

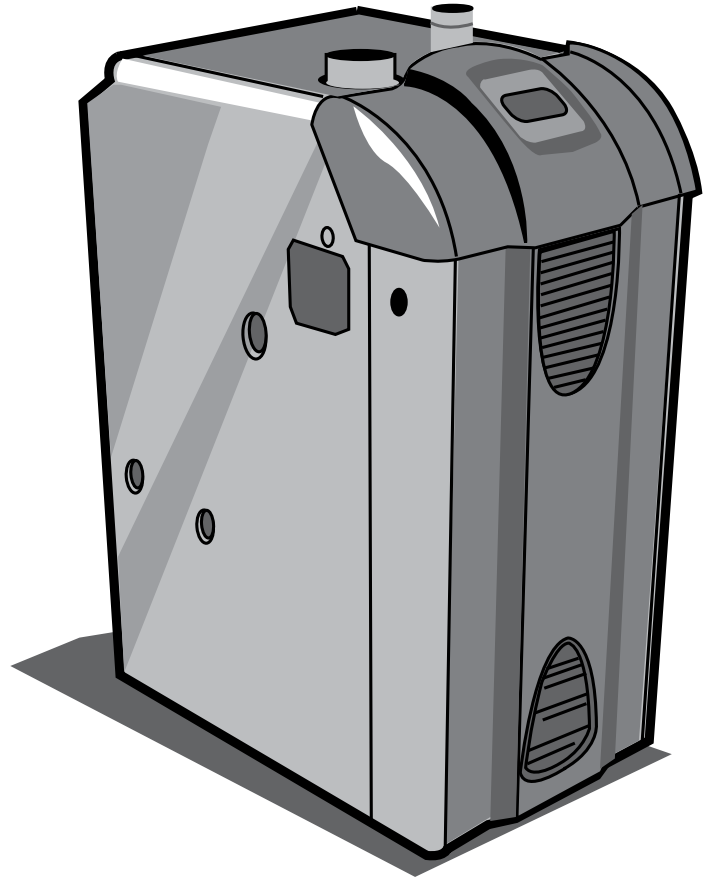
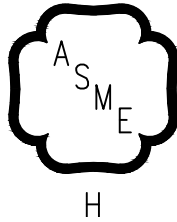
# INSTALLATION, OPERATING AND SERVICE INSTRUCTIONS FOR

## ESC™

### ENHANCED SEALED COMBUSTION Gas - Fired Boiler



**Intertek**  
9700609



For service or repairs to boiler, call your heating contractor. When seeking information on boiler, provide Boiler Model Number and Serial Number as shown on Rating Label.

Boiler Model Number <b>ESC_C</b>	Boiler Serial Number	Installation Date
Heating Contractor		Phone Number
Address		





## 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. If you must leave your home unattended for an extended time

when outdoor temperatures are below 32°F, first turn off your home's main water supply and drain the water from all pipes.

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, including your boiler. 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 heat load. 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.

1. Installation must conform to requirements of authority having jurisdiction or, in the absence of such requirements, with the *National Fuel Gas Code*, ANSI Z223.1/ NFPA 54.
2. Where required by authority having jurisdiction, the installation must conform to Standard for *Controls and Safety Devices for Automatically Fired Boilers*, ANSI/ASME CSD-1.
3. ALL WIRING must be in accordance with requirements of authority having jurisdiction or, in the absence of such requirements, with the *National Electrical Code* ANSI/NFPA 70.

### INSTALLING CONTRACTOR IS RESPONSIBILITY

to verify that all controls are correctly installed and are operating properly when installation is complete.

1. Limit Sensor Fully inserted.  
Failure to properly install limit sensor may result in property damage, personal injury or loss of life due to elevated operating temperatures and/or pressures.
2. Safety relief valve installed in supply water manifold.

## Special Installation Requirements for Massachusetts

- A. For all side wall horizontally vented gas fueled equipment installed in every dwelling, building or structure used in whole or in part for residential purposes and where the side wall exhaust vent termination is less than seven (7) feet above grade, the following requirements shall be satisfied:
1. If there is no carbon monoxide detector with an alarm already installed in compliance with the most current edition of NFPA 720, NFPA 70 and the Massachusetts State Building Code in the residential unit served by the side wall horizontally vented gas fueled equipment, a battery operated carbon monoxide detector with an alarm shall be installed in compliance with the most current edition of NFPA 720, NFPA 70 and the Massachusetts State Building Code.
  2. In addition to the above requirements, if there is not one already present, a carbon monoxide detector with an alarm and a battery back-up shall be installed and located in accordance with the installation requirements supplied with the detector on the floor level where the gas equipment is installed. The carbon monoxide detector with an alarm shall comply with 527 CMR, ANSI/UL 2034 Standards or CSA 6.19 and the most current edition of NFPA 720. In the event that the requirements of this subdivision can not be met at the time of the completion of the installation of the equipment, the installer shall have a period of thirty (30) days to comply with this requirement; provided, however, that during said thirty (30) day period, a battery operated carbon monoxide detector with an alarm shall be installed in compliance with the most current edition of NFPA 720, NFPA 70 and the Massachusetts State Building Code. In the event that the side wall horizontally vented gas fueled equipment is installed in a crawl space or an attic, the carbon monoxide detector may be installed on the next adjacent habitable floor level. Such detector may be a battery operated carbon monoxide detector with an alarm and shall be installed in compliance with the most current edition of NFPA 720, NFPA 70 and the Massachusetts State Building Code.
  3. A metal or plastic identification plate shall be permanently mounted to the exterior of the building at a minimum height of eight (8) feet above grade directly in line with the exhaust vent terminal for the horizontally vented gas fueled heating appliance or equipment. The sign shall read, in print size no less than one-half (1/2) inch in size, **“GAS VENT DIRECTLY BELOW. KEEP CLEAR OF ALL OBSTRUCTIONS”**.
  4. A final inspection by the state or local gas inspector of the side wall horizontally vented equipment shall not be performed until proof is provided that the state or local electrical inspector having jurisdiction has granted a permit for installation of carbon monoxide detectors and alarms as required above.
- B. EXEMPTIONS: The following equipment is exempt from 248 CMR 5.08(2)(a) 1 through 4:
1. The equipment listed in Chapter 10 entitled “Equipment Not Required To Be Vented” in the most current edition of NFPA 54 as adopted by the Board; and
  2. Product Approved side wall horizontally vented gas fueled equipment installed in a room or structure separate from the dwelling, building or structure used in whole or in part for residential purposes.
- C. When the manufacturer of Product Approved side wall horizontally vented gas equipment provides a venting system design or venting system components with the equipment, the instructions for installation of the equipment and the venting system shall include:
1. A complete parts list for the venting system design or venting system; and
  2. Detailed instructions for the installation of the venting system design or the venting system components.
- D. When the manufacturer of a Product Approved side wall horizontally vented gas fueled equipment does not provide the parts for venting flue gases, but identifies “special venting systems”, the following shall be satisfied:
1. The referenced “special venting system” instructions shall be included with the appliance or equipment installation instructions; and
  2. The “special venting systems” shall be Product Approved by the Board, and the instructions for that system shall include a parts list and detailed installation instructions.
- E. A copy of all installation instructions for all Product Approved side wall horizontally vented gas fueled equipment, all venting instructions, all parts lists for venting instructions, and/or all venting design instructions shall remain with the appliance or equipment at the completion of the installation.

Congratulations on your purchase of a new ESC™ boiler—designed and constructed to provide you with years of reliable service.

- *Cast iron heat exchanger* – for reliability and durability, nothing beats a cast iron heat exchanger.
- *IQ Control™ System* – the most advanced and easiest to use control available.
- *System-friendly* – built-in protection from condensation and thermal shock.

### **\*IQ Control System Overview**

ESC Boiler uses a microprocessor based control system called the "IQ Control System". This "IQ Control System" consists of an Intelligent Hydronic Control Control (Control) and an IQ Option Panel (Option Panel) with optional "plug-in" IQ Option Cards (Option Card). The IQ Control System fully integrates both factory and field installed components, simplifying installation and troubleshooting. The IQ Control System is designed to efficiently operate the entire boiler system to save energy, installation and setup time while ensuring adequate supply of heat and domestic hot water.


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#### **What's in the crate?**

1. ESC™ Boiler
2. Circulator & Gasket Kit
  - Taco 007-2 (8056170)
  - Grundfos UP-15 (102805-01)
  - B & G NRF-22 (8056174)
3. Miscellaneous Parts Carton
  - Cartons Include:
    - (1) Safety Relief Valve, Set at 30 PSI
    - (1) Pressure/Temperature Gauge
    - (1) Water Manifold
    - (1) Circulator Harness
    - (1) Vent Connector
    - (1) Vent Terminal (tee required 6-9 products)
    - (1) Air Intake Terminal
    - (1) Drain Valve
4. Instruction Envelope (103787-01)
  - Instruction & Operation Manual (103788-04)
  - Warranty Sheet (103203-01)

## SPECIFICATIONS

### Ratings

<b>ESC Series</b>				
Boiler Model	Input (MBH)	Heating Capacity (MBH)	Net AHRI Rating, Water (MBH) <sup>(1)</sup>	AFUE (%)
ESC3C	60.8	52	45	85.5
ESC4C	91.2	78	68	85.4
ESC5C	121.6	104	90	85.3
ESC6C	152.0	130	113	85.2
ESC7C	182.4	156	136	85.0
ESC8C	212.8	180	157	84.5
ESC9C	243.2	206	179	84.0

<sup>(1)</sup> Net AHRI Water Ratings shown based on piping and pickup allowance of 1.15. Consult manufacturer before selecting boiler for installations having unusual piping and pickup requirements, such as intermittent system operation, extensive piping systems, etc.

### Electrical Requirements: 120VAC, 60 Hz, 1-ph, 15A

Maximum Allowable Working Pressure - 50 psi. Boiler shipped from factory with a 30 psi relief valve.

### Dimensions, Weights and Connections

Boiler Model	Depth	Width	Height	Supply NPT (inch)	Return NPT (inch)	Vent (inch)	Air Intake (inch)	Gas NPT (inch)	Relief Valve NPT (inch)	Drain IPS (inch)
ESC3C	33	12¾	41	1¼	1¼	3	3	½	¾	¾
ESC4C	33	15½	41	1¼	1¼	3	3	½	¾	¾
ESC5C	33	18½	41	1¼	1¼	3	4	½	¾	¾
ESC6C	33	21½	41	1¼	1¼	3	4	½	¾	¾
ESC7C	33	24¾	41	1¼	1¼	3	5	¾	¾	¾
ESC8C	33	27¾	41	1¼	1¼	4	5	¾	¾	¾
ESC9C	33	30¾	41	1¼	1¼	4	5	¾	¾	¾

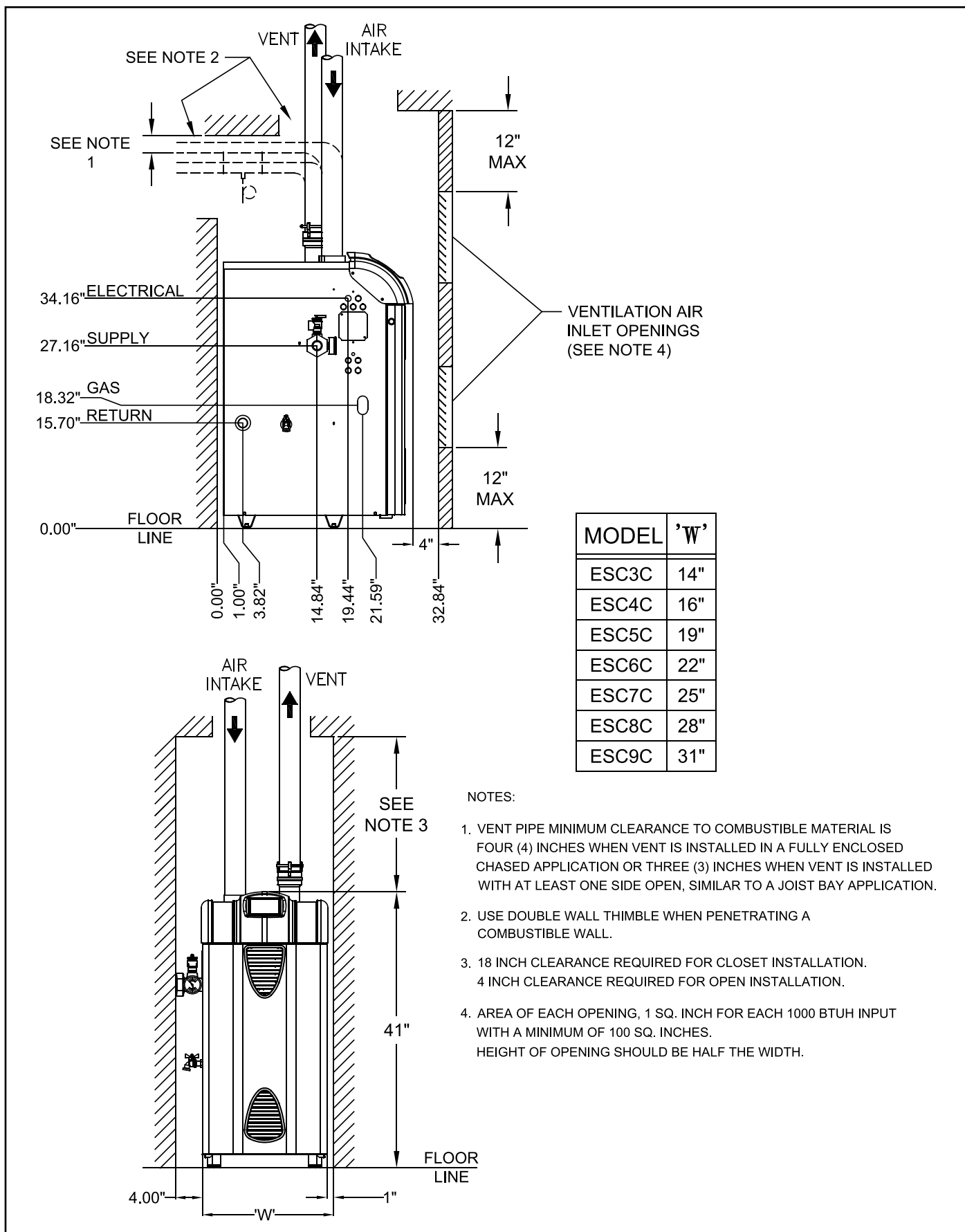
### Water Temperatures and Flows

Boiler Model	Allowable Supply Water Temperature (°F)	Minimum Return Water Temperature (°F)	Minimum Flow (GPM)	Waterside Pressure Drop at 20°F ΔT (Ft. of Head)
ESC3C	130-220	110	None	<1
ESC4C	130-220	110	None	<1
ESC5C	130-220	110	None	<1
ESC6C	130-220	110	None	<1
ESC7C	130-220	110	None	<1
ESC8C	130-220	110	None	<1
ESC9C	130-220	110	None	<1

### Weights and Volume

Boiler Model	Shipping Weight (lbs)	Empty Weight (lbs)	Water Content (gal)
ESC3C	250	170	2
ESC4C	300	220	3
ESC5C	350	270	4
ESC6C	410	320	5
ESC7C	460	370	5
ESC8C	510	420	6
ESC9C	560	470	7

## SPECIFICATIONS (continued)



**Figure S-1: Minimum Clearances to Combustibles**

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# BOILER QUICK-START

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## Installation:

1. Unpack the crate .....	9
2. Position the boiler .....	9
3. Provide combustion air .....	10
4. Connect venting.....	10
5. Connect gas piping.....	12
6. Connect boiler water piping .....	12
7. Connect electrical wiring.....	14
8. Program the controls .....	15
9. Check for gas and water leaks .....	18
10. Perform startup checks and adjustments .....	19

<b>Annual Maintenance Checklist.....</b>	<b>21</b>
<b>Troubleshooting.....</b>	<b>23</b>
<b>Repair Parts List.....</b>	<b>29</b>
<b>Internal Wiring.....</b>	<b>37</b>

## Appendices:

A – Combustion Air.....	41
B – Venting .....	42
C – Gas Piping .....	51
D – System Piping .....	53
E – Filling the System and Checking for Leaks .....	57
F – Adjusting Gas Input Rate .....	58
G – Checking Draft and Combustion.....	59
H – Operation .....	60
I – IQ Control System .....	61



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## 1. UNPACK THE CRATE

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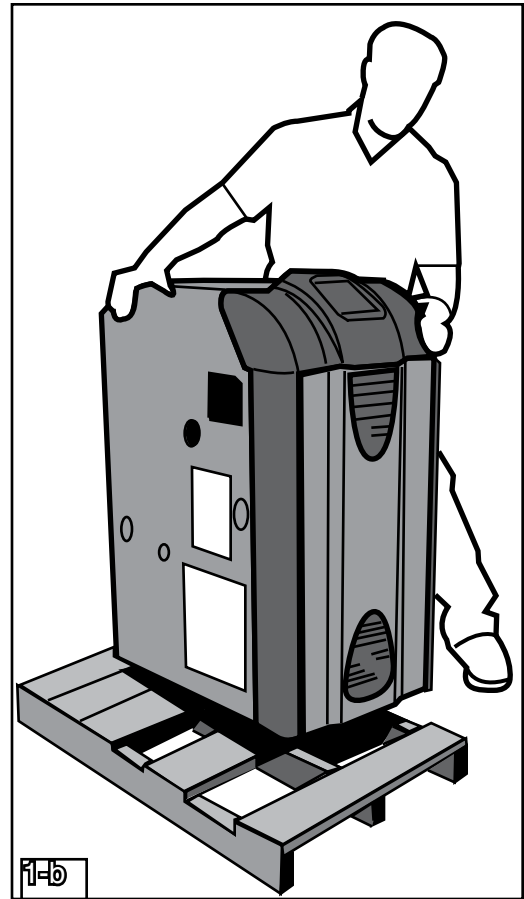


THE BOILER IS TOP-HEAVY. Do not allow it to tip over.

1. Remove the sleeve.
2. Remove the contents from the skid, except the boiler.
3. Remove the four (4) hex-drive lag screws holding the boiler to the skid (Figure 1-a).



4. Tip the boiler and shimmy it off the skid.



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## 2. POSITION THE BOILER

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### WARNINGS

OBSERVE MINIMUM CLEARANCES to combustible walls and ceilings to avoid potential fire hazard.

DO NOT INSTALL ON CARPET. This may cause a fire.

INSTALLING THE BOILER NEAR A SOURCE OF FLAMMABLE LIQUIDS or gases may cause fire or explosion.

CLEAN BURNERS DAILY if operating the boiler in a dusty environment.

PROTECT IGNITION SYSTEM COMPONENTS from sources of water that may spray, drip, or rain on them during installation, operation and service.

1. Slide the boiler into desired location.
2. Meet the minimum clearances to combustible construction per the *Specification* Section of this manual.
3. Allow 24" service clearance in front and on the left side of the boiler.
4. Level the boiler, using shims as necessary.

### 3. PROVIDE COMBUSTION AIR

**!** **INSUFFICIENT COMBUSTION AIR SUPPLY** may result in the production and release of deadly carbon monoxide (CO) into the home.

Provide combustion and ventilation air in accordance with the section "Air for Combustion and Ventilation," of the *National Fuel Gas Code*, ANSI Z223.1/NFPA 54, or applicable provisions of the local building codes.

Like all fuel-burning appliances, boilers need air to operate reliably and safely.

1. If equipping for direct vent (sealed combustion), provide combustion air according to *Appendix B2—Venting for Direct Vent boilers*.
2. If not equipping the ESC for direct vent, provide combustion air from the boiler room according to *Appendix A—Combustion Air*.

### 4. CONNECT VENTING

**!** **IMPROPER VENTING** may result in property damage and the release of deadly carbon monoxide (CO) into the home.

**!** **FAILURE TO INSTALL** a condensate drain line could cause boiler to shutdown unexpectedly.

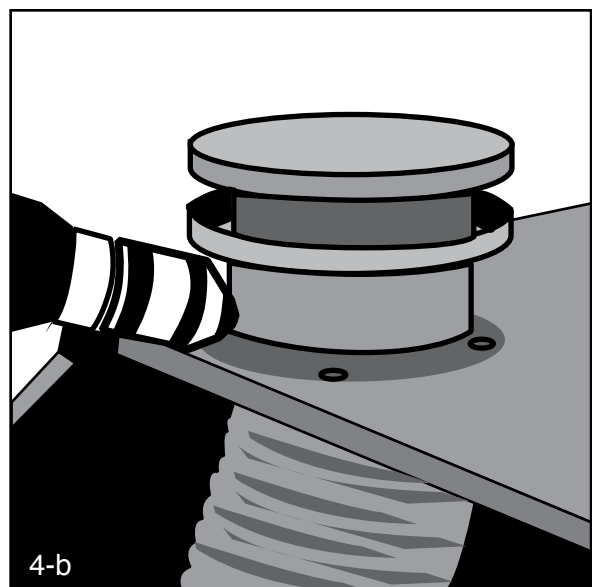
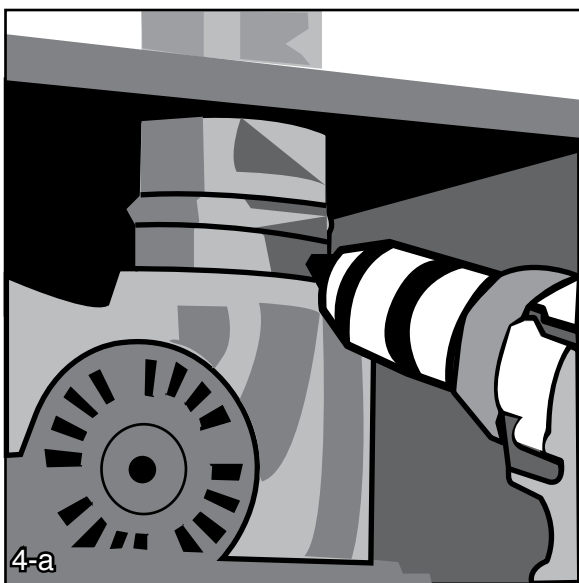
Observe all general venting guidelines provided in *Appendix B—Venting*. Additionally:

Follow all instructions in *Appendix B-2 Direct Vent* or *B-3 Power Vent*.

1. For the exhaust, attach special (Category IV) gas vent to the fan outlet using a single sheetmetal screw (Figure 4-a).
2. Configure the air intake:

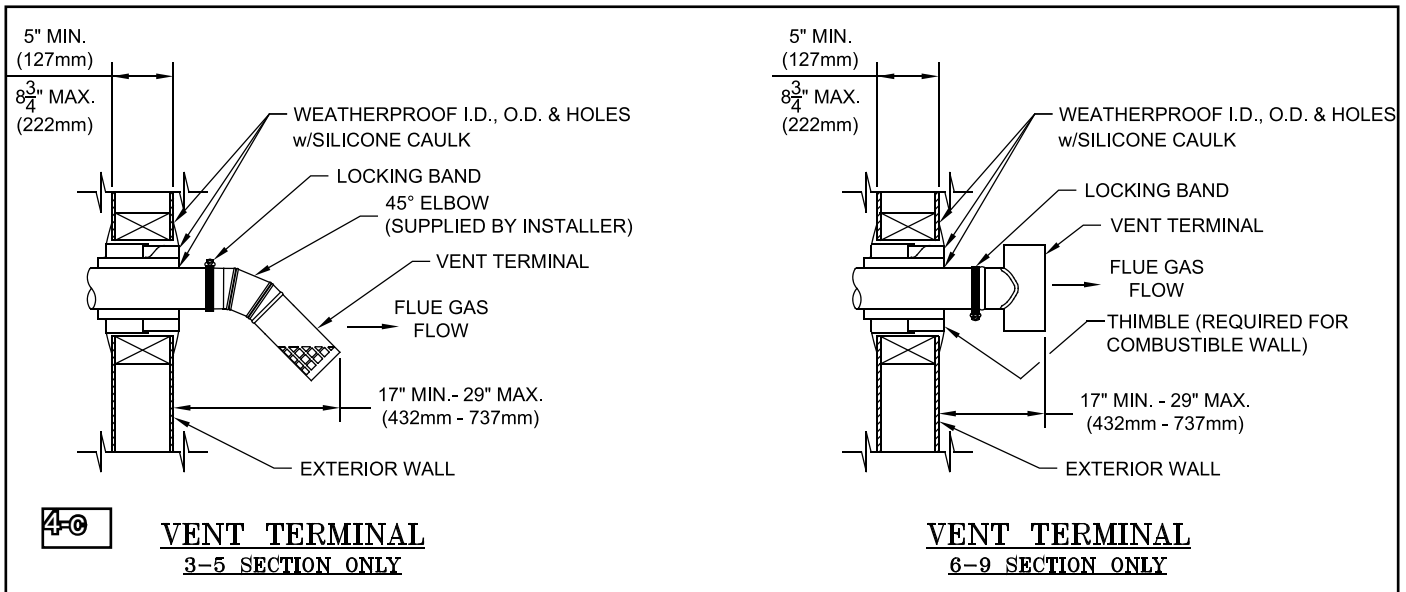
- (1) To equip the ESC for outdoor combustion air (direct vent), attach the plastic or metal intake air pipe to the inlet air duct.
- (2) To equip the ESC for indoor combustion air (power vent), attach the air intake terminal to the boiler's inlet air duct with a single sheetmetal screw (Figure 4-b).

3. For horizontal venting, follow the instructions in *Appendix B2—Direct Venting, Special Instructions for Stainless Steel Venting—Horizontal Installations, Specifically*,
  - (1) Cut a hole in the exterior wall, large enough to fit the wall thimble. Hole diameter for the ESC3-7 is 7", hole diameter for the ESC8-9 is 8".
  - (2) Install wall thimble.



## 4. CONNECT VENTING (continued)

- (3) Install vent piping.
  - (4) When configuring the ESC for Power Vent (indoor combustion air) install a 45° vent elbow, pointing downward.
  - (5) Install vent terminal and seal around all exterior openings.
  - (6) The final installation should appear as in Figure 4-c.
4. For vertical venting, follow instructions in *Appendix B2 — Direct Venting, Special Instructions for Stainless Steel Venting — Vertical Installations, Specifically,*
- (1) Install fire stops and wall thimbles.
  - (2) Install vent piping and vent terminal.
  - (3) Install condensate line.
  - (4) Install roof flashing and roof supports.
  - (5) The final installation should appear as in Figure B-7 in *Appendix B-2*.
5. Do not use cellular core PVC (ASTM F891), cellular core CPVC, or Radel® (polyphenolsulfone).
6. Do not cover non-metallic vent pipe and fittings with thermal insulation.
- Note: Non-metallic vent cannot be used with this boiler.



## 5. CONNECT GAS PIPING

Size gas piping according to *Appendix C – Gas Piping*



**SHUT OFF GAS SUPPLY** before servicing the boiler.



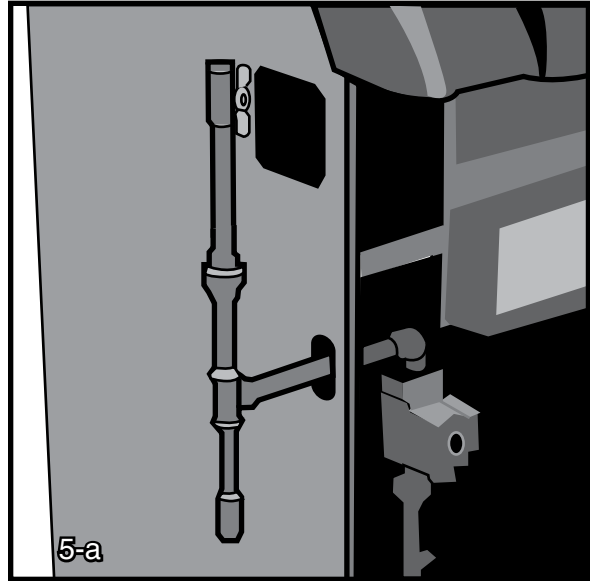
**ALL GAS PIPING MUST BE GAS TIGHT.** Use gas rated thread compound on all threaded joints to avoid leaks, which may result in fire or explosion.



**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.

1. Remove boiler door, locate gas valve and remove plastic shipping plug.
2. Thread a  $\frac{3}{4}$ " x  $1\frac{1}{2}$ " nipple, a 90° street elbow, or a Honeywell flange onto the gas valve and pipe through the slot in the left jacket panel (Figure 5-a).

