



**D E S I G N E D   T O   L E A D**

# AWR Series

**Gas-Fired Natural Draft Hot Water Boilers**

## INSTALLATION INSTRUCTIONS

These instructions must be affixed on or adjacent to the boiler

### Models:

- AWR038
- AWR070
- AWR105
- AWR140
- AWR175
- AWR210
- AWR245
- AWR280

**WARNING:** Improper installation, adjustment, alteration, service or maintenance can cause property damage, injury, or loss of life. For assistance or additional information, consult a qualified installer, service agency or the gas supplier. Read these instructions carefully before installing.

**Equipped with Honeywell  
S9361A Control System**



**Intertek**  
9902339



Manufacturer of Hydronic Heating Products  
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## WARNINGS FOR THE HOMEOWNER

FOLLOW ALL INSTRUCTIONS and warnings printed in this manual and posted on the boiler.

INSPECT THE BOILER ANNUALLY. To keep your boiler safe and efficient, have a service technician follow the Service checklist near the end of this manual.

IF YOU ARE NOT QUALIFIED to install or service boilers, do not install or service this one.

THE BOILER MAY LEAK WATER at the end of its useful life. Be sure to protect walls, carpets, and valuables from water that could leak from the boiler.

PROTECT YOUR HOME IN FREEZING WEATHER. A power outage, safety lockout, or component failure will prevent your boiler from lighting. In winter, your pipes may freeze and cause extensive property damage. Do not leave the heating system unattended during cold weather

unless alarms or other safeguards are in place to prevent such damage

DO NOT BLOCK AIR FLOW into or around the boiler. Insufficient air may cause the boiler to produce carbon monoxide or start a fire.

KEEP FLAMMABLE LIQUIDS AWAY from the boiler, including paint, solvents, and gasoline. The boiler may ignite the vapors from the liquids causing explosion or fire.

KEEP CHILDREN AND PETS away from hot surfaces of the boiler, boiler piping, and vent pipe.

CARBON MONOXIDE (CO) is an odorless, deadly gas that may be introduced into your home by any malfunctioning fuel-burning product or vent system failure. Consider installing CO alarms near bedrooms in all levels of the building to warn you and your family of potential CO exposure.



## WARNINGS FOR THE INSTALLER

READ THIS ENTIRE MANUAL before attempting installation, start-up, or service. Improper installation, adjustment, alteration, service, or maintenance may cause serious property damage, personal injury, or death.

DO NOT DISCONNECT PIPE FITTINGS on the boiler or in the heating system without first verifying that the system is cool and free of pressure and that your clothing will protect you from a release of hot water or steam. Do not rely solely on the boiler's temperature and pressure gage when making this judgment.

USE PROPER PERSONAL PROTECTION EQUIPMENT when servicing or working near the boiler. Materials of construction, flue products, and fuel contain alumina, silica, heavy metals, carbon monoxide, nitrogen oxides, and/or other toxic or harmful substances that can be hazardous to health and life and that are known to the State of California to cause cancer, birth defects, and other reproductive harm.

INSTALL ALL GUARDS, cover plates, and enclosures before operating the boiler.

SIZE THE BOILER PROPERLY relative to the design heat load or, if using domestic hot water priority, the peak hot water load, whichever is larger. A grossly oversized boiler will cycle excessively and this will lead to premature failure of the boiler and its components. Our warranty does not apply to damage from excessive cycling.

ADHERE TO ALL LOCAL CODE REQUIREMENTS. Contact your local code inspector prior to installation. In the absence of a local code, adhere to the *National Fuel Gas Code ANSI Z223.1/NFPA 54* or *CAN/CSA B149.1, Natural Gas and Propane Installation Code*.

ALL WIRING must comply with the *National Electrical Code ANSI/NFPA 70* (in the USA) or the *Canadian Electrical Code CSA C22.1* (in Canada) and any local regulations.

## Table of Contents

I.	Product Description .....	3
II.	Specifications .....	3
III.	Before Installing .....	4
IV.	Locating the Boiler .....	4
V.	Air for Combustion & Ventilation .....	6
VI.	Venting .....	10
VII.	Gas Piping .....	13
VIII.	System Piping .....	14
IX.	Wiring .....	19
X.	Start-Up & Checkout .....	24
XI.	Operation .....	28
XII.	Service & Maintenance .....	36
XIII.	Troubleshooting .....	38
XIV.	Parts .....	42

## I Product Description

The AWR series boiler is a cast iron gas fired water boiler designed for use in closed forced circulation heating systems. This boiler is a Category I drafthood equipped appliance, which must be vented by natural draft using a lined masonry or listed metal chimney system. An adequate supply of air for combustion, ventilation and dilution of flue gases must be available in the boiler room.

## II Specifications

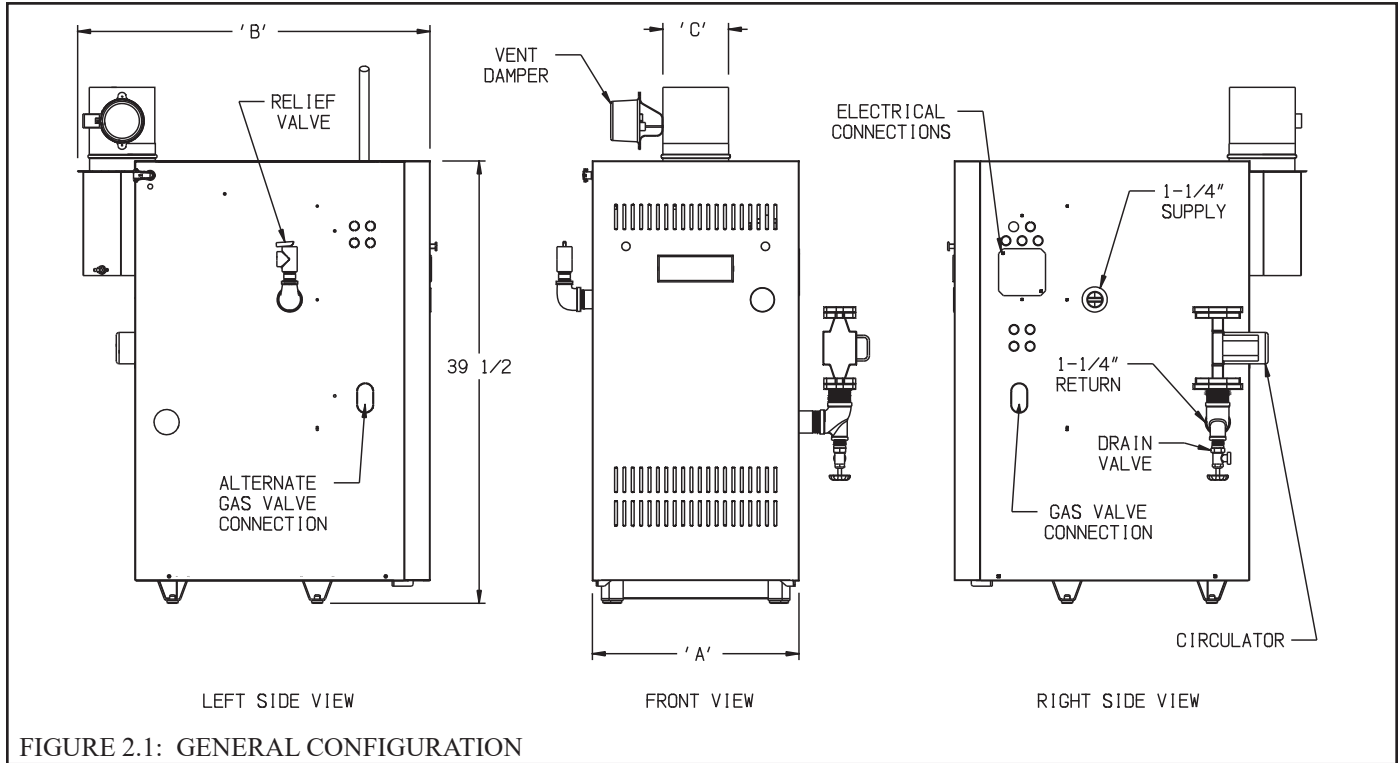


TABLE 2.2: SPECIFICATIONS

BASIC BOILER MODEL	RATINGS - NATURAL AND LP GASES					DIMENSIONS (INCHES)		
	NUMBER OF SECTIONS	INPUT	HEATING CAPACITY	NET AHRI RATING, WATER	AFUE	'A'	'B'	'C'
		MBH	MBH	MBH	%			
AWR038E	2	38	32	28	83.0	9-3/4	31-1/2	4
AWR070E	3	70	58	50	83.5	12-7/8	31-1/2	4
AWR105E	4	105	87	76	83.7	15-3/8	31-1/2	5
AWR140E	5	140	117	102	83.6	18-1/2	31-1/2	6
AWR175E	6	175	146	127	83.5	21-1/2	31-3/4	7
AWR210E	7	210	175	152	83.4	24-5/8	33-1/2	7
AWR245E	8	245	205	178	83.4	27-5/8	33-1/2	8
AWR280E	9	280	234	203	83.3	30-3/4	33-1/2	8

Notes:

The Net AHRI Water Ratings shown are based on a piping and pickup allowance of 1.15.

The manufacturer should be consulted before selecting a boiler for installations having unusual piping and pickup requirements, such as intermittent system operation, extensive piping systems, etc.

Add Suffix N for Natural Gas or Suffix L for Propane Gas to basic AWR Boiler Model shown (Example: AWR210EN, AWR210EL)

### III Before Installing

- 1) Safe, reliable operation of this boiler depends upon installation by a professional heating contractor in strict accordance with this manual and the requirements of the authority having jurisdiction.
  - In the absence of an authority having jurisdiction, installation must be in accordance with this manual and the *National Fuel Gas Code*, ANSI Z223.1-latest edition.
  - Where required by the authority having jurisdiction, this installation must conform to the *Standard for Controls and Safety Devices for Automatically Fired Boilers* (ANSI/ASME CSD-1)-latest edition.
- 2) Make sure that a properly sized chimney is available which is in good condition. Consult the authority having jurisdiction, Part VI of this manual, and the *National Fuel Gas Code* for additional information on venting requirements.
- 3) Make sure that the boiler is correctly sized:
  - For heating systems employing convection radiation (baseboard or radiators) use an industry accepted sizing method such as the *I=B=R* Guide RHH published by the Air-Conditioning, Heating and Refrigeration Institute (AHRI).
  - For new radiant heating systems refer to the radiant tubing manufacturer's boiler sizing guidelines.
  - For systems including a Crown Mega-Stor indirect water heater, size the boiler to have either the Heating Capacity required for the Mega-Stor or the *I=B=R* Net Rating required for the heating system, whichever results in the larger boiler.
  - For systems that incorporate other indirect water heaters, refer to the indirect water heater manufacturer's instructions for boiler output requirements.
- 4) Make sure that the boiler received is configured for the correct gas (natural or LP).
- 5) Boilers built for installations at altitudes above 2000 ft. require different main burner orifice. Make sure that the boiler is configured for use at the correct altitude.

### IV Locating the Boiler

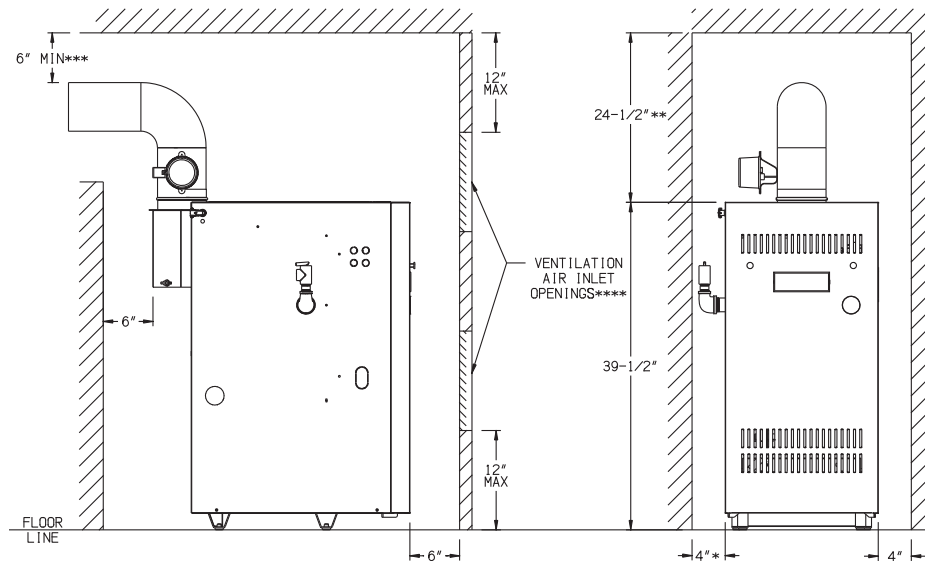


#### WARNING

FAILURE TO OBSERVE THE FOLLOWING LOCATION REQUIREMENTS COULD RESULT IN A FIRE, EXPLOSION OR CARBON MONOXIDE (CO) HAZARD.

#### 1) Clearances:

- Observe minimum clearances shown below to avoid potential fire hazard. These clearances apply to all combustible construction as well as noncombustible walls, ceilings and doors. Also see Figures 4.1 and 4.2.
  - Front (AWR038-210) - 6"
  - Front (AWR245-280) - Alcove
  - Left Side - 1" (requires relocation of relief valve to right hand side of boiler - Figure 8.2)
  - Right Side - 4"
  - Rear - 6"
  - Top - 24-1/2" Additional Height May Be Required To Maintain 6" Clearance From All Breeching Components
- A 24" service clearance from the jacket is recommended on the left, right, and front of the boiler. These clearances may be reduced to those shown in Figures 4.1 & 4.2, however servicing the boiler will become increasingly difficult as these service clearances are reduced.



NOTES:

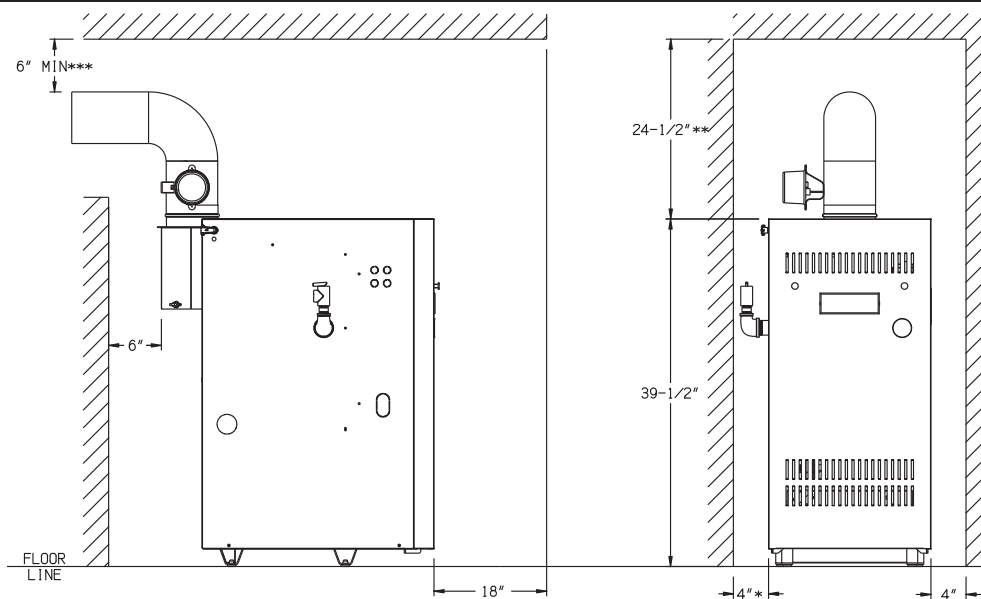
\* LEFT SIDE CLEARANCE MAY BE REDUCED TO 1" IF RELIEF VALVE IS RELOCATED TO SUPPLY PIPING NEXT TO RIGHT SIDE OF BOILER. (FIG 8.2)

\*\* ADDITIONAL HEIGHT MAY BE REQUIRED TO MAINTAIN REQUIRED CLEARANCE FROM VENT SYSTEM.

\*\*\* MINIMAL RADIAL DISTANCE FROM VENT PIPE TO COMBUSTIBLE CONSTRUCTION.

\*\*\*\* AREA OF EACH OPENING TO BE 1 SQ. INCH FOR EACH 1000 BTUH INPUT - WITH MINIMUM OF 100 SQ. INCHES. HEIGHT OF OPENING SHOULD BE HALF THE WIDTH.

FIGURE 4.1: AWR038-210 MINIMUM CLEARANCE FROM BOILER TO ALL TYPES OF COMBUSTIBLE CONSTRUCTION AND NONCOMBUSTIBLE CEILINGS, WALLS AND DOORS (CLOSET)



NOTES:

\* LEFT SIDE CLEARANCE MAY BE REDUCED TO 1" IF RELIEF VALVE IS RELOCATED TO SUPPLY PIPING NEXT TO RIGHT SIDE OF BOILER. (FIG 8.2)

\*\* ADDITIONAL HEIGHT MAY BE REQUIRED TO MAINTAIN REQUIRED CLEARANCE FROM VENT SYSTEM.

\*\*\* MINIMAL RADIAL DISTANCE FROM VENT PIPE TO COMBUSTIBLE CONSTRUCTION.

FIGURE 4.2: AWR245-280 MINIMUM CLEARANCE FROM BOILER TO ALL TYPES OF COMBUSTIBLE CONSTRUCTION AND NONCOMBUSTIBLE CEILINGS AND WALLS (ALCOVE)

- 2) The boiler must be installed on a hard level surface. This surface may be combustible.
- 3) Do not install this boiler in a location where gasoline or other flammable vapors or liquids will be stored or used.
- 4) Do not install this boiler in an area where large amounts of airborne dust will be present, such as a workshop.
- 5) The boiler should be located as close to the chimney as possible.
- 6) Do not install this boiler over carpeting. This may cause a fire.
- 7) Do not install this boiler directly on a surface that may get wet. Raise the boiler on a pad.
- 8) Protect ignition system components from sources of water that may spray, drip or rain on them during installation or service.
- 9) Level boiler using shims as necessary.

## V Air for Combustion and Ventilation



### WARNING

- INSUFFICIENT COMBUSTION AIR SUPPLY MAY RESULT IN THE PRODUCTION AND RELEASE OF DEADLY CARBON MONOXIDE (CO) INTO THE HOME WHICH CAN CAUSE SEVERE PERSONAL INJURY OR DEATH.
- THIS BOILER IS NOT DESIGNED FOR USE IN A SPACE THAT IS DEPRESSURIZED RELATIVE TO THE OUTDOORS. OPERATING THIS BOILER IN A DEPRESSURIZED SPACE MAY CAUSE SEVERE PERSONAL INJURY OR DEATH.

Sufficient fresh air must be supplied for combustion, ventilation, and flue gas dilution. Provisions for an adequate fresh air supply must be made in accordance with local codes, or in the absence of such codes, the *National Fuel Gas Code* (NFPA 54/ANSI Z223.1). In Canada, refer to the *Natural Gas and Propane Installation Code* (CAN/CSA 149.1).

The *National Fuel Gas Code* describes three basic ways to supply this boiler with adequate fresh air:

Indoor Combustion Air – Combustion air is drawn into the boiler room from other parts of the building and from the outdoors through natural infiltration (cracks under doors, etc). **This method can not be used in all cases – see discussion below.**

Outdoor Combustion Air – Combustion air is brought directly into the boiler room from outdoors through ducts or grills sized and installed specifically for this purpose.

Mechanical Combustion Air Supply – Combustion air is brought into the room from outdoors using a blower system that is engineered specifically for this purpose.

Each of the above methods is described in more detail in the following sections. The *National Fuel Gas Code* also describes some acceptable variations on these techniques that do not appear here.

### Using the Indoor Combustion Air Method

- 1) Total the input of all appliances in the boiler room in thousands of BTU/hr.
- 2) Find the volume of the boiler room in cubic feet:

$$\text{Volume (ft}^3\text{)} = \text{Length (ft)} \times \text{Width (ft)} \times \text{Height (ft)}$$

If the boiler room adjoins another room and there is no door present between these two rooms, add the volumes of the



rooms together. Repeat for any other connected rooms which do not have doors. **Do not add the volume of two rooms separated by a door even if that door is “always left open”.**

- 3) Divide the volume obtained in Step 2 by the input calculated in Step 1.
- 4) If the result is at least 50 ft<sup>3</sup> per 1000BTU/hr, and neither of the conditions described in (6) below are met, normal infiltration should provide adequate fresh air into the boiler room.
- 5) If the result is less than 50 ft<sup>3</sup> per 1000BTU/hr, provide two openings into the boiler room, one near the floor and one near the ceiling. The top edge of the upper opening must be within 12” of the ceiling and the bottom edge of the lower opening must be within 12” of the floor (Figure 5.1):
  - Each opening must have a free area of 1 square inch per 1000 BTU/hr input of all gas burning appliances in the boiler room. The minimum opening dimension is 3 inches. Minimum opening free area is 100 square inches per opening.
  - If the total volume of both the boiler room and the room to which the openings connect is less than 50 cubic feet per 1000 BTU/hr of total appliance input, install a pair of identical openings into a third room. Connect additional rooms with openings until the total volume of all rooms is at least 50 cubic feet per 1000 BTU/hr of input.
  - The “free area” of an opening takes into account the blocking effect of mesh, grills, and louvers. Where screens are used, they must be no finer than ¼” (4 x 4) mesh.
  - If providing openings into adjacent rooms is undesirable, use the Outdoor Combustion Air Method.
- 6) Do not use the Indoor Combustion Air Method described above if either of the following are true:
  - a. The indoor space is so tightly constructed that the number of air changes per hour is known to be 0.4 or less.
  - b. The boiler room is depressurized relative to the outdoors. This depressurization is possible if the structure is tightly constructed and/or is equipped with exhaust fans.

