

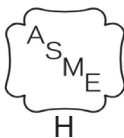
GAS FIRED COMMERCIAL COPPER BOILERS



25589, Highway 1
McBee, SC 29101

Burkay®

AHRI CERTIFIED®
www.ahridirectory.org



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

- Do not store or use gasoline or other flammable vapors and liquids in the vicinity of this or any other appliance.
- WHAT TO DO IF YOU SMELL GAS:
 - Do not try to light any appliance.
 - Do not touch any electrical switch; do not use any phone in your building.
 - Immediately call your gas supplier from a neighbor's phone. Follow the gas supplier's instructions.
 - If you cannot reach your gas supplier, call the fire department.
- Installation and service must be performed by a qualified installer, service agency or the gas supplier.

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

**MODELS: HW
300, 399, 420, 520, 670
FOR HYDRONIC HEATING AND
HOT WATER SUPPLY
UP - FLOW MODELS
INSTALLATION - OPERATION
MAINTENANCE - LIMITED WARRANTY
INDOOR ONLY**



⚠ WARNING

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

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


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SAFE INSTALLATION, USE AND SERVICE

The proper installation, use and servicing of this boiler 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 boiler 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 boiler.

	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.
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 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.

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

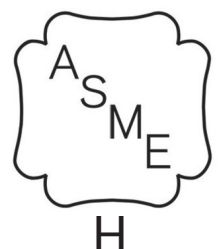
IMPORTANT DEFINITIONS

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.

APPROVALS



Low Lead Content



GENERAL SAFETY

GROUNDING INSTRUCTIONS

This boiler must be grounded in accordance with the National Electrical Code, Canadian Electrical Code and/or local codes. Boiler is polarity sensitive; 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 service technician:

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.

PROPANE OR LIQUEFIED PETROLEUM (LP) GAS MODELS


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

Propane (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 propane (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 propane (LP) gas leak. One cause is odor fade, which is a loss of the chemical odorant that gives propane (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 boilers yourself. Call your local service agent. Only trained propane (LP) professionals should conduct the required safety checks in accordance with industry standards.

HIGH ALTITUDE INSTALLATIONS

⚠ WARNING	
Breathing Hazard - Carbon Monoxide Gas	
	<ul style="list-style-type: none">• Special consideration must be taken with installations above 2000 feet (610 m).• 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.
<p>Breathing carbon monoxide can cause brain damage or death. Always read and understand instruction manual.</p>	

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

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.

Thank you for purchasing this boiler. Properly installed and maintained, it should give you years of trouble free service.

QUALIFICATIONS

QUALIFIED INSTALLER OR SERVICE AGENCY

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

ANSI Z21.13 - CSA 4.9: "Qualified Agency" - "Any individual, firm, corporation or company that either in person or through a representative is engaged in and is responsible for (a) the installation, testing or replacement of gas piping or (b) the connection, installation, testing, repair or servicing of appliances and equipment; that is experienced in such work; that is familiar with all precautions required; and that has complied with all the requirements of the authority having jurisdiction."

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

ABBREVIATIONS USED

Abbreviations found in this Instruction Manual include :

- ANSI - American National Standards Institute
- ASME - American Society of Mechanical Engineers
- NEC - National Electrical Code
- NFPA - National Fire Protection Association
- UL - Underwriters Laboratory
- CSA - Canadian Standards Association

DIMENSIONS AND CAPACITY DATA

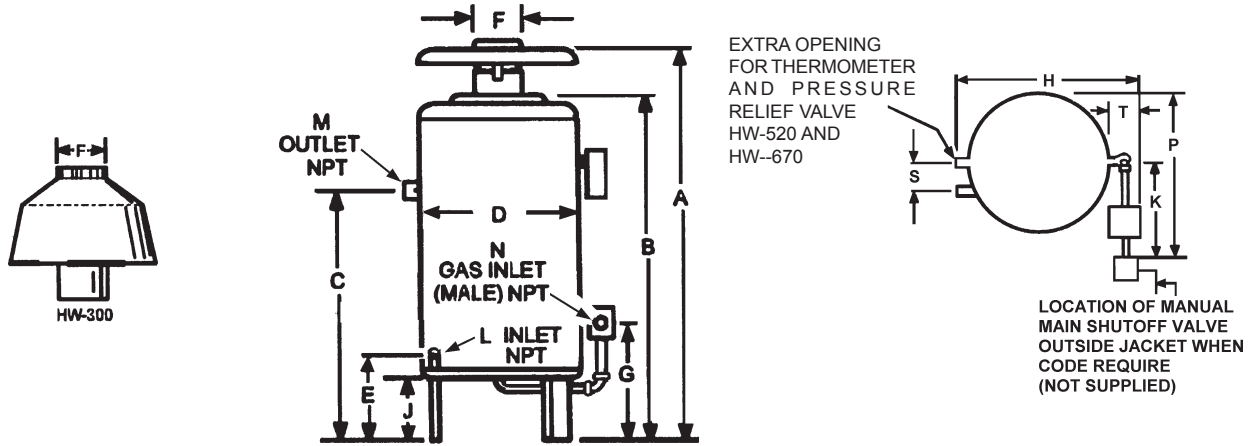


FIGURE 1. DIMENSIONS

TABLE 1. DIMENSIONS AND CAPACITY DATA

DIMENSIONS IN INCHES		MODELS				
		HW-300	HW-399	HW-420	HW-520	HW-670
A	Overall height	65 (1651)	57-1/8 (1451)	57-1/8 (1451)	68-5/16 (1735)	67-1/2 (1715)
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)
C	Floor to Center Line Water Inlet	36 (914)	38-3/4 (984)	38-3/4 (984)	46 (1168)	46 (1168)
D	Diameter of Jacket	25-1/4 (641)	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)
F	Draft Diverter Outlet Diameter	8 (203)	10 (254)	10 (254)	10 (254)	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)
H	Overall Depth	29-5/8 (753)	31-1/2 (800)	31-1/2 (800)	36-1/2 (927)	36-1/2 (927)
J	Support Height	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)
L	Pipe Size of Water Inlet (NPT)	1-1/4	1-1/2	1-1/2	2	2
M	Pipe Size of Water Outlet (NPT)	1-1/4	1-1/2	1-1/2	2	2
N	Pipe Size of Gas Inlet (NPT)	3/4	3/4	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)
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)
T	Control String from Jacket	5 (127)	5 (127)	5 (127)	7 (178)	7 (178)
Approximate shipping weight lbs. (Kilograms)		250 (113)	301 (137)	301 (137)	381 (173)	381 (173)

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

TABLE 2. FLOW, HEAD AND TEMPERATURE RISE

BTU INPUT/OUTPUT			TEMPERATURE RISE AND PRESSURE DROP					
			20 DEG. F RISE		30 DEG. F RISE		40 DEG. F RISE	
MODELS	INPUT RATING BTU/HR NATURAL & PROPANE (LP) GAS	OUTPUT RATING BTU/HR NATURAL & PROPANE (LP) GAS	GPM	PD-FT HEAD	GPM	PD-FT HEAD	GPM	PD-FT HEAD
HW 300	300,000	240,000	24	8	16	3	12	2
HW 399	399,000	319,200	32	16	21	7	16	5
HW 420	420,000	336,000	34	18	22	8	17	5.5
HW 520	520,000	416,000	42	12	28	5	21	4
HW 670 Nat	660,000	528,000	53	22	35	10	26	5.5
HW 670 Prop	670,000	536,000	54	22	36	10	27	5.5

TABLE 3. RECOVERY CAPACITIES

MODELS	TYPE OF GAS	INPUT		°F	20	40	50	60	70	80
		BTU/HR	KW	°C	(11)	(22)	(28)	(33)	(39)	(44)
HW 300	Natural	300,000	88	GPH	1,455	727	582	485	416	364
	Propane			LPH	5,506	2,753	2,202	1,835	1,573	1,377
HW 399	Natural	399,000	117	GPH	1,935	967	774	645	553	484
	Propane			LPH	7,323	3,662	2,929	2,441	2,092	1,831
HW 420	Natural	420,000	123	GPH	2,036	1,018	815	679	582	509
	Propane			LPH	7,708	3,854	3,083	2,569	2,202	1,927
HW 520	Natural	520,000	152	GPH	2,521	1,261	1,008	840	720	630
	Propane			LPH	9,544	4,772	3,818	3,181	2,727	2,386
HW 670	Natural	660,000	193	GPH	3,200	1,600	1,280	1,067	914	800
				LPH	12,113	6,057	4,845	4,038	3,461	3,028
HW 670	Propane	670,000	196	GPH	3,248	1,624	1,299	1,083	928	812
				LPH	12,297	6,148	4,919	4,099	3,513	3,074

ELECTRICAL REQUIREMENTS

TABLE 4. ELECTRICAL REQUIREMENTS

MODELS	SUPPLY VOLTAGE (VOLTS)	FREQUENCY (HZ)	CURRENT (AMPS)
HW 300	120	60	12
HW 399	120	60	12
HW 420	120	60	12
HW 520	120	60	12
HW 670	120	60	12

CONTROL COMPONENTS

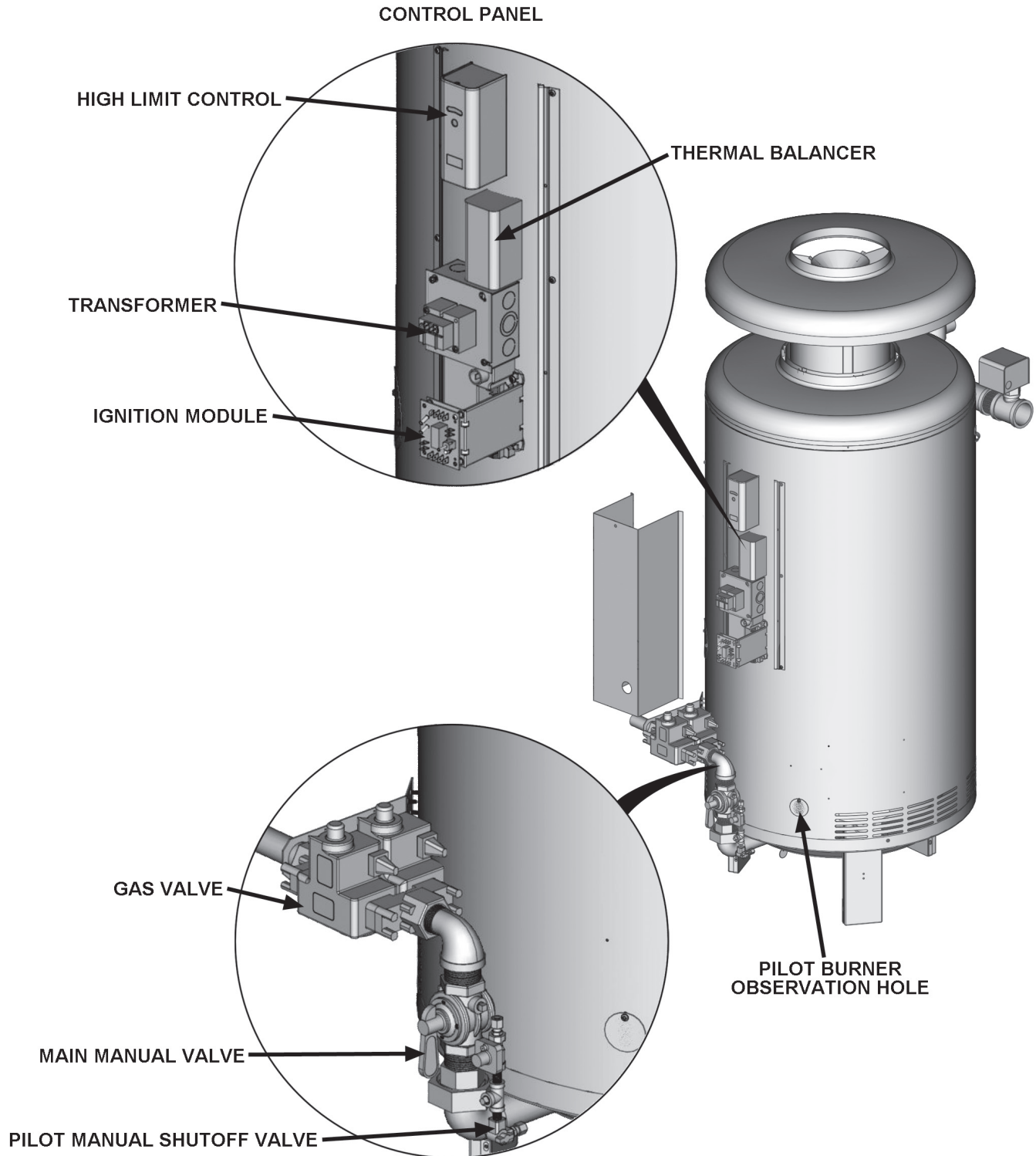


FIGURE 2. COMPONENT LOCATIONS

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 100°F above the maximum designed system temperature. If the boiler outlet water temperature should exceed the high limit setting, the main gas control valve will close but the circulating pump will continue to operate. Maximum adjustable setting is 115°C (239°F) cut-out with a 30°C (86°F) to 250°C (482°F) adjustable differential, see Figure 3.

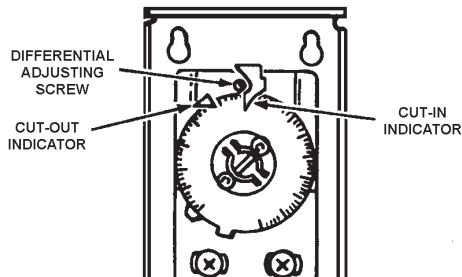


FIGURE 3. AUTO RESET HIGH LIMIT

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 boiler. 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 boiler 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 refer to TROUBLESHOOTING SECTION for more information.

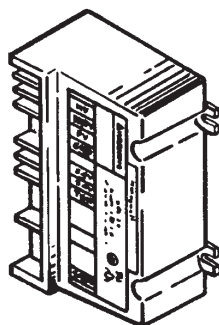


FIGURE 4. S-8600 INTERMITTENT IGNITION CONTROL MODULE (IID)

THERMAL BALANCER

Figure 5 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.

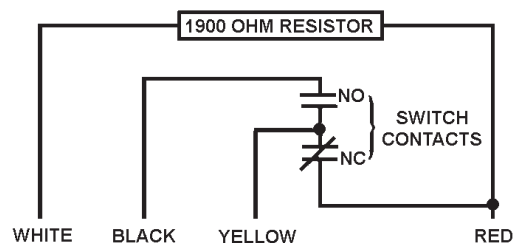


FIGURE 5. THERMAL BALANCER

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 6. 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 control 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 circulating pump 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.

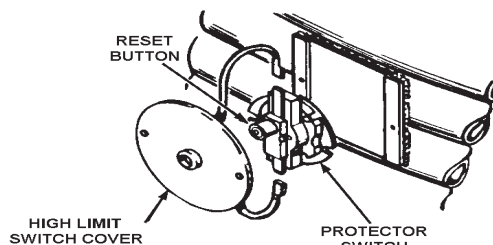
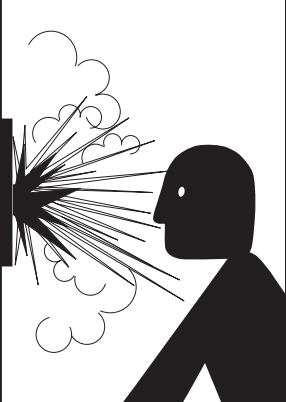


FIGURE 6. HIGH LIMIT SWITCH

PRESSURE RELIEF VALVE

An ASME rated pressure relief valve is furnished with the boiler. A fitting for the pressure relief valve is provided in the top of the boiler. Never operate the heating elements without being certain the boiler is filled with water and a properly sized pressure relief valve is installed in the pressure relief valve opening provided.

The pressure rating of the pressure relief valve should be equal to or less than the rated pressure capacity of any component in the system including the boiler. Should the valve need to be replaced, call the toll free phone number listed on the back of this manual for further technical assistance.

	⚠ WARNING
	Explosion Hazard <ul style="list-style-type: none">• Pressure Relief Valve must comply with ASME code.• Properly sized Pressure Relief Valve must be installed in opening provided.• Can result in overheating and excessive tank pressure.• Can cause serious injury or death.

A discharge pipe from the pressure relief valve should terminate at an adequate floor drain. Do not thread, plug, or cap the end of the drain line.

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

The Discharge Pipe:

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

Once the boiler is installed and filled with water and the system is pressurized, manually test the operation of the pressure relief valve.

If any pressure 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 pressure 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 pressure relief valve for hot water supply systems and 50 psi pressure 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.

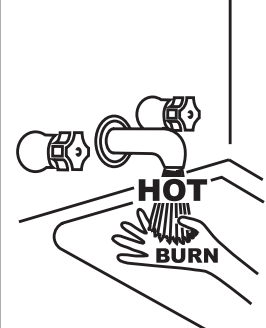
The storage tank temperature and pressure (T & P) relief valve must comply with the applicable construction provisions of the Standard for Relief valves and Automatic Gas Shutoff Devices for Hot Water Supply Systems, Z21.22 - CSA 4.4. The T & P valve must be of the automatic reset type and not embody 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 Figure 29 to Figure 42 on Pages 47 to 60. Tapping shall be threaded in accordance with the latest version of the Standard for Pipe Threads, General Purpose (inch), ANSI/ASME B.120.1.

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.



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

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

Feel water before bathing or showering.

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

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 boiler and minimize scale formation.

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

TABLE 5. TEMPERATURE AND TIME TO PRODUCE BURNS

Water Temperature °F (°C)	Time for 1st Degree Burn (Less Severe Burns)	Time for Permanent Burns 2nd & 3rd Degree (Most Severe Burns)
110 (43)	(normal shower temp.)	
116 (47)	(pain threshold)	
116 (47)	35 minutes	45 minutes
122 (50)	1 minute	5 minutes
131 (55)	5 seconds	25 seconds
140 (60)	2 seconds	5 seconds
149 (65)	1 second	2 seconds
154 (68)	instantaneous	1 second
(U.S. Government Memorandum, C.P.S.C., Peter L. Armstrong, Sept. 15, 1978)		

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.

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" 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 Instructions on Page 40 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.

BOILER INSTALLATION CONSIDERATIONS

HYDRONIC SYSTEM

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 °F (10 °C) drop in systems for a fully loaded boiler will maintain the following approximate flow rates:

TABLE 6. WATER FLOW RATES

MODELS	GPM (LPM)
HW-300	24 (91)
HW-399	32 (121)
HW-420	34 (127)
HW-520	42 (158)
HW-670	54 (203)

Figure 29 to Figure 42 on Pages 47 to 60 show typical installations of the boiler with pipe sizing and circulating pump 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 the piping diagrams. The balancer connects between the system supply and the return line before the circulating pump 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 °F (30 °C) temperature rise across the boiler are as follows:

TABLE 7. MINIMUM WATER FLOW RATES RESULTING IN TEMPERATURE RISE

MODELS	GPM (LPM)
HW-300	10 (36)
HW-399	13 (49)
HW-420	13 (49)
HW-520	17 (63)
HW-670	21 (81)

Pipe sizing and boiler loop pump selection data are shown in Table 8 for several different temperature rises across the boilers.

**TABLE 8. PUMP AND PIPE SIZING DATA
(PIPING FROM TEES IN MAIN TO BOILER BRANCHES)**

MODEL	TEMP. RISE °F (°C)	GPM	*PUMP SIZE	PIPE SIZE
HW-300	20 (10)	24	1-1/2" PR	2"
	30 (15)	16	150	1-1/2"
	30 (15)	16	125	1-1/4"
	40 (20)	12	100	1"
HW-399	20 (10)	32	60-13	2"
	35 (15)	18	1-1/2" HV	1-1/2"
	40 (20)	16	150	1-1/2"
	40 (20)	16	125	1-1/4"
HW-420	20 (10)	34	60-13	2"
	35 (15)	19	1-1/2" HV	1-1/2"
	40 (20)	17	150	1-1/2"
	40 (20)	17	125	1-1/4"
HW-520	20 (10)	42	2-1/2"	2-1/2"
	20 (10)	42	1-1/2" HV	2"
	35 (17)	24	1-1/2" HV	1-1/2"
	40 (20)	21	150	1-1/2"
HW-670	20 (10)	54	60-13	3"
	30 (15)	36	2-1/2"	2-1/2"
	35 (17)	31	2"	2"
	40 (20)	27	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.

HOT WATER SUPPLY BOILER SYSTEM - GENERAL WATER LINE CONNECTIONS

Piping diagrams will serve to provide the installer with a reference for the materials and methods of piping necessary for installation. It is essential that all water piping be installed and connected as shown on the diagrams. Check the diagrams to be used thoroughly before starting installation to avoid possible errors and to minimize time and material cost. It is essential that all water piping be installed and connected as shown on the diagrams. Figure 29 to Figure 42 on Pages 47 to 60.

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, 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.

