# MODELS HW 300, 399, 420, 520, 610, 670

## GAS-FIRED COMMERCIAL COPPER BOILERS FOR HYDRONIC HEATING AND HOT WATER SUPPLY

## UP-FLOW MODELS

**• INSTALLATION • OPERATION • MAINTENANCE • LIMITED WARRANTY • INDOOR ONLY**

Burkay®

FM APPROVED

DESIGN CERTIFIED

CERTIFIED


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

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

— **WHAT TO DO IF YOU SMELL GAS**

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

— **Installation and service must be performed by a qualified installer, service agency or the gas supplier.**

A.O. Smith

**500 Tennessee Waltz Parkway**
**Ashland City, TN 37015**
**www.hotwater.com**

PLACE THESE INSTRUCTIONS ADJACENT TO BOILER AND NOTIFY OWNER TO KEEP FOR FUTURE REFERENCE

PRINTED 0210

317693-000

# SAFE INSTALLATION, USE AND SERVICE

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

Many safety-related messages and instructions have been provided in this manual and on your own water heater to warn you and others of a potential injury hazard. Read and obey all safety messages and instructions throughout this manual. It is very important that the meaning of each safety message is understood by you and others who install, use, or service this water heater.

| | |
|---|---|
|  | This is the safety alert symbol. It is used to alert you to potential personal injury hazards. Obey all safety messages that follow this symbol to avoid possible injury or death. |

| | |
|---|---|
| **DANGER** | DANGER indicates an imminently hazardous situation which, if not avoided, will result in injury or death. |
| **WARNING** | WARNING indicates a potentially hazardous situation which, if not avoided, could result in injury or death. |
| **CAUTION** | CAUTION indicates a potentially hazardous situation which, if not avoided, could result in minor or moderate injury. |
| **CAUTION** | CAUTION used without the safety alert symbol indicates a potentially hazardous situation which, if not avoided, could result in property damage. |

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

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

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

## IMPORTANT DEFINITIONS

- **Qualified Installer:** A qualified installer must have ability equivalent to a licensed tradesman in the fields of plumbing, air supply, venting and gas supply, including a thorough understanding of the requirements of the National Fuel Gas Code or the Natural Gas and Propane Installation Code as it relates to the installation of gas fired boilers. The qualified installer must have a thorough understanding of this instruction manual.

- **Service Agency:** A service agency also must have ability equivalent to a licensed tradesman in the fields of plumbing, air supply, venting and gas supply, including a thorough understanding of the requirements of the National Fuel Gas Code as it relates to the installation of gas fired boilers. The service agency must also have a thorough understanding of this instruction manual, and be able to perform repairs strictly in accordance with the service guidelines provided by the manufacturer.

- **Gas Supplier: The Natural Gas or Propane Utility or service who supplies gas for utilization by the gas burning appliances within this application. The gas supplier typically has responsibility for the inspection and code approval of gas piping up to and including the Natural Gas meter or Propane storage tank of a building. Many gas suppliers also offer service and inspection of appliances within the building.**

# GENERAL SAFETY

## ⚠ WARNING

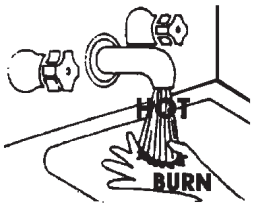
Read and understand this manual and all Warnings and Cautions within before installing and using this appliance.

Place these instructions adjacent to boiler and notify owner to keep for future reference.

## ⚠ DANGER

Untempered hot water can cause severe burns instantly resulting in severe injury or death.

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




Feel water before bathing or showering. Temperature limiting valves are available.

Read instruction manual for safe temperature setting.

## ⚠ DANGER

### Fire or Explosion Hazard

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

Read instruction manual before installing, using or servicing.

## ⚠ WARNING

### Fire Hazard

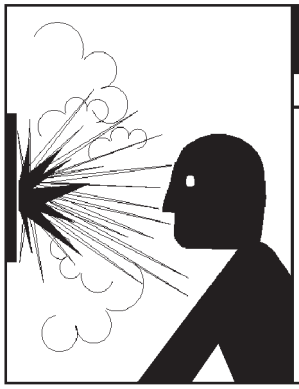
For continued protection against risk of fire:

- Do not install boiler on carpeted floor.
- Do not operate boiler if flood damaged.

## ⚠ DANGER

### Fire or Explosion Hazard

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

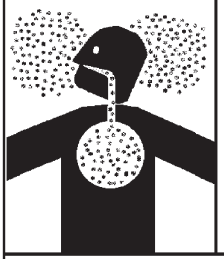
## ⚠ WARNING

### Explosion Hazard

- Overheated water can cause water tank explosion.
- Properly sized temperature and pressure relief valve must be installed.

## ⚠ WARNING

### Breathing Hazard - Carbon Monoxide Gas



- Special consideration must be taken with installations above 2,000 feet.
- Please contact an A. O. Smith qualified service agent to obtain the proper setup and instructions before lighting.
- Failure to implement the proper setup will result in improper and inefficient operation of the appliance resulting in production of increased levels of carbon monoxide gas in excess of the safe limits which could result in serious personal injury or death.

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

## CAUTION

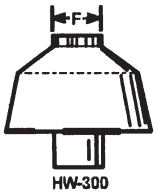
**Improper installation and use may result in property damage.**

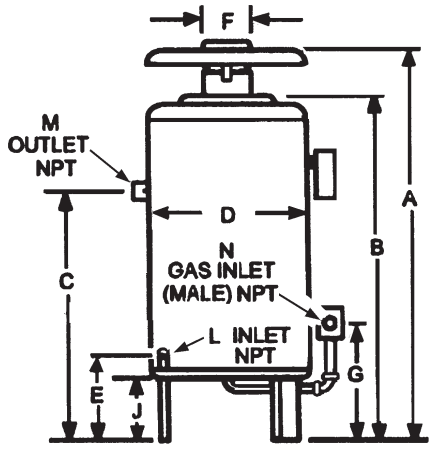
- Do not operate boiler if flood damaged.
- Install in location with drainage.
- Fill boiler with water before operation.
- Be alert for thermal expansion.

Refer to instruction manual for installation and service.

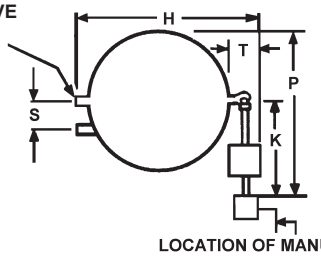
# TABLE OF CONTENTS

# DIMENSIONS AND CAPACITY DATA




EXTRA OPENING
FOR THERMOMETER
AND RELIEF VALVE
HW-520, 610
AND HW--670




LOCATION OF MANUAL
MAIN SHUTOFF VALVE
OUTSIDE JACKET WHEN
CODE REQUIRE
(NOT SUPPLIED)

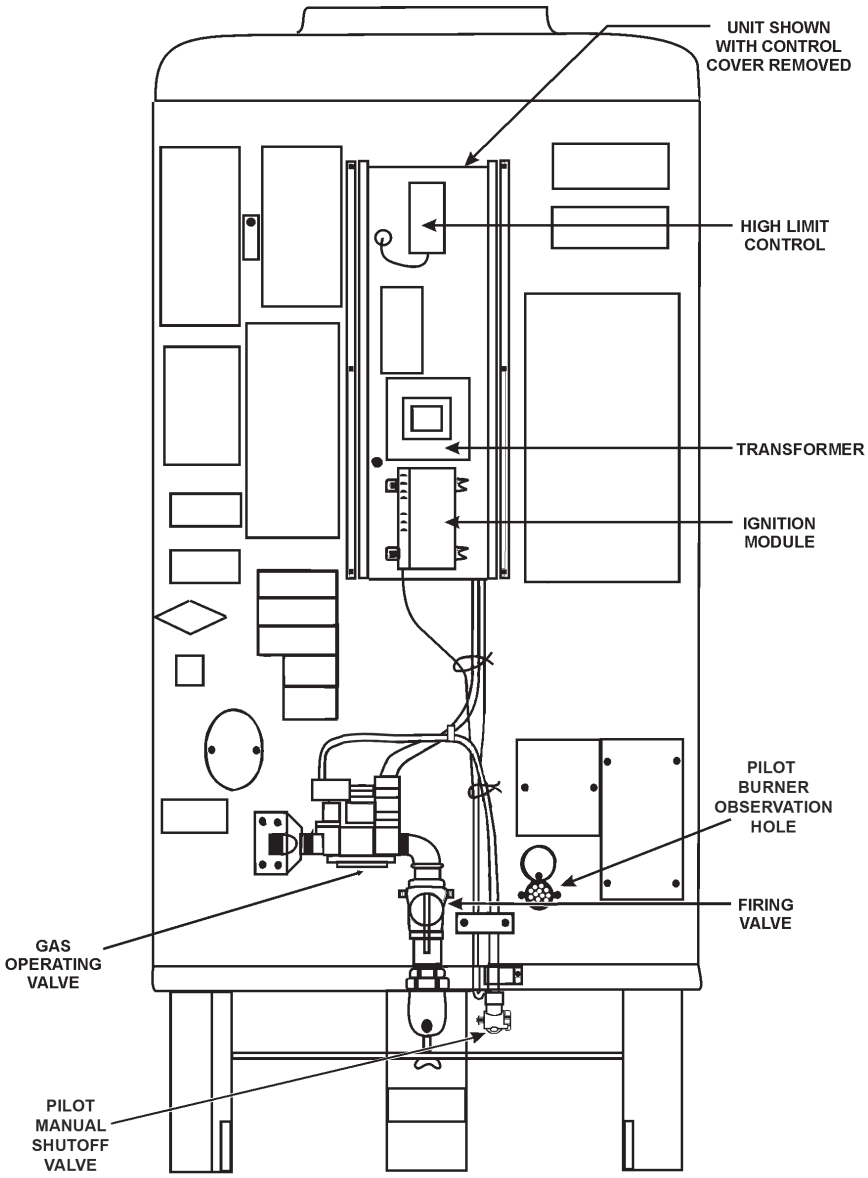
**TABLE 1**

| DIMENSIONS IN INCHES | | MODELS | | | | | |
|---|---|---|---|---|---|---|---|
| | | HW-300 | HW-399 | HW-420 | HW-520 | PROPANE HW-610/670 | NATURAL HW-610/670 |
| A | Overall height | 65 (1651) | 57-1/8 (1451) | 57-1/8 (1451) | 68-5/16 (1735) | 67 (1702) | 64-3/4 (1645) |
| B | Height to Top of Jacket | 43-1/4 (1099) | 45-1/8 (1146) | 45-1/8 (1146) | 56-1/4 (1429) | 56-1/4 (1429) | 56-1/4 (1429) |
| C | Floor to Center Line Water Inlet | 36 (914) | 38-3/4 (984) | 38-3/4 (984) | 46 (1168) | 46 (1168) | 46 (1168) |
| D | Diameter of Jacket | 25-1/4 (641) | 27 (686) | 27 (686) | 27 (686) | 27 (686) | 27 (686) |
| E | Floor to Center Line Water Outlet | 12 (305) | 12 (305) | 12 (305) | 12 (305) | 12 (305) | 12 (305) |
| F | Draft Diverter Outlet Diameter | 8 (203) | 10 (254) | 10 (254) | 10 (254) | 12 (305) | 12 (305) |
| G | Floor to Center Line Gas Inlet | 16-1/2 (419) | 16-3/4 (425) | 16-3/4 (425) | 18 (457) | 18 (457) | 18 (457) |
| H | Overall Depth | 29-5/8 (753) | 31-1/2 (800) | 31-1/2 (800) | 36-1/2 (927) | 36-1/2 (927) | 36-1/2 (927) |
| J | Support Height | 9 (229) | 9 (229) | 9 (229) | 9 (229) | 9 (229) | 9 (229) |
| K | Width of Control String (approx.) | 14 (356) | 14 (356) | 14 (356) | 11 (279) | 11 (279) | 11 (279) |
| L | Pipe Size of Water Inlet (NPT) | 1-1/4 | 1-1/2 | 1-1/2 | 2 | 2 | 2 |
| M | Pipe Size of Water Outlet (NPT) | 1-1/4 | 1-1/2 | 1-1/2 | 2 | 2 | 2 |
| N | Pipe Size of Gas Inlet (NPT) | 3/4 | 1 | 1 | 1 | 1 | 1 |
| P | Control String Plus 1/2 Jacket Diameter (approx.) | 26-5/8 (676) | 27-1/2 (699) | 27-1/2 (699) | 24-1/2 (622) | 24-1/2 (622) | 24-1/2 (622) |
| S | Horizontal Length between Water Inlet and Outlet | 5-3/8 (137) | 5-1/2 (140) | 5-1/2 (140) | 5-3/4 (146) | 5-3/4 (146) | 5-3/4 (146) |
| T | Control String from Jacket | 5 (127) | 5 (127) | 5 (127) | 7 (178) | 7 (178) | 7 (178) |
| | Approximate shipping weight lbs. (Kilograms) | 240 (109) | 291 (132) | 291 (132) | 361 (164) | 361 (164) | 361 (164) |

**NOTE:** All dimensions in inches (millimeters) except pipe size which is NPT

**TABLE 2, RECOVERY CAPACITIES**

| Model | Input | °F | 20 | 40 | 50 | 60 | 70 | 80 |
|---|---|---|---|---|---|---|---|---|
| | BTUH (kW) | °C | 11.1 | 22.2 | 27.7 | 33.3 | 38.8 | 44.4 |
| HW 300 | 300,000 (88) | GPH | 1439 | 719 | 576 | 480 | 411 | 360 |
| | | LPH | 5448 | 2724 | 2179 | 1816 | 1556 | 1362 |
| HW 399 | 399,000 (117) | GPH | 1914 | 957 | 765 | 638 | 547 | 478 |
| | | LPH | 7245 | 3623 | 2898 | 2415 | 2070 | 1811 |
| HW 420 | 420,000 (123) | GPH | 2014 | 1007 | 806 | 671 | 576 | 504 |
| | | LPH | 7627 | 3813 | 3051 | 2542 | 2179 | 1907 |
| HW 520 | 520,000 (152) | GPH | 2494 | 1247 | 998 | 831 | 713 | 624 |
| | | LPH | 9443 | 4721 | 3777 | 3148 | 2698 | 2361 |
| HW 610 | 610,000 (179) | GPH | 2926 | 1463 | 1170 | 975 | 836 | 731 |
| | | LPH | 11077 | 5538 | 4431 | 3692 | 3165 | 2769 |
| HW 670 | 660,000 (193) | GPH | 3165 | 1583 | 1266 | 1055 | 904 | 791 |
| | | LPH | 11985 | 5992 | 4794 | 3995 | 3424 | 2996 |




**COMPONENT LOCATION**
**FIGURE 1.**

# INTRODUCTION

This design complies with the current edition of the ANSI Z21.13 low-pressure boiler standard.

Compliance under this standard implies that when the boiler underwent test, the gas manifold and control assembly provided on the boiler met safe lighting and other performance criteria.

Detailed installation diagrams are found in this manual. These diagrams will serve to provide the installer a reference for the materials and methods of piping necessary. It is essential that all water, gas piping and wiring be installed as shown on the diagrams. You should thoroughly read and understand this manual before installation and/or operation of this boiler.

The factory warranty will be void if the boiler(s) have been improperly installed or operated.

In addition to these instructions, the boiler(s) shall be installed in accordance with those installation regulations in force in the local area where the installation is to be made. These shall be carefully followed in all cases. Authorities having jurisdiction should be consulted before installations are made.

In the absence of local codes, the installation must comply with the current editions, as follows:

In the United States:
The National Fuel Gas Code, ANSI Z223.1/NFPA 54 and the National Electric Code, NFPA 70.

In Canada:
Installation Code CAN/CSA B149.1 and Canadian Electrical Code, CSA C22.1.

**GROUNDING INSTRUCTIONS**

This boiler must be grounded in accordance with the National Electrical Code, Canadian Electrical Code and/or local codes. Correct wiring is imperative for proper operation.

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

**CORRECT GAS**

**MAKE SURE THE GAS ON WHICH THE BOILER WILL OPERATE IS THE SAME AS THAT SPECIFIED ON THE BOILER RATING PLATE. DO NOT INSTALL THE BOILER IF EQUIPPED FOR A DIFFERENT TYPE OF GAS — CONSULT YOUR SUPPLIER.**

**PRECAUTIONS**

**IF THE UNIT IS EXPOSED TO THE FOLLOWING, DO NOT OPERATE UNTIL ALL CORRECTIVE STEPS HAVE BEEN MADE BY A QUALIFIED SERVICEMAN:**

1. **EXPOSURE TO FIRE.**
2. **IF DAMAGED.**
3. **FIRING WITHOUT WATER.**
4. **SOOTING.**

**IF THE BOILER HAS BEEN EXPOSED TO FLOODING, IT MUST BE REPLACED.**

**LIQUEFIED PETROLEUM GAS MODELS**

Boilers for propane or liquefied petroleum gas (LPG) are different from natural gas models. A natural gas boiler will not function safely on LP gas and no attempt should be made to convert a boiler from natural gas to LP gas.

LP gas must be used with great caution. It is highly explosive and heavier than air. It collects first in the low areas making its odor difficult to detect at nose level. If LP gas is present or even suspected, do not attempt to find the cause yourself. Leave the building, leaving doors open to ventilate, then call your gas supplier or service agent. Keep area clear until a service call has been made.

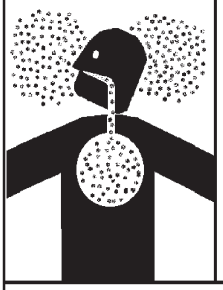
At times you may not be able to smell an LP gas leak. One cause is odor fade, which is a loss of the chemical odorant that gives LP gas its distinctive smell. Another cause can be your physical condition, such as having a cold or diminishing sense of smell with age. For these reasons, the use of a propane gas detector is recommended.

IF YOU EXPERIENCE AN OUT OF GAS SITUATION, DO NOT TRY TO RELIGHT APPLIANCES YOURSELF. Call your local service agent. Only trained LP professionals should conduct the required safety checks in accordance with industry standards.

**HIGH ALTITUDE INSTALLATIONS**

**⚠ WARNING**

**Breathing Hazard - Carbon Monoxide Gas**



- Special consideration must be taken with installations above 2,000 feet (609m).
- Please contact an A. O. Smith qualified service agent to obtain the proper setup and instructions before lighting.
- Failure to implement the proper setup will result in improper and inefficient operation of the appliance resulting in production of increased levels of carbon monixide gas in excess of the safe limits which could result in serious personal injury or death.

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

Rated inputs are suitable up to 2000 feet (610 m) elevation. Consult the factory for installation at altitudes over 2000 feet (610 m).

**HIGH ALTITUDE INSTALLATIONS**

**IN CANADA**

Acceptance of these models for use at altitudes above 2000 feet (600 m) is based on field test of the individual installation by the provincial/state authority having jurisdiction.

**IN THE U.S.A.**

**⚠ WARNING**

INSTALLATIONS ABOVE 2000 FEET REQUIRE REPLACEMENT OF THE BURNER ORIFICES IN ACCORDANCE WITH THE CURRENT EDITION OF THE NATIONAL FUEL GAS CODE (ANSI Z223.1). FAILURE TO REPLACE THE ORIFICES WILL RESULT IN IMPROPER AND INEFFICIENT OPERATION OF THE APPLIANCE RESULTING IN THE PRODUCTION OF INCREASED LEVELS OF CARBON MONOXIDE GAS IN EXCESS OF SAFE LIMITS WHICH COULD RESULT IN SERIOUS PERSONAL INJURY OR DEATH.

For specific orifice requirements, please refer to the appropriate section of the National Fuel Gas Code ANSI Z223.1.

You should contact your gas supplier for any specific changes which may be required in your area.

Ratings specified by manufacturers for most boilers apply for elevations up to 2000 feet (600 m). For elevations above 2000 feet (600 m) ratings must be reduced by a rate of 4% for each 1000 feet (300 m) above sea level.

Example: If a boiler is rated at 610,000 Btu/hr. at sea level, to operate the boiler at 5000 feet (1500 m) it must be derated by 20% (4% x 5) to a new rating of 488,000 Btu/hr.

A. O. Smith does build some models specifically for high altitude service. Please check the rating plate before making changes.

The input reduction is primarily achieved by reducing the size of the main burner orifices. To do this, the main burner orifices require replacement with orifices sized for the particular installation elevation. When ordering, be sure to state the model number and the altitude of the location where the boiler is being installed.

Upon field deration of the boiler, adjustment to the gas pressure regulator is required. See CHECKING AND ADJUSTING THE INPUT in this manual for inlet and manifold pressure requirements. Also, due to the input rating reduction required at high altitudes, the output rating of the appliance is also reduced and should be compensated for in the sizing of the equipment for applications.

# CONTROLS AND FUNCTION

**AUTO RESET HIGH LIMIT**

The high limit is a safety device wired in series with the ignition system. Set the high limit control to approximately $10^0$F above the maximum designed system temperature. If the boiler outlet water temperature should exceed the high limit setting, the main gas valve will close but the circulator will continue to operate. Maximum adjustable setting is $115^0$C (239°F) cut-out with a $3^0$C ($5^0$F) to $25^0$C ($45^0$F) adjustable differential, see Figure 2.

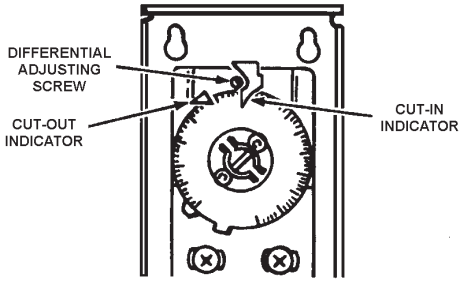



**FIGURE 2.**

**INTERMITTENT IGNITION CONTROL MODULE**

The Honeywell S-8600 control module contains the electronic components of the system and also serves as a control wiring system for the controls mounted on the heater. The control module performs the following functions:

1. Checks for safe-start by sensing for a false flame condition on start-up.

2. Generates a potential of 15,000 volts for spark ignition of the pilot burner.

3. Opens the pilot valve.

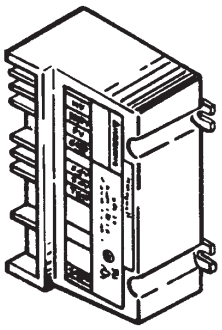
4. Discontinues ignition spark when the pilot flame is established. The S-8600 control used on propane gas models provides safety lockout if the pilot fails to ignite within the pilot flame establishing period. The S-8600 control used on natural gas models continues trial for ignition until pilot flame is established.

5. After proof of pilot flame, opens then main valve.

6. On a power loss, shuts the heater down. When power is restored it will begin a new ignition cycle.

7. On a loss of flame, shuts off main gas and starts trial for pilot ignition.

PLEASE SEE TROUBLESHOOTING SECTION FOR MORE INFORMATION.



**S-8600 INTERMITTENT IGNITION CONTROL MODULE (IID)**

**FIGURE 3.**

## THERMAL BALANCER

Figure 4 shows the internal wiring of the thermal balancer. The device may be tested after disconnecting the four leads from their respective terminals on the unit.

1. Apply a test light to the yellow and red leads.
   - The lamp should light as the contact in this circuit is normally closed when the resistor is cool.

2. Apply a light to the black and yellow leads.

- The lamp should not light as the contact in this circuit is normally open when the resistor is cool.

3. Remove the test light.

4. Apply 120 volts to the white and red leads which power the 1900 ohm resistor. After a warming period the contacts of the thermal balancer should operate.

5. Remove the test light.

6. Apply the test light as described in steps 1 and 2.

   While the resistor is still warm the lamp indications should be the opposite as described previously.

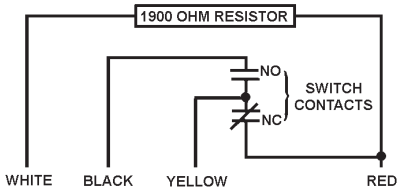


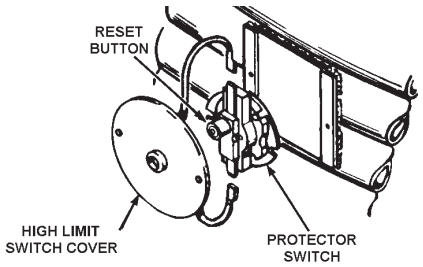

**FIGURE 4.**

## MANUAL RESET HIGH LIMIT

This boiler is equipped with a manual reset high limit switch, located under the small cover on the side of the jacket, see Figure 5. This device provides positive shutdown of the boiler in the event of boiler or system malfunction. Should the surface temperature of the copper tubing heat exchanger reach 250°F (120°C), the high limit switch will activate, the gas valve will close, the pilot and main burners will be extinguished. If the high limit switch should shut off unit, check the following conditions:

- No water in boiler.
- Restricted water flow through the boiler.
- Improper wiring (boiler firing without circulator operating).
- Pump failure.

After correcting failure condition remove the protector switch cover and push the reset button. The high limit switch may be reset after the coil surface cools to 6°F (3.3°C) below the trip setting.




**HIGH LIMIT SWITCH**
**FIGURE 5.**

## SAFETY FLOW SWITCH

The safety flow switch is a safety device which must be installed at the water outlet of the unit to prevent main burner operation in the event of inadequate water flow through the unit.

An accessory package containing a safety flow switch is available for this application.

This switch may be mounted in a horizontal pipe line or a vertical pipe line with upward water flow. Do not install the switch where the water flow is downward.

For proper performance mount the switch in a section of pipe where there is a straight run of at least 5 pipe diameters on each side of the flow switch (i.e. do not locate adjacent to valves, elbows, orifices, etc.).

The flow switch shall be mounted in a standard 1-1/2" x 1-1/2" x 1" tee for a 1-1/2" pipe application. For larger pipe sizes use a reducing tee in order to keep the switch as close to the pipe as possible. Install the flow switch in the branch (top) opening of the reducing tee and provide adequate paddle length in the flow stream. For example in a 2" pipe installation use a 2" x 2" x 1" reducing tee. For 2", or 3" pipe use paddle segments as supplied. For other pipe sizes (i.e. 1-1/4", 1-1/2" and 2-1/2") trim the paddle to the proper pipe size, see Figure 6 on page 10. If a standard tee is used, install a face or hex bushing in the top opening. The paddle must be adjusted or trimmed to the size of the pipe in which it will be installed.

**⚠ CAUTION**

Any part of the paddle must not touch the pipe or any restrictions in the pipe. Screw the flow switch in position so the flat of the paddle is at right angles to the flow. The arrow on the side case must point in the direction of the flow.

**TABLE 3 - SAFETY FLOW SWITCH**

| Minimum Pipe Rate | | | | |
|---|---|---|---|---|
| Model Number | Contacts Closed (Flow) | | Contacts Open (No Flow) | |
| | GPM | LPM | GPM | LPM |
| HW-300 | 5.8 | 22.0 | 3.7 | 14.0 |
| HW-399 | 7.5 | 28.4 | 5.0 | 18.9 |
| HW-420 | 7.5 | 28.4 | 5.0 | 18.9 |
| HW-520 | 13.7 | 51.9 | 9.5 | 36.0 |
| HW-610/670 | 13.7 | 51.9 | 9.5 | 36.0 |

The safety flow switch may be field adjusted to obtain higher minimum flow rates than those shown in table 3.

To adjust the flow rate setting:

1. Remove the flow switch cover.

2. For higher flow rate - turn the range adjusting screw clockwise.

3. For lower flow rate - turn the range adjusting screw counterclockwise.

**⚠ CAUTION**

The switch is factory set at approximately the minimum flow rate, see Table 3 on page 9. It must not be set lower than the factory setting as this may result in the switch failing to return at 'no flow' condition.

4. Replace flow switch cover. Where units are installed in multiples, each boiler must be individually protected by a safety flow switch.

**⚠ CAUTION**

Paddle must be trimmed at the dotted arc. It must not touch the pipe or have any restriction when installed.

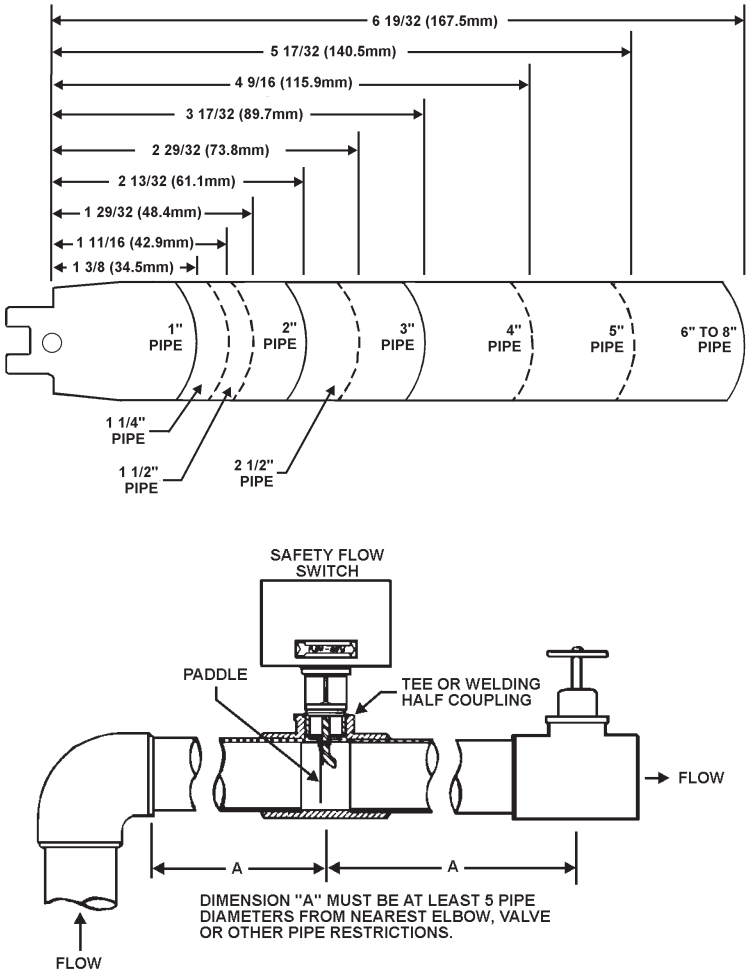



**FIGURE 6.**

**SAFETY RELIEF VALVES**

Your local code authority may have other specific relief valve requirements not covered below.

**⚠ WARNING**

THE PURPOSE OF A SAFETY RELIEF VALVE IS TO AVOID EXCESSIVE PRESSURE OR TEMPERATURE INTO THE STEAM RANGE WHICH MAY CAUSE SCALDING AT FIXTURES, TANK EXPLOSION, SYSTEM OR BOILER DAMAGE.