*Example:*

*An AWR105EN and a water heater are to be installed in a room measuring 6 ft - 3 in x 7 ft with an 8 ft ceiling. The water heater has an input of 30000 BTU/hr:*

*Total input in thousands of BTU/hr = (105000 BTU/hr + 30000 BTU/hr) ÷ 1000 = 135*

*Volume of room = 6.25 ft x 7 ft x 8 ft = 350 ft<sup>3</sup>*

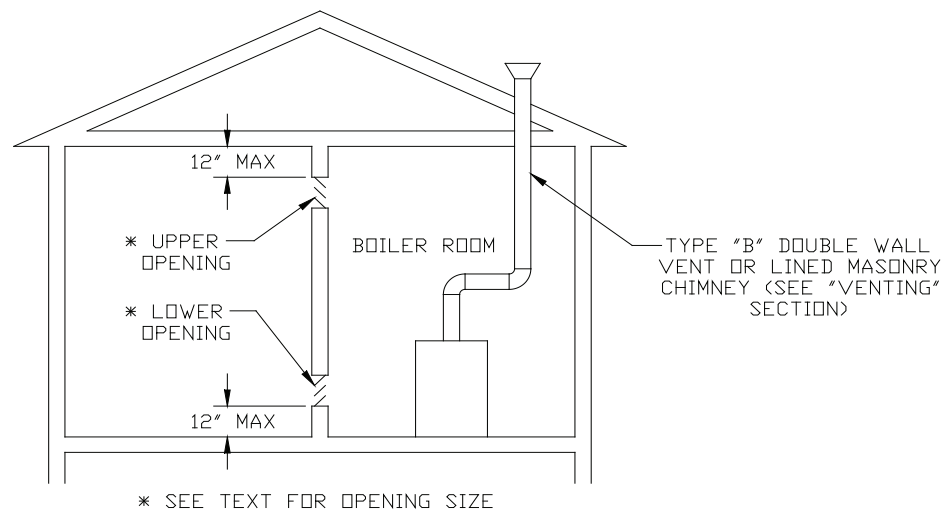


FIGURE 5.1: INDOOR COMBUSTION AIR METHOD

$350 \div 135 = 2.59$ . Since 2.59 is less than 50, there will be an inadequate fresh air supply in the boiler room unless openings are installed between the boiler room and at least one adjacent room. It turns out that the boiler room in this example is adjacent to a full basement which is 20ft x 45ft x 8ft high. If two openings are installed into this basement that each have a free area of 135in<sup>2</sup>, the combined volume of the boiler room and basement will be:

$$350\text{ft}^3 + 6400\text{ft}^3 = 6750\text{ft}^3 \text{ and:}$$

$$6750 \div 135 = 50\text{ft}^3 \text{ per } 1000 \text{ BTU/hr.}$$

In the absence of one of the conditions described in (6) above, this arrangement should provide an adequate fresh air supply to all the appliances in the boiler room.

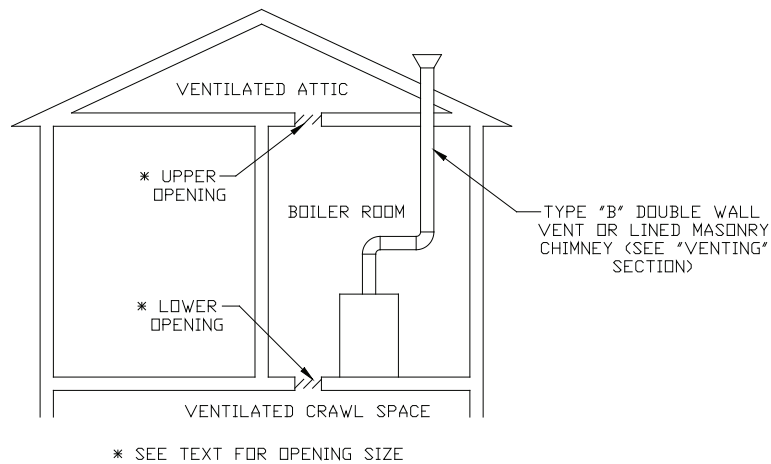


FIGURE 5.2: ALL AIR FROM OUTDOORS, VENTILATED CRAWL SPACE AND ATTIC

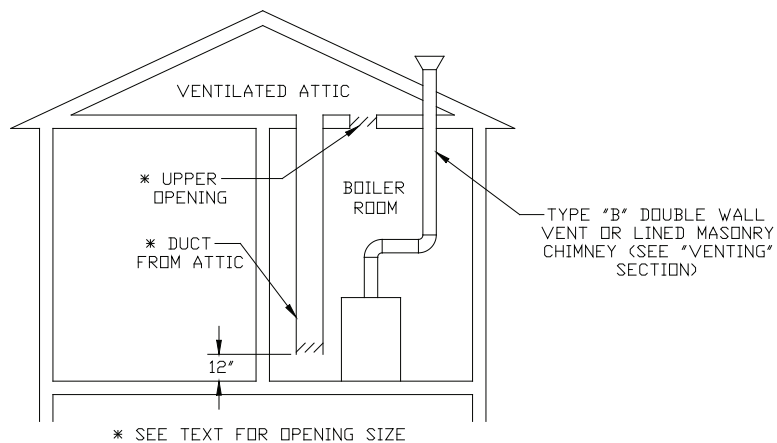


FIGURE 5.3: ALL AIR FROM OUTDOORS, VIA VENTILATED ATTIC

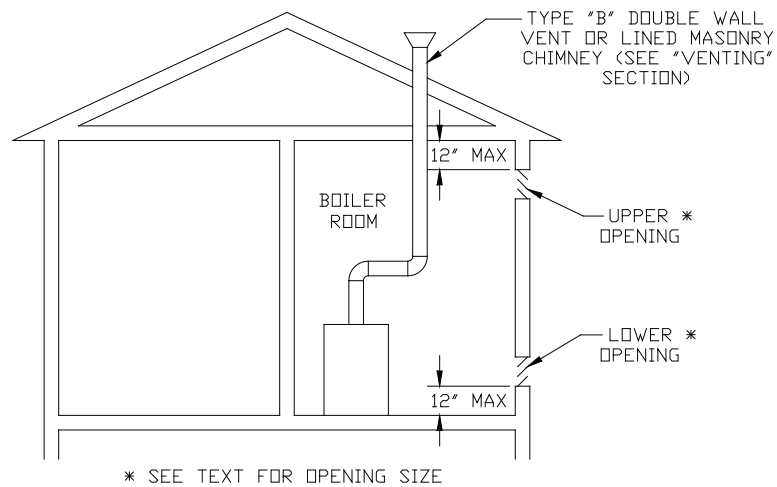


FIGURE 5.4: OUTDOOR COMBUSTION AIR METHOD: USING OPENINGS INTO BOILER ROOM

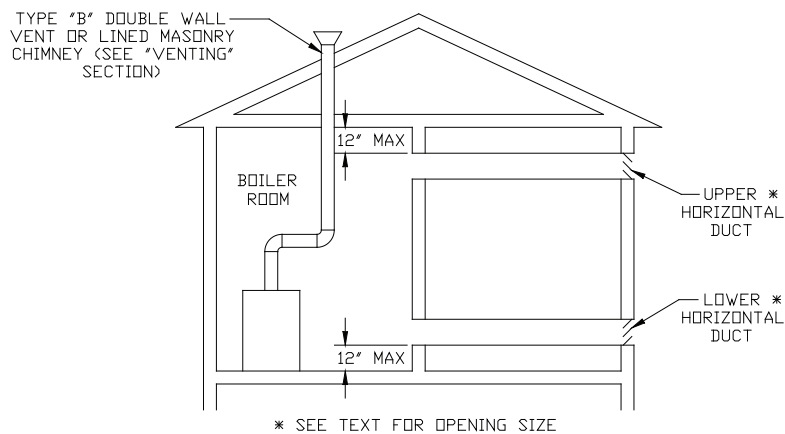


FIGURE 5.5: OUTDOOR COMBUSTION AIR METHOD: USING HORIZONTAL DUCTS INTO BOILER ROOM

### Using the Outdoor Combustion Air Method

- 1) Openings must be installed between the boiler room and the outdoors or a ventilated space, such as an attic or crawl space, which communicates directly with the outdoors.
- 2) Two openings are required. The top edge of the upper opening must be within 12 inches of the ceiling. The bottom edge of the lower opening must be within 12 inches of the floor.
- 3) Size openings and ducts as follows:
  - Vertical ducts or openings directly outdoors (Figure 5.2, Figure 5.3, and Figure 5.4) - Each opening must have a free cross sectional area of 1 square inch per 4000 BTU/hr of the total input of all gas-fired appliances in the boiler room. Minimum opening size is 3 inches.
  - Openings to outdoors via horizontal ducts (Figure 5.5) - Each opening must have a free cross sectional area of 1 square inch per 2000 BTU/hr of the total input of all gas fired appliances in the boiler room. Minimum opening size is 3 inches.
  - The “free area” of an opening takes into account the blocking effect of mesh, grills, and louvers. Where screens are used, they must be no finer than ¼” (4 x 4) mesh.

- If motorized louvers are installed in the openings to the outdoors, they must be interlocked to prevent operation of the fuel burning appliances in the boiler room unless the louvers are open.

## Mechanical Combustion Air Supply

A mechanical system may be used to bring all combustion air to the boiler which meets all of the following requirements:

- 1) The system must be manufactured specifically for this purpose.
- 2) Size the system to deliver combustion air at the rate prescribed by the system manufacturer's instructions, but no less than 0.35 CFM for each 1000 BTU/hr of the combined input of all fuel burning appliances in the boiler room. If exhaust fans are present within the building, additional capacity may be required to prevent the boiler room from being depressurized.
- 3) The system must be interlocked to prevent operation of the fuel burning appliances in the boiler room if the system is not operating.

## VI Venting



### WARNING

- IMPROPER VENTING MAY RESULT IN PROPERTY DAMAGE AND/OR THE RELEASE OF FLUE GASES, WHICH CONTAIN DEADLY CARBON MONOXIDE (CO), INTO THE HOME, WHICH CAN CAUSE SEVERE PERSONAL INJURY OR DEATH.
- DO NOT USE PLASTIC VENTING MATERIALS (SUCH AS CPVC, PVC AND RADEL) TO VENT THIS BOILER.
- INSPECT EXISTING CHIMNEY BEFORE INSTALLING BOILER. FAILURE TO CLEAN OR REPLACE DAMAGED PIPE OR TILE LINING WILL CAUSE SEVERE INJURY OR DEATH.

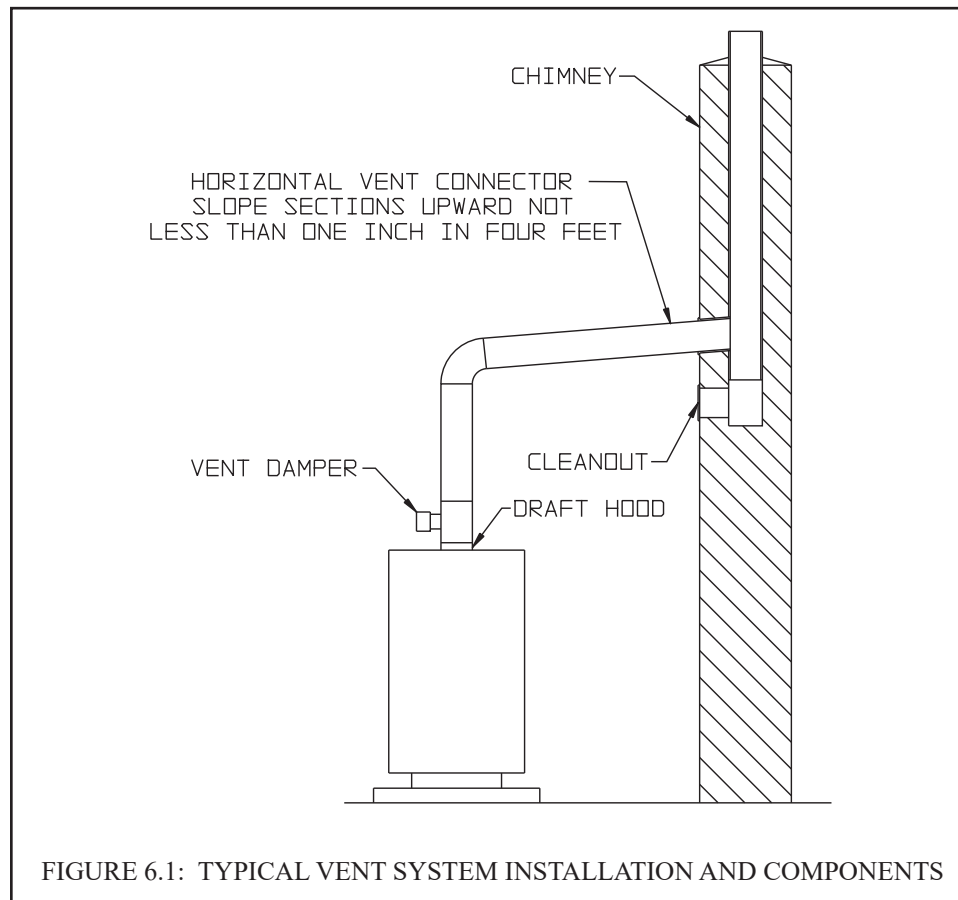
The vent system installation must be in accordance with local codes, or in the absence of such codes, the *National Fuel Gas Code* (NFPA 54/ANSI Z223.1). In Canada, refer to the *Natural Gas and Propane Installation Code* (CAN/CSA 149.1).

A typical vent installation is illustrated by Figure 6.1. The components of vent installation are boiler draft diverter, vent damper, vent connector and chimney. The AWR series boilers are equipped with a draft hood which is built into the boiler; do not attempt to install an external draft hood.

- 1) Acceptable Chimneys - The following chimneys may be used to vent AWR series boilers:
  - Listed Type B or L gas vent - Install in accordance with the manufacturer's instructions, the terms of its listing, and applicable codes.
  - Masonry Chimney - The masonry chimney must be constructed in accordance with local codes, or in the absence of any, the *Standard for Chimneys, Fireplaces, Vents, and Solid Fuel Burning Appliances* (NFPA 211). The chimney must be lined with a clay liner or other listed lining system. Do not vent an AWR series boiler into an unlined chimney.
- 2) Acceptable Vent Connectors - The following may be used for vent connectors:
  - Listed type B or L Gas Vent
  - Single Wall Galvanized Pipe - Use 0.018" (26 gauge or heavier). The size and location of the chimney may not permit the use of a single wall connector in some cases. (see the *National Fuel Gas Code*). Do not use single wall pipe for vent connectors in attics.
  - Other Vent Connectors Permitted by the *National Fuel Gas Code*.
- 3) Chimney and Vent Connector Sizing - Size the chimney and vent connector in accordance with the *National Fuel Gas Code*.

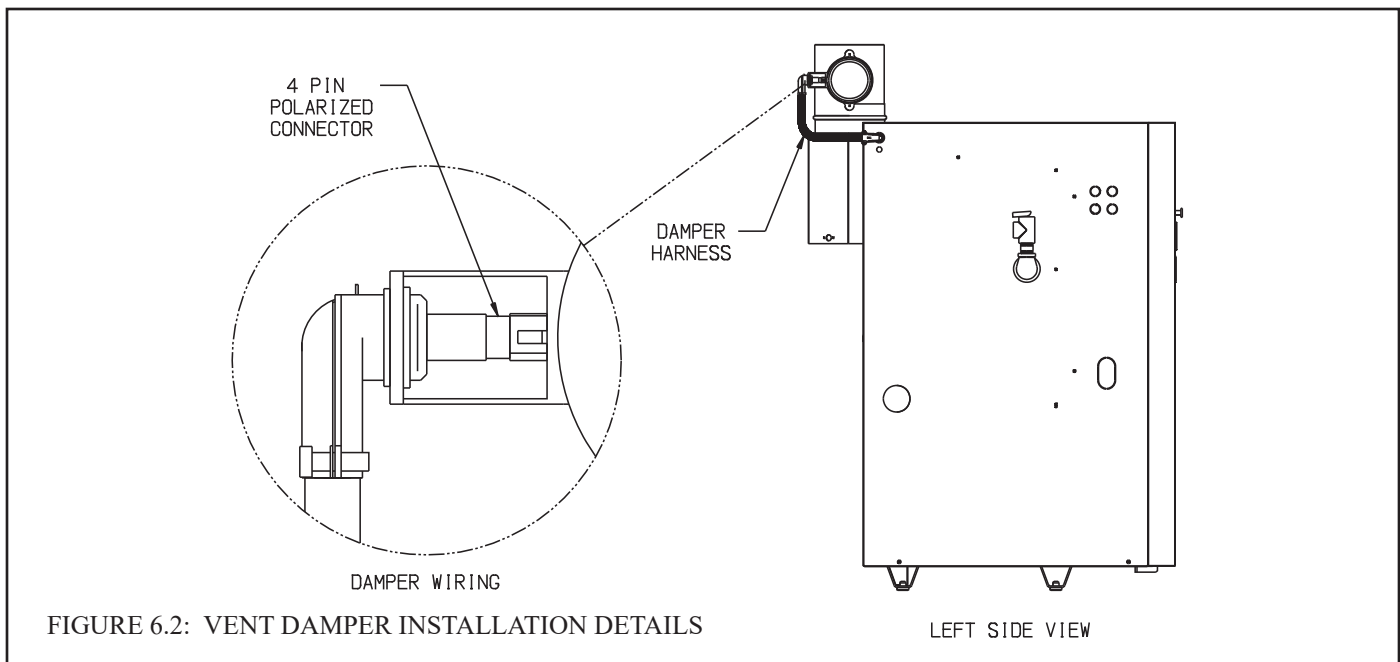
4) Exterior Chimneys - An exterior chimney has one or more sides exposed to the outdoors below the roof line. The *National Fuel Gas Code* prescribes two conditions under which an exterior chimney may be used:

- In some very restrictive cases, the AWR series boilers may be vented into an exterior ceramic lined masonry chimney. See the *National Fuel Gas Code* for information on when exterior chimneys may be used.
- An exterior masonry chimney may be used if it is lined with B vent or a listed chimney lining system.



- 5) This boiler may be vented using a listed power venter. The power venter must be in sized and installed in accordance with the power venter manufacturer's instructions, the terms of the power venter listing, and applicable codes. The boiler must be electrically interlocked with the power venter to prevent boiler operation if the power venter fails to operate. Before deciding to use a power venter, make certain that the flue gas exiting the power venter will not damage adjacent construction or other structures. Also make certain that the power venter terminal will not be subjected to winds which could affect power venter operation.
- 6) Do not connect the vent of this appliance into any portion of a mechanical vent system operating under positive pressure.
- 7) Do not connect the boiler into a chimney flue serving an open fireplace or other solid fuel appliance.
- 8) Prior to boiler installation, inspect chimney for obstructions or other defects and correct as required. Clean chimney as necessary.
- 9) Vent pipe should slope upward from draft diverter not less than one inch in four feet. No portion of vent pipe should run downward or have sags. Vent pipe must be securely supported.
- 10) The vertical section of vent pipe coming off the boiler should be as tall as possible, while still maintaining the proper clearance from the horizontal vent connector to combustibles and the proper pitch called for in (9) above.
- 11) Vent pipe should be installed above the bottom of the chimney to prevent blockage.
- 12) Vent pipe must be inserted flush with inside face of the chimney liner and the space between vent pipe and chimney sealed tight.
- 13) Do not install the vent damper in any portion of the vent system which is used by appliances other than the boiler being installed.

- 14) Vent damper installation is mandatory on all AWR series boilers. Install vent damper (see Figure 6.2) as follows:
- Open vent damper carton and remove installation instructions. Read the instructions thoroughly before proceeding. Verify that vent damper is same size as draft diverter outlet (Figure 2.1). Unpack vent damper carefully. **Do not force closed damper blade.** Forcing vent damper closed may result in damaged gear train and void warranty.
  - Vent damper is factory shipped having approximately  $\frac{3}{4}$ " diameter hole in the vent damper blade, which must be plugged on all AWR boilers. Use the plug supplied with the damper.
  - Mount the vent damper on the flue collar without modification to either and secure with sheet metal screws. Make sure screws do not interfere with damper blade operation. Vent damper blade position indicator must be visible to users.
  - The damper wire harness is shipped pre-wired into the boiler. Plug the loose end of this harness into the damper and secure the flexible conduit to the damper using a connector nut provided. Provide adequate clearance to combustible construction and servicing.
  - Install vent connector pipe and vent fittings from vent damper outlet to chimney or gas vent. Secure with sheet metal screws and support as required.



