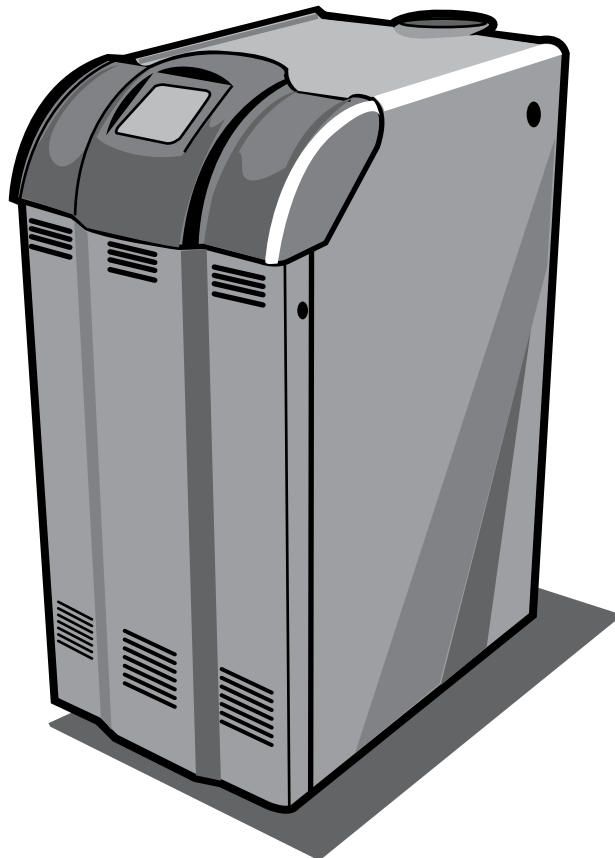


INSTALLATION, OPERATING AND SERVICE INSTRUCTIONS FOR

ES2™

ENHANCED SERIES 2 Gas - Fired Boiler



As an ENERGY STAR® Partner, U.S. Boiler Company has determined that this boiler meets the ENERGY STAR® guidelines for energy efficiency established by the United States Environmental Protection Agency (EPA).

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 ES2__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 or vent system failure. Consider installing CO alarms near bedrooms in all levels of the building to warn you and your family of potential CO exposure.



WARNINGS FOR THE INSTALLER

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

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

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

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

THIS INSTALLATION IS NOT COMPLETE until the front air dam is installed (See Figure 2-a). Product performance will be negatively affected if

the front air dam is not installed which can cause serious property damage, personal injury or death.

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

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

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

IT IS THE RESPONSIBILITY OF THE INSTALLING CONTRACTOR to see that all controls are correctly installed and are operating properly when installation is complete including verifying that the limit sensor is fully installed.

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.

Congratulations on your purchase of a new ES2™ boiler—designed and constructed to provide you with years of reliable service.

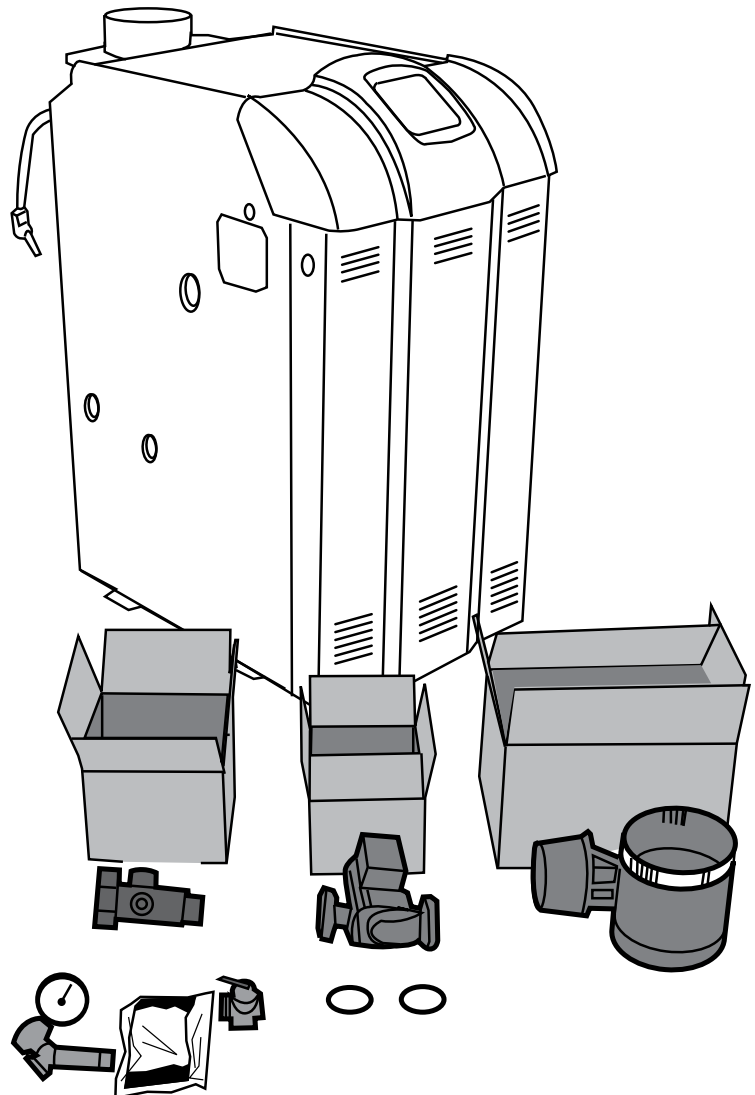
- *ENERGY STAR™ efficiency* – friendly on the environment and your wallet.
- *Cast iron heat exchanger* – for reliability and durability, nothing beats a cast iron heat exchanger.
- *IQ Control™ System*– the most advanced and easiest to use control available.
- *System-friendly* – built-in protection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

*IQ Control System Overview

ES2 Boiler uses a microprocessor based control system called the "IQ Control System". This "IQ Control System" consists of an Intelligent Hydronic 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.


What's in the crate?

1. ES2™ Boiler
2. Vent Damper w/ Carton
 - 4" Damper — ES23 (102284-01)
 - 5" Damper — ES24 (102284-02)
 - 6" Damper — ES25 & ES26 (102284-03)
 - 7" Damper — ES27 & ES28 (102284-04)
 - 8" Damper — ES29 (102284-05)
3. Circulator & Gasket Kit
 - Taco 007-2 (8056170)
 - Grundfos UP-15 (102805-01)
 - B & G NRF-22 (8056174)
4. Miscellaneous Parts Bag (102627-01)
 - Temperature/Pressure Gage; 1/4" NPT (100282-01)
 - Circulator Mounting Hardware Kit, 1-1/4" NPT (6056007)
 - Circulator Wiring Harness (6130701)
 - Drain Valve; 3/4" NPT (806603012)
 - Pressure Relief Valve; 30 psi (81660363)
 - Water Manifold for Pressure Relief/Temp. Gage (80607001)
5. Instruction Envelope (103779-01)
 - Instruction & Operation Manual (103780-02)
 - Hydronics Institute Instructions (81460061)
 - Boiler Warranty Sheet (103203-01)
 - Boiler Warranty Card (103204-02)



SPECIFICATIONS

Ratings

		<h3 style="margin: 0;">ES2 Series</h3>		
Boiler Model	Input (MBH)	DOE Heating Capacity (MBH)	Net AHRI Rating (MBH)	AFUE (%)
ES23	70	59	51	85
ES24	105	89	77	85
ES25	140	119	103	85
ES26	175	149	130	85
ES27	210	178	155	85
ES28	245	208	181	85
ES29	280	238	207	85

Electrical Requirements: 120VAC, 60 Hz, 1-ph, Less than 12A

Dimensions and Connections

Boiler Model	Depth	Width	Height	Supply NPT (inch)	Return NPT (inch)	Vent (inch)	Gas NPT (inch)	Relief Valve NPT (inch)	Drain NPT (inch)
ES23	33	12 ³ / ₄	41	1 ¹ / ₄	1 ¹ / ₄	4	1/2	3/4	3/4
ES24	33	15 ¹ / ₂	41	1 ¹ / ₄	1 ¹ / ₄	5	1/2	3/4	3/4
ES25	33	18 ¹ / ₂	41	1 ¹ / ₄	1 ¹ / ₄	6	1/2	3/4	3/4
ES26	33	21 ¹ / ₂	41	1 ¹ / ₄	1 ¹ / ₄	6	1/2	3/4	3/4
ES27	33	24 ³ / ₄	41	1 ¹ / ₄	1 ¹ / ₄	7	3/4	3/4	3/4
ES28	33	27 ³ / ₄	41	1 ¹ / ₄	1 ¹ / ₄	7	3/4	3/4	3/4
ES29	33	30 ³ / ₄	41	1 ¹ / ₄	1 ¹ / ₄	8	3/4	3/4	3/4

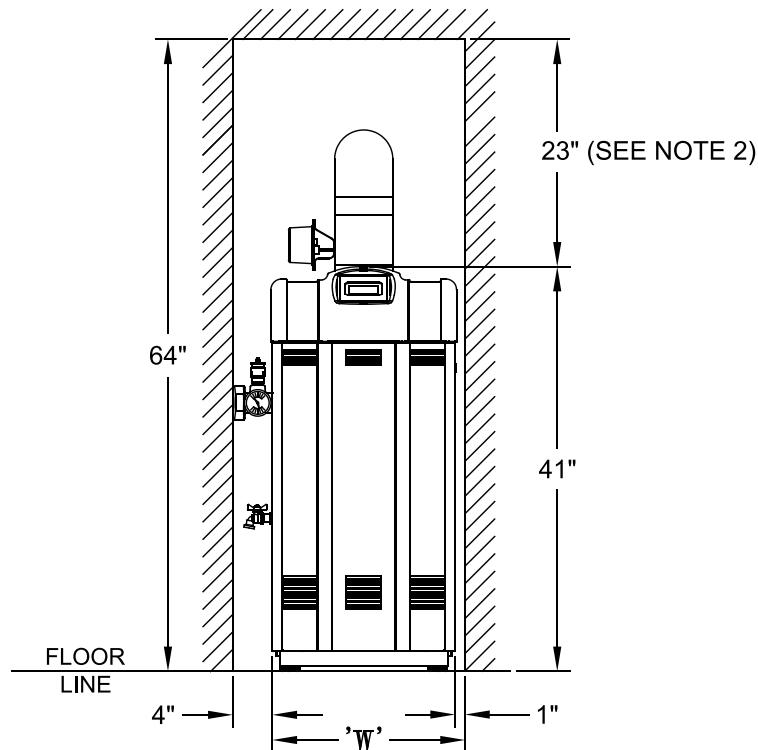
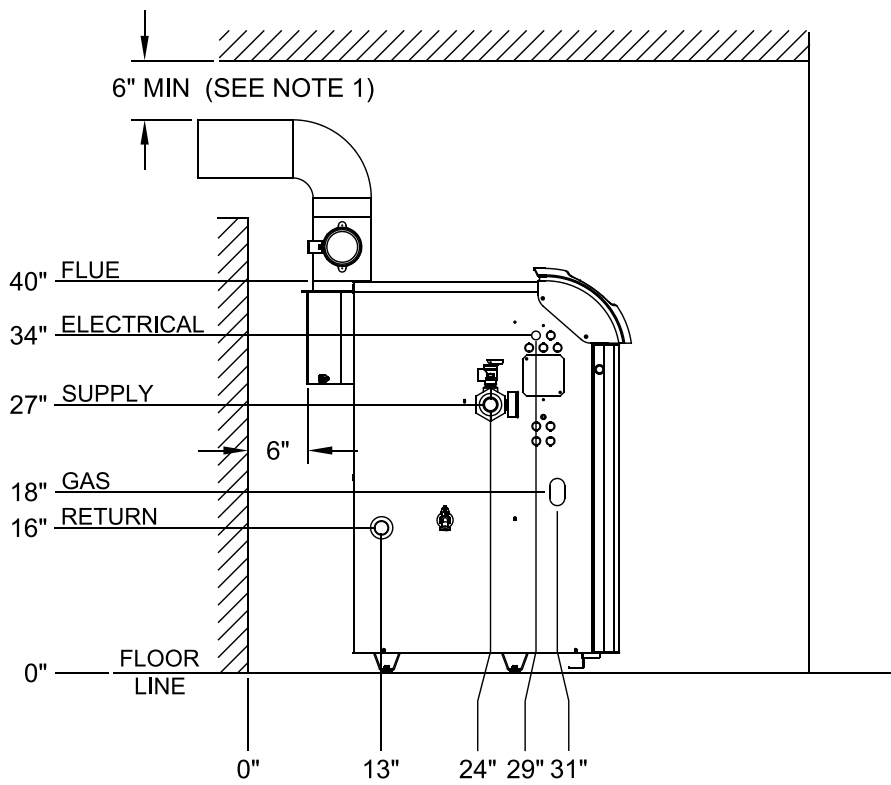
Water Temperatures and Flows

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)
ES23	130-220	110	None	<1
ES24	130-220	110	None	<1
ES25	130-220	110	None	<1
ES26	130-220	110	None	<1
ES27	130-220	110	None	<1
ES28	130-220	110	None	<1
ES29	130-220	110	None	<1

Weights and Volume

Boiler Model	Shipping Weight (lbs)	Empty Weight (lbs)	Water Content (gal)
ES23	254	180	2
ES24	304	231	3
ES25	357	284	4
ES26	405	332	5
ES27	462	382	5
ES28	518	438	6
ES29	564	484	7

SPECIFICATIONS (continued)



MODEL	'W'
ES23	14"
ES24	16"
ES25	19"
ES26	22"
ES27	25"
ES28	28"
ES29	31"

NOTES:

1. MINIMAL RADIAL DISTANCE AROUND VENT PIPE AND BREECHING FOR SINGLE-WALL METAL PIPE VENT CONNECTOR. OTHERWISE, FOLLOW VENT CONNECTOR MANUFACTURER'S RECOMMENDED CLEARANCES.
2. ADD HEIGHT REQUIRED TO MAINTAIN 6" CLEARANCE FROM ALL BREECHING COMPONENTS.

Figure S-1: Minimum Clearances to Combustibles and Alcove Dimensions

BOILER QUICK-START

Installation:

1. Unpack the crate	7
2. Position the boiler	8
3. Provide combustion air	9
4. Connect venting.....	9
5. Connect gas piping.....	10
6. Connect boiler water piping	10
7. Connect electrical wiring.....	12
8. Program the controls	13
9. Check for gas and water leaks	16
10. Perform startup checks and adjustments	17

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F – Adjusting Gas Input Rate	46
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1. UNPACK THE CRATE



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

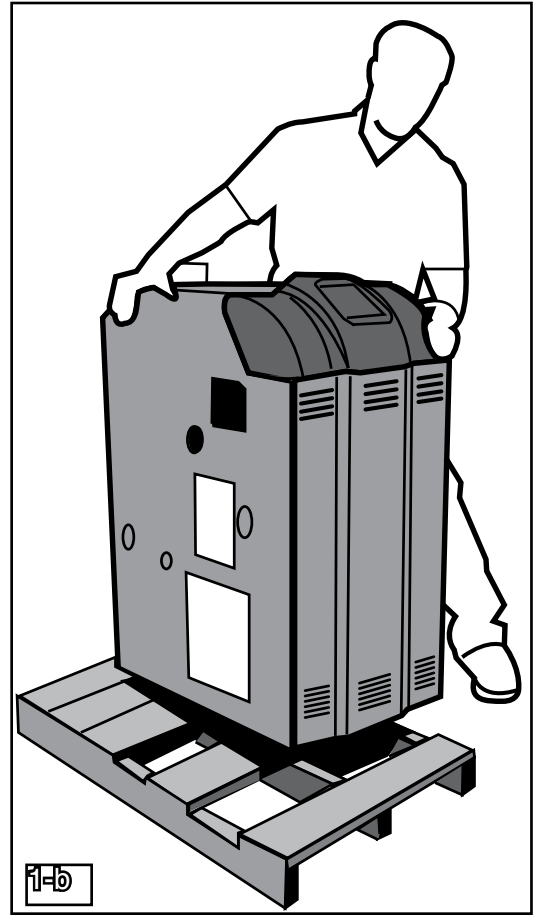
1. Remove the sleeve.
2. Remove the contents from the skid, except the boiler.
3. Remove the four (4) hex-drive lag screws holding the boiler to the skid (Figure 1-a).



DO NOT DAMAGE front air dam. It is required for proper operation of the boiler.