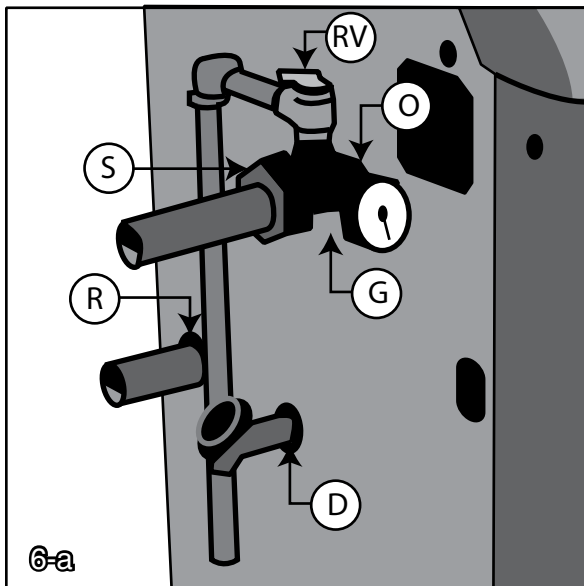
3. Pipe from the street elbow through the left jacket panel, and complete drip leg as shown (Figure 5-a).



## 6. CONNECT BOILER WATER PIPING

General system piping guidelines are included in *Appendix D—System Piping*.

Additionally, for this particular boiler install piping shown below (Figure 6-a).



1. Apply sealant to all threads.
2. Screw the water supply manifold into the boiler outlet tapping "O."
3. Orient the manifold with the relief valve on top.
4. Screw the relief valve into manifold tapping "RV".



*This installation is not complete until the relief valve is installed.*



**PIPE THE RELIEF VALVE DISCHARGE** to a location where it will not harm people or damage property. The relief valve may discharge scalding hot water or steam.

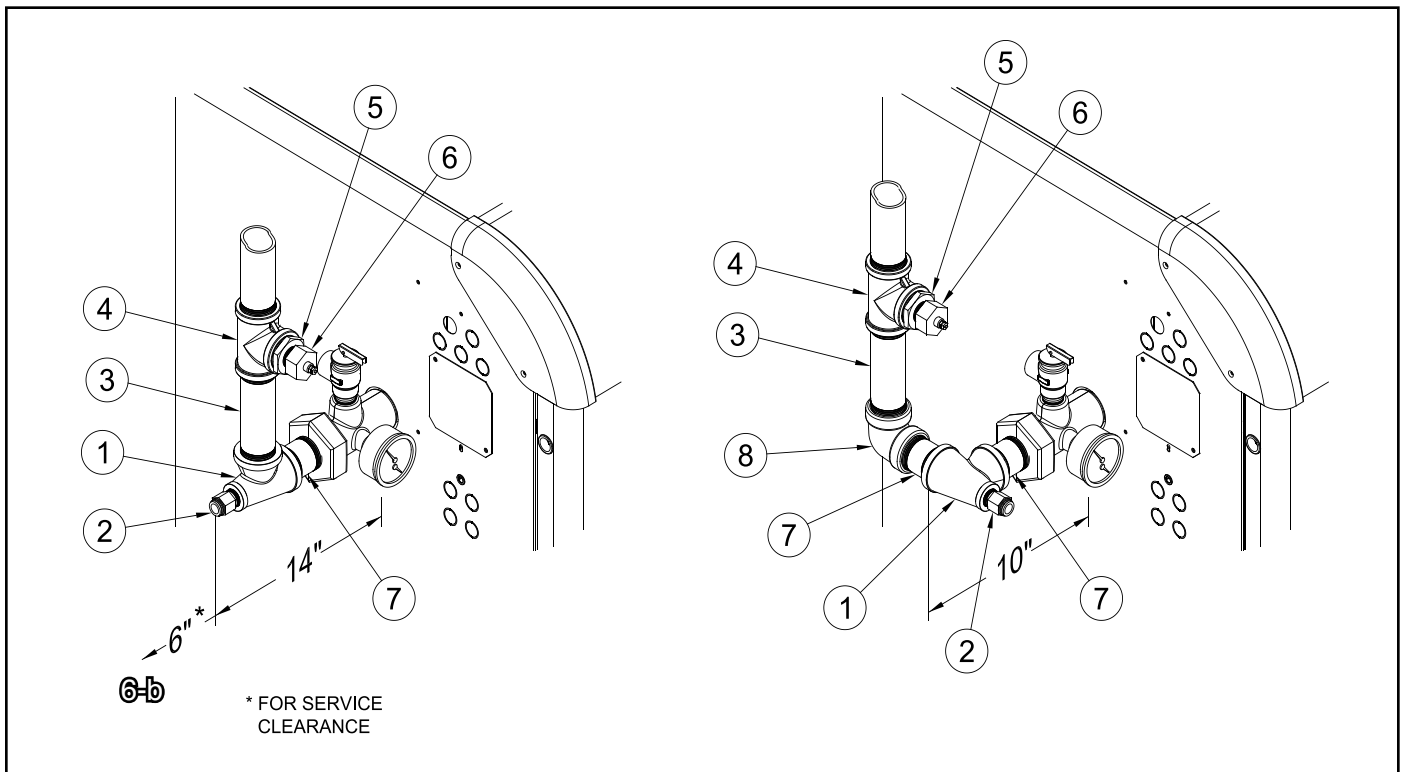


**BLOCKING THE RELIEF VALVE** may result in boiler explosion.

5. Screw the temperature-pressure gage into manifold tapping "G".

## 6. CONNECT BOILER WATER PIPING (continued)

6. Connect the system supply to the open end of the manifold "S" using a 1 1/4" male NPT fitting.
7. Screw an installer-supplied 1 1/4" pipe or nipple into the water return tapping "R".
8. Screw the supplied drain valve into tapping "D".
9. See Figure 6b for suggested near boiler piping of IQ Options.
10. Maintain minimum 1/2" clearance between water piping and combustible construction.



Item	Description	Part Number
1	1 1/4 x 1 1/4 x 1/2 Tee	806601021
2	Immersion Well, 1/2 NPT	80160456
3	1 1/4 x 6 Nipple	806600029
4	1 1/4 Tee	806601030
5	1 1/4 x 3/4 Bushing	806600504
6	LWCO Sensor, 3/4 NPT	102305-01
7	1 1/4 x 3 Nipple	806600005
8	1 1/4 Elbow	806601528

## 7. CONNECT ELECTRICAL WIRING



**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

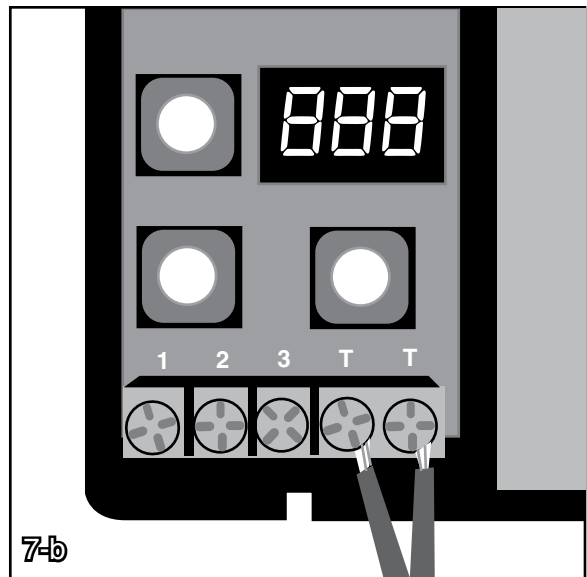
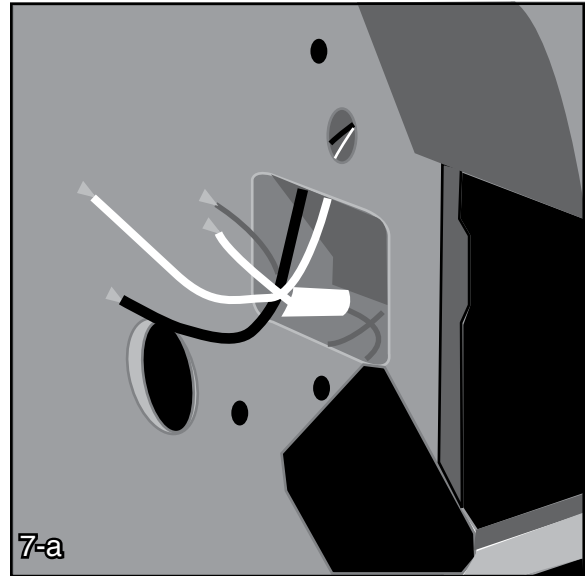
Refer to the *Internal Wiring* diagrams later in this manual.

1. Locate the wiring box on the left side of the boiler and open the cover (Figure 7-a).
2. Install a 120V disconnect near the boiler.
3. Connect the 120V wiring from the disconnect to the boiler's white (neutral), black (hot), and green (ground) labeled "120VAC Power supply". Do not reverse polarity.
4. Connect the 120V wiring from the circulator to the white (neutral) yellow (hot) wires marked "circulator".
5. Electrically bond to ground in accordance with requirements of authority having jurisdiction or, in the absence of such requirements, with the *National Electrical Code*, ANSI/NFPA 70.



**WIRE AN ADDITIONAL SAFETY LIMIT** such as a low water cutoff or temperature limit device, other than an IQ Control™ device, in series with the 120V circuit used to power the boiler. Do not alter the boiler's factory wiring when adding an additional limit.

6. Connect the 24V wiring from the thermostat to the "T-T" terminals on the Option Control Panel.
7. To connect other external devices, refer to the instructions included with these devices.

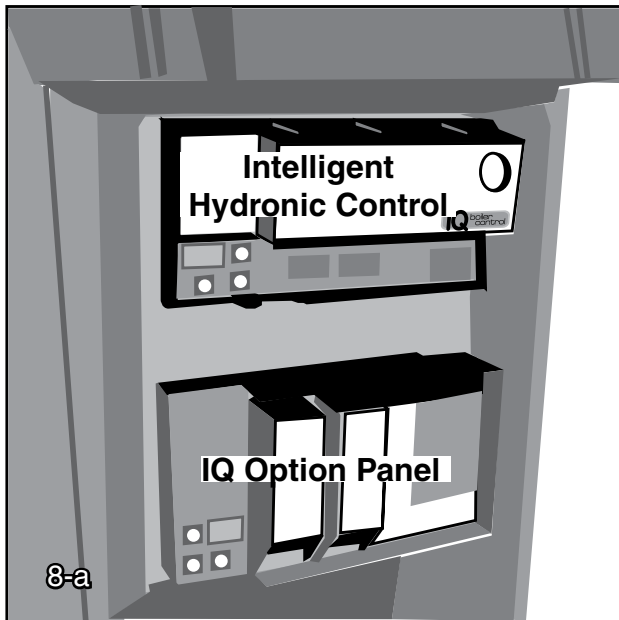


**THE MAXIMUM ALLOWABLE CURRENT** for each circulator is 5 amps at 120V AC. For circulators with higher amp ratings, you must install a circulator relay or starter coil to provide line voltage to the circulator and connect only the relay or starter coil to boiler terminals. The combined boiler and circulator amperage must not exceed 12 amps. Install over-current protection in accordance with authority having jurisdiction or, in the absence of such requirements, follow the *National Electric Code*, ANSI/NFPA 70. Do not provide over-current protection greater than 15 amperes.

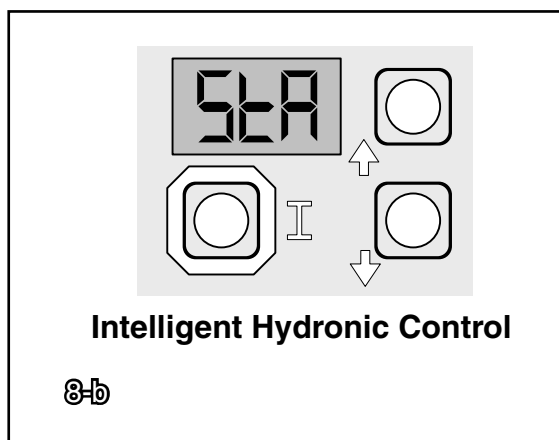
## 8. PROGRAM THE CONTROLS

### Using Intelligent Hydronic Control Display

The Intelligent Hydronic Control is located inside the boiler front door, just above the IQ Option Panel (Figure 8-a).



The control display, along with Up ↑, Down ↓, and “I” keys may be used to view boiler operating status (Figure 8-b). Please note that these keys look similar to the keys on the IQ Option Panel but are in a different orientation, and they perform different functions.



### Viewing the Operating Mode Options

In operating mode the user may view (but not change) boiler operating status, settings and troubleshooting information. To view control display information:

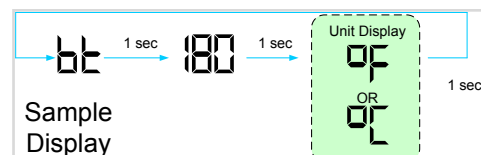
1. Press and release the “I” key on the IQ control to change from one parameter to the next. Each setting will alternately flash between the relevant display code and its corresponding value.

Operating Mode Options	
5tA	Status
bE	Boiler Temperature
SP	Operating Setpoint (Outdoor Reset)
HL	High Limit Setting
HdF	High Limit Differential
tE	Heat Request Status
dh	DHW Heat Request Status
FLA	Flame Current
rUn	Run Time Hours
CYC	Boiler Cycles
Err	Error (see Error Numbers)

The 5tA (status) display code has the below listed values. This list is also available on the control cover.

Status Code Displayed in 5tA Mode	
1	Standby
2	Waiting for Pressure Switch to Open
3	Waiting for Pressure Switch to Close
4	Prepurge
6	Spark
7	Flame Proving
8	Running
10	Retry/Recycle Delay
11	Pressure Switch Failed to Open
12	Pressure Switch Failed to Close
13	Soft Lockout
14	Hard Lockout
15	Waiting for Limit to Close
16	Flame Present Out of Sequence
17	Self Test

For example, when the “I” key is pressed on the control until “bE” is displayed, it will then flash a three digit number (such as “180”) followed by either “F” (or “L”). This indicates that the boiler water temperature is 180°F. Other operating parameters display the information in a similar fashion.



## 8. PROGRAM THE CONTROLS (continued)

Please note that in operating mode to hold the display on the value the user can press and hold either the Up  $\uparrow$  or Down  $\downarrow$  keys and the value will be continuously shown. This may be helpful in watching a value “live”.

### Changing the Adjustable Parameters

To adjust the Parameters such as High Limit Setpoint and High Limit Differential:

1. Access the adjustment mode by pressing and holding the Up  $\uparrow$ , Down  $\downarrow$ , and “ $\square$ ” keys simultaneously for three (3) seconds. This procedure is intended to discourage unauthorized changes or accidental changes to limit settings.
2. Press the “ $\square$ ” key to display available Adjustment Mode options. Select an option.

Adjustment Mode Options		
HL <sub>-</sub>	140-220°F	Adjust High Limit Setting
dF <sub>-</sub>	10-30°F	Adjust High Limit Differential
Or <sub>-</sub>	0-10 minutes	Circulator Overrun Time
PP <sub>-</sub>	2-20 minutes	Circulator Pre-purge Time
St <sub>-</sub>	140-180°F	Start Temperature
Pt <sub>-</sub>	On or Off	Priority time
dh <sub>-</sub>	dh or Ltc	DH Terminal Function
rSt		Reset Lockout
F-C	F or C	Select degrees F or C Mode
bRc		Back to Operating Mode

3. Press the Up  $\uparrow$  and Down  $\downarrow$  keys to adjust the displayed item to the desired value.
4. To return to the normal operating mode from the Adjustment Mode, when the “bRc” option is displayed, press either the Up  $\uparrow$  or Down  $\downarrow$  key. If no keys are pressed, after five (5) minutes the control will automatically return to the Operating Mode.

### More Information about Adjustable Parameters

1. High Limit (HL<sub>-</sub>)  
The control is factory programmed with a High Limit Setpoint of 180°F. The burner turns “off” when the boiler temperature (bT) is above Operating Setpoint. The Operating Setpoint (SP) will equal the High Limit Setpoint unless an Outdoor Reset IQ Option Card is installed. The Outdoor Reset IQ Option Card reduces the Operating

Setpoint to regulate heat delivery, increase home comfort and save energy. Refer to the Appendix I for additional information. The High Limit setpoint is adjustable between 140° and 220°F.

2. Differential (dF<sub>-</sub>)  
The control is factory programmed with a Differential of 15°F. The Differential is the number of degrees the boiler temperature must decrease below the Operating Setpoint before the boiler can restart. The differential is adjustable between 10° through 30°F.
3. Circulator Overrun Time (Or<sub>-</sub>)  
The control is factory programmed with a Circulator Overrun Time of 0 minutes. Circulator Overrun Time (also called “circulator off delay” or “circulator post purge”) continues circulator operation after a call for heat has ended, sending excess heat from the boiler into the system. Ensure system piping and zone panel settings allow water flow to the priority zone after the call for heat ends. The Circulator Overrun Time is adjustable between 0 through 10 minutes.
4. Circulator Pre-purge Time (PP<sub>-</sub>)  
When the boiler is warm (boiler water temperature higher than 140°F (adjustable using Start Temperature parameter)) and there is a thermostat call for heat, the system circulator is started and boiler firing is delayed Circulator Pre-purge minutes. If the temperature drops below 140°F or there is a DHW call for heat the boiler is started without delay. Additionally, the boiler is started without delay if the thermostat call for heat is initiated when the boiler water temperature is less than 140°F. This feature helps save energy by satisfying home heating needs with residual boiler heat rather than cycling the boiler. The Circulator Pre-purge time has a factory setting of 2 minutes and is field adjustable between 2 and 20 minutes. When reset card is installed, pre-purge time may be adjusted down to zero (0) minutes. Refer to Table 8a.



## 8. PROGRAM THE CONTROLS (continued)

**Table 8a: Circulator Pre-purge Time example,**  
( $PP_{-} = 2$  minutes)

Call for Heat Source	DHW Terminal Selection	Boiler Temperature	Burner Status
TT = on	-	<140	Start with no delay
TT = on	-	>140	Start after 2 minute delay
DHW = on	$\text{tt}^2$	<140	Start with no delay
DHW = on	$\text{tt}^2$	>140	Start after 2 minute delay
DHW = on	$dh$	<140	Start with no delay
DHW = on	$dh$	>140	Start with no delay

### 5. Start Temperature ( $St_{-}$ )

Amount of “Heat available” is calculated by taking the difference between measured boiler water temperature and the Start Temperature setting. Useful “Heat Available” is dependent on the type of heating emitter installed in the home. Heat emitters require a certain minimum temperature to operate effectively. Our default settings reflect cast iron radiators. Fan Coils may require a start temperature setting of 180°F or 160°F before providing heat to the home. The Start Temperature has a factory setting of 140°F and is field adjustable between 140°F and 180°F.

### 6. Priority Time ( $Pt_{-}$ )

When the Priority Time parameter is set to “on” and Domestic Hot Water (DHW) call for heat is “on” the DHW demand will take “Priority” over home heating demand. During Priority Time the system circulator will be forced “off”. Priority Time ends and the system circulator is released to service home heating demand when Domestic Hot Water call for heat is over. When Priority Time parameter is set to “Off” the DHW call for heat does not force “off” the system circulator. The Priority Time has a factory setting of “On” and is field adjustable between “On” and “Off” Refer to Table 8b.

### 7. Domestic Hot Water (DHW) Terminal Function ( $dh_{-}$ )

The control allows configuration of the DHW Circulator output functionality to help the ESC integrate into each installation more effectively. The DHW Circulator output can be connected to a domestic hot water circulator or a second heating zone circulator. These applications are selected as follows:

#### a. When $dh_{-}$ is set equal to Domestic Hot Water Demand ( $dh$ )

When there is an Indirect Water Heater (IWH) the control provides “DHW” input terminals for the IWH Aquastat and “DHW Circulator” output terminals for the DHW Circulator. When there is a DHW call for heat, the System Circulator is “forced off”, the DHW Circulator terminal is energized and the circulator pre-purge time delay control logic is bypassed to allow the boiler to fire without delay. When DHW demand ends the System Circulator “force off” is removed, the circulator can respond normally, and the DHW Circulator is de-energized. The DHW call for heat is detected by a voltage on to the DHW terminal. When the Priority Time parameter is set to “OFF” the System Circulator is not forced off for a DHW call for heat. Refer to Table 8b.

**Table 8b: DHW Terminal Function ( $dh_{-}$ )**  
Selection = Domestic Hot Water Demand,  
(Parameter  $dh_{-} = dh$ )

Call for Heat		Priority Time ( $Pt_{-}$ )	Circulator Status	
T-T Input	DHW Input		System Circulator Output	DHW Circulator Output
on	off	$On$	on	off
on	on	$On$	off	on
off	on	$On$	off	on
on	off	$OFF$	on	off
on	on	$OFF$	on	on
off	on	$OFF$	off	on

## 8. PROGRAM THE CONTROLS (continued)

- b. When  $dh_{-}$  is set equal to Second Heating Zone (tt2)

When there is no IWH the "DHW Circulator" output may be configured to control a second heating zone. This is particularly helpful when the home uses only two heating zones. The control replaces the need for a two circulator zone panel. When DHW Terminal Function ( $dh_{-}$ ) is set to "tt2" the control's two circulator outputs are used to control two independent heating zones. Refer to Table 8c. A "TT" input causes a call for heat and energizes the "System Circulator" output to service heating zone 1 and a second zone's thermostat wired to the "DHW" input causes a call for heat and energizes heating zone 2 circulator wired to the "DHW Circulator" output. When there is a Second Heating Zone (call for heat) the boiler is started and the DHW Circulator terminal is energized. When Second Heating Zone is de-energized the call for heat is ended and the Second Heating Zone Circulator is de-energized. A Second Heating Zone is detected by sensing a voltage on the "DHW" terminal.

### Using the IQ Option Panel

IQ Option Cards are available from U.S. Boiler Company distributors and are the simplest way to add functionality, safety and efficiency to your heating system. The IQ Option Panel provides an easy and convenient means to "plug-in" an Auxiliary High Limit, Low Water Cut-off and/or Outdoor Reset function.

For installation, programming, and troubleshooting instructions, refer to the instructions supplied with those cards.

### Using the Optional LCD Display Kit

The LCD Display is an easy to use touch screen type display that allows a technician to monitor and adjust the control and connected IQ Option Cards. All boiler settings, status and error codes are displayed in full text. All Outdoor Reset IQ Option Card parameters are adjustable with graphic and help information screens. The LCD Display Kit includes a mounting bracket and wiring harness to allow mounting in the ESC plastic hood above the front door. For installation, programming, and troubleshooting instructions, refer to the instructions supplied with the display.

**Table 8c: DHW Terminal Function ( $dh_{-}$ )**  
Selection = Second Heating Zone,  
(Parameter  $dh_{-}$  = tt2)

Call for Heat		Circulator Status	
T-T Input	DHW Input	System Circulator Output (Zone 1)	DHW Circulator Output (Zone 2)
off	off	off	off
on	off	on	off
on	on	on	on
off	on	off	on

## 9. CHECK FOR GAS AND WATER LEAKS



**GAS LEAKS** may result in fire or explosion.

Refer to *Appendix E – Filling the System and Checking for Leaks*



**WATER LEAKS** may cause extensive property damage.

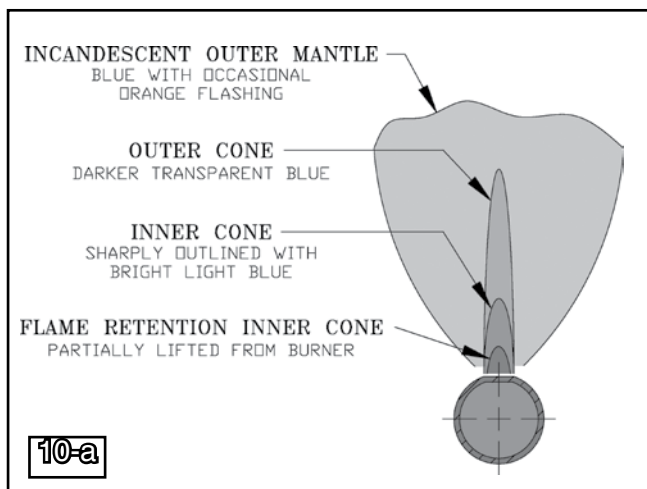
## 10. PERFORM STARTUP CHECKS AND ADJUSTMENTS

**!** FAILURE TO PERFORM THESE CHECKS of the boiler's combustion and safety systems may result in serious property damage, injury, or death.

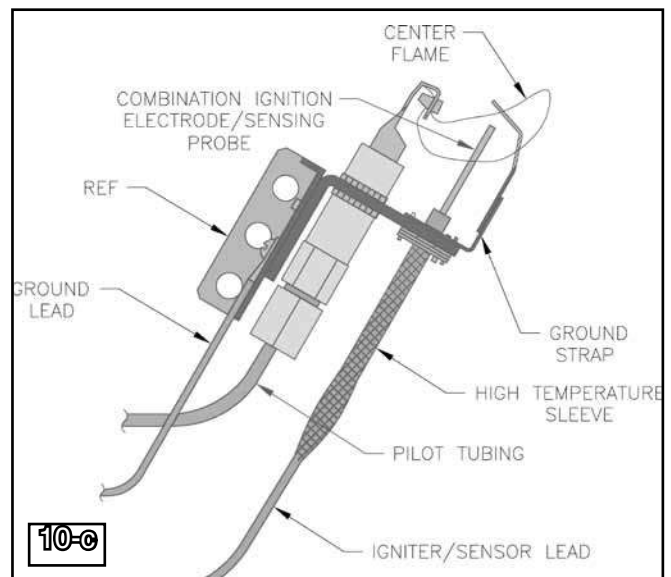
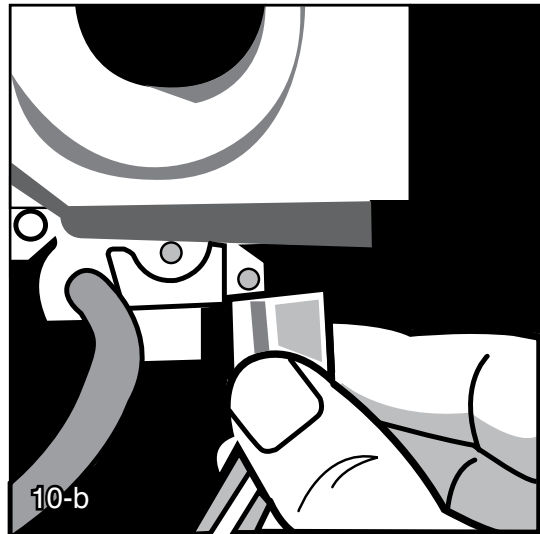
**!** IF YOU SMELL GAS, STOP and repair the leak. Lighting the boiler when gas is leaking may cause explosion or fire.

Follow the checklist below:

1. Verify that the venting, water piping, gas piping, and electrical systems are properly installed and checked.
2. Apply power to the boiler.
3. Adjust zone thermostat to maximum setting.
4. Allow gas line to purge of air.
  - Boiler lights cleanly within 60 seconds.
5. Adjust gas input rate. See *Appendix F – Adjusting Gas Input Rate*
  - Pilot and main burner flames appear clean and blue.



6. Disconnect pilot lead wires from gas valve (Figure 10-b).
  - Boiler shuts off.
7. Reconnect pilot lead wires to gas valve.
  - Boiler restarts.
8. Adjust zone thermostat to minimum setting.
  - Boiler shuts off.
9. Adjust zone thermostat to maximum setting.
10. Observe temperature gage as boiler heats.



11. Adjust the high limit setting to its minimum level (see "Programming High Limit" in Section 8).
  - Boiler shuts off when temperature gage reads within 15°F of high limit setting.
12. Return high limit to the desired setting (see "Programming High Limit" in Section 8).
13. Check combustion in the vent stack and record results in the spaces provided below.
 

_____	CO <sub>2</sub>	(less than 7%)
_____	O <sub>2</sub>	(more than 9%)
_____	CO	(less than 50 ppm, air free)

**!** ANY FAILED STARTUP CHECK Must be corrected before placing the boiler in service.

## 10. PERFORM STARTUP CHECKS AND ADJUSTMENTS (continued)

### FOR YOUR SAFETY READ BEFORE OPERATING/POUR VOTRE SECURITE LISEZ AVANT DE METTRE EN MARCHÉ

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

**AVERTISSEMENT:** Quiconque ne respecte pas à la lettre les instructions dans la présente notice risque de déclencher un incendie ou une explosion entraînant des dommages, des blessures ou la mort.