### Removing an Existing Boiler from a Common Chimney

In some cases, when an existing boiler is removed from a common chimney, the common venting system may be too large for the remaining appliances. At the time of removal of an existing boiler the following steps shall be followed with each appliance remaining connected to the common venting system placed in operation, while the other appliances remaining connected to the common venting system are not in operation.

- Seal any unused opening 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 practical, close all building doors and windows and all doors between the space in which all the appliances remaining connected to the common venting system are located and other spaces of the building. Turn on clothes dryers and any appliance not connected to the common venting system. Turn on any exhaust fans, such as range hoods and bathroom exhausts, so they will operate at maximum speed. Do not operate a summer exhaust fan. Close fireplace dampers.
- Place in operation the appliance being inspected. Follow the lighting instructions. Adjust thermostat so the appliance will operate continuously.
- Test for spillage at the draft hood relief opening after five (5) minutes of main burner operation. Use the flame of a match or candle, or smoke from a cigarette, cigar, or pipe.

- f) After it has been determined that each appliance remaining connected to the common venting system properly vents when tested as outlined above, return doors, windows, exhaust fans, fireplace dampers and any other gas-burning appliances to their previous condition of use.
- g) Any improper operation of the common venting system should be corrected so the installation conforms with the National Fuel Gas Code, ANSI Z223.1. When resizing any portion of the common venting system, the common venting system should be resized to approach the minimum size as determined using the appropriate tables in Part 10 of the National Fuel Gas Code, ANSI Z223.1.

## VII Gas Piping



### WARNING

- SHUT OFF GAS SUPPLY BEFORE SERVICING THE BOILER.
- ALL GAS PIPING MUST BE GAS TIGHT. USE GAS RATED THREAD COMPOUND ON ALL THREADED JOINTS TO AVOID LEAKS, WHICH MAY RESULT IN FIRE OR EXPLOSION.
- SIZE GAS PIPING, REGULATORS, VALVES AND METERS SO AS TO PROVIDE AN ADEQUATE GAS FLOW AND PRESSURE TO THE BOILER DURING OPERATION. FAILURE TO DO SO MAY CAUSE POOR COMBUSTION, NOISE, INJURY OR DEATH.

Gas piping to the boiler must be sized to deliver adequate gas for the boiler to fire at the nameplate input at a line pressure between the minimum and maximum values shown on the rating plate. For more information on gas line sizing, consult the utility or the *National Fuel Gas Code*.

Figure 7.1 shows typical gas piping connection to the AWR boiler. A sediment trap must be installed upstream of all gas controls. Install a manual shut-off valve outside the jacket and ground joint union as shown.

The boiler and its gas connection must be leak tested before placing the boiler in operation. When doing this, the boiler and its individual shut-off must be disconnected from the rest of the system during any pressure testing of that system at pressures in excess of 1/2 psi. When pressure testing the gas system at pressures of 1/2 psi or less, isolate the boiler from the gas supply system by closing its individual manual shut-off valve.

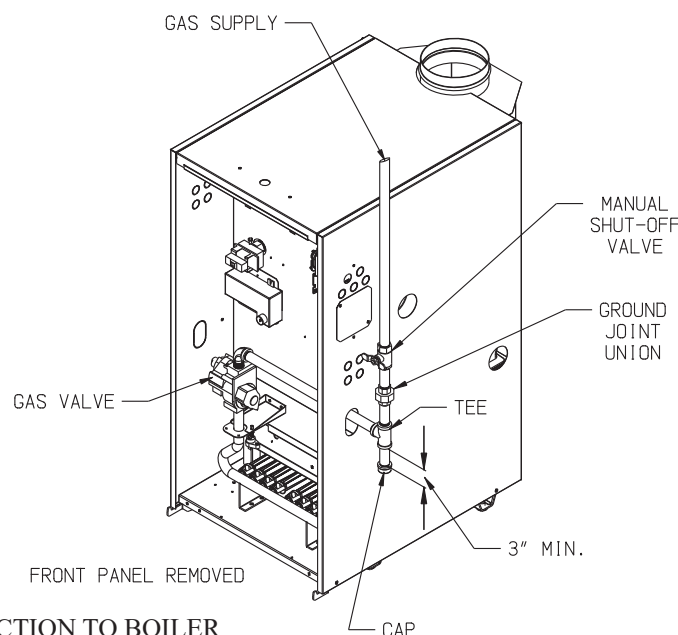


FIGURE 7.1: GAS CONNECTION TO BOILER

## VIII System Piping



### WARNING

- INSTALL BOILER SO THAT THE GAS IGNITION SYSTEM COMPONENTS ARE PROTECTED FROM WATER (DRIPPING, SPRAYING, RAIN, ETC.) DURING APPLIANCE OPERATION AND SERVICE (CIRCULATOR REPLACEMENT, ETC.).
- OPERATION OF THIS BOILER WITH CONTINUOUS RETURN TEMPERATURES BELOW 120°F CAN CAUSE SEVERE HEAT EXCHANGER CORROSION DAMAGE.
- OPERATION OF THIS BOILER IN A SYSTEM HAVING SIGNIFICANT AMOUNTS OF DISSOLVED OXYGEN CAN CAUSE SEVERE HEAT EXCHANGER CORROSION DAMAGE.
- DO NOT USE TOXIC ADDITIVES, SUCH AS AUTOMOTIVE ANTIFREEZE, IN A HYDRONIC SYSTEM.
- PIPE RELIEF VALVE DISCHARGE TO A SAFE LOCATION. THE RELIEF VALVE MAY DISCHARGE SCALDING HOT WATER.
- DO NOT INSTALL A VALVE IN THE RELIEF VALVE DISCHARGE LINE.
- DO NOT MOVE RELIEF VALVE FROM FACTORY LOCATION.
- DO NOT PLUG RELIEF VALVE DISCHARGE. BLOCKING THE RELIEF VALVE MAY RESULT IN BOILER EXPLOSION.

### Standard Piping

Figure 8.3 shows typical boiler system connections on a single zone system. Additional information on hydronic system design may be found in the *I=B=R Guide RHH* published by the Air-Conditioning, Heating and Refrigeration Institute (AHRI). The components in this system and their purposes are as follows:

- 1) Relief valve (Required) - Mount the relief valve on the left side of the boiler as shown in Figure 8.1 using the 1-1/4 x 4 nipple, 1-1/4 x 3/4 reducing elbow and 3/4 x close nipple provided. The relief valve shipped with the boiler is set to open at 30 psi. This valve may be replaced with one having a pressure up to the “Maximum Allowable Working Pressure” shown on the rating plate. If the valve is replaced, the replacement must have a relief capacity in excess of the DOE heating capacity for the boiler.  
  
Pipe the discharge of the relief valve to a location where water or steam will not create a hazard or cause property damage if the valve opens. The end of the discharge pipe must terminate in an unthreaded pipe. If the relief valve discharge is not piped to a drain it must terminate at least 6 inches above the floor. Do not run relief valve discharge piping through an area that is prone to freezing. The termination of the relief valve discharge piping must be in an area where it is not likely to become plugged by debris.  
  
If necessary, the relief valve may be installed in the supply piping as shown in Figure 8.2. When this is done, the relief valve must be as close to the boiler supply tapping as possible with no intervening shut-off valves.
- 2) Circulator (Required) - The circulator is shipped loose with the boiler. Fittings are provided to mount it on the boiler return as shown in Figure 8.3, however it can be installed on the boiler supply. If the circulator is moved to the supply it should be positioned just downstream of the expansion tank as shown in Figure 8.3.
- 3) Expansion Tank (Required) - If this boiler is replacing an existing boiler with no other changes in the system, the old expansion tank can generally be reused. If the expansion tank must be replaced, consult the expansion tank manufacturer’s literature for proper sizing.
- 4) Fill Valve (Required) - Either a manual or automatic fill valve may be used. The ideal location for the fill is at the expansion tank.



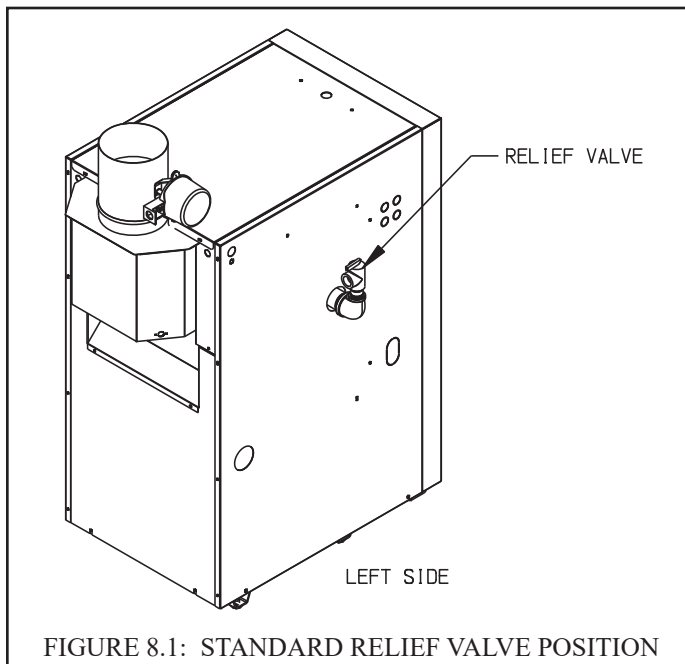


FIGURE 8.1: STANDARD RELIEF VALVE POSITION

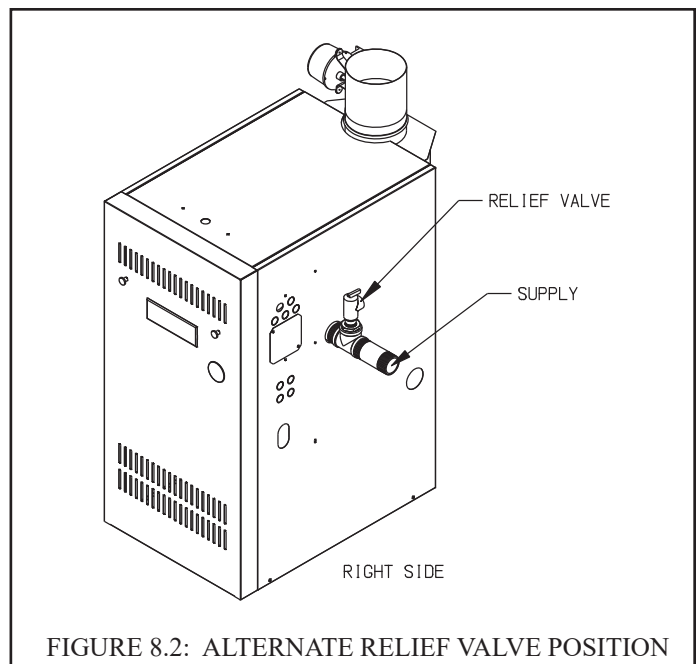


FIGURE 8.2: ALTERNATE RELIEF VALVE POSITION

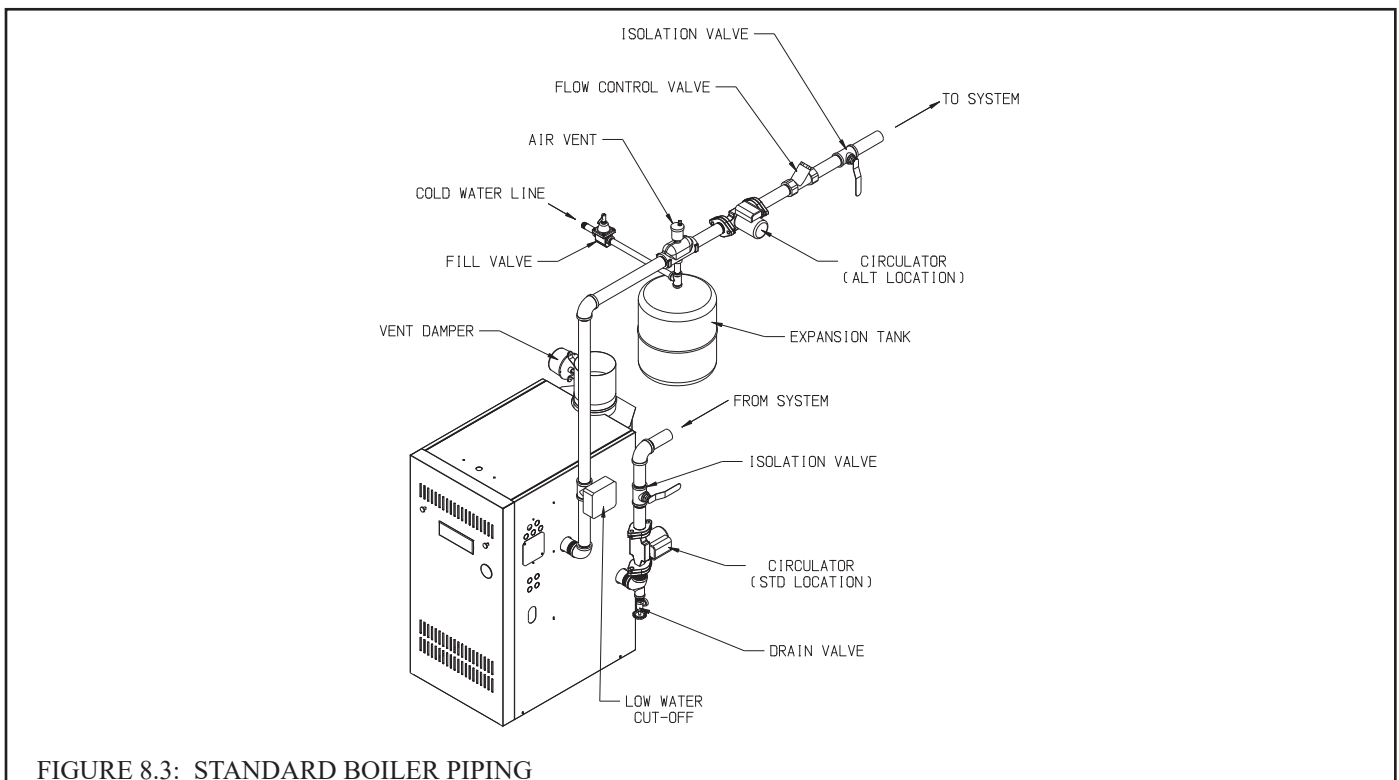


FIGURE 8.3: STANDARD BOILER PIPING

- 5) Automatic Air Vent (Required) - At least one automatic air vent is required. Manual vents will usually be required in other parts of the system to remove air during initial fill.
  
- 6) Low Water Cut-Off (Required in some situations) - A low water cutoff (LWCO) is required when the boiler is installed above radiation. In addition, some codes such as ASME CSD-1 require low water cutoffs. Codes may also require that this low water cutoff have a manual reset function. The low water cutoff may be a float type or probe type, but must be designed for use in a hot-water system. The low water cutoff should be piped into the boiler supply just above the boiler with no intervening valves between it and the boiler.  
 Crown LWCO kit PN 761000 is designed to be mounted in the boiler supply piping immediately adjacent to the boiler and to plug directly into the factory low voltage wiring. If using a field supplied LWCO, use a LWCO that breaks the 120VAC supply to the boiler. Do not attempt to wire a field-supplied 24VAC LWCO into the factory wiring.

- 7) Manual Reset High Limit (Required by some codes) - This control is required by ASME CSD-1 and some other codes. Install the high limit in the boiler supply piping just beyond the boiler with no intervening valves. Set the manual reset high limit as far above the operating limit setting as possible, but not over 240°F. Wire the control to break the 120 VAC electrical supply to the boiler.
- 8) Flow Control Valve (Required under some conditions) - The flow control valve prevents flow through the system unless the circulator is operating. A flow control valve may be necessary on converted gravity systems to prevent gravity circulation. Flow control valves are also used to prevent flow in circulator zone systems through zones that are not calling for heat.
- 9) Isolation Valves (Optional) - Isolation valves are useful if the boiler must be drained, as they will eliminate having to drain and refill the entire system.
- 10) Drain Valve - The drain valve is shipped in the boiler parts bag. Install it in the tee under the circulator as shown in Figure 11b.

## Piping for Special Situations

Certain types of heating systems have additional requirements. Some of the more common variations follow:

- 1) “Left Piped” Boilers – If necessary, the supply and return may be connected to the left side of the boiler by moving the 1-1/4” plug and the relief valve fittings from the tapings in the left side of the boiler to the corresponding tapings on the right. Both the supply and return connections must be made on the same side of the boiler.
- 2) Indirect Water Heaters - Figure 8.4 shows typical indirect water heater piping. Boiler piping is the same as for any two-zone system. Figure 8.4 shows circulator zoning, which is usually preferred for indirect water heaters. Size the circulator and indirect water heater piping to obtain the boiler water flow through the indirect water heater called for by the indirect water heater manufacturer.
- 3) Large Water Volume Systems - The piping shown in Figure 8.5 will minimize the amount of time that the boiler operates with return temperatures below 120°F on these systems. A bypass is installed as shown to divert some supply water directly into the return water. The bypass pipe should be the same size as the supply. The two throttling valves shown are adjusted so that the return temperature rises above 120°F during the first few minutes of operation. A three-way valve can be substituted for the two throttling valves shown. If the circulator is mounted on the supply, the bypass must be on the discharge side of the circulator.

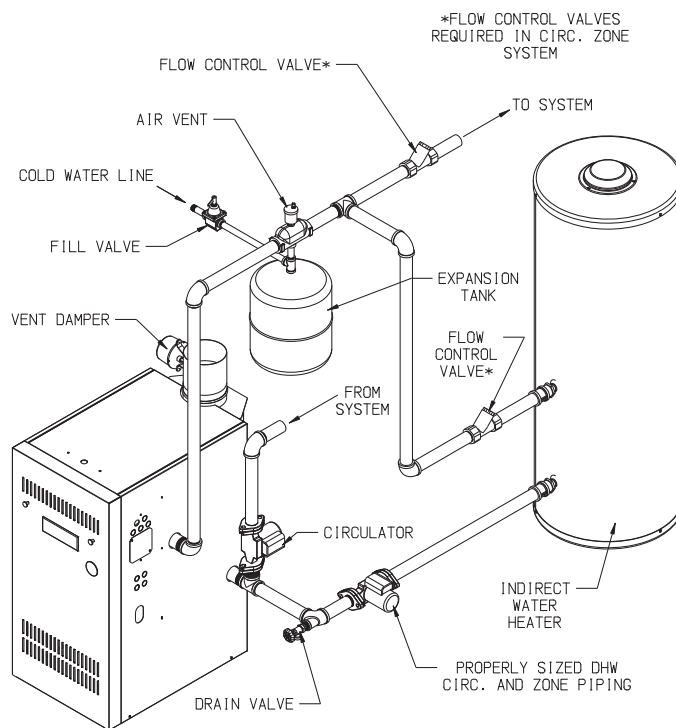


FIGURE 8.4: INDIRECT WATER HEATER BOILER SIDE PIPING

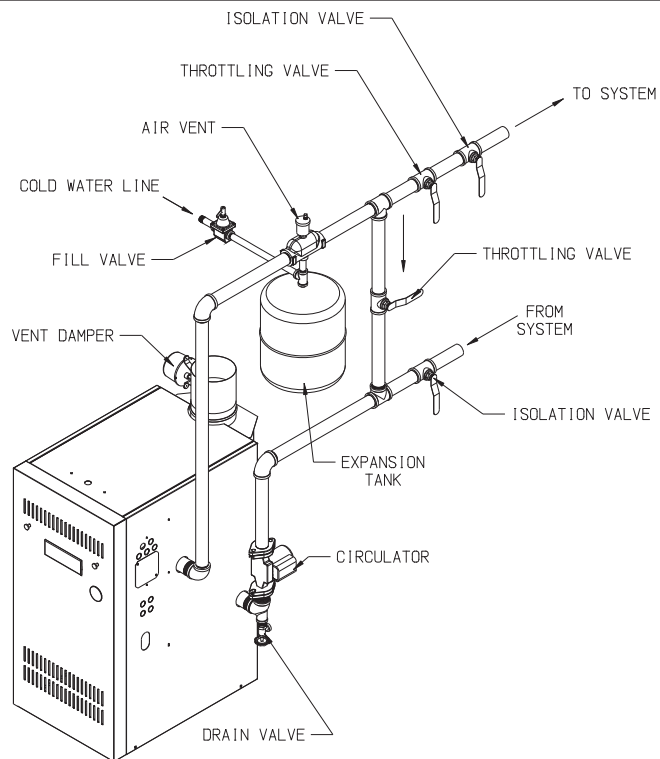


FIGURE 8.5: BOILER BYPASS PIPING

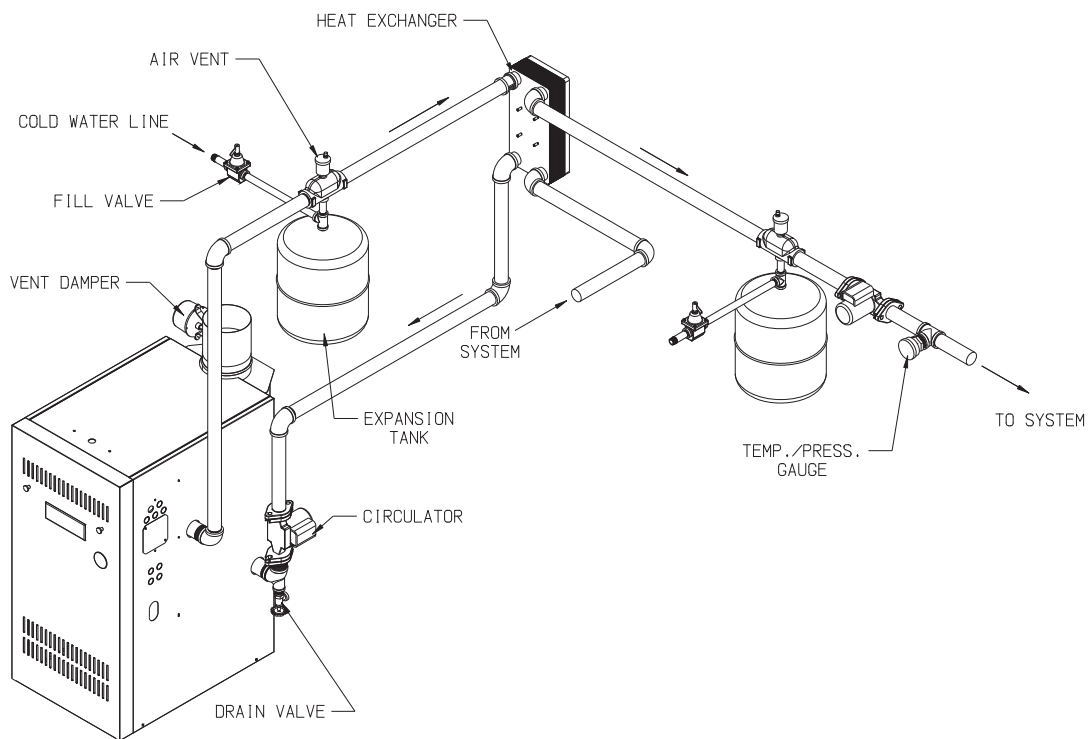


FIGURE 8.6: ISOLATION OF BOILER FROM SYSTEM WITH A HEAT EXCHANGER

- 4) Low Temperature Systems - Some systems, such as radiant tubing systems, require the system water temperature to be limited to a value below the temperature of the water leaving the AWR. These systems also typically have return temperatures well below the 120°F minimum.

