

## SECTION 3.

### Operation

#### 3.1 Controls - General (see Figures 12 and 13)

1. Electronic Ignition Controls:
  - a. Intermittent Ignition:  
 Pilots are automatically lit when the operating control calls for heat (Systems #4 and #9). The unit performs its own safety check and opens the main valves only after the pilot is proven to be lit. Whenever the pilot flame is interrupted, the main gas valve closes within 0.8 seconds.
  - b. Electronically Supervised Standing Pilot System (System #16):  
 When pilot flame fails, the ignition control module responds in less than 0.8 seconds and provides 100% safety shutdown.
2. Operating Controls:  
 An electronic temperature control is provided on model MT boilers to control the pool water temperature. The temperature sensor (thermistor) is located in the filter circulation piping (see Section 2.8).
3. Boiler Power (On/Off/Auto) Switch:  
 This provides for constant or automatic pump operation.
4. High Limit Controls:

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

5. Flow Switch:  
 Standard on all model MT pool heating boilers. The switch is mounted in a tee fitting on the outlet header. This is a paddle type switch which is deflected by the water flow in the fitting. Any condition which interrupts or decreases the flow through the secondary loop will shut down the burners.
6. Low Water Cut Off (optional):  
 The low water cut off automatically shuts off boiler whenever water level in the heat exchanger drops below probe level. It is located in the inlet header.

#### 3.2 Initial Start-Up

### ⚠ WARNING

Do not use this appliance if any part has been under water. Immediately call a qualified service technician to inspect the heater. The possible damage to a flooded appliance can be extensive and present numerous safety hazards. Any appliance that has been under water must be replaced.