- A. This appliance does not have a pilot. It is equipped with an ignition device which automatically lights the burner. Do not try to light the burner by hand.
- B. BEFORE OPERATING smell all around the appliance area for gas. Be sure to smell next to the floor because some gas is heavier than air and will settle on the floor.

#### WHAT TO DO IF YOU SMELL GAS:

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

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



- A. Cet appareil ne comporte pas de veilleuse. Il est muni d'un dispositif d'allumage qui allume automatiquement le brûleur. Ne tentez pas d'allumer le brûleur manuellement.
- B. AVANT DE FAIRE FONCTIONNER, reniflez tout autour de l'appareil pour déceler une odeur de gaz. Reniflez près du plancher, car certains gaz sont plus lourds que l'air et peuvent s'accumuler au niveau du sol.

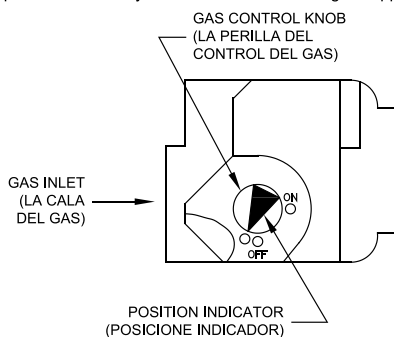
#### QUE FAIRE SI VOUS SENTEZ UNE ODEUR DE GAZ:



- Ne pas tenter d'allumer d'appareil.
- Ne touchez à aucun interrupteur ; ne pas vous servir des téléphones se trouvant dans le bâtiment.
- Appelez immédiatement votre fournisseur de gaz depuis voisin. Suivez les instructions du fournisseur.
- Si vous ne pouvez rejoindre le fournisseur, appelez le service des incendies.

- C. Ne poussez ou tournez la manette d'admission du gaz qu'à la main; ne jamais utiliser d'outil. Si la manette reste coincée, ne pas tenter de la réparer; appelez un technicien qualifié. Le fait de forcer la manette ou de la réparer peut déclencher une explosion ou un incendie.
- D. N'utilisez pas cet appareil s'il a été plongé dans l'eau, même partiellement. Faites inspecter l'appareil par un technicien qualifié et remplacez toute partie du système de contrôle et toute commande qui ont été plongés dans l'eau.


### OPERATING INSTRUCTIONS/INSTRUCTIONS DE FONCTIONNEMENT

1. STOP! Read safety information above (to the left) 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 burner. Do not try to light the burner by hand.
5. Remove front door.
6. Locate the gas control valve at the end of the gas supply pipe going into the boiler. The gas control knob is the brown or blue plastic knob located on top of the gas control valve.
7. Rotate gas control knob clockwise  from "ON" position to "OFF". Make sure knob rests against stop.
8. Wait five (5) minutes to clear out any gas. Then smell for gas, including near the floor. If you smell gas, STOP! Follow "B" in the safety information above (to the left) on this label. If you don't smell gas, go to the next step.
9. Rotate gas control knob counterclockwise  from "OFF" to "ON". Make sure knob rests against stop. Do not force.
10. Replace front door.
11. Turn on all electric power to the appliance.
12. Set the thermostat to the desired setting.
13. If the appliance will not operate, follow the instructions "To Turn Off Gas To Appliance" and call your service technician or gas supplier.



1. ARRÊTEZ ! Lisez les instructions de sécurité sur la portion supérieure (à gauche) cette étiquette.
2. Réglez le thermostat à la température la plus basse.
3. Coupez l'alimentation électrique de l'appareil.
4. Cet appareil est équipé de l' dispositif d'allumage qui automobile allume maticallyle brûleur. Ne pas essayer d'allumer le brûleur près main.
5. Enlevez la porte de devant.
6. Localisez la valve du controle du Gaz a la fin du depart de la pipe de la proovision du gaz dans l'appareil. Le bouton plastique brun ou bleu localise sur la valve du controle du gaz. Voyez le diagramme.
7. Faites pivoter le bouton de contrôle du gaz dans le sens inverse  des aiguilles d'une montre de "OFF" pour "ON".
8. Attendre cinq (5) minutes pour laisser échapper tout le gaz. Reniflez tout autour de l'appareil, y compris près du plancher, pour déceler une odeur de gaz, ARRÊTEZ ! Passez à l'étape B des instructions de sécurité sur la portion supérieure (à gauche) cette étiquette. S'il n'y a pas d'odeur de gaz, passez à l'étape suivante.
9. Faites pivoter gas contrôle bouton clockwisefrom  la position "ON" à "OFF". Assurez-vous que pommeau repose contre stop. Ne forcez pas.
10. Remplacer la porte de devant.
11. Allumer toute l'énergie électrique au appareil.
12. Réglez le thermostat à la température désirée.
13. Si l'appareil ne se met pas en marche, suivez les instructions intitulées "Comment couper l'admission de gaz de l'appareil" et appelez un technicien qualifié ou le fournisseur de gaz.

### TO TURN OFF GAS TO APPLIANCE/COMMENT COUPER L'ADMISSION DE GAZ DE L'APPAREIL

1. Set the thermostat to lowest setting.
2. Turn off all electric power to the appliance if service is to be performed.
3. Remove front door.
4. Rotate gas control knob clockwise  from "ON" position to "OFF". Make sure knob rests against stop.
5. Replace front door.


1. Regler le thermostat au plus bas regle.
2. Coupez l'alimentation électrique de l'appareil si le service devrait être exécuté.
3. Enlever la porte de devant.
4. Tourner le gaz regle le bouton dans le sens des aiguilles d'une montre a partir  de position a de. Assurer que le se repose contre arete.
5. Remplacer la porte de devant

Figure 10-d: Operating Instructions

### **Important Product Safety Information** **Refractory Ceramic Fiber Product**

#### **Warning:**

The Repair Parts list designates parts that contain refractory ceramic fibers (RCF). RCF has been classified as a possible human carcinogen. When exposed to temperatures about 1805°F, such as during direct flame contact, RCF changes into crystalline silica, a known carcinogen. When disturbed as a result of servicing or repair, these substances become airborne and, if inhaled, may be hazardous to your health.

#### **AVOID Breathing Fiber Particulates and Dust**

#### **Precautionary Measures:**

Do not remove or replace RCF parts or attempt any service or repair work involving RCF without wearing the following protective gear:

1. A National Institute for Occupational Safety and Health (NIOSH) approved respirator
  2. Long sleeved, loose fitting clothing
  3. Gloves
  4. Eye Protection
- Take steps to assure adequate ventilation.
  - Wash all exposed body areas gently with soap and water after contact.
  - Wash work clothes separately from other laundry and rinse washing machine after use to avoid contaminating other clothes.
  - Discard used RCF components by sealing in an airtight plastic bag. RCF and crystalline silica are not classified as hazardous wastes in the United States and Canada.

#### **First Aid Procedures:**

- If contact with eyes: Flush with water for at least 15 minutes. Seek immediate medical attention if irritation persists.
- If contact with skin: Wash affected area gently with soap and water. Seek immediate medical attention if irritation persists.
- If breathing difficulty develops: Leave the area and move to a location with clean fresh air. Seek immediate medical attention if breathing difficulties persist.
- Ingestion: Do not induce vomiting. Drink plenty of water. Seek immediate medical attention.

## ANNUAL MAINTENANCE CHECKLIST (continued)



### WARNINGS

LABEL ALL WIRES prior to disconnection when servicing controls. Wiring errors can cause improper and dangerous operation

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.

Equipment you will need:

- Soft bristle brush
- Bristle flue brush
- Vacuum with brush attachment

Perform these tasks each year:

1. Clean low water cutoff probe (if applicable).
2. Inspect vent for obstruction and signs of condensation, distortion, overheating or gas leakage.
3. Clean vent terminal and air intake screens.
4. Clean condensate collection and disposal system.
5. Inspect boiler flue passages:
  - (1) Remove vent pipe.
  - (2) Remove top panel and hood.
  - (3) Remove canopy.
  - (4) Examine all flue passageways. Using bristle flue brush and vacuum, remove any soot or obstructions.
  - (5) Use installation procedure to reassemble and reseal air intake system and vent pipe.
6. Remove and clean main burners:
  - (1) Remove jacket front panel.
  - (2) Remove air box door.
  - (3) Disconnect pilot tubing at gas valve.
  - (4) Disconnect pilot lead wires at gas valve.
  - (5) Remove wires from flame roll-out switch.
  - (6) Remove burner access panel.

(7) Mark location of the pilot main burner on the manifold if the marking on manifold is missing or obliterated.

(7) Hold burner at throat. Lift front of burner to clear orifice (Figure AM-1). The burner that holds the pilot can only be removed by first lifting the burner adjacent to its right.

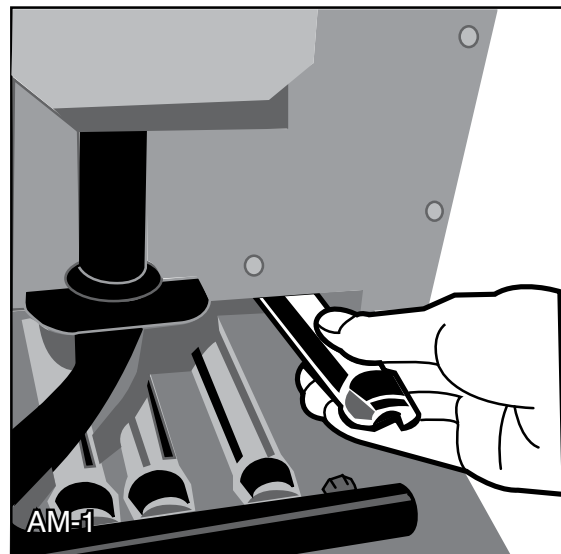
7. Perform *Startup Checks and Adjustments* described earlier in this manual.

8. Check operation of airflow sensing switches.

9. Check for water leaks on the boiler or water pooling around boiler.

10. Manually operate the relief valve. If the water is grey or black, there is excessive oxygen in the system. Oxygen is corrosive to boilers. Eliminate any source of oxygen.

11. Verify proper operation after servicing.



# TROUBLESHOOTING

## Before troubleshooting

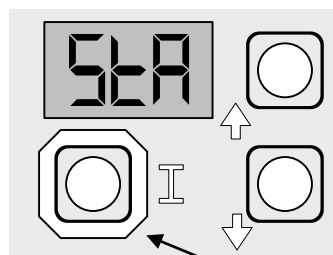
The following pages contain trouble shooting tables for use in diagnosing control problems. When using these tables the following should be kept in mind:

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 Section 10, Perform Startup Checks and Adjustments on page 18.
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 IW-1 and IW-2. 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) and polarity is correct.

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 wiring harness pins be careful not to insert the meter probes into the pins. Doing so may damage the pin, resulting in a loose connection when the harness is reconnected.

Operating Mode Parameters	
<i>StA</i>	Status (see Status Numbers)
<i>bt</i>	Boiler Temperature
<i>SP</i>	Operating Setpoint (Outdoor Reset)
<i>HL</i>	High Limit Setpoint
<i>HdF</i>	High Limit Differential Setpoint
<i>tt</i>	Heat Request Status
<i>dh</i>	DHW Heat Request Status
<i>FLA</i>	Flame Current
<i>run</i>	Run Time Hours
<i>CYC</i>	Boiler Cycles
<i>Err</i>	Error (see Error Numbers)



Press "I" key on the control to change from one parameter to the next. Each setting will alternate between display code (for example *StA*) and value.

When *Err* (error) is shown:

Value	Description
2	Pressure Switch Failed to Open
4	Flame current lower than threshold
6	Flame Out of Normal Sequence
18	Electronics Failure
23	Flame Sensed During Pre-purge
29	Pressure Switch Failed to Close
32	Temperature Sensor Failure
35	Duplicate Zone Alarm
57	Flame Rod Shorted to Ground
58	AC Line Frequency
59	Line Voltage Error
60	Thermostat input higher than threshold
61	Line Voltage Unstable
63	Soft Lockout – Recycles Exceeded
64	Soft Lockout – Internal Failure

Possible *StA* (status) values:

Value	Description
1	Standby
2	Waiting for Pressure Switch to Open
3	Waiting for Pressure Switch to Close
4	Pre-purge
6	Spark
7	Flame Proving
8	Running
10	Retry/Recycle Delay
11	Pressure Switch Failed to Open
12	Pressure Switch Failed to Close
13	Soft Lockout
14	Hard Lockout
15	Waiting for Limit to Close
16	Flame Present Out of Sequence
17	Self Test

## TROUBLESHOOTING (continued)

### Use Control Display *Err* (error) Number To Direct Troubleshooting Efforts

If the control detects an error it will flash "Err" (error) followed by a number. Use this number to identify the boiler problem and corrective action in the table below. If there is no Err display proceed to next Section:

IQ Boiler Control Error Codes (when "Err" is flashing)		
Display	Status	Boiler / Control Action(s)
Blank	Boiler and Circulator off	No 120 Vac power at boiler, check breaker and wiring between breaker panel and boiler.
<i>Err</i> 2	Pressure Switch Failed to Open	While the blower is "off" the pressure switch failed to open (contact stuck closed). <ul style="list-style-type: none"> <li>- Check wiring</li> <li>- Kinked or blocked pressure switch tubing</li> <li>- Defective pressure switch</li> </ul>
<i>Err</i> 4	Flame Current Lower than Threshold	Check pilot assembly. Refer to Troubleshooting Section, 5.
<i>Err</i> 6	Flame Sensed Out of Normal Sequence	Flame sensed out of normal sequence (before opening gas valve or after closing gas valve). Check gas valve operation.
<i>Err</i> 18	Electronics Failure	Cycle power to control. Replace control if problem persists.
<i>Err</i> 23	Flame Sensed During Pre-Purge	Flame sensed during post-purge (before gas valve signaled open). Check the gas valve for proper operation. Replace gas valve if problem persists..
<i>Err</i> 29	Pressure Switch Failed to Close	While the blower is "on" the pressure switch failed to close. <ul style="list-style-type: none"> <li>- Connect manometer to pressure switch. Is differential pressure greater than minimum, replace pressure switch.</li> <li>- Check if tubing is securely connected to canopy</li> <li>- Check if tubing is free of cracks or holes or condensate</li> <li>- Check for blockage in vent/air intake system</li> <li>- Vent system not installed in accordance with installation manual</li> <li>- Wind at horizontal vent terminal in excess of 40 mph</li> <li>- Replace blower</li> </ul>
<i>Err</i> 32	Temperature Sensor Failure	Temperature sensor or interface failure (open or short connection, increased connection resistance, dual sensor mismatch) or control hardware failure.
<i>Err</i> 35	Duplicate Zone Alarm	Refer to IQ Zone Panel Instructions.
<i>Err</i> 57	Flame Rod Shorted to Burner Ground	Flame Rod shorted to burner ground, this can result from excessive flue gas condensation. <ul style="list-style-type: none"> <li>- Check for excessive condensate, dry pilot. Adjust setpoint higher.</li> <li>- Check for loose or damaged ignition wire.</li> </ul>
<i>Err</i> 58	AC Line Frequency Error	AC Signal is too noisy or frequency is incorrect. Check supply voltage.
<i>Err</i> 59	Line Voltage Error	AC voltage out of specification high or low. Check supply voltage.
<i>Err</i> 60	Thermostat Input Higher than Threshold	Check thermostat wiring.
<i>Err</i> 61	Line Voltage Unstable	Possibly too many heavy loads switching on and off cause erratic supply voltage. Check supply voltage.
<i>Err</i> 63	Soft Lockout - Maximum Recycles Exceeded	Maximum number of recycles exceeded. Refer to Troubleshooting Section, 5.
<i>Err</i> 64	Soft Lockout - Internal Failure	The electronics has detected an error. This can be caused by an actual controller internal fault or wiring fault: <ul style="list-style-type: none"> <li>- Check pilot assembly,</li> <li>- If problem persists, replace the control.</li> </ul>
<i>Err</i> 89	Communication Lost	Check wiring between control and IQ Zone Panel or IQ Reset Card.



## TROUBLESHOOTING (continued)

### Use *SEtA* (status) Number To guide TroubleShooting

The control will flash “SEtA” followed by a number. Use this number to identify the boiler problem in the table below:

### 1. Boiler and Circulator Off

Display / Status	Recommended Corrective Action
<p style="text-align: center;"><b>SEtA 1</b></p> <p>Standby Burner off Circulator off</p>	<p>The boiler has not detected a call for heat (<i>tL</i> = <i>oFF</i> and <i>dh</i> = <i>oFF</i>).</p> <p>Check the thermostat:</p> <ul style="list-style-type: none"> <li>- When a thermostat call for heat is detected control display “<i>tL</i>” will show “<i>oN</i>”</li> <li>- Make sure thermostat is calling for heat and contacts (including appropriate zone controls) are closed. Check for loose connection.</li> </ul> <p>Check the DHW demand:</p> <ul style="list-style-type: none"> <li>- When a domestic call for heat is detected “<i>dh</i>” will show “<i>oN</i>”</li> <li>- Make sure the DHW aquastat contact is closed. Check for loose connection.</li> </ul>

### 2. Circulator is On, But Boiler is Off

Display / Status	Recommended Corrective Action
<p style="text-align: center;"><b>SEtA 1</b></p> <p>Circulator Pre-purge Burner off Circulator on</p>	<p>The boiler is warm and circulator is providing residual boiler heat to building:</p> <p>Check boiler temperature</p> <ul style="list-style-type: none"> <li>- The boiler will not start until boiler water temperature is less than the Setpoint (<i>SP</i>) minus differential (<i>dF</i>)</li> <li>- If boiler water temperature is higher than Start Temperature (<i>StL</i>_, default = 140 F) and the Circulator Pre-purge (<i>PP</i>_, default = 2 minutes) time has not expired, boiler start will be delayed until water temperature drops or time expires. To permit the boiler to start sooner increase Start Temperature parameter. Refer to Operation Section for additional information.</li> </ul>

### 3. Boiler is On, But Circulator is Off

Display / Status	Recommended Corrective Action
<p style="text-align: center;"><b>SEtA 8</b></p> <p>Burner on Circulator off</p>	<p>Domestic Hot Water (DHW) Priority Forcing Circulator Off</p> <ul style="list-style-type: none"> <li>- When there is a DHW heat request wired to the control's DHW terminal the System Circulator will be “forced off” for the duration of the DHW heat request. When the DHW heat request ends the System Circulator “force off” is removed, the circulator can respond normally. When the Priority Time, (<i>PtL</i>_ ) Parameter is set to “<i>oFF</i>” the System Circulator is not “forced off” for a DHW call for heat.</li> <li>- When there is DHW heat request and an Outdoor Air Reset IQ Card is installed the System Circulator will be forced off for the duration of the Reset Card's Priority Time (<i>PtL</i>_ ) parameter. Check Priority Time (<i>PtL</i>_ ) parameter using the Outdoor Air Reset IQ Option Card Adjustment Mode (see Reset Card Adjustment Mode Instructions).</li> </ul> <p>Wiring / Circulator Issue:</p> <ul style="list-style-type: none"> <li>- Check wiring for loose connection, miswiring</li> <li>- Check circulator</li> </ul>

### 4. Circulator is On, But Blower is Not On

Display / Status	Recommended Corrective Action
<p style="text-align: center;"><b>SEtA 15</b></p> <p>Limit Open</p>	<p>Waiting for Limit to Open.</p> <ul style="list-style-type: none"> <li>- Check Flame Rollout Switch, in the event of excessive blockage of the boiler section flue passageways is developed the flame rollout switch will open interrupting power to control P5-4. The main burners will be extinguished immediately and the circulator will remain on until the thermostat is turned off. If the flame rollout switch is activated, do not attempt to place the boiler in operation. The source of the blockage must be corrected and the identical flame rollout switch replaced by trained and skilled personnel from a qualified service agency.</li> <li>- Check External Limit. Check IQ Option Panel Display.</li> </ul>

## TROUBLESHOOTING (continued)

### 5. Circulator is On, Blower is On but Boiler Fails to Start

Display / Status	Description
<b>5tA 10</b> Retry / Recycle Delay	The Boiler is in "Retry Delay": <ul style="list-style-type: none"> <li>- The burner failed to light (no flame signal). After a 5 minute delay, control will attempt to light the burner again. There is no limit to the number of retries.</li> </ul> Recycle Delay <ul style="list-style-type: none"> <li>- The burner loses flame during running mode, "5tA B". After a 10 second delay, control will attempt to light the burner again. If the burner loses flame during running mode, "5tA B" during the next six recycles, control will progress to a soft lockout.</li> </ul>
<b>5tA 11</b> Pressure Switch Failed to Open	Refer to Troubleshooting Section, <i>Err 2</i> for corrective action.
<b>5tA 12</b> Pressure Switch Failed to Close	Refer to Troubleshooting Section, <i>Err 29</i> for corrective action.
<b>5tA 13</b> Soft Lockout	When a soft lockout occurs, boiler will shut down. Boiler automatically restarts once condition that caused the lockout is corrected and the one-hour time delay is completed. Boiler can be restarted sooner than the time delay by entering Adjustment Mode and selecting the reset button (see Adjustment Mode instructions) or by cycling power. Soft Lockout is caused by one of the following: <ul style="list-style-type: none"> <li>- <i>Err 63</i>, Maximum Recycles Exceeded – The burner lost flame during running mode, "5tA B" six times in a row. Refer to recommended corrective actions on next page to help determine the cause of the problem.</li> <li>- <i>Err 64</i>, Internal Failure, refer to Error code listing for recommended corrective action.</li> <li>- <i>Err 23</i>, Flame sensed during post-purge (before gas valve signaled open). Check the gas valve for proper operation. Replace gas valve if problem persists.</li> </ul>
<b>5tA 14</b> Hard Lockout	When a hard lockout occurs boiler shuts down.
<b>5tA 16</b> Flame Out of Sequence	If flame is detected in pre-purge control goes to Flame Out of Sequence Before trial, "5tA 16" and "Err 23" is reported. The control gives a flame 10 seconds to disappear. If flame goes away, control resumes heating cycle from the beginning. If it doesn't "Err 23" is cleared and "Err 6" is reported. When flame is off control goes to Soft Lockout and "Err 6" is cleared. Check gas valve for proper operation.

## TROUBLESHOOTING (continued)

Display / Status	Recommended Corrective Action
<p><b>5LR 10</b> Retry / Recycle Delay</p> <p><b>5LR 13</b> Soft Lockout</p>	<p><b>1. No Spark</b></p> <p>a. Can you hear sparking while 5LR 6 is displayed?</p> <ul style="list-style-type: none"> <li>- If there is no spark noise replace the control.</li> </ul> <p>b. If you can hear spark noise check the following:</p> <ul style="list-style-type: none"> <li>- Loose connection in ignition cable or ground wire</li> <li>- Continuity of ignition cable</li> <li>- Break in ignition cable insulation</li> <li>- Loose ground connection</li> <li>- Break in pilot ceramic insulator</li> <li>- Incorrect pilot spark gap</li> </ul>
	<p><b>2. No Pilot Flame</b></p> <p>a. If pilot does not light check the following:</p> <ul style="list-style-type: none"> <li>- All manual gas valves are open</li> <li>- Supply tubing is not plugged, kinked or leaking</li> <li>- Gas line pressures are good</li> <li>- Gas line is purged of air</li> <li>- Pilot orifice is not plugged (pilot gas is flowing)</li> <li>- Condensate quenching pilot</li> </ul> <p><b>Note:</b> It may be necessary to recycle the "call for heat" more than once to clear the pilot supply tubes of air.</p> <p>b. If no gas flow check the following:</p> <ul style="list-style-type: none"> <li>- 24 volts across PV and MV/PV at gas valve, if voltage ok replace defective gas valve</li> <li>- Check for break in wiring harness to gas valve</li> <li>- 24 volts across control connector P5-2 and P5-5, if no voltage at control replace defective control</li> </ul>
	<p><b>3. Spark does Not Stop When Pilot Lights</b></p> <p>If the spark does not stop when the pilot lights check the following:</p> <ul style="list-style-type: none"> <li>- Loose connection in ignition cable or ground wire</li> <li>- Continuity of ignition cable</li> <li>- Clean flame rod</li> <li>- Pilot electrode porcelain cracked</li> <li>- Pilot flame covers flame rod and is steady and blue, if not adjust pilot flame</li> <li>- Low gas pressure at gas valve inlet</li> <li>- Defective control</li> </ul>
	<p><b>4. Main Flame Does Not Light</b></p> <p>If the main burners do not light check the following:</p> <ul style="list-style-type: none"> <li>- Check orifice size and/or blockage</li> <li>- 24 volts across control terminals P5-8 and P5-5? If no voltage while in 5LR 7 defective control.</li> <li>- 24 volts across MV and MV/PV at gas valve? Check for break in wiring harness to gas valve</li> <li>- Defective gas valve</li> </ul>

## TROUBLESHOOTING (continued)

**If Control Shows Status Code "5LR 15":** The control is "Waiting for Limit to Close" and the display on the IQ Option Panel should be the first place to check. The IQ Option Panel display (lower display) will show one of the following status codes:

IQ Option Panel Display Shows "Err"			
Display		Status	Boiler / Control Action(s)
Err	1	Low Input Voltage	AC voltage is too low
Err	2 - card #	IQ Option Card Type Change without Re-Learn	Whenever a new IQ Option Card is <u>first</u> installed into the IQ Option Panel, the IQ Option Panel automatically "Learns" the card. This means it detects the specific card and lists it as a card number (E1, E2, or E3). However, to help avoid errors or unauthorized option card changes, once an IQ Option Card is initially installed, the IQ Option Panel will <u>not</u> automatically "Learn" a different card in the same slot. In this situation, the IQ Option Panel has to "Learn" about the new card manually. To have the IQ Option Panel recognize or "Learn" about a different card, the user must press the <b>LEARN</b> key on the IQ Option Panel until "Lrn" is displayed. Then press and hold either the Up ↑ or Down ↓ key for at least three (3) seconds. The IQ Option Panel will then recognize and "Learn" the new IQ Option Card.
Err	3 - card #	IQ Option Card Communications Error	The IQ Option Card is not installed properly or has an internal fault. Remove the card and check for bent IQ Option Panel card interface pins. Straighten bent or misaligned pins or choose another card slot and reinstall card. If problem persists, replace card.
Err	4 - card #	IQ Option Card Hardware Interface Error	The IQ Option Card is not installed properly, there is a option card or IQ Option Panel fault. Remove the card and check for bent IQ Option Panel card interface pins. Straighten bent or misaligned pins or choose another card slot and reinstall card. If problem persists, replace card.
Err	5	Limit Output OFF in ON State	Check limit string wiring, replace the IQ Option Panel.
Err	6	Incorrect Wiring	Check boiler wiring.
Err	7	Internal IQ Option Panel Error	Replace the IQ Option Panel.
Err	8	Limit Output ON in OFF State	Check limit string wiring, replace the IQ Option Panel.
Err	9	Hard lockout due to repeated Err 8	Check limit string wiring, replace the IQ Option Panel.

**If IQ Option Panel Display Shows "OL":** The OL - "card number" indicates the card slot causing the Open Limit. For example, "OL-E1" means open limit in the card located in card slot 1. To determine the cause of the open limit the user must switch the display on the IQ Option Panel to show the view mode of the IQ Option Card installed in Slot 1.