4. Tip the boiler and shimmy it off the skid (Figure 1-b).



2. POSITION THE BOILER



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.

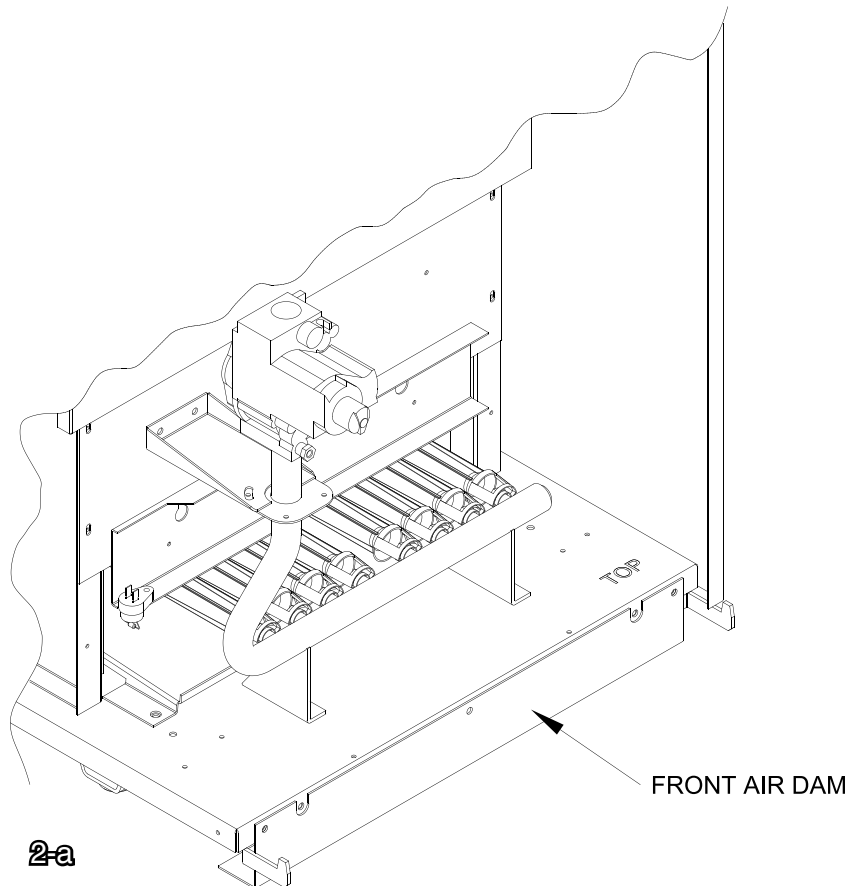
PROTECT IGNITION SYSTEM COMPONENTS from sources of water that may spray, drip, or rain on them during installation or service.

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.
5. Assure that the front air dam (applicable to 5-section thru 9-section boilers only) is in place and undamaged. See Figure 2-a.




CAUTION

ASSURE THAT THE FRONT AIR DAM is in place and undamaged. A damaged front air dam will negatively affect the performance of this boiler, which can cause serious property damage, personal injury or death.




3. PROVIDE COMBUSTION AIR

 **INSUFFICIENT COMBUSTION AIR SUPPLY** may result in the production and release of deadly carbon monoxide (CO) into the home which can cause severe personal injury or death.

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

Provide combustion air using the instructions in *Appendix A—Combustion Air*.

4. CONNECT VENTING

 **IMPROPER VENTING** may result in property damage and the release of flue gases which contain deadly carbon monoxide (CO) into the home, which can cause severe personal injury, death or substantial property damage.

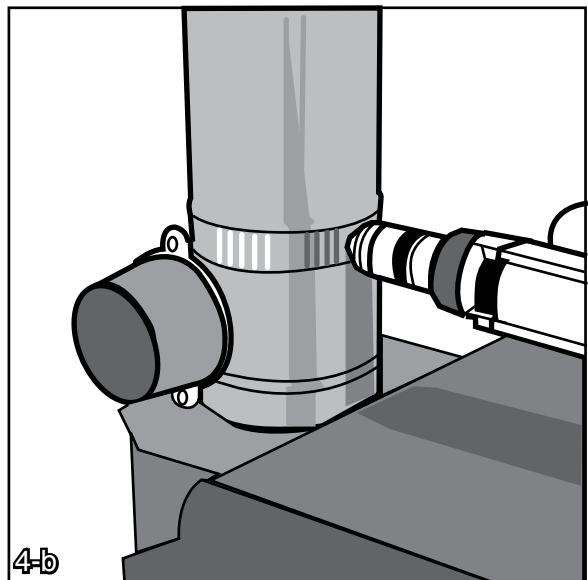
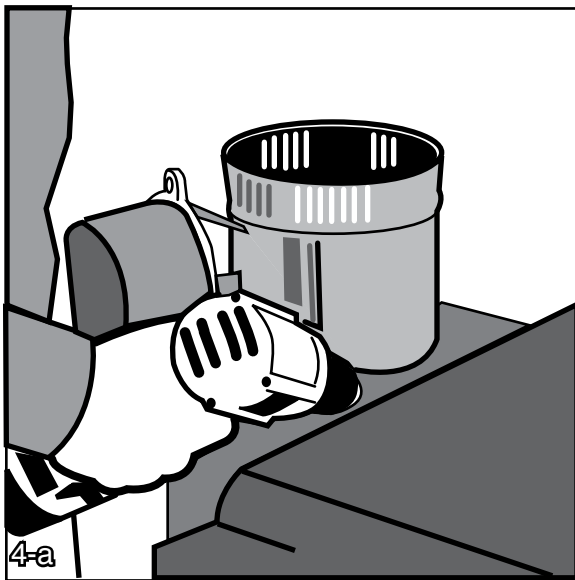
The vent system shall be designed and constructed in accordance with NFPA 54 and applicable local codes to develop a positive flow adequate to convey flue or vent gases to the outdoors, while ensuring that flue gases do not cool prematurely.

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

1. This appliance shall be vented into a listed gas vent, masonry**, metal, or factory-built chimney as required by NFPA 54 and applicable local codes for Category I appliances.

**If venting this appliance into a masonry chimney, the chimney must be lined with a listed chimney lining system (i.e. Type B gas vent or flexible metal) as required by NFPA 54 and applicable local codes. Clay flue lined masonry chimneys do not meet the venting requirements for this appliance.

2. Attach the vent damper with three sheetmetal screws around the perimeter of the flue collar (Figure 4-a), oriented so that the position indicator is visible. The vent damper may also be mounted anywhere between the flue outlet and the chimney within reach of the electrical harness.
3. Vent connector shall be double-wall insulated gas vent as supplied with this boiler or Type B (double-wall) gas vent only. Using sheetmetal screws, attach the vent connector between the vent damper and the vertical chimney (Figure 4-b).



DAMPER MUST BE OPEN when the main burner is firing.

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.

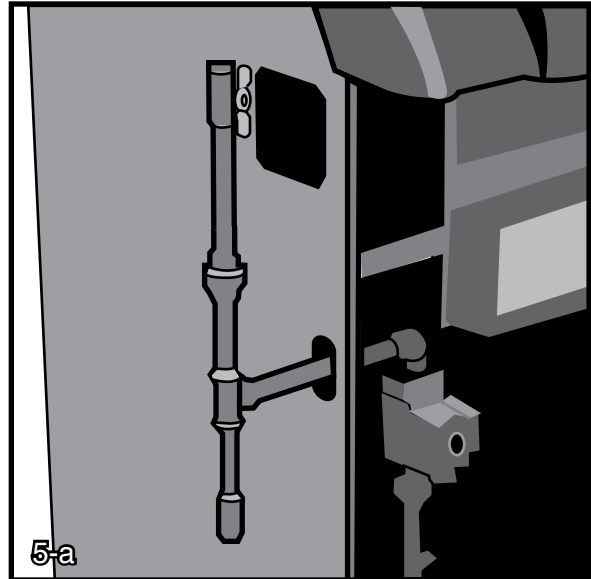


SIZE GAS PIPING, regulators, valves, and meters so as to provide an adequate gas flow and pressure to the boiler during operation. Failure to do so may cause poor combustion, noise, injury, or death.

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). In Canada, close

nipples and street ells are not approved for use as gas piping.

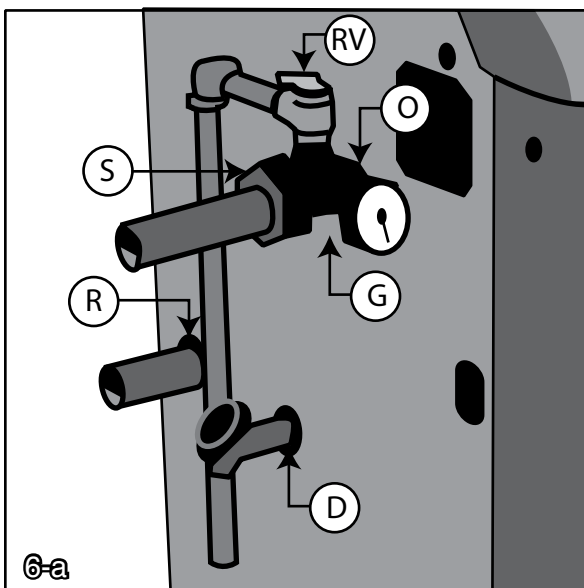
3. Pipe through the left jacket panel, and complete drip leg as shown (Figure 5-a).



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.



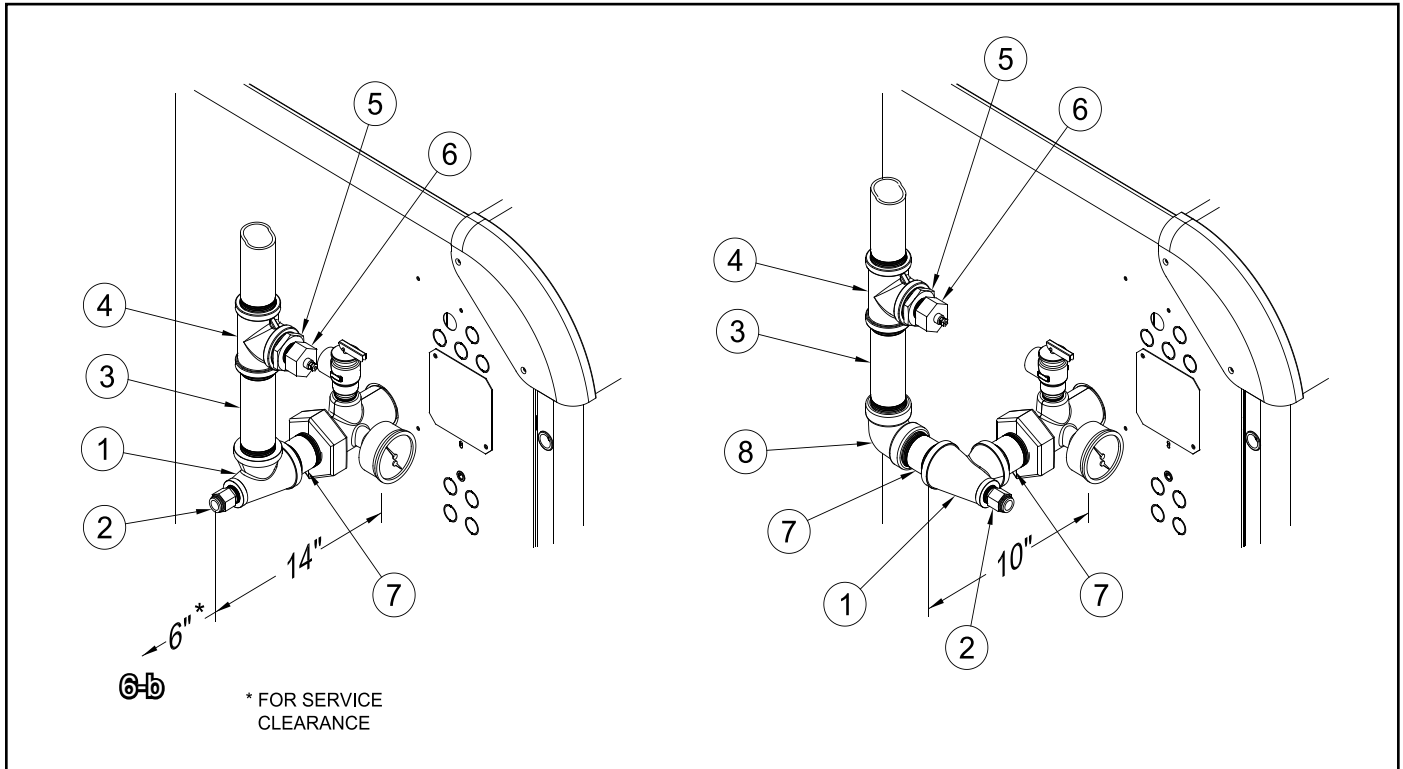
BLOCKING THE RELIEF VALVE may result in boiler explosion.

5. Screw the temperature-pressure gage into manifold tapping "G".
6. Connect the system supply to the open end of the manifold "S" using a $1\frac{1}{4}$ " male NPT fitting.

6. CONNECT BOILER WATER PIPING (continued)

7. Screw an installer-supplied 1 ¼" 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.



Item	Description	Part Number
1	1 ¼ x 1 ¼ x ½ Tee	806601021
2	Immersion Well, ½ NPT	80160456
3	1 ¼ x 6 Nipple	806600029
4	1 ¼ Tee	806601030
5	1 ¼ x ¾ Bushing	806600504
6	LWCO Sensor, ¾ NPT	102305-01
7	1 ¼ x 3 Nipple	806600005
8	1 ¼ 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.



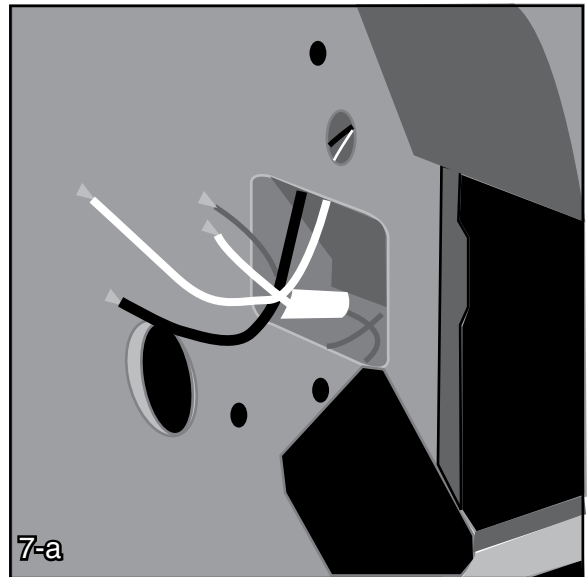
NEVER DEFEAT OR JUMP OUT safety devices.



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



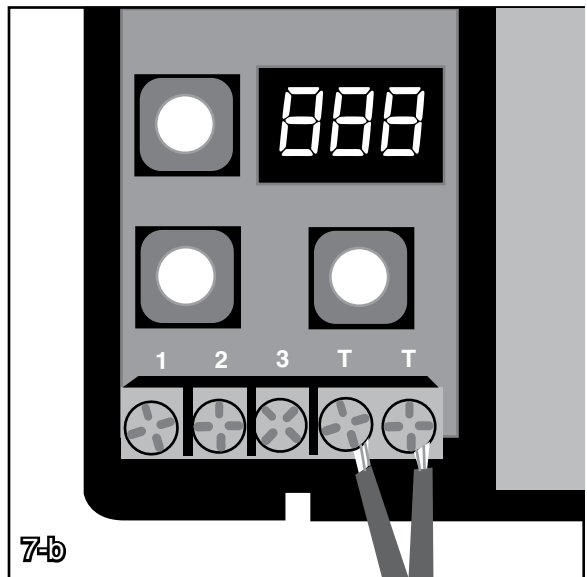
Refer to the *Internal Wiring* diagrams later in this manual.

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".



