

Supplemental Instructions

Honeywell L7224/L7248

CL Series Oil Boiler

A. General.

These instructions contain information for use of Honeywell's L7224/L7248 Aquastat.

These Instructions are to be used in conjunction with the Boiler's latest Installation, Operating and Service Instructions (IO&S).

WARNING

Improper installation, adjustment, alteration, service or maintenance can cause property damage, personal injury, or loss of life. Failure to follow all instructions in the proper order can cause personal injury or death. Read and understand all instructions, including all those contained in component manufacturers manuals which are provided with the boiler before installing, starting-up, operating, maintaining or servicing this boiler.

- Failure to properly wire electrical connections to the boiler may result in serious physical harm.
- Electrical power may be from more than one source. Make sure all power is off before attempting any electrical work.
- Each boiler must be protected with a properly sized fused disconnect.
- Never jump out or make inoperative any safety or operating controls.
- The primary control may be damaged or may not function properly if 120 volt power supply is NOT wired into control as follows:

The 120V interrupted hot (black) wire must be connected to the primary control black wire, the 120V neutral (white) wire must be connected to the primary control white wire and the 120V constant hot (red) wire must be connected to the primary control red wire.

DANGER

Positively assure all electrical connections are unpowered before attempting installation or service of electrical components or connections of the boiler or building. Lock out all electrical boxes with padlock once power is turned off.

Installation, maintenance, and service must be performed only by an experienced, skilled and knowledgeable installer or service agency.

Electrical

A. General.

1. Install wiring and electrically ground boiler in accordance with requirements of the authority having jurisdiction, or in absence of such requirements the National Electrical Code, ANSI/NFPA 70.
2. Refer to National Electrical Code or Local Electric Codes for proper size and type of wire required. Follow Code.
3. A separate electrical circuit must be run from the main electrical service with an over-current device/disconnect in the circuit. A service switch is recommended and may be required by some local jurisdictions.
4. Use anti-short bushings on all wiring passing through boiler jacket, junction boxes and/or control boxes.
5. Use armored cable (BX) over all exposed line voltage wiring.

6. If an indirect domestic water heater is used, use priority zoning. DO NOT use priority zoning for Hydro-Air Systems.

7. Wiring should conform to Figures 1 through 3.

- #### B.
- Install room thermostat on an inside wall about four feet above floor. Never install thermostat on an outside wall or where it will be influenced by drafts, hot or cold water pipes, lighting fixtures, television, rays of the sun or near a fireplace. Keep large furniture away from thermostat so there will be free movement of room air around this control.