Figure 14 illustrates the use of a heat exchanger to connect the AWR boiler to this type of system. The heat exchanger will permit the transfer of heat from the boiler water to the low temperature system while holding the system supply and boiler return temperatures within their limits. For this system to work properly the heat exchanger must be properly sized and the correct flow rates are required on either side of the heat exchanger. Consult the heat exchanger manufacturer for sizing information. The water in the boiler is completely isolated from the water in the system. This means that separate fill and expansion tanks are required for the heating system loop.

There are several other ways to connect low temperature systems to the non-condensing boilers like the AWR such as four way mixing valve and variable speed injection Circulating systems.

- 5) Systems containing oxygen - Many hydronic systems contain enough dissolved oxygen to cause severe corrosion damage to a cast iron boiler such as the AWR. Some examples include:
- Radiant systems that employ tubing without an oxygen barrier.
  - Systems with routine additions of fresh water.
  - Systems which are open to the atmosphere.

If the boiler is to be used in such a system, it must be separated from the oxygenated water being heated with a heat exchanger as shown in Figure 8.6.

Consult the heat exchanger manufacturer for proper heat exchanger sizing as well as flow and temperature requirements. All components on the oxygenated side of the heat exchanger, such as the Circulator and expansion tank, must be designed for use in oxygenated water.

- 6) Piping with a Chiller - If the boiler is used in conjunction with a chiller, pipe the boiler and chiller in parallel as shown in Figure 8.7. Use isolation valves to prevent chilled water from entering the boiler.
- 7) Air Handlers - Where the boiler is connected to air handlers through which refrigerated air passes, use flow control valves in the boiler piping or other automatic means to prevent gravity circulation during the cooling cycle.

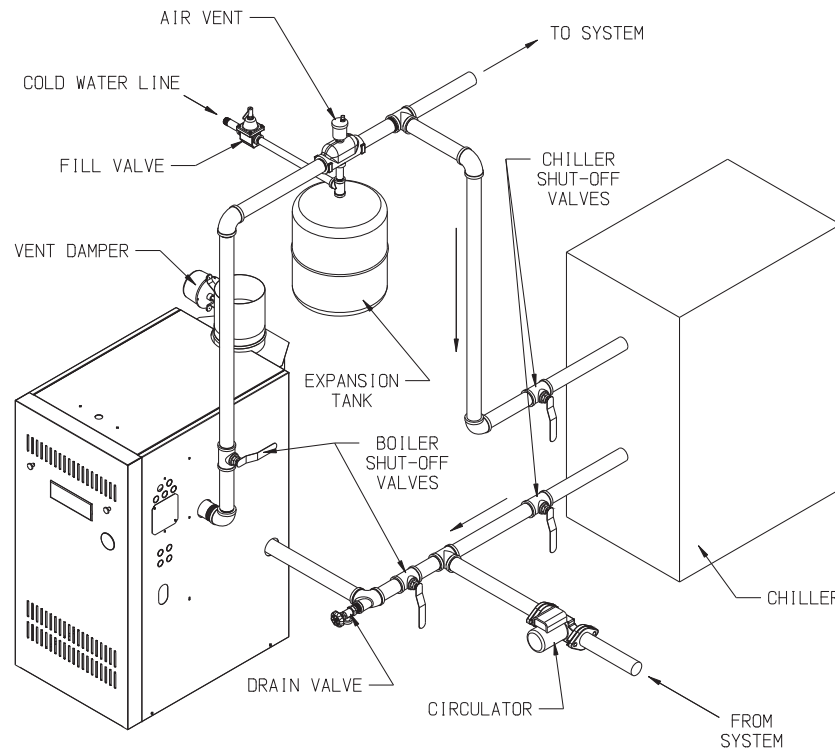


FIGURE 8.7: BOILER PIPING WITH CHILLER

## IX Wiring



### WARNING

- ALL WIRING AND GROUNDING MUST BE DONE IN ACCORDANCE WITH THE AUTHORITY HAVING JURISDICTION OR, IN THE ABSENCE OF SUCH REQUIREMENTS, WITH THE *NATIONAL ELECTRICAL CODE (ANSI/NFPA 70)*.
- DISCONNECT ELECTRICAL POWER TO THE BOILER AND HEATING SYSTEM BEFORE SERVICING. POSITIVELY ASSURE THAT NO VOLTAGE IS PRESENT. LOCK ELECTRICAL BOXES TO PREVENT SOMEONE FROM INADVERTENTLY RESTORING POWER BEFORE THE HEATING SYSTEM IS SAFE TO OPERATE.
- NEVER DEFEAT OR JUMP OUT SAFETY DEVICES.
- PROTECT EACH BOILER CIRCUIT WITH A PROPERLY SIZED OVER-CURRENT PROTECTION DEVICE.
- MAKE ELECTRICAL CONNECTIONS CAREFULLY ACCORDING TO THE BOILER'S WIRING DIAGRAM AND INSTRUCTIONS.
- WIRE ADDITIONAL FIELD SUPPLIED SAFETY LIMITS, SUCH AS LOW WATER CUTOFFS AND TEMPERATURE LIMIT DEVICES, IN SERIES WITH THE 120V CIRCUIT USED TO POWER THE BOILER. DO NOT ALTER THE BOILER'S FACTORY WIRING WHEN ADDING AN ADDITIONAL LIMIT DEVICE.

- 1) Line Voltage (120 VAC) Field Connections – See Figure 9.0 for line voltage connections. Provide a dedicated circuit for the boiler of 15A or greater. A service switch is recommended and is required by many local codes. Locate this switch in accordance with local codes or, in the absence of any, in a location where it can be safely accessed in an emergency involving the boiler. All 120VAC connections to the boiler itself are made inside the junction box on the right side of the boiler (accessible through the cover plate on the right side jacket panel). 120VAC connections are:

- Ground
- 120VAC Hot (Black)
- 120VAC Neutral (White)
- Heating Circulator Hot (Red)
- Heating Circulator Neutral (White)
- DHW Circulator Hot (Blue)
- DHW Circulator Neutral (White)

The use of the Circulator outputs are as follows (also refer to the Piping Section)

- a) Heating Circulator - Pumps water upon a call for heat (CH) from the thermostat terminals T-T shown in Figure 9.1 or from an EnviraCom thermostat. This output is factory wired to the “circulator whip” mounted on the boiler.
- b) DHW Circulator - Pumps boiler water to an indirect water heater upon a call for domestic hot water (DHW) from the DHW thermostat terminals shown in Figure 9.1. This output can also be used for a second space heating zone. See Section XI of this manual for additional information.

Maximum circulator current draw is 5.0 FLA.

2. Low Voltage Connections – Low voltage field connections are located as shown in Figure 9.1 and are as follows:

- a) Heating Thermostat - Connect to a 24 volt thermostat or other “dry contacts” (such as a zone panel end switch) that close upon a call for heat. Follow thermostat manufacturer’s instructions. To insure proper thermostat operation, avoid installation in areas of poor air circulation, hot spots (near any heat source or in direct sunlight), cold spots (outside walls, walls adjacent to unheated areas, locations subject to drafts). Provide Class II circuit between thermostat (or zone controls) and boiler.
- b) DHW - If used, connect to a 24VAC domestic hot water thermostat or 2nd space heating thermostat.
- c) Option Plug #1 - Used to connect either of the following:
  - Crown #761000 optional LWCO kit
  - Crown Option Card Panel kit (See instructions provided with this kit for additional details).

Note: When Option Plug #1 is not used, the factory supplied jumper plug shown in Figure 9.1 must be installed for boiler to operate.

- d) Option Plug #2 - Used to connect Crown optional touch screen display or service tool (see instructions provided with these options for additional details).
- e) EnviraCOM - Used to connect EnviraCom thermostat or other EnviraCom device approved by Crown for use with this boiler.

### **CAUTION**

- When making low voltage connections, make sure that no external power source is present in the thermostat circuits. If such a power source is present, it could destroy the boiler’s control. One example of an external power source that could be inadvertently connected to the low voltage connections is a transformer in old thermostat wiring.
- Do not attempt to use EnviraCOM connections for any purpose not explicitly permitted by Crown Boiler Company. Attempting to do so may result in unreliable operation and/or damage to controls.
- Do not use the transformer provided on the boiler to power external devices such as zone valves. Doing so may cause damage to the transformer.

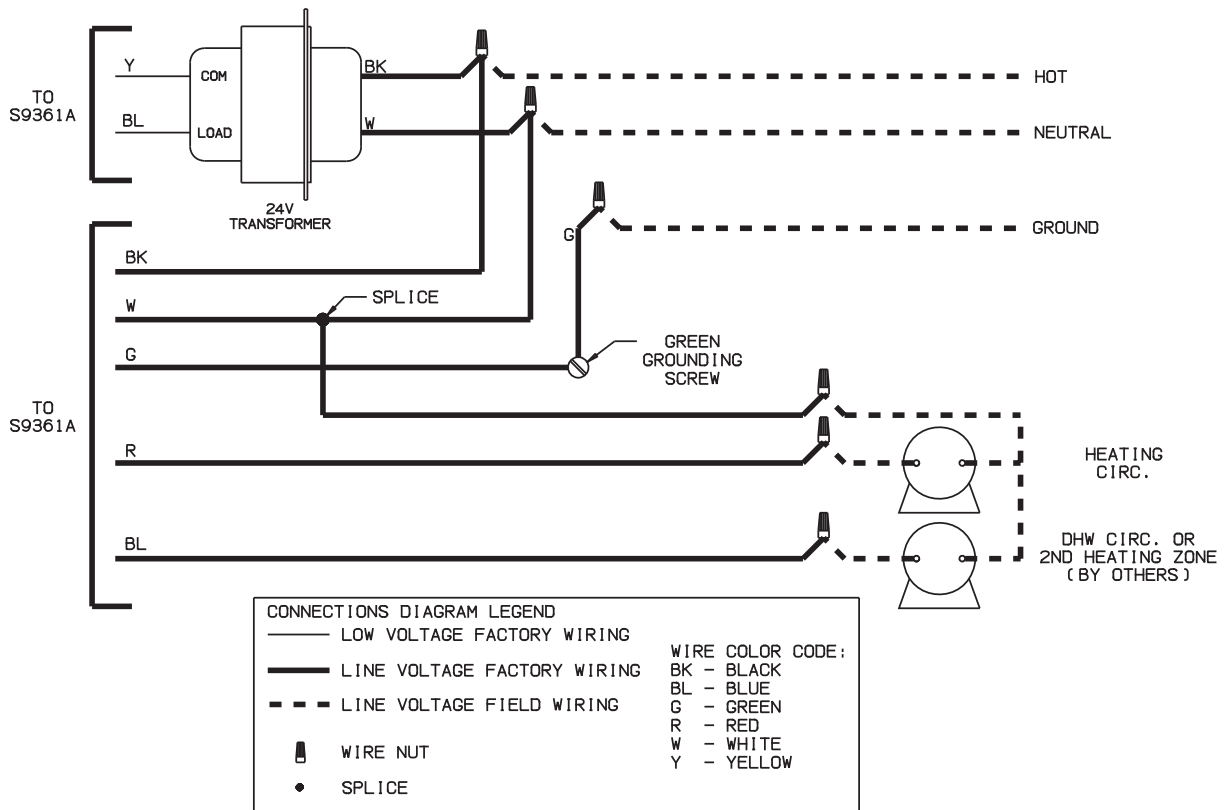


FIGURE 9.0: LINE VOLTAGE FIELD CONNECTIONS

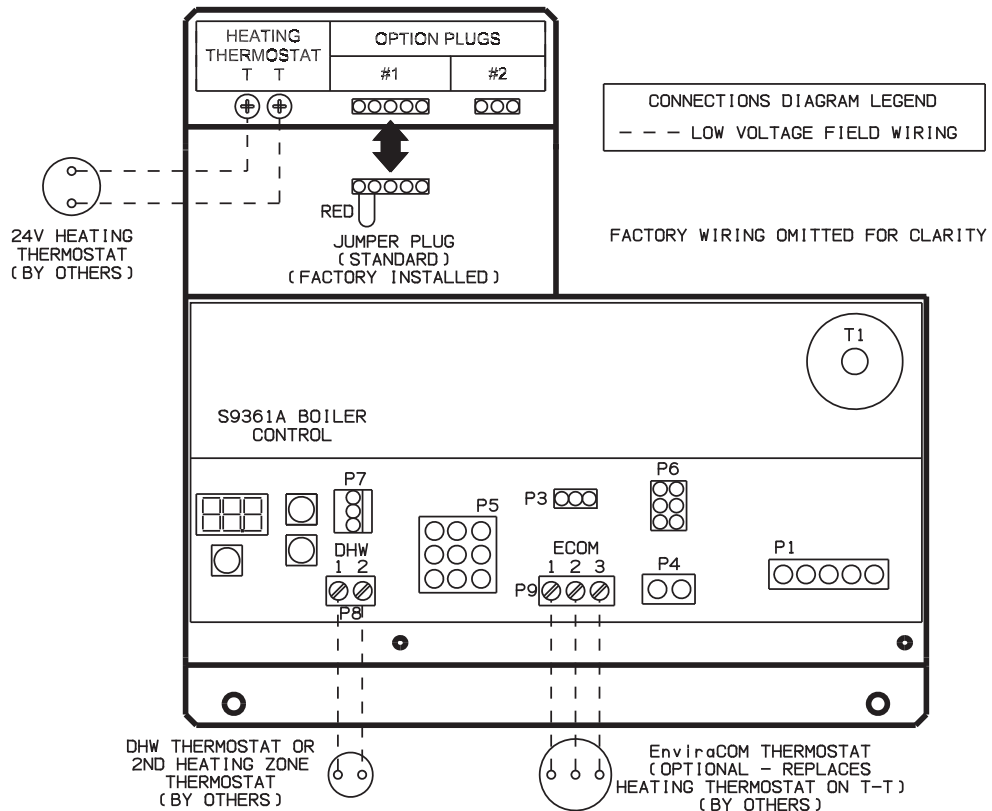
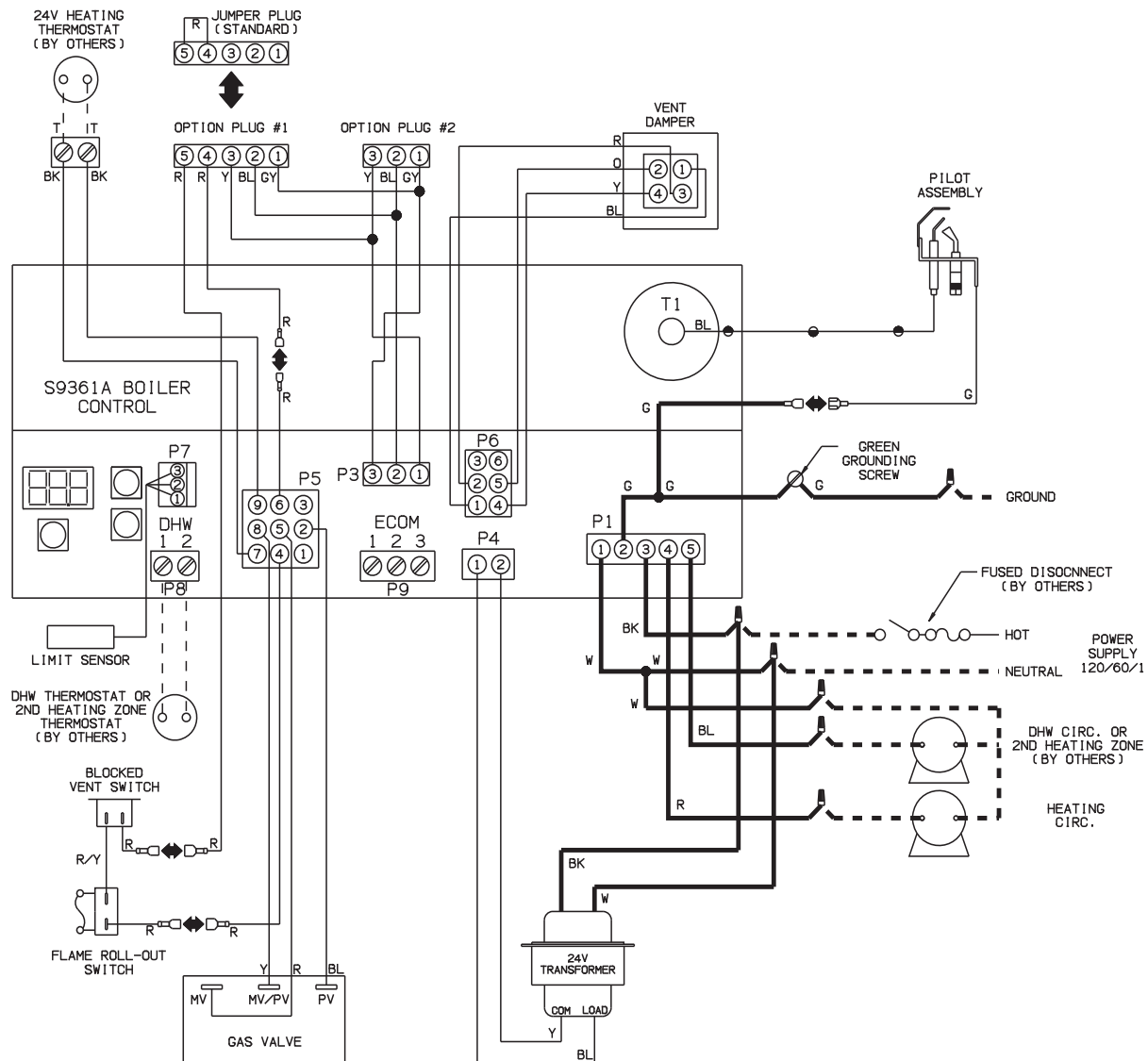


FIGURE 9.1: LOW VOLTAGE FIELD CONNECTIONS



#### CONNECTIONS DIAGRAM LEGEND

- LOW VOLTAGE FACTORY WIRING SIZE 18 AWG TYPE AWM STRANDED WIRE, 105°C
- LINE VOLTAGE FACTORY WIRING SIZE 14 AWG TYPE AWM STRANDED WIRE, 105°C
- — — LINE VOLTAGE FIELD WIRING
- - - LOW VOLTAGE FIELD WIRING
- IGNITOR - 250°C
- ◆ CONNECTOR
- ⊞ WIRE NUT
- SPLICE

**WIRE COLOR CODE:**  
 BK - BLACK  
 BL - BLUE  
 G - GREEN  
 GY - GRAY  
 R - RED  
 W - WHITE  
 Y - YELLOW  
 R/Y - RED W/ YELLOW TRACE

#### NOTES:

1. IF ANY OF THE ORIGINAL WIRE SUPPLIED WITH THE APPLIANCE MUST BE REPLACED, IT MUST BE REPLACED WITH THE SAME TYPE SHOWN OR ITS EQUIVALENT.