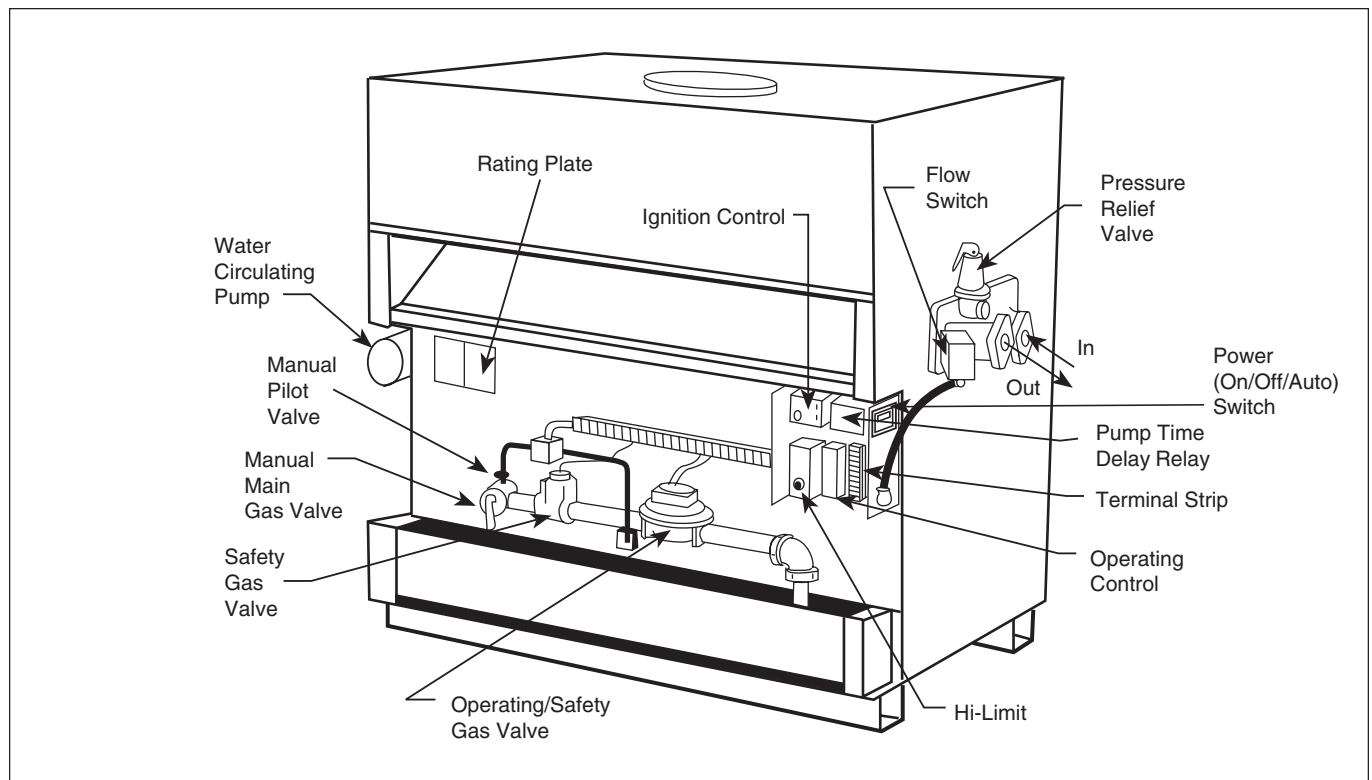


Figure 13. Controls Location.

On a newly constructed pool, be sure to run the filter pump long enough for a complete “turn-over” of the pool water before starting heater so that dirt and residue from construction will have been removed. The filter may clog rapidly during this period, causing severe cycling of the heater.

1. Before placing the heater in operation, be certain that the heater is filled with water and that all air is purged from the system. Open all the valves in the secondary piping.
2. With the filter pump running, run the heater pump in manual “CONSTANT PUMP” for minimum of 10 minutes and listen for the flow switch to make as the pump is started. Loosen the pipe plug on the top of the pump scroll casting to bleed off any air. NOTE: If the system will be operated in a manner that causes air to be drawn into the heater and the secondary piping, an automatic float type air vent should be permanently installed on top of the pump scroll.
3. To check the heater firing, proceed as follows:
  - a. Turn off the power switch.
  - b. Turn off all manual gas valves and wait five minutes (Figure 13).
  - c. Set operating control to the lowest setting.
  - d. After placing the manual pilot gas valve in the open position and resetting all safety devices (high limit, low water cutoff, etc.), the pilot(s) can be lit following the procedure on the heater rating plate.
  - e. For standing pilot system, press on pilot relay knob (see Figure 15), light pilot and keep relay knob depressed for one minute then release. Once the pilot is lit, turn power switch to “AUTO PUMP.”
- f. Wait 5 minutes and turn up operating control until heater fires (for intermittent ignition system, the pilot will be ignited automatically). The main burners should ignite smoothly. Turn the operating control back to the lowest setting.

**NOTE: DO NOT OPERATE HEATER UNTIL THE FOLLOWING SAFETY CHECKS HAVE BEEN PERFORMED.**

### 3.3 Safety Shutoff Component Checkout

1. Once the pilot(s) is lit and has been established for five minutes, the flame failure response time should be checked as follows:

**Systems 4 and 9** - (intermittent ignition). With this system pilots are automatically lit when the operating controls call for heat. If the pilot flame fails for any reason, the main valve is shut off within one second

and the pilot spark ignition is initiated until the pilot flame has been reestablished. This sequence should be checked by turning off the manual pilot gas valve (see Figure 14), and, at the same time, monitoring the audible sparking at the pilot burner and signal interruption to the main valve.

#### Caution

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

**System 16** - (electronically supervised standing pilot system). Extinguish the pilot flame by placing the manual pilot valve in the closed positions (see Figure 14), and at the same time, begin recording the time it takes for the output signal from the electronic ignition control to be interrupted. The signal interruption can be detected either with a test light or a voltmeter. The response time should never exceed one second.

2. Hi-Limit Checkout. For spas see Section 3.9. The manual reset high limit is factory preset to 150°F (66°C). Confirm this set point on the unit and adjust if necessary. After running the heater in a firing mode for 10 minutes, slowly close the outlet valve “A” to raise the outlet temperature as indicated on the outlet thermometer. The high limit should trip within 2°F (1°C) or 3°F (2°C) of the 150°F (66°C) setpoint and shut off the burners. If this does not occur, adjust the set point on the unit to shut off the burners when the outlet thermometer reads 150°F (66°C). Open the outlet valve “A” and push the reset button. The main burners should reignite.
3. Flow Switch: See attached vendor literature.
4. Low Water Cutoff (optional): See attached vendor literature.