TO AVOID SCALDING OR WATER DAMAGE A DRAIN LINE MUST BE CONNECTED TO A RELIEF VALVE TO DIRECT DISCHARGE TO A SAFE LOCATION. A DRAIN LINE MUST NOT BE REDUCED FROM THE SIZE OF THE VALVE OUTLET AND IT MUST NOT CONTAIN ANY VALVES BETWEEN THE BOILER AND THE RELIEF VALVE OR THE RELIEF VALVE AND THE DRAIN EXIT. IN ADDITION, THERE SHOULD NOT BE ANY RESTRICTIONS IN A DRAIN LINE NOR SHOULD IT BE ROUTED THROUGH AREAS WHERE FREEZING CONDITIONS MIGHT OCCUR. DO NOT THREAD OR CAP THE DRAIN LINE EXIT. RESTRICTING OR BLOCKING A DRAIN LINE WILL DEFEAT THE PURPOSE OF THE RELIEF VALVE AND MAY CREATE AN UNSAFE CONDITION. INSTALL A DRAIN LINE WITH A DOWNWARD SLOPE SUCH THAT IT NATURALLY DRAINS ITSELF.

If any safety relief valve is replaced, the replacement valve must comply with the current editions of the ASME Boiler and Pressure Vessel

Code, Section IV or CSA B51, as applicable. Select a relief valve with a discharge NOT less than the boiler input, and a pressure rating NOT exceeding the working pressure of any component in the system.

A. O. Smith supplies a 125 psi relief valve for hot water supply systems and 50 psi relief valve for space heating application.

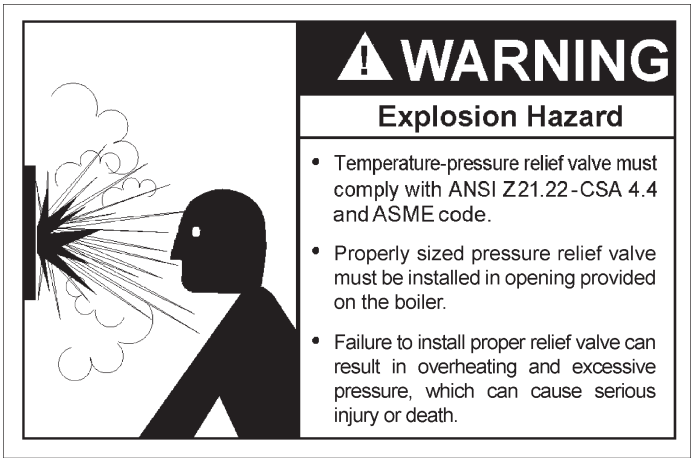
An ASME rated temperature and pressure relief valve must be installed on each and every water storage tank in a hot water supply system.

The storage tank temperature and pressure (T & P) relief valve must comply with the applicable contruction provisions of the Standard for Relief valves and Automatic Gas Shutoff Devices for Hot Water Supply Systems, Z21.22 - CSA 4.4. The T & P valve must be of the automatic reset type and not embody a single-use type of fusible plug, cartridge or linkage.

The T & P relief valve should have a maximum temperature rating of 100°C (210°F), a pressure rating NOT exceeding the lowest rated working pressure of any system component, and a discharge capacity exceeding the total input of the water boilers supplying water to the storage tank.

Locate the T & P relief valve (a) in the top of the storage tank or (b) in the side of the tank on centerline within upper 6 inches from the top of the tank. See Figures 28 to 33, Pages 34 to 38. Tapping shall be threaded in accordance with the latest version of the Standard for Pipe Threads, General Purpose (inch), ANSI/ASME B.120.1.

Mark location with a class III Label. See ANSI Z21.10.1, Part 1, Marking, See CAN/CSA B149.

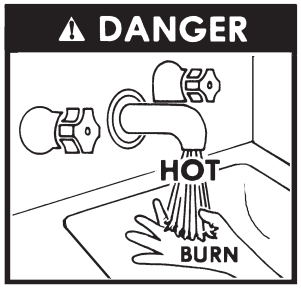



**TANK TEMPERATURE CONTROL**

The water temperature in the storage tank is controlled by the Tank Temperature Control. The sensing element is mounted inside the hot water storage tank.

**⚠ DANGER**

HOT WATER TEMPERATURES REQUIRED FOR AUTOMATIC DISHWASHER AND LAUNDRY USE CAN CAUSE SCALD BURNS RESULTING IN SERIOUS PERSONAL INJURY AND/OR DEATH. THE TEMPERATURE AT WHICH INJURY OCCURS VARIES WITH THE PERSON'S AGE AND TIME OF EXPOSURE. THE SLOWER RESPONSE TIME OF CHILDREN, AGED OR DISABLED PERSONS INCREASES THE HAZARDS TO THEM. NEVER ALLOW SMALL CHILDREN TO USE A HOT WATER TAP, OR TO DRAW THEIR OWN BATH WATER. NEVER LEAVE A CHILD OR DISABLED PERSON UNATTENDED IN A BATHTUB OR SHOWER.




The tank temperature control is adjustable from 100°F (37.7°C) to 220°F (104.4°C). It is recommended that lower water temperatures be used to avoid the risk of scalding. It is further recommended, in all cases, that the water temperature be set for the lowest temperature which satisfies the user's hot water needs. This will also provide the most energy efficient operation of the water heater and minimize scale formation.

THE WATER HEATER SHOULD BE LOCATED IN AN AREA WHERE THE GENERAL PUBLIC DOES NOT HAVE ACCESS TO SET TEMPERATURES. SETTING THE WATER TEMPERATURE AT 120°F (49°C) WILL REDUCE THE RISK OF SCALDS. Some states or provinces require settings at specific lower temperatures. Below you will find listed the approximate time-to-burn relationship for normal adult skin. Valves for reducing point-of-use temperature by mixing cold and hot water are available. Also available are inexpensive devices that attach to faucets to limit hot water temperatures. Contact a licensed plumber or the local plumbing authority.

| Water Temperature | Time to Produce 2nd & 3rd Degree Burns on Adult Skin |
|---|---|
| OVER: 170°F (77°C) | Nearly Instantaneous |
| 160°F (71°C) | About 1/2 second |
| 150°F (65°C) | About 1-1/2 seconds |
| 140°F (60°C) | Less than 5 seconds |
| 130°F (54°C) | About 30 seconds |
| 120°F (49°C) | More than 5 minutes |

USE ANTI-SCALD VALVE(S) in the hot water system to reduce the risks of scalds at points of use such as lavatories, sinks and bathing facilities.

A change in water temperature in the storage tank lower than the Tank Temperature Control setting will cause the sensor to close its contacts and consequently energize the boiler.

If the Tank Temperature Control is out of calibration, replace it with a new one; do not attempt to fix this control.

**⚠ WARNING**

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

**THERMOMETERS**

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

Thermometers are installed in the system as a means of detecting a possible liming condition in the boiler. An increase of 5°F (3°C) over the normal temperature rise through the boiler is an indication that lime is present. The term "temperature rise" designates the difference between the boiler inlet and outlet water temperature.

An increase of 5°F (3°C) above the recorded temperature rise may signify a liming condition in the coils or heat exchanger. Refer to CLEANING AND FLUSHING section of this manual for deliming instructions.

Record temperature rise at initial start-up for future reference.

**DRAIN VALVE (Not Supplied)**

A drain valve must be obtained and installed on each boiler and tank for draining purposes, see installation diagrams in this manual.

# GENERAL

**REQUIRED ABILITY**

Installation or service of this boiler requires ability equivalent to that of a licensed tradesman in the field involved. Plumbing, air supply, venting, gas supply and electrical work are required.

**LOCATION**

When installing the boiler, consideration must be given to proper location. Location selected should be as close to the stack or chimney as practicable with adequate air supply and as centralized with the piping system as possible. This location should also be such that the gas ignition system components are protected from water (dripping, spraying, etc.) during appliance operation and service (circulator replacement, control replacement, etc.).

THE BOILER MUST NOT BE INSTALLED ON CARPETING.

THE BOILER SHOULD NOT BE LOCATED IN AN AREA WHERE IT WILL BE SUBJECT TO FREEZING.

LOCATE IT NEAR A FLOOR DRAIN. THE BOILER SHOULD BE LOCATED IN AN AREA WHERE LEAKAGE FROM THE BOILER OR CONNECTIONS WILL NOT RESULT IN DAMAGE TO THE ADJACENT AREA OR TO LOWER FLOORS OF THE STRUCTURE.

WHEN SUCH LOCATIONS CANNOT BE AVOIDED, A METAL DRAIN PAN SHOULD BE INSTALLED UNDER THE BOILER. Such pans should be fabricated with sides at least 60mm (2-1/2") deep, with length and width at least 50mm (2") greater than the diameter of the boiler and must be piped to an adequate drain. The pan must not restrict combustion air flow.

**⚠ WARNING**

KEEPING BOILER AREA CLEAR AND FREE FROM COMBUSTIBLE MATERIALS, GASOLINE AND OTHER FLAMMABLE VAPORS AND LIQUIDS.

**⚠ WARNING**

THERE IS A RISK IN USING FUEL BURNING APPLIANCES SUCH AS BOILERS IN ROOMS OR AREAS WHERE GASOLINE, OTHER FLAMMABLE LIQUIDS OR ENGINE DRIVEN EQUIPMENT OR VEHICLES ARE STORED, OPERATED OR REPAIRED. FLAMMABLE VAPORS ARE HEAVY AND TRAVEL ALONG THE FLOOR AND MAY BE IGNITED BY THE IGNITER OR MAIN BURNER FLAMES CAUSING FIRE OR EXPLOSION. SOME LOCAL CODES

PERMIT OPERATION OF GAS APPLIANCES IF INSTALLED 18 INCHES OR MORE ABOVE THE FLOOR. THIS MAY REDUCE THE RISK IF LOCATION IN SUCH AN AREA CANNOT BE AVOIDED.

**⚠ WARNING**

FLAMMABLE ITEMS, PRESSURIZED CONTAINERS OR ANY OTHER POTENTIAL FIRE HAZARDOUS ARTICLES MUST NEVER BE PLACED ON OR ADJACENT TO THE BOILER. OPEN CONTAINERS OF FLAMMABLE MATERIAL MUST NOT BE STORED OR USED IN THE SAME ROOM WITH THE BOILER.

A hot water boiler installed above radiation level or as required by the authority having jurisdiction, must be provided with a low water cutoff device at the time of boiler installation.

**AIR REQUIREMENTS**

Provisions for combustion and ventilation air in accordance with the current edition of the National Fuel Gas Code, ANSI Z223.1, CAN/CSA B149.1, Installation Codes, or applicable provisions of the local building codes.

Provisions for vent, bleed and gas relief lines (when applicable).

Keep appliance area free of combustible or flammable liquids.

Do not obstruct the flow of combustion or ventilating air.

**⚠ WARNING**

FOR SAFE OPERATION PROVIDE ADEQUATE AIR FOR COMBUSTION AND VENTILATION. AN INSUFFICIENT SUPPLY OF AIR WILL CAUSE RECIRCULATION OF COMBUSTION PRODUCTS RESULTING IN AIR CONTAMINATION THAT MAY BE HAZARDOUS TO LIFE. SUCH A CONDITION OFTEN WILL RESULT IN A YELLOW, LUMINOUS BURNER FLAME, CAUSING CARBONING OR SOOTING OF THE COMBUSTION CHAMBER, BURNERS AND FLUE TUBES AND CREATES A RISK OF ASPHYXIATION.

**Unconfined Space**

In buildings of conventional frame, brick or stone construction, unconfined spaces may provide adequate air for combustion, and draft hood dilution.

If the unconfined space is within a building of tight construction (buildings using the following construction: weather stripping, heavy insulation, caulking, vapor barrier, etc.) air for combustion, ventilation, and draft hood dilution must be obtained from outdoors or spaces freely communicating with the outdoors. The installation instructions for confined spaces in tightly constructed buildings must be followed to ensure adequate air supply.

**Confined Space**

**(a) U. S. Installations**

When drawing combustion and dilution air from inside a conventionally constructed building to a confined space, such a space shall be provided with two permanent openings, ONE WITHIN 12 INCHES OF THE ENCLOSURE TOP AND ONE WITHIN 12 INCHES OF THE ENCLOSURE BOTTOM. Each opening shall have a free area of at least one square inch per 1000 Btuh of the total input of all appliances in the enclosure, but not less than 100 square inches.

If the confined space is within a building of tight construction, air for combustion, ventilation, and draft hood dilution must be obtained from outdoors. When directly communicating with the outdoors or communicating with the outdoors through vertical ducts, two permanent openings, located in the above manner, shall be provided. Each opening shall have a free area of not less than one square inch per 4000 Btuh of the total input of all appliances in the enclosure. If horizontal ducts are used, each opening shall have a free area of not less than one square inch per 2000 Btuh of the total input of all appliances in the enclosure.

**(b) Canadian Installations**

Ventilation of the space occupied by the boiler(s) shall be provided by an opening for ventilation air at the highest practical point communicating with outdoors. The total cross-sectional area shall be at least 10% of the area of the combustion air opening but in no case shall the cross-sectional area be less than 10 square inches (6500 $mm^2$).

In additional to the above, there shall be permanent air supply opening(s) having a cross-sectional area of not less than 1 square inch per 7,000 BTUH (310 $mm^2$/KW) up to and including 1,000,000 BTUH plus 1 square inch per 14,000 BTU in excess of 1,000,000 BTUH. This opening(s) shall be located at, or ducted to, a point neither more than 18" (450 mm) nor less than 6 inches (150 mm) above the floor level.

Where power vented equipment is used in the same room as the boiler, sufficient air openings must be supplied.

UNDERSIZED OPENINGS MAY RESULT IN INSUFFICIENT AIR FOR COMBUSTION.

WHERE AN EXHAUST FAN IS INSTALLED IN THE SAME ROOM WITH A BOILER, SUFFICIENT OPENINGS FOR AIR MUST BE PROVIDED IN THE WALLS.

UNDERSIZED OPENINGS WILL CAUSE AIR TO BE DRAWN INTO THE ROOM THROUGH THE CHIMNEY, CAUSING POOR COMBUSTION. SOOTING MAY RESULT WITH AN INCREASED RISK O F ASPHYXIATION.

**CHEMICAL VAPOR CORROSION**

**⚠ WARNING**

CORROSION OF THE FLUEWAYS AND VENT SYSTEM MAY OCCUR IF AIR FOR COMBUSTION CONTAINS CERTAIN CHEMICAL VAPORS WHICH BREAK DOWN INTO ACIDS AT HIGH TEMPERATURE. SUCH CORROSION MAY RESULT IN FAILURE AND RISK OF ASPHYXIATION.

Water boiler corrosion and component failure can be caused by the heating and breakdown of airborne chemical vapors. Spray can propellants, cleaning solvents, refrigerator and air conditioning refrigerants, swimming pool chemicals, calcium and sodium chloride, waxes, and process chemicals are typical compounds which are corrosive. These materials are corrosive at very low concentration levels with little or no odor to reveal their presence. Products of this sort must not be stored near the boiler. Also, air which is brought in contact with the water boiler should not contain any of these chemicals. If necessary, uncontaminated air should be obtained from remote or outside sources.

### INSTALLATION CLEARANCES

These boilers are approved for installation on combustible flooring in an alcove with minimum clearance to combustibles of:

**TABLE 4**

| | HW 300 | HW 399 | HW 420 | HW 520 | HW 610 & 670 |
|---|---|---|---|---|---|
| **TOP** | 28" (711.2) | 32" (812.8) | 24" (609.6) | 24" (609.6) | 24" (609.6) |
| **SIDES** | 6" (152.4) | 6" (152.4) | 24" (609.6) | 24" (609.6) | 24" (609.6) |
| **REAR** | 6" (152.4) | 6" (152.4) | 24" (609.6) | 24" (609.6) | 24" (609.6) |
| **VENT** | 6" (152.4) | 6" (152.4) | 6" (152.4) | 6" (152.4) | 6" (152.4) |

Two inch (50.8mm) clearance is allowable from combustible construction for hot water pipes.

Sufficient area should be provided at the front and rear of the unit for proper servicing. Clearances of 24 inches (609.4mm) in the rear and 48 inches (1,219mm) in the front are required by code. In a utility room installation, the door shall be wide enough to allow the boiler to enter or to permit the replacement of another appliance such as a water heater.

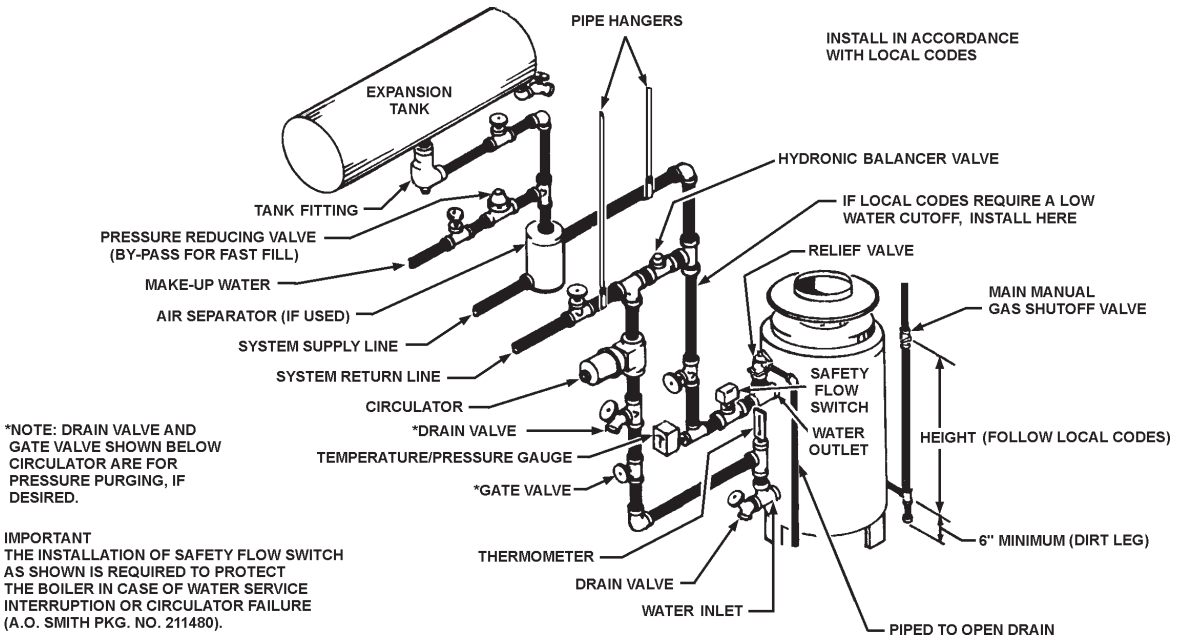
### LEVELING

Each unit should be checked after installation to be certain that it is level.

If the unit is not level, insert metal shims under the legs of the unit to correct this condition.

### SYSTEM CONNECTIONS

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




**A TYPICAL BOILER INSTALLATION**
**FIGURE 7.**

# VENTING

### VENTING THE BOILER - STANDARD VENTING

**⚠ WARNING**

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

TYPE B VENTING MAY BE USED WITH THESE BOILERS. ALL LOCAL UTILITY REGULATIONS ON VENTING SHOULD BE FOLLOWED.

For boilers for connection to gas vents or chimneys, vent sizing, installation and termination shall be in accordance with the current edition of the National Fuel Gas Code, ANSI Z223.1, or CAN/CSA B149.1, Installation Codes, or applicable provisions of the local building codes.

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

The minimum distance from adjacent public walkways, adjacent buildings, openable windows and building openings shall not be less than those values specified in the National Fuel Gas Code, ANSI Z223.1 and/or CAN/CSA B149.1, Installation Codes;

Stack or chimney must be a minimum height of 12" (305mm) above the annual snow fall to prevent blockage.

Building materials must not come in contact with combustion products from stack or chimney, due to the degradating properties of flue products.

Flue products must have a minimum clearance of 4 feet (1.22m) horizontally from, and in no case above or below, unless a 4-foot (1.22m) horizontal distance is maintained, from electric meters, gas meters, regulators and relief equipment.

CAN/CSA B149.1, Installation Code specifies a 6 foot horizontal vent terminal clearance to gas and electric meters and relief devices (this clearance is specified as 4 feet in the U.S. under the National Fuel Gas Code, ANSI/Z223.1). Therefore instruction, which specifies compliance with the 4 foot clearance, as applies in the U.S. only, and the CAN/CSA B149.1 Installation Code applies in Canada.

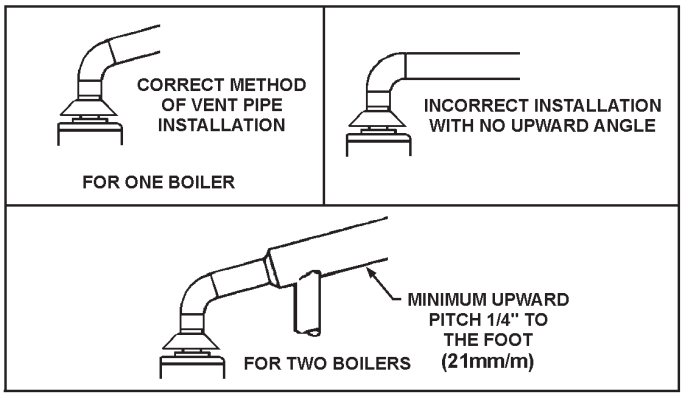
1. DRAFT HOOD

The draft hood furnished with this boiler must be installed without alteration. Provision must be made if the boiler is installed in confined space or a small boiler room to accommodate draft hood spillage and avoid risks described above. The upper air opening called for in the AIR REQUIREMENTS section of this manual is for this purpose.

2. VENT CONNECTION

Size and install proper size vent pipe. Do not reduce pipe size to less than that of the draft hood outlet.

Horizontal runs of vent pipe shall be securely supported by adequately placed (approximately every 4 feet or 1 meter), non-combustible hangers and/or slip joints suitable for the weight and design of the materials employed to prevent sagging and to maintain a minimum upward slope of 1/4" (21mm/m) per foot from the boiler to the vent terminals, see Figure 8. Dampers or other obstructions must not be installed in the vent. Be sure that the vent pipe does not extend beyond the inside wall of the chimney.




**VENT PIPE INSTALLATION**
**FIGURE 8.**

Where a continuous or intermittent back draft is found to exist the cause must be determined and corrected. A special vent cap may be required. If the back draft cannot be corrected by the normal methods or if a suitable draft cannot be obtained, a blower type flue gas exhauster may be employed to ensure proper venting and correct combustion if permitted by local codes.

**⚠ WARNING**

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

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

3. CONNECTING BOILER TO A COMMON VENT

Do not connect the boiler to a common vent or chimney with solid fuel burning equipment. This practice is prohibited by many local building codes as is the practice of venting gas fired equipment to the duct work of ventilation systems.

Where a separate vent connection is not available and the vent pipe from the boiler must be connected to a common vent with oil burning equipment, the vent pipe should enter the common vent or chimney at a point ABOVE the flue pipe from the oil fired unit.

Where two or more appliances vent into a common vent connector or manifold, the area of the common vent or vent connector should at least equal the area of the largest vent connector plus 50% of the areas of the additional draft hood outlets.

When removing a boiler from a system with a common vent, use the following steps:

Be sure the other appliances connected to the common vent are not in operation.

Seal any unused openings in the common venting system.

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.

**⚠ WARNING**

Ensure sufficient supply and ventilation air. Under no circumstances should the equipment room where the boiler is installed ever be under negative pressure. Insufficient air supply can interfere with combustion and ventilation of this boiler resulting in unsafe conditions.

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. Close fireplace dampers.

Place in operation the appliance being inspected. Follow the lighting instructions. Adjust thermostat so appliance will operate continuously.

Test for spillage at the draft hood relief opening after five minutes of main burner operation. Use the flame of a match or candle.

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 any other gas burning appliance to their previous conditions of use.

Any improper operation of the common venting system should be corrected so the installation conforms with the current edition of CAN/CSA B149.1 (current edition). 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 CAN/CSA B149.1.

4. MULTIPLE VENT TABLE

Table 5 on page 17 has been compiled to show the material sizes in a Type B doublewall combined vent system. Refer to CAN/CSA B149 .1 (current edition), or the ASHRAE 1983 Equipment Volume for further information.

A combined vent system is one in which two or more boilers at one level are attached to a common vent.

In order to use table 5, the connector rise and total vent height must be known. Connector rise is vertical distance from the draft hood outlet to the point where the manifold connection is made. Total vent height is the least vertical distance from a draft hood outlet to the top of the vent. Local codes or utility requirements often govern termination height. ULC listed doublewall gas vents, up through 24" (610mm) diameter, can be installed in heated and unheated areas and can pass through floors, ceilings, partitions, walls and roofs, provided the required one inch clearance is observed. These vents should be installed in accordance with CAN/CSA B149.1 (current edition).

**EXAMPLE SHOWING USE OF THE HW-610 COMBINED VENT SIZING TABLE**

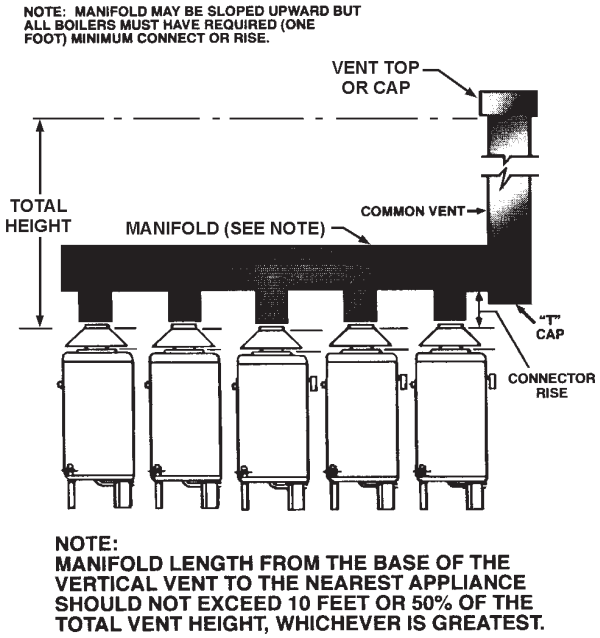



**FIGURE 9.**

**VENTING MAINTENANCE - STANDARD VENTING**

It is recommended that the heating surfaces and vent piping of the appliance be checked every six months for dust, deterioration and carbon deposits. Remove all soot or other obstructions from chimney and flue which will retard free draft. Replace any damaged or deteriorated parts of the venting system.

Qualified servicers should follow this procedure when the boiler's external heating surfaces and vent pipe need cleaning.

**⚠ CAUTION**

DO NOT USE A NYLON BRUSH OR OTHER STATIC CREATING MATERIAL TO CLEAN DUST AND CARBON DEPOSITS FROM HEATING SURFACES AND VENT.

SUCH DEPOSITS ARE FLAMMABLE AND MAY BE IGNITED BY STATIC ELECTRICITY. USE A METAL BRUSH TO MINIMIZE THE DANGER OF EXPLOSION.

1. Turn off the electrical power (main manual gas shutoff and pilot valves, if applicable).

   Allow boiler parts and vent to cool before disassembly.

2. Remove the boiler draft diverter and vent pipe running to the chimney.
   - Check parts and chimney for obstructions and clean as necessary.

3. Remove burner from boiler and other metal parts as required to clean and vacuum the heat exchanger and combustion coils.
   - Refer to parts list supplied with this manual for disassembly aid.

4. Reinstall the parts removed in steps 2 and 3.
   - Be sure the vent pipe has a minimum upward pitch of one quarter inch per foot of length (21mm/m) and is sealed as necessary.

5. Restore electrical power and gas supply to boiler.
   - Place boiler in operation by following the lighting instructions in this manual.
   - Check for gas leaks and proper boiler and vent operation.

**VENTING - SIDEWALL (OPTIONAL) POWER VENT SYSTEM**

If you are installing the optional Power Vent Kit, refer to your HW Power Vent Kit Installation Instructions for proper wiring and installation procedures. Contact your local A. O. Smith representative for details.

**VENTING SYSTEM**

HAVE VENTING SYSTEM CHECKED EVERY SIX MONTHS FOR OBSTRUCTIONS AND/OR DETERIORATION IN VENT PIPING.

A. Insofar as is practical, close all doors, windows and air inlets to the building. Turn on all exhaust fans (range hood, bathroom exhaust, etc.) so they will operate at their maximum speed. Close fireplace dampers.

B. After allowing appliance to operate for five minutes, test for spillage at the draft hood relief opening.

C. "CHECKING THE DRAFT. Operate vent connected gas utilization equipment for several minutes and check to see that the combustion products are going up the chimney or gas vent properly by passing a lighted match or taper around the edge of the relief opening of the draft hood. If the chimney or gas vent is drawing properly, the match flame will be drawn into the draft hood. If not, the combustion products will tend to extinguish this flame. IF THE COMBUSTION PRODUCTS ARE ESCAPING FROM THE RELIEF OPENING OF THE DRAFT HOOD, DO NOT OPERATE THE EQUIPMENT UNTIL PROPER ADJUSTMENT OR REPAIRS ARE MADE TO PROVIDE ADEQUATE DRAFT THROUGH THE CHIMNEY OR GAS VENT."

D. Next, turn on all other fuel burning appliances within the same room so they will operate at their full input.

   Repeat step C above, checking the draft on each appliance.