For example, if, while the boiler has a Heat Request, and the Aquastat IQ Option Card installed in Slot 1 has a sensor failure the IQ Option Panel displays OL-E1 (Open Limit Card Slot 1). To investigate the status of option card E1:

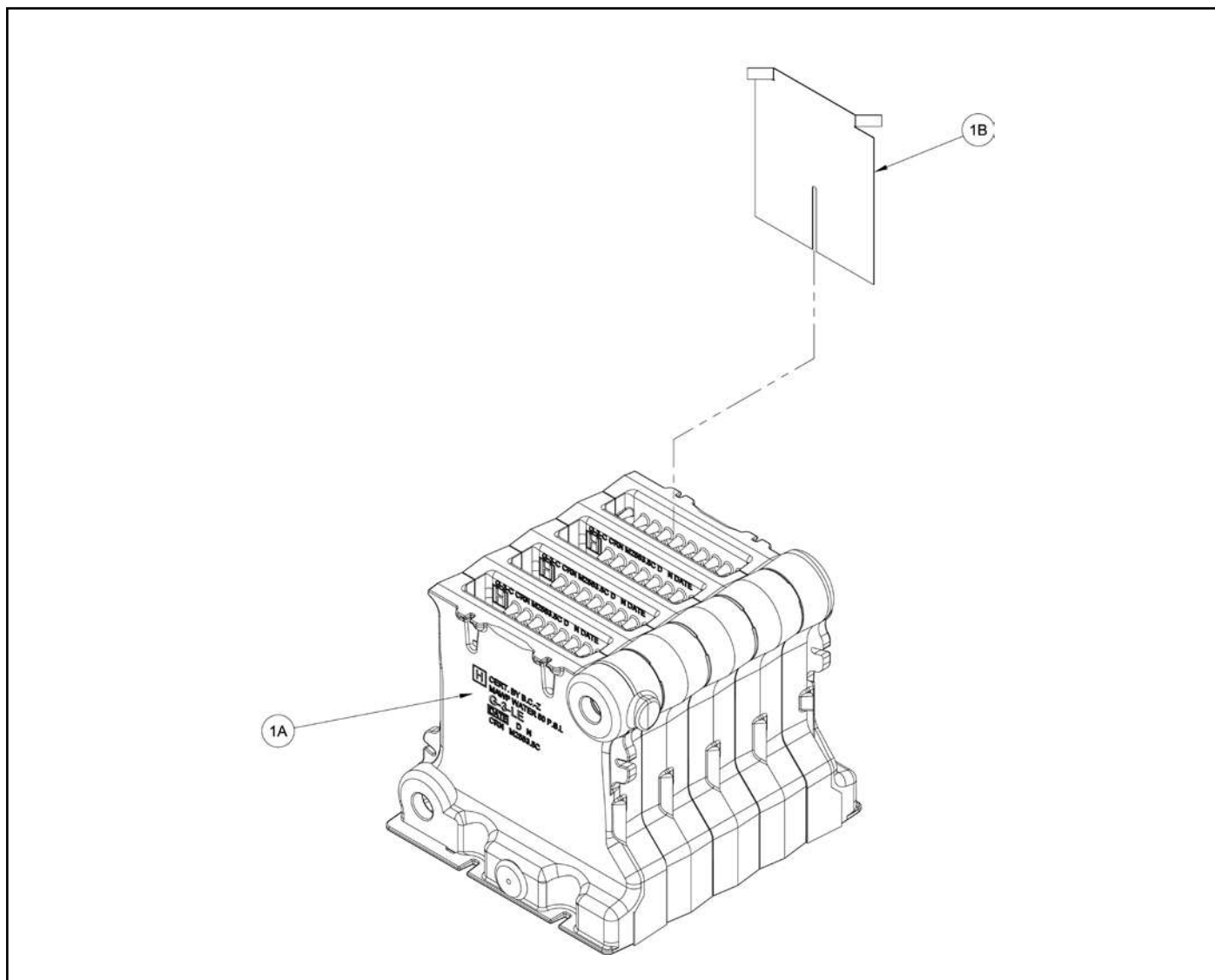
1. Press the "1" key on the IQ Option Panel. The display will go from "OL-E1" to E1.
2. When the display shows E1, press either the Up ↑ or Down ↓ keys to switch the display to show the view mode of the Aquastat Limit Control IQ Option Card inserted in Slot 1. The display will now read Err 19, Sensor Failure.
3. Check the sensor connections and when required replace the sensor.
4. When the sensor failure is corrected the IQ Option Panel will return to the "O.C.P" display and the control start sequence will continue.

For additional information refer to the instruction manual supplied with the IQ Option Card.

**If IQ Option Panel Display Shows "O.C.P":** The Option Panel is in normal run or operating mode, the IQ Option Panel display will show "O.C.P" (Option Card Panel) along with a floating decimal point that flashes on and off (the "heartbeat" flash indicating the panel is functioning properly and there are no open limits or errors). The Option Panel or the card installed in the option panel are not causing the open limit.

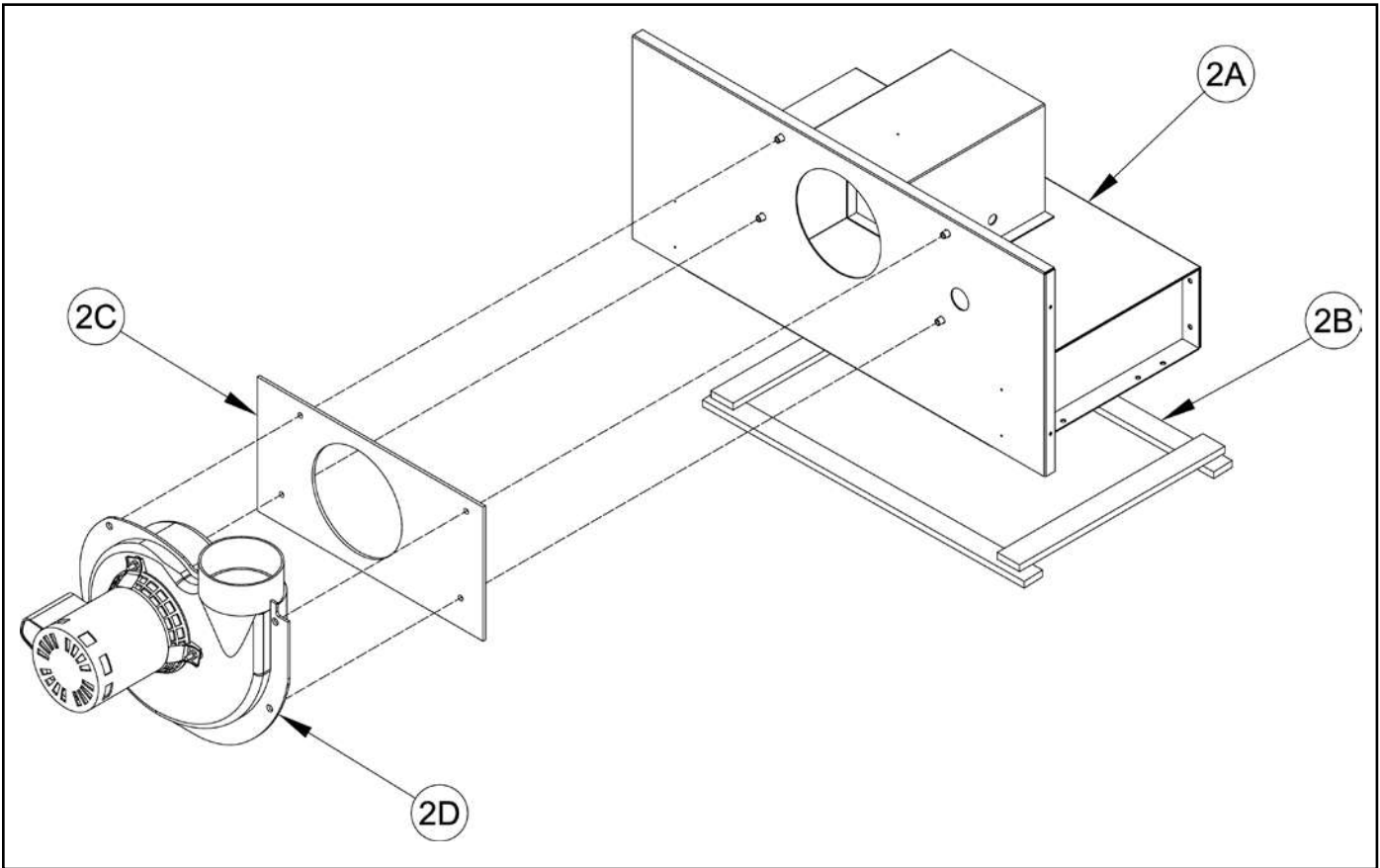
## REPAIR PARTS

All ESC™ Repair Parts may be obtained through your local U.S. Boiler Company Wholesale distributor. Should you require assistance in locating a U.S. Boiler Company Distributor in your area, or have questions regarding the availability of U.S. Boiler Company products or repair parts, please contact U.S. Boiler Company Customer Service at (717) 481-8400 or Fax (717) 481-8408.



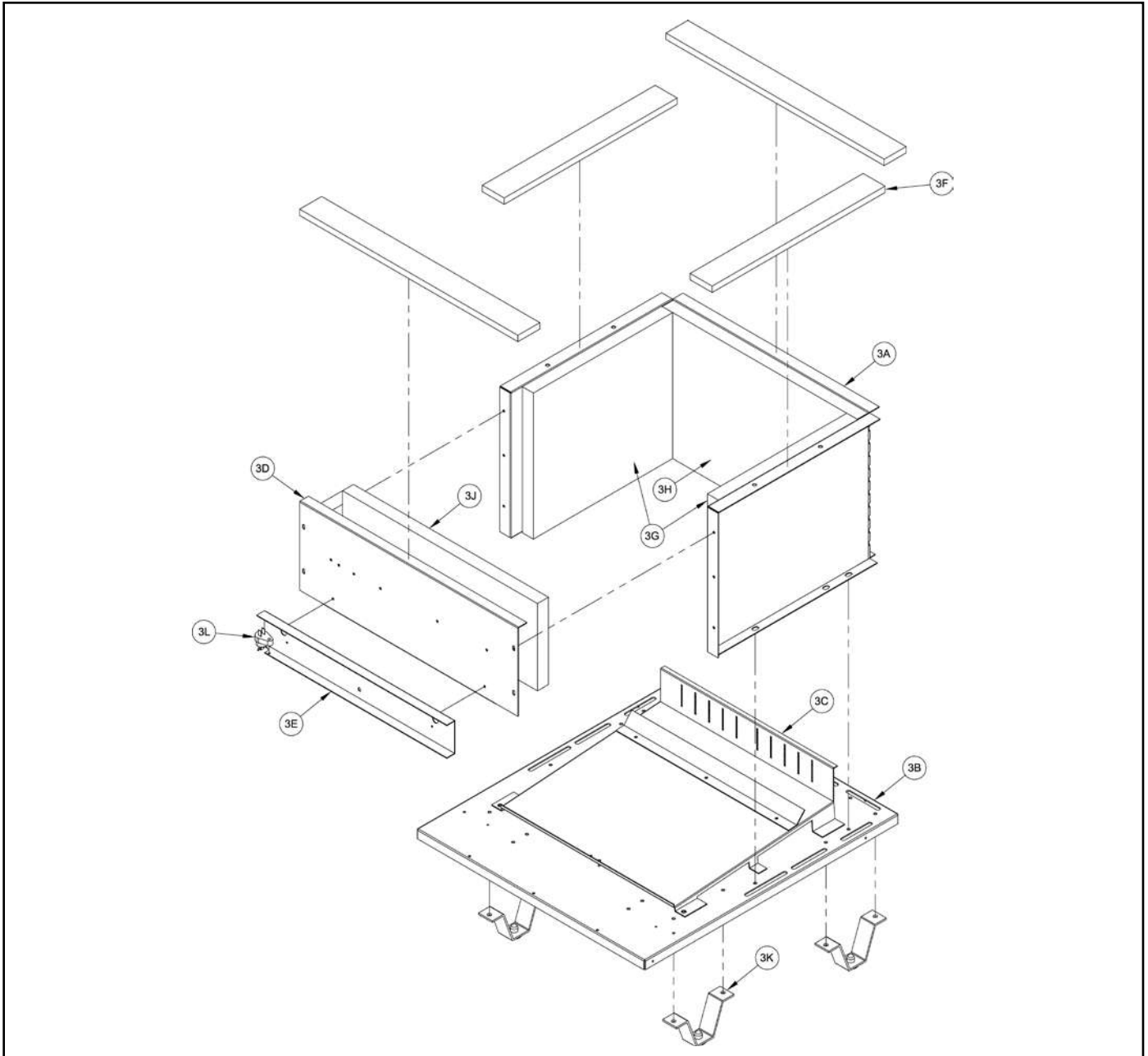
Key No.	Description	[Quantity] Part Number						
		ESC3C	ESC4C	ESC5C	ESC6C	ESC7C	ESC8C	ESC9C
1A	Block Assembly	102287-03	102287-04	102287-05	102287-06	102287-07	102287-08	102287-09
1B	Flue Baffle	[2] 71107002	[3] 71107002	[4] 71107002	[5] 71107002	[6] 71107002	[7] 71107002	[8] 71107002

## REPAIR PARTS (continued)



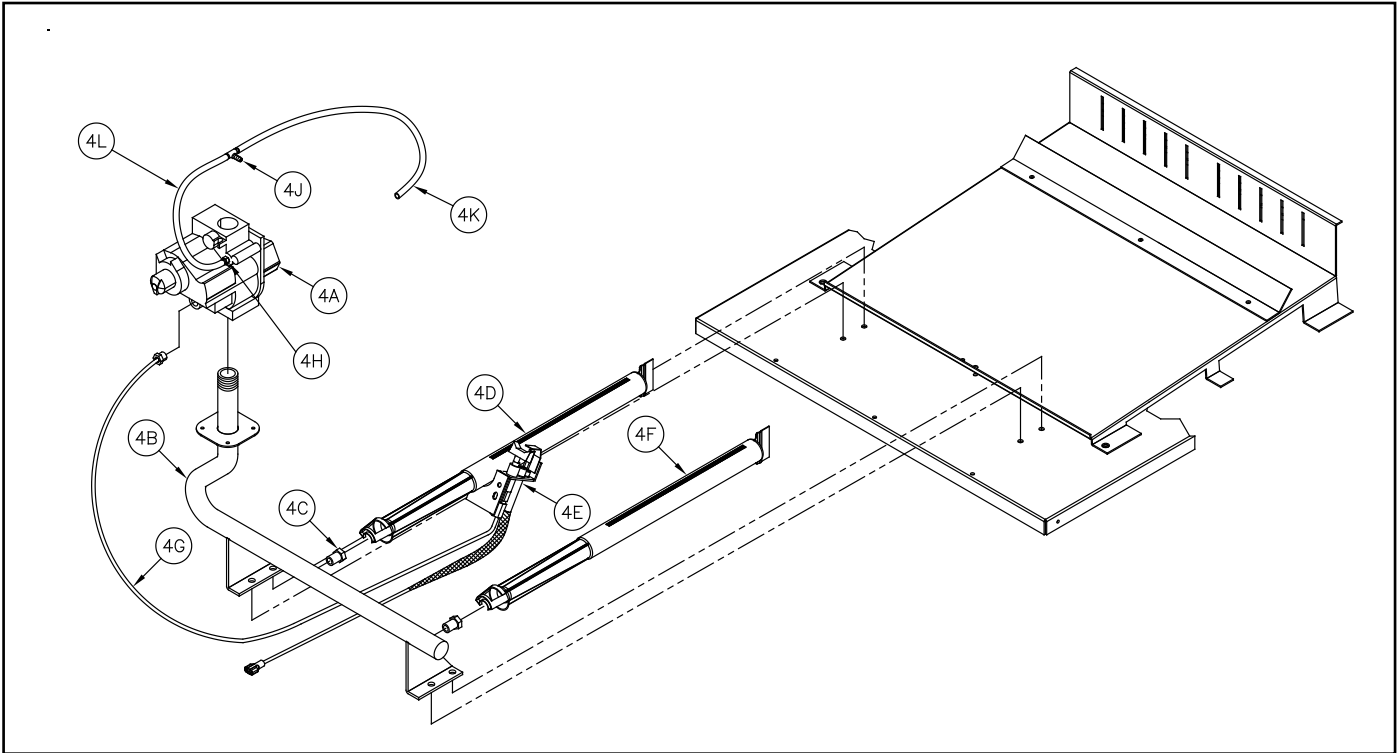
Key No.	Description	[Quantity] Part Number						
		ESC3C	ESC4C	ESC5C	ESC6C	ESC7C	ESC8C	ESC9C
2A	Canopy Assembly - Sea Level	102594-03	102594-04	102594-05	102594-06	102594-07	102594-08	102594-09
	Canopy Assembly - High Altitude	102594-13	102594-14	102594-15	102594-16	102594-17	102594-18	102594-19
2B	Canopy Gasket Kit				6206001			
2C	Fan Gasket				8206085			
2D	Fan				81161512			
2E	Magnet for Fan (not shown)				104672-01			

## REPAIR PARTS (continued)



Key No.	Description	[Quantity] Part Number						
		ESC3C	ESC4C	ESC5C	ESC6C	ESC7C	ESC8C	ESC9C
3A	Base Wrapper	71807031	71807041	71807051	71807061	71807071	71807081	71807091
3B	Base Tray	102543-03	102543-04	102543-05	102543-06	102543-07	102543-08	102543-09
3C	Burner Tray Assembly	61807031	61807041	61807051	61807061	61807071	61807081	61807091
3D	Base Front Panel	102705-03	102705-04	102705-05	102705-06	102705-07	102705-08	102705-09
3E	Burner Access Panel	102707-03	102707-04	102707-05	102707-06	102707-07	102707-08	102707-09
3F	Base Gasket Kit	6206002						
3G	Base Side Insulation	[2] 72007001						
3H	Base Rear Insulation	72007031	72007041	72007051	72007061	72007071	72007081	72007091
3J	Base Front Insulation	72007032	72007042	72007052	72007062	72007072	72007082	72007092
3K	Base Leg Assembly	[4] 6186001						
3L	Flame Roll-out Switch	80160044						

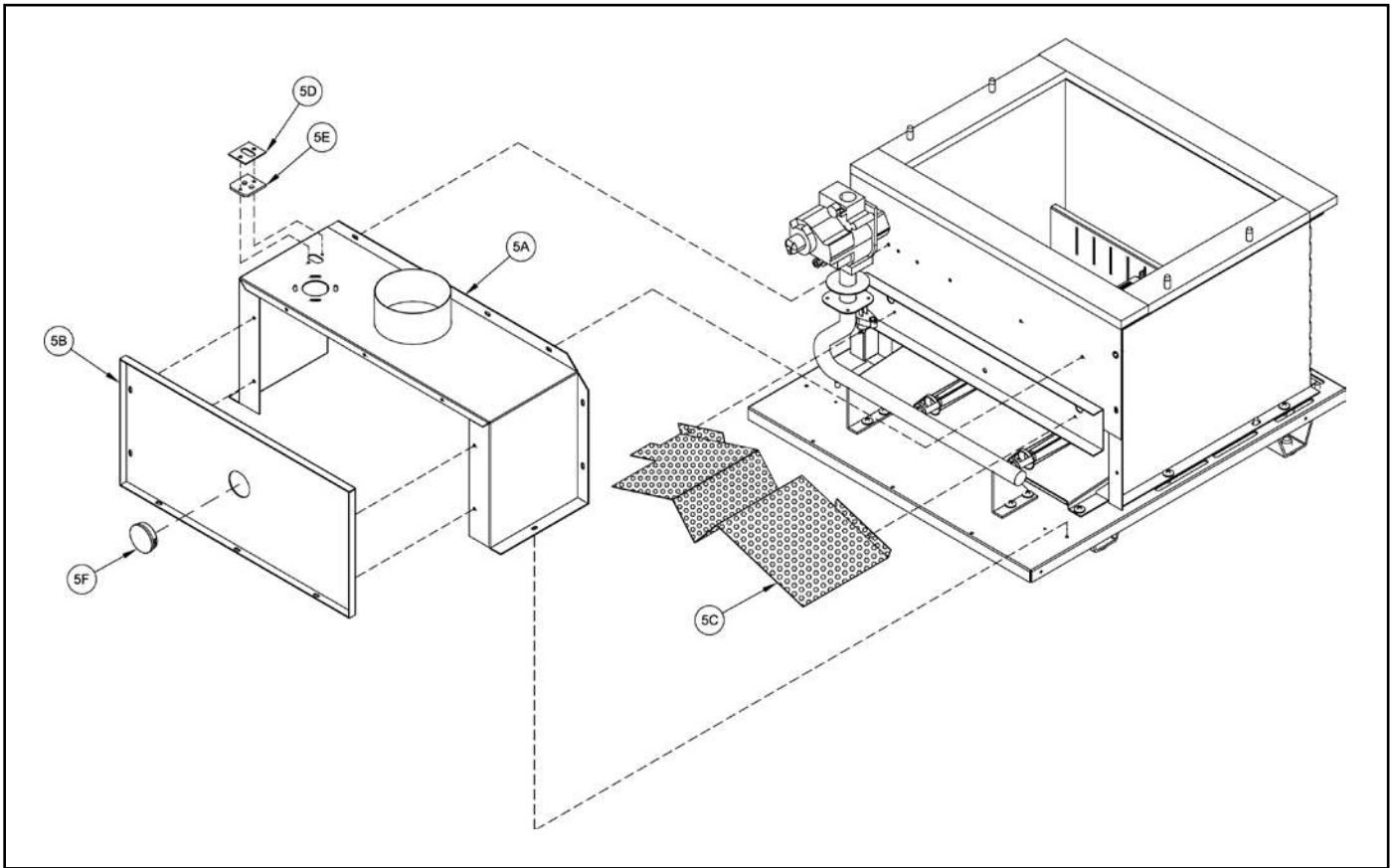
## REPAIR PARTS (continued)



Key No.	Description	[Quantity] Part Number						
		ESC3C	ESC4C	ESC5C	ESC6C	ESC7C	ESC8C	ESC9C
4A	Gas Valve (Natural Gas), Honeywell VR8204P1171		81660282				N/A	
	Gas Valve (Natural Gas), Honeywell VR8304P4496		N/A				81660283	
	Gas Valve (LP Gas), Honeywell VR8204C3015		81660146				N/A	
	Gas Valve (LP Gas), Honeywell VR8304P4280		N/A				81660160	
4B	½" Gas Manifold	82207031	82207041	82207051	82207061	---	---	---
	¾" Gas Manifold	---	---	---	---	82207071	82207081	82207091
4C	Burner Orifices - Natural Gas #49	[4] 822709	[6] 822709	[8] 822709	[10] 822709	[12] 822709	[14] 822709	[16] 822709
	Burner Orifices - LP Gas #56	[4] 822707	[6] 822707	[8] 822707	[10] 822707	[12] 822707	[14] 822707	[16] 822707
4D	Pilot Burner				100147-01			
4E	Pilot Assembly - Natural Gas				8236163			
	Pilot Assembly - LP Gas				8236164			
4F	Main Burner	[3] 100146-01	[5] 100146-01	[7] 100146-01	[9] 100146-01	[11] 100146-01	[13] 100146-01	[15] 100146-01
4G	Pilot Tubing				8236122			
4H	Gas Valve Hose Barb Fitting				104635-01			
4J	Plastic Hole T				104636-01			
4K	24" Lg. Black Silicone Hose				104658-01			
4L	6" Black Silicone Hose		104654-01				N/A	
	14" Black Silicone Hose (not shown)			N/A			104720-01	

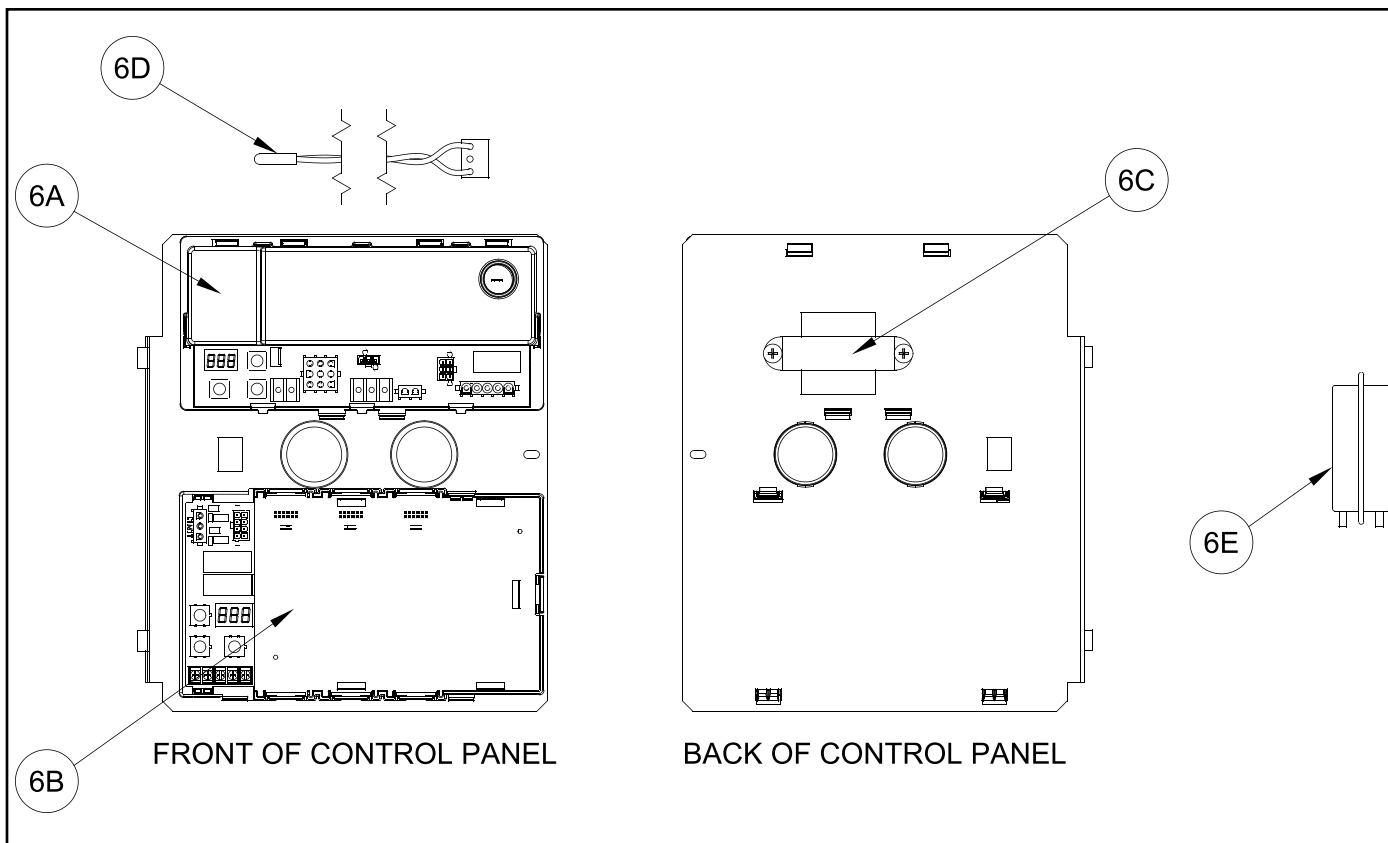


## REPAIR PARTS (continued)



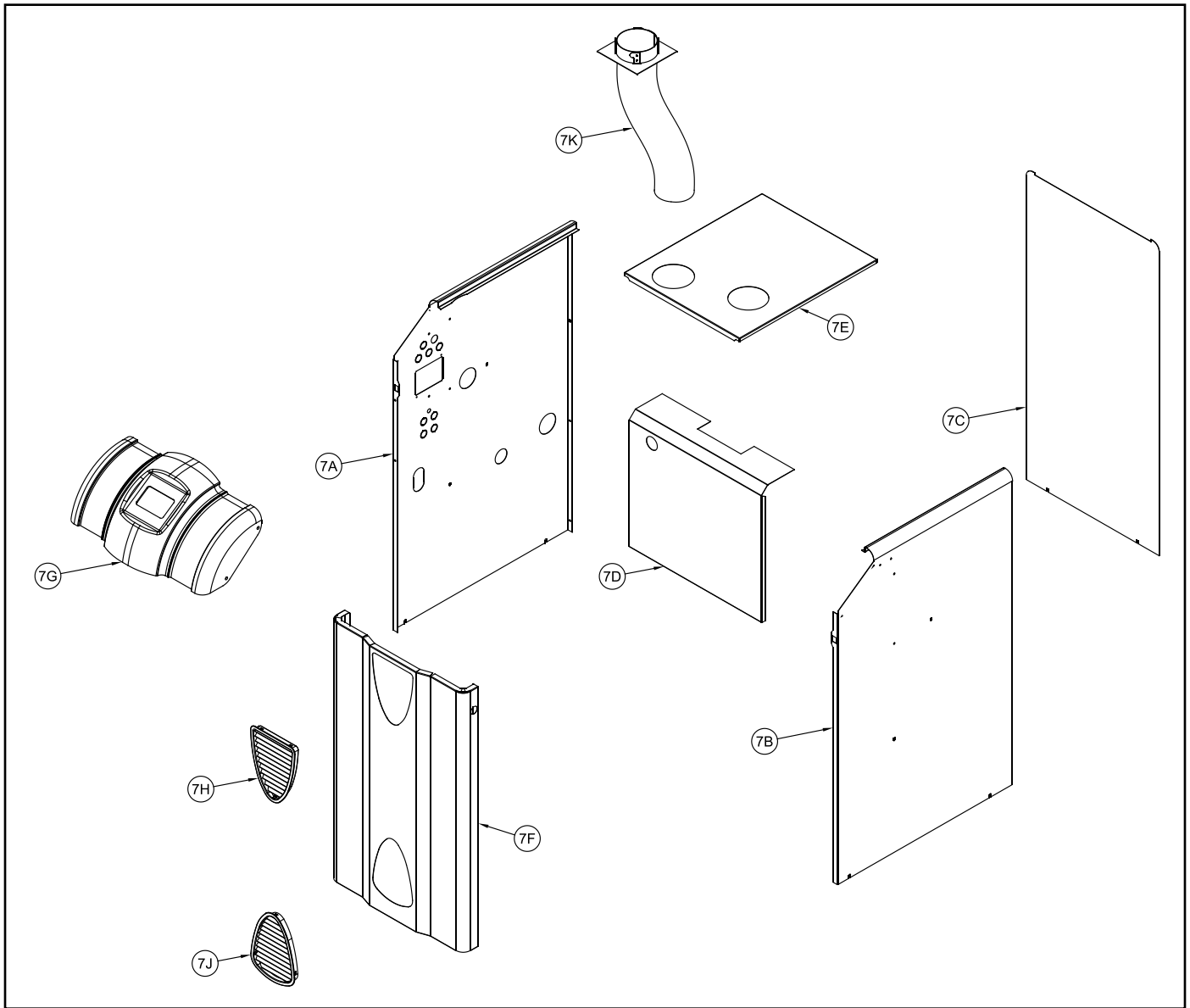
Key No.	Description	[Quantity] Part Number						
		ESC3C	ESC4C	ESC5C	ESC6C	ESC7C	ESC8C	ESC9C
5A	Air Box Assembly	61807032	61807042	61807052	61807062	61807072	61807082	61807092
5B	Air Box Door	71807034	71807044	71807054	71807064	71807074	71807084	71807094
5C	Combustion air diffuser	N/A	71807049	71807059	71807069	71807079	71807089	71807099
5D	Pilot Tube Gasket Cover Plate				7096002			
5E	Pilot Tube Gasket				8206038			
5F	Window Plug				102202-01			