### 3.4 Inlet Temperature and Temperature Rise Adjustment

For proper operation the bypass and outlet valves must be adjusted to obtain the correct heater temperature rise. Use the following method to set the bypass assembly at start up:

1. With all bypass valves open, fire the heater for at least 10 minutes. The operating control should be set at least 5° to 10° F above the pool temperature to ensure continued operation throughout this set up procedure.
2. Observe the thermometer on the inlet header. To prevent condensation and damage to the boiler, the inlet water temperature has to be 100°F.

**If the inlet temperature is LESS THAN 100°F:**

With the bypass valve “A” fully open, throttle (turn down) outlet valve “B” slightly. Observe the inlet thermometer for 5 minutes to see where the inlet temperature stabilizes. If it remains under 100°F, throttle outlet valve “B” a little more. Repeat as necessary. If the inlet temperature rises above 100°F, open outlet valve “B” slightly until the inlet temperature stabilizes as close to 100°F as possible (plus or minus 2°F).

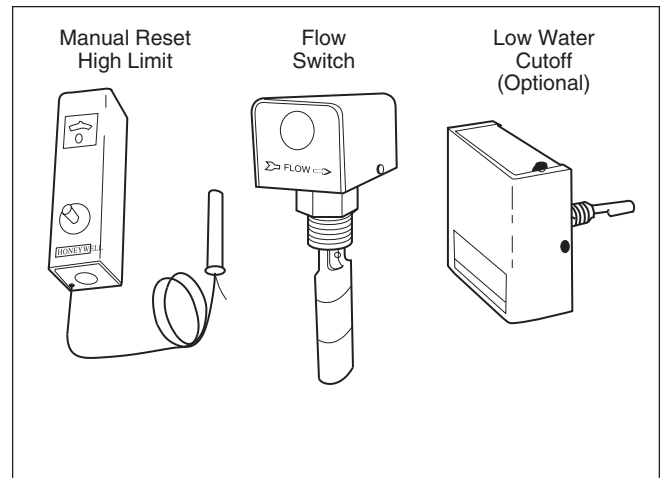
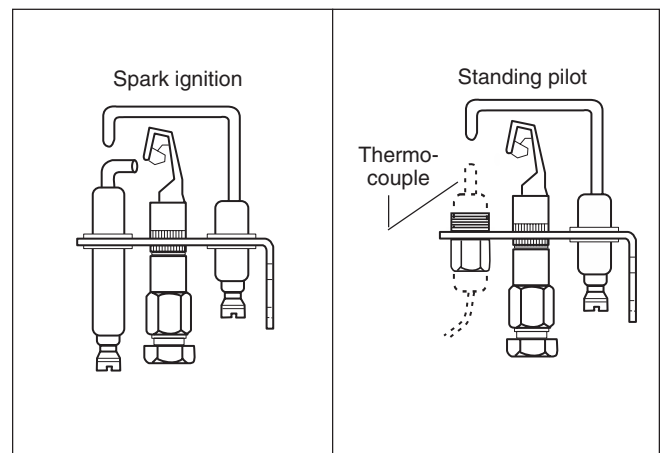
**If the inlet temperature is MORE THAN 100°F.** If outlet valve “B” has been throttled partially closed, open it slightly, wait 5 minutes, and, if the temperature is not down to 100°F (plus or minus 2°F) open it some more. If bypass valve “B” is fully open and you are still seeing inlet water temperatures in excess of 100°F, you can adjust bypass valve “A”. Throttle it (turn down) slightly towards closed, and wait until the inlet water temperature stabilizes again. Repeat as necessary. When the inlet temperature is stabilized at 100°F, either lock the valve handles, remove them, or prominently mark them to prevent tampering or accidental changes to the valve positions.

If the pool water temperature needs to be raised more than 10° F to reach a comfortable swimming temperature, inspect and re-adjust the valves twice a day to maintain the 100°F inlet water temperature.