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

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

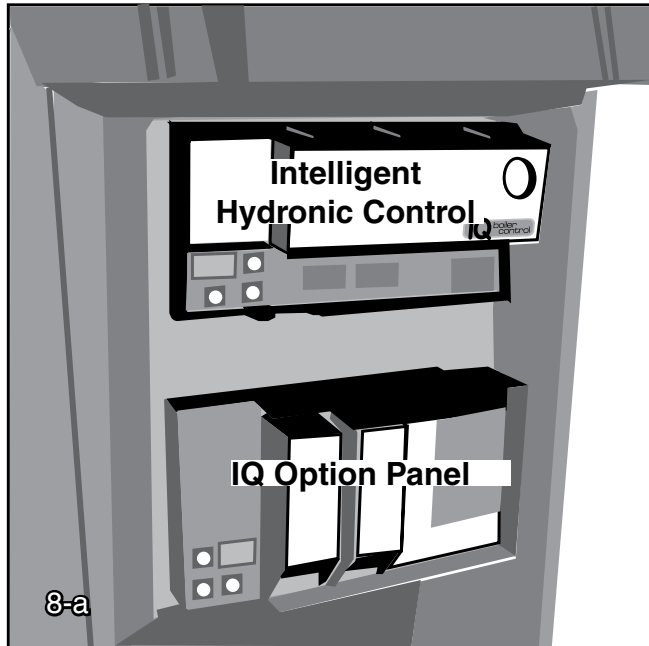


THE MAXIMUM ALLOWABLE CURRENT for each circulator is 5 amps at 120V AC. For circulators with higher amp ratings, you must install a circulator relay or starter coil to provide line voltage to the circulator and connect only the relay or starter coil to boiler terminals. The combined boiler and circulator amperage must not exceed 15 amps. Install over-current protection in accordance with authority having jurisdiction or, in the absence of such requirements, follow the National Electric Code, NFPA 70, and/or CSA C22.1 Electrical Code. Do not provide over-current protection greater than 15 amperes.

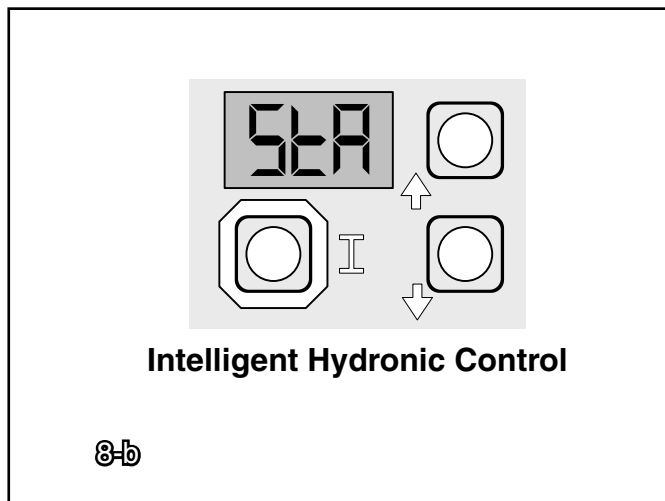
8. PROGRAM THE CONTROLS

Using Intelligent Hydronic Control Display

The Intelligent Hydronic Control (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 control to change from one parameter to the next. Each setting will alternately flash between the relevant display code and its corresponding value.

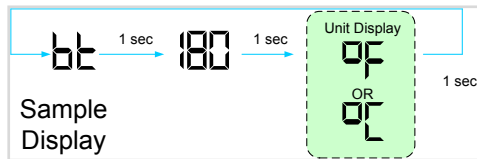
Operating Mode Options	
5tR	Status
bT	Boiler Temperature
SP	Operating Setpoint (Outdoor Reset)
HL	High Limit Setting
HdF	High Limit Differential
tT	Heat Request Status
dh	DHW Heat Request Status
FLR	Flame Current
rUn	Run Time Hours
CYC	Boiler Cycles
Err	Error (see Error Numbers)

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

Status Code Displayed in 5tR Mode	
1	Standby
4	Prepurge
6	Spark
7	Flame Proving
8	Running
10	Retry/Recycle Delay
13	Soft Lockout
14	Hard Lockout
15	Waiting for Limit to Close
16	Flame Present Out of Sequence
17	Self Test
18	Waiting for Damper to Open
20	Damper Failure to Open

For example, when the “I” key is pressed on the control until “bT” is displayed, it will then flash a three digit number (such as “180”) followed by either “F” (or “C”). 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 ↑ or Down ↓ 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 ↑, Down ↓, and “” keys simultaneously for three (3) seconds. This procedure is intended to discourage unauthorized changes or accidental changes to limit settings.
2. Press the “” key to display available Adjustment Mode options. Select an option.

Adjustment Mode Options		
HL_	140-220°F	Adjust High Limit Setting
dF_	10-30°F	Adjust High Limit Differential
Or_	0-10 minutes	Circulator Overrun Time
PP_	2-20 minutes	Circulator Pre-purge Time
St_	140-180°F	Start Temperature
Pt_	On or OFF	Priority time
dh_	dh or Lt2	DH Terminal Function
rSt		Reset Lockout
F-[]	F or C	Select degrees F or C Mode
bRc		Back to Operating Mode

3. Press the Up ↑ and Down ↓ 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 ↑ or Down ↓ 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_)

The control is factory programmed with a High Limit Setpoint of 180°F. The burner turns "off" when the boiler temperature (bt) is above this value. The High Limit setpoint is adjustable between 140° and 220°F. 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.
2. Differential (dF_)

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_)

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_)

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

8. PROGRAM THE CONTROLS (continued)

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.

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	tt2	<140	Start with no delay
DHW = on	tt2	>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 boiler 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			Circulator Status	
T-T Input	DHW Input	Priority Time (Pt_{-})	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 ES2 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 3)	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.




WATER LEAKS may cause extensive property damage.

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

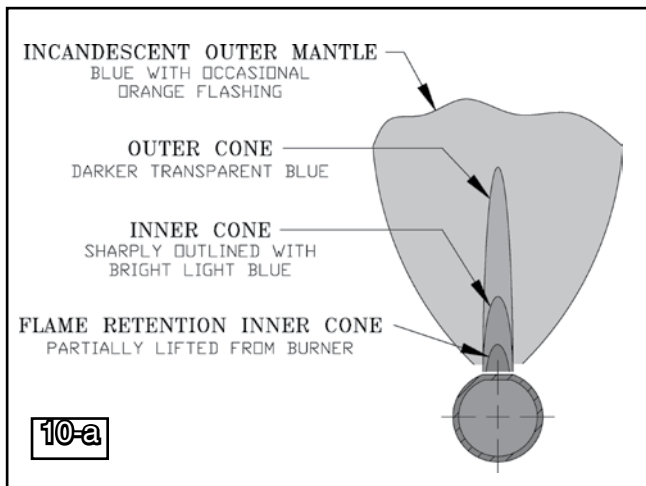
10. PERFORM STARTUP CHECKS AND ADJUSTMENTS

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

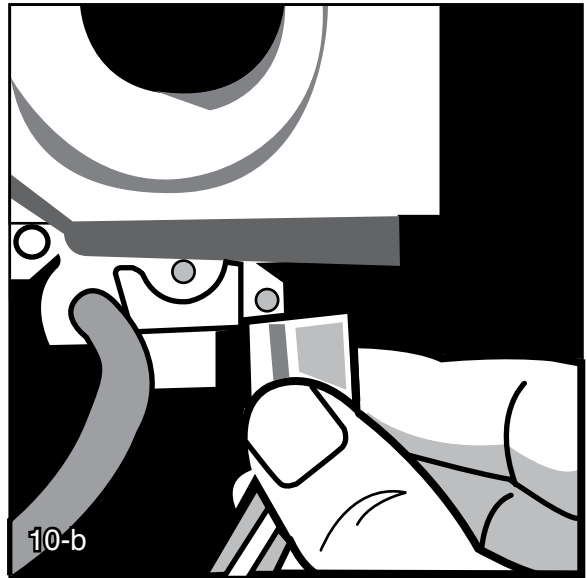
 IF YOU SMELL GAS, STOP and repair the leak. Lighting the boiler when gas is leaking may cause explosion or fire.

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 draft. See *Appendix G – Checking Draft and Combustion*.
 - No spillage observed.
14. Check combustion in the vent stack and record results in the spaces provided below.
 - _____ CO₂ (less than 7%)
 - _____ O₂ (more than 9%)
 - _____ CO (less than 50 ppm, air free)

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

ANNUAL MAINTENANCE CHECKLIST



WARNINGS

THE BOILER CONTAINS REFRACTORY

CERAMIC FIBER, a possible human carcinogen. Use a NIOSH approved respirator when servicing high-temperature insulation and gasket materials. Wash exposed skin gently with soap and water after contact. Wash exposed clothing separate from normal laundry.

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:

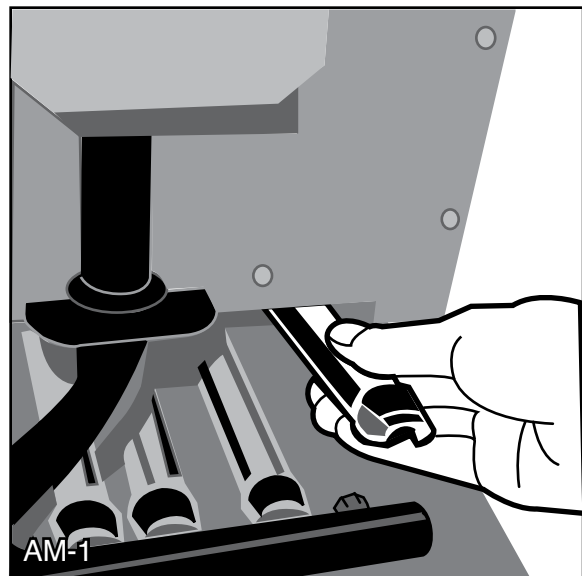
- Soft bristle brush
- Bristle flue brush
- Vacuum with brush attachment

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. Inspect boiler flue passages:
 - (1) Remove vent pipe, damper.
 - (2) Remove top panel and hood.
 - (3) Remove blocked vent switch and canopy.
 - (4) Examine all flue passageways. Using bristle flue brush and vacuum, remove any soot or obstructions.
5. Remove and clean main burners:
 - (1) Remove jacket front panel.
 - (2) Disconnect pilot tubing at gas valve.
 - (3) Disconnect pilot lead wires at gas valve.
 - (4) Remove wires from flame roll-out switch.
 - (5) Remove burner access panel.
 - (6) 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.

6. Perform *Startup Checks and Adjustments* described earlier in this manual.
7. Check operation of airflow sensing switches.
8. Check for water leaks on the boiler or water pooling around boiler.
9. 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.
10. Verify proper operation after servicing.



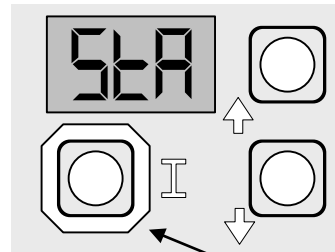
TROUBLESHOOTING

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 the Section 10 "Perform Startup Checks and Adjustments" on page 17.
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 IW1 and IW2. 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>5tA</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 *5tA*) and value.

When *Err* (error) is shown:

Value	Description
4	Flame current lower than threshold
6	Flame Out of Normal Sequence
18	Electronics Failure
23	Flame Sensed During Pre-purge
32	Temperature Sensor Failure
55	Damper Failed to Open
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 *5tA* (status) values:

Value	Description
1	Standby
4	Pre-purge
6	Spark
7	Flame Proving
8	Running
10	Retry/Recycle Delay
13	Soft Lockout
14	Hard Lockout
15	Waiting for Limit to Close
16	Flame Present Out of Sequence
17	Self Test
18	Waiting for Damper to Open
20	Damper Failure to Open

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 the next Section:

Display	Status	Recommended Corrective Action
Blank	Boiler or Control is not powered	No 120 Vac Power at boiler, check breaker and wiring between breaker panel and boiler
<i>Err</i> 4	Flame Current Lower than Threshold	Check pilot assembly. Refer to Troubleshooting Section, 6.
<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 for proper 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> 32	Temperature Sensor Failure	Temperature sensor or interface failure (open or short connection, increased connection resistance, dual sensor mismatch) or control hardware failure. <ul style="list-style-type: none"> - Check sensor is securely attached to control P7 connector. - Check sensor wire is not damaged. - If secure and in good condition, replace sensor. - If problem persists, replace control.
<i>Err</i> 35	Duplicate Zone Alarm	Refer to IQ Zone Panel Instructions.
<i>Err</i> 55	Damper Failed to Open	Atmospheric Damper End Switch failed to close (end switch contacts stuck open). Refer to Troubleshooting Section, 5.
<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"> - Check for excessive condensate. Dry pilot. Adjust setpoint higher. - Check for loose or damaged ignition wire.
<i>Err</i> 58	AC Line Frequency	Error AC Signal is too noisy or frequency is incorrect. Check supply voltage. Check Sensor for Common shorted to ground.
<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, 6.
<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"> - Check vent damper, cycle power with vent damper disconnected. If error is cleared, reconnect the vent damper and refer to Recommended Corrective Action listed under <i>Err</i> 20, damper failed to open. - Check pilot assembly, - If problem persists, replace the control.
<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
SEtA 1 Standby Burner off Circulator off	The boiler has not detected a call for heat (<i>tL</i> = <i>oFF</i> and <i>dh</i> = <i>oFF</i>). Check the thermostat: - When a thermostat call for heat is detected control display “ <i>tL</i> ” will show “ <i>oN</i> ” - Make sure thermostat is calling for heat and contacts (including appropriate zone controls) are closed. Check for loose connection. Check the DHW demand: - When a domestic call for heat is detected “ <i>dh</i> ” will show “ <i>oN</i> ” - Make sure the DHW aquastat contact is closed. Check for loose connection.

2. Circulator is On, But Boiler is Off

Display / Status	Recommended Corrective Action
SEtA 1 Circulator Pre-purge Burner off Circulator on	The boiler is warm and circulator is providing residual boiler heat to building: Check boiler temperature - The boiler will not start until boiler water temperature is less than the Setpoint (<i>SP</i>) minus differential (<i>dF</i>) - 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.

3. Boiler is On, But Circulator is Off

Display / Status	Recommended Corrective Action
SEtA 8 Burner on Circulator off	Domestic Hot Water (DHW) Priority Forcing Circulator Off - 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. - 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). Wiring / Circulator Issue: - Check wiring for loose connection, miswiring - Check circulator

4. Circulator is On but Damper is Not Open

Display / Status	Recommended Corrective Action
SEtA 15 Limit Open	Waiting for Limit to Open. - Check Blocked Vent Switch, in the event of a blocked vent or poor draft condition, the blocked vent 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. The source of blockage must be corrected by trained and skilled personnel from a qualified service agency before resetting switch. Blocked Vents are caused by a collapsed chimney resulting in full or partial blockage, chimney cross sectional area too small, height insufficient or cold chimney causing sustained poor draft. Always follow the recommendations in Section 4, Connect Venting and Appendix B and B1. - 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. - Check External Limit. Check IQ Option Panel Display.

TROUBLESHOOTING (continued)

5. Circulator is On but Damper is Not Open

Display / Status	Recommended Corrective Action
<p>5tA 20 Damper Failed to Open</p>	<p>The control is waiting for the damper to open. Damper end switch has failed to close (end switch contact is stuck open). Combustion can never take place unless the damper blade is in the fully open position. Check the following:</p> <ul style="list-style-type: none"> - During status "5tA 18" or "5tA 20" the control terminal "P6 - 5" (yellow wire) is energized. - Check for loose connection between control and vent damper, check damper harness. - Check for obstruction in path of damper - When damper is open (end switch closed) control terminal "P6 - 2" should receive power from the vent damper. - Place jumper between control terminal P6-5 and P6-2. If error 55 does not clear, replace control. - Defective harness or vent damper.

6. Circulator is On, Damper is Open but Boiler Fails to Start

Display / Status	Description
<p>5tA 10 Retry / Recycle Delay</p>	<p>The Boiler is in "Retry Delay":</p> <ul style="list-style-type: none"> - 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. <p>Recycle Delay</p> <ul style="list-style-type: none"> - 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.
<p>5tA 13 Soft Lockout</p>	<p>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 using Adjustment Mode and selecting the reset button (see Adjustment Mode instructions) or by cycling power. Soft Lockout is caused by one of the following:</p> <ul style="list-style-type: none"> - Err 63, 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. - Err 64, Internal Failure, refer to Error code listing for recommended corrective action. - Err 23, Flame sensed during post-purge (before gas valve signaled open). Check the gas valve for proper operation. Replace gas valve if problem persists.
<p>5tA 14 Hard Lockout</p>	<p>When a hard lockout occurs boiler shuts down.</p>
<p>5tA 16 Flame Out of Sequence</p>	<p>If flame is detected in pre-purge Control goes to Flame Out of Sequence Before trial, "5tA 15" 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 5" is reported. When flame is off control goes to Soft Lockout and "Err 5" is cleared. Check the gas valve for proper operation.</p>

TROUBLESHOOTING (continued)

6. Circulator is On, Damper is Open But Boiler Fails to Start (continued)

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

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 (E 1, E 2, or E 3). 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 LT 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 - E 1” 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.