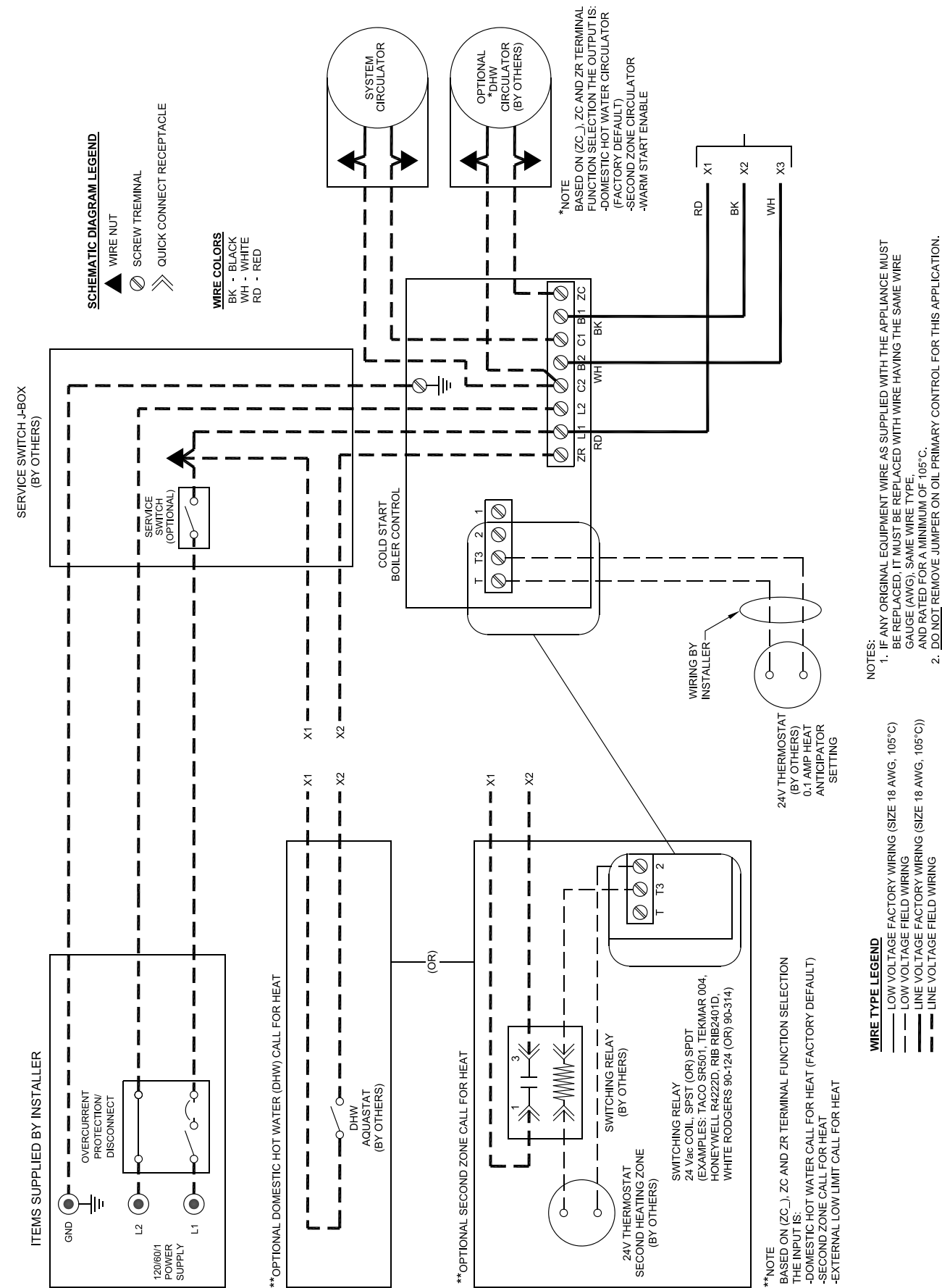


Figure 1: Schematic Wiring Diagram, without Tankless Heater, Cold Start Control (All Burners)