- To prevent nuisance high limit tripping, set the adjustable pump time delay relay to 10 minutes for all models. This allows the boiler pump to circulate water through the heat exchanger after the burners shut off, recovering all residual heat in the metal components.
- The boiler outlet temperature with the bypass adjusted as detailed above should be less than 142°F. The normal range will be 10 to 37°F higher than the inlet temperature. If it exceeds 142°F, please contact the Service Department at 800-900-9276, extension 5406 for instructions. Outlet temperatures in excess of 142°F may cause intermittent high limit tripping.

**POOL OPERATING CONTROL ADJUSTMENT:**

- Adjustable Differential Feature:** Remove the cover from the control box and verify that the white differential potentiometer is set at about 2°F (1°C). NOTE: a 2°F differential means that, if the thermostat is set at 80°F, the heater will come on at 78°F and go off when the pool reaches 80°F. The 2°F value is a good starting point for most installations. This differential may be adjusted up or down to suit individual applications.
- The operating control temperature setting can be

**Figure 14. Safety Components.****Figure 15. Pilot Burners.**

adjusted incrementally to obtain the desired pool operating temperature.

**3.5 Heater Shut Down**

- If heater is firing, turn operating control to lowest value, wait 10 minutes for pump to stop running, then turn power switch to off.
- If heater is not firing, turn power switch to off.

**3.6 Spring and Fall Operation Stand-by Service**

Turn the thermostat down to approximately 70°F (21°C). This will prevent the pool and surrounding ground from becoming chilled and also permit the pool to be raised to swimming temperature in a shorter time.

A pool may be maintained at a lower temperature than 70°F (21°C) with some increased likelihood of condensation and damage to the unit. Models 500 through 1010 will maintain an inlet temperature of 85°F (29°C) to 90°F (32°C) (if the bypass is properly adjusted) with a pool temperature of 60°F (16°C). Models 1200 and 1430 can maintain the above with a pool temperature of 65°F (18°C). For models 1670

and 1825 pool temperature should be maintained at 70°F (21°C) or above. See item 3 in the next section.

- An adjustable pump time delay relay is mounted in the control panel (see Figure 11). This relay keeps the pump running after the burners shut off. The delay should be set to 5-6 minutes for models 500-850 and 9-10 minutes for models 1010-1825.

### 3.7 Winter Operation Complete Shutdown

- To shut down the heater for periods of several months or more, turn manual main gas valve and pilot gas valve to "OFF." Where danger of freezing does not exist, some water should flow through the heater during the normal filter cycle all year long, even when the heater is turned off or shut down completely, if all bypass valves are opened.
- If the heater is not protected from freezing temperatures, it should be **completely drained before the first frost**. Drain the heater by removing the drain plug on the bottom of the front header casting. Leave the plug out until ready to use the heater again. Heater must be level to permit adequate draining. When compressed air is used to blow out lines, it is still necessary to follow the above procedure. Keeping the pool heated and the filter pump running continuously will not be adequate protection. If there is a pump failure or an electrical power failure, the boiler cannot fire and may freeze and be damaged.
- Improper Use of Heater:** The heating boiler is not designed for continuous use as an "anti-freezing" device for pools. Operating the heater with low water temperatures will cause the fins on the heat exchanger to be partially blocked with condensation. Incomplete combustion and prolonged operation under these conditions will result in the heat exchanger sooting up. This can seriously damage the heater and may create a dangerous fire hazard.

### 3.8 Time Clock Operation

During the warm-up period, the heater must run continuously so it can raise the pool temperature from cold to above 70°F (21°C).

Remove all time clock stops and permit the heater to raise pool temperature to 70°F (21°C) or above in one continuous operation.

When the time clock stops are replaced, be sure to allow the filter pump and the heater to stay on long enough to keep the pool up to the desired temperature.

### 3.9 Therapeutic Pools (Spas)

Therapeutic pools or "spa" pools are usually piped and controlled so that very warm or hot water, often with air injection, is forced at high velocity into a confined area of a swimming pool or into a small separate pool. For the purposes of this manual, any application in which the water temperature is maintained above 85°F (30°C) is considered a *spa*.