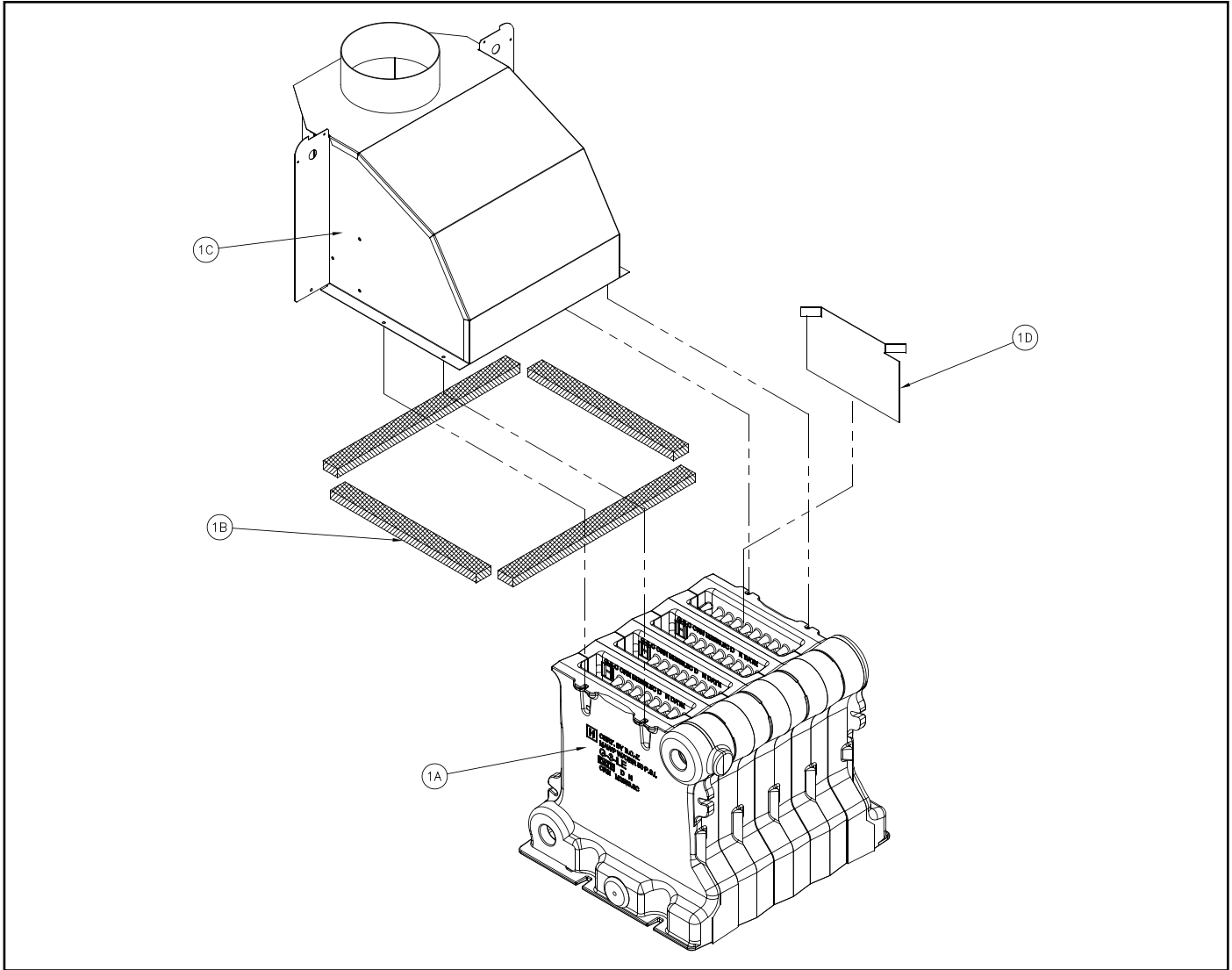
For example, if, while the boiler has a Heat Request, and the Aquastat IQ Option Card installed in Slot 1 has a sensor failure the IQ Option Panel displays OL - E 1 (Open Limit Card Slot 1). To investigate the status of option card E 1:

1. Press the “1” key on the IQ Option Panel. The display will go from “OL - E 1” to E 1.
2. When the display shows E 1, 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 - 1 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.L.P” display and the control start sequence will continue.

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

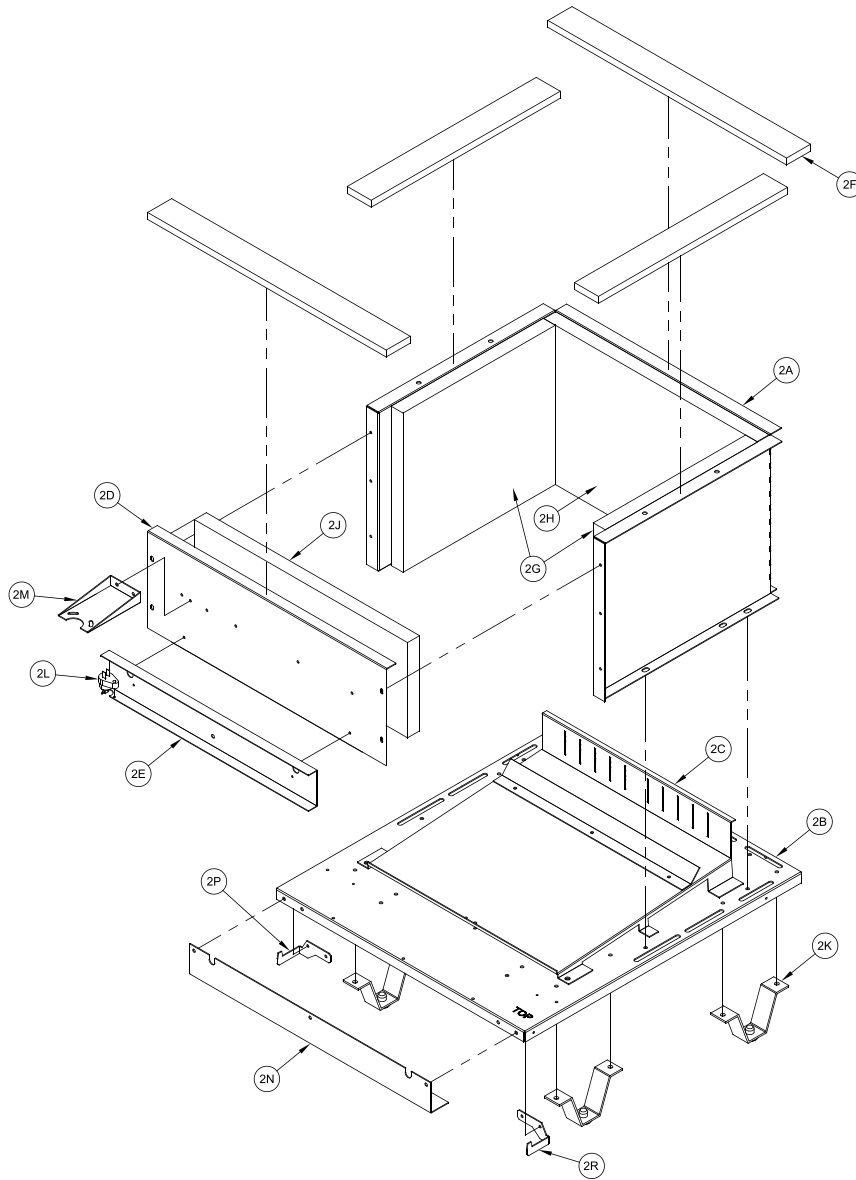
If IQ Option Panel Display Shows “O.L.P”: The Option Panel is in normal run or operating mode, the IQ Option Panel display will show “O.L.P” (Option Card Panel) along with a floating decimal point that flashes on and off (the “heartbeat” flash indicating the panel is functioning properly and there are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

REPAIR PARTS LIST



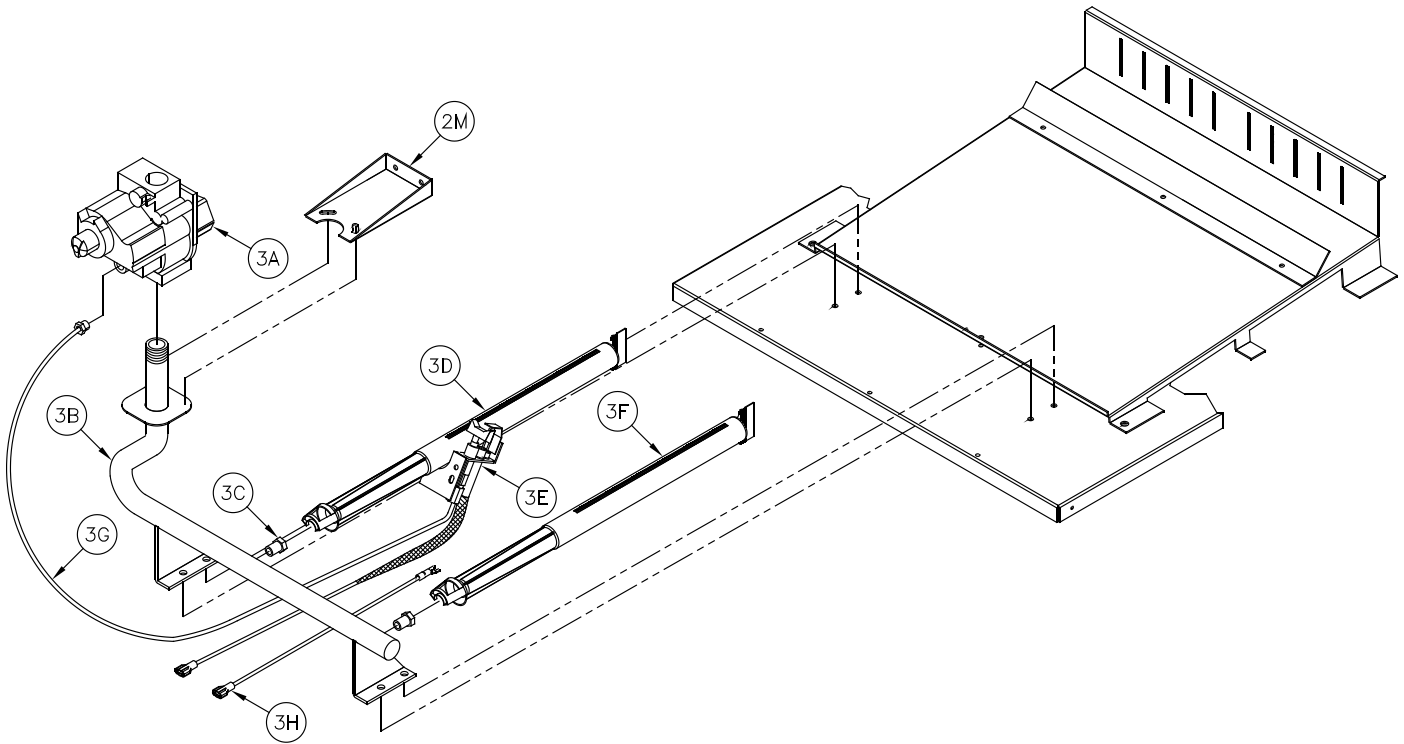
Key No.	Description	[Quantity] Part Number							
		ES23	ES24	ES25	ES26	ES27	ES28	ES29	
1A	Block Assembly	102287-03	102287-04	102287-05	102287-06	102287-07	102287-08	102287-09	
1B	Canopy Gasket Kit	6206001							
1C	Canopy Assembly	102554-03	102554-04	102554-05	102554-06	102554-07	103860-08	102554-09	
1D	Flue Baffle	[2] 102678-01	[3] 102678-01	[4] 102678-01	[5] 102678-01	[6] 102678-01	[7] 102678-01	[8] 102678-01	
	Blocked Vent Switch (not shown)	80160157							

REPAIR PARTS LIST (continued)



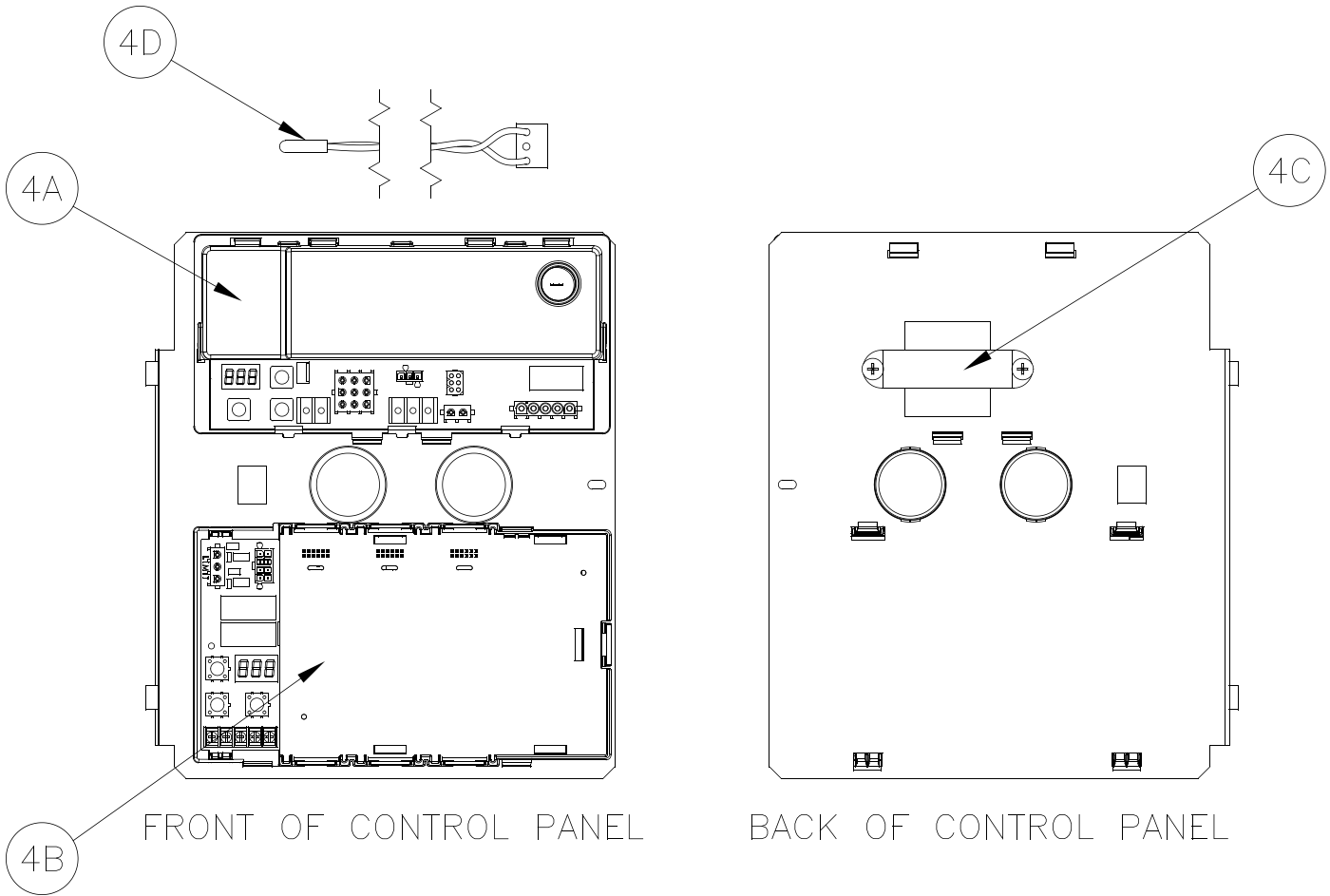
Key No.	Description	[Quantity] Part Number						
		ES23	ES24	ES25	ES26	ES27	ES28	ES29
2A	Base Wrapper	71807031	71807041	71807051	71807061	71807071	71807081	71807091
2B	Base Tray	102543-03	102543-04	102543-05	102543-06	102543-07	102543-08	102543-09
2C	Burner Tray Assembly	61807031	61807041	61807051	61807061	61807071	61807081	61807091
2D	Base Front Panel	102705-03	102705-04	102705-05	102705-06	102705-07	102705-08	102705-09
2E	Burner Access Panel	102707-03	102707-04	102707-05	102707-06	102707-07	102707-08	102707-09
2F	Base Gasket Kit	6206002						
2G	Base Side Insulation	[2] 72007001						
2H	Base Rear Insulation	72007031	72007041	72007051	72007061	72007071	72007081	72007091
2J	Base Front Insulation	72007032	72007042	72007052	72007062	72007072	72007082	72007092
2K	Base Leg Assembly	[4] 6186001						
2L	Flame Roll-out Switch	80160044						
2M	Manifold Support Bracket	71807001						
2N	Front Air Dam	N/A	N/A	103718-05	103718-06	103718-07	103718-08	103718-09
2P	Left Door Bracket	102551-01						
2R	Right Door Bracket	102552-01						

