator	Make visual inspection of linkage; check for proper operation
Igniter	Weekly	Operator	Make visual inspection, check flame signal strength if meter-fitted (see "Combustion Safety Controls")
Fuel valves: pilot and main (primary and secondary)	Weekly	Operator	Operate burner. Using a manometer or pressure gauge, check pressure to the burner as required on rating label.
Pilot and main gas or oil train	Annually	Service Tech	Perform leakage tests - refer to instructions
Combustion safety controls (flame failure)	Weekly	Operator	Close manual fuel supply for the pilot and main fuel valve(s); check safety shutdown timing; log result.
Flame signal strength	Weekly	Operator	With flame signal meter installed, read and log for both pilot and main flames. Notify service organization if readings are very high, very low or fluctuating. Refer to instructions for nominal values
Pilot turndown test	As required / annually	Service Tech	Required after any adjustment to flame scanner mount or pilot burner; verify annually - refer to instructions.
Low-water fuel cutoff and alarm	Daily/weekly Semiannually	Operator	Refer to instructions and perform a slow drain test.
High limit safety thermostat control	Annually	Service Tech	Refer to instructions
Operating thermostat control	Annually	Service Tech	Refer to instructions
Vent draft fan, and air pressure switches	Monthly	Operator	Refer to instructions
High and low gas pressure interlocks	Monthly	Operator	Refer to instructions
High and low oil pressure interlocks	Monthly	Operator	Refer to instructions
Fuel valve interlock switch	Annually	Operator	Refer to instructions
Low fire start interlock	Annually	Operator	Refer to instructions
Automatic changeover control (dual fuel)	At least annually	Service Tech	Under supervision of gas utility
T&P valves	As required	Operator	In accordance with procedure in Section VI ASME Boiler and Pressure Vessel Code, Recommended Rules for Care and Operation of Heating Boilers.
Inspect Burner Components	Semiannually	Operator	Refer to burner instructions

SCALE AND SEDIMENT REMOVAL

THE MANUFACTURER CANNOT CONTROL USE OF THE WATER HEATER, WATER CONDITIONS OR MAINTENANCE. THE WATER HEATER WARRANTY DOES NOT COVER POOR PERFORMANCE, STRUCTURAL FAILURE OR LEAKING DUE TO AN EXCESSIVE ACCUMULATION OF SCALE.

The tank should be flushed to remove accumulated sediment at intervals depending on water conditions. To flush, turn off electrical disconnect to heater. Open drain valve and allow water to flow through the tank until it runs clear of sediment. Close the drain valve and turn electrical disconnect on.

Scale can form during operation and will accumulate on the bottom of the tank. Scale is formed from natural chemicals in the water which precipitate out during heating cycles. Some water supplies contain more scaling chemicals than others. The rate of scale accumulation increases as the temperature of stored water increases.

Sediment and scale accumulation in a tank reduce the water heater's ability to heat water. When heating energy cannot be effectively transferred to the water, tank metal can overheat. Overheating can cause the metal to lose its structural strength which can result in tank leakage.

The tank has a hand hole for inspection and cleaning. Remove hand hole cover on a regular basis and inspect tank for scale buildup. If scale is present, it can be loosened with a high pressure stream of water. Smaller flakes can be flushed through the drain, but larger flakes can be removed by hand through the hand hole. The frequency of inspection should be determined by the rate of scale buildup.

FIRETUBE CLEANING

The water heater contains a turbulator in each firetube, which increases flue gas velocity against the tube wall. This increased velocity does two things.

1. Transfers more heat into the water thus reducing fuel cost.
2. Helps in maintaining a cleaner tube wall should combustion adjustment change (which can produce sooting).

By maintaining the burner, and keeping CO₂ in the 9.0 to 9.5% range (gas), or 13.5% (#2 oil), you will help reduce sooting. This will also keep fuel cost down.

To check for and remove sooting, remove the top pan and turbulators and wire brush each tube. Clean all soot from turbulators and reinstall into the firetubes.