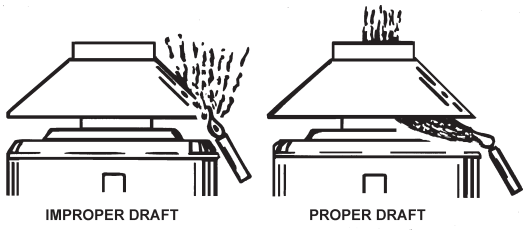



**FIGURE 10.**

## TABLE 5, COMBINED VENT SIZING TABLES

| MODEL HW-300 BOILER | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Input: 300,000 Btuh | | | | | | Draft Hood Outlet 8" | | | | |
| Required Connector or Smoke Pipe Diameter | | | | | | | | | | |
| | Connector Rise in Feet | Total Vent Height (Measured in Feet Above Draft Hood) | | | | | | | | |
| | | 10 | 15 | 20 | 30 | 40 | 50 | 60 | 80 | 100 |
| | | Connector Diameter (in Inches) | | | | | | | | |
| | 1 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 |
| | 2 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 |
| | 3 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 |
| | 4 or more | | | | | | | | | |
| Number if Units Combined | Total Input Btuh x 1000 | Total Vent Height (Measured in Feet Above Draft Hood) | | | | | | | | |
| | | 10 | 15 | 20 | 30 | 40 | 50 | 60 | 80 | 100 |
| | | Manifold and Common Vent Diameter (in Inches) | | | | | | | | |
| 2 | 600 | 14 | 12 | 12 | 12 | 10 | 10 | 10 | 10 | 10 |
| 3 | 900 | 16 | 14 | 14 | 14 | 12 | 12 | 12 | 12 | 12 |
| 4 | 1200 | 18 | 16 | 16 | 14 | 14 | 14 | 14 | 12 | 12 |

| MODEL HW-399 BOILER | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Input: 399,000 Btuh | | | | | | Draft Hood Outlet 10" | | | | |
| Required Connector or Smoke Pipe Diameter | | | | | | | | | | |
| | Connector Rise in Feet | Total Vent Height (Measured in Feet Above Draft Hood) | | | | | | | | |
| | | 10 | 15 | 20 | 30 | 40 | 50 | 60 | 80 | 100 |
| | | Connector Diameter (in Inches) | | | | | | | | |
| | 1 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 |
| | 2 | 12 | 12 | 12 | 10 | 10 | 10 | 10 | 10 | 10 |
| | 3 | 12 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 |
| | 4 or more | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 |
| Number if Units Combined | Total Input Btuh x 1000 | Total Vent Height (Measured in Feet Above Draft Hood) | | | | | | | | |
| | | 10 | 15 | 20 | 30 | 40 | 50 | 60 | 80 | 100 |
| | | Manifold and Common Vent Diameter (in Inches) | | | | | | | | |
| 2 | 798 | 14 | 14 | 14 | 12 | 12 | 12 | 12 | 12 | 12 |
| 3 | 1197 | 18 | 16 | 16 | 14 | 14 | 14 | 14 | 14 | 12 |
| 4 | 1596 | 20 | 20 | 18 | 16 | 16 | 16 | 14 | 14 | 14 |

| MODEL HW-420 BOILER | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Input: 420,000 Btuh | | | | | | Draft Hood Outlet 10" | | | | |
| Required Connector or Smoke Pipe Diameter | | | | | | | | | | |
| | Connector Rise in Feet | Total Vent Height (Measured in Feet Above Draft Hood) | | | | | | | | |
| | | 10 | 15 | 20 | 30 | 40 | 50 | 60 | 80 | 100 |
| | | Connector Diameter (in Inches) | | | | | | | | |
| | 1 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 |
| | 2 | 12 | 12 | 12 | 10 | 10 | 10 | 10 | 10 | 10 |
| | 3 | 12 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 |
| | 4 or more | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 |
| Number if Units Combined | Total Input Btuh x 1000 | Total Vent Height (Measured in Feet Above Draft Hood) | | | | | | | | |
| | | 10 | 15 | 20 | 30 | 40 | 50 | 60 | 80 | 100 |
| | | Manifold and Common Vent Diameter (in Inches) | | | | | | | | |
| 2 | 840 | 14 | 14 | 14 | 12 | 12 | 12 | 12 | 12 | 12 |
| 3 | 1260 | 18 | 16 | 16 | 14 | 14 | 14 | 14 | 14 | 12 |
| 4 | 1680 | 20 | 20 | 18 | 16 | 16 | 16 | 14 | 14 | 14 |

| MODEL HW-520 BOILER | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Input: 520,000 Btuh | | | | | | Draft Hood Outlet 10" | | | | |
| Required Connector or Smoke Pipe Diameter | | | | | | | | | | |
| | Connector Rise in Feet | Total Vent Height (Measured in Feet Above Draft Hood) | | | | | | | | |
| | | 10 | 15 | 20 | 30 | 40 | 50 | 60 | 80 | 100 |
| | | Connector Diameter (in Inches) | | | | | | | | |
| | 1 | 14 | 14 | 14 | 12 | 12 | 12 | 12 | 12 | 12 |
| | 2 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 |
| | 3 | 12 | 12 | 12 | 12 | 10 | 10 | 10 | 10 | 10 |
| | 4 or more | 12 | 12 | 12 | 12 | 10 | 10 | 10 | 10 | 10 |
| Number if Units Combined | Total Input Btuh x 1000 | Total Vent Height (Measured in Feet Above Draft Hood) | | | | | | | | |
| | | 10 | 15 | 20 | 30 | 40 | 50 | 60 | 80 | 100 |
| | | Manifold and Common Vent Diameter (in Inches) | | | | | | | | |
| 2 | 1040 | 16 | 16 | 14 | 14 | 14 | 14 | 12 | 12 | 12 |
| 3 | 1560 | 20 | 18 | 18 | 16 | 16 | 14 | 14 | 14 | 14 |
| 4 | 2080 | 22 | 22 | 20 | 18 | 18 | 18 | 16 | 16 | 14 |
| 5 | 2600 | 26 | 24 | 22 | 20 | 20 | 18 | 18 | 18 | 18 |
| 6 | 3120 | 28 | 26 | 24 | 22 | 22 | 20 | 20 | 18 | 18 |
| 7 | 3640 | 30 | 28 | 26 | 24 | 24 | 22 | 22 | 20 | 20 |
| 8 | 4160 | 32 | 30 | 28 | 26 | 24 | 24 | 22 | 22 | 20 |

| MODEL HW-610 BOILER | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Input: 610,000 Btuh | | | | | | Draft Hood Outlet 12" | | | | |
| Required Connector or Smoke Pipe Diameter | | | | | | | | | | |
| | Connector Rise in Feet | Total Vent Height (Measured in Feet Above Draft Hood) | | | | | | | | |
| | | 10 | 15 | 20 | 30 | 40 | 50 | 60 | 80 | 100 |
| | | Connector Diameter (in Inches) | | | | | | | | |
| | 1 | 16 | 14 | 14 | 14 | 14 | 14 | 14 | 14 | 14 |
| | 2 | 14 | 14 | 14 | 14 | 14 | 12 | 12 | 12 | 12 |
| | 3 | 14 | 14 | 12 | 12 | 12 | 12 | 12 | 12 | 12 |
| | 4 or more | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 |
| Number if Units Combined | Total Input Btuh x 1000 | Total Vent Height (Measured in Feet Above Draft Hood) | | | | | | | | |
| | | 10 | 15 | 20 | 30 | 40 | 50 | 60 | 80 | 100 |
| | | Manifold and Common Vent Diameter (in Inches) | | | | | | | | |
| 2 | 1220 | 18 | 18 | 16 | 16 | 14 | 14 | 14 | 14 | 14 |
| 3 | 1830 | 22 | 20 | 20 | 18 | 18 | 16 | 16 | 16 | 14 |
| 4 | 2440 | 26 | 24 | 22 | 20 | 20 | 18 | 18 | 18 | 16 |
| 5 | 3050 | 28 | 26 | 26 | 24 | 22 | 22 | 20 | 20 | 18 |
| 6 | 3660 | 32 | 28 | 28 | 26 | 24 | 24 | 22 | 22 | 20 |
| 7 | 4270 | 34 | 32 | 30 | 28 | 26 | 24 | 24 | 22 | 22 |
| 8 | 4880 | 36 | 34 | 32 | 30 | 28 | 26 | 26 | 24 | 24 |
| 9 | 5490 | 38 | 36 | 34 | 30 | 30 | 28 | 28 | 26 | 24 |
| 10 | 6100 | 40 | 38 | 36 | 32 | 30 | 30 | 28 | 26 | 26 |
| 11 | 6710 | 42 | 38 | 38 | 34 | 32 | 30 | 28 | 28 | 26 |
| 12 | 7320 | 44 | 42 | 38 | 36 | 34 | 32 | 32 | 30 | 28 |

| MODEL HW-670 BOILER | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Input: 660,000 or 670,000 Btuh | | | | | | Draft Hood Outlet 12" | | | | |
| Required Connector or Smoke Pipe Diameter | | | | | | | | | | |
| | Connector Rise in Feet | Total Vent Height (Measured in Feet Above Draft Hood) | | | | | | | | |
| | | 10 | 15 | 20 | 30 | 40 | 50 | 60 | 80 | 100 |
| | | Connector Diameter (in Inches) | | | | | | | | |
| | 1 | 16 | 14 | 14 | 14 | 14 | 14 | 14 | 14 | 14 |
| | 2 | 14 | 14 | 14 | 14 | 14 | 12 | 12 | 12 | 12 |
| | 3 | 14 | 14 | 12 | 12 | 12 | 12 | 12 | 12 | 12 |
| | 4 or more | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 |
| Number if Units Combined | Total Input Btuh x 1000 | Total Vent Height (Measured in Feet Above Draft Hood) | | | | | | | | |
| | | 10 | 15 | 20 | 30 | 40 | 50 | 60 | 80 | 100 |
| | | Manifold and Common Vent Diameter (in Inches) | | | | | | | | |
| 2 | 1220 | 18 | 18 | 16 | 16 | 14 | 14 | 14 | 14 | 14 |
| 3 | 1830 | 22 | 20 | 20 | 18 | 18 | 16 | 16 | 16 | 14 |
| 4 | 2440 | 26 | 24 | 22 | 20 | 20 | 18 | 18 | 18 | 16 |
| 5 | 3050 | 28 | 26 | 26 | 24 | 22 | 22 | 20 | 20 | 18 |
| 6 | 3660 | 32 | 28 | 28 | 26 | 24 | 24 | 22 | 22 | 20 |
| 7 | 4270 | 34 | 32 | 30 | 28 | 26 | 24 | 24 | 22 | 22 |
| 8 | 4880 | 36 | 34 | 32 | 30 | 28 | 26 | 26 | 24 | 24 |
| 9 | 5490 | 38 | 36 | 34 | 30 | 30 | 28 | 28 | 26 | 24 |
| 10 | 6100 | 40 | 38 | 36 | 32 | 30 | 30 | 28 | 26 | 26 |
| 11 | 6710 | 42 | 38 | 38 | 34 | 32 | 30 | 28 | 28 | 26 |
| 12 | 7320 | 46 | 44 | 40 | 38 | 36 | 34 | 34 | 32 | 30 |

Known: (5) model HW-610 boilers. (See illustration). Connector rise - 2' (Note 1' is minimum). Total vent height 30'.

Problem: Determine diameter of connector, manifold and common vent.

Procedure: Enter the top of the HW-610 table (total vent height) at 30' and the side at 2' (connector rise). A 14" connector diameter is indicated for each connector rise.

To determine the manifold and common vent size, enter table on this page (total vent height) at 30 and the side at 5 boilers. A manifold diameter of 24" (610 mm) is indicated.

# SYSTEM INSTALLATIONS

### 1. CONVENTIONAL INSTALLATIONS

All modern hydronic type boilers are exceptionally fast heating units. The low water volumes in relation to firing rates require special attention to water flow rates for smooth, efficient operation. These considerations for the A. O. Smith copper heat exchanger boilers are covered below.

Conventional 20$^0$F (10$^0$C) drop in systems for a fully loaded boiler will maintain the following approximate flow rates:

| MODELS | GPM (LPM) |
|---|---|
| HW-300 | 23 (87) |
| HW-399 | 30 (114) |
| HW-420 | 35 (132) |
| HW-520 | 39 (148) |
| HW-610/670 | 46 (175) |

Figure 7 on page 14 shows a typical installation of the boiler with pipe sizing and circulator selected by the installer to provide adequate water flow whenever the boiler is firing.

In a system with several large zones of which any might be smaller than approximately 1/3 of the system should include a hydronic balancer as shown in Figure 7. The balancer connects between the system supply and the return line before the circulator inlet. Adjustment of the balancing cock should permit adequate boiler flow rate when only the smallest zone is in operation.

Attention should be given to balancing inputs and water flow rates where wide variations of system flow rates can occur.

The recommended minimum flow rates that will result in approximately 50$^0$F (30$^0$C) temperature rise across the boiler are as follows:

| MODELS | GPM (LPM) |
|---|---|
| HW-300 | 9 (34) |
| HW-399 | 12 (45) |
| HW-420 | 14 (53) |
| HW-520 | 16 (61) |
| HW-610 | 18 (69) |
| HW-670 | 20 (76) |

If system flow rate is unknown, or if zoning creates extreme variations in flow rates, the boiler should be installed as shown in Figure 11 on this page for A. O. Smith LINEAR-TEMP installations.

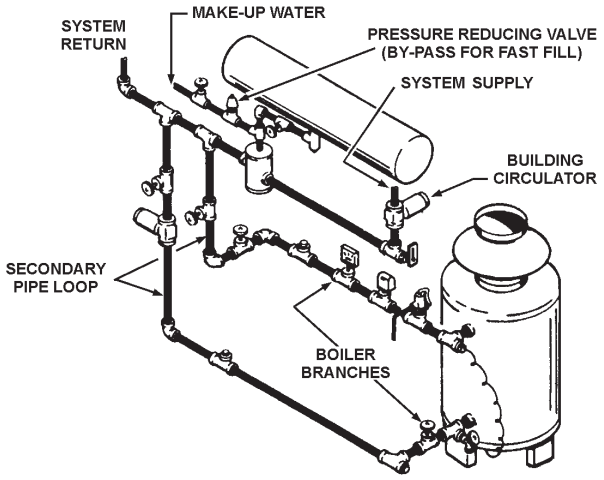
### 2. LINEAR-TEMP INSTALLATIONS

A. New Installations

A. O. Smith LINEAR-TEMP systems have been designed to provide efficient, trouble-free operation of the boiler sizes covered in this manual with any of the following conditions:

a. Unknown system flow rate
b. Varying flow rate as with zoned systems
c. Multiple boiler installations

Figure 11 on this page shows piping and accessory arrangement for a boiler pumped independent of the primary system mains. Pipe sizing and boiler loop pump selection data are shown in Table 6 for several different temperature rises across the boilers.




**ONE BOILER INSTALLED INDEPENDENT OF THE PRIMARY SYSTEM FIGURE 11.**

Total heating requirements for the building can be supplied by a series of boiler loops all connecting to a common pipe joining the system supply and return mains. The supply and return branches of each boiler loop must join the common pipe only a short nipple length apart. The different sets of branches should be installed reasonably close together, but not necessarily to the short nipple length as required for the supply and return of each set. These branches may be made with tees or with welded connections.

The installer is reminded that the total boiler flow rates need not match the system flow rate.

**TABLE 6.**
**PUMP AND PIPE SIZING DATA**
**(PIPING FROM TEES IN MAIN TO BOILER BRANCHES)**

| Model | Temp. Rise °F (°C) | G.P.M. | *Pump Size | Pipe Size |
|---|---|---|---|---|
| HW-300 | 20 (10) | 23 | 1-1/2" PR | 2" |
| | 30 (15) | 15 | 150 | 1-1/2" |
| | 30 (15) | 15 | 125 | 1-1/4" |
| | 40 (20) | 11 | 100 | 1" |
| HW-399 | 20 (10) | 30 | 60-13 | 2" |
| | 35 (15) | 20 | 1-1/2" HV | 1-1/2" |
| | 40 (20) | 15 | 150 | 1-1/2" |
| | 40 (20) | 15 | 125 | 1-1/4" |
| HW-420 | 20 (10) | 32 | 60-13 | 2" |
| | 35 (15) | 21 | 1-1/2" HV | 1-1/2" |
| | 40 (20) | 16 | 150 | 1-1/2" |
| | 40 (20) | 16 | 125 | 1-1/4" |
| HW-520 | 20 (10) | 39 | 2-1/2" | 2-1/2" |
| | 20 (10) | 26 | 1-1/2" HV | 2" |
| | 35 (17) | 23 | 1-1/2" HV | 1-1/2" |
| | 40 (20) | 20 | 150 | 1-1/2" |
| HW-610/670 | 20 (10) | 51 | 60-13 | 3" |
| | 30 (15) | 34 | 2-1/2" | 2-1/2" |
| | 35 (17) | 29 | 2" | 2" |
| | 40 (20) | 25 | 1-1/2" HV | 1-1/2" |

NOTE: Pipe loop sizes and pump selections based on 50 equivalent feet of pipe and fittings.

*All pump sizes listed are B & G model numbers.

| NO. | SUGGESTED ITEMS FOR INSTALLATION |
|---|---|
| 1 | Short pipe nipple and pair of boiler loop tees in piping between system supply and return. One set per each group of boilers. |
| 2 | Boiler pipe loop. See piping sizing data. |
| 3 | Boiler circulator. See pump sizing data. |
| 4 | Thermometer. |
| 5 | Theraltimeter. |
| 6 | Plug cock to control flow rate. |
| 7 | Safety flow switches. For interlock with other systems or instead of low water cutoff. |
| 8 | Relief valve. |
| 9 | With one -300, -399 or -420 item 9 is - sensing element of remote control. With a group of -300's, -399's or -420's, item 9 is - for 1st boiler, the sensing element as above. For additional boilers, install a 2nd limit control if required by local codes. With any -520, -610 or 670 boilers, install 2nd limit control here if required by local code. |
| **BOILER INLET - OUTLET SIZES** | |
| 10 | HW-300 - 1-1/4", HW-399 - 1-1/2", HW-420 - 1-1/2", HW-520 & HW-610 - 2". |
| 10 | HW-300 - 1-1/4", HW-399 - 1-1/2", HW-420 - 1-1/2", HW-520 & HW-670 - 2". |
| **MINIMUM BRANCH SIZES TO BOILERS** | |
| 11 | HW-300 - 1-1/4" HW-399 - 1-1/2" HW-420 - 1-1/2" — HW-520, 610 (Single boiler per pump) 2" |
| 11 | HW-300 - 1-1/4" HW-399 - 1-1/2" HW-420 - 1-1/2" — HW-520, 670 (Single boiler per pump) 2" |
| 12 | Flow control valve. Required only if flow rate of system primary is excessive for size of boiler branch tees or if chilled water main is above boilers. |
| 13 | System supply temperature thermometer. |
| 14 | Boiler headers for three (3) boilers can be larger than pipe loop, if desired, to aid in balancing. |

The system flow rate is selected to give the desired system temperature drop - depending on the design criteria.

The boiler generator flow rates, on the other hand, should be selected to give the temperature rise through the generator that is both economical and offers the best generator efficiency.

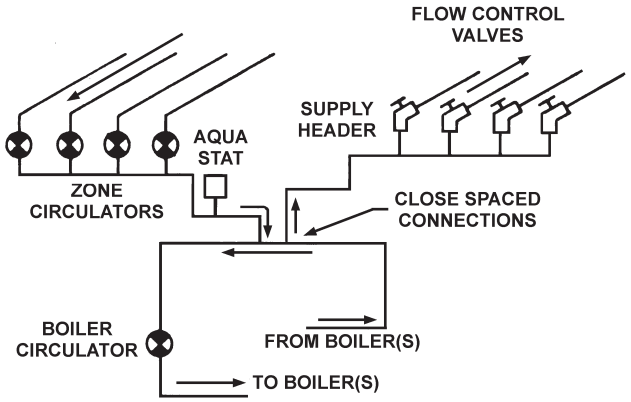
The boiler temperature rise is normally between $10^0$C and $20^0$C ($20^0$F and $40^0$F). The system temperature that will be introduced to the boiler (inlet temperature) plus the selected boiler temperature rise selected from PUMP AND PIPE SIZING DATA should not exceed the high limit control setting of $115^0$C ($240^0$F).

There should be a relation of the minimum system load to the size boiler selected as the first firing or base boiler. This will stabilize operation during minimum load periods.

B. Commercial Boiler Replacements

Application of LINEAR-TEMP® to a commercial boiler replacement with an old multiple pump installation is an excellent way to modernize the system. The A. O. Smith boiler(s) should be installed on a pipe loop with a separate circulating pump selected from PUMP AND PIPE SIZING DATA TABLE.

Figure 12 shows a line drawing of how the system headers should be connected to the pipe loop installed with the replacement boiler(s). Make-up water connections and accessories are not shown.




**SCHEMATIC OF THE LINEAR-TEMP® SYSTEM FIGURE 12.**

Supply and return headers of the old system should be connected to the boiler loop with a pair of tees set close together. The boiler loop pump and the boiler(s) should be wired to operate only when any of the system pumps are in operation. The number of zone pumps that may be in operation at any particular time will take their required flow rate out from the first tee in the boiler piping. This water will be circulated through the proper branches from the supply header to the zones calling for heat. The water will be brought back to the return header and then into the second tee in the boiler pipe loop. There will be no conflict between the boiler pump and the zone pumps when the two tees in the boiler loop are placed close together.

Normal use of flow control valves is required to prevent cross circulation of zones as with any multiple pump system. Flow control is not required on boiler circuit.

Attention should be given to balancing gas inputs and water flow rates. Large systems with multiple boilers should include main water temperature control (with or without outdoor reset) to stage the boilers on and off in relation to the load on the system.

### 3. WATER SUPPLY LINE

These boilers can be used ONLY in a forced circulation hot water heating system. Since most forced circulation systems will be of the closed type, install the water supply line as shown on piping diagrams, Figure 7 to 11 on pages 14 and 18.

Fast filling of large pipe, old radiator installations and pressure purging of series loop systems (where high pressures are not available) requires bypassing of the pressure reducing valve. Generally, pressure purging is not possible with a well pump system. High point air venting is essential.

If the system is of the open type, a pressure reducing valve will not be required as the water supply to the system will be controlled by a manually operated valve. An overhead surge tank is required.

### 4. EXPANSION TANK

**⚠ CAUTION**

A closed system will exist if a check valve (without bypass), pressure reducing valve (without bypass), or a water meter (without bypass) is installed in the cold water line between the water heater and street main (or well).

Excessive pressure may develop causing premature tank failure or intermittent relief valve operation. This is not a warranty failure. An expansion tank or a similar device may be required in the inlet supply line between the appliance and the meter or valve to compensate for the thermal expansion of water under supply pressure, see Figure 7 on page 14.

An air separator as shown in the piping diagrams is recommended especially for modern commercial hydronic systems.

**5. VENT VALVES**

It is recommended that automatic, loose key or screwdriver type vent valves be installed at each convector or radiator.

**6. MANIFOLD HEADERS**

Split systems with individual supply and return lines from the boiler room should normally have this piping connected to supply and return manifold headers near the boiler. To achieve good water distribution with maximum pressure drop for several circuits, manifolds of at least 2-1/2" (64mm) diameter are suggested on HW-399, HW-420, HW-520, HW-610 and HW-670 units. HW-300 units should have 1-1/2" (38mm) diameter manifolds.

The circuits should be spaced on the header at a minimum of 3" (76mm) center to center. Install a balancing cock in each return line.

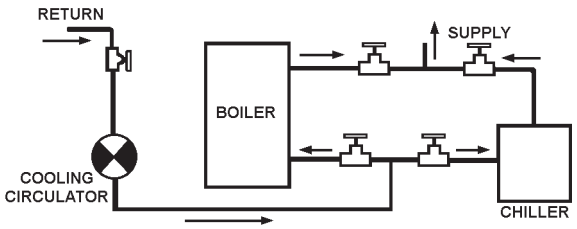
Manifold headers are recommended for split systems with or without zone valves and also those installations with zone circulators. If the system is to be split at remote points, good practice requires special attention be given to main pipe sizing to allow balancing of water flow.

The boiler piping system of a hot water boiler connected to heating coils located in air handling units where they may be exposed to refrigerated air circulation must be equipped with flow control valves or other automatic means to prevent gravity circulation of the boiler water during the cooling cycle.

**7. COOLING PIPING**

When the boiler is used in conjunction with a refrigeration system it must be installed so that the chilled medium is piped in parallel with the boiler with appropriate valves to prevent the chilled medium from entering the boiler, see Figure 13.

Water temperature in the heating system must be reduced to less than $100^0$F (38°C) before cooling system is started, or damage to the chiller unit may occur.

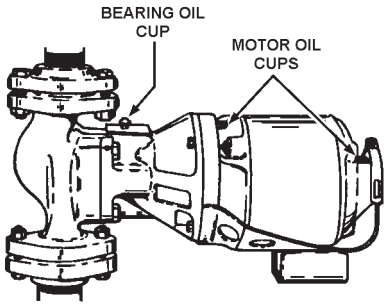



**SCHEMATIC SHOWING PROPER PIPING ISOLATION OF THE BOILER FROM THE CHILLER FIGURE 13.**

If the boiler is connected to chilled water piping or its heating coils are exposed to refrigerated air, the boiler piping system must be equipped with flow valves or other automatic means to prevent gravity circulation through the boiler during the cooling cycle.

**8. CIRCULATING PUMP**

CONSTANT CIRCULATING PUMP OPERATION OF THE BOILER VOIDS THE WARRANTY. Constant water flow through the unit will “wash” away the copper’s natural protective coating. This is called velocity erosion. This erosion is not as great a problem when intermittent circulating operation is used per the recommended installation procedure. Constant circulation of water through the building’s system main is permissible as long as the water does not constantly flow through the boiler. Only all bronze or stainless steel circulators are to be used with the unit when it is installed in HOT WATER SUPPLY SYSTEMS.




**A TYPICAL CIRCULATING PUMP FIGURE 14.**

Although each circulator that requires oiling is oiled and operated by the manufacturer, IT MUST BE OILED AGAIN BEFORE OPERATED. Oil the three oil cups (2 on the motor, 1 on the pump) as instructed on the oil tube supplied with the unit, see Figure 14 on this page.

Thereafter, during the heating season, lubricate the three oil cups at least once every four months. Combination heating-cooling systems should be lubricated every four months year ‘round.

Use 2 or 3 teaspoonsful in bearing oil cups or 12 drops in the motor oil cups, see Figure 14 on this page. Use No. 20 non-detergent motor oil.

Follow the same oiling procedure if a replacement circulator is installed into the system.

# GAS CONNECTIONS

⚠ WARNING

THIS BOILER IS NOT INTENDED TO OPERATE AT GAS SUPPLY PRESSURE OTHER THAN SHOWN ON THE RATING PLATE. EXPOSURE TO HIGHER GAS SUPPLY PRESSURE MAY CAUSE DAMAGE TO GAS VALVES WHICH CAN RESULT IN FIRE OR EXPLOSION. IF OVERPRESSURE HAS OCCURRED SUCH AS THROUGH IMPROPER TESTING OF GAS LINES OR EMERGENCY MALFUNCTION OF THE SUPPLY SYSTEM, THE GAS VALVES MUST BE CHECKED FOR SAFE OPERATION. MAKE SURE THAT THE OUTSIDE VENTS ON THE SUPPLY REGULATORS AND THE SAFETY VENT VALVES ARE PROTECTED AGAINST BLOCKAGE. THESE ARE PARTS OF THE GAS SUPPLY SYSTEM, NOT THE BOILER. VENT BLOCKAGE MAY OCCUR DURING ICE BUILD-UP OR SNOW STORMS.

WHEN LOCAL CODES REQUIRE A MAIN MANUAL SHUTOFF VALVE OUTSIDE THE BOILER JACKET, A SUITABLE MAIN MANUAL SHUTOFF VALVE MUST BE INSTALLED IN A LOCATION COMPLYING WITH THOSE CODES.

IT IS IMPORTANT TO GUARD AGAINST GAS VALVE FOULING FROM CONTAMINANTS IN THE GAS WAYS. SUCH FOULING MAY CAUSE IMPROPER OPERATION, FIRE OR EXPLOSION.

IF COPPER SUPPLY LINES ARE USED THEY MUST BE CERTIFIED FOR GAS SERVICE.

BEFORE ATTACHING THE GAS LINE BE SURE THAT ALL GAS PIPE IS CLEAN ON THE INSIDE.

TO TRAP ANY DIRT OR FOREIGN MATERIAL IN THE GAS SUPPLY LINE, A DIRT LEG (SOMETIMES CALLED DRIP LEG or sediment trap) MUST BE INCORPORATED IN THE PIPING, see Figure 1 on page 6. The dirt leg must be readily accessible and not subject to freezing conditions. INSTALL IN ACCORDANCE WITH RECOMMENDATIONS OF SERVING GAS SUPPLIERS. (Refer to National Fuel Gas Code, ANSI Z223.1 or CAN/CSA-B 149.1 Installation Codes.

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

Fittings and unions in the gas line must be the metal to metal type.

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

THE BOILER AND ITS GAS CONNECTIONS MUST BE LEAK TESTED BEFORE PLACING THE BOILER IN OPERATION. Use soap and water solution or other material acceptable for the purpose in locating gas leaks. DO NOT USE MATCHES, CANDLES, FLAME OR OTHER SOURCES OF IGNITION FOR THIS PURPOSE.

DISCONNECT THE BOILER AND ITS MAIN MANUAL GAS SHUTOFF VALVE FROM THE GAS SUPPLY PIPING SYSTEM DURING ANY PRESSURE TESTING OF THE GAS SUPPLY SYSTEM OVER 1/2 PSIG (3.5kPa). THE GAS SUPPLY LINE MUST BE CAPPED WHEN NOT CONNECTED TO THE BOILER.

THE BOILER MUST BE ISOLATED FROM THE GAS SUPPLY PIPING SYSTEM BY CLOSING ITS MAIN MANUAL GAS SHUTOFF VALVE DURING ANY PRESSURE TESTING OF THE GAS SUPPLY PIPING SYSTEM AT TEST PRESSURES EQUAL TO OR LESS THAN 1/2 PSIG (3.5kPa).

**PURGING AND SIZING**

Gas line purging is required with new piping or systems in which air has entered.

**⚠ CAUTION**

PURGING SHOULD BE PERFORMED BY PERSONS EXPERIENCED IN THIS TYPE GAS SERVICE TO AVOID RISK OF FIRE OR EXPLOSION. PURGE DISCHARGE MUST NOT ENTER CONFINED AREAS OR SPACES WHERE IGNITION CAN OCCUR. THE AREA MUST BE WELL VENTILATED AND ALL SOURCES OF IGNITION MUST BE INACTIVATED OR REMOVED.

1. CORRECT GAS

Make sure the gas on which the boiler will operate is the same as that specified on the boiler rating plate. Do not install the boiler if equipped for a different type gas — consult your supplier.

2A. SIZING GAS SUPPLY LINE (For single boiler installations and for installations of multiples of two or three of same size boilers).

Use table 7, or CAN/CSA B149.1 (current edition) to size iron pipe or equivalent gas supply line. Table 7 is based on a pressure drop of 0.3 inches of water and a specific gravity of 0.60 approximately that of natural gas. (LP gas has an S.G. of about 1.53). If the service pressure is five inches water column or less, use one pipe size larger in order to minimize pressure drop in the line.

