

INSTALLATION AND SERVICE MANUAL

HOT WATER HEATING BOILER

665,000 - 3,080,000 BTUs

HOT WATER SUPPLY BOILER

665,000 - 3,080,000 BTUs

WARRANTY

Factory warranty (shipped with unit) does not apply to heaters improperly installed or improperly operated.

IMPORTANT: Consult and follow local Building, Fire Regulation, and other Safety Codes that apply to this installation. Consult local gas utility company to authorize and inspect all gas connections and flue connections.

1. Excessive water hardness causing a lime build-up in the copper tube is not a fault of the equipment and is not covered under the manufacturer's warranty (See paragraph on Inspection).
2. Excessive pitting and erosion on the inside of the copper tube may be caused by too much water velocity through the tubes, and is not covered by the manufacturer's warranty. (See Installation Instructions for proper pump performance).

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

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

— WHAT TO DO IF YOU SMELL GAS

- Do not try to light any appliance.
- Do not touch any electrical switch; do not use any phone in your building.
- Immediately call your gas supplier from a 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.

WARNING: IMPROPER INSTALLATION, ADJUSTMENT, ALTERATION, SERVICE OR MAINTENANCE CAN CAUSE INJURY OR PROPERTY DAMAGE. REFER TO THIS MANUAL FOR ASSISTANCE OR ADDITIONAL INFORMATION CONSULT A QUALIFIED INSTALLER, SERVICE AGENCY OR THE GAS SUPPLIER.

SPECIAL INSTRUCTIONS TO OWNER

NOTE: Retain this manual for future reference. Your gas boiler must have a supply of fresh air circulating around it during burner operation for proper gas combustion and proper venting.

WARNING: Improper installation, adjustment, alteration, service, maintenance, or use can cause carbon monoxide poisoning, explosion, fire, electric shock, or other occurrences which may injure you or damage your property. Consult a qualified installer, service agent or the gas supplier for information or assistance.

WARNING: Should over-heating occur or the gas supply fail to shut off, do not turn off or disconnect the electrical supply to the pump. Instead, shut off the gas supply at a location external to the appliance.

WARNING: To minimize the possibility of serious personal injury, fire, damage to your boiler or improper operation, never violate the following safety rules:

1. Always keep the area around your boiler free of combustible materials, gasoline, and other flammable liquids and vapors.
2. Never cover your unit, lean anything against it, store trash or debris near it, stand on it, or in any way block the flow of fresh air to your boiler.

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CHECKING EQUIPMENT

Upon receiving equipment, check for signs of shipping damage. Pay particular attention to controls and accessories mounted on the boiler, which may show signs of being hit or otherwise being mishandled. Check underneath the appliance to be sure that burner manifolds have not been bent in shipment and that the burners are all intact. Verify total number of pieces shown on packing slip with those actually received.

IMPORTANT: Note any damage or shortage on freight bill and immediately notify carrier. File all claims for shortage or damage with carrier.

Storage Prior to Installation

If the boiler is not immediately installed, and must be stored, it must be adequately protected from the weather, preferably by storage in a warehouse. If this is not possible, it should be covered by a tarpaulin or other waterproof covering. In extremely damp or humid climates remove the flame safeguard and other electronic equipment and store in a warm dry location.

NOTE: Controls and other equipment that are damaged, or fail due to weather exposure are not covered by warranty.

CODES

The installation must conform to the requirements of the authority having jurisdiction or, in the absence of such requirements, to the latest edition of the National Fuel Gas Code, ANSI Z223.1.

Where required by the authority having jurisdiction, the installation must conform to American Society of Mechanical Engineers Safety Code for Controls and Safety Devices for Automatically Fired Boilers, ANSI/ASME CSD-1. All boilers conform to the latest edition of the ASME Boiler and Pressure Vessel Code, Section IV.

Installations in Canada must conform to local codes or, in the absence of local codes, to the CAN1-B149 - installation codes for gas burning equipment.

THIS APPLIANCE MEETS THE SAFE LIGHTING PERFORMANCE CRITERIA, WITH THE GAS MANIFOLD AND CONTROL ASSEMBLY PROVIDED, AS SPECIFIED IN THE ANSI STANDARD FOR GAS-FIRED BOILERS, ANSI Z21.13

INSTALLATION INSTRUCTIONS

NOTE: If this boiler is installed above radiation level, it must be provided with a low water cut-off device at the time of boiler installation (optional, available from factory).

LOCATION OF BOILER

1. Locate the unit so that if the water connections should leak, water damage will not occur. When such locations cannot be avoided, it is recommended that a suitable drain pan, adequately drained, be installed under the unit. The pan must not restrict combustion air flow. Under no circumstances is the manufacturer to be held liable for water damage in connection with this unit, or any of its components.
2. The unit must be installed so that the ignition system components are protected from water (dripping, spraying, rain, etc.) during appliance operation and service (circulator replacement, control replacement, etc.)
3. The appliance must be placed on a level, non-combustible floor. Concrete over wood is not considered non-combustible.
4. The appliance must not be installed on carpet.
5. Allow sufficient space for servicing pipe connections, pump, and other auxiliary equipment, as well as the boiler.

DO NOT USE THIS BOILER IF ANY PART HAS BEEN UNDER WATER. IMMEDIATELY CALL A QUALIFIED SERVICE TECHNICIAN TO INSPECT THE UNIT AND TO REPLACE ANY PART OF THE CONTROL SYSTEM AND ANY GAS CONTROL WHICH HAS BEEN UNDER WATER.

665,000-3,080,000 BTU Models

Clearances:

If the boiler is to be installed near combustible surfaces the minimum clearance must be 24 inches from all sides and ceiling.

The appliance must be installed so as to provide at least 24" of unobstructed clearance in front. Clearance from vent and hot water pipes is 6".

665,000-3,080,000 BTU Models

If the appliance must be installed over a combustible floor, provide a base of hollow clay tile or concrete blocks from 8" to 12" thick and extending 24" beyond the sides. The blocks must be placed in line so that the holes line up horizontally to provide a clear passage through the blocks. This procedure should also be followed if electrical conduit runs through the floor, and beneath the appliance.