#### SPECIAL SET-UP AND OPERATING PROCEDURES APPLY TO SPAS.

- Models 1010I and 1010E and larger should **not** be used for spas due to their higher temperature rises.
- Since outlet temperatures can approach 140°F (60°C) units **must** be piped in a primary-secondary style, similar to that shown in Figure 10.
- To insure that the spa inlet water does not exceed 104°F (40°C), the spa filter pump must circulate at the minimum flow rates shown in Table 5.

Boiler Model	Minimum Filter Pump Flow Rate
500	220 GPM
600	270 GPM
715	320 GPM
850	380 GPM

**Table 5. Minimum Filter Pump Flow Rates For Spas.**  
**Note: Maximum Spa Temperature Is Assumed To Be 100°F (38°C).**

- The high limit stop should be changed to 140°F (60°C). The set point should then be checked following the procedure in 3.3.
- Use the outlet valve "A" to set the inlet temperature per section 3.4.
- Spas are excellent for relaxation, body-conditioning and for arthritic and rheumatic problems, but can be hazardous. The Consumer Product Safety Commission has recommended the following "Safety Rules for Hot Tubs:"
  - Spa or hot tub water temperature should never exceed 104°F (40°C). A temperature of 100°F (38°C) is considered safe for a healthy adult. Special caution is suggested for young children.
  - Drinking of alcoholic beverages before or during spa or hot tub use can cause drowsiness which could lead to unconsciousness and subsequently result in drowning.
  - Pregnant women beware! Soaking in water above 102°F (39°C) can cause fetal damage during the first three months of pregnancy (resulting in the birth of a brain-damaged or deformed child). Pregnant women should stick to the 100°F (38°C) maximum rule.
  - Before entering the spa or hot tub, users

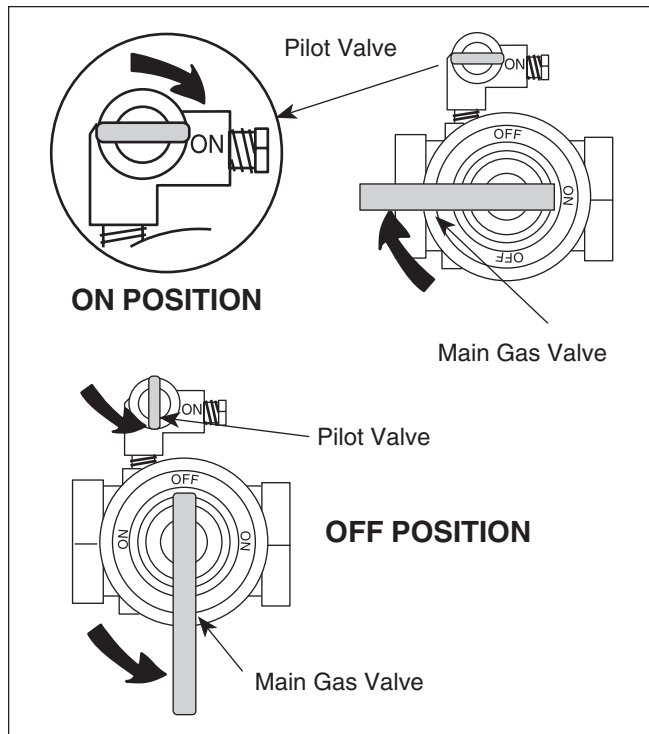


Figure 14. Manual Gas Valves.

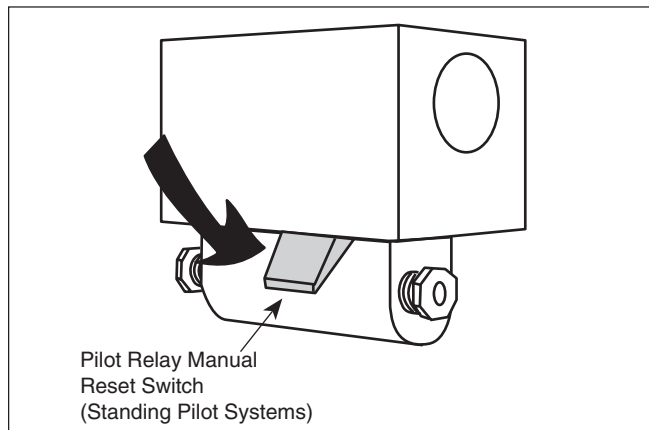


Figure 15. Pilot Safety Relay.

should check the water temperature with an accurate thermometer; spa or hot tub thermostats may err in regulating water temperatures by as much as four degrees Fahrenheit (2.2°C).