REPAIR PARTS LIST (continued)



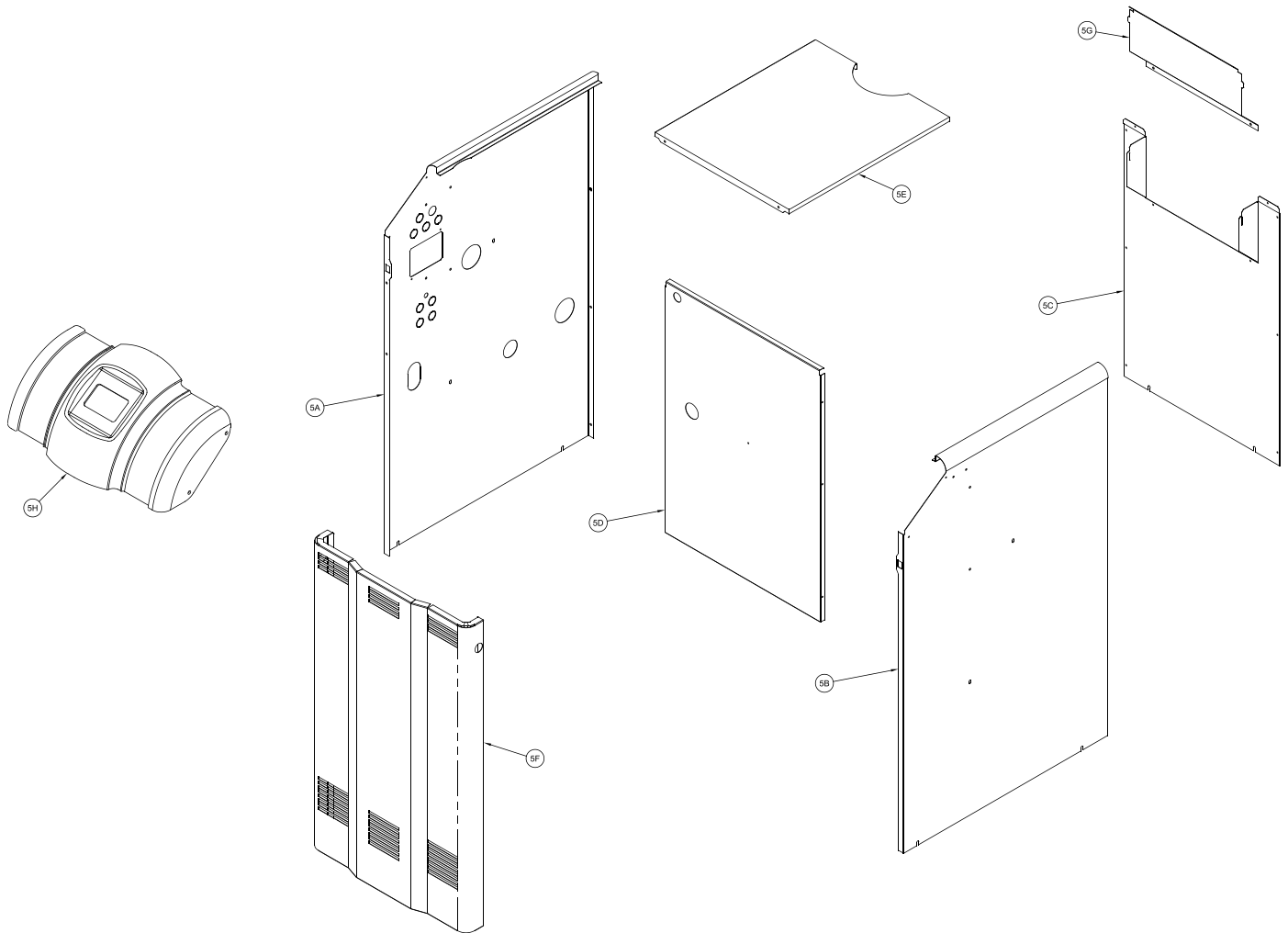
Key No.	Description	[Quantity] Part Number							
		ES23	ES24	ES25	ES26	ES27	ES28	ES29	
3A	Gas Valve (Natural Gas), Honeywell VR8204P1171	81660282				N/A			
	Gas Valve (Natural Gas), Honeywell VR8304P4496	N/A				81660283			
	Gas Valve (LP Gas), Honeywell VR8204C3015	81660146				N/A			
	Gas Valve (LP Gas), Honeywell VR8304P4314	N/A				81660160			
3B	½" Gas Manifold	82207031	82207041	82207051	82207061	N/A			
	¾" Gas Manifold	N/A				82207071	82207081	82207091	
3C	Burner Orifices - Natural Gas #47	[4] 822710	[6] 822710	[8] 822710	[10] 822710	[12] 822710	[14] 822710	[16] 822710	
	Burner Orifices - LP Gas 1.20mm	[4] 822792	[6] 822792	[8] 822792	[10] 822792	[12] 822792	[14] 822792	[16] 822792	
3D	Pilot Burner								100147-01
3E	Pilot Assembly - Natural Gas								8236163
	Pilot Assembly - LP Gas								8236164
3F	Main Burner	[3] 100146-01	[5] 100146-01	[7] 100146-01	[9] 100146-01	[11] 100146-01	[13] 100146-01	[15] 100146-01	
3G	Pilot Tubing								8236122
3H	Ground Wire Assembly								103776-01

REPAIR PARTS LIST (continued)



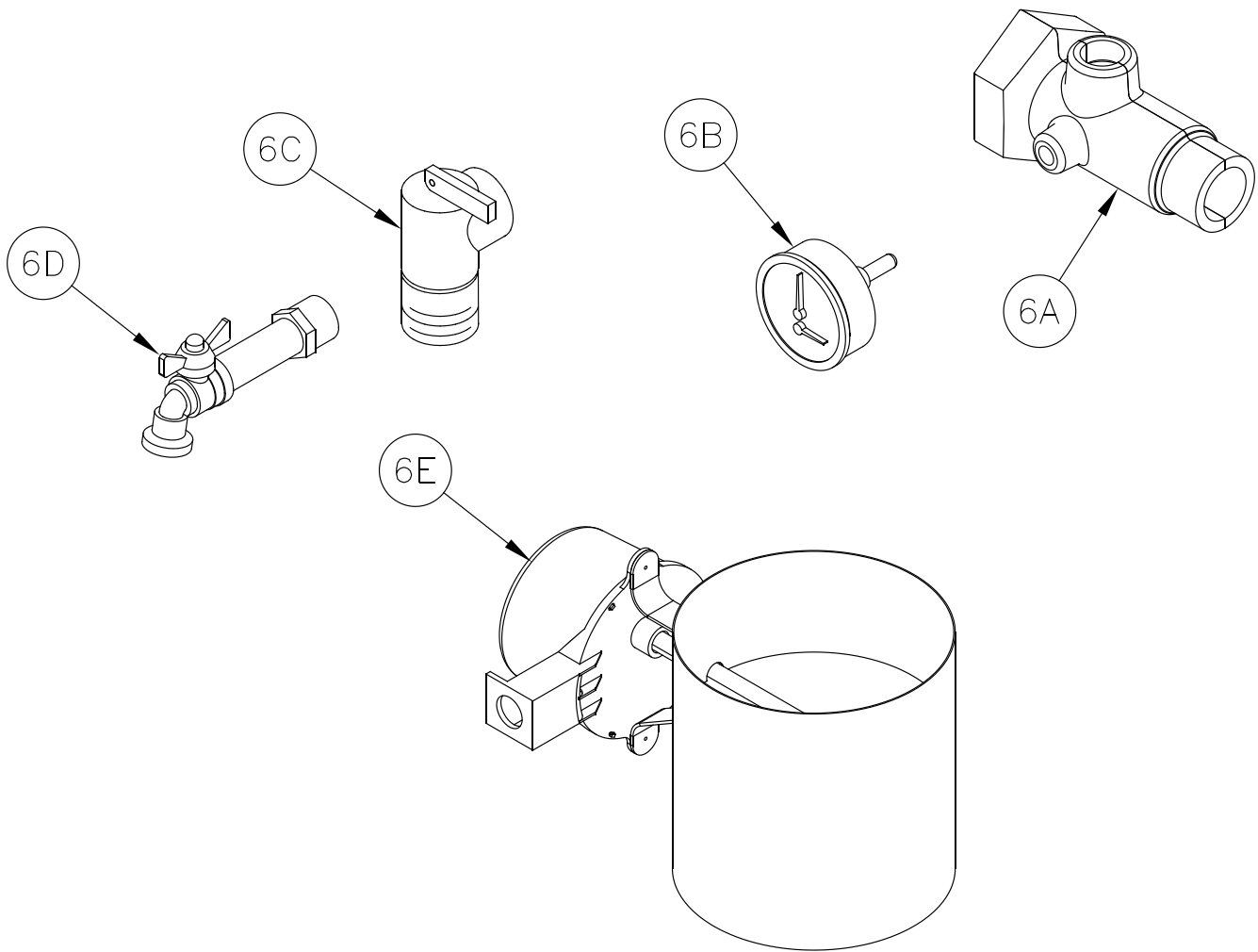
Key No.	Description	[Quantity] Part Number						
		ES23	ES24	ES25	ES26	ES27	ES28	ES29
4A	Control				103660-01			
4B	IQ Option Panel				102291-01			
4C	Transformer				102516-01			
4D	Temperature Sensor				102411-01			

REPAIR PARTS LIST (continued)



Key No.	Description	[Quantity] Part Number						
		ES23	ES24	ES25	ES26	ES27	ES28	ES29
5A	Jacket Left Side Panel				102566-01			
5B	Jacket Right Side Panel				102567-01			
5C	Jacket Rear Panel	102569-03	102569-04	102569-05	102569-06	102569-07	102569-08	102569-09
5D	Jacket Vestibule Panel	102565-03	102565-04	102565-05	102565-06	102565-07	102565-08	102565-09
5E	Jacket Top Panel	102568-03	102568-04	102568-05	102568-06	102568-07	102568-08	102568-09
5F	Jacket Front Door	103717-03	103717-04	103717-05	103717-06	103717-07	103717-08	103717-09
5G	Jacket Rear Discharge	102549-03	102549-04	102549-05	102549-06	102549-07	102549-08	102549-09
5H	Jacket Poly Front Cover	102600-03	102600-04	102600-05	102600-06	102600-07	102600-08	102600-09

REPAIR PARTS LIST (continued)



Key No.	Description	[Quantity] Part Number						
		ES23	ES24	ES25	ES26	ES27	ES28	ES29
6A	Supply Water Manifold				80607001			
6B	Temperature/Pressure Gauge				100282-01			
6C	30 PSI Relief Valve				81660363			
6D	Drain Valve				102802-01			
6E	Vent Damper	102284-01	102284-02	102284-03		102284-04		102284-05
	Circulator (not shown):							
	Taco 007-2				8056170			
	Grundfos UP-15				102805-01			
	B & G NRF-22				8056174			

INTERNAL WIRING

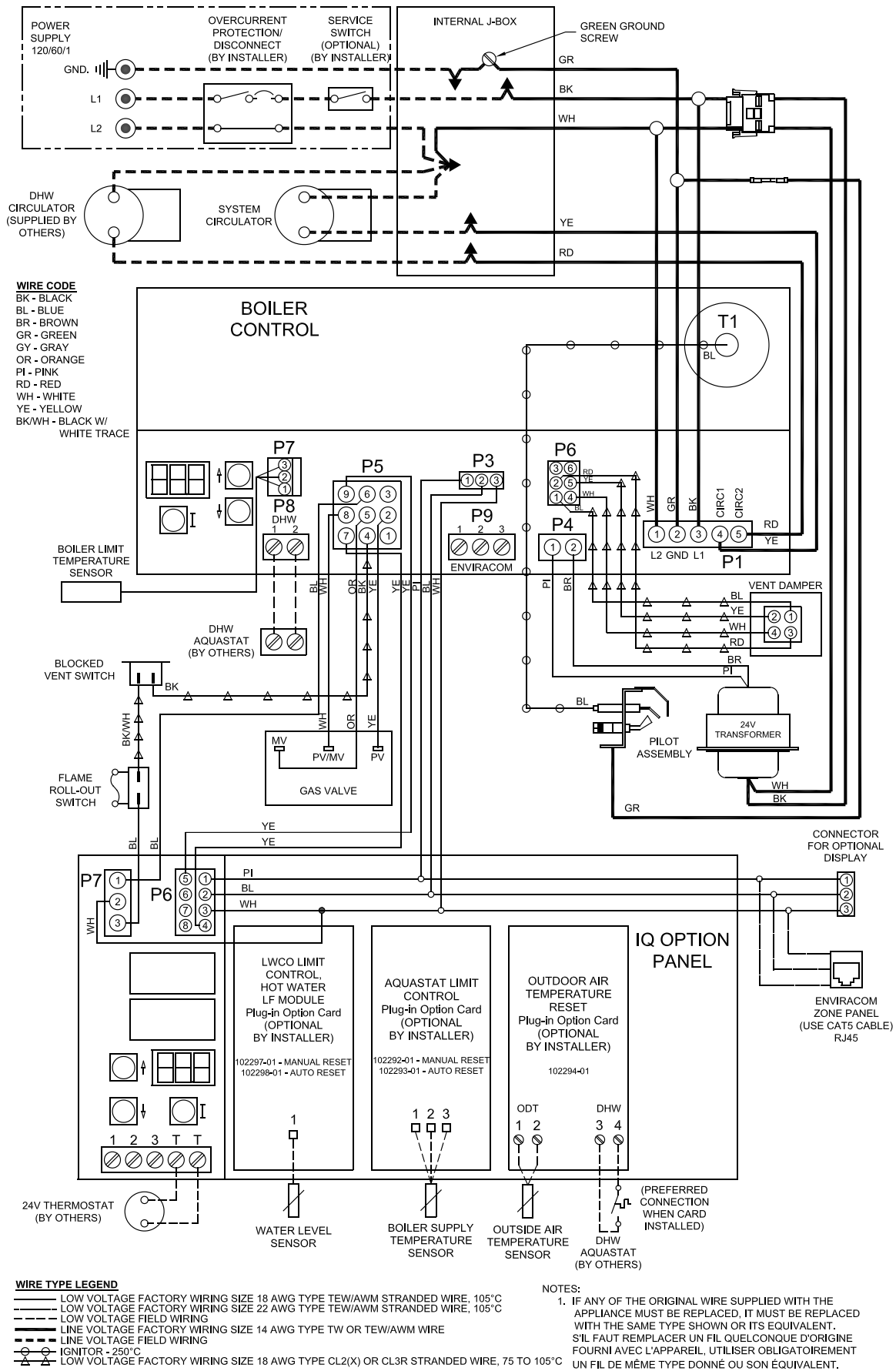


Figure IW-1: Wiring Diagram

INTERNAL WIRING (continued)