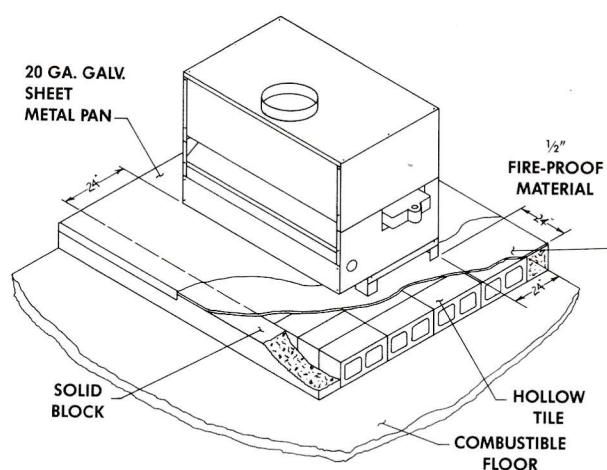


FIG. 1

COMBUSTION & VENTILATION AIR OPENING

Provisions for combustion and ventilation air must be in accordance with Section 5.3, Air For Combustion And Ventilation, of the latest edition of the National Fuel Gas Code ANSI Z223.1, or applicable provisions of the local building codes.

The equipment room must be provided with two openings to assure adequate combustion air and proper ventilation.

1. If air is taken directly from outside the building:
 - a. Combustion air opening, 1 square inch per 2,000 BTU input. This opening must be located near the floor.
 - b. Ventilation air opening, 1 square inch per 2,000 BTU input. This opening must be located near the ceiling.
2. If air is taken from another interior space, each opening specified above should have a net free area of one square inch for each 1,000 BTU of input.

CAUTION: Under no circumstances should the equipment room ever be under a negative pressure. Particular care should be taken when exhaust fans, compressors, air handling units, etc. may rob air from the boiler.

The combustion air supply must be completely free of any chemical fumes which may be corrosive to the boiler. Common chemicals which must be avoided are fluorocarbons and other halogenated compounds, most commonly present as refrigerants or solvents, such as freon, trichlorethylene, perchlorethylene, chlorine, etc. These chemicals, when burned, form acids which quickly attack the boiler tubes, tube sheets, flue collectors, and boiler stack. The result is improper combustion and premature boiler failures.

VENTING

General

Vent installations for connection to gas vents or chimneys must be in accordance with Part 7, "Venting of Equipment," of the latest edition of the National Fuel Gas Code, ANSI Z223.1, or applicable provisions of the building codes.

Adequate combustion and ventilation air must be supplied to the mechanical room in accordance with the latest edition of the National Fuel Gas Code, ANSI Z223.1 or applicable provisions of the local building codes.

The distance of the vent terminal from adjacent buildings, windows that open and building openings **MUST** comply with the latest of the National Fuel Gas Code, ANSI Z223.1.

WARNING: Vent connectors serving appliances vented by natural draft shall not be connected into any portion of mechanical draft systems operating under positive pressure.

The boiler is designed with a built in draft diverter. No additional diverter is required. The negative draft must be within the range of .02 to .05 negative to insure proper operation.

The connection from the appliance vent to the stack must be made as direct as possible and of the same diameter as the vent outlet. The horizontal breeching of a vent must have at least $\frac{1}{4}$ " rise per linear foot. The horizontal portions shall also be supported for the design and weight of the material employed to maintain clearances, prevent physical damage and separation of joints.

The connection from the appliance vent to the stack or vent termination outside the building **MUST** be made with listed Type "B" double wall vent (or equivalent) connectors the same size as the appliance vent. The Type "B" vent and accessories,

such as firestop spacers, thimbles, caps, etc., MUST be installed in accordance with the manufacturer's listing. The vent connector and firestop must provide correct spacing to combustible surfaces and seal to the vent connector on the upper and lower sides of each floor or ceiling through which the vent connector passes.

The weight of the venting system must not rest on the boiler. Adequate support of the venting system must be provided in compliance with local codes and other applicable codes. All connections should be secured with rustproof sheet metal screws.

VENT TERMINATIONS

The vent must terminate outside the building and should be at least 2 feet above the highest point of the roof within a 10 foot radius of the termination. The vent cap should have a minimum clearance of 4 feet horizontally from, and in no case be located above or below (unless a 4 foot horizontal distance is maintained from) electric meters, gas meters, regulators and relief equipment. The distance of the vent terminal from adjacent public walkways, adjacent buildings, windows that open and building openings MUST comply with the latest edition of the National Fuel Gas Code, ANSI Z223.1. Check the vent cap during periods of snow, leaf dropping, etc., to be sure that no blockage occurs from buildup.

Common venting systems may be too large when an existing unit is removed. At the time of removal of an existing boiler, the following steps shall be followed with each appliance remaining connected to the common venting system placed in operation, while the other appliances remaining connected to the common venting system are not in operation.

- a. Seal any unused opening in the common venting system.
- b. Visually inspect the venting system for proper size and horizontal pitch and determine there is no blockage or restriction, leakage, corrosion and other deficiencies which could cause an unsafe condition.
- c. Insofar as is practical, close all building doors and windows and all doors between the space in which the appliances remaining connected to the common venting system are located and other spaces of the building. Turn on clothes dryers and any appliance not connected to the common venting system. Turn on any exhaust fans, such as range hoods and bathroom exhausts, so they will operate at maximum speed. Do not operate a summer exhaust fan. Close fireplace dampers.
- d. Place in operation, the appliance being inspected. Follow the lighting instructions. Adjust thermostat so appliance will operate continuously.
- e. Test for spillage at the draft hood relief opening after 5 minutes of main burner operation. Use the flame of a match or candle, or smoke from a cigarette, cigar or pipe.

- f. After it has been determined that each appliance remaining connected to the common venting system properly vents when tested as outlined above, return doors, windows, exhaust fans, fireplace dampers and other gas burning appliances to their previous conditions of use.
- g. Any improper operation of the common venting system should be corrected so that the installation conforms with the latest edition of the National Fuel Gas Code, ANSI Z223.1. When resizing any portion of the common venting system, the common venting system should be resized to approach the minimum size as determined using the appropriate tables in Appendix G of the National Fuel Gas Code, ANSI Z223.1.

GAS SUPPLY

1. Before making gas hook-up, verify that the boiler is being supplied with same gas type as indicated on the data plate. These boilers are orificed for operation up to 2,000 feet altitude. Consult factory for installations at higher elevations.

INLET PRESSURE: Measured upstream of gas valve and pressure regulator. Inlet pressure tap located at main gas cock.

TABLE A

665,000-3,808,000 BTU Models	Nat. Gas	LPG
Max. Allowable (Inches-water column)	14"	14"
Min. Allowable (Inches-water column)	6"	11"

The maximum inlet gas pressure must not exceed the value specified. Minimum value listed is for the purposes of input adjustment.