**TABLE 7.**
**MAXIMUM CAPACITY OF PIPE IN CUBIC FEET OF GAS PER HOUR (BASED UPON A PRESSURE DROP OF 0.3 INCH WATER COLUMN AND 0.6 SPECIFIC GRAVITY GAS)**

| Distance from Gas Meter | Nominal Iron Pipe Size (Inches) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 1/2 | 3/4 | 1 | 1 1/4 | 1 1/2 | 2 | 2 1/2 | 3 | 4 |
| 10 (3) | 132 | 278 | 520 | 1,050 | 1,600 | 3,050 | 4,800 | 8,500 | 17,500 |
| 20 (6) | 92 | 190 | 350 | 730 | 1,100 | 2,100 | 3,300 | 5,900 | 12,000 |
| 30 (9) | 73 | 152 | 285 | 590 | 890 | 1,650 | 2,700 | 4,700 | 9,700 |
| 40(12) | 63 | 130 | 245 | 500 | 760 | 1,450 | 2,300 | 4,100 | 8,300 |
| 50 (15) | 56 | 115 | 215 | 440 | 670 | 1,270 | 2,000 | 3,600 | 7,400 |
| 60 (18) | 50 | 105 | 195 | 400 | 610 | 1,150 | 1,850 | 3,250 | 6,800 |
| 70 (21) | 46 | 96 | 180 | 370 | 560 | 1,050 | 1,700 | 3,000 | 6,200 |
| 80 (24) | 43 | 90 | 170 | 350 | 530 | 990 | 1,600 | 2,800 | 5,800 |
| 90 (27) | 40 | 84 | 160 | 320 | 490 | 930 | 1,500 | 2,600 | 5,400 |
| 100 (30) | 38 | 79 | 150 | 305 | 460 | 870 | 1,400 | 2,500 | 5,100 |
| 125 (38) | 34 | 72 | 130 | 275 | 410 | 780 | 1,250 | 2,200 | 4,500 |
| 150 (45) | 31 | 64 | 120 | 250 | 380 | 710 | 1,130 | 2,000 | 4,100 |
| 175 (53) | 28 | 59 | 110 | 225 | 350 | 650 | 1,050 | 1,850 | 3,800 |
| 200 (60) | 26 | 55 | 100 | 210 | 320 | 610 | 980 | 1,700 | 3,500 |

*The heating value of Natural Gas is approximately 1,050 Btu/Ft$^3$.
Propane (LP) Gas has a heating value of approximately 2,500 Btu/Ft$^3$.
1 cu. meter=35.31 cu. feet.

Where it is necessary to use more than the average number of pipe fittings i.e. elbows, tees, and valves in gas supply line, use a pipe larger than specified to compensate for increased pressure drop.

2B. SIZING GAS SUPPLY LINE (For multiples of over three boilers of same size or for multiple installations of two or more mixed sizes).

Capacities in cubic feet per hour of 0.60 specific gravity gas for different sizes and lengths are shown in table 7. No additional allowance is necessary for an ordinary number of fittings.

Applications of the gravity factor converts the figures given in table 7 to capacities with another gas of different specific gravity. Such application is accomplished by multiplying the capacities given in table 7 by the multipliers shown in table 8 on page 22.

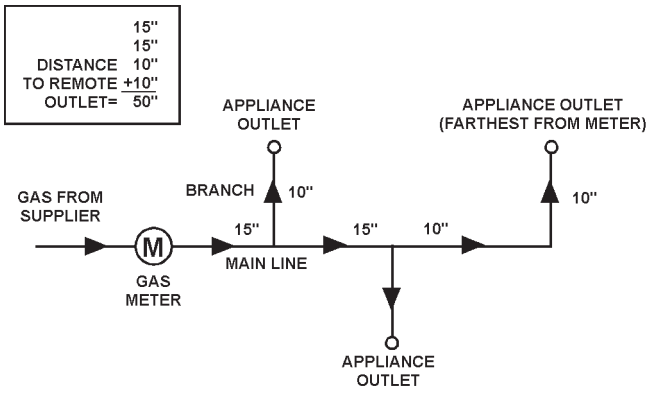
To determine the size of each section of gas piping in a system within the range of table 7 proceed as follows:

- Determine the gas demand of each appliance to be attached to the piping system. When table 7 is to be used to select the piping size, calculate the gas demand in terms of cubic feet per hour for each piping system outlet. The gas demand for an appliance can be found by dividing its heat input rate by the gas's heating value.

- Obtain or determine the length of piping from the gas meter or service regulator to the appliance(s).

- In table 7 on page 21, select the row showing the distance to the most remote outlet or the next longer distance if the table does not give the exact length. This is the only distance used in determining the size of any section of gas piping. If the gravity factor is to be applied, the values in the selected row of table 7 are multiplied by the appropriate multiplier from table 8.

- Total the gas demands of all appliances on the piping system. Enter table 7, on the left hand side, at the row equal to or just exceeding the distance to the most remote outlet. Select the pipe size in the row with a capacity equal to or just exceeding the total gas demand. This is the required main gas supply line size leading away from the gas meter or regulator. To determine the pipe size required for each branch outlet leading away from the main supply line, determine the gas demand for that outlet. Enter table 7 on the same row, and select the branch pipe size for a capacity equal to or just exceeding the demand at that outlet. The main line can be resized for a lesser capacity after each branch outlet, since the gas demand is reduced. Total the gas demands of all remaining appliances branching off downstream on the main gas line. Re-enter table 8 in the same row and select the appropriate pipe size with adequate capacity. Repeat the branch sizing and main line re-sizing for any remaining appliances in the system.




EXAMPLE

Job Condition:

Determining the required gas pipe size for a system composed of two HW-420 boilers and two HW-610 boilers to be installed as a multiple group, 50 lineal feet from meter. Gas to be used has a .60 specific gravity and heating value of 1,000 Btu per cubic foot.

Solution:

2 HW-420 Boilers = 840,000 Btuh
2 HW-610 Boilers = 1,220,000 Btuh

Total Btuh Input = 2,060,000 Btuh

Total Btuh Input = 2,060,000 Btuh = 2,060 cf/h

Btu per Cubic Foot of Gas 1,000

With a cubic foot per hour demand of 2,060 and with 50 lineal feet of gas supply line, table 7 shows a pipe size of 3" (76mm) is required.

NOTE: For other than .60 specific gravity, apply multiplier factor as shown in table 8.

**TABLE 8.**
**MULTIPLIERS TO BE USED WITH TABLE 7 WHEN APPLYING THE GRAVITY FACTOR TO OTHER THAN .60 SPECIFIC GRAVITY**

| Specific Gravity | Multiplier | Specific Gravity | Multiplier |
|---|---|---|---|
| .35 | 1.31 | 1.00 | .78 |
| .40 | 1.23 | 1.10 | .74 |
| .45 | 1.16 | 1.20 | .71 |
| .50 | 1.10 | 1.30 | .68 |
| .55 | 1.04 | 1.40 | .66 |
| *.60 (Nat.) | 1.00 | *1.50 (Prop.) | .63 |
| .65 | .96 | 1.60 | .61 |
| .70 | .93 | 1.70 | .59 |
| .75 | .90 | 1.80 | .58 |
| .80 | .87 | 1.90 | .56 |
| .85 | .84 | *2.00 (Butane) | .55 |
| .90 | .82 | 2.10 | .54 |

*Use these correction factors if exact specific gravity of the gas is not known.

## GAS PRESSURE REGULATORS

The gas pressure regulator is included in the combination gas valve, Figure 15, and is set to operate on the gas specified on the boiler model and rating plate.

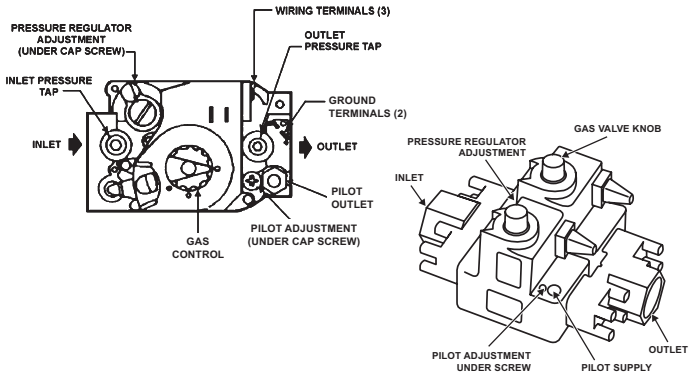



**FIGURE 15.**

Periodically check main burner, Figure 34 on page 39, and pilot flame, Figure 35 on page 40, for proper operation. This should be checked every six months.

Do not subject the gas valve to inlet gas pressures of more than 14" W.C. (1/2 P.S.I.). If higher gas pressures are encountered, a service regulator is necessary.

**TABLE 9.**
**CORRECT MANIFOLD PRESSURE FOR FULL BOILER INPUT (IN INCHES OF WATER COLUMN)**

| Model Number | Rated Input | Manifold Pressure | |
|---|---|---|---|
| | | Natural | Propane |
| HW-300 | 300,000 | 3.5 | 10.0 |
| HW-399 | 399,000 | 3.2 | 9.5 |
| HW-420 | 420,000 | 3.5 | 10.0 |
| HW-520 | 520,000 | 3.5 | 10.0 |
| HW-610 | 610,000 | 3.5 | 10.0 |
| HW-670 Nat. | 660,000 | 3.5 | |
| HW-670 Prop. | 670,000 | | 10.0 |

Adjustment, if required, is performed as follows:

1. Set primary system temperature control dial (thermostat) at lowest setting so that boiler will not call for heat.
2. Attach a pressure gauge to the tapping in the control string elbow.
3. Reset primary system temperature control dial (thermostat) to highest setting. Main burner will now ignite.
4. With main burner firing, adjust pressure, if necessary, by turning pressure regulator adjusting screw with a screwdriver.
   - Clockwise to increase pressure.
   - Counterclockwise to decrease pressure.
5. Set primary system temperature control dial (thermostat) to lowest setting.
6. Remove pressure gauge and replace sealing plug.
7. Set primary system temperature control dial (thermostat) to desired setting.

**⚠ WARNING**

DO NOT INCREASE GAS PRESSURE ABOVE THAT SPECIFIED ON THE RATING PLATE, AS OVERFIRING WILL RESULT IN DAMAGE TO THE BOILER, AS WELL AS INCREASED RISK OF FIRE, SOOTING AND ASPHYXIATION.

If gas pressure regulator cannot be adjusted to correct pressure with sufficient gas pressure at the valve, replace with new gas valve.

# WIRING

**WIRING CONNECTIONS**

**⚠ CAUTION**

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

1. CONVENTIONAL INSTALLATIONS

ALL ELECTRICAL WORK MUST BE INSTALLED IN ACCORDANCE WITH NATIONAL ELECTRICAL CODE, ANSI/NFPA 70 AND/ OR THE CANADIAN ELECTRICAL CODE, PART 1, CSA C22.1, ELECTRICAL CODE AND MUST CONFORM TO LOCAL REGULATIONS.

The boiler, when installed, must be electrically bonded to ground in accordance with the requirements of the authority having jurisdiction or, in the absence of such requirements, with the National Electrical Code, ANSI/NFPA 70 and/or the Canadian Electrical Code Part 1, CSA C22.1, Electrical Code.

STRICT ADHERENCE TO PIPING AND WIRING DIAGRAMS IS REQUIRED TO PREVENT CONSTANT PUMP OPERATION WHEN SYSTEM TEMPERATURE CONTROL IS SATISFIED. OTHERWISE THE WARRANTY IS VOID AS STIPULATED IN THE LIMITED WARRANTY ON THE INSTRUCTIONS MANUAL.

The electrical connections must be made so that the circulator will operate before the gas valve opens. At no time may the controlling system allow the burner to fire when there is no water flow through the boilers.

Refer to the diagrams in Figures 16 and 17 on pages 24 and 25 for proper wiring sequence with conventional single boiler installations.

The THERMAL BALANCER shown is factory included by A. O. Smith. This device serves as a pump shutdown delay switch to balance the rising boiler water temperature to system temperature before the pump stops. Overshooting of boiler temperature is prevented and stack loss after shutdown is negligible.

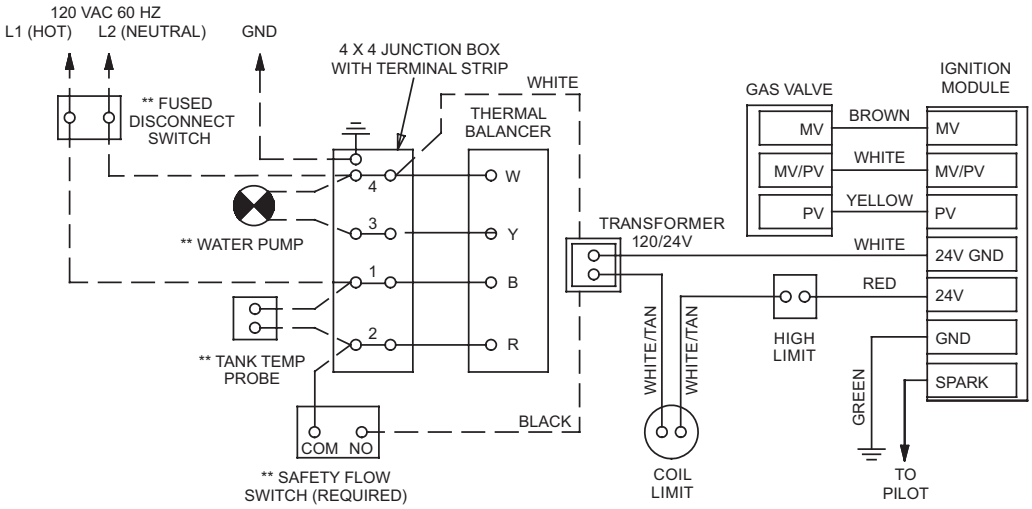
**⚠ WARNING**

AN ELECTRICAL GROUND IS REQUIRED TO REDUCE RISK OF ELECTRIC SHOCK OR POSSIBLE ELECTROCUTION. Make the ground connection to the screw provided in the electrical supply junction box on the boiler.

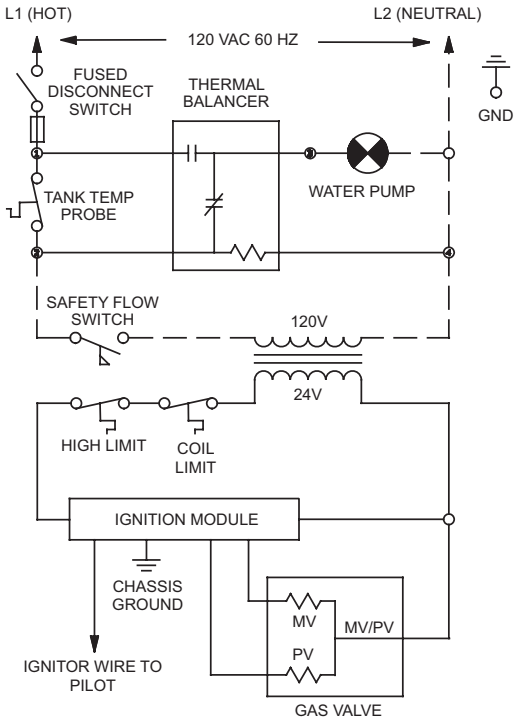
IF ANY OF THE ORIGINAL WIRE, AS SUPPLIED WITH THE APPLIANCE, MUST BE REPLACED, IT MUST BE REPLACED WITH TYPE 105$^0$C WIRE OR ITS EQUIVALENT, EXCEPT FOR THE FLAME SENSOR AND IGNITION CABLE WHICH ARE 250$^0$C AND WIRES CONNECTED TO THE COIL PROTECTOR WHICH ARE 200$^0$C.

**HW 300 TO 670**
**I.I.D. SYSTEM**

## CONNECTION DIAGRAM




## SCHEMATIC DIAGRAM




**NOTE:** IF REPLACING ANY FACTORY WIRING, USE TYPE 105°C WIRE OR EQUIVALENT, EXCEPT FOR THE IGNITION WIRE WHICH USES 250°C WIRE AND THE COIL LIMIT WHICH USES 200°C WIRE.

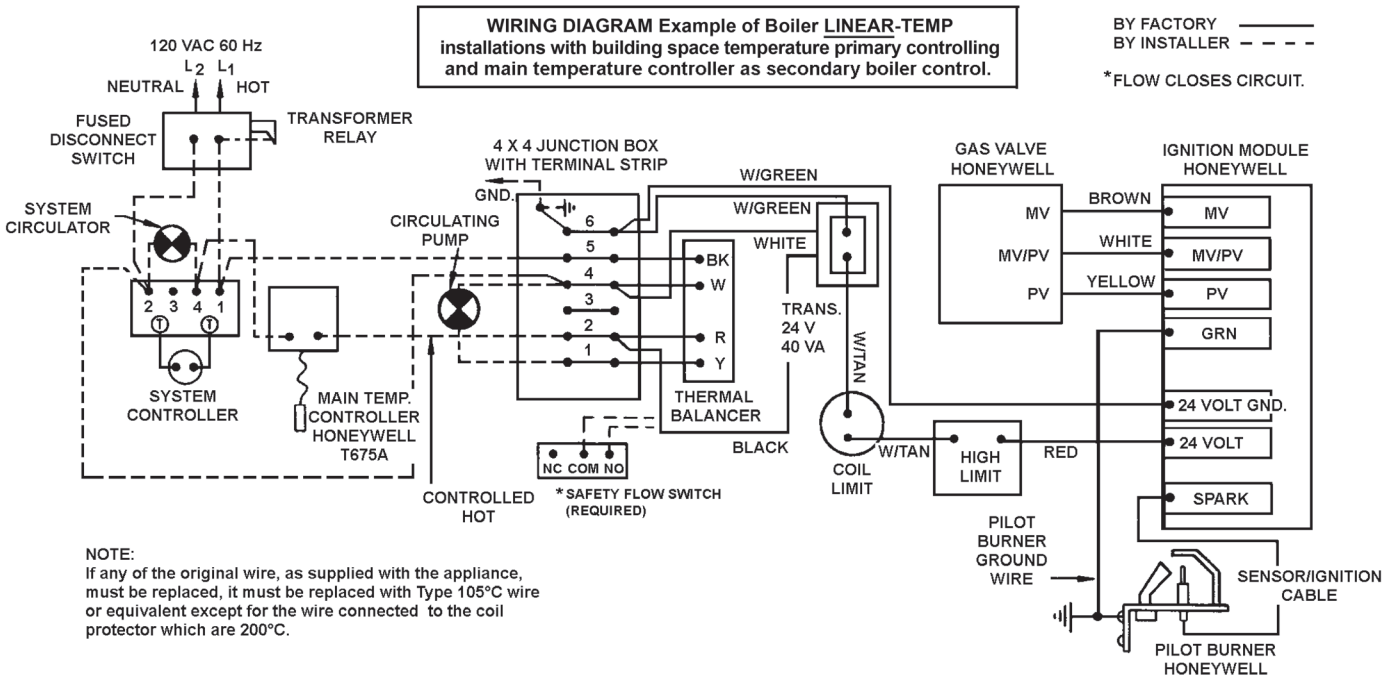
** THESE COMPONENTS ARE NOT FACTORY INSTALLED AND MUST BE SUPPLIED BY THE INSTALLER.

%%UWIRING

BY FACTORY
BY INSTALLER

192359-000 Rev. 3

**SINGLE STAGE I.I.D. - HONEYWELL GAS VALVE**
**HW (300 thru 670). (NATURAL AND PROPANE GAS) - U.S. & CANADA**
**FIGURE 16.**




**TYPICAL WIRING DIAGRAM (IID SYSTEM) FOR SINGLE BOILER LINEAR-TEMP® INSTALLATION FIGURE 17.**

2. LINEAR-TEMP INSTALLATIONS

Control for these systems is decided mainly by the type of building system controlling that is desired. A single boiler installation might be controlled directly from space temperature thermostat(s). Multiple boiler installations are more effective when the boilers are sequenced in and out of operation by some form of main water temperature controller. With one to three boilers, individual controls set at progressive temperatures may be used. For more than three or four boilers, a step controller is recommended.

Individual boiler controls, or the separate stages of a step controller, should fire a boiler and also start the boiler loop circulator whenever the first boiler of a group supplied by that boiler loop is fired. Some large installations may require the firing of more than one boiler per stage.

The system or primary circulator may or may not be controlled by the boiler sequencer. When this pump is operated through the first switch of any type of step controller, care should be taken to determine if a motor starter is needed due to insufficient switch capacity.

If the primary pump is controlled by a manual switch or any other controllers, the electric current supply to the boiler group should be through the primary pump controller. The fast response of A. O. Smith boilers eliminates any need to maintain boiler temperature when the system is satisfied. Wiring should always prevent firing of boiler(s) when there is no water flow in the mains.

Installation diagrams show flow switches in the outlet piping from each boiler as good protection against any boiler being fired when the boiler loop circulator is not in operation. These flow switches will also serve as protection if there is a loss of water.

Outdoor vent systems will normally require an automatic shutdown control if there is a continuous recirculating main and/or if the entire building is not under control of space temperature thermostats. A single bulb outdoor sensing control will prevent overheating of halls, stairways or other uncontrolled areas. There are occasions when outdoor temperatures are temporarily too warm for even a moderate amount of heating in these areas.

Space temperature controlling can be varied to meet the building requirements. Either the single thermostat, as shown, or multiple zone thermostats should control a common relay. This relay controls electric power to the system primary circulator and to the main water temperature controller. This provides for water movement in the system before the main temperature controller can start the secondary circulating pump or fire the boiler.

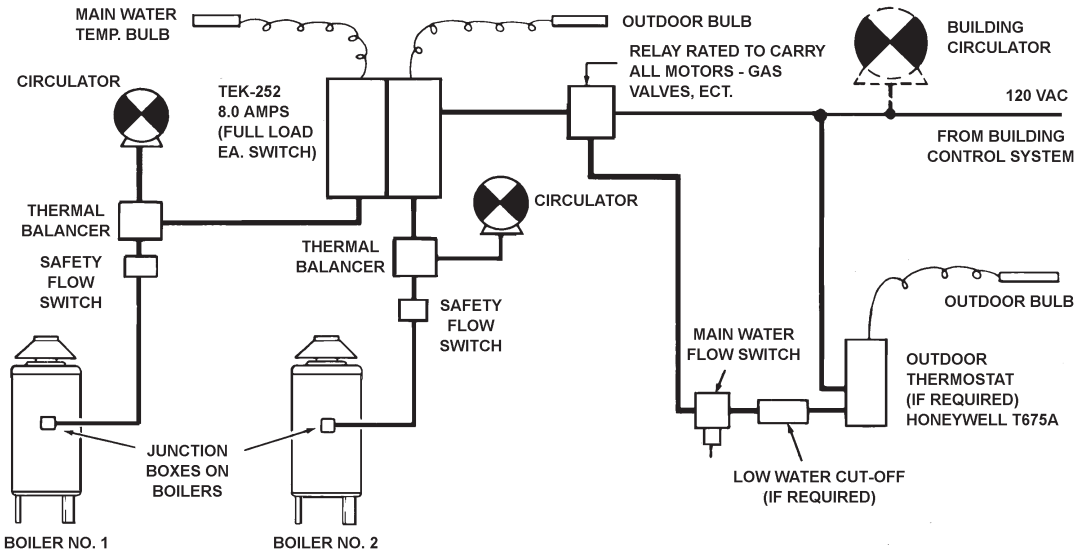
Figure 17 shows a typical wiring diagram for a single boiler space heating installation. The boiler may be controlled by a main temperature controller as shown or may include outdoor reset if desired.

Figure 18 on page 26 shows a layout for various choices of controls often found in commercial heating. These layouts are not intended to be wiring diagrams and only show the relation of one device to another in the system.

Figure 18 is a typical layout of controls for two boilers with one circulator and including optional outdoor reset and thermal balancer. If a secondary circulator is used with each boiler, arrangement for boiler no. 2 will be as shown for boiler no. 1.

Commercial size installations are always best when designed to individual building requirements.

The layout in figure 18 is typical of many combination possibilities to meet the requirements of different buildings. Brand names of controls shown are suggestions and not directly related to any particular type of system. THESE LAYOUTS ARE NOT WIRING DIAGRAMS.




**NOTE:**

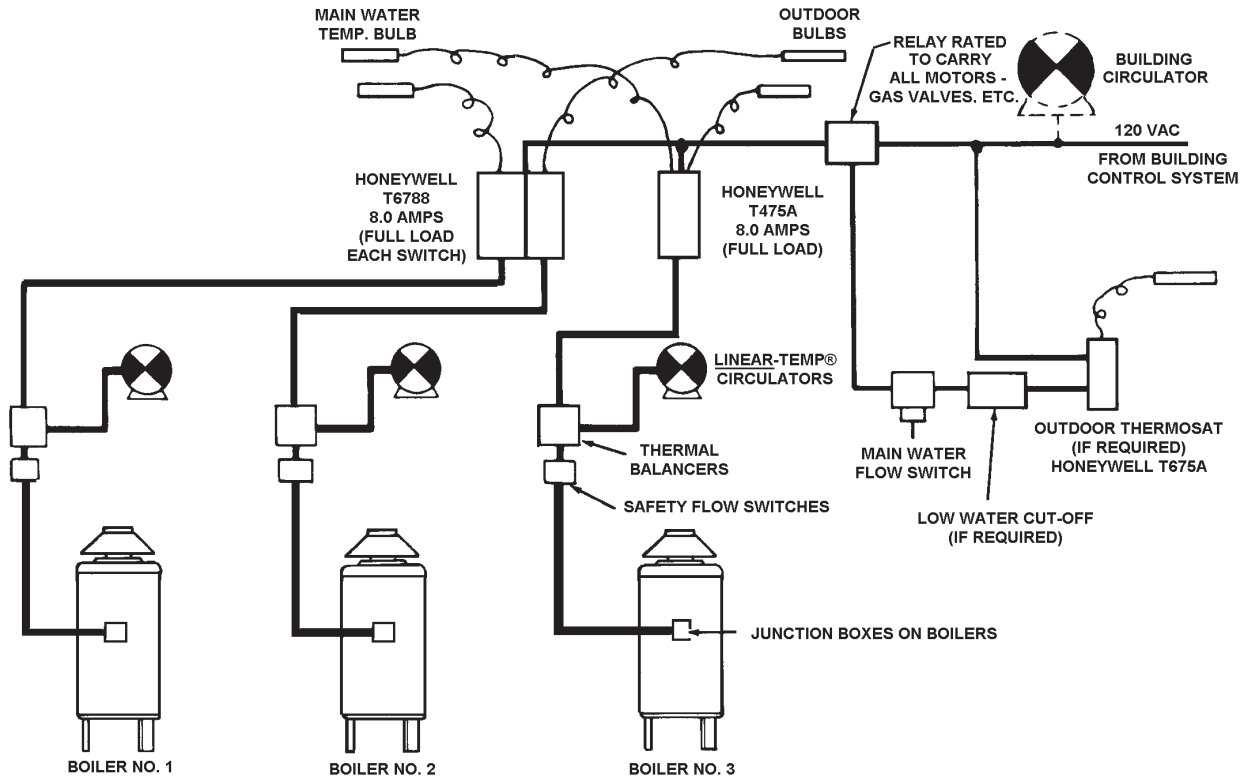
1. Building temperature controls supply electric power to building circulator.
2. Main flow switch proves main water flow before energizing sequencing and resetting controls.
3. Outdoor thermostat required if building controls do not provide automatic shutdown of reset controls during warm weather.

Boilers and Secondary Circulator are Controlled by

- Dual Bulb, Dual Switch Controller

Staging and Outdoor Reset of Main Water Temperature

**CONTROL APPLICATION DIAGRAM - TWO BOILER LINEAR-TEMP® INSTALLATION WITH TWO CIRCULATORS**
**FIGURE 18.**




**NOTE:**

1. Building temperature controls supply electric power to building circulator.
2. Main flow switch proves main water flow before energizing sequencing and resetting controls.
3. Outdoor thermostat required if building controls do not provide automatic shutdown of reset controls during warm weather.

Boilers and Secondary Circulator are Controlled by

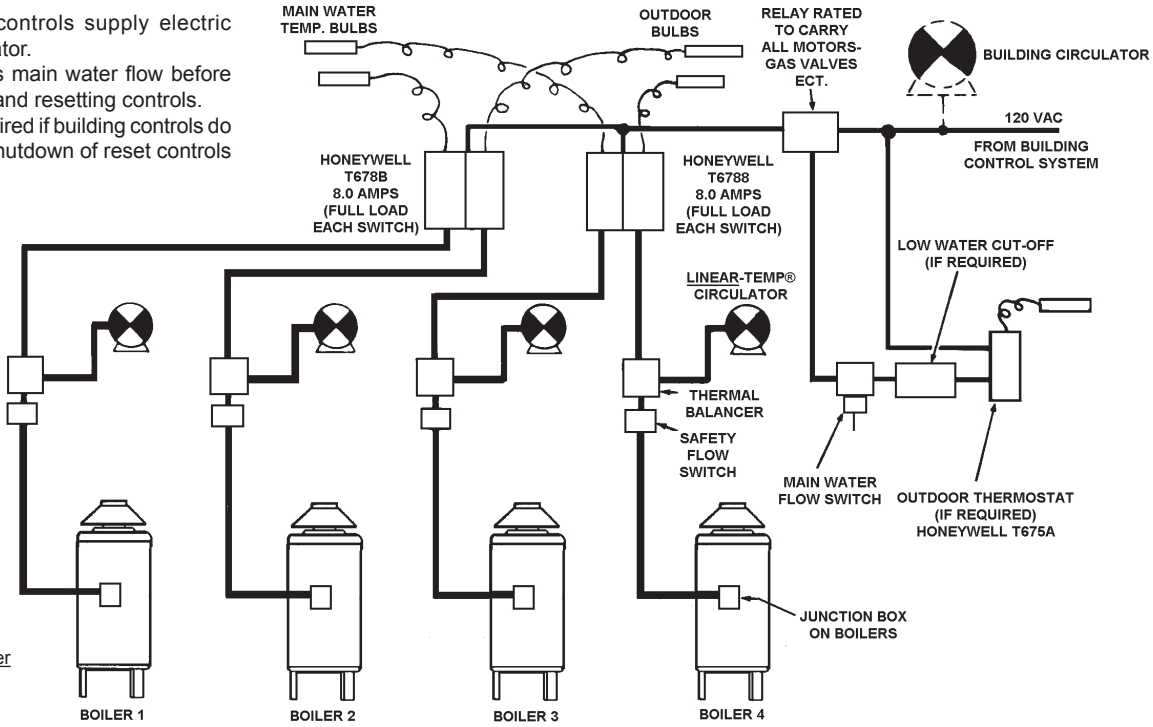
- One Dual Bulb, Dual Switch Mechanical Controller and
- One Dual Bulb, single Switch Mechanical Controller

Sequencing and Outdoor Reset of Main Water Temperature.