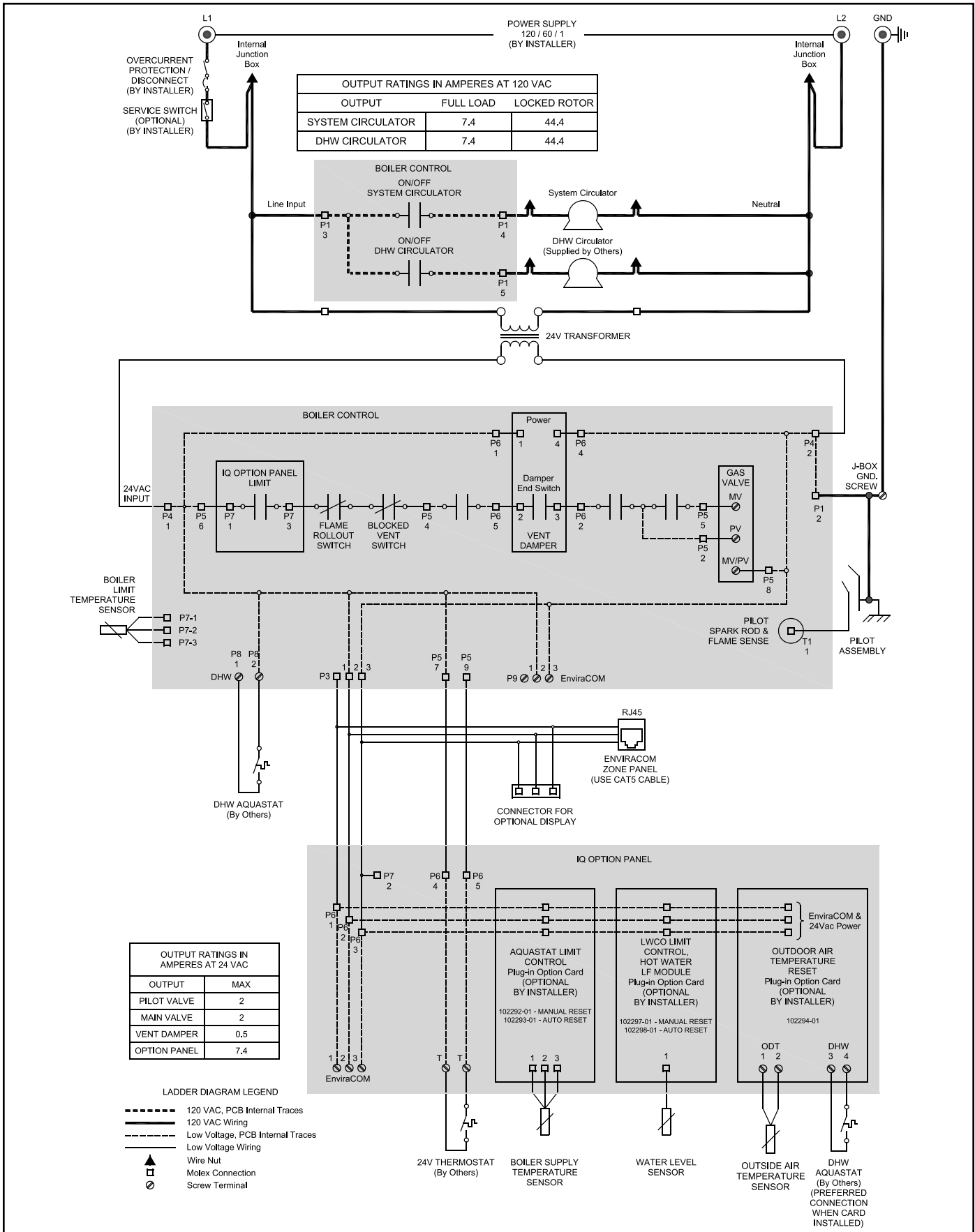


Figure IW-2: Wiring Schematic

INTERNAL WIRING (continued)

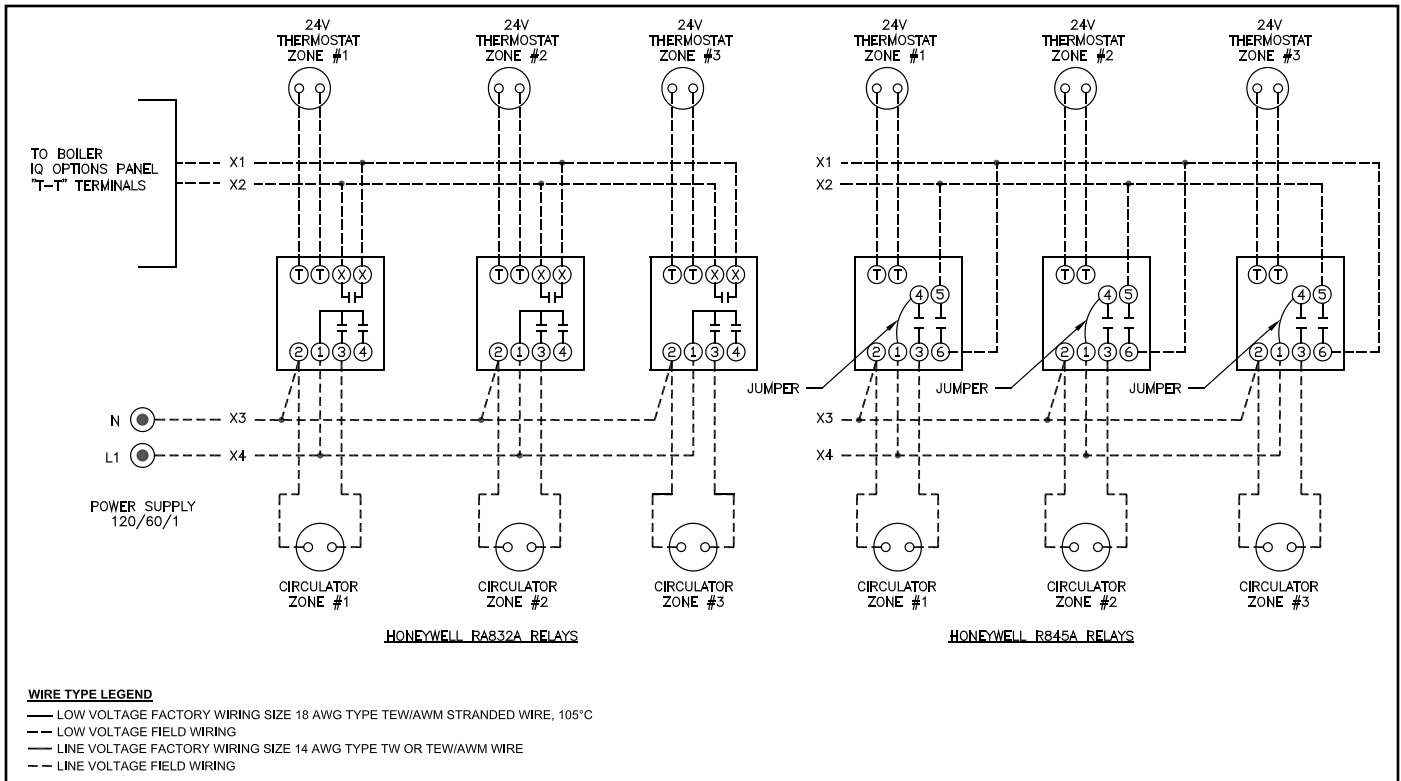


Figure IW-3: Multiple Zone System with Zone Circulators

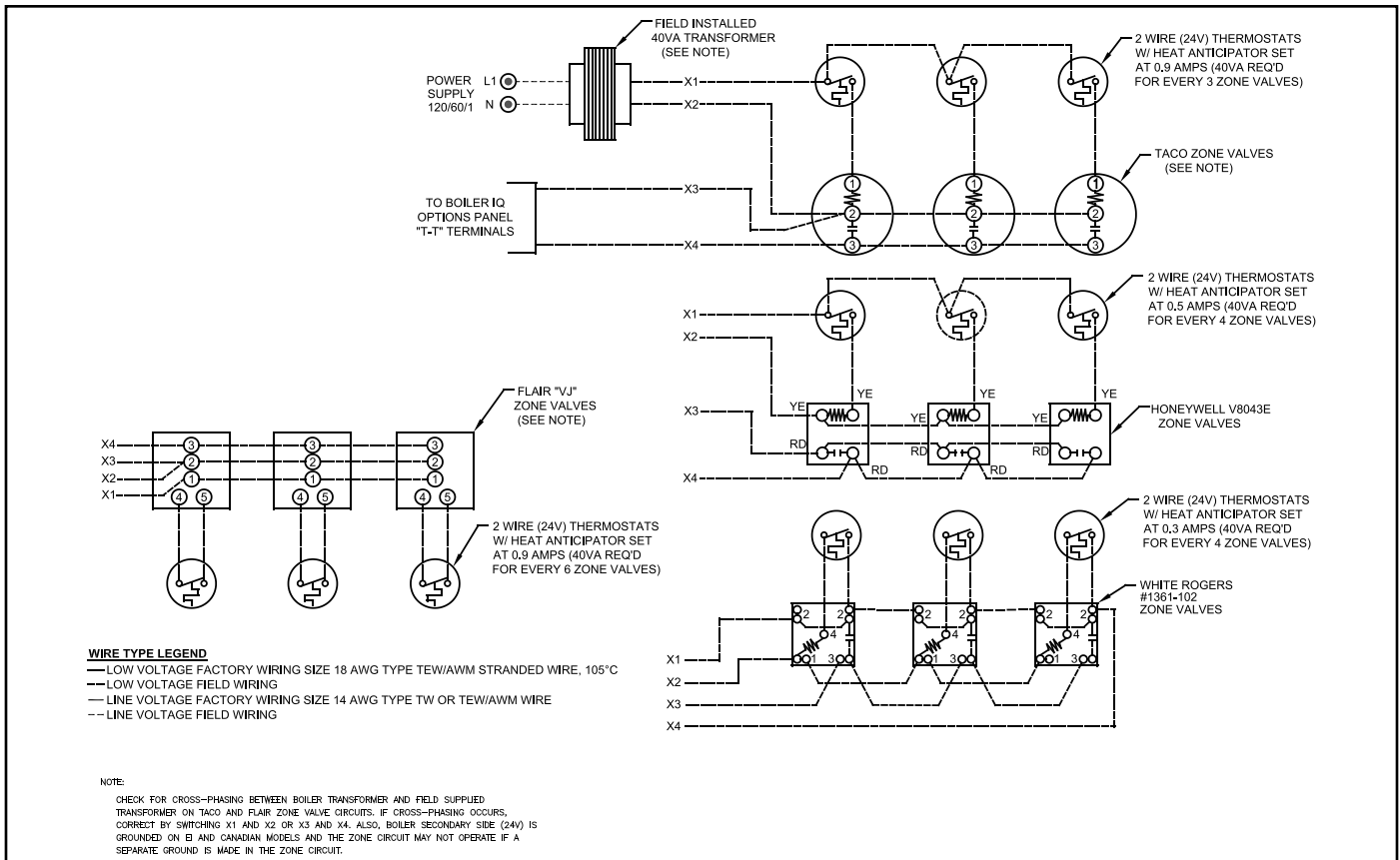


Figure IW-4: Multiple Zone System with Zone Valves

INTERNAL WIRING (continued)

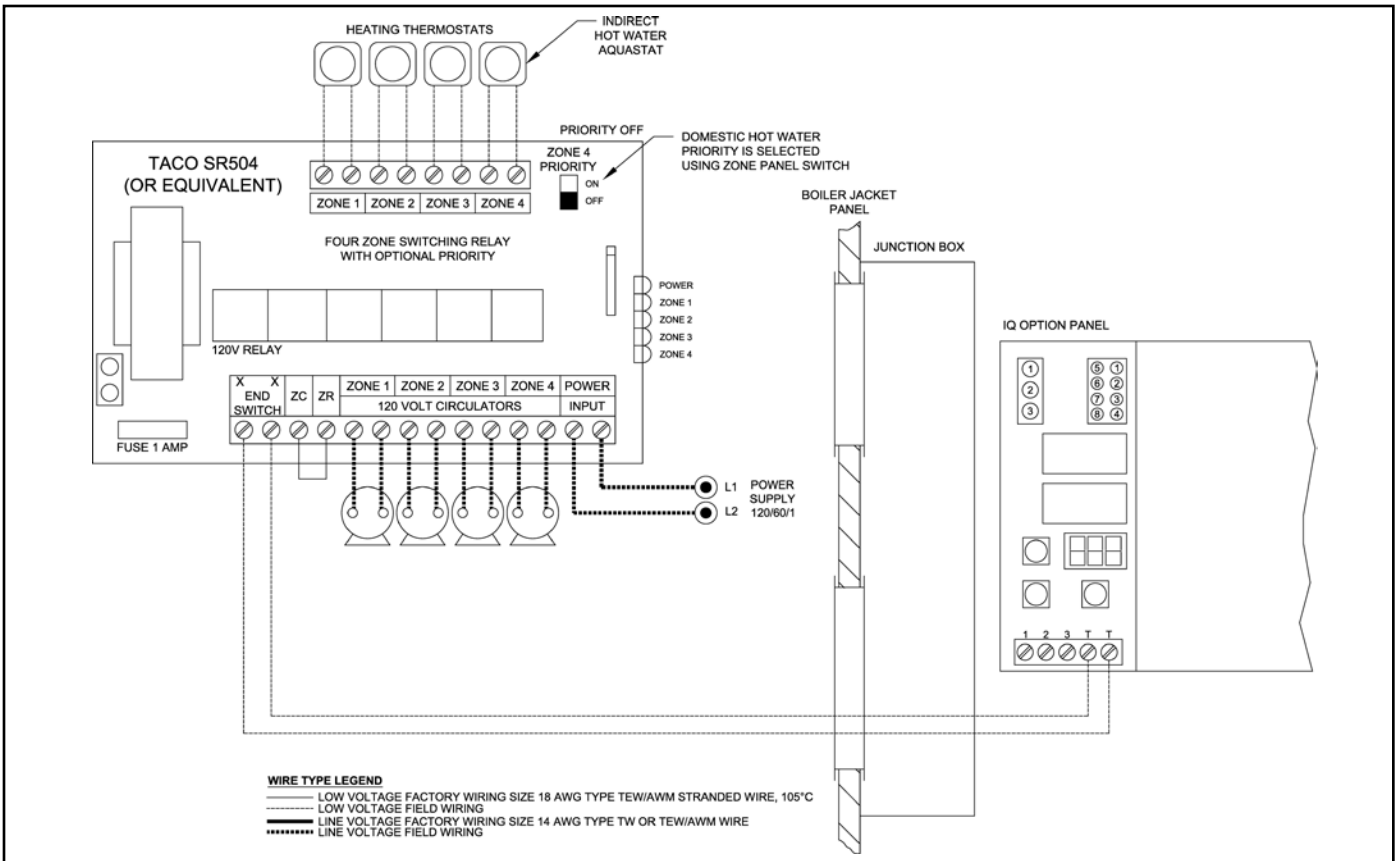


Figure IW-5: Multiple Zone System with Zone Circulator Panel

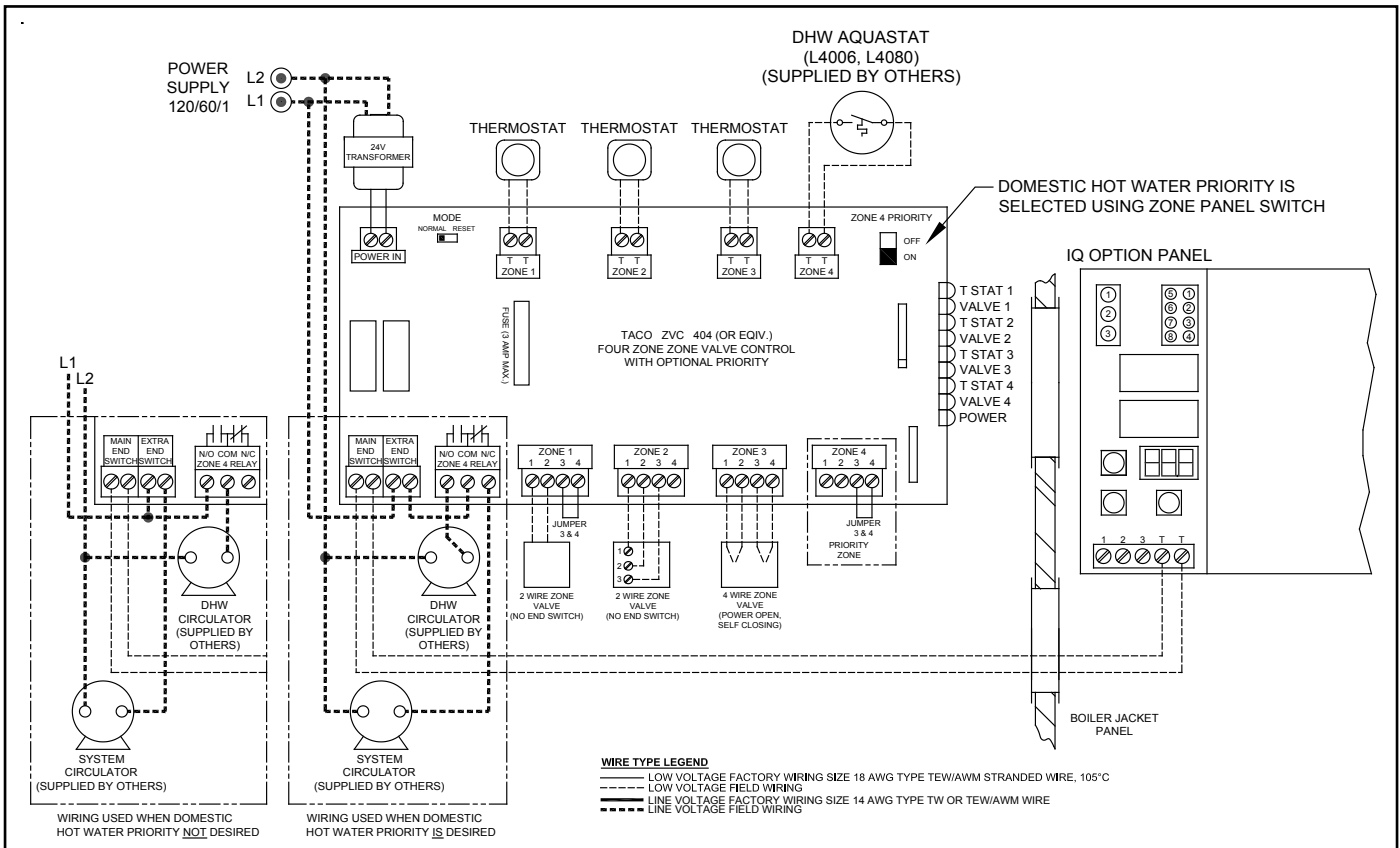


Figure IW-6: Multiple Zone System with Zone Valve Panel

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 gasketed 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 your local building code, the *National Fuel Gas Code (NFPA 54 and ANSI Z223)*, and the *Canadian Natural Gas Installation Code CAN/CGA-B149.1* or *Propane Installation Code CAN/CGA-B149.2*.