MANIFOLD PRESSURE: Measured downstream of main gas valve.

TABLE B

BTU Input	Nat. Gas	LPG
665,000-3,080,000 BTU	4.0"	10"

Manifold pressure tap located downstream of main gas valve.

GAS PRESSURE TEST

1. The appliance must be *disconnected* from the gas supply piping system during any pressure testing of that system at test pressure in excess of 1/2 PSIG (3.5kPa). The appliance must be isolated from the gas supply piping system by *closing* the manual shutoff valve during any pressure testing of the gas supply piping system at test pressure equal to or less than 1/2 PSIG (3.5 kPa).
2. The appliance and its gas connection must be leak-tested before placing it in operation.

- The gas pressure regulator supplied is for low pressure service. If upstream pressure exceeds 8 oz. (14" water column), an intermediate gas pressure regulator, of the lock-up type, must be installed.
- Install a union connection at inlet to the boiler manifold to permit servicing controls when necessary.
- The gas line should be a separate line direct from meter, unless the existing gas line is of sufficient capacity. Verify pipe size with your gas supplier.

GAS CONNECTION

- Safe operation of unit requires properly sized gas supply piping. See data below.
- Gas pipe size may be larger than heater connection.
- Installation of a union is suggested for ease of service.
- Install a manual main gas shutoff valve, outside of the appliance gas connection and before the gas valve, when Local Codes require.
- A trap (drip leg) should be provided in the inlet of the gas connection to the unit.

Install Piping to Control

- Use new, properly threaded black iron pipe free from chips. If tubing is used, make sure the ends are square, deburred and clean. All tubing bends must be smooth and without deformation.
- Run pipe or tubing to the control or gas cock.. If tubing is used, obtain a tube-to-pipe coupling to connect the tubing to the control.
- Thread pipe proper amount for correct thread insertion **DO NOT THREAD PIPE TOO FAR.** Valve distortion or malfunction may result if the pipe is inserted too deeply.
- Apply a moderate amount of good quality pipe compound (DO NOT use Teflon tape); to pipe only, leaving two end threads bare.
- All gas connections must be made with a pipe joint compound resistant to the action of liquefied petroleum and natural gases.
- Remove seal over control inlet or gas cock.
- Connect pipe to control inlet. Use a parallel jaw wrench to hold the valve or gas cock while pipe is inserted and tightened.
- For LP gas, consult your LP gas supplier for expert installation.

All piping must comply with local codes and ordinances or with the National Fuel Gas Code (ANSI Z223.1 NFPA NO. 54), whichever applies. Tubing installation must comply with approved standards and practices.

Table C indicates the proper size and length of standard black steel pipe to install from gas meter to the appliance.

**GAS PIPE SIZING
TABLE C**

BTU Input	DISTANCE FROM METER							
	0-50'	50-100'	100-200'	200-300'	300-500'			
665,000	1½"	1½"	2"	1"	2½"			
760,000	1½"	2"	2"	2¼"	3"			
940,000	2"	2"	2½"	2½"	3"			
1,206,400	2"	2½"	2½"	3"	3"			
1,540,000	2½"	2½"	3"	3"	3½"			
1,694,000	2½"	2½"	3"	3"	3½"			
2,002,000	2½"	3"	3"	3½"	4"			
2,310,000	2½"	3"	3½"	3½"	4"			
2,618,000	2½"	3"	3½"	3½"	4"			
3,080,000	3"	3"	3½"	4"	4"			
For each elbow or tee, add equivalent of straight pipe to total length.								
Diameter Pipe	¾"	1"	1¼"	1½"	2"	3"	4"	5"
Equivalent Length of Straight Pipe	2'	2'	3'	4'	5'	10'	14'	20'
Based on 0.5 inches of water column drop, natural gas, 0.65 specific gravity.								

**MULTIPLE UNIT INSTALLATIONS
GAS PIPING SIZE CHART
TABLE D**

Nominal Iron Pipe Size, Inches	Length of Pipe in Straight Feet															
	10	20	30	40	50	60	70	80	90	100	125	150	175	200		
¾	369	256	205	174	155	141	128	121	113	106	95	86	79	74		
1	697	477	384	328	292	267	246	256	210	200	179	164	149	138		
1¼	1,400	974	789	677	595	543	502	472	441	410	369	333	308	287		
1½	2,150	1,500	1,210	1,020	923	830	769	707	666	636	564	513	472	441		
2	4,100	2,820	2,260	1,950	1,720	1,560	1,440	1,330	1,250	1,180	1,100	974	871	820		
2½	6,460	4,460	3,610	3,100	2,720	2,460	2,310	2,100	2,000	1,900	1,700	1,540	1,400	1,300		
3	11,200	7,900	6,400	5,400	4,870	4,410	4,000	3,800	3,540	3,330	3,000	2,720	2,500	2,340		
4	23,500	16,100	13,100	11,100	10,000	9,000	8,300	7,690	7,380	6,870	6,150	5,640	5,130	4,720		

Maximum capacity of pipe in thousands of BTU's per hour for gas pressures of 14" water column (0.5 PSIG) or less and a pressure drop of 0.5 Inch Water Column (Based on NAT GAS, 1025 BTU's per cubic foot of gas and 0.60 specific gravity gas).

Bleeds and Vents

When required, each boiler is provided with bleeds and vents for gas valves which are vented into the combustion chamber. When the unit is equipped with a regulator its bleeds and vents must be vented to atmosphere outside the building.

Checking Manifold Pressure with Manometer

665-000 - 3,080,000 BTU's

- Turn main gas cock to OFF position
- Remove manifold pressure tap plug from end of burner manifold.
- Connect manometer to pressure tap on manifold.

4. Remove cap from main gas regulator.
5. Turn main gas cock to ON position, adjust thermostat to fire burners.
6. Observe manifold pressure while boiler is firing. See GAS SUPPLY for correct manifold pressure.
7. Adjust manifold pressure by turning regulator adjustment screw clockwise to increase and counterclockwise to decrease pressure.
8. Turn gas cock to OFF position, disconnect manometer and replace plug in pressure tap. Install cap on regulator. Tighten firmly to prevent gas leakage.