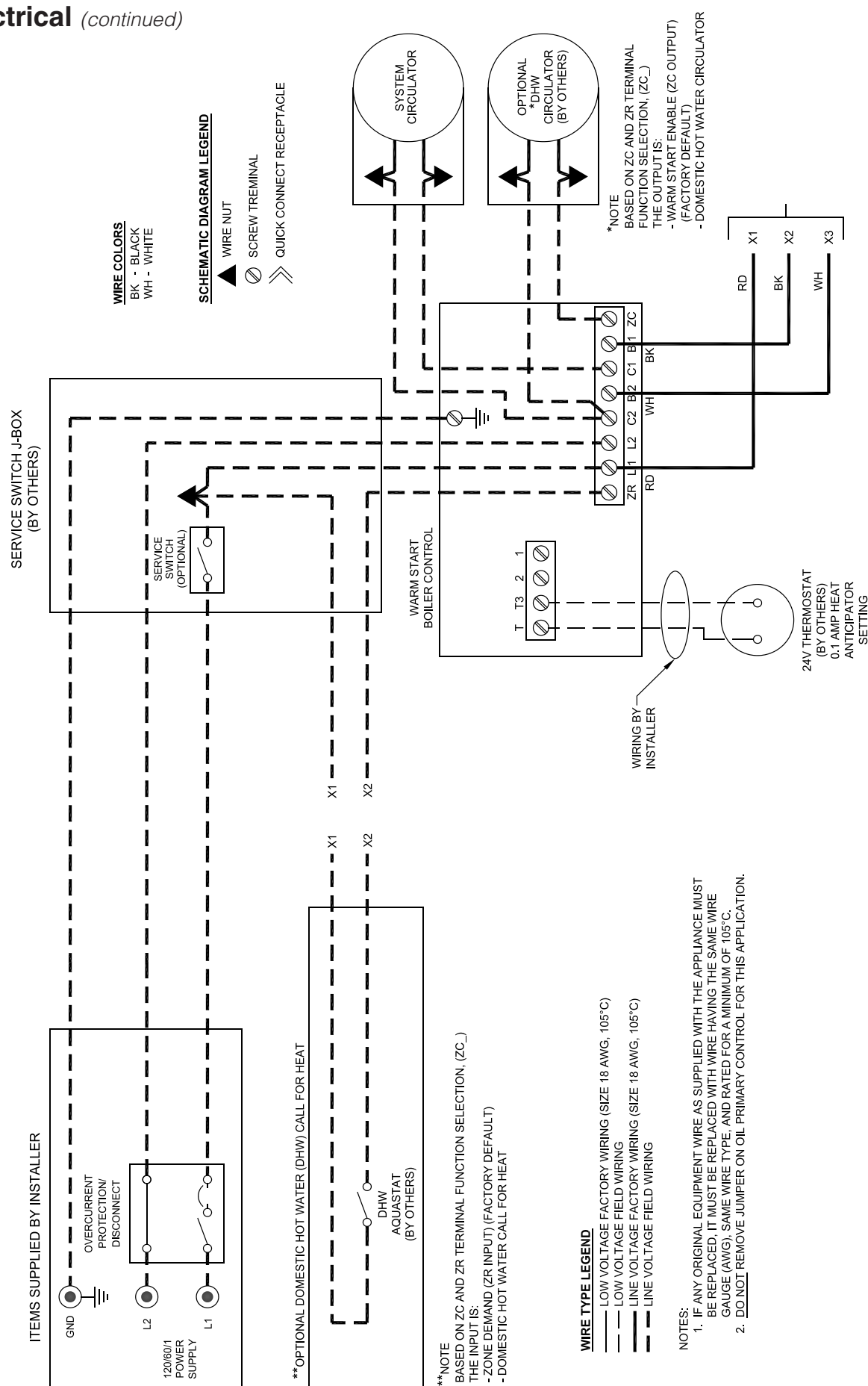


Figure 2: Schematic Wiring Diagram, with Tankless Heater, Warm Start Control (All Burners)

Electrical (continued)