CLOSED WATER SYSTEMS

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

THERMAL EXPANSION

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

A properly sized thermal expansion tank must be installed on all closed systems to control the harmful effects of thermal expansion. Contact a local plumbing service agency to have a thermal expansion tank installed. An expansion tank or a similar device may be required in the inlet supply line between the boiler and the meter or valve to compensate for the thermal expansion of water under supply pressure, see Piping Diagrams section on Page 47.

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

VENT VALVES

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

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" (64 mm) diameter are suggested on HW-399, HW-420, HW-520 and HW-670 units. HW-300 units should have 1-1/2" (38 mm) diameter manifolds.

The circuits should be spaced on the header at a minimum of 3" (76 mm) 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 circulating pumps. 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.

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 7.

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

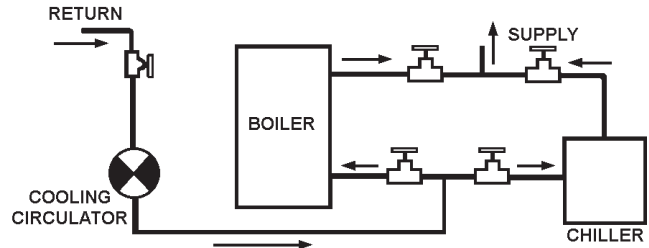


FIGURE 7. SCHEMATIC SHOWING PROPER PIPING ISOLATION OF THE BOILER FROM THE CHILLER

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.

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 circulating pumps are to be used with the unit when it is installed in hot water supply systems.

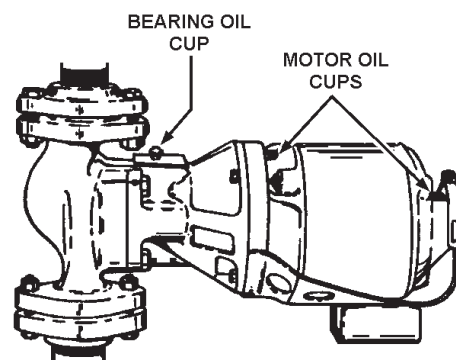


FIGURE 8. A TYPICAL CIRCULATING PUMP

Although each circulating pump that requires oiling is oiled and operated by the manufacturer, it must be oiled again before operated. See Figure 8 above.

Refer to the pump manufacturer's instructions for lubrication requirements.

FLOW SWITCH

The 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 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 9 below. 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.

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 9. FLOW SWITCH

Model Number	Minimum Pipe Rate			
	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-670	13.7	51.9	9.5	36.0

The flow switch may be field adjusted to obtain higher minimum flow rates than those shown in Table 9.

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.

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

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

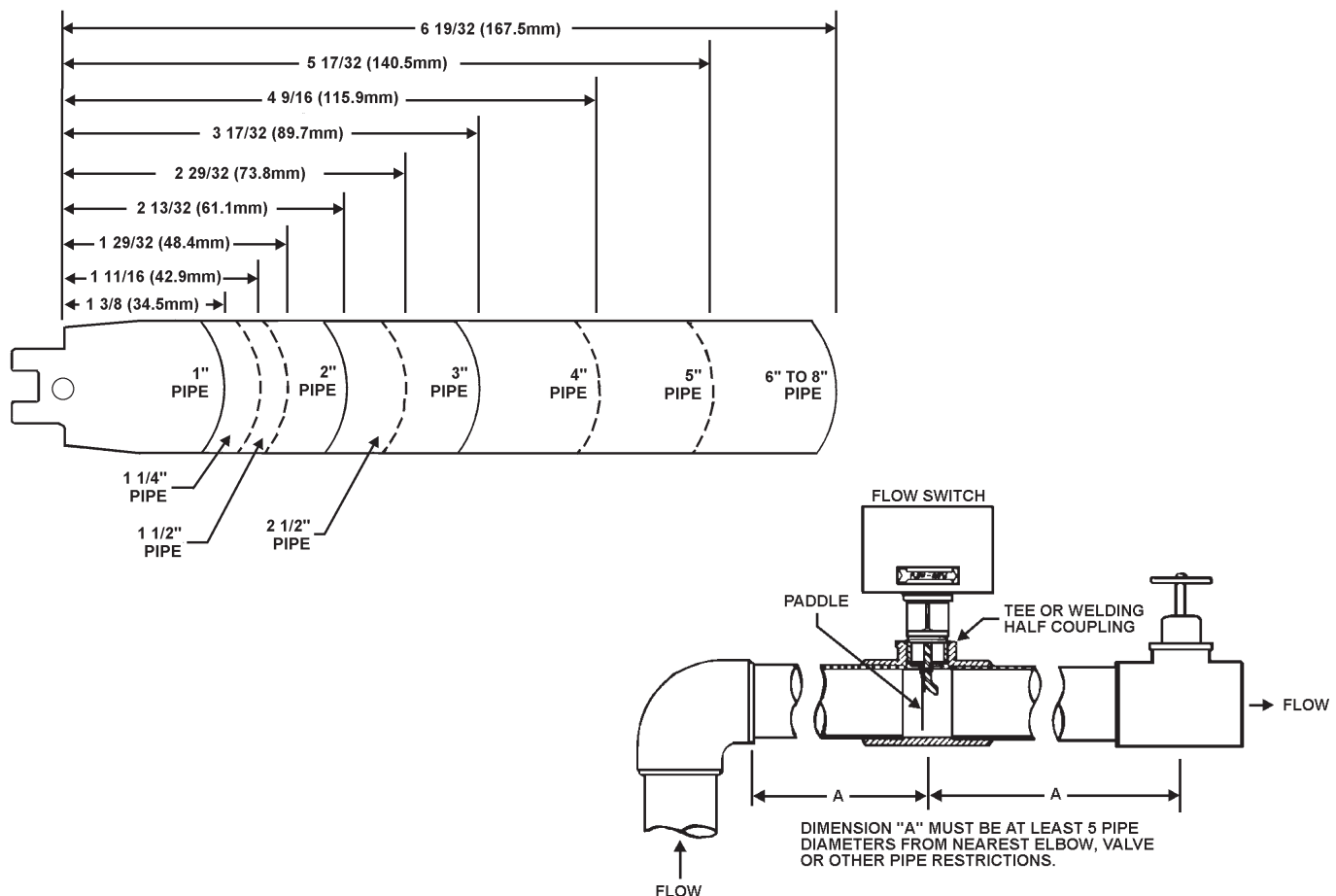


FIGURE 9. FLOW SWITCH

GENERAL REQUIREMENTS

REQUIRED ABILITY

Installation or service of this boiler requires ability equivalent to that of a qualified service technician 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. The location selected should provide adequate air supply and be 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 boiler operation and service (circulating pump replacement, control replacement, etc.).

⚠ CAUTION

Property Damage Hazard

This boiler should not be installed on carpeting.

This boiler should not be located in an area where it may be subject to freezing.

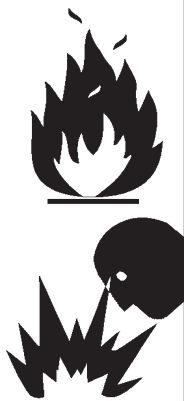
This boiler must be located near a floor drain. It should be located in an area where leakage from the boiler or connections will not result in damage to the adjacent area or to lower floors of the structure.



⚠ WARNING

Fire Hazard

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



⚠ DANGER

Fire Explosion Hazard

There is a risk of fire or explosion in areas where gasoline, other flammable liquids, or engine driven equipment and vehicles are stored, operated, or repaired when a fuel burning appliance such as a boiler is operated.

Flammable vapors are heavy and travel along the floor. They may be ignited by sparks causing fire or explosion.

REPLACING EXISTING COMMON VENTED BOILER

When an existing boiler is removed from a common venting system, the common venting system is likely to be too large for proper venting of the appliances remaining connected to it. 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.

1. Seal any unused openings in the common venting system.
2. 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.
3. 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.
4. Place in operation the appliance being inspected. Follow the lighting instructions. Adjust thermostat so appliance will operate continuously.
5. 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.
6. 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.
7. Any improper operation of the common venting system should be corrected so the installation conforms with the National Fuel Gas Code, ANSI Z223.1/NFPA 54 and/or CSA B149.1, 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 the National Fuel Gas Code, ANSI Z223.1/NFPA 54 and/or CSA B149 .1, Installation Codes.

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.

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.

CHEMICAL VAPOR CORROSION

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 (water softener salt), waxes, and process chemicals are typical compounds which are potentially corrosive. These materials are corrosive at very low concentration levels with little or no odor to reveal their presence.

Products of this sort should not be stored near boiler. Also, air which is brought in contact with boiler should not contain any of these chemicals. If necessary, uncontaminated air should be obtained from remote or outside sources. Failure to observe this requirement will void warranty.

INSTALLATION CLEARANCES

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

TABLE 10. INSTALLATION CLEARANCES

	HW 300	HW 399	HW 420	HW 520	HW 670
TOP	28" (711.2)	28" (711.2)	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)

2 inches (51 mm) 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 (609.6 mm) in the rear and 48 inches (1,219 mm) 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 boiler.

LEVELING


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

If the unit is not level, obtain and insert 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.

AIR REQUIREMENTS



WARNING

Breathing Hazard - Carbon Monoxide Gas



- Install appliance in accordance with the Instruction Manual and NFPA 54 or CAN/CSA-B149.1.
- To avoid injury, combustion and ventilation air must be taken from outdoors.
- Do not place chemical vapor emitting products near the boiler.

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

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

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

Do not install the boiler in a confined space unless an adequate supply of air for combustion and ventilation is brought in to that space using the methods described in the Confined Space section that follows.

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

UNCONFINED SPACE

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

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

UNUSUALLY TIGHT CONSTRUCTION

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

CONFINED SPACE

A confined space is one whose volume is less than 50 cubic feet per 1,000 Btu/hr (4.8 cubic meters per kW) of the total input rating of all appliances installed in the space.

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

DIRECT VENT BOILERS

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

EXHAUST FANS

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

LOUVERS AND GRILLES

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

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

FRESH AIR OPENINGS FOR CONFINED SPACES

The following instructions shall be used to calculate the size, number and placement of openings providing fresh air for combustion, ventilation and dilution in confined spaces. The illustrations shown in this section of the manual are a reference for the openings that provide fresh air into confined spaces only. Do not refer to these illustrations for the purpose of vent installation. See Venting section on Page 21 for complete venting installation instructions.

OUTDOOR AIR THROUGH TWO OPENINGS

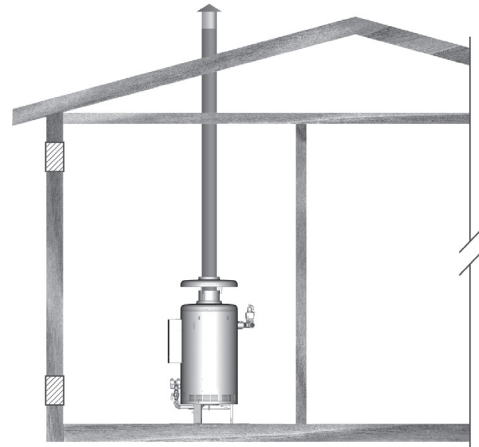


FIGURE 10. OUTDOOR AIR THROUGH TWO OPENINGS

The confined space shall be provided with two permanent openings, one commencing within 12 inches (300 mm) of the top and one commencing within 12 inches (300 mm) of the bottom of the enclosure. The openings shall communicate directly with the outdoors. See Figure 10.

Each opening shall have a minimum free area of 1 square inch per 4,000 Btu/hr (550 mm² per kW) of the aggregate input rating of all appliances installed in the enclosure. Each opening shall not be less than 100 square inches (645 cm²).

OUTDOOR AIR THROUGH ONE OPENING

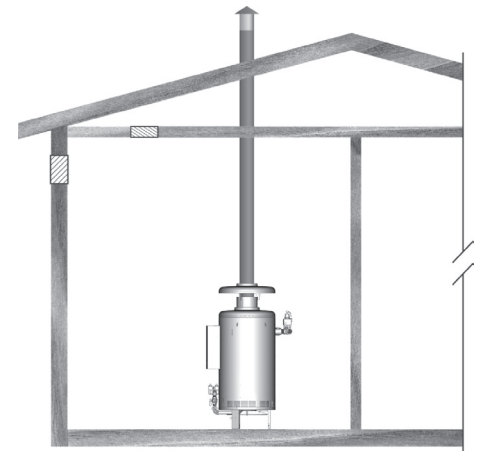


FIGURE 11. OUTDOOR AIR THROUGH ONE OPENING

Alternatively a single permanent opening, commencing within 12 inches (300 mm) of the top of the enclosure, shall be provided. See Figure 11. The boiler shall have clearances of at least 1 inch (25 mm) from the sides and back and 6 inches (150 mm) from the front of the appliance. The opening shall directly communicate with the outdoors or shall communicate through a vertical or horizontal duct to the outdoors or spaces that freely communicate with the outdoors and shall have a minimum free area of the following:

1. 1 square inch per 3000 Btu/hr (700 mm² per kW) of the total input rating of all appliances located in the enclosure, and
2. Not less than the sum of the areas of all vent connectors in the space.

OUTDOOR AIR THROUGH TWO HORIZONTAL DUCTS

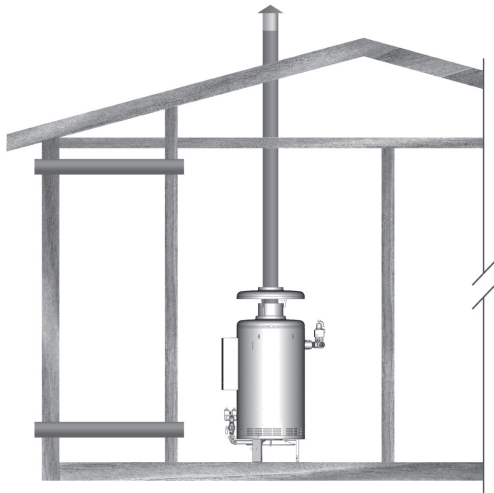


FIGURE 12. OUTDOOR AIR THROUGH TWO HORIZONTAL DUCTS

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

Each duct opening shall have a minimum free area of 1 square inch per 2,000 Btu/hr (1100 mm² per kW) of the aggregate input rating of all appliances installed in the enclosure.

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

OUTDOOR AIR THROUGH TWO VERTICAL DUCTS

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

Do not refer to these illustrations for the purpose of vent installation.

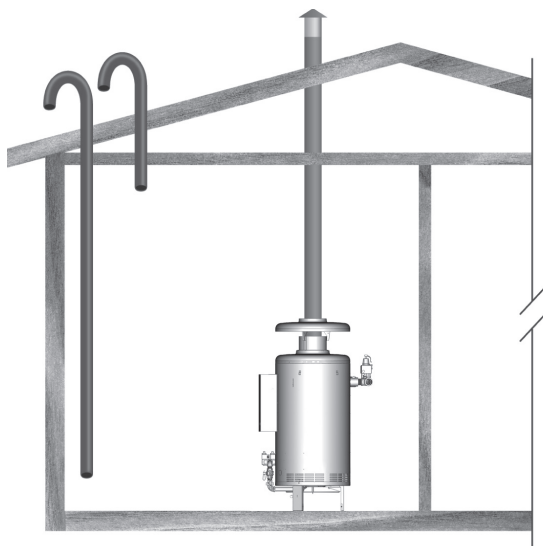


FIGURE 13. OUTDOOR AIR THROUGH TWO VERTICAL DUCTS

The confined space shall be provided with two permanent vertical ducts, one commencing within 12 inches (300 mm) of the top and one commencing within 12 inches (300 mm) of the bottom of the enclosure. The vertical ducts shall communicate directly with the outdoors. See Figure 13.

Each duct opening shall have a minimum free area of 1 square inch per 4,000 Btu/hr (550 mm² per kW) of the aggregate input rating of all appliances installed in the enclosure.

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

AIR FROM OTHER INDOOR SPACES

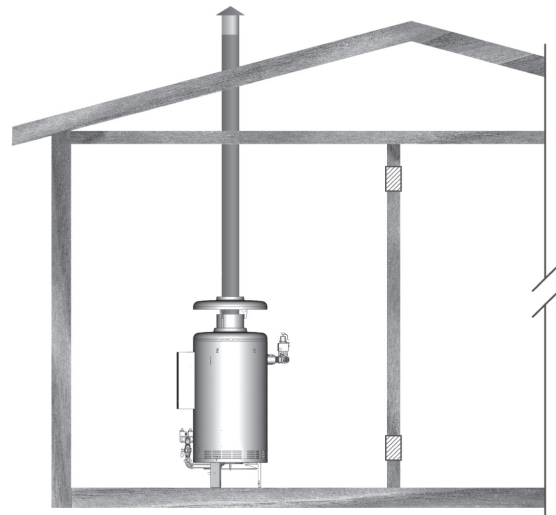


FIGURE 14. AIR FROM OTHER INDOOR SPACES

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

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

Each opening shall have a minimum free area of 1 square inch per 1,000 Btu/hr (1100 mm² per kW) of the aggregate input rating of all appliances installed in the enclosure. Each opening shall not be less than 100 square inches (645 cm²).

GAS CONNECTIONS

CAUTION

Gas Supply

- The gas type must match the gas type on the rating plate.
- Gas supply pressure must match pressure indicated on the rating plate
- Isolate boiler from gas supply piping system.
- Disconnect boiler and main manual gas shutoff valve from gas supply during pressure testing of gas supply system

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

This boiler is not intended to operate at gas supply pressure other than shown on the rating plate. A lock-up or positive shut-off type regulator must be installed in gas supply line. For proper gas regulation the lock-up style regulators must be installed no closer than a minimum of 3 feet from the boiler and a maximum of 8 feet away from the boiler. Exposure to higher gas supply pressure may cause damage to gas control valves which can result in fire or explosion. If overpressure has occurred such as through improper testing of gas lines or emergency malfunction of supply system, the gas control valves must be checked for safe operation. Make sure that the outside vents on supply regulators and the safety vent valves are protected against blockage. These are parts of the gas supply system, not boiler. Vent blockage may occur during ice build-up or snowstorms.

The boiler must be isolated from the gas supply piping system by closing its main manual gas shut off valve during any pressure testing of the gas supply piping system at test pressures equal to or less than 1/2 psig.

Disconnect the boiler and its main manual gas shut-off valve from the gas supply piping during any pressure testing of the gas supply system over 1/2 psig. The gas supply line must be capped when not connected to the boiler.

It is important to guard against gas control 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 approved for gas service.

When local codes require a main manual shut-off valve outside the boiler jacket, a suitable main manual shut-off valve must be installed in a location complying with those codes.

Before attaching gas line be sure that all gas pipe is clean on inside. To trap any dirt or foreign material in the gas supply line, a sediment trap must be incorporated in piping. The sediment trap must be readily accessible and not subject to freezing conditions. Install in accordance with recommendations of serving gas supplier. Refer to the current edition of the National Fuel Gas Code, ANSI Z223.1/NFPA 54 or the Natural Gas and Propane Installation Code, CAN/CSA B149.1

Size of gas supply piping may be larger than heater connection on installations where a significant run of piping is required.

To prevent damage, care must be taken not to apply too much torque when attaching gas supply pipe to boiler gas inlet. When installing and tightening gas piping use a second wrench to hold the gas control valve to keep the valve from turning. To prevent damage to the gas control valve do not use pipe wrench on the valve body.

Fittings and unions in gas line must be of 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 connection must be leak tested before placing the boiler in operation.

SIZING GAS SUPPLY LINE (FOR SINGLE BOILER INSTALLATIONS AND FOR INSTALLATIONS OF MULTIPLES OF TWO OR THREE OF SAME SIZE BOILERS).

Use Table 11 or CAN/CSA B149.1 (current edition) to size iron pipe or equivalent gas supply line. Table 11 is based on a pressure drop of 0.3 inches of water and a specific gravity of 0.60 approximately that of natural gas. (Propane (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 11.
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/Ft³.

Propane (LP) Gas has a heating value of approximately 2,500 Btu/Ft³.

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.