If outlet pressure cannot be properly adjusted, check inlet pressure by using a manometer connected to the inlet pressure tap on the gas control. Before removing inlet pressure tap plug, shut off gas supply at the manual valve in the gas piping to the appliance or, for LP, at the tank. Also shut off gas supply before disconnecting manometer and replacing plug. If inlet pressure is within the normal range, replace the gas control; if not, take the necessary steps to provide proper gas pressure to the control.

WATER CONNECTIONS

Inlet and Outlet Water Connections

For ease of service, install unions on inlet and outlet of the boiler. The connection to the unit marked "inlet" on the header should be used for the return from the system. The connection on the header marked "outlet" is to be connected to the supply side of the system.

Relief Valve Piping

Boiler is supplied with a pressure-relief valve, sized in accordance with ASME requirements. The relief valve must be installed in the outlet piping of the unit. Do not install any flow limiting devices between the relief valve and the unit. The relief valve must be installed in a vertical position and the discharge piped to a suitable floor drain for disposal when relief occurs. No reducing coupling or other restriction can be installed in the discharge line. It is strongly recommended that this valve should be manually operated at least once a year.

LOW WATER CUTOFF (IF EQUIPPED)

Low water cutoffs should be inspected every six months including flushing of float types.

WATER TREATMENT

In hard water areas, water treatment should be used to reduce introduction of minerals into the system. Minerals in the water can collect in the heat exchanger tubes and cause noise on operation. Excessive buildup of minerals in the heat exchanger can cause a non-warrantable failure (See step 7 in Placing the Boiler in Operation.

INITIAL START-UP

Follow instructions on the label applied to the top of the boiler.

ELECTRICAL REQUIREMENTS (USA)

The appliance is wired for 120 volt service. The heater when installed, must be electrically grounded in accordance with the requirements of the authority having jurisdiction or in the absence of such requirements, with the latest edition of the National Electrical Codes ANSI/NFPA No. 70.

1. All wiring between the unit and field installed devices shall be made of type T wire [63° F (35° C) rise].
2. Line voltage wire exterior to the appliance must be enclosed in approved conduit or approved metal-clad cable.
3. The pump must run continuously when unit is being fired (except when unit is provided with optional intermittent pump controller).
4. To avoid serious damage, DO NOT energize the unit until the system is full of water.

Provide boiler with proper overload protection.

Provide circulating pump with proper overload protection.

- A. **Pump Operation - MOST IMPORTANT** - This boiler is designed for continuous pump operation. Intermittent pump operation is available with the optional solid state intermittent pump controller. Properly installed, the constant circulation of water through the unit will help prevent freezing. (*See Freeze Protection*)
- B. **Location** - The boiler should be located within a room having a temperature safely above freezing (32° F).
- C. **Shut-down and Draining** - If for any reason the boiler is to be shut off, the following precautionary measures must be taken:
 1. Shut off gas supply.
 2. Shut off water.
 3. Shut off the electrical supply.
 4. Drain the heater completely by removing the drain plug(s) in the headers.
 5. Drain Pump.

PLACING THE BOILER IN OPERATION

Filling the Boiler

Fill the system with water. To be sure that the boiler is not "air bound", open the pressure-relief valve. Leave the valve open until a steady flow of water is observed. Close the valve and complete filling the system.

1. Close all drain cocks and air vents.
2. Fill the system to the correct pressure. Residential systems are designed for cold water fill pressure of 15 pounds.

CAUTION: THIS UNIT SHOULD NOT BE OPERATED AT LESS THAN 12 PSIG.

3. If used, open automatic vents two (2) turns.
4. Open manual water feed valve.
5. Starting with the first vent in the system, open until water flows, then close. Repeat procedure for remaining vents.
6. When proper pressure is achieved, close manual water feed valve.
7. Make sure that are no system leaks.

Note: Do not use petroleum based stop leak products. All system leaks must be repaired. The constant addition of make-up water can cause damage to the boiler heat exchanger. Minerals in the water can collect in the heat exchanger, reducing the flow and heat transfer, causing overheating of the heat exchanger.

8. **Freeze protection**, if required. **CAUTION: DO NOT** use undiluted or automotive type antifreeze. Use only hydronic system antifreeze. Inhibited propylene glycol is recommended. A solution of 50% antifreeze will provide maximum protection of approximately -30° F. Follow the instruction of the antifreeze manufacturer.

Pre-Start Check List

All cover plates, enclosures and guards must be in place at all times, except during maintenance and servicing.

Before attempting to start the boiler, verify that the following items have been checked:

1. Inspect the burners to be sure that they are properly aligned.
2. Inspect the pilot gas line, sensor wires, and ignition leads to be sure none were damaged during shipment. Check that the pilot is in the proper position to ignite the main burners.
3. Gas connection has been made and the line purged of all air.
4. Water connections are tight and the boiler and system has been filled.
5. Relief valve has been piped to floor drain.
6. Combustion air openings are not obstructed in any way.
7. Check for gas leaks.
8. Read the check out procedure for each firing system
"For your safety read before lighting."

OPERATING INSTRUCTIONS FOR INTERMITTENT PILOT SYSTEMS

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 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.

- 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.

LIGHTING INSTRUCTIONS

Intermittent Pilot: 665,000-3,080,000 BTUs

Intermittent/Module Firing: 665,000-3,080,000 BTUs

1. Stop! Read the safety information above on this page.
2. Set the thermostat to lowest setting.
3. Turn off all electrical power to the appliance.
4. This appliance is equipped with an ignition device which automatically lights the pilot. DO NOT attempt to light the pilot by hand.
5. Turn the manual gas cock counterclockwise  to "OFF" position.
6. Wait five (5) minutes to clear out any gas. If you then smell gas, STOP! Follow "B" in safety information on page 7. If you don't smell gas, go on to next step.

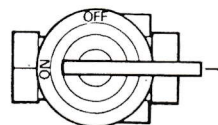




FIG. 2

7. Turn the manual gas cock clockwise  to the "ON" position. Turn on all electrical power to the appliance.
8. Set the thermostat to the desired setting.
9. If the appliance does not light repeat steps 6 thru 11. 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 TO APPLIANCE

1. Set the thermostat to the lowest setting.
2. Turn off all electric power to the appliance if service is to be performed.
3. Turn manual gas cock counterclockwise  to the full "OFF" position.

NOTE: Should overheating occur or the gas supply fail to shutoff, turn the manual gas control valve to the appliance off.

CHECK OUT PROCEDURE FOR INTERMITTENT PILOT SYSTEMS

Step One - Visual Inspection

1. Make sure boiler is grounded in accordance with installation instructions.
2. With electric power off, check all wiring connections.
3. Make sure the high voltage lead is attached to the ignition module.
4. Turn gas supply off to the boiler.