**CONTROL APPLICATION DIAGRAM - THREE BOILER LINEAR-TEMP® INSTALLATION WITH THREE CIRCULATORS**
**FIGURE 19.**

**NOTE:**

1. Building temperature controls supply electric power to building circulator.
2. Main flow switch proves main water flow before energizing sequencing and resetting controls.
3. Outdoor thermostat required if building controls do not provide automatic shutdown of reset controls during warm weather.




Boilers and Secondary Circulator are Controlled by Dual Bulb, Dual Switch Controller Staging and Outdoor Reset of Main Water Temperature

**CONTROL APPLICATION DIAGRAM - FOUR BOILER LINEAR-TEMP® INSTALLATION WITH TWO CIRCULATORS FIGURE 20.**

## CER-TEMP 80 - 1 UNIT INSTALLATION - FOR HOT WATER SUPPLY APPLICATION
### CANADIAN MODELS, JUNCTION BOX W/6 TERMINALS

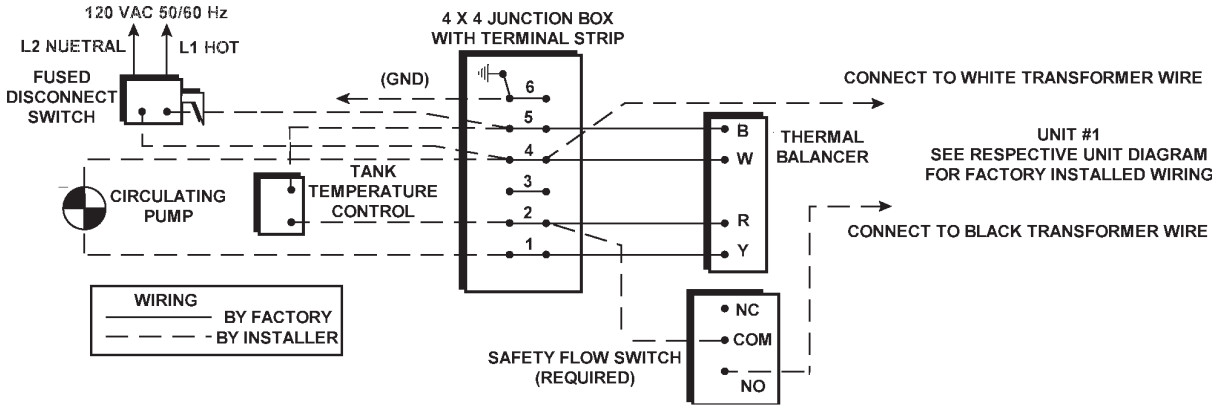



FIGURE 21.

## CER-TEMP 80 - 1 UNIT INSTALLATION - FOR HOT WATER SUPPLY APPLICATION
### U.S. MODELS, JUCNTION BOX W/4 TERMINALS

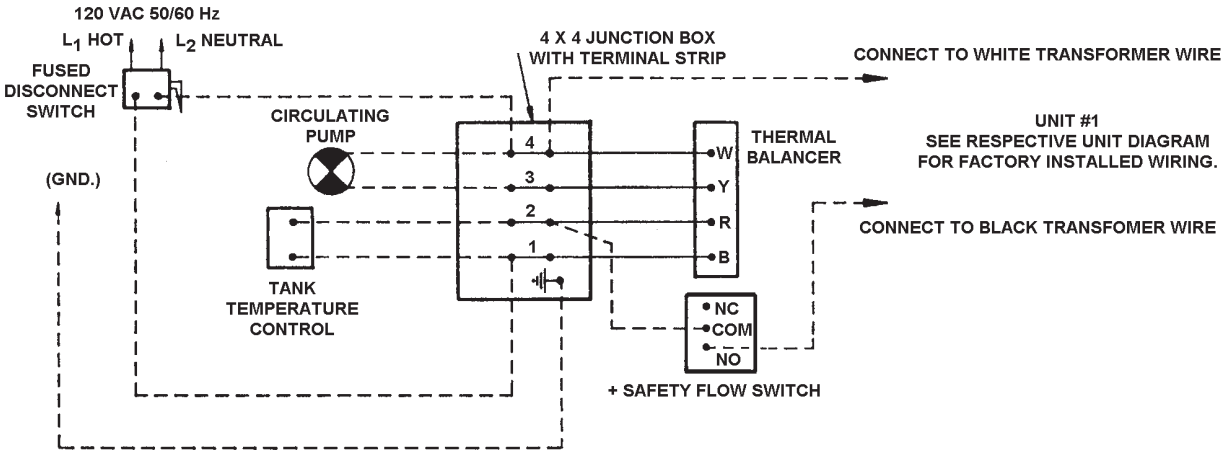
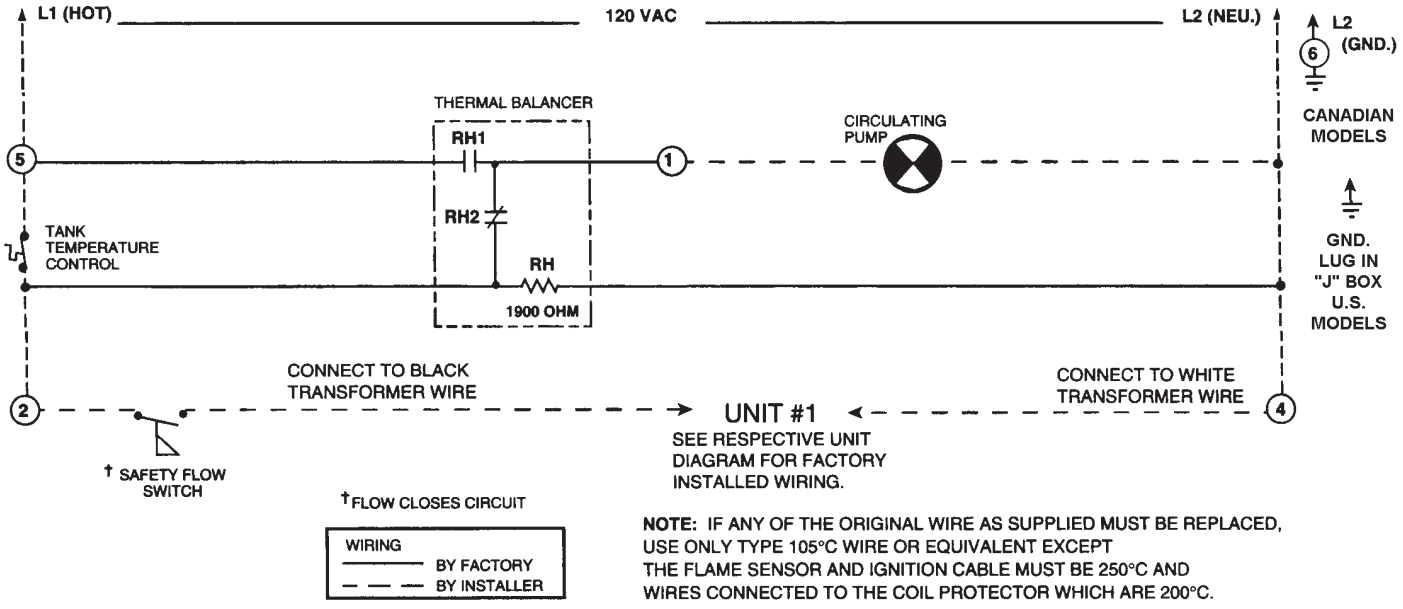



FIGURE 22.

## SCHEMATIC




**NOTE:** IF ANY OF THE ORIGINAL WIRE AS SUPPLIED MUST BE REPLACED, USE ONLY TYPE 105°C WIRE OR EQUIVALENT EXCEPT THE FLAME SENSOR AND IGNITION CABLE MUST BE 250°C AND WIRES CONNECTED TO THE COIL PROTECTOR WHICH ARE 200°C.

FIGURE 23.

# CER-TEMP 80 - 2 OR 3 UNIT INSTALLATION - FOR HOT WATER SUPPLY APPLICATION

## CANADIAN MODELS, JUNCTION BOX W/6 TERMINALS

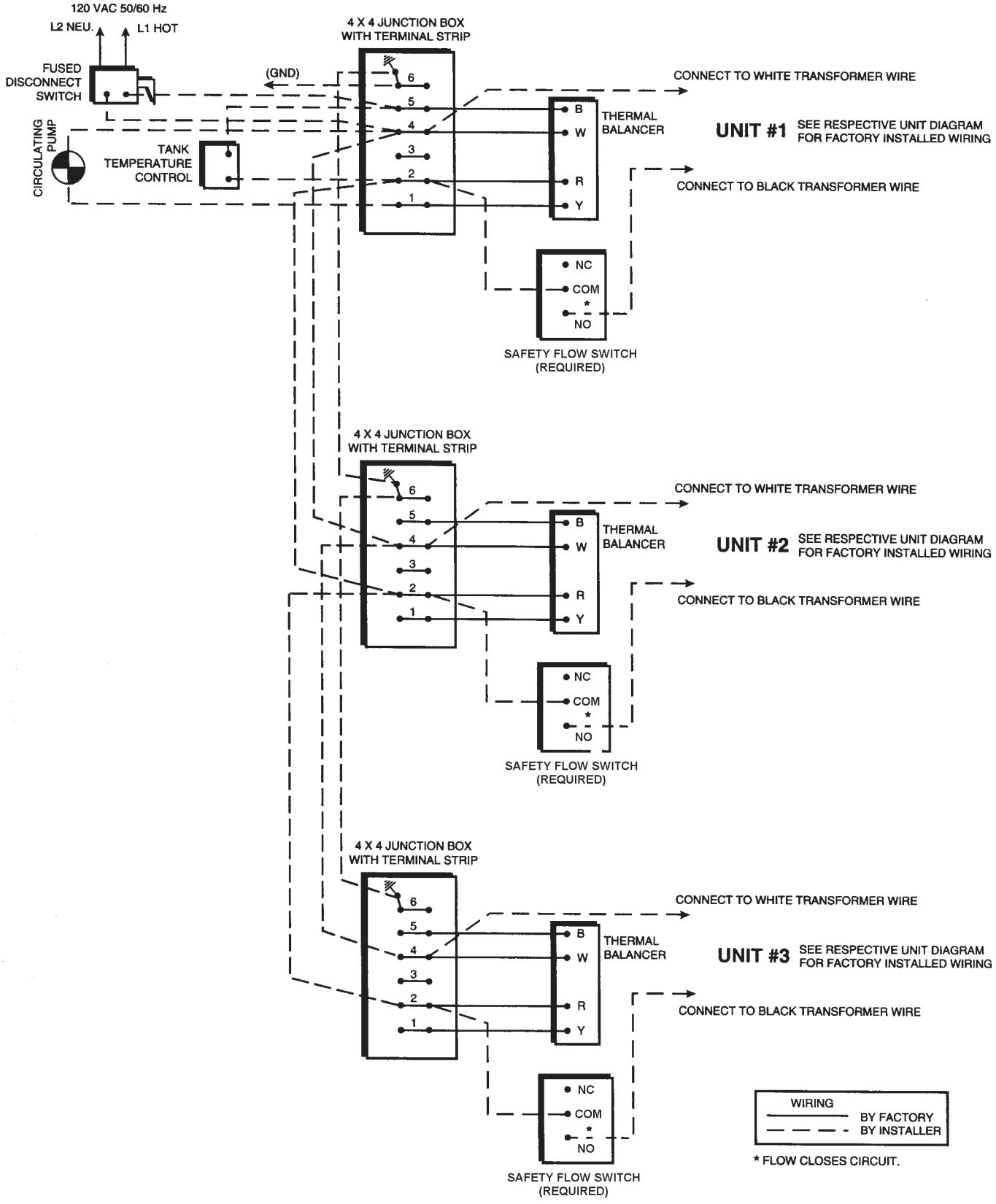



**FIGURE 24.**

# SCHEMATIC

## CANADIAN MODELS, JUNCTION BOX W/6 TERMINALS

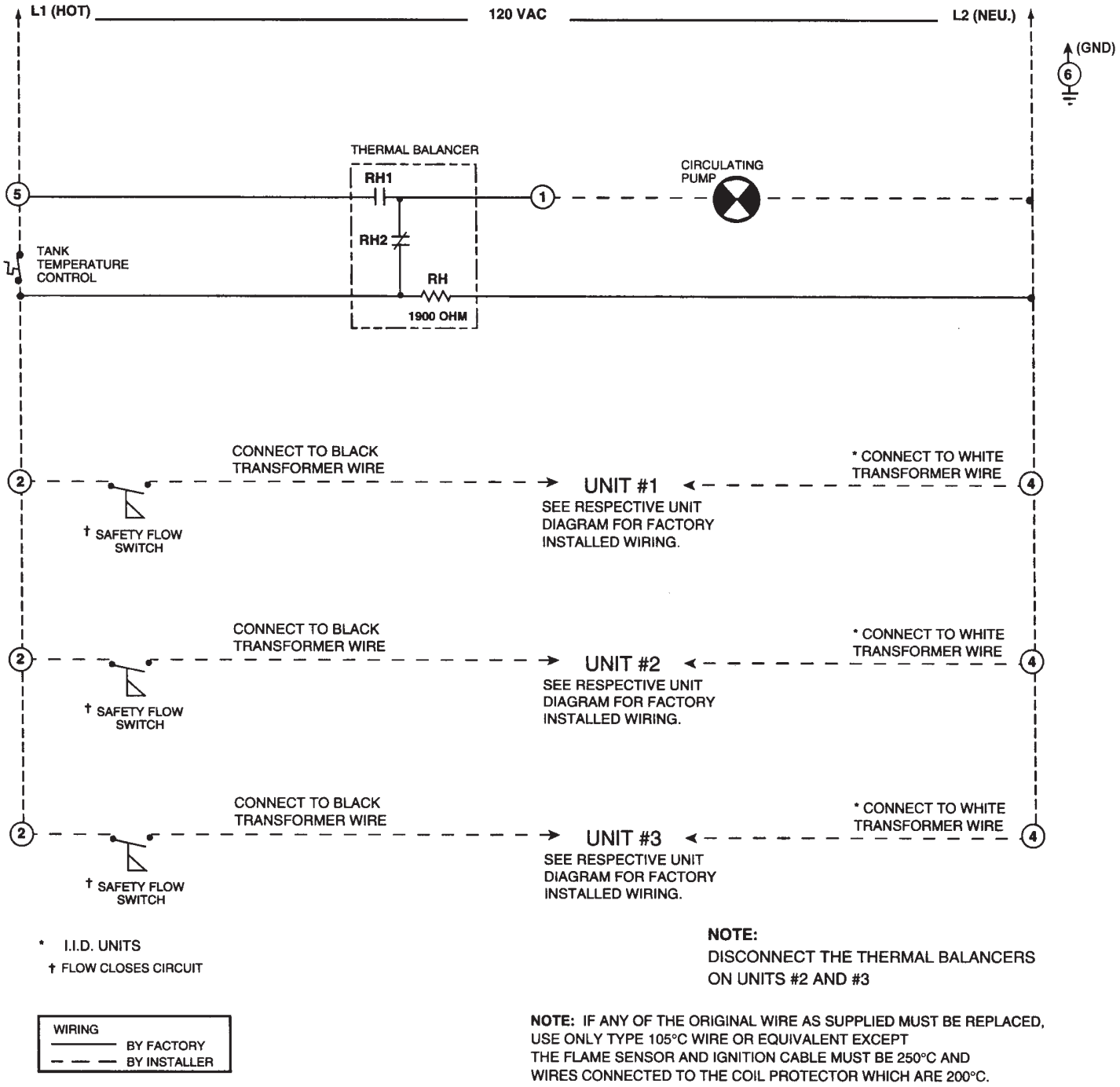
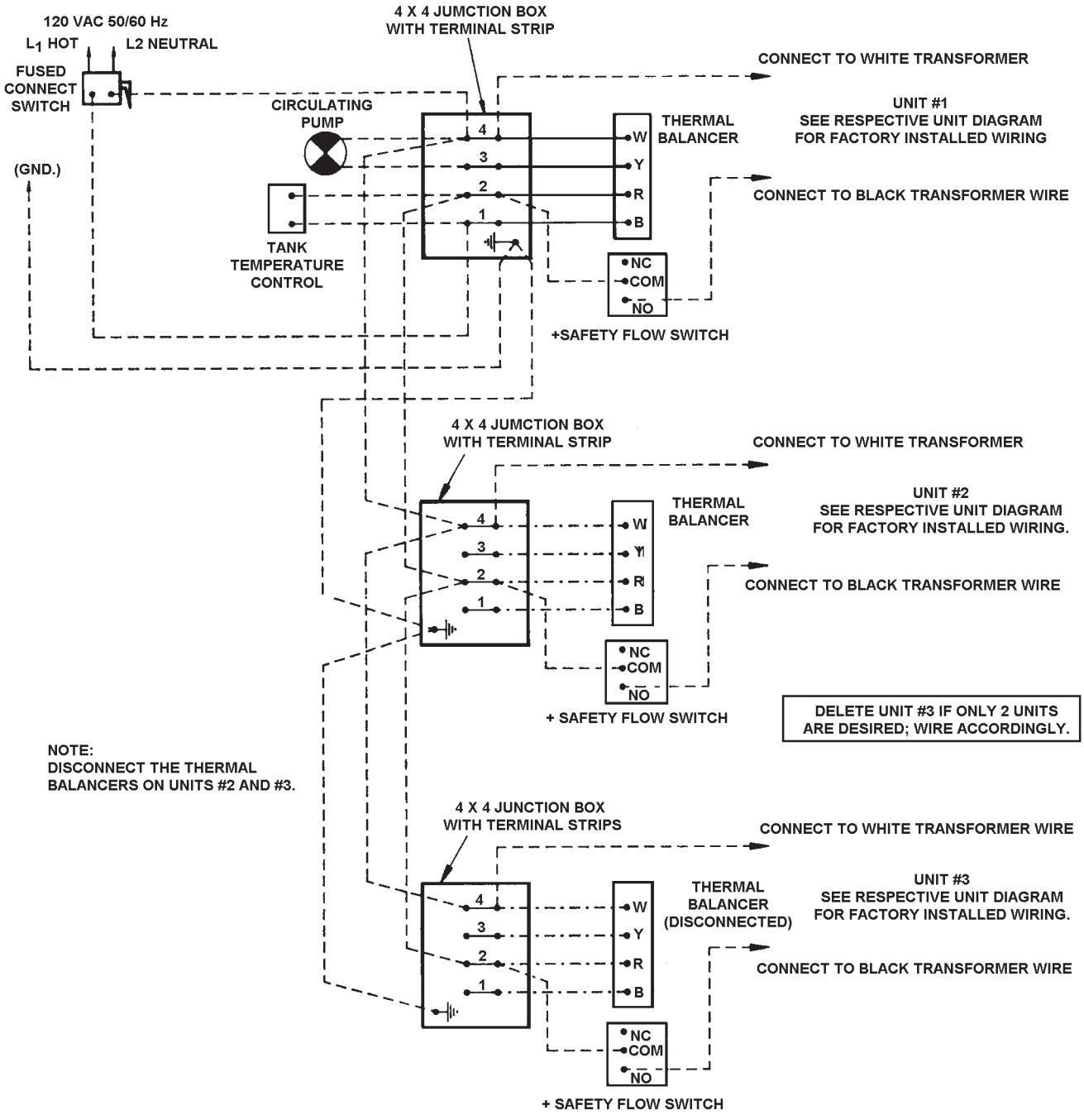



**FIGURE 25.**

# CER-TEMP 80 - 2 OR 3 UNIT INSTALLATION CONNECTION DIAGRAM (FOR HOT WATER SUPPLY APPLICATION)

## U.S. MODELS, JUNCTION BOX W/4 TERMINALS

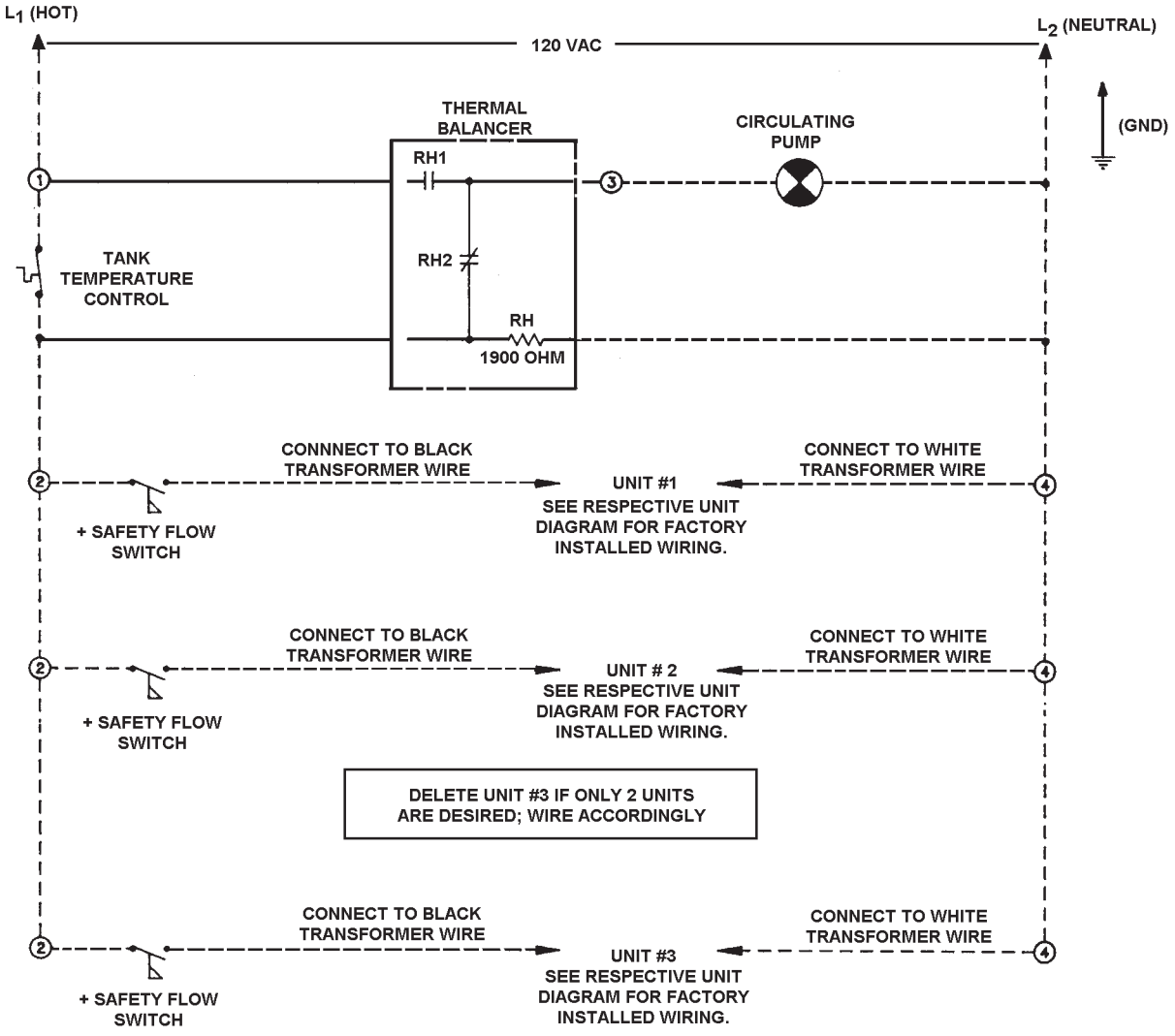



NOTE:
IF ANY OF THE ORIGINAL WIRE, AS SUPPLIED WITH THE APPLIANCE, MUST BE REPLACED, IT MUST BE REPLACED WITH TYPE 105°C WIRE OR ITS EQUIVALENT, EXCEPT FOR THE FLAME SENSOR AND IGNITION CABLE (I.I.D. UNITS ONLY) WHICH ARE 250°C AND WIRES CONNECTED TO THE COIL PROTECTOR WHICH ARE 200°C.

**FIGURE 26.**

# CER-TEMP 80 - 2 OR 3 UNIT INSTALLATION SCHEMATIC DIAGRAM (FOR HOT WATER SUPPLY APPLICATION)

## U.S. MODELS, JUNCTION BOX W/4 TERMINALS




+ FLOW CLOSES CIRCUIT

WIRING

——— BY FACTORY

– – – – – – BY INSTALLER

NOTE:
IF ANY OF THE ORIGINAL WIRE, AS SUPPLIED WITHTHE APPLIANCE, MUST BE REPLACED, IT MUST BE REPLACED WITH TYPE 105°C WIRE OR EQUIVALENT, EXCEPT FOR THE FLAME SENSOR AND IGNITION CABLE (I.I.D. UNITS ONLY) WHICH ARE 250°C AND WIRES CONNECTED TO THE COIL PROTECTOR WHICH ARE 200°C.

**FIGURE 27.**

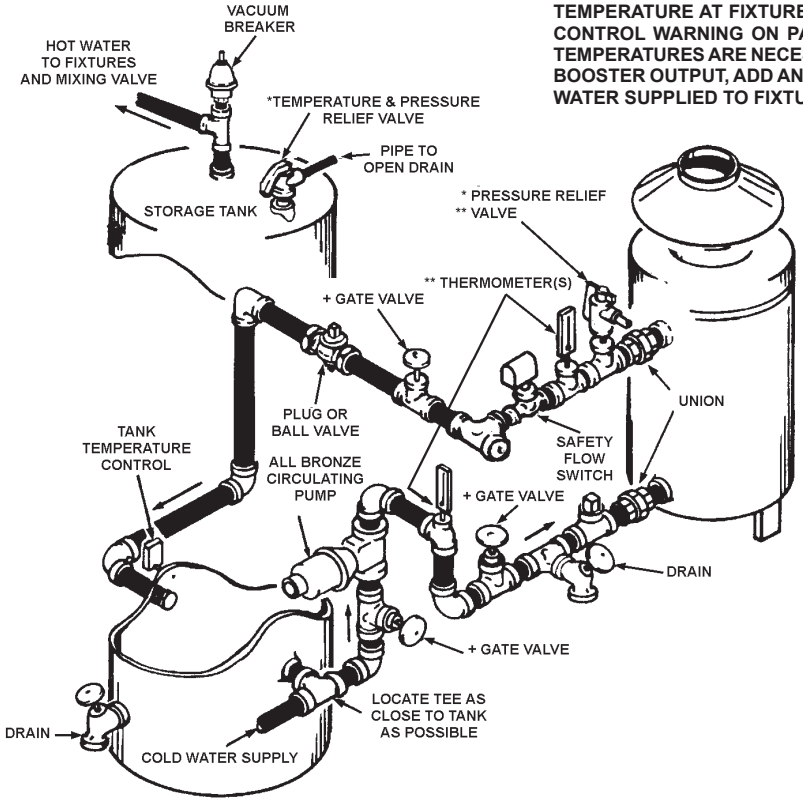
# PIPING

**ONE HW-300, HW-399, HW-420, HW-520, HW-610 OR ONE HW-670 UP-FLOW MODEL COMMERCIAL BOILER WITH VERTICAL TANK**

**⚠ DANGER**

**TEMPERATURE SETTING SHOULD NOT EXCEED SAFE USE TEMPERATURE AT FIXTURES. SEE TANK TEMPERATURE CONTROL WARNING ON PAGE 11. IF HIGHER PREHEAT TEMPERATURES ARE NECESSARY TO OBTAIN ADEQUATE BOOSTER OUTPUT, ADD AN ANTI-SCALD VALVE FOR HOT WATER SUPPLIED TO FIXTURES.**

A.O. SMITH Cer-Temp 80® RECOVERY SYSTEM




IMPORTANT
THE INSTALLATION OF SAFETY FLOW SWITCH AS SHOWN IS REQUIRED TO PROTECT THE BOILER IN CASE OF WATER SERVICE INTERRUPTION OR CIRCULATOR FAILURE.

\+ PIPING AND FITTINGS BETWEEN GATE VALVES AND BOILERS SHOULD BE BRASS OR BRONZE. OTHER PIPING SHOULD CONFORM TO LOCAL CODES.

GATE VALVES ARE SHOWN FOR SERVICING BOILER. HOWEVER, LOCAL CODES SHALL GOVERN THEIR USAGE.

* PRESSURE RELIEF VALVE RATING SHOULD NOT EXCEED PRESSURE CAPACITY OF ANY COMPONENT IN THE SYSTEM.

** INSTALL THERMOMETER AND PRESSURE RELIEF IN OPENINGS PROVIDED ON HW-520, HW-610 & HW-670.

**WIRING - FIGURES 16 and 17 on pages 24 and 25.**

INSTALL IN ACCORDANCE WITH ALL LOCAL CODES

**USE THIS TABLE FOR CORRECT PUMP AND WATER PIPE SIZE**

| Model Number | Minimum Pipe Size (Inches) | B & G Pump Size | *Armstrong Pump Size |
|---|---|---|---|
| HW-300 | 1-1/4" | 125 | S-25 1-1/4" |
| HW-399 | 1-1/2" | 1-1/2" HV | H-32 1-1/2" |
| HW-420 | 1-1/2" | 1-1/2" HV | H-32 1-1/2" |
| HW-520 | 1-1/2" | 1-1/2" HV | H-32 1-1/2" |
| HW-610/670 | 2" | 2" | S-35 |

* Assumes 50 equivalent feet of piping or less.

**FIGURE 28.**

## ONE HW-300, HW-399, HW-420, HW-520, HW-610 OR ONE HW-670 UP-FLOW MODEL COMMERCIAL BOILER WITH HORIZONTAL TANK

A.O. SMITH Cer-Temp 80® RECOVERY SYSTEM

**⚠ DANGER**

TEMPERATURE SETTING SHOULD NOT EXCEED SAFE USE TEMPERATURE AT FIXTURES. SEE TANK TEMPERATURE CONTROL WARNING ON PAGE 11. IF HIGHER PREHEAT TEMPERATURES ARE NECESSARY TO OBTAIN ADEQUATE BOOSTER OUTPUT, ADD AN ANTI-SCALD VALVE FOR HOT WATER SUPPLIED TO FIXTURES.