After tube cleaning, remove the burner, clean combustion head internals and vacuum the combustion chamber before placing water heater back into service.

BURNER SERVICE

IMPORTANT

IT IS HIGHLY RECOMMENDED THAT REPLACEMENT PARTS OR ASSEMBLIES BE OBTAINED FROM THE WATER HEATER OR BURNER MANUFACTURER.

The enclosed burner installation and operation manual contains a service suggestion (troubleshooting) section and a periodic checklist that recommends a variety of component tests designed to help maintain the water heater's reliable, efficient and safe operation.

For additional assistance, contact the burner manufacturer's customer service department.

Availability of spare parts varies from area to area. The burner material list provides the part number you require for obtaining replacements. If the item is not available locally, contact the service department at the location listed on the cover page.

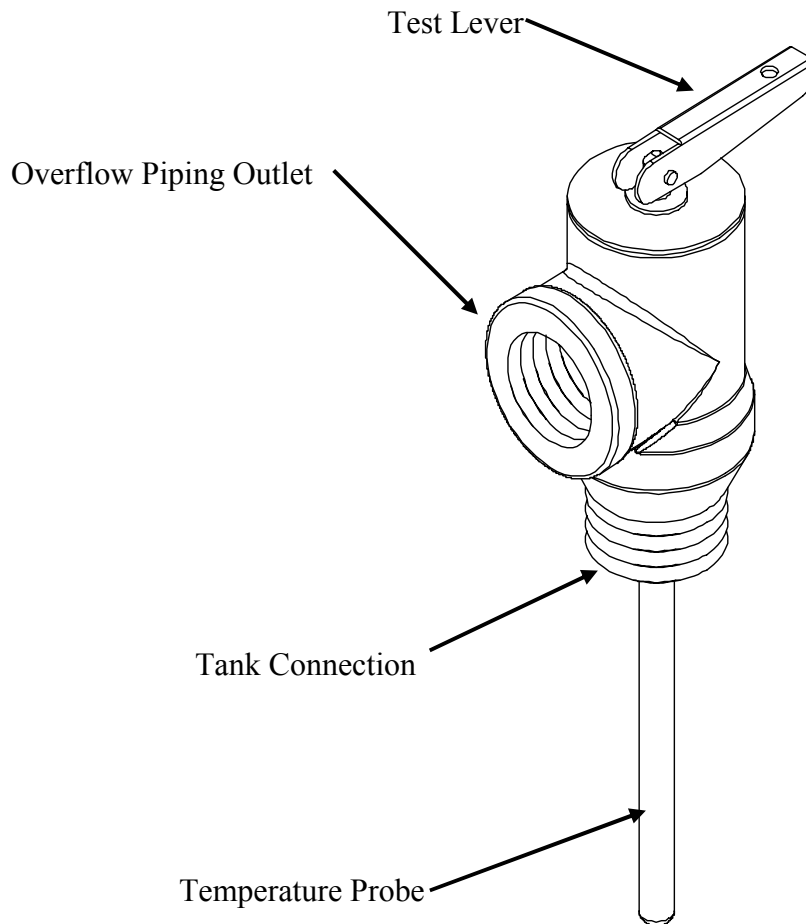
WATER HEATER SERVICE

Serviceable water heater components include the control and high limit thermostats, the temperature and pressure relief valve(s), the drain valve and , low water cut off. Optional components such as a temperature and pressure gauge may also be installed. Replacement instructions for some of these items are listed below.

For additional assistance, contact the water heater manufacturer's customer service department.