Step Two - Operational Check

1. Turn electric power on to the boiler.
2. Turn thermostat and high limit to highest setting.
3. Verify that the pump is operating.
4. Pilot ignition starts sparking.
5. Ignition module will lock out in 15 seconds.

Step Three - Reset and Fire Boiler

1. Turn electric power off to boiler.
2. Turn main gas to boiler on.
3. Turn electric power on to boiler.
4. Turn thermostat and high limit to highest settings.
5. Verify that the pump is operating.
6. Pilot ignition sparks and lights pilot.
7. Main burner(s) ignite.

Step Four - Control Check

1. Turn thermostat to lowest setting.
2. Burner(s) goes off.
3. Turn thermostat to highest setting.
4. Verify that the pump is operating.
5. Pilot ignition sparks and lights pilot.
6. Main burner(s) ignite.
7. Repeat steps 1 thru 6 with high limit.
8. Set the thermostat and high limit to normal operating settings.

MODULE FIRE CONTROLS

A boiler equipped for "Module Fire" controls can operate automatically at 50% reduced gas input permitting a low fire condition when moderate ambient temperatures reduce the heating demand. The operator controls the "Low Fire" set point. The "High Fire" aquastat on the control panel may be adjusted to the desired temperature setting where full rate firing is required.

MAINTENANCE

Listed below are items that should be checked to ensure safe and reliable operation:

1. Examine the venting system at least once a year. Check all joint and pipe connections for tightness, also check pipe for corrosion or deterioration.

2. Remove pilot shield and visually check main burner and pilot burner flames at each start-up after long shutdown periods or at least every six months.

- a. **Normal Flame:** A normal flame is blue, without yellow tips, with a well defined inner cone and with no flame lifting.
 - b. **Yellow Tip:** Yellow tip can be caused by debris under infront of the water heater blocking flow of primary air to the burner(s).
 - c. **Yellow Flames:** Yellow flames can be caused by debris blocking the flow of primary air to the burner(s), burner(s) and venturi tubes not properly in place or excessive gas input. This condition **MUST** be corrected immediately.
 - d. **Lifting Flames:** Lifting flames can be caused by overfiring the burner(s) or excessive primary air.
3. Keep appliance area clear and free from combustible materials, gasoline and other flammable vapors and liquids.
 4. Check frequently to be sure the flow of combustion and ventilating air to the unit is not obstructed.
 5. Flue Gas Passageway Cleaning Procedures:

PILOT FLAME PATTERNS



A. CORRECT FLAME



B. YELLOW TIPS



C. YELLOW FLAME



D. FLAME LIFT OFF

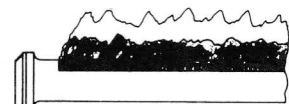
FIG. 3

MAIN BURNER FLAME PATTERNS

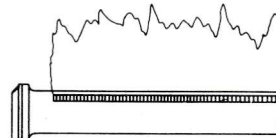
BLUE TIPS



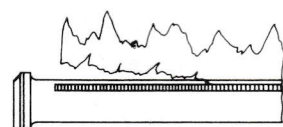
A. CORRECT FLAME



B. YELLOW TIPS



C. YELLOW FLAME



D. FLAME LIFT OFF

FIG. 4

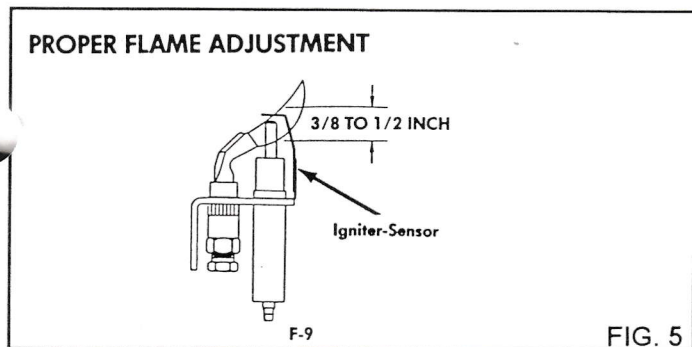
- a. Remove the flue pipe from the top of the boiler.
 - b. Disconnect inlet/outlet piping from the heat exchanger.
 - c. Remove outer jacket panels and flue collector.
 - d. Remove the heat exchanger. Lift vertically from the frame.
 - e. Remove "V" baffles from the top of the heat exchanger.
 - f. Take a garden hose and wash the heat exchanger, making sure that all soot is removed from the tubes.
 - g. Clean the ports of the burner with a wire brush.
 - h. Reassemble the boiler.
6. Low water cutoffs should be inspected every six months including flushing of float types.

WARNING: After checking control operation manually, make sure that controls are reset to their proper setting. *Never* attempt to operate a unit that has failed to pass its safety check. Repair work should be done by a qualified serviceman or installer.

PILOT FLAME ADJUSTMENT

Pilot Gas Pressure Regulator: 665,000-3,080,000 BTUs

1. Remove cover from the pilot pressure regulator.
2. Turn the adjustment screw clockwise to increase or counterclockwise to decrease pilot flame.
3. Always replace regulator cover. Tighten firmly after adjustment to prevent leakage.



The pilot flame should envelop 3/8 to 1/2 inch of the tip of the thermocouple or the ignitor-sensor.

ELECTRICAL REQUIREMENTS

The appliance is wired for 120 volts. The voltage is indicated on the rating plate. Consult diagram shipped with the unit. Before starting unit, check to insure proper voltage is supplied to the unit. The unit must be grounded in accordance with all codes.

If any of the original wire, as supplied with appliance, must be replaced, it must be replaced with 105° C wire or its equivalent, except for the hi-tension cable and the sensor wire (intermittent systems only) which should be replaced with 200° C insulated wire or its equivalent. Refer to separate wiring diagram sheet.

TUBES

Unlike most other hot water boilers, this copper tube boiler is especially designed to operate without accumulation of scale in copper tubes. The copper tubes may be inspected to insure that no scale or sediment accumulates in the tubes. The inspection covers, located at both ends of the boiler, can be removed to allow viewing of the tubes. Accumulation of scale or sediment indicates a system problem which must be corrected. Periodic reinspection can be made to insure that a system problem has been corrected.

CAUTION: A leak in a boiler system will cause the system to intake fresh water constantly which will cause the tubes to accumulate lime build-up and cause failure of the tubes. This is not a warrantable failure.