TABLE 12. SUGGESTED PIPE SIZE FOR MULTIPLE GAS APPLIANCES (NATURAL GAS)




Nominal Iron Pipe Size (Inches)	Maximum Capacity of Pipe in BTU/hr and kW for Gas Pressures of 14 in. W.C. (0.5 psi) or Less and a Pressure Drop of 0.5 in. W.C. (based on 0.60 Specific Gravity Gas w/Heating Value of 1,000 BTU's/Ft3)																		
	Length of Pipe in Feet (Meters)																		
	10 (3.05)	20 (6.1)	30 (9.14)	40 (12.19)	50 (15.24)	60 (18.29)	70 (21.34)	80 (24.38)	90 (27.43)	100 (30.48)	125 (38.1)	150	175	200					
1 1/2 BTU/hr kW	2,100,000 615	1,460,000 428	1,180,000 346	990,000 290	900,000 264	810,000 237	750,000 220	690,000 202	650,000 190	620,000 182	550,000 161	500,000 146	460,000 135	—					
2 BTU/hr kW	3,950,000 1,157	2,750,000 805	2,200,000 644	1,900,000 556	1,680,000 492	1,520,000 445	1,400,000 410	1,300,000 381	1,220,000 357	1,150,000 337	1,020,000 299	950,000 278	850,000 249	800,000 234					
2 1/2 BTU/hr kW	6,300,000 1,845	4,350,000 1,274	3,520,000 1,031	3,000,000 879	2,650,000 776	2,400,000 703	2,250,000 659	2,050,000 600	1,950,000 571	1,850,000 542	1,650,000 483	1,500,000 439	1,370,000 401	1,280,000 375					
3 BTU/hr kW	11,000,000 3,222	7,700,000 2,255	6,250,000 1,830	5,300,000 1,552	4,750,000 1,391	4,300,000 1,259	3,900,000 1,142	3,700,000 1,084	3,450,000 1,010	3,250,000 952	2,950,000 864	2,650,000 776	2,450,000 718	2,280,000 668					
4 BTU/hr kW	23,000,000 6,736	15,800,000 4,627	12,800,000 3,749	10,900,000 3,192	9,700,000 2,841	8,800,000 2,577	8,100,000 2,372	7,500,000 2,197	7,200,000 2,109	6,700,000 1,962	6,000,000 1,757	5,500,000 1,611	5,000,000 1,464	4,600,000 1,347					

TABLE 13. SUGGESTED PIPE SIZE FOR MULTIPLE GAS APPLIANCES (PROPANE GAS)

Nominal Iron Pipe Size (Inches)	Maximum Capacity of Pipe in BTU/hr and kW for Gas Pressures of 14 in. W.C. (0.5 psi) or Less and a Pressure Drop of 0.5 in. W.C. (based on 0.60 Specific Gravity Gas w/Heating Value of 1,000 BTU's/Ft3)																		
	Length of Pipe in Feet (Meters)																		
	10 (3.05)	20 (6.1)	30 (9.14)	40 (12.19)	50 (15.24)	60 (18.29)	70 (21.34)	80 (24.38)	90 (27.43)	100 (30.48)	125 (38.1)	150	175	200					
1 1/2 BTU/hr kW	3,276,000 959	2,277,600 667	1,840,800 539	1,544,400 452	1,404,000 411	1,263,600 370	1,170,000 343	1,076,400 315	1,014,000 297	967,200 283	858,000 251	780,000 228	717,600 210	670,800 196					
2 BTU/hr kW	6,162,000 1,805	4,290,000 1,256	3,432,000 1,005	2,964,000 868	2,620,800 768	2,371,200 694	2,184,000 640	2,028,000 594	1,903,200 557	1,794,000 525	1,591,200 466	1,482,000 434	1,326,000 388	1,248,000 366					
2 1/2 BTU/hr kW	9,828,000 2,878	6,786,000 1,987	5,491,200 1,608	4,680,000 1,371	4,134,000 1,211	3,744,000 1,097	3,510,000 1,028	3,198,000 937	3,042,000 891	2,886,000 845	2,574,000 754	2,340,000 685	2,137,200 626	1,999,800 585					
3 BTU/hr kW	17,160,000 5,026	12,012,000 3,518	9,750,000 2,856	8,268,000 2,421	7,410,000 2,170	6,708,000 1,965	6,084,000 1,782	5,772,000 1,690	5,382,000 1,576	5,070,000 1,485	4,602,000 1,348	4,134,000 1,211	3,822,000 1,119	3,556,800 1,042					
4 BTU/hr kW	35,880,000 10,508	24,648,000 7,219	19,968,000 5,848	17,004,000 4,980	15,132,000 4,432	13,728,000 4,021	12,636,000 3,701	11,700,000 3,427	11,232,000 3,290	10,452,000 3,061	9,360,000 2,741	8,580,000 2,513	7,800,000 2,284	7,176,000 2,102					

VENTING

STANDARD VENTING

 WARNING		
Fire and Breathing Hazard		
	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.

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 or CAN/CSA B149.1, Installation Codes;

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.

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), noncombustible 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" (21 mm/m) per foot from the boiler to the vent terminals, see Figure 15. 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.

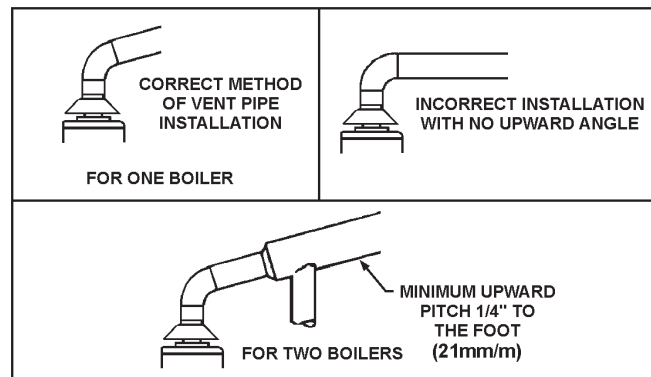


FIGURE 15. VENT PIPE INSTALLATION

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.

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

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.

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 National Fuel Gas Code, ANSI Z223.1 or CAN/CSA B149.1. When resizing any portion of the common venting system, the common venting system should be resized to approach the minimum size as determined using the appropriate tables in the National Fuel Gas Code, ANSI Z223.1 or CAN/CSA B149.1.

MULTIPLE VENT TABLE

Table 14 on Page 23 has been compiled to show the material sizes in a Type B doublewall combined vent system. Refer to the current edition of NFPA 54 or CAN/CSA B140.1 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 14, 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" (610 mm) 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 National Fuel Gas Code, ANSI Z223.1 or CAN/CSA B149.1.

EXAMPLE SHOWING USE OF THE HW-670 COMBINED VENT SIZING TABLE

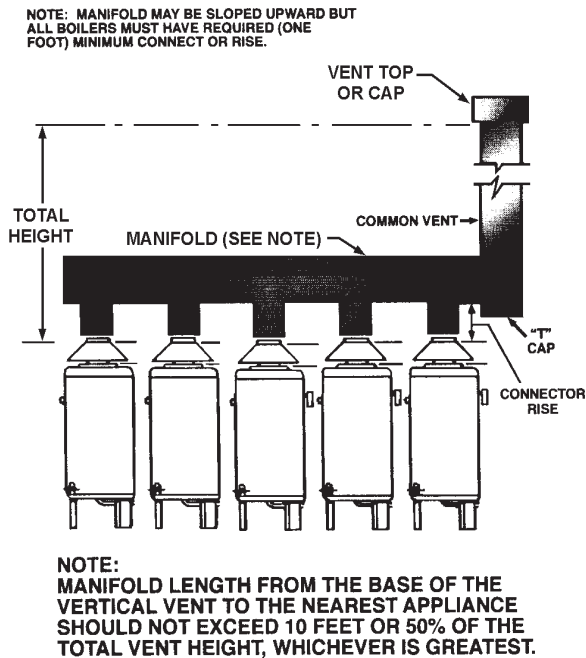


FIGURE 16. EXAMPLE FOR COMBINED VENT SIZING TABLE

SIDEWALL VENTING

The optional sidewall power vent system is certified for maximum 100' equivalent venting. The power vent kits p/n for HW300, 399-420, 520, 670 are 325614-000, 325614-001, 325614-002 and 325614-003 respectively. 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. Refer to Venting Maintenance on Page 41.

1. 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.
2. After allowing the boiler to operate for five minutes, test for spillage at the draft hood relief opening.
3. "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."

4. 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.

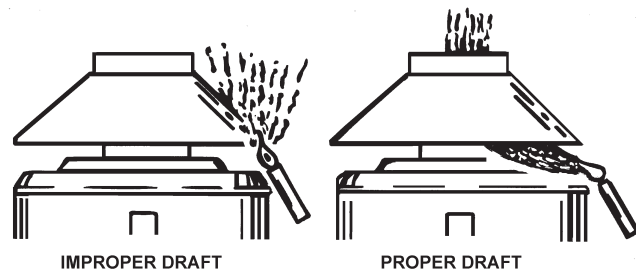


FIGURE 17. VENTING SYSTEM

TABLE 14. 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	12	
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	12	10	10	10	10	10	10
	3	12	10	10	10	10	10	10	10	10	10
	4 or more	10	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	12	12	12
	3	1560	20	18	18	16	16	14	14	14	
	4	2080	22	22	20	18	18	18	16	14	
	5	2600	26	24	22	20	20	18	18	18	
	6	3120	28	26	24	22	22	20	20	18	
	7	3640	30	28	26	24	24	22	22	20	
	8	4160	32	30	28	26	24	24	22	20	

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
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
	3	1830	22	20	20	18	18	16	16	14
	4	2440	26	24	22	20	20	18	18	16
5	3050	28	26	26	24	22	22	20	20	
6	3660	32	28	28	26	24	24	22	22	
7	4270	34	32	30	28	26	24	24	22	
8	4880	36	34	32	30	28	26	26	24	
9	5490	38	36	34	30	30	28	28	26	
10	6100	40	38	36	32	30	30	28	26	
11	6710	42	38	38	34	32	30	28	26	
12	7320	46	44	40	38	36	34	34	32	

Example: Known: (5) model HW-670 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-670 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.

GAS SUPPLY CONNECTIONS

GAS SUPPLY PIPE CONNECTIONS

1. Make sure to install ground joint union for servicing.

In Canada – When using manual main shutoff to support the weight of the piping with valves, ensure that it is identified by the installer.

2. Install sediment trap per NFPA 54 for US and CAN B149.1 for Canada.
3. Support the piping with hangers, not by the boiler or its accessories. The gas control valve and blower will not support the weight of the piping. Failure to comply could result in severe personal injury, death, or substantial property damage.
4. Purge all air from the gas supply piping.
5. Before setting the boiler in operation, check the boiler and its gas connection for leaks.
 - Disconnect the boiler from the gas supply piping system during any pressure testing, at a test pressure in excess of 1/2 PSIG (3.5 kPa)
 - The boiler must be isolated from the gas supply piping system by closing a manual shutoff valve during any pressure testing, at test pressures equal to or less than 1/2 PSIG (3.5 kPa).

Do not check for gas leaks with an open flame, instead use the bubble test. Failure to use the bubble test or check for gas leaks can cause severe personal injury, death, or substantial property damage.

6. Use pipe sealing compound compatible with propane gases. Apply sparingly only to male threads of the pipe joints so that pipe dope does not block gas flow.

Failure to apply pipe sealing compound as detailed in this manual can result in severe personal injury, death, or substantial property damage.

7. Make sure the maximum inlet gas pressure do not exceed the value specified. Minimum value specified is for input adjustment only.

Make sure to use two wrenches when tightening gas piping at the boiler, using one wrench to prevent the boiler gas line connection from turning. Failure to support the boiler gas connection pipe to prevent it from turning could damage gas line components. Do not use wrench on valve body as damage would occur.

GAS PRESSURE REQUIREMENTS

The maximum allowable gas supply pressure for this boiler is 14 inches w.c. (3.5 kPa). Install a positive lock-up gas pressure regulator in the gas supply line if inlet gas pressure can exceed 14 inches w.c. (3.5 kPa) at any time.

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

1. Positive lock-up gas pressure regulators must be rated at or above the input Btu/hr rating of the boiler they supply.
2. Positive lock-up gas pressure regulator(s) should be installed no closer than 3 feet (1 meter) and no farther than 8 feet (2.4 meters) from the boiler's inlet gas connection.
3. After installing the positive lock-up gas pressure regulator(s), an initial nominal supply pressure setting of 7 inches w.c. (1.7 kPa) while the boiler is operating is recommended and will generally provide good boiler operation. Some addition adjustment maybe required later to maintain a steady gas supply pressure.

4. When installing multiple boilers in the same gas supply system it is recommended that individual positive lock-up gas pressure regulators be installed at each unit.

PIPE SIZES FOR PROPANE GAS

Make sure to contact the gas supplier for pipe sizes, tanks, and 100% lockup gas pressure regulator.

PURGING GAS LINE

Gas line purging is required with new piping or systems in which air has entered. Gas purging should be performed per NFPA 54 for US and CAN B149.1 for Canada.

CHECK GAS SUPPLY INLET PRESSURE

CSA or UL listed flexible gas connections are acceptable, but make sure that the line has adequate capacity to allow your boiler to fire at full rate. Consult with local codes for proper installation or service procedures.

Do not adjust or attempt to measure gas control valve outlet pressure. Attempting to alter or measure the outlet pressure could result in damage to the valve, causing potential severe personal injury, death, or substantial property damage.

Make sure the gas piping are sized for the proper flow and length of pipe, to avoid excessive pressure drop. The gas meter and the gas regulator must be properly sized for the total gas load.

Perform the below steps when checking inlet gas supply:

1. Turn the main power switch to the "OFF" position.
2. Shut off gas supply.
3. Remove the 1/8" pipe plug on the main gas shutoff valve and install a suitable 1/8" fitting (field supplied) for the manometer tubing. Place the tubing of the manometer over the tap once the 1/8" fitting is installed.
4. Slowly turn on the gas supply.
5. Ensure inlet pressure is within specified range.
6. If the gas pressure is out of range, contact the gas utility, gas supplier, qualified installer or service agency to determine the necessary steps to provide proper gas pressure to the control.

CHECK FOR GAS LEAKS

Before operating the boiler, make sure to check the floor near and around the boiler for gas odorant or any unusual odor. Remove the top access panel and check for odor in the interior of the boiler enclosure. Do not start the boiler if there is any indication of a gas leak. Use an approved leak detection solution and repair any leaks at once.

In the case of propane boilers, the supplier mixes an odorant with the propane to make its presence detectable. But in some instances, the odorant can fade, and the gas may no longer have an odor. Before operating the boiler, make sure the propane supplier verify the correct odorant level in the gas.

Do not adjust or attempt to measure the outlet pressure. The gas valve is factory set for the correct outlet pressure. This setting is suitable for natural gas and propane, equiring no field adjustment. Attempting to alter or measure the outlet pressure could result in damage to the valve, causing potential severe personal injury, death, or substantial property damage.

GAS MANIFOLD PRESSURE REGULATORS

The gas manifold pressure regulator is included in the combination gas control valve, Figure 18, and is set to operate on the gas specified on the boiler model and rating plate.

Periodically check main burner, Figure 19 on Page 26, and pilot flame, Figure 20 on Page 27, for proper operation. This should be checked every six months.

Do not subject the gas control 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 15.
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	3.5	10.0
HW-420	420,000	3.5	10.0
HW-520	520,000	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.

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 control valve.

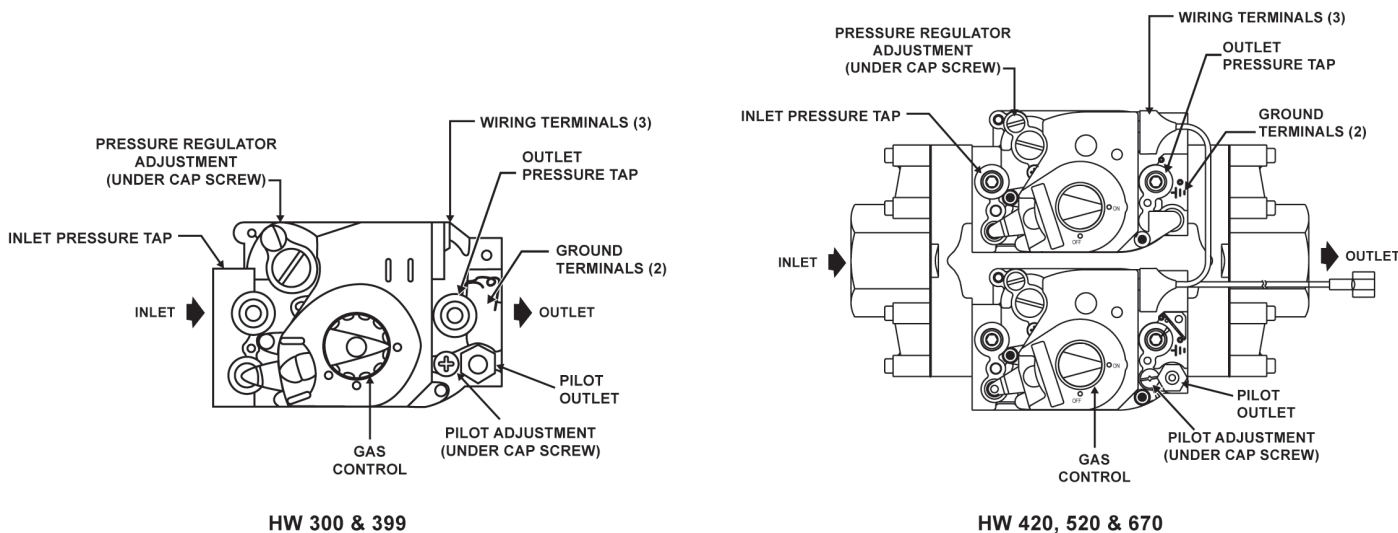


FIGURE 18. GAS CONTROL VALVES (NATURAL GAS & PROPANE)

BOILER START UP AND OPERATIONS

After placing the 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 3 on Page 9).
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 pressure relief valves should be inspected and manually operated at least twice a year.

IMPORTANT

It is recommended that a qualified service technician 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 29 to Figure 42 on Pages 47 to 60.

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 service technician:

- Flooding to level of burner or controls or higher.
- Exposure to fire.
- If damaged.
- Firing without water.
- Sooting.

⚠ CAUTION

Gas Supply

Should overheating occur or the gas supply fail to shut off, turn off the gas supply at a location external to the boiler (i.e., main manual gas shutoff valve).

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 19, 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.

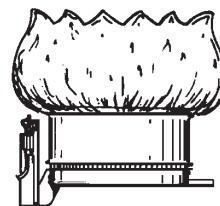


FIGURE 19. MAIN BURNER

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.

- a. Turn off the electrical power and close the main manual gas shutoff valve. Refer to Lighting & Operating Instructions on Pages 30 and 31.
 - Allow boiler parts to cool before disassembly.
- b. Remove main burner manifold assembly from boiler.
 - Refer to parts list supplied with this manual for disassembly aid.
- c. 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.
- d. Reinstall the burner manifold assembly on boiler.
- e. 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. Refer to Pages 30 and 31.
 - 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 20.

- Open fused disconnect switch or shut off electrical power to the boiler.
- Disconnect wire from MV wire on valve.
- Close fused disconnect switch to restore electrical power to the boiler.

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

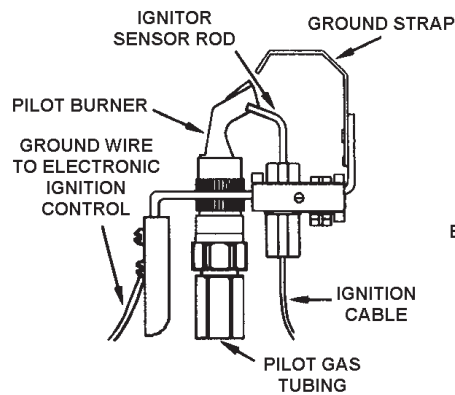
- Adjust pilot flame.

To adjust the pilot flame, remove the cap screw from the pilot adjusting screw (Figure 21) and turn to deliver a sufficient flame at the pilot burner to cover $3/8"$ to $1/2"$ (10-12 mm) of the sensing probe tip. See Figure 20.

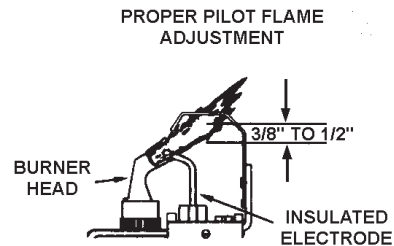
Check for good terminal connection at the sensing probe at the pilot burner assembly if pilot does not light.

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.

- Low gas pressure
 - Adjust pilot flame by means of the pilot gas adjustment located in the gas control valve.
 - The pilot flame should envelop $3/8"$ to $1/2"$ (10-12 mm) of the tip of the thermocouple. Remove pilot adjustment cover screw, Figure 21. 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 control valve after adjustment to prevent possible gas leakage.
- Clogged pilot burner orifice.
 - Clean or replace orifice. A clogged orifice will restrict gas flow and result in low thermocouple output.
- Incorrect orifice.
 - Replace. The Orifice size is stamped on the wrench flats.
- Clogged primary air opening.
 - Restricted air passages will soften the pilot flame and result in poor thermocouple flame impingement.