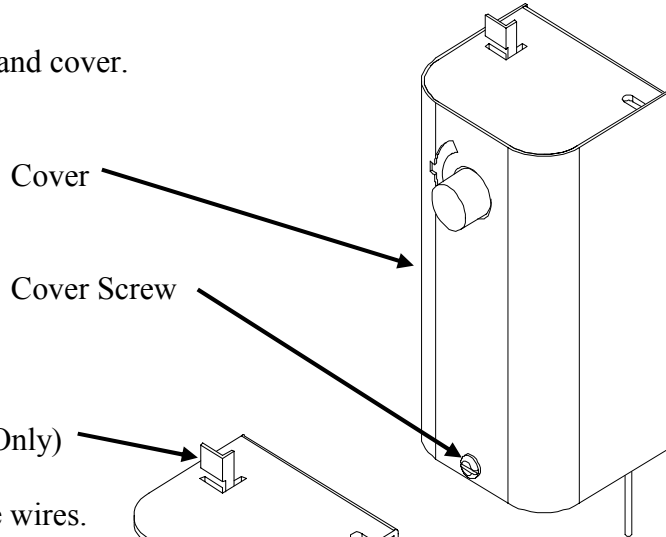
RELIEF VALVE

1. Disconnect power from unit.
2. Shut off incoming water and boiler water supply.
3. Lift test lever on relief valve to relieve pressure in tank.
4. Disconnect overflow piping.
5. Unscrew relief valve, remove assembly and replace with new one.
6. Connect overflow piping.
7. Turn on incoming water supply and check for leaks.
8. Turn safety switch to ON position.

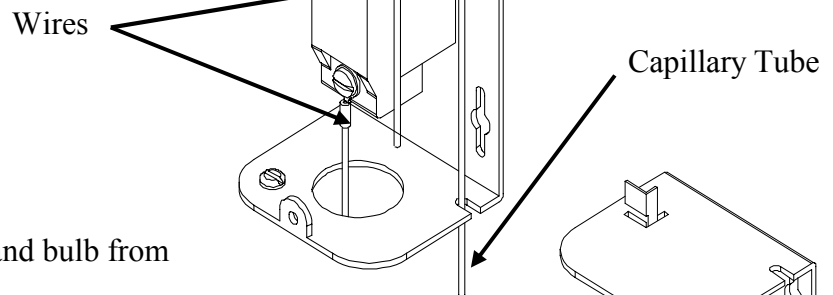


IMMERSION TEMPERATURE HIGH LIMIT CUT-OFF, HIGH, OR LOW THERMOSTAT

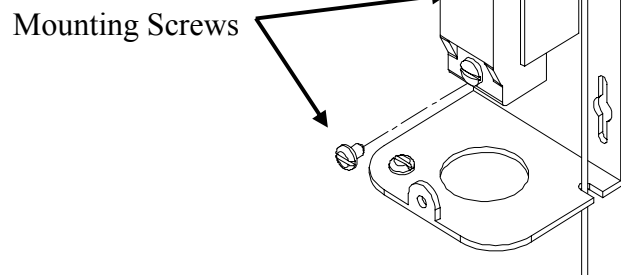
1. Disconnect power from unit.
2. Remove access cover.
3. Remove high limit cover screw and cover.



4. Disconnect the two (2) 14 gauge wires.



5. Remove capillary tube and bulb from thermowell
6. Remove two (2) mounting screws.



7. Remove control and install new high limit switch by performing above steps in reverse order. (Note: Be sure to place capillary tube into slot in base prior to installing cover.)

SECTION V – TROUBLESHOOTING
(See separate component O&M for additional details.)

Symptom	Probable Cause	Corrective Action / Remedy
No hot water.	Flame safeguard locked out.	Reset flame safeguard.
	Manual gas valve closed.	Open gas valve and reset flame safeguard.
	Blown control circuit.	Replace fuse.
	No power.	Reset circuit breaker.
	Gas pressure too high or too low.	Reset gas pressure switch and reset flame safeguard.
Water not hot enough.	Operating control thermostat set too low.	Increase control thermostat setting to a higher temperature. Note: Higher water temperatures increase the danger of scalding.
	Recovery rate too low for demand.	Input rate too low/not operating at peak efficiency.
		Call serviceman to check input rate and efficiency.
Water temperature too hot.	Operating control thermostat failed.	Call serviceman to replace control thermostat.
	Operating control thermostat set too high.	Adjust operating control thermostat to lower temperature.
Water leaks.	Temperature and pressure safety relief valve not closed.	Replace valve.
	If leakage source cannot be determined.	Shut off fuel and electrical supply, close cold water inlet valve, and call serviceman.
Gas odors.	Possible gas leak.	Shut off gas supply and call the gas company.
	Improper combustion.	Call serviceman.
	Blower wheel dirty.	Call serviceman.
	Down draft in vent.	Call serviceman.
	Gas train vents not vented outdoors.	Call serviceman.
	Blower wheel running backward.	Call serviceman.