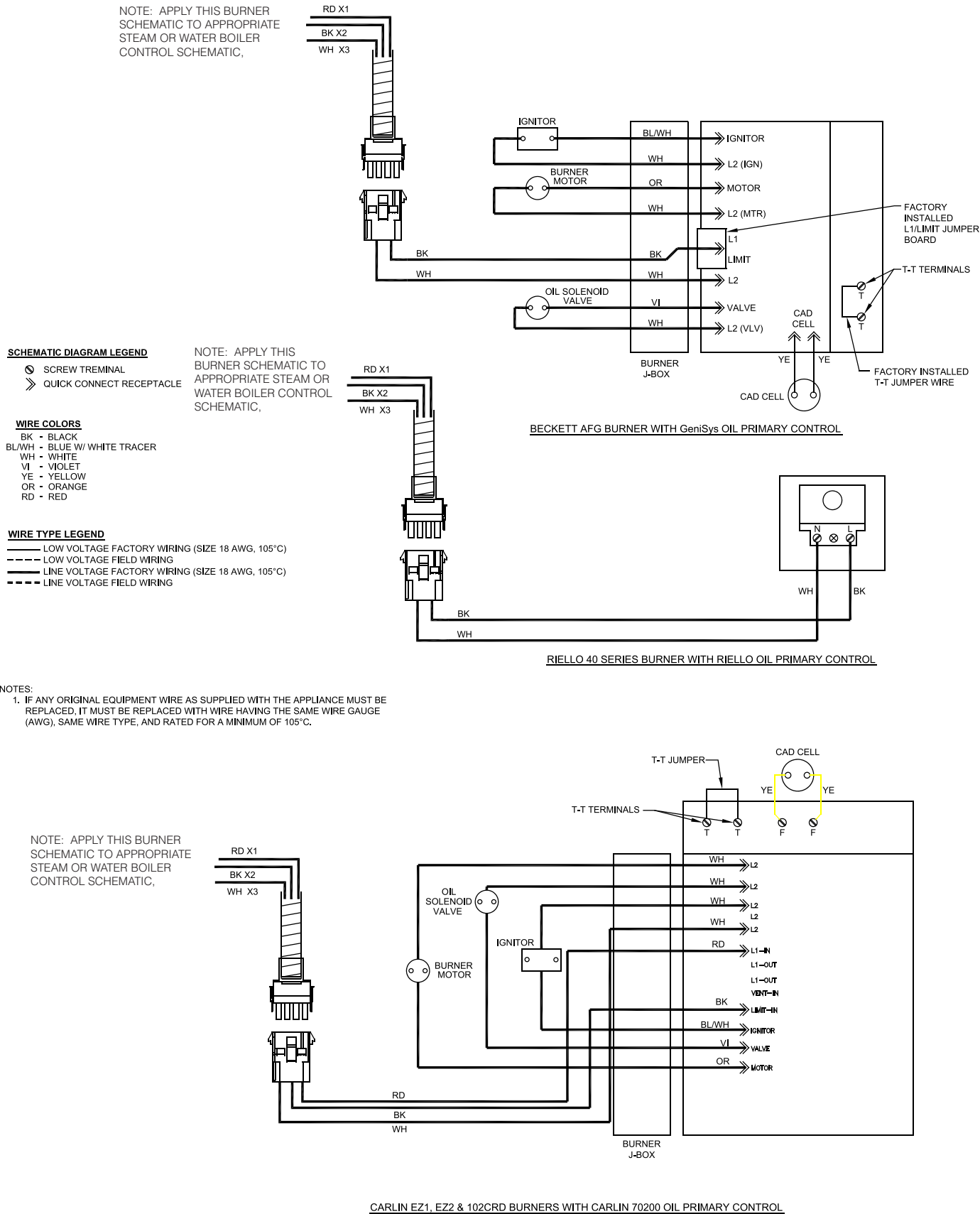


Figure 3: Schematic Wiring Diagrams For All Burner Options w/Various Oil Primary Controls

System Start-up

4. Check High Limit
 - a. Adjust system thermostat(s) to highest setting.
 - b. Allow burner to run until boiler water temperature exceeds high limit setting. The burner should shut down and circulators continue running.
 - c. Allow the temperature to drop below control setting. The burner must restart.
 - d. Boiler installation is not considered complete until this check has been made.
 2. Check operating control on boiler applications equipped with tankless heater(s). With burner off, draw hot water until burner starts, then turn off hot water and check burner shut-down.
- C. IF CONTROLS MEET REQUIREMENT outlined in Paragraph 4, allow boiler to operate for approximately 30 minutes, confirm the boiler and system have no leaks.
- D. IF CONTROLS DO NOT MEET REQUIREMENTS outlined in Paragraph 4, replace control and repeat checkout procedures.

Table 4: Sequence of Operation

Status Codes Displayed in 5tR Mode		
5tR	Status	Description
I	Standby (burner off, pump off)	No call for heat detected
I	Standby (burner off, pump on)	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 140 F and Pump Pre-Purge Time has not expired.
B	Running	The burner runs until the call for heat is satisfied.
n	Self Test	Control internal checking

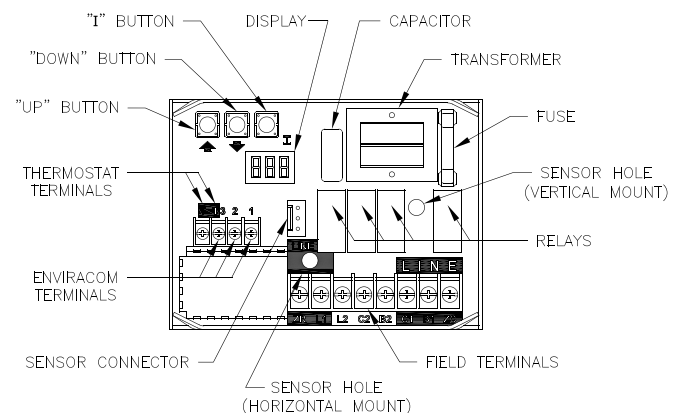


Figure 5: Intelligent Oil Boiler Control

Operating

A. WATER BOILERS SEQUENCE OF OPERATION

1. Water Boilers Without Tankless Heaters (Cold Start), Sequence Of Operation:

- a. The CL Boiler is equipped with an Intelligent Oil Boiler Control (Cold Start Boiler Control). The boiler control replaces the traditional electronic aquastat and circulator relays 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.
- b. The boiler's sequence of operation is shown as Status Codes on Boiler Control display. See Table 4 and Figure 5.

- c. When the thermostat calls for heat the boiler 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 oil primary to operate the following sequence: blower is started and operates for pre-purge time; spark is energized and fuel valve is opened for ignition trial time; burner fires until the thermostat is satisfied.
- d. If the thermostat is not satisfied and the Operating Setpoint (SP) 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.