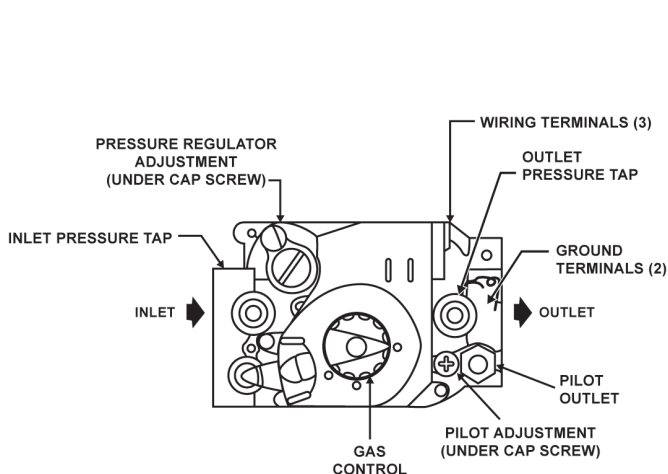


**SPARK IGNITION
PILOT BURNER**

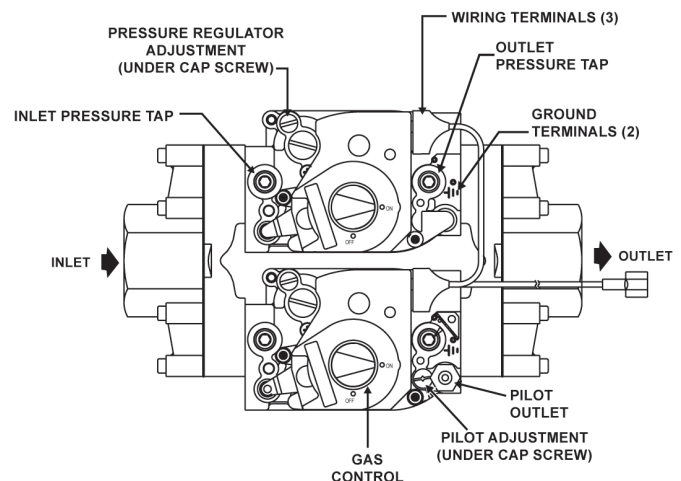


**TYPICAL PILOT
BURNER FLAME**

FIGURE 20. SPARK IGNITION PILOT BURNER AND BURNER FLAME




HW 300 & 399



HW 420, 520 & 670

FIGURE 21. ADJUSTING PILOT FLAME


CHECKING AND ADJUSTING INPUT



! WARNING

Fire and Explosion Hazard

- Under no circumstances should the input exceed the rate shown on the boiler's rating label.
- Overfiring could result in fire or explosion.
- Gas and carbon monoxide detectors are available.



! WARNING

Breathing Hazard - Carbon Monoxide Gas

- Under no circumstances should the input exceed the rate shown on the boiler's rating label.
- Overfiring could result in damage to the boiler's and sooting.
- Gas and carbon monoxide detectors are available.

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

1. Follow steps 1 thru 6 of the OPERATING INSTRUCTIONS on Page 31.
2. Attach a pressure gauge or a manometer to the manifold pressure tapping and refer to Table 16 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.

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

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/ft³

H = 1050 Btu/ft³(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, refer to Gas manifold pressure regulators on Page 25. Under no circumstances should you exceed the maximum input rate for the boiler given in Table 3 on Page 7.

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 on Page 31. The boiler will resume normal operation.

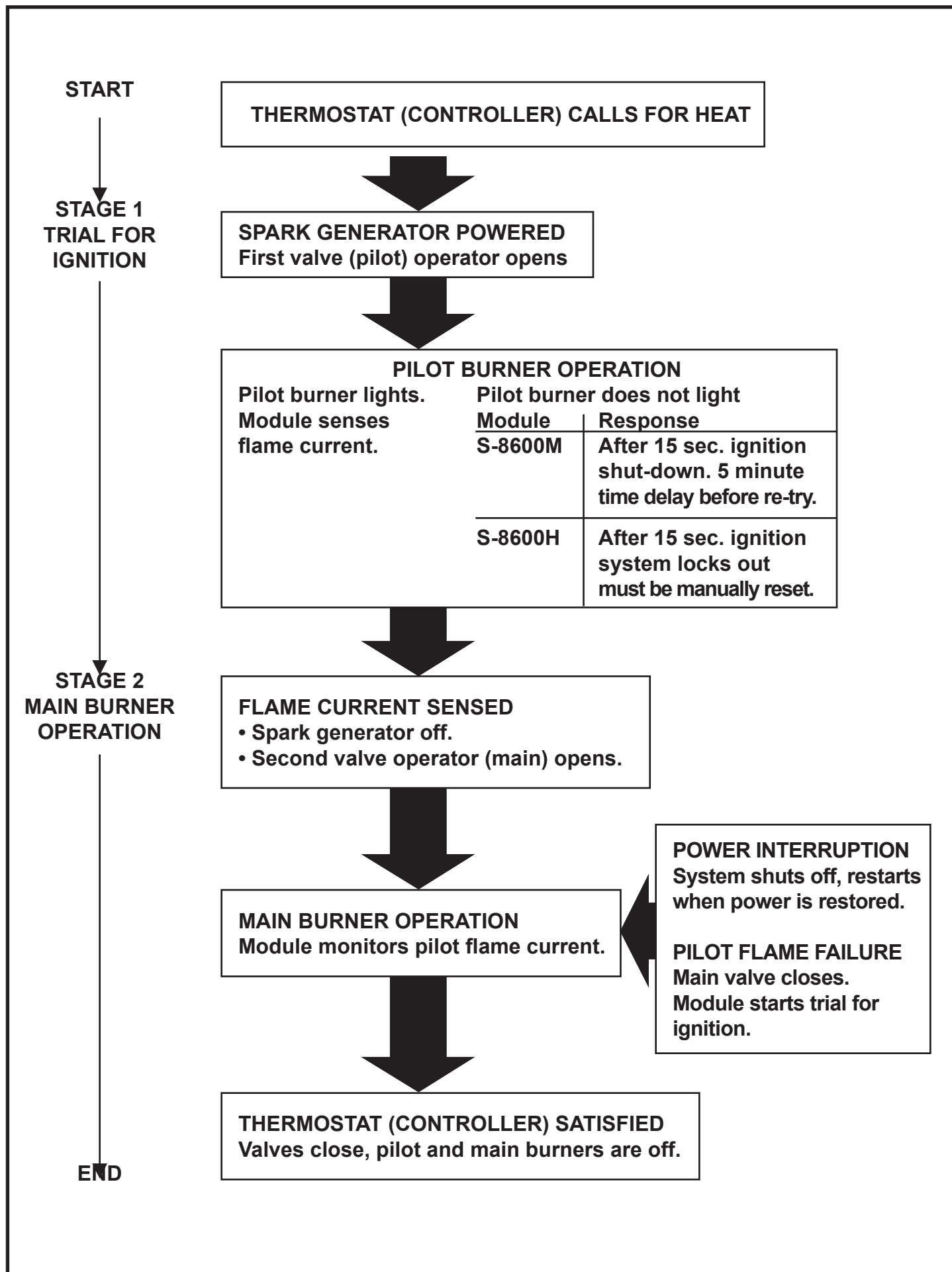
When the boiler is operating at full capacity, or full gas input, it should consume 1 cu. ft. of gas in approximately the time indicated in Table 16.

TABLE 16. 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-670
Natural	1050	12.6	9.5	9.0	7.3	5.7
Propane	2500	30.0	22.6	21.4	17.3	13.4

Minor variances from input on rating plate can be corrected by adjustment of gas pressure regulators. Refer to Gas manifold pressure regulators on Page 25.

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



FOR YOUR SAFETY READ BEFORE LIGHTING



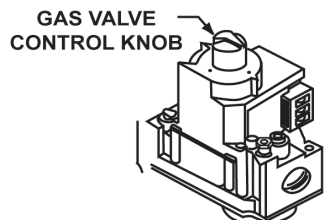
WARNING: If you do not follow these instructions exactly, a fire or explosion may result causing property damage, personal injury or loss of life.



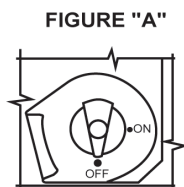
WARNING: HOT WATER CAN PRODUCE 3rd DEGREE BURNS IN 6 SECONDS AT 140° F. (60° C).

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.

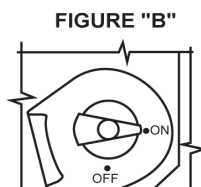
- A. THIS APPLIANCE IS EQUIPPED WITH AN IGNITION DEVICE WHICH AUTOMATICALLY LIGHTS THE PILOT. DO NOT TRY TO LIGHT THE PILOT BY HAND.
- B. BEFORE OPERATING: SMELL ALL AROUND THE APPLIANCE AREA FOR GAS. BE SURE TO SMELL NEXT TO THE FLOOR BECAUSE SOME GAS IS HEAVIER THAN AIR AND WILL SETTLE ON THE FLOOR.



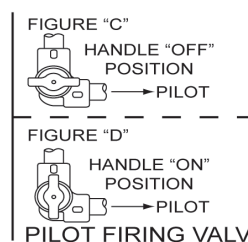
HONEYWELL GAS VALVE



"OFF" POSITION



"ON" POSITION



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, DO NOT TRY TO REPAIR IT. CALL A QUALIFIED SERVICE TECHNICIAN. FORCE OR ATTEMPTED REPAIR MAY RESULT IN A FIRE OR EXPLOSION.
 - D. DO NOT USE THIS APPLIANCE IF ANY PART HAS BEEN UNDER WATER. IMMEDIATELY CALL A QUALIFIED SERVICE TECHNICIAN TO INSPECT THE APPLIANCE AND TO REPLACE ANY PART OF THE CONTROL SYSTEM AND ANY GAS CONTROL WHICH HAS BEEN UNDER WATER.

LIGHTING INSTRUCTIONS

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 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 FIRING AND PILOT MANUAL VALVES, COUNTER-CLOCKWISE ↺.
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.

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.



- 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.

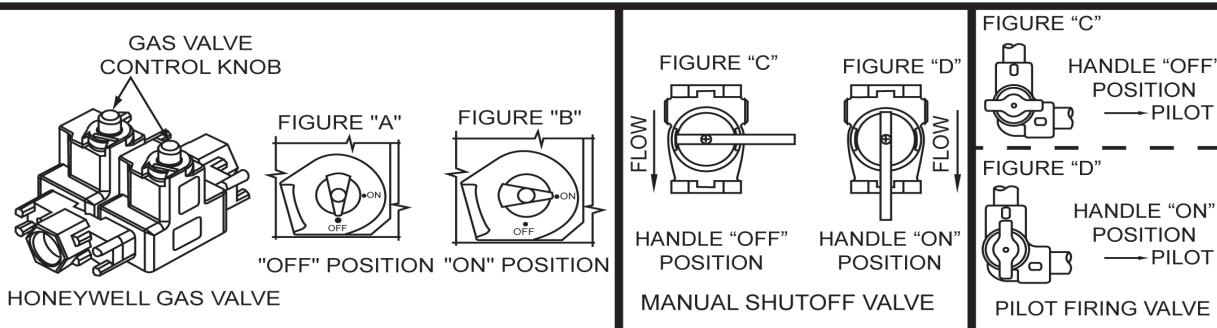
WHAT TO DO IF YOU SMELL GAS

- 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.



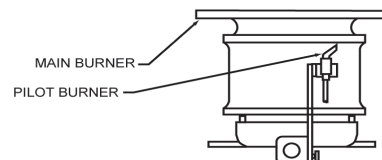
OPERATING INSTRUCTIONS

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 COUNTERCLOCKWISE ↻ 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 IGNITION 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 CONTROL CLOCKWISE ↻ TO "OFF". (FIG. "A")
3. TURN MAIN FIRING VALVE COUNTERCLOCKWISE ↻ TO "OFF" (FIG. C), AND TURN PILOT FIRING VALVE COUNTERCLOCKWISE ↻ TO "OFF" (FIG "E").
4. SET THE THERMOSTAT TO LOWEST SETTING.

TROUBLESHOOTING

Before any extensive troubleshooting, perform the following:

Ensure that:

- Voltage (120 vac) is supplied to the boiler.
- System control (tank temperature control, thermostat, etc.) is calling for boiler 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 boiler rating plate/label.

- Voltage (24 vac) is supplied by transformer.
- Boiler is wired according to wiring diagram.

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

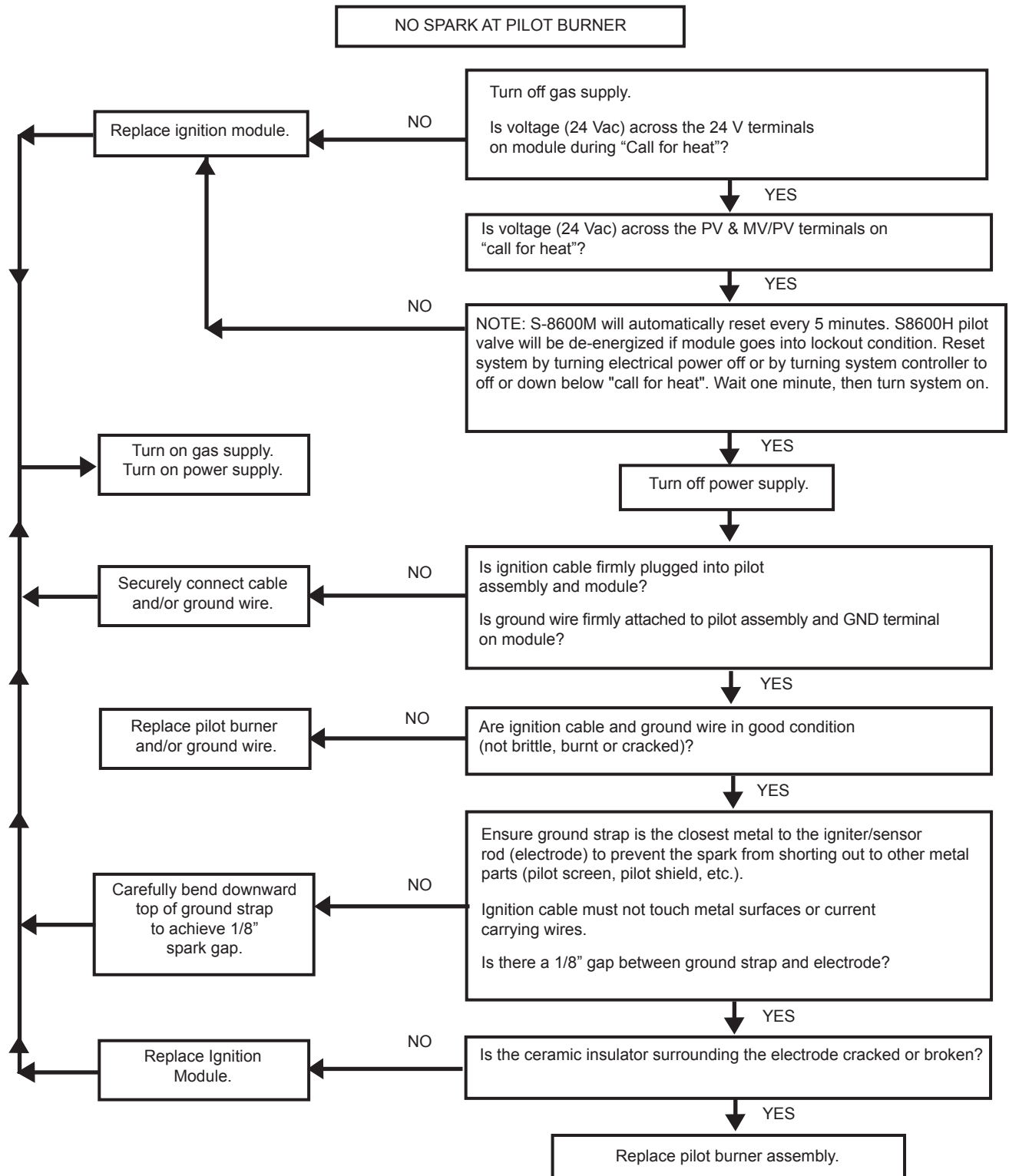
- All wire terminals/connectors are firmly attached to valves, modules, switches, limit controls, etc.
- For Propane (LP) models only check for possible lockout condition of the ignition module.

TABLE 17. 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
	CORRECT	INCORRECT		
Set tank temperature control (thermostat) 20°F (10°C) below tank water temperature.	Circulating pump and burner shut off.	Pump and burner remain on.	Tank temperature control (thermostat) defective.	Replace.
			System wiring is incorrect.	Correct wiring.
	With thermal balancer, pump off delay of approximately 2 minutes.	Circulating pump on.	Pump wired for continuous operation.	Correct wiring.
		Burner on.	Gas control valve stuck or defective.	Correct or replace valve.
Set tank temperature control (thermostat) 20°F (10°C) above tank water temperature.	Circulating pump and burner on.	Circulating pump on.	System wiring is incorrect.	Correct wiring.
			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 control 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.
Boiler outlet temperature exceeds 210°F (100°C).	Circulating pump on.	Circulating pump and burner on.	System wiring is incorrect.	Correct wiring.
			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-8600M INTERMITTENT IGNITION CONTROLS



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

SPARK AT PILOT BURNER BUT PILOT WILL NOT LIGHT

Ensure all manual shutoff valves are fully open; all filters are clean; all gas connections are gas tight; pilot tubing is not damaged, obstructed or kinked; and pilot orifice is unclogged. Check for air in gas line, purge (bleed) line if necessary.

YES

Are the wires securely attached to the pilot operator on the gas control and to the PV & MV/PV terminals on the ignition module?

NO

Attach wires firmly.

YES

Install a pressure gauge in the pilot tubing line between the gas control and the pilot burner assembly. Ensure that the pilot adjustment screw (under cap) is adjusted to a position that will permit gas to flow.
Is pilot gas flowing during ignition attempt?

NO

Replace gas control valve.

YES

Turn off power supply.

YES

Is ignition cable firmly plugged into pilot assembly and module?
Is ground wire firmly attached to pilot assembly and GND terminal on module?

NO

Securely connect cable and/or ground wire.

YES

Are ignition cable and ground wire in good condition (not brittle, burnt, or cracked)?

NO

Replace pilot burner and/or ground wire.

YES

Ensure ground strap is the closest metal to the igniter/sensor rod (electrode) to prevent the spark from shorting out to other metal parts (pilot screen, pilot shield, etc.).
Ignition cable must not touch metal surfaces or current carrying wires.
Is there a 1/8" gap between ground strap and electrode?

NO

Carefully bend downwards top of ground strap to achieve 1/8" spark gap.

YES

Is ceramic insulator surrounding the electrode in good condition (not cracked or broken)?

NO

Replace pilot burner.

YES

Is there excessive draft conditions that may cause pilot burner ignition problems?

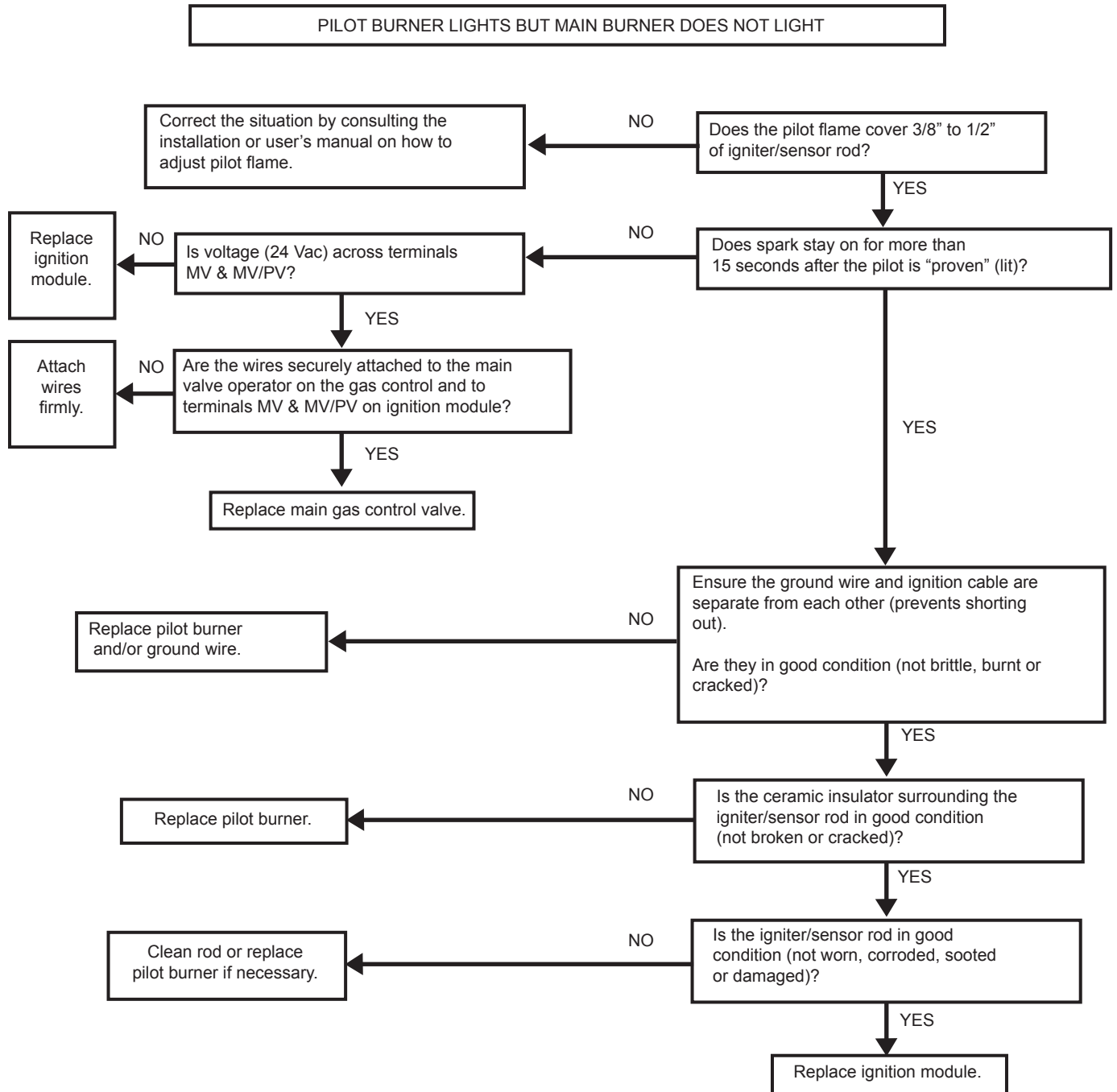
NO

Replace ignition module.