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.



Install this boiler according to this manual and the National Fuel Gas Code, ANSI Z223.1/NFPA 54, the Natural Gas and Propane Installation Code, CAN/CSA B149.1, or applicable provisions of the local building codes. Contact local building or fire officials about restrictions and installation inspection in your area. In addition to previously mentioned vent codes of the main general guidelines, atmospheric vented installations must also be in accordance with the Standard for Chimneys, Fireplaces, Vents and Solid Fuel Burning Appliances, ANSI/NFPA 211. For Canada installations, refer to the Natural Gas and LP Installation Code, CAN/CSA- B149.1.

1. Per ANSI Z223.1/NFPA 54 the vent terminal shall have a minimum clearance of 4 feet horizontally from, and in no case above or below, unless a 4 feet horizontal distance is maintained, from electric meters, gas meters, regulators and relief equipment for U.S. installations. Per B149.1 this minimum distance shall be 6 feet for Canadian installations.

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

APPENDIX B – Venting (continued)

Au moment du retrait d'une chaudière existante, les mesures suivantes doivent être prises pour chaque appareil toujours raccordé au système d'évacuation commun et qui fonctionne alors que d'autres appareils toujours raccordés au système d'évacuation ne fonctionnent pas:

- (1) Sceller toutes les ouvertures non utilisées du système d'évacuation.
- (2) Inspecter de façon visuelle le système d'évacuation pour déterminer la grosseur et l'inclinaison horizontale qui conviennent et s'assurer que le système est exempt d'obstruction, d'étranglement, de fuite, de corrosion et autres défaillances qui pourraient présenter des risques.
- (3) Dans la mesure du possible, fermer toutes les portes et les fenêtres du bâtiment et toutes les portes entre l'espace où les appareils toujours raccordés au système d'évacuation sont installés et les autres espaces du bâtiment. Mettre en marche les sècheuses, tous les appareils non raccordés au système d'évacuation commun et tous les ventilateurs d'extraction comme les hottes de cuisinière et les ventilateurs des salles de bain. S'assurer que ces ventilateurs fonctionnent à la vitesse maximale. Ne pas faire fonctionner les ventilateurs d'été. Fermer les registres des cheminées.
- (4) Mettre l'appareil inspecté en marche. Suivre les instructions d'allumage. Régler le thermostat de façon que l'appareil fonctionne de façon continue.
- (5) Faire fonctionner le brûleur principal pendant 5 min ensuite, déterminer si le coupe-tirage déborde à l'ouverture de décharge. Utiliser la flamme d'une allumette ou d'une chandelle ou la fumée d'une cigarette, d'un cigare ou d'une pipe.

(6) Une fois qu'il a été déterminé, selon la méthode indiquée ci-dessus, que chaque appareil raccordé au système d'évacuation est mis à l'air libre de façon adéquate. Remettre les portes et les fenêtres, les ventilateurs, les registres de cheminées et les appareils au gaz à leur position originale.

(7) Tout mauvais fonctionnement du système d'évacuation commun devrait être corrigé de façon que l'installation soit conforme au *National Fuel Gas Code*, ANSI Z223.1 et (ou) aux codes *d'installation* CAN/CSA-B149.1. Si la grosseur d'une section du système d'évacuation doit être modifiée, le système devrait être modifié pour respecter les valeurs minimales des tableaux pertinents de l'appendice F du *National Fuel Gas Code*, ANSI Z223.1 et (ou) des codes *d'installation* CAN/CSA-B149.1.

3. Horizontal portions of the venting system shall be supported to prevent sagging. Follow venting Manufacturer's instructions.

For Category I, II and IV boilers, have horizontal runs sloping upwards not less than 1/4 inch per foot (21 mm/m) from the boiler to the vent terminal.

Les sections horizontales doivent être supportées pour prévenir le fléchissement. Suivez les instructions de ventilation Manufacturer.

Les chaudières de catégories I, II et IV doivent présenter des tronçons horizontaux dont la pente montante est d'au moins 1/4 po par pied (21 mm/m) entre la chaudière et l'évent.

4. Damper must be in open position when appliance main burner(s) is operating.

Le registre doit être ouvert lorsque le brûleur principal de l'appareil fonctionne.

APPENDIX B1 – ATMOSPHERIC VENTING



GENERAL WARNINGS FOR ATMOSPHERIC VENTING SYSTEMS

USE ATMOSPHERIC VENTING only with boilers approved for atmospheric venting as noted in the *Specifications* Section of this manual.

INSPECT EXISTING CHIMNEY for obstructions and deterioration and repair or line the chimney prior to placing the boiler in service.

UNLINED MASONRY CONSTRUCTION is prohibited for use as a chimney.

FIREPLACES AND FAN-ASSISTED GAS APPLIANCES must not be vented into the same chimney space as this boiler.

DO NOT REDUCE THE DIAMETER of the vent connector between the boiler and the chimney. It must not be smaller than the outlet on the drafthood, damper, or vent reducer supplied with the boiler.

UNLISTED VENT DAMPERS AND OBSTRUCTIONS in the vent pipe are prohibited.

THE VENT DAMPER supplied with the boiler shall not be used to block the vent of any other appliance.

Install vent and vent connector (Figure B-1). Comply with all design and installation requirements in the *Connect Venting* Section of this manual, local code, and the *National Fuel Gas Code* or *Can/CSA B149.1*. Clay flue lined masonry chimneys do not meet the venting requirements for this appliance.

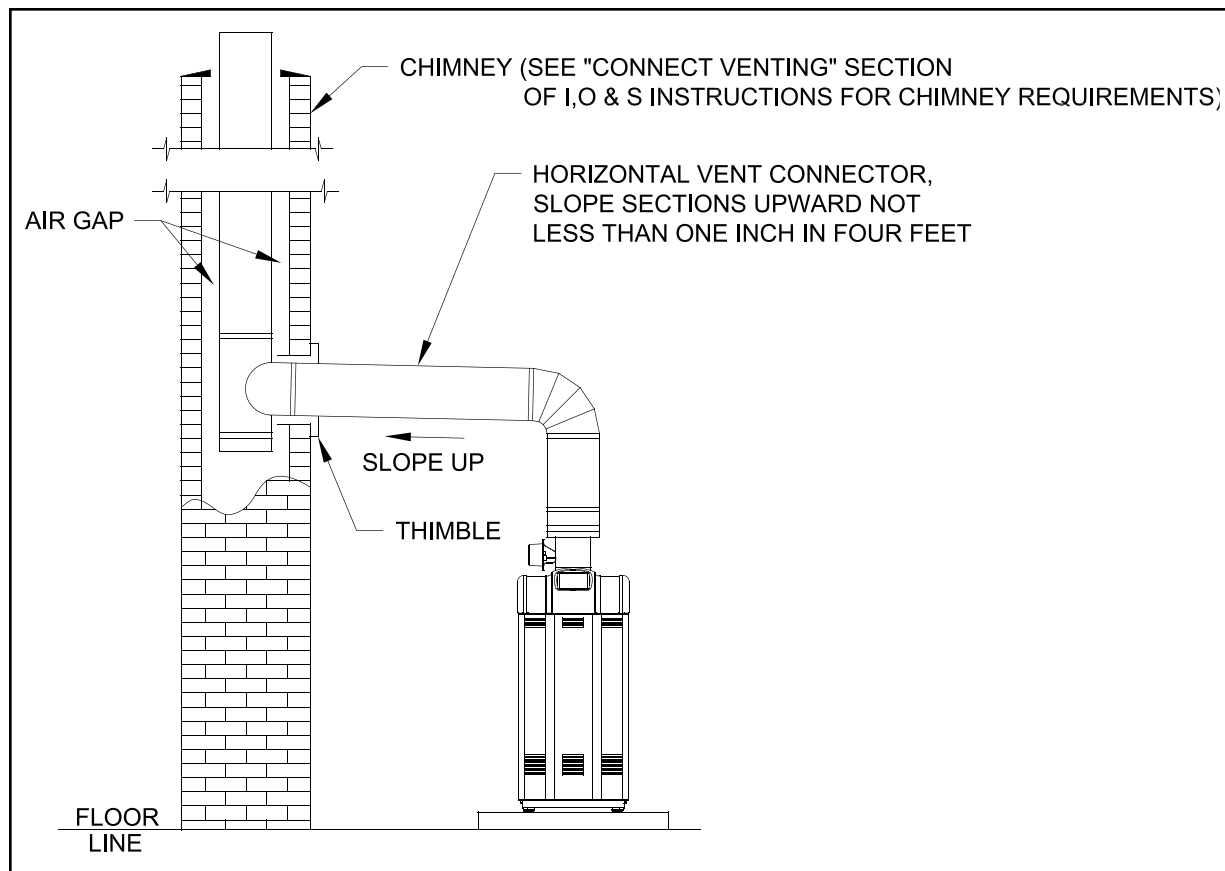


Figure B-1: Typical Atmospheric Vent Installation

APPENDICE B1 – SYSTÈMES D'ÉVACUATION DES PRODUITS DE LA COMBUSTION DU GAZ DANS L'ATMOSPHÈRE



AVERTISSEMENTS GÉNÉRAUX POUR LES SYSTÈMES D'ÉVACUATION DES PRODUITS DE LA COMBUSTION DU GAZ DANS L'ATMOSPHÈRE

N'ÉVACUEZ LES PRODUITS DE LA COMBUSTION DU GAZ DANS L'ATMOSPHÈRE que dans le cas de chaudières approuvées pour cela comme le stipule la section *Spécifications* de ce manuel.

VÉRIFIER SI LA CHEMINÉE EXISTANTE n'est pas obstruée ou détériorée et la réparer ou la chemiser avant de mettre la chaudière en service.

L'USAGE D'UN OUVRAGE DE MAÇONNERIE NON CHEMISÉ comme cheminée est interdit.

LES PRODUITS DE COMBUSTION DU GAZ DES FOYERS ET DES APPAREILS À GAZ VENTILÉS ne doivent pas être évacués dans la même cheminée que ceux de la chaudière.

Installer le conduit d'évacuation des produits de la combustion du gaz et son raccord (figure B-1). Respecter toutes les instructions d'installation et de conception exposées dans la section *Raccordement du système d'évacuation* de ce manuel, dans le code local et le *National Fuel Gas Code ou CAN/CSA B149.1*. Les cheminées en maçonnerie revêtues intérieurement d'argile ne respectent pas les exigences d'évacuation de cet appareil.

NE PAS RÉDUIRE LE DIAMÈTRE du conduit d'évacuation des produits de la combustion du gaz entre la chaudière et la cheminée. Ce diamètre ne doit pas être plus petit que l'orifice de sortie du coupe-tirage ou du registre ou du réducteur d'évacuation fourni avec la chaudière.

LES REGISTRES D'ÉVACUATION ET LES OBSTRUCTIONS NON INSCRITS AU RÉPERTOIRE sont interdits.

LE REGISTRE D'ÉVACUATION fourni avec la chaudière ne doit pas être utilisé pour bloquer l'évacuation des produits de combustion du gaz de tout autre appareil.

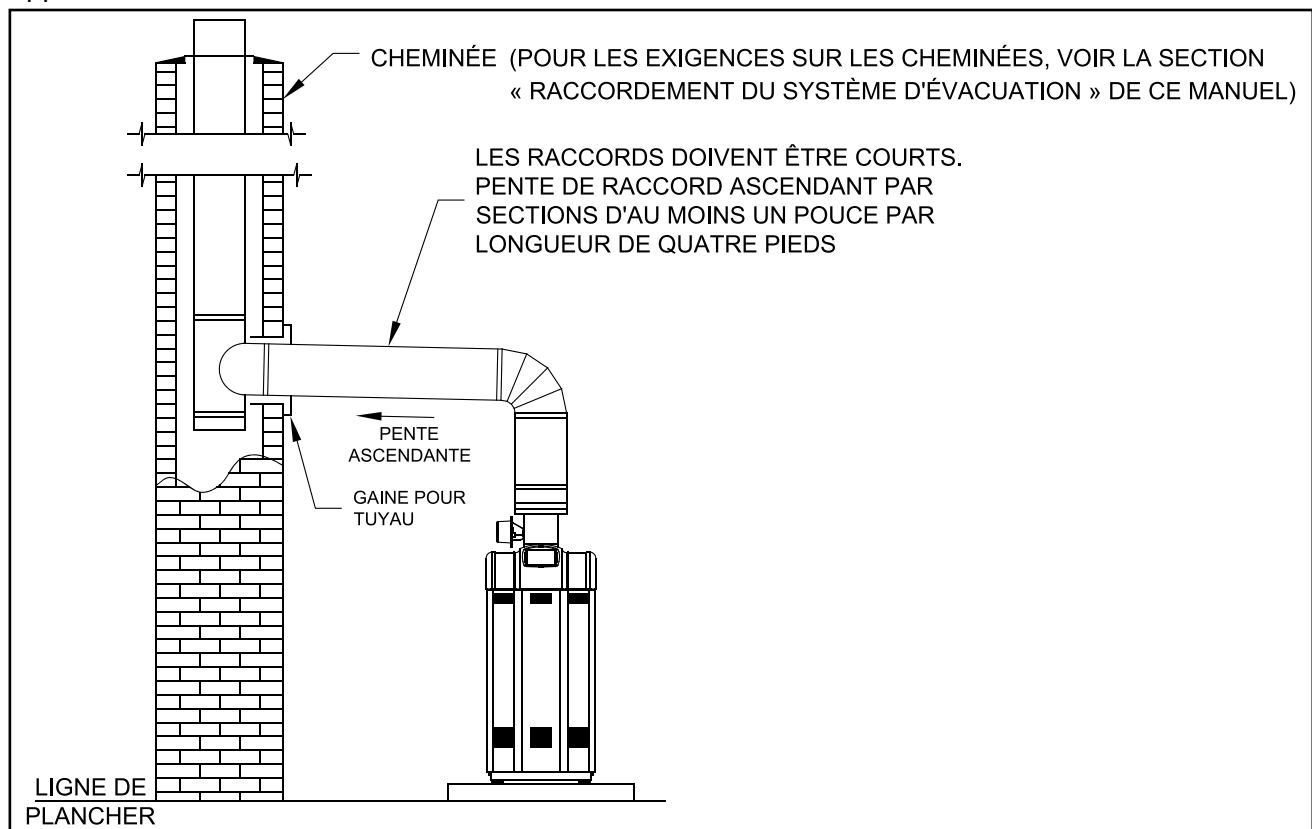


Figure B-1 Installation type d'évacuation dans l'atmosphère

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. Tables C-1 and C-2 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

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

Code, NFPA54/ANSI Z223.1, 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.