## REPAIR PARTS (continued)



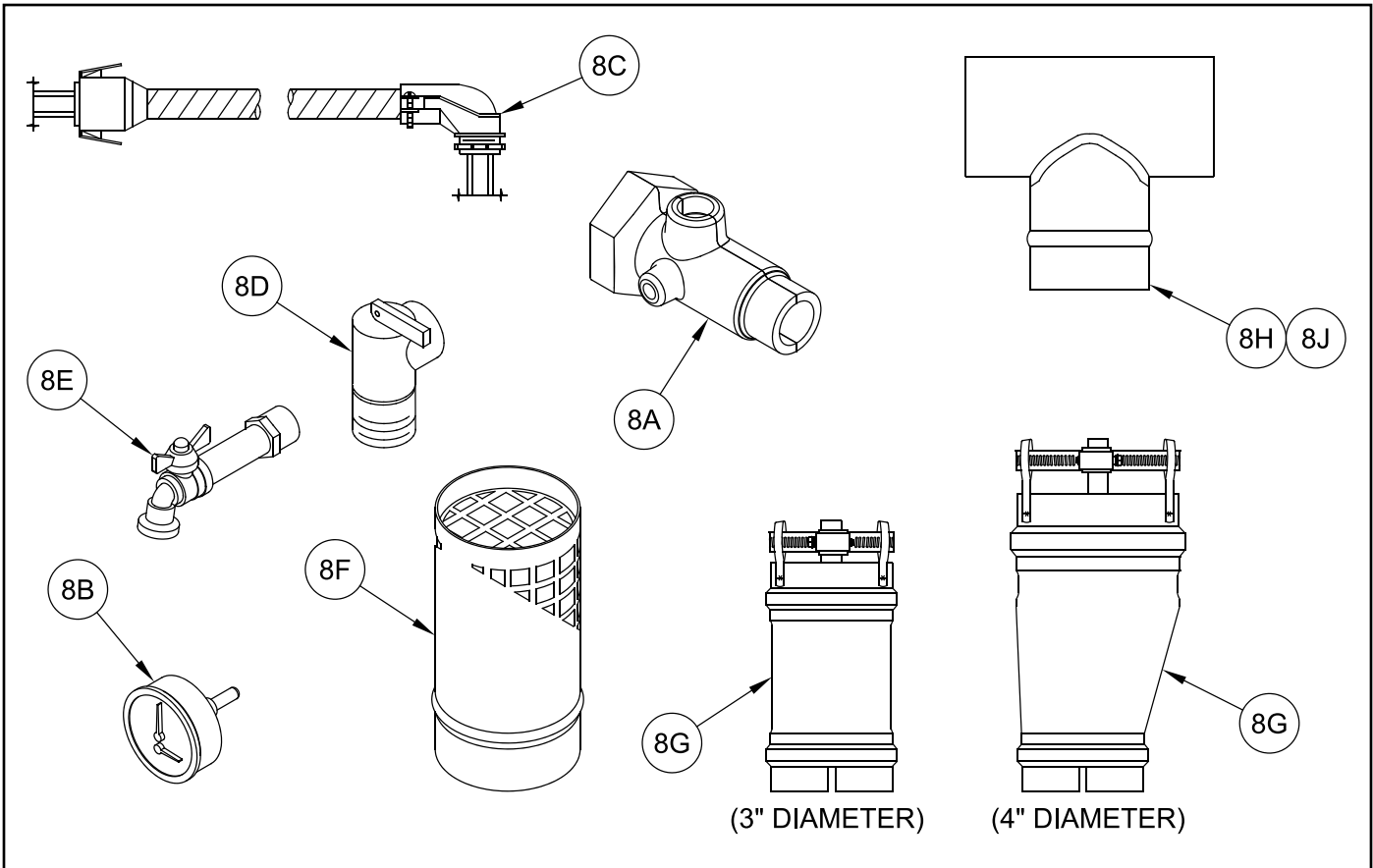
Key No.	Description	[Quantity] Part Number						
		ESC3C	ESC4C	ESC5C	ESC6C	ESC7C	ESC8C	ESC9C
6A	IQ Boiler Control				103661-01			
6B	IQ Option Panel				102291-01			
6C	Transformer				102516-01			
6D	Temperature Sensor				102411-01			
	Differential Pressure Switch Sea Level 0' - 4999'	80160762	80160761		80160760	80160759		80160760
6E	Differential Pressure Switch High Altitude - 5000' - 10,000' (Natural Gas)		104803-01				104801-01	
	Differential Pressure Switch High Altitude - 5000' - 10,000' (LP Gas)		80160760		104803-01	104801-01		104803-01
	Temperature Sensor Spring Clip (not shown)				102422-01			

## REPAIR PARTS (continued)



Key No.	Description	[Quantity] Part Number							
		ESC3C	ESC4C	ESC5C	ESC6C	ESC7C	ESC8C	ESC9C	
7A	Jacket Left Side Panel				102566-01				
7B	Jacket Right Side Panel				102567-01				
7C	Jacket Rear Panel	102587-03	102587-04	102587-05	102587-06	102587-07	102587-08	102587-09	
7D	Jacket Vestibule Panel	102588-03	102588-04	102588-05	102588-06	102588-07	102588-08	102588-09	
7E	Jacket Top Panel	102586-03	102586-04	102586-05	102586-06	102586-07	102586-08	102586-09	
7F	Jacket Front Door	102661-03	102661-04	102661-05	102661-06	102661-07	102661-08	102661-09	
7G	Jacket Poly Front Cover	102600-03	102600-04	102600-05	102600-06	102600-07	102600-08	102600-09	
7H	Upper Poly Grille				102621-01				
7J	Lower Poly Grille				103477-01				
7K	Air Intake Collar Assembly		102644-01		102644-02		102644-03		

## REPAIR PARTS (continued)



Key No.	Description	[Quantity] Part Number						
		ESC3C	ESC4C	ESC5C	ESC6C	ESC7C	ESC8C	ESC9C
8A	Water Manifold				80607001			
8B	Temperature/Pressure Gauge				100282-01			
8C	Circulator Wiring Harness				6130701			
8D	30 PSI Relief Valve				81660363			
8E	Drain Valve				102802-01			
8F	Vent Terminal		8110701				N/A	
8G	Vent Connector		8110703				N/A	
8H	Vent Tee AL294C, 3"		N/A		8116310			N/A
8J	Vent Tee AL294C, 4"			N/A				8116313
	Air Intake Terminal (not shown)	6116045		6116044			6116063	
	Circulator (not shown):							
	Taco 007-2				8056170			
	Grundfos UP-15				102805-02			
	B & G NRF-22				8056174			

# INTERNAL WIRING

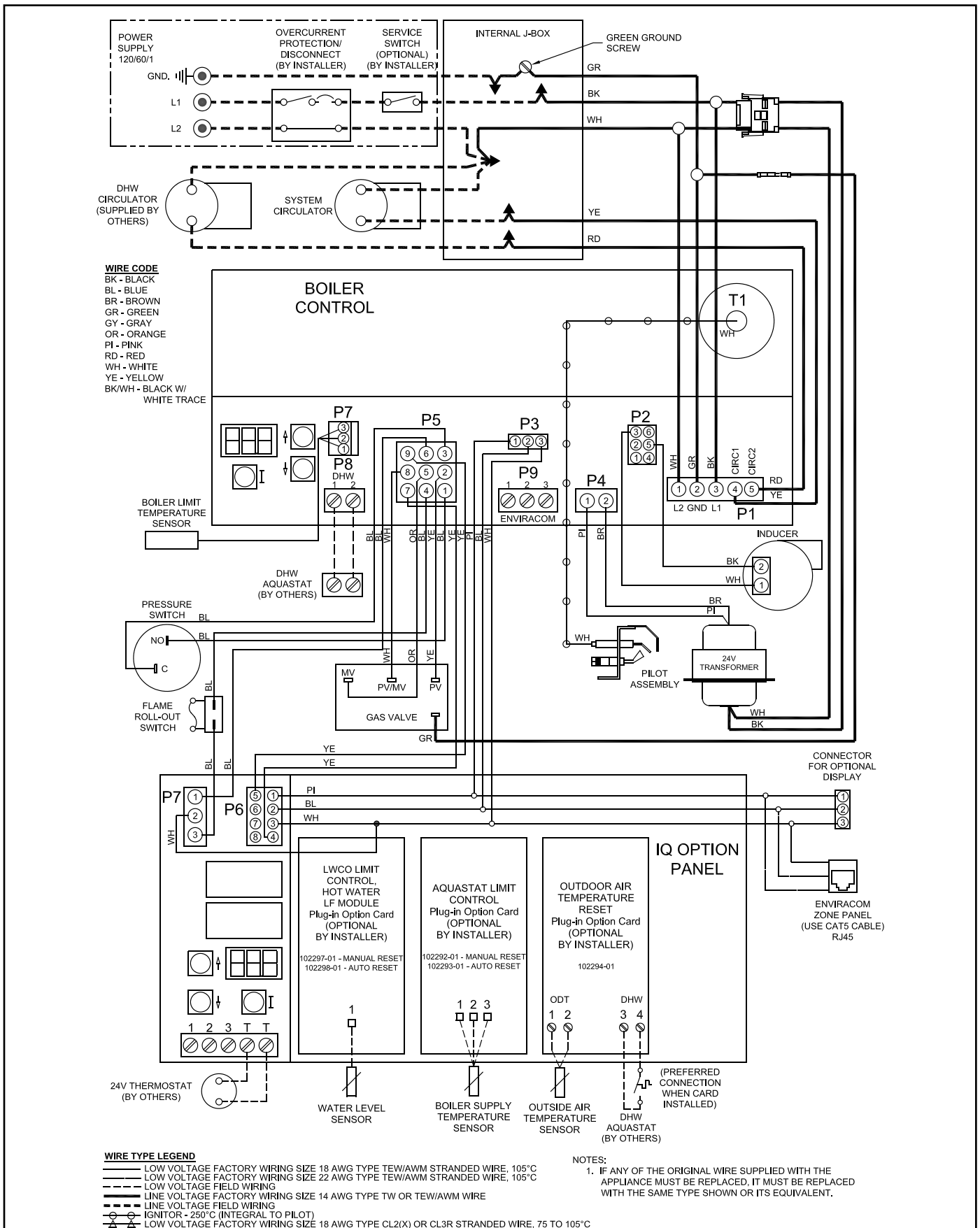


Figure IW-1: Wiring Diagram

# INTERNAL WIRING (continued)

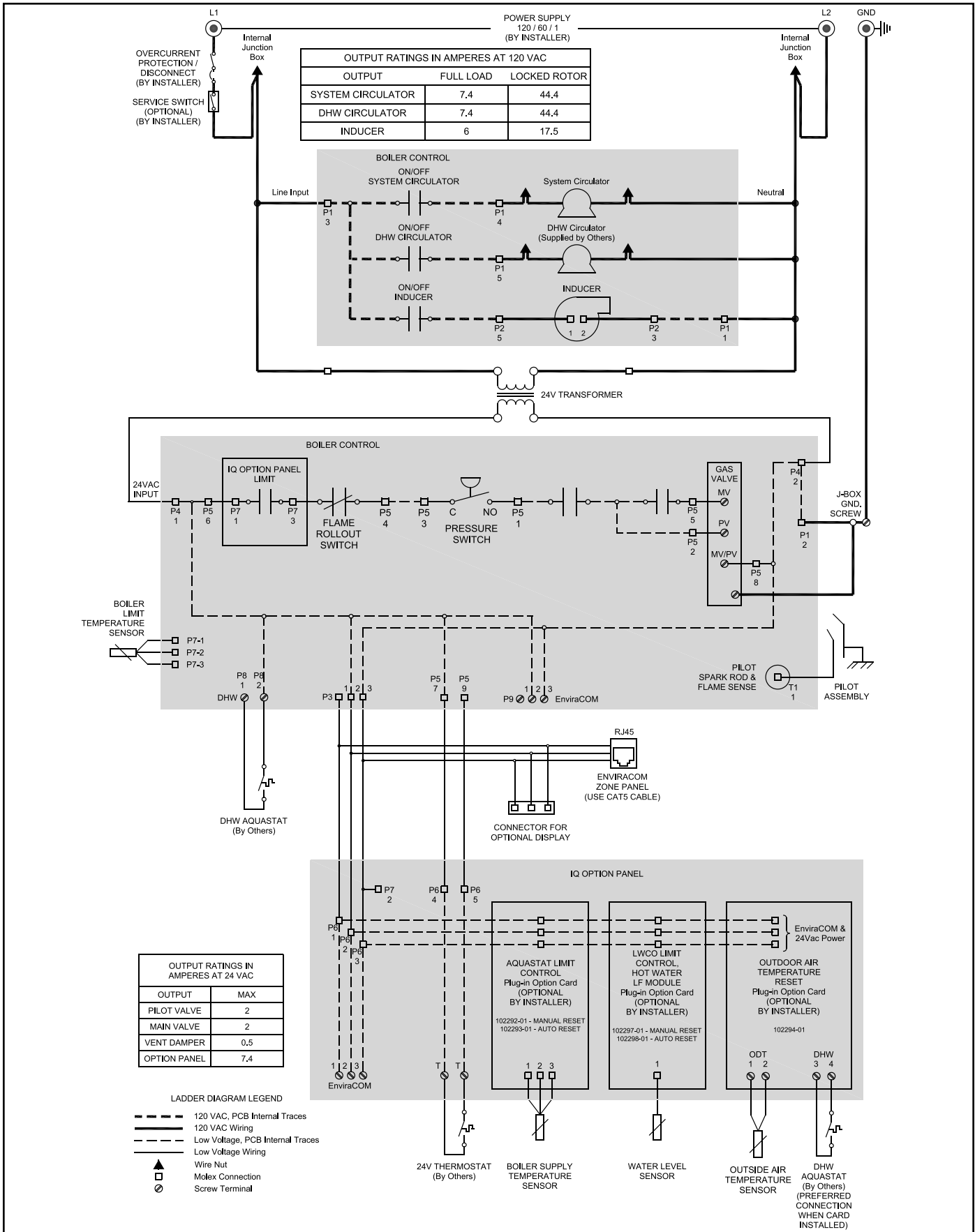
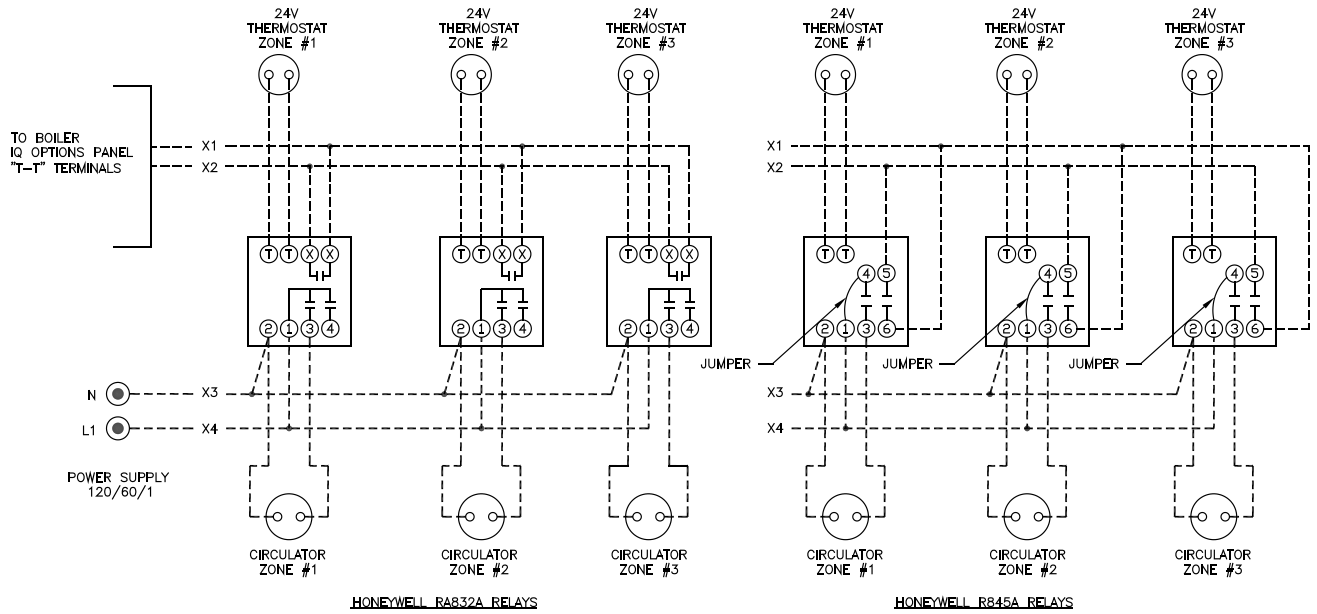


Figure IW-2: Wiring Diagram

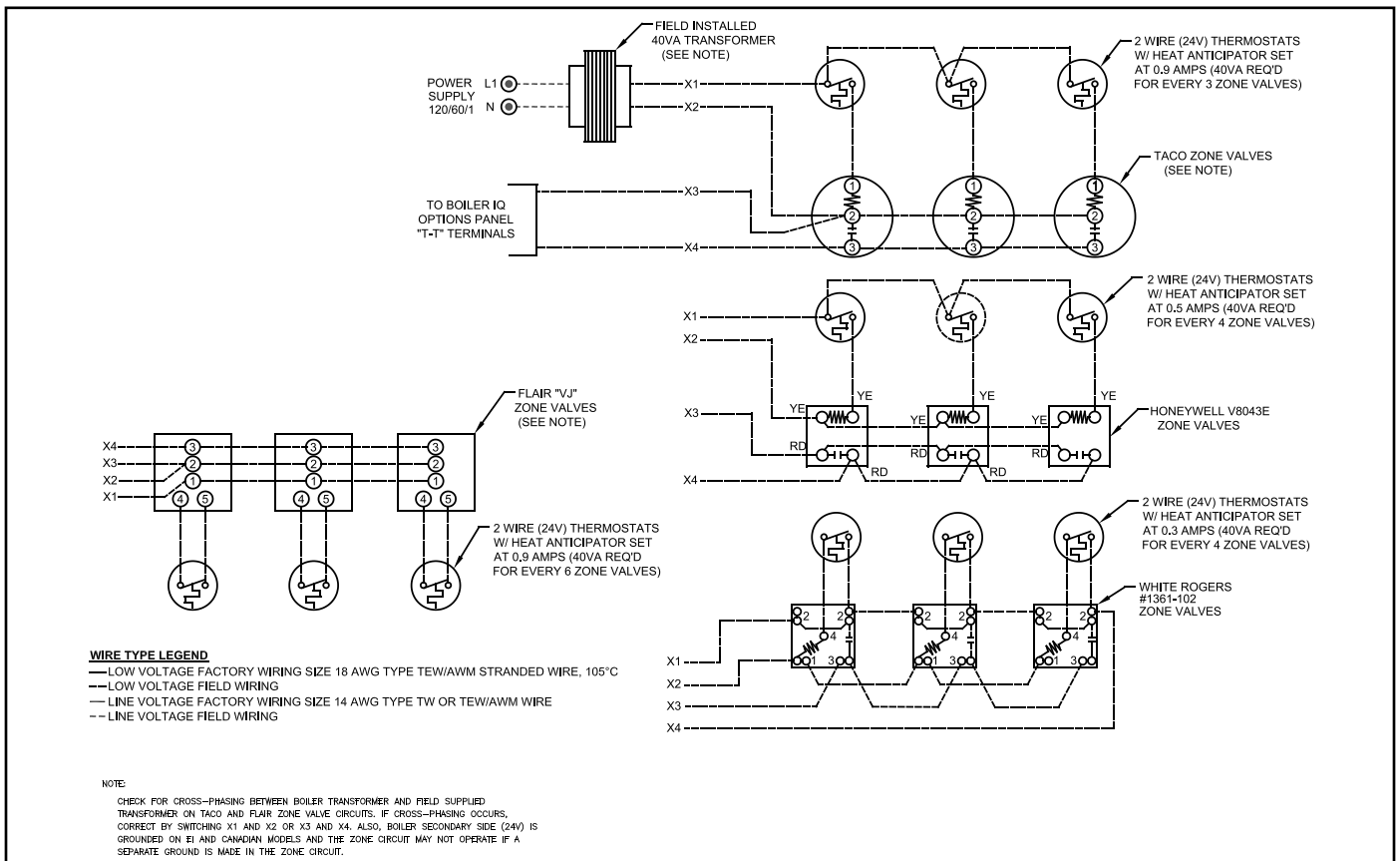
# INTERNAL WIRING (continued)



**WIRE TYPE LEGEND**

- LOW VOLTAGE FACTORY WIRING SIZE 18 AWG TYPE TEW/AWM STRANDED WIRE, 105°C
- LOW VOLTAGE FIELD WIRING
- LINE VOLTAGE FACTORY WIRING SIZE 14 AWG TYPE TW OR TEW/AWM WIRE
- LINE VOLTAGE FIELD WIRING

**Figure IW-3: Multiple Zone System with Zone Circulators**



**WIRE TYPE LEGEND**

- LOW VOLTAGE FACTORY WIRING SIZE 18 AWG TYPE TEW/AWM STRANDED WIRE, 105°C
- LOW VOLTAGE FIELD WIRING
- LINE VOLTAGE FACTORY WIRING SIZE 14 AWG TYPE TW OR TEW/AWM WIRE
- LINE VOLTAGE FIELD WIRING

**NOTE:**

CHECK FOR CROSS-PHASING BETWEEN BOILER TRANSFORMER AND FIELD SUPPLIED TRANSFORMER ON TACO AND FLAIR ZONE VALVE CIRCUITS. IF CROSS-PHASING OCCURS, CORRECT BY SWITCHING X1 AND X2 OR X3 AND X4. ALSO, BOILER SECONDARY SIDE (24V) IS GROUNDING ON E1 AND CANADIAN MODELS AND THE ZONE CIRCUIT MAY NOT OPERATE IF A SEPARATE GROUND IS MADE IN THE ZONE CIRCUIT.

**Figure IW-4: Multiple Zone System with Zone Valves**

# INTERNAL WIRING (continued)

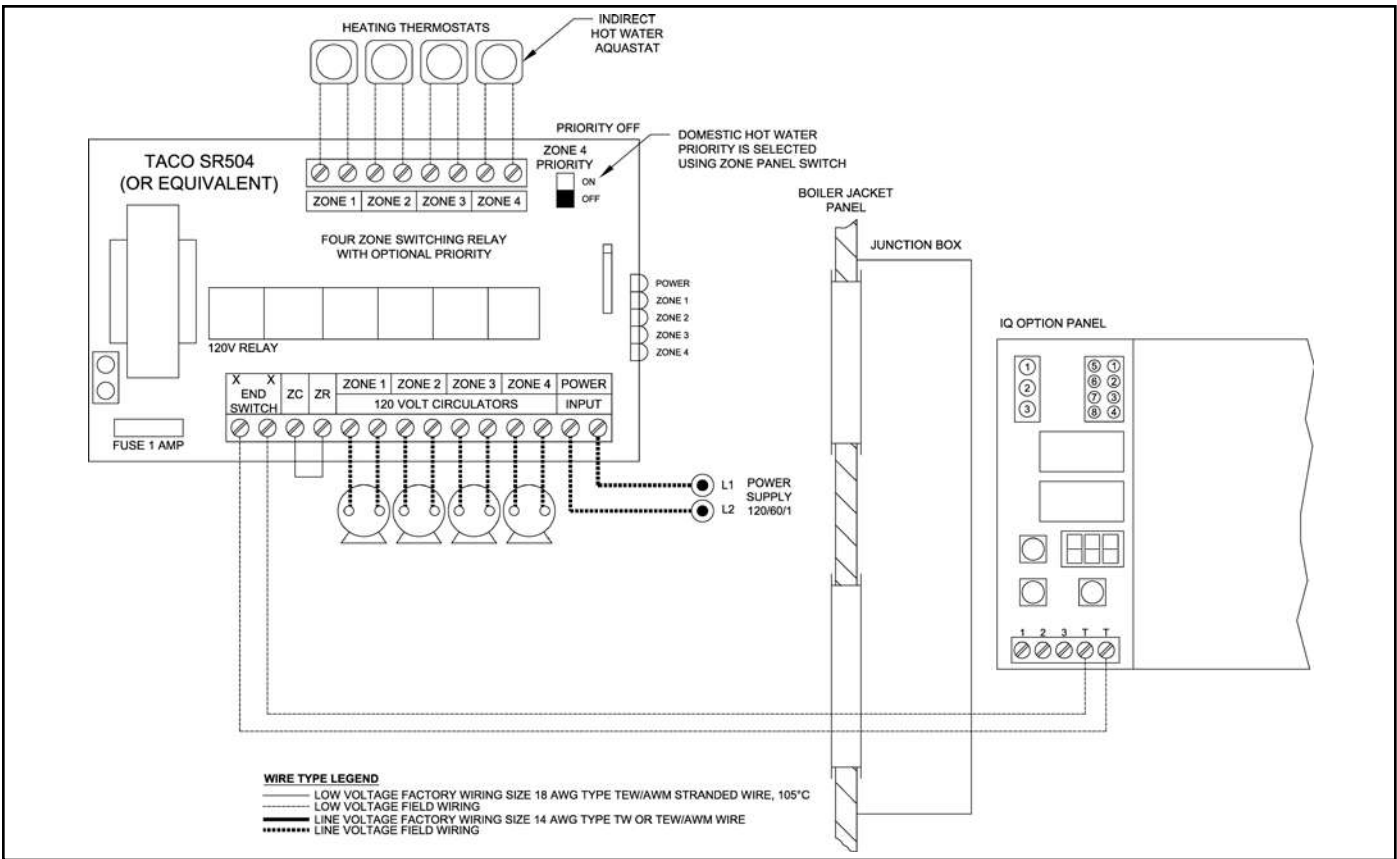


Figure IW-5: Multiple Zone System with Zone Circulator Panel

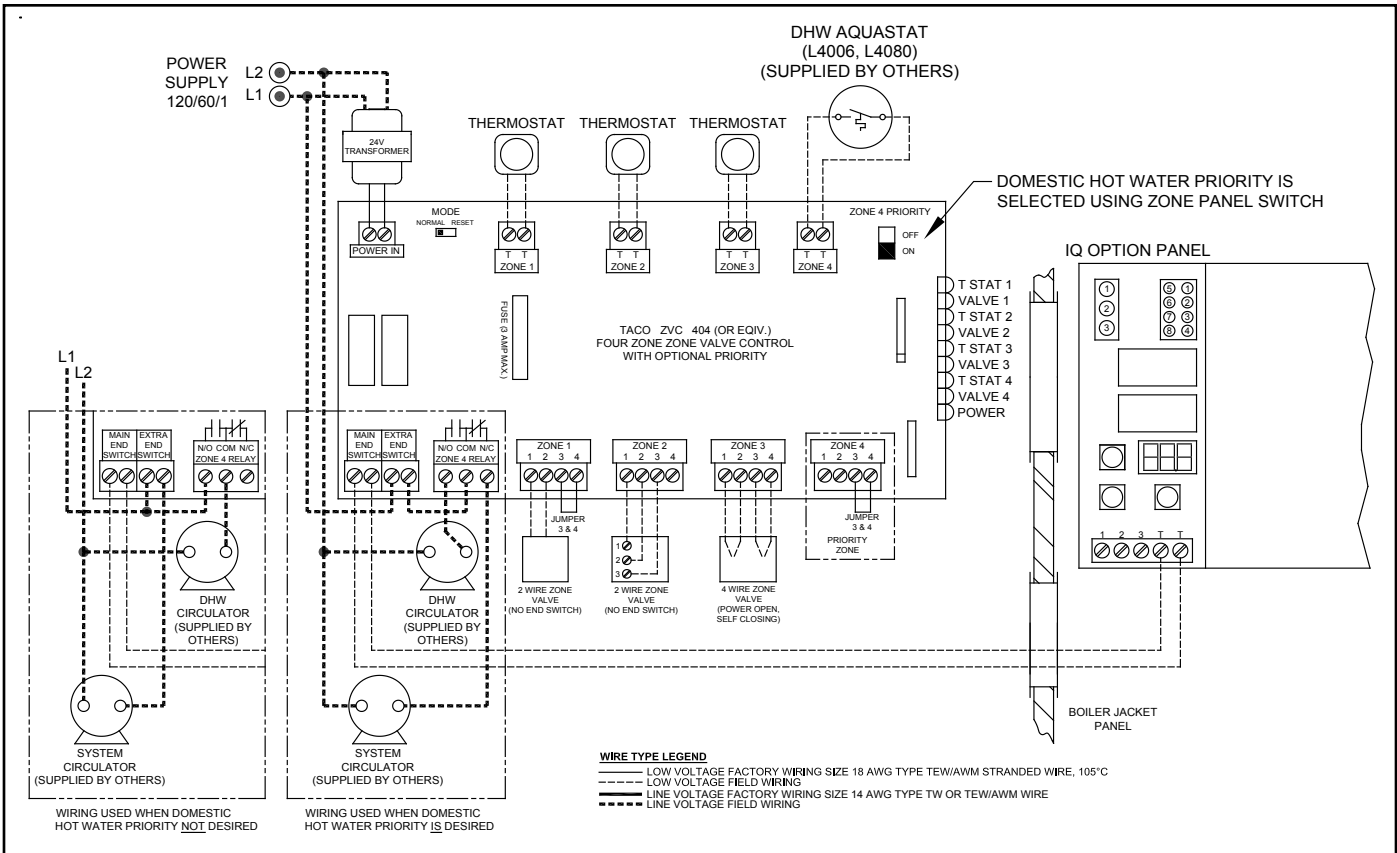


Figure IW-6: Multiple Zone System with Zone Valve Panel



## APPENDIX A – COMBUSTION AIR



**PROVIDE ENOUGH AIR** to ventilate the boiler room, dilute the flue gases, and sustain combustion. Ignition failure, overheating, fire, carbon monoxide, and spillage of flue gases may result from poor air supply.