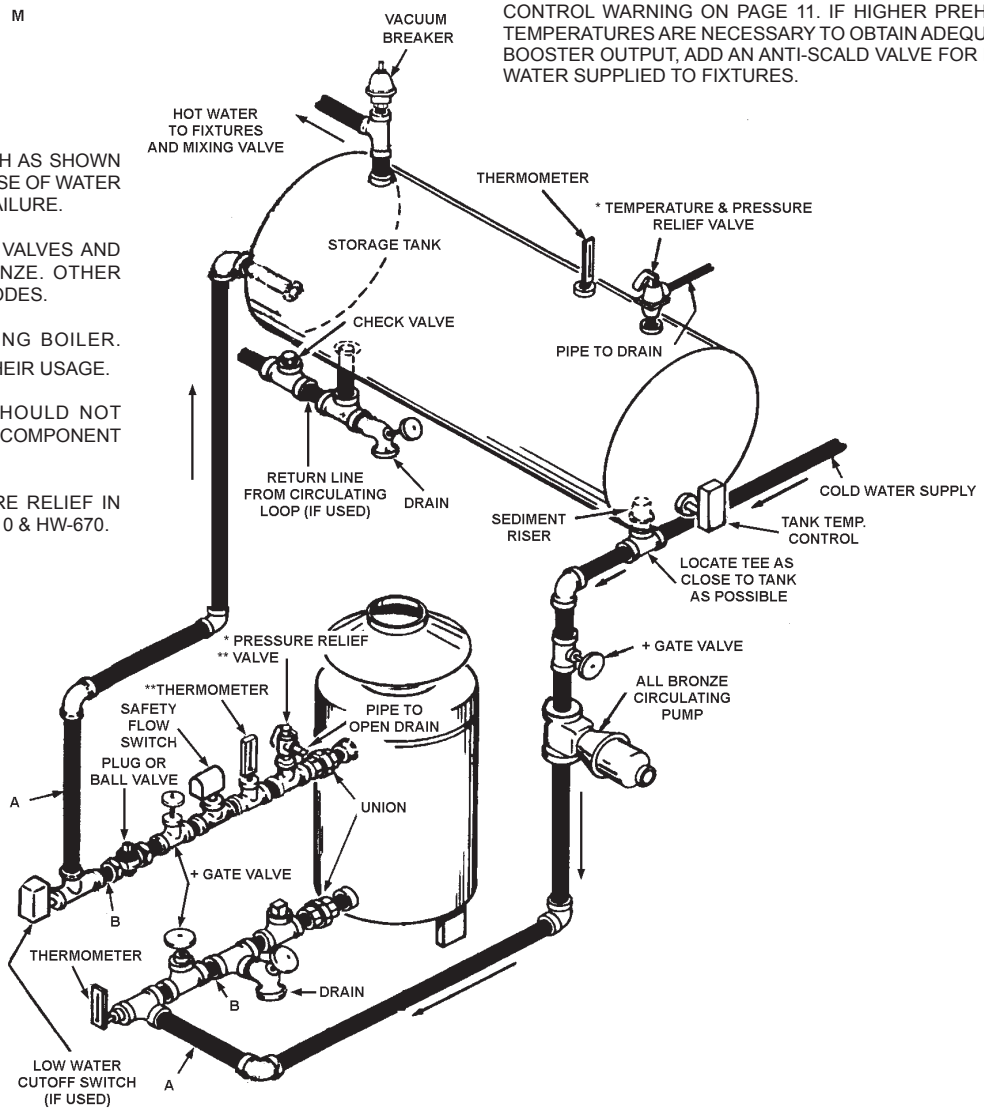
IMPORTANT
THE INSTALLATION OF SAFETY FLOW SWITCH AS SHOWN IS REQUIRED TO PROTECT THE BOILER IN CASE OF WATER SERVICE INTERRUPTION OR CIRCULATOR FAILURE.

\+ PIPING AND FITTINGS BETWEEN GATE VALVES AND BOILERS SHOULD BE BRASS OR BRONZE. OTHER PIPING SHOULD CONFORM TO LOCAL CODES.

GATE VALVES ARE SHOWN FOR SERVICING BOILER. HOWEVER, LOCAL CODES SHALL GOVERN THEIR USAGE.

* PRESSURE RELIEF VALVE RATING SHOULD NOT EXCEED PRESSURE CAPACITY OF ANY COMPONENT IN THE SYSTEM.

** INSTALL THERMOMETER AND PRESSURE RELIEF IN OPENINGS PROVIDED ON HW-520, HW-610 & HW-670.




**WIRING - FIGURES 16 and 17 on pages 24 and 25.**

INSTALL IN ACCORDANCE WITH ALL LOCAL CODES

### USE THIS TABLE FOR CORRECT PUMP AND WATER PIPE SIZE

| Model Number | Minimum Pipe Size (Inches) | B & G Pump Size | *Armstrong Pump Size |
|---|---|---|---|
| HW-300 | 1-1/4" | 125 | S-25 1-1/4" |
| HW-399 | 1-1/2" | 1-1/2" HV | H-32 1-1/2" |
| HW-420 | 1-1/2" | 1-1/2" HV | H-32 1-1/2" |
| HW-520 | 1-1/2" | 1-1/2" HV | H-32 1-1/2" |
| HW-610/670 | 2" | 2" | S-35 |

* Assumes 50 equivalent feet of piping or less.

**FIGURE 29.**

## TWO HW-399's, HW-420's, HW-520's, HW-610's or HW-670's UP-FLOW MODEL COMMERCIAL BOILER WITH VERTICAL TANK, CER-TEMP 80

A.O. SMITH Cer-Temp 80® RECOVERY SYSTEM

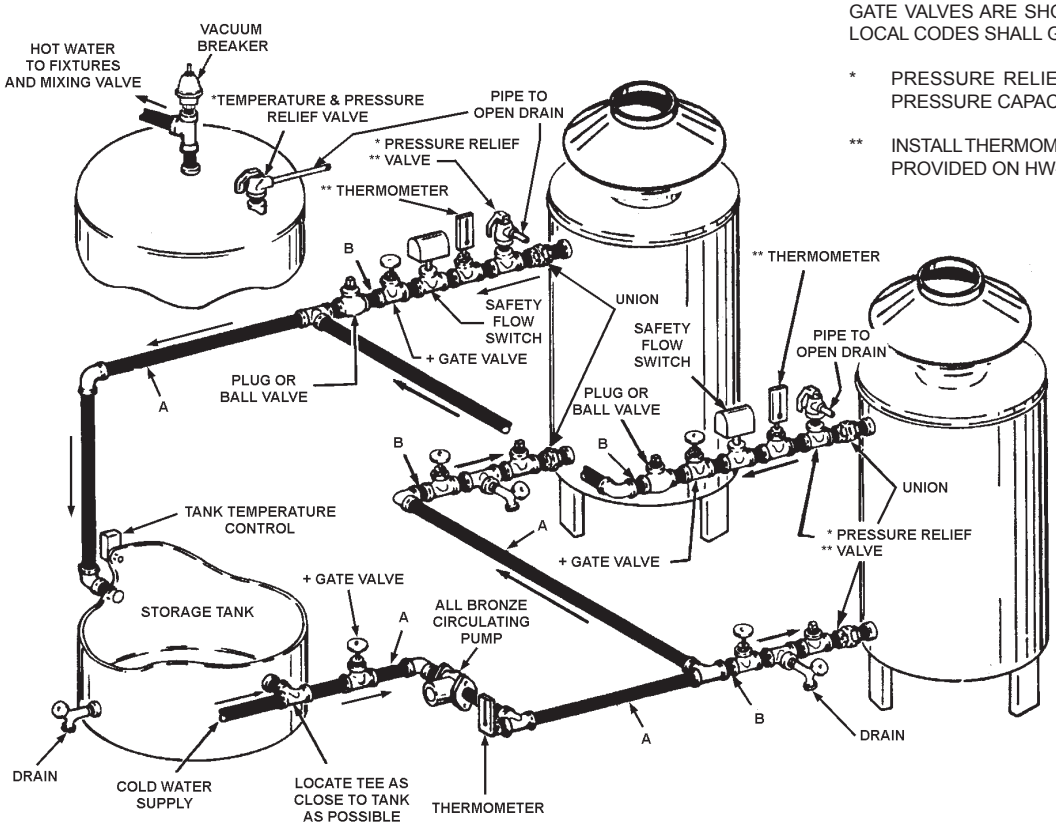
IMPORTANT
THE INSTALLATION OF SAFETY FLOW SWITCH AS SHOWN IS REQUIRED TO PROTECT THE BOILER IN CASE OF WATER SERVICE INTERRUPTION OR CIRCULATOR FAILURE.

\+ PIPING AND FITTINGS BETWEEN GATE VALVES AND BOILERS SHOULD BE BRASS OR BRONZE. OTHER PIPING SHOULD CONFORM TO LOCAL CODES.

GATE VALVES ARE SHOWN FOR SERVICING BOILER. HOWEVER, LOCAL CODES SHALL GOVERN THEIR USAGE.

* PRESSURE RELIEF VALVE RATING SHOULD NOT EXCEED PRESSURE CAPACITY OF ANY COMPONENT IN THE SYSTEM.

** INSTALL THERMOMETER AND PRESSURE RELIEF IN OPENINGS PROVIDED ON HW-520, HW-610 & HW-670.




**⚠ DANGER**

**TEMPERATURE SETTING SHOULD NOT EXCEED SAFE USE TEMPERATURE AT FIXTURES. SEE TANK TEMPERATURE CONTROL WARNING ON PAGE 11. IF HIGHER PREHEAT TEMPERATURES ARE NECESSARY TO OBTAIN ADEQUATE BOOSTER OUTPUT, ADD AN ANTI-SCALD VALVE FOR HOT WATER SUPPLIED TO FIXTURES.**

### WIRING - FIGURES 21 to 27 on pages 28 to 32.

HEATERS SPACED 30" APART

INSTALL IN ACCORDANCE WITH ALL LOCAL CODES

### USE THIS TABLE FOR CORRECT PUMP AND WATER PIPE SIZE

| Model Number | Minimum Pipe Size (Inches) | | B & G Pump Size | *Armstrong Pump Size |
|---|---|---|---|---|
| | A | B | | |
| HW-300 | 2" | 1-1/2" | 2" | S-35 |
| HW-399 | 2" | 1-1/2" | 2" | S-35 |
| HW-420 | 2" | 1-1/2" | 2" | S-35 |
| HW-520 | 2" | 1-1/2" | 2" | S-35 |
| HW-610/670 | 2-1/2" | 1-1/2" | 2-1/2" | S-45 2-1/2" |

* Assumes 50 equivalent feet of piping or less.

**FIGURE 30.**

## TWO HW-300's, HW-399's, HW-420's, HW-520's, HW-610's OR HW-670's UP-FLOW MODEL COMMERCIAL BOILER WITH HORIZONTAL TANK

IMPORTANT
THE INSTALLATION OF SAFETY FLOW SWITCH AS SHOWN IS REQUIRED TO PROTECT THE BOILER IN CASE OF WATER SERVICE INTERRUPTION OR CIRCULATOR FAILURE.

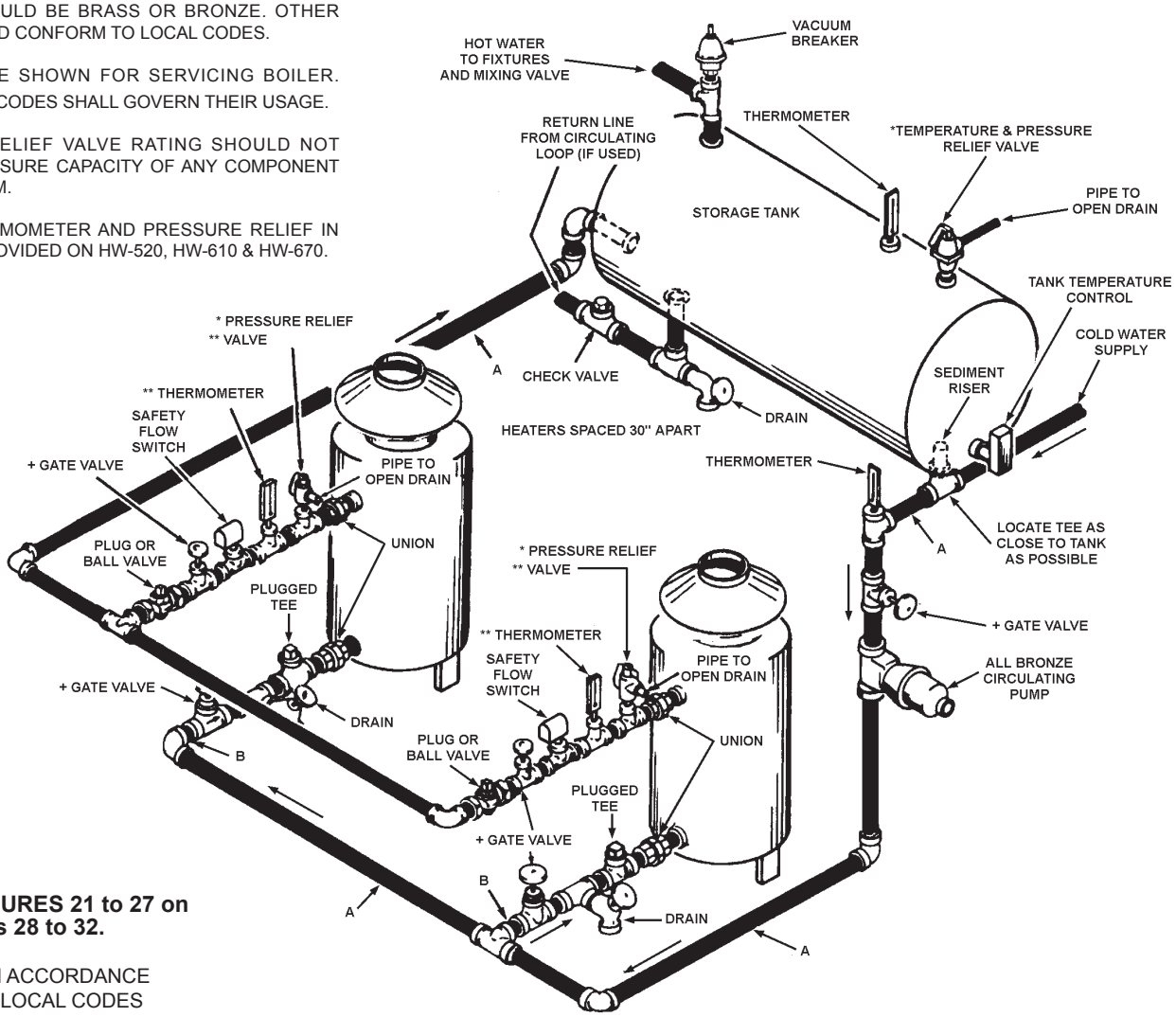
\+ PIPING AND FITTINGS BETWEEN GATE VALVES AND BOILERS SHOULD BE BRASS OR BRONZE. OTHER PIPING SHOULD CONFORM TO LOCAL CODES.

GATE VALVES ARE SHOWN FOR SERVICING BOILER. HOWEVER, LOCAL CODES SHALL GOVERN THEIR USAGE.

* PRESSURE RELIEF VALVE RATING SHOULD NOT EXCEED PRESSURE CAPACITY OF ANY COMPONENT IN THE SYSTEM.

** INSTALL THERMOMETER AND PRESSURE RELIEF IN OPENINGS PROVIDED ON HW-520, HW-610 & HW-670.

A.O. SMITH Cer-Temp 80® RECOVERY SYSTEM




**WIRING - FIGURES 21 to 27 on pages 28 to 32.**

INSTALL IN ACCORDANCE WITH ALL LOCAL CODES

**⚠ DANGER**

**TEMPERATURE SETTING SHOULD NOT EXCEED SAFE USE TEMPERATURE AT FIXTURES. SEE TANK TEMPERATURE CONTROL WARNING ON PAGE 11. IF HIGHER PREHEAT TEMPERATURES ARE NECESSARY TO OBTAIN ADEQUATE BOOSTER OUTPUT, ADD AN ANTI-SCALD VALVE FOR HOT WATER SUPPLIED TO FIXTURES.**

### USE THIS TABLE FOR CORRECT PUMP AND WATER PIPE SIZE

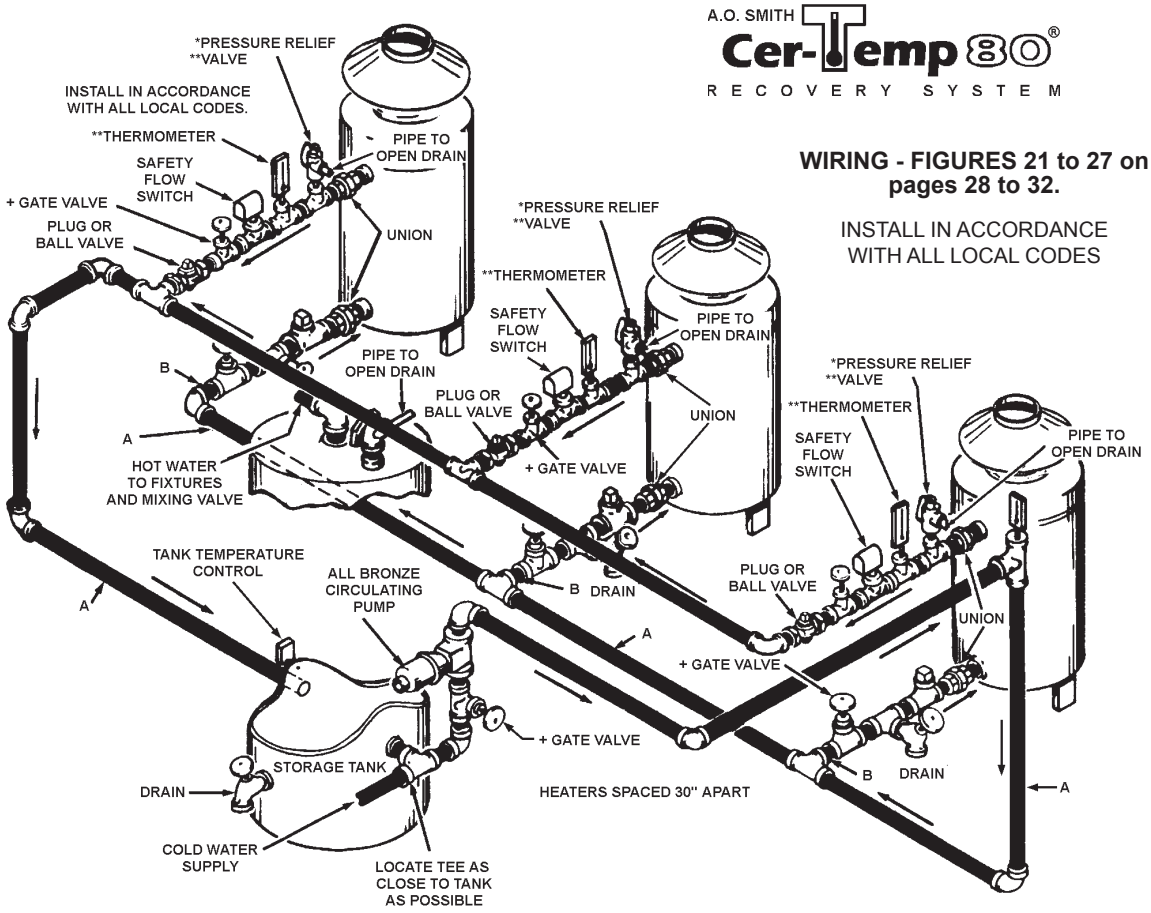
| Model Number | Minimum Pipe Size (Inches) | | B & G Pump Size | *Armstrong Pump Size |
|---|---|---|---|---|
| | A | B | | |
| HW-300 | 2" | 1-1/2" | 2" | S-35 |
| HW-399 | 2" | 1-1/2" | 2" | S-35 |
| HW-420 | 2" | 1-1/2" | 2" | S-35 |
| HW-520 | 2" | 1-1/2" | 2" | S-35 |
| HW-610/670 | 2-1/2" | 1-1/2" | 2-1/2" | S-45 2-1/2" |

* Assumes 50 equivalent feet of piping or less.

**FIGURE 31.**

## THREE HW-520's, HW-610's OR HW-670's UP-FLOW MODEL COMMERCIAL BOILER WITH VERTICAL TANK, CER-TEMP 80

A.O. SMITH Cer-Temp 80® RECOVERY SYSTEM




**WIRING - FIGURES 21 to 27 on pages 28 to 32.**

INSTALL IN ACCORDANCE WITH ALL LOCAL CODES

**⚠ DANGER**

**TEMPERATURE SETTING SHOULD NOT EXCEED SAFE USE TEMPERATURE AT FIXTURES. SEE TANK TEMPERATURE CONTROL WARNING ON PAGE 11. IF HIGHER PREHEAT TEMPERATURES ARE NECESSARY TO OBTAIN ADEQUATE BOOSTER OUTPUT, ADD AN ANTI-SCALD VALVE FOR HOT WATER SUPPLIED TO FIXTURES.**

IMPORTANT
THE INSTALLATION OF SAFETY FLOW SWITCH AS SHOWN IS REQUIRED TO PROTECT THE BOILER IN CASE OF WATER SERVICE INTERRUPTION OR CIRCULATOR FAILURE.

\+ PIPING AND FITTINGS BETWEEN GATE VALVES AND BOILERS SHOULD BE BRASS OR BRONZE. OTHER PIPING SHOULD CONFORM TO LOCAL CODES.

GATE VALVES ARE SHOWN FOR SERVICING BOILER. HOWEVER, LOCAL CODES SHALL GOVERN THEIR USAGE.

* PRESSURE RELIEF VALVE RATING SHOULD NOT EXCEED PRESSURE CAPACITY OF ANY COMPONENT IN THE SYSTEM.

** INSTALL THERMOMETER AND PRESSURE RELIEF IN OPENINGS PROVIDED ON HW-520, HW-610 & HW-670.

### USE THIS TABLE FOR CORRECT PUMP AND WATER PIPE SIZE

| Model Number | Minimum Pipe Size (Inches) | | B & G Pump Size | *Armstrong Pump Size |
|---|---|---|---|---|
| | A | B | | |
| HW-520 | 2-1/2" | 1-1/2" | 2" | S-45 2-1/2" |
| HW-610/670 | 3" | 1-1/2" | 3" HD-3 | S-46 |

* Assumes 50 equivalent feet of piping or less.

**FIGURE 32.**

## THREE HW-520's, HW-610's OR HW-670's UP-FLOW MODEL COMMERCIAL BOILER WITH HORIZONTAL TANK, CER-TEMP 80

**⚠ DANGER**

**TEMPERATURE SETTING SHOULD NOT EXCEED SAFE USE TEMPERATURE AT FIXTURES. SEE TANK TEMPERATURE CONTROL WARNING. IF HIGHER PREHEAT TEMPERATURES ARE NECESSARY TO OBTAIN ADEQUATE BOOSTER OUTPUT, ADD AN ANTI-SCALD VALVE FOR HOT WATER SUPPLIED TO FIXTURES.**

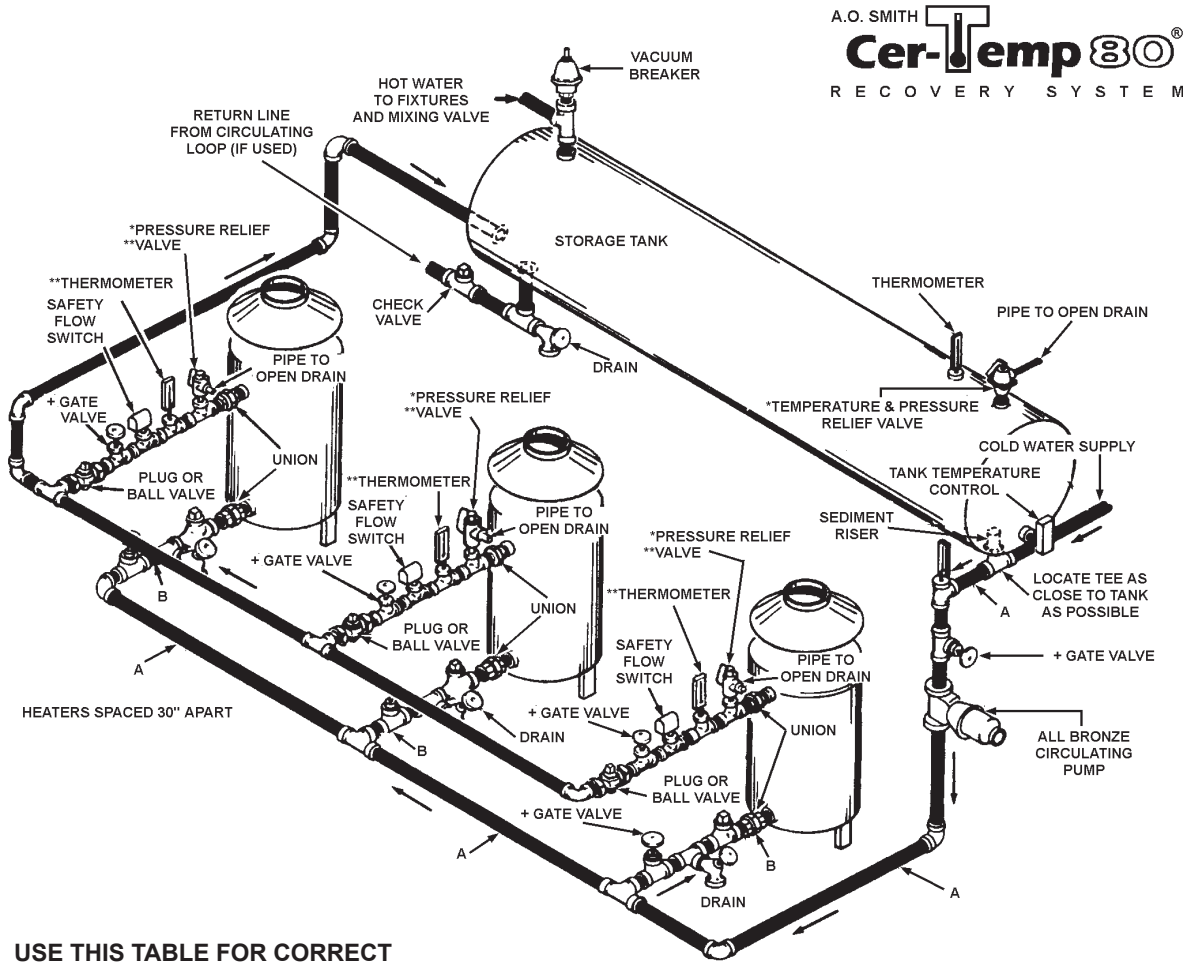
IMPORTANT
THE INSTALLATION OF SAFETY FLOW SWITCH AS SHOWN IS REQUIRED TO PROTECT THE BOILER IN CASE OF WATER SERVICE INTERRUPTION OR CIRCULATOR FAILURE.

\+ PIPING AND FITTINGS BETWEEN GATE VALVES AND BOILERS SHOULD BE BRASS OR BRONZE. OTHER PIPING SHOULD CONFORM TO LOCAL CODES.

GATE VALVES ARE SHOWN FOR SERVICING BOILER. HOWEVER, LOCAL CODES SHALL GOVERN THEIR USAGE.

* PRESSURE RELIEF VALVE RATING SHOULD NOT EXCEED PRESSURE CAPACITY OF ANY COMPONENT IN THE SYSTEM.

** INSTALL THERMOMETER AND PRESSURE RELIEF IN OPENINGS PROVIDED ON HW-520, HW-610 & HW-670.




### USE THIS TABLE FOR CORRECT PUMP AND WATER PIPE SIZE

| Model Number | Minimum Pipe Size (Inches) | | B & G Pump Size | *Armstrong Pump Size |
|---|---|---|---|---|
| | A | B | | |
| HW-520 | 2-1/2" | 1-1/2" | 2" | S-45 2-1/2" |
| HW-610/670 | 3" | 1-1/2" | 3" HD-3 | S-46 |

* Assumes 50 equivalent feet of piping or less.

**WIRING - FIGURES 21 to 27 on pages 28 to 32.**

HEATERS SPACED 24" APART

INSTALL IN ACCORDANCE WITH ALL LOCAL CODES

**FIGURE 33.**

# OPERATION AND START-UP INSTRUCTIONS

**⚠ WARNING**

After placing boiler into operation, the ignition system safety shutoff device must be tested by the following test method.

1. Reset High Limit Temperature Control to lowest setting. (See figure 2 on page 8).

2. Reset System Controller to maximum setting, causing a call for heat and allowing unit to run until High Limit Temperature Control trips.

3. Resetting the High Limit Temperature Control to a higher setting, unit should run.

4. Reset System Controller and High Limit Temperature Control to desired temperature. If unit fails to run, see Trouble-Shooting in this manual.

Before operating the boiler, the entire system must be filled with water, purged of air and checked for leaks. Do not use Stop Leak or other boiler compounds. The gas piping should also be leak tested.

Any safety devices including low water cutoffs used in conjunction with this boiler should receive periodic (every six months) inspection to assure proper operation. A low water cutoff device of the float type should be flushed every six months. All relief valves should be inspected and manually operated at least twice a year.

**IMPORTANT**

IT IS RECOMMENDED THAT A QUALIFIED PERSON PERFORM THE INITIAL FIRING OF THE BOILER. AT THIS TIME THE USER SHOULD NOT HESITATE TO ASK THE INDIVIDUAL ANY QUESTIONS WHICH HE MAY HAVE IN REGARD TO THE OPERATION AND MAINTENANCE OF THE UNIT.

**FILLING THE SYSTEM**

1. Fast fill system through bypass until pressure approaches desired system pressure. Close bypass valve and permit pressure to be established by the pressure reducing valve.

2. Vent all high points in system to purge system of air.

If pressure bleeding of system is desired, install valves as shown in Figure 7 on page 14.

Where cast iron radiation and motorized valves are used, conventional system pressure and installation practices should be followed.

Provisions should be made to permit manual venting of radiators or convectors.

**PRECAUTIONS**

If the unit is exposed to the following, do not operate boiler until all corrective steps have been made by a qualified serviceman:

1. Flooding to level of burner or controls or higher.
2. Exposure to fire.
3. If damaged.
4. Firing without water.
5. Sooting.