- e. Persons with a medical history of heart disease, circulatory problems, diabetes or blood pressure problems should obtain their physician's advice before using spas or hot tubs.
- f. Persons taking medications which induce drowsiness, such as tranquilizers, antihistamines or anticoagulants, should not use spas or hot tubs.

## SECTION 4. Maintenance

1. Lubricate the pump seal every 6 months with ½ oz. of SAE 30 non-detergent oil. Slowly add to pump oil cup located on top of the bearing bracket.
2. At start-up and every six (6) months thereafter, the pilot and main burner flame should be observed for proper performance (see Figure 16). See attached lighting and shut-down instructions for proper pilot flame pattern. If flame has the appearance of "sooting" tips, check for debris near orifices and call the Pentair Water commercial Pool and Spa technical support (see page 2).
3. Inspect the venting system for obstruction, leakage and corrosion at least once each year.
4. Keep heater area clear and free from combustible material, gasoline and other flammable vapors and liquids (see Table 1 for minimum clearances).
5. Be certain all combustion air and ventilation openings in the room are unobstructed.
6. Check for fouling on the external surfaces of the heat exchanger every six months. (**NOTE:** after installation and first start-up, check the heat exchanger for fouling after the following periods of operation: 24 hours, 7 days, 30 days, 90 days and once every six months thereafter.)  
Fouling on the external surfaces of the heat exchanger is caused by incomplete combustion and is a sign of combustion air and/or venting problems. As soon as any fouling is observed, the cause of the fouling should be corrected (see Section 5, Troubleshooting Guide). The heat exchanger can be checked with a flashlight by locating a mirror under the burners. An alternate method is to remove the venting and top panels as necessary to inspect the heat exchanger from above. Also check the vent system for defects at this time. (If cleaning is required, shut off all electrical and gas supply to the heater.)
7. To expose the heat exchanger:  
**Indoor Models:** Remove the flue pipe, top of unit, rear upper jacket, flue collector rear panel and heat exchanger baffles.  
**Outdoor Models:** Remove vent top assembly, rear upper jacket, flue collector rear panel and heat exchanger baffles.
8. To remove all burners:  
It is usually more convenient to remove the burner tray assembly. Disconnect sensor wire, ignition cable (or thermocouple generator) and pilot gas line. Disconnect manifold inlet union(s). Remove the four (4) retaining screws. Grasp the manifold pipe and slide out the burner tray.

### ⚠ Caution

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

9. Clean heat exchanger using a wire brush to remove soot and loose scale from the unit. Clean fallen debris from bottom of heater. Make sure burner ports are clear and pilot assembly is free of debris.
10. Reassemble in reverse order and be sure the heat exchanger baffles are replaced.
11. The gas and electric controls installed on the heater are engineered for both dependable operation and long life, but the proper functioning of these components is necessary for safe operation of the heater. It is strongly recommended that the basic items be checked by a competent serviceman every year and replaced when necessary. The basic controls are:
  - a. Water temperature controls.
  - b. Pilot safety system.
  - c. Automatic electric gas valve(s)
  - d. Flow switch.
12. Low water cutoffs should be inspected every six (6) months, when provided.

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

#### 13. Pool Water Chemistry

The mineral content of the pool water increases every day. This is due to the natural evaporation which removes only distilled water and leaves the minerals behind. The regular addition of algicidal and sanitizing chemicals also adds greatly to the mineral content of the pool. If the concentration of minerals in the pool is permitted to become too high, the minerals will precipitate out of the water and deposit onto the walls of the pool, in the filter and in the tubes of the heat exchanger.

For this reason it is very advantageous to drain the pool regularly (at least every two years). This precautionary measure will save the cost of expensive repairs to the finish, filter system and heater.