If the boiler is a Direct Vent boiler and exchanges all combustion air and combustion products directly with the outdoors, there are no special requirements for providing combustion, ventilation, and dilution air.

If the boiler is chimney vented, power vented or induced draft and draws combustion air from within the building, follow the steps below to determine how to provide air to the boiler.

Is the boiler located in a confined space?:

1. Calculate the floorspace (in square feet) of the boiler room and all rooms connected to the boiler room by passageways not furnished with doors.

\_\_\_\_\_ floorspace (sq. ft.)

2. Add up the input rates of all the combustion appliances installed in the same floorspace.

\_\_\_\_\_ combined appliance  
input (BTU/hr)

3. In the table below, find the Minimum Allowable Floorspace based on the Combined Input Rate from Step 2 and the ceiling height. If the Combined Input Rate is between two rates, use the next highest rate.

\_\_\_\_\_ minimum allowable  
floorspace (sq. ft.)

**Minimum Allowable Floorspace in the Boiler Room and Freely Connected Rooms (sq. ft.)**

		Ceiling Height			
		7'	8'	9'	10'
Combined Appliance Input Rate (see Step 2) (BTU/hr)	50,000	357	313	278	250
	100,000	714	625	556	500
	150,000	1071	938	833	750
	200,000	1429	1250	1111	1000
	250,000	1786	1563	1389	1250
	300,000	2143	1875	1667	1500
	350,000	2500	2188	1944	1750
	400,000	2857	2500	2222	2000

4. If the Floorspace from Step 1 is *less than* the Minimum Floorspace from Step 3, then you must provide outdoor air to the boiler room. Proceed to Step 6.

Is the boiler located in a building of unusually tight construction?

5. If the answer to *all* of the three questions below is “yes”, then you must provide outdoor air to the boiler room.

Do the walls and ceilings exposed to the outside atmosphere have a continuous water vapor retarder with a rating of 1 perm or less, with openings gasket or sealed?

Yes  No

Are operable windows and doors weatherstripped?

Yes  No

Are exterior wall joints caulked or sealed?

Yes  No

6. If you must provide outdoor air to the boiler room, the top of the permanent opening into the boiler room must be within 12” of the ceiling, and the free area of the opening (sq. in.) must be no less than the Combined Appliance Input (from Step 2) divided by 3000 BTU/hr/sq. in.

\_\_\_\_\_ combined appliance  
input (Step 2)

÷ \_\_\_\_\_ 3000 BTU/hr/sq. in.

\_\_\_\_\_ Minimum Opening Size  
(sq. in.)

7. Duct this opening vertically or horizontally directly to the outdoors, or directly to a space that communicates directly with the outdoors, such as an attic or crawlspace.

For more details and options, refer to the *National Fuel Gas Code (ANSI Z223.1/NFPA 54)*, or applicable provisions of local building codes.

## APPENDIX B – VENTING



VENT THIS BOILER according to the instructions. Failure to do so may cause products of combustion to enter the building resulting in severe property damage, personal injury or death.



FAILURE TO INSTALL a condensate drain line could cause boiler to shutdown unexpectedly.



*Install this boiler according to this manual and the National Fuel Gas Code, ANSI Z223.1/NFPA 54, or applicable provisions of the local building codes. Contact local building or fire officials about restrictions and installation inspection in your area.*

This Appendix consists of two sections (B2, and B3). Refer to the section appropriate for the type of boiler you are installing or servicing.

**B2 Direct Vent** “Direct vent” is also called “sealed combustion”. All combustion air is drawn from outside the building directly into the boiler. The boiler vents vertically or horizontally, assisted by a fan in the boiler. Gas vent must resist temperature and corrosion and be sealed against leakage of flue gases and condensate. Approved materials include AL29-4C stainless steel. Combustion air provided by a separate PVC or galvanized steel pipe.

**B3 Power Vent** Similar to Direct Vent, but some or all combustion air is drawn from inside the building. May draw air directly from the boiler room without the use of a combustion air pipe.

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

### IF AN EXISTING BOILER IS REMOVED

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

At the time of removal of an existing boiler, the following steps shall be followed with each appliance remaining connected to the common venting system placed in operation, while the other appliances remaining connected to the common venting system are not in operation:

- (1) Seal any unused openings in the common venting system.
- (2) Visually inspect the venting system for proper size and horizontal pitch and determine there is no blockage or restriction, leakage, corrosion, and other deficiencies which could cause an unsafe condition.
- (3) Insofar as is practical, close all building doors and windows and all doors between the space in which the appliances remaining connected to the common venting system are located and other spaces of the building. Turn on clothes dryers and any appliance not connected to the common venting system. Turn on any exhaust fans, such as range hoods and bathroom exhausts, so they will operate at maximum speed.

Do not operate a summer exhaust fan.  
Close fireplace dampers.

- (4) Place in operation the appliance being inspected. Follow the Lighting (or Operating) Instructions. Adjust thermostat so appliance will operate continuously.
- (5) Test for spillage at the draft hood relief opening after 5 minutes of main burner operation. Use the flame of a match or candle, or smoke from a cigarette, cigar or pipe.
- (6) After it has been determined that each appliance remaining connected to the common venting system properly vents when tested as outlined above, return doors, windows, exhaust fans, fireplace dampers and any other gas burning appliance to their previous conditions of use.
- (7) Any improper operation of the common venting system should be corrected so the installation conforms with the *National Fuel Gas Code, ANSI Z223.1/NFPA 54*. 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 Chapter 13 of the *National Fuel Gas Code, ANSI Z223.1/NFPA 54*.

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## APPENDIX B2 – DIRECT VENTING

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### GENERAL WARNINGS FOR DIRECT VENT SYSTEMS

DRAFT HOODS, VENT DAMPERS and other obstructions or openings in the vent system are prohibited.

DO NOT REDUCE THE DIAMETER of the vent pipe.

MOISTURE AND ICE may collect around and below the vent terminal. Keep the area in good repair.

IF USING A CHIMNEY AS A CHASE for the vent, do not vent any other appliance into the space between the chimney wall and the vent.

ELIMINATE LOW SPOTS in the vent where flue gas condensate may pool.

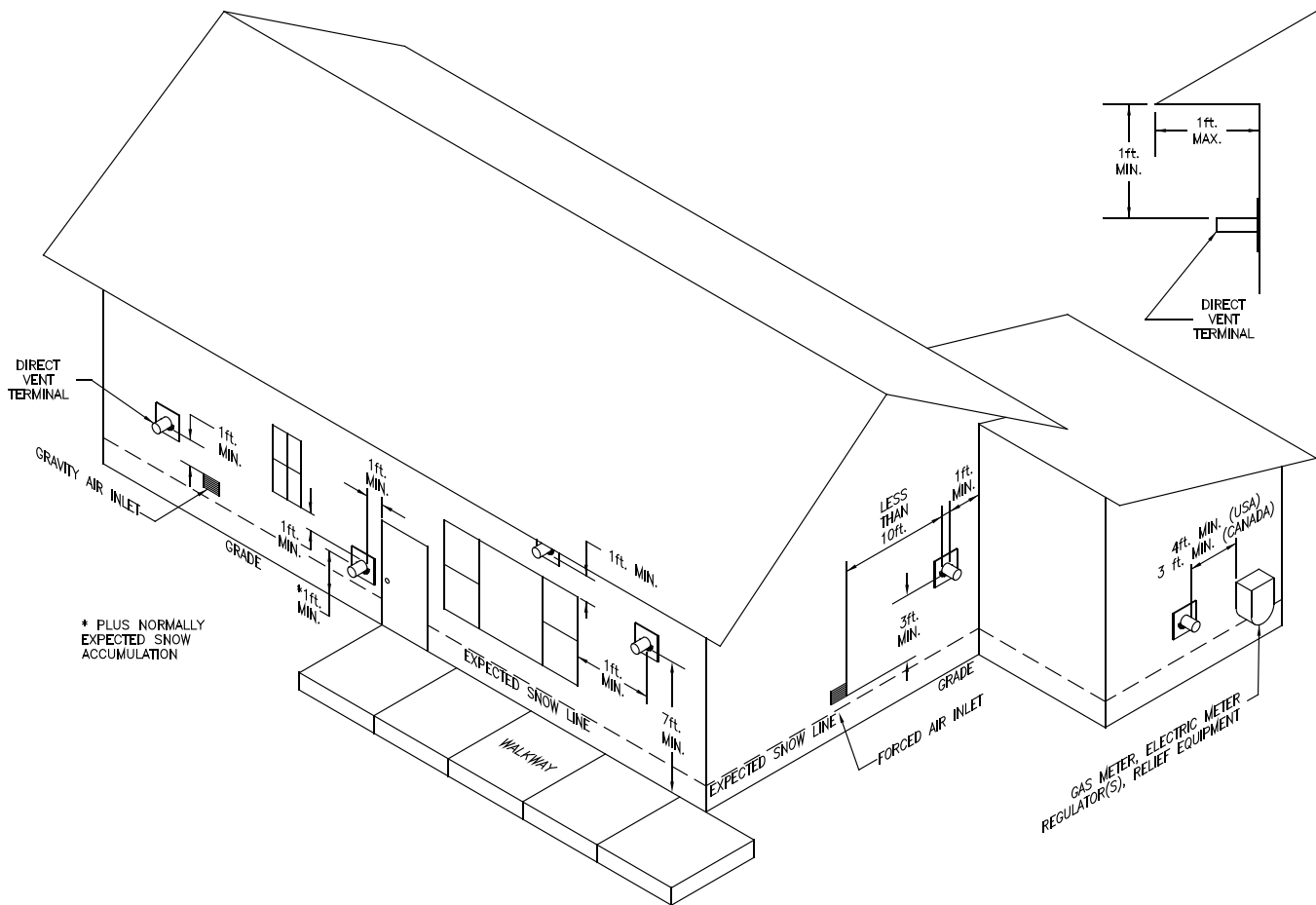
DO NOT PENETRATE VENT PIPE with holes or fasteners.

---

### Planning a Direct Vent System

1. Avoid contact with plumbing or electrical wires.
2. Horizontal vent pipe must maintain a minimum  $\frac{1}{4}$  inch per foot slope down towards boiler.
3. Any condensate forming in the vent will return to the boiler. Provide for a condensate trap or siphon near the boiler to remove condensate from the vent.
4. Support the piping to maintain vent location, prevent sag and prevent accumulation of condensate. The vent and/or air intake piping must be adequately supported with straps or supports with a maximum spacing of five (5) feet on horizontal runs.
5. Adhere to the boiler's maximum and minimum allowable vent lengths. Vent length is provided in terms of *equivalent length* of straight pipe plus equivalent length of fittings, including both the vent and the combustion air piping, but not including vent or intake terminals.
6. Maintain minimum allowable clearances between the vent pipe and combustible materials as specified by the vent pipe supplier, this manual, and applicable building codes.
7. Do not install venting system components on the exterior of the building except as specifically required by these instructions.
8. Locate the vent terminal per these restrictions and Figure B-2:
  - (1) Minimum twelve (12) inches above grade plus normally expected snow accumulation level, or seven (7) feet above grade, if located adjacent to public walkway. Do not install over public walkway where local experience indicates appliance flue gas vapor or condensate creates a nuisance or hazard.
  - (2) Minimum three (3) feet above any forced air intake located within ten (10) feet.  
Exception: Combustion air intake of direct vent system.
  - (3) Minimum 4 ft. horizontally from, and in no case above or below, unless a 4 ft. horizontal distance is maintained, from electric meters, gas meters, regulators and relief equipment.
  - (4) Minimum twelve (12) inches from overhangs or corners of buildings.
  - (5) If window and/or air inlet is within four (4) feet of an inside corner, then vent terminal must be at least six (6) feet from adjoining wall of inside corner.
  - (6) Minimum one (1) foot below, one (1) foot horizontally from, or one (1) foot above any door, window, gravity air inlet, or other air opening into building.
9. Locate the combustion air terminal on the same face of the building as the vent termination to prevent nuisance boiler shutdowns.

## APPENDIX B2 – Direct Venting (continued)



**Figure B-2: Approved Terminal Locations**

However, boiler may be installed with vertical venting and sidewall combustion air inlet or visa versa, if installation conditions do not allow alternate arrangement.

10. If the vent passes through interior spaces in floors above the boiler room, enclose the vent with material having a fire resistance rating at least equal to the rating of the adjoining floor or ceiling. Maintain minimum clearances to combustible materials between the enclosure and the vent.
11. Use appropriate designed thimbles when passing through combustible walls (thimble use is optional for noncombustible walls). Ensure thimble is sealed to prevent moisture from entering structure.
12. Protect building materials from degradation from flue gases or flue gas condensate.
13. Vent-Air Intake system may be installed through wall 3" - 24" thick.

### *Planning Vertical Installations –*

1. Install fire stop where vent and air intake passes through floors, ceilings or framed walls. The fire stop must close the opening between the vent and/or air intake pipe and the structure.
2. Size roof opening to allow easy insertion of vent and air intake piping to allow proper installation of flashing and storm collar to prevent moisture from entering the structure
3. Use appropriately designed vent flashing when passing through roofs. Follow flashing manufacturers' instructions for procedures.
4. Ensure there is a weather-tight seal between the vent and/or air intake piping were it penetrates the storm collar and roof flashing.
5. Extend the vent and air intake pipe to maintain a minimum vertical and horizontal distance of twelve (12) inches from the roof surface. Allow additional vertical distance for expected snow accumulation. Brace as required.

## APPENDIX B2 – Direct Venting (continued)

### Special Instructions for Stainless Steel Direct Vent



**USE STAINLESS STEEL VENTING** only with boilers approved for use with stainless steel venting as noted in the *Specifications* Section of this manual.

AL 29-4C® stainless steel vent systems resist the corrosive effects of high temperature acidic flue gas condensate and are leak-tight. Alternate stainless steel venting systems require special adaptors to connect to the parts supplied with the boiler. Obtain the adaptors from the supplier of the alternate manufacturer's venting system. Approved alternate brands are:

- (1) *Heat-fab Inc – Saf-T-Vent*  
800-772-0739
- (2) *Flex –L International Inc. – Star 34*  
800- 561-1980
- (3) *Z-Flex U.S. Inc. – Z-Vent*  
800-654-5600
- (4) *Protech Systems, Inc. – FasNSeal*  
800-766-3473

#### Installing Stainless Steel Vent

1. Follow all general warnings and instructions for Direct Vent systems described in the opening section of *Appendix B2 Direct Venting*. Start at the vent connector on the boiler and work towards the vent terminal.
2. Select stainless steel vent components from Table B-1.
3. Verify that the vent and air intake components do not exceed the boiler's maximum allowable equivalent venting length, and do not fall below the boiler's minimum equivalent venting length, using the worksheet on the following page.
4. If a non-standard length is required, there are two options:
  - (1) Select adjustable length pipe from Table B-1. The pipe adjusts 7" from 12 ¾" to 19 ¾". Or,
  - (2) Cut the non-gasketed end of a standard straight length. Make a square cut and file the end smooth.

**Table B-1: Vent System and Air Intake System Components**

Vent System Component	Part Number
3" Dia. Pipe x 1 Ft	8116296U
4" Dia. Pipe x 1 Ft	100176-01
3" Dia. Pipe x 3 Ft	8116298U
4" Dia. Pipe x 3 Ft	100177-01
3" Dia. Pipe x 5 Ft	8116300U
4" Dia. Pipe x 5 Ft	100178-01
3" Dia. Pipe x Adjustable	8116319U
4" Dia. Pipe x Adjustable	100179-01
3" Dia. 90° Elbow	8116294U
4" Dia. 90° Elbow	100180-01
3" Dia. 45° Elbow	8116292U
4" Dia. 45° Elbow	100181-01
3" Dia. Horizontal Drain Tee	8116302U
4" Dia. Horizontal Drain Tee	100182-01
3" Dia. Vertical Drain Tee	8116304U
4" Dia. Vertical Drain Tee	100183-01
3" Single Wall Thimble	8116116
4" Single Wall Thimble	100184-01
3" Double Wall Thimble	103877-01
4" Double Wall Thimble	100185-01

5. Remove dirt and grease from the male end of the joint using an alcohol pad.
6. Align weld seams in pipes and use a slight twisting motion to fully insert the male end into the female end of the joint.



**DO NOT DISLODGE, SCRATCH, OR CUT THE FACTORY GASKET.**

7. Tighten locking band by hand with a 5/16" nut driver, plus ¼" turn past snug, ensuring that the locking band fully captures the bead in the pipe.

#### Horizontal Stainless Steel Vent Installations

1. Install vent and intake piping per Figure B-3.
2. Where the vent pipe penetrates any combustible wall (Figure B-4):

## APPENDIX B2 – Direct Venting (continued)

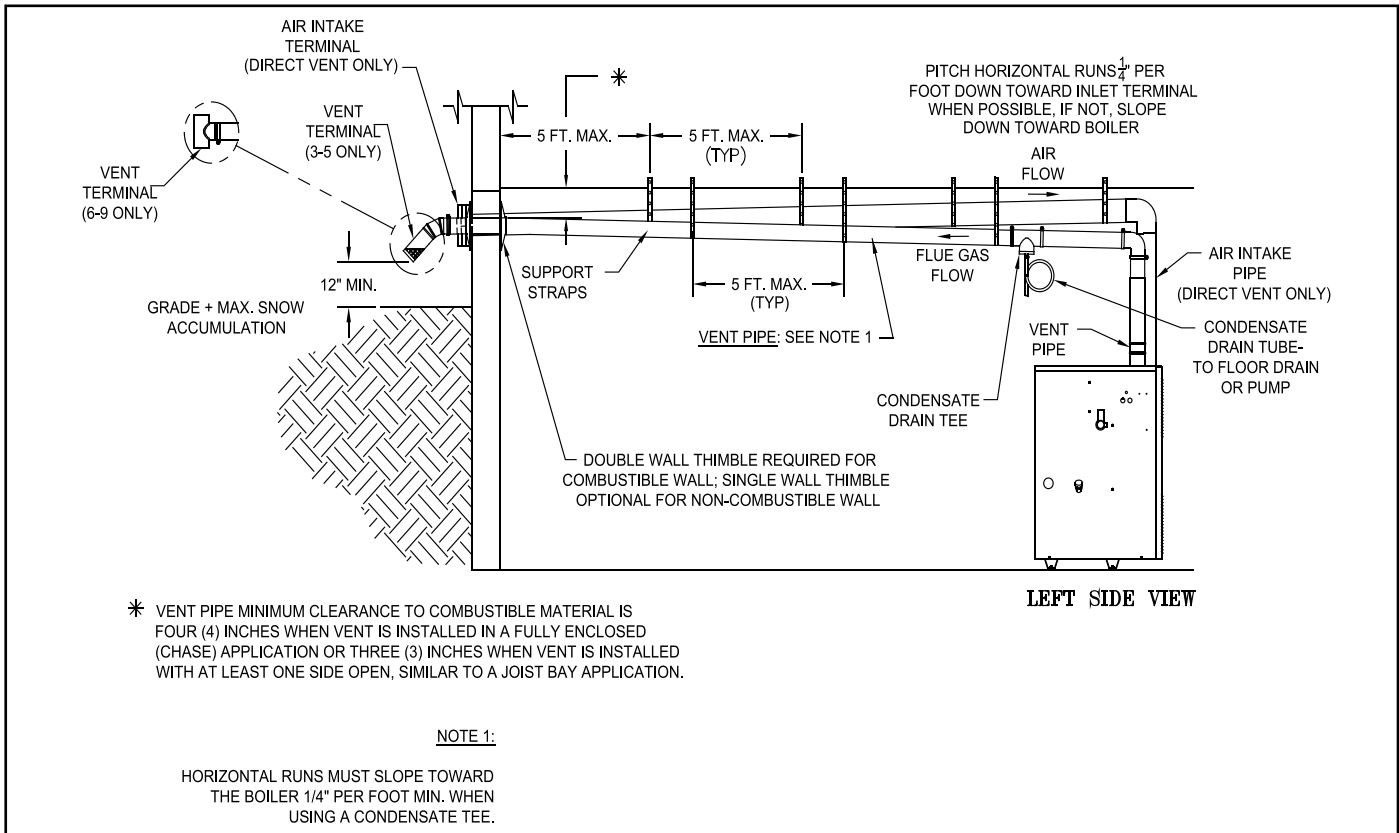
### Special Instructions for Stainless Steel Direct Vent (continued)

#### Vent/Combustion Air, Equivalent Length Work Sheet

This sheet is supplied to assist in vent/combustion air, equivalent length calculating

Combustion Air (PVC shown)	Vent (stainless special gas vent)
90° elbow(s) PVC Quantity = <input style="width: 50px;" type="text"/> x 5' = <input style="width: 50px;" type="text"/> equiv. ft. a.	90° elbow(s) Quantity = <input style="width: 50px;" type="text"/> x 5' = <input style="width: 50px;" type="text"/> equiv. ft. a.
45° elbow(s) PVC Quantity = <input style="width: 50px;" type="text"/> x 2.5' = <input style="width: 50px;" type="text"/> equiv. ft. b.	45° elbow(s) Quantity = <input style="width: 50px;" type="text"/> x 5' = <input style="width: 50px;" type="text"/> equiv. ft. b.
Straight pipe PVC Length ft. = <input style="width: 50px;" type="text"/> x 1 = <input style="width: 50px;" type="text"/> equiv. ft. c.	Straight pipe Length ft. = <input style="width: 50px;" type="text"/> x 1 = <input style="width: 50px;" type="text"/> equiv. ft. c.
	Horizontal drain tee Length ft. = <input style="width: 50px;" type="text"/> x 2' = <input style="width: 50px;" type="text"/> equiv. ft. d.
	Vertical drain tee Length ft. = <input style="width: 50px;" type="text"/> x 7' = <input style="width: 50px;" type="text"/> equiv. ft. e.
<b>Total*</b> a.+b.+c. = <input style="width: 50px;" type="text"/> equiv. ft.	<b>Total*</b> a.+b.+c.+d.+e.= <input style="width: 50px;" type="text"/> equiv. ft.

\* Total length cannot exceed 50 equivalent feet length (ESC3C through ESC7C) or 40 equivalent feet (ESC8C, ESC9C).  
Vent and combustion air terminals do not count towards total equiv. ft.