Operating *(continued)*

- e. After the thermostat is satisfied the burner and circulator are stopped.
 - f. When an indirect water heater aquastat call for heat is wired to the "ZR" terminal the Boiler Control starts a domestic hot water circulator connected to the "ZC" terminal and when the boiler temperature is less than Operating Setpoint (SP), the boiler control energizes the oil primary to turn on the burner without circulator pre-purge delay.
 - g. On burner start, if the CAD cell does not see flame within approximately 15 seconds, primary control will shut down the burner and enter into a lockout mode. A lockout is reset by pressing the reset button located on the primary control. If the flame is lost while the burner is firing, the primary control shuts down the burner, enters a 60 second recycle delay, and repeats the ignition sequence. If after three (3) trials for ignition, flame is not detected, primary control will enter into restricted mode. Restricted mode is reset by holding down the reset button for 15 seconds.
2. Water Boilers with Tankless Heaters (Warm Start), Sequence Of Operation:
- a. The CL Boiler is equipped with a Warm Start Intelligent Oil Boiler Control (Warm Start Boiler Control). The Warm Start Boiler Control replaces the traditional high and low limit aquastat and circulator relays.
 - b. The boiler's sequence of operation is shown as Status Codes on Boiler Control display. See Table 4 and Figure 5.
 - c. When the thermostat calls for heat the boiler control starts the system circulator and the start sequence continues by energizing the oil primary to operate the following sequence: blower is started and operates for pre-purge time; spark is energized and fuel valve is opened for ignition trial time; burner fires until the thermostat is satisfied. Optionally, the thermal purge (circulator pre-purge time) may be added adjusting the Circulator Pre-purge time parameter. This feature saves energy by starting the circulator and delaying the burner start when there is residual heat available in the boiler .
 - d. If the thermostat is not satisfied and the Operating Setpoint (SP) 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.
 - e. After the thermostat is satisfied the burner and circulator are stopped.
 - f. The Warm Start Boiler Control also includes a low limit control function. When the boiler water temperature falls below the Low Limit Setpoint less the Low Limit Differential the "ZC" terminal and System Circulator outputs are de-energized and the oil primary is energized to start the burner. As temperature rises above the Low Limit Setpoint the burner is stopped, the "ZC" output is energized and the System Circulator is enabled to run in response to a call for heat.
 - g. On burner start, if the CAD cell does not see flame within approximately 15 seconds, primary control will shut down the burner and enter into a lockout mode. A lockout is reset by pressing the reset button located on the primary control. If the flame is lost while the burner is firing, the primary control shuts down the burner, enters a 60 second recycle delay, and repeats the ignition sequence. If after three (3) trials for ignition, flame is not detected, primary control will enter into restricted mode. Restricted mode is reset by holding down the reset button for 15 seconds.
3. Using Boiler Control
- The Boiler Control is located on front of boiler. The Boiler Control display, along with Up ↑, Down ↓, and "I" keys may be used to view boiler operating status (Figure 6).
4. Viewing the Operating Mode Options
- In operating mode the user may view (but not change) boiler operating status, settings and troubleshooting information. To view Boiler Control display information:
- Press and release the "I" key on the Boiler Control to change from one parameter to the next. Each setting will alternately flash between the relevant display code and its corresponding value.

Operating *(continued)*

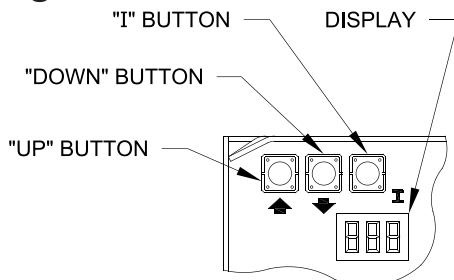
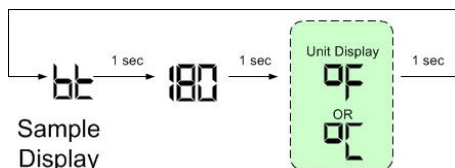


Figure 6: Boiler Control Key Function & Orientation

Operating Mode Options	
Status Numbers:	
<i>StA</i>	1 Standby 8 Running 17 Self Test
<i>bT</i>	Boiler Temperature
<i>SP</i>	Operating Setpoint (Outdoor Reset)
<i>HL</i>	High Limit Setting
<i>HdF</i>	High Limit Differential
<i>LL</i>	Low Limit Setpoint (warm start only)
<i>LdF</i>	Low Limit Differential (warm start only)
<i>hr</i>	Heat Request Status
<i>dh</i>	DHW Request Status
<i>Err</i>	Boiler Error

For example, when the “**I**” key is pressed on the Boiler 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.