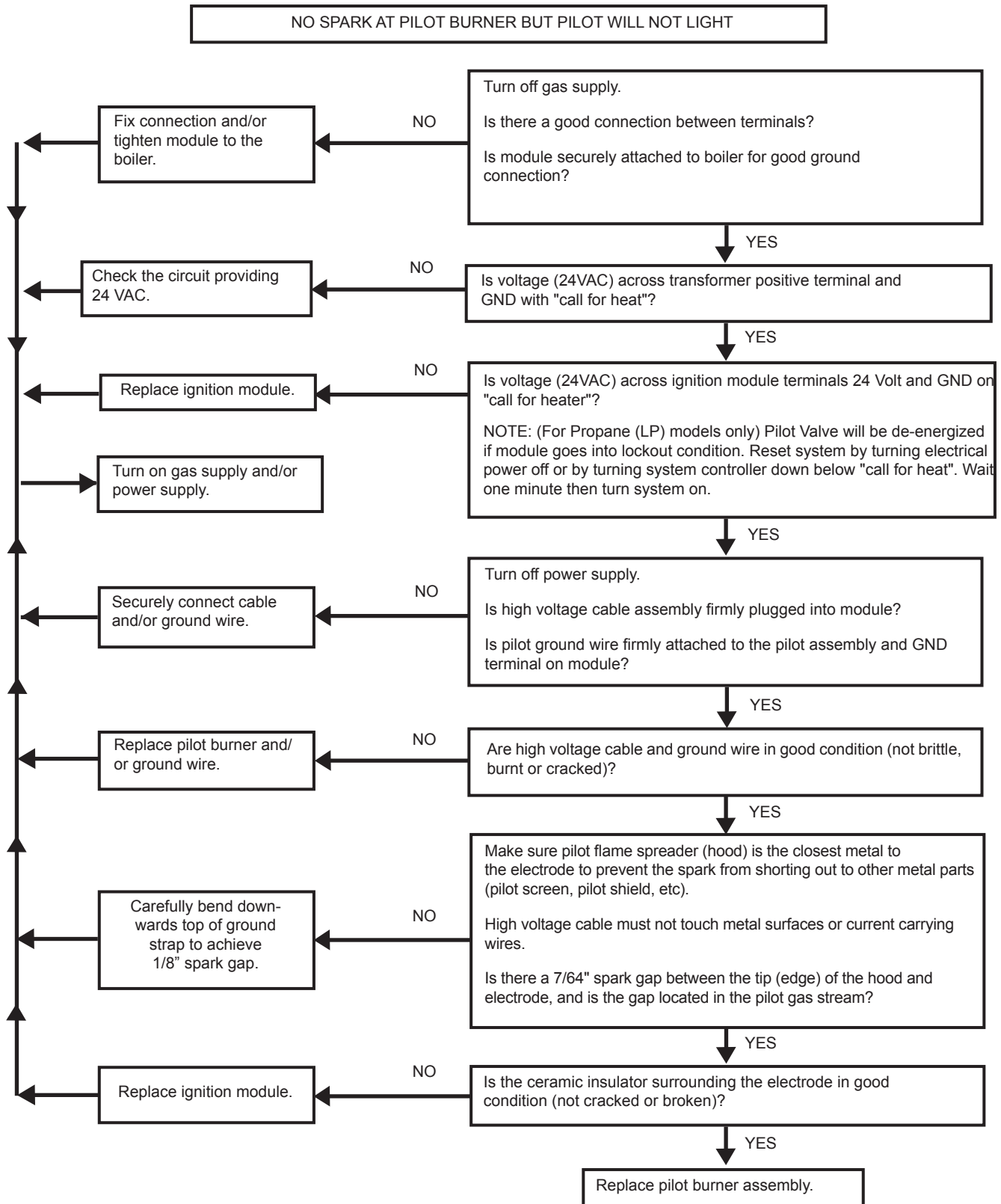
YES

Correct draft problems in a manner that would ensure adequate combustion and ventilation air and proper pilot burner performance.

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



CHECKING HONEYWELL S8600H OR S-8600M 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:

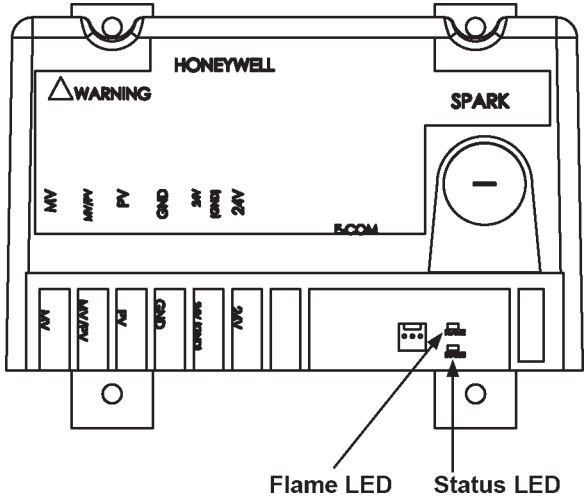


FIGURE 22. LOCATION OF LED'S

- Flame LED (Yellow)
Indicates flame presence and strength. Refer to Table 18.
- Status LED (Green)
Indicates system operation status and error conditions. Refer to Table 19 and Table 20 on Pages 38 and 39 for status specific to each model.

TABLE 18. YELLOW LED FLAME CODES

YELLOW LED FLASH CODE ^A	INDICATES	RECOMMENDED SERVICE ACTION
Heartbeat	Normal Flame Signal	not applicable
2	Weak Flame Signal- System will operate reliably but flame signal is less than desired. 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 1.1µA)- System may not operate reliably over time. Service call recommended. 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 sensor, burner ground connection.
OFF	No Flame or Flame Signal below minimum threshold for system operation.	not applicable

- ^AFlash 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 19. 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 • 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 sensor contaminated or out of position, burner ground connection.
3	Recycle • Flame failed during run	Initiate new trial for ignition. Flash code will remain through the ignition trial until flame is proved.	If system fails to light on next trial for ignition, check gas supply, pilot burner, flame sense wiring, contamination of flame sensor, 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 control 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 sensor is in proper position. Check flame sensor 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 • 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 sensor 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 sensor, 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 control 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.

^AFlash 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 20. 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 • 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 sensor, 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 control 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 sensor is in proper position. Check flame sensor 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 sensor 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 sensor, 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 control 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.

^AFlash 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.

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 boiler 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 pressure 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.

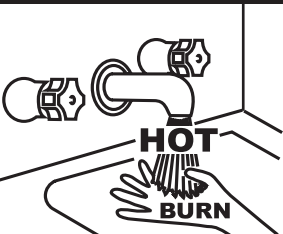
The boiler mounted gas and electrical controls have been designed to give both dependable service and long life. However, malfunction can occur, as with any piece of equipment. It is therefore recommended that all components be checked periodically by a qualified service technician for proper operation.

MANUAL RESET HIGH LIMIT SWITCH CONTINUITY TEST

Do not depress the switch reset button prior to testing. With the boiler being 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. 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.

PRESSURE RELIEF VALVE TEST

	<ul style="list-style-type: none">• Burn hazard.• Hot water discharge.• Keep clear of Pressure Relief Valve discharge outlet.
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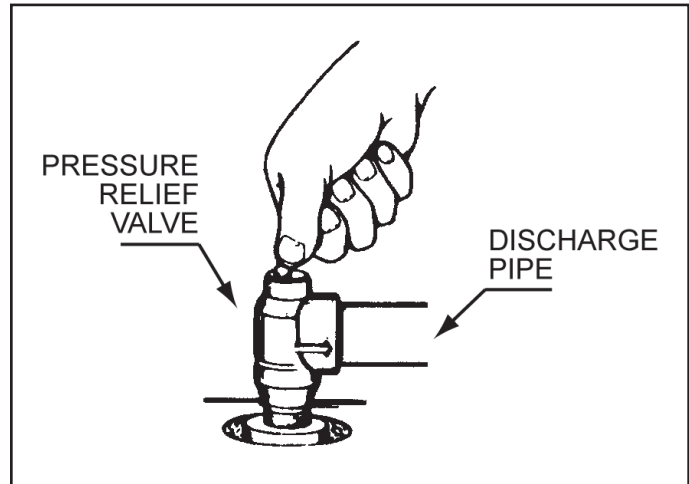


FIGURE 23. PRESSURE RELIEF VALVE TEST

If after manually operating the valve, it fails to completely reset and continues to release water, turn off power to the boiler at the main disconnect switch or breaker. Close the cold water inlet to the boiler and follow the draining instructions in this manual to drain the boiler. Should the pressure relief valve need to be replaced, call the toll free phone number listed on the back of this manual for further technical assistance.

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 circulating pump.

All hot water heating systems should be completely flushed with a grease removing solution to assure trouble-free 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 heat 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.

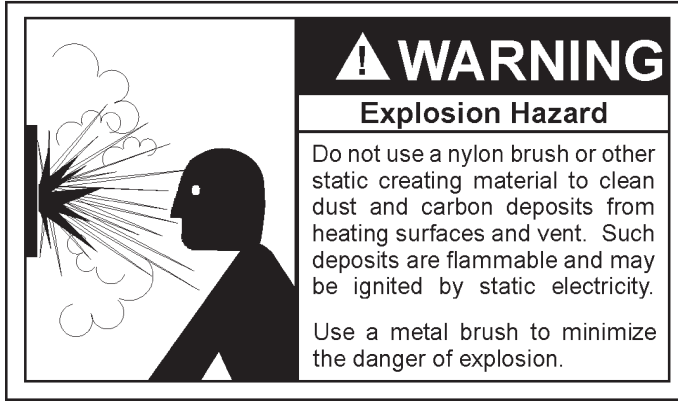
HOT WATER SUPPLY BOILERS PREVENTIVE MAINTENANCE

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

VENTING MAINTENANCE

It is recommended that the heating surfaces and vent piping of the boiler 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.



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 (21 mm/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.

WIRING

WIRING CONNECTIONS

	<p>⚠ CAUTION</p> <p>Label all wires prior to disconnection when servicing controls. Wiring errors can cause improper and dangerous operation. Verify proper operation after servicing.</p>
---	---

CONVENTIONAL INSTALLATIONS

All electrical work must be installed in accordance with current editions 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 current editions 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 circulating pump will operate before the gas control valve opens. At no time may the controlling system allow the burner to fire when there is no water flow through the boilers.

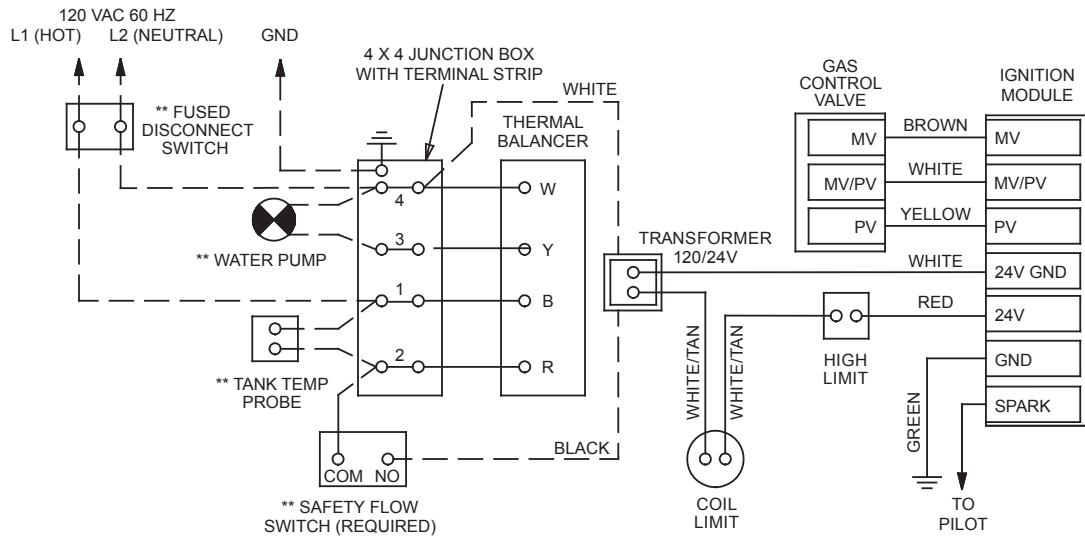
Refer to the diagram in Figure 24 on Pages 43 for proper wiring sequence with conventional single boiler installations.

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.

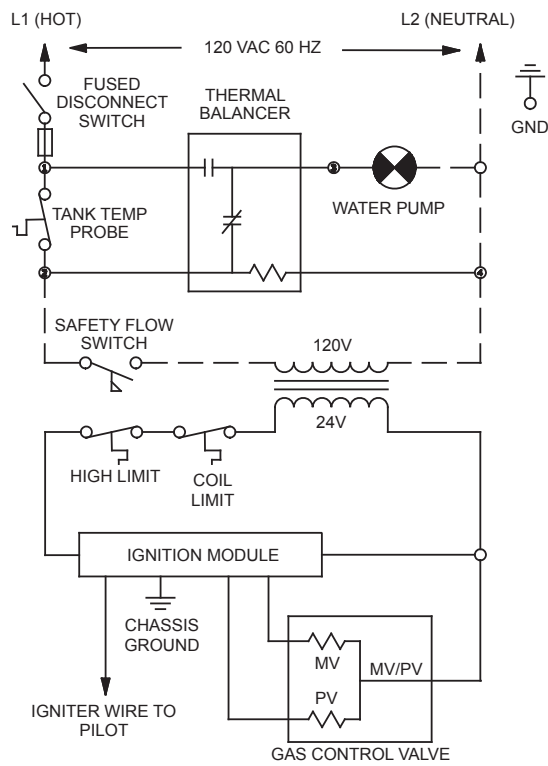
	<p>⚠ WARNING</p> <p>An electrical ground is required to reduce risk of electric shock or possible electrocution. Make the ground connection to the screw provided in the electrical supply junction box on the boiler.</p>
--	---

If any of the original wire, as supplied with the boiler, must be replaced, it must be replaced with type 105°C wire or its equivalent, except for the flame sensor and ignition cable which are 250 °C and wires connected to the coil protector which are 200°C.