SECTION VI – MISCELLANEOUS CHARTS AND FORMULAS

TORQUE VALUES

BOLT SIZE	18-8 S/S IN.-LBS.	BRASS IN.-LBS.	SILICON BRONZE IN.-LBS.	ALUMINUM 2024-T4 IN.-LBS.	316 S/S IN.-LBS.	MONEL IN.-LBS.
4-40	5.2	4.3	4.8	2.9	5.5	5.3
4-48	6.6	5.4	6.1	3.6	6.9	6.7
5-40	7.7	6.3	7.1	4.2	8.1	7.8
5-44	9.4	7.7	8.7	5.1	9.8	9.6
6-32	9.6	7.9	8.9	5.3	10.1	9.8
6-40	12.1	9.9	11.2	6.6	12.7	12.3
8-32	19.8	16.2	18.4	10.8	20.7	20.2
8-36	22.0	18.0	20.4	12.0	23.0	22.4
10-24	22.8	18.6	21.2	13.8	23.8	25.9
10-32	31.7	25.9	29.3	19.2	33.1	34.9
1/4-20	75.2	61.5	68.8	45.6	78.8	85.3
1/4-28	94.0	77.0	87.0	57.0	99.0	106.0
5/16-18	132	107	123	80	138	149
5/16-24	142	116	131	86	147	160
3/8-16	236	192	219	143	247	266
3/8-24	259	212	240	157	271	294
7/16-14	376	317	349	228	393	427
7/16-20	400	327	371	242	418	451
1/2-13	517	422	480	313	542	584
1/2-20	541	443	502	328	565	613
9/16-12	682	558	632	413	713	774
9/16-18	752	615	697	456	787	855
5/8-11	1110	907	1030	715	1160	1330
5/8-18	1244	1016	1154	798	1301	1482
3/4-10	1530	1249	1416	980	1582	1832
3/4-16	1490	1220	1382	958	1558	1790
7/8-9	2328	1905	2140	1495	2430	2775
7/8-14	2318	1895	2130	1490	2420	2755
1-8	3440	2815	3185	2205	3595	4130
1-14	3110	2545	2885	1995	3250	3730

METRIC CONVERSIONS

$$\text{Liters} \times 0.2641 = \text{Gallons}$$

$$\text{Gallons} \times 3.79 = \text{Liters}$$

$$\text{Gallons} \times 0.003785 = \text{m}^3$$

$$\text{m}^3 \times 264.2 = \text{Gallons}$$

$$1^{\circ}\text{C} \Delta T = 1.8^{\circ}\text{F} \Delta T$$

$$^{\circ}\text{F} = (^{\circ}\text{C} \times 1.8) + 32$$

$$^{\circ}\text{C} = (^{\circ}\text{F} - 32) \times 0.556$$

$$\text{psi} \times 0.06896 = \text{Bar}$$

$$\text{Bar} \times 14.5 = \text{psi}$$

$$\text{psi} \times 6.86 = \text{kPa}$$

$$\text{kPa} \times 0.1456 = \text{psi}$$

$$\text{Lbs} \times 0.4536 = \text{Kg}$$

$$\text{Kg} \times 2.2 = \text{Lbs}$$

$$\text{ft}^2 \times 0.0929 = \text{m}^2$$

$$\text{m}^2 \times 10.765 = \text{ft}^2$$