Soot

External sides of copper tubes should be free of any soot deposits. (A slight black smudge is normal with some types of gases.) Any abnormal deposit should be removed and the CAUSE CORRECTED. Check the following:

1. Insufficient air supply.
2. Inadequate venting.
3. Abnormally high gas pressure in burner manifold.
4. Blockage of secondary air supply.
5. Incorrect gas orifice for gas type used or altitude of installation.

Prevention Of Freezing:

Copper-tube heat exchangers and headers, damaged by freezing, are not covered by warranty. If equipment is installed in cold weather areas, the following precautions must be observed.

- A. **Pump Operation - MOST IMPORTANT** - This boiler is designed for continuous pump operation.* Properly installed, the constant circulation of water through the unit will help prevent freezing. (See Freeze Protection)
- B. **Location** - The boiler should be located within a room having a temperature safely above freezing (32° F).
- C. **Shut-down and Draining** - If for any reason the boiler is to be shut off, the following precautionary measures must be taken:
 1. Shut off gas supply.
 2. Shut off water supply.
 3. Shut off the electrical supply.
 4. Drain boiler completely.
 5. Drain Pump.

*Unless provided with solid state intermittent pump controller (optional).

BOILER TEMPERATURE RISE

These copper tube boilers are generally capable of operating within the design flow rates for the building heating system. Should the flow rate of the system exceed the maximum allowable flow rate through the boiler, however, an external boiler bypass must be installed in accordance with the specifications of Table E to prevent boiler damage. See Figures 8 and 9.

MAXIMUM BOILER FLOW RATES

665,000 - 1,350,000 BTUs

1,540,000 - 3,060,000 BTUs

Table E

90 GPM

135 GPM

If the temperature rise through the boiler is lower than recommended in Table F, water velocity is too high.

To adjust

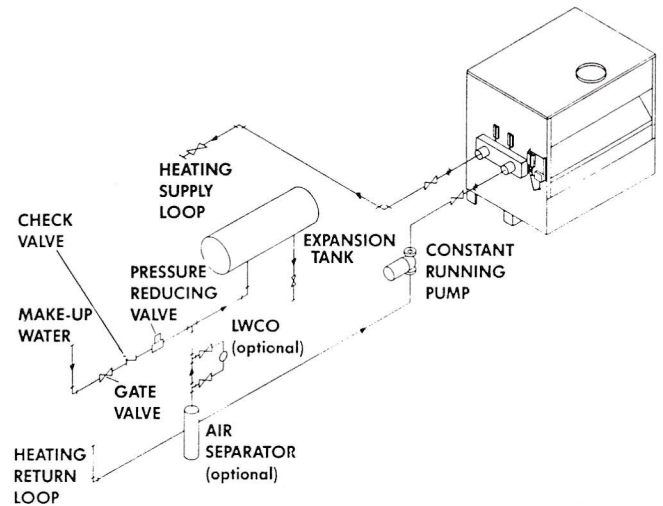
Allow the boiler to operate until the temperature differential between the inlet and outlet is stabilized. Slowly close the balancing cock on the outlet side of the boiler (or boiler by-pass if furnished) until the desired temperature differential is established and remains constant. The boiler is now adjusted to assure optimum results. Periodic inspections should be made to insure that proper flow rates are being maintained through the boiler.

Adjusting the Boiler Flow Rate

Proper installation requires that a balancing cock be placed on the outlet side of the boiler for purposes of adjusting the flow rate through the heat exchanger. Thermometers are installed on both the inlet and outlet side of the boiler. By determining the temperature rise through the boiler in accordance with the recommendations in the chart (Table F) the proper velocity through the boiler may be maintained for peak efficiency, long life, and economy of operation.

TYPICAL BOILER INSTALLATION - FIG. 6
665,000-3,080,000 BTUs

Note: Flow rates must not exceed those shown in Table E



SYSTEM TEMPERATURE RISE CHART – TABLE F
According To BTU Input

Input	Output	ΔT 10°		ΔT 20°		ΔT 30°		ΔT 40°		ΔT 50°		ΔT 60°	
		GPM	FT.HD	GPM	FT.HD	GPM	FT.HD	GPM	FT.HD	GPM	FT.HD	GPM	FT.HD
475,000	380,000	76	4	38	1.5	25	1	—	—	—	—	—	—
570,000	456,000	91	6	46	2	30	1	23	1	—	—	—	—
665,000	532,000	106*	6†	53	2.5	36	1.5	27	1	—	—	—	—
760,000	608,000	122*	6†	61	2.5	41	1.5	30	1	24	1	—	—
940,000	752,000	151*	6†	75	4	50	2	38	1.5	30	1	25	1
1,206,000	965,000	193*	6†	97*	8†	64	3	48	2	39	1.5	37	1
1,540,000	1,232,000	247*	11†	123*	11†	82	4	62	2.5	49	2	41	1.5
1,700,000	1,355,000	271*	11†	136*	11†	90	5	68	3	54	2	45	1.5
2,000,000	1,601,000	321*	11†	160*	11†	107	6.5	80	4	64	2.5	53	2
2,310,000	1,848,000	370*	11†	185*	11†	123	9	92	5	74	3	62	2.5
2,620,000	2,094,000	419*	11†	210*	11†	140*	11†	105	6.5	84	4	70	3
3,080,000	2,464,000	493*	11†	247*	11†	164*	11†	123	9	99	6	82	4

*These flow rates exceed recommended flow rates of the boiler. If these system temperature rises are used, an external piping by-pass should be installed as shown in Fig. 8 & 9, pgs. 11 & 12.

†These foot head calculations are for the maximum allowable flow rate of the boiler.

SPECIAL DESIGN APPLICATIONS

Installation of Air Conditioning System

Pipe refrigeration system in parallel. Install a duct coil downstream of cooling coil. Where the hot water heating boiler is connected to a heating coil located in air handling units where they may be exposed to refrigerated air circulation, the boiler piping system must be equipped with flow control valves or other automatic means to prevent gravity circulation of the boiler hot water during cooling cycle. The coil must be vented at the high point and the hot water from the boiler must enter the coil at this point. Due to the fast heating capacity of the boiler, it is not necessary to provide a ductstat to delay circulator operation; also, omit thermal flow checks, as the boiler is cold when heating thermostat is satisfied. This provides greater economy over maintaining a standby heat. See Figure 7.