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”.

5. Changing the Adjustable Parameters

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

- Using the Boiler Control display, access the adjustment mode by pressing and holding the Up ↑, Down ↓, and “**I**” keys simultaneously for three (3) seconds. This procedure is intended to discourage unauthorized changes or accidental changes to limit settings.
- Press the “**I**” key to display available Adjustment Mode options. Select an option.

Cold Start Boiler Control Adjustment Mode Options

<i>HL</i>	140-240°F	Adjust High Limit Setting
<i>HdF</i>	10-30°F	Adjust High Limit Differential
<i>ZC</i>	<i>dh</i> , <i>Zr</i> or <i>ELL</i>	ZC and ZR Terminal Function
<i>Or</i>	0-10 minutes	Pump Overrun Time
<i>PP</i>	2-20 minutes	Pump Pre-purge Time
<i>St</i>	140 - 180°F	Start Temperature
<i>Pt</i>	<i>On</i> or <i>OFF</i>	Priority Time
<i>F-C</i>	<i>F</i> or <i>C</i>	Select degrees F or C Mode
<i>bRc</i>		Back to Operating Mode

Warm Start Boiler Control Adjustment Mode Options

<i>HL</i>	140-240°F	Adjust High Limit Setting
<i>LL</i>	110-220°F	Adjust Low Limit Setting
<i>LdF</i>	10-25°F	Adjust Low Limit Differential Setting
<i>ZC</i>	<i>Zr</i> or <i>dh</i>	ZC and ZR Terminal Function
<i>Or</i>	0-10 minutes	Pump Overrun Time
<i>PP</i>	0-20 minutes	Pump Pre-purge Time
<i>St</i>	140 - 180°F	Start Temperature
<i>Pt</i>	<i>On</i> or <i>OFF</i>	Priority Time
<i>F-C</i>	<i>F</i> or <i>C</i>	Select degrees F or C Mode
<i>bRc</i>		Back to Operating Mode

- Press the Up ↑ and Down ↓ keys to adjust the displayed setpoint to the desired value.
- 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 Boiler Control will automatically return to the Operating Mode.

6. More Information about Adjustable Parameters

a. High Limit (*HL*)

The Boiler Control is factory programmed with a High Limit Setpoint of 180°F. The boiler turns “off” when the boiler water temperature (*bT*) is above this value. The High Limit setpoint is adjustable between 140° and 240°F. The Operating Setpoint (*SP*) will equal the High Limit Setpoint.

b. High Limit Differential (*HdF*)

- The Cold Start Boiler 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° and 30°F.
- On Warm Start Boiler Control the High Limit Differential is not adjustable and is fixed at 10°F.

Operating *(continued)*

c. Low Limit (LL₋)

The Warm Start Boiler Control is factory programmed with a Low Limit Setpoint of 110°F. On falling temperature the boiler turns “on” and the “ZC” terminal and System Circulator outputs are de-energized when the boiler temperature is less than the Low Limit Setpoint less the differential. On a rising temperature when the boiler temperature is above the Low Limit Setpoint the boiler turns “off”, the “ZC” terminal output is energized and the System circulator is enabled to respond to a call for heat. The Low Limit Setpoint is adjustable between 110°F and 220°F.

d. Low Limit Differential (LdF)

The Warm Start Boiler Control is factory programmed with a Low Limit Differential Setpoint of 10°F. The Low Limit Differential is the number of degrees the boiler temperature must decrease below the Low Limit Setpoint before the Warm Start Boiler Control takes actions to warm the boiler. These actions include starting the burner and stopping water flow through the boiler. The Low Limit Differential is adjustable between 10°F and 25°F.

e. Circulator Overrun Time (Or₋)

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 priority zone. Ensure system piping and zone panel settings allow water flow to the priority zone after the call for heat ends. The Circulator Overrun Time has a factory setting of 0 minutes and is field adjustable between 0 and 10 minutes.

f. 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. If the temperature drops below 140°F or there is a DHW Call for Heat the boiler is started without delay. Additionally, the boiler is started without delay if the thermostat call for heat is initiated when the boiler water temperature is less than 140°F. This feature helps save energy by satisfying home heating needs with residual boiler heat rather than cycling the boiler. The Circulator Pre-purge time has a factory setting of 2 minutes and is field adjustable between 2 and 20 minutes. Refer to Table 7.