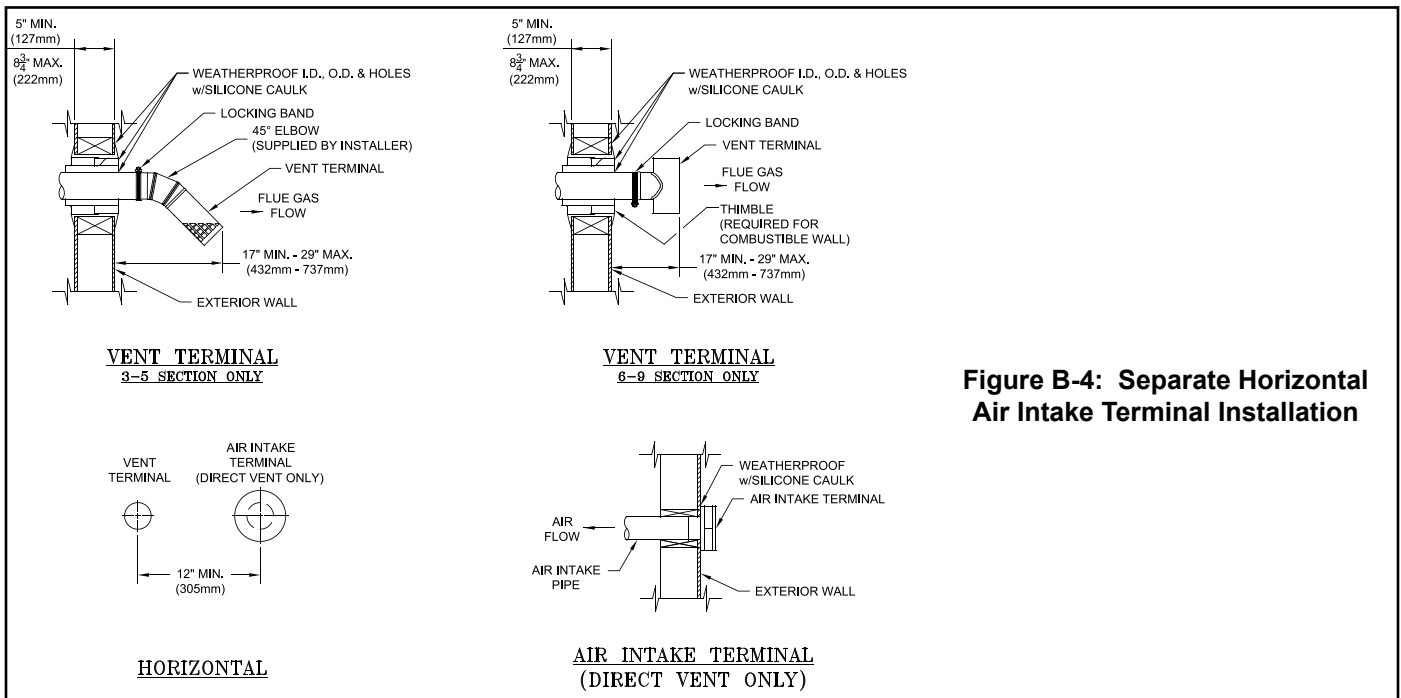


**Figure B-3: Separate Horizontal – Vent/Air Intake Installation**

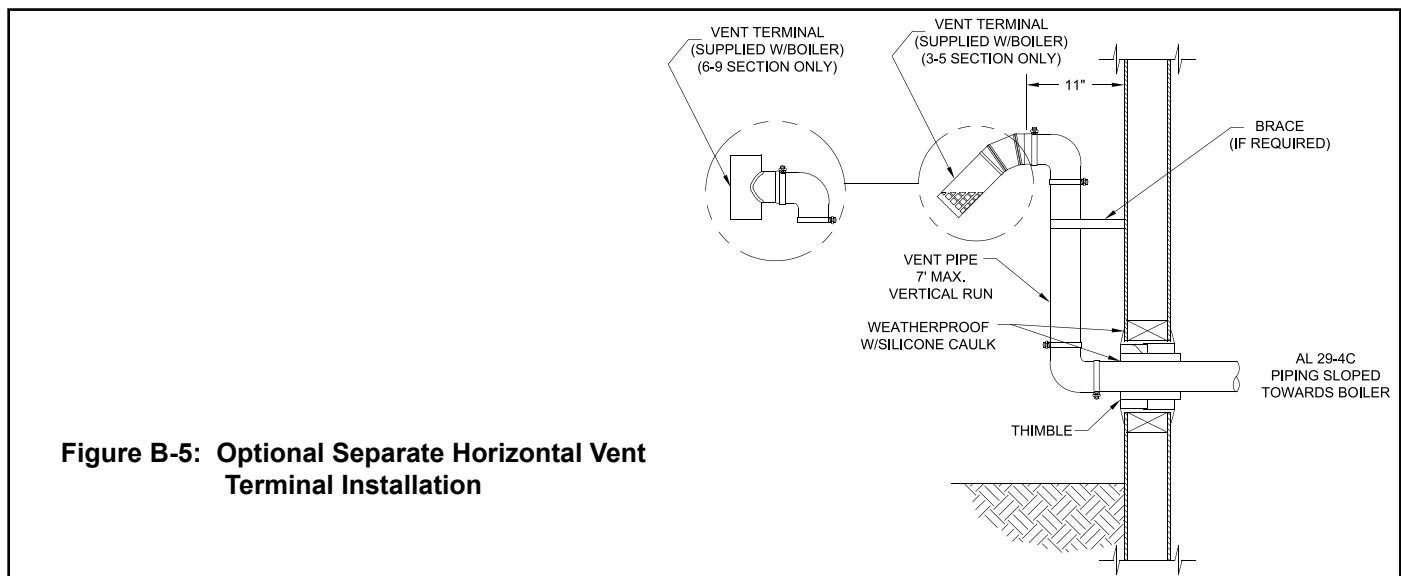
## APPENDIX B2 – Direct Venting (continued)

### Special Instructions for Stainless Steel Direct Vent (continued)

- (1) Insert the wall thimble from the outside of the wall, and secure the outside flange to the wall using nails or screws.
  - (2) Seal any exterior openings in the wall thimble, or between the thimble and the wall, using a weatherproof sealant.
  - (3) Install the inside thimble flange and secure the flange to the inside wall using screws or nails.
3. Maintain 12" separation between vent and intake terminals. Where the intake air pipe penetrates the external wall, seal the opening with weatherproof sealant (Figure B-4).
4. To install a vertical "snorkel" exterior to the building, refer to Figure B-5 or B-6.
  5. An optional concentric adapter kit (P/N 61106012) is available for 3" & 4" stainless steel vents to provide a single exterior wall penetration accommodating both the intake and exhaust. Refer to the installation instructions provided with the concentric adapter.



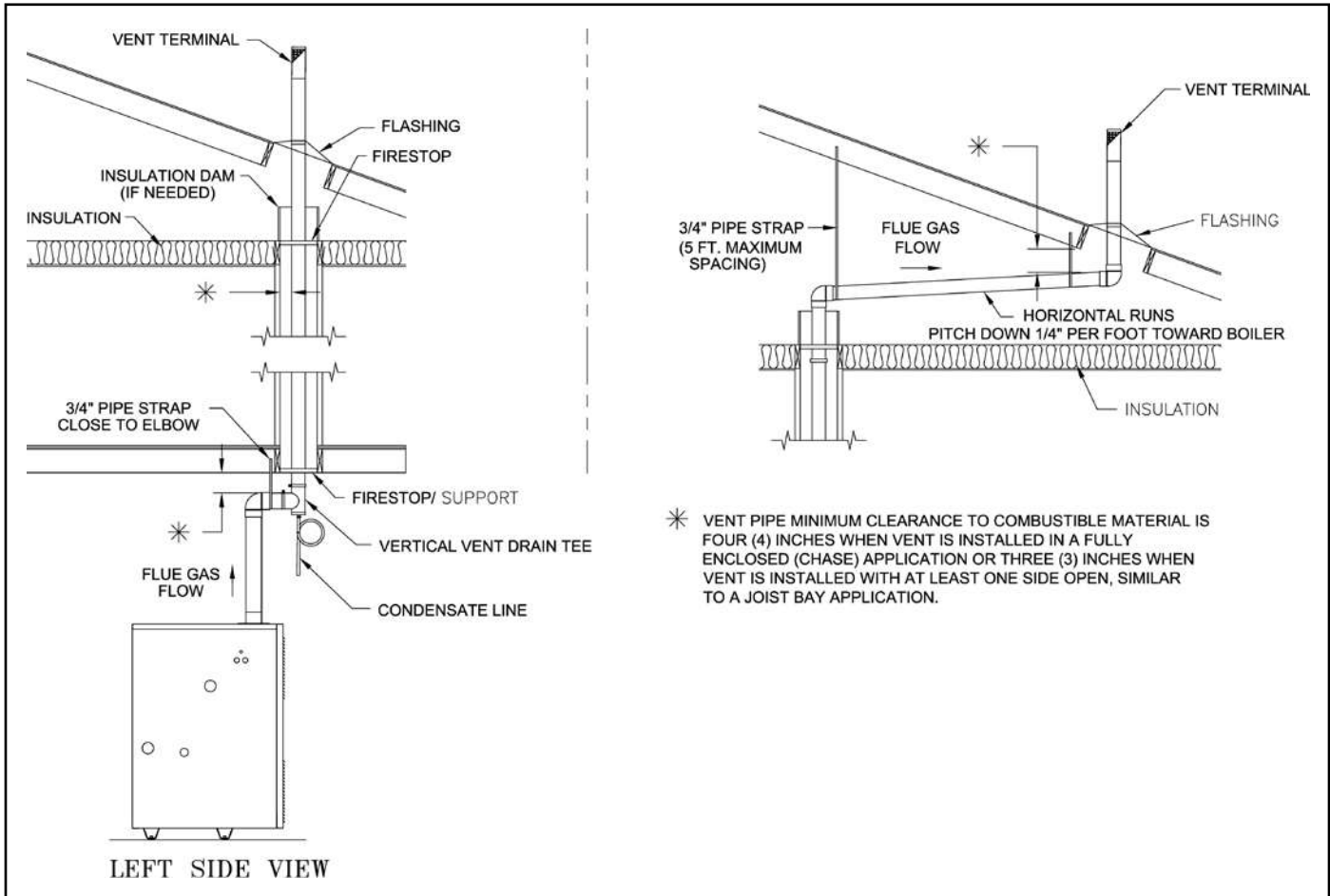
**Figure B-4: Separate Horizontal Air Intake Terminal Installation**



**Figure B-5: Optional Separate Horizontal Vent Terminal Installation**

## APPENDIX B2 – Direct Venting (continued)

### Special Instructions for Stainless Steel Direct Vent (continued)



**Figure B-6: Typical Vertical Stainless Steel Venting**

6. Install the intake air terminal supplied with the boiler onto the outdoor end of the air intake pipe per the instructions in *Connect Venting* in this manual.
7. Install the vent terminal supplied with the boiler onto the outdoor end of the vent pipe per the boiler-specific instructions in *Connect Venting* in this manual.

#### Vertical Stainless Steel Vent Installation

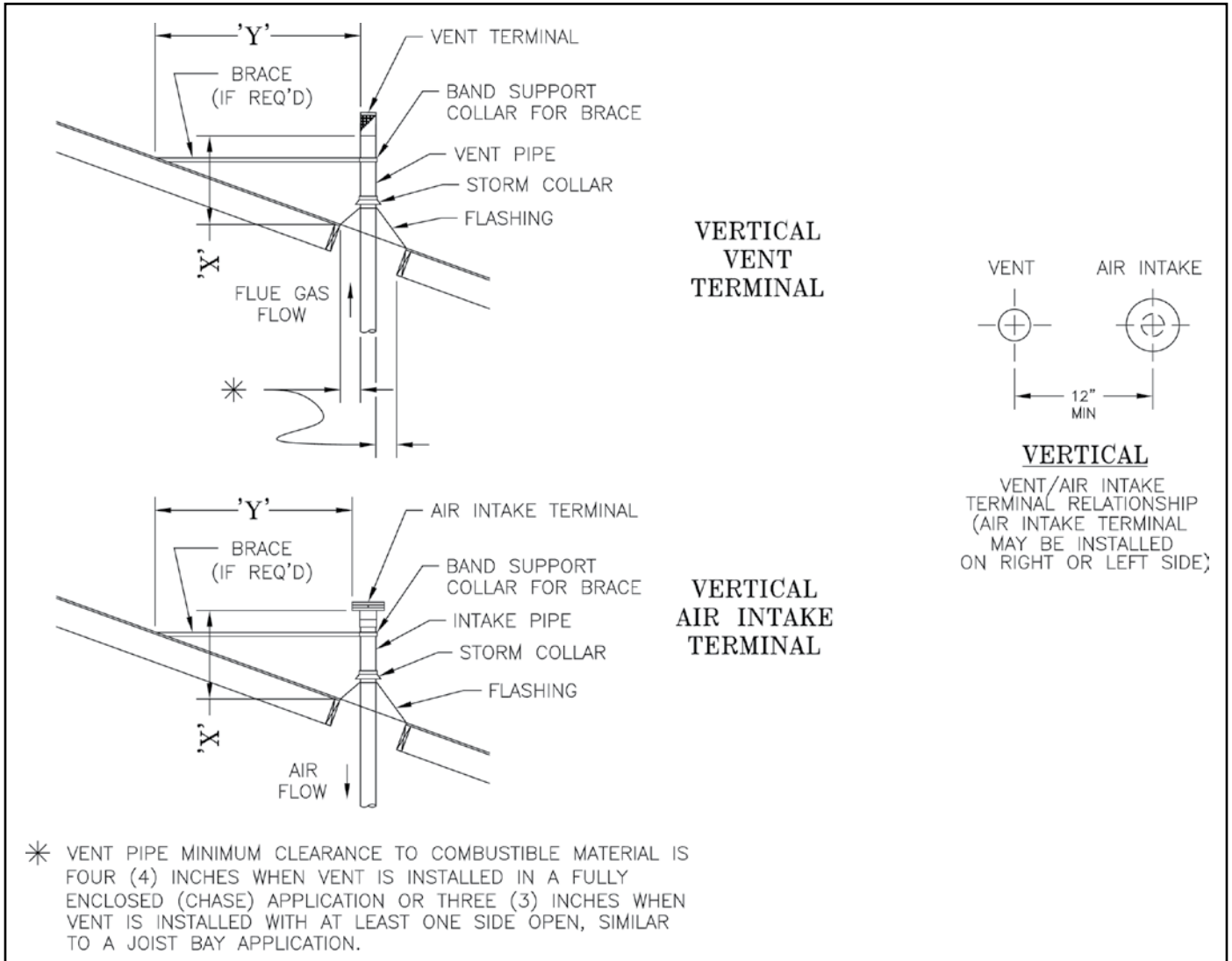
**i** Storm collar, flashing and sealant for roof penetration, and vertical vent tee for collection of condensate are required for vertical venting and are not supplied with the boiler.

1. Install vent and intake piping per Figures B-6 thru B-8.
2. Install the storm collar onto the vent pipe immediately above the flashing.

3. Apply Dow Corning Silastic 732 RTV Sealant between the vent pipe and the storm collar to provide a watertight and heat-resistant seal.
4. Install the vent terminal per the boiler-specific instructions in *Connect Venting* in this manual.
5. Install the air intake terminal per the boiler-specific instructions in *Connect Venting* in this manual.
6. An optional concentric adapter kit (P/N 100222-01 (3") and 100223-01 (4")) is available to accommodate both intake and exhaust piping in a single roof penetration. This kit is compatible only with Saf-T Vent SC gas vent produced by Heat-Fab. Refer to the installation instructions included with the kit.



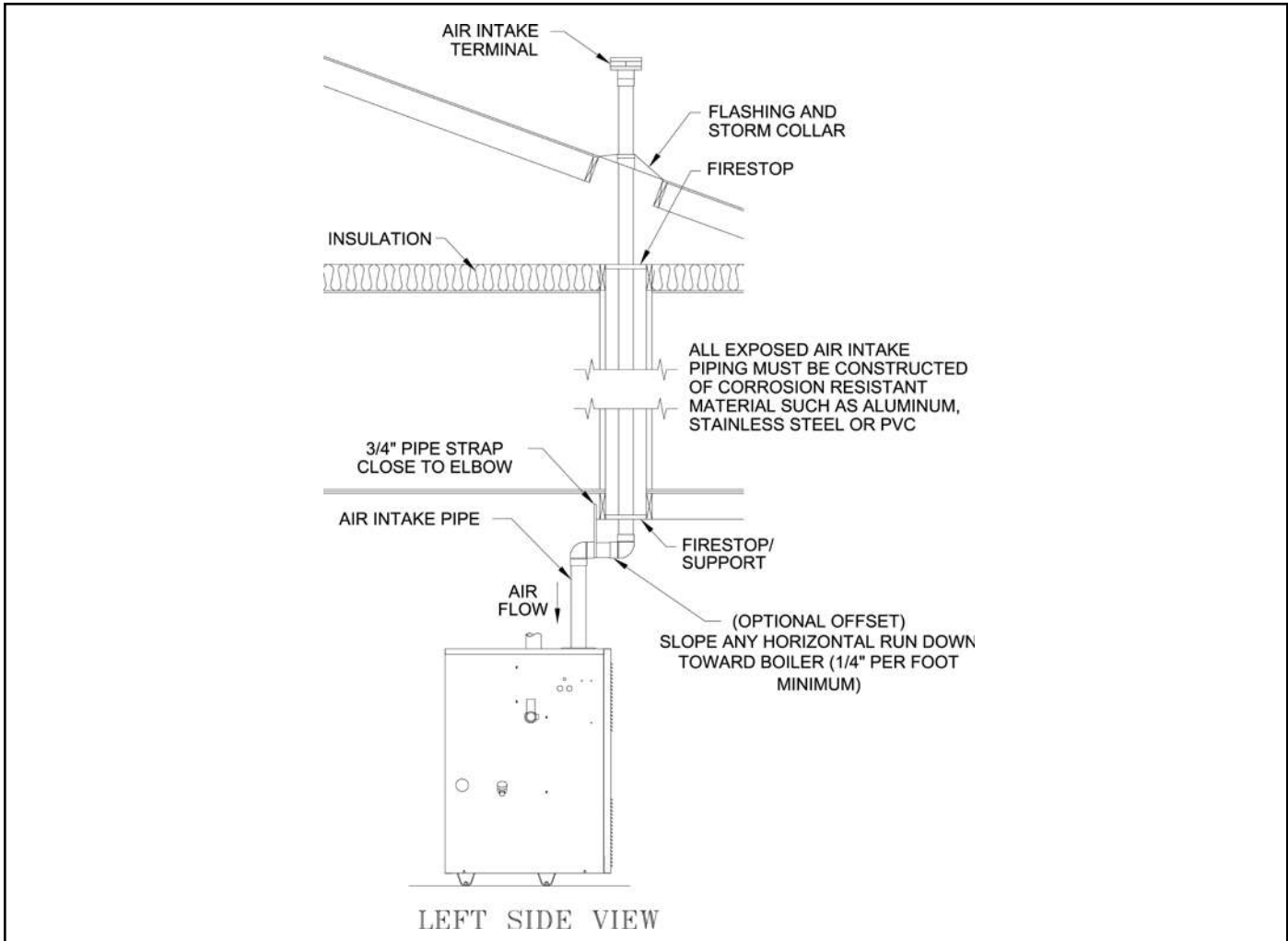
**APPENDIX B2 – Direct Venting (continued)**  
**Special Instructions for Stainless Steel Direct Vent (continued)**



**Figure B-7: Vertical Vent/Air Termination Details for Stainless Steel Direct Vent**

**Extend Vent/Air Intake Piping to maintain minimum vertical (“X”) and minimum horizontal (“Y”) distance of twelve (12) inches from roof surface. Allow additional vertical (“X”) distance for expected snow accumulation.**

**APPENDIX B2 – Direct Venting (continued)**  
**Special Instructions for Stainless Steel Direct Vent (continued)**



**Figure B-8: Vertical Air Intake Piping for Direct Venting**

## APPENDIX B3 – POWER VENTING

Some direct vent boilers are also approved with use of indoor combustion air. If the boiler you are installing is approved for use with indoor combustion air, install the vent according to the instructions in *Appendix B2 Direct Venting*, but omit the “optional” indoor air piping and components. Specific instructions for configuring the boiler for indoor air appear in the boiler-specific instructions at the front of this manual.

Locate vent terminal at least 4 ft. below, 4 ft. horizontally from, or 1 ft above any door, operable window, or gravity air inlet. Locate at least 10 ft. horizontally from an operable opening in an adjacent building.

## APPENDIX C – GAS PIPING



**ASSURE GAS PIPING IS LEAK FREE AND OF PROPER SIZE and type for the connected load.**



**SHUT OFF MAIN GAS SUPPLY prior to installing or servicing boiler gas piping.**

1. Determine the boiler’s maximum gas demand and minimum gas supply pressure (printed on the boiler’s rating label) and the

demand of other gas appliances served by the same gas meter.

2. Ensure that gas piping, fittings, and gas meter capacities can supply the maximum gas demand of all appliances at pressures above their minimum allowable gas pressure. The following tables provide typical capacities of gas pipes and fittings.

**Table C-1: Maximum Capacity of Schedule 40 Pipe in Cubic Feet Per Hour (CFH)\***

Length (Feet)	0.3" w.c. Pressure Drop				0.5" w.c. Pressure Drop			
	½	¾	1	1¼	½	¾	1	1¼
10	132	278	520	1050	175	360	680	1400
20	92	190	350	730	120	250	465	950
30	73	152	285	590	97	200	375	770
40	63	130	245	500	82	170	320	660
50	56	115	215	440	73	151	285	580
60	50	105	195	400	66	138	260	530
70	46	96	180	370	61	125	240	490
80	43	90	170	350	57	118	220	460
90	40	84	160	320	53	110	205	430
100	38	79	150	305	50	103	195	400

\*1 CFH of Natural Gas is approximately equal to 1000 BTU/hr; 1 CFH of LP is approximately equal to 2500 BTU/hr.

**Table C-2: Equivalent Lengths (ft) Of Standard Pipe Fittings & Valves**

Pipe Size	Gate	Globe	Angle	Swing Check	90° Elbow	45° Elbow	90° 'T', Flow Through Run	90° 'T', Flow Through Branch
½"	0	19	9	4	2	1	1	3
¾"	0	23	12	5	2	1	1	4
1"	1	29	15	7	3	1	2	5
1 ¼"	1	39	20	9	4	2	2	7
1 ½"	1	45	22	11	5	3	3	8

## APPENDIX C – Gas Piping (continued)



**ASSURE GAS PIPING IS LEAK FREE AND OF PROPER SIZE** and type for the connected load.



**SHUT OFF MAIN GAS SUPPLY** prior to installing or servicing boiler gas piping.

1. Determine the boiler's maximum gas demand and minimum gas supply pressure

**Table C-3: Specific Gravity Correction Factors For Natural Gas**

Specific Gravity	Correction Factor	Specific Gravity	Correction Factor
0.50	1.10	0.85	0.81
0.55	1.04	0.90	0.82
0.60	1.00	1.00	0.78
0.65	0.96	1.10	0.74
0.70	0.93	1.20	0.71
0.75	0.90	1.30	0.68
0.80	0.87	1.40	0.66

(printed on the boiler's rating label) and the demand of other gas appliances served by the same gas meter.

2. Ensure that gas piping, fittings, and gas meter capacities can supply the maximum gas demand of all appliances at pressures above their minimum allowable gas pressure. The following tables provide typical capacities of gas pipes and fittings.
3. Derate the gas flow through pipes by multiplying by a correction factor in Table C-3 based on the specific gravity of the gas.

4. For materials or conditions other than those listed above, refer to the National Fuel Gas Code, ANSI Z223.1/NFPA 54, or size the system using standard engineering methods acceptable to authority having jurisdiction.



**USE PROPER THREAD COMPONENTS** on all gas connectors.



**USE THREAD (JOINT) COMPOUNDS** (pipe dope) rated for liquefied petroleum gas.

5. Bond all above-ground gas piping to a grounding electrode and ensure the piping is electrically continuous.



**DO NOT USE GAS PIPING AS A GROUNDING ELECTRODE.** Refer to National Electrical Code, NFPA 70.

6. Install sediment trap, ground-joint union and manual shut-off valve upstream of boiler gas control valve and outside jacket.
7. When the piping is completed, test it for leaks.
  - (1) When testing over ½ psig, disconnect the boiler and its individual shut-off valve from the gas supply piping.
  - (2) When testing at ½ psig or less, isolate boiler from gas supply piping by closing boiler's individual manual shut-off valve.
  - (3) Locate leaks using approved combustible gas detector or nonflammable, non-corrosive leak detection solution.



**DO NOT CHECK FOR LEAKS USING OPEN FLAMES** such as matches or candles or devices that spark.

8. Repair any detected leaks.

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## APPENDIX D – SYSTEM PIPING

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USE PROPER DESIGN AND INSTALLATION PRACTICES and observe all local codes when installing system piping. Property damage and injury may result from an improperly piped or designed heating system.



*Boiler damage caused by flawed system design or operation is excluded from our warranty.*

Training and experience is required to design and install a piping system that will protect the boiler and provide many years of comfort to the building occupants. Be sure to protect the boiler from the following problems:

### 1. Corrosion

- (1) Comply with the boiler's specific water quality requirements. See the *Specifications* Section of this manual.
- (2) Pressurize the system above the highest net positive suction head (NPSH) required for each circulator and ensure positive pressure at the uppermost point in the system.
- (3) Maintain a closed boiler system using heat exchangers to transfer heat to open systems, such as domestic hot water systems.
- (4) Purge the system completely of dissolved oxygen by bleeding all radiators and installing a properly installed air scoop or air vent.
- (5) Repair leaking pipes, fittings, and vents to minimize the need to add makeup water.
- (6) Do not fill the boiler with softened water unless makeup water is extremely hard and it is not possible to eliminate all system leaks. If filling the boiler with softened water, test regularly the water softener regularly to ensure that brine solution is not entering the boiler's water supply.

### 2. Lime scale

- (1) Repair leaking pipes, fittings, and vents to minimize the need to add makeup water.
- (2) Comply with the boiler's specific water quality requirements. See the *Specifications* Section of this manual.

- (3) Comply with the boiler's specific requirements for minimum water flow through the boiler, installing a system bypass or primary-secondary loop if necessary to maintain flow through the boiler when serving small zones.

### 3. Overpressure

- (1) Install a properly sized expansion tank.
- (2) Do not exceed the boiler's specific requirements for maximum allowable working pressure.
- (3) Do not plug or block the relief valve.

### 4. Freezing

- (1) Run all portions of the system piping inside a heated space unless the system is properly protected with an inhibited antifreeze solution.

### 5. Overheating

- (1) Comply with the boiler's specific requirement for minimum water flow through the boiler. See the *Specifications* Section of this manual.
- (2) Install a low-water cutoff device whenever the boiler is installed above the level of the lowest heat emitter or radiator. Also add a low-water cutoff when required by local code requirements.

It is recommended that the LWCO control is installed above the boiler to provide the highest level of protection. However, where the LWCO control is approved by the LWCO control manufacturer for installation in a high boiler tapping of a

## APPENDIX D – System Piping (continued)

water boiler, the use of the listed LWCO control is permitted when it is installed according to the LWCO manufacturer's instructions.

### 6. Thermal shock

- (1) Do not over-pump. Adhere to the design flow requirements for each zone.
- (2) Install a boiler bypass, system bypass, or primary-secondary loop when needed to avoid returning large volumes of cold water directly to a hot boiler.

### 7. Condensation

- (1) Do not over-pump. Adhere to the design flow requirements for each zone.
- (2) Adhere to the boiler's specific minimum return water and supply water temperature requirements. Install a boiler bypass, system bypass, or primary-secondary loop when needed to maintain water temperatures and flows within the specified limits.
- (3) Do not allow chilled water to enter the boiler during the heating cycle, or heated water to enter chilled water coils during the cooling cycle.

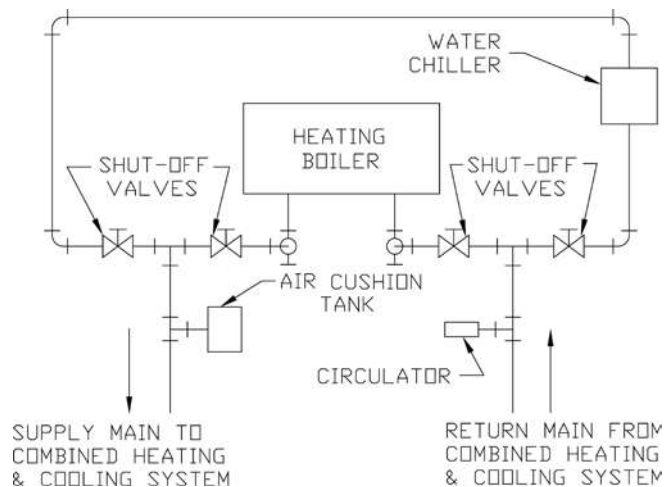
### 8. Dry Fire

Install a low-water cutoff when the boiler is installed above the level of the lowest radiator and when required by local code.

### 9. Combination Heating and Cooling Systems

If this boiler is used in connection with refrigeration systems, the boiler must be installed so that the chilled medium is piped in parallel with the heating boiler using appropriate valves or other automatic means to prevent the chilled medium from entering the boiler, see Figure D-1. Also consult Residential Hydronic Heating Installation and Design I=B=R Guide.

If this Boiler is connected to heating coils located in air handling units where they may be exposed to refrigerated air, the boiler piping must be equipped with flow control valves to prevent gravity circulation of boiler water during the operation of the cooling system.



**Figure D-1: Recommended Piping for Combination Heating & Cooling (Refrigeration) Systems**



The following system diagrams are intended to provide a minimum level of guidance for a successful and trouble-free installation of the boiler in common applications. They do not substitute for proper design, evaluation, and installation by a trained and qualified installer using the proper tools, techniques, and design expertise. Not all options are available with every boiler.