**⚠ CAUTION**

SHOULD OVERHEATING OCCUR OR THE GAS SUPPLY FAIL TO SHUT OFF, DO NOT TURN OFF OR DISCONNECT THE ELECTRICAL SUPPLY TO THE PUMP. INSTEAD, SHUTOFF THE GAS SUPPLY AT A LOCATION EXTERNAL TO THE APPLIANCE.

**PILOT AND MAIN BURNER**

To maintain safe operation of the boiler, check the pilot and the main burner once every six months for proper flame characteristics.

1. MAIN BURNER

   The main burner, Figure 34, should display the following characteristics:

   - Provide complete combustion of gas.
   - Cause rapid ignition and carryover of flame across entire burner.
   - Give reasonably quiet operation during ignition, burning and extinction.
   - Cause no excessive lifting of flame from burner ports.

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

Also check for good flow of combustion and ventilating air to the unit. Maintain a clear area around the boiler at all times.

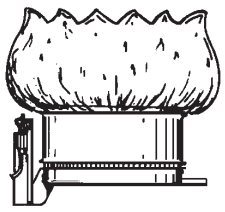


**FIGURE 34.**

The boiler should be periodically inspected by a qualified servicer for continuous safe operation.

Qualified servicers should follow this procedure when the boiler's burners need cleaning.

1. Turn off the electrical power and close the main manual gas shutoff valve. See L&O instructions on pages 43 and 44.

   - Allow boiler parts to cool before disassembly.

2. Remove main burner manifold assembly from boiler.
   - Refer to parts list supplied with this manual for disassembly aid.

3. Remove any loose foreign material such as dust or lint with a vacuum. Check all ports, orifices, and air openings for blockage. Dislodge any foreign material causing blockage. Remove any soot or carbon deposits with a rag making sure to remove any lint left on burner by vacuuming again.

4. Reinstall the burner manifold assembly on boiler.

5. Restore electrical power and gas supply to boiler.

   - Put the boiler back in operation by following the lighting instructions in this manual or on the lighting and operating label on the boiler. See pages 43 - 44.

   - Check for gas leaks and proper boiler and vent operation.

2. PILOT BURNER - ELECTRONIC IGNITION

To establish pilot flame without main burner operation, it will be necessary to perform the following steps:

Servicing of the pilot burner (every six months) includes keeping pilot shield (not shown) free of lint, cleaning the burner head, the primary air opening and the orifice of the pilot burner, Figure 35.

1. Open fused disconnect switch or shut off electrical power to the boiler.

2. Disconnect wire from MV wire on valve.

3. Close fused disconnect switch to restore electrical power to the boiler.

   The pilot will now ignite provided the system is calling for heat.

4. Adjust pilot flame.

   To adjust the pilot flame, remove the cap screw from the pilot adjusting screw (Figure 36) and turn to deliver a sufficient flame at the pilot burner to cover 3/8" to 1/2" (10-12mm) of the sensing probe tip. See Figure 35.

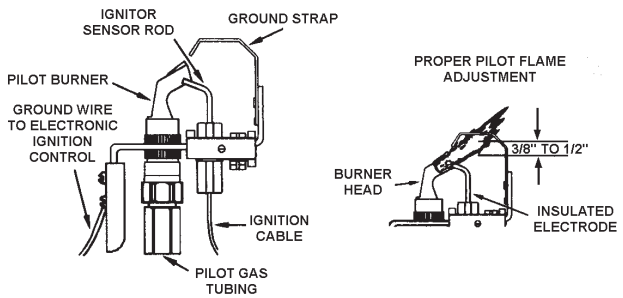



**FIGURE 35.**

Check for good terminal connection at the sensing probe at the pilot burner assembly if pilot does not light.

Check for electrical power to the valve. If electrical power and gas are present at the valve and the pilot does not operate when system calls for heat, replace valve.

5. Low gas pressure

   - Adjust pilot flame by means of the pilot gas adjustment located in the gas valve.

   - The pilot flame should envelop 3/8 to 1/2 inch of the tip of the thermocouple. Remove pilot adjustment cover screw, Figure 36. Turn inner adjustment screw or pilot adjusting valve clockwise to decrease, or counterclockwise to increase pilot flame. Be sure to replace cover screw on combination gas valve after adjustment to prevent possible gas leakage.

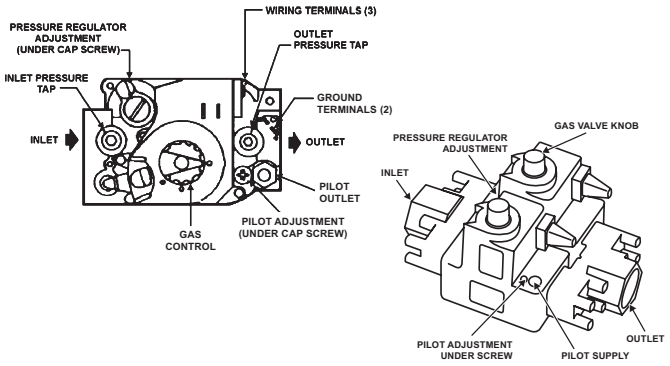



**FIGURE 36.**

6. Clogged pilot burner orifice.

   - Clean or replace orifice. A clogged orifice will restrict gas flow and result in low thermocouple output.

7. Incorrect orifice.

   - Replace. The Orifice size is stamped on the wrench flats.

8. Clogged primary air opening.

   - Restricted air passages will soften the pilot flame and result in poor thermocouple flame impingement.

**CHECKING AND ADJUSTING THE INPUT**

1. Follow steps 1 thru 6 of the OPERATING INSTRUCTIONS.

2. Attach a pressure gauge or a manometer to the manifold pressure tapping and refer to table 10 for correct manifold pressure.

3. Follow steps 7 thru 11 of the OPERATING INSTRUCTIONS.

4. Use this formula to "clock" the meter. Be sure that other gas consuming appliances are not ON during this interval.

$$\frac{3600}{T} \times H = Btuh$$

Btuh = The approximate actual input rate.
T = Time in seconds to burn one cubic foot of gas.
H = Heating value of the fuel gas in Btu per cubic foot of gas.

EXAMPLE:

T = 9.0 seconds/ft$^3$
H = 1050 Btu/ft$^3$(natural gas)
Btuh = ?
Gas flow through meter:

$$\frac{3600}{9.0} \times 1050 = 420{,}000 \text{ Btuh}$$

Small changes in the input rate may be made by adjusting the manifold pressure, see GAS PRESSURE REGULATORS. Under no circumstances should you exceed the maximum input rate for the boiler given in table 2 on page 6.

5. Repeat steps 1 thru 6 of the OPERATING INSTRUCTIONS.

6. Remove the pressure gauge or manometer from the manifold pressure tapping. Replace the screw-in plug in the manifold pressure tap.

7. Repeat steps 7 thru 11 of the OPERATING INSTRUCTIONS. The boiler will resume normal operation.

When the boiler is operating at full capacity, or full gas input, it should consume 1 cu. ft. of gas in approximately the time indicated in table 10.

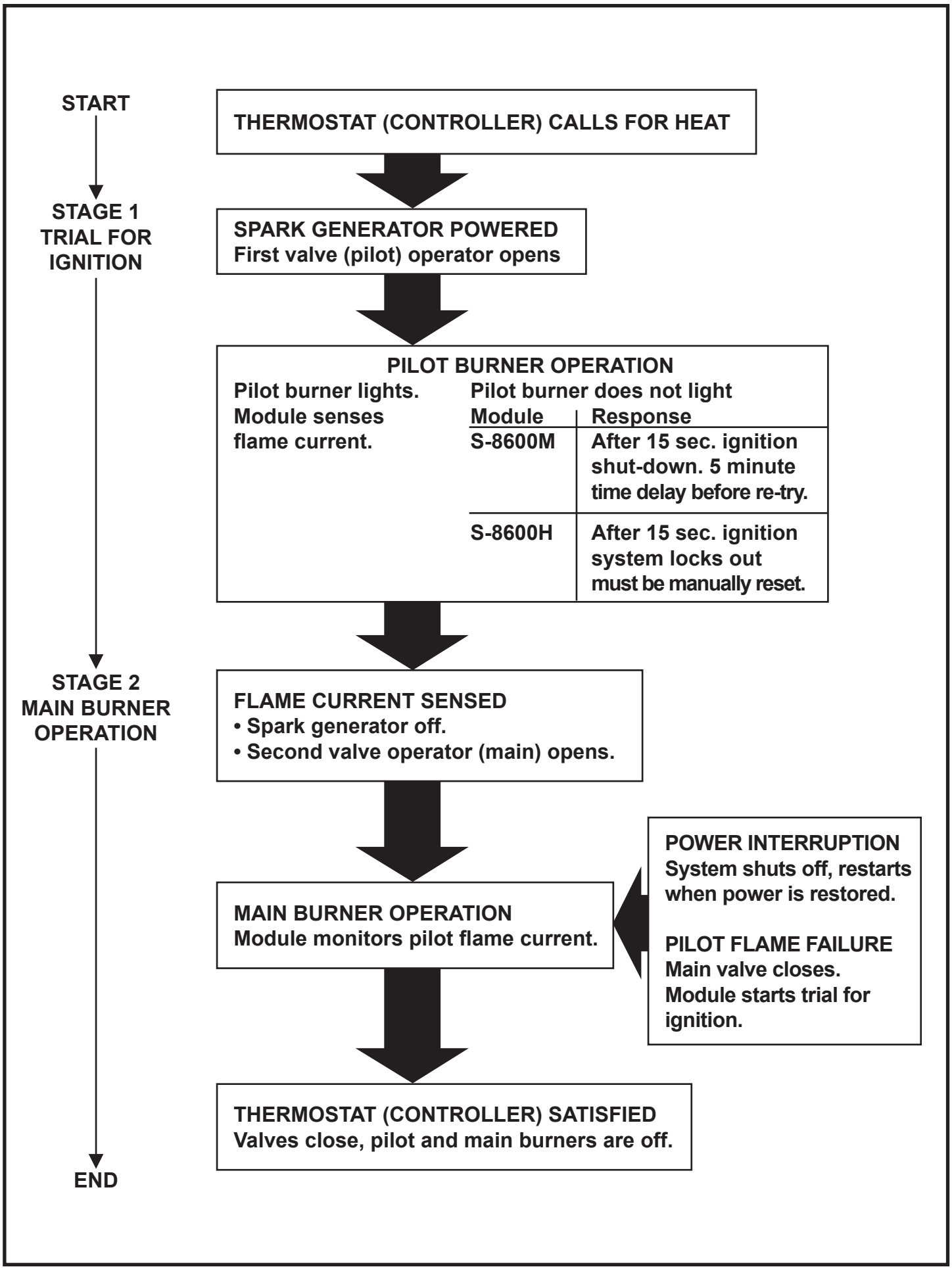
**TABLE 10.**
**CONSUMPTION RATE**
**(Refer to Operating at Full Input or Full Capacity)**

| Type Gas | Heating Value Btu/Ft. | Time to Consume 1 cu. ft. of gas (seconds) | | | | | |
|---|---|---|---|---|---|---|---|
| | | HW-300 | HW-399 | HW-420 | HW-520 | HW-610 | HW-670 |
| Natural | 1050 | 12.6 | 9.5 | 9.0 | 7.3 | 6.2 | 5.7 |
| Propane | 2500 | 30.0 | 22.6 | 21.4 | 17.3 | 14.8 | 13.4 |

**IMPORTANT**

UNDER NO CIRCUMSTANCES SHOULD THE GAS INPUT EXCEED THE INPUT SHOWN ON THE BOILER MODEL AND RATING PLATE. OVERFIRING COULD RESULT IN DAMAGE OR SOOTING OF THE BOILER. Minor variances from input on rating plate can be corrected by adjustment of gas pressure regulators described in GAS PRESSURE REGULATORS section of this manual.

The inlet gas pressure must not exceed or be less than the values shown on rating plate.


START
THERMOSTAT (CONTROLLER) CALLS FOR HEAT
STAGE 1
TRIAL FOR
IGNITION
SPARK GENERATOR POWERED
First valve (pilot) operator opens
PILOT BURNER OPERATION
Pilot burner lights.
Module senses
flame current.
Pilot burner does not light
Module
Response
S-8600M
After 15 sec. ignition
shut-down. 5 minute
time delay before re-try.
S-8600H
After 15 sec. ignition
system locks out
must be manually reset.
STAGE 2
MAIN BURNER
OPERATION
FLAME CURRENT SENSED
• Spark generator off.
• Second valve operator (main) opens.
POWER INTERRUPTION
System shuts off, restarts
when power is restored.
PILOT FLAME FAILURE
Main valve closes.
Module starts trial for
ignition.
MAIN BURNER OPERATION
Module monitors pilot flame current.
THERMOSTAT (CONTROLLER) SATISFIED
Valves close, pilot and main burners are off.
END

# FOR YOUR SAFETY READ BEFORE LIGHTING

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

FLAMMABLE

**WARNING: HOT WATER CAN PRODUCE 3rd DEGREE BURNS IN 6 SECONDS AT 140° F. (60° C).**

**IN CASE OF POWER FAILURE DO NOT ATTEMPT TO OPERATE APPLIANCE. IMPROPER INSTALLATION, ADJUSTMENT, ALTERATION, SERVICE OR MAINTENANCE CAN CAUSE PROPERTY DAMAGE, PERSONAL INJURY OR LOSS OF LIFE. REFER TO THE USER'S INFORMATION MANUAL PROVIDED WITH THIS APPLIANCE. INSTALLATION AND SERVICE MUST BE PERFORMED BY A QUALIFIED INSTALLER, SERVICE AGENCY OR THE GAS SUPPLIER.**

**A. THIS APPLIANCE IS EQUIPPED WITH AN IGNITION DEVICE WHICH AUTOMATICALLY LIGHTS THE PILOT. DO NOT TRY TO LIGHT THE PILOT BY HAND.**

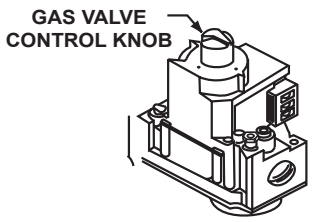
**B. BEFORE OPERATING: SMELL ALL AROUND THE APPLIANCE AREA FOR GAS. BE SURE TO SMELL NEXT TO THE FLOOR BECAUSE SOME GAS IS HEAVIER THAN AIR AND WILL SETTLE ON THE FLOOR.**

**WHAT TO DO IF YOU SMELL GAS**

- **DO NOT TRY TO LIGHT ANY APPLIANCE.**
- **DO NOT TOUCH ANY ELECTRIC SWITCH; DO NOT USE ANY 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.**

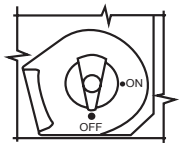
**C. USE ONLY YOUR HAND TO TURN THE GAS CONTROL KNOB. NEVER USE TOOLS. IF THE KNOB WILL NOT TURN BY HAND, DON'T TRY TO REPAIR IT. CALL A QUALIFIED SERVICE TECHNICIAN. FORCE OR ATTEMPTED REPAIR MAY RESULT IN A FIRE OR EXPLOSION.**

**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.**



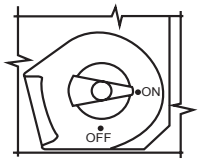

HONEYWELL GAS VALVE

FIGURE "A"




"OFF" POSITION

FIGURE "B"




"ON" POSITION

FIGURE "C"

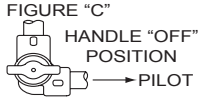
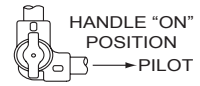



FIGURE "D"




PILOT FIRING VALVE

# LIGHTING INSTRUCTIONS

1. **STOP! READ THE SAFETY INFORMATION ABOVE ON THIS LABEL.**
2. **MAKE SURE BOILER AND SYSTEM ARE FILLED WITH WATER AND ALL AIR HAS BEEN EXPELLED FROM APPLIANCE.**
3. **TURN OFF ALL ELECTRIC POWER TO THE APPLIANCE. SET SYSTEM TEMPERATURE CONTROLLER TO LOWEST SETTING. PURGE ALL GAS LINES OF AIR.**
4. **DO NOT ATTEMPT TO LIGHT THE PILOT BY HAND**
5. **REFER TO DIAGRAMS ABOVE. TURN TOP KNOB OF GAS CONTROL & PILOT VALVE (FIG. "C") CLOCKWISE ↷, TO "OFF" POSITION (FIG. "A")**
6. **WAIT FIVE (5) MINUTES TO CLEAR OUT ANY GAS. THEN SMELL FOR GAS, INCLUDING NEAR THE FLOOR. IF YOU SMELL GAS, STOP! FOLLOW "B" IN THE SAFETY INFORMATION ABOVE ON THIS LABEL. IF YOU DON'T SMELL GAS, GO TO THE NEXT STEP.**
7. **TURN TOP KNOB OF GAS CONTROL COUNTER-CLOCKWISE ↶ TO "ON" (FIG. B). OPEN PILOT MANUAL VALVES, COUNTER-CLOCKWISE ↶ . FIGURE "D"**
8. **TURN ON ALL ELECTRIC POWER TO THE APPLIANCE.**
9. **SET SYSTEM TEMPERATURE CONTROLLER TO DESIRED SETTING.**
10. **WHEN CONTROLLER CALLS FOR HEAT, THE CIRCULATING PUMP WILL OPERATE AND THE PILOT BURNER WILL BE SPARK IGNITED. GAS CONTROL WILL OPEN AND MAIN BURNER WILL THEN IGNITE. NOTE: IF PILOT FAILS TO IGNITE, TURN OFF APPLIANCE AND CONSULT YOUR "INSTALLATION AND USER'S MANUAL" FOR ADJUSTMENTS AND TROUBLE SHOOTING.**
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

**A. SET THE SYSTEM CONTROLLER TO THE LOWEST SETTING.**

**B. TURN OFF ELECTRICAL POWER TO APPLIANCE.**

**C. TURN TOP KNOB OF GAS CONTROL VALVE CLOCKWISE ↷ TO "OFF" POSITION SEE, (FIG A). CLOSE FIRING AND PILOT MANUAL VALVES, CLOCKWISE ↷ . SEE ABOVE.**

211686-000 REV. XX

# 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.

FLAMMABLE

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 LIGHTING: SMELL ALL AROUND THE APPLIANCE AREA FOR GAS. BE SURE TO SMELL NEXT TO THE FLOOR BECAUSE SOME GAS IS HEAVIER THAN AIR AND WILL SETTLE ON THE FLOOR.

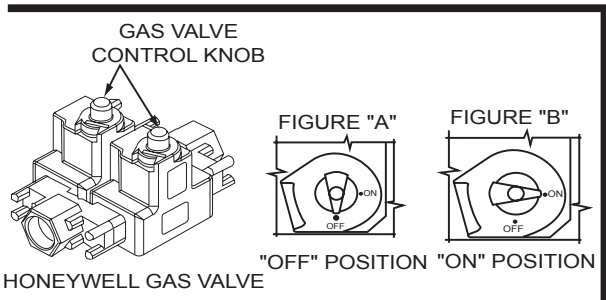
WHAT TO DO IF YOU SMELL GAS

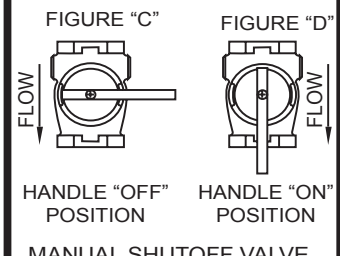
- DO NOT TRY TO LIGHT ANY APPLIANCE.
- DO NOT TOUCH ANY ELECTRIC SWITCH.
- DO NOT USE ANY PHONE IN YOUR BUILDING.
- IMMEDIATELY CALL YOUR GAS SUPPLIER FROM A NEIGHBOR'S PHONE. FOLLOW THE GAS SUPPLIER'S INSTRUCTIONS.
- IF YOU CANNOT REACH YOUR GAS SUPPLIER, CALL THE FIRE DEPARTMENT.

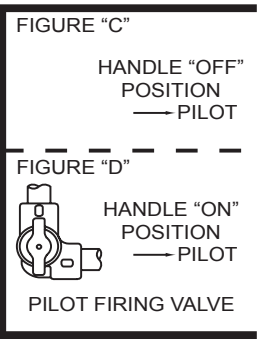
C. USE ONLY YOUR HAND TO TURN THE GAS CONTROL KNOB. NEVER USE TOOLS. IF THE KNOB WILL NOT TURN BY HAND, DON'T TRY TO REPAIR IT. CALL A QUALIFIED SERVICE TECHNICIAN. FORCE OR ATTEMPTED REPAIR MAY RESULT IN A FIRE OR EXPLOSION.

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.

E. DO NOT OPERATE APPLIANCE UNLESS UNIT IS FILLED WITH WATER AND INLET LINES ARE FULLY OPEN.



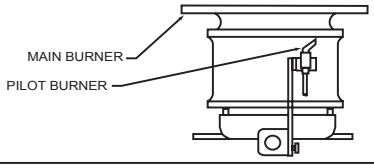

# OPERATING INSTRUCTIONS

1. **STOP!** READ THE SAFETY INFORMATION ABOVE ON THIS LABEL.
2. SET THE THERMOSTAT TO LOWEST SETTING.
3. TURN OFF ALL ELECTRIC POWER TO THE APPLIANCE.
4. THIS APPLIANCE IS EQUIPPED WITH AN IGNITION DEVICE WHICH AUTOMATICALLY LIGHTS THE PILOT. DO NOT TRY TO LIGHT THE PILOT BY HAND.
5. REFER TO DIAGRAMS ABOVE. TURN TOP KNOB OF GAS CONTROL CLOCKWISE ↷, TO "OFF" POSITION (FIG. A)
6. TURN MANUAL SHUTOFF VALVE COUNTERCLOCKWISE ↶ TO "OFF" (FIG C). TURN PILOT MANUAL VALVE COUNTERCLOCKWISE ↶ TO "OFF" (FIG E).
7. WAIT FIVE (5) MINUTES TO CLEAR OUT ANY GAS. THEN SMELL FOR GAS, INCLUDING NEAR THE FLOOR. IF YOU SMELL GAS, STOP! FOLLOW "B" IN THE SAFETY INFORMATION ABOVE ON THIS LABEL. IF YOU DON'T SMELL GAS, GO TO THE NEXT STEP
8. TURN TOP KNOB OF GAS CONTROL COUNTER-CLOCKWISE ↶ TO "ON" (FIG B).
9. TURN PILOT FIRING VALVE CLOCKWISE ↷ TO "ON" (FIG F).
10. TURN ON ALL ELECTRIC POWER TO THE APPLIANCE
11. SET THERMOSTAT TO DESIRED SETTING. PILOT BURNER WILL BE IGNITED BY ELECTRONIC SPARK.
12. LOCATE PEEP HOLE IN FRONT OF THE PILOT BURNER. MAKE SURE PILOT IS BURNING.

ADVISORY: THERE IS A FIFTEEN (15) SECOND TRIAL PERIOD FOR PILOT IGNITION WHICH IS TIME ENOUGH FOR IGNITION WHEN AIR HAS BEEN BLED FROM GAS LINES PRIOR TO IGNITIION ATTEMPT. IF PILOT FAILS TO IGNITE AND YOU SUSPECT THAT IT IS DUE TO AIR IN THE LINES, CLOSE PILOT MANUAL VALVE AND REPEAT LIGHTING PROCEDURE STEPS 1 THRU 12

13. WITH PILOT FLAME ESTABLISHED, TURN MANUAL SHUT OFF VALVE CLOCKWISE ↷ TO "ON" (FIG D), TO ALLOW GAS TO REACH MAIN BURNER. NOTE: THE REDUNDANT MAIN COMBINATION VALVE WILL ALREADY BE OPEN, AND MAIN BURNER WILL IGNITE.

ADVISORY: IF MAIN BURNER FAILS TO IGNITE, MAKE SURE PILOT IS BURNING. IF THE APPLIANCE WILL NOT OPERATE, FOLLOW THE INSTRUCTIONS BELOW ON THIS LABEL "TO TURN OFF GAS TO APPLIANCE" AND CALL YOUR SERVICE TECHNICIAN OR GAS SUPPLIER.




# TO TURN OFF GAS TO APPLIANCE

1. TURN OFF ALL ELECTRICAL POWER TO APPLIANCE.
2. TURN TOP KNOB OF GAS CONTRO L VALVE CLOCKWISE ↷ TO "OFF". (FIG. "A")
3. TURN MAIN FIRING VALVE COUNTER CLOCKWISE ↶ TO "OFF" (FIG. C), AND TURN PILO T FIRING VALVE COUNTERCLOCKWISE ↶ TO "OFF" (FIG "E").
4. SET THE THERMOSTAT TO LOWWEST SETTING.

210135-000 REV 02

# REMOVAL OF EXISTING BOILER FROM A COMMON VENTING SYSTEM

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.

Seal any unused openings in the common venting system.

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.

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.

Place in operation the appliance being inspected. Follow the lighting instructions. Adjust thermostat so appliance will operate continuously.

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.

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 any other gas-burning appliance to their previous condition of use.

Any improper operation of the common venting system should be corrected so the installation conforms with the National Fuel Gas Code, ANSI Z223.1 and/or CAN/CSA B149, Installation Codes. 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 F in the National Fuel Gas Code, ANSI Z223.1 and/or CAN/CSA B149 Installation Codes.

# GENERAL MAINTENANCE

These boilers are designed to give many years of efficient and satisfactory service when properly operated and maintained. To assure continued good performance, the following recommendations are made.

The area around the unit should be kept clean and free from lint and debris. Sweeping the floor around the boiler should be done carefully. This will reduce the dust and dirt which may enter the burner and pilot air passages, causing improper combustion and sooting.

THE FLOW OF COMBUSTION AND VENTILATION AIR TO THE BOILER MUST NOT BE OBSTRUCTED.

THE BOILER AREA MUST BE KEPT CLEAR AND FREE FROM COMBUSTIBLE MATERIALS, GASOLINE, AND OTHER FLAMMABLE VAPORS AND LIQUIDS.

Any safety devices including low water cutoffs used in conjunction with this boiler should receive periodic (every six months) inspection to assure proper operation. A low water cutoff device of the float type should be flushed every six months. All relief valves should be inspected and manually operated at least twice a year. More frequent inspections may be necessary depending on water conditions.

Periodic checks, at least twice a year, should be made for water and/or gas leaks.

More frequent inspections may be necessary depending on water conditions.

The boiler mounted gas and electrical controls have been designed to give both dependable service and long life. However, malfunction can occur, as with any piece of equipment. It is therefore recommended that all components be checked periodically by a qualified serviceman for proper operation.

**MANUAL RESET HIGH LIMIT SWITCH CONTINUITY TEST**

Do not depress the switch reset button prior to testing. With the unit cold, disconnect the leads from the switch. With a multimeter place a probe on each side of the switch. If the meter reads zero the switch is good. If you receive an infinite or OL signal, the reason could be:

1. Protector switch contacts open.

- Depress reset button on switch (switch cannot be reset until water temperature in the boiler coils drop below 200°F). Meter should read zero.

2. Defective switch or bad leads.

- With leads attached, depress the switch button. If the meter does not read zero, the switch is defective and must be replaced.

**RELIEF VALVE**

The safety relief valve should be opened at least twice a year to check its working condition. This will aid in assuring proper pressure relief protection. Lift the lever at the top of the valve several times until the valve seats properly and operate freely.

⚠ DANGER

THE WATER PASSING OUT OF THE VALVE DURING CHECKING OPERATION MAY BE EXTREMELY HOT. BEFORE OPERATING RELIEF VALVE MAKE SURE DRAIN LINE IS INSTALLED TO DIRECT DISCHARGE TO A SAFE LOCATION SUCH AS AN OPEN DRAIN, TO AVOID SCALDING OR WATER DAMAGE.

⚠ WARNING

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

# CLEANING AND FLUSHING INSTRUCTIONS

**INTERNAL CONTAMINANTS**

The hydronic system must be internally cleaned and flushed after a new or replacement boiler has been installed to remove contaminants that may have accumulated during installation. This is doubly important when a replacement boiler is installed into an existing system where Stop Leak or other boiler additives have been used.

Failure to clean and flush the system can produce acid concentrations that become corrosive, cause gases to form that block water circulation or lead to formation of deposits on the boiler surfaces, any of which could result in damage to the system and circulator.

All hot water heating systems should be completely flushed with a grease removing solution to assure trouble-tree operation. Pipe joint compounds, soldering paste, grease on tubing and pipe all tend to contaminate a system.

Failure to flush contaminates from a system can cause solids to form on the inside of boiler exchangers, create excessive amounts of air and other gases to block circulation, foul various system accessories and even deteriorate circulation seals and impellers.

It is recommended that after installation, the boiler and system when filled should include the proper percentage of cleaning solution related to approximate water volume of the system. Fire and circulate for about one hour and then flush clean with fresh water. Commercial grease removing solutions are available from your distributor.

**HOT WATER SUPPLY BOILERS PREVENTIVE MAINTENANCE**

For care of the HW water system please refer to the A. O. Smith Users Information Manual supplied with the Boiler.

# PRE-TROUBLESHOOTING

Before any extensive troubleshooting, perform the following:

Ensure that:

- Voltage (120 vac) is supplied to the appliance.
- System control (tank temperature control, thermostat, etc.) is calling for appliance operation (call for heat).
- Other contacts (switches) are closed (relay, low water cutoff, flow switch, coil protector, pressure switch, etc.).
- Gas supply pressure is within the maximum and minimum operating ranges listed on the appliance rating plate/label.
- Voltage (24 vac) is supplied by transformer.
- Appliance is wired according to wiring diagram.

Note: Cross wiring the 24 volt circuit of the relay will short the transformer.

- All wire terminals/connectors are firmly attached to valves, modules, switches, limit controls, etc.
- For LP models only check for possible lockout condition of the the ignition module.