FIGURE 9.2: INTERNAL CONNECTIONS DIAGRAM



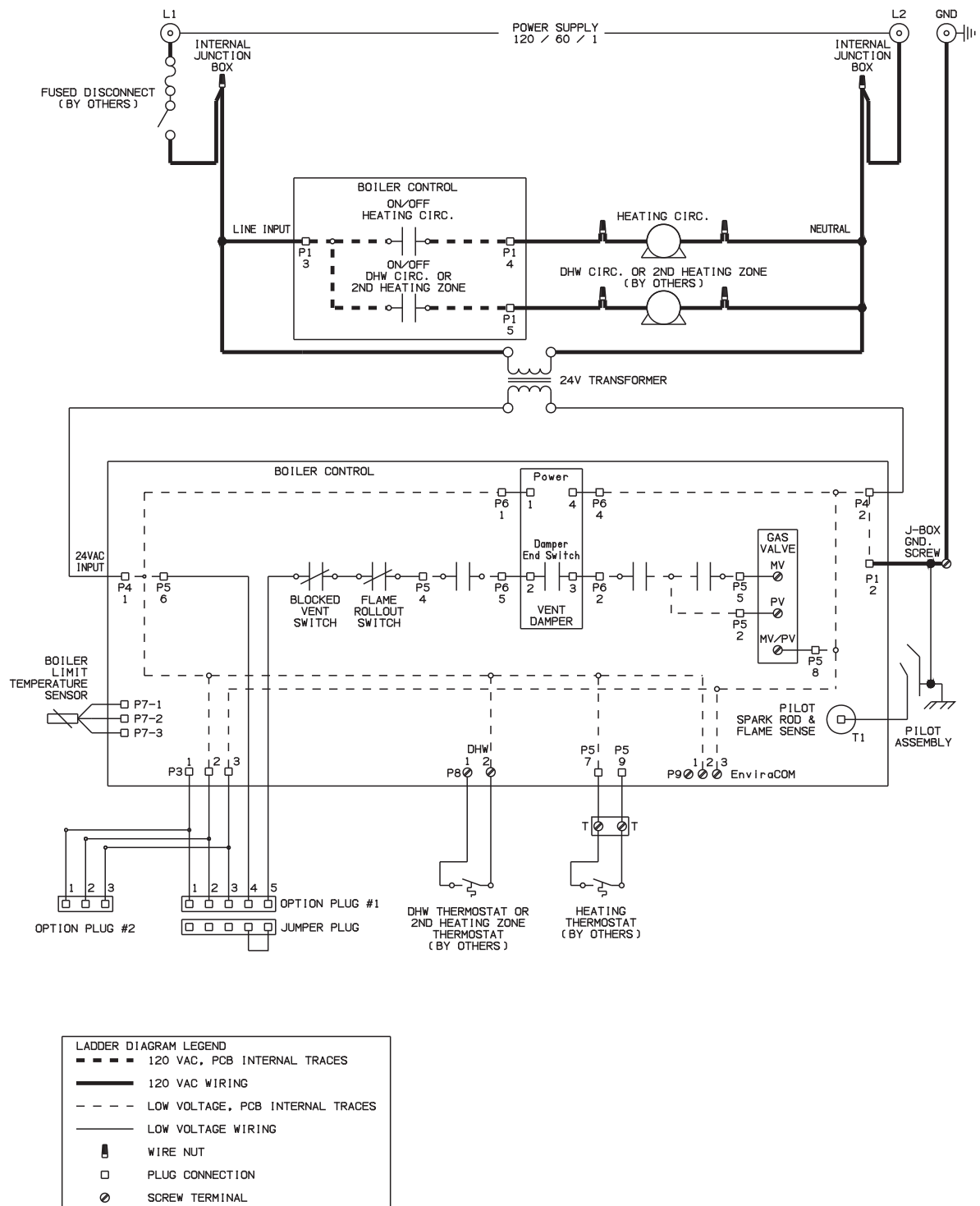


FIGURE 9.3: LADDER DIAGRAM

## X Start-up and Checkout



### WARNING

DO NOT LEAVE THE BOILER IN SERVICE IF IT FAILS ANY OF THE FOLLOWING START-UP CHECKS. DOING SO MAY RESULT IN FIRE, EXPLOSION, OR CARBON MONOXIDE (CO) POISONING.



### WARNING

- GAS LEAKS MAY RESULT IN FIRE OR EXPLOSION.
- NEVER USE A FLAME TO CHECK FOR GAS LEAKS.
- MAKE SURE THAT THE AREA AROUND THE BOILER IS CLEAR AND FREE FROM COMBUSTIBLE MATERIALS, GASOLINE AND OTHER FLAMMABLE VAPORS AND LIQUIDS.
- WATER LEAKS MAY CAUSE EXTENSIVE PROPERTY DAMAGE.

### NOTE

SAFE LIGHTING AND OTHER PERFORMANCE CRITERIA WERE MET WITH THE GAS MANIFOLD AND CONTROL ASSEMBLY PROVIDED ON THE BOILER WHEN THE BOILER UNDERWENT THE TESTS SPECIFIED IN Z21.13.

Use the following procedure for initial start-up of the boiler:

- 1) Make sure that the boiler and system are filled with water.
- 2) Check all gas piping for leaks and purge piping sections that are filled with air. See of the *National Fuel Gas Code* for additional information on testing and purging gas lines.
- 3) Verify that vent system is complete and free of obstructions before attempting to fire boiler.
- 4) Inspect all wiring for loose or uninsulated connections.
- 5) Make sure the main burners are seated properly in the rear of burner tray and on orifices.
- 6) Adjust thermostat to the highest setting.
- 7) Start the boiler using the operating instructions on page 25. The red LED display on boiler control should illuminate as soon as power is applied to the boiler, but it will take approximately 1 minute from the time power is applied to the boiler, and the thermostat is closed, until the first trial for ignition. For additional information on boiler operation, see Section XI.
- 8) Upon initial start-up, the gas train will be filled with air. Even if the gas line has been completely purged of air, it may take several tries for ignition before a flame is established. Once a flame has been established for the first time, subsequent calls for burner operation should result in a flame on the first try.
- 9) Inspect the pilot burner flame. The pilot burner produces three flames. The center one should be a steady medium blue flame covering around 3/8" to 1/2" of spark electrode/flame rod. (Figure 10.1)
- 10) Make sure vent damper is in open position when main burners are firing.
- 11) Inspect the main burner flames visible through the observation port in burner access panel. The flame should be stable and mostly blue (see Figure 10.2). No yellow tipping should be present; however, intermittent flecks of yellow and orange in the flame are normal.
- 12) Check entire gas train for leaks using soap and water or other approved leak detection method while boiler is firing. Fix any leaks found immediately.

## 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

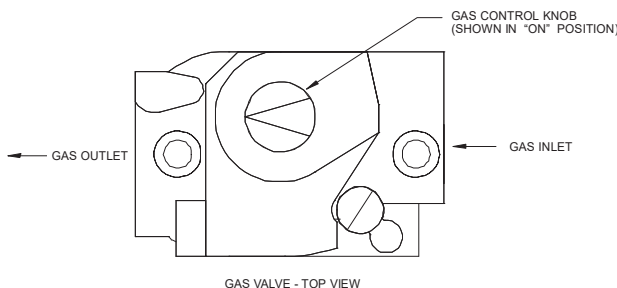
- Do not try to light any appliance.
- Do not touch any electric switch; do not use any phone in your building.
- Immediately call your gas supplier from a neighbor's phone. Follow the gas supplier's instructions.

- If you cannot reach your gas supplier, call the fire department.

- C. Use only your hand to push in or turn the gas control knob. Never use tools. If the knob will not push in or turn by hand, don't try to repair it, call a qualified service technician. Force or attempted repair may result in a fire or explosion.
- D. Do not use this appliance if any part has been under water. Immediately call a qualified service technician to inspect the appliance and to replace any part of the control system and any gas control which has been under water.

## 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. Remove front access panel.
6. Rotate the gas control knob clockwise ↻ to OFF.
7. Wait five (5) minutes to clear out any gas. Then smell for gas, including near the floor. If you then 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. Rotate the gas control knob counter clockwise ↺ to "ON".
9. Replace front access panel.
10. Turn on all electric power to the appliance.
11. Set thermostat to desired setting.
12. If the appliance will not operate, follow the instructions "To Turn Off Gas To Appliance" and call your service technician or gas supplier.

## TO TURN OFF GAS TO APPLIANCE

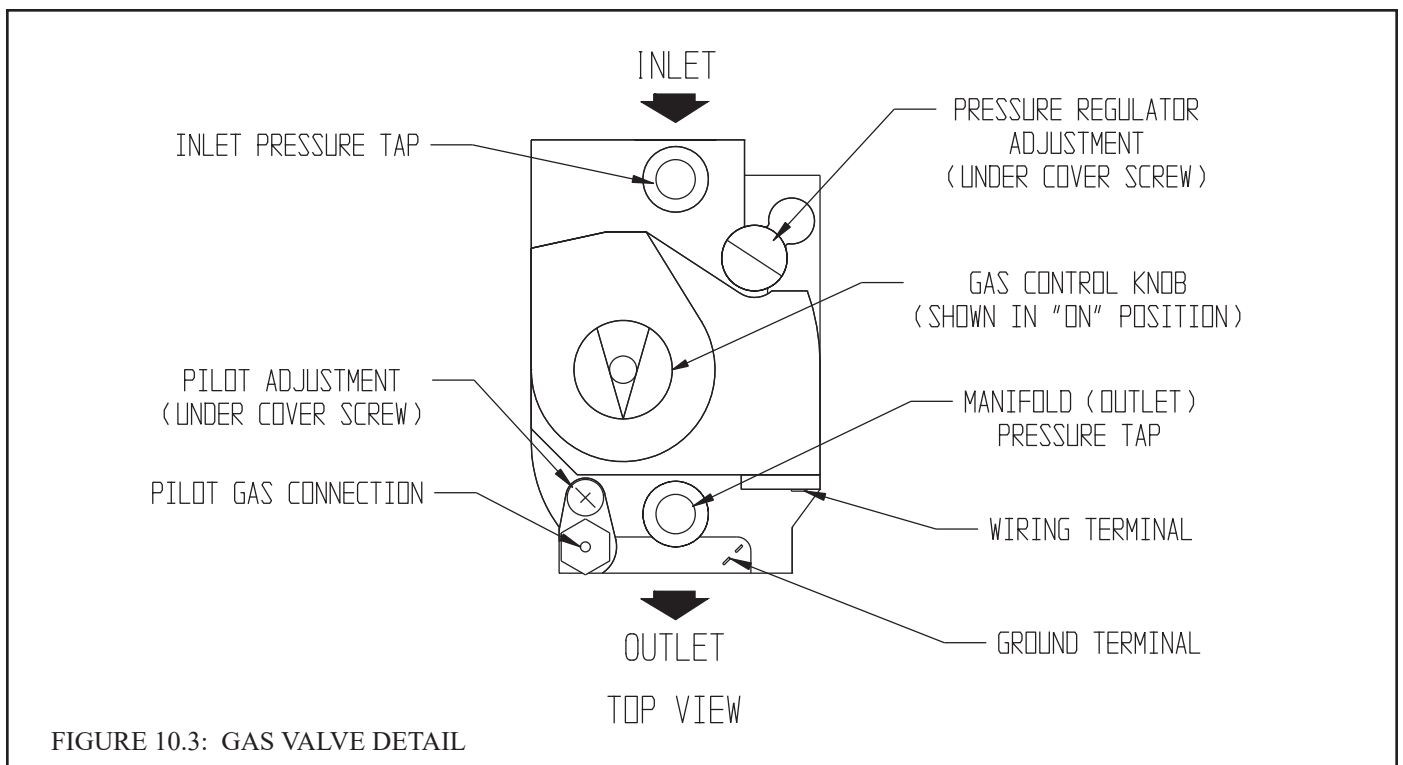
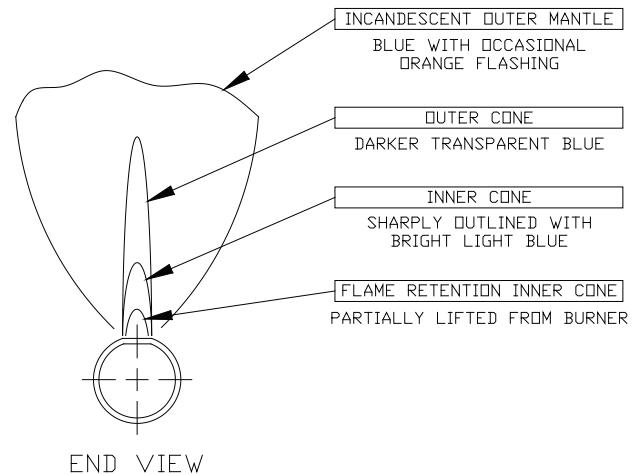
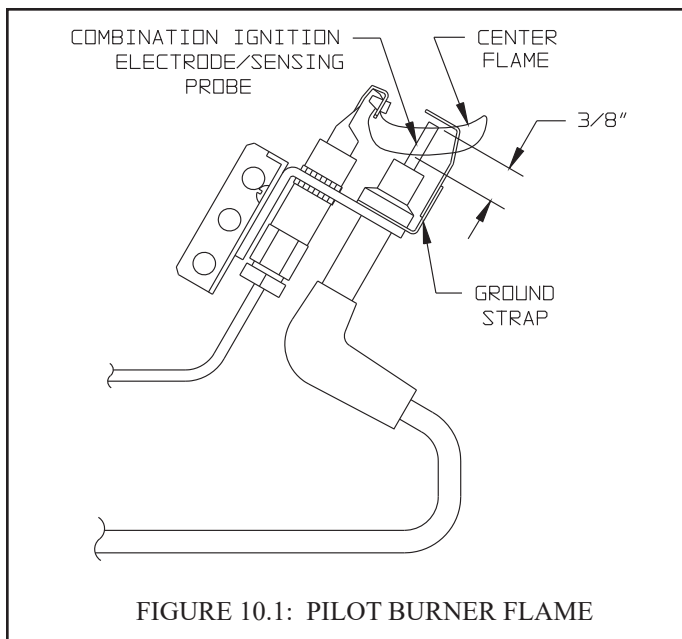
1. Set the thermostat to lowest setting.
2. Turn off all electric power to the appliance if service is to be performed.
3. Push in gas control knob slightly and turn clockwise ↻ to "OFF". Do not Force.

- 13) Run gas valve safety shutdown test. With main burners firing, disconnect ignition cable from ignition module. Both pilot burner and main burners should stop firing.
- 14) Check the manifold pressure and adjust if necessary. To do this, use the following procedure:
  - a) Connect a manometer to the inlet pressure tap on the gas valve (see Figure 10.3).
  - b) Check the line pressure with all gas appliances on and off. The line pressure at the boiler must be within the following limits regardless of what combination of appliances is firing:

Line Press (inches w.c.)	Natural Gas	LP Gas
Min.	5.0	11.0
Max.	14.0	13.0

If the line pressure falls outside of these limits, find and correct the cause of the problem before proceeding further.

- c) Connect a manometer to the manifold (outlet) pressure tap on the gas valve (see Figure 10.3).
  - d) Read the manifold pressure. It should be set at 3.5 in w.c. for natural gas and 10.0 in w.c. for LP
  - e) If a manifold pressure adjustment is needed, make the adjustment by turning the regulator (see Figure 10.3) screw clockwise to raise the pressure and counter clockwise to reduce the pressure. If a manifold pressure adjustment is made, recheck the line pressure to be certain that it is still within acceptable limits. Replace the cover screw on the regulator.
- 15) Test thermostat operation while the boiler is running. Turn the thermostat to the lowest setting. Circulator should stop running and both pilot burner and main burners should stop firing. Raise the thermostat back to the highest setting. Circulator should restart. The pilot burner and main burners should relight.
- 16) Verify high limit operation. Allow the boiler water temperature to increase to high limit setting (factory set to 180F). Circulator should continue running. Both pilot burner and main burners should stop firing when the gauge reading is within 15F of the high limit setting.
- 17) Allow the boiler water temperature to drop below high limit setting. The pilot burner and main burners should relight.
- 18) After the boiler has operated for approximately 30 minutes, check the boiler and heating system piping for leaks. Repair any leaks found at once.
- 19) Inspect the vent system for flue gas leaks and for proper operation. To do this:
  - a) Insofar as practical, close all building doors and windows and all doors between the space in which all the boiler is located and other spaces of the building. Turn on clothes dryers and any other appliance not connected to the same vent system as the boiler. Turn on any exhaust fans, such as range hoods and bathroom exhausts, so they will operate at maximum speed. Close fireplace dampers.
  - b) Place in operation the appliance being inspected. Follow the lighting instructions. Adjust thermostat so the appliance will operate continuously.
  - c) Test for spillage at the draft hood relief opening after five (5) minutes of main burner operation. Use the flame of a match or candle, or smoke from a cigarette, cigar, pipe, etc.
  - d) Repeat (c) for any other appliances connected to the same vent system as the boiler. No spillage should be present with any combination of appliances in operation.
  - e) After it has been determined that the vent system operates properly when tested as outlined above, return doors, windows, exhaust fans, fireplace dampers and any other gas-burning appliances to their previous condition of use.
  - f) Any improper operation of the common venting system should be corrected so the installation conforms with the National Fuel Gas Code, ANSI Z223.1. When resizing any portion of the common venting system, the common venting system should be resized to approach the minimum size as determined using the appropriate tables in Part 10 of the National Fuel Gas Code, ANSI Z223.1.
- 20) Use a combustion analyzer to confirm normal combustion performance. To do this, insert the probe of the combustion analyzer through the draft hood opening and into the area above the block. Slowly wave the probe around in this area to obtain an average sample of the flue products upstream of the draft diverter. Readings obtained should be as shown in Table 10.4
- 21) Verify proper operation of any field installed safety devices, such as low water cut-offs.



Fuel	Max. CO <sub>2</sub> (%)	Min O <sub>2</sub> (%)	Max CO (PPM)
Natural Gas	8.5	6.0	50 PPM
Propane	10.0	5.8	50 PPM

TABLE 10.4: FLUE GAS COMBUSTION READING

# XI Operation

## A. General Information

This boiler uses a proprietary version of the Honeywell S9361A “integrated boiler control” to manage all boiler functions including flame supervision, temperature control, and Circulator operation. This control can operate one or two circulator zones without the use of additional relays.

Crown offers several control options that plug into Option Plugs 1 and 2. These include a touch screen display, low water cut-off kits, and an outdoor reset control. Specific information on these options, along with installation and operating instructions, are available through Crown distributors and at [www.crownboiler.com](http://www.crownboiler.com).

In accordance with the 2007 Energy and Independence Security Act, this control first attempts to use residual heat in the boiler to satisfy a space heating demand before firing the burner. In this manual, this function is referred to as a “thermal purge”. For additional information see Part C of this section.

## B. Reading Status and Using Menu

The boiler’s status, as well as all parameters, are viewed and adjusted using the 3 digit LED and three buttons shown in Figure 11.0. The S9361A has four basic modes of operation (also see Figure 11.1):

- 1) Status Mode - This is the default mode of operation for the control. In it, the display alternates between  $5\text{E}9$  and a number indicating the current status of the boiler. A list and description of these status numbers is shown in Table 11.2 and is also shown on the face of the control itself.
- 2) Operating Mode - Provides additional information about the current status of the boiler. Operating mode is entered by pressing the **I** button shown in Figure 11.0. When this button is first pressed in Status mode, the display will alternately display  $b\text{E}$  and the current boiler water temperature as shown in Figure 11.3. Pressing the **I** button again will display the next line item shown in Table 11.2. In the same manner it is possible to advance through all of the “parameters” shown in Table 11.2. To return to Status mode, press **I** repeatedly until  $5\text{E}9$  once again appears on the display. Alternatively, the control will return to Status mode if no key is touched for 30 minutes.
- 3) Error Mode - In Error mode, the control alternately displays  $E\text{r}$  and an error code. A list of these error codes is found on the front of the control, as well as in Section XIII of this manual (along with suggested corrective actions).
- 4) Adjustment Mode - Used to change parameters, such as high limit setting. See Part C for using Adjustment Mode.