## APPENDIX D – System Piping (continued)

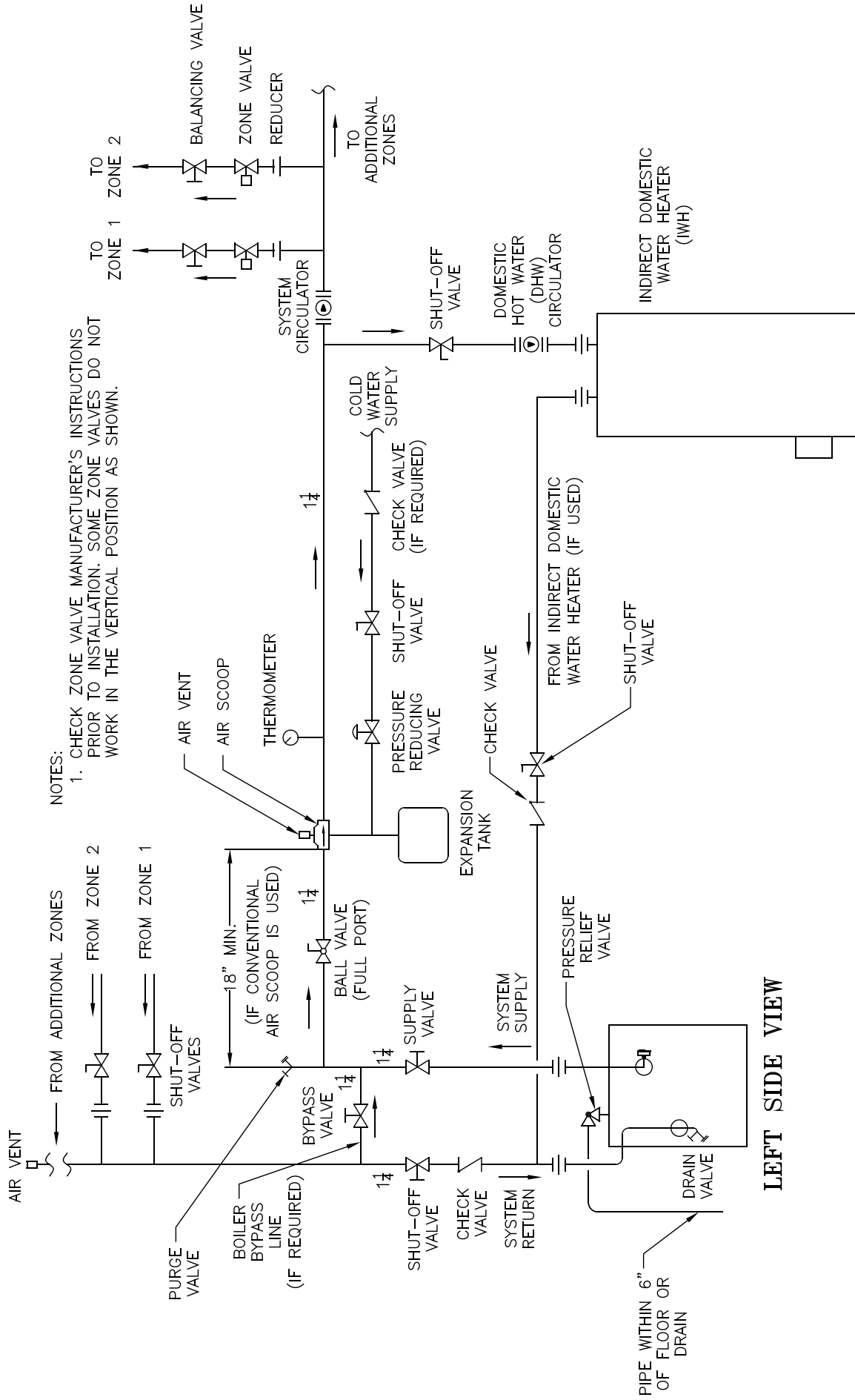
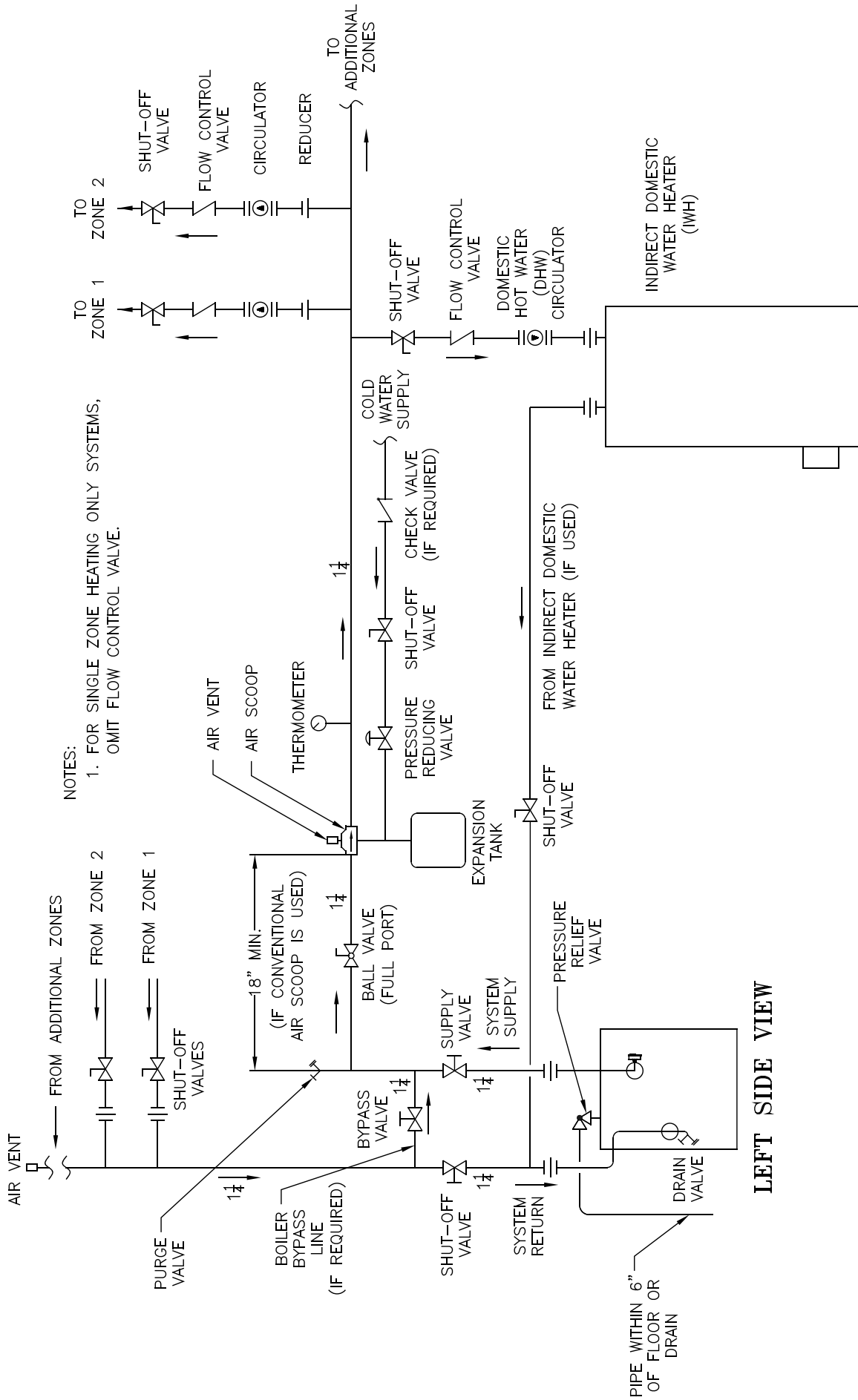


Figure D-2: Recommended Water Piping for Zone Valve Zoned Heating Systems

# APPENDIX D – System Piping (continued)



NOTES:  
 1. FOR SINGLE ZONE HEATING ONLY SYSTEMS, OMIT FLOW CONTROL VALVE.

Figure D-3: Recommended Water Piping for Circulator Zoned Heating Systems



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## APPENDIX E – FILLING THE SYSTEM AND CHECKING FOR LEAKS

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**Fill entire heating system with water and vent air from system.** Use the following procedure on a Series Loop or multi-zoned system installed as per the figure below. Remove air from system when filling.

1. Close full port ball valve located between vertical hose bib and air scoop in boiler supply piping (see *Appendix D – System Piping*).
2. Isolate all zones by closing zone valves or shut-off valves in supply and return of each zone(s).
3. Attach a hose to the vertical hose bib located prior to the full port ball valve in the system supply piping.

**i**

*Terminate hose in five-gallon bucket at a suitable floor drain or outdoor area.*

4. Starting with one circuit at a time, open zone valve or shut-off valve in system supply and return piping.
5. Open hose bib.
6. Open fill valve (Make-up water line should be located directly after full port ball valve in system supply piping between air scoop and expansion tank).
7. Allow water to overflow from bucket until discharge from hose is bubble free for 30 seconds.
8. Close hose bib, continue filling the system until the pressure gauge reads 12 psi. Close fill valve.
9. Starting with the first convactor in the loop, open air vent to purge air until a steady stream of water flows into container for approximately 5 seconds. Proceed to next convactor and repeat procedure until all convectors in the loop are purged of air.
10. Close the opened zone valve or shut-off valve for the zone being purged of air.

11. Open the zone valve or shut-off valve for the next zone to be purged. Repeat the previous steps until all zones have been purged. At completion, open all zone valves or shut-off valves.
12. Close hose bib, continue filling the system until the pressure gauge reads 12 psi. Close fill valve.

**i**

*If make-up water line is equipped with pressure reducing valve, system will automatically fill to 12 psi. Follow fill valve manufacturer's instructions.*

13. Open isolation valve in boiler supply piping.
14. Remove hose from hose bib.

**Confirm that the boiler and system have no water leaks.**

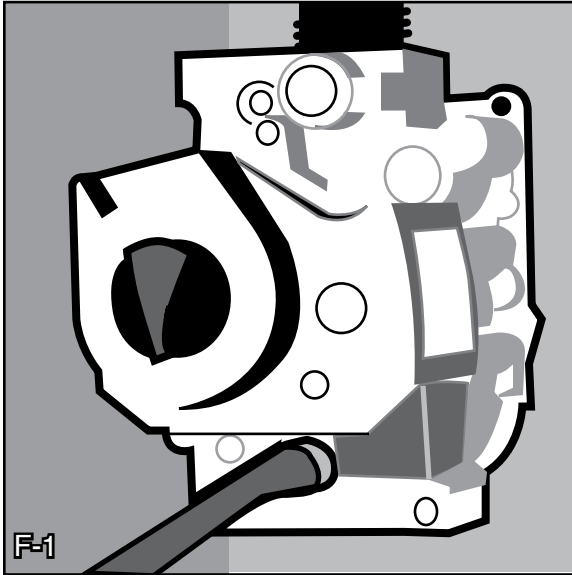
1. Check Rating Label for maximum operating pressure of this boiler. Never exceed this pressure during leak test. Do not plug or change pressure relief valve. Perform visual inspection for leaks or weeping joints after initial fill and during boiler warm-up period. Repair all leaks before placing boiler into permanent operation.
2. If it is required to perform a long-term pressure leak test of the hydronic system, the boiler should first be isolated to avoid a pressure loss due to the escape of air trapped in the boiler.
3. To perform a long-term pressure test including the boiler, all trapped air must be removed from the boiler and system as prescribed above. A loss of pressure during such a test, with no visible leakage, is an indication that the boiler or system contained trapped air.

## APPENDIX F – ADJUSTING GAS INPUT RATE

### Natural Gas Boilers:

#### Check Manifold Pressure:

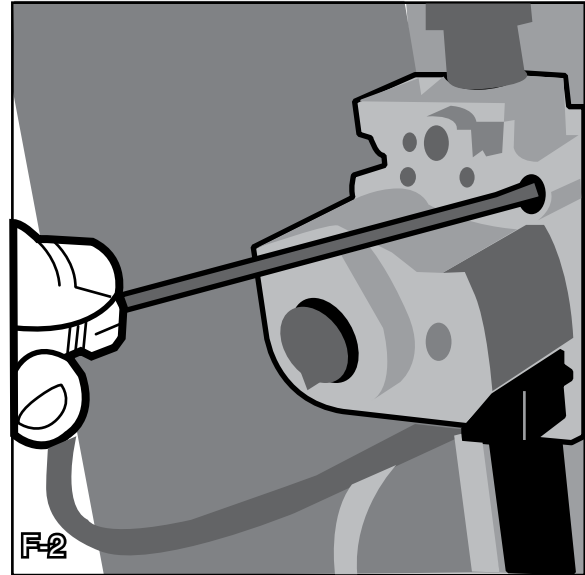
1. Note the rated manifold gas pressure listed on the boiler's rating label.
2. Connect Manometer to manifold pressure tapping on Gas Valve (Figure F-1).
3. Light main burners by adjusting thermostat to highest setting.



4. Gas valve has step-opening regulator, which initially opens at a lower manifold pressure and then steps to full pressure after approximately 30 seconds. Check manifold pressure after step has occurred.
5. If required, adjust gas manifold pressure to the rated setting by turning the gas valves adjustment screw clockwise to increase manifold pressure or counterclockwise to decrease manifold pressure (Figure F-2). Several turns may be required.



Do not force the adjustment screw.



DO NOT EXCEED the boiler's rated gas input.

6. Recheck Main Burner Flame.

#### Leak Test Gas Piping:



THE BOILER AND ITS GAS CONNECTIONS must be leak tested and leak free before placing boiler in operation.



FOR LEAK TESTING OVER ½ PSIG, disconnect boiler and its individual shut-off valve from gas supply piping.

1. For testing at ½ psig or less, isolate boiler from gas supply piping by closing boiler's individual manual shut-off valve.
2. Check for gas leaks in all piping joints, valves, and fittings using a non-corrosive leak detection solution or an electronic leak detector.
3. Repair any leaks.

### NOTICE

ESC boilers built for altitudes greater than 4,999 feet above sea level do not need to be re-orificed. The ESC boiler "H" Model has been certified to operate in atmospheric conditions from 5,000 to 10,000 feet above sea level. Input is naturally derated approximately 2% per every 1000 feet above sea level.

The ESC boiler is available in two (2) altitude Models: The "S" Model 0 to 4,999 feet above sea level, and the "H" Model 5,000 to 10,000 feet above sea level.

For applications above 10,000 feet, please follow recommendations in current version of NFPA 54.

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## APPENDIX G – CHECKING DRAFT AND COMBUSTION

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1. Insofar as is practical, close all doors and windows in the building.
2. Turn on all appliances not connected to the same venting system as the boiler being checked.
3. Turn on all exhaust fans (such as range hoods and bathroom exhausts) to their maximum speed. Do not turn on any summer exhaust fans.
4. Close all fireplace dampers.
5. Operate the appliance being checked. Follow lighting instructions.
6. After 5 minutes of main burner operation, test for spillage at the draft hood relief opening, using a lighted match, candle, cigarette, etc.
7. Repeat this test for each appliance connected to the common venting system.
8. If any appliance does not vent properly, per the above test, make corrections, so that the installation conforms to the *National Fuel Gas Code, ANSI Z223.1/NFPA 54*.
9. Return doors, windows, exhaust fans, fireplace dampers, and any other gas-burning appliance to their previous condition of use.

### CHECK COMBUSTION

1. Use a flue gas analyzer that accurately measures CO<sub>2</sub>, O<sub>2</sub>, CO, and flue gas temperature.
2. For oil boilers, also use a smoke tester with smoke test paper.
3. Operate the boiler at its rated (high fire) input.
4. With the analyzer, check the CO<sub>2</sub> (or O<sub>2</sub>), CO and temperature of the flue gases exiting the boiler.
5. For two-stage or modulating boilers, also check the CO<sub>2</sub> (or O<sub>2</sub>), CO and temperature of the flue gases at low fire.
6. Confirm that the measured CO<sub>2</sub> (or O<sub>2</sub>) matches the required CO<sub>2</sub> (or O<sub>2</sub>) specified for the boiler.
7. For oil boilers, also take a smoke measurement of the flue gases. Smoke should not exceed #1.



If CO<sub>2</sub>, O<sub>2</sub>, or CO fall outside of the range specified for the boiler, review the installation and startup instructions and make any necessary adjustments to the boiler or associated venting or piping systems.



*Note the gross flue gas temperature for future reference. Significant changes in flue gas temperature can indicate changes in the boiler's operating efficiency.*



CO target is less than 50 ppm AF.

## APPENDIX H – OPERATION

### Boiler Sequence of Operation

#### NORMAL OPERATION

1. The ESC Boilers are equipped with an Intelligent Hydronic Control (control). This control replaces the traditional separate ignition control, high limit switch, blower relay and circulator relay and adds energy saving thermal purge features. Energy is saved by starting the circulator and delaying the burner start when there is residual heat available in the boiler.
2. The boiler's sequence of operation is shown in Table 4.
3. When the thermostat calls for heat the control starts the system circulator and the thermal purge (circulator Pre-purge time) begins. If the time is completed or boiler temperature is less than the Start Temperature (140°F default) the start sequence continues by energizing the blower. Once the pressure switch is proven, the ignition sequence is started allowing gas flow and ignition of the burners.
4. If the thermostat is not satisfied and the operating setpoint is reached the system circulator will continue to operate and the burner will stop. When the boiler water temperature drops below the setpoint less the differential setting the burner will restart.
5. After the thermostat is satisfied the burner, circulator and blower are stopped.
6. When a indirect water heater aquastat call for heat is wired to the DHW input the control starts the Domestic Hot Water circulator and, if the boiler temperature is less than the operating setpoint less differential, the blower is energized without delay. Once the pressure switch is proven, the ignition sequence is started allowing gas flow and ignition of the burners.

#### BOILER FAULT

In the event the boiler fails to start, the control provides status information to help determine the cause of the problem. Table 5 provides a list of boiler status codes that are reported. Refer to the Troubleshooting Section for more information.

**Table 4: Sequence of Operation**

Status Codes displayed in 5LR Mode		
Status	5LR	Description
Standby (Burner off Circulator off)	1	No call for heat detected
Circulator Pre-purge (burner off circulator on)	1	Either condition is true: a. Call for heat detected and boiler temperature higher than operating setpoint. b. Call for heat detected and boiler temperature higher than Start Temperature (140°F default) and Circulator Pre-purge Time has not expired.
Self Test	17	Control internal checking
Waiting for Pressure Switch to Close (Blower on)	3	The blower is turned on. The control is waiting for the pressure switch to close.
Pre-purge	4	The blower is run for a 30 second pre-purge
Spark	6	The pilot fuel valve is open and sparking is started.
Flame Proving	7	The main fuel valve is open and flame is being proven.
Running	8	The burner runs until the call for heat is satisfied or the operating setpoint is reached.

**Table 5: Sequence Fault**

Status Codes displayed in 5LR Mode		
Status	5LR	Description
Retry / Recycle Delay	10	If the burner fails to light off (no flame signal), it waits 5 minutes and retries or if the control loses flame signal during running, it will wait 10 seconds and then recycle.
Pressure Switch Failed to Open	11	The blower is off and the pressure switch as failed to open.
Pressure Switch Failed to Close	12	The blower is on and the pressure switch has failed to close.
Soft Lockout	13	System is shutdown and will restart following a one hour enforced delay.
Hard Lockout	14	System is locked out. A manual or power reset is required to be able to light off again.
Limit Open	15	There is a call for heat from the thermostat, but a Safety Limit is open.
Flame Present Out of Sequence	16	Flame signal is still present when expected to be 0 (no flame).

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## APPENDIX I – IQ CONTROL SYSTEM

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### IQ Control System Overview

The “IQ Control System” consists of a control and an IQ Option Panel with optional “plug in” cards:

- Fully integrates both factory and field installed components, simplifying installation and troubleshooting.
- Efficiently operates the entire boiler system to save energy.
- Ensures adequate heat and supply of domestic hot water.
- UL / CSA Listed or Recognized and tested as part of a complete system.
- Communicate with other EnviraCom™ enabled components to provide a complete system solution to maximize comfort and energy efficiency.

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### Control: P/N 103661-01

The heart of IQ Control System is the Intelligent Hydronic Control. The control replaces the traditional separate ignition control, primary boiler aquastat, as well as the fan and circulator relays.

The control stores two boiler temperature setpoints in its memory; one setpoint is for the High Limit Setting and the second is for the Operating Setpoint.



When the optional Outdoor Air Reset Card is installed in the IQ Option Panel, the Operating Setpoint temperature is automatically adjusted according to the outdoor temperature. For example, as the outdoor temperature increases the Operating Setpoint temperature is reduced from the High Limit Setting to save energy while improving home comfort. By better matching boiler heat supply to actual home heat demand, room air temperatures are more closely maintained. In addition, when there is a domestic hot water (DWH) heat request, the Operating Setpoint temperature is automatically adjusted to a DWH Setpoint to satisfy the DWH heating requirements. When the Outdoor Air Reset Card is not installed the Operating Setpoint equals High Limit Setting.

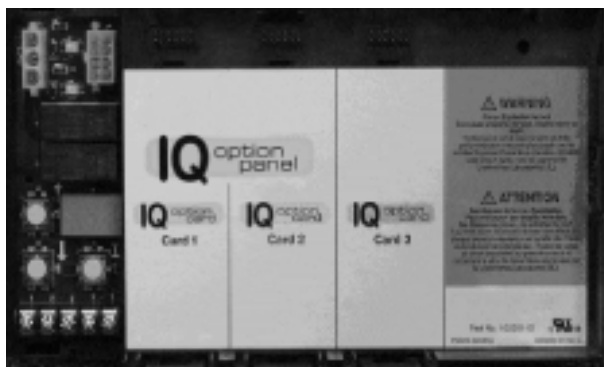
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### IQ Option Panel: P/N 102291-01

The IQ Option Panel works together with the IQ Oil Boiler Control to provide an easy and convenient means to add factory-engineered auxiliary boiler control features. When installed into the IQ Option

Panel, IQ Option Cards provide plug-'n-play high temperature limit, low water cut-off and outdoor reset controls. A separate 3-digit LED readout displays settings, status and diagnostic information for all installed IQ Option Cards making them simpler and functionally superior to stand alone auxiliary controls. IQ Option Cards are available for the following features:

- Outdoor Air Reset with Domestic Hot Water Demand
- Auxiliary High Temperature Limit (available in auto reset or manual reset versions)
- Low Water Cut-off (available in auto reset or manual reset versions)



## APPENDIX H – IQ Control System (continued)

### IQ Outdoor Reset Option Card: P/N 102723-01

Installing the IQ Outdoor Reset Option Card is the simplest way to maximize the efficiency of any ESC Boiler. The IQ Outdoor Reset Card is a microprocessor-based control that regulates the water temperature of the heating system based on the outdoor temperature. By modulating the water temperature of the heating system, the ESC Boiler equipped with an IQ Outdoor Reset Option Card will deliver annual fuel savings up to 16%, while increasing home comfort. The IQ Outdoor Reset Option Card is simple to set up yet it includes a powerful list of features that can be customized for any job.



IQ Oil Boiler Control Operating Setpoint is normally set to the High Limit Setpoint. However, when an IQ Outdoor Reset Option Card is installed the Operating Setpoint may be reduced to the outdoor reset or Domestic Hot Water (DHW) Setpoint. When an IQ Outdoor Reset Option Card is added the following user defined setpoints are available:

- High Limit Setpoint - The High Limit becomes the upper limit for the operating setpoint. The operating setpoint can not be set higher than this value. The High Limit is set to protect the boiler and hydronic system from excessive temperature.
- DHW Setpoint - The Operating Setpoint is set to the DHW Setpoint when the Outdoor Reset Option Card DHW input is energized. This setpoint is set equal to the Indirect Water Heater manufacturer's recommended water temperature.
- High Boiler Water Temperature - The High Boiler Water Temperature (also known as the "Boiler Water Design Temperature") setpoint is set to the lowest boiler water temperature that will heat the home on the home's design day. This adjustment typically depends on the type and quantity radiation (heating element) installed in the home.

#### Kit Includes:

- IQ Outdoor Reset Option Card
- Outdoor temperature sensor w/mounting bracket & 60" lead
- Instructions

#### Major Features:

- Selectable DHWP
- Selectable/adjustable DHWP protection
- Selectable/adjustable boost feature
- Simple adjustment of reset curve

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### IQ LWCO Option Card (Auto Reset): P/N 102711-01

### IQ LWCO Option Card (Manual Reset): P/N 102714-01

IQ LWCO Option Cards add a low water cut-off function to ESC Boilers. LWCO Option Cards plug into the IQ Option Panel and connect to the system-mounted sensor with a single-wire connection. IQ LWCO Option Cards feature built-in diagnostics, probe signal strength display, and include a "Test" and "Reset" feature in compliance with UL 353 and CSA 22.2 for CSD-1 Compliance in US and Canada.



#### Kit Includes:

- IQ LWCO Option Card
- 3/4" NPT level sensor
- 36" wire sensor connector
- Instructions

#### Major Features:

- UL 353 approved
- Displays signal strength
- Warns when probe cleaning required

## APPENDIX H – IQ Control System (continued)

**IQ Hi Limit Option Card (Auto Reset): P/N 102717-01**

**IQ Hi Limit Option Card (Manual Reset): P/N 102720-01**

IQ High Limit Option Cards add auxiliary temperature limit-rated controls to ESC Boilers. High Limit Option Cards plug into the IQ Option Panel and connect to a system-mounted probe with a single Molex connection. IQ High Limit Option Cards feature an adjustable set point and differential, as well as built-in diagnostics. Manual Reset models are UL 353 for CSD-1 Compliance in US and Canada.



**Kit Includes:**

- High Limit Option Card
- Limit-rated probe with 36" lead
- 1/2" well
- Probe retainer clip
- Instructions

**Major Features:**

- UL 353 approved
- Error code LED and display
- Temperature display
- Electronic adjustment of high limit and differential

---

**3.5" Touch Screen Display: P/N 102728-01**

The Display Kit provides a 3.5" LCD multi-color Touch Screen display for mounting in the plastic "hood" above the front door of any ESC Boiler. The Display Kit communicates with the control and all installed IQ Option Cards. All boiler settings, status, and errors are displayed in full text on the bright, backlit display. All adjustments are password protected to prevent unauthorized access. Display will turn red and flash in the event of a boiler error or lock-out. Display features full-text explanations of all features and settings, as well as help screens with diagnostics and troubleshooting information.



**Kit Includes:**

- 3/4" Multi-color LCD touch screen
- Display software
- Enviracom gateway
- Wiring harness connectors
- Mounting bracket
- Instructions

**Major Features:**

- Fully assembled kit requires only 4 mounting screws and a single Molex type connection
- Adjusts all Outdoor Reset IQ Option Card parameters with graphics and help information screens

- Full English descriptive alarm displays with Recommended Corrective Action
- Real time trend displays
- Extensive Help screens to aid understanding of terminology and setup

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**EnviraCOM Thermostats:**

Connected thermostats provide a red LED and display the IQ Oil Boiler Control, Primary Control or IQ Option Card Error Codes. A home owner is alerted to a problem even before the water is cold. When an Outdoor Reset card is installed with a setback thermostat, "leave" or "sleep" modes are used to shifts the reset curve to save energy while the home is in a reduced room temperature mode.



Honeywell VisionPro IAQ Setback Thermostat  
(Honeywell P/N TH942lc1004)

## APPENDIX H – IQ Control System (continued)

### System Parts List

#### Optional Components

Part Number	Item Description
102723-01	<b>Outside Reset</b> IQ Option Card, Domestic Hot Water Priority, for use with Option Control Panel, with Outside Air Temperature Sensor, Instructions, Unit Pack
102294-01	<b>Outdoor Reset</b> IQ Option Card, Domestic Hot Water Priority, for use with IQ Option Panel, less Sensor
102439-01	Outdoor Air Temperature Sensor, 10k ohm
102711-01	<b>LWCO</b> IQ Option Card kit, Hot Water LF Module, Automatic Reset, for use with Option Control Panel, with Probe, ¾ inch NPT, Instructions, Unit Pack
102714-01	<b>LWCO</b> IQ Option Card kit, Hot Water LF Module, Manual Reset, for use with Option Control Panel, with Probe, ¾ inch NPT, Instructions, Unit Pack
102305-01	<b>LWCO</b> Probe, ¾ inch NPT
102720-01	<b>Aquastat</b> IQ Option Card, 130-220 Deg F, Manual Reset for use with Option Control Panel, Temperature Sensor, Well, Sensor Clip, Instructions, Unit Pack
102717-01	<b>Aquastat</b> , IQ Option Card, 130-220 Deg F, 15 Deg F Adjustable Differential, Auto Reset, for use with Option Control Panel, Temperature Sensor, Well, Sensor Clip, Instructions, Unit Pack
102292-01	<b>Aquastat</b> IQ Option Card, 130-220 Deg F, Manual Reset for use with IQ Option Panel, less well, Less Sensor
102293-01	<b>Aquastat</b> , IQ Option Card, 130-220 Deg F, 15 Deg F Adjustable Differential, Auto Reset, for use with IQ Option Panel, less Well, less Sensor
102295-01	Limit Rated Temperature Sensor, 36 inch length
102296-01	Limit Rated Temperature Sensor, 48 inch length
102728-01	<b>IQ LCD Display</b> , Boiler Exterior Mounted, STN Monochrome, White/Red backlight, 5Vdc Power Supply, RS422 (RS485) Communication, Pure Black Bezel with Gateway, Wire Harness, Mounting Bracket, ESC Logo Plates and Instructions
102725-01	<b>IQ LCD Display</b> , Boiler Exterior Mounted, STN Monochrome, White/Red backlight, 5Vdc Power Supply, RS422 (RS485) Communication, Pure Black Bezel
102495-01	Envirocom/Modbus RS422 Gateway and 5 Vdc Power Supply for Communication Between the IQ Controls and LCD Display, 24 Vac Power Supply Input

### Additional Information List

Aquastat IQ Option Card Instruction Sheet - part number 103589-01

Outdoor Reset IQ Option Card Instruction Sheet - part number 103590-01

Low Water Cut-off IQ Option Card Instruction Sheet - part number 103591-01

LCD Display Kit - part number 103592-01

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