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

FIGURE 24. WIRING DIAGRAMS

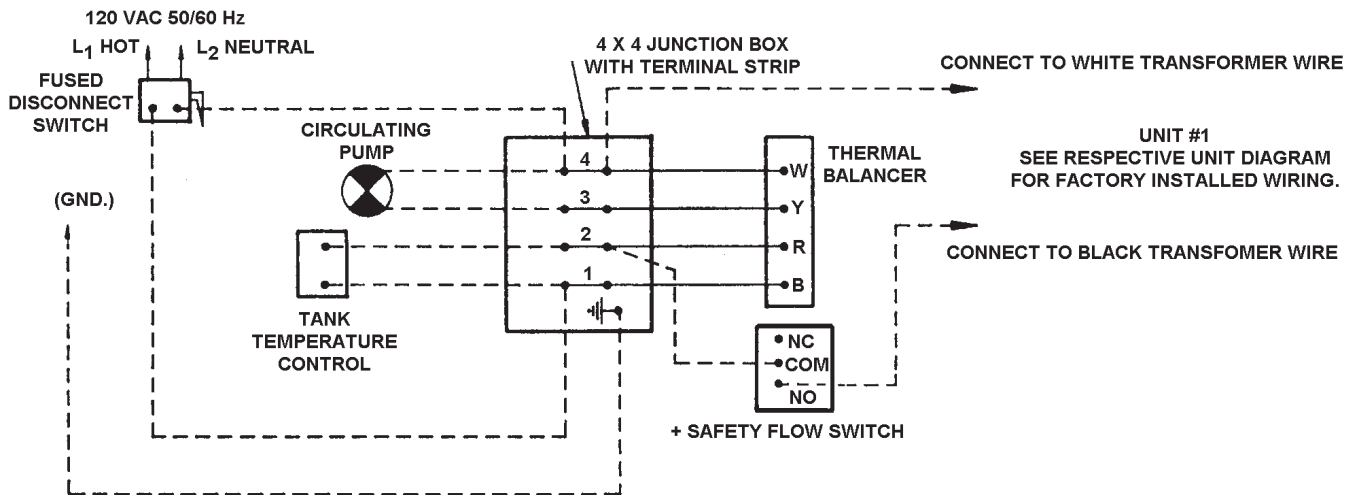


FIGURE 25. CER - TEMP 80 - 1 UNIT INSTALLATION - FOR HOT WATER SUPPLY APPLICATION

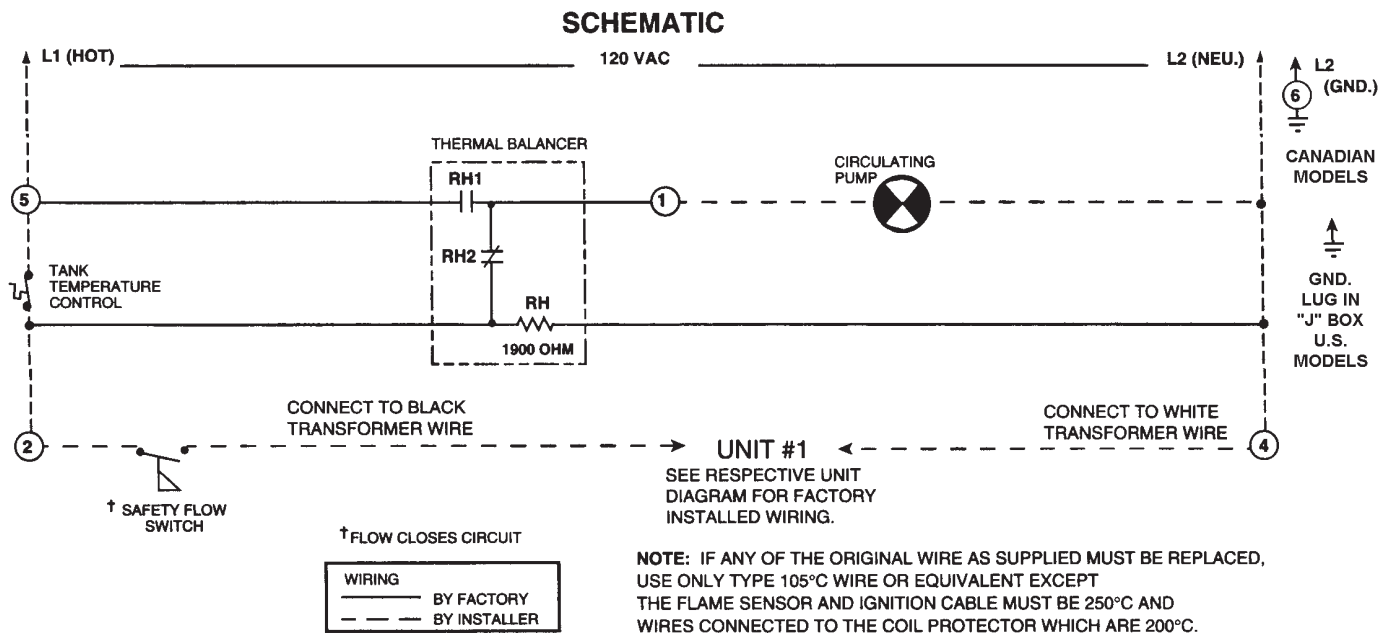


FIGURE 26. SCHEMATIC: CER - TEMP 80 - 1 UNIT INSTALLATION - FOR HOT WATER SUPPLY APPLICATION

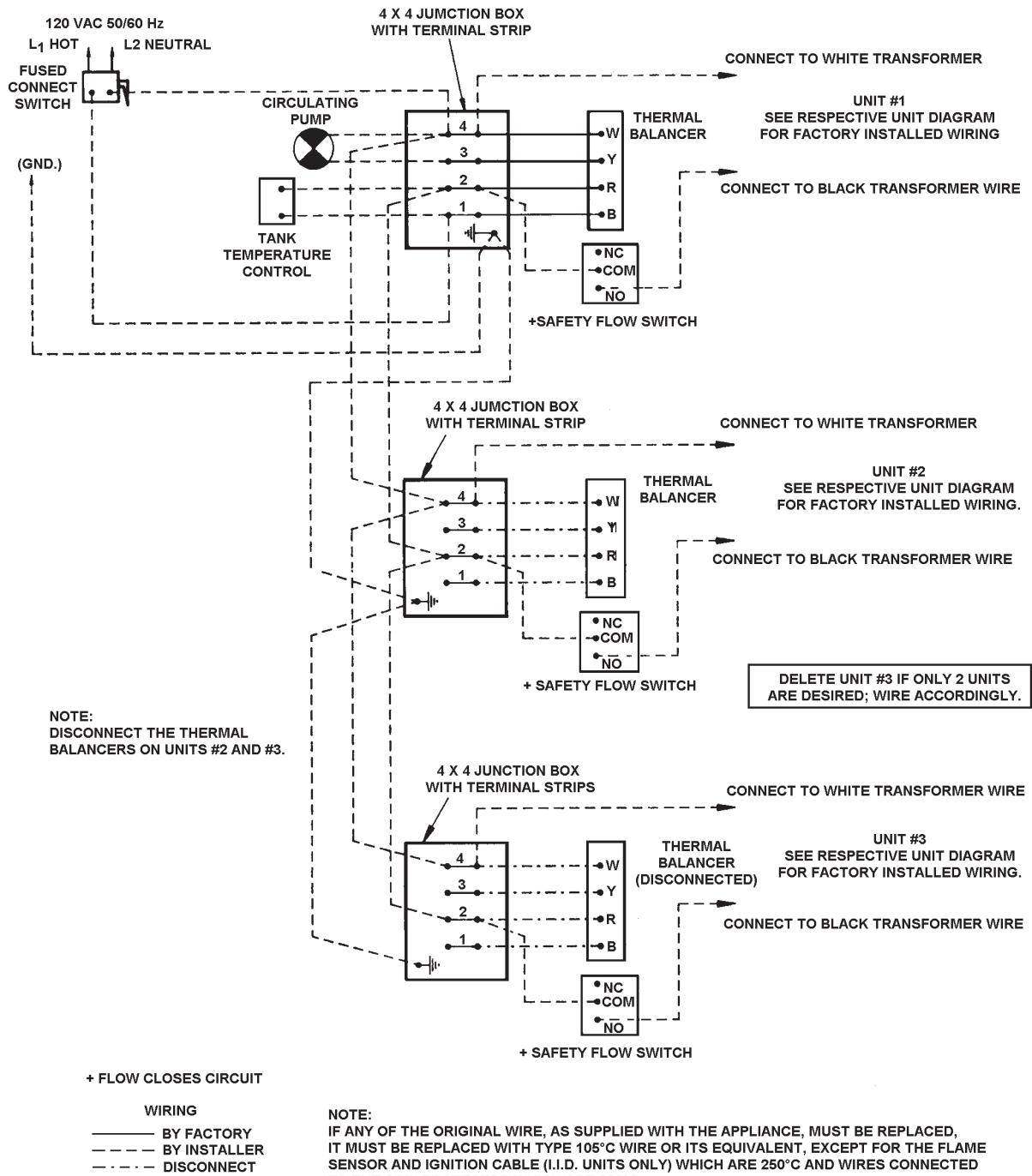


FIGURE 27. CER - TEMP 80 - 2 OR 3 UNIT INSTALLATION CONNECTION DIAGRAM - FOR HOT WATER SUPPLY APPLICATION

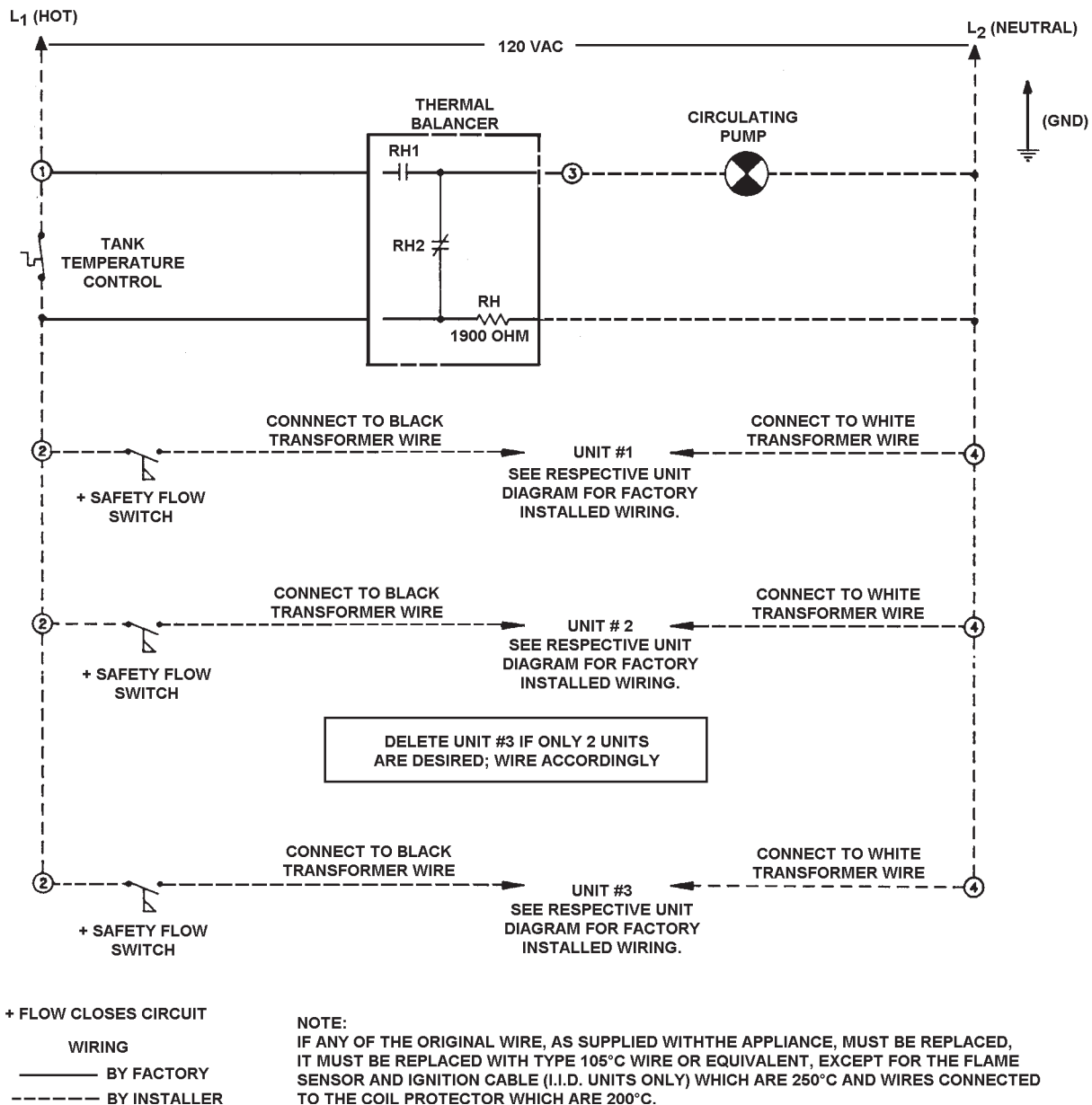
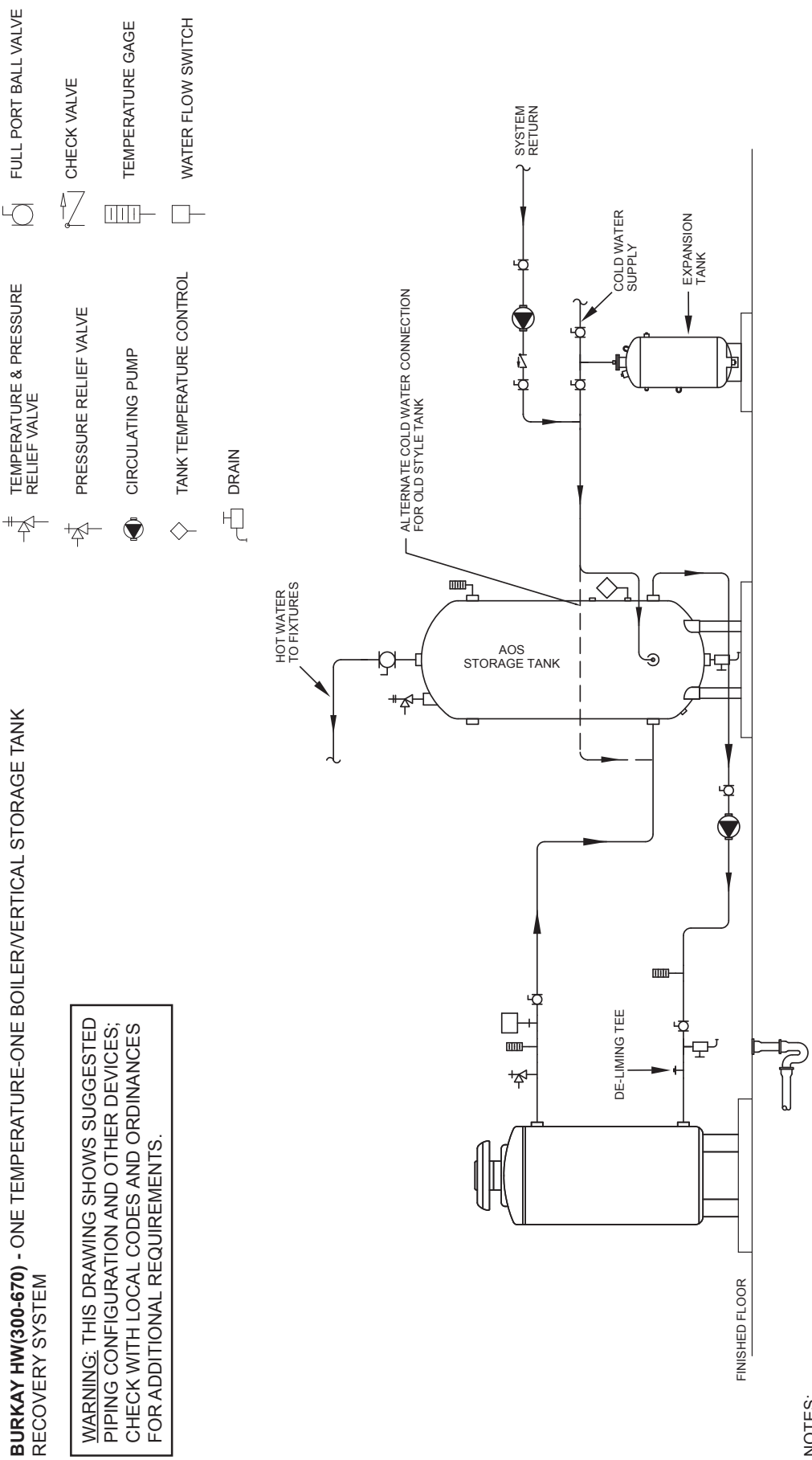


FIGURE 28. CER - TEMP 80 - 2 OR 3 UNIT INSTALLATION SCHEMATIC DIAGRAM - FOR HOT WATER SUPPLY APPLICATION

PIPING DIAGRAMS












- NOTES:
1. Preferred piping diagram.
 2. The temperature and pressure relief valve setting shall not exceed pressure rating of any component in the system.
 3. Service valves are shown for servicing unit. However, local codes shall govern their usage.
 4. A. O. Smith piping method is based on 50 equivalent feet of piping. Boiler placement shall be as close as practical to the storage tank. Applications in excess of these recommendations shall require a licensed engineer for design assistance.

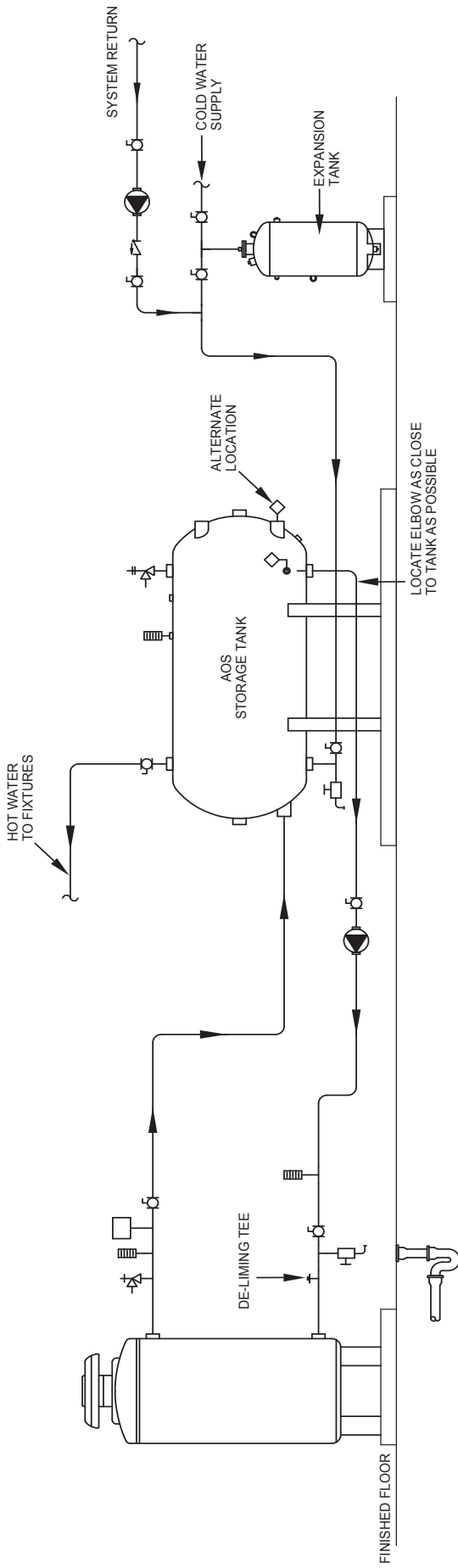
FIGURE 29. ONE TEMPERATURE - ONE BOILER/ VERTICAL STORAGE TANK RECOVERY SYSTEM

BURKAY HW(300-670) - ONE TEMPERATURE-ONE BOILER/HORIZONTAL STORAGE TANK RECOVERY SYSTEM

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

LEGEND

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



- NOTES:
1. Preferred piping diagram.
 2. The temperature and pressure relief valve setting shall not exceed pressure rating of any component in the system.
 3. Service valves are shown for servicing unit. However, local codes shall govern their usage.
 4. A. O. Smith piping method is based on 50 equivalent feet of piping. Boiler placement shall be as close as practical to the storage tank. Applications in excess of these recommendations shall require a licensed engineer for design assistance.

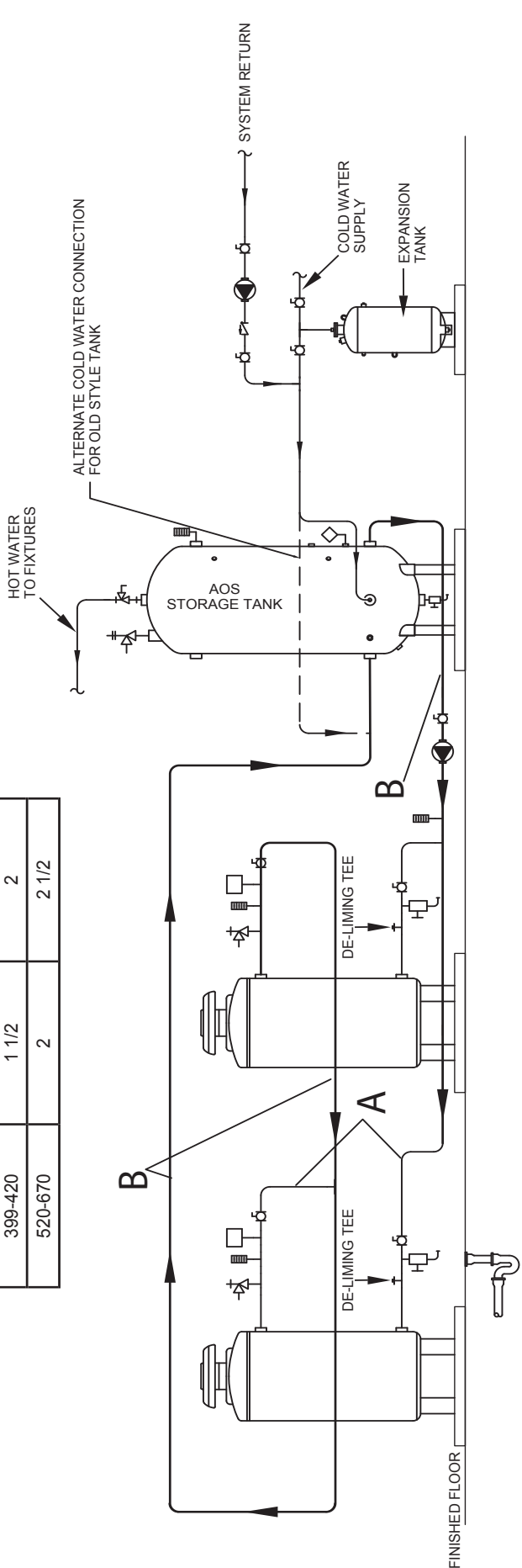
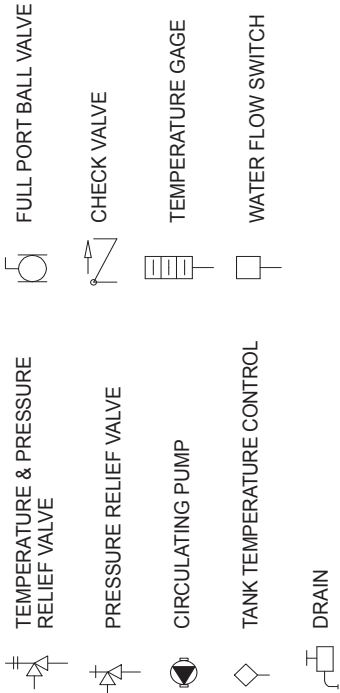
FIGURE 30. ONE TEMPERATURE - ONE BOILER/ HORIZONTAL STORAGE TANK RECOVERY SYSTEM

BURKAY HW(300-670) - ONE TEMPERATURE-TWO BOILER/VERTICAL STORAGE TANK RECOVERY SYSTEM

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

BOILER MODEL (HW)	BOILER PIPING SIZE "A" (INCH)	MANIFOLD PIPING SIZE "B" (INCH)
300	1 1/4	2
399-420	1 1/2	2
520-670	2	2 1/2

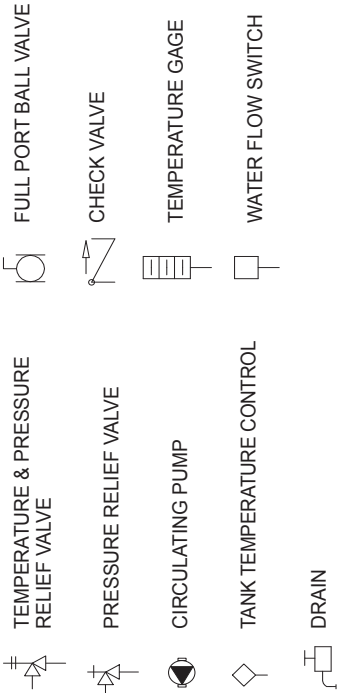
LEGEND



- NOTES:
1. Preferred piping diagram.
 2. The temperature and pressure relief valve setting shall not exceed pressure rating of any component in the system.
 3. Service valves are shown for servicing unit. However, local codes shall govern their usage.
 4. A. O. Smith piping method is based on 50 equivalent feet of piping. Boiler placement shall be as close as practical to the storage tank. Applications in excess of these recommendations shall require a licensed engineer for design assistance.