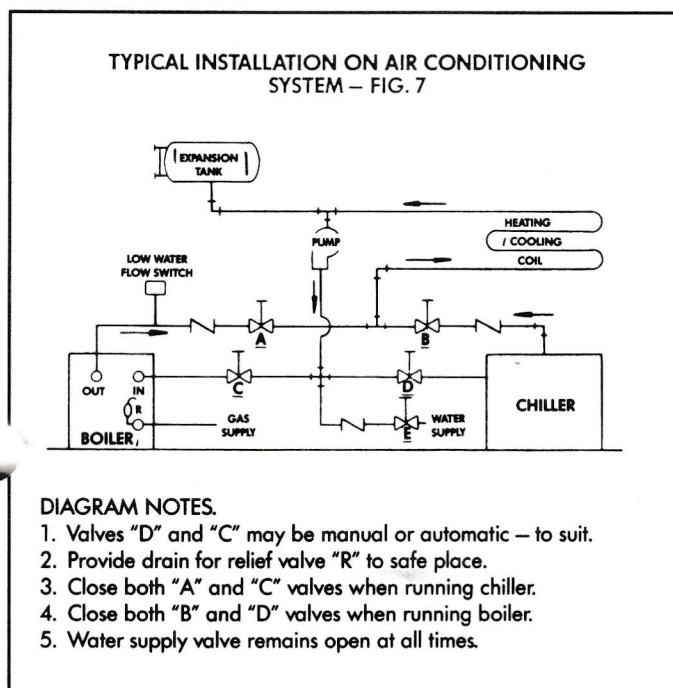


Figure 8 indicates the recommended piping layout for boiler installations requiring a by-pass. This is a simple and inexpensive means of recirculating a portion of the water in the system where the building flow rate exceeds the capacity of the boiler.

LOW WATER TEMPERATURE SYSTEMS

A number of hydronic boiler applications call for system water temperature operation in the range of 60° to 110° F. Several of the more typical of these applications are: Water Source Heat Pump Systems; Greenhouse Soil Heating and Irrigation Systems; Process or Manufacturing Operations.

Installations such as these, while increasingly common, often present problems resulting from boiler condensation, thermal stresses, and poor overall system efficiency. Our copper tube boilers are particularly adaptable to applications of this type for several reasons:

1. This is an instantaneous boiler, requiring virtually no heat-up time, and having no temperature "overshoot". Result? High system efficiency!

2. The boiler unique construction prevents the transfer of heat exchanger thermal stresses to other boiler components- reducing wear and tear, while increasing equipment life expectancy.
3. Its compact, simple design and low boiler mass permits simple by-pass arrangements which allow the system to be operated at any temperature above 60° F.

The piping illustration and instructions in Figures 8 and 9 detail a simple details a simple by-pass arrangement which will allow the system to be operated at any temperature above 60° F, without condensation forming in the boiler.

Condensation is prevented by simply regulating the flow balancing valve so as to divert sufficient water flow through the boiler to maintain water temperatures specified, while allowing the system to operate at design temperature (as low as 60°F).

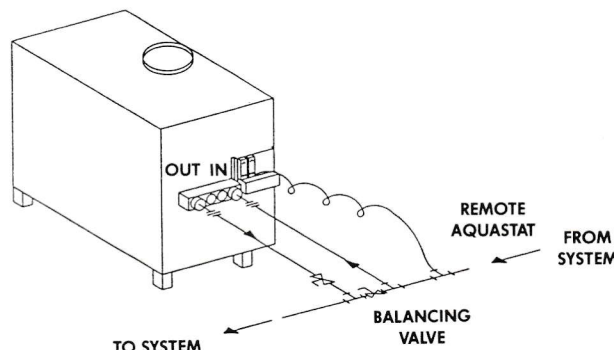
For Low Temperature Operation Proceed As Follows:

1. Select proper boiler size.
2. Set remote control aquastat at desired system temperature.

LOW TEMPERATURE PIPING

Boilers in this input range may be installed with a balancing valve in the main system to divert water flow through the boilers. The system pump provided all flow. Piping and valves shown below.

FIG. 8

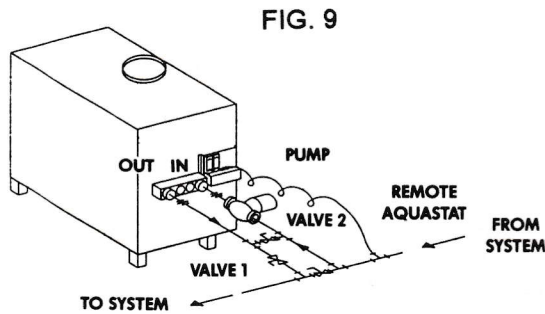


Low Temperature Operation (continued)

3. Start system and adjust balancing valve until boiler temperature rise stabilizes at approx. 60°F differential.
4. The minimum outlet water temperature is 120°F.
5. Operate boiler until desired system operating temperature is achieved. Check out all components for operation.
6. Carefully following these instructions will permit the system circulating loop to operate at the desired temperature regardless of the higher boiler water temperature.

ALTERNATE LOW TEMPERATURE PIPING

If the system pump will not provide proper flow, the boiler may be installed with a secondary pump, valves and bypass as shown below.



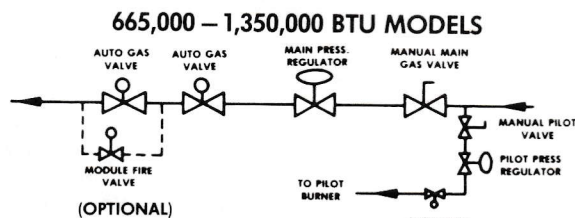
3. Start system and adjust balancing valve (1), slowly closing until inlet temperature to boiler is 140° F minimum.
4. If temperature to boiler exceeds 140°F, slowly close valve (2) until 140° F is maintained.
5. Operate boiler until desired system operating temperature is achieved. Check out all components for operation.
6. Carefully following these instructions will permit the system circulating loop to operate at the desired temperature regardless of the higher boiler water temperature.

NOTE: Closed Loop Systems may require an expansion tank, water feeder, air vents, and/or other components not furnished with the boiler.

BOILER GAS TRAIN & CONTROLS

NOTE: The boiler gas train and controls assembly have been tested under the American National Standard for Hot Water Boilers to meet minimum safety and performance criteria such as safe lighting, combustion and safety shutdown operation.