The Warm Start Boiler Control Pre-purge Time is factory set to 0 minutes.

Table 7: Circulator Pre-Purge Time Example, Parameter PP₋ = 2 Minutes

Call for Heat	ZC and ZR Terminal Function (ZC ₋)	Boiler Temp.	Boiler Status, (B1 Output)
TT= on	--	< 140	Start with no delay
TT = on	--	>140	Start after 2 minute delay
ZR = on	ZC ₋ = Zr	<140	Start with no delay
ZR = on	ZC ₋ = Zr	>140	Start after 2 minute delay
ZR = on	ZC ₋ = dH	<140	Start with no delay
ZR = on	ZC ₋ = dH	>140	Start with no delay

Operating *(continued)*

g. Start Temperature (St_{-})

The 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.

h. 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 and 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 8.

i. ZC and ZR Terminal Function (ZC_{-})

The boiler control allows configuration of the ZC output functionality to help the CL integrate into each installation more effectively. The ZC output can be connected to a domestic hot water circulator or a second heating zone circulator or be used to enable pumps in a warm start application. These applications are selected as follows:

- i. When ZC_{-} is set equal to Domestic Hot Water Demand (dH)

When there is an Indirect Water Heater (IWH) the boiler control provides a "ZR" input terminal for the IWH Aquastat and "ZC" output terminal 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 "ZR" terminal. When a Priority Time parameter is set to "off" the System Circulator is not forced off for a DHW call for heat. Refer to Table 8.

Table 8: Domestic Hot Water Demand, (Parameter $ZC_{-} = dH$)

Call for Heat		Priority Time (Pt_{-})	Circulator Status	
T-T Input	ZR Input		System Circulator Output	DHW Circulator ZC 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

Operating *(continued)*

- ii. When $\mathcal{Z}\mathcal{C}_{-}$ is set equal to Zone Request ($\mathcal{Z}\mathcal{r}$)

When there is no IWH the Cold Start Boiler Control "ZC" output may be configured to control a second heating zone. This is particularly helpful when the home uses only two heating zones. The boiler control replaces the need for a two circulator zone panel. When DHW Terminal Function ($\mathcal{d}h_{-}$) is set to $\mathcal{Z}\mathcal{r}$ the boiler control's two circulator outputs are used to control two independent heating zones. Refer to Table 9. A "TT" input causes a call for heat and energizes the System Circulator output to service heating zone 1. A second zone's thermostat may be wired to the "ZR" input to energize heating zone 2 circulator wired to the "ZC" output. Both outputs function independently, "TT" input controls only the System Circulator output and the "ZR" input controls only the "ZC" output. Both inputs cause a boiler call for heat.

The Warm Start Boiler Control with $\mathcal{Z}\mathcal{C}_{-}$ set equal to Zone Request ($\mathcal{Z}\mathcal{r}$) energizes the "ZC" terminal while the boiler is warm as described earlier in this section (refer to Paragraph A,2,f). The "ZR" input is a call for heat that starts the boiler.

- iii. External Low Limit, Parameter $\mathcal{Z}\mathcal{C} = \mathcal{E}\mathcal{L}\mathcal{L}$

The Cold Start Boiler Control is capable of functioning as a warm start control when external limit control is installed that closes a contact when boiler water temperature falls below a setpoint. When an external limit contact closes (boiler water is cold) the boiler is started and the "ZC" and "C1" output terminals are de-energized. When the "ZR" terminal is de-energized (boiler water temperature is above setpoint) the call for heat is ended and the "C1" terminal is released to operation and the "ZC" terminal is energized. An External Low Limit Request is detected by sensing a voltage on the "ZR" terminal. The Warm Start Boiler Control does not have the External Low Limit Option. Refer to Table 10.