FIGURE 31. ONE TEMPERATURE - TWO BOILERS/ VERTICAL STORAGE TANK RECOVERY SYSTEM

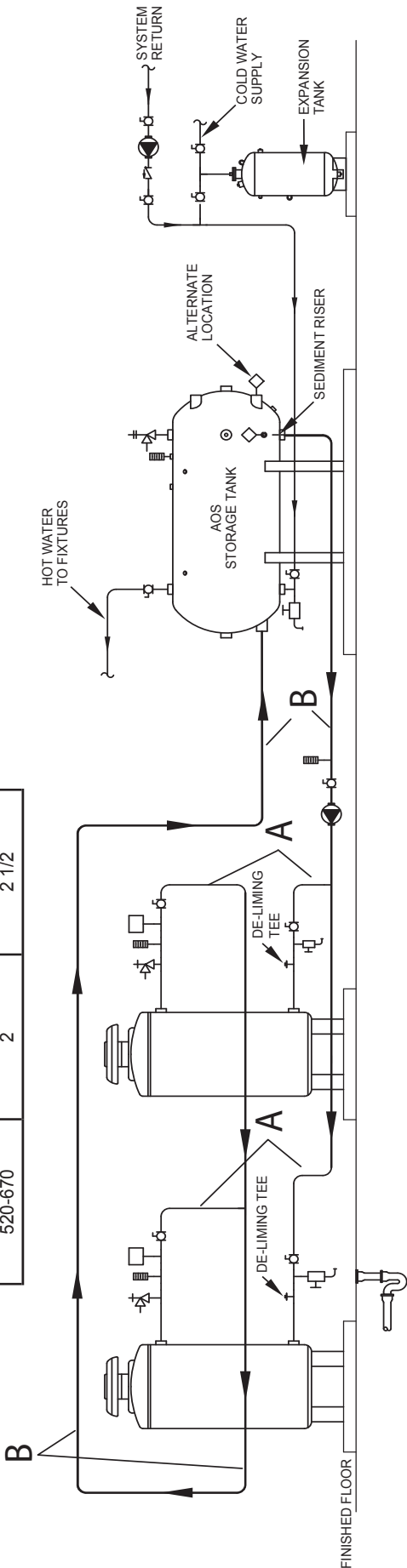
LEGEND



BURKAY HW(300-670) - ONE TEMPERATURE-TWO BOILER/HORIZONTAL STORAGE TANK RECOVERY SYSTEM

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

BOILER MODEL (HW)	BOILER PIPING SIZE "A" (INCH)	MANIFOLD PIPING SIZE "B" (INCH)
300	1 1/4	2
399-420	1 1/2	2
520-670	2	2 1/2



- NOTES:
1. Preferred piping diagram.
 2. The temperature and pressure relief valve setting shall not exceed pressure rating of any component in the system.
 3. Service valves are shown for servicing unit. However, local codes shall govern their usage.
 4. A. O. Smith piping method is based on 50 equivalent feet of piping. Boiler placement shall be as close as practical to the storage tank. Applications in excess of these recommendations shall require a licensed engineer for design assistance.


FIGURE 32. ONE TEMPERATURE - TWO BOILERS/ HORIZONTAL STORAGE TANK RECOVERY SYSTEM

BURKAY HW(300-670) - ONE TEMPERATURE-THREE BOILER/VERTICAL STORAGE TANK RECOVERY SYSTEM


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

BOILER MODEL (HW)	BOILER PIPING SIZE "A" (INCH)	MANIFOLD PIPING SIZE "B" (INCH)
300	1 1/4	2
399-420	1 1/2	2 1/2
520-670	2	3


LEGEND




TEMPERATURE & PRESSURE RELIEF VALVE




PRESSURE RELIEF VALVE




CIRCULATING PUMP




TANK TEMPERATURE CONTROL




DRAIN




FULL PORT BALL VALVE



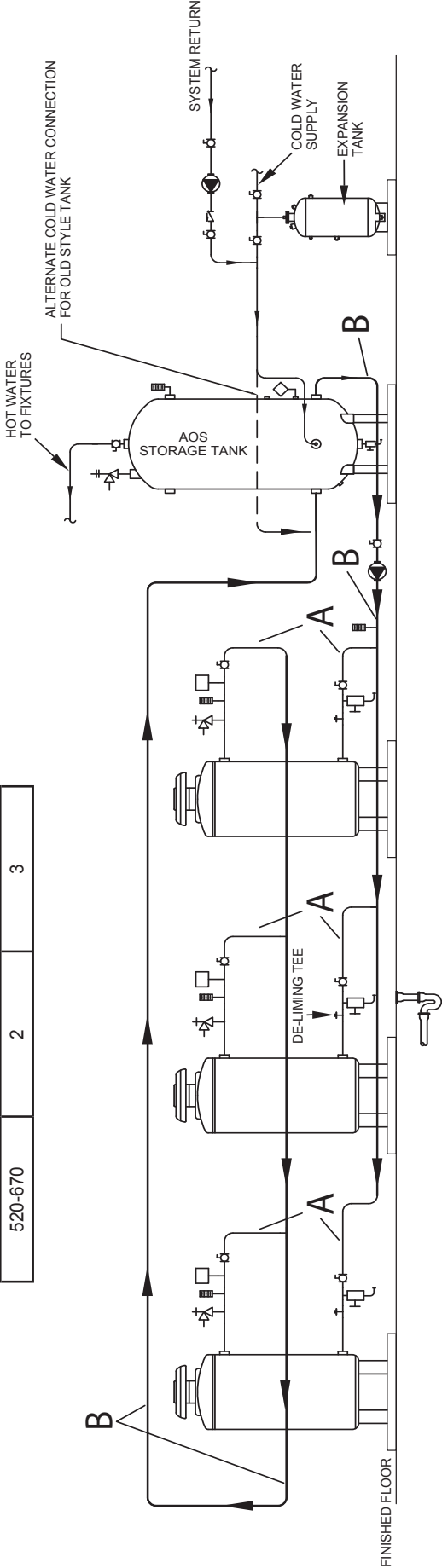
CHECK VALVE



TEMPERATURE GAGE



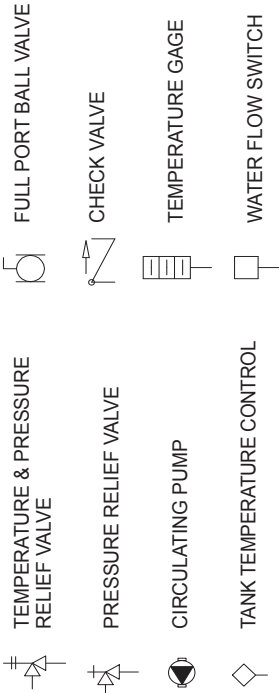
WATER FLOW SWITCH



- NOTES:
1. Preferred piping diagram.
 2. The temperature and pressure relief valve setting shall not exceed pressure rating of any component in the system.
 3. Service valves are shown for servicing unit. However, local codes shall govern their usage.
 4. A. O. Smith piping method is based on 50 equivalent feet of piping. Boiler placement shall be as close as practical to the storage tank. Applications in excess of these recommendations shall require a licensed engineer for design assistance.

FIGURE 33. ONE TEMPERATURE - THREE BOILERS/ VERTICAL STORAGE TANK RECOVERY SYSTEM

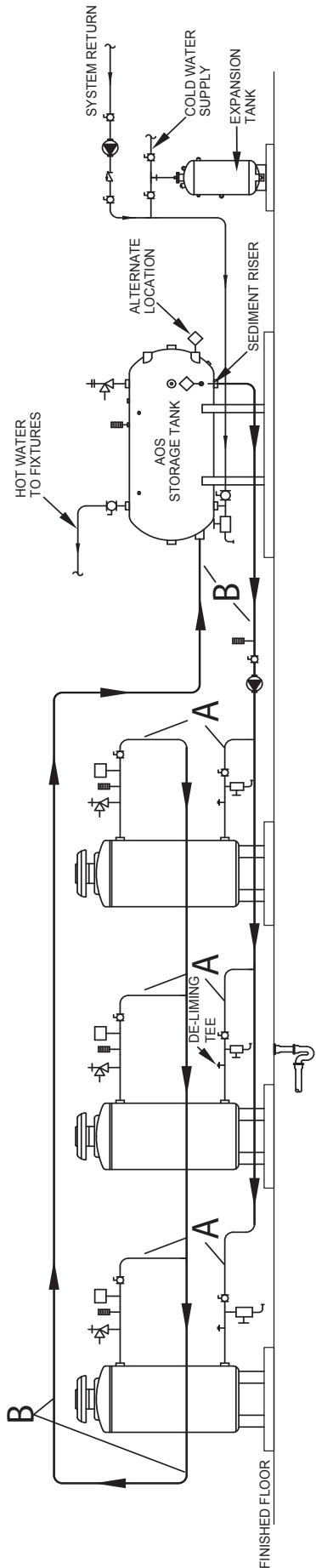
LEGEND



BURKAY HW(300-670) - ONE TEMPERATURE-THREE BOILER/HORIZONTAL STORAGE TANK RECOVERY SYSTEM

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

BOILER MODEL (HW)	BOILER PIPING SIZE "A" (INCH)	MANIFOLD PIPING SIZE "B" (INCH)
300	1 1/4	2
399-420	1 1/2	2 1/2
520-670	2	3



NOTES:

1. Preferred piping diagram.
2. The temperature and pressure relief valve setting shall not exceed pressure rating of any component in the system.
3. Service valves are shown for servicing unit. However, local codes shall govern their usage.
4. A. O. Smith piping method is based on 50 equivalent feet of piping. Boiler placement shall be as close as practical to the storage tank. Applications in excess of these recommendations shall require a licensed engineer for design assistance.

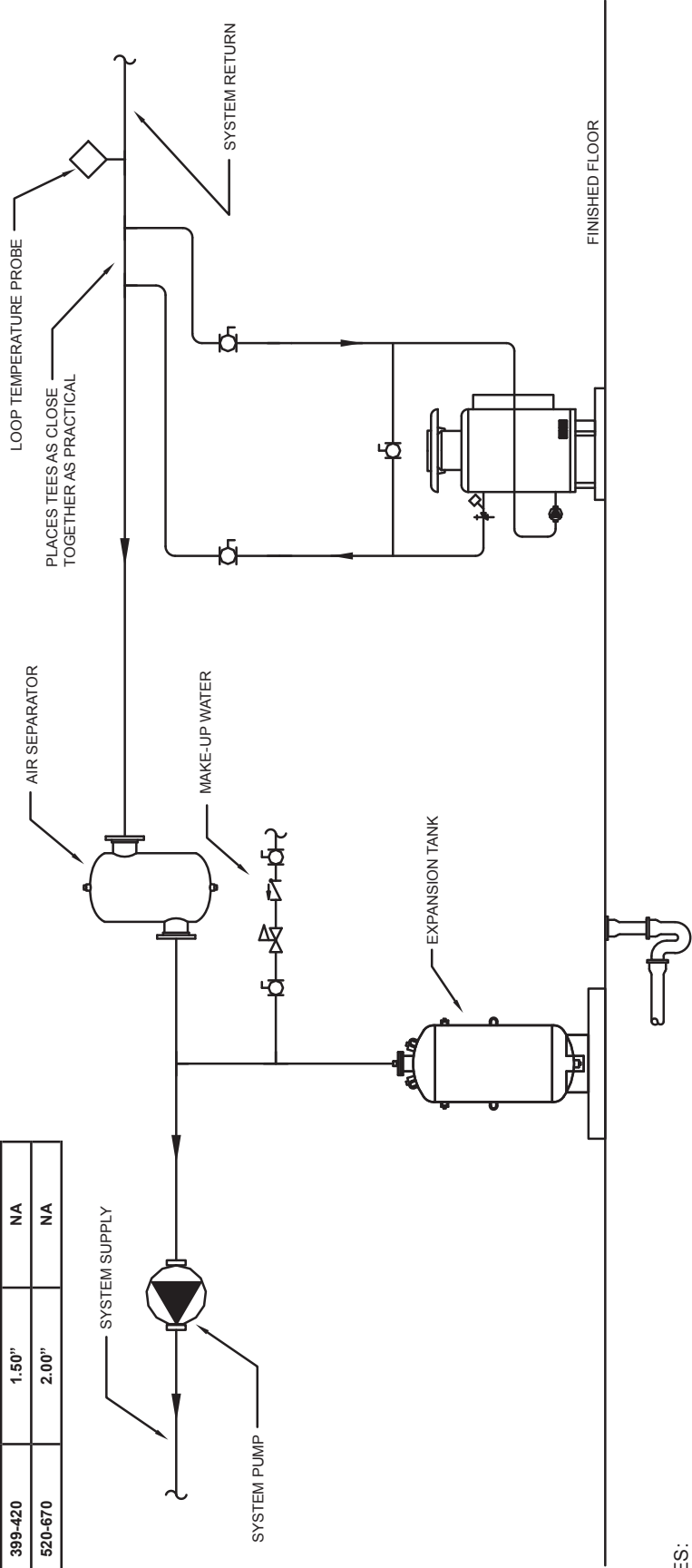
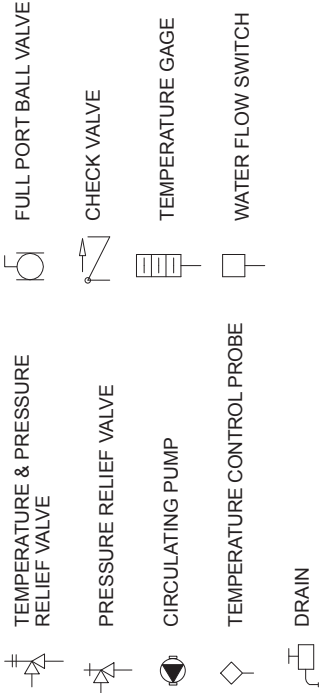
FIGURE 34. ONE TEMPERATURE - THREE BOILERS/ HORIZONTAL STORAGE TANK RECOVERY SYSTEM

HW BURKAY BOILER (300-670) - ONE BOILER PRIMARY/SECONDARY HYDRONIC PIPING SYSTEM

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

HW BOILER	BOILER PIPING SIZE "A" (INCH)	MANIFOLD PIPING SIZE "B" (INCH)
300	1.25"	NA
399-420	1.50"	NA
520-670	2.00"	NA

LEGEND



NOTES:

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










FIGURE 35. ONE BOILER PRIMARY/ SECONDARY HYDRONIC PIPING SYSTEM

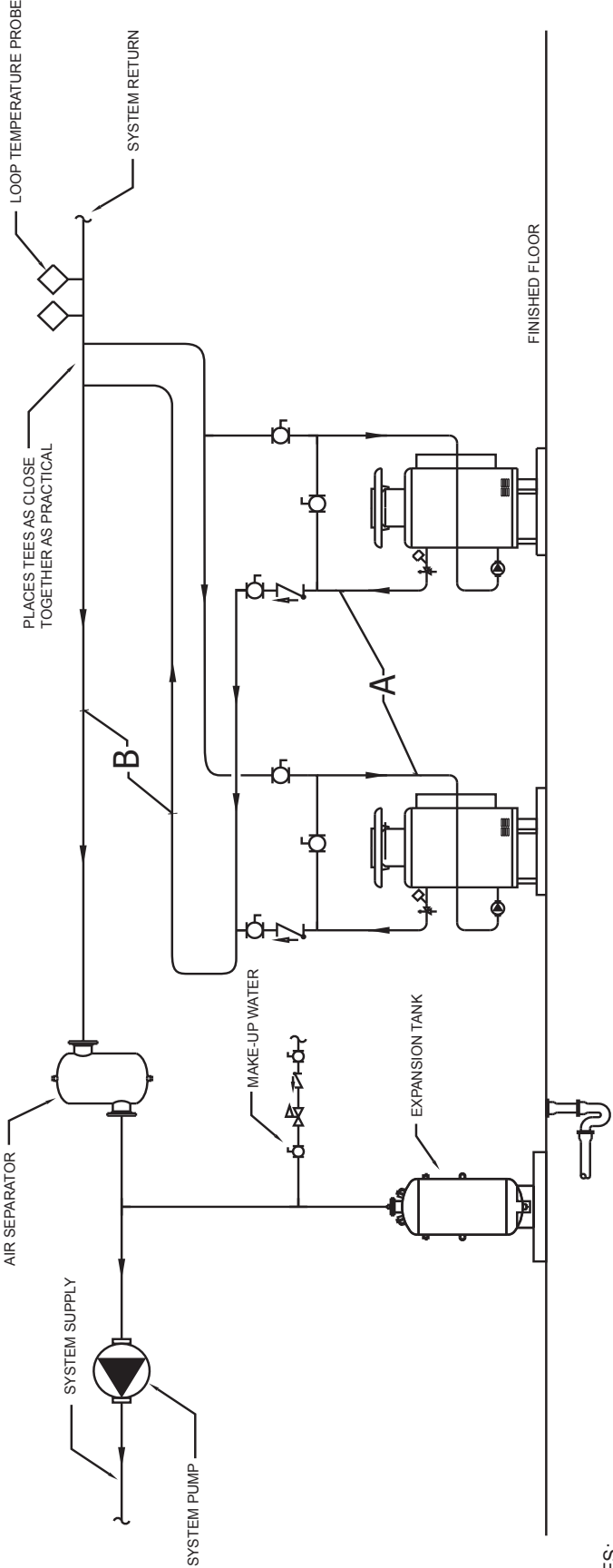
HW BURKAY BOILERS (300-670) - TWO BOILERS PRIMARY/SECONDARY
HYDRONIC PIPING SYSTEM

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

HW BOILER	BOILER PIPING SIZE "A" (INCH)	MANIFOLD PIPING SIZE "B" (INCH)
300	1.25"	2.00"
399-420	1.50"	2.00"
520-670	2.00"	2.50"

LEGEND

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



NOTES:

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

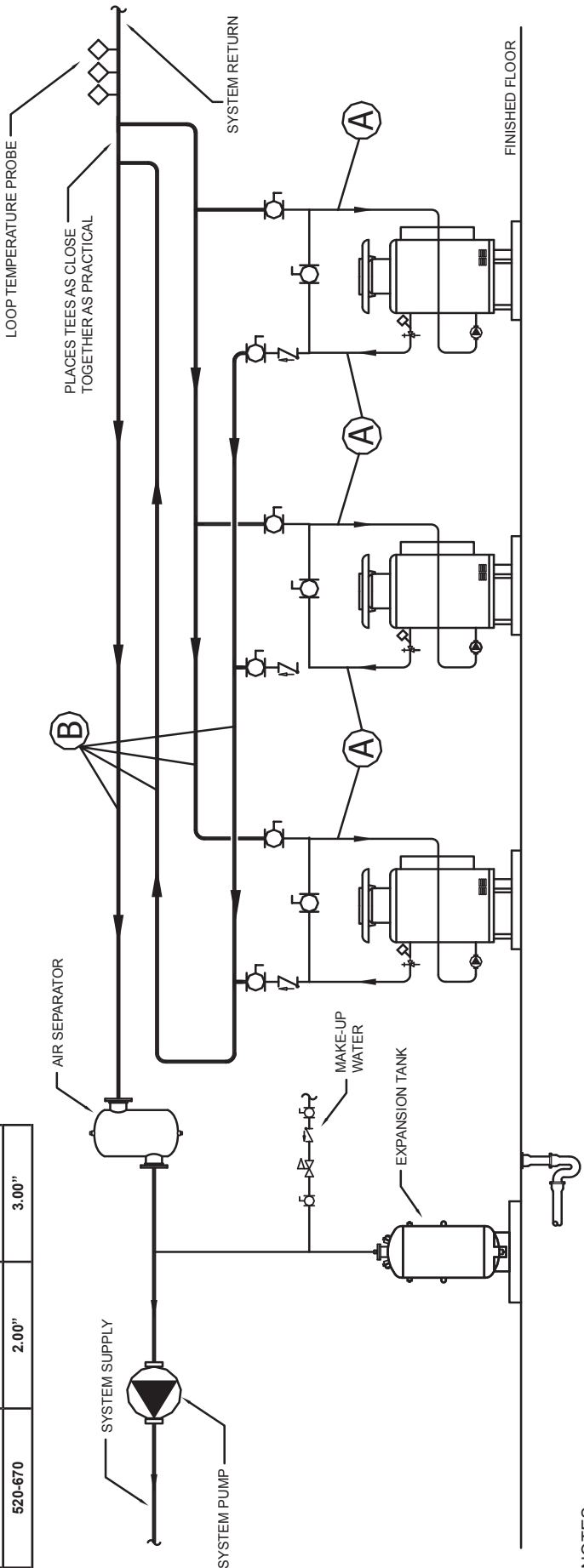
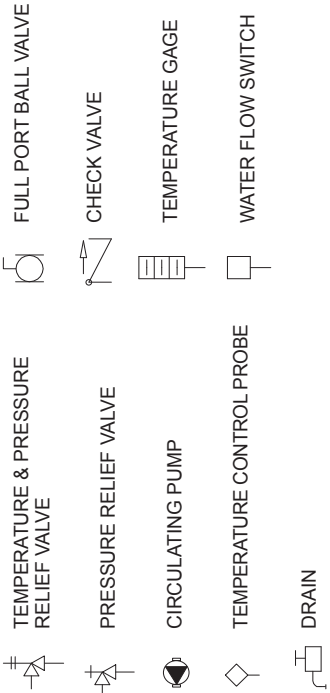
FIGURE 36. TWO BOILERS PRIMARY/ SECONDARY HYDRONIC PIPING SYSTEM

HW BURKAY BOILER (300-670) - THREE BOILERS PRIMARY/SECONDARY HYDRONIC PIPING SYSTEM

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

HW BOILER	BOILER PIPING SIZE "A" (INCH)	MANIFOLD PIPING SIZE "B" (INCH)
300	1.25"	2.50"
399-420	1.50"	2.50"
520-670	2.00"	3.00"

LEGEND



NOTES:

1. Preferred piping layout.
2. The temperature and pressure relief valve setting shall not exceed pressure rating of any component in the system.
3. Service valves are shown for servicing boiler. However, local codes shall govern their usage.
4. A. O. Smith piping method is based on 50 equivalent feet of piping. Boiler placement shall be as close as practical to the heating loop. Applications in excess of these recommendations shall require a licensed engineer for design assistance.