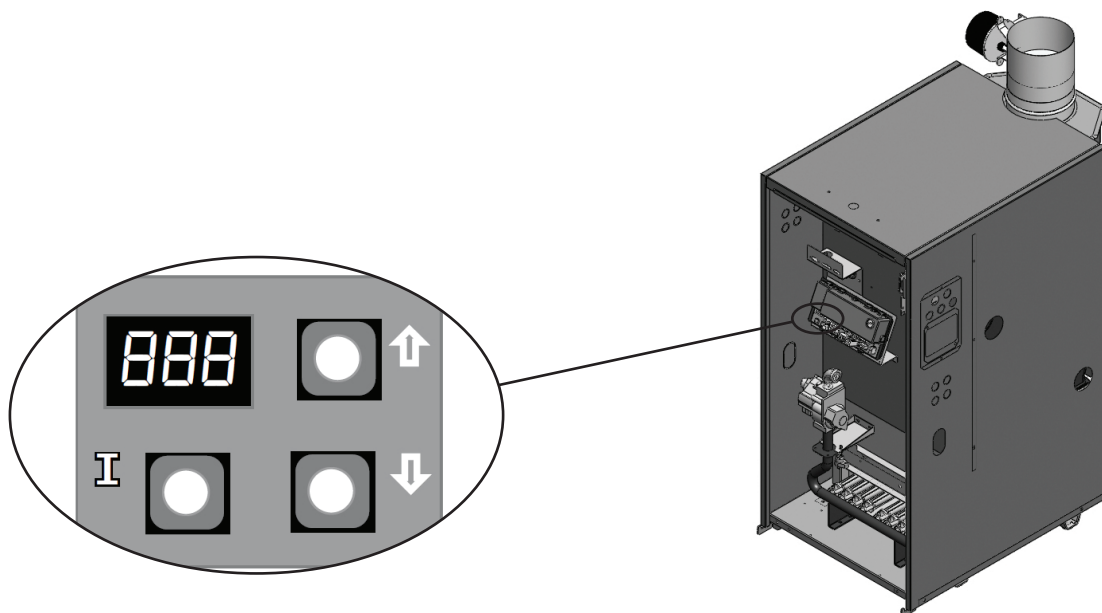
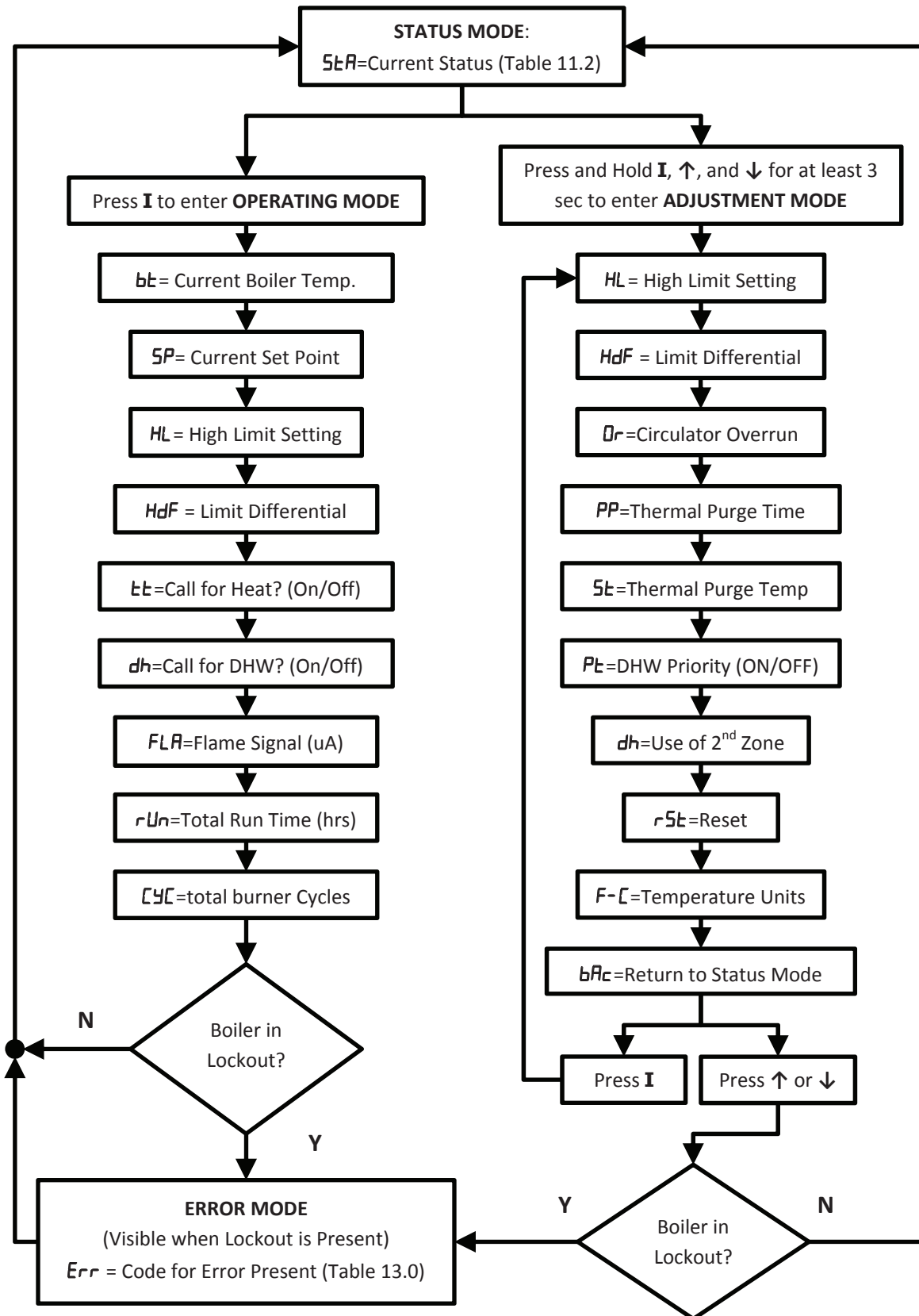


FIGURE 11.0 LOCATION/APPEARANCE OF LED, BUTTONS

FIGURE 11.1: BOILER CONTROL MENU



- Except as shown above, press **I** to navigate through menu.
- Use **↑, ↓** to change parameters in Adjustment Mode

TABLE 11.2: STATUS CODES

Status #	Description	Meaning
1	Standby	No call for heat or DHW OR Call for heat present , but boiler is in thermal purge (See <i>PP</i> on page 32) OR Call for heat/DHW present but boiler temperature is above set point ( <i>SP</i> ) setting.
4	Prepurge	Damper has opened and control is briefly waiting before starting trial for ignition (pre-purge time is 1.7s).
6	Spark	Control is attempting to light pilot
7	Flame proving	Control is verifying that the pilot flame is on and stable.
8	Running	Main burner is on
10	Retry/Recycle Delay	Control was unable to establish pilot and is waiting 5 minutes before trying again OR Proof of pilot was lost after pilot was established and control is waiting 10 seconds before attempting to relight.
13	Soft Lockout	A fault is preventing the boiler from firing. Boiler will be allowed to fire after problem clears itself AND a forced delay period has passed.
14	Hard Lockout	A fault has occurred which requires manual intervention before the boiler will again operate. This intervention can be in the form of interruption of the power supply to the boiler or resetting the control in Adjustment mode.
15	Waiting for limit to close	A call for heat/dhw is present, but there is an open safety device, such as a blocked vent switch, that is preventing the boiler from operating.
16	Flame Present out of Sequence	A flame was detected when none should have been present.
17	Self test	Boiler was just energized and control is running a self check.
18	Waiting for Damper to open	Control is waiting for vent damper to prove open
20	Damper failed to open	Damper failed to prove open 60 seconds after being called to open.

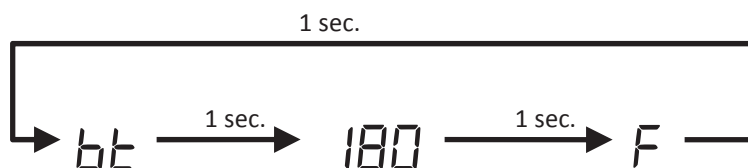


FIGURE 11.3: TYPICAL OPERATING MODE DISPLAY (BOILER TEMP SHOWN)

**NOTE**

In operating mode, holding either the  $\uparrow$  or  $\downarrow$  button while viewing a given parameter will keep the display on the actual reading. For example, pressing  $\uparrow$  while reading boiler temperature as shown in Figure 11.3 will keep the display on 180 for as long as this button is held. This makes it easier to view readings “live” if they are changing rapidly



TABLE 11.4: OPERATING MODE PARAMETERS

Parameter #	Description	Meaning
<i>b<sub>t</sub></i>	Boiler Temperature	Current boiler water temperature measured by the control's sensor.
<i>S<sub>P</sub></i>	Boiler water set point	Current target temperature (always the same as the high limit setting unless Crown outdoor reset card option is installed).
<i>H<sub>L</sub></i>	High Limit Set point	Boiler will stop firing if boiler water temperature exceeds this value (Circulator/s will continue to operate)
<i>H<sub>dF</sub></i>	High Limit Differential	If high limit setting is reached, boiler water temperature will need to drop by this amount before boiler will again fire during the same call for heat.
<i>t<sub>t</sub></i>	Heat Request Status	Shown as either ON or OFF. Indicates whether there is a call for heat.
<i>dh</i>	DHW Request Status	Shown as either ON or OFF. Indicates whether there is a call for domestic hot water (DHW). Note that if the dh zone on the S9361A is used as a second heating zone (see Table 11.5), this parameter will be shown as OFF and it will be shown as ON when this zone calls for heat.
<i>F<sub>LA</sub></i>	Flame Current	Flame rectification signal (uA)
<i>r<sub>Un</sub></i>	Run Time Hours	Total amount of time gas valve has been open (burner firing) since control was new (hours, starting from 1).
<i>C<sub>YC</sub></i>	Boiler Cycles	Total number of burner cycles on the control
<i>E<sub>rr</sub></i>	Error Number	Present only if the control has detected a problem. See Table 13.0 for a list of error codes and suggested corrections.

TABLE 11.5: ADJUSTMENT MODE PARAMETERS

Status #	Description	Factory Setting	Permissible Range
<i>H<sub>L</sub></i>	High Limit Set point	180F	140-220F
<i>d<sub>F</sub></i>	High Limit Differential	15F	10-30F
<i>O<sub>r</sub></i>	Circulator overrun	0 min	0-10 minutes
<i>P<sub>P</sub></i>	Thermal Purge time	2 min	2-20 minutes*
<i>S<sub>t</sub></i>	Thermal Purge Start Temp	140F	140-180F
<i>P<sub>t</sub></i>	DHW Priority	ON	ON or OFF
<i>dh</i>	Use of Second Zone	dh	dh (dhw) or tt2 (2nd heating zone).
<i>r<sub>S<sub>t</sub></sub></i>	Reset	N/A	OFF or Momentary ON
<i>F-<sub>C</sub></i>	Temperature Units	F	F or C
<i>b<sub>A<sub>C</sub></sub></i>	Exit Adj. mode	N/A	N/A

\* Thermal purge time may be reduced to 0 minutes if Crown outdoor reset card is installed.

## C. Using Adjustment Mode



### WARNING

**Improper adjustments to control parameters could result in unreliable boiler operation, property damage, personal injury, or loss of life. Adjustments should only be made by a qualified heating technician.**

A list of parameters which can be changed on this control are shown in Table 11.5. To enter Adjustment mode and change parameters:

- 1) Press and hold **I**, **↑**, **↓** together for at least 3 seconds.
- 2) Use **I** to advance to the parameter which is to be changed.
- 3) Use the **↑** or **↓** buttons to change the setting or select from possible choices. See below for additional information on the use of these parameters.
- 4) If other parameters are to be changed, use the **I** button to advance to the next parameter needing adjustment and change it in the same way.
- 5) After all parameters have been changed, use the **I** button to advance until **bHc** is shown on the display.
- 6) Press either the **↑** or **↓** key to return to Status mode. Alternatively, the control will return to Status mode if no key is touched for 5 minutes.

**HL** (High limit Set point) - Burners shut down if the boiler water temperature exceeds this setting. The circulator will continue to run. Unless the Crown outdoor reset card is installed, the high limit setting also serves as the water temperature set point (**SP**) during calls for both heat and DHW.

**dF** (High limit differential) - If the boiler shuts off on high limit, the water temperature must fall by an amount equal to the differential during the same call for heat before the burners will again start. For example, with HL=180 and dF=15, the burners will shut off if the water temperature exceeds 180F and stay off until the temperature falls to 165F (180 - 15). Note that if all calls for heat end while the burners are off on high limit, the burner will not restart during the next call for heat until the thermal purge requirements described below are met.

**Or** (Circulator Overrun) - Determines how long the Heating Circulator will operate after the call for heat ends. In some cases, this can help reduce energy consumption by sending heat stored in the boiler out into the system. At the same time, caution should be exercised before setting this value to something other than zero. Before doing so, verify that the system will permit flow (e.g. flow is not completely cut-off by closed zone valves) and that the overrun will not cause overheating problems.

Circulator overrun is only possible on the heating zone. The DHW Circulator will not over-run, even if the DHW zone is used as a second heating zone.

**PP** (Thermal Purge Time) - Upon a call for heat, the boiler will prevent burner operation until either:

- The water temperature drops below the Thermal Purge start temperature (**St**) OR:
- The thermal purge time has passed

For some examples of this operation, see Table 11.6. If the “DHW” zone is used for space heating (dh=tt2), this thermal purge function will also keep the burner off at the beginning of a call from the thermostat connected to the “DHW” terminals in the manner described above. If the “DHW” zone is being used for DHW (dh=dh), the burners will immediately come on upon a call for DHW as long as the water temperature is below the high limit setting.

Thermal purge is only invoked when a call for heat first appears and the boiler is not already firing. For this reason, if the boiler is already firing in response to an call for heat, and a call for heat appears at the second zone, the boiler will continue to fire.

**St** (Thermal Purge Start Temperature) - See description for Thermal Purge Time above.

TABLE 11.6 EXAMPLES OF THERMAL PURGE OPERATION

Example #	Call for Heat From	Use of DHW Zone	Thermal Purge Settings		Boiler Temp at Begin Call	Boiler Behavior
			Time (P <sub>t</sub> )	Start Temp (S <sub>t</sub> )		
1	T-T	N/A	2 min.	140F	130	<ul style="list-style-type: none"> <li>• Heating Circulator starts immediately</li> <li>• Burner fires immediately</li> </ul>
2	T-T	N/A	2 min.	140F	150	<ul style="list-style-type: none"> <li>• Heating Circulator starts immediately</li> <li>• Burner fires when either: 2 minutes have passed OR Temperature falls below 140</li> </ul>
3	DHW	DHW (dh=dh)	2 min.	140F	150	<ul style="list-style-type: none"> <li>• DHW Circulator starts immediately</li> <li>• Burner fires immediately</li> </ul>
4	Heat T'stat on DHW terminals	Heat (dh=tt2)	2 min.	140F	150	<ul style="list-style-type: none"> <li>• "DHW" Circulator starts immediately</li> <li>• Burner fires when either: 2 minutes have passed OR Temperature falls below 140</li> </ul>
5	T-T	N/A	2 min.	145F	150	<ul style="list-style-type: none"> <li>• Heating Circulator starts immediately</li> <li>• Burner fires when either: 2 minutes have passed OR Temperature falls below 145</li> </ul>
6	T-T	N/A	3 min.	140	150	<ul style="list-style-type: none"> <li>• Heating Circulator starts immediately</li> <li>• Burner fires when either: 3 minutes have passed OR Temperature falls below 140</li> </ul>

P<sub>t</sub> (DHW Priority) - If this feature is turned on, and simultaneous calls for heat and DHW are present, the heating circulator will be forced off for as long as it takes the boiler to satisfy the call for DHW. This feature is sometimes useful when the boiler size is marginal for the peak DHW demand, but should be used with caution as it can result in lack of heat if the DHW call is very long, or if there is a problem with the DHW zone which causes the DHW demand to be indefinite. Figure 11.7 describes the behavior of both the Heating and DHW Circulators with P<sub>t</sub> turned both ON and OFF.

dh (Use of DHW zone) - Although the second zone on the boiler is designated "DHW", it can be used as a second heating zone by setting dh = "tt2" instead of dh="dh". When the "DHW" zone is used for heating, the thermal purge function is active when this zone calls for heat. When dh = tt2, the setting of P<sub>t</sub> (DHW priority) is ignored.

r<sub>5t</sub> (Reset) - Used to reset the boiler from a hard lockout (as an alternative to momentarily interrupting power to the control). Pressing the up key will turn rst momentarily to on. When it goes back off (typically within one or two seconds), the control is reset.

F-C (Temperature Units) - Determines whether temperature units on the S9361A are displayed in F or C. Note that this selection

TABLE 11.7 SUMMARY OF CIRCULATOR BEHAVIOR

Thermostat Inputs		Use of “DHW” Zone	Parameters		Circulator Outputs	
T-T	“DHW”		2nd Zone (dh)	DHW Priority (Pt)	Heating (Red Circ. Lead)	“DHW” (Blue Circ. Lead)
ON	OFF	DHW	dh=dh	On	ON	OFF
OFF	ON	DHW	dh=dh	On	OFF	ON
ON	ON	DHW	dh=dh	On	OFF	ON
ON	ON	DHW	dh=dh	OFF	ON	ON
ON	OFF	DHW	dh=dh	OFF	ON	OFF
OFF	ON	DHW	dh=dh	OFF	OFF	ON
ON	OFF	Heat	dh=tt2	On or OFF	ON	OFF
OFF	ON	Heat	dh=tt2	On or OFF	OFF	ON
ON	ON	Heat	dh=tt2	On or OFF	ON	ON

only applies to the temperature displayed on the LED shown in Figure 11.0. Temperature units must be selected independently on the displays of any control options plugged into Option Plugs 1 or 2.

**bRc** (Return to Status mode) - Exits adjustment mode. Any changes made to the parameters described above are saved, and become effective, as soon as they are made; bAc only exits adjustment mode.

### D. Sequence of Operation

(Refer to Figures 9.2 or 9.3 for Connection and Ladder diagrams)

- When the boiler is energized, 24 volts is immediately applied to terminals 1 (blue) and 4 (yellow) on the vent damper. Assuming that there is no call for heat, and that the damper switch is in the “automatic” position, the damper will close.
- A call for heat from the thermostat connected to T-T energizes the Heating Circulator (connected to red and white leads in J-box).
- Depending on the boiler water temperature at the time of the call for heat, the control will do one of two things:
  - If the water temperature is below the thermal purge start temperature (5t), the control will continue the ignition sequence.
  - If the boiler water temperature is above the thermal purge start temperature, the boiler will wait until either of the following conditions are met before continuing the ignition sequence:
    - The boiler water temperature falls below the thermal purge start temperature (5t) Factory default is 140F.
    - The thermal purge time elapses (PP). Factory default is 2 minutes.
- If the blocked vent switch, flame roll-out switch, and any external limits connected to Option Plug #1 are made, 24 VAC will be applied across pin terminal 2 (orange) and 4 (yellow) at the vent damper and the damper will open.
- Once the vent damper is fully open, an end switch inside the damper will make, energizing pin 3 (red) at the damper. The control reads 24VAC between this pin and pin 4 (yellow) as proof that the damper has opened.
- The control waits for a 1.7s “prepurge period” to pass before attempting to light the pilot.
- The control starts an ignition spark at the pilot and applies 24 volts across the pilot valve (terminals PV and MV/PV on the gas valve).
- Once the pilot is established, the pilot flame will act as a diode, converting the AC current at the electrode to a half wave DC current at the pilot’s ground strap. This DC current flows through the boiler to the ground connection on the S9361A. For the ignition module to recognize that a pilot flame is present, the DC current flowing into this terminal must be in excess of approximately 1.0 uA.
- If the pilot is not proven within 90 seconds of the beginning of the trial for ignition, the pilot valve will close and wait 5 min-

utes before the ignition sequence is retried.

- 10) Once the ignition module detects the presence of a pilot flame, voltage is applied across the main valve (terminals MV and MV/PV on the valve), opening the valve and establishing main flame.
- 11) If the water temperature climbs above the high limit setting during the call for heat, the burner will shut down, and the vent damper close, while the Heating Circulator continues to operate. The ignition sequence will restart (from Step 4) when the water temperature falls to the high limit setting (*HL*) minus the high limit differential (*HdF*).
- 12) A call for DHW results in a sequence of operation that is identical to that described above except for omission of the thermal purge function described in (3).

### **E. Safety Control Operation**

Blocked Vent Switch - Automatically interrupts main burner operation in the event that a blocked vent causes flue gas to spill from the draft diverter opening. This switch is equipped with a reset button which must be pressed to restore normal burner operation. An open blocked vent switch is indicative of a problem with the vent system and/or the combustion air supply. If the blocked vent switch opens, the cause of this problem must be found and corrected by a qualified gas service technician before the blocked vent switch is reset.

Flame Roll-out Switch - Automatically interrupts boiler operation when flames or excessive heat are present in vestibule. The flame roll-out switch is a single use device which must be replaced by an identical switch in order to restore normal operation. An open flame roll-out switch is usually indicative of a plugged heat exchanger. The cause of the flame roll-out must be found and corrected by a qualified gas service technician, and the switch replaced with an identical one, before the boiler is returned to operation.