FIG. 10



DOMESTIC HOT WATER SUPPLY BOILER

This section contains specific requirements for hot water supply boilers. All warnings, cautions and notes regarding boilers apply to these units in addition to the comments contained below for those units used to supply domestic hot water usually in conjunction with a storage tank. The use of a proper pump size and the control of water velocity, as explained below, are important for correct operation of your hot water supply boiler.

WATER VELOCITY CONTROL

IMPORTANT - To insure proper velocity through the heat exchanger, it is necessary to regulate the temperature rise across the heat exchanger from inlet to outlet. This must be done on initial installation and periodically rechecked. With the correct temperature rise across the heat exchanger, you may be assured of the proper velocity in the tubes and long life and economical operation from your hot water supply boiler. Excessive lime build-up in the tubes is a result of too little velocity through the tubes. Excessive pitting or erosion in the tubes is caused by too much velocity through the tubes. Care should be taken to measure temperature rise and maintain a velocity as follows:

1. The pump must run continuously.
2. With the pump running and the water heater off, the inlet and outlet thermometers should read the same temperature. If they do not, an adjustment must be made to your final calculation.
3. Turn the water heater on and allow time for the temperature to stabilize. Record the difference between the inlet and outlet temperatures. This difference will be the "temperature rise".
4. Compare the temperature rise on the heater with the required temperatures rise in Table G. Should adjustment be needed, proceed as follows:

If the temperature rise is too high, the water velocity is too low. Check the following:

1. Check for restrictions in the outlet of the heater.
2. Be sure all valves are open between the heater and the tank.
3. Check the pump to be sure it is running properly and that the pump motor is running in the proper direction.
4. Be sure that the circulation pipes between the heater and storage tank are no less than 2" diameter for 665,000-1,350,000 BTU models and 3" diameter for 1,540,000-3,080,000 BTU models.

If the temperature rise is too low, the water velocity is too high. Adjust as follows:

1. Slowly throttle the valve on the outlet side of the heater until the temperature rise is steady at the required temperature rise in the chart below.

REQUIRED TEMPERATURE RISE

BTUs	ΔT, °F	BTUs	ΔT, °F
665,000	20	1,540,000	25
760,000	20	1,700,000	30
940,000	25	2,000,000	35
1,210,000	30	2,310,000	40
		2,620,000	45
		3,080,000	50

TABLE G

PUMP OPERATION

1. The Hot Water Supply Boiler must be connected with a properly sized, continuously running pump that circulates water between heater and storage tank.
2. Pump is sized to heater input and water hardness. Care should be taken that pump is sized correctly.

The pump chart is based on the following fittings:

665,000 - 3,080,000

6-90° elbows

2 unions

2 ball valves

1 cold water supply tee

Not more than 45 feet of straight pipe

For every elbow and tee in excess of those shown above, DEDUCT 5 FEET from maximum allowable straight pipe in heater-to-tank circulating loop.

BTUs	Pump Performance Water Hardness of 25 grains	
	GPM	Ft. Hd.
665,000-1,350,000	55	10
1,540,000-3,080,000	90	9

Table H

HEAT EXCHANGER

This is a highly sophisticated heat exchanger, designed to carry water in such a way that it generates a scouring action which keeps all interior surfaces free from a build-up of impurities. The straight-line, four-pass design of the tubes sends water into the headers at properly rated velocity. The configuration of the headers, in turn, creates a high degree of turbulence which is sufficient to keep all contaminants in motion and in suspension. This "scouring action" provides greater cost savings for owners. Tubes are always able to transfer heat at peak efficiency. Every surface within this water containing section is of a non-

ferrous material, providing clear, clean, rust-free hot water. Straight copper tubes - finned on the outside for maximum heat transfer - coated cast iron headers, and inspection covers make up an entirely rust-proof unit. On all models, header inspection covers can be removed for field inspection and cleaning of copper tubes. Entire heat exchanger may be easily removed from the unit.

CATHODIC PROTECTION

When cathodic protection devices are used in the storage tank, hydrogen gas can be produced when the system has not been used for a long time (generally, two weeks or more). To prevent injury, we recommend a hot water faucet be open for several minutes. *Hydrogen gas is extremely flammable.* If hydrogen is present, it will probably sound as though air is escaping through the hot water faucet. There should be no smoking or open flame near the faucet while it is open.

COMMON WATER MANIFOLD SIZE FOR MULTIPLE WATER HEATER INSTALLATION

Pipe sizing chart provides minimum pipe size for common manifold piping to insure adequate flow.

Number of Units	Common Manifold Size (Min.)
665,000-1,350,000	
1	2"
2	3"
3	3½"
4	4"
5	5"
6	5"
1,540,000-3,080,000	
1	3"
2	3½"
3	4"
4	5"
5	6"
6	6"

Table I

TEMPERATURE ADJUSTMENT (Domestic Hot Water Use)

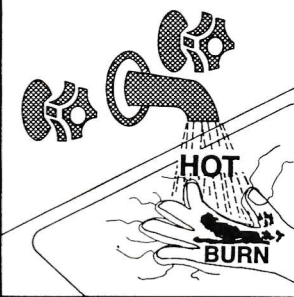
This unit has an adjustable thermostat to control water temperature. The thermostat is factory pre-set at approximately 125° F. Households with small children or invalids may require a 120° F or lower temperature setting to reduce risk of scald injury. Some states may require a lower temperature setting. Check with your gas supplier for local requirements governing the temperature setting. Remember, no water heating system will provide exact temperatures at all times. Allow a few days of operation at the setting to determine the correct temperature setting consistent with your needs.

NOTE: (1) This water heater, when set at the lower temperature setting, is not capable of producing hot water of sufficient temperature for sanitizing purposes. (2) Higher stored water temperature increases the ability of the water heater to supply desired quantities of hot water, however remember

CAUTION: Hotter water increases the risk of scald injury.

Incorrect piping of the cold water supply to the system may result in condensate formation on the heat exchanger and operational problems. See the typical installation drawings provided with the unit for correct piping. Higher water temperatures reduce condensate formation.

CAUTION: Setting the temperature selector dial higher provides hotter water, which increases the risk of scald injury.



! DANGER

- Water temperature over 125°F can cause severe burns instantly or death from scalds.
- Children, disabled and elderly are at highest risk of being scalded.
- See instruction manual before setting temperature at heating appliance.
- Feel water before bathing or showering.
- If this appliance is used to produce water that could scald if too hot, such as domestic hot water use, adjust the outlet control (limit) or use temperature limiting valves to obtain a maximum water temperature of 125°F.