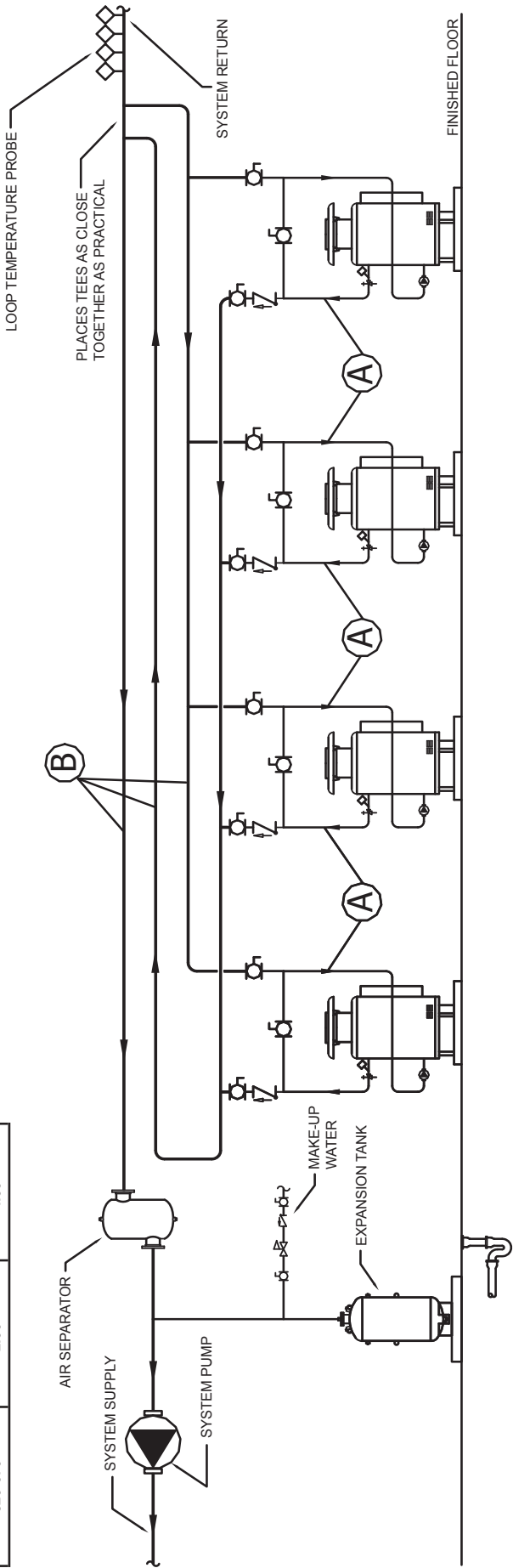
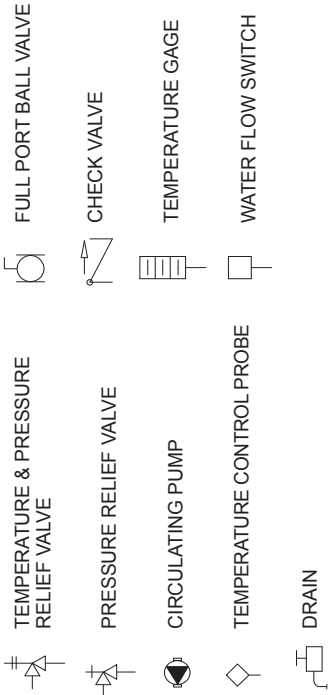
FIGURE 37. THREE BOILERS PRIMARY/ SECONDARY HYDRONIC PIPING SYSTEM

**HW BURKAY BOILER (300-670) - FOUR BOILERS PRIMARY/SECONDARY
HYDRONIC PIPING SYSTEM**

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

HW BOILER	BOILER PIPING SIZE "A" (INCH)	MANIFOLD PIPING SIZE "B" (INCH)
300	1.25"	2.50"
399-420	1.50"	3.00"
520-670	2.00"	4.00"

LEGEND



NOTES:










1. Preferred piping layout.
2. The temperature and pressure relief valve setting shall not exceed pressure rating of any component in the system.
3. Service valves are shown for servicing boiler. However, local codes shall govern their usage.
4. A. O. Smith piping method is based on 50 equivalent feet of piping. Boiler placement shall be as close as practical to the heating loop. Applications in excess of these recommendations shall require a licensed engineer for design assistance.

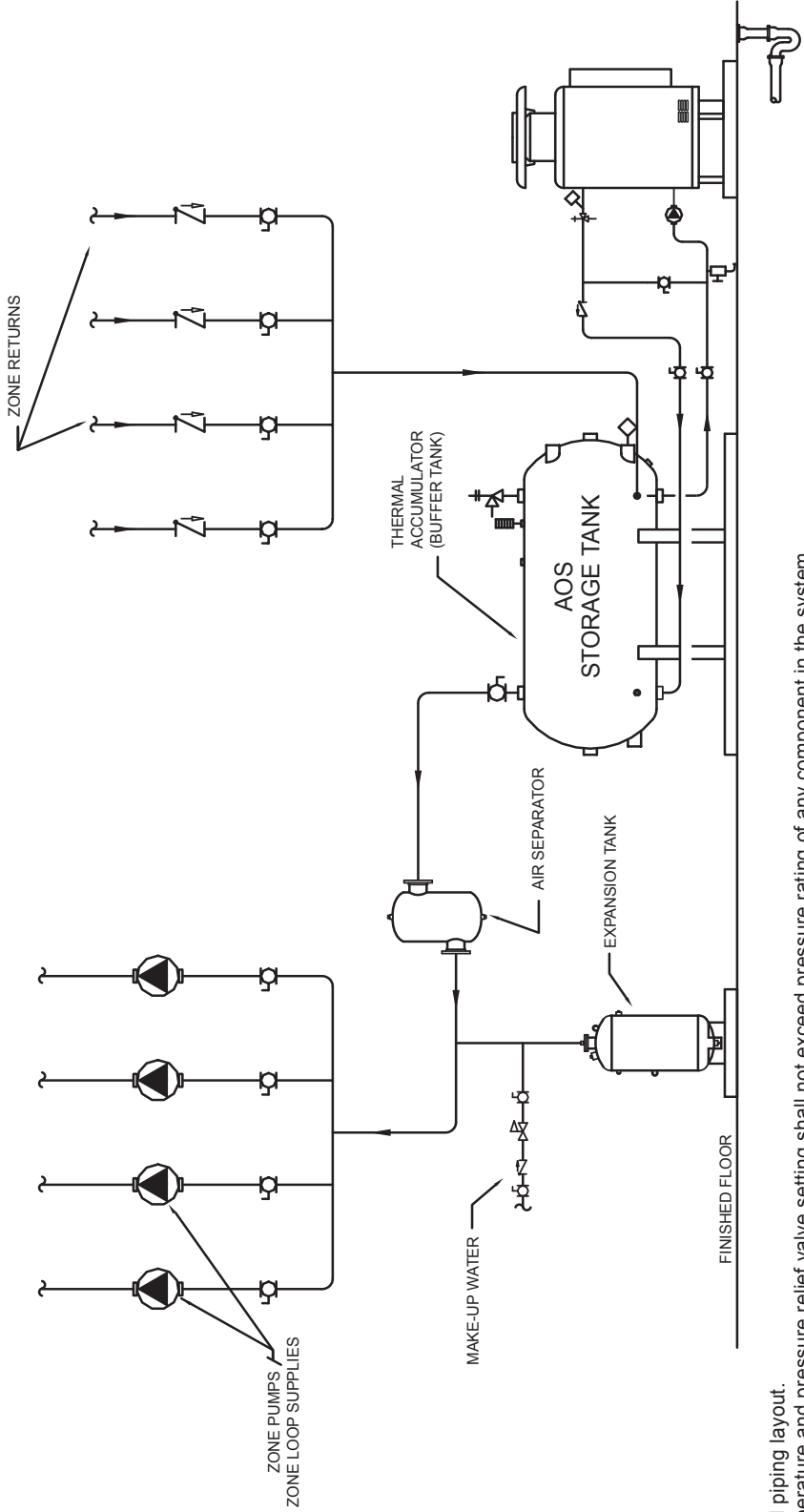
FIGURE 38. FOUR BOILERS PRIMARY/ SECONDARY HYDRONIC PIPING SYSTEM

HW BURKAY BOILER (300-670) - ZONE PUMPING/HORIZONTAL BUFFER TANK HEATING SYSTEM

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

LEGEND

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











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

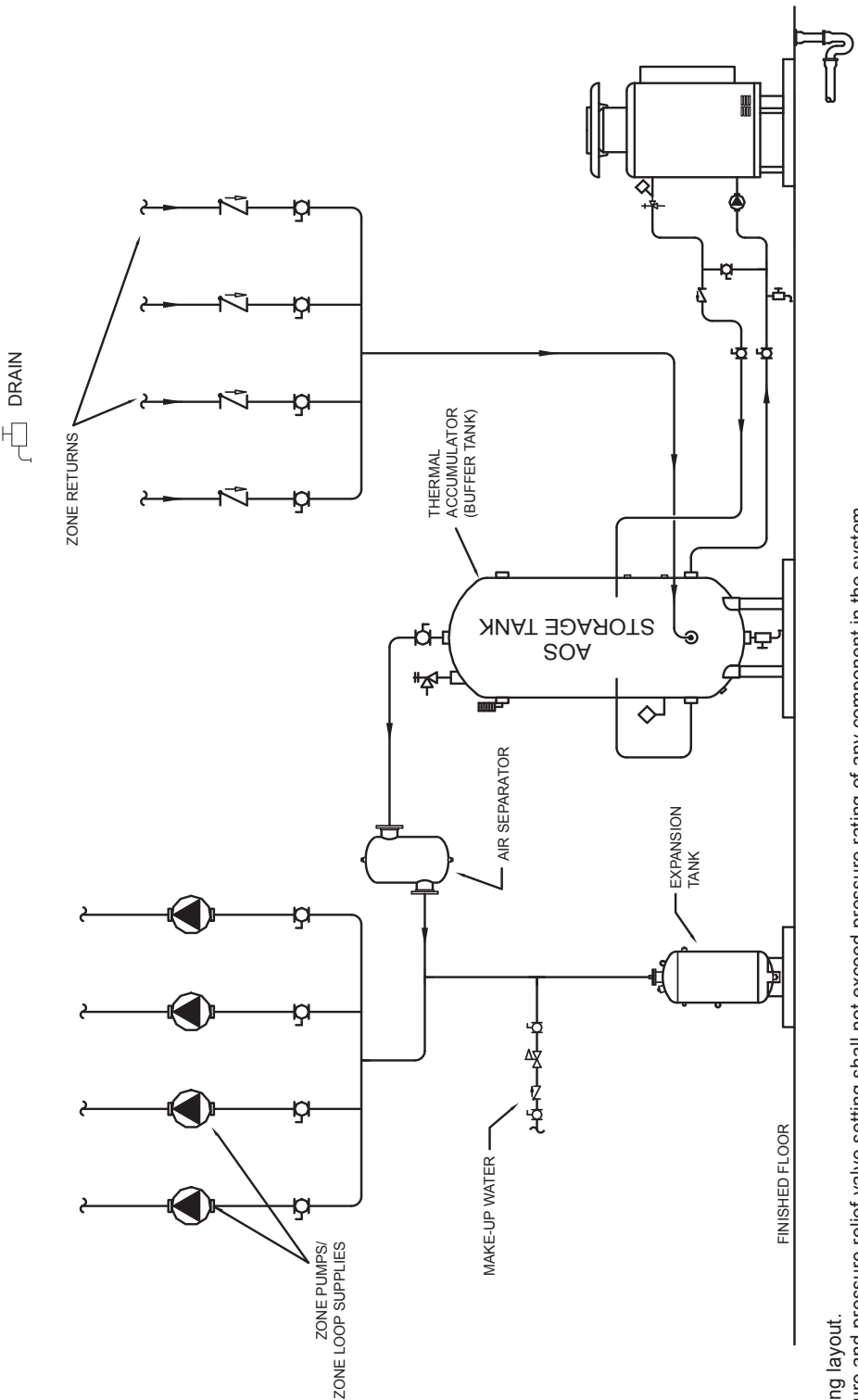
FIGURE 39. ZONE PUMPING/ HORIZONTAL BUFFER TANK HEATING SYSTEM

HW BURKAY BOILER (300-670) - ZONE PUMPING/VERTICAL BUFFER TANK HEATING SYSTEM

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

LEGEND

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



NOTES:










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

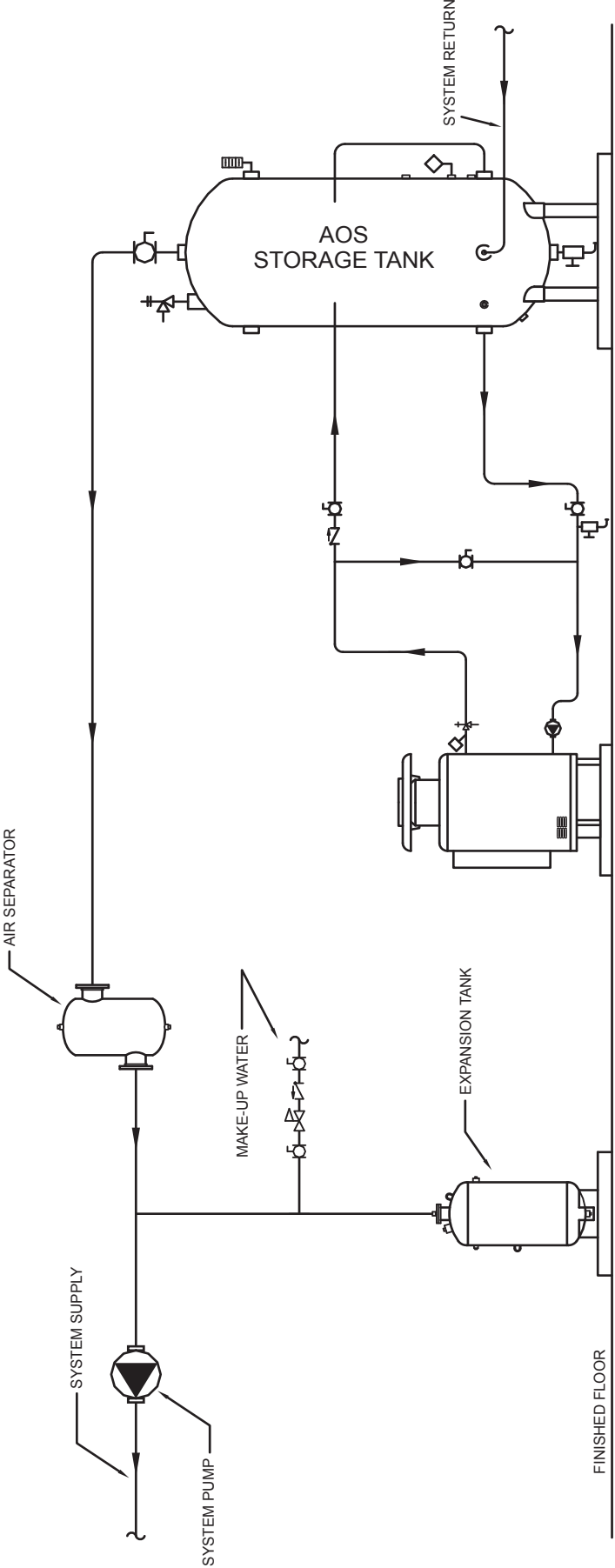
FIGURE 40. ZONE PUMPING/ VERTICAL BUFFER TANK HEATING SYSTEM

HW BURKAY BOILER (300-670) - BOILER/VERTICAL BUFFER TANK HEATING SYSTEM

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

LEGEND

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



NOTES:









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

FIGURE 41. BOILER/ VERTICAL BUFFER TANK HEATING SYSTEM

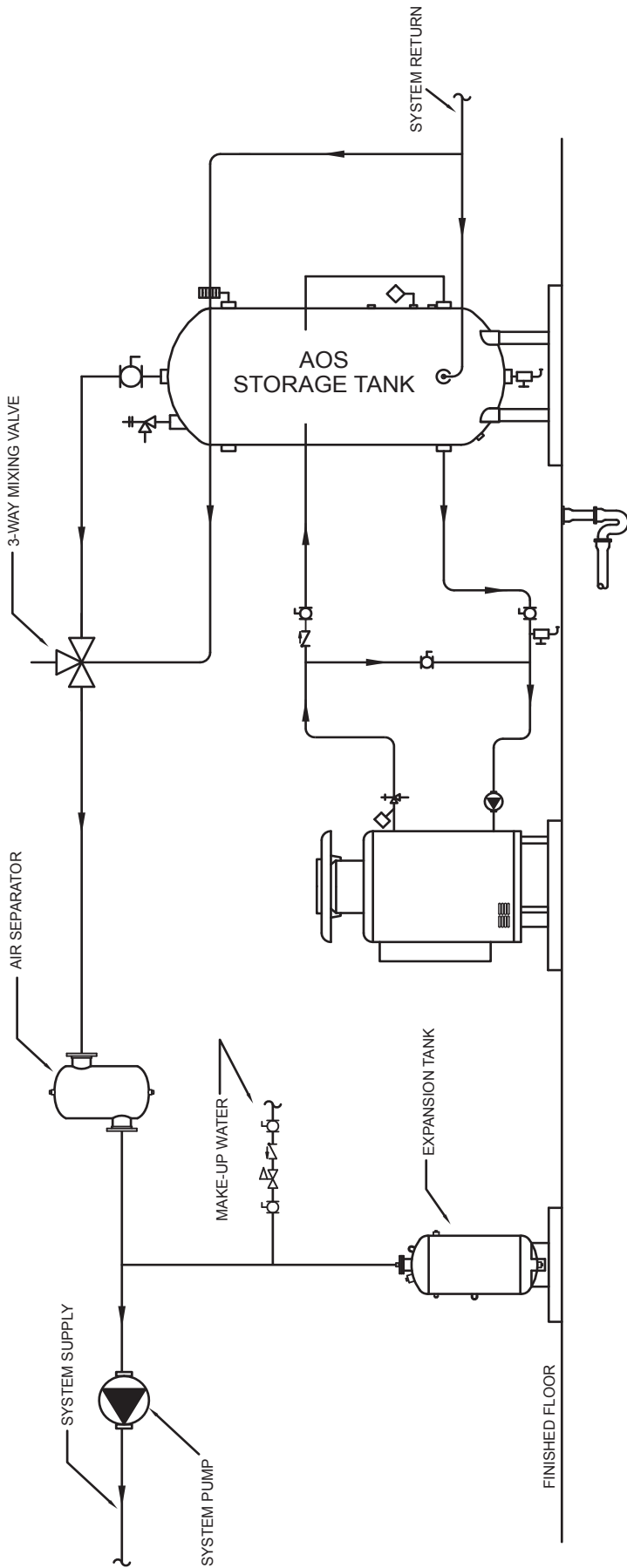
HW BURKAY BOILER (300-670) - BOILER/VERTICAL BUFFER TANK, 3-WAY MIXING VALVE HEATING SYSTEM

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

LEGEND

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

 DRAIN



NOTES:

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

FIGURE 42. BOILER/ VERTICAL BUFFER TANK, 3 WAY MIXING VALVE HEATING SYSTEM

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 or gas burner should 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 should 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, a pressure relief valve, certified by C.S.A. and approved by the American Society of Mechanical Engineers, must have been installed and fresh water used for filling and make-up purposes.

a. This warranty should apply only when the boiler is used:

- (1) with outlet water temperatures not exceeding the maximum setting of its operative and/or high limit control;
- (2) at water pressure not exceeding the working pressure shown on the boiler;
- (3) when filled with boiler water, free to circulate at all times and with the heat exchanger free of damaging scale deposits;
- (4) in a non-corrosive and non-contaminated atmosphere;
- (5) in the United States, its territories or possessions, and Canada;
- (6) at a water velocity flow rate not exceeding or below the boiler's designed rates;
- (7) 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 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 material and/or permits required for installation of the replacement.

4. LIMITATIONS ON IMPLIED WARRANTIES

Implied warranties, including any warranty of merchantability imposed on the sale of this boiler under state or provincial law are limited to one (1) year duration for the boiler or any of its parts. Some states and provinces 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

A. O. Smith Corporation
500 Tennessee Waltz Parkway
Ashland City, TN 37015
Telephone: 800-527-1953

Canadian Customers

A. O. Smith Enterprises Ltd.
599 Hill Street West
Fergus, ON N1M 2X1
Telephone: 1-888-479-2837

- 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 ON BEHALF OF THE WARRANTOR WITH RESPECT TO THE MERCHANTABILITY OF THE BOILER OR THE INSTALLATION, OPERATION, REPAIR OR REPLACEMENT OF THE BOILER. THE WARRANTOR SHOULD 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 SHOULD 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 and 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 or province to province.

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 _____ Zip Code _____

Date Installed _____ Model No. _____ Serial No. _____

Dealer's Name _____ Phone No. _____

Dealer's Address _____

FILL IN WARRANTY AND KEEP FOR FUTURE REFERENCE



25589 Highway 1, McBee, SC 29101
Technical Support: 800-527-1953 • Parts: 800-433-2545 • Fax: 800-644-9306
www.hotwater.com