## XII Service and Maintenance



### WARNING

- THE BOILER CONTAINS REFRACTORY CERAMIC FIBER, A POSSIBLE HUMAN CARCINOGEN. USE A NIOSH APPROVED RESPIRATOR WHEN SERVICING HIGH-TEMPERATURE INSULATION AND GASKET MATERIALS. WASH EXPOSED SKIN GENTLY WITH SOAP AND WATER AFTER CONTACT. WASH EXPOSED CLOTHING SEPERATE FROM NORMAL LAUNDRY.
- LABEL ALL WIRES PRIOR TO DISCONNECTION WHEN SERVICING CONTROLS. WIRING ERRORS CAN CAUSE IMPROPER AND DANGEROUS OPERATION. VERIFY PROPER OPERATION AFTER SERVICING.
- FAILURE TO MAINTAIN THE BOILER IN PROPER WORKING CONDITION MAY LEAD TO FIRE, EXPLOSION, PERSONAL INJURY OR DEATH AND EXTENSIVE PROPERTY DAMAGE.
- TURN OFF ALL GAS AND ELECTRIC POWER SUPPLIES TO THE BOILER BEFORE SERVICING. CONTACT WITH OR RELEASE OF DANGEROUS FLAMMABLE GAS, ELECTRICAL VOLTAGE, MOVING PARTS AND VERY HOT WATER UNDER PRESSURE MAY CAUSE SERIOUS PERSONAL INJURY, PROPERTY DAMAGE OR DEATH.
- LOCK ELECTRICAL BOXES AND GAS VALVES CLOSED TO PREVENT SOMEONE FROM INADVERTENTLY RESTORING POWER OR GAS BEFORE THE HEATING SYSTEM IS SAFE TO OPERATE.
- WATER LEAKS CAN CAUSE SEVERE CORROSION DAMAGE TO THE BOILER OR OTHER SYSTEM COMPONENTS. REPAIR ANY LEAKS FOUND IMMEDIATELY.

The following routine maintenance should be performed on an annual basis:

- 1) Turn off electrical power and gas supply to the boiler
- 2) Inspect the flue passages for signs of blockage. If there is any carbon in the combustion chamber or the flue passages, clean the heat exchanger before proceeding further. See the cleaning procedure below.
- 3) Remove all burners, noting the location of the pilot main burner. If burners show signs of deterioration, they should be replaced (some discoloration around the burner ports is normal). Clean the burners by first brushing the ports with a soft bristle brush and then vacuuming out any debris through the venturi opening.
- 4) Remove any debris found in the combustion chamber, being careful not to disturb combustion chamber insulation.
- 5) Inspect the pilot assembly. Clean any deposits found on the electrode and grounding strap. The ideal gap between the electrode and the ground strap is 1/8". Inspect the porcelain for cracks or other deterioration. Replace pilot assembly if deterioration is found.
- 6) Inspect the combustion chamber insulation for deterioration.
- 7) Inspect the ignition cable insulation for cracks or other deterioration. If deterioration is found, replace cable.
- 8) Reinstall burners, being careful to put the pilot main burner in its original location.
- 9) Inspect all boiler wiring for loose connections or deterioration.
- 10) Inspect the vent system:
  - Make sure that the vent system is free of obstructions.
  - Make sure that all vent system supports are intact.
  - Inspect joints for signs of condensate or flue gas leakage.
  - Inspect venting components for corrosion or other deterioration. Replace any defective vent components.

- 11) Inspect the boiler and hydronic system for leaks.
- 12) Place the boiler back in operation using the procedure outlined in “Start-up”. Check the pilot line and any other gas piping disturbed during the inspection process for leaks.

### Heat Exchanger Cleaning Procedure



#### WARNING

SOOT DEPOSITS IN THE FLUE PASSAGES ARE A SIGN THAT THE BOILER MAY BE OPERATING AT HIGH CARBON MONOXIDE (CO) LEVELS. AFTER CLEANING THE BOILER OF SOOT DEPOSITS, CHECK THE CO LEVEL IN THE FLUE GAS TO INSURE THAT THE BOILER IS OPERATING PROPERLY.

If it is necessary to check CO, use a combustion analyzer, or other instrument which is designed to measure CO in flue gas. A CO “sniffer” designed for testing CO levels in ambient air cannot be used to check boiler combustion. Take a flue gas sample by inserting a sample probe through the draft diverter opening and into the flue collector so that the sample is taken in the area directly over the heat exchanger. Do not take a sample until the boiler has been firing for at least five minutes. A normal CO reading for an AWR series boiler is less than 50ppm (0.005%). A reading of more than 100ppm (0.01%) is indicative of a combustion problem.

Some causes of excessive CO include:

- Incorrectly sized main burner orifice for the altitude at which boiler is installed
- Crooked or out-of-round orifice holes (never attempt to drill orifice for this boiler in the field)
- Partially plugged flue passages
- Improper manifold pressure
- Foreign material in burner venturis or burner ports
- Leak in seal between flue collector and heat exchanger
- Inadequate supply of combustion air

- 1) Turn off electrical power and gas supply to the boiler.
- 2) Disconnect the damper and vent connector from the boiler.
- 3) Remove the top jacket panel. If possible, remove the rear and left side jacket panels
- 4) Remove the burners.
- 5) Disconnect the wiring at the blocked vent switch.
- 6) Remove the four #10 sheet metal screws holding the flue collector onto the block. Also remove the two #10 sheet metal screws securing the flue collector to the rear jacket panel.
- 7) Remove the flue collector from the heat exchanger.
- 8) Carefully remove the flue collector gasket strips and set them aside.
- 9) Clean the flue passageways using a stiff bristle brush. Be certain that all foreign material is removed from the gaps between the pins.
- 10) Clean the bottom surfaces of the heat exchanger.
- 11) Put a light in the combustion chamber and look through the flue passages from the top to verify that they have been thoroughly cleaned.
- 12) Replace the flue collector gasket strips. If desired, RTV-732 silicone sealant with a 500F intermittent duty temperature rating may be substituted for this rope gasket. The flue collector must be thoroughly sealed to the heat exchanger.
- 13) Reattach the flue collector.
- 14) Reattach all the jacket components.
- 15) Reinstall burners, being careful to put the pilot main burner in its original location.
- 16) Replace the blocked vent switch.
- 17) Reconnect the damper and vent system.

## **XIII Troubleshooting**

### **A. Before Troubleshooting**

The following pages contain trouble shooting tables for use in diagnosing control problems. When using these tables the following should be kept in mind:

- 1) This information is only meant to be used by a professional heating technician as an aid in diagnosing boiler problems.
- 2) Where applicable, follow all precautions outlined in the Section X (Start-up and Checkout).
- 3) In general, these tables assume that there are no loose or miswired electrical connections. Before using these tables inspect all electrical connections on the boiler to make sure that they are tight. Also, check the wiring on the boiler against the wiring diagram in Figures 9.2 and 9.3. Ensure that incoming 120 VAC power polarity is correct and that the boiler is properly grounded. Further, ensure that the control power supply is 24 VAC (minimum 18 VAC to maximum 30 VAC).
- 4) All controls on the boiler are tested at least once in the manufacturing process and a defective control or component is generally the least likely cause. Before replacing a component, try to rule out all other possible causes.
- 5) When checking voltage across at wiring connectors (such as at the vent damper harness plug) be careful not to insert the meter probes into the metal sockets. Doing so may damage the socket, resulting in a loose connection when the harness is reconnected.

### **B. If Display is Blank**

- 1) Check for 24 VAC on transformer secondary connections (screws to which blue and yellow leads are connected). If voltage across these screws is between 18 and 30 VAC, possible causes include:
  - Loose connection at either plug or transformer end of transformer harness (blue/yellow harness).
  - Defective transformer harness
  - Defective boiler control
- 2) If voltage is less than 18VAC at transfer secondary, possible causes include:
  - Service switch off
  - Trip 120VAC breaker
  - Miswired or loose connection in 120VAC boiler circuit.
  - Loose connection inside J-box between transformer primary and 120VAC line.
  - Defective transformer (possibly caused by short circuit in 24VAC wiring or additional loads connected to the transformer in the field).

### **C. If Control Shows *Err* Code**

Use Table 13.0 to help identify and correct the cause of the problem.

### **D. If Control Shows *5EA* Code, but Other Problem Present**

If no *Err* Code is observed (even after repeatedly pressing **I** to cycle through Operation Mode), use Table 13.1 to help identify and correct the cause of the problem.



TABLE 13.0 - ERROR CODES

Error Code	Meaning	Possible Cause
4	Low Flame Signal	<ul style="list-style-type: none"> <li>Low gas pressure at gas valve inlet</li> <li>Partially plugged pilot tubing or pilot orifice</li> <li>Loose connection in ignition cable or ground wiring</li> <li>Dirty pilot electrode/ground strap</li> <li>Pilot electrode porcelain cracked</li> <li>Damaged pilot hood/ assembly</li> <li>Defective control</li> </ul>
6	Pilot Flame detected when no flame should be present	<ul style="list-style-type: none"> <li>Defective gas valve</li> <li>High gas pressure</li> <li>Defective control</li> </ul>
18	Internal electronics failure	<ul style="list-style-type: none"> <li>Possible internal problem with boiler control. Cycle power to the boiler and replace control if problem persists.</li> </ul>
23	Flame sensed during 1.7s pre-purge (before pilot valve opened)	<ul style="list-style-type: none"> <li>Defective gas valve</li> <li>High gas pressure</li> <li>Defective control</li> </ul>
32	Boiler water temperature sensor failure	<ul style="list-style-type: none"> <li>Loose sensor connection at control</li> <li>Defective Sensor</li> <li>Defective control</li> </ul>
35	Duplicate Zone	Error code reserved for future use
55	Damper failed to open after 60s	<ul style="list-style-type: none"> <li>Loose or defective damper harness</li> <li>Obstruction in path of damper blade</li> <li>Defective damper</li> <li>Defective control</li> </ul>
56	Power at end of limit string when it shouldn't be.	<ul style="list-style-type: none"> <li>Control, vent damper, or damper harness is defective. With Error 56 present, and no call for heat, unplug damper harness from control and check for 24VAC between terminal P6-5 on control (see Figure 9.2 for location) and ground. If voltage is present, replace control. If not, inspect the damper harness for shorts or miswired connections. If no harness defect is found, replace vent damper.</li> </ul>
57	Grounded pilot electrode	<ul style="list-style-type: none"> <li>Condensate or foreign material is shorting pilot electrode to ground.</li> <li>Ignition cable insulation is damaged and touching ground.</li> <li>Pilot is damaged</li> </ul>
58	AC Power Frequency Error	<ul style="list-style-type: none"> <li>120VAC power supply frequency is incorrect (Should be 60Hz)</li> <li>120VAC power supply is dirty (consult electrician and/or Utility)</li> <li>Boiler water temperature sensor common (center wire) is damaged and shorted to ground</li> </ul>
59	Line voltage error (Supply voltage too high or low)	<ul style="list-style-type: none"> <li>Power supply voltage is incorrect (should be 120VAC nominal)</li> <li>Defective or incorrect 24VAC transformer</li> <li>Loose 120VAC connection or 24VAC connection between transformer and control</li> </ul>
60	Thermostat input higher than threshold	<ul style="list-style-type: none"> <li>External voltage is applied to thermostat connections (most common cause is external transformer in old thermostat wiring).</li> </ul>
61	Line Voltage Unstable	<ul style="list-style-type: none"> <li>120VAC power supply is dirty (consult electrician and/or Utility)</li> <li>Loose 120VAC connection or 24VAC connection between transformer and control</li> <li>Large electrical loads elsewhere on the installation are switching on and off, causing incoming voltage to swing excessively at boiler.</li> </ul>
63	Maximum recycles exceeded	<ul style="list-style-type: none"> <li>See Error Code 4 above (boiler lost proof of pilot 6 times in a row)</li> </ul>
64	Internal failure	<ul style="list-style-type: none"> <li>Loose or defective damper harness</li> <li>Obstruction in path of damper blade</li> <li>Defective damper</li> <li>Improper pilot operation</li> <li>If problem persists, replace control</li> </ul>
89	EnviraCom communication lost	Communication lost between boiler control and certain Crown control options. Consult Crown control option manual.

TABLE 13.1 - FAULTS WITHOUT ERROR CODE PRESENT

Displayed Codes	Problem	Possible Cause
StA 1 tE OFF dh OFF	Burners and Circulator Off	<ul style="list-style-type: none"> <li>Thermostat/s not calling for heat</li> <li>Loose connection in thermostat, zone valve end switch, or zone panel wiring.</li> <li>Thermostat, zone valve, or zone panel miswired</li> <li>Defective thermostat, zone valve, or zone panel</li> </ul>
StA 1 tE On	Burners Off Circulator On Boiler Warm	<ul style="list-style-type: none"> <li>Boiler off on high limit (normal operation)</li> <li>Boiler off on thermal purge (normal operation - See Table 11.6)</li> </ul>
tE On	Heating Circulator Off	<ul style="list-style-type: none"> <li>Heating Circulator is being forced off on DHW priority (normal operation if Pt=ON - see Table 11.7).</li> <li>See causes for “DHW Circulator off “ below</li> </ul>
dh On	DHW Circulator Off	<ul style="list-style-type: none"> <li>Loose connection in circulator wiring</li> <li>Defective circulator</li> <li>Circulator is running, but system problem is preventing circulation</li> </ul>
StA 15	Burners Off and Damper is closed.	<ul style="list-style-type: none"> <li>Limit or LWCO connected to Option Plug #1 is open.</li> <li>No option is connected at Option Plug #1 and jumper plug (PN 9601830 ) is missing.</li> <li>Blocked vent switch (BVS) open due to problem with vent system, such as a blocked chimney, or a combustion air supply problem. Correct and press reset button on BVS.</li> <li>Flame roll-out switch (FRS) open due to blocked heat exchanger. Correct problem and replace FRS with exact replacement (see parts list)</li> </ul>
StA 6	No spark at pilot	<ul style="list-style-type: none"> <li>Loose connection in ignition cable or pilot ground</li> <li>Damaged electrode porcelain or ignition wire insulation (replace pilot)</li> <li>Pilot electrode or Ground strap damaged (replace pilot)</li> <li>If you cannot hear spark at all , replace control</li> </ul>
StA 6	Spark, but no pilot flame	<ul style="list-style-type: none"> <li>Low inlet gas pressure</li> <li>Plugged, kinked, or leaking pilot tubing</li> <li>Plugged pilot orifice</li> <li>Gas line not purged of air</li> <li>Defective pilot assembly</li> <li>Defective gas valve (before replacing, confirm that there is 24VAC between PV and MV/PV. If there is not, control harness is loose or the control itself is defective).</li> <li>Loose connection in harness between control and gas valve.</li> </ul>
StA 6	Pilot flame present, but spark does not shut off	<ul style="list-style-type: none"> <li>Low inlet gas pressure</li> <li>Partially plugged, kinked, or leaking pilot tubing</li> <li>Partially plugged pilot orifice</li> <li>Loose connection in ignition cable or pilot ground</li> <li>Damaged electrode porcelain or ignition wire insulation (replace pilot)</li> <li>Pilot electrode or Ground strap damaged (replace pilot)</li> <li>Defective Control</li> </ul>
StA 8	Pilot flame present, spark off, but Main Burner does not light at all	<ul style="list-style-type: none"> <li>Loose connection in harness between control and gas valve</li> <li>Defective gas valve (before replacing, confirm that there is 24VAC between MV and MV/PV. If there is not either there is a loose connection in the control harness or the control itself is defective).</li> </ul>
StA 10	Main burner lights, but shuts off immediately	<ul style="list-style-type: none"> <li>Low inlet gas pressure</li> <li>Partially plugged, kinked, or leaking pilot tubing</li> <li>Partially plugged pilot orifice</li> </ul>
StA 10 or StA 13	No spark or pilot	<ul style="list-style-type: none"> <li>Pilot was either never established or proof of pilot was lost after it was lit. Cycle power to the boiler and look for symptoms above.</li> </ul>

## Notes

## XIV PARTS

The following parts may be obtained from any Crown distributor. To find the closest Crown distributor, consult the area Crown representative or the factory at:

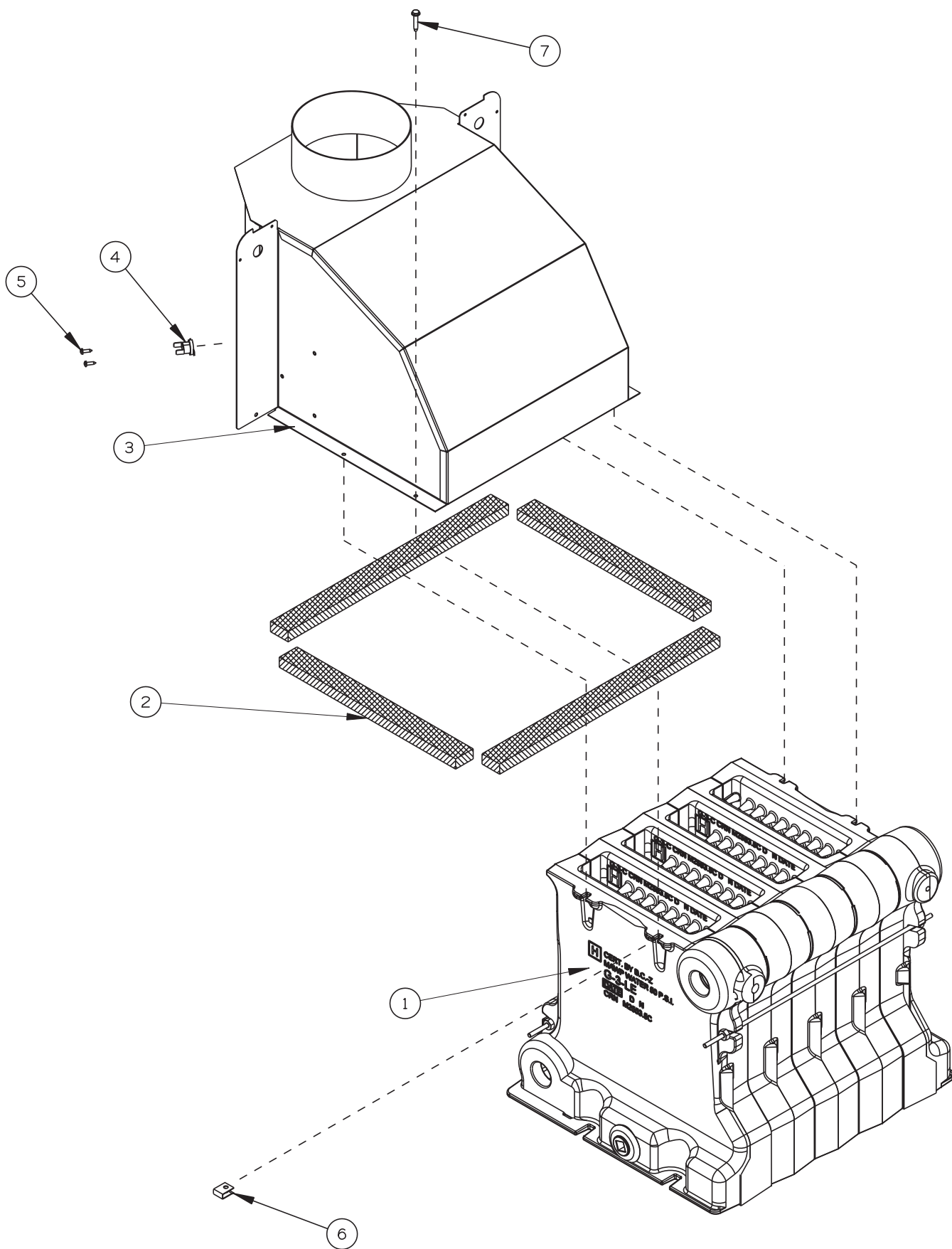
Crown Boiler Co.  
Customer Service  
P.O. Box 14818  
Philadelphia Pa. 19134  
[www.crownboiler.com](http://www.crownboiler.com)

Main burner orifice shown are for sea level configured boilers. For boilers installed at elevations above 2000 ft, consult the local Crown representative or the factory for the correct main burner orifice.