**Table 10: External Low Limit,
Parameter $\mathcal{Z}\mathcal{C}_{-} = \mathcal{E}\mathcal{L}\mathcal{L}$**

Call for Heat		Circulator Status	
T-T Input	ZR Input	C1 Output	ZC Output
off	off	off	on
on	off	on	on
on	on	off	off
off	on	off	off

Table 9: Zone Request, Parameter $\mathcal{Z}\mathcal{C}_{-} = \mathcal{Z}\mathcal{r}$

Call for Heat		Circulator Status	
T-T Input	ZR Input	C1 Output	ZC Output
off	off	off	off
on	off	on	off
on	on	on	on
off	on	off	on

Troubleshooting

A. INTELLIGENT OIL BOILER CONTROL

- Cold Start Boiler Control is used on Boilers without Tankless Heaters.
 - Warm Start Boiler Control is used on Boilers with Tankless Heaters
1. When a problem occurs with the boiler operation, the Boiler Control easily provides specific, valuable information to help resolve the issue quickly. The display on the Boiler Control should be the first place to check.
 - a. If an Error Code "Err" **IS NOT** displayed on the Boiler Control: In this circumstance, Table 11 can be used to determine the problem and possible causes.

Table 11: Troubleshooting Guide

System Condition	Diagnostic Condition	Check	Action
Boiler is cold, house is cold.	Display is OFF.	120 Vac System power.	Turn system power on.
	Display is ON.	24 Vac T-T	No 24 V; replace control.
		24 V present; disconnect thermostat, short T-T.	Boiler starts, check wiring and thermostat.
		120 Vac at B1-B2	<ul style="list-style-type: none"> • If no, replace control. • If yes, check burner and wiring.
		Refer to Err on display.	-----
Boiler is hot, house is cold.	Display is ON.	120 Vac at C1-C2	<ul style="list-style-type: none"> • 120 Vac at C1-C2, check wiring to pump. • Wiring OK, is pump running? • If not, replace the pump. • If pump is running, check for trapped air or closed zone valves
		Boiler below the Low Limit temperature, wait for boiler to go above Low Limit temperature.	-----
		Boiler above LL? If yes, check for 120 Vac between ZC and L2.	<ul style="list-style-type: none"> • If no 120 Vac , replace control. • If yes, check zone relays, circulators and wiring.

- b. If the Boiler Control detects an error it will flash "Err" (boiler control error) followed by a number. Use this text and number to identify the boiler problem and corrective action in Table 12.

Troubleshooting *(continued)*

Table 12: Boiler Control Error Numbers

Display	Status	Recommended Corrective Actions
<i>Err 1</i>	Temperature Sensor Fault	Temperature sensor failure, wire harness loose or shorted connection or control hardware failure: <ul style="list-style-type: none"> - Check sensor is securely attached to boiler control - Check that sensor wire is not damaged - If secure and in good condition, replace sensor - If problem persists, replace control
<i>Err 2</i>	Communication Fault	EnviraCom terminal is shorted to ground or line voltage. <ul style="list-style-type: none"> - Check wiring to EnviraCOM terminals 1,2 and 3. Wiring to external EnviraCom device is incorrect.
<i>Err 3</i>	Internal Hardware Fault	Error detected with AC power supply frequency or boiler control failure. Cycle power to the control. Replace control if problem persists.
<i>Err 4</i>	Burner Output (B1) Fault	B1 output sensed powered during safety output relay check sequence or un-powered during running, or powered in idle in combination with water temperature above 264°F limit. Cycle power to the control. Replace control if problem persists.
<i>Err 5</i>	Line Voltage Fault (< 80 Vac)	AC voltage out of specification high or low; check L1, L2, 110 VAC.
<i>Err 6</i>	Fuse missing	Internal fuse is blown or missing. The fuse protects the Aquastat from miswiring the L1 and L2 on Oil Primary. When the Oil Primary is correctly wired the fuse is useless and not detected. If Primary is wired incorrectly the fuse is blown out and Aquastat report error 6. EnviraCOM message is sent when the wiring is fixed and the error disappears to indicate the end of the error state. Check wiring and replace fuse.
<i>Err 7</i>	User settings lost, (reset to factory defaults)	Warning: Generated if user adjustments are lost and the device uses factory default values. Error is cleared by entering and exiting the Adjustment mode. Replace control if problem persists.
<i>Err 8</i>	Manual Reset Lockout (resettable)	Set if <i>Err 4</i> was invoked four times in a row. Check wiring and clear Lockout by pressing all three user keys for 30 seconds.