Another important safety precaution - always keep the pH of the pool water between 7.3 and

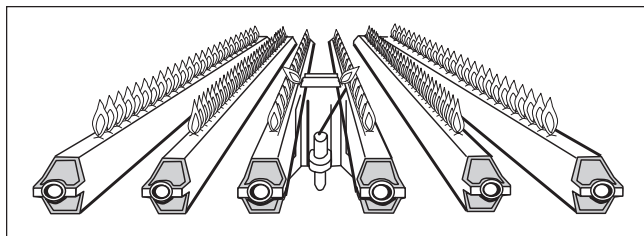


Figure 16. Main Burner Flame Pattern.

7.7. This will add years to the life of the pool finish, filter system and heater.

Most algicidal and sanitizing chemicals contain sodium hypochlorite, while others contain calcium hypochlorite. Sodium is not a scaling chemical but calcium is. When using calcium hypochlorite it is especially important to frequently check the pH of the pool and to change the pool water when the dissolved solids indicate an excessive mineral content.

## SECTION 5. Troubleshooting

For proper service and problem diagnosis of the heater and heater system, the following tools are required:

- a. Gas pressure test kit with range from zero to 14 W.C. Either a slack tube manometer or an accurate gas pressure gauge is acceptable with proper adapters to connect to the available fittings in the line and on the gas valve.
- b. Multi-meter with the following ranges:
  - 0 to 500 volts A.C.
  - 0 to 1000 ohms continuity.
  - 0 to 50 millivolts.
- c. Tube cleaning kit consisting of reamer, stainless steel brush, speed handle and handle extensions.
- d. A pool thermometer with a proper range.
- e. A pressure gauge with proper range.

## SECTION 6. PARTS

### 1. Symptom: heater is pounding, knocking or emitting steam from relief valve

Possible Cause	What to Do
A. Low or no water flow (most likely).	A. Is the heater wired into the filter pump circuit so that the heater cannot fire unless the pump is running? Check to see that all valves in system are open to be sure that water can circulate through the heater. Check pool filter, clean if clogged. Examine heater pump for clogged or frozen impeller. Check flow switch for proper operation and range setting.
B. Debris from system piping is blocking tubes.	B. Remove header covers. Examine all tubes and waterways. Clean out tubes. Use new gaskets when reassembling.
C. Scale has formed in tubes from high mineral content.	C. Clean tubes with tube cleaning kit. Determine hardness. Check water flow, and clean pool filter.

### 2. Symptom: heater will not fire

A. Heater not getting power.	A. Check to see that power switch is "ON." Use testing device to trace power to heater power source. Check fuse and secondary voltage in heater control.
B. Operating or safety control has opened circuit to electric gas valve.	B. Turn off power. Check continuity across terminals of each operating and safety control switch up to the electric gas valve. Replace defective control.
C. Pilot flame is out.	C. Relight pilot per instruction.
D. Manual reset device has tripped.	D. Reset pilot safety and all manual reset safety switches. Follow instructions for start-up.
E. No gas pressure to burners.	E. Trace gas line to service shutoff cock. If service cock is open, trace gas line to meter. If no pressure is present at meter, call for public utility service. If gas is present in heater inlet, check pressures in following sequence: (1) downstream from pressure regulator; (2) downstream from electric gas valve. Replace or adjust as necessary.
F. Electric gas valve operator is burned out or shorted.	F. Disconnect wiring harness at gas valve terminals. Check continuity of actuator coil. If open circuit or short is indicated, replace coil or operator.
G. Pump does not run.	G. Operate in manual. Check power to pump from relay. Check that pump/motor is free to rotate. Replace relay or motor as necessary.
H. Pump runs, but flow switch not closing.	H. Check continuity across flow switch. Inspect paddle for proper movement. Adjust flow range setting.
I. Field interlock open.	I. Jumper terminals and isolate problem in other equipment.

### 3. Symptom: pressure relief valve leaking intermittently or steadily

A. Faulty relief valve.	A. Replace with a new relief valve with proper setting (see rating plate).
-------------------------	--

### 4. Symptom: soot in flueways or in tubes, or noxious fumes from bad combustion

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

### 5. Symptom: water dripping in firebox

A. Tube in heat exchanger has overheated and ruptured.	A. Tube failure is almost always caused by scale formation in the tube, or inadequate water flow through the heater.
B. Heater is condensing from low inlet temperature.	B. Check bypass valve adjustment.