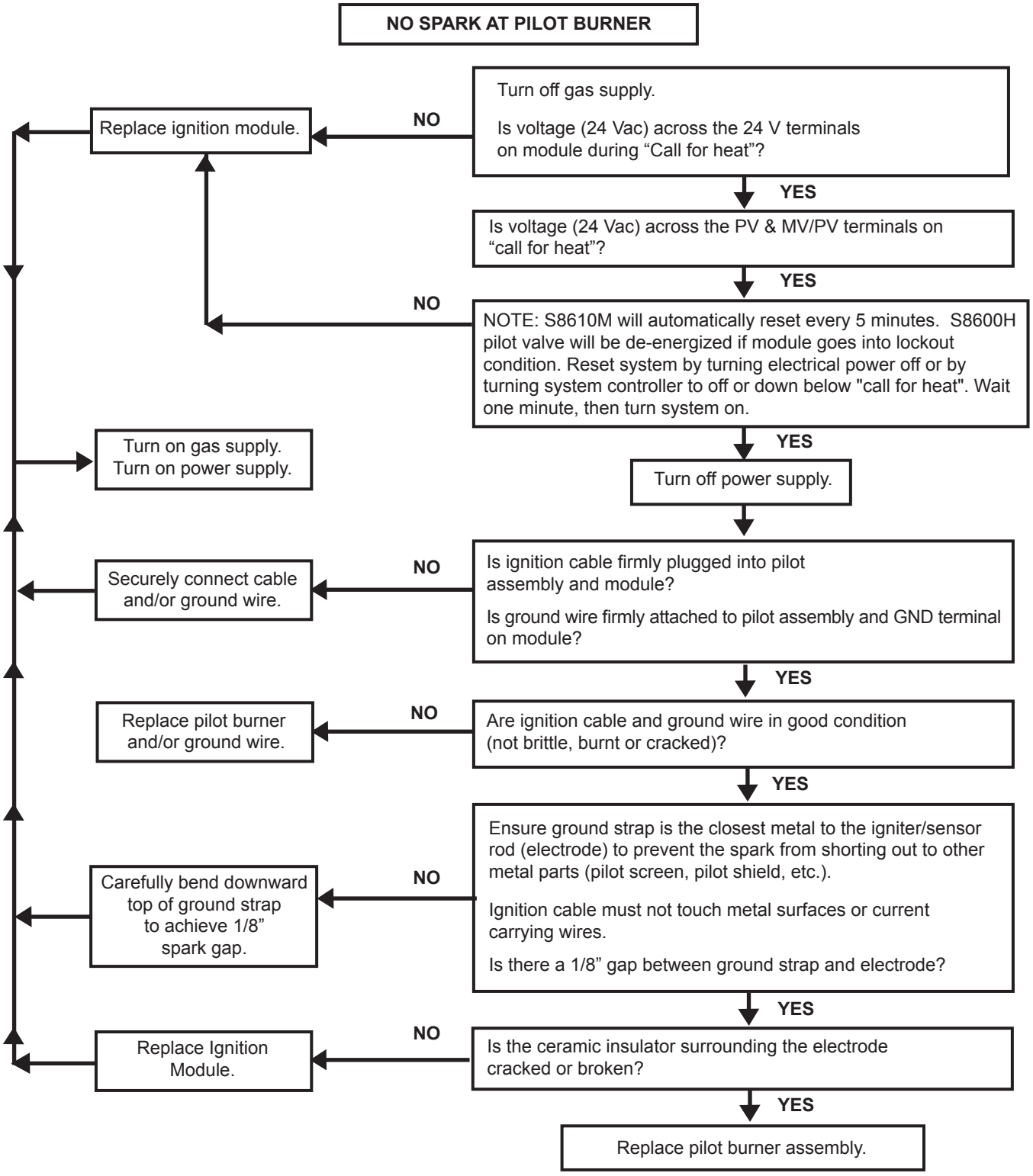
# TROUBLESHOOTING

**CER-TEMP 80 RECOVERY SYSTEM CHECKOUT PROCEDURE**

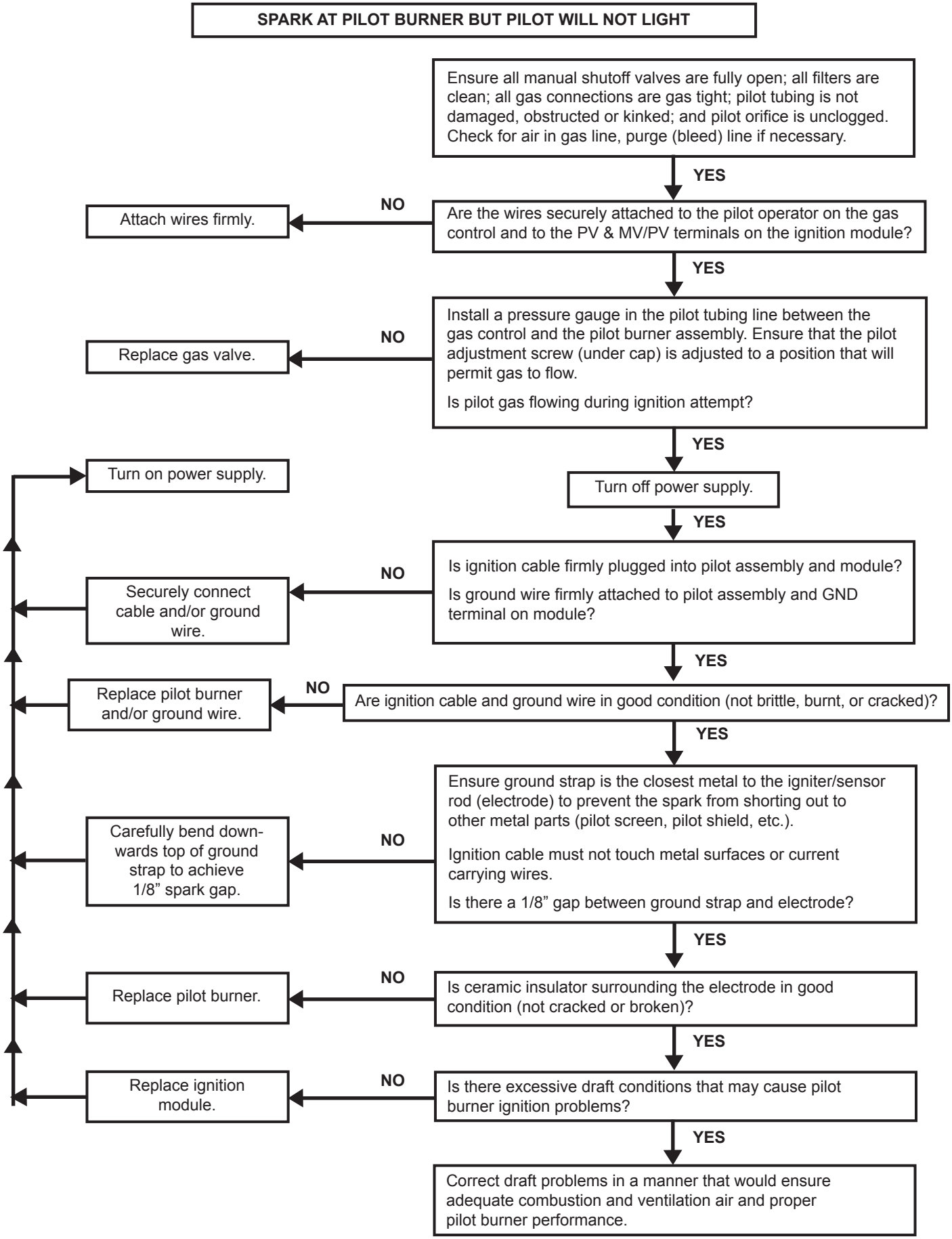
Use this checkout for Cer-Temp 80 Recovery Systems. (For hot water supply application only)

| Checkout Sequence | System Operation | | Cause | Remedy |
|---|---|---|---|---|
| | Contact | Incorrect | | |
| Set tank temperature control (thermostat) 20°F (10°C) below tank water temperature. | Circulating pump and burner shut off.<br><br>With thermal balancer, pump off delay of approximately 2 minutes. | Pump and burner remain on. | Tank temperature control (thermostat) defective. | Replace. |
| | | | System wiring is incorrect. | Correct wiring. |
| | | Circulating pump on. | Pump wired for continuous operation. | Correct wiring. |
| | | Burner on. | Gas valve stuck or defective. | Correct or replace valve. |
| | | | System wiring is incorrect. | Correct wiring. |
| Set tank temperature control (thermostat) 20°F (10°C) above tank water temperature. | Circulating pump and burner on. | Circulating pump on. | High limit control set too low. | Replace. (If problem proven to be at this control by applying jumper to terminals.) |
| | | | High limit control differential too wide. | |
| | | | System wiring is incorrect. | Correct wiring. |
| | | | Coil protector switch has activated. | Remove control cover, depress reset button. |
| | | | Gas valve or wiring defective. | Check wiring. Repair or replace valve. |
| | | Circulating pump and burner off. | Power off or system wiring is incorrect. | Check power supply and wiring. |
| | | | Tank temperature control (thermostat) defective. | Replace. |
| | | Burner on. | System wiring is incorrect. | Correct wiring. |
| Boiler outlet temperature exceeds 210°F (100°C). | Circulating pump on. | Circulating pump and burner on. | High limit control defective, or set too high (max. should be set at 200°F). | Replace. |
| Set tank temperature control (thermostat) for desired water temperature. | System maintains desired water temperature. | | | |

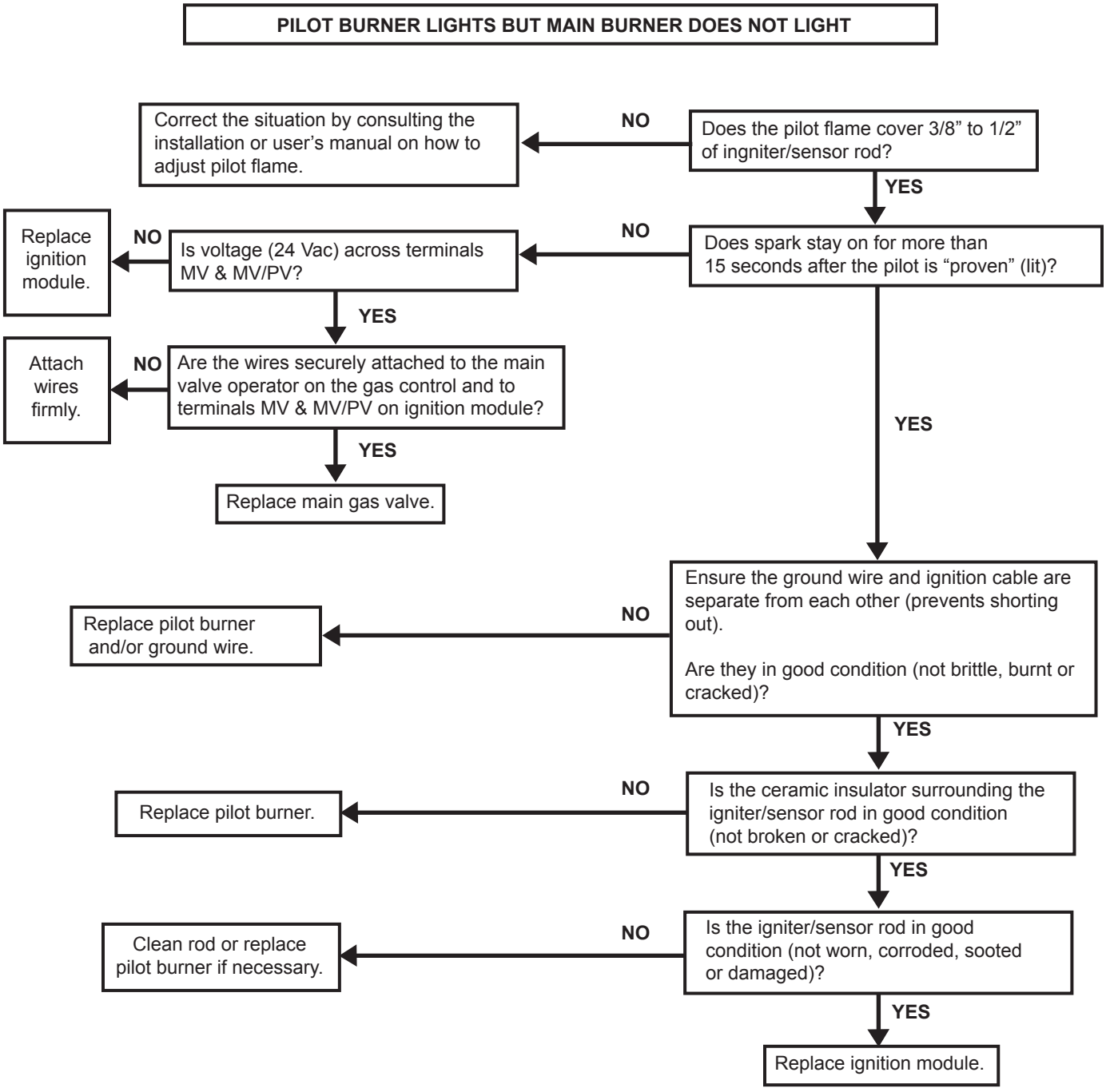
**CHECKING HONEYWELL S-8600H OR S-8610M**
**INTERMITTENT IGNITION CONTROLS**



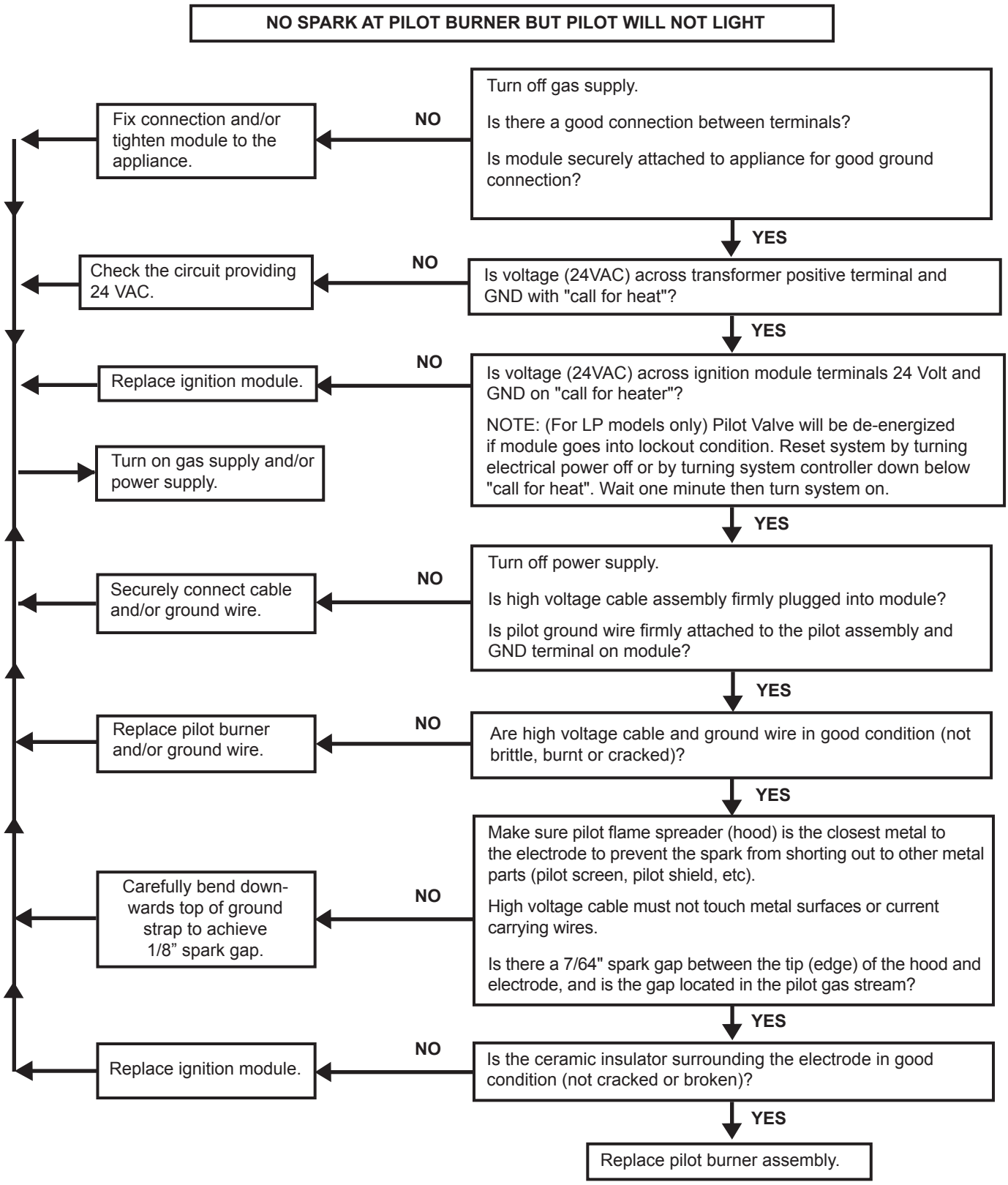
**CHECKING HONEYWELL S8600H OR S-8610M**
**INTERMITTENT IGNITION CONTROLS**



**CHECKING HONEYWELL S-8600H OR S8610M**
**INTERMITTENT IGNITION CONTROLS**



**CHECKING HONEYWELL S8600H OR S-8610M**
**INTERMITTENT IGNITION CONTROLS**



The following procedures are provided as a general guide.

Any module should be replaced if it does not perform properly on checkout or troubleshooting.

In addition, replace any module if it is wet or looks like it has ever been wet.

**LED STATUS AND TROUBLESHOOTING**

The control has two LEDs; one for flame sensing and one for system status:

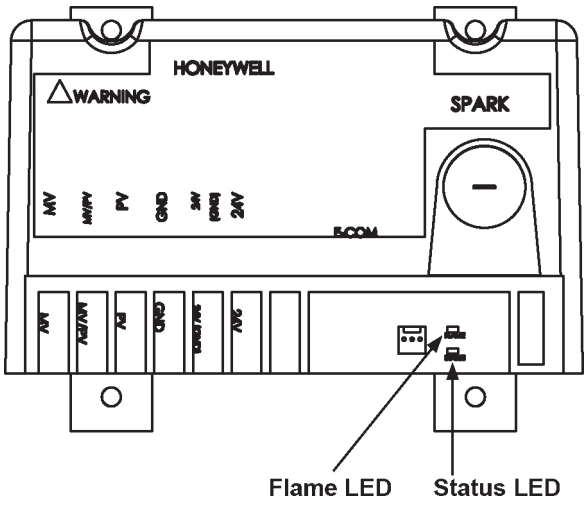



**FIGURE 37.**
**Location of LEDs.**

- **Flame LED (Yellow)**
  – Indicates flame presence and strength. See Table 11.

- **Status LED (Green)**
  – Indicates system operation status and error conditions. See Table 12 and Table 13 on pages 53 and 54 for status specific to each model.

**Table 11**
**Yellow LED Flame Codes**

| Yellow LED Flash Code[a] | Indicates | Recommended Service Action |
|---|---|---|
| Heartbeat | Normal Flame Signal | not applicable |
| 2 | Weak Flame Signal-Sytem will operate reliably but flame signal is less than desired.<br><br>NOTE: This indication may flash temporarily during or shortly after lightoff on some applications. | Perform routine maintenance to assure optimum flame signal. |
| 1 | Marginal Flame Signal (less than 1.1$\mu$A)-System may not operate reliably over time.<br><br>Service call recommended.<br><br>NOTE: This indication may flash temporarily during or shortly after lightoff on some applications. | Check gas supply, pilot burner, flame sense wiring, contamination of flame rod, burner ground connection. |
| OFF | No Flame or Flame Signal below minimum threshold for system operation. | not applicable |

[a]Flash Code Descriptions:
- Heartbeat: Constant 1/2 second bright 1/2 second dim cycles.
- The flash code number signifies that the LED flashes X times at 2Hz, remains off for two seconds, and then repeats the sequence.

**Table 12.**
**Continuous Retry Models C, M, E, and K Only - Green LED Status Codes**

| Green LED Flash Code (X+Y)[a] | Indicates | Next System Action | Recommended Service Action |
|---|---|---|---|
| OFF | No "Call for Heat" | not applicable | none |
| Flash Fast | Startup - Flame sense calibration | not applicable | none |
| Heartbeat | Normal operation | not applicable | none |
| 2 | 5 minute Retry Delay<br>- Pilot flame not detected during trial for ignition | Initiate new trial for ignition after retry delay completed. | If system fails to light on next trial for ignition check gas supply, pilot burner, spark and flame sense wiring, flame rod contaminated or out of position, burner ground connection. |
| 3 | Recycle<br>- Flame failed during run | Initiate new trial for ignition. Flash code will remain through the ignition trial until flame is proved. | If system fails to light on next trial for ignition, check gas supply, pilot burner, flame sense wiring, contamination of flame rod, burner ground connection. |
| 4 | Flame sensed out of sequence | If situation self corrects within 10 seconds, control returns to normal sequence. If flame out of sequence remains longer than 10 seconds, control goes to Flash code 6+4 (see below). | Check for pilot flame. Replace gas valve if pilot flame is present. If no pilot flame, cycle "Call for Heat." If error repeats, replace control. |
| 7 | Flame sense leakage to ground | Control remains in wait mode. When the fault corrects, control resumes normal operation after a one minute delay. | Check flame sense lead wire for damage or shorting. Check that flame rod is in proper position.<br><br>Check flame rod ceramic for cracks, damage or tracking. |
| 8 | Low secondary voltage supply-(below 15.5 Vac) | Control remains in wait mode. When the fault corrects, control resumes normal operation after a one minute delay. | Check transformer and AC line for proper input voltage to the control. Check with full system load on the transformer. |
| 6+2 | 5 minute Retry Delay<br>- On every third retry on the same "Call for Heat" | Initiate new trial for ignition after retry delay completed. | Check gas supply line, pilot burner, spark and flame sense wiring, flame rod contaminated or out of position, burner ground connection. |
| 6+3 | On every 6th flame failure during run on the same "Call for Heat" | 5 minute retry delay, then initiate new trial for ignition. | Check gas supply, pilot burner, flame sense wiring, contamination of flame rod, burner ground connection. |
| 6+4 | Flame sensed out of sequence-longer than 10 seconds | Control waits until flame is no longer sensed and then goes to soft lockout. Flash code continues. Control auto resets from soft lockout after one hour. | Check for pilot flame. Replace gas valve if pilot flame present. If no pilot flame, cycle "Call for Heat." If error repeats, replace control. |
| ON | Soft lockout due to error detected during self check sequences | Control auto resets from soft lockout after one hour. | Reset by cycling "Call for Heat." If error repeats, replace the control. |

[a]Flash Code Descriptions:
- Flash Fast: rapid blinking.
- Heartbeat: Constant 1/2 second bright 1/2 second dim cycles.
- A single flash code number signifies that the LED flashes X times at 2Hz, remains off for two seconds, and then repeats the sequence.
- X+Y flash codes signify that the LED flashes X times at 2Hz, remains off for two seconds, flashes Y times at 2Hz, remains off for three seconds, and then repeats the sequence.

**Table 13.**
**Lockout Models B, H, D and J Only - Green LED Status Codes**

| Green LED Flash Code (X+Y)[a] | Indicates | Next System Action | Recommended Service Action |
|---|---|---|---|
| OFF | No "Call for Heat" | not applicable | none |
| Flash Fast | Startup - Flame sense calibration | not applicable | none |
| Heartbeat | Normal operation | not applicable | none |
| 3 | Recycle<br>- Flame failed during run | Initiate new trial for ignition. Flash code will remain through the ignition trial until flame is proved. | If system fails to light on next trial for ignition, check gas supply, pilot burner, flame sense wiring, contamination of flame rod, burner ground connection. |
| 4 | Flame sensed out of sequence | If situation self corrects within 10 seconds, control returns to normal sequence. If flame out of sequence remains longer than 10 seconds, control goes to Flash code 6+4 (see below). | Check for pilot flame. Replace gas valve if pilot flame is present. If no pilot flame, cycle "Call for Heat." If error repeats, replace control. |
| 7 | Flame sense leakage to ground | Control remains in wait mode. When the fault corrects, control resumes normal operation after a one minute delay. | Check flame sense lead wire for damage or shorting. Check that flame rod is in proper position.<br><br>Check flame rod ceramic for cracks, damage or tracking. |
| 8 | Low secondary voltage supply-(below 15.5 Vac) | Control remains in wait mode. When the fault corrects, control resumes normal operation after a one minute delay. | Check transformer and AC line for proper input voltage to the control. Check with full system load on the transformer. |
| 6+2 | Failed trial for ignition resulting in lockout | Remain in lockout until "Call for Heat" is cycled. | Check gas supply line, pilot burner, spark and flame sense wiring, flame rod contaminated or out of position, burner ground connection. |
| 6+3 | More than 5 flame failures during run on the same "Call for Heat" resulting in lockout | Remain in lockout until "Call for Heat" is cycled. | Check gas supply, pilot burner, flame sense wiring, contamination of flame rod, burner ground connection. |
| 6+4 | Flame sensed out of sequence-longer than 10 seconds | Control waits until flame is no longer sensed and then goes to soft lockout. Flash code continues. Control auto resets from soft lockout after one hour. | Check for pilot flame. Replace gas valve if pilot flame present. If no pilot flame, cycle "Call for Heat." If error repeats, replace control. |
| ON | Soft lockout due to error detected during self check sequences | Control auto resets from soft lockout after one hour. | Reset by cycling "Call for Heat." If error repeats, replace the control. |

[a]Flash Code Descriptions:
- Flash Fast: rapid blinking.
- Heartbeat: Constant 1/2 second bright 1/2 second dim cycles.
- A single flash code number signifies that the LED flashes X times at 2Hz, remains off for two seconds, and then repeats the sequence.
- X+Y flash codes signify that the LED flashes X times at 2Hz, remains off for two seconds, flashes Y times at 2Hz, remains off for three seconds, and then repeats the sequence.

# LIMITED WARRANTY

A. O. Smith Corporation, the warrantor, extends the following LIMITED WARRANTY to the owner of this boiler.

1. If within TEN years after initial installation of the boiler, a heat exchanger, coil or gas burner shall prove upon examination by the warrantor to be defective in material or workmanship, the warrantor, at his option will exchange or repair such part or portion. This term is reduced to FIVE years if this boiler is used for water heating purposes other than hydronic space heating.
   a. This warranty is extended to the owner for all other parts or portion during the FIRST year following initial installation of this boiler.
   b. The warranty on the repair or replacement of the part or portion will be limited to the unexpired term of the original warranty.

2. **CONDITIONS AND EXCEPTIONS**
   This warranty shall apply only when the boiler is installed in accordance with local plumbing and building codes, ordinances and regulations, the printed instructions provided with it and good industry practices. In addition, an appropriately sized safety relief valve certified to the ASME Boiler and Pressure Vessel Code must have been installed and fresh, clean water used for filling and make-up purposes.
   a. This warranty shall apply only when the boiler is:
      (1) used at temperatures not exceeding the maximum setting of its operative and/or high limit control;
      (2) used at water pressure not exceeding the working pressure shown on the boiler;
      (3) used when filled with potable water, free to circulate at all times and with the heat exchanger(s) and coil(s) free of damaging scale deposits;
      (4) in a non-corrosive and non-contaminated atmosphere;
      (5) owned by the original purchaser;
      (6) in it's original installation location;
      (7) is sized in accordance with proper sizing techniques for commercial boilers;
      (8) bearing a rating plate which has not been altered, defaced or removed except as required by the warrantor;
      (9) fired at the factory rated input using the fuel stated on the rating plate;
      (10) maintained in accordance with the instructions printed in the manual included with the boiler;
      (11) in the United States, its territories or possessions, and Canada;
      (12) with an intermittent circulating action and with the pump and burner operating together.
      (13) in an indoor installation only.
   b. Any accident to the boiler, any misuse, abuse (including freezing) or alteration of it, any operation of it in a modified form, or any attempt to repair leaks in the coil or heat exchanger will void this warranty.

3. **SERVICE AND REPAIR EXPENSE**
   Under this limited warranty the warrantor will provide only a replacement part. The owner is responsible for all other costs. Such costs may include but are not limited to:
   a. Labor charges for service, removal, repair or reinstallation of the component part;
   b. Shipping, delivery, handling, and administrative charges for forwarding the replacement part from the nearest distributor and returning the claimed defective part to such distributor.
   c. All cost necessary or incidental for any materials and/or permits required for installation of the replacement.

4. **LIMITATION ON IMPLIED WARRANTIES**
   Implied warranties, including any warranty of merchantability imposed on the sale of this boiler under state law are limited to one (1) year duration for the boiler or any of its parts. Some states do not allow limitations on how long an implied warranty lasts, so the above limitation may not apply to you.

5. **CLAIM PROCEDURE**
   Any claim under this warranty should be initiated with the dealer who sold the boiler, or with any other dealer handling the warrantor's products. If this is not practicable, the owner should contact:

| U. S. Customers | Canadian Customers |
|---|---|
| A. O. Smith Corporation | A. O. Smith Enterprises Ltd. |
| 500 Tennessee Waltz Parkway | P. O. Box, 310 - 768 Erie Street |
| Ashland City, TN 37015 | Stratford, Ontario N5A 6T3 |
| Telephone: 1-800-323-2636 | Telephone: 1-800-265-8520 |

   a. The warrantor will only honor replacement with identical or similar parts thereof which are manufactured or distributed by the warrantor.
   b. Dealer replacements are made subject to in-warranty validation by warrantor.

6. **DISCLAIMERS**
   NO OTHER EXPRESS WARRANTY HAS BEEN OR WILL BE MADE IN BEHALF OF THE WARRANTOR WITH RESPECT TO THE MERCHANTABILITY OF THE BOILER OR THE INSTALLATION, OPERATION, REPAIR OR REPLACEMENT OF THE BOILER. THE WARRANTOR SHALL NOT BE RESPONSIBLE FOR WATER DAMAGE, LOSS OF USE OF THE UNIT, INCONVENIENCE, LOSS OR DAMAGE TO PERSONAL PROPERTY, OR OTHER CONSEQUENTIAL DAMAGE. THE WARRANTOR SHALL NOT BE LIABLE BY VIRTUE OF THIS WARRANTY OR OTHERWISE FOR DAMAGE TO ANY PERSONS OR PROPERTY, WHETHER DIRECT OR INDIRECT, AND WHETHER ARISING IN CONTRACT OR TORT.
   a. Some states or provinces do not allow the exclusion or limitation of the incidental or consequential damage, so the above limitations or exclusions may not apply to you.
   b. This warranty gives you specific legal rights, and you may also have other rights which vary from state to state.

Fill in the following for your own reference. Keep it. Registration is not a condition of warranty. The model and serial number are found on the boiler's rating plate.

Owner _____
Installation Address _____
City and State/Province _____ Postal/Zip Code _____
Date Installed _____ Model No. _____ Serial No._____
Dealer's Name _____ Phone No. _____
Dealer's Address _____

**FILL IN DATA AND KEEP FOR FUTURE REFERENCE**

500 Tennessee Waltz Parkway, Ashland City, TN 37015
Technical Support: 800-527-1953 • Parts: 800-433-2545 • Fax: 800-644-9306
www.hotwater.com