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)

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.

APPENDIX D – SYSTEM PIPING

 **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.

APPENDIX D – System Piping (continued)

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 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 to prevent the chilled medium from entering the boiler, see Figure D-W1. 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.

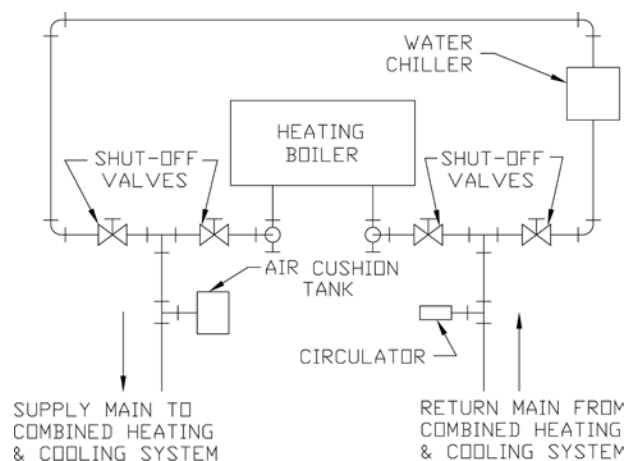


Figure D-W1: Recommended Piping for Combination Heating & Cooling (Refrigeration) Systems



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)

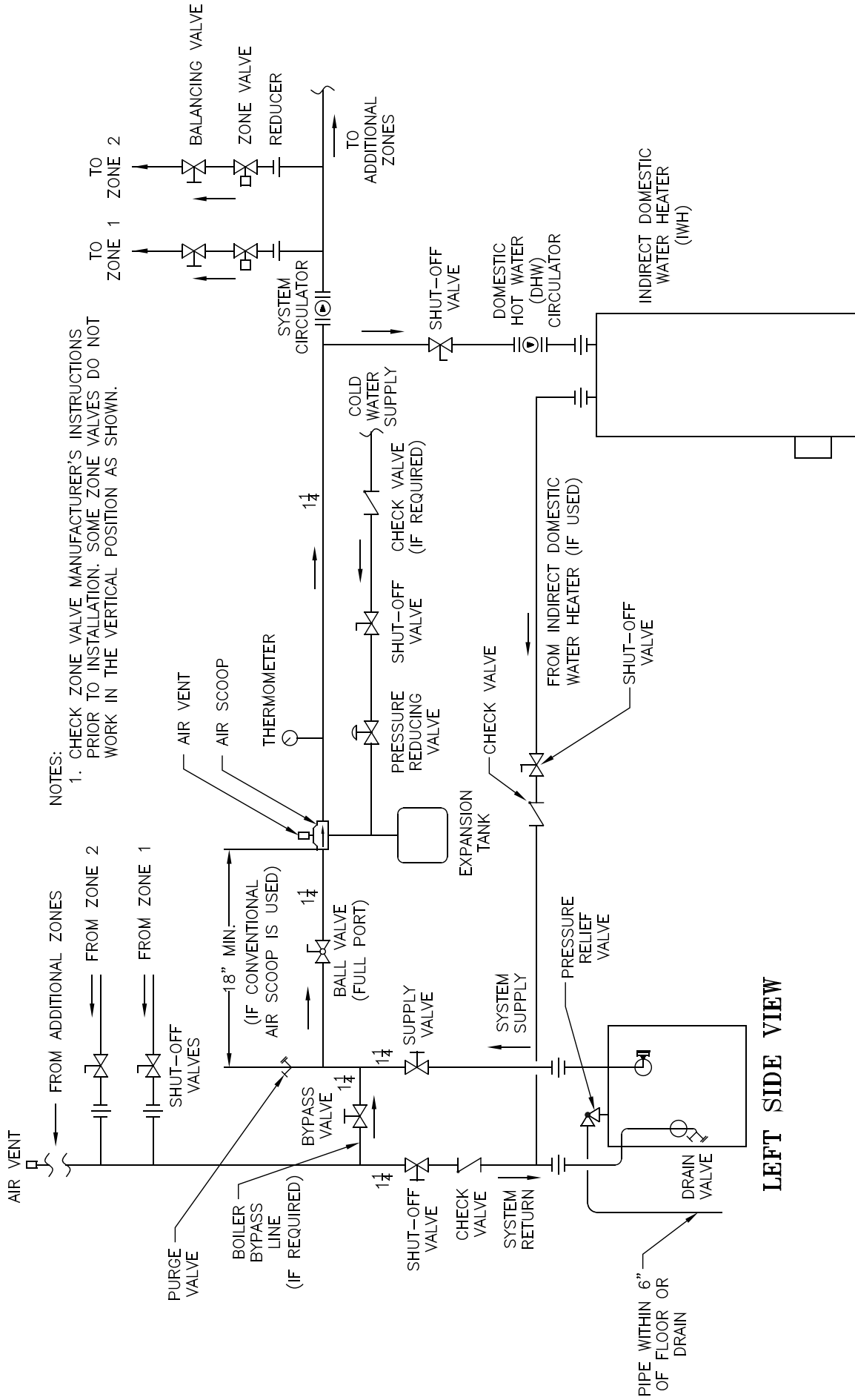
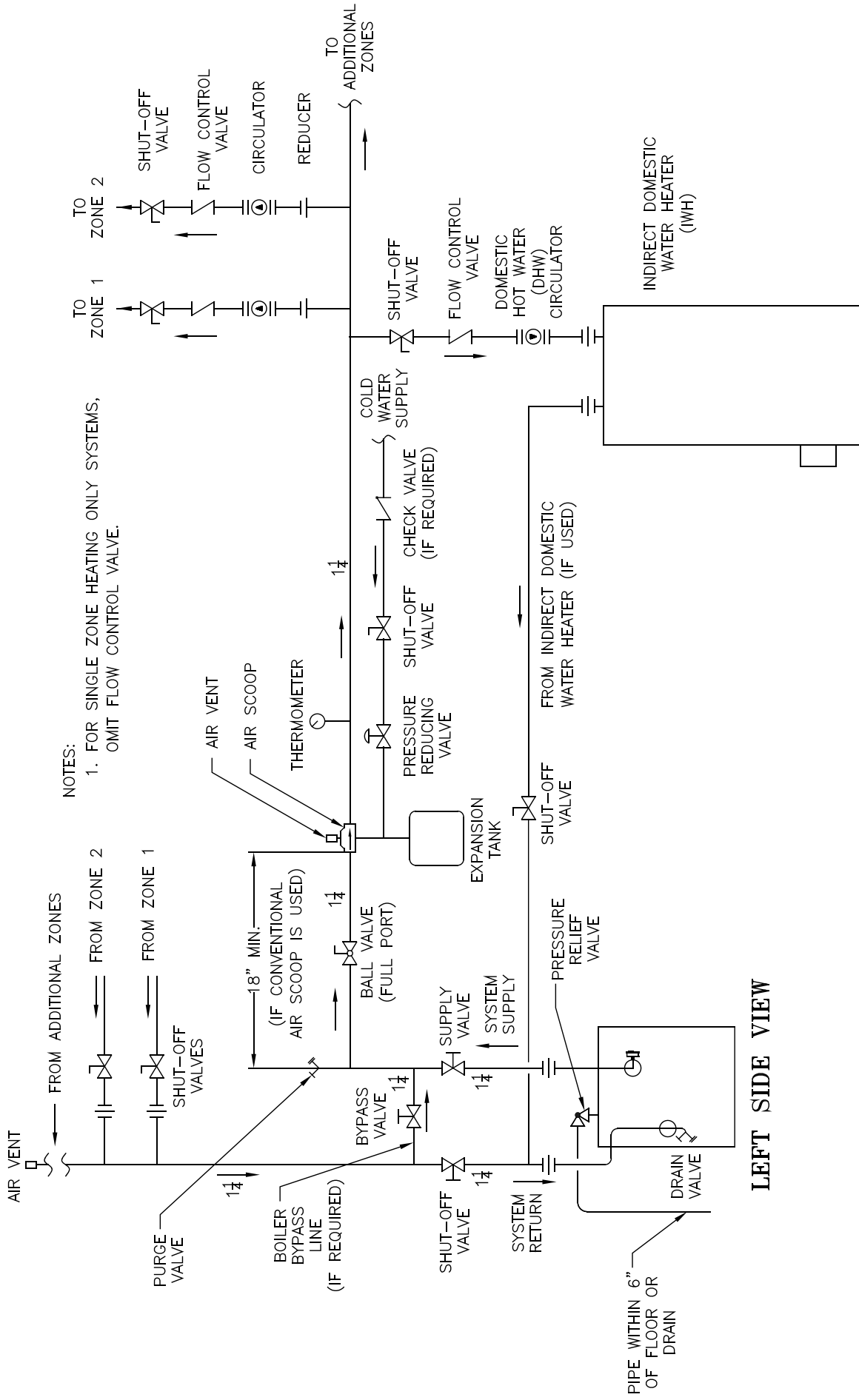


Figure D-W2: Recommended Water Piping for Zone Valve Zoned Heating Systems

APPENDIX D – System Piping (continued)



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

Figure D-W3: Recommended Water Piping for Circulator Zoned Heating Systems

APPENDIX E – FILLING THE SYSTEM AND CHECKING FOR LEAKS

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 Figures in Appendix D. 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.

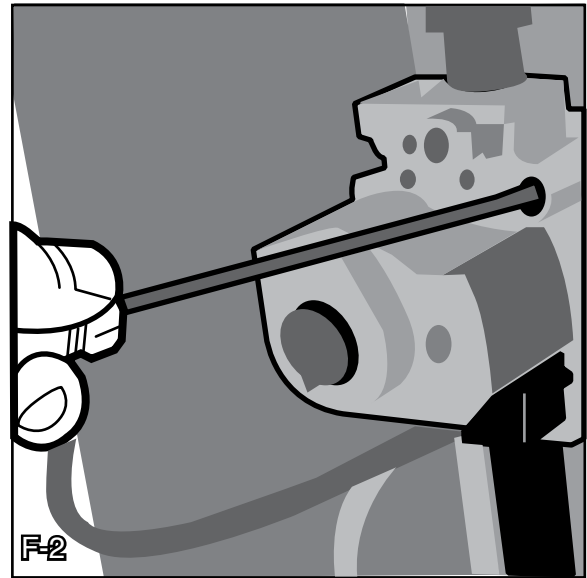
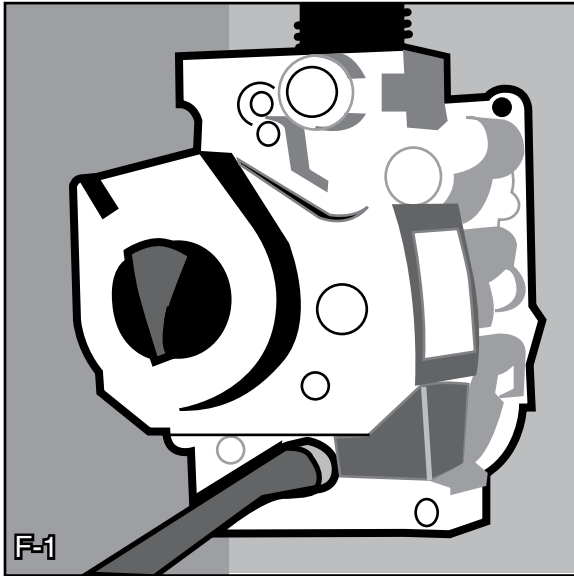
Confirm that the boiler and system have no water leaks.

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.
4. At completion of any leak test, open the hose bib until pressure is reduced to 12 PSI (cold).

APPENDIX F – ADJUSTING GAS INPUT RATE

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.



! 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.

! Do not force the adjustment screw.

APPENDIX G – CHECKING DRAFT AND COMBUSTION

CHECK DRAFT (GAS BOILERS WITH DRAFT HOODS)

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, NFPA 54/ANSI Z223.1*, and/or *Installation Codes, CAN/CSA B149.1*.
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 CO₂, O₂, CO, and flue gas temperature.
2. Operate the boiler at its rated (high fire) input.
3. With the analyzer, check the CO₂ (or O₂), CO and temperature of the flue gases exiting the boiler.
4. Confirm that the measured CO₂ (or O₂) matches the required CO₂ (or O₂) specified for the boiler.



If CO₂, O₂, 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.

APPENDIX H – OPERATION

Boiler Sequence of Operation

NORMAL OPERATION

1. The ES2 Boilers are equipped with an Intelligent Hydronic Control (control). This control replaces the traditional separate ignition control, high limit switch 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 vent damper. Once the vent damper is fully open 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 and circulator are stopped and vent damper is closed.
6. When an 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 vent damper is energized without delay. Once the vent damper is fully open, 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
Drive Damper Open	18	The damper is energized. The control is waiting for the damper switch to close. If the damper end switch doesn't close within 60 seconds, the control goes to 5LR 20
Pre-purge	4	Damper is open for a 2 second delay
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.
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).
Damper Failed to Open	20	The damper is still energized and the damper end switch has not closed.

APPENDIX I – IQ CONTROL SYSTEM

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.

Control: P/N 103660-01

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.

IQ Option Panel: P/N 102291-01

The IQ Option Panel works together with the 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 I – IQ Control System (continued)

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

Installing the IQ Outdoor Reset Option Card is the simplest way to maximize the efficiency of any ES2 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 ES2 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.



Intelligent Hydronic 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 Control or 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

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

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

IQ LWCO Option Cards add a low water cut-off function to ES2 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 I – IQ Control System (continued)

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

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

IQ High Limit Option Cards add auxiliary temperature limit-rated controls to ES2 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 Kit: 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 ES2 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



EnviraCOM Thermostats:

Connected thermostats provide a red LED and display the Intelligent Hydronic 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 I – IQ Control System (continued)

System Parts List

Optional Components

Part Number	Item Description
102723-01	Outside Reset IQ Option Card, Domestic Hot Water Priority, for use with Option Control Panel, with Outside Air Temperature Sensor with 60 inch lead, Instructions, Unit Pack. No additional pipe fittings required.
102294-01	Outdoor Reset IQ Option Card, Domestic Hot Water Priority, for use with IQ Option Panel, less Sensor.
102946-01	Outdoor Air Temperature Sensor, 10k ohm, 60 inch lead.
102711-01	LWCO IQ Option Card kit, Hot Water LF Module, Automatic Reset, for use with Option Control Panel, with ¼ inch NPT Probe, Instructions, Unit Pack. Additional pipe fittings are required.
102714-01	LWCO IQ Option Card kit, Hot Water LF Module, Manual Reset, for use with Option Control Panel, with ¼ inch NPT Probe, Instructions, Unit Pack. Additional pipe fittings are required.
102301-01	LWCO IQ Option Card, Hot Water LF Module, Automatic Reset, for use with IQ Option Panel, less Probe.
102302-01	LWCO IQ Option Card, Hot Water LF Module, Manual Reset, for use with IQ Option Panel, less Probe.
102305-01	LWCO ¼ inch NPT Probe.
102720-01	Aquastat IQ Option Card, 130-220 Deg F, Manual Reset for use with Option Control Panel, Temperature Sensor with 36 inch lead, Well, Sensor Clip, Instructions, Unit Pack. Additional pipe fittings are required.
102717-01	Aquastat , IQ Option Card, 130-220 Deg F, 15 Deg F Adjustable Differential, Auto Reset, for use with Option Control Panel, Temperature Sensor with 36 inch lead, Well, Sensor Clip, Instructions, Unit Pack. Additional pipe fittings are required.
102292-01	Aquastat IQ Option Card, 130-220 Deg F, Manual Reset for use with IQ Option Panel, less well, Less Sensor.
102293-01	Aquastat , 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	IQ LCD Display , Boiler Exterior Mounted, STN Monochrome, White/Red backlight, 5Vdc Power Supply, RS422 (RS485) Communication, Pure Black Bezel with Gateway, Wire Harness, Mounting Bracket, Logo Plate and Instructions.
102725-01	IQ LCD Display , Boiler Exterior Mounted, STN Monochrome, White/Red backlight, 5Vdc Power Supply, RS422 (RS485) Communication, Pure Black Bezel.
102495-01	Enviracom/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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