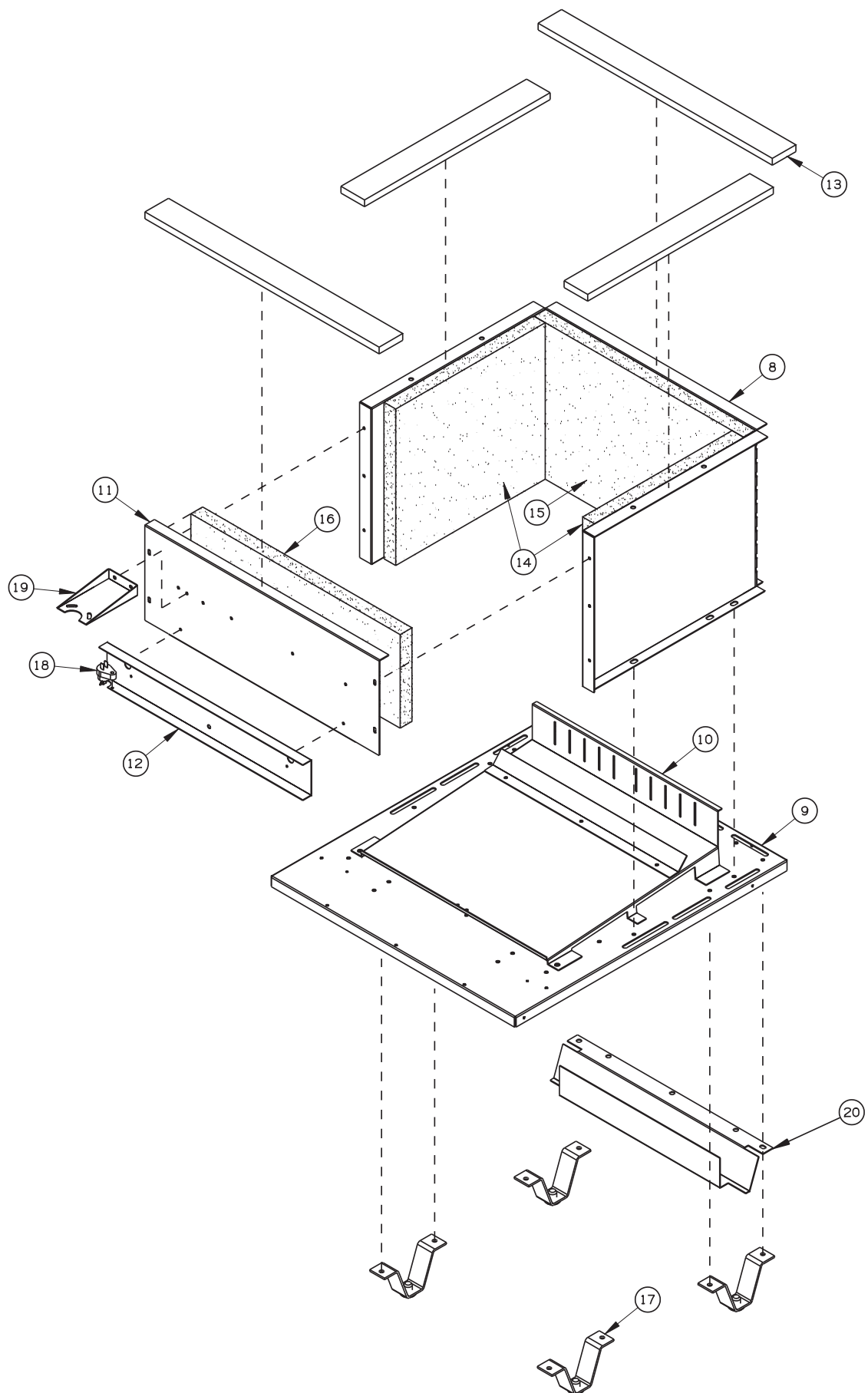
In some cases, the following parts lists do not include Crown part numbers because they were not available at the time of printing. Order these parts by their description, specifying the boiler model number on which they are to be used.

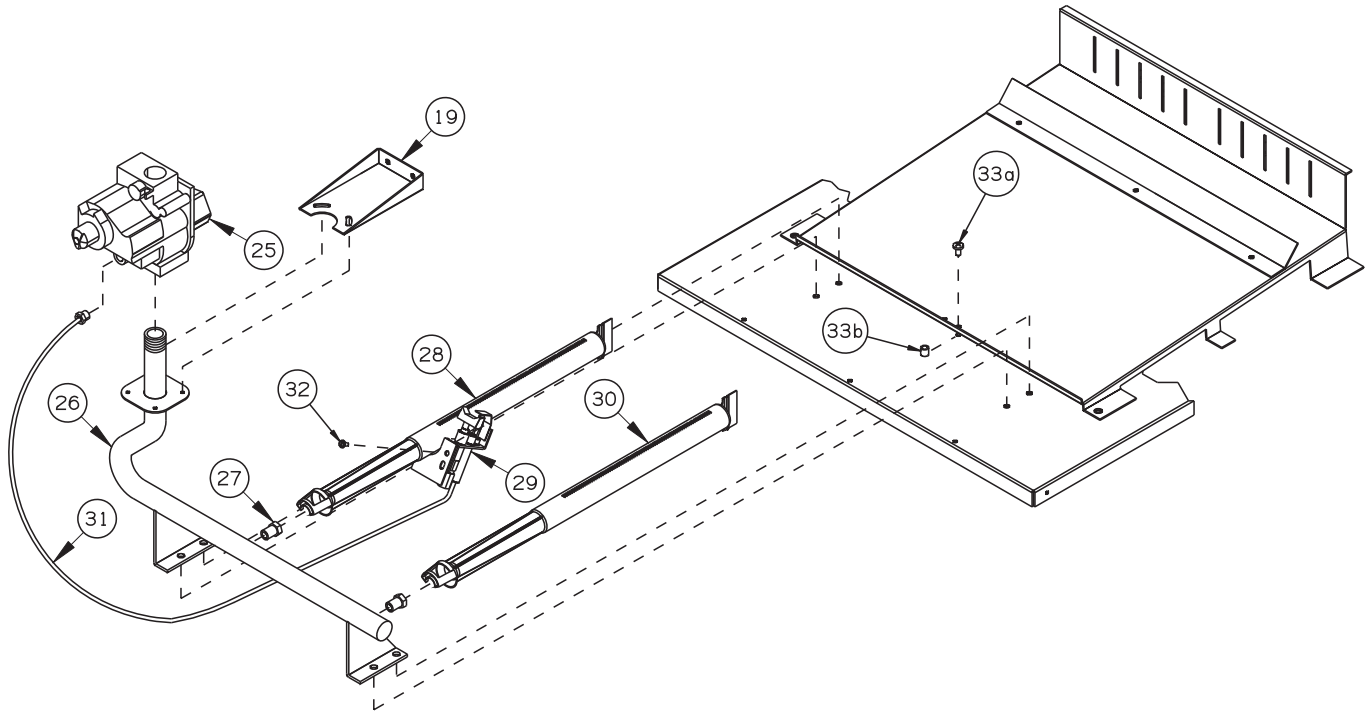
KEY #	DESCRIPTION	QTY. OR CROWN PN	QUANTITY PER BOILER OR CROWN PART NUMBER							
			38	70	105	140	175	210	245	280
1	COMPLETE HEAT EXCHANGER ASSEMBLY	1 EA	760012	760013	760014	760015	760016	760017	760018	760019
*	LEFT END SECTION	760030	1 EA	1 EA	1 EA	1 EA	1 EA	1 EA	1 EA	1 EA
*	RIGHT END SECTION	760031	1 EA	1 EA	1 EA	1 EA	1 EA	1 EA	1 EA	1 EA
*	INTERMEDIATE SECTION	760032		1 EA	2 EA	3 EA	4 EA	5 EA	6 EA	7 EA
*	PUSHNIPPLE	760033	2 EA	4 EA	6 EA	8 EA	10 EA	12 EA	14 EA	16 EA
2	1/2" x 1" SEALING STRIP	900145	2.8 FT	3.3 FT	3.8 FT	4.3 FT	4.6 FT	5.4 FT	5.9 FT	6.4 FT
3	DRAFTHOOD	1 EA	760122	760123	760124	760125	760126	760127	760128	760129
4	BLOCKED VENT SWITCH	960129	1 EA	1 EA	1 EA	1 EA	1 EA	1 EA	1 EA	1 EA
5	6-32 x 1/2" SELF TAPPING SCW	900161	2 EA	2 EA	2 EA	2 EA	2 EA	2 EA	2 EA	2 EA
6	TINNERMAN CLIP	900164	4 EA	4 EA	4 EA	4 EA	4 EA	4 EA	4 EA	4 EA
7	#10 X 1 HWH TYPE B SCREW	900162	4 EA	4 EA	4 EA	4 EA	4 EA	4 EA	4 EA	4 EA

\* NOT PICTURED



KEY #	DESCRIPTION	QTY. OR CROWN PN	QUANTITY PER BOILER OR CROWN PART NUMBER							
			38	70	105	140	175	210	245	280
8	BASE WRAPPER	1 EA	760662	760663	760664	760665	760666	760667	760668	760669
9	BASE TRAY	1 EA	760642	760643	760644	760645	760646	760647	760648	760649
10	BURNER TRAY ASSEMBLY	1 EA	760682	760683	760684	760685	760686	760687	760688	760689
11	BASE FRONT PANEL	1 EA	760602	760603	760604	760605	760606	760607	760608	760609
12	BURNER ACCESS PANEL	1 EA	760622	760623	760624	760625	760626	760627	760628	760629
13	1/2" X 2" SEALING GASKET	900146	3.9 FT	4.4 FT	4.9 FT	5.4 FT	5.9 FT	6.4 FT	7.0 FT	7.5 FT
14	BASE SIDE INSULATION	760520	2 EA	2 EA	2 EA	2 EA	2 EA	2 EA	2 EA	2 EA
15	BASE REAR INSULATION	1 EA	760532	760533	760534	760535	760536	760537	760538	760539
16	BASE FRONT INSULATION	1 EA	760522	760523	760524	760525	760526	760527	760528	760529
17	BASE LEG ASSEMBLY	700110	4 EA	4 EA	4 EA	4 EA	4 EA	4 EA	4 EA	4 EA
18	ROLL-OUT SWITCH G4AM0600240C	960122	1 EA	1 EA	1 EA	1 EA	1 EA	1 EA	1 EA	1 EA
19	MANIFOLD SUPPORT BRACKET	760150	1 EA	1 EA	1 EA	1 EA	1 EA	1 EA	1 EA	1 EA
20	REAR BASE DAM	1 EA	760612	760613	760614	760615	760616	760617	760618	760619



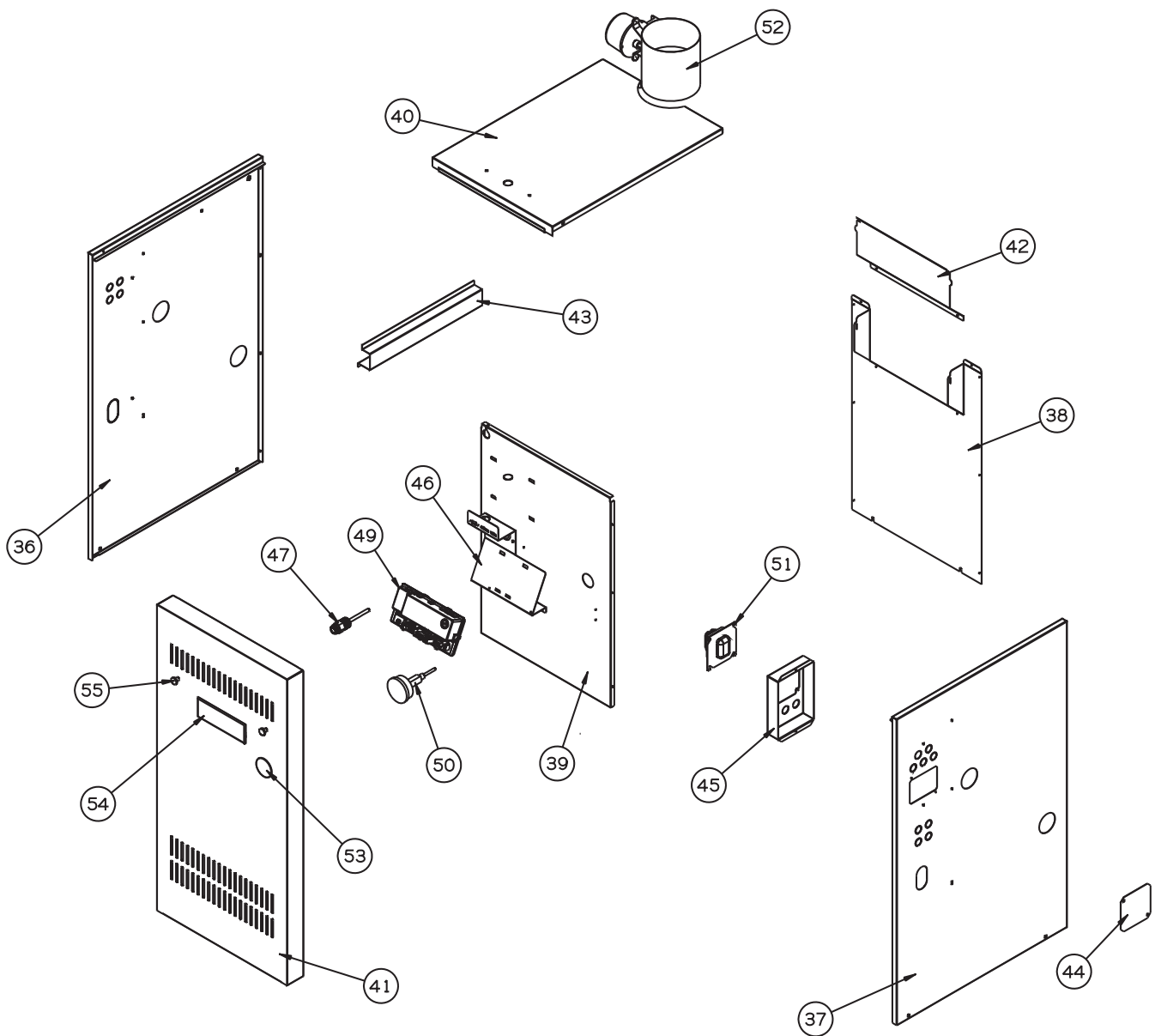


KEY #	DESCRIPTION	QTY. OR CROWN PN	QUANTITY PER BOILER OR CROWN PART NUMBER							
			38	70	105	140	175	210	245	280
25	GAS VALVE (NAT. GAS) ** HONEYWELL VR8204C6000	3507020	1 EA	1 EA	1 EA	1 EA	1 EA			
25	GAS VALVE (NAT. GAS) ** HONEYWELL VR8304P4298	3507120						1 EA	1 EA	1 EA
25	GAS VALVE (LP GAS) ** HONEYWELL VR8204C6018	3507220	1 EA	1 EA	1 EA	1 EA	1 EA			
25	GAS VALVE (LP GAS) ** HONEYWELL VR8304P4280	3507240						1 EA	1 EA	1 EA
26	GAS MANIFOLD	1 EA	760152	760153	760154	760155	760156	760157	760158	760159
27	NAT GAS ORIFICE # 46 DRILL	950302	2 EA							
27	NAT GAS ORIFICE # 47 DRILL	950303		4 EA	6 EA	8 EA	10 EA	12 EA	14 EA	16 EA
27	LP GAS ORIFICE 1.25MM DRILL	950345	2 EA							
27	LP GAS ORIFICE 1.20MM DRILL	950346		4 EA	6 EA	8 EA	10 EA	12 EA	14 EA	16 EA
28	PILOT BURNER	150760	1 EA	1 EA	1 EA	1 EA	1 EA	1 EA	1 EA	1 EA
29	PILOT ASSEMBLY - NAT GAS HONEYWELL Q3481B1636	3504080	1 EA	1 EA	1 EA	1 EA	1 EA	1 EA	1 EA	1 EA
29	PILOT ASSEMBLY - LP GAS HONEYWELL Q3481B1511	3504085	1 EA	1 EA	1 EA	1 EA	1 EA	1 EA	1 EA	1 EA
30	MAIN BURNER	150761	1 EA	3 EA	5 EA	7 EA	9 EA	11 EA	13 EA	15 EA
31	3/16" PILOT TUBING	1 EA	900035	900035	900035	900035	900035	900035	900036	900036
32	10-32 X 3/16 HX HD SCREW	146-95-301	1 EA	1 EA	1 EA	1 EA	1 EA	1 EA	1 EA	1 EA
33a	10-32 X 5/8 PHIL PAN HD SCW	900160					1 EA	1 EA	1 EA	1 EA
33b	#10 X 5/16" SPACER	960057					1 EA	1 EA	1 EA	1 EA

\* NOT PICTURED

\*\* REQUIRES CROWN PN 3501160 3/16" COMPRESSION FITTING WHEN USED WITH 3/16" PILOT TUBING





KEY #	DESCRIPTION	QTY. OR CROWN PN	QUANTITY PER BOILER OR CROWN PART NUMBER							
			38	70	105	140	175	210	245	280
36	LEFT SIDE JACKET PANEL	760301	1 EA	1 EA	1 EA	1 EA	1 EA	1 EA	1 EA	1 EA
37	RIGHT SIDE JACKET PANEL	760300	1 EA	1 EA	1 EA	1 EA	1 EA	1 EA	1 EA	1 EA
38	REAR JACKET PANEL	1 EA	760302	760303	760304	760305	760306	760307	760308	760309
39	VESTIBULE PANEL	1 EA	760332	760333	760334	760335	760336	760337	760338	760339
40	TOP JACKET PANEL	1 EA	760322	760323	760324	760325	760326	760327	760328	760329
41	FRONT DOOR PANEL	1 EA	760312	760313	760314	760315	760316	760317	760318	760319
42	REAR DISCHARGE PANEL	1 EA	760342	760343	760344	760345	760346	760347	760348	760349
43	WIRE SHIELD	760352	1 EA	1 EA	1 EA	1 EA	1 EA	1 EA	1 EA	1 EA

KEY #	DESCRIPTION	QTY. OR CROWN PN	QUANTITY PER BOILER OR CROWN PART NUMBER							
			38	70	105	140	175	210	245	280
44	JUNCTION BOX COVER PLATE	760902	1 EA	1 EA	1 EA	1 EA	1 EA	1 EA	1 EA	1 EA
45	JUNCTION BOX	760901	1 EA	1 EA	1 EA	1 EA	1 EA	1 EA	1 EA	1 EA
46	IGNITION MODULE BRACKET	760900	1 EA	1 EA	1 EA	1 EA	1 EA	1 EA	1 EA	1 EA
47	1/2" SHORT WELL	35-1005	1 EA	1 EA	1 EA	1 EA	1 EA	1 EA	1 EA	1 EA
49	INTEGRATED BOILER CONTROL (ATMOSPHERIC) (HONEYWELL S9361A2076)	3505076	1 EA	1 EA	1 EA	1 EA	1 EA	1 EA	1 EA	1 EA
*	12" SENSOR (HONEYWELL 50001464-001/B)	350076	1 EA	1 EA	1 EA	1 EA	1 EA	1 EA	1 EA	1 EA
*	SENSOR CLAMP (HONEYWELL)	350077	1 EA	1 EA	1 EA	1 EA	1 EA	1 EA	1 EA	1 EA
50	TRIDICATOR GAUGE	95-038	1 EA	1 EA	1 EA	1 EA	1 EA	1 EA	1 EA	1 EA
51	TRANSFORMER (HONEYWELL AT72D1006)	35-2100	1 EA	1 EA	1 EA	1 EA	1 EA	1 EA	1 EA	1 EA
52	VENT DAMPER	1 EA	96-030	96-030	96-031	96-032	96-033	96-033	96-035	96-035
53	HEYCO 2" WINDOW	900723	1 EA	1 EA	1 EA	1 EA	1 EA	1 EA	1 EA	1 EA
54	CROWN NAMEPLATE	98-004	1 EA	1 EA	1 EA	1 EA	1 EA	1 EA	1 EA	1 EA
55	DOOR KNOB	90-210	2 EA	2 EA	2 EA	2 EA	2 EA	2 EA	2 EA	2 EA
*	3/4" RELIEF VALVE - 30 PSI	95-040	1 EA	1 EA	1 EA	1 EA	1 EA	1 EA	1 EA	1 EA
*	CIRCULATOR (TACO 007)	95-012	1 EA	1 EA	1 EA	1 EA	1 EA	1 EA	1 EA	1 EA
*	TACO FLANGE SET	95-014	1 EA	1 EA	1 EA	1 EA	1 EA	1 EA	1 EA	1 EA
*	BOILER CONTROL HARNESS	9601800	1 EA	1 EA	1 EA	1 EA	1 EA	1 EA	1 EA	1 EA
*	GROUND WIRE HARNESS	9601101	1 EA	1 EA	1 EA	1 EA	1 EA	1 EA	1 EA	1 EA
*	2-POLE TERMINAL STRIP	960099	1 EA	1 EA	1 EA	1 EA	1 EA	1 EA	1 EA	1 EA
*	BLOCKED VENT SWITCH/ FLAME ROLLOUT SWITCH HARNESS	9601805	1 EA	1 EA	1 EA	1 EA	1 EA	1 EA	1 EA	1 EA
*	ECOM/LIMIT HARNESS	9601810	1 EA	1 EA	1 EA	1 EA	1 EA	1 EA	1 EA	1 EA
*	LIMIT JUMPER HARNESS	9601830	1 EA	1 EA	1 EA	1 EA	1 EA	1 EA	1 EA	1 EA
*	POWER & CIRC. HARNESS	1 EA	9601840	9601840	9601840	9601840	9601841	9601841	9601841	9601841
*	VENT DAMPER HARNESS	9601850	1 EA	1 EA	1 EA	1 EA	1 EA	1 EA	1 EA	1 EA
*	TRANSFORMER HARNESS	1 EA	9601855	9601855	9601855	9601855	9601856	9601856	9601856	9601856

\* NOT PICTURED



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